PUBLIC INSTITUTION PRACTICAL SCIENTIFIC INSTITUTE OF HORTICULTURE AND FOOD TECHNOLOGY

SCIENTIFIC SUBSTANTIATION AND DEVELOPMENT OF GRAPE PRODUCTION TECHNOLOGY ELEMENTS IN THE AGRO-ECOLOGICAL CONDITIONS OF THE ATU GAGAUZIA

Thesis Doctor Habilitate in Agricultural Sciences

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INSTITUŢIA PUBLICĂ INSTITUTUL ŞTIINŢIFICO-PRACTIC DE HORTICULTURĂ ŞI TEHNOLOGII ALIMENTARE

ARGUMENTAREA ȘTIINȚIFICĂ ȘI ELABORAREA ELEMENTELOR TEHNOLOGIEI DE PRODUCERE A STRUGURILOR ÎN CONDIȚIILE AGRO-ECOLOGICE ALE UTA GĂGĂUZIA

Teza de doctor habilitat în agricultură

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CONTENTS

ANNOTATION

Cara S. **“Scientific Substantiation and Development of Grape Production Technology Elements in the Agro-Ecological Conditions of the ATU Gagauzia”**. Thesis Doctor Habilitate in Agricultural Sciences. Chisinau, 2024. The thesis structure: introduction, 8 chapters, general conclusions, practical recommendations, bibliography – 342 sources of information, 12 annexes, 213 basic text pages, 66 tables, 45 figures. Research results have been published in more than 70 scientific papers, including 1 monograph.

Key words: Clone, Cuttings, Grapes, Harvest, Productivity, Quality, Regeneration, Rootstock, Scion, Vines.

Domain of study: 06.01.08 – Viticulture.

The aim of research: to determine the potential of introduced grape clones and develop agricultural techniques aimed at enhancing the viability and productivity of vineyards under the agro-ecological conditions of the ATU Gagauzia, thereby improving the sustainability and economic efficiency of viticulture in the region.

Scientific novelty of work. It consists in the creation of a modern conceptual approach to the management of the productivity of vine plantations in the Southern viticulture zone of the Republic of Moldova. For the first time, the potential was identified and the reserve for increasing the yield of grape vines in the ATU Gagauzia was calculated. Monitoring the characteristics of the Growth and Development of Shoots, Leaf Surface and Establishing their correlation with the Productivity of Plantations can be the basis for obtaining High Quality Grape Products.

Theoretical significance lies in identifying important aspects and technological peculiarities of the growth, development, and adaptation of introduced clones R5 Cabernet Sauvignon and 348 Merlot, which influence the quality and productivity of grape plantations in the agro-ecological conditions of the ATU Gagauzia.

The applicative value of the research. The scientific data obtained make a significant contribution to the development and improvement of ampelocenosis models characterized by a high coefficient of photosynthetically active radiation, in studying the correspondence of biological and varietal characteristics of grapevines to the ecological conditions of their cultivation zone, and to cultivation methods.

The implementation of scientific results. The results of the research were implemented in the cultivation of grafted grapevine planting material and its planting in a permanent place, the production of grape variety clones in SC "Tomai-Vinex" SA in 2004-2021.

ADNOTARE

Cara S. **"Argumentarea științifică și elaborarea elementelor tehnologiei de producere a strugurilor în condițiile agro-ecologice ale UTA Găgăuzia".** Teza de doctor habilitat în științe agricole, Chişinău, 2024. Structura tezei: introducere, 8 capitole, concluzii generale, recomandări practice, bibliografie - 342 surse de informare, 12 anexe, 213 pagini de text de bază, 66 tabele, 45 figuri. Rezultatele cercetărilor sunt publicate în peste 70 lucrări științifice, inclusiv o monografie.

Cuvintele cheie: Viţa de vie, Clona, Portaltoi, Altoi, Productivitate, Calitate, Regenerare, Viţe, Butaşi, Recolta.

Domeniul de studiu: 411.07 – Viticultură.

Scopul cercetărilor: determinarea potenţialului clonelor de viță de vie de introducție și elaborarea procedeelor tehnologice de sporire a viabilității și productivității plantațiilor viticole în condițiile agroecologice ale UTA Gagauzia, în scopul sporirii sustenabilității și eficienței economice a viticulturii în regiune.

Noutatea ştiinţifică a lucrării. Constă în crearea unei abordări conceptuale moderne a managementului productivității plantațiilor de viță de vie din zona de viticultura de sud a Republicii Moldova. Pentru prima dată a fost identificat potențialul și s-a calculat rezerva pentru creșterea randamentului plantelor de vița de vie în UTA Găgăuzia. Monitorizarea caracteristicilor de creștere și dezvoltare a lăstarilor, a suprafeței frunzelor și stabilirea corelației acestora cu productivitatea plantațiilor poate sta la baza obținerii unor produse din vița de vie de calitate superioară.

Semnificaţa teoretică constă în identificarea aspectelor importante și a caracteristicilor tehnologice ale creșterii, dezvoltării și adaptării clonelor introduse R5 Cabernet Sauvignon și a clonului 348 Merlot, care influențează calitatea și productivitatea plantațiilor de viță de vie în condițiile agro-ecologice ale UTA Găgăuzia.

Valoarea aplicativă a lucrării. Datele științifice obținute aduc o contribuție semnificativă la dezvoltarea și îmbunătățirea modelelor agroecosistemelor viticole, care prezintă un coeficient ridicat de eficiență a radiației fotosintetice active, în studierea compatibilității caracteristicilor biologice și de soi ale plantei de viță de vie cu condițiile ecologice din zona lor de cultivare și practicilor culturale.

Implementarea rezultatelor ştiinţifice. Rezultatele cercetărilor au fost implementate la cultivarea viţelor vița de vie, plantarea viţelor vița de vie la locul permanent, producerea clonelor de vița de vie în SC „Tomai-Vinex” SA în perioada 2004-2021.

АННОТАЦИЯ

Кара С. **«Научное обоснование и разработка элементов технологии производства винограда в агроэкологических условиях АТО Гагаузия»**. Диссертации на соискание ученой степени доктора хабилитат сельскохозяйственных наук, Кишинев, 2024. Структура диссертации: введение, 8 глав, выводы, рекомендации производству, библиография – 342 источников, 12 приложений, 213 страниц основного текста, 66 таблиц, 45 рисунков. Результаты исследований опубликованы в более чем 70 научных работах, включая 1 монографию.

Ключевые слова: Виноград, Клон, Подвой, Привой, Продуктивность, Разнокачественность, Регенерация, Саженцы, Черенки, Урожайность.

Специальность: 411.07 – Виноградарство.

Цель исследований: определить потенциал интродуцированных клонов винограда и разработать технологические приемы увеличения жизнеспособности и продуктивности виноградных насаждений в агроэкологических условиях АТО Гагаузия, для повышения устойчивости и экономической эффективности виноградарства региона.

Научная новизна и оригинальность. Заключается в создании современного концептуального подхода к управлению продуктивностью виноградных насаждений в Южной зоне виноградарства Республики Молдова. Впервые выявлен потенциал и рассчитан резерв повышения урожайности растений винограда в АТО Гагаузия. Мониторинг особенностей роста и развития побегов, листовой поверхности и установление их корреляционной связи с продуктивностью насаждений может явиться основой для получения виноградной продукции высокого качества.

Теоретическая значимость заключается в выявлении важных аспектов и технологических особенностей роста, развития и адаптации интродуцированных клонов R5 Каберне-Совиньон и 348 Мерло, которые оказывают влияние на качество и продуктивность виноградных насаждений в агроэкологических условиях АТО Гагаузия.

Практическая оценка работы. Полученные научные данные вносят значительный вклад в разработку и совершенствование моделей ампелоценозов, обладающих высоким коэффициентом полезного действия фотосинтетически активной радиации, в изучение соответствия биологических и сортовых особенностей виноградного растения экологическим условиям зоны их возделывания и способам культуры.

Внедрение в производство. Результаты исследований внедрены при выращивании привитых саженцев винограда, посадке саженцев винограда на постоянное место, производстве клонов винограда в SC «Tomai-Vinex» SA в 2004-2021 гг.

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LIST OF ABBREVIATIONS

RM – *Republic of Moldova*

ATU Gagauzia – *Autonomous Territorial Unit Gagauzia*

SC «Tomai-Vinex» SA – *Commercial Company «Tomai-Vinex» Joint Company*

RPGI – *Regions with Protected Geographical Indication*

RxR 101-14 – *Riparia x Rupestris 101-14*

Kober 5BB –*Berlandieri x Riparia Kober 5BB*

Cl – *Clone of the variety*

Cl R5 – *Clone R5 of the Cabernet Sauvignon variety*

Cl 348 – *Clone 348 of the Merlot variety*

VCR – *Vivai Cooperativi Rauscedo*

Table A 1.2 – *The Second Table of the First Appendix*

Figure A 1.3 – *The Third Figure of the First Appendix*

ch. a - *Chlorophyll a*

ch. b - *Chlorophyll b*

caroten. - *Carotenoids*

c - *Centner*

kg – *Kilogram*

g – *Gram*

mg - *Milligram*

m – *Meter*

l - *Liter*

sm – *Centimeter*

ha – *Hectare*

th. – *Thousands*

LSD_{05} – *Least Significant Difference at a 0.95 Probability Level*

r – *Correlation coefficient*

r^2 – *Coefficient of determination*

y – *Regression equation*

b_{yx} – *Regression coefficient*

SP – *Shoot Productivity*

LS – *Leaf Surface Area of a Shoot*

LAI – *Leaf Area Index*

VC – *Vegetation cover*

K_1 - *Fruiting Coefficient*

K_2 - *Fruitfulness Coefficient*

W – *Weight of Clusters, in grams*

Δ_q – *Yield Growth Reserve*

q_{pot} - *Potential Productivity*

q_a – *Actual Yield*

T - *Number of Years in the Analysed Period*

Ƙ - *Highest Yields Years*

Ρ – *Multiplication of the Highest Yields "**Ƙ**" Years*

pcs. – *Pieces*

Y_{ec} – *Yield Economic, (Cluster Yield), tonnes per hectare*

N_{pl} – *Number of Plants, pieces per hectare*

N_{sh} – *Number of Shoots, pieces per vine*

Recon. – *Reconstruction*

P – *Profit of Production*

R – *Revenue from Sales*

E – *Expenses*

PL – *Profitability Level*

INTRODUCTION

The Autonomous Territorial Unit of Gagauzia (ATU Gagauzia) has favourable soil and climatic conditions for the development of viticulture and winemaking.

To promote the growth of this industry, programs for the restoration and development of viticulture and winemaking have been adopted at both national and regional levels. These include the "Program of Restoration and Development of Viticulture and Winemaking in the Republic of Moldova (2002-2020)" [102] and the regional program "Development Program of Viticulture in ATU Gagauzia for the period 2008-2020" [101].

The main goal of these programs is to establish a modern grape industry capable of producing high-quality grapes that are competitive in the market and economically efficient. Currently, the main objective is to shift the focus of the industry towards expanding vineyard areas planted with high-quality planting material of increased biological value, as well as adopting new technological methods during the establishment and maintenance of grape plantations.

At the same time, one of the current challenges in modern viticulture is the development and improvement of progressive grape cultivation technologies, with the main objective being to achieve stable and high-quality yields. For further advancements in the grape industry, great importance lies in the establishment of vineyards using planting material that promotes high plant survival rates, vigorous growth, high productivity, and longevity. The success of the grapevine's establishment greatly impacts its overall performance and contributes to the overall success of the vineyard. Therefore, continuous efforts are being made to refine and optimise the methods and techniques used in vineyard establishment and management to ensure the production of consistent and high-quality grape yields.

Increasing the efficiency of grape production is a complex problem, and numerous studies have been dedicated to its development by both domestic researchers such as Mikhaylyuk I. et al., [265, 266]; Perstnev N. [294]; Rapcea M. et al. [307]; Cuharschi M., Antoci A. [34]; Cuharschi M. and others, [101]; Cuharschi M., Cebanu V. [38]; Cuharschi M. and others [40]; Ungureanu S., Cebanu V. [38]; Ungureanu S., Cebanu V. [130], Dadu C. [178], Nicolaescu Gh. [87] and others. Foreign scientists such as: Winkler A. [145]; Goldammer T [59]; Hartman H. [66]; Hofacker W. [68]; Edwards J. [51]; Calo A. et al. [8]; 1985; Boidron R.[5]; Borsellino V. et al. [6]; Dardeniz A [44]; Doğan A. [48] and others.

However, the existing production potential of viticulture is not utilised efficiently due to various objective and subjective reasons. Both viticulture and winemaking are facing a financial crisis, which does not correspond to the potential possibilities of this subcomplex. The majority of Grape-growing enterprises have become unprofitable and have replaced viticulture with less energy-consuming and labour-intensive productions.

This is due to several reasons. Firstly, it is related to the long-term use of perennial plantations - vineyards, which constitute a significant proportion of the industry's fixed assets. Secondly, the reconstruction and establishment of young vineyards require substantial capital investments per 1 hectare. Thirdly, young plantations only start bearing fruit in the third or fourth year after establishment, necessitating additional expenses for their care before they enter the fruiting stage. Fourthly, in viticulture located in southern regions, there is a smaller gap between the working period and the production time compared to other crops, and some tasks related to vineyard maintenance and repair are carried out in the autumn-winter period (pruning, trellis repair, etc.). Fifthly, viticulture cannot promptly respond to market fluctuations since the assortment of wine and table grape varieties is determined at the time of planting the vineyards. Finally, the pursuit of maximum yields in viticulture is not always justified as it may lead to a decrease in grape quality, and consequently, its price and profitability per hectare of vineyards. The aforementioned characteristics of viticulture as an agricultural industry need to be taken into account when assessing its economic efficiency.

One of the key directions in the modernization of the viticulture and winemaking sector in the Republic of Moldova is the introduction of high-yielding grape clones of European selection [39]. In recent years, this strategy has arnered significant scientific and production interest. As a result, since 1998, certified virus-free clones of classic European varieties, such as Cabernet Sauvignon, Merlot, the Pinot group, Chardonnay, Sauvignon, and Riesling, have been actively incorporated into the assortment [42]. Preliminary studies conducted by Moldovan Researchers M. Cuharschii, S. Ungureanu, N. Taran, B. Gaina, A. Botnarenco and others [216, 35, 36, 220, 216] suggest the recommendation to implement these clones in the Republic of Moldova. According to these researchers, the adoption of these clones can significantly increase both the yield and the quality of the final products in the viticulture and winemaking sector of the republic.

An important aspect of the development strategy for the viticulture and winemaking sector is the rational use of the country's natural resources [28] which will increase the efficiency of winemaking production [29]. Environmental factors significantly impact the development and production of grapes [106]. Climatic conditions, soil characteristics, and terrain play a key role in the successful growth of grapevines [105]. For this reason, scientists have repeatedly studied the relationship between grape yield, the quality of the harvested crop, and the climatic conditions specific to vineyard locations [90]. This issue remains a relevant subject of research in many grape-growing and winemaking countries worldwide [133]. Climate change has a significant impact on the physiological growth processes of grapevines, leading to changes in their development dynamics, yield, and product quality [79]. To ensure the sustainability of viticulture, it is essential to implement innovative approaches and adapt cultivation technologies aimed at minimizing the negative consequences of climate change [72]. The change in climate affects many characteristics of grapevines from yield through quality [9].

Identifying the patterns of physiological adaptation of grapevines to specific environmental conditions enables effective management of growth, development, and fruiting processes [27]. This understanding is critically important, given that the best productive potential of clones is often realized in the regions where they were developed. When introduced to new growing conditions, clones can significantly alter their properties, and these changes can be either positive or negative [47]. This fact highlights the necessity of thoroughly studying the response of newly introduced clones in new growing conditions.

Currently, despite the improvement and modernization of elements of grafted planting material production technology, one of the main tasks of nursery farming remains the cultivation of high-quality grape saplings free from hidden, latent disease pathogens. In countries where grape cultivation is traditional, international and domestic standards for propagation material and planting stock have been developed to suit climatic conditions [10]. Europe – European and Mediterranean Plant Protection Organization [52]; New Zealand – New Zealand Winegrowers [85]; Australia – Standards Australia [118]; and the Republic of Moldova – SM 206:2022 [115], SM 207:2021 [116], Production, certification, control and marketing of vine propagating and planting material [100], Operational procedure PO-02/02 [99]. These regulations specify the quality parameters of scion and rootstock cuttings and grape saplings, compliance with which contributes to the longevity and productivity of vineyards.

For the further advancement of the viticulture industry, the establishment of vineyards using planting material that ensures high vine survival rates, robust growth, high yields, and longevity is of great importance [96]. Through long-term research conducted by L. Kolesnik [205]; A.G. Mishurenko

[270, 267, 268]; V. Nikolenko [286]; E. Podgorny [303]; A. Mishurenko, E. Podgorny [272]; N. Guzun [172, 173]; L. Maltabar [229, 233, 236, 237]; I. Gromakovskiy [171]; Eifert Jozsef, Eifert Jozsefny [337]; N. Perstnev [295]; A. Derendovskaia [181] and others, it has been established that the variability of grapevines is manifested in changes in biometric, biochemical, anatomical, and other growth and development indicators of grafted plants in the nursery. At the same time, most authors, while identifying signs of different quality in canes, cuttings and saplings, did not research to clarify its influence on the different quality of vines, the productivity of plantations, yield quality, and other indicators after the establishment and operation of vineyards.

Alongside this, a need arises to create plantings characterized by a high uniformity of vines. It is essential to strive for uniformity across all vines in the vineyards in terms of growth strength, yield, and product quality. Importantly, the production of high-biological value grape planting material is crucial. Utilizing this material for establishing new plantations will enhance their productivity and longevity.

Research Goal and Objectives

The Goal of the Research: to determine the potential of introduced grape clones and develop agricultural techniques aimed at enhancing the viability and productivity of vineyards under the agro-ecological conditions of the ATU Gagauzia, thereby improving the sustainability and economic efficiency of viticulture in the region.

The Objectives of the Research:

- conduct an analysis of the meteorological conditions in the ATU Gagauzia;
- identify the specific features of the state and development of viticulture in the ATU Gagauzia;
- evaluate the meteorological conditions in the ATU Gagauzia;
- identify the specific features of the viticulture industry in the southern region of the Republic of Moldova;
- to study the influence of the quality of rootstock and scion cuttings on the processes of regeneration, growth, and development of grafted plants in the nursery, as well as the output of grafted grape vines from the nursery and their shoot and root system development;
- to determine the characteristics of grafted grape vine's survival, obtained from different quality rootstock and scion cuttings;
- to analyse the changes in shoot growth parameters and leaf surface of plants derived from different quality planting materials;

- to analyse the prolonged effects of the different quality planting materials on the yield of grapevines and the quality of the products;
- to develop and improve technological practices aimed at increasing the productivity of grape plantations in the conditions of ATU Gagauzia, using the example of the SC "Tomai-Vinex" enterprise.

Scientific Hypothesis. The development and implementation of an optimal management strategy for ampelocenoses, based on considering the quality of planting material, the characteristics of grape varieties and clones, and the survival rate of saplings obtained from scion and rootstock cuttings of different quality, can create favorable conditions for enhancing the adaptive capacity of the vines, fully realizing the plants' potential productivity, and contributing to the economic sustainability of the industry and the region.

Methodology of Scientific Research. The research methods are based on a review of scientific and technical literature, a systematic approach to problem formulation, the development of objectives, tasks, and research programs. The methodology of the work is based on field and laboratory studies related to the production of grafted planting material; conducting experiments and observations on the annual growth of the shoots, the concentration of plastid pigments, the development of the leaf area index, shoot productivity, yield, and the quality of the grape harvest; mathematical processing of experimental data using correlation analysis, one-way and two-way ANOVA with post-hoc Tukey's HSD test to evaluate the mean values of variants and their grouping by the Tukey method at a 95% confidence level. The work was carried out in accordance with standard and specialized research methodologies.

Scientific Novelty of the Obtained Results. The scientific novelty of research lies in the development of a modern conceptual approach to managing the productivity of grapevine plantations in the Southern region of the Republic of Moldova. For the first time, the potential and reserves for increasing the yield of grape plants in ATU Gagauzia have been identified and calculated. These can be achieved through the utilization of high-quality planting material of modern European clone varieties. New data on the adaptive capacity of the R5 clone of Cabernet Sauvignon and 348 clone of Merlot in ampelocenoses in the Southern region of the Republic of Moldova vineyards have been obtained. The limiting environmental factors that reduce the parameters of photosynthetic activity and productivity of the plants have been identified. Monitoring the growth and development characteristics of shoots, and leaf surfaces, and establishing their correlation with the productivity of the plantations can serve as a basis for obtaining high-quality grape products. The analysis of indicators of economic efficiency of grape production allowed us to identify the real dynamics of the industry's efficiency using the example of SC "Tomai-Vinex" SA. The dependence of the profitability of grape production and sales on the use of diverse clone varieties and different qualities of vines has been established due to the variability in the quality of the grafted saplings used for planting.

Scientific Problem. To enhance the economic efficiency of modern viticulture, there is a need to transition the industry to more intensive, cost-effective, energy- and resource-saving technologies that ensure high yields and product quality. Our research has revealed that the quality of cuttings used for grafting significantly influences the quality and adaptive characteristics of grapevines after planting in a permanent location. The data obtained contribute to identifying the most effective methods for producing grafted planting material, thereby enhancing the quality and adaptation of grapevines to the environment. The studies have uncovered important aspects of the relationship between physiological parameters of introduced grape clones, such as vine growth, assimilative surface, and productivity, and their adaptation to changing environmental conditions. This allows for a better understanding of how the studied grape clones respond to various environmental factors and optimizing the conditions for their cultivation.

Theoretical Significance lies in identifying important aspects and technological peculiarities of the growth, development, and adaptation of introduced clones R5 Cabernet Sauvignon and clone 348 Merlot, which influence the quality and productivity of grape plantations in the agro-ecological conditions of the ATU Gagauzia. The obtained data allow for a deeper understanding of the physiological and adaptive characteristics of the investigated clones, their response to various environmental factors, and optimizing the conditions of their cultivation. This opens the way for the development of more efficient methods for producing grafted planting material, contributing to the improvement of quality and adaptation of introduced clones to the agro-ecological conditions of the ATU Gagauzia. The research results enable the development of management strategies aimed at enhancing the resilience of grape plants to stressful conditions such as drought or extremely high temperatures, ultimately contributing to the increased economic efficiency of viticulture both in the Autonomous and in the Republic of Moldova as a whole.

Practical Significance. The obtained scientific data make a significant contribution to the development and improvement of ampelocenosis models characterized by a high coefficient of photosynthetically active radiation, in studying the correspondence of biological and varietal characteristics of grapevines to the ecological conditions of their cultivation zone, and to cultivation methods. The results of experimental research represent significant practical and economic interest, contain innovative elements, and contribute to the implementation of industrial technologies in viticulture. They allow recommending the use of uniform grafted saplings of the studied clones for planting in the conditions of the Southern zone of viticulture of the Republic of Moldova (ATU Gagauzia), obtained by using for grafting the 1st and 2nd cuttings from the base of the rootstock cane, scion cuttings with tendrils, and pre-stratification treatment of grafted cuttings with a solution of Calovit.

Approbation of Research Results. The materials of the Thesis were presented and discussed at the following events: 5th International Congress on Engineering and Life Science, (Pitesti, Romania, 2024); 4th International Conference on Food, Agriculture and Animal Sciences, ICOFAAS 2023, (Sivas, Turkey, 2023, online); 4th International Congress on Engineering and Life Science, (Comrat, Moldova, 2023); International Scientific Symposium: Modern Trends in the Agricultural Higher Education, (UTM, Chisinau, Moldova, 2023); VI International Scientific-Practical online-offline Conference "Biotechnology: Achievements and Development Prospects", (Pinsk, Republic of Belarus, 2023); IX National Scientific and Practical Conference “Problems and Challenges of Regional Economy in the Conditions of Globalization”, (CSU, Comrat, Moldova, 2023); International Scientific and Practical Conference "Science, Education, Culture" (CSU, Comrat, Moldova, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024); International Scientific Symposium „Agriculture and Food Industry - Achievements and Perspectives”, (UTM, Chisinau, Moldova, 2022); 5th International Agriculture Congress, UTAK 2022, (Turkey, 2022); 4th Internanional Agriculture Congress, UTAK 2021, Online, 2021); International Congress on Applied Sciences-II. AL-FARABI, (Baku, Azerbaijan, 2021, online); London International Conference, London, United Kingdom, (UKEY, 2021, online); Innovative Development within the Smart Specialization of the Region: Challenges and Prospects, Innovation Week in CSU, (CSU, Comrat, Moldova, 2020); 3rd International Agriculture Congress (Tunis, Online, 2020,); 1st International Symposium on Agriculture and Food in Turkish world (Izmir, Turkey, 2019); 2nd Internanional Agriculture Congress (Ayas, Ankara, Turkey, 2019); International Tairov Readings, V.E. Tairov Research and Development Institute. V.E. Tairov (Odessa, Ukraine, 2019); V National Scientific and Practical Conference “Problems and Challenges of Regional Economy in the Conditions of Globalization” (CSU, Comrat, 2019); International Symposium: Horticulture. Agronomy "85 years of the Faculty of Agronomy - Achievements and

Perspectives" (SAUM, Chisinau, Moldova, 2018); 1st Internanional Agriculture Congress (Chisinau/Comrat, Moldova, 2018); X International Conference "Geology in School and University: Earth Sciences and Civilization" (St. Petersburg, Russia, 2017); Scientific and Practical Conference "Modern Achievements of Science and Ways of Innovative Ascent of the Economy of the Region, Country", (CSU, Comrat, 2017); III National Scientific and Practical Conference "Problems and Challenges of Regional Economy in the Conditions of Globalization" (CSU, Comrat, 2017).

Publications on the subject of the Thesis: The main materials of the thesis have been published in 73 Scientific Papers, including: 1 Monograph, 1 article in Journals from Web of Science and SCOPUS databases, 2 articles in Journals of other databases accepted by ANACEC, 10 articles in recognized foreign Journals, 1 article in Journals of the National Register of Category B, 12 articles in International Scientific Conferences abroad, 27 articles in International Scientific Conferences in Moldova, 2 articles of Republican Scientific Conferences with international participation, 12 abstracts in International Scientific Conferences abroad, 5 abstracts in International Scientific Conferences in Moldova.

The structure and volume of the Thesis: The Thesis consists of 213 pages of the main text and includes the following: Introduction, 8 Chapters, Conclusions, Recommendations for Production, and Bibliography. It contains 66 tables and 43 figures, along with 12 appendixes. The bibliography comprises 342 sources.

A Summary of the Chapter of the Thesis:

Chapter 1 - "Technological Features of Grafted Planting Stock Production and Their Impact on the Productivity of Vineyards". This chapter summarises literature data (approximately 60 years' worth) on the main technological features of producing grafted grapevine planting material. It indicates that modern production technologies should be based on the quality of the initial material used for propagation, as it affects the survival rate of vines, the longevity, and the productivity of future vineyards.

Chapter 2 - "Materials and Methods". This chapter provides a comprehensive overview of the experimental designs and a detailed description of the research objects. It outlines the methodologies employed in both field and laboratory settings, offering insights into the techniques used for observations, analyses, and data collection throughout the study. Particular attention is given to statistical data analysis, which was utilized to interpret the results and assess the significance of observed trends. Additionally, presented the economic efficiency of the proposed approaches, highlighting their practical implications and potential for improving productivity.

Chapter 3 - " The State and Development of the Viticulture Sector in ATU Gagauzia". This chapter provides a characterization of ATU Gagauzia as an integral part of the region with the protected geographical indication "Valul lui Traian." A comparative analysis of climatic indicators has been conducted, highlighting the microclimatic features specific to ATU Gagauzia. Additionally, an assessment of the current state and development prospects of viticulture in the conditions of ATU Gagauzia, with a focus on the case of JSC "Tomai-Vinex," over the past 25 years, is presented. The potential yield level of vineyards in the region has been determined, and reserves for its increase have been calculated.

Chapter 4 - "Biological and Technological Features of Grafted Vine Saplings Production". The chapter examines the main quality parameters of the rootstock and scion canes and their influence on the processes of regeneration, growth, and development in the nursery, as well as the output and quality of grafted saplings. It is established that the morphological and biochemical parameters of grapevine cuttings taken from the rootstocks BxR Kober 5 BB and RxR 101-14 before grafting, naturally vary depending on their position along the length of the rootstock cane (from the base to the top).

Chapter 5 - " Productivity of Vineyards Depending on the Quality of Planting Material".

The chapter presents data on the survival rate of grafted vine saplings in their permanent location, depending on their quality. It also examines the peculiarities of Shoot Growth, Annual Growth, and the formation of young grapevines of the R5 clone of Cabernet-Sauvignon. The results regarding the yield and quality of the products of the grapevines entering the fruiting stage are also provided.

Chapter 6 - "Growth, Development, and Productivity of Clones Depending on the Shoot Training System of Grape Vines". The chapter presents a comparative assessment of the grape plantations of the R5 clone of Cabernet-Sauvignon and the 348 clone of Merlot before and after reconstruction. Key parameters such as Shoot Growth, Leaf Surface Area, Photosynthetic Activity of Leaves, and Vine Productivity of the studied grape varieties are analyzed. The findings demonstrate that the reconstruction of grapevine plantations, involving modifications to the shoot training system, results in significant changes in the Phytometric Indicators of the vine canopy. These include increased

Shoot Growth Parameters, expanded assimilation surface area, and enhanced Leaf Photosynthetic Activity, ultimately contributing to higher productivity in the studied clones.

Chapter 7 - "Monitoring of the Growth, Development and Productivity of Grapevine Clones". The chapter includes the accounting, analyses, and observations on the grape plantations of the R5 clone of Cabernet-Sauvignon grafted onto the rootstocks BxR Kober 5 BB and RxR 101-14 during the period of full fruiting (2015-2021). The results are presented concerning the Average Load of Shoots on the vines, their Growth and Development of Annual Growth, changes in the parameters of Photosynthetic Activity, and the Productivity of Shoots and vines over the years of the research. It is shown that the Growth, Development of Leaf Surface, and Productivity of the grape vines of the Clone R5 Cabernet-Sauvignon variety are directly dependent on the quality of the vine saplings and the conditions of their growth.

Chapter 8 - "Economic Efficiency of Grape Production in SC Tomai-Vinex SA". The chapter provides an economic justification for the efficiency of grape production using the developed agricultural practices, depending on the different saplings' quality. The dependence of economic efficiency indicators is demonstrated, on one hand, on the quality of the scion and rootstock material and, on the other hand, on meteorological conditions, which may not always be adequate during the years of the study.

1. TECHNOLOGICAL FEATURES OF GRAFTED PLANTING STOCK PRODUCTION AND THEIR IMPACT ON THE PRODUCTIVITY OF VINEYARDS

1.1. The Main Technological Features of Grape-Grafted Planting Stock

In viticulture, the most widespread method of propagation is vegetative, using cuttings, layering, and grafting. However, grafting holds a leading position in grapevine propagation. Grafting is used to address many issues in viticultural practices, breeding, organisation, and the economics of grape growing.

According to N. Perstnev [297], grafting allows grape growers to address four main issues: combating phylloxera by grafting cultivated varieties onto phylloxera-resistant rootstocks; combating nematodes by grafting European fruiting varieties onto nematode-resistant rootstocks; expanding grapes into more northern regions by grafting cultivated varieties with low frost-resistant roots onto frost-resistant rootstocks; combating chlorosis caused by high carbonate content in the soil or other reasons, by grafting onto rootstocks that are tolerant to carbonates.

The emergence of the most dangerous pest for European grape varieties, phylloxera, in Europe [189], became a significant impetus for the development of knowledge about grape grafting. The phylloxera catastrophe that loomed over viticulture in the late 19th century led to the necessity of transitioning to grafted cultivation of European varieties onto phylloxera-resistant rootstocks of American species. Over 140 years of practice in cultivating grafted vineyards in all European countries have proven their high profitability.

The theoretical foundations and practical application of grafting European varieties onto phylloxera-resistant rootstocks were established in France (Planchon, Millardet, Viala, Ravaz, Foex, Coudere, and others) and Germany (Dumler, Zeeliger, Kremer, Müller, and others) [294].

The technology of growing grafted planting material is a complex process that combines several independent techniques. The timely and sequential execution of these techniques determines the production of high-quality grafted saplings and the productivity of the established grape plantations. Many scientists, including G. Borovikov [156], L. Kolesnik [202, 203, 204], L. Maltabar [231, 234, 232, 235, 230], A. Mishurenko [269, 268], A. Subbotovich [321, 323], E. Podgorny [303] (1968), V. Nikolenko [283, 284], I. Gromakovskiy [168, 169], N.D. Perstnev [294], S. Ungureanu [129], and others, have made significant contributions to the development of the technology for grape-grafted planting material production.

The production of planting material is one of the main tasks in viticulture and should meet the requirements of the industry's development in the region, including varietal policy. Considering the specific nature of this crop, it is important to note that the variety and planting material determine the direction and effectiveness of grape cultivation for the next 20-30 years. Improving the agricultural techniques for cultivating grafted and rootstock varieties, as well as the conditions for their storage, grafting methods, and technology for growing grafted grape seedlings, is a necessary condition for increasing the profitability of the industry.

In viticulture, a large number of different grafting methods are applied, including bench grafting, simple and improved cleft grafting, in-place grafting, greenwood grafting, budding, and others [294].

Bench grafting, also known as whip-and-tongue grafting, is a widely used grafting method in viticulture. In this technique, a one-year-old single-bud cutting (scion) is grafted onto a one-year-old cutting of the rootstock, which is separated from the mother plant. This method allows for good fusion of the grafted components due to the formation of callus under appropriate conditions. It enables the industrial production of planting material and ensures high labour productivity for grafters, facilitating the implementation of mechanization and automation in the process.

Grafting can be performed manually or with the help of machines, where the scion is grafted onto one-year-old rootstock cuttings of standard or elongated sizes [226, 239]. For grafting, unrooted cuttings or cuttings with prior rooting can be used [269].

Developing the technology for producing grafted grape saplings, L. Kolesnik [205] proposed the following agrotechnical practices for their cultivation:

- collecting rootstock woods (canes) from mother plants before the onset of stable frosts or at the beginning of the frost period (in December or January);
- storing rootstock and scion canes during winter as whole shoots at temperatures ranging from +2°C to -2°C and with moderate humidity;
- careful selection of rootstock cuttings based on ripening indicators at all stages of preparation for grafting and during the grafting process itself;
- selecting the best buds and shoots for grafting, collecting shoots from vigorously growing and productive bushes, preferably from the middle or lower parts of the rootstock vines. Selecting buds from the middle part of the shoots, at the nodes with axillary buds or inflorescences;

- applying an improved grafting method that significantly facilitates callus formation and speeds up the fusion of components;
- incorporating structural soil together with fertilizers (boron, zinc, manganese, and molybdenum) into stratification boxes when laying the grafts;
- stratifying the grafts at a temperature of 25°C and regularly ventilating the greenhouse;
- hardening the grafts in open air conditions at temperatures in the boxes not exceeding 12-15°C;
- planting the grafts in open trenches with maximum preservation of the roots formed during the pre-sprouting period and leaving the tops of green shoots uncovered;
- fertilising the grafts with nitrogen, phosphorus, potassium, and micronutrients (boron, zinc, and manganese) during planting in the nursery;
- providing careful maintenance of the grafts throughout the entire vegetation period.

L. Kolesnik [205] paid great attention to the physiological and biochemical processes occurring in grapevines, scion cuttings, and rootstock vines before grafting, as well as in grafted cuttings during stratification, hardening, and growth in the nursery. He believed that the problem of increasing the output of grape seedlings from the nursery could be successfully solved only by understanding the complex processes of graft fusion, with particular emphasis on the importance of roots. He believed that roots, by absorbing water and mineral elements, stimulate the fusion of graft components. In the technology for producing grafted grape seedlings developed by L. Kolesnik, a significant role is given to the method of planting grafted cuttings in open trenches, with the complete preservation of the root system.

For grafting, use cuttings taken from the first meter from the base rootsctock canes, as they contain more plastic substances. After cutting the cuttings, calibrate them according to the upper diameter (7.1-8.0; 8.1-10.0; 10.1-12.0). When preparing one-bud scion cuttings, it is important to consider the biological characteristics of the variety and the variation in bud quality based on the length of the one-year-old shoot [248].

All stages of the grape grafted saplings production technology are primarily aimed at active regeneration in the graft union area. The author believes that grafted cuttings, after stratification and hardening, should have only root buds at the base of the rootstock, as the formation of abundant callus and roots leads to their exhaustion before transplanting into the soil. The focus is on ensuring that the grafted components unite successfully and efficiently without depleting their energy reserves during the stratification and hardening processes. This approach is crucial to achieving higher survival rates and better growth performance of the grafted grapevines after transplanting them into the field.

According to the National Scientific Centre «V.Ye. Tairov Institute of Viticulture and Winemaking» [268], a high yield of grape saplings from the nursery is observed when grafts are planted with their intact root system and planted with a ball of soil. The author notes that nurseries achieve a consistently high yield of grafted grape vines by conducting stratification and hardening at a different temperature near the graft union and the base of the rootstock. A lower temperature at the base of the rootstock during stratification and hardening leads to the formation of root primordia while simultaneously inhibiting the development of roots. This approach promotes better root development and overall growth performance of the grafted grape seedlings after transplanting into the field.

A. Mishurenko [271] proposed a differentiated temperature regime inside the stratification boxes: an elevated temperature at the graft union between the scion and the rootstock (24-26^{0}C) and a reduced temperature at the base of the rootstock (15-18^{0}C). According to N. Romanenko and I. Tikhvinsky [310], such a differentiated temperature regime should also be maintained in the stratification boxes during the stratification of grafted cuttings using local electric heating.

József and Eifert Józsefné [339] in Hungary, on the production of grafted grape vines, emphasize the importance of considering the energy reserves stored in the vines in the form of carbohydrates throughout the various stages of the technology. They propose that the stratification process should be carried out in a way that allows sufficient energy to remain after the formation of the callus to support proper rooting.

The possibility to control the course of physiology-biochemical processes in grafts in the desired direction emerged with the open method of stratification and hardening of grafts developed by V. Nikolenko [285]. With this method of stratification, active callus formation and graft union occur in the zone of the splice, while at the base of the rootstock, root primordia are formed, ensuring rapid rooting of the grafts after planting in the nursery. This method allows for the regulation of lighting conditions, aeration, mineral nutrition, and other factors during the stratification process. The open method of stratification involves three main periods: pre-stratification, actual stratification, and hardening. During the second and third stages, lighting plays a particularly significant role, and it should be maintained at 350 W/m^2 during stratification and 450 W/m^2 during hardening.

If grafting and stratification are carried out early, and weather conditions do not permit planting, the grafts can be preserved or conserved at a temperature close to biological zero (4-8^{0}C) in a well-lit, well-ventilated area with forced ventilation. The main goal of conservation is to slow down metabolic processes, prevent shoot overgrowth, delay root development, and acclimate the plants to their natural habitat conditions.

L. Maltabar and I. Tikhvinsky [251], L. Maltabar [233] developed a method of open light hardening for first-grade grafts in water or nutrient solutions, with a duration of 7-10 days. During this period, the outer cells of the callus become corky due to exposure to moist air and light, while the inner cells turn bright green due to the accumulation of chlorophyll. The open hardening in water activates physiological processes throughout the grafted cutting. The intercomponent callus and shoots experience an increase in dry matter content, enhanced oxidative processes, and pigment accumulation. At the base of the grafts, root primordia are formed. The grafts establish well in the nursery, resulting in a 10-30% increase in seedling yield. However, the open hardening method required further development, especially for early grafts, due to the extended hardening duration.

The work of I. Gromakovskiy [169] revealed the possibility of extending the hardening duration of grafts under different temperatures, lighting, and substrate conditions. This technique combines elements of conservation by using additional lighting and reduced temperatures with elements of hardening, hence, it is called "conservation-hardening." The positive effects of a 30-45-day conservation-hardening in water under illumination of 10,000 lux and temperature of 7^0C, as well as under illumination of 5,000 lux and temperature of 15^0C, were observed on the output of grape saplings in the nursery. These conservation-hardening regimes lead to enhanced cell differentiation in the callus and the development of a well-established conducting system, resulting in a 13.8% to 15.9% increase in the output of grape saplings compared to the control group [162].

The general technology of grapevine grafted planting material production emphasizes special attention to its cultivation since the output and quality of grapevine planting material depend on a complex set of conditions and practices during their cultivation in the nursery. Often, high-quality grafts perish immediately after being planted in the nursery due to improper soil selection, inadequate soil preparation, a lack of irrigation, and insufficient pest and disease control. Therefore, grapevine grafts should be placed in specific crop rotations, on light sandy and loamy soils that are well-draining and highly fertile. It is essential to cultivate them in areas with artificial irrigation and protect the grafts from drying out right after planting in the nursery [168, 331].

In recent years, the method of cultivating planting material with a so-called closed root system has gained widespread popularity. The essence of this method is to plant the grafts before or after stratification into peat-cellulose or paper pots, compressed peat briquettes, tubular containers, perforated polyethene pots, cardboard packets, and other containers filled with a nutrient mixture. The grafts are placed in greenhouse conditions, where they root and form new growth. When favourable external conditions arise, the grafts, together with their containers, are transplanted to their permanent location or into the nursery. In both cases, a high survival rate is achieved due to the presence of an intact root system and new growth. Upon transplantation to their permanent location or nursery, the root system and green growth of the grafts are preserved, enabling them to continue functioning and developing [295].

The described method of cultivating planting material with a closed root system has become popular and widely used in various countries such as Germany, Italy, France, the United States, Romania, Bulgaria, Czechoslovakia, and others. The application of this method is justified by its advantages, such as increased survival rate, better preservation of the root system and green growth, and the possibility of mechanizing the cultivation processes, which contributes to the increased efficiency and profitability of grape cultivation [278]. These countries actively develop and improve methods for growing grafted planting material to ensure a high level of quality and yield of seedlings, as well as to facilitate the work of grape growers and enhance the resilience of plantations to various weather conditions and diseases.

L. Maltabar [229] considers the method of growing grafted saplings in cardboard cups to be highly effective, as it allows grafting to be done in February and high saplings output from the nursery or high survival rates at the permanent location. L. Maltabar, A. Zhdamarova, D. Bachurin [244], L. Maltabar, A. Zhdamarova [243, 241], in addition to the technology used in Germany, recommend using electric heating of the cups and tying the grafting site with plastic film to protect the callus from drying out after planting the grafts in the nursery or at the permanent place.

According to A.P. Tereshchenko [327], the experience of nursery companies in California, which produce vegetative grafted grape vines in reusable pots on artificial substrate, is very interesting in this respect. Selected cuttings of the scion and rootstock, according to the standard requirements, are used for grafting after undergoing pre-grafting preparation. Right after grafting, the site of the union of components and the entire grafted cutting are wrapped with a special semi-permeable polymeric film, which has high adhesion properties.

This film hermetically isolates the graft and the site of the union from the surrounding environment, thereby preventing moisture loss from the graft and drying out of the graft union.

However, due to its diffusive gas permeability, this film does not impede the flow of oxygen to the graft union and the release of carbon dioxide produced during respiration by the cuttings. Therefore, the stratification of the grafts is conducted using the open method on water, with periodic water changes. This stratification method allows for continuous visual monitoring throughout the stratification process.

The forming callus, protected by the film, stretches the film without compromising its hermetic seal. In turn, the film compresses the callus, promoting faster development of the primary elements of the conducting vascular system within it. Thus, by the end of the stratification process, a significant portion of the grafts have established physiological contact between the understock and the scion, accelerating the formation of a unified organism from the two graft components. Towards the end of the stratification process, the bud freely emerges through the film without breaking its hermetic seal and, under intense illumination and reduced air humidity, develops actively photosynthesizing green growth, which also contributes to the fusion of the graft components.

After stratification, the grafted cuttings are planted in multi-use plastic pots filled with a peat-perlite substrate. Grafts that have not developed root primordia during the stratification period are treated with a rooting stimulant, which facilitates faster root formation on their basal parts in the loose, moist substrate.

The pots with the planted grafted cuttings are placed in a greenhouse. Under optimal temperature and humidity conditions, roots rapidly develop on the basal parts of the grafted cuttings. There is a more vigorous growth of shoots on the scion compared to what occurs in an open-ground grape nursery, which is subjected to a range of adverse environmental influences.

In greenhouse conditions, it is easier than in an open-ground nursery to carry out watering, fertilization, and disease control, while achieving significant savings on expensive chemicals. As a result, about 40-45 days after planting the grafts in the greenhouse, they develop a growth rate of 25-30 cm, a well-established root system, and form a physiologically integrated entity, that is, a grapevine sapling. After a short hardening period and treatment with the "Anti-stress" preparation, which prevents wilting of the green growth under the influence of drying winds, these saplings are transplanted to their permanent location. Planting is done using a hydro-borer of a special design.

By the end of the growing season, the growth of grapevines usually reaches 70-80 cm (in California conditions - over a metre), and a well-developed root system actively forms on the rootstock. As a result, the farmer who establishes their plantation using vegetative planting material with an intact root system obtains a fully established vineyard already in the year of ordering the saplings, thus bringing forward the time of harvesting by a year.

Thus, grafted grapevines, obtained from grafted cuttings using various methods, can be grown in field conditions in open-ground nurseries, as well as in greenhouses, tunnels, trenches with nutrient mixtures, hydroponic systems, various types of containers like cups, pots, bags, and others.

According to A.P. Tereshchenko [326], modern technologies for producing grafted grape planting material should primarily be based on the variety composition of rootstocks and scions. Depending on the soil and climatic conditions, at least six main rootstock varieties should be grown in the mother grapevine: RxR 101-14, RxR Schwarzmann, 44-53 Maleg, Freedom, BxR SO4, and BxR Kober 5BB. It is essential to establish the mother grapevines with the material of the biological category "Base," free from viral diseases and bacterial canker. The mother vineyards should be cultivated using the "Kendall-Jackson" trellis system, which allows for the formation of bushes without the need for suckering and yields 120-140 thousand cuttings per hectare.

Scion mother vineyards must be established using material that meets the standards of the Basic Biological Category to ensure high quality and stability of future saplings. It is essential to select grape varieties and clones not only based on agronomic characteristics but also with a focus on the needs of winemakers, who seek varieties with specific organoleptic properties for wine production. Additionally, consumer preferences must be taken into account to meet the demand for wines with diverse flavor and aromatic profiles. It is equally important to consider the climatic and soil conditions of the specific region, as well as the local market's potential for product sales, to ensure the selection of varieties is optimally adapted to these factors.

The cultivation of saplings should be carried out using new moisture-retaining materials with selective gas permeability. The scion and rootstock materials should be stored in refrigerators. To reduce the strain on labour resources, grafts can be conserved before stratification.

Implementing a comprehensive set of devices and tools for monitoring environmental conditions and the status of grafted plants in nurseries is a necessary step to enhance the efficiency of grapevine nursery operations. These systems enable specialists to monitor changes in environmental parameters (such as temperature, humidity, solar radiation intensity, and other meteorological conditions) and perform comprehensive diagnostics of mineral nutrition and plant health during various stages of the vegetation period. Such monitoring systems allow for the timely identification of deficiencies or excesses of micro- and macronutrients, enabling precise adjustments to fertilization and irrigation methods. This, in turn, optimizes the use of fertilizers and water, improving the economic efficiency of production. The adoption of these technologies also enhances the quality of grapevine saplings, prevents diseases resulting from improper nutrition, and increases plant resilience to adverse climatic conditions.

L.M. Maltabar and his colleagues [240, 245, 246, 247, 248, 248], have summarized and proposed new elements of industrial technology for producing grafted grape vines:

- creation of mother rootstock and scion vineyards of intensive and super-intensive types to obtain certified cuttings and vines of desired varieties and their clones without the risk of infection by chronic diseases (bacterial cancer, viruses, etc.);
- utilisation of grafting machines such as "Omega-Star," known for their high labour productivity in producing grafted grape cuttings;
- application of hormone-containing paraffin for pre-stratification treatment of grafted grape cuttings to stimulate callus formation and protect them from desiccation, as well as fungicide-containing paraffin before planting in the nursery;
- the production of grafted grapevines includes closed and open stratification of grafted cuttings, their pre-planting treatment with growth regulators (rooting stimulants such as exuberant) and antitranspirants, planting in the nursery, and plant care;
- the use of machines for planting grafted cuttings in the nursery also involves, laying and perforating mulch film, pruning shoots, and defoliating leaves on vines before lifting them from the nursery. These machines are also used for lifting the vines while bundling them, and they are widely used in all nursery enterprises in Italy, Germany, and France.

According to Hermann Weis [67], planting grafted cuttings in the nursery should be done after May 10^{th}, at a depth of 13-15 cm, under black mulch film with irrigation systems installed beneath it. During the growing season, the following practices should be carried out: watering every 5-8 days (approximately 15-20 mm); pest and disease control every 8-10 days; shoot pruning 2-4 times. After lifting from the nursery and sorting, the growth of the vines is shortened to 5-8 cm. To control Botritis cinerea, the vines are treated with hinazol for 5 hours (annual growth - 0.5%, roots - 0.1%). Storage is carried out in polyethene bags in cold storage rooms at temperatures ranging from +2 to $+30^{0}$C.

Considering the advancements in science and technology, modern grape nurseries have evolved into highly specialized production facilities, resembling factories designed for the efficient mass production of planting material. Operators within these nurseries are tasked with optimizing production lines through precision techniques and innovative methodologies to meet the growing demand for high-quality vines. However, despite these advancements, significant internal losses ranging from 40% to 60%, as reported by nursery operators worldwide – highlight persistent challenges. These losses stem from various factors, including diseases, suboptimal rooting success, genetic inconsistencies, and environmental stresses, underscoring the need for enhanced quality control measures, improved propagation technologies, and the development of more resilient rootstocks and scion varieties. Addressing these issues is crucial for ensuring sustainable and economically viable grapevine production, particularly in the face of climate change and increasing global demand for viticulture [137].

This requires the development of standards that provide clear criteria for the quality indicators of scion and rootstock cuttings, as well as grape vines. Despite significant progress in modernizing the nursery infrastructure [6], one of the main challenges remains the production of healthy, uniform, and high-quality planting material that meets the required standards.

Sanitary standards in the grape-growing industry have improved, but overall sanitary procedures are not consistently applied throughout the entire propagation process [139]. Random contamination of grapevine material from various sources, including dust, water, tools, and clothing, is a common occurrence [1, 4, 19, 51, 135, 143,].

General sanitary measures, including regular and thorough cleaning of nursery premises and equipment, proper and timely removal of plant debris and waste, as well as management of wastewater and drainage [3, 119], are essential elements in combating pests and diseases in nursery management. Special grafting rooms, protected from rain and dust, reduce the risk of contamination.

Consumables should be stored in a designated warehouse away from the grapevines [3]. During the grafting process, the grafting rooms should be cleaned frequently. Benches, grafting machines, and tools should be disinfected with appropriate agents at each meal break and at the end of each day. However, activities such as sweeping or washing the floor should only be carried out at the end of the day, as they can create clouds of dust or water droplets that may contaminate everything in the grafting rooms.

Other minor actions that jeopardize the quality of grafts and contribute to losses during propagation include delays in processing grafted cuttings due to meal breaks, exposure to high temperatures, and agrochemicals [86, 108, 138, 140].

In recent years, due to complex economic relations, one of the main tasks has been to grow, procure, and store scion and rootstock cuttings of a certain quality.

To obtain high-quality grape planting material in the technology of its production, starting from the preparation of grafts and ending with the storage of vines in the autumn-winter period, scientists and practitioners recommend the following improved Agrotechnical practices:

- sorting and calibrating grafts of rootstock and scion varieties according to their diameter, soaking them before grafting in clean water with the addition of corresponding biologically active substances as provided by the technologies [186, 187, 188];
- enhancing callus formation and union, treatment of the apical part of grafted cuttings with solutions of growth regulators, depending on their quality [254, 296, 221, 180, 131];
- paraffin coating of the apical part of grafted cuttings with paraffin mixed with growth regulators, plasticizers, and wax-based antitranspirants for protection against dehydration and to enhance regeneration processes [66, 86, 113];
- disinfection from mycoplasma and viral infections (of grafted cuttings of rootstock and scion varieties, grafted vines) through thermal treatment [22, 54, 55, 56, 60, 61, 62, 63];
- observing sanitary conditions at all stages of grafted grapevines and rooting production [78, 144, 97, 114, 142, 93, 110].

The implementation of advanced agrotechnical practices in grapevine planting material production is essential for ensuring high-quality and healthy vines. These measures, which include precise sorting and treatment of grafts, enhancement of callus formation, application of protective paraffin coatings, rigorous disinfection protocols, and adherence to strict sanitary standards, significantly contribute to improving the efficiency and reliability of the propagation process. By integrating these scientifically backed techniques, the industry can minimize losses, enhance the physiological quality of planting material, and meet the increasing demands for quality, robust, and productive grapevine stock, even under challenging environmental and market conditions.

In the Republic of Moldova, standards for propagation materials have been developed. However, within the allowable parameters, there are variations in the quality of cuttings and vines, which may lead to different quality of grape hub vines in terms of their growth, development and productivity.

In the complex chain of grapevine propagation, the development of suitable technology is crucial. This technology should enable obtaining a high yield of vines with strong graft unions, well-developed shoots, and a robust root system. Planting such vines should ensure good survival rates, longevity, and productivity of the plantations.

Indeed, modern technologies for producing grafted grapevine seedlings should be tailored according to the quality of the initial material used for grafting. The quality of this material directly influences the yield of grape vines from the nursery, their survival, growth, and longevity in their permanent place. The significance of research in this direction is also linked to the current focus on creating new, high-quality, and high-yielding plantations with superior product quality.

1.2 The Impact of the Different Quality Cuttings for Propagation and Planting Stock on the Viability and Productivity of Vineyards

In the complex chain of grapevine propagation, the development of a technology based on the understanding of physiological and biochemical processes occurring during the graft union is crucial. Modern grapevine propagation technologies should be tailored to the quality of the initial material used for grafting. The material used for propagation must possess sufficient energy reserves to support regenerative processes and be in a physiological state that allows for the mobilisation and utilisation of these energy reserves while enduring the demands of complex technological procedures [339].

A. Mishurenko [268] believes that the decisive factor in increasing the output and improving the quality of grafted planting material is to shoot maturation and accumulation of nutrients in them.

In most cases, cane quality is determined by the degree of vine maturation, which is associated with external characteristics, as well as carbohydrate accumulation, anatomical structure and other parameters [207, 231]. Simple histochemical methods have been developed to determine the degree of cane maturation and its suitability for grafting [264, 163].

Eifert Jozsef, Eifert Jozsefny [337] believe that the percentage of carbohydrates in the cane is not always a good criterion for determining its quality, therefore the total carbohydrate reserve in the cuttings is important. In this sense, a thick can always has a greater carbohydrate reserve than a thin cane, despite the same percentage of carbohydrate content. The energy stored in carbohydrates must be sufficient for callus formation and rooting, as they are actively used during the regeneration process.

Eifert Jozefny [339] believes that the concept of mature cane is a very succinct one. It includes the ability of the cane to possess all the physiological properties necessary for bipolar regeneration (grafting, fusion and rooting) and to be in a physiological state in which it can withstand the stresses imposed by the technology. The author believes that cane maturity should be assessed by anatomical structure (the ratio of wood to heartwood and the number of layers of hard husk); water content in the cane and the ability to retain it; carbohydrate content as a percentage of dry matter and carbohydrate reserve in 100 cuttings, as well as other indicators - frost resistance, mineral composition (nitrogen, potassium, boron and zinc content), weight of cuttings and other factors determined by the methods of their cultivation.

The highest regeneration capacity (callus formation, rooting) is characterised by cuttings prepared from the middle and upper parts of the cane. Based on the research of L. Kolesnik [205], L. Maltabar [233], A. Mishurenko [268], the most productive cuttings within one shoot are those cut from the middle and lower parts of the shoot. Cuttings from the top part of the shoot, even if they fulfill the requirements of the standard and have matured normally, give a lower survival rate and somewhat worse quality seedlings, compared to cuttings from the lower or middle part of the same shoot. At the same time, thin, normally woody cuttings, if well preserved, root no worse and often even better than thicker cuttings.

L. Kolesnik [205] notes that morphological features of cuttings (thickness, character of bark and wood structure on different sides of cuttings, as well as the ratio of wood and heartwood diameters) can serve as indicators of nutrient distribution, largely determining the regeneration processes in grafted grape cuttings. The author found that the cuttings suitable for grafting are those that have a diameter of 6-10 mm in the upper part, a full circle of bundles of hard husk, uninterrupted on the grooved side, well-developed wood on all sides and a small heartwood.

D. Petrash [299] also notes that the increasing radius of conducting tissues as well as the decreasing ratio of cuttings diameter to heartwood are the main anatomical indicators of the quality of rootstock cuttings. At the same time, according to Eifert Jozsefny [339], anatomical characteristics, although interestingly informing about cane development, variety, growing place and weather conditions, at the same time are not suitable for determining the valuable qualities of the vine, its ability to regenerate, the exception being the number of layers of the hard husk.

According to A.I. Derendovskaia [181], cuttings of the rootstock differ in anatomical structure, carbohydrate content and level of physiological activity by cane length. According to the totality of anatomical and biochemical parameters, cuttings from all zones within the standard are suitable for grafting in the RxR 101-14 variety, and cuttings from the base and middle of the cane in the BxR CO_4 variety. Cuttings from the upper zone, even though in terms of thickness they are suitable for grafting, at the same time, in terms of anatomical and biochemical parameters (size of conductive tissues, number of layers of solid husk) are inferior to cuttings of the RxR 101-14 variety. The author found that the activity of regeneration processes in grafted grape cuttings depends on the content and activity of phytohormones - auxins and inhibitors. A clear regularity in the change of phytohormone activity in rootstock cuttings by cane length was revealed. In the RxR 101-14 variety, the 2nd and 3rd cuttings have the highest activity, while the 1st, 4th and 5th cuttings have the lowest. In the variety BxR CO_4 biological activity of zones is higher than in RxR 101-14 and decreases from the base of the cane to the top. Similarly, to the biological activity of cuttings before grafting, their regeneration activity also changes.

In grafted cuttings of Shasla white variety onto RxR 101-14, the most active regeneration is characterised by cuttings from the middle, then lower and upper zones, grafting onto BxR CO_4 - from the lower, then middle and upper zones, grafted saplings output is 49.2; 44.7; 28.9% and 43.7; 27.9, 16.4%. This is confirmed by other authors [225].

Studies by Mahmoud Abu-Raya [253] and Nabila El Badawi Kasem [275], conducted under the supervision of A. Subbotovich established that the quality of scion and rootstock depends on their thickness. The formation of callus, root system, germination of eyes, development of grafted saplings in the nursery, as well as the output of grape saplings from the nursery are in direct dependence on the thickness of cuttings used for grafting. Thus, these indicators increase with increasing thickness of cuttings.

A. Doğan et al. [48] conducted a study on the influence of scion diameter (4-7 mm, 8-10 mm, 10-12 mm) grafted onto three rootstock varieties (Kober 5BB, 420A, and 41B) on root formation and the rooting process. Their findings revealed that scions with a diameter of 10-12 mm demonstrated the best performance across key parameters, including rooting percentage, root length, and root mass. This suggests that the choice of scion diameter is a critical factor in improving the success rate of grafting and subsequent root development. Larger scions likely possess more robust vascular tissues and energy reserves, which may facilitate better callus formation and nutrient transport during the rooting phase. Moreover, the compatibility between scion and rootstock, combined with optimal scion dimensions, enhances the efficiency of the grafting process, contributing to stronger root systems and healthier plants. These results emphasize the importance of carefully selecting scion diameter to maximize the productivity and quality of nursery plants, especially when working with specific rootstock varieties.

According to L. Kolesnik [205], callus formation and rooting efficiency are thus influenced by a trade-off between regenerative capacity and nutrient reserves. Younger cuttings, typically taken from the upper or middle sections of the cane, exhibit higher metabolic activity and greater potential for cell division, which supports rapid callus development and rooting. However, these cuttings often lack the stored carbohydrates and other essential nutrients needed to sustain growth under stressful conditions, such as drought or low temperatures. Conversely, older cuttings, usually obtained from the basal part of the cane, contain more substantial nutrient reserves, including starches and proteins. These reserves enhance the cutting's resilience and provide the energy required for initial root growth, even in suboptimal environmental conditions. However, their lower regenerative potential may lead to slower callus formation and rooting rates. To optimize propagation success, it may be beneficial to balance these opposing factors. For example, treating younger cuttings with growth regulators [181] or nutrient supplements can enhance their resilience, while using controlled environmental conditions for older cuttings can stimulate faster callus formation. Understanding this dynamic can help viticulturists select the most suitable parts of the cane for propagation, depending on the environmental challenges and the specific goals of the nursery.

The ability of grapevine canes to actively regenerate is often linked to their maturation. However, it's not always the case that cuttings taken from the base of the cane, which are well-matured, exhibit intense callus and root formation. Strong development of mechanical tissues in the stem can often limit the potential for propagation through cuttings, while an increase in parenchyma development enhances the intensity of the process [206, 342].

The compatibility of rootstock and scion [76, 31], the combination of rootstock and scion [126, 44, 7, 71, 77], and the level of lignification of the scions [53] have a significant influence on callus development around the graft union.

The compatibility between rootstock and scion [76, 31], as well as their proper combination [126, 44, 7, 71, 77], are key factors for the successful grafting of grapevines. These parameters directly affect the development of callus tissue – a protective and connective layer that forms around the graft union. A well-developed callus not only ensures the mechanical strength of the graft but also optimizes the conductivity of water and nutrients between the rootstock and scion, which is critical for the growth and resilience of the grapevine.

The lignification level of scions [53] and the degree of tissue woodiness also play a significant role. Poorly lignified scions may be less resistant to mechanical damage and may exhibit lower grafting success, especially under conditions of low temperature or high humidity. Conversely, excessive lignification can hinder callus formation and slow down the grafting process, particularly when the rootstock and scion have differing growth rates or structural characteristics.

These factors are especially critical in the industrial production of planting material, where high production rates demand minimal losses during grafting. Consequently, modern grapevine nurseries place significant emphasis on developing methods for the preliminary assessment of rootstock and scion compatibility based on biochemical and physiological parameters. This includes the study of hormonal balance, anatomical tissue characteristics, and enzyme activity responsible for callus formation. In recent years, biotechnological approaches have been actively developed, including the use of growth stimulators, anti-stress agents, and callus formation regulators. These innovations enhance compatibility, accelerate graft union formation, improve the quality of planting material, reduce production losses, and enhance the adaptability of grafted plants to various growing conditions.

L. Kolesnik [205], while studying the different quality of buds on grapevine canes, found that nodes, where inflorescences or tendrils are located, have a higher carbohydrate content. Therefore, the highest yield of first-grade saplings is obtained when grafting buds from the lower part of the cane, where inflorescences or tendrils were present. The best canes for grafting are those located on replacement canes, at the base of fruiting canes, and on perennial branches. They form callus more effectively and provide a higher yield of grafted saplings.

Reducing the photoperiod during shoot growth, which is believed to decrease carbohydrate reserves due to reduced photosynthesis, negatively impacts the rooting of cuttings [65, 66]. The reduction in available carbohydrates limits the energy resources necessary for callus formation and root initiation, critical processes in the establishment of new plants. This factor may also explain the lower productivity of cuttings from the apical parts of the grapevine compared to those from basal ends [86]. Apical cuttings often contain fewer stored nutrients and lower carbohydrate reserves due to their younger, less lignified tissues and their proximity to the shoot's growing tip, where energy is primarily directed toward elongation and leaf formation. In contrast, basal cuttings, being more mature, tend to accumulate greater carbohydrate reserves and exhibit more robust lignification, contributing to improved callus formation and rooting efficiency. Understanding these physiological dynamics highlights the importance of selecting cuttings from specific parts of the vine for propagation and optimizing photoperiod conditions during the growing season to enhance the success rate of grapevine propagation. But there is limited evidence of a direct correlation between starch reserves and rooting of cuttings [125].

Carbohydrates are mainly stored in the central cylinder of the one-year-old shoot, and the cane does not mature until the entire tissue of the central cylinder is filled with starch grains [83]. Therefore, a fully matured (ripened) cutting with a diameter ≥ 7 mm does not have sufficient reserves for rooting and callus formation of the graft, and it is possible that other, yet unidentified physiological factors influence the regenerative capacity of cuttings [125, 109].

According to A. Mishurenko [270], scions taken from high-yielding hub vines and harvested from the middle part of normally developed woody shoots ensure good callus formation and graft union during grafting. Buds located at the nodes in the middle part of the shoot are more differentiated and usually contain a higher amount of nutrients, especially at the axillary nodes, where the diaphragm is better developed.

L. Kolesnik [202] considers that the anatomical structure of nodes differs from that of internodes, with nodes having a more robust development of parenchyma and mechanical tissues and, conversely, a weaker vascular system development. The pith parenchyma, pericycle fibres, and medullary rays are wider at the node, and in the peripheral part of the bark, collenchyma is well pronounced. The diameter of the pith is larger, and its cells are larger, with a reduction in cork formation on the cell walls at the node.

N. Guzun [172, 173] suggests using buds located in the zone of 1-4 pairs of tendrils for grafting in the conditions of Moldova, as the winter buds in this part of the shoot are formed under the most favourable temperature conditions.

V. Nikolenko [286] believes that the best results are in grafting under the conditions of the National Scientific Centre «V.Ye. Tairov Institute of Viticulture and Winemaking» are obtained from buds located above the clusters, specifically in the range of 5-6 to 10-13. This approach increases the yield and improves the quality of the grafted saplings.

N. Perstnev, E. Moroshan [297] during the study and development of the grafting saplings cultivation technology, it was found that regardless of the grafting method, when using nodes with tendrils, the occurrence of dead tissue at the site of shoot development is less pronounced. The authors propose using nodes with tendrils as the initial material to improve the saplings' quality and ensure better vine development at their permanent location. These nodes have a solid diaphragm that prevents deep tissue necrosis.

A. Subbotovich [322] notes that, when using scion cuttings with tendril in the cultivation of grape saplings in the nursery and after planting the saplings at their permanent location, tissue necrosis on the opposite side of the growing shoot of the scion mostly occurs up to the node, and only a small number of vines experience necrosis beyond the node. On the other hand, when using scion cuttings without tendril, in the majority of plants (up to 70%), tissue necrosis occurs on the opposite side of the growing shoot of the scion at a considerable distance, extending below the node up to 3 cm.

The quality of scion and rootstock canes is largely determined by their varietal characteristics, soil and climatic conditions of growth, and the level of agricultural technology. Activation of regeneration processes is achieved through various external factors, among which synthetic growth regulators play a leading role. The action of these compounds on regeneration processes depends, on the one hand, on the content of plastic substances in the cuttings, and the other hand, on the internal hormonal status of the components during the period of their union [181].

Based on long-term research, it has been established that rootstock cuttings taken from different zones of the cane exhibit varying regenerative activity and, at the same time, different responsiveness to treatment with growth regulators, particularly heteroauxin. It has been found that treating the apical part of grafted cuttings with a solution of heteroauxin promotes the enhancement of their regenerative activity and increases the output of grafted saplings from the nursery by 6.0-10.0%, especially when using cuttings from the upper zone of the cane, characterised by weak callus-forming ability [225].

Therefore, in production conditions, an essential practice should be the calibration of rootstock cuttings before grafting into groups based on thickness and using heteroauxin only for treating grafted cuttings with relatively low callus-forming ability, especially those from the upper zone of the cane.

Thus, up until now, there has been no clear and definite concept established to determine the influence of the quality of rootstock and scion cuttings on the output of grape saplings from the nursery, the longevity and productivity of future grapevine plantations, and the effectiveness of all subsequent agrotechnical methods during their cultivation.

1.3. Planting and Care Technology for Vineyards

The effectiveness of the grape growing industry largely depends on how well the site for planting the vineyard is chosen. There are numerous cases where vineyards in significant areas produce low or poor-quality yields, despite high-level agronomic practices. The reasons for such phenomena are likely related to the mismatch between the soil and hydrological conditions of the area and the requirements of grapevines [96].

When establishing new grape plantations, it is essential to consider that they will be in operation for several decades, and mistakes made during their establishment can have long-lasting effects on the conditions of operation, as well as on the quantity and quality of the harvest [201].

When establishing grape vineyards, it is essential to consider the specific characteristics of the grape culture that distinguish it among other perennial crops. These include cultivation requirements, commercial qualities, biological characteristics, environmental factors, and agrotechnical features [165].

The establishment of new vineyards must be carried out in accordance with the law on grape and wine [80]. Vineyards should be located within the designated areas suitable for grape cultivation, where the climate, soil, terrain, and other environmental factors meet the requirements of grape culture [24, 25, 27, 199].

The selection of land for establishing vineyards is a technical and legal process regulated by governmental authorities, through which the land plot for the vineyard is determined, along with the choice of grape variety and the intended purpose of the vineyard (e.g., for producing table grapes, sparkling wine materials, white and red wines, etc.) [26, 197, 200].

The influence of weather and climatic conditions on crops, especially on perennial fruit crops and vineyards, is evident. With the selection of new high-yielding varieties, the demand for accurate and detailed agroclimatic information significantly increases.

Agro-climatic conditions of territories characterise the long-term patterns of light exposure, temperature, and moisture during the vegetation periods of crops, as well as during the preparation and completion of vegetation and the period of forced winter dormancy. Comparing these conditions with the requirements of crops for light, warmth, and moisture allows us to determine the availability of light, heat, and moisture resources for the crops, as well as the risk of frost and freezing on the territories. In the first half of the last century, various indicators were proposed to characterise the resources of light, heat, and moisture. These indicators include the duration of sunshine, the sum of total and photosynthetically active radiation, the sum of active and effective temperatures, the amount of precipitation during warm and cold periods, and the storage of productive soil moisture in layers of 0-50 cm, 0-100 cm, and 0-150 cm. Frost hazard is assessed based on the average of absolute annual minimum air temperatures while freezing hazard is evaluated using the dates of the last spring and first autumn frosts, as well as the duration of the frost-free period [165].

The planting of grapevines and the care of young plantations include pre-planting soil preparation for vineyards, such as deep ploughing, aimed at improving the physical and chemical properties of the soil and enhancing microbiological processes within it. Grapevines planted on well-prepared soil with deep ploughing typically enter into fruiting 1-2 years earlier, and exhibit vigorous growth, high productivity, and longevity.

The arrangement of grapevines is related to the choice of row direction, planting scheme, and planting density. In the Republic of Moldova, the standard practice is to have rows spaced at intervals of 2.5 to 3.0 metres, and within each row, the distance between individual vines ranges from 1.0 to 2.0 metres. These distances may vary based on factors such as the vigour of vine growth, soil fertility, and moisture conditions [32].

Grape growers from around the world [70, 8, 81, 69, 146, 30, 5, 147, 141, 2, 328] have recognized the effectiveness of clonal selection. Currently, it is practised in 26 countries worldwide, with ongoing research to improve grape production varieties. Over 3,500 clones have been registered to date, and a significant portion of them outperform mother plants in productivity by 2-5 times, harvest quality by 1-3%, and show increased resistance to stress and pathogens by 1-2 points. Often, the new clones show superior characteristics compared to the base varieties, undoubtedly making the clonal selection the modern foundation for increasing grapevine productivity [303].

In 1998-1999, several certified clones of European grape varieties were imported to the Republic of Moldova, including from Italy. These clones included [35, 36, 37]:

- Chardonnay – cl. R8, ENTA V95, SMA 123, etc.;
- Pinot Blanc – cl. VCR 1 and VCR 7;
- Pinot Gris – cl. R6, cl. 52;
- Pinot Noir – cl. R4, INRA 115, SMA 201;
- Sauvignon Blanc – cl. ISV F2 and F5, ENTA V297;
- Traminer – cl. R1, R4, and GM-1;
- Riesling – cl. R2, VCR 3, ENTA V49;
- Aligoté – cl. 263, 264;
- Merlot – cl. F5, R5, R18, ENTA V314, ISVF V2;
- Cabernet Sauvignon – cl. R5, F5, ENTA V337, ISVFVS;

- Cabernet Franc – cl. VCR 5, VCR 10, R9;
- Malbec – cl. ENTA V594, etc.

These clones are considered to belong to high-biological categories according to their countries of origin [216, 218].

Considering that the soil and climatic conditions, as well as the grape cultivation technology in the Republic of Moldova, differ somewhat from those in Western Europe, the authors conducted an agrotechnical assessment of these clones to determine the specifics of their variety of agrotechnics. When establishing the plantations, the spacing between hub vines in the row was determined based on the growth vigour of the clones. For moderately vigorous varieties, the hub vine spacing in the row was set at 1.25 metres (Chardonnay, Pinot group, Traminer, Aligoté); for above-average growth vigour - 1.50 metres (Riesling, Cabernet Sauvignon); and highly vigorous growth - 1.75 metres (Sauvignon), with a row spacing of 2.5 metres. In the Southern zone, the planting scheme was set at 2.75x1.35-1.50 metres. The pruning system of the hub vines corresponded to their biological properties.

As a rule, for planting vineyards, rootings or grafted vines one-year-old, two-year-old, or green saplings are used, and in some cases, matured one-year-old cuttings, stratified or non-stratified grafted cuttings, as well as seedlings are exceptions. Industrial vineyards are primarily established using one-year-old saplings, less frequently two-year-old saplings, and in some cases, green saplings. Only first-class vines that meet the requirements of the standard (SM 207:2021) [116] and the criteria of biological value and phytosanitary condition are allowed for planting [100].

For further improvement of the viticulture sector, the planting of vineyards with planting material is of great importance, which should contribute to high plant survival rates, vigorous growth, high productivity, and longevity of the vineyard. There is a need to create vineyards characterised by uniformity among the vines, as mechanisation is essential for labour-intensive tasks such as pruning and harvest. Uniformity in vine growth facilitates the efficient use of machinery and equipment, leading to higher productivity and better management practices in the vineyard [322].

K. Smirnov et al. [313, 314] believe that the success of establishing a vineyard largely depends on the quality of the planting material used. This quality influences the survival rate of the saplings, the time it takes for the vineyard to start bearing fruit, its productivity, and overall profitability. By the term "Quality of Planting Material," they mean the level of development of the plants, the presence of a well-developed aboveground and root system, and, in the case of grafted saplings, a well-formed union at the grafting point.

A. Subbotovich [322] notes that an important factor influencing the survival, growth, and development of young vines in their permanent location is the thickness of the rootstock portion. This thickness often varies significantly in saplings that fully meet the standards' requirements. The division of vines into groups based on the thickness of the rootstock portion: 6.5-7.9 mm, 8.0-9.9 mm, and >10.0 mm, allowed the author to conclude that with increasing thickness, the content of carbohydrates in the vines increases by 1.5-2.0 times, as well as the moisture content in the tissues of the organs, and there are changes in the anatomical structure of the shoots. Such saplings, after planting in their permanent location, exhibit a 100% survival rate, good growth, early onset of fruiting, and higher yields in the third year after planting compared to saplings with rootstock thicknesses of 6.5-7.9 mm. Further research has established a direct correlation between the thickness of the cuttings used for grafting, the output of grape saplings from the nursery, their survival rate, and growth in their permanent location. The author suggests that the uneven development of vines and significant variability in yields within the vineyard are a direct consequence of the considerable diversity in the quality of the planting material within the standard. The author recommends calibrating the saplings and planting them in their permanent location in groups, depending on the thickness of the rootstock portion.

Indeed, according to G. Nicolaescu et al. [282], the quality of the grafted saplings used has a significant impact on their survival, growth, and development in their permanent location. Ultimately, this has a substantial influence on the productivity of the plantations.

In recent years, in the Republic of Moldova, vineyards have been established using high-quality planting material of selected clones, which are free from viral and mycoplasma diseases, nematodes, and bacterial canker [157]. The grafted saplings exhibit enhanced viability. After being planted in their permanent location, vines show vigorous growth of main shoots and lateral shoots, as well as increased physiological activity of the leaf apparatus and proper vine ripening, all within the first year. The task of grape growers is to use these observed characteristics rationally to accelerate the formation of appropriate plant shapes and ensure a faster entry into fruit-bearing. In connection with this, one of the main tasks is to determine the cultivation system (covered, uncovered, or semi-covered), types of supports, and vine training methods, to organise the vineyard management practices for the future years. It is especially important to carry out meticulous work on young vineyards before they enter into fruit-bearing, as this ensures better fruit production and longevity of the vines in the long run [298].

Not later than the beginning of the vegetation in the second year, trellises are installed, and the process of vine training begins. To facilitate plant care, mechanise vineyard operations, increase productivity, and improve product quality, the grapevine is shaped into specific forms, which are determined by the presence or absence of a trunk, the number, length, and direction of the permanent branches (arms), cordons, sometimes the style of pruning and tying, and the presence or absence of fruiting links. In global practice, many different types of forms are constantly being improved and adapted to specific grape-growing regions [294].

Therefore, the main technological tasks for young and entering fruiting stage vineyards are:

- Ensuring hundred percent plant density.
- Making final decisions on the cultivation method (covered, uncovered, or semi-covered) and selecting or creating appropriate forms and types.
- Timely and high-quality pruning and manipulation of the green parts of the vines during the process of shaping the desired forms.
- Choosing a reliable method to protect vines from winter frosts and damage.

Achieving optimal establishment and productivity in young and fruiting vineyards requires a systematic approach to their management. Key priorities include ensuring full plant density for uniform development, adopting the most suitable cultivation methods and vine forms to match environmental conditions, and performing timely pruning and canopy management to shape desired vine structures. Additionally, implementing effective measures to safeguard vines from winter frosts is critical for maintaining their health and longevity. These practices collectively contribute to creating a robust foundation for sustainable vineyard productivity and high-quality grape production [298].

Training systems for grapevines have been used since ancient times in regions such as the Middle East, Greece, and Rome. Modern systems vary widely but can be classified into four basic types based on trunk height, the presence of cordons, and the pruning method: head/spur, head/cane, cordon/spur, and cordon/cane. These systems differ in the amount of perennial wood retained and may employ cane-pruning, spur-pruning, or a combination of both to optimize vine structure and productivity [145].

Grapevine training plays a key role in optimizing vineyard management [83]. It ensures efficient light exposure by properly arranging perennial wood and annual growth, promoting a balanced leaf area-to-crop ratio, increased productivity, and improved grape quality, while also enhancing disease control [107]. Additionally, training systems simplify mechanized vineyard maintenance. An ideal training system should consider site-specific conditions, cultivar characteristics, winter hardiness, bud fruitfulness, and adaptability to mechanized processes [84].

Research by P. Dry [49], has shown that improper canopy management in vineyards can reduce light penetration within the canopy, negatively impacting bud fruitfulness and ultimately leading to decreased vineyard yields. Optimizing light distribution through the grapevine canopy is a critical component of vineyard management. This can be achieved through pruning, trellising, and proper spatial arrangement of shoots, enabling maximum utilization of available sunlight. For instance, vertical and horizontal trellising systems help position shoots and leaves to ensure uniform light exposure across all parts of the plant, especially the lower branches, which are often at risk of light deficiency.

The experience of cultivating grapes in the conditions of the Republic of Moldova shows significant advantages of high-stemmed grape cultivation over other vine training systems. Such a kind culture allows for a considerable reduction in the technological labour intensity of the industry by eliminating or significantly reducing the need for manual labour. It also helps increase the level of comprehensive mechanisation of work processes and reduce seasonality in carrying out major tasks, among other benefits.

The high-culture style of training is a method of training vines in open soil without covering the hub vines with soil or other insulating materials for winter. This vine training system is allowed in regions with a low frequency of critical low temperatures, which can lead to a complete loss of yields no more than once every ten years [194, 195].

For Vitis vinifera varieties, critical temperatures are the temperatures at which the plants are susceptible to damage or death, such as:

- for relatively frost-resistant varieties: -23^{0}C to -25^{0}C.
- for moderately frost-resistant varieties: -21^{0}C to -22^{0}C.
- for weakly frost-resistant varieties: -18^{0}C to -20^{0}C.

Therefore, in the viticulture regions where the recurrence of low temperatures (-18^{0}C to -20°C) happens no more than once every ten years, all grapevine varieties are cultivated without covering the hub vines for winter, which is typical for the conditions in the South of Moldova [197].

The pioneer of the high-culture style of training vines was Lenz Moser from Austria. According to L. Moser's method [273] for training vines high-culture, it involves planting high-trained vineyards with relatively frost-resistant varieties, using 3 pairs of training wires, a feeding area of 3-3.5 x 1.2 metres, forming a straight and stable trunk of 1.3-1.35 metres high, and tying each plant to support, allowing the shoots to develop freely and hang down.

After initial research conducted in the Republic of Moldova by I. Mikhaylyuk [265], in Crimea by P. Bolgarev et al. [155], in the southern Ukraine, Odessa region, by L. Nikiforova et al. [281], in the Don and Northern Caucasus regions by Sh. Guseynov [176], O. Ryabchun [312], and others, the high-trained vine system was widely adopted in production.

Information about the state and development features of the high-stem grape culture in the Republic of Moldova is summarised in the works of I. Mikhaylyuk [265], I. Mikhaylyuk, M. Cuharschii et al. [266], M. Cuharschii et al. [208, 211, 212, 215, 219].

At present, the improvement of the high-culture vine system is being pursued through the rational placement of plantations in the most optimal natural and economic zones [41, 42]. This system of vine training is used alongside traditional varieties for new selection varieties, high-yielding ones, with group resistance to adverse environmental conditions, diseases, and pests [23]. Research is being conducted to find effective vine training systems and variety-specific agronomic practices, as well as to increase the mechanisation level of various vineyard tasks, including harvesting and pruning, among others [33]. Ultimately, the main goal of these new technologies is to consistently achieve high yields of top-quality grapes while minimising the need for manual labour and resources [39].

The creation of intensive vine plantations with a high-trained vine system requires timely training of the vines, and their pruning during the preparation period for fruit-bearing has its specific characteristics. These are largely determined by the soil-climatic and biological properties of the grape varieties, as well as several other factors [208].

Cordon forms of grapevines are characterised by the presence of elongated permanent branches called "cordons," on which spurs bearing fruit links, spurs, and canes are arranged in a specific order. They have trunks of varying heights and 1-2, rarely 4, permanent arms [210].

Horizontal cordons, particularly the two-trunk bilateral cordon introduced by I.V. Mihailiuk, have gained the most widespread adoption [294]. The two-trunk cordon form of the hub vine is characterised by its simplicity in development and the ability to create equal strength and age of arms and other skeletal elements by the fourth year of vegetation. Years of practice have shown that this form of hub vines, especially with vigorous varieties and relatively nutrient-rich and well-watered soils, is highly effective and easier to rejuvenate [215].

According to I. Mihayluk's recommendations [265], the formation of the trunk in cordon-trained vines should begin in the second or third year of vegetation. For this purpose, during the spring pruning, 1-2 two or three-bud spurs are left on the hub vine. In the future, during the first bending and tying, two of the most well-developed shoots are retained for the trunks, and one is kept as a reserve on each vine. On the main trunk shoots, the lateral shoots are removed during tying, while on the reserve shoots, starting from the second breaking and training, the tops are pinched, and no lateral shoot removal is done.

When the shoots reach approximately 40-50 cm above the future level of the first wire tier of the trellis, they are gently bent and tied to the first wire. To provide greater strength to the future trunks, they are interwoven with each other at the upper part and, after bending, laid horizontally in opposite directions on the first wire tier of the trellis and tied to form branches (cordons). The creation of cordons' branches can also be achieved from the upper lateral shoots by pruning the main trunk shoots at the level of the first wire tier of the trellis. The choice of methods for forming cordons' branches and other skeletal elements of the vine depends on the biological characteristics of the varieties and the conditions of their cultivation [216]. The more vigorous the growth of the vines and the more favourable the soil and climatic conditions, the easier it is to achieve the planned training of the plantings through green operations [37, 43].

One of the most commonly used training methods in U.S. commercial viticulture is the cordon training system. This system is widely adopted for its effectiveness in managing vine growth, optimizing photosynthetic activity, and improving yield quality. The cordon system involves arranging the vine horizontally along wire, where individual branches are secured, ensuring good ventilation and easy access to the plants for agronomic practices such as pruning, treatment, and harvest [107].

The architecture of grapevines, their geometric structure, and their external form determine the distribution of the assimilation surface in space. These aspects play a key role in shaping the radiation regime of the vines, thereby determining their photosynthetic activity, the level of energy exchange in plants, and the vineyards as a whole [154].

The ecological conditions of the area are key factors that determine the growth and development of grapevine shoots. Climate parameters, such as temperature, precipitation, solar radiation, as well as soil characteristics, including structure, fertility, and water retention capacity, play a critical role. These factors directly impact photosynthetic activity, the growth dynamics of green mass, and the formation and development of fruit buds. Additionally, extreme weather conditions, such as drought, frost, or excessive humidity, can significantly slow down shoot growth or cause damage. In the context of climate change, understanding the interconnection between ecological factors and the biological processes of the grapevine becomes especially important. This understanding supports the development of adapted agrotechnical approaches, including optimal systems for managing shoot growth and canopy formation [74].

The microclimatic conditions of each grapevine can be regulated through various canopy management methods, which create more favorable conditions for the growth and development of the plant [111].

The use of training systems, such as vertical or horizontal positioning of shoots, allows for the optimization of light, air, and moisture distribution [179]. This, in turn, enhances photosynthetic activity, improves yield and grape quality, and provides better protection against adverse weather conditions. Additionally, proper canopy management can reduce the risk of diseases by lowering humidity in the lower parts of the plant and improving air circulation.

An important task is to improve the structure of vineyard plantations to achieve an optimal combination of a high efficiency coefficient (EC) for utilizing photosynthetically active radiation (PAR) and the implementation of progressive cultivation technologies. To achieve this, various factors need to be considered, such as planting density, the selection of suitable vine training systems, and canopy management methods that ensure the most efficient distribution of sunlight across the plant. This helps increase photosynthetic activity, which directly influences shoot growth, as well as yield levels and fruit quality [314]. Combined with advanced vineyard management techniques, such as the mechanization of pruning, treatment, and harvesting processes, productivity can be significantly improved while reducing costs and minimizing the environmental impact on agricultural land. Ultimately, improving plantation structure contributes to the sustainable development of viticulture, ensuring high product quality and stable yields amid changing climatic conditions.

The biological unit of the agrocenosis of vineyard plantations should be considered the shoot, as it represents the primary element where all physiological processes of the plant are realized—from photosynthesis to nutrient accumulation and fruit formation [175]. Understanding the shoot as the biological unit of the agrocenosis allows for more accurate modeling and optimization of grapevine growth, development, and fruiting processes. This is crucial for creating effective vineyard management systems, where each shoot can be seen as an element influencing the overall productivity of the plantation. Analyzing the structure of the shoots, their length, number, and positioning on the vine helps determine optimal parameters for crop formation, as well as ensuring an even distribution of photosynthetically active radiation across the grapevine. With precise calculations and monitoring of shoot growth, it is possible to predict the yield potential and quality of the resulting crop. This, in turn, facilitates better planning of agronomic practices such as pruning, tying, and plant treatments, allowing for increased vineyard efficiency and high-quality harvests under various agroecological conditions.

The growth and productivity of the grapevine canopy, functioning as an optico-biological system, are closely related to the rhythm of physiological processes that determine shoot development and the functional capacity of the leaf surface [154].

The productivity of the grapevine canopy directly depends on the rhythm of physiological processes related to shoot development and the functionality of the leaf surface. The efficiency of these processes influences the plant's ability to produce and redistribute organic substances, which in turn determines vine growth and fruit production. The rhythm of physiological processes such as photosynthesis, transpiration, and respiration define how effectively the grapevine utilizes solar energy, water, and nutrients for its development. Shoot development, as a key component of this process, is directly linked to canopy productivity. The growth of shoots and their active development contribute to an increase in leaf surface area, enhancing the plant’s photosynthetic capacity. This, in turn, improves the vine's energy supply, stimulating the growth and development of clusters. An optimal balance between the number of active shoots and functional leaf surface area promotes maximum canopy productivity, ensuring high yield and grape quality [64].

The parameters of leaf surface development have a significant impact on several key processes in viticulture, including transpiration, root system growth, and the photosynthetic potential of grapevines. The development of the leaf surface affects the efficiency of transpiration, which in turn regulates the plant's water balance and contributes to its resilience to stressful conditions such as drought or high temperatures [46]. The photosynthetic potential of grapevines is directly dependent on the leaf surface area, as leaves are the primary organs responsible for photosynthesis. The larger the leaf surface, the more sunlight can be used for carbohydrate synthesis, which directly influences vine development and crop formation. Root system development is also closely related to leaf surface parameters, as an increase in leaf area stimulates root growth, enhancing their ability to absorb water and nutrients, which contributes to the overall growth and yield of the plant [75].

The leaves play a pivotal role in vital life processes such as photosynthesis, transpiration, and respiration. These processes are heavily influenced by the genetic characteristics of the plant and its ability to adapt to environmental conditions. The higher the photosynthetic activity of the leaves, the more energy is supplied to the plant for growth and fruiting. The overall efficiency of these processes depends on the cumulative Leaf Surface Area, which is the combined result of the activity of individual leaves within shoots, vines, rows, and vineyards [314].

Leaf Blade Area, Leaf Area of the Shoot, Leaf Area of the Vine, and Vineyard, as well as the Leaf Area Index (LAI), are key parameters used to assess the growth and development of the grapevine's leaf surface. Each of these indicators has its own significance and directly impacts the overall productivity of the plant. These parameters are interrelated, and their optimization contributes to improving the photosynthetic efficiency of the vineyard, as well as enhancing both the quality and quantity of the yield. Effective management of these parameters through pruning, vine training, and canopy management techniques can significantly improve results, especially under changing climate conditions and varying agro-ecological factors.

The Leaf Area Index (LAI) stands as a fundamental parameter in viticulture, serving as a crucial tool for evaluating the canopy area of vineyards. LAI serves as a key indicator of vineyard productivity and fruit quality, as it directly influences light interception, photosynthesis rates, and grape ripening dynamics. The assessment of LAI holds significant importance in optimizing vineyard performance and ensuring sustainable grape production [45]. Leaf Area Index serves as a critical indicator due to its profound impact on various physiological processes essential for grapevine growth and development [16]. The parameters associated with leaf area profoundly influence key biological functions such as transpiration, root growth, and the photosynthetic capacity of grapevines [75]. The LAI is affected by the management of agronomic practices such as grapevine trellis and training systems [92].

The architecture of grapevines, meaning the structure and organization of their canopy, as well as the environmental conditions that influence the development of leaf surface, are key factors determining both the biological productivity and the economic yield of vineyards. A well-designed vine training system ensures the optimal distribution of light, water, and nutrients, which promotes more efficient photosynthesis and shoot growth. This, in turn, impacts both the quantity and quality of the harvest [335]. Climatic conditions such as temperature, solar radiation, humidity, and rainfall, as well as soil characteristics (structure, fertility, water retention capacity), directly affect the plant's ability to develop a sufficient leaf area, which is necessary for the accumulation of carbohydrates and other nutrients. In unstable climatic conditions, extreme temperatures, or water scarcity, properly trained vines and effective canopy management become crucial for maintaining high yields and quality grapes. Additionally, the structure of the vine and the development of the leaf surface are significant for the plant's resistance to diseases and stress, directly influencing the economic viability of the vineyard. The impact of these factors on yield and vine resilience makes proper vineyard management not only important for achieving stable, high-quality harvests but also for reducing maintenance costs and improving the profitability of the vineyard.

According to research conducted by Poenaru et al. [98] and Naumenko [277], the development rates of Leaf Areas in vine plants exhibit variation. These differences are influenced by the inherent biological characteristics of the grapevine varieties and their ability to adapt to specific growth conditions.

The main indicators of grapevine adaptation to environmental conditions are shoot growth and development, leaf formation, yield, and the quality of the harvested product. These indicators serve as measures of how effectively the grapevine adapts to changes in climate, soil, and other ecological factors, and how well it can function in various agroecological conditions. Active shoot growth indicates good water supply, adequate sunlight, and proper agronomic practices. It also suggests that the plant is capable of accumulating the necessary resources for future fruiting. Leaves are the primary organs of photosynthesis, and their quantity and condition directly influence the plant's ability to produce organic compounds that nourish the roots and contribute to crop formation. In conditions of stress or resource shortages, the vine may redistribute its efforts by increasing or decreasing the number of leaves to optimize photosynthetic activity, which also affects final yield. Growth indicators of shoots, leaf formation, yield, and product quality are interconnected and comprehensive markers that help determine the degree of grapevine adaptation to agroecological conditions [50].

The productivity of the grapevine canopy is the result of the complex interaction between the rhythm of physiological processes, shoot development, and the functionality of the leaf surface. Optimizing these factors through proper vineyard management can significantly enhance the efficiency of viticulture.

The accelerated formation of vines, their longevity, and the productivity of future vineyards largely depend on the quality of the initial material used for propagation. This is one of the main conditions that determine the effectiveness of all subsequent agrotechnical measures.

In this regard, there is a need to conduct research on the study of different quality of rootstocks and scion's cuttings and their influence on the processes of regeneration, the success rate of grafting grapevines in the nursery, as well as their survival, growth, and development in the conditions of Southern region of Moldova (ATU Gagauzia).

1.4. Conclusions to Chapter 1

Based on the analysis of literature data (approximately 60 years) on the cultivation technology of grafted grape vines and the impact of individual agronomic practices on the productivity of grape plantations, the following conclusions can be drawn:

1. The quality of the initial material used for grapevine propagation plays a crucial role in the success of grafted sapling production and subsequent vineyard development. Selecting high-quality saplings, considering their development, fully matured above-ground parts, and root systems, and ensuring a complete graft union in grafted saplings, promotes high survival rates, robust growth, and overall vine development;
2. Studies show that saplings with a rootstock thickness of 8.0-9.9 mm and above have a higher carbohydrate and moisture content, favouring their successful rooting and good growth. Such saplings, when planted in a permanent location, have a high survival rate, early fruiting and higher yield in the third year after planting;
3. Implementing a high-culture vine system represents a crucial and promising approach to enhance viticulture efficiency. It reduces labour intensity in vineyards and enables greater mechanization, thereby contributing to increased productivity and product quality while ensuring vineyard stability and profitability;
4. The application of modern techniques in the production of grafted saplings and the cultivation of grapevines, based on the quality of the grape-grafted planting material, contributes to the creation of healthy, productive and long-lasting vineyards with high yields and quality products.

2. MATERIALS AND METHODS

2.1. Experimental plot

The experimental vineyards are located in the southern part of the Republic of Moldova, in the ATU Gagauzia, at the SC "Tomai-Vinex" SA farm. Experimental plot No. 1 (Experimental Scheme I and II) covers an area of 1.11 ha, with the following coordinates: 46.157727, 28.791652. Experimental plot No. 2 (Experimental Scheme III and IV) is located at coordinates 46.1542651, 28.8011721.

The experiments were conducted in the nursery and on the grapevine plantations (Experimental Schemes I, II). After stratification and hardening, the grafted cuttings were planted in the nursery, which was mulched with black light-impermeable film, in a 4-fold repetition. After digging out from the nursery, the different-quality grape saplings of clone R5 Cabernet Sauvignon variety, grafted on the rootstocks BxR Kober 5 BB and RxR 101-14, were planted in their permanent place in the spring of 2005. The experimental plot is situated on a southwest-facing slope with a steepness of 5^0. The planting scheme for the vines is 2.75 m between rows and 1.5 m between plants in a row (fig. A 1.8).

Experimental Schemes III, IV - grape plantations of clone R5 Cabernet Sauvignon variety, and clone 348 Merlot variety, grafted on 5BB rootstock, were planted in 2006, with a planting scheme of 2.5x1.35 meters (Figure A 1.13).

Formation of a two-trunk bilateral horizontal cordon vine-shape according to I. Mikhaylyuk [265]. Shoot management was implemented using a vertical shoot positioning system on an upright trellis. A plant support stake is placed near each vine trunk. The trellis system consists of intermediate posts set at a height of 1.8 meters, and edge posts set at a height of 2 meters at a 45-degree angle opposite to the row direction, secured with anchor bracing. All tiers of wires are tensioned using Gripple devices, ensuring the trellis structure's strength, vine canopy and ability to withstand the load of the total mass of green shoots and clusters.

The soil in the experimental plots is kept under "black steam". Weed control is carried out through mechanical methods such as inter-row and inter-plant cultivation, deep loosening, hand weeding, and others. Chemical methods are employed to combat diseases and pests through the application of fungicides and insecticides. During the vegetation period, various operations on the green parts of the plants were performed, such as pruning, tying and training of shoots, shoot tipping, and more.

2.2. Experimental Design

When designing experimental schemes, determining the arrangement of repetitions, deciding on the number of accounting plants and grafted cuttings, and selecting samples for analysis, commonly accepted field experiment methodologies developed by L. Kolesnik [205], S. Melnik [256], D. Petrash [300], L. Maltabar [237], N. Perstnev [295], B. Dosphehov [184], D. Petrash, E. Morosan [301], and others were used as a basis.

Experimental Scheme I aimed to study the influence of the positioning of rootstock cuttings along the length of the stock cane on regeneration processes, the growth of grafts in the nursery, the emergence of grafted saplings from the nursery, their survival rate, growth, development, and productivity of vines.

Canes were collected from rootstock mother-grapevines at SC "Tomai-Vinex" SA in the autumn of 2003 in the mother grape plantations of the phylloxera-resistant varieties BxR Kober 5BB and RxR 101-14. The collected canes were stored in the cellar under a plastic cover. Before grafting, cuttings (from 1^{st} to 5^{th}) were taken from the prepared rootstock canes, starting from the base to the top along the length of the cane. By group: 1st cuttings from the base of the rootstock cane - experimental group 1 (EG 1); 2^{nd} cuttings from the base - experimental group 2 (EG 2); 3^{rd} cuttings from the base - experimental group 3 (EG); 4^{th} cuttings from the base - experimental group 4 (EG 4); 5^{th} cuttings from the base - experimental group 5 (EG 5); the control group consisted of cuttings without grouping – the production variant.

Experimental Scheme I	
Experimental Variants:	
Clone R5 Cabernet Sauvignon Grafting onto Rootstock Cuttings, from the Base of the Stock Cane	
Stock Variety	*Positioning of Cuttings Along the Length of the Stock Cane*
BxR Kober 5BB	1. Control Group (CG) – without grouping (the production variant) 2. Experimental Group 1 (EG 1) – 1^{st} cutting (0-50 cm) 3. Experimental Group 2 (EG 2) – 2^{nd} cutting (50-100 cm) 4. Experimental Group 3 (EG 3) – 3^{rd} cutting (100-150 cm) 5. Experimental Group 4 (EG 4) – 4^{th} cutting (150-200 cm) 6. Experimental Group 5 (EG 5) – 5^{th} cutting (200-250 cm)
RxR 101-14	1. Control Group (CG) – without grouping (the production variant) 2. Experimental Group 1 (EG 1) – 1^{st} cutting (0-50 cm) 3. Experimental Group 2 (EG 2) – 2^{nd} cutting (50-100 cm) 4. Experimental Group 3 (EG 3) – 3^{rd} cutting (100-150 cm) 5. Experimental Group 4 (EG 4) – 4^{th} cutting (150-200 cm) 6. Experimental Group 5 (EG 5) – 5^{th} cutting (200-250 cm)

In 2004, the one-bud scion cuttings of the clone R5 Cabernet Sauvignon variety, were grafted onto the rootstock cuttings of each of these groups separately. The control group consisted of grafted cuttings without any division into groups.

When designing this experimental scheme, guidance was taken from the studies conducted by L. Maltabar [233], A. Mishurenko [268], E. Podgorny [303], Eifert Józsefné [339], A. Derendovskaia [181], N. Lukyan [225], and others. These authors have established that rootstock cuttings taken from different parts of the cane exhibit varying levels of regenerative activity, which in turn affects the emergence and quality of grafted vines in the nursery.

Experimental Scheme II - to study the influence of the quality variation of scion cuttings and the treatment of grafted cuttings with Calovit on the processes of regeneration, grafted saplings' emergence from the nursery, and their viability at the permanent place.

Experimental Scheme II
Clone R5 Cabernet Sauvignon onto BxR Kober 5BB
Experimental Variants:
1. Experimental Group 1 – Without tendrils H_2O
2. Experimental Group 2 – With tendrils H_2O
3. Experimental Group 3 – Without tendrils Calovit
4. Experimental Group 4 – With tendrils Calovit

The scion canes of the clone R5 Cabernet Sauvignon variety were collected from autumn on the scion mother grapevines. Single-bud cuttings were taken from scions of clone R5 of the Cabernet-Sauvignon variety, collected in the autumn, in the zone of 4-12 buds. After storage in the cellar, one-bud cuttings were cut from the scion canes in the spring. The one-bud scions were divided into two groups: with tendrils (developed diaphragm) and without tendrils (insufficiently developed diaphragm). Each of these scion cutting groups was grafted onto rootstock cuttings of the BxR Kober 5BB variety. One part of the grafted cuttings served as a control, while the second part underwent pre-stratification treatment with a Calovit solution. The treatment was carried out as follows: the apical part of the grafted cuttings was dipped 5-7 cm in the solution for 1-2 seconds. The control group was dipped in water.

Calovit is a chemical plant growth regulator (originating from Romania). It is a transparent colourless liquid with a density of 0.975 and a pH range of 5.0-5.5. To prepare the treatment solution, a working solution with a concentration of 1.0-1.5% is prepared (10-15 ml per litre of water). The preparation is used to stimulate the union during the grafting of grapevines. It promotes better callus formation at the grafting site, the formation of compact and uniform callus around the entire circumference of the graft cut, and enhances the growth and maturation of the grafted vines. When selecting the concentration of Calovit for treating the apical part of the grafted cuttings, the studies of S. Ungureanu, I. Panea, T. Panea et al. [132] were followed, which recommended using the preparation at a dosage of 1.5% to enhance callus formation at the graft union.

In the development of this experimental scheme, the studies conducted by N. Guzun [172, 173], E. Morosan [274], A. Subbotovich, N. Perstnev, E. Moroshan [323] was taken into account. These studies have established that using the apical parts of grafted cuttings as the initial material for grafting contributes to the improvement of grafted vines' quality and better development of vines in their permanent place.

Grafting (Experimental Scheme I, and II) was performed at the same time - mid-March (2004), using a mechanized method with the help of the UPV-1 device. The formation of the grafting components was done with an omega-shaped knife, creating a tongue on the rootstock and a corresponding groove on the scion. In each experimental option, 500-700 grafts were performed, depending on the experimental schemes. The grafted cuttings were stratified in boxes filled with sawdust in a general heating area. After stratification and hardening, the grafted cuttings were planted in the nursery. After digging out the saplings from the nursery, storage, their preplanting preparation, an experimental plot of vine plantations was established in 2005, according to the experimental schemes (Figure A 1.5, Figure A 1.6, Figure A 1.7). The experimental plot was used for long-term studies of growth, development and productivity of grapevines.

Experimental Scheme III aimed to study the features of growth, development, and productivity of clone R5 of the Cabernet-Sauvignon variety and clone 348 of the Merlot variety grafted onto the BxR Kober 5BB rootstock, depending on the shoot management system of the grapevines.

At SC "Tomai-Vinex" SA, the vineyards of the clone R5 Cabernet Sauvignon and the clone 348 Merlot grafted onto the BxR Kober 5BB were planted using a specific technique: distance between rows was 2.5 m, and the distance between vines was 1.35 m, shape of vines - two-stem horizontal two-sided cordon, with hanging shoot positioning; height of the stem 80 cm; trellis - vertical with two tiers of wires, the first tier of wires is located at the height of the stem, the second at a distance of 50-55 cm from the first; intermediate and marginal posts height of 1.5m.

According to the developed projects of the Agency for Innovation and Technology Transfer of the Academy of Sciences of the Republic of Moldova (13.824.14.184T, 2013; 14.824.05.196T, 2014) (fig. A 9.1, fig. A 9.2), a complete reconstruction of the 8-year-old fruit-bearing grapevine plantations of these clones was carried out, including changes in the type of support structures, vine training system and trellis system, and vines shape. In 2013, a comparative assessment of the condition of the vineyards at SA Tomai-Vinex SC was conducted before reconstruction (with hanging shoot positioning system) and after reconstruction (with vertical shoot positioning system). The study focused on parameters such as Shoot Growth, Leaf Surface Area, Photosynthetic Activity, and Productivity of grapevines of the R5 clone of Cabernet Sauvignon and the 348 clone of Merlot. In 2014, an analysis of the grapevines' condition was carried out in the second year following reconstruction (fig. A 8.4, fig. A 8.5).

Experimental Scheme IV – long-term monitoring of growth, development, and productivity of the R5 clone Cabernet-Sauvignon and 348 clone Merlot grapevines under changing agroecological conditions of ATU Gagauzia.

From 2015 to 2021, the R5 Cabernet Sauvignon and 348 Merlot clones were monitored, focusing on parameters related to Shoot Growth and Development, Leaf Area Growth, and Vineyard Productivity. The study of this experimental scheme focused on evaluating the adaptation of introduced clones, their productivity, and potential for producing high-quality grapes under the agroecological conditions of ATU Gagauzia. Particular attention was given to optimizing vineyard management methods, including pruning techniques and shoot positioning systems tailored to the specific requirements of the studied clones. Additionally, the research aimed to analyze the economic efficiency of cultivating these clones over an extended period, considering the changing climatic conditions of ATU Gagauzia.

2.3. Objects of the Research

The research was conducted on: rootstock cuttings of BxR Kober 5BB and RxR 101-14, prior to grafting; grafted cuttings from bench grafting during their stratification, hardening, and growth in the nursery, as well as saplings after being dug out from the nursery; young, entering the fruiting stage grape plantations of the R5 clone of Cabernet Sauvignon variety; fruiting vineyards of the R5 clone of Cabernet Sauvignon variety; vineyards of the R5 clone of Cabernet Sauvignon and the 348 clone of Merlot variety with hanging and vertical shoot position training systems.

2.3.1. Cabernet Sauvignon Clone R5

Cabernet Sauvignon is a popular French variety with a medium-late ripening period. It belongs to the Western European Ecogeographical group of grape varieties and is widely cultivated in many countries around the world. It is also recognized and grown in several countries of the Commonwealth of Independent States (CIS) such as Moldova, Ukraine, Russia, Kazakhstan, Georgia, and Azerbaijan.

The leaves of this variety are medium-sized, rounded, five-lobed, deeply divided, wide-cupped, dark green, with a reticulated and wrinkled texture, and partially pubescent on the lower side. The leaves of this variety are medium-sized, rounded, five-lobed, deeply divided, wide-cupped, dark green, with a reticulated and wrinkled texture, and partially pubescent on the lower side. The pedicel sinus is deep, closed, round, or open, lyre-shaped, limited by veins. The flowers are hermaphroditic. The clusters are medium-sized, cylindrical-conical, dense, and sometimes loose. The berries are medium-sized to small, round, dark blue with abundant wax bloom. The skin is thick and strong. The flesh is juicy with a Muscat Flavour (fig. 2.1).

Fig. 2.1. Grape cluster.
Cabernet Sauvignon Variety.

The period from budbreak to technical maturity of the berries is 145-165 days with a sum of active temperatures of 2900-3200 degrees Celsius. The vines are of medium to vigorous growth. Shoot maturation is good. Yield ranges from 6 to 10 tons per hectare. The variety is relatively resistant to frost and grey mould.

Cabernet Sauvignon is used for the production of sparkling wine materials as well as high-quality table, fortified, and dessert wines.

It thrives well on slopes with warm exposures and moderately productive soils. It is recommended to be grown on ordinary and calcareous chernozems with medium to heavy loamy mechanical composition. To obtain sparkling wine materials, the variety should be cultivated on alkaline black soils, typical black soils, and ordinary medium loamy soils. The recommended rootstocks for grafting this variety are RxR 101-14 and BxR Kober 5BB [340].

Clone R5 of Cabernet Sauvignon (*Cabernet Sauvignon 39, Conegliano, Italy*) was obtained through individual clone selection. It was introduced to the Republic of Moldova from Italy in 1998-1999. This clone exhibits good and stable yield characteristics, ranging from 10 to 12 tons per hectare [20]. Its ampelographic description does not differ from the Cabernet Sauvignon variety. In favourable climatic conditions, it accumulates high sugar content, which is sufficient for the production of high-quality red table wines (sugar content up to 230 g/dm^3, acidity - 6-8 g/dm^3) [216, 35, 36].

2.3.2. Merlot Clone 348

Merlot (derived from the French word "merle," meaning "blackbird") is a French technical grape variety widely cultivated along the Mediterranean coast, in Algeria, and in southern Russia. According to genetic research conducted by the Davis Institute (California, USA), its parents are Cabernet Franc and Magdeleine Noire des Charentes [340]. *Synonyms*: Ojaleshi Lekhumi, Ojaleshi, Bigney, Bini, Picard, Planet Medoc, Vitraille, Vidal.

Merlot belongs to the eco-geographical group of Western European grape varieties. The young shoot crown has a grey colour with pink spots. It is densely and velvety pubescent. The leaves are green with a slight bronze hue. Mature one-year-old shoots are yellowish-brown with darker nodes. The Merlot leaf is medium-sized, rounded, moderately dissected, five-lobed, funnel-shaped curved. The upper notches are medium-deep, mostly closed, with an elliptical aperture. At the bottom of the notch, a denticle is often observed. Petiolar notch open, lyre-shaped or lancet-shaped. The triangular-toothed tips of the blades have weakly convex sides. The teeth along the edge are triangular. The undersurface of the leaf has sparse cobweb-like hairs. The flower is bisexual. The grape cluster is medium-sized (12-17 cm long, 7-12 cm wide), cylindrical-conical, sometimes winged, and moderately dense. The cluster weighs 113-150 grams (fig. 2.2). The cluster stem is of medium length. The berry is medium-sized (13-14 mm long, 12-13 mm wide), round, and black with abundant wax bloom. The pulp is juicy, with colourless juice. The skin is firm. The taste is harmonious, with a hint of plum flavour. The average weight of 100 berries is 100-140 grams. There are 1-3 seeds per berry.

Fig. 2.2. Grape cluster. Merlot Variety.

The vegetative period, from bud break to the technical maturity of the grapes intended for table wine production, takes 152 days for dessert wines and 164 days. The sum of active temperatures during this period reaches 3000^{0}C-3300^{0}C. The grape harvest is carried out in late September to early October. The growth of shoots is of medium to above-average strength. By the time autumn frosts occur, the vine is 90-95% ripe. The variety has a high and stable yield. Fruit-bearing shoots make up 52.8% of the vine, with an average number of clusters per developed shoot being 0.6 and 1.2 fruit-bearing shoots. Regarding resistance, the Merlot variety shows relative resistance to mildew, grape rot, and frost, but it is highly susceptible to powdery mildew. Occasionally, berry shelling may occur. The Merlot variety has moderate resistance to drought. Secondary, dormant, and axillary buds have low productivity.

Mechanical composition of the grape (%): juice - 73.5, skins - 4.3, pulp and seeds - 22.2. Sugar content at harvest ranges from 19.5 to 22 g/100 ml, acidity ranges from 5.2 to 8.5 g/l. In cooler years, Merlot ripens better than Cabernet Sauvignon, while in warmer years, it accumulates more sugar.

The grape harvest of Merlot is used for the production of high-quality table and dessert wines, as well as for blending to enhance other red wines and juices. Its large and thin-skinned berries typically produce wines with lower tannin content and richer flavours, and they also ripen earlier than other varieties. Merlot is used to produce varietal wines, especially in the United States, where it is considered a lighter wine compared to Cabernet Sauvignon, and in northeastern Italy, where this grape also ripens well. Merlot is very common in Chile. Wines made from Merlot are known for their intense colour, fullness, harmonious taste, and distinctive bouquet.

Clone 348 of the Merlot variety was imported to the Republic of Moldova from France in 1998-1999. According to data from the Chambre d'Agriculture de Gironde, Chambre d'Agriculture de l'Aude, Chambre d'Agriculture des Bouches-du-Rhône, and Chambre d'Agriculture du Gard, this clone was developed in 1975 by the research institute INRA in Gironde (Bordeaux), France [21]. The grape harvest from this clone allows for the production of rounded, extractive wines that are rich in colouring substances. These wines have high alcohol content and relatively low levels of titratable acidity. They are full-bodied and well-structured, with fairly supple tannins, demonstrating good typicity. They are fruity, approachable, and vibrant, with a tannic structure that makes them suitable for ageing. The aromas are complex and elegant.

2.3.3. Berlandieri x Riparia Kober 5BB

Synonyms: Kober, Kober 5BB, Teleki 5BB. The variety was developed by breeder F. Kober in Austria in Neusberg through clonal selection from seeds of Berlandieri x Riparia Teleki obtained in 1904 from Teleki (Hungary). It has been widely spread in Moldova since 1946.

The woody shoots are dark brown in colour. The variety has vigorous growth, weak suckering, and good compatibility with most European varieties. It noticeably enhances the growth of grafted varieties, so it should primarily be used for low-vigour varieties (such as Pearl Saba, White Chasselas, etc.). Cuttings root relatively well but not as well as with the RxR 101-14 variety. Despite the pronounced dorsiventral orientation of the shoots, callus formation on the grafting cuts occurs faster than with RxR 101-14.

The variety is practically resistant to the root form of phylloxera and rarely affected by leaf form. The frost resistance of one-year-old woody shoots and perennial wood is relatively high, while the roots have insufficient frost resistance. According to A. Mishurenko [268], the roots can withstand temperatures as low as -8^{0}C. Considering its high heat requirement and insufficient frost resistance of the root system, planting the seedlings on this rootstock is recommended in the southern and central zones of Moldova.The rootstock is resistant to drought and, to some extent, excess moisture. It grows well on almost all types of soil and does not suffer from chlorosis when the soil contains up to 20% active lime (according to P. Gale). Disadvantages of the variety include the formation of long internodes with loose wood and large pith, as well as weak shoot maturity in years with unfavourable weather conditions [171, 271].

2.3.4. Riparia x Rupestris 101-14

Was developed in 1882 by Millardet and de Grasset in France through the crossing of Riparia (maternal variety) with Rupestris [341]. The shoot tips and young leaves are light purple-red in colour. The leaves are relatively large, undivided with barely noticeable upper sinuses, smooth, slightly wrinkled, and green with a matte sheen. The lateral sides of the leaf are raised upward, forming a channel-like shape. The petiolar sinus is open, vaulted in shape, and has a rounded bottom. The toothed margins are triangular with convex sides. The leaf stalk is reddish with a groove in the middle. The flowers are functionally female. The clusters are small and cylindrical in shape.

Riparia x Rupestris 101-14 belongs to the class of rootstocks with a short vegetative period (170-190 days of active vegetation). Budburst in Moldova usually occurs in the middle of the second decade of April and is about 2-3 days later than in the Riparia Gloire variety. Flowering begins in the late second or early third decade of May. The growth vigour of the vines is medium, while the yield of standard cuttings is quite high, as the shoots have a uniform thickness almost along their entire length and mature well. The woody shoots are brown with a reddish tint, more intense at the nodes. The internode length is 10-15 cm. The dorsoventrality is weakly expressed, and the pith is small.

The variety is practically resistant to the root form of phylloxera, but it is highly susceptible to its leaf form. It exhibits very high frost resistance but relatively low drought resistance. The variety shows great adaptability to different soils; however, it cannot tolerate high levels of soluble carbonates. Therefore, it can only be planted on soils with active lime content not exceeding 9% (according to the P. Gale scale) [332].

It has a good affinity (compatibility) with the majority of European grape varieties. When grafted onto this rootstock, early-ripening grape varieties mature faster and accumulate more sugars compared to other rootstocks [171].

2.4. Methods

2.4.1. Soil conditions

The characterization of soil conditions was based on data provided in the vineyard planting project [103].

2.4.2. Meteorological conditions

The analysis of meteorological conditions for the research years was conducted using data from the Agro-Industrial Complex of ATU Gagauzia. The monthly precipitation was calculated in millimetres, and the annual precipitation totals for each year of the study were also calculated in millimetres. The average monthly air temperature values for each year of the study were calculated in degrees Celsius, and the average annual air temperature for each year of the study was determined. The sum of active temperatures was calculated for each year of the study [73].

2.4.3. Quality of Rootstock Cuttings before Grafting

1. Measurements of cutting thickness (from the ventral to the dorsal side and from the flat to the grooved side) in millimetres were performed using a calliper;
2. Determination of raw and absolutely dry biomass of the cuttings was carried out in grams. The analysis was conducted on 10 cuttings from each rootstock batch;
3. The content of soluble sugars was determined using a modified micro-method by Bertrand with the assistance of a Photocolorimeter [167, 263];
4. The starch content was determined using the calorimetric method by H. Pochink [185].

2.4.4. Processes of Regeneration, the Growth of Grafted Plants in the Nursery, the Emergence of Saplings from the Nursery, and Their Quality

1. Accounting for callus formation at the site of graft union was done separately for scion and rootstock. The assessment was performed on an average sample of grafts (25 pieces) taken from different parts of the stratification box at the end of the stratification period. The percentage of grafts with a circular callus on scion and rootstock was calculated relative to the total number of grafts in the sample [205];

2. The growth of shoots emerging from the eyes of the scion was measured with a ruler and expressed in centimetres. The formation of roots below the eyes, callus, root primordia, and roots on the basal part of the grafted cuttings was evaluated through visual inspection of the grafted cuttings selected for analysis;
3. Graft union success was determined by visually inspecting the grafting cuts after the separation of the graft components. The percentage of grafts with vessels was calculated;
4. The number of grafted cuttings with budding (swollen) buds was determined after sorting and expressed in both absolute numbers and percentages;
5. The survival rate of grafted cuttings in the nursery was assessed by counting the successfully established cuttings and expressed in both absolute numbers and percentages;
6. The dynamics of shoot growth in the grafted plants in the nursery were analysed following S. Melnik's method [256];
7. The yield of first-grade grape vines was recorded after digging them out from the nursery and expressed as a percentage of both the number of grafts made and the number of vines planted in the nursery;
8. The quality of grafted vines was evaluated based on morphological characteristics, such as the presence of a circular callus, the size of shoot growth, and the root system. The assessment was conducted on 10 vines in each experimental variant.
9. The length, diameter, and volume (mass) of the total and matured shoots' growth were measured and expressed in centimetres (cm) and cubic centimetres (cm^3) respectively. The total number of roots and the number of roots with diameters of 2-3mm and <2mm were determined by counting them and expressed in absolute numbers (counted as pieces).

2.4.5. Survival Rate of Grafting Saplings, Growth, and Development of Vines

1. The survival rate of grafted saplings in their permanent location was determined by counting the surviving vines, expressed as a percentage of the planted number [242];
2. The assessment of vine development was conducted in the third year after planting, in the spring after pruning. They were categorically divided into: vigorous (with two trunks and two arms), medium (with one or two trunks and one arm), and weak (with underdeveloped trunks). In all experimental variants, the number of vines in each of these groups was counted and expressed in units and percentages (%);

3. The dimensions of annual and mature growth (length, diameter, in the middle part of the shoot) were determined at the end of the vegetation period using linear measurements. The total linear (in cm) and volumetric (in cm^3) shoot growth of vines was calculated [258, 259, 227, 228]. The measurements were conducted on 10 model shoots (of the same type) on five vines, throughout various stages of the vegetation cycle: during the intensive growth of shoots and inflorescences, berry ripening, and at the end of the vegetation period;
4. Growth and development of Leaf Area. The number of leaves on shoots and vines (in pieces), the average area of Leaf Blades Area - by ampelometric method [259]. The Leaf Surface Area per shoot (dm^2), vine (m^2), and hectare (thousand m^2) was calculated. Determinations were carried out dynamically, simultaneously with shoot growth indicators;
5. Plastid pigments' concentration (content) (chlorophylls a, b, and carotenoids) was determined using an SF-26 spectrophotometer. The pigment concentrations were calculated using the formula of Wintermans and De Mots [316]. The results were expressed in mg/dm^2 of Leaf Surface Area. Chlorophyll index (chlorophyll a/chlorophyll b), pigment index (chlorophyll a + b/carotenoids), chlorophyll index (total chlorophyll content in plants per unit area, in mg/m^2) [324]; superficial chlorophyll content in the Leaf (the ratio of pigment mass to Leaf Area), mg/m^2 [224] were calculated. Determinations were carried out dynamically according to the stages of vegetation: intensive shoot and inflorescence growth, berry ripening, and at the end of the vegetation period. Leaves for analysis were taken from the middle part of the shoot (8-12th leaf from the base), located in the same canopy layer with equal illumination;
6. The Leaf Area Index (LAI) was calculated as the ratio of the Leaf Area of the vine to its feeding Area and expressed in m^2/m^2 by N. Laman [224];
7. The accumulation of absolutely dry leaf biomass was determined by weighing a specific amount of fresh biomass and then drying it at a temperature of 105^0C until a constant weight was achieved by A. Amirdjanov [153];
8. The Specific Leaf Weight (SLW) was calculated as the ratio of the leaf dry biomass to its area by K. Stepanov [316];
9. Determination of Vine Productivity Parameters: We counted the number of developed shoots on the vine, including fruiting ones, as well as the number of formed flower clusters, in units. We calculated the fruiting coefficient $\mathbf{K_1}$ (number of flower clusters / per one developed shoot) and the fruitfulness coefficient $\mathbf{K_2}$ (number of flower clusters / per one fruiting shoot) [222, 315];

10. Shoot Productivity, the weight of clusters per one developed shoot was calculated using the formula:

$$\mathbf{SP} = \mathbf{K_1} \times \mathbf{W}, \quad (2.1)$$

where **SP** stands for shoot productivity in grams per shoot, $\mathbf{K_1}$ is the fruiting coefficient (number of clusters per developed shoot), and **W** is the Cluster Weight in grams [152];

11. Fruit yield per vine, yield, was recorded at the end of ripening by K. Smirnov [315]. The following parameters were determined: the number of clusters per vine (in pieces/vine), the average cluster weight (in grams), fruit yield (in kilograms per vine) and yield (centner per hectare);

12. The determination of yield quality involved measuring the content of dry substances in the berry must using a refractometer, expressed as a percentage (%). The titratable acidity content was determined through titration with a ⅓N sodium hydroxide (NaOH) solution, mg/l [315]. The mass concentration of sugars and titratable acidity was calculated in accordance with Standard Moldovan SM-84 [117], in g/dm^3;

2.4.6. Economic efficiency

1. The economic efficiency was calculated using the methodology of the of D. Parmakli [291, 293].
2. The calculation of Yield Growth Reserve ($\mathbf{\Delta_q}$) was performed as the difference between the Potential Productivity ($\mathbf{q_{pot}}$) level and the Actual Yield ($\mathbf{q_a}$) using the formula [292]:

$$\mathbf{\Delta_q = q_{pot} - q_a} \quad (2.2)$$

3. The calculation of grapevine's potential yield indicators was conducted using the formula:

$$\mathbf{q_{pot}} = \sqrt[K]{\mathbf{P}} \quad (2.3)$$

were, P – multiplication of the highest yields “**K**” years

$$\mathbf{K} = \sqrt{\mathbf{P}}, \quad (2.4)$$

T – number of years in the analysed period

2.4.7. Statistical data analysis

1. Statistical data analysis was conducted using variance and correlation analysis methods [184, 166, 223, 260], calculations were performed in the Microsoft Excel-2016 program included in the Microsoft Office-2016 package;
2. The effects of the variant in the experimental scheme were determined by performing a one-way and a two-way analysis of variance (ANOVA). Differences between the means of the variants were evaluated according to Tukey's posthoc test (HSD), grouping using the Tukey method and 95% confidence (Appendix 11, 12). Calculations were performed using Minitab 17 [82].

2.5. Conclusions to Chapter 2

1. When designing experimental layouts, establishing repetition systems, determining the number of grafted cuttings and experimental grape plants, as well as selecting samples for analyses, universally accepted field and laboratory experiment methodologies were employed;

2. The research was conducted on the R5 clone of Cabernet Sauvignon variety, grafted onto the rootstocks BxR Kobber 5BB and RxR 101-14, as well as on the clone 348 of Merlot variety grafted onto BxR Kobber 5BB rootstock, in the conditions of the ATU Gagauzia;

3. In the course of the research, we carried out accounting, analyses and observations to characterise the quality of rootstock cuttings before grafting; regeneration processes, growth of grafted plants in the nursery, sapling output from the nursery and its quality; survival rate of saplings; growth and development of young vines; productivity of vine plantations. Statistical data processing was carried out using dispersion and correlation analyses, utilizing software packages such as Minitab 17 and Microsoft Excel.

3. THE STATE AND DEVELOPMENT OF THE VITICULTURE SECTOR IN ATU GAGAUZIA

The grape and wine-growing territory of the Republic of Moldova has been divided into Regions, Centers, and Districts [94]. Four grape and wine-growing regions have been identified: Southern, Central, Southeastern, and Northern; there are 22 grapes and wine-growing centers, with 7 in the Southern region, 10 in the Central region, 2 in the Southeastern region, and 3 in the Northern region, each with specified settlements belonging to them (fig. A 3.1).

Geographical areas for wine production with protected geographical indication (PGI) have been designated (fig. A 3.2). Regions with protected geographical indication (PGI) include "Valul lui Traian," "Ștefan-Vodă," and "Codru" [95]. Each region is managed by a wine producers' association and is legally protected in the territory of the Republic of Moldova and the European Union.

The specific climate of the "Valul lui Traian " region provides the necessary insolation, with high temperatures balanced by the Black Sea breeze and the shade of the Tighechi Codri. It is suitable for growing red grape varieties such as Cabernet Sauvignon, Merlot, Saperavi, and Fetească Neagră, which account for approximately 60% of the total, while among white grape varieties, Sauvignon Blanc, Chardonnay, and Muscat Ottonel are predominant (fig. 3.1).

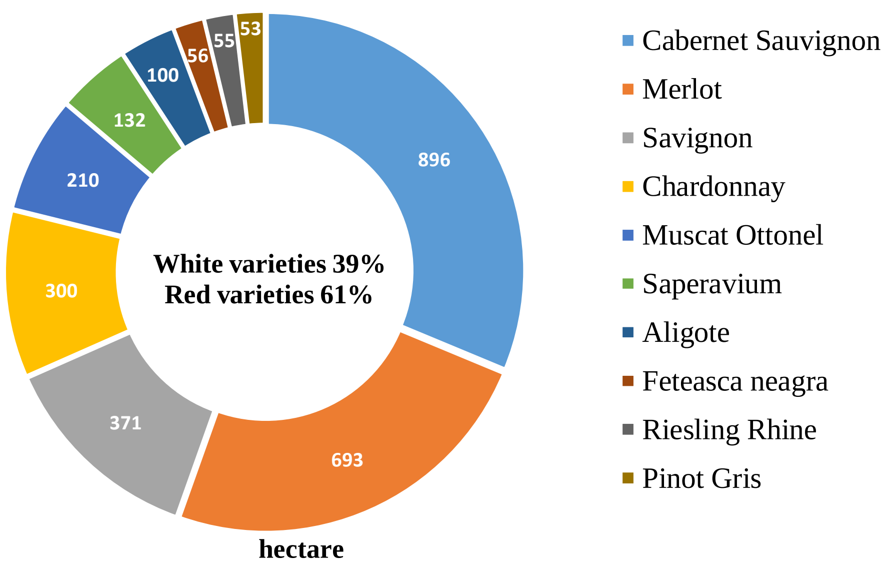


Fig. 3.1. Assortment of Grape Varieties in the Region with Protected Geographical Indication "Valul lui Traian".

Source: Calculated by the author

The region with Protected Geographical Indication "Valul lui Traian" includes 5 districts: Leova, Cantemir, Cahul, Taraclia, and Gagauzia Autonomous Territorial Unit (fig. A 3.3).

3.1. Specific Features of the Conditions in ATU Gagauzia

3.1.1. Soil conditions

One of the most important elements of the external environment is the soil. Soil, as an ecological factor, plays a crucial role in grape cultivation, as it largely determines the quantity and quality of the harvest [195, 198, 25].

Unlike other perennial plantings, grapevines have the ability to develop a powerful root system and spread to great depths not only in the soil but also in the subsoil and even in the mother rock. Therefore, for grape cultivation, the entire thickness of the soil that is penetrated by the plant's roots is important [213, 214].

Moldova is characterised by exceptional diversity in climate, soils, topography, and other conditions, as well as possessing significant land potential suitable for grape cultivation [57]. The soil cover in Moldova is highly diverse and comprises more than 700 soil varieties [332], however, 75% of the total territory (or 2.5 million hectares) is occupied by chernozems. Most of the industrial vineyards of the country are located on them. There are 5 main subtypes: typical, leached, podzolic, carbonate, and ordinary. There are also rare subtypes of chernozems: xerophytic-forest, merged, southern and others.

V. Ungureanu [328, 330] suggests that in viticulture practice, soils with various granulometric compositions can be used. However, the highest accumulation of root mass and the best growth of above-ground parts of the vines were observed on light loamy and medium loamy grey and brown forest soils, as well as on light, medium, and heavy loamy Chernozems. The balanced granulometric composition of soils about the slope exposure ensures not only high productivity but also the longevity of the plantations.

The territory of ATU Gagauzia is located in the Budjak Steppe, which is part of the Southern Moldavian hilly plain. Its surface is characterized by wide valleys, while the slopes are cut by numerous ravines. The region's relief is characterized by steppes and small elevations, with small rivers such as Ialpug, Ialpugel, Lunga, and Lunguţa. Gagauzia, like Moldova, is located in the Carpathian seismic zone.

The total area of Gagauzia is 1848 km², which accounts for 6.1% of the total territory of the Republic of Moldova. The region consists of three districts: Comrat, Chadir-Lunga, and Vulcanesti.

Table 3.1. Characteristics of the Physical and Chemical Properties of the Soils of Experimental Plots

Horizons	Depth of sample, cm	Humus by Tyurin, %	Absorbed Bases, mg/100 g soil			Carbonates, %		pH aqueous	Mobile substances, mg/100g soil		Granulometric composition	
			Ca^{++}	Mg^{++}	Sum	total	active		P_2O_5	K_2O	<0,01 мм	>0,01 мм
Loamy chernozem, rich in clay, (on the nursery)												
A_{plough}	0-20	3,25	27,9	6,9	34,8	no	no	7,4	3,2	21,8	41	59
A	30-40	2,95	28,4	6,8	35,2	1,2	no	7,4	3,5	22,1	42	58
B_1	50-60	2,50	28,2	6,9	35,1	3,1	0,2	7,8	3,6	19,0	40	60
B_2	70-80	1,47	-	-	-	6,7	1,8	7,9	-	-	43	57
BC	90-100	1,10	-	-	-	19,8	4,6	8,0	-	-	42	58
C	110-120	0,90	-	-	-	13,4	5,9	8,5	-	-	44	56
Loamy carbonate chernozem, rich in clay (on the vineyards)												
A_{plough}	0-20	2,90	26,3	6,9	33,2	2,2	0,5	7,6	3,0	19,9	42	58
A	30-40	2,83	25,9	6,9	32,8	3,7	1,1	7,9	2,9	20,0	41	59
B_1	50-60	1,39	26,3	6,7	33,0	3,8	1,3	8,0	3,1	19,7	42	58
B_2	70-80	1,00	-	-	-	7,9	4,8	8,2	-	-	43	57
BC	90-100	0,90	-	-	-	12,5	6,7	8,5	-	-	44	56
C	110-120	0,87	-	-	-	11,8	5,9	8,6	-	-	44	56

Source: Analysis was carried out by the author of the data from the Vineyard Planting Project [103].

The total area of agricultural land in ATU Gagauzia is about 150,000 hectares. The area of agricultural land in ATU Gagauzia is 78,032.6 hectares, including arable land covering 65,516.6 hectares, perennial plantations covering 12,749.62 hectares, of which vineyards account for 9,247.32 hectares, distributed across the districts as follows: Comrat District - 6,204.62 hectares, Ceadîr-Lunga District - 427 hectares, and Vulcănești District - 2,615.7 hectares.

Agricultural land covers 150,000 hectares, of which 65,400 hectares consist of calcareous chernozems, and 63,400 hectares are represented by typical low-humus chernozems [120].

Characterization of Soil Conditions on the Experimental Plots. The vine nursery was planted on a powerful, loamy chernozem with clayey loam (tab. 2.1). The humus content in the 0-30 cm layer is 3.25% and decreases with depth to 2.5% at 50-60 cm and 1-1.1% at 90-95 cm. Effervescence with 10% HCl is observed at 35-40 cm and increases with depth. Visible carbonates in the form of mould start at 55 cm, reaching their maximum at a depth of 120-125 cm, while in the form of small white concretions (white-eyed carbonates), they appear at 70 cm and reach their maximum at a depth of 140-150 cm. The structure of the upper horizons is characterised as cloddy-granular and granular-cloddy. The soil reaction is weakly alkaline, close to neutral. In the upper horizon (A), the soil pH is 7.4, and at a depth of 70-80 cm, it increases to pH 8.5.

The vineyards were planted in a deep layer of calcareous chernozem, loamy clayey on loam (tab. 2.1). The humus layer thickness is 82 cm, and the humus content in the upper horizons is 2.9%, gradually decreasing to 1% at a depth of 80-90 cm. Effervescence with 10% HCl is observed from the surface. Visible carbonates in the form of efflorescence are seen at 45 cm, and white eyespot at 60 cm, reaching a maximum at depths of 110-120 cm (efflorescence) and 130-140 cm (white eyespot). The soil structure is granular-aggregated, transitioning to aggregated with depth. The soil reaction is weakly alkaline, with a soil pH of 7.6 at the surface, increasing to 8.6 at depth.

The soil conditions of the experimental plots are favourable for the growth and development of the research grape variety clones. The grafted vines are planted in a deep layer of thick loamy clayey chernozem on loam (nursery), and the vineyard plantations are established on a deep layer of thick calcareous chernozem on loam.

3.1.2. Meteorological Conditions

Grapes belong to the group of crops that are highly responsive to changes in environmental factors and cultivation practices [177].

According to A. Merzhanian [261], the active life of grapevines, depending on the variety, starts at temperatures between +9^{0}C to +12^{0}C. For calculations, the biological zero is taken at an average daily air temperature of +10^{0}C. According to N. Perstniov [294], a minimum cumulative sum of active temperatures of 2500^{0}C is required for grape development.

Normal shoot growth is observed at temperatures between +20^{0}C to +30^{0}C, while an increase in temperature to +25^{0}C to +30^{0}C promotes more vigorous growth and good flowering. Further temperature rises during the vegetation period to +37^{0}C to +40^{0}C suppresses the plants, and weakens their growth, especially under soil moisture deficiency [96].

Grapes are plants of warm and temperate climates and are often subjected to the adverse effects of low temperatures [279, 280]. It has been established that in some years, buds are damaged at temperatures between -18^{0}C to -20^{0}C, shoots at -22^{0}C, perennial wood at -25^{0}C, European varieties' roots at -5^{0}C to -7^{0}C, and American varieties' roots at -10^{0}C.

The territory of Moldova is characterized by high variability of climate due to atmospheric circulation and the relief of the terrain. During winter, the invasion of northern and eastern anticyclones, as well as western and southwest cyclones, leads to sharp drops in air temperatures and anomalous warm spells with increased precipitation. In summer, under the influence of the Azore's high-pressure system, hot and dry weather prevails in Moldova [197, 199].

The annual duration of sunshine varies from 2060 hours in the north to 2330 hours in the south. The average annual air temperature is positive and ranges from +8.0^{0}C to +9.0^{0}C in the north, from +9.0^{0}C to +9.5^{0}C in the central region, and from +9.5^{0}C to +10.0^{0}C in the south. The average monthly air temperature in the warmest month (July) fluctuates from +19.5^{0}C in the north to +22.0^{0}C in the south, and in the coldest month (January) from -4.5^{0}C in the north to -30^{0}C in the south. The sum of active air temperatures varies in the north from 2750°C to 3000°C, in the central region from 2850^{0}C to 3100^{0}C, and in the south from 3100^{0}C to 3350^{0}C. The duration of the vegetation period ranges from 169 to 174 days in the north, from 175 to 180 days in the central region, and from 184 to 189 days in the south. The average of absolute annual minimum temperatures is -24^{0}C to -23^{0}C in the north, -23^{0}C to -22^{0}C in the central region, and -21^{0}C to -19^{0}C in the south [18].

Humidity, like temperature, has a significant impact on the growth, development, and fruiting of grapes, which, thanks to its deep-rooting system, is considered relatively drought-resistant. Grape cultivation can be successful with annual precipitation ranging from 250-300 to 600-700 mm [150, 151].

The average annual precipitation in the Republic of Moldova decreases from northwest to southeast, ranging from 560 mm to 370 mm. The amount of precipitation during the warm period varies from 300 to 400 mm. The main climatic feature of Moldova is the occurrence of dry periods, which are particularly pronounced during the summer. Dry winds are common during the warm season. The highest number of days with dry winds (from 20 to 46) is observed in the central and southern parts of the Republic.

The climate of ATU Gagauzia has been influenced by global changes in recent decades, which is accompanied by an increase in climate risks, including frequent and prolonged droughts [112].

To identify differences in meteorological conditions, a comparative analysis of climatic indicators for the southern (ATU Gagauzia) and central (Chisinau) regions of the Republic of Moldova was conducted for the period 2003–2023 (fig. 3.2). Microclimatic differences typical for ATU Gagauzia were revealed, including significantly lower precipitation compared to the central region, higher air temperatures, and a greater sum of active temperatures, with particularly noticeable differences in recent years (2019-2023).

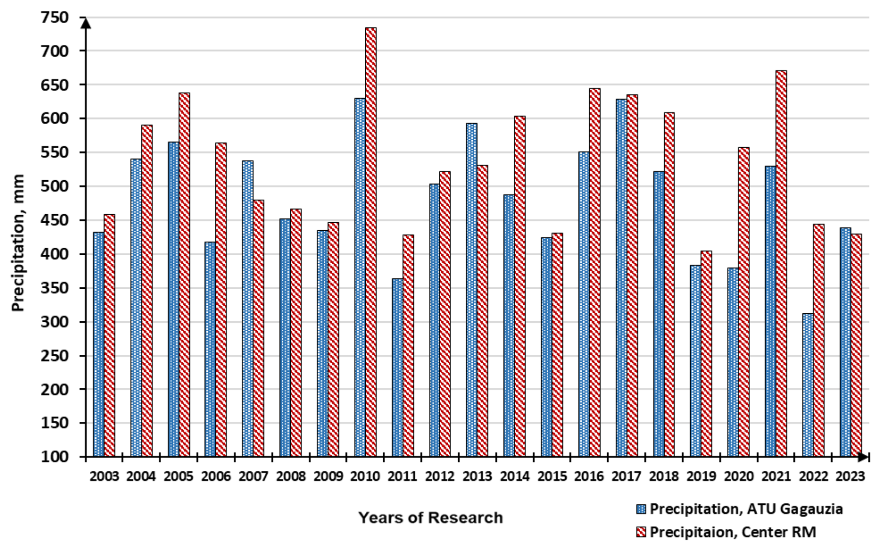


Fig. 3.2. Variation in Precipitation Totals for the Period 2003-2023

The greatest difference in precipitation was recorded in 2010: 734 mm in the central zone compared to 630.1 mm in ATU Gagauzia, which is 103.9 mm (14.2%) less. The maximum precipitation levels were also observed in 2010, with 734 mm in the central zone and 630.1 mm in ATU Gagauzia. The minimum precipitation values were recorded in 2019 in the central zone (405 mm) and in 2022 in ATU Gagauzia (312.3 mm), which is 92.7 mm (22.9%) less. These data highlight significant differences in precipitation distribution between the regions, which are crucial for viticulture in ATU Gagauzia. Viticulture, as one of the key agricultural sectors in the region, is particularly sensitive to climatic variations and requires a tailored approach to vineyard management. The lower precipitation levels in ATU Gagauzia emphasize the importance of using high-quality seedlings with well-developed root systems, enabling the establishment of resilient vineyards with stable yields.

It has been established that the temperature in ATU Gagauzia consistently exceeds the values in the central zone by an average of 0.1–0.3°C, with this difference being particularly noticeable in the last years of the study (2019-2023). The highest temperatures in both regions were recorded in 2020 and 2023, indicating that the warmest period occurred in the final years of the observations. Both regions show a consistent trend of increasing temperatures over the 20-year period.

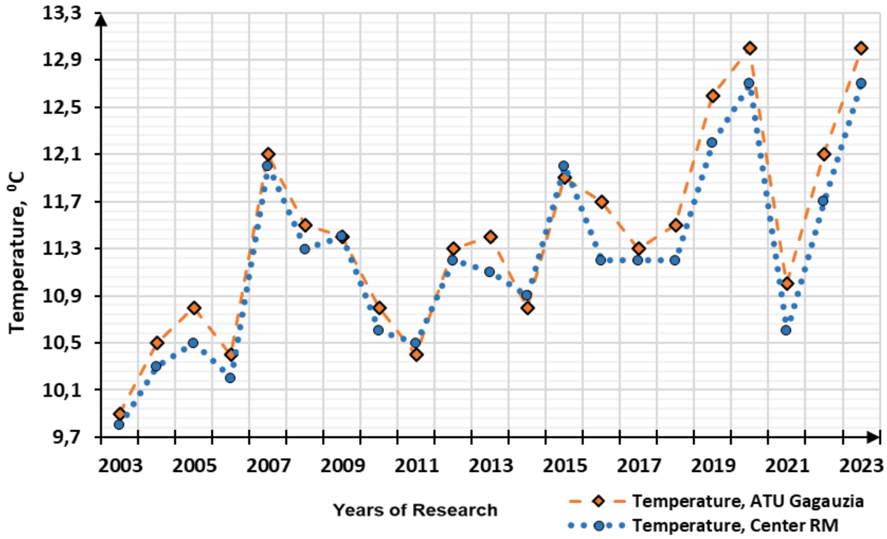


Fig. 3.3. The Dynamics of Average Annual Temperature Values by Regions of the Republic of Moldova. 2003-2023.

The climate of the Autonomous Territorial Unit of Gagauzia is warm, with temperatures of 10°C and above lasting for 179-187 days, which is significantly longer than in other parts of the Republic of Moldova. The sum of active temperatures is 3300^{0}C (tab. A 2.3). The average annual precipitation level is 350-370 mm (tab. A 2.2). The annual geothermal coefficient ranges from 0.7 to 0.8. These characteristic climate features determine the specialization and structure of agricultural production in the ATU of Gagauzia.

Registered values (1961-2019) (fig. 3.4) of heat resources determine the possibility of introducing and properly locating agricultural plant varieties on the territory of the ATU Gagauzia [104].

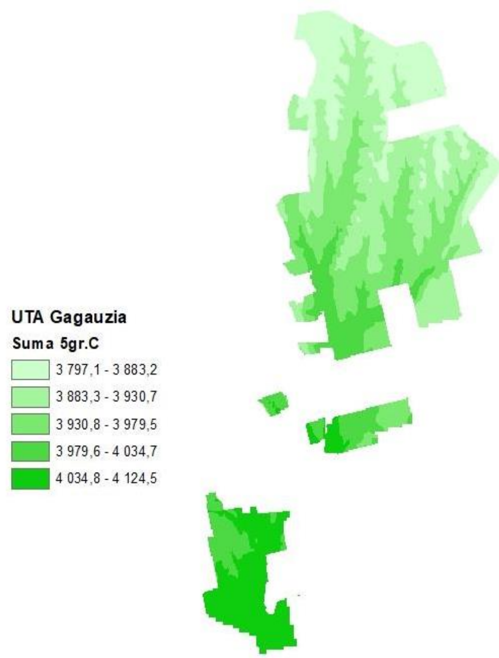


Fig. 3.4. Distribution of Heat Resources Expressed by the Sum of Daily Temperatures above 5^{0}C (1961-2019), ATU Gagauzia [104].

In the depression forms of relief within the territory of ATU Gagauzia, heat resources show some of the highest values recorded in the country, ranging from 4034.8^0C to 4124.5^0C, while at higher altitudes, they range from 3797.1^0C to 3883.2^0C, with a spatial differentiation of 337.4^0C.

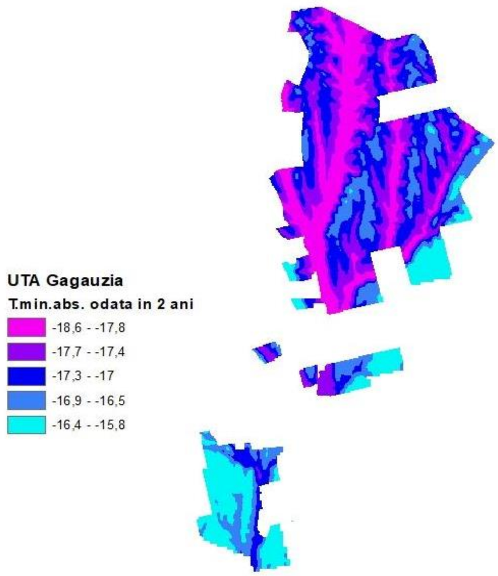
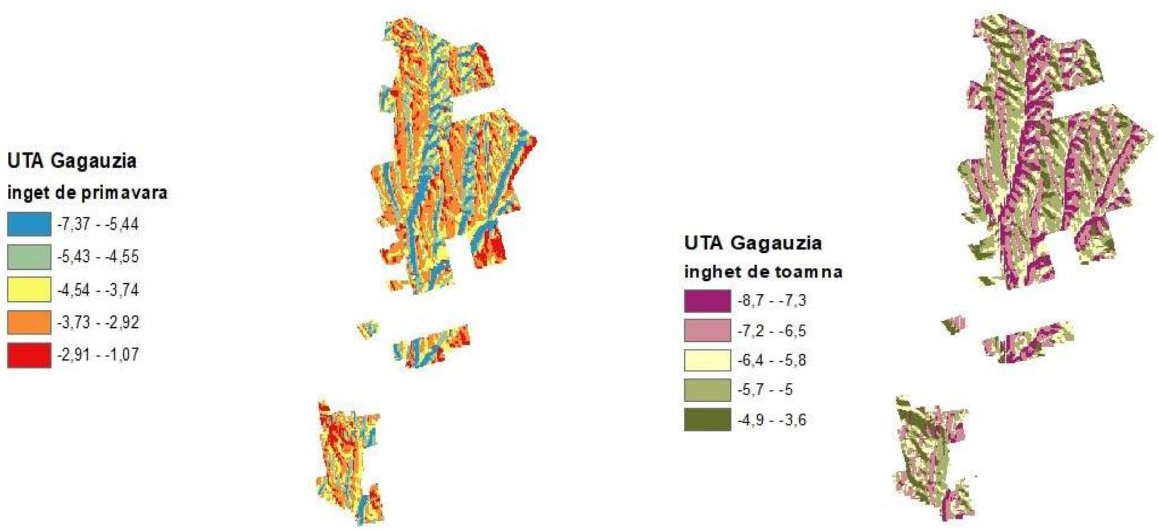


Fig. 3.5. Period of Return of Absolute Minimum Temperatures Once in 2 years (1961-2019), ATU Gagauzia [104].

The proper placement of perennial plantations also depends on the absolute minimum temperature, which occurs once every 10 years and is the main indicator for assessing wintering conditions. The significant climate variability at present requires considering the manifestations of cold waves, which have a more frequent recurrence, to protect grape plantations.

With climate warming, the return period of absolute minimum values within the Autonomous Territorial Unit of Gagauzia is once every 2 years, ranging from -18.6^0C to -17.8^0C in depression forms of relief, and from -16.4^0C to -15.8^0C in the eastern and southwestern parts of the region (fig. 3.5). It should be noted that the accumulation of cold air, forming so-called "cold air lakes" with temperatures of -18.6°C, negatively affects the overwintering of grapevines in depression forms of relief.



a) **b)**

Fig. 3.6. Spatial Distribution of Dangerous Spring (a) and Autumn (b) Frosts, ATU Gagauzia [104].

In transitional seasons (spring and autumn), the frequent alternation of elevated and depressed forms of relief, along with the accelerated pace of climate change, result in significant climatic variability in the occurrence of hazardous frosts in limited areas, significantly affecting the cultivation grapevines (fig. 3.6).

The provided digital map of frost occurrence highlights the role of slope exposure and orientation, geographic latitude, and absolute elevation in redistributing cold waves against a backdrop of persistent high temperatures. Therefore, the thermal differentiation on the territory of ATU Gagauzia for minimum temperatures occurring once every 10 years is 6.3^{0}C in spring and reaches 5.1^{0}C in autumn, which is one of the main factors reducing the crop yield of crops in the region.

The annual amount of atmospheric precipitation is one of the key indicators characterizing moisture resources in the ATU Gagauzia. It varies from 457 mm to 587 mm, compared to the average of 540 mm for the entire Republic of Moldova (fig. 3.7, tab. A 2.2).

Thus, while at higher elevations, the annual amount of atmospheric precipitation is 47 mm higher than the average for the country, at lower relief forms, it is lower by 83 mm.

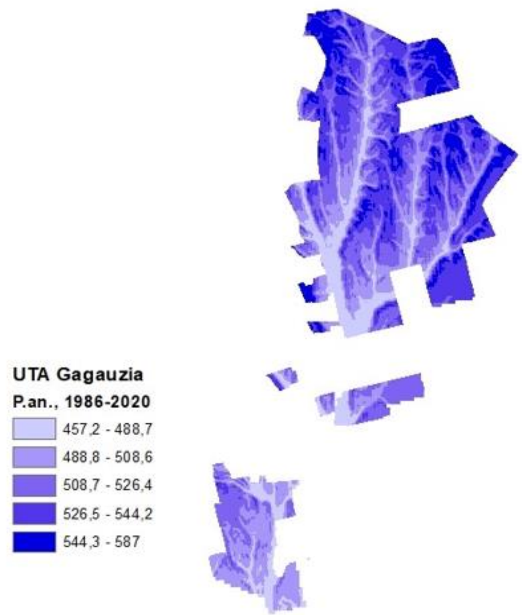


Fig. 3.7. Spatial distribution of annual amount of atmospheric precipitation in (1986-2020), ATU Gagauzia [104].

Characterization of Meteorological Conditions on the Experimental Plots. We divided the analysis of meteorological conditions during the research period into three blocks: 1) 2003-2008; 2) 2009-2014; 3) 2015-2020.

Based on long-term observations, the average annual air temperature in the ATU Gagauzia is 9.7^{0}C (fig. 3.8, tab. A. 2.1). Positive temperatures are maintained for about nine months. The average monthly temperature of the warmest month (July) is 21.4^{0}C, and the coldest month (January) is -2.2^{0}C. The average annual precipitation based on long-term data is 466 mm [11, 12].

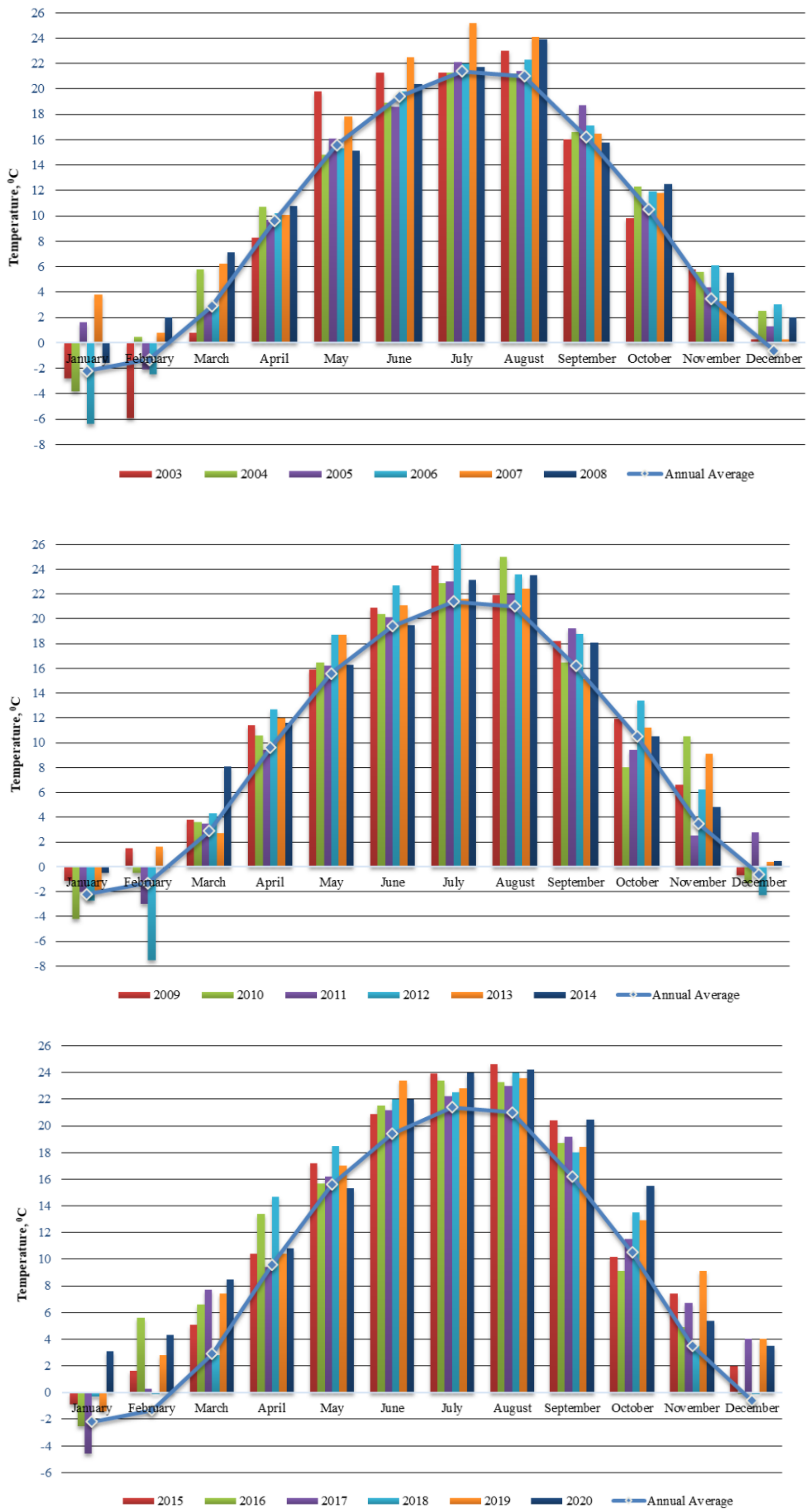


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Fig. 3.8. Mean monthly temperature values (t,^{0}C).

Source: Analysis was carried out by the author of the data from the Agro-Industrial Complex of the ATU Gagauzia

It has been established that in the year 2003, meteorological conditions (average monthly air temperatures, precipitation) were very favourable for the growth and ripening of woods on the rootstock mother-grapevines (fig. 3.8, fig. 3.9, tab. A. 2.1, tab. A. 2.2).

In the year 2004, the coldest month was January, although minimum temperatures were also observed in February. Winter lasted for 2.5 months (from the first decade of December to the second decade of February).

Moderately frosty weather accounted for about 50%, while frost-free weather was up to 25% of the total winter period. The summer was hot, with an average monthly temperature of +18.9^{0}C in June, and +21.5^{0}C to +21.3^{0}C in July and August. The total precipitation for the year was 557 mm, with May being the rainiest month (103 mm). The summer was dry, with only 163 mm of rainfall from June to August, which necessitated additional watering in the nursery. In the autumn period, there was little precipitation (108 mm). Air temperatures steadily decreased from 16.6^{0}C in September to 5.6^{0}C in November. The grafted vines' shoot ripening was good.

In 2005, the meteorological conditions during the grapevine's vegetation period were similar to those in 2004. The hottest months were July and August, with average monthly temperatures of +22.1^{0}C and +21.4^{0}C, respectively. During the summer months, there was 194 mm of precipitation, which accounted for about 40% of the annual total. In the autumn months, there was very little precipitation – only 85 mm, especially in September, which had only 8 mm. The total precipitation for the year 2005 was 483 mm, which is 13% less than in 2004.

The year 2006 is characterized by a very cold winter, with an average monthly temperature in January of -6.4^{0}C, which is 4.2^{0}C below the long-term average. The hottest months were also July and August, with temperatures of +22.0^{0}C and +22.3^{0}C, respectively. The total precipitation for the year was 475 mm, with June being the rainiest month with 101 mm of rainfall. During the summer period, there was approximately the same amount of precipitation as in the previous year, and in the autumn period, there was 109 mm of rainfall.

In 2007, the winter was relatively mild. The average monthly temperature in January and February was positive and amounted to +3.8^{0}C and +0.8^{0}C, respectively. The summer was dry and hot, especially in July, with an average monthly temperature of +25.2^{0}C and no precipitation. However, the total precipitation for the year was 509 mm, which is 43 mm more than the long-term average.

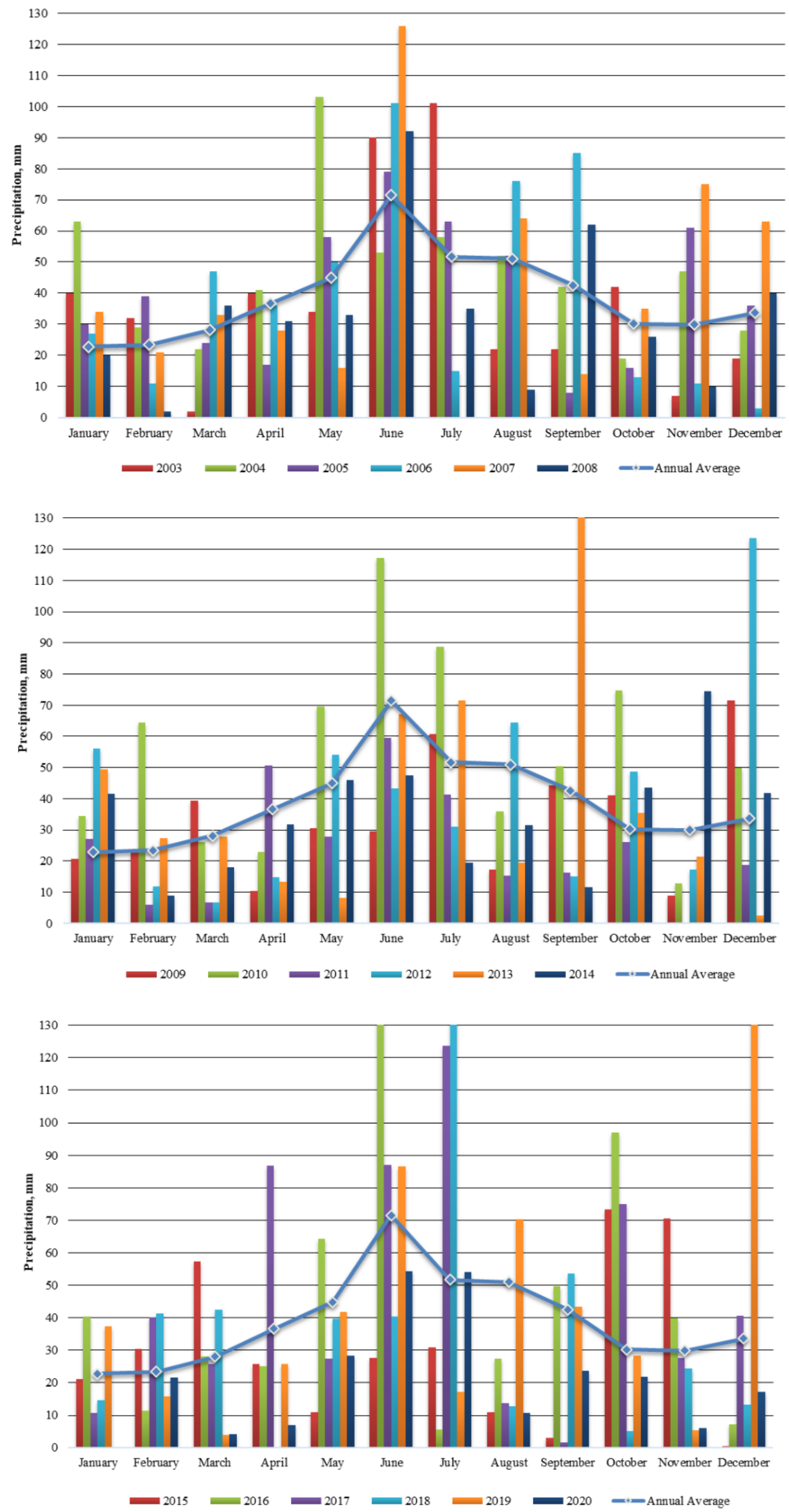


Fig. 3.9. Monthly averages of precipitation (mm)

Source: Analysis was carried out by the author of the data from the Agro-Industrial Complex of the ATU Gagauzia

In 2008, the year was also characterized by a relatively mild winter (January -1.6^{0}C, February +2.0^{0}C). The warmest month was August with an average temperature of +23.9^{0}C. The total precipitation for the year was 396 mm, which is 85% of the long-term average, and during the summer period, there was approximately 136 mm of precipitation.

2010 and 2013 were characterised by higher precipitation totals, while 2009, 2012 and 2014 were relatively drier, according to the analysis of meteorological conditions for the period 2009-2014 (fig. 3.9, tab. A 2.1). In terms of temperature, 2010 was warmer, while 2012 was relatively colder. The other years remained close to the annual mean temperature. When analysing the meteorological data, it is also necessary to take into account their influence on the growth and development of the grapevine and to determine which of the years were the most favourable for grapevine cultivation in the study area.

From this comparative analysis, it can be seen that the years 2009 and 2011 were characterised by lower rainfall, while 2010, 2012, 2013 and 2014 were warmer and rainy (Figure 2.8, Table A 2.2).

From the comparative analysis of the data by month for the period from 2009 to 2014, it was found that the average annual temperature for the period from 2009 to 2014 was between 9.8^{0}C and 11.3^{0}C. The coldest month was January 2011 with a temperature of -4.2^{0}C and the warmest month was July 2012 with a temperature of 26.0^{0}C. The total amount of precipitation received during the year has also varied. From 2010 to 2014, the total rainfall ranged from 295.3 mm to 646.1 mm. The driest month was July 2014 with only 19.4 mm of precipitation and the wettest month was May 2010 with 69.6 mm of precipitation.

Comparing the meteorological conditions by month shows that the differences in temperature and rainfall between different years can be significant. For example, February 2010 had a temperature of 1.5^{0}C and February 2013 had a temperature of 1.6^{0}C. This shows the significant variability in meteorological conditions over time. A comparative analysis by month shows that the values of temperature and precipitation fluctuate in different years. In some months there are significant differences between years, while in other months the differences are not so significant. It is also noticeable that there were periods of warmer or colder weather during the years studied.

The analysis of data from 2015 to 2020 shows that temperature and precipitation vary from year to year and month to month (fig. 3.8, fig. 3.9, tab. A 2.1, tab. A 2.2). Some years are recorded as warmer and with less precipitation (e.g. 2016 and 2019), while others are recorded as colder and with more precipitation (e.g. 2017 and 2018). The average annual temperature ranges from -0.6^{0}C to

13.1⁰C, with a difference of 13.7⁰C between the coldest and the warmest year. Average annual rainfall varies from 357.8 mm to 569.3 mm, with a difference of 211.5 mm between the wettest and the driest years. Some months, such as January and February, show the greatest variations in temperature and rainfall, which has a stressful effect on the vines during the winter period.

It is noted that meteorological conditions in the last years of the study have changed towards an increase in average annual temperatures and a decrease in precipitation.

Over the last six years, average annual air temperatures have increased by 2.8⁰C compared to the long-term averages, reaching 13.2⁰C in 2016, 12.5⁰C in 2017, 11.5⁰C in 2018, and 12.5⁰C in 2019 (fig. 3.10). We have determined that the recent years are characterized by a lower amount of precipitation compared to the long-term averages. For example, in 2018, the total annual precipitation amounted to 431.4 mm, while in 2019, it was 380.6 mm, both of which were less than the long-term averages by 34.6 mm and 85.6 mm, respectively. Alongside this, the distribution of precipitation within the periods of grapevine growth and dormancy has also changed. It has been noted that grapevine plants experienced moisture deficits during critical growth and developmental periods, negatively impacting the processes of growth, development, and bush productivity.

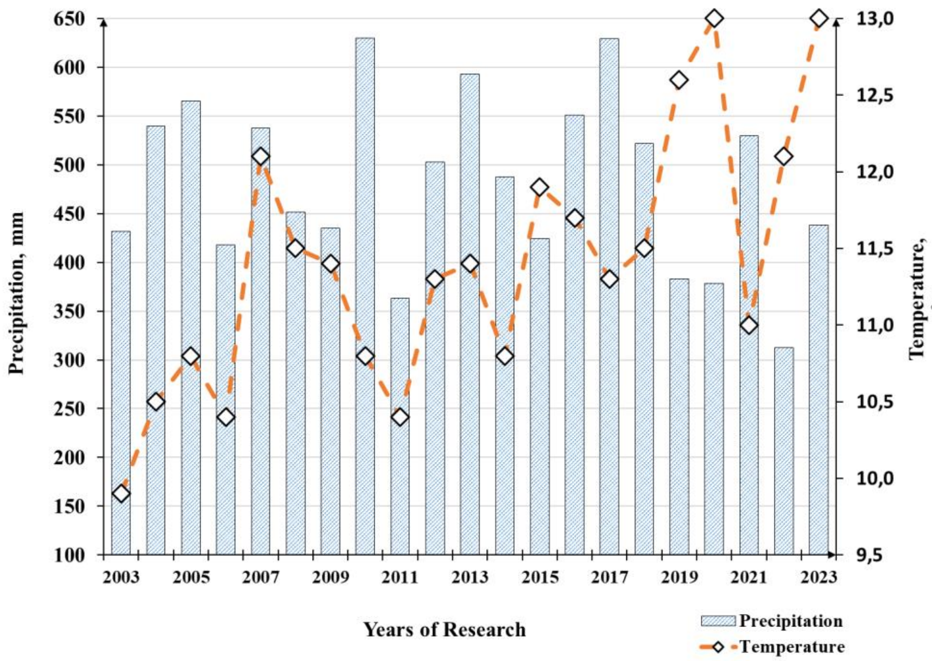


Fig. 3.10. Dynamics of Annual Precipitation Amounts and Air Temperature in UTA Gagauzia

In general, it should be noted that the meteorological conditions during the years of study were not uniform. The years 2003, 2004, 2005, 2010, 2013, and 2017 were more favourable for the growth and development of grapevine plants. Conversely, the years 2011, 2019, and 2020 were less favourable due to a significant reduction in precipitation and high temperatures during the summer vegetation periods. This has a consistent impact on shoot growth and the productivity of grape plantations.

3.2. Peculiarities of the Development of the Viticulture Sector under the Conditions of ATU Gagauzia

The characteristic features of the climate, soil, and relief determine the specialization and structure of agricultural production in ATU Gagauzia.

In the economy of Gagauzia Autonomous Territorial Unit, the Agro-Industrial sector traditionally dominates, accounting for up to 70% of the region's GDP. However, with the introduction of market relations and modern technologies, the share of agriculture in the labour market is decreasing, although agriculture still provides employment for up to 20% of the economically active population of Gagauzia [292].

Table 3.2. Structure of Land Use in the ATU Gagauzia (as of January 1, 2024)

No. n/a	Types of Land Use	ATU Gagauzia	Comrat District	Ceadîr-Lunga District	Vulcănești District
1.	Land Area	201796,39	108860,3	66116,09	26820
2.	Agricultural Land Area	78032,57	10779,57	41298	25955
	including:	0			
3.	Arable land	65516,6	8269,6	38567	18680
4.	Perennial plantations:	12749,62	7931,62	1897	2921
5.	- Vineyards	*9247,32*	*6204,62*	*427*	*2615,7*
6.	- Orchards	2606,3	1727	574	305,3
7.	Pastures	28547,6	9877+17,5	26222	2325,6
8.	Follow and Abandoned Lands	3068,027	3066		2,027
9.	Forest Plantations	8906	8906		
10.	Water Bodies	5052,31	2899,3	1620,01	533
11.	Roads	201796,39			548,05

Source: Analysis was carried out by the author of the data from the Agro-Industrial Complex of the ATU Gagauzia.

Viticulture is the most intensive sector in agricultural production in the autonomy. The intensification of this sector involves the continuous improvement of technology, machinery, and production organization, as well as the implementation of high-yielding varieties, clones, scientific achievements, and best practices. The main goal of modern viticulture in ATU Gagauzia is to create a high-quality grape industry that is competitive in the market and economically efficient.

An analysis of grape cultivation in the autonomy allows us to assess its level of development, identify existing shortcomings, and determine paths for further growth. We conducted an analysis of changes in the area, gross harvest, and yield of grape plantations in the agricultural sector of ATU Gagauzia from 1997 to 2021, covering the past 25 years [292].

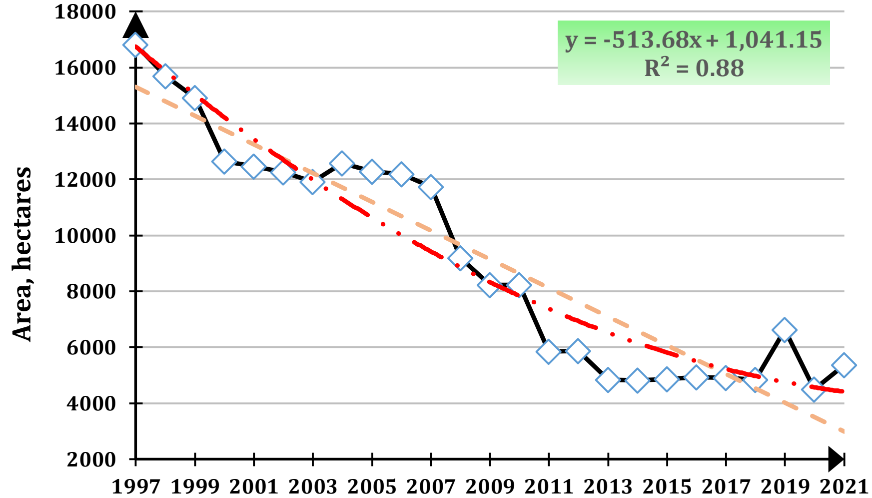


Fig. 3.11. Dynamics of the Area of Fruit-Bearing Grape Plantations, ATU Gagauzia, 1997-2021

Source: Calculated by the author of the data from the Agro-Industrial Complex of the ATU Gagauzia.

According to the trend equation (y=-513.68x+1,041.15), a decreasing trend in the fruit-bearing area of grape plantations in ATU Gagauzia from 1997 to 2021 has been observed, with an average annual decrease of 513.68 hectares (fig. 3.11, tab. A 3.1).

An analysis of the dynamics of grape cultivation over the past 25 years (1997-2021) shows a noticeable increase in grape yield. As indicated by the trend equation (y = 0.23x - 4552.1), the average annual increase in grape productivity amounts to 0.23 tons per hectare (fig. 3.12, tab. A 3.1).

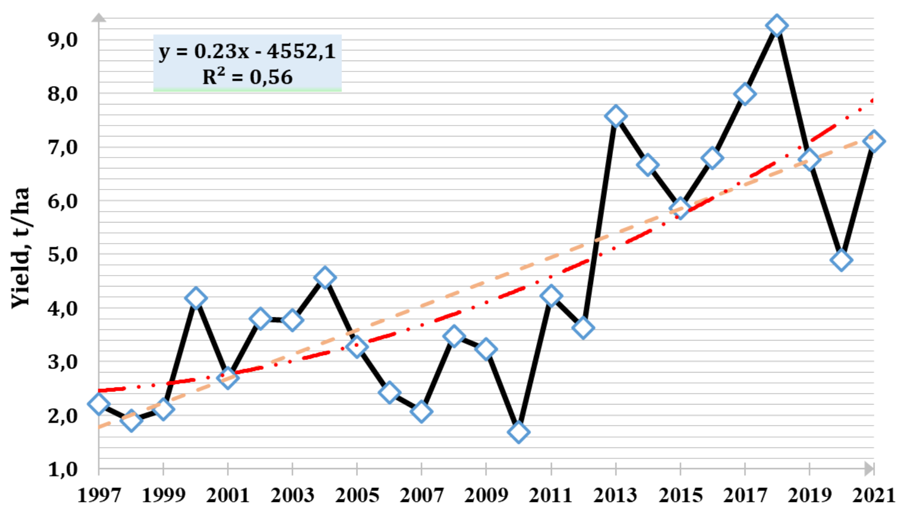


Fig. 3.12. Dynamics of Grapevine Plantations Yield, ATU Gagauzia, 1997-2021.

Source: Calculated by the author of the data from the Agro-Industrial Complex of the ATU Gagauzia.

The graphical representation of grapevine plantations yield dynamics for the study period indicates that according to the polynomial trend ($y = 0.0671x^2 - 267,39x + 266339$), the grape harvest per unit area shows a tendency to increase, especially in recent years (fig. 3.12).

During the period of 1997-2008, the average annual grape yield is 2.97 tons/hectare, with a slight yearly increase of 0.07 tons/hectare ($y = 0.07x - 12.2$) (fig. A 3.4a). For the years 2009-2021, the average annual yield is 5.53 tons/hectare, with an annual growth of 0.37 tons/hectare ($y = 0.37x - 73.3$) (Figure A 3.4b).

On average, over the analyzed period, the total grape harvest in ATU Gagauzia amounts to 30,743.1 tons per year, of which 54.5% (16,764 tons) comes from the Comrat District, 29.1% (8,948.6 tons) from the Vulcanesti District, and 16.4% (5,031.8 tons) from the Chadir-Lunga District. It is noteworthy that as grape yield increases, there is a tendency for a decrease in the total grape harvest by 262.94 tons per year ($y = -262.94x + 563,017$), which is associated with a reduction in the cultivated area for grapevines (fig. 3.13, tab. 3.2).

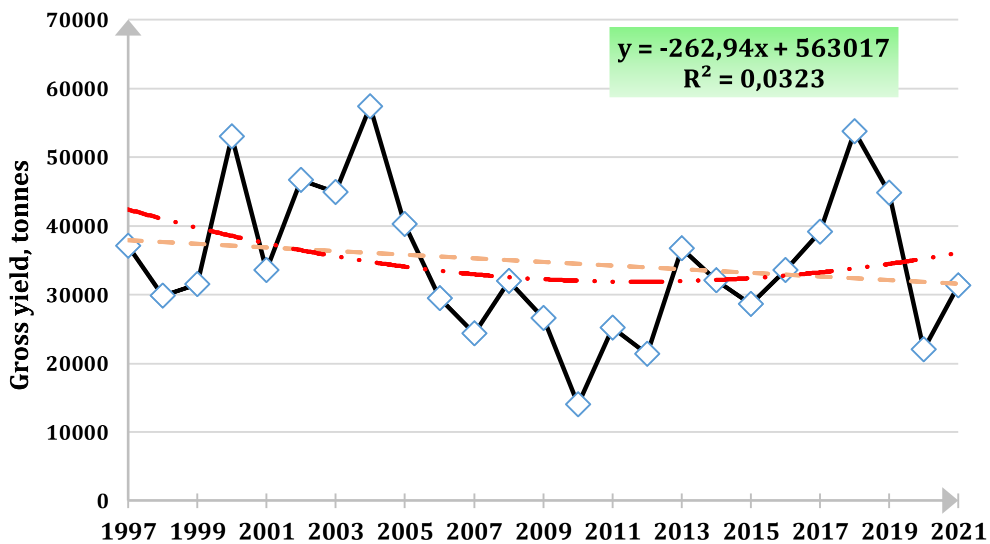


Fig. 3.13. Dynamics of Gross Grape Yield in the ATU Gagauzia, 1997-2021.

Source: Calculated by the author of the data from the Agro-Industrial Complex of the ATU Gagauzia.

Calculations of indicators for the sustainability of grape production in agricultural enterprises in ATU Gagauzia from 1997 to 2021 reveal a significant difference between the maximum and minimum values, indicating a substantial range of variation. On average, over the 25-year period, the coefficient of variation for harvested area is 129.0%, for gross yield is 124.5%, and for yield is 202.1%. It is commonly accepted that if the coefficient of variation exceeds 20%, production is considered unstable. In the agricultural sector, this means that production is concentrated in areas of unstable (risky) agriculture. Consequently, grape production in ATU Gagauzia is characterized by low stability.

The presence of potential and actual yield indicators for cultivated crops allows for the identification of existing reserves to increase productivity and take measures to increase the volume of gross production. According to the research conducted by Parmacli D. [291, 293], the calculation of yield growth reserve (Δ_q) carried out as the difference between the potential productivity (q_{pot}) level and the actual yield (q_a) using the formula:

$$\Delta_q = q_{pot} - q_a \tag{3.1}$$

The calculation of grapevine's potential yield indicators was conducted using the formula:

$$q_{pot} = \sqrt[К]{P} \tag{3.2}$$

where, **P** – multiplication of the highest yields "**К**" years:

$$К = \sqrt{P}, \tag{3.3}$$

T is the number of years in the analyzed period.

A more objective value for the potential grape yield in agricultural enterprises can be obtained by considering the actual conditions of the region where the crop is cultivated. Therefore, we conducted calculations of productivity indicators for grape plantations in the districts of ATU Gagauzia. The calculated data for yield indicators are presented for the average across ATU Gagauzia and by districts (fig. 3.14).

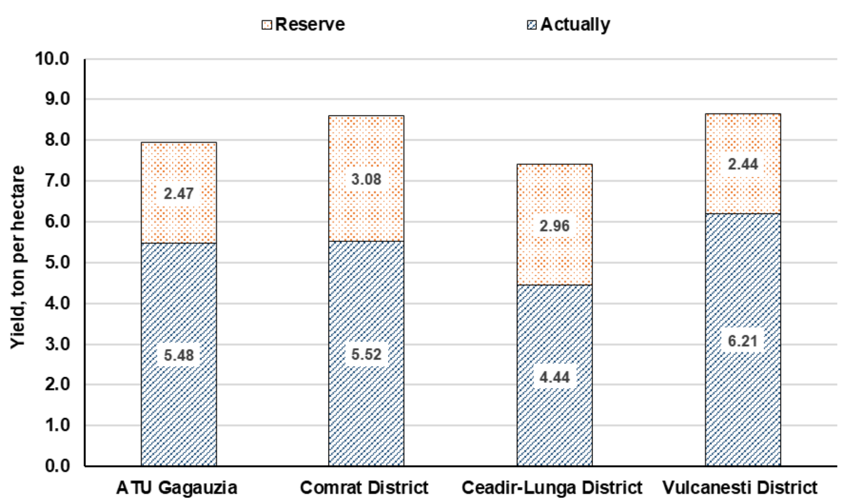


Fig. 3.14. Grape Yield Indicators and Growth Reserves in Farms of the ATU Gagauzia, 2009-2021.

Source: Calculated by the author of the data from the Agro-Industrial Complex of the ATU Gagauzia.

It has been determined that the average grape yield in ATU Gagauzia is 5.48 tons per hectare. However, the highest productivity of grape plantations was achieved in agricultural enterprises in the Vulcanesti District, with a yield of 6.21 tons per hectare, which is higher than in the Comrat and Ceadir-Lunga Districts by 0.69 and 1.77 tons per hectare, respectively (tab. A 3.2).

When calculating the potential grape yield in ATU Gagauzia, we used the highest yield indicators for 2013, 2016, 2017, 2018, and 2019 (tab. A 3.3), as conducted by us, according to the method Parmacli D., Cara S. [292]:

$$\mathbf{q_{pot}} = \sqrt[5]{8.58 \cdot 6.77 \cdot 7.99 \cdot 9.27 \cdot 6.78} = 7.82 \text{ t/ha}$$

The established potential yield level for ATU Gagauzia is 7.95 tons per hectare, with 8.60 centners per hectare in the Comrat district, 7.39 tons per hectare in the Ceadir-Lunga District, and 8.65 tons per hectare in the Vulcanesti district (Appendix 3.3). The obtained data indicates that the potential grape yield exceeds the actual yield by 45%, which represents a possible reserve for increasing the productivity of grape plantations. The growth reserves for yield can reach 2.47 tons per hectare for ATU Gagauzia, 3.08 tons per hectare for the Comrat district, 2.96 tons per hectare for the Ceadir-Lunga District, and 2.44 tons per hectare for the Vulcanesti District. Therefore, the data suggests that grape cultivation in the Ceadir-Lunga District exhibits the lowest yield and gross production compared to the Comrat and Vulcanesti Districts.

3.3. State and Prospects of Grape Growing in SC "Tomai-Vinex" SA

According to the preserved archival data, in 1903, a local landowner and winemaker named Georghii Topciu, together with fellow villagers, established a winery in the village of Tomai and laid the foundations for wine cellars at the site of the current winery.

To achieve the set goals, in 1998, a joint-stock company called "Tomai-Vinex" was created in the village of Tomai, based on the former Soviet grape-growing and wine production collective farm. It became the legal successor of the winemaking industry in the village.

The new enterprise, while preserving experienced grape growers and winemakers, underwent complete technical and technological modernization driven by the times. New winemaking equipment of Italian production was purchased, double-rooted mother plantations and a grafting workshop for grape seedlings were revived, and new grape plantations were established.

Today, SC "Tomai-Vinex" SA is a modern and dynamically developing enterprise that has managed to achieve a leading position in the Moldovan wine industry. The winery is equipped with high-tech Italian equipment, and the laboratory is equipped with modern instruments that ensure high precision in research and quality control of the produced goods (fig. 3.15).

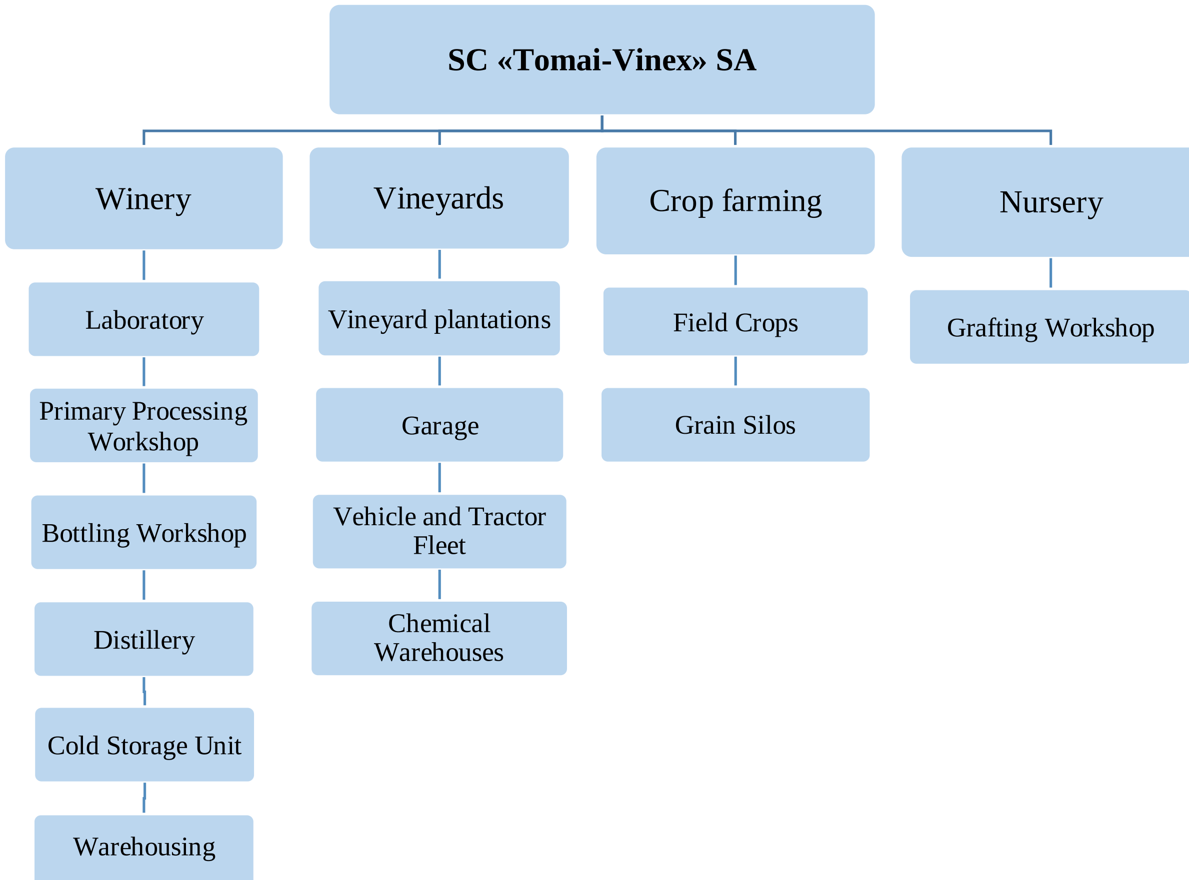


Fig. 3.15. Production structure of SC "Tomai-Vinex" SA.

Source: Estimated by the author

One of the main objectives of SC "Tomai-Vinex" SA is the development of grape growing and winemaking based on modern technologies. Innovations have yielded positive results, and the enterprise currently produces up to 3,000,000 liters of high-quality wine.

The wines produced by the company are in high demand and consistently receive awards at annual republican and international exhibitions, as evidenced by a large number of medals.

The produced wines meet regulatory documents and international standards for physico-chemical and organoleptic parameters, which is confirmed by quality certificates, conformity certificates, and test protocols. Additionally, all wines are produced using an automated fermentation temperature control system, ensuring consistently high quality.

The enterprise has a winery, its own raw material base (grape plantations - 170 hectares), cellars, storage facilities, a tractor brigade, a garage, chemical warehouses, and a grafting workshop. Its main activities include grape production, wine production, wholesale trade of alcoholic and other beverages, and the sale of grape seedlings (until 2006).

SC "Tomai-Vinex" SA is a vertically integrated enterprise in the wine industry, starting from the cultivation of bench-grafted vines and ending with the secondary processing of wine. It has a bottling line with a capacity of 3000 bottles per hour and plans to start producing alcohol, part of which will be sold. The range of products for sale includes bulk wine (dry, semi-dry, dessert) and bottled wine with 43 different varieties.

The central office of the company is located in the city of Comrat. The winery is situated in the village of Tomai, which covers an area of 8.56 km^2. The winery has a long history, founded in 1903, and has gone through a triumphant path from a small home winery to a major international export company with the Tomai brand.

The vineyards of the farm are located in the Southern region of viticulture, in the grape-growing and winemaking district of Comrat, specifically in the micro-district of Tomai. The plots are situated on the slopes with a southwest exposure. The grape cultivation is conducted without the use of covers.

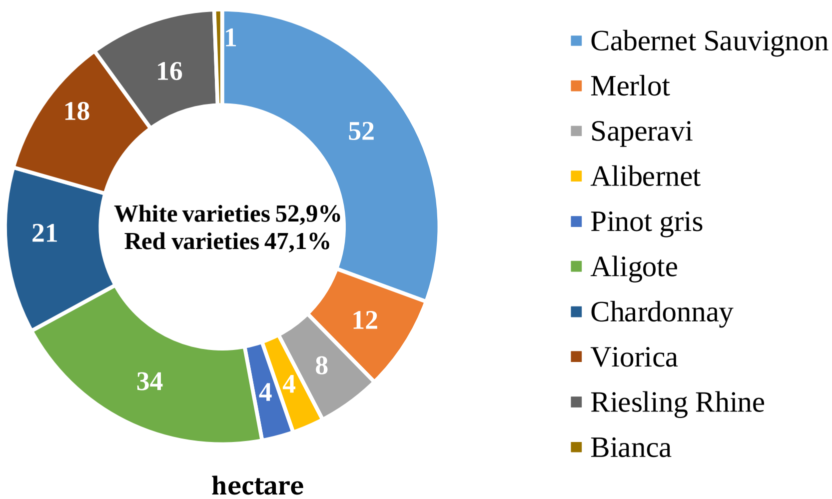


Fig. 3.16. Assortment of Grapes in SC "Tomai-Vinex" SA, 2024.

Source: Estimated by the author

The agro-climatic conditions are favourable for growing the cultivated grape varieties with black-coloured berries, including Cabernet Sauvignon (52 ha), Merlot (12 ha), Saperavi (8 ha), Alibernet (4 ha), and Pino Gris (4 ha). Additionally, white-coloured berry varieties are also grown, such as Aligote (34 ha), Chardonnay (21 ha), Viorica (18 ha), Riesling Rhine (16 ha), and Bianca (1 ha) (fig. 3.16).

It has been established that the variety structure of the investigated grape plantations in SC "Tomai-Vinex" SA is based on the following factors: the requirements of rootstock-scion combinations to soil and ecological conditions, the specialization of the micro-district and the location of the farm, the thermal provision and frost susceptibility of the territory, and the biological characteristics of the varieties and their zoning. The grape plantations were established based on optimal placement schemes, planting schemes, and formation methods, taking into account the natural fertility of the soil, the vigour of the rootstock, the presence of carbonates, and the cultivation practices.

We conducted an analysis of the condition of the grape plantations in SC "Tomai-Vinex" SA, which showed that the reduction in the area due to the uprooting of old vineyards is accompanied by an increase in the yield of the main grape varieties (fig. A 8.6).

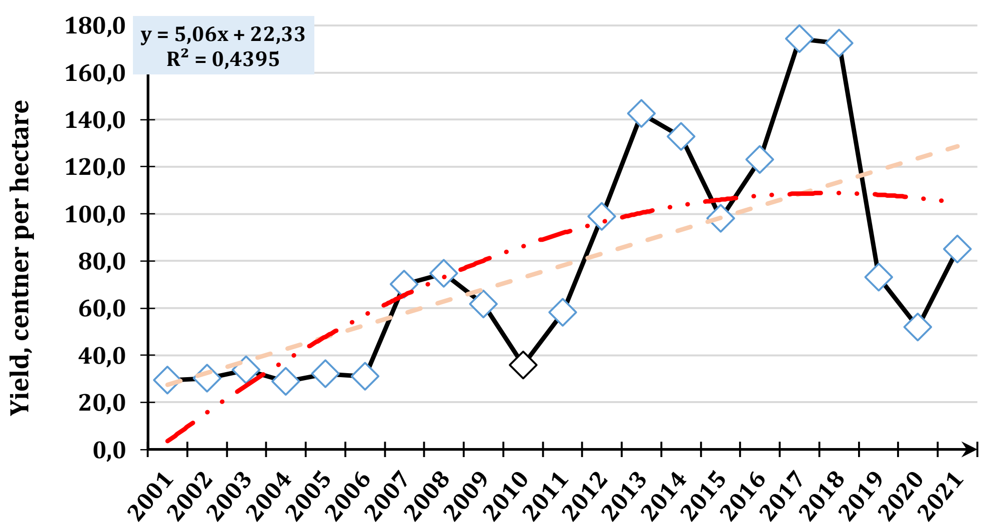


Fig. 3.17. Dynamics of grape yield in plantations, SC "Tomai-Vinex" SA, 2009-2021.

Source: Calculated by the author of the data from the SC "Tomai-Vinex" (Figure A 8.6).

From 2001 to 2009, there were old vineyards in operation that were scheduled for uprooting and simultaneous replanting with new plantations. The saplings for the new plantations were produced in the farm's own nursery (until 2006). It has been demonstrated that the planting of new vineyards is carried out using modern methods of vine cultivation. From 2013 to 2016, a portion of the production vineyards underwent reconstruction. Since 2016, the planting of grape vineyards, primarily of white varieties, has been resumed, utilizing new cultivation technologies.

It has been observed that from 2001 to 2021 (21 years), there is an increase in grape yield by 0.51 tons per hectare per year (y = 0.51x + 22.33) (fig. 3.17, tab. A 3.5). Notably, there has been a significant increase in productivity over the past six years, despite the unfavourable weather and climatic conditions in 2020. The grape yield reached 17.43 tons per hectare in 2017 and 17.25 tons per hectare in 2018, which is higher than the previous years of vineyard operation.

3.4. Conclusions to Chapter 3:

1. The ATU Gagauzia, located within the "Valul lui Traian" protected geographical indication, covers a total area of 1848 km² and includes three districts: Comrat, Ceadir-Lunga, Vulcanesti;
2. The soil conditions of the experimental plots are favourable for the growth and development of the studied grapevine clones. They consist of typical chernozem with a deep loam texture (nursery); and rich carbonate chernozem with a deep loam texture (grapevine plantation areas);
3. Microclimatic differences typical for ATU Gagauzia were revealed, including significantly lower precipitation compared to the central region, higher air temperatures, and a greater sum of active temperatures, with particularly noticeable differences in recent years (2019-2023).
4. The meteorological conditions during the years of the study were not uniform, being more favourable for the growth and development of grapevine plants in 2003, 2004, 2005, 2010, 2013, and 2017. Conversely, the years 2011, 2019, and 2020 were less favourable, exerting a consistent impact on the growth and productivity of grapevine plantations.
5. An analysis of the changes in vineyard areas, gross harvest, and grape yield in the farms of Gagauzia over the past 25 years has been conducted. It has been shown that the fruit-bearing area of vineyards decreases annually by 513.68 hectares, while the grape yield increases by 0.23 tons per hectare and the gross harvest of grapes decreases by 262.94 tons per year;
6. The potential yield level of vineyards in Gagauzia has been determined, and the growth reserve has been calculated, which will allow increasing the productivity of vineyards by 45%;
7. An analysis of the condition of the grape plantations in SC "Tomai-Vinex" SA has been conducted, which showed a decrease in the area but a simultaneous increase in yield by 0.51 tons per hectare per year. The highest productivity was observed in the production plantations in 2017 and 2018, with yields of 17.43 tons per hectare and 17.25 tons per hectare, respectively. Unfavourable weather and climatic conditions (soil-air drought) since the end of 2019 have led to a decrease in plantation productivity and a reduction in grape harvest by 2-2.5 times.

4. BIOLOGICAL AND TECHNOLOGICAL FEATURES OF GRAFTED VINE SAPLINGS PRODUCTION

4.1. The Processes of Regeneration, Output, and Quality of Grafted Saplings Depending on the Quality of the Stock Material

The influence of the varying quality of rootstock cuttings on the processes of regeneration, the yield of grafted vines from the nursery, and the development of their shoot and root systems have been established by authors such as L. Kolesnik [205], L. Maltabar [233], A. Mishurenko [268], N. Perstnev [295], A. Derendovskaia [181], and others. However, the lack of data on the viability of the obtained vines in their permanent location and the productivity of the bushes became the basis for conducting research in this direction in the conditions of Southern the Republic of Moldova (Autonomous Territorial Unit of Gagauzia).

Research on the influence of the varying different quality of rootstock cuttings on the processes of regeneration, the survival rate of grafted plants, and the yield of vines from the nursery were conducted by us from 2003 to 2005 at the SC "Tomai-Vinex" SA. Before grafting, cuttings (from the 1st to the 5th) were prepared separately from the base to the top of the rootstock canes BxR Kober 5BB and RxR 101-14 varieties, onto which scion cuttings of the R5 clone Cabernet Sauvignon variety were grafted. The control group consisted of grafted cuttings without being divided into groups.

4.1.1. The Quality of Stock Cuttings

The rootstock cane is an excellent model along its length, where zones with different physiological activity can be identified. During the research, the main quality parameters of the rootstock cane used in production (weight and diameter, carbohydrate content) have been studied, and their influence on the yield of grafted vines from the nursery has been examined (tab. 4.1).

So, for the variety RxR 101-14, the weight of cuttings, ranging from 0 to 35 cm in length, noticeably decreases from 19.57 to 13.15 g per cutting. The average diameter of cuttings from the base of the cane is 8.12-7.81 mm EG 1, EG 2 (1st-2nd), from the middle zone of the cane is 7.78-7.44 mm EG 3- EG 4 (3rd-4th), and from the top zone is 7.05 mm EG 5 (5th). For the variety BxR Kober 5BB, there is also a decrease in the weight of cuttings from the EG 1 to EG 5 (1st to the 5th), that is from the base to the top, ranging from 18.27 to 11.29 g per cutting. The largest mass cuttings are characterized from the base and middle of the cane EG 1, EG 2 (^{1st}-2nd), with a biomass of 18.27 and 17.11 g per cutting, respectively, and the smallest mass is the experimental group 5 (5th cutting) with 11.29 g per cutting.

Table 4.1. Dependence of the Mass and Diameter of Grape Rootstock Cuttings on their Layout Along the Stock Cane, 2004.

Variants	Mass of one Cutting, g	d_1^*, mm	d_2^*, mm	d_{ad}^*, mm
		BxR Kober 5BB		
CG	15,77±0,32	8,21±0,12	7,48±0,10	7,85±0,13
EG 1	18,27±0,51	9,50±0,14	7,90±0,12	8,70±0,14
EG 2	17,11±0,38	8,72±0,14	7,82±0,11	8,42±0,14
EG 3	16,39±0,34	8,40±0,13	7,56±0,10	7,98±0,13
EG 4	15,80±0,32	8,16±0,12	7,36±0,10	7,76±0,10
EG 5	11,29±0,30	7,25±0,10	6,53±0,09	6,90±0,09
LSD_{05}	*1,17*	*0,42*	*0,39*	*0,40*
		RxR 101-14		
CG	16,71±0,33	8,20±0,13	7,01±0,10	7,60±0,11
EG 1	19,57±0,52	8,74±0,14	7,50±0,11	8,12±0,12
EG 2	18,84±0,41	8,58±0,13	7,10±0,10	7,81±0,11
EG 3	16,77±0,32	8,30±0,13	7,28±0,10	7,78±0,10
EG 4	15,22±0,31	7,96±0,12	6,92±0,08	7,44±0,10
EG 5	13,15±0,31	7,46±0,12	6,64±0,08	7,05±0,11
LSD_{05}	*2,00*	*1,36*	*1,45*	*1,35*

d_1^* - diameter of the cutting from the ventral to the dorsal side;
d_2^* - diameter of the stem from flat to grooved side;
d_{ad}^* - mean diameter.

The mean diameter of the cuttings of the BxR Kober 5BB variety from the base of the cane is 8.70-8.42 mm (EG 1, EG 2); from the middle zone of the cane - 7.98-7.76 mm (EG 3, EG 4), and from the top - 6.90 mm (EG 5). It gradually decreases from the 1st (EG 1) to the 5th cutting (EG 5).

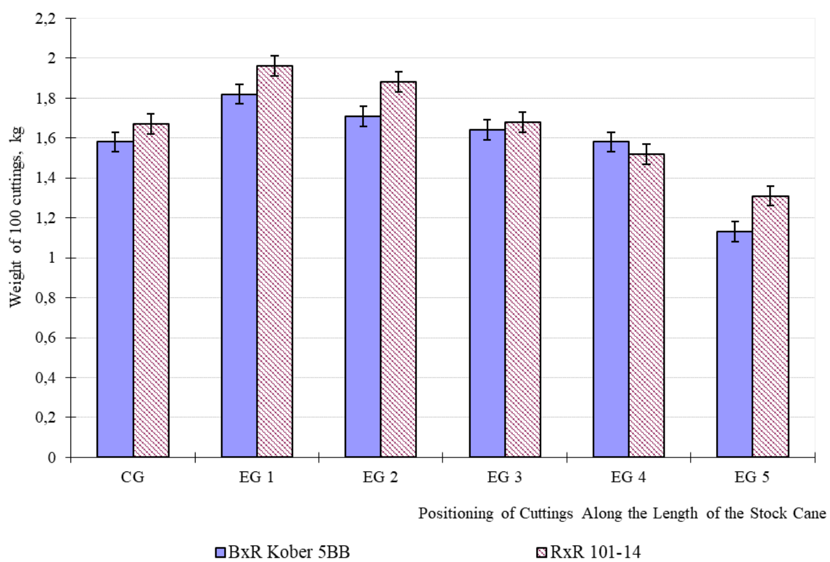


Fig. 4.1. The Mass of 100 pieces of Rootstock Cuttings, Depending on Their Layout Along the Length of the Stock Cane, 2004.

In their study, József Eifert and Józsefné Eifert (1984) use mass of bundles, the total amount of carbohydrates (in dry matter), and the carbohydrate reserve in 100 pieces of rootstock cuttings as indicators of cane quality. According to the authors, the cuttings should have sufficient energy stored in carbohydrates to withstand the complex production process while maintaining the necessary activity to utilize this energy reserve during stratification and hardening.

In our research, it was found that the mass of 100 cuttings, ranging from 0 to 35 cm in length, consistently decreases from the base of the rootstock cane to the top (tab. A. 4.1 and fig. 4.1).

So, for the RxR 101-14 stock variety, when cuttings are taken from the base of the cane, their mass ranges from 1.96 to 1.88 kg, from the middle of the cane - from 1.68 to 1.52 kg, and from the top - 1.31 kg. In the BxR Kober 5BB stock variety, the mass of cuttings ranges from 1.82 to 1.71 kg, from the middle of the cane - from 1.64 to 1.58 kg, and from the top - 1.13 kg. A similar pattern is observed for the dry matter content in the RxR 101-14, ranging from 1.27 to 0.85 kg, and in the BxR Kober 5BB, ranging from 1.18 to 0.70 kg. Cuttings from the base and middle of the stock-cane contain significantly more dry matter.

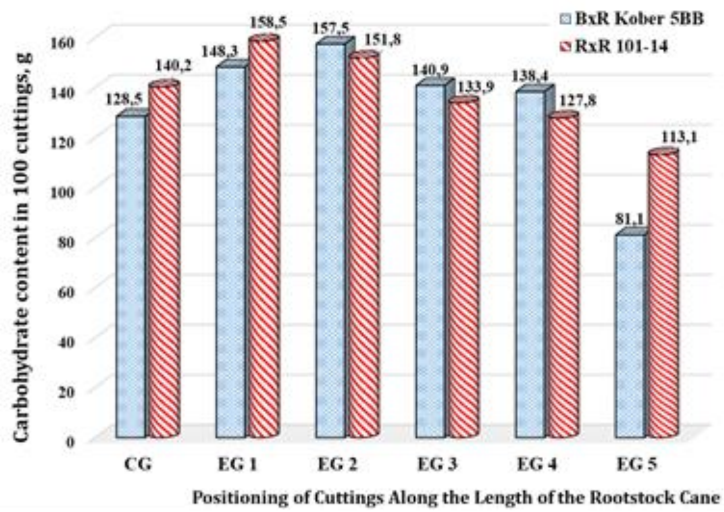


Fig. 4.2. The Carbohydrate Content in 100 pieces of Rootstock Cuttings, Depending on Their Layout Along the Length of the Stock Cane, 2004.

Along with the mass of cuttings, important indicators of the quality of the cane are the total carbohydrate content (in dry matter) and the carbohydrate reserves in 100 pieces of cuttings, which are necessary for the bipolar regeneration of grafted cuttings during their stratification and hardening period. According to N. Lukyan [225], the carbohydrate content in 100 pieces of cuttings has a significant impact on the output of grafted vines from the nursery.

From the data in Table A. 4.1 and Figure 4.2, it can be observed that the carbohydrate content in the investigated cuttings of all variants, except the 5th cutting of BxR Kober 5BB, exceeds 100g/100 pieces of cuttings.

So, in the case of the RxR 101-14 variety, the carbohydrate content varies from 158.5±2.2 g to 113.1±1.8 g, and for the BxR Kober 5BB variety, it ranges from 148.3±2.1 g to 81.1±1.7 g (from the 1st to the 5th cuttings), with higher values in the basal-cane and mid-cane region and lower in the top-cane. In the control groups (GC), the carbohydrate reserves in the cuttings vary depending on the variety and amount to 140.2±2.0 g (RxR 101-14) and 128.5±1.8 g (BxR Kober 5BB), corresponding to the 3rd and 4th cuttings.

Therefore, the cuttings RxR 101-14 and BxR Kober 5BB of the rootstock varieties noticeably changing in morphological characteristics (mass and diameter of the cuttings), the mass of 100 pieces of cuttings, and the content of dry matter depending on their collected from the basal-cane to the top-cane region. The most valuable indicators are represented by the cuttings taken from the base and middle region of the cane.

4.1.2. Regeneration Processes in Grafted Grapevine Cuttings

To achieve high results in growing grape planting material, it is necessary to create optimal conditions that promote timely appearance and vigorous development of callus, root primordia, and subsequently vascular systems in the intercomponent callus, as well as the fusion of graft components. This will also lead to a more robust development of the root system and one-year growth in the nursery.

The intensity of callus formation, its differentiation, and consequently the union of grafted components depend on a complex of internal and external factors. Among the internal factors is the quality of the cuttings used for grafting and their physiological activity. The determining external factors include temperature, humidity, oxygen supply, and others. All of these factors influence the processes of regeneration: callus formation, root and shoot development, and the fusion of graft components.

We have found that the budbreak in the scion occurs on the 4th to 5th day of stratification. By the end of stratification, the number of grafted cuttings with budbreaks in clone R5 Cabernet Sauvignon onto RxR 101-14 ranges from 19.8% to 26.7%, while those with non-budburst are 72.7% to 79.0%. In clone R5 Cabernet Sauvignon onto BxR Kober 5BB, the numbers are 30.2% to 44.7% and 54.7% to 69.1%, respectively (tab. A 4.3).

The effect of inhibition of budbreak is likely associated with the action of biologically active substances present in red paraffin. According to N. Lukyan [225], pre-stratification treatment of grafted cuttings with heteroauxin at a dose of 500 mg/l also leads to the suppression of budbreak on the scion and an increase in the number of grafted cuttings with non-budburst.

Table 4.2. Regeneration Processes in Grafted Grape Cuttings, Depending on Their Layout Along the Length of the Stock Cane. End of Stratification, 2004.

Variants	Shoot growth, cm	Number of grafted cuttings, %			Formation of callus, root primordia (r.p.), roots at the stock bottom
		with a circular callus on		with vessels in the callus	
		scion	stock		
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB					
CG	0.7±0.02	76.8	96.4	73.3	callus, r.p., roots
EG 1	1.1±0.03	85.7	100.0	100.0	weak r.p., callus
EG 2	1.1±0.03	83.3	100.0	100.0	r.p., callus
EG 3	0.8±0.02	81.8	93.3	100.0	r.p., callus
EG 4	1.0±0.03	73.3	93.3	100.0	r.p., callus, small roots
EG 5	1.5±0.04	66.7	86.7	100.0	r.p., callus
Cl R5 Cabernet Sauvignon onto RxR 101-14					
CG	0.8±0.02	74.6	97.3	95.9	r.p., callus, roots
EG 1	0.4±0.01	86.7	100.0	100.0	r.p., callus
EG 2	0.8±0.02	80.0	100.0	100.0	r.p., callus, roots
EG 3	0.9±0.02	73.3	100.0	100.0	r.p., callus, roots
EG 4	0.5±0.01	68.8	93.8	93.8	callus, r.p., small roots
EG 5	1.5±0.03	64.3	92.9	85.7	callus, r.p., small roots

The shoot growth of clone R5 Cabernet Sauvignon onto RxR 101-14 is 0.4-1.5 cm, and onto BxR Kober 5BB is 0.2-1.13 cm. The formation of the callus was observed on the 5th day of stratification. By the end of stratification, in the control variants (production grafting), for clone R5 Cabernet Sauvignon onto RxR 101-14, the number of grafted cuttings with a circular callus on the scion is 74.6%, on the stock - 97.3%, with vessels in the callus - 95.9%; onto BxR Kober 5BB - 76.8%, 96.4%, and 73.3%, respectively (tab. 4.2).

It should be noted that in grafted cuttings made using the simple improved cleft grafting method, due to polarity, callus formation always occurs better on the scion than on the stock [205]. In our experiment, the callus-forming ability of the stock is higher than that of the scion, which is likely related to the method of graft production, where an Omega-wedge is made on the stock and an Omega-groove on the scion. As a result, metabolites, including phytohormones such as auxins and cytokinins, seem to flow from the scion to the surface of the rootstock's cut, enhancing its callus-forming ability, especially from the side of the swelling or budbreaks.

We have established that the regenerative capacity of grafted cuttings depends on the rootstock cuttings' position along the cane's length. The most active regeneration is observed in grafted cuttings from the basal and middle of the cane, regardless of the rootstock variety. The number of grafted cuttings with circular callus formation (1st to 3rd cutting) in clone R5 Cabernet Sauvignon onto RxR 101-14 on the scion is 86.7-73.3%, on the rootstock is 100.0%; for clone R5 Cabernet Sauvignon onto BxR Kober 5BB, it is 85.7-81.8% and 100.0-93.3%, respectively. When using the 4th and 5th cuttings (from the basal of the cane) for grafting, the regenerative capacity of grafted cuttings decreases and, in most cases, remains at the level of control variants.

Root primordia, callus, and small roots were found on the heel of rootstock cuttings in the control variants. It should be noted that the rhizogenic activity of rootstock cuttings depends on their varietal characteristics and position along the length of the rootstock cane. Being higher in RxR 101-14 compared to BxR Kober 5BB. When using cuttings from the base (1st cutting) and upper zones of the cane (5th cutting) for grafting, their rhizogenic activity decreases, regardless of the rootstock variety. The 2nd and 3rd cuttings exhibit the highest rooting capacity.

Thus, the regenerative activity of grafted cuttings is variable and depends on the varietal characteristics of the graft components as well as the quality of the rootstock cuttings used for grafting.

4.1.3. Survival, Growth, and Development of Grafted Cuttings in the Nursery

Grafted cuttings, after stratification and hardening, were planted in the nursery with a 4-fold replication.

When grafting Clone R5 Cabernet Sauvignon onto Bx R Kober 5BB rootstock using cuttings from the lower zone of the cane (1st cutting), the survival rate of grafted cuttings decreases by 2.1% compared to the control variant, which is presumably linked to their low rooting activity (tab. 4.3).

When grafting onto the 2nd and 3rd cuttings, compared to the first one, the survival rate of grafted cuttings in the nursery increases by 4.0-5.7% and, correspondingly, decreases from the upper zone of the cane (4th-5th cuttings) and remains at the level of the first cutting, reaching 72.0% and 67.3%, respectively.

When grafting clone R5 Cabernet Sauvignon onto RxR 101-14 rootstock, the control variant shows a survival rate of 76.6%. Grafting onto cuttings from the basal zone of the cane leads to an increase in survival rate by 3.6-8.1% compared to the control, reaching 80.3% and 84.7%, respectively; from the middle zone of the cane, the survival rate remains unchanged.

Table 4.3. Survival Rate, Growth Development, and Leaf Surface of Grafted Plants in the Nursery, Depending on the Layout Along Cuttings the Length of the Stock Cane, 23.08.2004.

Variants	Survival in the nursery, %	Growth Length, cm		Growth Volume, cm^3	Leaf Surface Area, dm^2
		one vine	including main shoot		
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB					
CG	73.8±1.1	205.6±1.9	60.4±0.9	25.0±0.2	41.8±0.5
EG 1	71.7±1.2	265.0±2.1	69.5±1.0	33.0±0.3	47.0±0.6
EG 2	75.7±1.2	248.0±2.1	64.5±1.0	29.7±0.3	44.1±0.6
EG 3	77.4±1.1	196.0±2.0	59.0±1.0	24.4±0.2	41.5±0.5
EG 4	72.0±1.0	179.5±2.0	53.7±0.9	22.5±0.2	38.1±0.4
EG 5	67.3±1.0	163.0±1.9	50.3±0.9	19.2±0.1	36.9±0.4
Cl R5 Cabernet Sauvignon onto RxR 101-14					
CG	76.6±1.1	188.5±2.0	45.9±0.9	24.1±0.2	39.8±0.5
EG 1	80.3±1.2	232.7±2.2	54.0±1.0	30.7±0.3	45.3±0.6
EG 2	84.7±1.2	215.0±2.1	50.1±1.0	27.6±0.3	42.2±0.5
EG 3	77.4±1.1	185.0±2.1	46.8±0.9	23.6±0.2	40.4±0.5
EG 4	71.3±1.0	175.0±2.0	43.7±0.8	20.8±0.2	39.0±0.5
EG 5	69.4±1.0	156.5±1.9	42.3±0.8	18.5±0.1	35.7±0.4

At the control level (77.4%); from the top zone of the cane, it decreases by 7.2% compared to the control and by 10.9-15.3% with the survival rate of grafted cuttings from the basal zone of the cane.

Growth is one of the most pronounced expressions of the activity of a plant organism. The character of growth depends on a combination of internal and external factors. The processes of growth occurring in a plant can be inferred from several indicators: an increase in the size of plants and their organs, an increase in the fresh and dry weight of plants, and others.

We have established that growth processes in grafted grape vines in the nursery vary among different experimental conditions and are significantly influenced by the quality of the rootstock cuttings used for grafting (tab. 4.3, fig. 4.3).

Thus, for Clone R5 Cabernet Sauvignon onto RxR 101-14 during the period of active shoot growth (August 23), the total length of growth per one grafted sapling in the control variant is 188.5 cm, Growth Volume is 24.1 cm^3, and the Leaf Surface Area is 39.8 dm^2.
When using for grafting EG 1 (1^{st} cuttings) and EG 2 (2^{nd} cuttings), the Length of Sapling Growth increases to 215.0-232.7 cm, Growth Volume to 27.6-30.7 cm^3, and Leaf Surface Area to 42.2-45.3 dm^2. When using the 3^{rd} cutting (EG 3) from the base of the rootstock, these indicators remain at the control level, while using the 4^{th} (EG 4) and 5^{th} cuttings (EG 5) leads to a significant decrease. A similar pattern is observed for clone R5 Cabernet Sauvignon grafted onto BxR Kober 5BB rootstock.

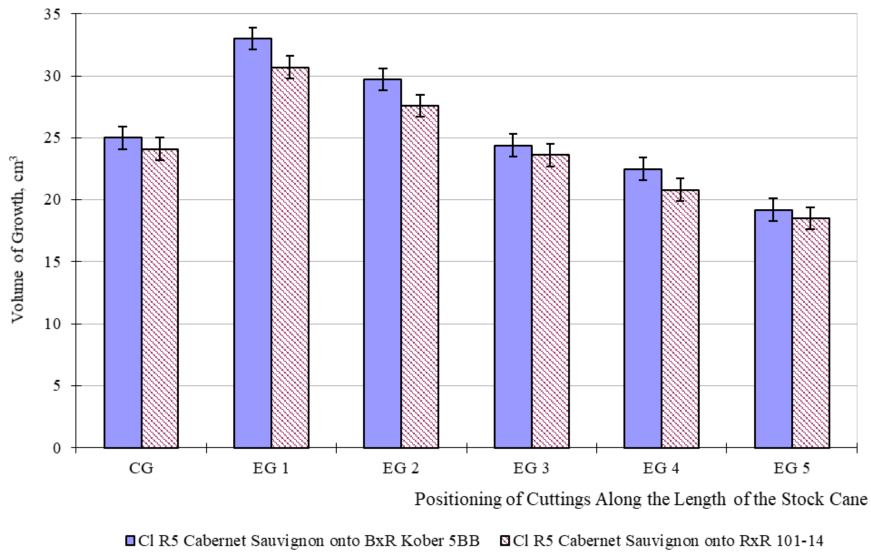


Fig. 4.3. Influence of Rootstock Cuttings Position Along the Cane Length on the Development of Growth in Grafted Plants in the Nursery, 23.08.2004.

Therefore, the survival rate and growth of grafted vines in the nursery depend on the position along the cane length, and they consistently decrease when using cuttings collected from the base to the top of the cane from 1^{st} (EG 1) to 5^{th} (EG 5) for grafting.

4.1.4. The Output of Grafted Vine Saplings from a Nursery and their Quality

The outcome of any agronomic technique in grapevine nursery management is the production of standard vine saplings with well-developed growth and root systems upon their output from the nursery.

The grafted sapling's output was calculated based on both the number of grafts made and the number of grafts planted in the nursery. We have determined that the rootstock variety and the position of cuttings along the stock-cane length significantly influence the grafted sapling output from the nursery (tab. 4.4).

Thus, for the grafted components of clone R5 Cabernet Sauvignon onto RxR 101-14, the output of saplings varies from 49.4% EG 1 (1^{st} cutting) to 28.4% EG 5 (5^{th} cutting) (from the number of grafts made). When grafting clone R5 Cabernet Sauvignon onto BxR Kober 5BB, the grafted saplings output increases when using cuttings from the base-cane and middle-cane zones EG 1, EG 2, EG 3 (1^{st} to 3^{rd} cuttings) and decreases when using cuttings from the top-cane zone EG 4, EG 5 (4^{th} and 5^{th} cuttings).

Table 4.4. The Output of Grafted Saplings from a Nursery and their Quality Depending on the Layout of Cuttings Along the Stock Cane Length, 2004.

Va-riants	The output of saplings from the number of grafted cuttings, %		Saplings' Growth Length, cm		Saplings' Growth Volume, cm^3		Diameter of the main shoot (at the base), mm	Number of roots, pcs		
	made	planted in the nursery	total	matu-red	total	matured		>2 mm	to 2 mm	tot al
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB										
CG	41.0±0.8	42.0±0.8	70.1±1.9	30.8±0.3	6.91±0.14	6.15±0.12	7.8±0.1	4	2	6
EG 1	47.9±1.1	48.9±1.1	78.6±2.0	39.8±0.4	7.50±0.15	6.99±0.12	8.7±0.2	5	6	11
EG 2	51.6±1.2	52.9±1.2	79.5±2.0	43.2±0.4	7.72±0.15	7.08±0.13	8.3±0.2	6	6	12
EG 3	45.9±1.1	46.7±1.1	73.0±1.9	32.8±0.4	7.04±0.14	6.44±0.12	7.9±0.2	5	4	9
EG 4	33.9±1.0	38.0±1.0	65.8±1.8	26.6±0.3	6.86±0.13	5.98±0.11	7.4±0.1	3	4	7
EG 5	31.1±1.0	35.3±1.0	61.7±1.8	23.1±0.2	6.30±0.13	5.06±0.11	6.5±0.1	3	3	6
LSD_{05}	*1.91*	*2.03*								
Cl R5 Cabernet Sauvignon onto RxR 101-14										
CG	39.1±1.0	41.8±1.0	72.1±1.8	32.9±0.3	7.17±0.14	5.09±0.13	7.6±0.1	4	4	8
EG 1	49.4±1.2	53.2±1.2	80.3±2.0	42.2±0.4	7.93±0.16	6.60±0.14	8.3±0.2	5	5	10
EG 2	46.8±1.2	48.1±1.2	76.7±2.0	36.3±0.4	7.82±0.15	6.34±0.14	8.0±0.2	5	4	9
EG 3	40.3±1.1	42.1±1.1	75.0±1.9	34.3±0.3	7.52±0.15	5.24±0.13	7.8±0.2	4	4	8
EG 4	34.4±1.1	36.0±1.1	70.1±1.8	32.4±0.3	6.92±0.13	4.60±0.12	7.6±0.2	4	4	8
EG 5	28.4±1.0	33.6±1.0	63.3±1.8	29.4±0.2	5.64±0.12	3.62±0.11	7.5±0.1	4	3	7
LSD_{05}	*2.25*	*2.38*								

We have established that there is a strong correlation (r = 0.98 ± 0.1) between the carbohydrate content in 100 rootstock cuttings and the output of grafted saplings from the nursery (figure 4.4). The coefficient of determination, which is 0.96, indicates that approximately 96% of the variations in vines output are explained by changes in carbohydrate content in 100 cuttings, while only 4% are attributed to other factors.

The regression line reveals that a 1g increase in carbohydrate content in 100 cuttings leads to a 0.46% increase in the output of vines from the nursery per hectare. According to the obtained data, carbohydrate content in the range of 150-160 g per 100 cuttings ensures an output of high-quality grafted vine saplings from the nursery within the range of 50-60%.

When grafting on cuttings taken from the base to the top rootstock cane (from 1^{st} to 5^{th}), there is a consistent decrease in the size of the vine saplings growth and the main shoot. The indicators of matured growth, the diameter at the base of the main shoot, total growth volume, matured growth volume, total root count, as well as the number of roots with a diameter > 2mm, all show a decrease.

Thus, the output of vine saplings from the nursery of clone R5 Cabernet Sauvignon onto BxR Kober 5BB and clone R5 Cabernet Sauvignon onto RxR 101-14 is dependent on the position of cuttings along the stock-cane length. Grafting on cuttings from the base-cane zone EG 1, EG 2 (1^{st} to 2^{nd}) significantly increases the output of saplings, their shoot development, and root system compared to grafting on cuttings from the top-cane zone EG 5 (5^{th}).

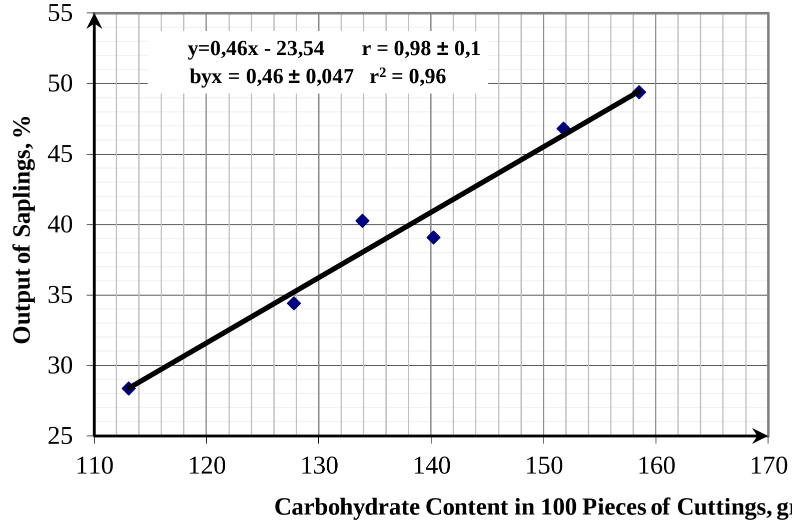


Fig. 4.4. Relationship Between Carbohydrate Content in 100 Pieces of Cuttings BxR Kober 5BB and Output of Grafted Saplings from a Nursery, 2004г.

Our research findings are consistent with the data from L. Kolesnik [205], L. Maltabar [233], and A. Mishurenko [268], who note that the most productive cuttings within a single cane are those taken from the middle and base parts of the cane. Cuttings from the top part, even if they meet the standard requirements and mature normally, exhibit lower survival rates and output vines of somewhat inferior quality compared to cuttings from the base-cane or middle-cane zones.

4.2. The Impact of the Quality of Scion Material and Treatment of Grafted Cuttings with Calovit on the Processes of Regeneration and the Output of Grafted Saplings from the Nursery

4.2.1. Quality of Scion Cuttings and Regeneration of Grafted Vines

From scion canes of clone R5 of the Cabernet Sauvignon variety, single-bud scionwood cuttings were taken and divided into two groups: those with tendrils (well-developed diaphragm) and those without tendrils (insufficiently developed diaphragm). Each of these groups was grafted onto rootstock cuttings of the BxR Kober 5 BB variety. The apical part of the grafted cuttings was treated with a solution of calovit before being subjected to stratification, while in the control groups, water was used for treatment.

We have determined that in bench grafting carried out by a mechanized method using an Omega-wedge, the regeneration processes do not proceed uniformly. The quality of scionwood cuttings (with or without tendrils) as well as treatment with a solution of calovit significantly influence these processes.

According to the data of L. Kolesnik [205, 202], nodes on a grape shoot are characterized by different qualities due to the uneven development of a special tissue called the diaphragm, which cuts through the pith of two adjacent internodes. The diaphragm consists of living parenchyma cells with a high starch content, resembling cells of the pith rays. By autumn, the cell walls with numerous pores thicken and become woody. The diaphragm separates from the pith with several layers of corkified cells, which along with the corkified cells of the pith form a protective tissue. It is directly connected to the bud, which receives the necessary substances for growth under favourable conditions. The appearance of the diaphragm as a storage tissue enhances the vitality of the grapevine plant. The forms of the diaphragm vary among different grapevine species. At nodes where tendrils are present, the diaphragm is usually complete, while at nodes without tendrils, it is better developed on the side of the bud and does not extend to the opposite side (intermittent) (fig. 4.5).

The specific structure of nodes and diaphragms is associated with their role in the life of the grapevine plant. They enhance the stem's strength and reduce its weight, isolate the pith from unfavourable environmental factors, and store nutrients essential for the growth of shoots, leaves, tendrils, and inflorescences that develop at the nodes. Therefore, the highest output of premium grafted vine saplings is achieved when buds with inflorescences or tendrils are used for grafting, as they tend to form better calluses.

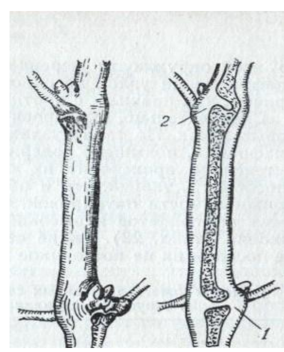


Fig. 4.5. Nodes of Scion Canes [205].
1 – With tendril, with solid diaphragm;
2 – Without tendril, with interrupted diaphragm

It has been established that by the end of stratification in control variants (H_2O), the number of grafted cuttings with a circular callus on the scion is 70.0% and 78.6% on the rootstock and 90.0% and 100.0% respectively, significantly higher in the scions with tendrils variant (tab. 4.5). The application of calovit enhances the callus-forming ability of the grafted components. Active differentiation of xylem vessels occurs in the callus. The number of grafted cuttings with vessels in the callus particularly increases when grafting scions with tendrils, and in the calovit variant, it reaches 100.0%.

According to S. Ungureanu et al. [132], the preparation ensures good callus formation - the formation of compact and uniform callus around the entire perimeter of the grafting area, stimulates the fusion of components, and enhances the growth and maturation of vines.

Table 4.5. The Influence of Different Quality of Scion Cuttings and Treatment with Calovit on Regeneration Processes. End of Stratification. Clone R5 Cabernet Sauvignon onto BxR Kober 5BB, 2004.

Variants	Shoot growth, cm	Number of grafted cuttings, %			Formation of callus, root primordia (r.p.), roots at the stock bottom
		with a circular callus on		with vessels in the callus	
		scion	stock		
without tendrils H_2O	1,5±0,04	70,0	90,0	90,0	r.p., callus, small roots
with tendrils H_2O	1,2±0,03	78,6	100,0	92,9	r.p., callus
without tendrils Calovit	0,9±0,02	85,7	100,0	92,9	abundant r.p.
with tendrils Calovit	1,3±0,03	100,0	100,0	100,0	abundant r.p.

It has been established that Calovit treatment, in addition to enhancing callus formation, leads to the inhibition of budbreaks and shoot growth. In the control variants (H_2O), the percentage of grafted cuttings with unopened eyes is 67.6% and 52.9%, while with calovit treatment, it increases to 85.3% and 60.0% (tab. A 4.4). It is characteristic that the inhibition of budbreaks is more pronounced in variants without tendril scions.

On the bottom of the rootstock cuttings in the control variants, root primordia and callus are formed, while calovit treatment induces the formation of root primordia and small roots.

Thus, the regenerative activity of grafted cuttings (shoot, callus, xylem, and root formation) is influenced by the quality of scion cuttings and significantly increases when using scion cutting with tendril compared to without tendril when using for grafting. Irrespective of scion quality, calovit treatment stimulates regeneration processes.

4.2.2. Survival, Growth, and Development of Grafted Cuttings in the Nursery

We have determined that the survival rate of grafted cuttings in the nursery under control variants is 62.6% and 63.1%, and it is not influenced by the quality of the scion cuttings used in the experiment (fig. 4.6).

When treated with Calovit, the survival rate increases by 8.8% and 19.6%, reaching 71.4% (scion without tendrils) and 82.7% (scion with tendrils), which is presumably attributed to active regeneration of root primordia at the bottom of the rootstock.

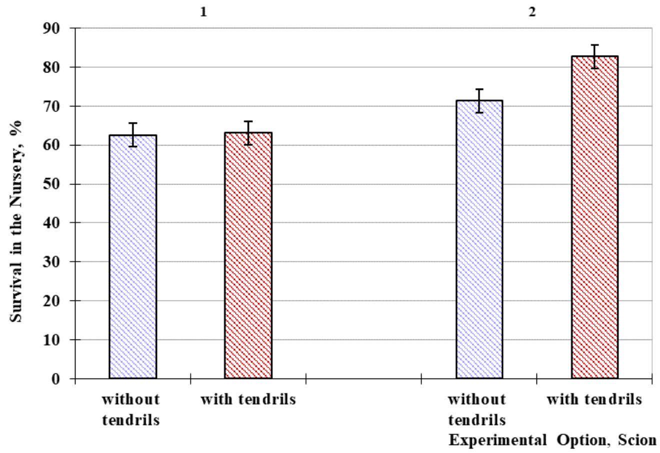


Fig. 4.6. Influence of Scion Cutting Quality and Treatment with Calovit on their Survival in the Nursery. Treatment: 1-Water; 2-Calovit. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB, 2004

Growth is one of the most vivid expressions of the activity of a plant organism. The nature of growth depends on a combination of internal and external factors. Various signs allow us to infer the ongoing processes of growth in a plant, such as an increase in the size of the plant and its individual organs, an increase in the fresh and dry weight of the plant, and others.

Table 4.6. The Influence of Different Quality of Scion Cuttings and Treatment with Calovit on Plant Survival and Growth Parameters. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB, 2004.

Variants	Survival in the nursery, %	Growth length, cm		Growth Volume, cm³	Leaf Surface Area, dm²
		one saplings	including main shoot		
without tendrils H_2O	62,6±1.0	173,0±2.0	49,0±0.9	23,1±0.2	36,4±0.4
with tendrils H_2O	63,1±1.0	194,3±2.0	53,3±1.0	25,7±0.3	39,7±0.5
without tendrils Calovit	71,4±1.1	210,1±2.1	55,3±1.1	26,7±0.3	40,0±0.5
with tendrils Calovit	82,7±1.1	250,3±2.2	65,1±1.1	31,1±0.4	45,0±0.6

We have determined that the growth processes of grafted vine saplings in the nursery vary among different experimental variants (tab. 4.6). For instance, during the period of active shoot growth (23.08), the total Length of Growth for one sapling in the control variants ranges from 173.0 to 194.3 cm, the Growth Volume ranges from 23.05 to 25.68 cm³, and the Leaf Surface Area ranges from 36.4 to 39.7 dm². When treated with calovit, the growth parameters of shoots and Leaf Surface Area significantly increase. In the variant of the scion with tendrils, the length of the main shoot is 65.1 cm, sapling growth measures 250.3 cm, growth volume reaches 31.05 cm³, and Leaf Surface Area extends to 45.0 dm².

4.2.3. The Output of Grafted Saplings from a Nursery and their Quality

The outcome of any agricultural practice in grapevine nursery management is the output of grafted vine saplings from the nursery and their quality.

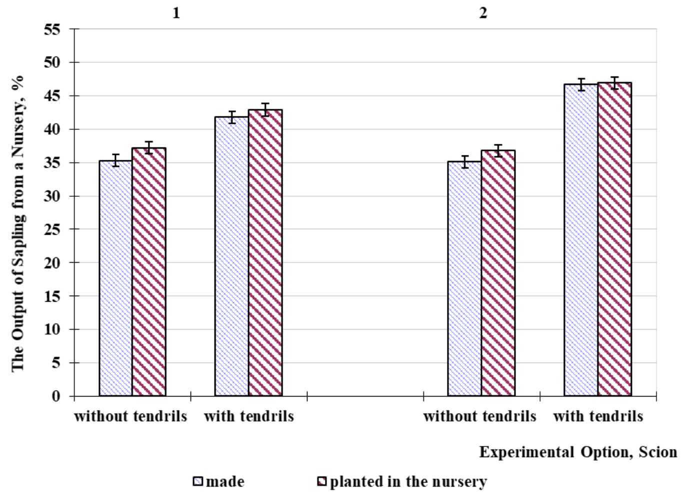


Table 4.7. The Influence of Different Quality of Scion Cuttings and Treatment with Calovit the Output of Saplings from a Nursery. Treatment: 1-Water; 2-Calovit. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB, 2004.

It has been determined by us that in the control variants (H_2O), the sapling output is 35.3% and 41.8% (based on the number of grafts made) and 37.2-42.9% (based on the number planted in the nursery) (fig. 4.7).

A certain regularity is observed, associated with the fact that when using cuttings with tendril, the sapling output increases by 6.5-5.7%. It is noteworthy that with calovit treatment in the without-tendriled graft variant, the vine output remains at the control level (35.1 and 36.8%). At the same time, with calovit treatment grafted cuttings with tendrils, the sapling output increases by 4.0-4.9% (LSD_{05} = 0.90 and 0.88%).

Table 4.7. The Output of Sapling from a Nursery and Their Quality Depending on Different Quality of Scion Cuttings and Treatment with Calovit. Clone R5 Cabernet Sauvignon onto BxR Kober 5BB, 2004.

Variants	**The output of saplings from the number of grafted cutting, %**		**Saplings' Growth Length, cm**		**Saplings' Growth Volume, cm^3**		**Number of roots, pcs**		
	made	**planted in the nursery**	**total**	**ma-tured**	**total**	**ma-tured**	**>2 mm**	**to 2 mm**	**tota l**
without tendrils H_2O	35.3±1.2	37.2±1.2	65.9±1.9	35.0±0.4	5.6±0.1	4.4±0.1	5	4	9
weith tendrils H_2O	41.8±1.2	42.9±1.2	72.4±1.9	41.4±0.4	7.2±0.2	6.6±0.1	5	4	9
without tendrils Calovit	35.1±1.1	36.8±1.2	75.4±1.9	50.0±0.5	8.5±0.2	7.1±0.2	5	4	9
with tendrils Calovit	46.7±1.2	46.9±1.3	94.2±2.0	50.6±0.5	9.2±0.2	7.9±0.2	6	3	9
LSD_{05}	*0,90*	*0,88*							

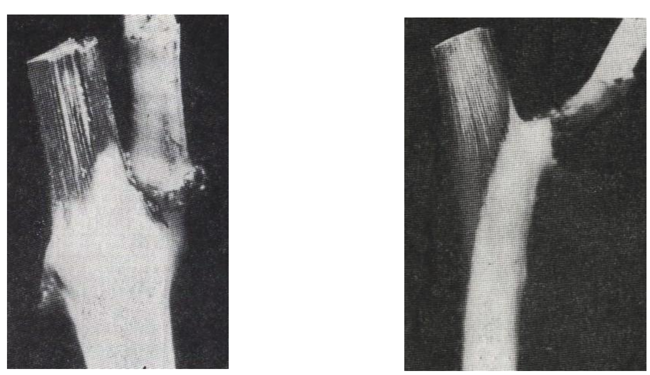
The grafting vine sapling of the researched variants are characterized by varying shoot growth and root system development (tab. 4.7). For instance, when grafting a scion with tendrils, compared to without tendrils an increase in the length and volume of both the total and mature growth of the grafted vine saplings.

Treatment of grafted cuttings with tendril scion with calovit leads to an increase in the growth parameters of grape saplings: the length of sapling growth is 94.2 cm, the main shoot - 50.6 cm; the total volume of growth - 9.2 cm^3, matured - 7.9 cm^3; the total number of roots - 9 pieces, including 6 pieces with diameter > 2 mm. These measurements significantly surpass the growth and root system sizes of saplings from other variants.

Treating grafted cuttings with calovit on the background of hormone-containing paraffin of the Actygref type yields more pronounced positive outcomes, particularly when utilizing high-quality grafting material (scion cuttings with a tendril), which can be capable of withstanding the complex hormonal demands during the regeneration period.

Therefore, the quality of the scion cuttings, and the presence of a node with a fully developed diaphragm, contribute to an increased output of grafted vine saplings from the nursery with fully developed growth and root systems, which subsequently affects their survival, growth, and development as vines in their permanent location.

When characterizing planting material obtained from the use of both with tendrils and without tendrils scion cuttings, an important aspect is the degree of tissue necrosis on the opposite side of the upper budbreaks. This phenomenon, as reported by A. Subbotovich et al. [323] occurs in all methods of vegetative propagation.



a *б*

Fig. 4.8. Degree of tissue die-off in grape saplings (according to A. Subbotovich et al. [323])**:**

a) grafting with tendril scion cuttings;
b) grafting without tendril scion cuttings.

However, if the upper node of the scion cutting or grafts with tendrils, the necrosis of tissues, upon reaching the node, is halted. In the case of without tendrils nodes, the necrosis progresses deeper, sometimes reaching the adjacent node or the point of fusion, which affects the quality of the grafting vine saplings (fig. 4.8).

According to the authors, tendrilled nodes exhibit a more developed diaphragm, increased content of plastidic substances, and more intensive metabolic processes. This enhanced regenerative capacity of tissues ensures a stronger fusion of the grafted components and a higher output of quality vine saplings from the nursery. Such grafted saplings, when planted in their permanent location, exhibit greater vitality, which is supported by the results of our research.

4.3. Conclusions for Chapter 4

1. Throughout the research, the key quality parameters of rootstock and scion canes have been examined, along with their impact on regeneration processes, growth, and development in the nursery, as well as the output and quality of grape-grafted saplings.
2. It has been determined that the morphological and biochemical parameters of grape cuttings collected from rootstock canes before grafting (diameter, dry mass of cuttings, total mass of 100 cuttings, dry matter content, and carbohydrate reserves) exhibit systematic variations depending on their position along the length of the cane (from the base to the top). The most valuable parameters are observed in cuttings collected from the base-cane and middle-cane zones.
3. The influence of the different quality of rootstock cuttings along the length of the cane, scion cuttings, the presence of a node with a developed diaphragm, and the treatment of grafted cuttings with calovit becomes evident in subsequent stages of stratification and nursery cultivation, contributing to an increased output of grape-grafted saplings from the nursery with well-developed shoots and root systems.
4. There is a strong correlation between the quality parameters of the cane, the output of grafted saplings from the nursery, and their quality. These indicators significantly increase when rootstock cuttings from the base and middle zones of the cane EG 1, EG 2, EG 3 (1^{st} to 3^{rd} cuttings) are used for grafting, and they decrease when cuttings are taken from the top-cane zone.
5. To ensure high output and quality of grape-grafted saplings from the nursery, it is advisable to use rootstock cuttings taken from the first two metres of the cane, scion cuttings with tendrils, and also perform pre-stratification treatment of grafted cuttings with a solution of calovit.

5. PRODUCTIVITY OF VINEYARDS DEPENDING ON THE QUALITY OF PLANTING MATERIAL

5.1. Survival Grafted Saplings, Growth, and Development of Young Vines

5.1.1. The Impact of Rootstock Quality on the Survival and Viability of Grafted Vine Saplings in Their Permanent Location

5.1.1.1. Survival Grafted Saplings, Growth, and Development of Young Vines

The grape-grafted saplings of clone R5 Cabernet Sauvignon onto BxR Kobber 5BB and onto RxR 101-14, after being dug up from the nursery, stored in cellars, were planted in their permanent location according to the experimental plots in 2005. At the end of the growing season, the saplings' survival rates were recorded, and the Annual Growth developed on young vines.

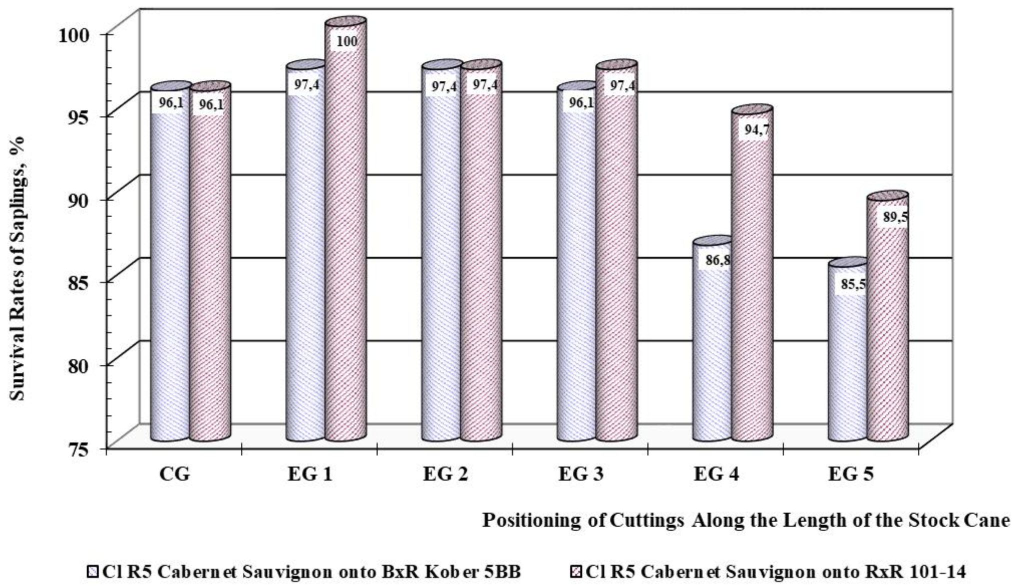


Fig. 5.1. Survival Rates of Grafted Vine Saplings in Permanent Location, Based on Their Quality. First Year After Planting, 2005.

It has been determined that in the control variants of clone R5 Cabernet Sauvignon onto BxR Kobber 5BB and onto RxR 101-14 the survival rate of the grafted saplings is 96.1% (Figure 5.1, Table A 5.1). The quality of the cuttings used for grafting significantly influences the survival rate of the grafted saplings in their permanent location. For instance, in clone R5 Cabernet Sauvignon onto RxR 101-14, when using cuttings from the base of the stock canes EG 1 (1^{st} cutting), the survival rate is 100.0%; for the EG 2 and EG 3 (2^{nd} and 3^{rd} cuttings), it is 97.4%; and for the EG 4 and EG 5 (4^{th} and 5^{th} cuttings), it ranges from 94.7% to 89.5%. In the clone R5 Cabernet Sauvignon onto BxR Kobber 5BB, the survival rate of the grafted saplings is lower compared to RxR 101-14. However, it should be noted that the highest percentage of survival is observed when using the EG 1 and EG 2 (1st and 2nd) cuttings for grafting, as compared to the EG 4 and EG 5 (4th and 5th cuttings).

One of the most significant biological features of the grapevine plant is the growth of its vegetative organs, with the main focus on the shoot. The types of shoots, their quantity, length, and diameter determine the overall plant habit and profoundly influence the course and direction of many physiological and biological processes, as well as the overall condition and productivity. Among the most informative aspects in this regard is the study of biological phenomena such as the growth vigour of primary shoots, the degree of their maturity, and the volume of annual shoot growth.

Table 5.1. Development of Annual Growth of Young Vines, Depending on the Quality of Saplings. First Year After Planting, 2005.

Variants	Growth Length				Growth Volume, cm^3		
	Vine, cm		Main Shoot Length, cm				
	total	matured	total	matured	total	matured	% matured
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB							
CG	289.7±3.8	138.1±2.7	83.8±2.0	47.8±1.3	49.4±1.9	31.1±0.3	63.0±1.0
EG 1	397.8±4.0	232.8±2.9	99.7±2.0	55.1±1.2	62.6±1.9	47.0±0.4	75.1±1.1
EG 2	342.0±4.0	147.8±2.9	90.0±2.0	49.2±1.2	52.1±1.9	35.5±0.3	68.1±1.1
EG 3	279.0±3.8	108.0±2.7	85.0±1.9	45.4±1.0	48.2±1.8	31.4±0.3	65.2±1.0
EG 4	222.8±3.3	102.0±2.2	72.4±1.8	44.8±1.0	34.7±1.5	22.7±0.2	65.5±1.0
EG 5	207.0±3.2	99.8±2.2	72.0±1.8	44.6±1.0	26.9±1.5	18.3±0.2	68.1±1.0
LSD_{05}					*2.51*	*2.20*	
Cl R5 Cabernet Sauvignon onto RxR 101-14							
CG	386.2±3.8	186.1±2.8	97.0±2.1	57.2±1.2	55.7±2.0	42.2±0.4	75.8±1.0
EG 1	523.4±4.1	237.8±3.3	114.0±2.2	68.4±1.3	78.7±2.2	57.1±0.5	72.6±1.1
EG 2	435.8±3.9	212.7±2.9	109.6±2.2	63.6±1.3	70.4±2.2	50.0±0.5	71.0±1.1
EG 3	376.4±3.8	210.0±2.9	94.3±2.1	62.7±1.2	57.4±2.1	48.6±0.4	84.6±1.1
EG 4	328.4±3.5	141.9±2.7	90.4±2.0	45.8±1.0	41.7±1.5	28.3±0.2	67.8±1.0
EG 5	266.8±3.3	130.0±2.2	76.9±2.0	45.6±1.0	30.1±1.5	25.1±0.2	83.4±1.0
LSD_{05}					*2.94*	*2.34*	

Annual (one-year) grape shoots are a crucial organ. Leaves, the plant's primary photosynthetic apparatus, and clusters, the main product for which grapes are cultivated, are formed on them. The essential plastic substances for nourishment and differentiation of generative organs accumulate in one-year shoots. The degree of development of Annual shoots determines frost and winter hardiness, as well as the overall longevity of the grapevine plant.

We have determined that the development of annual growth of grafted grapevines in the first year after planting, at the end of the vegetative period, significantly varies depending on the quality of stock cuttings used for grafting and their positioning along the length of the cane (tab. 5.1).

Thus, for young vines of clone R5 Cabernet Sauvignon onto RxR 101-14, cultivated from saplings obtained by using grafting cuttings of the rootstock from the base of the cane (1-2nd cuttings) the growth parameters are as follows: the total length of shoot growth in the vines is 523.4 and 435.8 cm; the length of matured growth is 237.8 and 212.7 cm; the length of the main shoot is 114.0 and 109.6 cm; the dimensions of matured growth of the main shoot are 68.4 and 63.6 cm; the diameter at the base of the main shoot is 1.72 and 1.51 cm; the total volume of shoot growth in the vines is 78.66 and 70.44 cm^3, including matured growth is 57.14 and 49.98 cm^3. These parameters are 1.5–2.6 times higher than the growth parameters of vines grafted onto cuttings from the top-cane stock zone. It should be noted that the grapevines' annual growth for the clone R5 Cabernet Sauvignon grafted onto BxR Kober 5BB at the end of the vegetation period is lower compared to the grafting onto the rootstock variety RxR 101-14. However, there is an observed pattern of decreasing growth indicators when using cuttings from the base of the stock cane to its top for grafting. The vines of clone R5 Cabernet Sauvignon onto BxR Kober 5BB, grown from saplings created by grafting rootstock cuttings from the cane's base (1-2nd cuttings) the total length of shoot growth in the vines is 397.8 and 342.0 cm; the length of matured growth is 332.8 and 147.8 cm; the length of the main shoot is 99.7 and 90.0 cm; the dimensions of matured growth of the main shoot are 55.1 and 49.2 cm; the diameter at the base of the main shoot is 1.30 and 1.24 cm; the total volume of shoot growth in the vines is 62.58 and 52.14 cm^3, including matured growth is 49.98 and 35.50 cm^3. These values considerably outperform the growth parameters of vines grafted onto cuttings from the top zone of the stock cane (4th-5th cuttings).

Considering the shoot as a biological unit, it is essential not to view and evaluate its vitality and functions in isolation from the grapevine as a holistic organism. Its autonomy cannot be absolutized since, being an integral part of it, the shoot actively interacts with other organs and is closely linked to all physiological and biochemical processes occurring within it.

The vitality of the shoot largely depends on the amount of perennial wood in the grapevine, which serves as an organ containing a substantial reserve of endogenous nutrients supplied to the shoot. The presence of perennial wood within the structure of the grapevine contributes to increased fruiting and fruitfulness coefficients of the shoot, leading to larger cluster masses. The more vigorous development of the above-ground part of the grapevine plant, due to a direct correlation between above-ground mass and underground root system development, enhances the overall vitality of the grapevine and counteracts adverse abiotic factors such as drought and low winter temperatures, as well as biotic factors like phylloxera.

We have determined that the different quality of saplings, depending on the position of the cuttings along the length of the stock-cane, exerts a systematic influence on the accumulation of perennial wood and the volumetric mass of the above-ground part of the vine (Table 5.2).

Table 5.2. Development of the Above-Ground Part of Young Vines, Depending on the Quality of Saplings. Third Year After Planting, 2007.

Variants	Perennial Wood Volume, cm^3	Annual Growth Volume, cm^3			Volume Mass of the Above-Ground Part of the Vine	
		total	matured	% matured	cm^3	% of control
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB						
CG	442.6±5.0	130.6±3.1	109.9±2.1	84.2±2.1	573.1±5.5	100.0
EG 1	581.0±5.2	214.9±3.3	171.4±2.2	79.8±2.0	795.9±5.5	138.9
EG 2	513.8±5.2	179.1±3.2	153.7±2.2	85.8±2.1	693.0±5.6	120.9
EG 3	467.1±5.1	125.2±3.1	107.5±2.1	85.9±2.1	592.2±5.5	103.3
EG 4	300.2±5.1	75.0±2.8	69.9±2.0	93.2±2.2	375.2±5.4	65.5
EG 5	259.9±5.0	68.5±2.5	56.5±1.8	82.6±2.0	328.4±5.4	57.3
LSD_{05}					*24.87*	
Cl R5 Cabernet Sauvignon onto RxR 101-14						
CG	446.7±5.0	136.9±3.2	121.6±2.1	88.8±2.0	583.5±5.6	100.0
EG 1	580.7±5.3	180.2±3.1	170.4±2.2	94.6±2.3	760.9±5.6	130.4
EG 2	504.2±5.2	166.2±3.1	148.7±2.2	89.5±2.2	670.4±5.6	114.9
EG 3	457.7±5.2	153.1±3.0	130.2±2.1	85.0±2.1	610.8±5.5	104.5
EG 4	310.8±5.0	102.6±3.0	86.8±2.0	84.6±2.1	413.3±5.4	70.8
EG 5	229.8±5.0	72.1±2.8	66.2±2.0	92.6±2.0	301.9±5.3	51.7
LSD_{05}					*22.08*	

When grafting onto cuttings from the base and middle of the stock cane, there is an increase in the volume of perennial wood and annual growth, as well as the volumetric mass of the above-ground part of the vine.

Therefore, regardless of the rootstock variety, the survival, growth, and development of the young vines in their permanent location increases when grafted with cuttings from the base and middle zones of the stock-cane (1st to 3rd cuttings). At the same time, the length of growth of vines and main shoots increases, as well as the volume of total and mature growth by 1.5-2.0 times, compared with grafting on cuttings from the top-cane zone of the stock. Vines grown from saplings obtained by using 1-2 cuttings for grafting in the third year after planting are characterised by the more powerful development of annual shoots and the accumulation of perennial wood, which is important in the formation of the shape establishment.

In our research, by the third year established, in the spring, after pruning, vines characterised by vigorous growth (vigorous vines) were trained to have well-developed two trunks and two cordons. On vines with moderate growth (medium vines), one to two trunks and one developed cordon were successfully formed. On vines with the weakest growth (weak vines), only one trunk was formed.

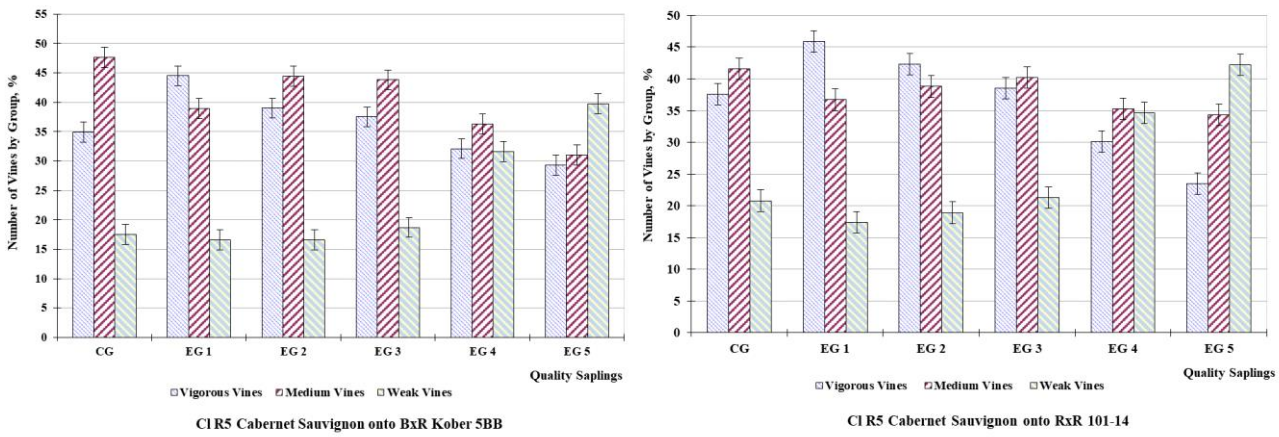


Fig. 5.2. The Impact of Different Quality Saplings on the Degree of Young Vines Development. Third Year After Planting, 2007.

We have determined that the distribution of vines among these groups varies in different experimental variants (fig. 5.2, tab. A 5.2). In the control group (CG), the number of vigorous vines for the clone R5 Cabernet Sauvignon onto the BxR 5BB and onto RxR 101-14 rootstocks is 34.9% and 37.6%, respectively, while the number of medium bushes is 47.6% and 41.6%, and weak vines constitute 17.5% and 20.8%, respectively. It is notable that when grafting onto cuttings from the base-cane of the stock 1st-2nd cuttings (EG 1, EG 2), the number of vigorous vines increases by 1.7–2.1 times and the number of weak vines decreases.

Under favourable growth and development conditions of plants with vigour growth, the formation of the vines' shape can generally be established within four years [215]. On grapevine bushes characterised by vigorous growth of main shoots and lateral shoots, as well as heightened physiological activity of the leaf apparatus and successful cane maturation, with rational utilisation of these traits, it is possible to expedite the formation of the appropriate shape and ensure a faster initiation of fruiting.

In the fourth year of planting, after pruning, the formation of shape parts on many vines was completed. In the control variants, the number of fully formed grape vines was 56.2% (clone R5

Cabernet-Sauvignon onto BxR Kober 5BB) and 55.3% (clone R5 Cabernet-Sauvignon onto RxR 101-14) (fig. 5.4, tab. A 5.3). It should be noted that when grafted onto BxR Kober 5BB, the number of fully formed grape vines compared to RxR 101–14 increases by 5.9–6.2% when cuttings from the base of the stock cane 1st-2nd cuttings (EG 1, EG 2) are used.

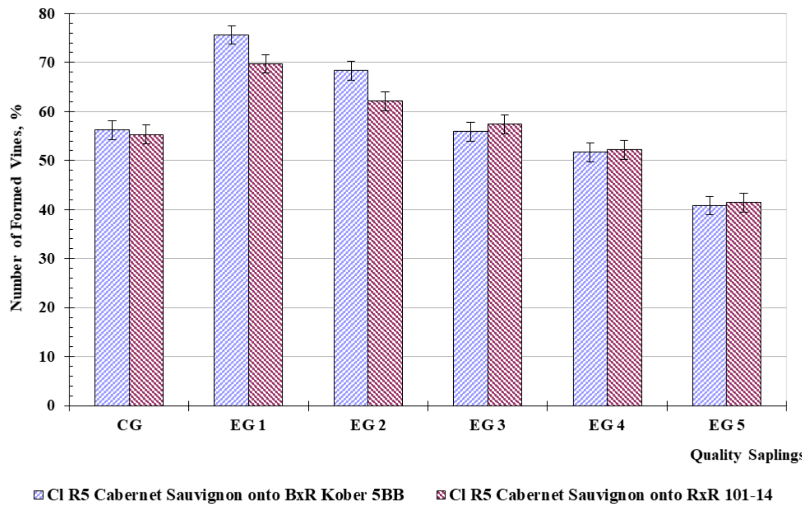


Fig. 5.3. The Impact of Grafted Saplings Quality on Formed Degree of Grapevine. Fourth Year of Planting, 2008.

The previously identified pattern of decreasing the number of fully formed grape vines when using saplings grown from cutting collected the base of the rootstock to the top is maintained. Thus, in clone R5 Cabernet-Sauvignon onto RxR 101-14, when grafting onto cuttings from the base of the stock cane EG 1 (1st cutting), the number of fully formed vines is 69.7%; from the middle of the stock cane EG 3 (3rd cutting) - 57.4% and the top-cane zone EG 5 (5th cutting) - 41.4%. In the clone R5 Cabernet-Sauvignon onto BxR Kober 5BB, these indicators are 75.6%; 55.9% and 40.8%, respectively.

5.1.1.2. Elements of Productivity and Yield of Young Vines

The most important criterion for characterising individual varieties, agronomic practices, vines, and plantations is productivity – the ability to produce a specific biological (biological productivity) and economic (economic productivity) yield.

Economic productivity (yield) is the weight of the grape harvest per unit area of the plantation or per vine. The economic productivity of a vineyard (yield) is composed of the total economic productivity of its individual vines and can be potential, embryonic, or actual.

Potential yield refers to the harvest that can be obtained from a plant under ideal conditions based on the 100% fruitfulness of overwintering buds.

Embryonic yield is calculated based on the study of embryonic fruitfulness (the number of primordial flower clusters on the overwintering bud) and their development during the dormant period.

The actual yield of vines and the yield of vineyards are generally lower than embryonic and even more so at potential levels. The yield of a grapevine and the yield of a vineyard are composed of a series of structural elements - indicators of productivity, based on the analysis of which opportunities for targeted regulation of productivity and quality are created. These include the number of shoots per vine and per unit area, the percentage of fruitful shoots, fruitfulness and productivity coefficients, and cluster weight. Due to the fact that grape yield is formed only on shoots developing on the vines in the current year, their quantity per vine and per unit area will determine the productivity of the grapevine and the plantation [314].

A. Amirdjanov [154], based on in-depth comprehensive analyses and generalisation of literature, as well as the results of his own research, showed that the shoot should be considered as a biological unit of grapevine plantation agrocenosis. As the main organ, the shoot actively participates in the creation of yield, and characterises the productivity index, depending on the influence of environmental factors and technological methods that determine the yield of grapevine plantations.

It has been established by us that in the third year after planting, the number of developed annual shoots on young vines of the R5 Cabernet Sauvignon clone varies, depending on the experimental variants, from 12.3±0.3 to 21.2±0.4 shoots per vine (onto BxR Kober 5BB) and from 11.0±0.2 to 15.6±0.4 shoots per vine (onto RxR 101-14) (tab. 5.3). The percentage of fruitful shoots ranges from 63.4% to 81.0% for BxR Kober 5BB and from 71.9% to 77.3% for grafting onto RxR 101-14, increasing when using cuttings from the base of the stock cane EG 1 – EG 3 (1^{st}-3^{rd} cuttings).

In the control variants, the number of flower clusters for the clone R5 Cabernet Sauvignon grafted onto BxR Kober 5BB is 20.8 per vine and for RxR 101-14, it is 16.9.

In terms of time, embryonic flower clusters laid in the bud of a wintering eye in the year preceding its formation, and their pre-formation continues in the early spring period of the next year. The growth and development of flower clusters occur in the phases of bud (eye) opening and shoot growth. Naturally, the potential yield is influenced by the number of embryonic flower clusters and the conditions of their formation, including the level of nutrients supplied from the shoot, the timing of bud initiation, and the biological characteristics of the variety. When grafting onto cuttings from the base of stock cane, regardless of the rootstock variety, the number of flower clusters increases by 1.1-1.2 times.

Table 5.3. The Impact of Grafted Sapling Quality on the Development of Productivity Elements in Young Vines. Third Year of Planting, 2007.

Variants	No. of Shoots, pcs./vine		Fruiting Shoots, %	No. of Flower Clusters, pcs./vine	Coefficients	
	total	with flower clusters			K_1	K_2
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB						
CG	16.2±0.3	11.4±0.2	70.4±1.1	20.8±0.2	1.28±0.02	1.82±0.05
EG 1	21.2±0.4	16.0±0.3	75.5±1.4	25.2±0.3	1.19±0.02	1.58±0.04
EG 2	19.8±0.4	16.0±0.3	81.0±1.4	23.3±0.3	1.18±0.02	1.46±0.04
EG 3	16.3±0.4	12.3±0.2	75.5±1.4	19.7±0.2	1.21±0.02	1.60±0.04
EG 4	12.3±0.3	9.0±0.1	73.5±1.3	15.0±0.1	1.22±0.02	1.67±0.04
EG 5	13.7±0.3	8.7±0.1	63.4±1.1	12.0±0.1	0.88±0.01	1.38±0.03
Cl R5 Cabernet Sauvignon onto RxR 101-14						
CG	13.5±0.3	9.7±0.1	71.9±1.2	16.9±0.2	1.25±0.02	1.74±0.05
EG 1	14.7±0.4	11.3±0.3	77.3±1.4	20.3±0.3	1.38±0.02	1.80±0.06
EG 2	15.6±0.4	11.5±0.3	73.7±1.3	18.4±0.3	1.18±0.01	1.60±0.04
EG 3	14.3±0.4	10.5±0.3	73.4±1.3	17.0±0.2	1.19±0.01	1.62±0.04
EG 4	12.0±0.3	8.7±0.1	72.5±1.3	15.5±0.1	1.29±0.02	1.78±0.05
EG 5	11.0±0.2	8.0±0.1	72.7±1.2	15.0±0.1	1.36±0.04	1.88±0.06

K_1 *– fruiting coefficient*
K_2 *– fruitfulness coefficient*

The coefficients of fruiting and fruitfulness vary slightly and amount to 1.2-1.3 and 1.4-1.8 for clone R5 Cabernet Sauvignon onto BxR Kober 5BB; onto RxR101-14, they are 1.2-1.4 and 1.6-1.9, respectively. According to K. Smirnov et al. [315] fruitfulness indicators are primarily determined by the biological characteristics of the variety but can also vary depending on environmental and weather conditions, the reserved of shoots on the vines, and the agrotechnical measures applied in the plantations.

The outcome determining the feasibility of cultivating a particular variety is its productivity. The yield magnitude represents a comprehensive expression of a range of biological, ecological, and anthropogenic (technological) indicators. From the time of buds set in the overwintering buds in the form of embryonic flower clusters to the grape harvest, more than a year passes, and during this period, the generative organs of the grapevine are subjected to the influence of a multitude of diverse factors [314].

On young vines in the third year of planting in the control variants, the number of grape clusters for clone R5 Cabernet-Sauvignon onto BxR Kober 5BB is 18.8 clusters per vine and onto RxR 101-14 is 15.5 clusters per vine (Table 5.4). It is noteworthy that when using cuttings from the base of the stock cane to the top (from 1st to 5th cuttings) for grafting, the number of clusters decreases for clone R5 Cabernet-Sauvignon onto BxR Kober 5BB from 23.5 to 11.5 clusters per vine and for RxR 101-14 from 17.5 to 13.5 clusters per vine. The mean cluster weight varies slightly, ranging from 85 to 91 grams (onto BxR Kober 5BB) and from 82 to 96 grams (onto RxR 101-14).

Table 5.4. Yield Indicators and Harvest Quality of Young Vines Depending on the Quality of Saplings. Third Year of Planting, 2008.

Variants	No. of Clusters pcs./vine	Weight of Clusters, g	Yield		Mass concentration, g/dm³	
			kg/vine	% to controll	sugars	titratable acids
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB						
CG	18.8±0.2	90±2.2	1.69±0.02	100	214±2	6.9±0.02
EG 1	23.5±0.4	85±2.1	2.00±0.03	118.3	250±3	7.4±0.03
EG 2	22.6±0.4	86±2.1	1.94±0.03	114.6	254±3	7.4±0.03
EG 3	18.5±0.3	90±2.2	1.67±0.02	98.8	233±2	7.5±0.03
EG 4	14.7±0.2	90±2.1	1.32±0.02	78	223±2	6.7±0.02
EG 5	11.5±0.1	91±2.2	1.05±0.02	62.2	228±2	6.6±0.02
LSD₀₅			*0.07*			
Cl R5 Cabernet Sauvignon onto RxR 101-14						
CG	15.5±0.2	89±2.0	1.38±0.02	100	235±3	6.8±0.03
EG 1	17.5±0.3	96±2.2	1.68±0.03	121.5	230±2	7.0±0.03
EG 2	16.0±0.3	97±2.2	1.55±0.03	112.2	238±2	7.0±0.03
EG 3	16.5±0.2	90±2.1	1.49±0.02	107.8	231±2	6.2±0.02
EG 4	13.8±0.1	90±2.1	1.24±0.02	89.9	239±3	6.5±0.02
EG 5	13.5±0.1	82±2.0	1.11±0.01	80.3	250±3	6.8±0.02
LSD₀₅			*0.08*			

For Grapevines of the R5 clone of Cabernet Sauvignon grafted onto BxR Kober 5BB rootstock, compared to those grafted onto RxR 101-14 rootstock, the yield increases regardless of the experimental variants (tab. 5.4, fig. 5.5). In the control variant, the yield is 1.69 kg/vine, while when grafted with cuttings from the base of the stock cane (1st and 2nd cuttings), it reaches 2.0 and 1.94 kg/vine, respectively, showing an increase of 18.3% to 14.8% compared to the control. When grafted with cuttings from the middle (3rd cutting) and top zones (4th and 5th cuttings) of the stock cane, the yield remains at the control level or decreases. The mass concentration of sugars in the control variant is 224 g/dm³, with titratable acidity at 6.9 g/dm³. When grafted with cuttings from the base and middle zones of the stock cane, these indicators increase by 11-26 g/dm³ and 0.5-0.6 g/dm³, respectively.

The yield of the young grapevines in the control variant clone R5 Cabernet Sauvignon grafted onto RxR 101-14 is 1.38 kg. When using cuttings from the base and middle of the stock canes EG 1-EG 3 (1^{st}-3^{rd} cuttings) for grafting, the yield increases by 21.5-7.8%, respectively. A decrease in yield of 10.1-19.7%, compared to the control, is observed when using cuttings from the top zone of the stock cane EG 4 – EG 5 (4^{th}-5^{th} cuttings) for grafting (LSD_{05} = 0.08). The mass concentration of sugars and titratable acidity in the grape berries changes insignificantly and amounts to 230-250 g/dm^3 and 6.2-7.0 g/dm^3.

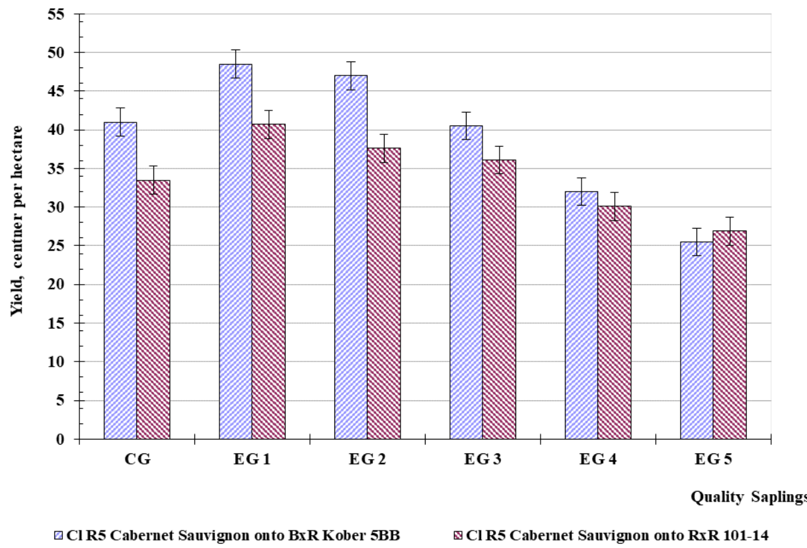


Fig. 5.4. Yield of Young Vineyard Depending on the Quality of Grafted Saplings, centner per hectare. Third Year of Planting, 2007.

It should be noted that Cabernet Sauvignon belongs to the Western European ecogeographical group of varieties, characterised by moderate vigour. The vine can develop from 8 to 30 shoots, the majority of which (80-90%) are fruiting. Each shoot bears 2-3 or more clusters. The average cluster weight, the most consistent indicator, is 70-80g, although, in dry years, clusters tend to be smaller than in wet years, resulting in reduced cluster weight [313]. The R5 clone of Cabernet Sauvignon, according to M. Cuharschi et al. [36] is classified among clones with increased yield potential (12 tons per hectare) and berry juice sugar content.

In the fourth year after planting, 60-80% of the vines of this clone were fully formed. On average, each of them developed 35-38 shoots and 42.9-57.9 clusters (tab. A 5.4, tab. 5.5, fig. 5.6). Compared to the third year, the number of clusters increased 2.7-3.1 times, depending on the experimental variants. At the same time, the average cluster weight decreased by 1.6-1.7 times, reaching 53-59 gram for the clone R5 Cabernet Sauvignon grafted onto BxR Kober 5BB and 50-58 g onto RxR 101-14.

Table 5.5. Yield Indicators and Harvest Quality of Young Vines Depending on the Quality of Saplings. Fourth Year of Planting, 2008.

Variants	No. of Clusters pcs./vine	Weight of Clusters, g	Yield		Mass concentration, g/dm^3	
			kg/vine	% to controll	sugars	titratable acids
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB						
CG	50.9±0.26	57±2.1	2.90±0.04	100	185±2	6.5±0.03
EG 1	57.9±0.32	59±2.2	3.42±0.04	117.9	190±2	6.4±0.03
EG 2	57.0±0.45	54±2.2	3.08±0.04	106.3	194±3	6.5±0.03
EG 3	56.1±0.24	53±2.1	2.97±0.03	102.4	180±2	6.5±0.03
EG 4	50.9±0.22	55±2.1	2.80±0.03	96.6	180±2	6.6±0.03
EG 5	42.9±0.21	58±2.2	2.49±0.03	85.9	172±2	6.7±0.03
LSD_{05}			*0.10*			
Cl R5 Cabernet Sauvignon onto RxR 101-14						
CG	46.1±0.08	55±2.2	2.53±0.04	100	202±3	6.3±0.01
EG 1	53.0±0.20	58±2.2	3.07±0.04	121.4	189±2	6.4±0.02
EG 2	51.9±0.20	55±2.2	2.86±0.04	113.1	200±3	6.2±0.01
EG 3	47.9±0.14	54±2.1	2.59±0.04	102.4	205±3	6.4±0.02
EG 4	45.1±0.11	52±2.1	2.34±0.03	92.5	192±2	6.3±0.02
EG 5	45.0±0.18	50±2.1	2.25±0.03	88.9	214±3	6.2±0.01
LSD_{05}			*0.20*			

The yield grapevines of clone R5 Cabernet Sauvignon onto BxR Kober 5BB is 2.49-3.42 kg per vine, vineyards 6.04-8.29 tons per hectare; when grafted onto RxR 101-14, it amounts to 2.25-3.07 kg per vine and 5.45-7.44 tons per hectare. There is a significant increase in yield in cases of grafting from the base and middle of the stock cane EG 1 – EG 3 (1st to 3rd cuttings). It should be noted that the mass concentration of sugars increases with grafting onto RxR 101-14 (189-214 g/dm^3) compared to grafting onto BxR Kober 5BB (180-194 g/dm^3), while the acidity of the berry juice, regardless of the rootstock, remains at a level of 6.2-6.6 g/dm^3.

Therefore, the morphological and biochemical parameters of grapevine cuttings, cut from stock canes before grafting (diameter, dry weight of cuttings, total weight of 100 cuttings, dry matter content, and carbohydrate reserves), consistently vary depending on their position along the length of the stock cane (from the base to the top). The most valuable parameters are exhibited by cuttings taken from the base and middle of the stock cane.

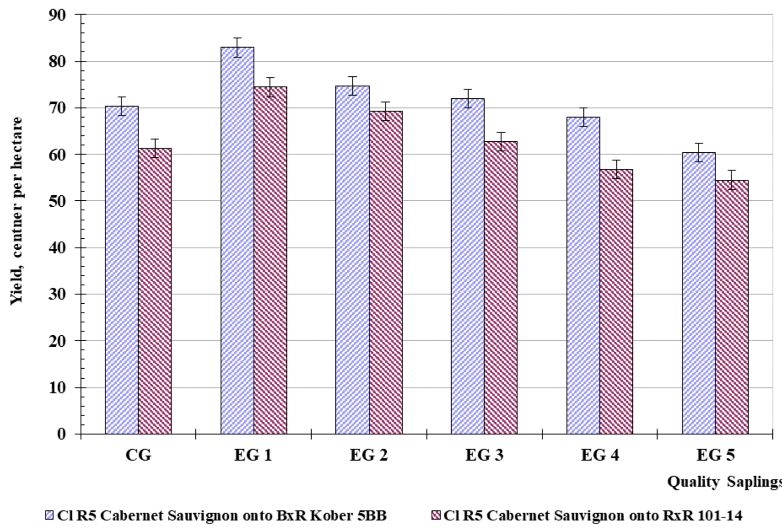


Fig. 5.5. Yield of Young Vineyard Depending on the Quality of Grafted Saplings, tons per hectare. Fourth Year After Planting, 2008.

The influence of the different quality of rootstock cuttings along the length of the stock cane is manifested during the stages of stratification, nursery cultivation of vines, and after their planting in the permanent location. Moreover, a strong correlation exists between stock cutting quality parameters, the success rate of grafted vines emerging from the nursery, their quality, survival upon transplantation, and the growth of young grapevines [17].

It has been that the growth and development of clone R5 Cabernet Sauvignon grapevines, their entry into fruiting, and productivity are influenced by the rootstock variety as well as the different quality of the planting stock. For this clone, the onset of fruiting in the vines is observed in the third to fourth year after planting, during the period of shape-establishment. In the fourth year, the plantation yield of clone R5 Cabernet Sauvignon onto BxR Kober 5BB depending on the experimental variations ranges from 60.4 to 82.9 centner per hectare; onto RxR 101-14 - from 5.45 to 7.44 tons per hectare, and significantly increases when planting vines obtained using cuttings from the base-cane and middle-cane of the stock (1^{st}-3^{rd} cuttings) (fig. 5.5).

We believe that to ensure high output and quality of grafted vines from the nursery, a hundred per cent survival rate upon plantation to their permanent location, as well as vigorous development of young vines and their early entry into fruiting period, it is advisable to use rootstock cuttings taken from the first two metres of the stock cane from the base for grafting.

5.1.2. The Impact of Scion Quality and Calovit on the Survival Rate and Viability of Grafted Vine Saplings in Their Permanent Location

5.1.2.1. Survival Grafted Saplings, Growth, and Development of Young Vines

Grafted grapevines of the clone R5 of Cabernet Sauvignon onto BxR Kober 5BB, obtained using heterogeneous scion grafting material, were planted in their permanent location after storage according to the experimental scheme in 2005.

It has been established that the survival rate of vines with a tendrilless scion is 93.4%, and with a tendril - 96.1% (fig. 5.6).

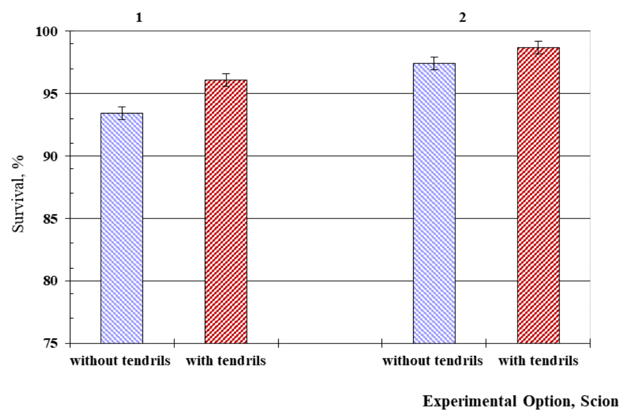


Fig. 5.6. Survival Rates of Grafted Vine Saplings in Permanent Location, Based on Their Quality. Treatment: 1-Water; 2-Calovit. First Year After Planting.

The use of scion with tendrils and subsequent pre-stratification treatment with a solution of calovit leads to increased regeneration processes, increased output of well-developed grafted vines with vigorous growth and root systems, as well as increased their survival rate in a permanent location.

Planted grafted saplings with a more branched and developed root system are provided with better nutrition and water supply during the period of their growth in a permanent place, which further affects the growth, health and resistance of grape plants to stressful conditions. This contributes to a more successful adaptation of plants to new conditions and provides for more effective development of vines.

We have determined that the development of annual growth of young vines, particularly the indicators of linear and volumetric growth, as well as the degree of its maturation in the first year after planting, significantly varies depending on the experience options (tab. 5.6). For instance, in the case of the clone R5 Cabernet Sauvignon variety onto BxR Kober 5BB, in the control variant (scion without tendril), the total length of the growth of the vines is 217.8±3.3 cm, including the main shoot length of 78.7±2.0 cm, the dimensions of the matured growth are 125.3±2.7 cm and 47.5±1.5 cm, and the total growth volume of the vine's is 23.5±1.4 cm^3 and matured 20.3±0.2 cm^3, respectively.

Table 5.6. Development of Annual Growth of Young Vines, Depending on the Quality of Saplings. First Year After Planting. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB, 2005.

Variants	Growth Length				Growth Volume, cm^3		
	Vine, cm		Main Shoot Length, cm				
	total	matured	total	matured	total	matured	% matured
without tendrils H_2O	217.8±3.3	125.3±2.7	78.7±2.0	47.5±1.5	23.5±1.4	20.3±0.2	86.2±1.3
with tendrils H_2O	257.0±3.4	147.7±2.9	90.5±2.1	58.0±1.6	34.8±1.5	27.2±0.3	78.4±1.2
without tendrils Calovit	224.3±3.3	129.3±2.7	79.0±2.0	52.5±1.5	27.6±1.4	23.6±0.3	85.5±1.3
with tendrils Calovit	281.3±3.5	155.7±2.8	100.0±2.2	74.3±1.7	42.8±1.6	33.1±0.4	77.4±1.2
LSD_{05}	*8.74*	*7.04*	*4.27*	*2.49*	*2.92*	*1.73*	

When vines with tendril scion are used as planting material, as compared to those without tendril, the growth parameters of vines increase by 1.2-1.5 times, especially in the variant with the use of calovit.

Monitoring the growth and development processes of young vines has been carried out by us, both in the immediate term and subsequently. This consistent dataset allowed us to pinpoint the dynamics of their changes with greater accuracy. This ongoing data compilation enabled us to identify the key factors influencing plant development, thus enabling us to make more informed decisions in the realm of agronomy and grapevine care.

Table 5.7. Development of the Above-Ground Part of Young Vines, Depending on the Quality of Saplings. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB. Third Year After Planting, 2007.

Variants	Perennial Wood Volume, cm^3	Annual Growth Volume, cm^3			Volume Mass of the Above-Ground Part of the Vine	
		total	matured	% matured	cm^3	% of control
without tendrils H_2O	350.0±5.1	76.7±2.8	58.9±2.0	76.8±2.1	426.6±5.5	100.0
with tendrils H_2O	406.1±5.2	113.3±3.1	92.6±2.1	81.8±2.1	519.3±5.6	121.7
without tendrils Calovit	352.6±5.1	83.4±2.9	66.9±2.0	80.2±2.1	436.0±5.5	102.2
with tendrils Calovit	557.7±5.2	165.5±3.2	139.2±2.2	84.1±2.1	723.2±5.6	169.5
LSD_{05}					*26.31*	

The significant increase in vines' vigour growth in the third year of vegetation is linked to the plants' preparation for entering the fruit-bearing stage. We have established that the different quality of vines, depending on the scion material and treatment with calovit solution, exerts a consistent influence on the above-ground growth part of the vines (tab. 5.7).

Vine grown from saplings obtained using scions with tendrils are characterised by a more vigorous development of perennial wood, which is crucial in forming the vine's shape.

In the third year after planting in the control variant scion with tendrils the volume of perennial wood is 406.1±5.2 cm^3 when using calovit solution - 557.7±5.2 cm^3, which is 1.2-1.4 times higher than in variants scion without tendrils.

A similar regularity is observed in the development of annual growth of bushes. As a result, in variants scion with tendrils the volumetric mass of the above-ground part of bushes increases by 21.7 (Control) and 69.5% (Calovit).

Thus, by the third year after planting, the grapevine bushes exhibit heterogeneity in terms of growth strength, annual growth development, and perennial wood, which exerts a consistent influence on the formation of the vine shape.

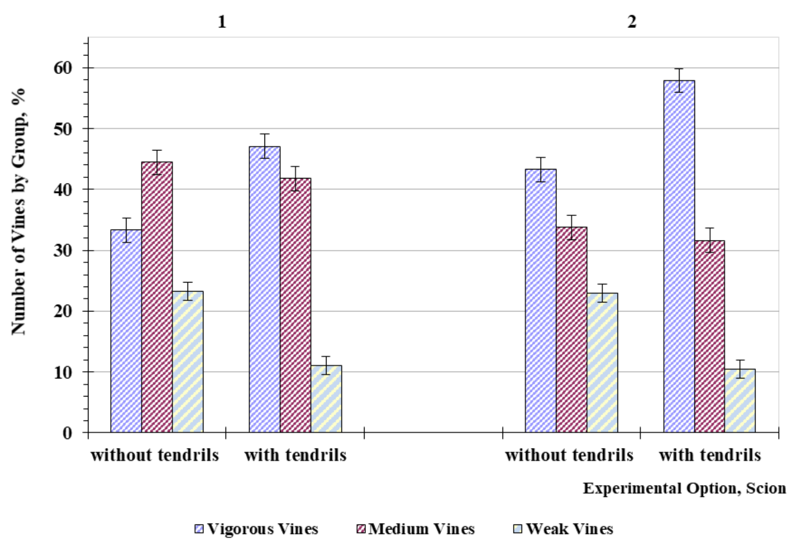


Fig. 5.7. The Impact of Different Quality Saplings on the Degree of Young Vines Development. Treatment: 1-H_2O; 2-Calovit. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB. Third Year After Planting, 2007.

As a result, after pruning, the vines characterised by vigorous growth (vigorous vines) were shaped into two trunks and two well-developed arms. On vines with moderate growth strength (medium vines), one to two trunks and one developed arm was successfully formed. Among vines with the lowest growth strength (weak vines), only one trunk was formed. The distribution of vines among these groups in different variants of the experiment varies (fig. 5.7).

So, in the control variant scion without tendrils, the number of vigorous vines for clone R5 Cabernet Sauvignon variety onto BxR Kober 5BB is 33.3%; medium - 44.5%, and weak - 23.2%. In the variant scion with tendrils, these numbers are 47.1%, 41.8%, and 11.1%, respectively. Interestingly, the number of strong bushes increases by 1.4 times, and the quantity of weak bushes decreases. In the variant using scion with tendrils and calovit, the percentage of strong vines is 57.9%, medium - 31.6%, and weak - 10.5%.

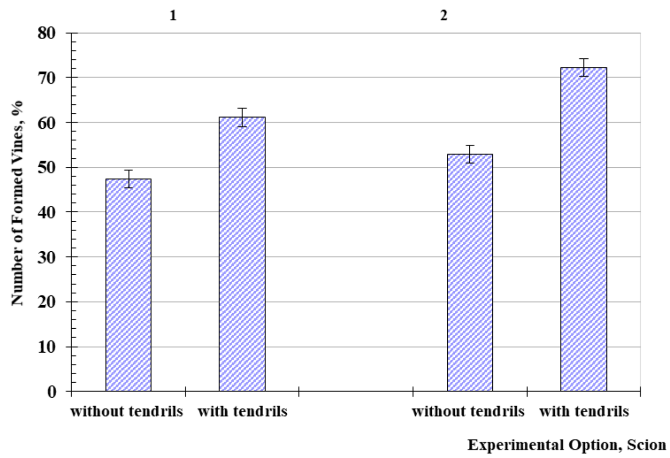


Fig. 5.8. The Impact of Grafted Saplings Quality on Formed Degree of Grapevine. Treatment: 1-H_2O; 2-Calovit. Clone R5 Cabernet Sauvignon onto BxR Kober 5BB. Fourth Year of Planting, 2008.

As a result, in the four-year-old vines after pruning in this variant, the formation of shape parts on many vines was completed. The number of fully formed vines was 72.2% (fig. 5.8).

The previously revealed regularity of increasing the number of fully formed bushes when using scion with tendrils compared to scion without tendrils is preserved.

5.1.2.2. Elements of Productivity and Yield of Young Vines

The final indicator that determines the appropriateness of a particular variety or clone is its yield. To provide a conclusive and comprehensive assessment of different quality planting materials for grapes cultivated using scion with and without tendril, as well as with the use of growth regulator Calovit, we conducted a study aimed at evaluating the yield of young bushes during the third and fourth years of vegetation.

Yield is essential in determining the potential of a particular variety or clone for successful cultivation under particular agroecological conditions. Data on the yield of young bushes allows a more complete and accurate determination of which vines are best used for planting grapevine plantations, as well as ensuring the best result in terms of economic efficiency.

Table 5.8. The Impact of Grafted Saplings Quality on of Young Vines Productivity Elements Development. Third Year of Planting. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB, 2007.

Variants	No. of Shoots, pcs./vine		Fruiting Shoots, %	No. of Flower Clusters, pcs./vine	Coefficients	
	total	with flower clusters			K_1	K_2
without tendrils H_2O	11.2±0.3	8.8±0.1	78.6±1.3	16.8±0.2	1.50±0.04	1.91±0.06
with tendrils H_2O	15.0±0.4	12.0±0.2	80.0±1.4	21.3±0.2	1.42±0.04	1.78±0.05
without tendrils Calovit	13.0±0.3	10.3±0.2	78.8±1.3	18.4±0.2	1.42±0.04	1.79±0.05
with tendrils Calovit	15.8±0.4	13.8±0.2	87.3±1.4	27.3±0.3	1.73±0.05	1.98±0.06

***K_1** – fruiting coefficient*
***K_2** – fruitfulness coefficient*

Thus, clone R5 Cabernet-Sauvignon was found onto BxR Kober 5BB in the three-year-old vines, the number of formed annual shoots varies, depending on the variants of the experiment, from 11.2 to 15.8 shoot/vine, including fruiting shoots, from 8.8 to 13.8 shoot/vine (tab. 5.8). The percentage of fruiting shoots varies from 78.6 to 87.3 and increases when using planting material obtained by grafting with tendrils scion cuttings.

In control variants, the number of flower clusters changes insignificantly and makes 16.8 - 18.4 pieces/vine. It should be noted that the number of flower clusters increases 1.3-1.5 times in the variants scion with tendrils compared to the without tendrils, especially when calovit solution is used. The coefficients of fruiting and fruitfulness capacity when using scion with tendrils are somewhat higher than those when using without tendrils, apparently, due to a higher percentage of fruiting shoots and a greater number of flower clusters on them.

Table 5.9. The Impact of Grafted Saplings Quality on of Young Vines Productivity Elements Development. Fourth Year of Planting. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB, 2008.

Variants	No. of Shoots, pcs./vine		Fruiting Shoots, %	No. of Flower Clusters, pcs./vine	Coefficients	
	total	with flower clusters			K_1	K_2
without tendrils H_2O	30.2±0.2	25.3±0.3	84.0±1.5	45.7±0.3	1.51±0.03	1.81±0.05
with tendrils H_2O	32.6±0.3	27.3±0.4	83.6±1.4	50.5±0.4	1.55±0.03	1.85±0.05
without tendrils Calovit	30.0±0.3	25.0±0.3	83.3±1.4	47.0±0.4	1.57±0.03	1.88±0.05
with tendrils Calovit	32.8±0.3	27.8±0.4	84.7±1.5	56.0±0.4	1.71±0.04	2.01±0.06

***K_1** – fruiting coefficient*
***K_2** – fruitfulness coefficient*

The analysis of data from Table 5.9 indicates that the percentage of fruiting shoots changes slightly (83.3-84.7%) regarding the formation of productivity elements of the clone R5 of Cabernet Sauvignon variety in the four-year-old vines. At the same time, the number of flower clusters developed on the vine varies depending on the experimental variants, ranging from 45.7 to 56.0, and increases when using scion with tendrils and treatment with calovit solution. The fruiting and fruitfulness coefficients, regardless of the experimental variants, are in the range of 1.5-1.7 and 1.8-2.0, respectively, which is characteristic of this variety.

Thus, one of the indicators of the economic productivity of the clone R5 of the Cabernet Sauvignon variety is the number of developed flower clusters per vine, which varies depending on the quality of the planting material.

Table 5.10. Yield Indicators and Harvest Quality of Young Vines Depending on the Quality of Saplings. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB. Third Year of Planting, 2007.

Variants	No. of Clusters pcs./vine	Weight of Clusters, g	Fruit Yield, kg/vine	Mass concentration, g/dm^3	
				sugars	titratable acids
without tendrils H_2O	13,5±0.2	94±2.2	1,27±0.02	239±2	7,2±0.03
with tendrils H_2O	17,2±0.3	102±2.3	1,75±0.02	240±2	7,3±0.03
without tendrils Calovit	14,1±0.2	105±2.3	1,48±0.02	238±2	7,0±0.03
with tendrils Calovit	21,6±0.3	94±2.2	2,03±0.03	243±2	6,7±0.03
LSD_{05}	*1,31*	*5,12*	*0,12*		

Based on the quality of the scion and the use of calovit solution for grafting, the actual yield also varies. The formation of grape clusters occurs following the same pattern as that of the actual flower clusters. For instance, in the third year of vegetation, the number of flower clusters ranges from 13.5 to 21.6 per vine, significantly increasing in variants of the scion with tendrils and treatment with calovit solution (LSD_{05} = 1.31) (tab. 5.10).

The mean clusters weight changes slightly, ranging from 94±2.2 grams to 105±2.3 grams. The yield of young vine in the control variant of scion without tendrils is 1,27±0.02 kg or 3.08 tons per hectare, whereas in the variant of scion with tendrils, it is 1,75±0.02 or 4.24 tons per hectare (fig. 5.10). In the variants utilizing the calovit solution, the yield predictably increases: for scions without tendrils to 1,48±0.02 or 3.59 tons per hectare, and for scions with tendrils to 2,03±0.03 kg or 4.92 tons per hectare (fig. 5.9). The mass concentration of sugars and titratable acids in grape berries changes slightly and amounts to 238±2 g/dm^3 - 243±2 g/dm^3, and 6,7±0.03 g/dm^3 - 7,3±0.03 g/dm^3, respectively.

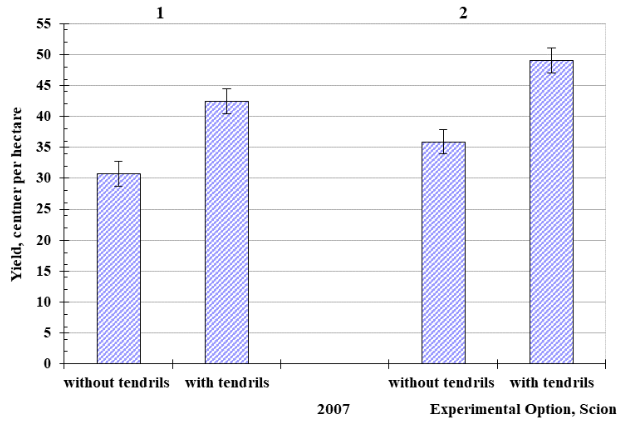


Fig. 5.9. Yield of Young Vineyard Depending on the Quality of Grafted Saplings, tons per hectare. Treatment: 1-H_2O; 2-Calovit. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB. Third Year of Planting, 2007.

It has been determined that by the four-year-old vines, a mean of 41.8±0.2 to 49.7±0.3 cluster per vine had developed on the studied vines (tab. 5.11). Compared to the three-year-old vines, the number of clusters increased by 2.3 to 3.1 times, depending on the experimental variants. However, the mean cluster weight decreased by 1.4 to 1.5 times, reaching 64-69 g in the control variants and 67-72 g in the variants utilizing the calovit solution.

Table 5.11. Yield Indicators and Harvest Quality of Young Vines Depending on the Quality of Saplings. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB. Fourth Year of Planting, 2008.

Variants	No. of Clusters pcs./vine	Weight of Clusters, g	Fruit Yield, kg/vine	Mass concentration, g/dm^3	
				sugars	titratable acids
without tendrils H_2O	41.8±0.2	64±2.2	2.68±0.03	189±2	6.9±0.02
with tendrils H_2O	47.1±0.3	69±2.2	3.25±0.04	180±2	6.9±0.02
without tendrils Calovit	44.6±0.2	67±2.3	2.99±0.04	184±2	6.8±0.02
with tendrils Calovit	49.7±0.3	72±2.3	3.58±0.04	201±3	6.5±0.02
LSD_{05}	*2.54*	*2.84*	*0.21*		

The degree of change in the mean weight of clusters, according to K. Stoev's [319] data varies for different grape varieties and is usually dependent on environmental conditions. For instance, meteorological conditions during the berry growth period (August) in 2008 were less favourable compared to 2007, attributed to a low amount of precipitation (9 mm).

The fruit yield of vine in the control variants ranges from 2.68±0.03 to 3.25±0.04 kg/vine or 6.49 to 7.88 tons per hectare. When using calovit solution, it increases to 2.99±0.04 to 3.58±0.04 kg/vine or 7.25 to 8.69 tons per hectare, particularly in the variant scion with tendrils (tab. 5.11, fig. 5.10).

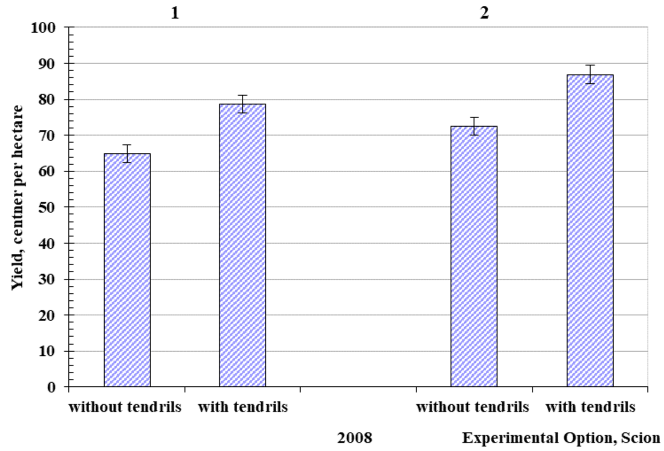


Figure 5.10. Yield of Young Vineyard Depending on the Quality of Grafted Saplings, tons per hectare. Treatment: 1-H_2O; 2-Calovit. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB. Fourth Year of Planting, 2008.

It should be noted that the mass concentration of sugars in the juice of the berries, compared to 2007, decreases by 42-58 g/dm³, reaching 180-201 g/dm³.

The warm and sunny weather promotes the intensive accumulation of sugars, colouring, and aromatic substances. However, a lack of moisture leads to a reduction in the rate of sugar accumulation [314], which is observed in our experiment variants as well. Notably, in the variant scion with tendrils and the application of calovit solution, the mass concentration of sugars increases to 201 g/dm³, with a titratable acid content of 6.5 g/dm³.

A. Amirdjanov et al. [152] argue that the productivity of a variety (clone) should also be evaluated based on the parameter of shoot productivity, as the shoot serves as a fundamental production unit of the bush vine. The indicator of shoot productivity characterizes the ratio of the bunch's mass to the total number of shoots in the bush. To determine the magnitude of shoot productivity, the contribution of all shoots on the vines is taken into account, thereby achieving an equivalence between the concepts of "Shoot Productivity" and "Variety Productivity," that is, realizing the principle: "a Variety (Clone) is a Shoot and its Production."

Hence, it becomes feasible to evaluate the productivity of this clone under various cultivation conditions or its performance under consistent conditions with varying shoot loads and diverse yield levels from individual vines.

It was determined that during the period when the vines of the R5 clone of the Cabernet Sauvignon variety enter the fruiting stage, there is a consistent increase in the number of shoots and vine productivity, along with a slight decrease in shoot productivity. Thus, in the three-year-old vines, the mean number of shoots is 11.2-15.8 pieces per vine, yield ranges from 1.27 to 2.03 kg per vine, and shoot productivity is 113.4-128.5 g per shoot (fig. 5.11).

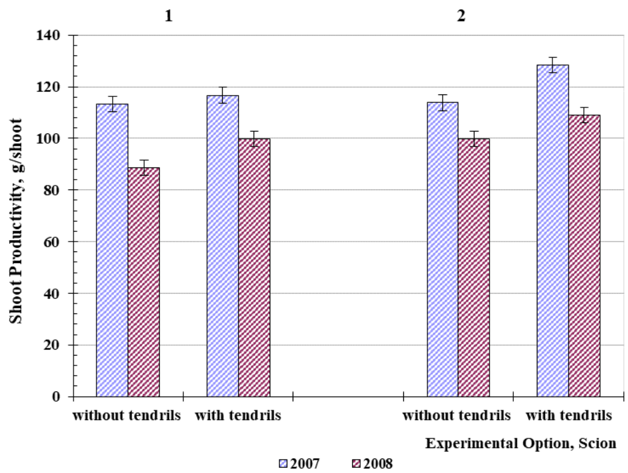


Figure 5.11. Shoot Productivity of Young Vines on the Quality of Grafted Saplings. Treatment: 1-H_2O; 2-Calovit. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

In the four-year-old vines, these indicators are, respectively, 30.2-32.8 shoots per vine; 2.68-3.58 kg per vine; and 88.7-109.1 g per shoot. In the variant's scion with tendrils, and particularly with the application of calovit solution, these indicators notably increase.

Thus, the impact of the different quality of scion cuttings manifests at the stages of stratification, vine growth in the nursery, and after planting them in a permanent place. In this regard, a strict correlation is observed between the parameters of scion cuttings quality, the output of grafted saplings from the nursery, their quality, the survival rate at the permanent location, and the growth of young vines.

It has been determined that the growth and development of young vines of the clone R5 Cabernet Sauvignon variety, their entry into fruiting, and their productivity are influenced by the different quality of planting material obtained through the use of scion cuttings with and without tendrils. For this clone, the onset of fruiting occurs in the third year after planting, during the formation of the vine's shape. On the four-year-old vines, the yield varies depending on the experimental variants and ranges from 64.9 to 86.9 centner per hectare, significantly increasing when planting vines obtained using scion cuttings with tendrils and the application of Calovit solution.

We believe that to ensure high output and quality of grafted saplings in the nursery, one hundred percent survival rate upon planting them in a permanent place, as well as vigorous development of young vines and their early entry into fruiting, it is advisable to utilize scion cuttings with tendrils for grafting, and also the pre-stratification treatment of the grafted cuttings with a solution of Calovit is recommended.

5.2. Growth and Productivity of Fruiting Vineyards

5.2.1. Analysis of the After-effect of Different Quality Planting Stock by Rootstock Attributes

5.2.1.1. Shoot Growth and Development

According to A. Subotovich [322], due to the necessity of extensive mechanization, especially in labour-intensive tasks such as pruning and harvest, there arises a need to establish plantations characterized by a high uniformity of vines. The goal should be to ensure that all vines in the vineyard have the same growth strength, yield, number, and length of shoots. The author believes that only in this case can consistently high yields be achieved in the vineyard and mechanization challenges be addressed more successfully.

In turn, we have found that using planting stock of different quality (based on the length of the stock cane) leads to the development of vines with uneven growth strength in the initial years after planting [190, 191, 192, 193]. In this regard, further research has been conducted on the impact of different quality vines on the growth and productivity parameters of the R5 clone of Cabernet Sauvignon vineyards when grown onto BxR Kober 5BB and RxR 101-14 stocks at SC "Tomai-Vinex" SA, planted in the year 2005.

It has been demonstrated that during the period of full fruiting (2015-2021), the average shoot load of the vines is established based on the vigour of the vines and varies from year to year. When grown onto the BxR Kober 5BB, the number of developed shoots ranges from 46.5 to 40.1 per vine; onto RxR 101-14, it ranges from 43.5 to 39.2 per vine (tab. 5.12, tab. 5.13). In specific years (2019-2020) characterized by extreme meteorological conditions (drought), there is a reduction in the shoot load of the vines.

The growth of young shoots begins after bud break and, depending on the variety and environmental conditions, usually continues until the onset of shoot ripening, and in some cases, even until the physiological maturity of the berries [318]. The maximum growth energy of the shoots is observed during the flowering period. At the beginning of the vegetative period, growth is slow. As the average temperature increases, shoot growth accelerates and reaches its peak just before flowering.

Table 5.12. Shoot Growth Parameters Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

N of Shoots								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	40.4±0.3 jkl	41.0±0.3 h-k	44.2±0.3 bcd	43.1±0.2 def	41.2 ±0.2 hij	31.5±0.2 r	37.5±0.2 mn	39.8±0.5 C
EG 1	43.5±0.2 cde	43.9±0.2 cd	46.5±0.2 a	44.4 ±0.2 bc	43.8 ±0.2 cd	35.5 ±0.2 op	42.1±0.2 fgh	42.8±0.4 A
EG 2	41.5±0.2 g-j	42.5±0.2 efg	45.3±0.2 b	43.2±0.2 def	40.9±0.2 ijk	34.7±0.2 p	39.9±0.1 kl	41.1±0.4 B
EG 3	40.0±0.2 kl	41.7±0.2 ghi	43.3±0.2 cde	41.9±0.1 ghi	39.4±0.2 l	31.3±0.2 r	36.5±0.2 no	39.2±0.5 D
EG 4	39.4±0.2 l	39.3±0.2 l	41.7±0.2 ghi	35.7±0.2 op	34.8±0.2 p	25.0±0.2 t	31.1±0.2 r	35.3±0.6 E
EG 5	37.7±0.2 m	31.7±0.2 qr	40.0±0.2 kl	32.7±0.2 q	31.7±0.2 qr	23.7±0.2 u	28.3±0.1 s	32.3±0.6 F
Mean	40.4±0.3 B	40.0±0.5 C	43.5±0.3 A	40.2±0.6 BC	38.6±0.5 D	30.3±0.6 F	35.9±0.6 E	38.4±0.3
ANOVA								
$F_{Variants}$ 2633.2***		F_{Year} 2634.7***		$F_{Variants*Year}$ 62.9***				
Shoot Length, cm								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	129.1±2.1 ijk	134.8±2.3 g-j	152.3±2.0 cde	149.8±1.9 c-f	125.5±1.9 jk	63.5±0.6 op	76.2±0.6 mn	118.7±4.0 C
EG 1	140.5±2.0 fgh	149.1±2.1 def	172.8±2.5 a	169.9±2.3 ab	144.5±2.3 efg	71.8±1.4 no	86.2±1.5 m	133.5±4.5 A
EG 2	135.2±2.3 g-j	138.2±2.6 ghi	160.1±2.1 bc	158.6±2.1 cd	134.8±2.0 g-j	63.8±1.6 op	76.6±1.6 mn	123.9±4.3 B
EG 3	127.1±1.9 jk	135.6±2.0 g-j	151.6±2.2 cde	149.1±2.1 def	126.7±2.0 jk	63.4±1.6 op	76.1±1.7 mn	118.5±4.0 C
EG 4	121.5±2.0 kl	128.8±2.0 ijk	144.5±2.3 efg	142.1±2.0 e-h	120.8±1.7 kl	55.1±1.6 pq	66.1±1.8 no	111.3±4.1 D
EG 5	114.2±2.0 l	119.4±2.1 kl	135.7±2.3 g-j	133.5±2.0 hij	113.5±1.9 l	51.8±1.4 q	62.2±1.7 opq	104.3±3.8 E
Mean	127.9±1.4 C	134.3±1.5 B	152.8±1.8 A	150.5±1.7 A	127.6±1.5 C	61.6±1.0 E	73.9±1.2 D	118.4±1.7
ANOVA								
$F_{Variants}$ 187.6***		F_{Year} 2069.9***		$F_{Variants*Year}$ 1.76**				
Annual Growth, m.vine								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	52.2 ± 0.4 l	55.3 ± 0.2 ijk	67.3 ± 0.3 d	64.6 ± 0.2 e	51.7 ± 0.2 lm	20.0 ± 0.1 w	28.6 ± 0.1 t	48.5 ± 2.0 C
EG 1	61.1 ± 0.3 g	65.5 ± 0.2 e	80.4 ± 0.4 a	75.4 ± 0.2 b	63.3 ± 0.3 f	25.5 ± 0.2 u	36.3 ± 0.2 s	58.2 ± 2.2 A
EG 2	56.1 ± 0.3 ij	58.7 ± 0.2 h	72.5 ± 0.2 c	68.5 ± 0.3 d	55.1 ± 0.2 jk	22.1 ± 0.2 v	28.6 ± 0.1 t	51.7 ± 2.1 B
EG 3	50.8 ± 0.3 mn	56.5 ± 0.2 i	65.6 ± 0.3 e	62.5 ± 0.2 f	49.9 ± 0.2 n	19.9 ± 0.1 w	27.8 ± 0.2 t	47.6 ± 1.9 D
EG 4	47.9 ± 0.2 o	50.6 ± 0.2 mn	60.3 ± 0.2 g	50.7 ± 0.2 mn	42.0 ± 0.2 q	13.8 ± 0.2 w	20.6 ± 0.2 w	40.8 ± 1.9 E
EG 5	43.1 ± 0.2 pq	37.8 ± 0.2 r	54.3 ± 0.3 k	43.7 ± 0.2 p	36.0 ± 0.2 s	12.3 ± 0.1 w	17.6 ± 0.2 w	35.0 ± 1.7 F
Mean	51.9 ± 0.8 D	54.1 ± 1.1 C	66.7 ± 1.1 A	60.9 ± 1.4 B	49.7 ± 1.2 E	18.9 ± 0.6 G	26.6 ± 0.8 F	46.9±0.9
ANOVA								
$F_{Variants}$ 8911.1***		F_{Year} 35736.0***		$F_{Variants*Year}$ 1386.0***				

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Table 5.13. Shoot Growth Parameters Depending on the Different Quality of Vines.
Cl R5 Cabernet Sauvignon onto RxR 101-14.

N of Shoots								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	37.3±0.2 lm	40.0±0.2 ghi	41.9±0.2 b-e	41.0±0.2 d-g	39.5±0.2 hi	28.2±0.2 uv	34.2±0.2 op	37.4±0.5 B
EG 1	40.6±0.2 fgh	42.5±0.2 abc	43.5±0.3 a	43.0±0.3 ab	41.5±0.2 c-f	29.6±0.2 t	38.2±0.2 jkl	39.8±0.5 A
EG 2	39.0±0.2 ijk	39.2±0.2 ij	42.1±0.2 bcd	39.4±0.3 hij	39.1±0.2 ijk	27.9±0.2 v	35.9±0.2 n	37.5±0.5 B
EG 3	37.9±0.2 kl	37.4±0.2 l	40.8±0.3 efg	38.2±0.2 jkl	37.2±0.2 lm	26.6±0.2 w	32.3±0.2 rs	35.8±0.5 C
EG 4	35.3±0.3 no	36.1±0.2 mn	39.2±0.2 ij	34.1±0.2 opq	33.7±0.2 pq	24.1±0.2 x	29.4±0.2 tu	33.1±0.6 D
EG 5	33.9±0.2 pq	34.1±0.2 opq	37.5±0.2 l	32.9±0.2 qr	31.5±0.3 s	22.5±0.2 y	27.5±0.2 vw	31.4±0.6 E
Mean	37.3±0.3 C	38.2±0.4 B	40.8±0.3 A	38.1±0.5 B	37.1±0.5 C	26.5±0.3 E	32.9±0.5 D	35.9±0.3
ANOVA								
$F_{Variants}$ 1308.9***		**F_{Year} 2621.8*****		**$F_{Variants*Year}$ 16.5*****				
Shoot Length, cm								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	119.2±2.1 i-n	126.7±2.4 f-k	141.5±2.4 bcd	139.8±2.1 b-e	117.1±2.0 k-n	61.1±1.5 rst	73.9±1.8 pq	111.3±3.6 C
EG 1	131.1±2.2 d-h	139.1±2.3 b-e	161.2±2.7 a	158.5±2.2 a	134.8±2.0 c-f	69.0±1.9 qrs	83.7±1.9 p	125.3±4.1 A
EG 2	127.1±2.0 f-k	128.9±2.2 e-j	147.3±2.1 b	144.4±2.1 bc	125.8±1.6 f-k	61.3±1.1 rst	74.4±1.7 pq	115.6±3.8 B
EG 3	119.2±1.7 i-n	126.5±1.9 f-k	138.9±2.0 b-e	136.2±2.0 c-f	118.2±1.9 j-n	60.0±1.6 stu	72.1±1.6 qr	110.2±3.6 C
EG 4	108.9±2.3 no	120.2±2.3h-m	132.9±2.3 d-g	130.2±2.3 e-i	112.7±2.0 l-o	52.9±1.6 tu	62.1±1.9 rst	102.8±3.7 D
EG 5	102.7±2.1 o	111.4±2.1mno	126.0±2.1 f-k	123.5±2.0 g-l	105.9±2.0 o	49.8±1.5 u	60.4±1.7 stu	97.1±3.4 E
Mean	118.0±1.5 C	125.5±1.4 B	141.3±1.7 A	138.8±1.7 A	119.1±1.4 C	59.0±1.0 E	71.1±1.2 D	110.4±1.6
ANOVA								
$F_{Variants}$ 169.8***		**F_{Year} 1576.0*****		**$F_{Variants*Year}$ 1.7*****				
Annual Growth, m.vine								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	44.5±0.3 lm	50.7±0.3 gh	59.3±0.4 d	57.3±0.4 e	46.3±0.3 jk	17.2±0.1 uv	25.3±0.2 r	42.9±1.8 C
EG 1	53.2±0.3 f	59.1±0.3 d	70.1±0.5 a	68.2±0.4 b	55.9±0.3 e	20.4±0.1 t	32.0±0.2 q	51.3±2.1 A
EG 2	49.6±0.3 hi	50.5±0.3 hi	62.0±0.4 c	56.9±0.3 e	49.2±0.2 i	17.1±0.2 uv	26.7±0.2 r	44.6±1.8 B
EG 3	45.2±0.2 kl	47.4±0.2 j	56.7±0.3 e	52.0±0.2 fg	44.0±0.2 lm	16.0±0.2 v	23.3±0.2 s	40.7±1.7 D
EG 4	38.5±0.2 o	43.3±0.2 m	52.1±0.3 fg	44.4±0.3 lm	38.0±0.2 o	12.7±0.2 w	18.3±0.2 u	35.3±1.6 E
EG 5	34.8±0.2 p	38.0±0.2 o	47.3±0.3 j	40.6±0.2 n	33.4±0.2 pq	11.2±0.1 x	16.6±0.1 v	31.7±1.5 F
Mean	44.3±0.8 D	48.2±0.9 C	57.9±1.0 A	53.2±1.2 B	44.5±1.0 D	15.8±0.4 F	23.7±0.7 E	41.1±0.8
ANOVA								
$F_{Variants}$ 4905.5***		**F_{Year} 21044.6*****		**$F_{Variants*Year}$ 73.1*****				

*Ns: not significant, *: significant at $p \leq 0.1$, **: significant at $p \leq 0.01$, ***: significant at $p \leq 0.001$*

At the beginning of the flowering period, rapid growth slows down until the shoots start maturing. The reduction in shoot growth occurs unevenly, similar to the uneven increase in shoot growth. Smirnov K. et al. [313] demonstrated that shoot growth is influenced by the environmental conditions of the growing site and cultivation practices (plant spacing, vine shape, irrigation, fertilization, physiological-active substances, etc.).

Our research has shown that the growth of shoots depends on the different quality of the vines and the rootstock onto which they are grafted. By the end of the vegetative period, the average length, depending on the year of study, ranges from 113.5 to 172.5 cm (BxR Kober 5BB); 105.9 to 161.2 cm (RxR 101-14) (tab. 6.1, tab. 6.2). This variation in the average length of shoots can be explained, on one hand, by the non-uniformity of the vines according to the experimental variants, and on the other hand, by a combination of unfavourable meteorological conditions - reduced precipitation and increased average monthly temperatures (soil-air drought) - observed in certain years (2019-2021).

Instead of to S. Melnik [255], the main indicator characterizing the degree of development of shoot growth in different grapevine varieties is the volume of one-year shoot growth. It depends on the number of developed shoots per vine, their average length, and diameter. K. Smirnov K. et al. [313], A. Stirbu [335], A. Derendovskaia et al. [183] believe that grapevine varieties of different eco-geographical groups are characterized by varying degrees of shoot growth development. Thus, varieties of the Eastern eco-geographical group exhibit greater growth vigour than those of the Western European or the Black Sea Basin groups. However, within each group, there are varietal differences.

In identical agrotechnical conditions, the degree of development of the annual shoot growth hinges on the different quality vines, associated with the heterogeneity of the planting stock. The average length and volume of the annual shoot growth of the vine increase when using 1^{st}-3^{rd} cuttings from the base of the stock cane for grafting, regardless of the rootstock variety onto which they were grafted. In favourable meteorological conditions in the years 2017-2018, by the end of the vegetation period, for the R5 of Cabernet Sauvignon onto Kober 5BB, the average length of the shoots is 172.8 cm EG 1 (1^{st} cutting), 160.1 cm EG 2 (2^{nd} cutting), and 151.6 cm EG 3 (3^{rd} cutting); the length of the annual shoot growth is 80.4, 72.5, and 65.6 cm per vine; the volume of the annual shoot growth is 5.7, 4.9, and 4.4 dm^3 per vine, respectively (tab. 5.14, tab. 5.15).

Table 5.14. Annual Growth Volume Parameters Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

cm^3 per shoot								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	67.3±0.9 klm	72.9±1.3 ijk	101.2±1.4 c	81.0±1.0 gh	66.2±1.0 lm	16.2±0.2 uv	30.2±0.3 qr	62.1±3.3 C
EG 1	75.1±0.8 ij	82.6±1.2 g	122.4±1.8 a	98.6±1.4 cd	82.0±1.3 gh	19.0±0.4 tu	36.1±0.6 p	73.7±4.0 A
EG 2	73.6±1.1 ij	76.5±1.5 hi	108.7±1.4 b	90.0±1.2 ef	71.2±1.0 i-l	16.9±0.4 uv	32.0±0.7 pq	67.0±3.6 B
EG 3	67.1±1.0 lm	73.3±1.1 ij	100.7±1.4 c	82.6±1.2 g	66.9±1.1 lm	16.8±0.4 uv	31.8±0.7 pq	62.7±3.3 C
EG 4	62.6±1.0 mno	69.7±1.1 jkl	93.9±1.5 de	75.0±1.0 ij	62.2±0.9 mno	13.6±0.4 uv	25.4±0.7 rs	57.5±3.2 D
EG 5	58.8±1.1 no	63.0±1.1 mn	86.3±1.5 fg	70.5±1.1 jkl	57.0±0.9 o	12.3±0.3 v	23.2±0.6 st	53.0±2.9 E
Mean	67.4±0.8 D	73.0±0.9 C	102.2±1.6 A	83.0±1.3 B	67.6±1.1 D	15.8±0.3 F	29.8±0.6 E	62.7±1.4
ANOVA								
$F_{Variants}$ 4993.3*** F_{Years} 336.6*** $F_{Variants*Years}$ 11.9***								
dm^3 per vine								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	2.72 ± 0.02 i	2.99 ± 0.02 h	4.47 ± 0.03 c	3.49 ± 0.03 ef	2.73 ± 0.03 i	0.51 ± 0.01 qr	1.13 ± 0.02 o	2.58 ± 0.15 C
EG 1	3.26 ± 0.04 g	3.63 ± 0.03 e	5.69 ± 0.04 a	4.38 ± 0.04 c	3.59 ± 0.04 ef	0.67 ± 0.01 pq	1.52 ± 0.02 n	3.25 ± 0.19 A
EG 2	3.06 ± 0.04 h	3.25 ± 0.04 g	4.92 ± 0.06 b	3.89 ± 0.04 d	2.91 ± 0.03 h	0.58 ± 0.01 q	1.28 ± 0.02 o	2.84 ± 0.17 B
EG 3	2.68 ± 0.02 i	3.06 ± 0.03 h	4.36 ± 0.05 c	3.46 ± 0.04 f	2.63 ± 0.04 ij	0.52 ± 0.01 q	1.16 ± 0.03 o	2.55 ± 0.15 C
EG 4	2.47 ± 0.02 j	2.74 ± 0.03 i	3.92 ± 0.04 d	2.68 ± 0.03 i	2.17 ± 0.02 kl	0.34 ± 0.01 rs	0.79 ± 0.02 p	2.16 ± 0.14 D
EG 5	2.22 ± 0.02 k	2.00 ± 0.02 l	3.45 ± 0.04 f	2.30 ± 0.04 k	1.81 ± 0.02 m	0.29 ± 0.01 s	0.66 ± 0.02 pq	1.82 ± 0.12 E
Mean	2.74 ± 0.05 D	2.94 ± 0.07 C	4.47 ± 0.09 A	3.37 ± 0.09 B	2.64 ± 0.07 E	0.48 ± 0.02 G	1.09 ± 0.04 F	2.53±0.07
ANOVA								
$F_{Variants}$ 1856.1*** F_{Years} 11521.3*** $F_{Variants*Years}$ 66.7***								
m^3 per hectare								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	6.60±0.05 i	7.24±0.05 h	10.82±0.07 c	8.46±0.08 ef	6.63±0.07 i	1.24±0.04 qr	2.74±0.05 o	6.25±0.37 C
EG 1	7.90±0.09 g	8.80±0.06 e	13.80±0.11 a	10.61±0.09 c	8.69±0.10 ef	1.62±0.03 pq	3.67±0.05 n	7.87±0.46 A
EG 2	7.41±0.10 h	7.86±0.09 g	11.92±0.14 b	9.44±0.10 d	7.06±0.08 h	1.40±0.04 q	3.11±0.04 o	6.88±0.40 B
EG 3	6.50±0.06 i	7.41±0.08 h	10.56±0.13 c	8.39±0.09 f	6.37±0.09 ij	1.25±0.03 q	2.81±0.07 o	6.18±0.36 C
EG 4	5.98±0.06 j	6.64±0.08 i	9.51±0.09 d	6.50±0.07 i	5.24±0.05 kl	0.83±0.03 rs	1.92±0.04 p	5.23±0.33 D
EG 5	5.39±0.05 k	4.85±0.04 l	8.35±0.10 f	5.56±0.09 k	4.39±0.04 m	0.70±0.03 s	1.60±0.04 pq	4.41±0.29 E
Mean	6.63±0.11 D	7.13±0.16 C	10.83±0.23 A	8.16±0.22 B	6.40±0.18 E	1.17±0.04 G	2.64±0.09 F	6.14±0.16
ANOVA								
$F_{Variants}$ 1861.6*** F_{Years} 11552.3*** $F_{Variants*Years}$ 66.9***								

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Table 5.15. Annual Growth Volume Parameters Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto RxR 101-14.

cm^3 per shoot								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	62.9±1.1 l-o	66.9±1.3 jkl	90.0±1.5 c	73.8±1.1 ghi	60.3±1.0 nop	15.0±0.4 w	28.4±0.7 st	56.8±2.9 C
EG 1	70.9±1.2 hij	75.2±1.2 fgh	107.1±1.8 a	87.8±1.2 cd	72.9±1.1 ghi	17.6±0.5 vw	34.1±0.8 s	66.5±3.5 A
EG 2	67.1±1.0 jkl	69.7±1.2 hij	97.9±1.4 b	80.0±1.2 ef	66.4±0.8 j-m	15.6±0.3 w	30.3±0.7 s	61.0±3.2 B
EG 3	61.4±0.9 l-p	66.8±1.0 jkl	88.3±1.3 cd	73.7±1.1 ghi	60.9±1.0 m-p	14.8±0.4 w	28.5±0.6 st	56.3±2.9 C
EG 4	56.1±1.2 pqr	63.4±1.2 k-n	82.6±1.4 de	68.7±1.2 ijk	56.6±1.0 pqr	13.0±0.4 w	23.9±0.7 tu	52.0±2.8 D
EG 5	51.6±1.1 r	57.4±1.1 opq	76.6±1.3 fg	63.6±1.0 k-n	53.2±1.0 qr	11.8±0.4 x	22.6±0.6 uv	48.1±2.6 E
Mean	61.7±0.9 D	66.6±0.8 C	90.4±1.4 A	74.6±1.1 B	61.7±0.9 D	14.6±0.3 F	28.0±0.6 E	56.8±1.3
ANOVA								
$F_{Variants}$ 4993.3* F_{Years} 336.6*** $F_{Variants*Years}$ 11.9*****								
dm^3 per vine								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	2.35±0.02 l	2.68±0.02 hi	3.77±0.03 c	3.03±0.03 f	2.38±0.02 kl	0.42±0.01 uv	0.97±0.02 qr	2.23±0.13 C
EG 1	2.88±0.03 g	3.20±0.03 e	4.66±0.04 a	3.78±0.04 c	3.02±0.03 f	0.52±0.01 tu	1.30±0.02 p	2.77±0.16 A
EG 2	2.62±0.02 ij	2.73±0.01 hi	4.12±0.03 b	3.15±0.03 ef	2.60±0.03 ij	0.44±0.01 uv	1.09±0.02 q	2.39±0.14 B
EG 3	2.33±0.02 l	2.50±0.02 jk	3.60±0.03 d	2.81±0.02 gh	2.27±0.02 l	0.39±0.01 uvw	0.92±0.02 r	2.12±0.12 D
EG 4	1.98±0.03 mn	2.29±0.03 l	3.24±0.04 e	2.34±0.03 l	1.91±0.02 n	0.31±0.01 vw	0.70±0.02 s	1.82±0.11 E
EG 5	1.75±0.02 o	1.96±0.03 mn	2.87±0.04 g	2.09±0.03 m	1.68±0.02 o	0.27±0.01 w	0.62±0.02 st	1.60±0.10 F
Mean	2.32±0.05 D	2.56±0.05 C	3.71±0.08 A	2.87±0.07 B	2.31±0.06 D	0.39±0.01 F	0.93±0.03 E	2.15±0.06
ANOVA								
$F_{Variants}$ 1856.1* F_{Years} 11521.3*** $F_{Variants*Years}$ 66.7*****								
m^3 per hectare								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	5.69±0.04 m	6.49±0.05 j	9.14±0.08 c	7.34±0.07 fg	5.76±0.04 lm	1.02±0.02 vw	2.36±0.05 rs	5.40±0.31 C
EG 1	6.97±0.07 h	7.74±0.07 e	11.30±0.10 a	9.17±0.08 c	7.31±0.07 g	1.26±0.02 uv	3.17±0.04 q	6.71±0.38 A
EG 2	6.34±0.04 jk	6.61±0.04 ij	9.98±0.06 b	7.64±0.07 ef	6.31±0.08 jk	1.07±0.02 vw	2.62±0.04 r	5.80±0.34 B
EG 3	5.64±0.04 m	6.07±0.05 kl	8.73±0.08 d	6.82±0.06 hi	5.50±0.06 m	0.97±0.01 vw	2.23±0.04 s	5.14±0.30 D
EG 4	4.79±0.07 no	5.51±0.07 m	7.88±0.08 e	5.68±0.07 m	4.63±0.04 o	0.77±0.01 w	1.69±0.04 t	4.42±0.27 E
EG 5	4.22±0.04 p	4.72±0.05 o	6.98±0.09 h	5.06±0.07 n	4.08±0.05 p	0.64±0.03 x	1.50±0.05 tu	3.89±0.24 F
Mean	5.61±0.12 D	6.19±0.12 C	9.00±0.19 A	6.95±0.18 B	5.60±0.14 D	0.96±0.03 F	2.26±0.07 E	5.22±0.13
ANOVA								
$F_{Variants}$ 1861.6* F_{Years} 11552.3*** $F_{Variants*Years}$ 66.9*****								

*Ns: not significant, *: significant at $p \leq 0.1$, **: significant at $p \leq 0.01$, ***: significant at $p \leq 0.001$*

On vines grown from saplings obtained using rootstock cuttings from the top zone of the stock cane EG 4, EG 5 (4^{th} and 5^{th} cuttings), the growth parameters of shoots decrease: the length of annual shoot growth decreases by 1.3-1.5 times, and the volume of annual shoot growth decreases by 1.5-1.6 times. A similar pattern is observed for the R5 clone of Cabernet Sauvignon onto RxR 101-14 rootstock.

In unfavourable meteorological conditions during the years 2019-2021, high average daily temperatures during the summer period and a lack of moisture led to a significant reduction in the annual shoot growth of the vines. For instance, in the anomalous year of 2020, the average length of shoots for the R5 clone of Cabernet Sauvignon onto BxR Kober 5BB ranges from 51.8 to 71.8 cm, the length of annual shoot growth ranges from 12.3 to 28.2 m per vine, and the volume of annual shoot growth ranges from 0.3 to 0.7 dm^3 per vine. Onto RxR 101-14, the average length of shoots decreases to 49.8-69.0 cm, the length of annual shoot growth ranges from 11.2 to 20.4 m per vine, and the volume of annual shoot growth ranges from 0.3 to 0.5 dm^3 per vine.

The data obtained by us are consistent with the materials presented in the monograph by Stoev K. [319], which confirms that the maximum shoot growth is determined by meteorological conditions, primarily the temperature factor. The relationship is so close that any increase or decrease in temperature corresponds to an almost proportional increase or decrease in growth intensity.

5.2.1.2. Growth and Development of Leaf Surface Area

The growth and productivity of the grapevine canopy as an optic-biological system depends on the rhythmicity of physiological processes associated with shoot development and leaf apparatus functioning. Leaves carry out vital life processes such as photosynthesis, transpiration, respiration, and their activity depend on plant varietal traits and adaptation to environmental factors. The cumulative leaf surface area of shoots, vines, rows, and vineyards is formed as a result of the activity of individual leaves [14, 15].

The magnitude of the leaf surface, its structure, and functional conditions determine the yield quantity, both in terms of biological and economic aspects, as well as the quality of production A. Amirdzhanov [154], K. Smirnov et al. [314]. The increase in leaf surface area in the ontogeny of grapevine plants is a fundamental process necessary for the proper assimilation of CO_2 during photosynthesis. According to L. Poenaru et al. [98] and V. Naumenko [276, 277] the rates of leaf area formation in grapevine plants vary and depend on the biological characteristics of the varieties and their response to growing conditions.

Table 5.16. Development of Leaf Surface Area Depending on the Different Quality of Vines.
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

Number of Leaves per Shoot								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	26.4±0.2 h-l	27.5±0.1 f-j	31.1±0.3 cd	30.6±0.3 cde	25.6±0.2 j-m	22.6±0.2 op	26.0±0.3 i-l	27.1±0.3 C
EG 1	28.7±0.4 d-h	30.4±0.4 cde	35.3±0.3 a	34.7±0.3 ab	29.5±0.2 def	24.2±0.3 l-o	27.8±0.3 f-j	30.1±0.4 A
EG 2	27.6±0.2 f-j	28.2±0.3 e-i	32.7±0.3 bc	32.4±0.6 bc	27.7±0.4 f-j	23.3±0.5 mno	26.8±0.4g-k	28.4±0.4 D
EG 3	25.9±0.3 i-l	27.7±0.4 f-j	30.9±0.4 cd	30.5±0.6 cde	26.5±0.4 h-l	22.4±0.4 op	25.8±0.3 jkl	27.1±0.4 C
EG 4	24.8±0.5 k-o	26.3±0.6 h-l	29.5±0.4 def	29.0±0.5 d-g	25.5±0.8 j-m	20.3±0.6 pq	23.3±0.4 mno	25.5±0.4 D
EG 5	23.3±0.5 mno	25.4±0.6 j-n	26.9±0.5 g-k	27.2±0.8 f-k	23.1±0.4 no	19.8±0.8 q	22.8±0.6 o	24.1±0.4 E
Mean	26.1±0.3 CD	27.6±0.3 B	31.0±0.4 A	30.7±0.4 A	26.3±0.3 C	22.1±0.3 E	25.4±0.3 D	27.0±0.18
ANOVA								
$F_{Variants}$ 161.5*** F_{Years} 303.2*** $F_{Variants*Years}$ 1.8**								
Leaf Blade Area, cm²/leaf								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	116.6±0.6 c	133.1±0.4 b	144.6±0.4 a	138.6±0.4 ab	116.5±0.4 c	85.1±0.3 e	97.8±0.3 d	118.9±2.4 A
EG 1	116.9±0.6 c	133.9±0.9 b	145.2±0.9 a	138.9±1.5 ab	117.8±1.0 c	86.7±0.4 e	99.7±1.0 d	119.9±2.4 A
EG 2	116.9±1.3 c	133.9±1.2 b	145.2±1.2 a	138.9±1.2 ab	116.8±1.6 c	84.9±2.5 e	97.8±2.8 d	119.2±2.5 A
EG 3	116.8±1.6 c	133.5±1.8 b	144.8±2.3 a	138.6±2.8 ab	116.5±2.2 c	84.6±0.6 e	97.6±2.4 d	118.9±2.6 A
EG 4	115.9±2.1 c	132.7±2.0 b	144.6±2.1 a	138.4±2.4 ab	116.3±1.8 c	84.3±2.3 e	97.6±1.7 d	118.5±2.6 A
EG 5	115.9±2.9 c	132.7±1.7 b	144.3±2.6 a	138.2±2.5 ab	116.3±3.2 c	84.3±2.3 e	97.6±2.1 d	118.5±2.6 A
Mean	116.5±0.7 D	133.3±0.6 C	144.8±0.7 A	138.6±0.8 B	116.7±0.8 D	85.0±0.7 F	98.0±0.7 E	119.0±1.0
ANOVA								
$F_{Variants}$ 0.6ns F_{Years} 894.6*** $F_{Variants*Years}$ 0.04ns								
Leaf Area, dm²/shoot								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	30.8±0.5 mn	36.6±0.2 ij	45.0±0.2 c	42.4±0.3 def	29.8±0.5 no	19.2±0.2 tu	25.4±0.2 qr	32.7±1.0 C
EG 1	33.5±0.3 kl	40.7±0.4 efg	51.3±0.3 a	48.2±0.4 b	34.8±0.4 jk	21.0±0.3 st	27.7±0.3 opq	36.8±1.2 A
EG 2	32.3±0.4 lm	37.8±0.4 hi	47.5±0.4 b	45.0±0.5 c	32.4±0.3 klm	19.8±0.4 t	26.2±0.3 qr	34.4±1.1 B
EG 3	30.3±0.3 mn	37.0±0.3 ij	44.7±0.6 cd	42.3±0.4 def	30.9±0.6 mn	19.0±0.4 tuv	25.2±0.3 r	32.8±1.0 C
EG 4	28.7±0.4 nop	34.9±0.6 jk	42.6±0.4 cde	40.1±0.6 fgh	29.6±0.5 no	17.1±0.4 uv	22.7±0.6 s	30.8±1.0 D
EG 5	27.0±0.4 pqr	33.7±0.8 kl	38.8±0.4 ghi	37.6±0.6 i	26.9±0.7 pqr	16.7±0.5 v	22.3±0.6 s	29.0±0.9 E
Mean	30.4±0.3 D	36.8±0.3 C	45.0±0.5 A	42.6±0.5 B	30.7±0.4 D	18.8±0.2 F	24.9±0.3 E	32.7±0.4
ANOVA								
$F_{Variants}$ 257.0*** F_{Years} 2646.6*** $F_{Variants*Years}$ 52.0***								

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Table 5.17. Development of Leaf Surface Area Depending on the Different Quality of Vines.
Cl R5 Cabernet Sauvignon onto RxR 101-14.

Number of Leaves per Shoot								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	24.4±0.3 k-s	25.9±0.5 f-n	28.9±0.5 cde	28.6±0.4 c-f	23.9±0.3 m-t	21.8±0.4 r-u	25.2±0.3 h-p	25.5±0.3 C
EG 1	26.8±0.5 d-l	28.4±0.6 c-g	33.0±0.4 a	32.4±0.7 ab	27.6±0.4 c-i	23.2±0.3 n-u	27.0±0.6 d-k	28.3±0.4 A
EG 2	25.9±0.6 f-n	26.4±0.6 e-m	30.1±0.6 bc	29.5±0.5 cd	25.7±0.7 g-o	21.9±0.4 r-u	26.0±0.4 f-m	26.5±0.4 B
EG 3	24.4±0.4 k-s	25.8±0.5 g-n	28.4±0.6 c-g	27.8±0.6 c-h	24.2±0.6 l-s	21.4±0.5 tuv	25.0±0.4 i-q	25.3±0.3 C
EG 4	22.3±0.4 q-u	24.5±0.4 j-r	27.2±0.4 d-j	26.6±0.6 e-m	23.0±0.5 o-u	18.8±0.4 vw	22.6±0.5 p-u	23.6±0.4 D
EG 5	21.1±0.4 uv	22.8±0.4 p-u	25.8±0.6 g-n	25.2±0.7 h-p	21.7±0.5 stu	18.0±0.3 w	22.0±0.4 r-u	22.4±0.3 E
Mean	24.2±0.3 C	25.6±0.3 B	28.9±0.4 A	28.4±0.4 A	24.4±0.3 C	20.9±0.3 D	24.6±0.3 C	25.3±0.2
ANOVA								
$F_{Variants}$ 130.4*** F_{Years} 187.2*** $F_{Variants*Years}$ 1.0ns								
Leaf Blade Area, cm^2/leaf								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	115.7±1.9 b	131.8±2.4 ab	141.0±2.6 a	131.6±3.2 ab	115.3±2.6 b	84.1±2.9 d	96.7±2.6 d	116.6±2.5 A
EG 1	116.8±3.3 b	132.7±4.8 ab	141.4±5.4 a	132.3±4.7 ab	115.9±2.7 b	84.9±1.5 d	96.9±2.1 cd	117.3±2.7 A
EG 2	116.5±3.0 b	132.7±3.2 ab	141.4±2.5 a	132.3±3.9 ab	115.9±2.4 b	84.1±2.7 d	96.9±2.5 cd	117.1±2.5 A
EG 3	115.9±2.6 b	131.6±3.9 ab	141.0±3.4 a	132.1±3.9 ab	115.3±4.0 b	83.9±2.4 d	96.7±1.9 d	116.6±2.6 A
EG 4	115.7±2.1 b	130.6±3.1 ab	140.7±4.4 a	131.8±4.2 ab	115.3±4.1 b	83.8±3.5 d	96.5±2.3 d	116.3±2.6 A
EG 5	114.9±2.6 bc	130.2±3.0 ab	140.7±4.4 a	131.8±3.6 ab	115.1±4.0 b	83.8±3.1 d	96.5±2.0 d	116.1±2.6 A
Mean	115.9±1.0 C	131.6±1.4 B	141.0±1.5 A	132.0±1.6 B	115.5±1.3 C	84.1±1.1 E	96.7±0.9 D	116.7±1.0
ANOVA								
$F_{Variants}$ 0.1ns F_{Years} 236.9*** $F_{Variants*Years}$ 0.01ns								
Leaf Area, dm^2/shoot								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	28.2±0.4 kl	34.1±0.6 ghi	40.7±0.2 bc	37.7±0.5 def	27.6±0.3 klm	18.3±0.3 qrs	24.4±0.4 no	30.1±0.9 C
EG 1	31.3±0.5 ij	37.7±0.5 def	46.7±0.8 a	42.9±0.6 b	32.0±0.4 ij	19.7±0.6 pqr	26.2±0.6 lmn	33.8±1.1 A
EG 2	30.2±0.5 jk	35.0±0.5 fgh	42.6±0.5 b	39.0±0.4 cde	29.8±0.3 jk	18.4±0.4 qrs	25.2±0.3 mn	31.5±0.9 B
EG 3	28.3±0.3 kl	34.0±0.6 ghi	40.0±0.6 bcd	36.7±0.7 efg	27.9±0.5 klm	18.0±0.4 rst	24.2±0.3 no	29.9±0.9 C
EG 4	25.8±0.6 lmn	32.0±0.8 ij	38.3±0.7 cde	35.1±0.8 fgh	26.5±0.4 lmn	15.7±0.5 st	21.8±0.5 op	27.9±0.9 D
EG 5	24.3±0.4 no	29.7±0.7 jk	36.3±0.8 efg	33.2±0.6 hi	25.0±0.5 mn	15.1±0.4 t	21.2±0.6 pq	26.4±0.8 E
Mean	28.0±0.4 D	33.8±0.4 C	40.8±0.5 A	37.4±0.5 B	28.1±0.3 D	17.5±0.3 F	23.8±0.3 E	29.9±0.4
ANOVA								
$F_{Variants}$ 167.3*** F_{Years} 1361.6*** $F_{Variants*Years}$ 2.4***								

Ns: not significant, *: significant at $p \leq 0.1$, **: significant at $p \leq 0.01$, ***: significant at $p \leq 0.001$

The determination of Leaf Growth parameters was conducted at the end of the vegetation period. Leaves located in the middle part of shoots (8-12 leaves from the base) with uniform illumination on the vines were selected for analysis (fig. A 10.11, fig. A 10.12). Morphological leaf parameters (length, width, and diagonal) were determined using simple linear measurements; the number of leaves on shoots and vines (in pieces), as well as the Leaf Blade Area, was assessed using ampelometric methods (following the approach of S.A. Melnik et al. [259]. The calculation of the Leaf Area parameters for a shoot was performed by multiplying the Leaf Blade Area by the number of leaves on a single shoot; the Leaf Area of vine was calculated by multiplying the Leaf Area of the "Average Shoot" by the Average Shoot Load [153].

The leaves of the R5 clone of Cabernet Sauvignon are medium-sized, rounded, five-lobed, deeply dissected, wide-funnel-shaped, dark green, reticulate-wrinkled, and partially pubescent on the lower side. It has been determined that the Leaf Blade Area during the years of the research does not depend on the experimental variants but varies from year to year. On average, depending on the year of the research, it ranges from 84.1±1.1 cm^2/leaf to 144.8±0.7 cm^2/leaf.

After analyzing the data presented in (tab. 5.16, tab. 5.17), we can conclude that the highest values of Leaf Area are observed in the vines of the year 2017. This elevated measure can be attributed to favourable weather conditions that positively influenced the plant development. Thus, the year 2017 had a significant positive impact on the formation of a greater Leaf Area. It is noteworthy that the data indicates a sharp decrease in Leaf Area values in the year 2020, as revealed during the analysis. This decline is linked to unfavourable factors that affected the growth and development of the plants during the mentioned period. After statistical analysis, the following results were obtained. There was a statistically significant difference in the number of leaves per shoot by experience variants ($F_{Variants}$ 130.4^{***}), and by years of study (F_{Years} 187.2^{***}). The interaction of factors on this indicator was not revealed ($F_{Variants*Years}$ 1.0ns), which can be explained by the lack of statistical significance (denoted as "ns", which means "not significant").

Thus, based on the statistical analysis, it can be concluded that the indicator, the number of leaves per shoot, significantly depends on the experimental variants and the years of study, but does not depend on their interaction. This implies that the differences in the number of leaves per shoot between the experimental variants within each year are statistically significant and have a sufficient level of statistical significance.

The indicator Leaf Blade Area (cm^2/leaf) showed no significant differences among the experimental variants (onto BxR Kober 5BB - $F_{Variants}$ 0.6ns; onto RxR 101-14 - $F_{Variants}$ 0.1ns). However, significant differences in this indicator were observed across the years of research (onto BxR Kober 5BB - F_{Years} 894.6^{***}; onto RxR 101-14 - F_{Years} 236.9^{***}). It can be concluded that the years of research have a significant impact on this trait. The interaction between the factors of variants and years of research was also not revealed. Changes of data on Leaf Blade development is related to inadequate meteorological conditions during the years of research. In favourable years (2017-2018), the Leaf Blade Area in the control variant measures 138.6±0.4-144.6±0.4 cm^2/leaf (BxR Kober 5BB) and 131.6±3.2-141.0±2.6 cm^2/leaf (RxR 101-14). In the subsequent years, there is a consistent decrease in Leaf Blade Area, which is attributed to reduced precipitation and elevated average monthly air temperatures during the vegetative period. For instance, in 2020, the Leaf Blade Area decreased by 1.7-1.8 times compared to 2017-2018. Thus, the analysis of the results regarding the development of the Leaf Blade Area in clone R5 Cabernet Sauvignon onto BxR Kober 5BB and onto RxR 101-14 indicates a statistically significant dependence of this indicator on the years of research.

It has been found that throughout all years of the research, the highest values of Leaf Area per shoot (dm^2/shoot) are observed in grapevines obtained from vines grafted using the first cutting taken from the base of the stock cane (EG 1). Through an in-depth analysis of the Leaf Area per shoot data indicator (dm^2/shoot), we have unearthed an interaction among the experimental variants, research years, and their interplay. Notably, it has been established that a significant association exists among the experimental variants, which wield influence over the Leaf Area per shoot (Cl R5 Cabernet Sauvignon onto BxR Kober 5BB - $F_{Variants}$ 257.0^{***}; Cl R5 Cabernet Sauvignon onto RxR 101-14 - $F_{Variants}$ 167.3^{***}), underscoring the substantial impact of differences between experimental variants on this indicator. Moreover, the years of research exert a considerable effect on the Leaf Area per shoot (Cl R5 Cabernet Sauvignon onto BxR Kober 5BB - F_{Years} 2646.6***; Cl R5 Cabernet Sauvignon onto RxR 101-14 - F_{Years} 1361.6^{***}), signifying the pivotal role played by variations in research years in reshaping this particular measure. Furthermore, the interaction between experimental variants and research years bears a discernible influence on the Leaf Area per shoot (onto BxR Kober 5BB - $F_{Variants*Years}$ 52.0^{***}; onto RxR 101-14 - $F_{Variants*Years}$ 2.4^{***}). The cumulative effect of experimental variants and research years indeed holds statistical significance for this indicator. These findings from the analysis underscore a robust and statistically significant relationship between experimental variants, research years, and the leaf area per shoot indicator.

Table 5.18. Development of Leaf Surface Area Depending on the Different Quality of Vines.
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

Leaf Area, m^2 per vine								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	12.4±0.2 k-n	15.0±0.1 f-i	19.9±0.1 bc	18.3±0.1 cde	12.3±0.2 k-o	6.1±0.1 u	9.5±0.1 rs	13.4±0.5 C
EG 1	14.6±0.1 f-j	17.9±0.5 de	23.8±0.4 a	21.4±0.3 b	15.2±0.2 fgh	7.4±0.1 tu	11.7±0.5 m-q	16.0±0.6 A
EG 2	13.4±0.3 i-l	16.0±0.2 f	21.5±0.3 b	19.4±0.3 cde	13.2±0.4 j-m	6.9±0.2 tu	10.5±0.3 pqr	14.4±0.6 B
EG 3	12.1±0.2 l-p	15.4±0.4 fg	19.4±0.3 cd	17.7±0.5 e	12.2±0.2 k-p	5.9±0.2 u	9.2±0.2 rs	13.1±0.5 C
EG 4	11.3±0.3 n-q	13.7±0.3 h-k	17.8±0.3 de	14.3±0.3 g-j	10.3±0.2 qr	4.3±0.3 v	7.1±0.3 tu	11.2±0.5 D
EG 5	10.2±0.3 qr	10.7±0.3 o-r	15.5±0.5 fg	12.3±0.6 k-o	8.5±0.3 st	3.9±0.2 v	6.3±0.3 u	9.6±0.4 E
Mean	12.3±0.2 D	14.8±0.3 C	19.7±0.4 A	17.2±0.4 B	11.9±0.3 D	5.7±0.2 F	9.0±0.3 E	13.0±0.2
ANOVA								
$F_{Variants}$ 392.0*** F_{Years} 1476.4*** $F_{Variants*Years}$ 6.6***								
Leaf Area, thousands of m^2 per hectare								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	30.2±0.4 klm	36.4±0.2 fg	48.2±0.3 c	44.3±0.3 d	29.8±0.4 lmn	14.7±0.2 vw	23.1±0.3 rs	32.4±1.3 C
EG 1	35.4±0.4 fgh	43.3±0.3 d	57.8±0.3 a	51.9±0.3 b	36.9±0.4 efg	18.1±0.3 u	28.3±0.2 mno	38.8±1.5 A
EG 2	32.4±0.3 ijk	38.9±0.3 e	52.1±0.4 b	47.1±0.8 c	32.1±0.3 jkl	16.7±0.2 uvw	25.3±0.3 pqr	35.0±1.4 B
EG 3	29.3±0.4 mn	37.4±0.4 ef	47.0±0.5 c	43.0±0.6 d	29.5±0.4 mn	14.4±0.3 w	22.3±0.4 st	31.8±1.3 C
EG 4	27.4±0.8 nop	33.2±0.3 hij	43.1±0.3 d	34.7±0.6 ghi	25.0±0.5 qr	10.4±0.4 x	17.1±0.3 uv	27.3±1.2 D
EG 5	24.7±0.6 qrs	25.9±0.6 opq	37.6±0.4 ef	29.8±0.8 lm	20.6±0.7 t	9.6±0.5 x	15.3±0.4 vw	23.4±1.1 E
Mean	29.9±0.5 D	35.9±0.7 C	47.6±0.8 A	41.8±1.0 B	29.0±0.7 E	14.0±0.4 G	21.9±0.6 F	31.4±0.6
ANOVA								
$F_{Variants}$ 1097.1*** F_{Years} 4128.1*** $F_{Variants*Years}$ 18.4***								
Leaf Area Index, m^2/m^2								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	3.01±0.06 k-n	3.64±0.04 f-i	4.82±0.03 bc	4.44±0.03 cde	2.98±0.06 k-o	1.48±0.02 u	2.30±0.02 rs	3.24±0.13 C
EG 1	3.54±0.03 f-j	4.35±0.12 de	5.78±0.09 a	5.20±0.08 b	3.67±0.05 fgh	1.81±0.03 tu	2.83±0.13 m-q	3.88±0.16 A
EG 2	3.24±0.07 i-l	3.87±0.06 f	5.20±0.07 b	4.70±0.08 cde	3.19±0.09 j-m	1.67±0.04 tu	2.55±0.08 pqr	3.49±0.14 B
EG 3	2.92±0.05 l-p	3.74±0.09 fg	4.71±0.07 cd	4.30±0.11 e	2.96±0.05 k-p	1.44±0.05 u	2.23±0.04 rs	3.18±0.13 C
EG 4	2.73±0.08 n-q	3.33±0.07 h-k	4.31±0.06 de	3.46±0.08 g-j	2.49±0.06 qr	1.03±0.06 v	1.73±0.08 tu	2.73±0.13 D
EG 5	2.46±0.07 qr	2.59±0.08 o-r	3.75±0.13 fg	2.97±0.14 k-o	2.05±0.08 st	0.95±0.06 v	1.52±0.07 u	2.33±0.11 E
Mean	2.98±0.05 D	3.58±0.08 C	4.76±0.09 A	4.18±0.10 B	2.89±0.07 D	1.39±0.04 F	2.19±0.07 E	3.14±0.06
ANOVA								
$F_{Variants}$ 393.0*** F_{Years} 1474.4*** $F_{Variants*Years}$ 6.5***								

*Ns: not significant, *: significant at $p\leq0.1$, **: significant at $p\leq0.01$, ***: significant at $p\leq0.001$*

Table 5.19. Development of Leaf Surface Area Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto RxR 101-14.

Leaf Area, m^2 per vine								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	10.5±0.3 k-n	13.7±0.3 fg	17.1±0.2 bc	15.4±0.2 de	10.9±0.2 j-m	5.2±0.2 stu	8.3±0.1 q	11.6±0.5 C
EG 1	12.7±0.2 ghi	16.0±0.3 cd	20.3±0.3 a	18.4±0.4 b	13.3±0.2 gh	5.8±0.3 st	10.0±0.2 m-p	13.8±0.6 A
EG 2	11.8±0.3 ijk	13.7±0.3 fg	17.9±0.5 b	15.4±0.2 de	11.6±0.2 ijk	5.1±0.2 stu	9.0±0.2 opq	12.1±0.5 B
EG 3	10.7±0.3 j-m	12.7±0.3 ghi	16.3±0.3 cd	14.0±0.3 efg	10.4±0.3 k-o	4.8±0.1 tuv	7.8±0.2 qr	11.0±0.4 D
EG 4	9.1±0.2 n-q	11.5±0.3 i-l	15.0±0.4 def	12.0±0.4 hij	8.9±0.2 pq	3.8±0.2 uv	6.4±0.2 rs	9.5±0.4 E
EG 5	8.2±0.2 q	10.1±0.3 l-p	13.6±0.3 fg	10.9±0.2 j-m	7.9±0.2 q	3.4±0.1 v	5.8±0.2 st	8.6±0.4 F
Mean	10.5±0.2 D	13.0±0.3 C	16.7±0.3 A	14.4±0.3 B	10.5±0.2 D	4.7±0.1 F	7.9±0.2 E	11.1±0.2
ANOVA								
$F_{Variants}$ 351.2*** F_{Years} 1411.2*** $F_{Variants*Years}$ 5.6***								
Leaf Area, thousands of m^2 per hectare								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	25.5±0.4 mn	33.1±0.6 hi	41.4±0.3 cd	37.4±0.4 ef	26.4±0.3 k-n	12.5±0.4 u	20.2±0.5 qrs	28.1±1.1 C
EG 1	30.8±0.6 ij	38.8±0.6 def	49.2±0.6 a	44.7±0.8 b	32.1±0.5 hi	14.1±0.5 tu	24.2±0.5 nop	33.4±1.4 A
EG 2	28.5±0.4 jkl	33.3±0.6 hi	43.4±0.8 bc	37.3±0.6 ef	28.2±0.4 jkl	12.5±0.2 u	21.9±0.4 opq	29.3±1.2 B
EG 3	26.0±0.4 lmn	30.8±0.5 ij	39.6±0.7 de	34.0±0.5 gh	25.2±0.5 n	11.6±0.3 uv	18.9±0.3 s	26.6±1.1 D
EG 4	22.1±0.5 opq	28.0±0.5 klm	36.4±0.6 fg	29.0±0.6 jk	21.7±0.5 pqr	9.2±0.2 vw	15.5±0.5 t	23.1±1.0 E
EG 5	19.9±0.4 qrs	24.5±0.5 no	33.0±0.5 hi	26.5±0.4 k-n	19.1±0.4 rs	8.2±0.2 w	14.2±0.4 tu	20.8±0.9 F
Mean	25.5±0.5 D	31.4±0.6 C	40.5±0.7 A	34.8±0.8 B	25.5±0.6 D	11.4±0.3 F	19.2±0.5 E	26.9±0.5
ANOVA								
$F_{Variants}$ 612.4*** F_{Years} 2475.2*** $F_{Variants*Years}$ 9.8***								
Leaf Area Index, m^2/m^2								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	2.55±0.08 j-n	3.31±0.07 fg	4.14±0.03 bc	3.74±0.06 de	2.64±0.06 j-m	1.25±0.04 rst	2.02±0.05 p	2.81±0.11 C
EG 1	3.08±0.06 ghi	3.88±0.08 cd	4.92±0.07 a	4.47±0.09 b	3.21±0.07 gh	1.41±0.07 rs	2.42±0.06 mno	3.34±0.14 A
EG 2	2.85±0.08 ijk	3.33±0.07 fg	4.34±0.11 b	3.73±0.06 de	2.82±0.04 ijk	1.25±0.03 rst	2.19±0.04 op	2.93±0.12 B
EG 3	2.60±0.06 j-m	3.08±0.07 ghi	3.96±0.08 cd	3.40±0.07 efg	2.52±0.08 k-o	1.16±0.03 stu	1.89±0.04 pq	2.66±0.11 D
EG 4	2.21±0.05 nop	2.80±0.06 i-l	3.64±0.09 def	2.90±0.11 hij	2.17±0.05 op	0.92±0.04 tu	1.55±0.05 qr	2.31±0.10 E
EG 5	1.99±0.05 p	2.45±0.07 l-o	3.30±0.08 fg	2.65±0.04 j-m	1.91±0.04 p	0.82±0.02 u	1.42±0.03 rs	2.08±0.09 F
Mean	2.55±0.05 D	3.14±0.06 C	4.05±0.07 A	3.48±0.08 B	2.55±0.06 D	1.14±0.03 F	1.91±0.05 E	2.69±0.05
ANOVA								
$F_{Variants}$ 347.1*** F_{Years} 1398.9*** $F_{Variants*Years}$ 5.5***								

*Ns: not significant, *: significant at $p \leq 0.1$, **: significant at $p \leq 0.01$, ***: significant at $p \leq 0.001$*

The Leaf Surface Area of a shoot, a vine, and a vineyard gradually increases, depending on the number of shoots (load) and the leaves developed on them.

According to A. Amirdzhanov [154], at the beginning of flowering, the leaf surface area constitutes 15...30% of its maximum size, and after 20...25 days after flowering, it reaches 60...65%. The maximum Leaf Surface Area is reached at the beginning of berry ripening.

The development of leaves on vines occurs unevenly and depends on a variety of internal and external factors: the number of shoots developed on the vines, the number of leaves developed on the shoots, the area of Leaf Blades, the arrangement of vines in space (slope steepness, exposure, and position on the slope), as well as a complex of agronomic practices [13].

The Leaf Area per vine of the R5 clone of Cabernet Sauvignon in 2017 at the end of the vegetation period in the control variant onto BxR Kober 5BB was 19.9±0.1 (bc) m^2/vine, and onto RxR 101-14 it was 17.1±0.2 (bc) m^2/vine (tab. 6.7, tab. 6.8). Grapevines obtained from grafted vines using 1^{st}-3^{rd} cuttings from the base of the stock cane (EG 1, EG 2, EG 3) showed an increase in Leaf Area as follows: onto BxR Kober 5BB, it was 23.8±0.4 (a) m^2/vine; 21.5±0.3 (b) m^2/vine; 19.4±0.3 (cd) m^2/vine (tab. 6.7). Cl R5 Cabernet Sauvignon onto RxR 101-14 was 20.3±0.3 (a) m^2/vine; 17.9±0.5 (b) m^2/vine; 16.3±0.3 (cd) m^2/vine (tab. 5.18). On vines received using stock cuttings from the top-cane (EG 4, EG 5), a decrease in leaf surface area by 1.1-1.2 times is observed, when grafted onto both rootstock varieties BxR Kober 5BB and RxR 101-14.

The same developmental pattern in terms of Leaf Surface Area is observed and for vineyard plantations (thousand of m^2/hectare) (tab. 6.7, tab. 6.8). These indicators depend on both experimental variants ($F_{Variants}$ 612.4***), the year of research (F_{Years} 2475.2***), as well as the interaction between variants and years of research ($F_{VariantsYears}$ 9.8***). Calculations of the Leaf Area of the vineyards of the studied clone grafted onto BxR Kober 5BB and RxR 101-14, revealed variations influenced by the different quality of the vines and a complex of meteorological conditions during their growth. In favourable years (2017), the Leaf Area reaches 48.2±0.3 and 41.4±0.3 thousand of m^2/hectare in the control variants. The highest indicators are characterised by grapevines grown from vines obtained by using cuttings from the first two metres from the base of the stock cane EG 1, EG 2 and EG 3, whereas when using cuttings from the top of stock cane, these indicators are significantly lower EG 4 and EG 5. This dependence is observed for all years of the research. During the analysis in the context of the years of the research, it was revealed that the highest indicators leaf surface area per hectare are characterised by vines (all variants) in 2017, decreasing indicators in 2020, which is due to unfavourable weather conditions, which were formed from the end of 2019 and throughout 2020.

According to A.A. Nichiporovich's research [287, 288], under natural field conditions, optimal Leaf Area for achieving the highest total photosynthesis is found in crops with a Leaf Area of 40-50 thousand m^2 per hectare or those with a Leaf Index of 4-5. Crops exhibit an optimal structure and developmental pattern of the assimilatory surface when the leaf area rapidly increases to 40 thousand m^2 per hectare. Subsequently, depending on the length of the plants' vegetative period, it remains active at the same level for an extended period. Eventually, it significantly decreases or completely withers, reallocating the assimilates for the formation of reproductive or storage organs.

It is characteristic that the development of grapevine Leaf Area depends on the rootstock variety onto which they are grafted. When grafted onto RxR 101-14, compared to BxR Kober 5BB in the control variant, the Leaf Area of shoots, vines and vineyard plantations decreases by 1.1-1.2 times, amounting to 29.9±0.4 dm^2/shoot, 11.1±0.2 m^2/vine, 26.9±0.5 thousand of m^2/hectare. A reduction in Leaf Area is observed when using 4^{th} (EG 4) and 5^{th} (EG 5) cuttings for grafting. In unfavourable years, the growth parameters of shoot, vine and vineyards Leaf Area sharply decrease.

We have established a positive linear correlation between the Length of Shoots and the area of their Leaf Areas. The correlation coefficients are high, ranging from $r = 0.96$ to 0.98. Research by A. Amirdzhanov [154], A. Shtirbu A.V. [335], A. Derendovskaia et al. [183] has also shown that a strong correlation exists between the Leaf Surface Area of each shoot and their individual length.

The developed Leaf Surface is a fundamental parameter of plant photosynthetic activity. The growth of biomass of plant organs and their productivity depends on its development.

When assessing a vineyard as an optical-biological photosynthetic system, the Leaf Area Index (LAI) is used [183]. The Leaf Area Index, or foliage cover index, represents the ratio of the Leaf Area of the plant cover to the area of the soil it occupies. The Leaf Area Index is one of the key indicators characterizing the ability of leaves to capture solar energy [224, 290].

The Leaf Area Index of the R5 clone of Cabernet Sauvignon varies depending on the different quality of the vines, growing conditions, and the year of the research. Under favourable conditions, the Leaf Area Index ranges from 3.75±0.13 to 5.78±0.09 m^2/m^2 (onto BxR Kober 5BB) and from 3.30±0.08 to 4.92±0.07 m^2/m^2 (onto RxR 101-14) (tab. 6.7, tab. 6.8). It significantly decreases under unfavourable conditions (2020-2021). Inhibition of Leaf Blade Area growth due to high temperatures and water deficiency leads to a reduction in the Leaf Area of shoots, vines, and vineyards.

It has also been shown by K. Stoyev [317] that the growth intensity of grafted plant leaves is significantly influenced by the root system of the rootstock. Typically, the most vigorous growth of Leaf Area is observed when grafted onto vigorously growing rootstocks, while the least intense growth occurs on weakly growing rootstocks and when cultivating fruiting varieties in their own-rooted culture.

The growth and development of the assimilating surface of grape plants depend not only on the biological characteristics of varieties and the influence of rootstocks but also on cultivation conditions. For instance, the largest productive Leaf Area (up to 12 m^2/vine) in cultivated grape varieties is achieved through the training of vines using the Single-Armed and Double-Armed Guyot-Shaped. With a smaller in the case of a small Head-Shape it reaches 8-9 m^2 [319]. On a Two-Plane Trellis System, up to 23,000 m^2 of Leaf Area develops per hectare, on a Pergola Trellis System – 21,800 m^2, on a Vertical Trellis System - 16,000 m^2 and in a Sprawling System - 8,000 m^2 [134].

With increasing vine load, the total leaf surface of shoots increases, but the average size of leaves decreases, and they become smaller [309]. In denser planting there are 3.26 per 1 m^2 of feeding area, in sparse planting - 2.55 m^2 of Leaf Area [154].

Analysing the data of literature K. Stoev [319] notes that significant variations of Leaf Area in grape plants, established by different authors, are connected with different conditions of cultivation of varieties and their specific biological features. The relationship has been proved between the Growth of One Annual Shoot and the Leaf Area formed on them, on the one hand, and the quantity and quality of grapes, on the other hand, and Leaf Productivity, on the third hand. The total accumulation of assimilates is proportional to the Leaf Area per hectare and is in full synchrony with the obtained yield per hectare. Thus, the yield is conditioned by Leaf Area and received solar radiation.

5.2.1.3. Productivity of Vineyards

According to A. Derendovskaia, A. Shtirbu [183], the biological model of productivity developed by many authors shows which elements make up the value of economic yield and at the expense of which of them it is possible to increase the yield in this or that case.

The structural formula for the yield per unit area of a vineyard can be summarised as follows:

$$\mathbf{Y_{ec.} = N_{pl} \cdot N_{sh} \cdot K_1 \cdot W \cdot 0{,}00001} \quad (6.1)$$

where: $\mathbf{Y_{ec}}$ – Yield Economic, Cluster Yield, tonnes per hectare; $\mathbf{N_{pl}}$ – Number of Plants, pieces per hectare; $\mathbf{N_{sh}}$ – Number of Shoots, pieces per vine; $\mathbf{K_1}$ – Coefficient of Fruiting (number of clusters/number of developed shoots); **W** – Weight of Clusters, in grams; **0,00001** – Multiplier to Convert Yield into Tonnes.

The value of $\mathbf{N_{pl}}$ (number of plants per area) for the same variety can be different, depending on both the structure of the plantation and the feeding area. Indicators $\mathbf{N_{sh}}$ (Number of Shoots per Vine), $\mathbf{K_1}$ (Coefficient of Fruiting) and **W** (Weight of Clusters) are relatively stable and depend on the biological characteristics of grape varieties [315].

At the same time, indicator $\mathbf{Y_{ec}}$ – Yield Economic, as a biological trait, depends on a) the ability of the variety to set fruit buds and b) to bear a certain load of vines with yield, without weakening the strength of shoot growth [222].

To assess the productivity of shoots of grape varieties, the fruiting coefficient ($\mathbf{K_1}$) is used, indicating the number of clusters developed on a single shoot that grew during the vegetation period from a dormant bud (eye). It was found that in the studied clone R5 of Cabernet-Sauvignon variety indicator $\mathbf{K_1}$ is 1.09-1.10 and insignificantly varies by years and variants of the experiment.

It has been demonstrated that the cluster weight varies depending on meteorological conditions that are inadequate in the years of the research (tab. 5.20). For instance, during the favourable years of 2015-2018, the cluster weight in the control grup with grafting onto BxR Kober 5BB ranged from 97.6±0.8 g to 130.3±3.0 g and sharply decreased during adverse meteorological conditions in 2020, reducing the average cluster weight to 55.9 g.

When grafted onto RxR 101-14, compared to BxR Kober 5BB, the average cluster weight decreases and is 95.4±1.9 g – 120.4±2.7 g in favourable years and also decreases in unfavourable years, 2020-2021 (tab. 5.21). It is demonstrated that on grapevines grown from vines when used for grafting 1^{st}-3^{rd} cuttings from the base of the stock cane (EG 1, EG 2, EG 3), the average cluster weight increases by 1.1-1.2 times compared to the control variant. This effect is consistent regardless of the rootstock variety. However, the average cluster weight decreases when 4^{th} (EG 4) and 5^{th} (EG 5) cuttings of the stock cane are used for grafting.

Table 5.20. Yield Indicators of Grapevines Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

Number of Clusters, pcs								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	44.8±0.8 a-h	43.0±1.0 b-i	46.9±1.0 a-e	47.4±1.3 abc	45.3±0.8 a-g	32.6±1.9 mno	40.8±1.5 e-k	43.0±0.7 BC
EG 1	47.4±0.9 abc	47.8±1.2 ab	49.6±0.9 a	48.5±1.2 ab	47.8±1.6 ab	36.7±1.6 j-n	45.9±0.6 a-f	46.2±0.7 A
EG 2	45.2±0.7 a-g	46.3±1.5 a-e	49.4±1.3 a	47.1±1.0 a-d	45.0±1.0 a-h	34.3±1.7 lmn	42.9±1.1 b-i	44.3±0.7 B
EG 3	43.6±0.3 a-i	45.5±0.9 a-g	46.2±1.0 a-e	45.7±0.9 a-g	42.9±1.0 b-i	31.7±1.3 nop	39.6±1.2 g-l	42.2±0.7 C
EG 4	43.0±1.0 b-i	42.8±0.9 b-j	41.5±1.0 c-k	38.9±0.8 h-l	37.9±1.0 i-m	27.7±1.6 op	34.6±0.9 lmn	38.1±0.7 D
EG 5	41.1±1.1 d-k	34.0±0.8 lmn	39.8±0.9 f-l	35.6±0.8 k-n	34.5±0.7 lmn	26.3±1.2 m-p	31.9±0.5	34.7±0.6 E
Mean	44.2±0.4 AB	43.2±0.7 BC	45.6±0.6 A	43.9±0.7 ABC	42.2±0.7 C	31.6±0.8 E	39.3±0.7 D	41.4±0.3
ANOVA								
$F_{Variants}$ 103.3***								
F_{Years} 111.6***								
$F_{Variants*Years}$ 2.0**								
Weight of Clusters, g								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	97.6±0.8 m-p	125.4±2.6 fgi	130.3±3.0 e-h	125.3±2.9 fgi	98.7±1.7 l-o	55.9±1.5 t	83.9±2.0 qrs	102.4±3.1 D
EG 1	120.5±2.0 hi	150.2±2.0 a	149.1±2.0 a	146.3±1.6 ab	115.5±3.2 ij	58.4±1.6 t	87.6±1.0 pqr	118.2±4.0 A
EG 2	109.1±1.5 jkl	142.8±2.1 a-d	144.6±2.6 abc	137.9±2.8 b-e	107.9±1.5 j-m	57.5±1.2 t	86.3±1.4 qrs	112.4±3.7 B
EG 3	106.4±1.7 j-m	132.4±1.5 d-g	142.5±2.6 a-d	136.3±2.6 b-e	100.6±2.1 k-n	55.3±1.6 t	83.0±2.8 rs	108.1±3.6 C
EG 4	97.2±2.0 m-p	123.8±1.5 ghi	135.2±2.1 c-f	120.9±1.8 hi	93.9±1.2 n-q	52.5±1.2 t	78.8±1.7 rs	100.3±3.3 D
EG 5	88.5±1.4 opr	120.5±1.7 hi	120.8±1.6 hi	109.4±1.5 jk	86.1±0.8 qrs	50.7±1.1 t	76.1±1.5 s	93.2±2.9 E
Mean	103.2±1.5 C	132.5±1.6 B	137.1±1.6 A	129.4±1.8 B	100.3±1.5 C	55.1±0.6 E	82.6±0.9 D	105.8±1.5
ANOVA								
$F_{Variants}$ 152.0***								
F_{Years} 1456.6***								
$F_{Variants*Years}$ 5.5***								

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Table 5.21. Yield Indicators of Grapevines Depending on the Different Quality of Vines.
Cl R5 Cabernet Sauvignon onto RxR 101-14.

Number of Clusters, pcs								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	42.9±0.4 e-i	41.2±0.4 g-j	45.7±0.5 a-d	46.2±0.4 abc	43.1±0.6 e-h	27.5±0.4 st	38.6±0.5 k-n	40.7±0.7 B
EG 1	44.2±0.4 cdf	46.3±0.5 abc	46.8±0.6 ab	47.6±0.6 a	45.2±0.5 a-e	31.3±0.3 r	43.5±0.5 dfg	43.6±0.7 A
EG 2	42.5±0.4 f-i	42.7±0.7 e-i	44.7±0.5 b-f	43.0±0.6 e-h	43.0±0.3 e-h	28.3±0.5 s	40.6±0.3 h-k	40.7±0.6 B
EG 3	41.3±0.6 g-j	40.8±0.5 h-k	42.6±0.6 f-i	41.6±0.5 g-j	40.6±0.4 h-k	25.7±0.4 t	36.4±0.4 nop	38.4±0.7 C
EG 4	38.5±0.3 k-n	39.3±0.4 j-m	40.4±0.6 i-l	37.2±0.3 mno	36.7±0.3 nop	25.0±0.3 t	32.6±0.4 qr	35.7±0.6 D
EG 5	36.9±0.4 mno	38.0±0.4 l-o	39.4±0.5 j-m	35.9±0.3 op	34.3±0.4 pq	21.3±0.3 u	31.0±0.5 r	33.8±0.7 E
Mean	41.1±0.4 CD	41.4±0.4 BC	43.3±0.4 A	41.9±0.6 B	40.5±0.5 D	26.5±0.4 F	37.1±0.6 E	38.8±0.3
ANOVA								
$F_{Variants}$ 432.2***								
F_{Years} 946.0***								
$F_{Variants*Years}$ 6.7***								
Weight of Clusters, g								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	95.4±1.9 k-n	122.1±2.8 c-g	124.5±2.7 c-f	120.4±2.7 d-g	96.5±1.3 j-m	53.9±1.7 s	81.4±1.1 pqr	99.2±3.0 C
EG 1	107.1±1.7 hij	144.5±1.4 a	138.1±2.3 ab	132.4±3.2 bc	112.1±2.4 gh	56.8±1.6 s	85.0±1.9 n-r	110.9±3.6 A
EG 2	105.0±1.8 h-k	144.4±3.2 a	132.4±2.9 bc	130.1±2.1 bcd	104.6±2.2 hik	55.5±1.5 s	83.7±1.3 o-r	108.0±3.6 A
EG 3	99.1±1.4 jkl	137.7±3.6 ab	132.1±2.2 bc	123.7±2.0 c-f	96.8±1.6 j-m	52.2±1.5 s	82.5±1.6 pqr	103.4±3.5 B
EG 4	94.8±2.0 k-o	125.7±2.1 cde	113.9±2.0 fgh	115.6±1.5 e-h	91.0±1.2 l-p	51.2±1.2 s	76.5±1.5 qr	95.5±2.9 D
EG 5	87.3±1.9 m-q	100.5±2.0 i-l	105.1±1.4h-k	111.2±1.9 ghi	84.6±1.9	50.3±1.2 s	75.8±1.8 r	87.8±2.4 E
Mean	98.1±1.1 C	129.2±2.3 A	124.4±1.7 B	122.2±1.3 B	97.6±1.4 C	53.3±0.7 E	80.8±0.8 D	100.8±1.4
ANOVA								
$F_{Variants}$ 123.9***								
F_{Years} 1109.9***								
$F_{Variants*Years}$ 7.3***								

*Ns: not significant, *: significant at $p≤0.1$, **: significant at $p≤0.01$, ***: significant at $p≤0.001$*

The biological model of grape productivity, according to Amirdzhanov's findings, is connected with the concepts of "Shoot Productivity" and "Variety Productivity" [154]. Bolgarev defines shoot productivity as the "Average Number of Clusters or Average Yield Weight per One Fruiting Shoot," while variety productivity is described as the "Total Yield Quantity divided by the Load of the Variety." The term "Load" refers to the number of buds left after pruning, typically per vine or unit area. This definition does not take into account the quantity of non-fruiting shoots.

Defining "Shoot Productivity" solely based only on the size of the fruiting shoot yield does not encompass the physiological aspect of crop production, as both leaves from non-fruiting shoots contribute to cluster formation [152]. Therefore, the author suggests that "Shoot Productivity" should be determined by the yield attributed not to a fruiting shoot, but to a developed shoot, taking into account the coefficient of fruiting rather than the coefficient of fruitfulness.

Our conducted research enabled us to determine that the Shoot Productivity of the R5 clone of Cabernet Sauvignon (raw cluster weight produced by the leaf apparatus of plants during the vegetation period per one developed shoot) varies depending on the rootstock variety and meteorological conditions.

Table 5.22. Shoot Productivity of Grapevines Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

Years	Variants						Mean
	CG	EG 1	EG 2	EG 3	EG 4	EG 5	
2015	108.2±2.2 j-n	131.3±3.5 fgh	118.8±2.4 g-k	116.0±1.9 ijk	106.1±1.9 k-o	96.5±2.1 m-q	112.8±1.7 B
2016	131.5±2.2efg	163.5±2.8 a	155.6±3.4abc	144.5±2.0cde	134.8±2.4 ef	129.2±3.2 fgh	143.2±2.0 A
2017	138.3±2.5 def	159.0±2.7 ab	157.7±2.8 ab	152.0±1.7 abc	134.6±2.1 ef	120.2±2.0 g-j	143.6±2.0 A
2018	137.8±3.0 def	159.8±3.3 ab	150.3±2.2 bcd	148.7±1.4 bcd	131.7±2.6 efg	119.1±2.0 g-k	141.2±2.0 A
2019	108.5±2.0 j-m	126.0±3.2 f-i	118.3±2.0 h-k	109.5±1.2 jkl	102.3±2.6 l-p	93.7±1.5 opq	109.7±1.6 B
2020	57.8±2.3 r	60.3±2.0 r	56.9±3.2 r	56.0±1.9 r	58.1±2.5 r	56.3±1.9 r	57.6±0.9 D
2021	91.3±2.7 pq	95.5±0.9 n-q	92.8±2.7 pq	90.0±1.5 pq	87.7±1.7 q	85.8±1.1 q	90.5±0.8 C
Mean	110.5±3.4 D	127.9±4.4 A	121.5±4.3 B	116.7±4.0 C	107.9±3.3 D	100.1±2.9 E	114.1±1.6
ANOVA							
$F_{Variants}$ 126.3***							
F_{Years} 1125.4***							
$F_{Variants*Years}$ 7.0***							

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

The Shoot Productivity of the R5 clone of Cabernet Sauvignon onto BxR Kober 5BB stock in the control variant during 2015-2018 ranges from 108.2±2.2 to 137.8±3.0 grams per shoot (tab. 5.22). On grapevines grown from grafted saplings in variants EG 1, EG 2, EG 3 (when using 1st-3rd cuttings from the base of the stock cane for grafting), the Shoot Productivity increases by 1.1-1.2 times regardless of the year of research. For instance, in 2017, the Shoot Productivity in these variants reached 152.0 to 159.0 grams per shoot. In grapevines grown from grafted saplings, the use of cuttings from the top-cane zone EG 4, EG 5 (4th and 5th cuttings) either maintains the Shoot Productivity at the control level or decreases it.

Table 5.23. Shoot Productivity of Grapevines Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto RxR 101-14.

Years	Variants						Mean
	CG	EG 1	EG 2	EG 3	EG 4	EG 5	
2015	109.7±2.4 h-k	116.6±2.4 ghi	114.4±2.5 ghi	108.0±2.3 h-l	103.3±2.5 i-m	95.2±1.8 lmn	107.9±1.3 C
2016	125.8±3.5 d-g	157.5±2.3 a	157.4±4.9 a	150.1±3.5 ab	137.0±2.7 bcd	112.0±2.8 g-j	140.0±2.6 A
2017	135.7±3.4 cde	148.6±3.6 abc	140.6±3.9 bc	137.9±3.2 bcd	117.4±2.1 ghi	110.4±2.3 h-k	131.8±2.1 B
2018	135.7±3.3 cde	146.6±4.2 abc	142.0±2.6 bc	134.8±2.0 c-f	126.1±2.2 d-g	121.3±2.0 fgh	134.4±1.6 B
2019	105.3±2.2 i-m	122.2±2.5 e-h	115.0±2.5 ghi	105.5±1.7 i-m	99.1±1.6 j-n	92.1±2.6 mn	106.5±1.6 C
2020	52.6±2.2 o	60.1±1.7 o	56.3±2.0 o	50.4±1.6 o	53.1±1.0 o	47.6±1.4 o	53.4±0.8 E
2021	91.9±1.4 mn	96.8±2.2 k-n	94.7±1.7 lmn	93.0±2.4 mn	84.8±2.0 n	85.4±2.4 n	91.1±1.0 D
Mean	108.1±3.4 C	121.2±4.0 A	117.2±4.0 B	111.4±3.9 C	103.0±3.2 D	94.9±2.8 E	109.3±1.5
ANOVA							
$F_{Variants}$ 95.8* **							
F_{Years} 828.6* **							
$F_{Variants*Years}$ 5.6* **							

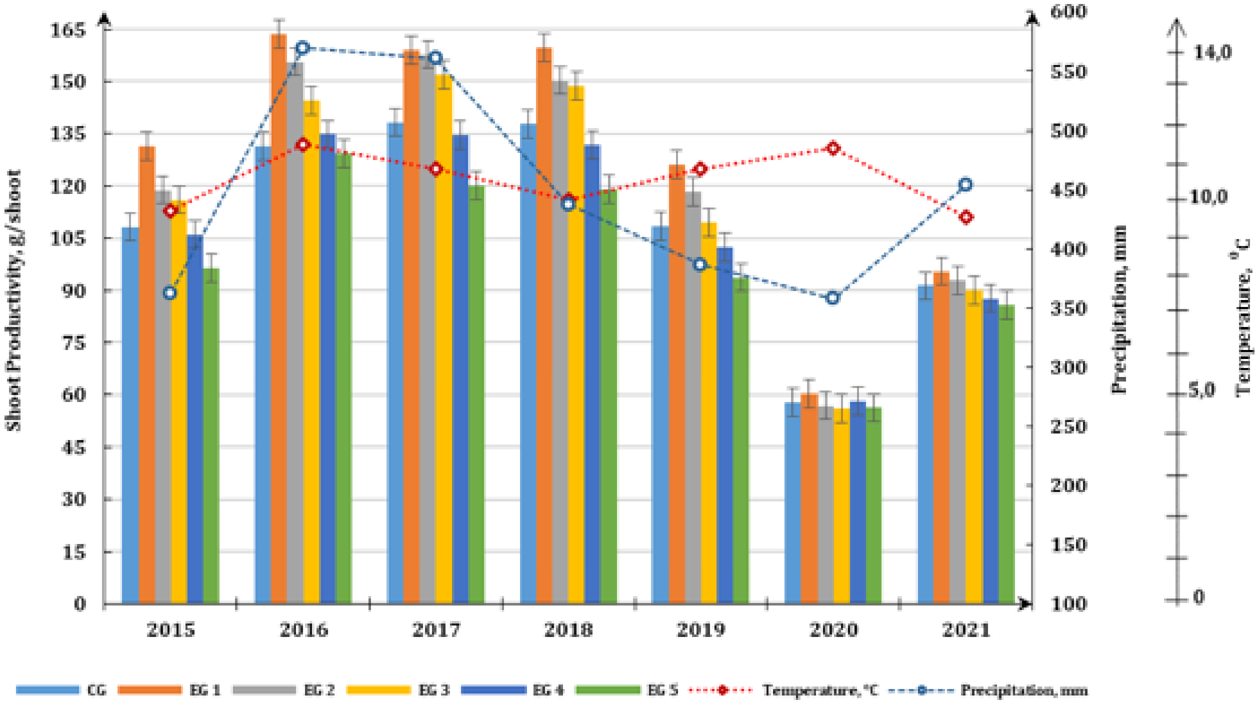
*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

It is characteristic that when grafted onto RxR 101-14, compared to BxR Kober 5BB, the development of Leaf Area decreases by 1.1-1.2 times, which affects the Shoot Productivity (tab. 5.23). Thus, in favourable years, in control variants, Shoot Productivity ranges from 109.7±2.4 to 135.7±3.3 grams per shoot, while in variants EG 1, EG 2, EG 3 (using 1st-3rd cuttings from the base of the stock cane), it reaches from 137.9±3.2 to 148.6±3.6 grams per shoot. A reduction in the size of Shoot Productivity is observed in EG 4, EG 5 variants (grapevines grown from grafted saplings using 4th and 5th cuttings from the top-cane of the stock). In unfavourable years, shoot productivity decreases.

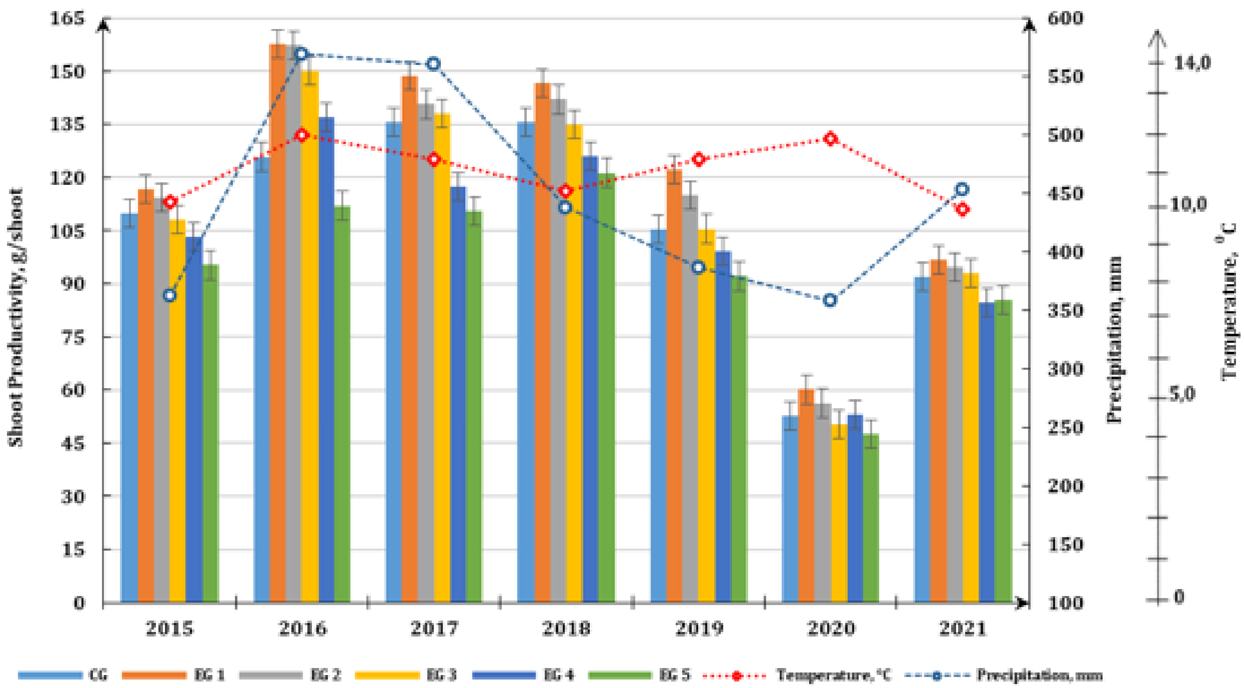
The productivity of grapevines, or the ability of grape plants to produce biological or economically valuable products during the growing season, depends on the Leaf Area of the plant, the efficiency of their functioning, and the duration of the yield formation period [152]. In this regard, the Economic Productivity (Yield per Vine) is determined by indicators of fruitfulness.

In a generalized form, the economic productivity of grapevines represents the product of the Number of Shoots per vine and the Shoot Productivity.

It has been established that the Shoot Productivity of the studied grapevine clones hinges on meteorological conditions, which do not consistently unfold in the years of the research.



Cl R5 Cabernet Sauvignon onto BxR Kober 5BB



Cl R5 Cabernet Sauvignon onto RxR 101-14

Fig. 5.12. Shoot Productivity of Grapes Depending on Different Quality of Vines and Meteorological Conditions.

It has been established that the Shoot Productivity of the studied grapevine clones' hinges on meteorological conditions, which do not consistently unfold in the years of the research. (fig. 5.12).

So, in 2017, the amount of precipitation was 560.4 mm, and the Shoot Productivity in the control variants was 138.3 grams per shoot (Clone R5 Cabernet Sauvignon onto BxR Kober 5BB) and 135.7 grams per shoot (Clone R5 Cabernet Sauvignon onto RxR 101-14). In 2018, 2019, and 2020, there was a decrease in precipitation to 437.6 mm, 386.5 mm, and 357.8 mm, respectively. At the same time, during these years, there was an increase in average annual temperature values to 11.6°C, 12.5°C, and 13.1°C, respectively. Thus, these changes in meteorological conditions lead to a reduction in Shoot Productivity. In 2020, Shoot Productivity decreased to 57.8 grams per shoot in the control variants (Clone R5 Cabernet Sauvignon onto BxR Kober 5BB) and 52.6 grams per shoot (Clone R5 Cabernet Sauvignon onto RxR 101-14). In 2021, an increase in precipitation to 453.3 mm and a decrease in the average annual temperature to 11.1°C led to a partial recovery of the vines and an increase in Shoot Productivity.

We established a positive linear correlation between Shoot Leaf Surface Area development and Shoot Productivity (r = 0.96-0.97) (fig. A 6.1, fig. A 6.2).

The yield of vines is composed of the load of vines with shoots and their productivity. The Economic Productivity of vineyards (Yield) depends on the total Economic Productivity of vines and can be Potential, Embryonic, and Actual.

We have established that the yield of vineyards of clone R5 Cabernet Sauvignon, grown under the conditions of SC "Tomai-Vinex" SA, depends on shoot productivity and varies from year to year. Thus, in the years 2015-2018, when grafting the vines onto BxR Kober 5BB, the yield in the control variant ranged from 4.09 to 5.69 kg per vine or 9.92 to 13.79 tons per hectare (tab. 5.24, tab. 5.25).

The yield of vines grown from grafted saplings when used for grafting 1^{st}-3^{rd} cuttings from the base of the stock cane increases 1.1-1.2 times and is 4.73-6.46 kg per vine or vineyards – 11.47-15.67 tons per hectare, especially in favourable weather years (2017). Whereas, the yield of vines grown from grafted vines when used for grafting cuttings from the top-cane (4^{th} and 5^{th} cuttings) is at the level of control or decreases. A similar pattern is observed when grafting the clone R5 of Cabernet Sauvignon onto the RxR 101-14 stock. Thus, a prolonged effect of the different quality of grafted saplings on the growth, development, and productivity of the grapevines and vineyards is observed.

Table 5.24. Vineyard Productivity Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

Yield, kg per vine								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	4.37±0.09 n-r	5.39±0.07 jk	6.11±0.09 d-g	5.94±0.14 f-i	4.47±0.08 m-q	1.82±0.08 z	3.42±0.10 v	4.50±0.17 D
EG 1	5.71±0.14 g-j	7.18±0.14 a	7.40±0.12 a	7.10±0.16 ab	5.52±0.13 ij	2.14±0.06 yz	4.02±0.04 q-u	5.58±0.22 A
EG 2	4.93±0.09klm	6.61±0.14 bc	7.14±0.11 a	6.50±0.09 cde	4.86±0.11 lmn	1.97±0.11 z	3.70±0.11 s-v	5.11±0.21 B
EG 3	4.64±0.07m-p	6.02±0.07 e-h	6.58±0.06 cd	6.23±0.06 c-f	4.32±0.06 o-r	1.75±0.06 z	3.29±0.06 x	4.69±0.20 C
EG 4	4.18±0.07 p-s	5.30±0.09 jkl	5.61±0.08 hij	4.70±0.08 mno	3.56±0.08 uv	1.45±0.06 z	2.73±0.06 yz	3.93±0.17 E
EG 5	3.64±0.07 tuv	4.10±0.09 q-t	4.81±0.09 l-o	3.89±0.07 r-v	2.97±0.04 xy	1.33±0.05 z	2.43±0.03 yz	3.31±0.13 F
Mean	4.58±0.09 C	5.77±0.14 B	6.27±0.12 A	5.73±0.15 B	4.27±0.12 D	1.74±0.05 F	3.27±0.08 E	4.52±0.08
ANOVA								
$F_{Variants}$ 576.9***								
F_{Years} 1925.6***								
$F_{Variants*Years}$ 15.0***								
Yield, centner per hectare								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	105.9±2.2m-q	130.7±1.7 ij	148.1±2.0 c-f	144.0±3.2 e-h	108.4±1.8 l-p	44.2±1.9 z	83.0±2.4 uv	109.2±4.2 D
EG 1	138.5±3.4 f-i	174.0±3.3 a	179.3±2.9 a	172.1±3.8 a	133.8±3.2 hi	51.9±1.5 yz	97.5±0.8 p-t	135.3±5.3 A
EG 2	119.5±2.1 jkl	160.3±3.3 b	173.2±2.5 a	157.4±2.1 bcd	117.8±2.6 klm	47.8±2.6 yz	89.7±2.6 r-v	123.8±5.1 B
EG 3	112.5±1.7 l-o	146.0±1.7 d-g	159.6±1.2 bc	151.0±1.5 b-e	104.6±1.3 n-q	42.5±1.3 z	79.7±1.4 v	113.7±4.8 C
EG 4	101.3±1.6 o-r	128.4±2.2 ijk	136.0±1.9 ghi	114.0±1.9 lmn	86.3±1.8 tuv	35.2±1.5 z	66.1±1.3 xy	95.3±4.0 E
EG 5	88.2±1.8 s-v	99.3±2.1 p-s	116.5±2.1 lm	94.4±1.5 q-u	72.0±1.0 uv	32.4±1.0 z	58.8±0.7 yz	80.2±3.2 F
Mean	111.0±2.2 C	139.8±3.3 B	152.1±2.9 A	138.8±3.6 B	103.6±2.8 D	42.3±1.1 F	79.1±1.8 E	109.6±2.0
ANOVA								
$F_{Variants}$ 598.8***								
F_{Years} 1998.9***								
$F_{Variants*Years}$ 15.6***								

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Table 5.25. Vineyard Productivity Depending on the Different Quality of Vines.
Cl R5 Cabernet Sauvignon onto RxR 101-14.

Yield, kg per vine								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	4.09±0.10 l-o	5.03±0.13 ghi	5.69±0.12 cd	5.56±0.13 d-g	4.16±0.08 l-o	1.49±0.06 vw	3.14±0.05 rs	4.17±0.17 C
EG 1	4.73±0.09 h-k	6.69±0.09 a	6.46±0.14 a	6.30±0.18 ab	5.07±0.09 f-i	1.78±0.05 v	3.70±0.09opq	4.96±0.20 A
EG 2	4.47±0.10 j-m	6.17±0.18 abc	5.92±0.16 bcd	5.59±0.11 def	4.50±0.10 j-m	1.57±0.06 vw	3.40±0.07 p-s	4.52±0.19 B
EG 3	4.09±0.08 l-o	5.62±0.13 de	5.63±0.13 de	5.15±0.08 e-h	3.93±0.07 no	1.34±0.04 vw	3.00±0.08 st	4.11±0.18 C
EG 4	3.65±0.09 o-r	4.94±0.10 hij	4.60±0.08 i-l	4.30±0.08 k-n	3.34±0.05 p-s	1.28±0.02 vw	2.50±0.06 tu	3.52±0.15 D
EG 5	3.22±0.06 qrs	3.82±0.10 nop	4.14±0.08 l-o	3.99±0.06 mno	2.90±0.08 st	1.07±0.03 w	2.35±0.07 u	3.07±0.12 E
Mean	4.04±0.07 C	5.38±0.13 A	5.41±0.11 A	5.15±0.11 B	3.98±0.10 C	1.42±0.03 E	3.01±0.07 D	4.06±0.08
ANOVA								
$F_{Variants}$ 350.3***								
F_{Years} 1386.5***								
$F_{Variants*Years}$ 9.7***								
Yield, centner per hectare								
Variants	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
CG	99.2±2.4 k-n	121.9±3.2 gh	137.9±2.9 cd	134.8±3.2 def	100.8±2.1 k-n	35.9±1.4 uv	76.2±1.1 qr	101.0±4.1 C
EG 1	114.7±2.3 g-i	162.2±2.2 a	156.7±3.5 a	152.8±4.2 ab	122.8±2.1 fgh	43.1±1.2 u	89.6±2.1 nop	120.3±4.9 A
EG 2	108.2±2.4 ijl	149.5±4.3 abc	143.5±3.8 bcd	135.6±2.5 de	109.0±2.3 ijl	38.1±1.4 uv	82.4±1.6 o-r	109.5±4.5 B
EG 3	99.2±2.0 k-n	136.2±3.0 de	136.4±3.2 de	124.7±1.8 efg	95.3±1.8 mn	32.5±1.0 uv	72.8±2.0 rs	99.6±4.3 C
EG 4	88.5±2.2 n-q	119.7±2.4 ghi	111.5±1.9 h-k	104.2±1.9 j-m	81.0±1.3 o-r	31.0±0.6 uv	60.5±1.5 st	85.2±3.5 D
EG 5	78.1±1.4 pqr	92.6±2.5 mno	100.4±1.8 k-n	96.8±1.4 lmn	70.3±1.8 rs	26.0±0.7 v	57.0±1.8 t	74.5±3.0 E
Mean	98.0±1.8 C	130.4±3.2 A	131.1±2.8 A	124.8±2.7 B	96.5±2.4 C	34.4±0.8 E	73.1±1.6 D	98.3±1.8
ANOVA								
$F_{Variants}$ 358.2***								
F_{Years} 1419.2***								
$F_{Variants*Years}$ 9.9***								

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Table 5.26. Yield Quality Parameters of Grapevines Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

Mass Sugar Concentration, g/dm^3

Variants	2015	2016	2017	2018	2019	2020	2021	Mean
CG	232±1 j-n	250±1 e-g	235±1 j-m	237±1 i-l	234±2 j-m	297±2 b	253±2 efg	248±3 BC
EG 1	224±1 no	245±2 ghi	228±2 l-o	230±2 k-o	222±2 o	281±2 d	251±2 efg	240±2 D
EG 2	226±1 mno	248±2 fgh	230±2 k-o	235±2 j-m	226±2 mno	283±1 cd	252±1 efg	243±2 D
EG 3	228±2 l-o	253±2 efg	235±2 j-m	237±2 i-l	230±2 k-o	292±2 bc	254±2 efg	247±3 C
EG 4	232±2 j-n	256±1 ef	237±2 i-l	238±2 ijk	232±2 j-n	300±2 b	256±2 ef	250±3 B
EG 5	238±2 ijk	258±2 e	240±2 hij	240±2 hij	236±2 i-l	316±2 a	258±2 e	255±3 A
Mean	230±1 D	252±1 B	234±1 C	236±1 C	230±1 D	295±2 A	254±1 B	247±1
ANOVA								
$F_{Variants}$ 63.4***								
F_{Years} 1029.0***								
$F_{Variants*Years}$ 4.3***								

Mass Concentration of Titratable Acids, g/dm^3

Variants	2015	2016	2017	2018	2019	2020	2021	Mean
CG	8.3±0.03 ghi	8.9±0.08 bcd	8.9±0.04 bcd	8.0±0.05 i	6.0±0.04 n	6.0±0.04 n	8.2±0.06 ghi	7.8±0.14 DE
EG 1	8.5±0.21 efg	9.3±0.06 a	9.1±0.04 abc	8.2±0.05 ghi	6.3±0.06 klm	6.7±0.06 j	8.3±0.02 ghi	8.1±0.13 A
EG 2	8.5±0.13 efg	9.2±0.06 ab	9.0±0.04 a-d	8.1±0.06 hi	6.2±0.04 lmn	6.6±0.07 jk	8.2±0.02 ghi	8.0±0.13 AB
EG 3	8.4±0.06 fgh	9.0±0.06 a-d	8.9±0.04 bcd	8.1±0.03 hi	6.1±0.03 mn	6.5±0.04 jkl	8.2±0.03 ghi	7.9±0.13 BC
EG 4	8.3±0.06 ghi	8.9±0.05 bcd	8.8±0.04 cde	8.0±0.03 i	6.1±0.04 mn	6.4±0.04 j-m	8.1±0.02 hi	7.8±0.13 CD
EG 5	8.1±0.05 hi	8.8±0.03 cde	8.7±0.03 def	8.0±0.04 i	6.0±0.03 n	6.1±0.08 mn	8.0±0.04 i	7.7±0.13 E
Mean	8.3±0.05 C	9.0±0.03 A	8.9±0.02 B	8.1±0.02 E	6.1±0.02 G	6.4±0.04 F	8.2±0.02 D	7.9±0.05
ANOVA								
$F_{Variants}$ 41.0***								
F_{Years} 2302.4***								
$F_{Variants*Years}$ 2.3***								

*Ns: not significant, *: significant at $p≤0.1$, **: significant at $p≤0.01$, ***: significant at $p≤0.001$*

Table 5.27. Yield Quality Parameters of Grapevines Depending on the Different Quality of Vines. Cl R5 Cabernet Sauvignon onto RxR 101-14.

Mass Sugar Concentration, g/dm³

Variants	2015	2016	2017	2018	2019	2020	2021	Mean
CG	244±2 ijk	265±2 cde	240±2 jk	245±2 h-k	255±2 e-h	298±2 b	261±2 c-f	258±2 CD
EG 1	240±2 jk	260±2 c-g	238±1 k	238±2 k	250±2 g-j	290±2 b	260±2 c-g	254±2 E
EG 2	242±1 ijk	262±2 c-f	242±2 ijk	240±2 jk	252±2 f-i	291±2 b	263±2 cde	256±2 DE
EG 3	244±2 ijk	265±2 cde	250±2 g-j	244±2 ijk	255±2 e-h	295±3 b	265±2 cde	260±2 C
EG 4	246±2 h-k	268±2 cd	255±2 e-h	246±2 h-k	258±2 d-g	300±2 b	268±1 cd	263±2 B
EG 5	250±2 g-j	270±2 c	260±2 c-g	250±2 g-j	260±2 c-g	316±2 a	268±2 cd	268±3 A
Mean	244±1 E	265±1 B	248±1 D	244±1 E	255±1 C	298±1 A	264±1 B	260±1
ANOVA								
$F_{Variants}$ 53.5***								
F_{Years} 664.2***								
$F_{Variants*Years}$ 3.1***								

Mass Concentration of Titratable Acids, g/dm³

Variants	2015	2016	2017	2018	2019	2020	2021	Mean
CG	8.1±0.05 ghi	8.7±0.04 bcd	8.8±0.08 a-d	7.6±0.05 kl	5.9±0.09 mn	5.6±0.05 no	8.1±0.06 ghi	7.5±0.15 C
EG 1	8.3±0.08 efg	9.1±0.04 a	9.0±0.07 ab	7.8±0.07 i-l	6.1±0.07 m	6.0±0.09 m	8.2±0.06 fgh	7.8±0.14 A
EG 2	8.2±0.07 fgh	8.9±0.07 abc	8.8±0.07 a-d	7.8±0.07 i-l	6.0±0.08 m	5.9±0.07 mn	8.1±0.07 ghi	7.7±0.14 B
EG 3	8.1±0.07 ghi	8.7±0.04 bcd	8.7±0.08 bcd	7.7±0.07 jkl	5.9±0.08 mn	5.8±0.07 mn	8.1±0.06 ghi	7.6±0.14 C
EG 4	8.0±0.07 g-j	8.6±0.04 cde	8.6±0.05 cde	7.6±0.05 kl	5.9±0.06 mn	5.3±0.07 op	8.0±0.05 g-j	7.4±0.15 D
EG 5	7.9±0.06 h-k	8.5±0.05 def	8.5±0.06 def	7.5±0.06 l	5.8±0.05 mn	5.1±0.07 p	8.0±0.06 g-j	7.3±0.15 E
Mean	8.1±0.03 B	8.8±0.03 A	8.7±0.03 A	7.7±0.03 C	5.9±0.03 D	5.6±0.05 E	8.1±0.02 B	7.6±0.06
ANOVA								
$F_{Variants}$ 44.8***								
F_{Years} 2328.7***								
$F_{Variants*Years}$ 2.6***								

*Ns: not significant, *: significant at $p≤0.1$, **: significant at $p≤0.01$, ***: significant at $p≤0.001$*

The quality of grape production is determined by parameters such as the mass concentration of sugars and titratable acids.

The R5 clone of Cabernet Sauvignon is characterized by high sugar accumulation. This parameter varies from year to year and depends on the stock variety on which it is grafted. When cultivated onto Kober 5BB stock, the mass concentration of sugars changes within the range of 224 g/dm^3 to 258 g/dm^3; the mass concentration of titratable acids is within 8.0 g/dm^3 to 9.1 g/dm^3. Onto the RxR 101-14 stock, these values are 238 g/dm^3 to 265 g/dm^3 for sugar concentration and 7.5 g/dm^3 to 9.1 g/dm^3 for titratable acids, respectively (tab. 5.26, tab. 5.27).

In most cases, general biological patterns are manifested, which are associated with the fact that an increase in yield leads to a decrease in the mass concentration of sugars and a slight increase in titratable acids in berry juice. A characteristic feature is a significant change in the quality of the product in unfavourable meteorological years. A decrease in yield results in an increase in the mass concentration of sugars and a reduction in the level of titratable acids (in 2020), which negatively impacts grape processing.

5.2.2. Analysis of the After-effect of Different Quality Planting Stock by Scion Attributes and Calovit Treatment

5.2.2.1. Shoot Growth and Development

It was previously established that the growth, development, and commencement of fruiting in clone R5 Cabernet Sauvignon grapevines are directly influenced by the quality of grafted vines obtained from the use of scion with and without tendrils, as well as the effects of a growth regulator (Calovit).

Table 5.28. Shoot Number of Cl R5 Cabernet Sauvignon, Depending on the Different Quality of Vines, pcs./vine.

Years	Without tendril H_2O	With tendril H_2O	Without tendril Calovit	With tendril Calovit	Mean
2015	38,3±0,3 ghi	40,1±0,3 def	39,3±0,2 fg	42,1±0,2 abc	40,0±0,3 A
2016	36,8±0,3 jkl	41,0±0,3 bcd	39,4±0,2 efg	42,3±0,3 ab	39,9±0,4 A
2017	36,5±0,3 kl	41,1±0,3 bcd	40,0±0,3 def	43,1±0,3 a	40,2±0,4 A
2018	35,7±0,2 l	40,1±0,3 def	38,3±0,3 ghi	41,8±0,3 abc	39,0±0,4 B
2019	35,6±0,3 l	38,1±0,2 g-j	37,0±0,2 i-l	40,8±0,3 cde	37,9±0,3 C
2020	26,3±0,2 o	30,6±0,2 n	29,4±0,2 n	33,0±0,3 m	29,8±0,4 D
2021	33,7±0,2 m	38,8±0,3 fgh	37,4±0,3 h-k	40,1±0,3 def	37,5±0,4 C
Mean	34,7±0,5 D	38,5±0,4 B	37,3±0,4 C	40,5±0,4 A	37,7±0,2
ANOVA					
$F_{Variants}$ 554.5*** F_{Year} 720.7*** $F_{Variants*Year}$ 4.7***					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Subsequent studies (2015-2021) have allowed us to determine the after-effects of different quality of grafted vines on the growth and productivity of vines and vineyards. During the full fruiting period, the average shoot load per vine varies over the years depending on the vine's vigour and stands at 37,7±0,2 shoots per vine when grafted onto BxR Kober 5BB stock (tab. 5.28). However, the load decreases in unfavourable years (2020). In 2020, the number of shoots per vine was 29.8±0.4 D, which was the lowest recorded value for the research period, as the number of shoots significantly lagged behind other years of the research (F_{Year} 720.7***). Of particular interest was taking note of the differences between different experimental variants. For instance, the "With tendril Calovit" variant demonstrated the highest number of shoots compared to other variants, suggesting the effectiveness of this experimental variant ($F_{Variants}$ 554.5***). Meanwhile, the " Without tendril H_2O" variant showed the lowest values, indicating lower adaptability of the grapevines in this experimental variant. Significant differences were observed in the interaction between the experimental variants and the years of the research in terms of the number of developed shoots per vine of Cl R5 Cabernet Sauvignon ($F_{Variants*Year}$ 4.7***).

Table 5.29. Shoot Length of Cl R5 Cabernet Sauvignon, Depending on the Different Quality of Vines, cm.

Years	Without tendril H_2O	With tendril H_2O	Without tendril Calovit	With tendril Calovit	Mean
2015	122.5±2.2 ij	136.5±2.2 e-h	127.1±2.4 hi	142.6±2.2 def	132.2±1.7 BC
2016	125.6±1.9 hi	139.2±2.2 d-g	130.2±2.0 ghi	145.8±2.2 cde	135.2±1.6 B
2017	135.7±2.0 e-h	159.2±2.2 b	145.7±1.8 cde	177.2±2.6 a	154.5±2.7 A
2018	133.5±2.2 f-i	156.6±2.1 bc	143.3±2.1 def	174.4±2.4 a	152.0±2.7 A
2019	114.2±1.6 j	134.0±1.8 fgh	122.6±2.2 ij	149.1±2.3 bcd	130.0±2.3 C
2020	55.2±2.0 n	64.8±1.8 mn	59.3±1.9 n	72.1±1.8 lm	62.9±1.4 E
2021	66.1±2.1 lmn	76.8±2.3 kl	76.0±2.2 kl	86.3±2.1 k	76.3±1.6 D
Mean	107.5±3.7 D	123.9±4.3 B	114.9±3.8 C	135.4±4.6 A	120.4±2.2
ANOVA					
$F_{Variants}$ 227.7* F_{Year} 1185.3*** $F_{Variants*Year}$ 5.4*****					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

It has been determined that the growth of shoots is influenced by the different quality of vines. By the end of the vegetation period, the mean length of shoots, depending on the year of the study, ranges from 107.5±3.7 cm to 123.9±4.3 cm (tab. 5.29). In the control groups (without calovit treatment), this length varies from 55.2±2.0 cm to 135.7±2.0 cm (scion without tendril) and from 64.8±1.8 cm to 159.2±2.2 cm (scion with tendril). With calovit treatment, the mean shoot length increases by 1.1-1.2 times, particularly in the case of the scion with tendrils However, in unfavourable years (2019-2021), regardless of experimental variants, the average shoot length decreases.

Table 5.30. Annual Growth Development of Cl R5 Cabernet Sauvignon, Depending on the Different Quality of Vines.

Years	*m per vine*				Mean
	Without tendril H_2O	**With tendril H_2O**	**Without tendril Calovit**	**With tendril Calovit**	
2015	47.0±0.9 gh	54.7±1.1 ef	49.9±0.9 gh	60.0±0.9 cd	52.9±0.9 C
2016	46.2±0.7 h	57.1±1.2 de	51.2±1.0 fg	61.7±0.9 bcd	54.1±1.1 C
2017	49.5±0.9 gh	65.4±1.0 b	58.3±0.9 cde	76.4±1.2 a	62.4±1.7 A
2018	47.6±0.9 gh	62.8±0.9 bc	55.0±0.8 ef	72.9±1.4 a	59.6±1.6 B
2019	40.7±0.8 i	51.1±0.8 fg	45.3±0.8 hi	60.8±0.9 bcd	49.5±1.3 D
2020	14.5±0.6 o	19.9±0.6 mn	17.4±0.7 no	23.8±0.5 lm	18.9±0.6 F
2021	22.3±0.7 m	29.8±0.8 k	28.4±0.8 kl	34.6±0.9 j	28.8±0.8 E
Mean	38.3±1.6 D	48.7±2.0 B	43.7±1.7 C	55.7±2.2 A	46.6±1.0
ANOVA					
$F_{Variants}$ 476.1*** F_{Year} 1313.4*** $F_{Variants*Year}$ 10.9***					
thousand m per hectare					
2015	115.9±2.7 jk	134.8±3.3 e-i	123.0±2.6 hij	141.8±3.0 def	128.9±2.1 C
2016	114.1±2.8 jk	140.3±3.7 d-g	126.6±2.7 f-j	149.1±2.3 cde	132.5±2.6 C
2017	124.8±4.5 g-j	162.2±4.3 bc	145.8±3.8 cde	182.2±3.7 a	153.7±3.9 A
2018	119.8±4.4 ij	155.3±4.0 cd	137.1±4.1 e-h	175.4±4.1 ab	146.9±3.9 B
2019	100.7±3.4 k	126.7±3.7 f-j	112.3±3.0 jk	145.9±3.3 cde	121.4±3.2 D
2020	36.3±1.9 o	49.5±1.9 no	42.7±2.0 no	56.5±1.6 mn	46.2±1.5 F
2021	56.2±2.2 n	73.1±2.6 lm	75.5±0.7 l	82.4±2.7 l	71.8±1.9 E
Mean	95.4±4.1 D	120.3±4.9 B	109.0±4.2 C	133.3±5.3 A	114.5±2.5
ANOVA					
$F_{Variants}$ 181.8*** F_{Year} 640.2*** $F_{Variants*Year}$ 4.8***					

*Ns: not significant, *: significant at $p\leq0.1$, **: significant at $p\leq0.01$, ***: significant at $p\leq0.001$*

The degree of development of Annual Growth depends on the different quality of vines, associated with the heterogeneity of planting stock. Vine growth parameters (Length and Volume of Annual Growth) vary from year to year and depend on the experimental variants.

It has been noted that the R5 Cabernet Sauvignon clone is characterized by an average Annual Growth of 46.6±1.0 m/vine over the years of research (tab. 5.30). The highest values were observed in 2017 (62.4±1.7 m/vine) and 2018 (59.6±1.6 m/vine). In 2019, there was a decrease in this indicator to 49.5±1.3 m/vine, which is associated with the onset of drought. In 2020, this indicator is the lowest over the entire study period (18.9±0.6 m/vine), which is a direct result of the drought in 2019-2020. In 2021, grapevines began to recover after challenging meteorological conditions; however, the Annual Growth indicator remains low - 28.8±0.8 m per vine.

When using grafted vines of scion without tendril H_2O for planting, in favourable years (2017), the length of Annual Growth of the vine reaches 49.5±0.9 meters per vine and 124.8±4.5 thousand meters per hectare. In the "with tendril H_2O" variant, there is an increase in this indicator to 65.4±1.0

m per vine and 162.2±4.3 thousand meters per hectare (tab. 5.31). The "with tendril calovit" variant is characterized by the highest results of this indicator: 76.4±1.2 m per vine and 182.2±3.7 thousand meters per hectare. As a result, it can be concluded that the vines of clone R5 Cabernet Sauvignon, when using planting material with Tendrils and treated with Calovit, are characterized by better Above-Ground Growth and the development of Annual Growth.

Table 5.31. Annual Growth Volume of Cl R5 Cabernet Sauvignon, Depending on the Different Quality of Vines.

Years	***cm³ per shoot***				Mean
	Without tendril H_2O	**With tendril H_2O**	**Without tendril Calovit**	**With tendril Calovit**	
2015	63.1±0.8 kl	73.8±1.1 fgh	67.1±1.1 ijk	77.1±0.9 efg	70.3±1.0 D
2016	66.3±1.0 jk	77.1±1.7 efg	70.4±1.1 hij	80.8±1.7 e	73.7±1.1 C
2017	90.2±1.3 d	110.4±1.5 b	98.9±1.2 c	125.5±1.7 a	106.3±2.2 A
2018	73.9±1.2 fgh	88.8±1.2 d	79.4±1.0 ef	101.3±1.4 c	85.8±1.8 B
2019	58.8±0.9 l	72.5±1.0 ghi	63.1±1.0 kl	80.6±1.6 e	68.8±1.5 D
2020	13.6±0.5 p	17.1±0.5 p	15.1±0.4 p	19.0±0.4 p	16.2±0.4 F
2021	25.4±0.8 o	32.1±0.9 mn	30.1±0.8 no	36.1±0.8 m	30.9±0.7 E
Mean	55.9±3.0 D	67.4±3.6 B	60.6±3.2 C	74.3±4.1 A	64.6±1.8
ANOVA					
$F_{Variants}$ 363.4*** F_{Year} 3094.4*** $F_{Variants*Year}$ 16.9***					
dm³ per vine					
2015	2.41±0.03 jk	2.96±0.06 gh	2.64±0.04 ij	3.22±0.03 ef	2.81±0.05 D
2016	2.44±0.04 jk	3.21±0.07 efg	2.78±0.05 hi	3.42±0.08 de	2.96±0.07 C
2017	3.29±0.06 e	4.54±0.06 b	3.96±0.06 c	5.41±0.08 a	4.30±0.13 A
2018	2.64±0.05 ij	3.56±0.05 d	3.04±0.04 fg	4.21±0.07 c	3.36±0.10 B
2019	2.09±0.04 l	2.76±0.05 hi	2.33±0.04 kl	3.29±0.07 ef	2.62±0.08 E
2020	0.36±0.01 q	0.53±0.02 pq	0.45±0.01 pq	0.62±0.01 op	0.49±0.02 G
2021	0.86±0.03 o	1.25±0.04 mn	1.12±0.03 n	1.43±0.02 m	1.16±0.04 F
Mean	2.01±0.12 D	2.69±0.15 B	2.33±0.13 C	3.08±0.18 A	2.53±0.08
ANOVA					
$F_{Variants}$ 639.9*** F_{Year} 2907.0*** $F_{Variants*Year}$ 31.5***					
thousand m³ per hectare					
2015	5.85±0.06 kl	7.18±0.14 hi	6.39±0.11 jk	7.87±0.06 fg	6.82±0.13 D
2016	5.92±0.09 kl	7.71±0.15 fgh	6.73±0.12 ij	8.29±0.19 ef	7.16±0.16 C
2017	7.99±0.15 f	11.00±0.15 b	9.59±0.14 d	13.11±0.19 a	10.42±0.31 A
2018	6.44±0.11 jk	8.63±0.12 e	7.37±0.10 gh	10.30±0.15 c	8.19±0.24 B
2019	5.08±0.09 m	6.70±0.11 ij	5.66±0.09 lm	7.97±0.18 fg	6.35±0.19 E
2020	0.87±0.03 r	1.28±0.03 q	1.08±0.03 q	1.51±0.03 q	1.18±0.04 G
2021	2.12±0.11 p	3.02±0.09 no	2.71±0.06 op	3.47±0.05 n	2.83±0.09 F
Mean	4.89±0.28 D	6.50±0.37 B	5.65±0.32 C	7.50±0.44 A	6.14±0.19
ANOVA					
$F_{Variants}$ 671.1*** F_{Year} 3020.4*** $F_{Variants*Year}$ 32.9***					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

We conducted studies on the development of the Volume of Annual Growth at the level of the shoot, the vine, and the vineyard (tab. 6.20). It has been noted that the different quality of vines the clone R5 Cabernet Sauvignon impacts the development of the Volume of Annual Growth at the level of the shoot ($F_{Variants}$ 363.4***), the vine ($F_{Variants}$ 639.9***), and the vineyard ($F_{Variants}$ 671.1***). Additionally, it was found that this indicator depends on the years of research, characterized by varying meteorological conditions (shoot - F_{Year} 3094.4***, the vine - F_{Year} 2907.0***), and the vineyard - F_{Year} 3020.4***).

In the "without tendril H_2O" variants, during favorable years such as 2017, the Volume of Annual Growth measures 90.2±1.3 cm^3 per shoot, 3.29±0.06 dm^3 per vine, and 7.99±0.15 m^3 per hectare. These parameters increase by 1.2-1.3 times when using grafted vines of scion with tendrils (with tendril H_2O). Significant growth enhancement the Volume of Annual Growth is observed in the variant with the use of scion with tendrils and application of calovit treatment (with tendril Calovit): the Volume of Annual Growth is 125.5±1.7 cm^3 per shoot, 5.41±0.08 dm^3 per vine, and 13.11±0.19m^3 per hectare. In unfavourable, dry years, the Volume of Annual Growth parameters of the R5 Cabernet Sauvignon sharply decreased, but the identified pattern remains consistent.

5.2.2.2. Growth and Development of Leaf Surface Area

It has been established that the number of developed leaves per shoot depends on both the experimental variants ($F_{Variants}$ 623.5***) and the years of research (F_{Year} 560.9***) (tab. 5.32). The lowest number of leaves was observed in the "Without tendril H_2O" variant – 24.7±0.3 leaves/ shoot. The lowest result of this indicator was recorded in 2020 – 22.3±0.3 leaves/shoot. On the other hand, the highest number of leaves per shoot was recorded in the "With tendril Calovit" variant – 30.5±0.5 leaves/shoot, as well as in 2017 – 31.6±0.5 leaves/shoot.

Table 5.32. The Impact of Different Quality of Vines on the Development of the Number of Leaves on Grapevine Shoots of Cl R5 Cabernet Sauvignon.

Years	Without tendril H_2O	With tendril H_2O	Without tendril Calovit	With tendril Calovit	Mean
2015	25.1±0.2 jk	27.9±0.2 efg	26.0±0.2 hij	29.2±0.3 cde	27.1±0.3 C
2016	25.7±0.3 ijk	28.5±0.3 def	26.6±0.2 ghi	29.8±0.3 cd	27.7±0.3 B
2017	27.8±0.3 fg	32.6±0.2 b	29.8±0.3 cd	36.2±0.2 a	31.6±0.5 A
2018	27.3±0.2 fgh	32.0±0.2 b	29.3±0.3 cd	35.7±0.3 a	31.1±0.5 A
2019	23.4±0.3 lm	27.4±0.2 fg	25.1±0.2 jk	30.5±0.3 c	26.6±0.4 CD
2020	20.3±0.2 n	23.0±0.2 m	21.6±0.3 n	24.4±0.3 kl	22.3±0.3 E
2021	23.5±0.3 lm	26.9±0.3 ghi	26.0±0.3 hij	27.9±0.3 efg	26.1±0.3 D
Mean	24.7±0.3 D	28.3±0.4 B	26.3±0.3 C	30.5±0.5 A	27.5±0.2
ANOVA					
$F_{Variants}$ 623.5*** F_{Year} 560.9*** $F_{Variants*Year}$ 12.8***					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Table 5.33. The Impact of Different Quality of Vines on the Area of Leaf Blades of Cl R5 Cabernet Sauvignon.

Years	Without tendril H_2O	With tendril H_2O	Without tendril Calovit	With tendril Calovit	Mean
2015	115.9±1.2 c	116.8±2.3 c	116.5±2.2 c	116.8±1.8 c	116.5±0.9 D
2016	132.7±2.1 b	133.5±2.0 b	133.5±2.2 b	133.9±2.0 b	133.4±1.0 C
2017	144.6±1.5 a	145.0±2.2 a	144.8±1.8 a	145.2±1.7 a	144.9±0.9 A
2018	138.4±1.3 ab	138.6±1.6 ab	138.6±1.4 ab	138.9±1.6 ab	138.6±0.7 B
2019	116.3±2.6 c	116.8±2.2 c	116.5±2.0 c	117.8±2.1 c	116.9±1.1 D
2020	84.3±1.4 e	84.9±1.3 e	84.6±1.4 e	86.5±2.0 e	85.1±0.8 F
2021	97.6±1.6 d	97.8±1.6 d	97.6±1.7 d	99.7±2.1 d	98.2±0.9 E
Mean	118.5±2.5 A	119.1±2.5 A	118.9±2.5 A	119.8±2.5 A	119.1±1.3
ANOVA					
$F_{Variants}$ 0.6ns F_{Year} 563.2*** $F_{Variants*Year}$ 0.04ns					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

The Area of Leaf Blades of the R5 clone of Cabernet Sauvignon onto Kober 5BB stock is not dependent on experimental variants during the years of research, but it varies annually (tab. 5.33). In favourable years (2017-2018), the Leaf Area amounts to 138.6±0.7 (B) cm^2 - 144.9±0.9 (A) cm^2. In unfavourable years (2019-2021), it significantly decreases by 1.5-1.8 times.

Table 5.34. The Impact of Different Quality of Vines on the Development on the Leaf Area of Cl R5 Cabernet Sauvignon.

Years	*dm^2 per shoot*				Mean
	Without tendril H_2O	With tendril H_2O	Without tendril Calovit	With tendril Calovit	
2015	29.1±0.4 lmn	32.6±0.6 ijk	30.3±0.6 klm	34.1±0.6 hij	31.5±0.4 D
2016	34.1±0.7 hij	38.0±0.6 fg	35.5±0.7 ghi	39.9±0.8 f	36.9±0.5 C
2017	40.2±0.5 ef	47.3±0.6 bc	43.1±0.4 de	52.6±0.6 a	45.8±0.8 A
2018	37.8±0.5 fg	44.4±0.6 cd	40.6±0.5 ef	49.6±0.6 ab	43.1±0.8 B
2019	27.2±0.7 mno	32.0±0.6 jkl	29.2±0.6 lmn	35.9±0.8 gh	31.1±0.6 D
2020	17.1±0.4 s	19.5±0.4 r	18.3±0.4 r	21.1±0.5 qr	19.0±0.3 F
2021	22.9±0.4 pq	26.3±0.6 no	25.4±0.5 op	27.8±0.8 mno	25.6±0.4 E
Mean	29.8±0.9 D	34.3±1.1 B	31.8±1.0 C	37.3±1.3 A	33.3±0.6
ANOVA					
$F_{Variants}$ 209.8*** F_{Year} 1014.1*** $F_{Variants*Year}$ 6.8***					
m^2 per vine					
2015	11.2±0.2 klm	13.1±0.3 hij	11.9±0.2 jkl	14.4±0.3 fgh	12.6±0.2 D
2016	12.5±0.2 ij	15.6±0.3 ef	14.0±0.3 gh	16.9±0.3 de	14.7±0.3 C
2017	14.7±0.2 fg	19.4±0.2 c	17.3±0.2 d	22.7±0.2 a	18.5±0.5 A
2018	13.5±0.2 ghi	17.8±0.3 d	15.6±0.3 f	20.7±0.3 b	16.9±0.5 B
2019	9.7±0.3 no	12.2±0.2 jk	10.8±0.3 lmn	14.7±0.4 fg	11.8±0.3 E
2020	4.5±0.1 s	6.0±0.1 qr	5.4±0.1 r	7.0±0.2 pq	5.7±0.2 G
2021	7.7±0.2 p	10.2±0.2 mno	9.5±0.2 o	11.2±0.4 klm	9.6±0.2 F
Mean	10.5±0.4 D	13.5±0.5 B	12.1±0.5 C	15.3±0.6 A	12.9±0.3
ANOVA					
$F_{Variants}$ 483.6*** F_{Year} 1254.8*** $F_{Variants*Year}$ 13.9***					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

A negative correlation between Area of Leaf Blades and average monthly positive temperatures has been identified. The Leaf Area of shoots, vines, and vineyards depends on the number of shoots (load) and the leaves developed on them (tab. 5.34). Thus, in 2017, the Leaf Area by the end of the vegetation period in the control variants amounts to 43.1 dm²/shoot, 18.0 m²/vine (without tendril, H_2O), and 50.7 dm²/shoot, 22.9 m²/vine (with tendril, H_2O). In variants using the solition of calovit, the Leaf Area of grape plants increases and amounts to 46.2 dm²/shoot, 20.0 m²/vine (without tendril, Calovit) and 56.3 dm²/shoot, 26.3 m²/vine (with tendril, Calovit). In unfavourable years (2020-2021), the Leaf Area of plants in the studied variants decreased by 1.8-2.5 times, which affected the productivity of the vineyards. Similar regularity is observed by us in other experimental variants and points to the dependence of Leaf Area development on meteorological conditions that do not develop adequately.

Table 5.35. The Impact of Different Quality of Vines on the Leaf Area Index of Cl R5 Cabernet Sauvignon.

Years	Without tendril H_2O	With tendril H_2O	Without tendril Calovit	With tendril Calovit	Mean
2015	2.71±0.04 klm	3.18±0.06 hij	2.88±0.06 jkl	3.49±0.08 fgh	3.06±0.06 D
2016	3.03±0.06 ij	3.78±0.07 ef	3.39±0.07 gh	4.09±0.07 de	3.57±0.07 C
2017	3.55±0.05 fg	4.71±0.06 c	4.19±0.04 d	5.49±0.05 a	4.49±0.12 A
2018	3.27±0.05 ghi	4.32±0.07 d	3.77±0.07 f	5.03±0.07 b	4.10±0.11 B
2019	2.35±0.07 no	2.95±0.06 jk	2.62±0.06 lmn	3.55±0.09 fg	2.87±0.08 E
2020	1.10±0.03 s	1.45±0.03 qr	1.30±0.02 r	1.69±0.05 pq	1.38±0.04 G
2021	1.87±0.04 p	2.48±0.06 mno	2.30±0.05 o	2.71±0.10 klm	2.34±0.06 F
Mean	2.55±0.10 D	3.27±0.13 B	2.92±0.11 C	3.72±0.15 A	3.11±0.07
ANOVA					
$F_{Variants}$ 483.5*** F_{Year} 1254.5*** $F_{Variants*Year}$ 13.9***					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Calculations of the Leaf Area Index of the R5 clone of Cabernet Sauvignon vineyards also demonstrated their variation depending on the different quality of vines ($F_{Variants}$ 483.5***) and the complex meteorological conditions during their growth (F_{Year} 1254.5***) (tab. 5.35). In favourable years (2017), the Leaf Area Index of the vineyards amounts to 3.55±0.05 m^2/m^2 (Scion Without Tendrils, H_2O) and 4.71±0.06 m^2/m^2 (scion with tendril, H_2O). In variants "without tendril, Calovit" and "with tendril, Calovit" (with the application of solution Calovit), the Leaf Area Index of the vineyards increases by 1.1-1.2 times.

5.2.2.3. Productivity of Vineyards

During the period of full fruiting (2015-2021), the number of clusters ranges from 42.0±0.4 to 43.4±0.3 clusters per vine in favourable years (2015-2018). In dry years (2020), the number of grape clusters decreases to 32.5±0.5 clusters per vine. In unfavourable years (2020), this count decreases by 1.3-1.4 times (tab. 5.36). The greatest decrease was noted in the variant "without tendril H_2O", the index amounted to 28.7±0.3 clusters per vine. This indicates a lower resilience of grapevines in this experimental variant to adverse growing conditions.

Table 5.36. The Impact of Different Quality of Vines on the Cluster Development of Cl R5 Cabernet Sauvignon, number/vine.

Years	Without tendril H_2O	With tendril H_2O	Without tendril Calovit	With tendril Calovit	Mean
2015	41.8±0.4 e-k	43.5±0.5 a-g	42.8±0.5 c-i	45.3±0.5 abc	43.4±0.3 A
2016	40.1±0.4 jkl	43.7±0.4 a-f	42.9±0.6 c-h	45.5±0.4 ab	43.1±0.4 A
2017	39.8±0.5 kl	43.8±0.5 a-e	43.0±0.5 b-h	45.8±0.4 a	43.1±0.4 A
2018	38.9±0.5 lm	42.6±0.4 d-j	41.8±0.4 e-k	44.5±0.6 a-d	42.0±0.4 B
2019	38.8±0.5 lm	41.0±0.5 g-l	40.3±0.3 i-l	43.2±0.6 b-h	40.8±0.3 C
2020	28.7±0.3 p	33.4±0.5 o	32.0±0.4 o	36.0±0.5 n	32.5±0.5 D
2021	36.7±0.5 mn	41.2±0.5 f-l	40.8±0.4 h-l	43.5±0.5 a-g	40.6±0.5 C
Mean	37.8±0.5 D	41.3±0.4 B	40.5±0.5 C	43.4±0.4 A	40.8±0.3
ANOVA					
$F_{Variants}$ 160.3*** F_{Year} 249.3*** $F_{Variants*Year}$ 1.7*					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

The lowest number of grape clusters was observed in the "without tendril H_2O" variant, amounting to 37.8±0.5 clusters per vine, while in the "without tendril Calovit" variant, it reached 40.5±0.5 clusters per vine. In the "with tendril H_2O" and "with tendril Calovit" variants, the number increased to 41.3±0.4 and 43.4±0.4 clusters per vine, respectively.

Table 5.37. The Impact of Different Quality of Vines on the Cluster Weight of Cl R5 Cabernet Sauvignon, g, SC «Tomai-Vinex» SA.

Years	Without tendril H_2O	With tendril H_2O	Without tendril Calovit	With tendril Calovit	Mean
2015	94.1±1.1 hij	99.8±2.1 ghi	95.6±1.6 hij	105.5±2.1 g	98.8±1.1 C
2016	118.2±1.9 f	124.5±2.5 def	122.1±1.5 ef	131.2±2.6 cde	124.0±1.3 B
2017	120.7±1.9 f	136.5±2.2 abc	127.2±2.0 c-f	145.3±1.7 a	132.4±1.8 A
2018	117.4±1.7 f	132.7±2.4 bcd	123.7±1.7 def	141.3±2.1 ab	128.8±1.7 A
2019	96.4±1.3 ghi	100.5±2.1 gh	98.3±1.7 ghi	101.2±2.2 gh	99.1±0.9 C
2020	52.9±1.5 m	55.1±1.9 m	54.1±1.7 m	57.7±1.1 m	55.0±0.8 E
2021	78.8±1.7 l	86.3±1.8 jkl	83.0±1.9 kl	90.1±2.1 ijk	84.6±1.1 D
Mean	96.9±2.8 D	105.1±3.3 B	100.6±3.0 C	110.3±3.6 A	103.2±1.6
ANOVA					
$F_{Variants}$ 66.2*** F_{Year} 875.3*** $F_{Variants*Year}$ 3.4***					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Meanwhile, it has been established that the cluster weight varies depending on meteorological conditions in the years of research (F_{Year} 875.3***), experimental variants ($F_{Variants}$ 66.2***) and the interaction between these factors ($F_{Variants*Year}$ 3.4***) (tab. 5.37). The most favourable years for cluster weight development were 2017 and 2018. Thus, in 2017-2018, the average cluster weight across all experimental variants was 128.8±1.7 g to 132.4±1.8 g, respectively. Since 2019, there has been a noticeable decrease in the cluster weight, which reached 55.0±0.8 g in 2020 (a decrease of 2.0-2.5 times), primarily attributed to the significantly lower precipitation levels during that year. This decline in cluster weight indicates a substantial reduction in grape yield, likely due to adverse weather conditions, particularly the decreased precipitation during the growing season in 2020.

It has been found that vines grown using scion without tendrils and growth regulators application (variant without tendril H_2O), are more significantly affected by adverse factors such as drought. At the same time, vines in the variant with tendrils and treated with the growth regulator Calovit (with tendril Calovit), demonstrated higher adaptability to adverse meteorological conditions occurring during the vegetation period. It has been demonstrated that in variants of scion with tendrils, the cluster growth parameters increase by 1.1-1.2 times; for variants of scion with tendrils and calovit application, the average cluster weight increases to 110.3±3.6 g.

Table 5.38. The Impact of Different Quality of Vines on the Yield Indicators of Cl R5 Cabernet Sauvignon.

Years	***Fruit Yield per Vine, kg/vine***				**Mean**
	Without tendril H_2O	**With tendril H_2O**	**Without tendril Calovit**	**With tendril Calovit**	
2015	3.93±0.05 ijk	4.34±0.13 ghi	4.09±0.09 hij	4.79±0.13 efg	4.29±0.07 C
2016	4.74±0.09 fg	5.45±0.08 d	5.24±0.11 de	5.97±0.13 bc	5.35±0.09 B
2017	4.80±0.11 efg	5.98±0.12 bc	5.47±0.13 d	6.65±0.08 a	5.73±0.12 A
2018	4.57±0.10 gh	5.65±0.10 cd	5.17±0.07 def	6.29±0.13 ab	5.42±0.11 B
2019	3.74±0.04 jkl	4.12±0.10 hij	3.96±0.06 ijk	4.37±0.10 ghi	4.05±0.05 D
2020	1.52±0.06 o	1.84±0.06 no	1.73±0.06 no	2.08±0.05 n	1.79±0.04 F
2021	2.89±0.07 m	3.56±0.09 kl	3.39±0.09 l	3.93±0.07 ijk	3.44±0.07 E
Mean	3.74±0.14 D	4.42±0.17 B	4.15±0.15 C	4.87±0.18 A	4.29±0.08
ANOVA					
$F_{Variants}$ 180.2*** F_{Year} 880.8*** $F_{Variants*Year}$ 5.6***					
Yield, tons per hectare					
2015	9.53±0.13 ijk	10.51±0.31 ghi	9.92±0.22 hij	11.60±0.31 efg	10.39±0.17 C
2016	11.48±0.21 fg	13.20±0.21 d	12.70±0.27 de	14.47±0.32 bc	12.96±0.21 B
2017	11.63±0.27 efg	14.50±0.28 bc	13.27±0.33 d	16.13±0.19 a	13.88±0.29 A
2018	11.08±0.23 gh	13.70±0.25 cd	12.53±0.17 def	15.24±0.32 ab	13.14±0.27 B
2019	9.06±0.09 jkl	9.99±0.23 hij	9.60±0.15 ijk	10.59±0.24 ghi	9.81±0.13 D
2020	3.69±0.14 o	4.46±0.15 no	4.20±0.16 no	5.04±0.13 n	4.35±0.10 F
2021	7.00±0.17 m	8.62±0.23 kl	8.21±0.21 l	9.51±0.17 ijk	8.34±0.17 E
Mean	9.07±0.33 D	10.71±0.40 B	10.06±0.37 C	11.80±0.44 A	10.41±0.20
ANOVA					
$F_{Variants}$ 180.3*** F_{Year} 880.8*** $F_{Variants*Year}$ 5.6***					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

The yield of vineyards of the R5 clone of Cabernet Sauvignon varies depending on the different quality of the vines, observed in the variants using grafted vines of the scion with and without tendrils and application of solution calovit (tab. 5.38). The difference between experimental variants is significant $F_{Variants}$ 180.3***, F_{Year} 880.8***, $F_{Variants*Year}$ 5.6***.

The highest vine yields are observed in 2017. Thus, in 2017, the yield in control variants amounted to 4.80±0.11 kg per vine and 11.63±0.27 tons per hectare (Scion without Tendrils, H_2O); 5.98±0.12 kg per vine and 14.50±0.28 tons per hectare (scion with tendril, H_2O) (tab. 5.38). It is characteristic that in the variant (scion with tendril, Calovit), the yield of vines and grapevine plantation increases by 1.3 times compared to the control and amounts to 5.73±0.12 kg per vine or 13.88±0.29 tons per hectare. In unfavourable years (2020), irrespective of the experimental variants, the yield decreases and amounts to 1.79±0.04 kg per vine or 4.35±0.10 tons per hectare, respectively.

Table 5.39. The Impact of Different Quality of Vines on the Yield Quality Indicators of Cl R5 Cabernet Sauvignon.

Years	*Mass Sugar Concentration, g/dm³*				Mean
	Without tendril H_2O	**With tendril H_2O**	**Without tendril Calovit**	**With tendril Calovit**	
2015	238±2 ijk	232±1 jkl	238±2 ijk	230±1 kl	235±1 D
2016	231±2 kl	223±2 lm	231±2 kl	220±2 m	226±1 E
2017	251±2 d-g	243±2 f-i	250±2 d-h	242±2 ghi	247±1 C
2018	249±1 d-h	241±2 hij	248±1 e-h	241±1 hij	245±1 C
2019	235±2 ijk	232±1 jkl	235±1 ijk	230±1 kl	233±1 D
2020	308±2 a	295±2 b	297±2 b	282±2 c	296±2 A
2021	258±2 d	252±1 def	256±2 de	251±1 d-g	254±1 B
Mean	253±3 A	245±3 B	251±3 A	242±2 C	248±1
ANOVA					
$F_{Variants}$ 160.3* F_{Year} 249.3*** $F_{Variants*Year}$ 1.7***					
Mass Concentration of Titratable Acids, g/dm³					
2015	7.70±0.03 i	8.00±0.03 fg	7.90±0.06 gh	7.80±0.05 hi	7.85±0.03 E
2016	8.00±0.02 fg	8.20±0.03 de	8.10±0.03 ef	8.30±0.05 cd	8.15±0.02 C
2017	8.50±0.03 ab	8.60±0.02 a	8.50±0.03 ab	8.60±0.02 a	8.55±0.01 A
2018	8.00±0.02 fg	8.10±0.03 ef	8.00±0.03 fg	8.10±0.03 ef	8.05±0.02 D
2019	6.00±0.02 j	6.10±0.03 j	6.00±0.05 j	6.00±0.05 j	6.03±0.02 F
2020	6.10±0.02 j	6.00±0.05 j	6.10±0.03 j	6.00±0.02 j	6.05±0.02 F
2021	8.20±0.03 de	8.40±0.03 bc	8.20±0.03 de	8.40±0.06 bc	8.30±0.03 B
Mean	7.50±0.11 B	7.63±0.12 A	7.54±0.12 B	7.60±0.13 A	7.57±0.06
ANOVA					
$F_{Variants}$ 17.8* F_{Years} 3501.3*** $F_{Variants*Years}$ 4.6***					

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

The mass concentration of sugars and titratable acids are among the key indicators that determine the quality of grape production (fig. A 10.18). We have determined that the R5 clone of the

Cabernet Sauvignon variety is characterized by high sugar accumulation (tab. 6.28). This indicator varies from year to year and depends on experimental variants. It changes within the range of 233±1 g/dm^3 to 296±2 g/dm^3 for mass concentration of sugars and 6.03±0.02 g/dm^3 to 8.55±0.01 g/dm^3 for mass concentration of titratable acids. Typically, an increase in yield leads to a decrease in the mass concentration of sugars. In unfavourable meteorological conditions, there is a reduction in yield, which increases the mass concentration of sugars and decreases the level of titratable acids (2020).

Therefore, the after-effect of different quality in grafted vines on the growth and productivity of R5 clone Cabernet Sauvignon vineyards during the period of full fruiting is observed. A strong direct correlation has been established between the shoot growth, leaf surface area, and grape vineyard productivity (r = 0.98). In the variants (Scion with Tendrils, H2O; Scion with Tendrils, Calovit), there is a significant increase in the parameters of shoot growth, assimilation area surface, and vine productivity.

5.3. Conclusions for Chapter 5

1. In the process of researching the after-effects of the quality of stock and scion canes on vine establishment in a permanent place, the growth and development of young bushes, and their entry into fruiting were studied.
2. To ensure a hundred percent survival rate of vines in their permanent place, as well as the growth and development of young vines, it is advisable to use rootstock cuttings cut from the first two meters from the base of the stock cane, scion cuttings with tendrils, and to conduct pre-stratification treatment of grafted cuttings with a solution of calovit.
3. The development level of the vines clone R5 Cabernet Sauvignon and their productivity manifest themselves depending on the variety of rootstock and the different quality of the planting material. The initiation of fruiting for the vines is observed in the third year after planting, and the completion of the vine shape formation period occurs in the fourth year. Depending on the experimental conditions, the yield when grafted onto BxR Kober 5BB rootstock ranges from 60.4 to 82.9 centner per hectare and onto RxR 101-14 ranges from 5.45 to 7.44 tons per hectare, it increases significantly when planting saplings obtained by using cuttings from the base-cane (EG 1, EG 2) and middle-cane of the stock zone (EG 3).
4. The use of scion cuttings with tendrils for grafting, with a well-developed diaphragm in comparison to those without tendrils, leads to enhanced regeneration processes at the graft union zone, resulting in an increased output of grafted saplings from the nursery by 5.7-9.5%, especially

when treated with the growth stimulant calovit, which is manifested in the viability of vines on the permanent place. Young vines come into fruiting in the third year after planting, during the period of forming the vine's shape. Four-year-old vines are characterized by a yield varying between 6.49 to 8.69 centner per hectare, significantly increasing when planting vines obtained from well-developed scion cuttings with tendrils and pre-stratification treatment with calovit solution.

5. It is shown that during the period of full fruiting (2015-2021), the average shoot load on the vines is established depending on the strength of the vine growth and varies from year to year. When cultivated onto the BxR Kober 5BB stock, the number of developed shoots per vine ranges from 46.5 to 40.1 shoots/vine, and onto RxR 101-14 stock, it ranges from 43.5 to 39.2 shoots/vine.
6. The growth of shoots and the development of the annual growth of the R5 clone Cabernet Sauvignon vines depend on agroecological conditions and vary from year to year. They increase the use of grafted vines for vineyard planting, produced by grafting I-II cuttings from the base of the stock cane. The growth parameters, in favourable years (2017), amount to (onto BxR Kober 5BB) 80.4 and 72.5 cm/vine; the volume of annual growth is 5.7 and 4.9 dm^3/vine, respectively.
7. The growth and productivity of the canopy of grapevine plants as an optical-biological system depends on the development of the leaf surface. As a result of the activity of individual leaves, the total leaf surface of shoots, vines, and vineyards is formed. It has been established that by the end of the vegetation period in 2017, the leaf surface of the R5 clone Cabernet Sauvignon onto BxR Kober 5BB in the control variant amounts to 48.2 cm^2/shoot and 21.3 m^2/vine. When the use of planting stock, produced by grafting 1^{st}-2^{nd} cuttings from the base of the stock cane, the Leaf Surface Area increases and amounts to 54.9 and 50.8 cm^2/shoot; 25.5 and 23.0 m^2/vine; when the use of planting stock, produced by the top-cane stock (4^{th} and 5^{th} cuttings), the Leaf Surface Area decreases by 1.1-1.2 times.
8. A positive linear correlation between shoot length and the area of their leaf surface has been established. The correlation coefficients are very high, ranging from 0.96 to 0.98, which is consistent with the studies of A. Amirdzhanov, A. Derendovskaia, A. Shtirbu.
9. The Leaf Area Index, representing the ratio of the leaf area of vineyards to the area they occupy, characterizes the ability of leaves to absorb solar energy and perform the process of photosynthesis. Under favourable conditions, the Leaf Area Index of the R5 clone of Cabernet

Sauvignon is 4.6 to 5.6 m^2/m^2 (onto BxR Kober 5BB) and 3.4 to 5.2 m^2/m^2 (onto RxR 101-14). It sharply decreases under unfavourable conditions (2020-2021).

10. A strong positive correlation (r = 0.96-0.97) has been established between the development of Leaf Surface and Shoot Productivity of the R5 clone of Cabernet Sauvignon. Notably, when cultivated onto RxR 101-14, compared to BxR Kober 5BB, Leaf Surface development decreases by 1.1-1.2 times, affecting Shoot Productivity.
11. In favourable years, in control variants, the Shoot Productivity of vines ranges from 109.7 to 135.7 g/shoot, while using planting stock, by I-II cuttings from the base of the stock cane, increases to 114.0 to 148.6 g/shoot. Reduction in the size of shoot productivity is observed when using planting stock, by 4^{th} and 5^{th} cuttings from the base of the stock cane. In unfavourable years, shoot productivity decreases.
12. The yield of vineyards of the R5 clone of the Cabernet Sauvignon variety, grown under the conditions of SC "Tomai-Vinex" SA, depends on the load of shoots on the vines, shoot productivity, and varies from year to year. In the control variants (2015-2018), when cultivated onto BxR Kober 5BB stock, the yield ranges from 4.09 to 5.69 kg per vine or 9.92 to 13.79 tons per hectare. It increases by 1.1-1.2 times when using planting stock, by 1^{st}-2^{nd} cuttings from the base of the stock cane, reaching 4.73 to 6.46 kg per vine or 11.47 to 15.67 tons per hectare.
13. The R5 clone of the Cabernet Sauvignon is characterized by high sugar accumulation. When cultivated onto BxR Kober 5BB stock, the mass concentration of sugars varies within the range of 224 to 258 g/dm^3; the mass concentration of titratable acids ranges from 8.0 to 9.1 g/dm^3. Onto RxR 101-14 stock, the values are 238 to 265 g/dm^3 for sugar concentration and 7.5 to 9.1 g/dm^3 for titratable acid concentration, respectively.
14. The growth, development of leaf surface, and productivity of clone R5 Cabernet Sauvignon grapevines are directly dependent on the quality of the planting stock, obtained using scion with and without tendrils, as well as the action of growth regulator (calovit). Yield (in 2017) in control variants amounts to 5.09 kg per vine and 123.5 centners per hectare (scion without tendrils, H_2O); 5.98 kg per vine and 14.49 tons per hectare (scion with tendril, H_2O). In the variant (scion with tendril, calovit), the yield compared to the control increases by 1.3 times and amounts to 6.65 kg per vine or 16.13 tons per hectare. In unfavourable years (2020-2021), regardless of the experimental variations, the yield decreases.

6. GROWTH, DEVELOPMENT, AND PRODUCTIVITY OF CLONES DEPENDING ON THE SHOOT TRAINING SYSTEM OF GRAPE VINES

6.1. Comparative Assessment of the Condition of Vineyard Plantations in the First Year of Reconstruction

The architecture of the grapevine canopy, or the geometric structure and external shape of the plant, determines the spatial arrangement of the assimilating surface. It plays a crucial role in shaping the radiation regime of vines, defining their photosynthetic activity, the level of energy exchange of the plant, and grapevine plantations as a whole. In vineyard plantations, the architecture of the grapevine canopy is determined by the type of support systems, the architecture of the vine itself (arrangement of trunk, arms, shoots, etc.), and the spatial positioning of the annual growth [154].

Experience in cultivating grapes in various habitats shows that to enhance the efficiency of the industry, it is necessary to employ appropriate agrotechnical practices for grapevine care [209, 212, 314]. As a result of such work, the term "Varietal Agrotechnics" emerged in the science of viticulture. According to the definition by S.A. Melnik et al. [258], varietal agrotechnics is a set of techniques and methods applied (established) in accordance with the biological properties of the grape variety in specific environmental conditions.

In SC "Tomai-Vinex" SA, vineyards of the R5 clone of Cabernet Sauvignon and the 348 clone of Merlot, grafted onto Kober 5BB stock in 2006, were planted using a technique that included the following: vine form – two-trunk horizontal bilateral cordon with dangling shoot positioning; trunk height of 80 cm; trellis system - vertical with two wire tiers, the first wire tier positioned at the height of the trunk, and the second one at a distance of 50-55 cm from the first; interior and ends posts with a height of 1.5 meters.

Under this management grapevine system, the vineyard yield ranges from 60.0 to 82.0 centners per hectare. Many agro-technical practices related to vine care (the use of machines for pre-pruning of vines, cultivators for soil cultivation between vines, mechanized shoot thinning and harvest, which will reduce the cost of manual labour) faced challenges. As a result, the need arose to transition to a new, innovative vine trellis and training system.

Projects (13.824.14.184T; 14.824.05.196T) were developed and implemented (fig. A 9.1, fig. A 9.2), according to which a complete reconstruction of eight-year-old fruiting grapevine plantations of R5 clone of Cabernet Sauvignon and 348 clone of Merlot was carried out.

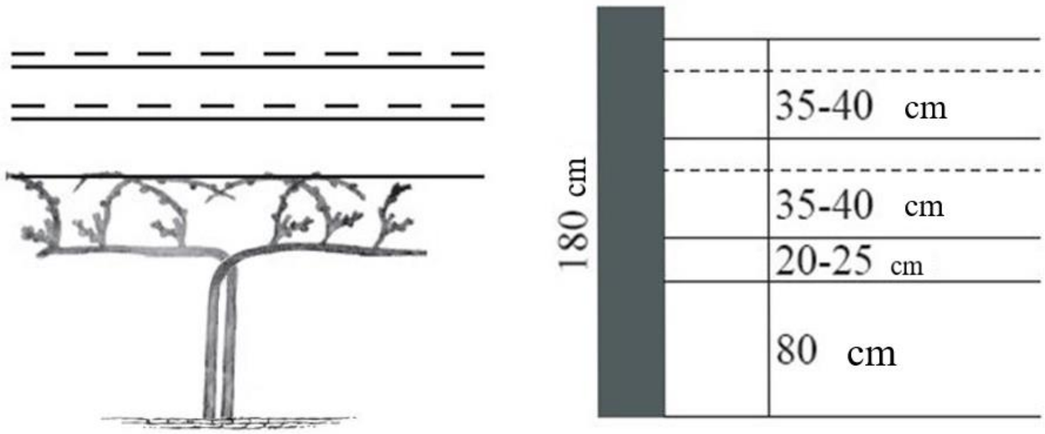


Fig. 6.1. Scheme of Grapevines After Reconstruction, 2013.

The reconstruction includes the following innovative changes:

– vine shape: two-trunk horizontal bilateral cordon with vertical shoot positioning;

– trellis system: vertical with four tiers of wires, trunk height 80 cm; the first wire tier is positioned at trunk height, the second - at 20-25 cm above the first, the third - at 35-40 cm above the second, and the fourth - at 35-40 cm above the third.

The trellis system is installed as follows: beside each trunk, trellis stakes are staked, interior posts are 1.8 m high, end posts are 2 m high at a 45-degree angle opposite to the row direction, secured with anchor braces; all wire tiers are tensioned using the Gripple device (fig. 6.1, fig. 6.2). This trellis system allows you to provide adequate support for managing vine vigour.

Fig. 6.2. Vineyards after Reconstruction, 2013.

The transition of cultivating European vine clones to a more intensive, cost-effective, energy- and resource-saving technology at SC «Tomai-Vinex» SA requires not only the reconstruction of trellis and support systems, changes in vine shape, and canopy management techniques but also the development of scientific foundations for these agricultural practices related to enhancing the photosynthetic activity of leaf surfaces and the biological productivity of shoots and vines. In connection with this, a comparative assessment of vineyard conditions before and after reconstruction was carried out in 2013-2014 (fig. A 8.4, fig. A 8.5). Parameters such as shoot growth, leaf surface area, leaf photosynthetic activity, and vine productivity of the studied clones were investigated. In commercial grape vine plantations, the architecture of vines is determined by the trellis and training system, the structure of the vine shape (placement of the trunk, cordons, shoots, etc.), and the vine canopy management.

6.1.1. Shoot and Leaf Growth

Vineyard canopy management is used to increase productivity, improve fruit quality, reduce disease risk, and make other vineyard operations easier. Shoot density, shoot length, lateral shoot growth, and others are some of the more widely utilised canopy assessment criteria [59].

Shoot Growth initiates after bud-break and, depending on the variety's characteristics and environmental conditions, typically continues until the onset of shoot maturation, and in some cases, until the physiological maturity of the berry [319]. We conducted research to determine the number of shoots, their average length, and to calculate the Annual Growth Development of vines before and after the reconstruction of vineyards at SC «Tomai-Vinex» SA (tab. 6.1).

Established that in 2013, the number of shoots for the R5 clone of Cabernet Sauvignon ranged from 27.0 to 28.1 per vine, while for the 348 clone of Merlot, it was 24.2 to 26.1 per vine. The shoot length during the phase of intensive growth before reconstruction was 91.4 cm for the R5 clone of Cabernet Sauvignon and 101.7 cm for the 348 clone of Merlot. After reconstruction, these values increased by 1.3 times, and a similar pattern was observed during the phase of growth attenuation.

According to S. Melnik's data [255], the main indicator characterizing the degree of growth in vines of different grape varieties is the Volume of Annual Shoot Growth. It depends on the number of developed shoots per vine, their average length, and their diameter. Besides varietal characteristics, the growth of shoots is influenced by the environmental conditions of the growing area and cultivation practices (plant nutrition area, vine shape, irrigation, fertilization, physiological-active substances, etc.) [313].

Table 6.1. Annual Growth Development of Vines in the First Year of Reconstruction, 2013.

Fruit set

Clone	Recon.	Number of Shoot, pcs./vine	Shoot Length, cm	Annual Growth Length	
				m/vine	th.m/ha
Cl R5	before	27.0±0.4	91.4±2.0	24.7±0.3	72.8±1.5
	after	28.1±0.4	116.7±2.1	32.8±0.4	96.7±1.6
Cl 348	before	23.1±0.3	101.7±2.0	23.5±0.3	69.3±1.5
	after	25.3±0.3	129.7±2.1	32.8±0.4	96.8±1.6

Clone	Recon.	Volume of Annual Growth		
		cm^3/shoot	th.m^3/ha	m^3/vine
Cl R5	before	21.7±0.2	0.6±0.01	1.7±0.02
	after	30.8±0.3	0.9±0.01	2.6±0.03
Cl 348	before	29.7±0.3	0.7±0.01	2.0±0.03
	after	44.4±0.2	1.1±0.02	3.3±0.04

Maturity

Clone	Recon.	Number of Shoot, pcs./vine	Shoot Length, cm	Annual Growth Length	
				m/vine	th.m/ha
Cl R5	before	27.0±0.4	105.7±2.1	28.5±0.4	84.2±1.6
	after	28.1±0.4	144.1±2.2	40.5±0.5	119.5±1.7
Cl 348	before	23.1±0.3	122.4±2.2	28.3±0.4	83.4±1.6
	after	25.3±0.3	160.5±2.2	40.6±0.5	119.8±1.7

Clone	Recon.	Volume of Annual Growth		
		cm^3/shoot	th.m^3/ha	m^3/vine
Cl R5	before	27.0±0.4	0.7±0.01	2.1±0.03
	after	44.9±0.4	1.3±0.01	3.7±0.05
Cl 348	before	36.9±0.4	0.9±0.01	2.5±0.04
	after	58.3±0.5	1.5±0.01	4.3±0.05

Recon. – Reconstruction
Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

In turn, we have found that under similar soil-climatic and agronomic conditions, the extent of annual vine shoot growth depends on the biological characteristics of the clones and varies throughout the growth stages. For instance, at the end of the vegetation period, during the completion of growth processes, the total length of Shoot Growth for clone R5 Cabernet Sauvignon before reconstruction is 28.5 m/vine, and after reconstruction, it is 40.5 m/vine; for clone 348 Merlot, it is 29.6 m/vine and 40.7 m/vine (tab. 6.1). A similar pattern is observed in terms of the Volume of Annual Shoot Growth. Regardless of the growth stages, clone grapevines exhibit more intensive growth and development, as in the case of the clone 348 Merlot, where the volume of Shoot Growth increases by 1.1-1.3 times.

Various phytometric characteristics are employed for the quantitative description of the architecture of individual plants or plant canopies [311]. Regarding the phytometric indicators of grapevine canopy, the following parameters are utilized: length, width, and height of the canopy;

canopy volume; number of leaves and shoots per vine and per linear metre of row; shoot length and leaf area; development pattern of lateral shoots, and more [183, 152] emphasizes that the formation of an optimally sized photosynthetic apparatus is crucial for achieving high yields.

As an optical-biological system, the growth and production of the grapevine canopy are dependent on the rhythmicity of physiological processes related to shoot development and leaf apparatus. Leaves play a crucial role in vital processes such as photosynthesis, transpiration, and respiration, the activity of which varies due to plant variety traits and their adaptation to external environmental factors. As a result of individual leaf activities, the cumulative leaf area of shoots, vines, rows, and vineyards is formed. The magnitude, structure, and functional conditions of the leaf surface determine the yield quantity, economic outcome, and product quality [154, 313, 335]. The increase of leaf surface area during grapevine ontogenesis represents a fundamental process essential for proper CO_2 assimilation during photosynthesis. According to V. Naumenko [276, 277], the rates of leaf surface formation in grapevines vary and are dependent on varietal biological traits and their response to growth conditions.

Under certain instances of solar radiation influx, the amount of energy absorbed by plants in terms of Photosynthetically Active Radiation (PAR) primarily depends on the dimensions of the Leaf Surface Area, the course of its formation throughout the vegetation period, and the spatial arrangement of leaf mass.

The research was conducted by us during periods of highest photosynthetic activity of leaves in the fruit set growth stage and the maximum development of the assimilation surface during the maturity stage. It has been established that for the investigated clones, the growth and development of leaf surface depend on varietal characteristics, and growth stages, and vary based on the system of shoot growth management.

It has been demonstrated that the length, width, and thickness of leaf blades are determined by individual clone traits. These measurements are higher in clone 348 Merlot compared to clone R5 Cabernet Sauvignon and vary according to vegetation stages (tab. A 6.1).

During the period of intense berry growth, the leaf blade area for clone R5 Cabernet Sauvignon before vineyard reconstruction is 105.3 cm^2/leaf and during ripening, it's 128.9 cm^2/leaf; for clone 348 Merlot, it's 125.5 and 143.5 cm^2/leaf, respectively (tab. 6.2).

Table 6.2. Development of Leaf Surface Area in Vines in the First Year of Reconstruction, 2013.

Fruit set

Clone	Recon.	No Leaves pcs./shoot	Leaf Area			
			cm^2/leaf	dm^2/shoot	m^2/vine	th.m^2/ha
Cl R5	before	30.1±0.2	105.3±2.0	31.7±0.3	8.6±0.15	25.2±0.2
	after	38.1±0.3	143.9±2.2	54.8±0.4	15.4±0.16	45.4±0.3
Cl 348	before	28.1±0.2	125.5±2.1	35.3±0.3	8.1±0.15	24.0±0.2
	after	41.1±0.3	151.5±2.2	62.3±0.4	15.8±0.16	46.5±0.3

Maturity

Clone	Recon.	No Leaves pcs./shoot	Leaf Area			
			cm^2/leaf	dm^2/shoot	m^2/vine	th.m^2/ha
Cl R5	before	32.3±0.3	128.9±2.6	41.6±0.4	11.2±0.15	33.2±0.3
	after	41.1±0.3	148.3±2.8	61.0±0.4	17.1±0.17	50.5±0.4
Cl 348	before	30.4±0.2	143.5±2.7	43.6±0.3	10.1±0.15	29.7±0.3
	after	43.9±0.3	156.5±2.8	68.7±0.4	17.4±0.17	51.3±0.4

Recon. – Reconstruction
Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

The reconstruction of vineyards leads to changes in the shoot positioning and the nature of the development of the assimilation surface of the vines. Thus, there is an increase in the length of shoots and the Number of Leaves per shoot by a mean of 1.3 to 1.4 times. The Leaf Area of one shoot, vine, and vineyard increases by 1.8 to 1.9 times. Leaf Index parameters increase during the maturity stage by 1.5 to 1.9 times (tab. 6.2).

The Leaf Area of a shoot is determined by summing the areas of all the leaves on the shoot. Depending on weather conditions, the Number of Leaves on the shoots can vary at the end of the growing season. Therefore, it is more reasonable to calculate the Leaf Area per "Mean" leaf. The total Leaf Area of the vine is obtained by multiplying the Leaf Area of the "Mean Shoot" by the Mean Shoot Load.

A. Amirdzhanov [154] considers that effective methods based on the linear relationship between shoot length and the area of its leaves are efficient for assessing the photosynthetic activity of grapevine plants.

In turn, we have established a positive linear correlation between Shoot Length and the Shoot Leaf Surface Area in the studied grapevine clones. The correlation coefficients (r) are high, ranging from 0.97 to 0.98.

Research conducted by T. Gunashev [174] has also shown that as the total length of the shoot increases, the average size of the leaves and the total leaf surface area per shoot increase. However, the number of leaves developing per unit length of the shoot decreases. A similar relationship was observed by H. Todorov (cited in Stoev [319]), who demonstrated a strong correlation (r = 0.81-0.99) between the leaf surface area of each shoot and their length. The sizes of the leaf surface area, per unit length of the shoots, are not uniform and vary depending on the number and size of leaves.

6.1.2. Parameters of Photosynthetic Activity

According to the data from V. Bukhantsov [161], during the vegetation period of grapevine plants, depending on the positioning of the leaves along the length of the shoots, their photosynthetic activity and donor capacity increase in the middle part of the shoot. In connection with this, the content of plastid pigments in the leaves was determined in the middle part of the shoot (8^{th}-12^{th} leaf from the base), which was located on the same level in the canopy with uniform illumination.

One of the components of the Photosynthetic Apparatus in plants is plastid pigments. In higher plants, including grapes, they are represented by two classes of substances - chlorophylls (a and b) and carotenoids [262].

The content of plastid pigments, their ratio and condition, and the dynamics of chlorophylls and carotenoids in leaves are important indicators of the photosynthetic activity of plants. In grape plants, these indicators change ontogenetically, depending on their varietal characteristics.

We've established that the content of plastid pigments in the leaves of the examined clones depends on the spatial arrangement of shoots before and after the vineyard reconstruction. During the stage fruit set (July 23, 2013), in the leaves of the clone R5 Cabernet Sauvignon and clone 348 Merlot, before reconstruction (with dangling shoot positioning) the content of plastid pigments varies insignificantly (tab. 6.3).

Table 6.3. Content of Plastid Pigments in the Leaves of Grape Plants in the First Year of Reconstruction, (milligrams per gram of absolute dry matter). Fruit set Stage, 2013.

Clone	Recon.	ch.a	ch.b	ch.a+ ch.b	caroten.	ch.a/ch.b	ch.a+ ch.b/ caroten.
Cl R5	before	5.579±0.06	3.167±0.04	8.746±0.10	1.619±0.02	1.8/1	5.4/1
	after	7.144±0.08	4.169±0.05	11.313±0.11	1.966±0.02	1.6/1	5.8/1
Cl 348	before	5.489±0.06	3.115±0.04	8.604±0.10	1.610±0.02	1.8/1	5.3/1
	after	7.441±0.08	4.266±0.05	11.707±0.11	2.461±0.03	1.7/1	4.8/1
LSD$_{05}$		*0.25*	*0.19*	*0.38*	*0.09*		

Recon. – Reconstruction
Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

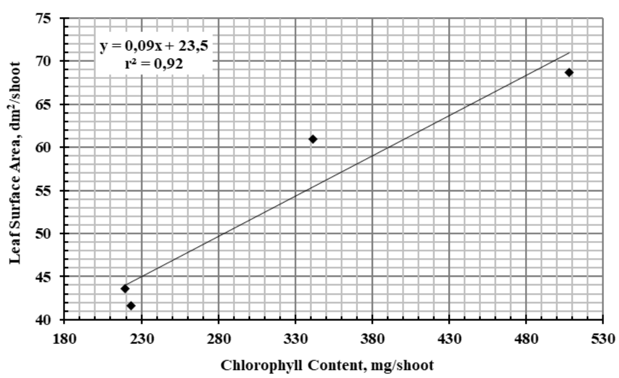
The concentration of chlorophyll a is 5.579 and 5.489, chlorophyll b is 3.167 and 3.115, chlorophyll a+b is 8.746 and 8.604, and carotenoids are 1.619 and 1.610 mg/g of absolute dry matter, respectively. At the same time, after reconstruction (with vertical shoot positioning), the content of chlorophylls increases by 1.3-1.4 times, and carotenoids increase by 1.2-1.5 times.

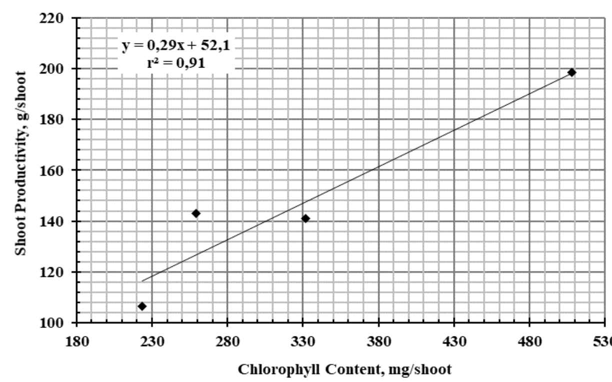
Table 6.4. Parameters of Photosynthetic Activity in Grapevine Leaves in the First Year of Reconstruction, 2013.

Fruit set					
Clone	**Recon.**	**Photosynthetic Activity of the Shoot**			
		Leaf Surface Area, dm²/shoot	**Chlorophyll Content, mg/shoot**	**Leaf Biomass, g/shoot**	
Cl R5	before	31.7±0.6	144.8±1.3	16.6±0.2	
	after	54.8±0.6	217.7±1.5	24.0±0.2	
Cl 348	before	35.3±0.6	181.3±1.3	21.1±0.2	
	after	62.3±0.7	316.8±1.5	35.7±0.3	
LSD₀₅		*2.52*	*0.38*	*0.14*	
Maturity					
Clone	**Recon.**	**Photosynthetic Activity of the Shoot**			**Shoot Productivity**
		Leaf Surface Area, dm²/shoot	**Chlorophyll Content, mg/shoot**	**Leaf Biomass, g/shoot**	
Cl R5	before	41.6±0.6	223.5±2.2	23.3±0.3	106.3±2.3
	after	61.0±0.7	341.5±2.4	34.5±0.4	140.9±2.4
Cl 348	before	43.6±0.6	219.4±2.1	22.4±0.3	142.9±2.4
	after	68.7±0.7	508.1±2.5	44.5±0.4	198.7±2.5
LSD₀₅		*2.70*	*0.34*	*0.15*	*2.52*

Recon. – Reconstruction
Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

The analysis of photosynthetic activity in grapevine leaves showed that for the investigated clones, after vineyard reconstruction, there is an increase in Leaf Surface Area by 1.6-1.7 times during the fruit set growth stage and by 1.5-2.5 times during the maturity stage (tab. 6.4).





a) ***Chlorophyll Content and Leaf Surface Area*** **b)** ***Chlorophyll Content and Shoot Productivity***

Fig. 6.3. Relationship between Leaf Photosynthetic Activity Parameters and Shoot Productivity of Grapevine Clones. First Year of Reconstruction, 2013.

The content of chlorophyll also increases by 1.5-2.3 and 1.5-3.2 times, respectively, with an increase in the surface content of chlorophyll. Leaf biomass accumulates, with an increase in its content by 7.44-14.61 and 11.26-42.11 grams of leaves per shoot.

It was established that the correlation coefficients between the Chlorophyll Content and the Leaf Surface Area per shoot are r = 0.92 (fig. 6.3), and between Chlorophyll Content and Shoot Productivity, the correlation coefficient is r = 0.92. These findings indicate a connection between Leaf Surface Development, Chlorophyll Content, Organic Substance Formation, and Grapevine Plant Productivity.

This confirms the importance of accumulating an optimal level of chlorophyll concentration, which in turn stimulates the development of grapevine leaf structures, enhances photosynthetic efficiency, and ultimately increases the productivity of grapevine shoots. This process also contributes to the formation of a greater quantity of organic substances, which serve as the foundation for plant growth and development. The enhanced productivity of grapevine shoots leads to increased yields and berry quality, essential for successful agricultural production and achieving the economic goals of viticulture.

According to Derendovskaia A. et al. [183], the increase in the assimilation surface area of grapevine plants during ontogenesis is a fundamental process necessary for normal plant metabolism. The rates of leaf surface formation in grapevine varieties vary and depend on their biological characteristics and how they respond to growing conditions. The authors note that the growth of the assimilation surface in grapevine plants, and the rates at which it increases, are more intense before the onset of berry growth. Subsequently, the growth of the assimilation surface slows down, which is likely related to changes in donor-acceptor relationships and the allocation of assimilates towards berry growth. There is a direct correlation observed between the development of the leaf surface and the chlorophyll content.

6.1.3. Productivity of Vineyards

Productivity is the end consequence that defines the viability of producing a specific grape variety. The final result that determines the usefulness of growing a particular variety is its productivity. Yield is the sum of a number of biological, ecological and anthropogenic (technological) indicators. More than a year elapses between the setting of the plant in the buds of the dormant buds in the form of embryonic inflorescences and the harvesting of the grapes. During this period, the reproductive organs of the grapevine are affected by a large number of different factors.

Table 6.5. Yield and Harvest Quality Indicators of Grapevine Clones in the First Year of Reconstruction, 2013.

Clone	Recon.	No. of Clusters pcs./vine	Weight of Clusters, g	Yield, kg/vine	Mass concentration, g/dm^3	
					sugars	titratable acids
Cl R5	before	39.8±0.4	72.1±1.2	2.87±0.07	220±2	9.3±0.02
	after	40.2±0.4	98.5±1.5	3.96±0.08	210±1	9.4±0.02
Cl 348	before	34.7±0.3	95.1±1.5	3.30±0.08	231±2	9.1±0.02
	after	37.1±0.4	135.5±1.8	5.03±0.09	222±2	9.2±0.02

Recon. – Reconstruction
Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

We, in turn, have found that the average number of clusters in the clone R5 of Cabernet Sauvignon variety varies from 39.8 to 40.2 clusters per vine, while in the clone 348 of Merlot variety, it is 34.7 clusters per vine before reconstruction and increases to 37.1 clusters per vine after reconstruction (tab. 6.5). The cluster weight varies in clone R5 Cabernet Sauvignon from 72.1 g to 98.5 g and in clone 348 Merlot from 95.1 g to 135.5 g, respectively. It has been established that the yield of clone R5 of Cabernet Sauvignon is 8.47-11.68 tons per hectare, while for clone 348 of Merlot, it is 9.73-14.83 tons per hectare and increases after the reconstruction of the vineyards by 1.1-1.3 times. There is some decrease in the mass concentration of sugars in the variant with vertical shoot positioning, regardless of the clone. The mass concentration of titratable acids changes insignificantly and varies from 9.1 g/dm^3 to 9.4 g/dm^3, staying within the technological requirements imposed on this group of clones.

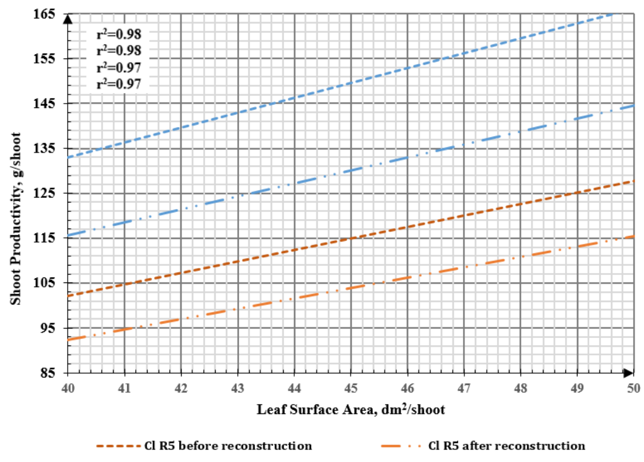


Figure 6.4. Relationship between Shoot Leaf Surface Area and its Productivity in Grapevine Plants in the First Year of Reconstruction, 2013.

A positive linear correlation has been established between the Shoot Leaf Surface Area and its Shoot Productivity in the grapevine clones under study. The correlation coefficients (r^2) are high, ranging from 0.97 to 0.98 (fig. 6.4).

Therefore, the reconstruction of the vineyards conducted at SC "Tomai-Vinex" SA in 2013 led to changes in the canopy phytometric characteristics, an increase in shoot growth parameters and assimilation surface, enhancement of leaf photosynthetic activity, which ultimately contributed to the increased productivity of the studied clones.

6.2. Assessment of the Condition of Vineyard Plantations in the Second Year After Reconstruction

A further analysis of the grapevines' condition was conducted in the second year following the reconstruction. Parameters such as growth, photosynthetic activity, and productivity of the reconstructed plantations were studied under the agroecological conditions of SC "Tomai-Vinex" SA. This analysis aimed to deepen our understanding of the reconstruction's effects in the subsequent year, its impact on the adaptation of grapevine plants, and the activity of physiological processes within them.

6.2.1. Shoot and Leaf Growth

At the post-reconstruction stage (2014), the number of shoots for clone R5 Cabernet Sauvignon ranges from 29.1 to 30.3 shoots per vine, and for clone 348 of Merlot, it ranges from 27.1 to 28.3 shoots per vine. The mean length of the shoots during the stage of shoot growth (June, 16) is 127.3 cm for clone R5 Cabernet Sauvignon and 141.2 cm for clone 348 Merlot (tab. 6.6).

Table 6.6. Development of Annual Growth of Vines in the Second Year After Reconstruction, 2014.

Growth Stage	Clone	Number of Shoot, pcs./vine	Shoot Length, cm	Annual Growth Length	
				m/vine	th.m/ha
Shoot Growth	Cl R5	29.1±0.2	127.3±2.4	37.0±0.3	89.8±2.2
	Cl 348	27.1±0.2	141.2±2.5	38.3±0.3	92.8±2.2
Cane Ripening	Cl R5	30.3±0.3	145.8±2.5	44.2±0.4	107.1±2.5
	Cl 348	28.3±0.2	162.7±2.8	46.0±0.4	111.6±2.8

Growth Stage	Clone	Volume of Annual Growth		
		cm^3/shoot	m^3/vine	th.m^3/ha
Shoot Growth	Cl R5	27.0±0.2	0.8±0.1	1.9±0.1
	Cl 348	33.5±0.3	0.9±0.1	2.2±0.1
Cane Ripening	Cl R5	73.2±0.5	2.2±0.1	5.4±0.2
	Cl 348	90.1±0.5	2.6±0.1	6.2±0.2

Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

During the stage of cane ripening (September, 26), their length increases to 145.8 cm and 162.7 cm, respectively. The total length of the vine's growth by the end of the vegetation period is 44.2 meters per vine for clone R5 Cabernet Sauvignon and 46.0 meters per vine for clone 348 Merlot.

The volume of Annual Growth for clone R5 Cabernet Sauvignon is 2.2 dm^3 per vine, while for clone 348 Merlot, it increases to 2.6 dm^3 per vine. Therefore, clone 348 of Merlot is characterized by more active growth and the ability to accumulate biomass.

6.2.2. Parameters of Photosynthetic Activity

Research on the development of the Leaf Surface of the reconstructed sections of grapevine clones at SC "Tomai-Vinex" SA was conducted during the period of maximum photosynthetic activity of the leaves, in the fruit set. It has been shown that the growth and development of the Leaf Surface Area in the studied clones are determined by the plant's varietal characteristics. We have found that during this period, on the shoots of the studied clones, clone R5 Cabernet Sauvignon developed 26.2±0.2 leaves per shoot, while clone 348 Merlot had 21.1±0.2 leaves per shoot. In the subsequent growth stages, an increase in the number of leaves is observed (tab. 6.7).

Table 6.7. Development of Leaf Surface Area of Vines in the Second Year After Reconstruction, 2014.

Clone	No Leaves pcs./shoot	Leaf Area			
		cm^2/leaf	dm^2/shoot	m^2/vine	th.m^2/ha
Fruit set					
Cl R5	26.2±0.2	152.9±1.5	40.1±0.4	11.7±0.2	34.5±0.5
Cl 348	21.1±0.2	217.9±1.7	46.0±0.4	12.5±0.2	36.9±0.5
Maturity					
Cl R5	27.1±0.2	167.7±1.8	45.4±0.5	13.8±0.2	40.7±0.6
Cl 348	22.5±0.2	220.6±2.1	49.6±0.5	14.0±0.2	41.3±0.6
Cane Ripening					
Cl R5	27.5±0.3	182.9±2.0	50.3±0.5	15.2±0.3	44.8±0.6
Cl 348	22.8±0.3	258.1±2.2	58.8±0.5	16.6±0.3	49.0±0.6

Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

During the growth stage fruit set, the leaf area of clone R5 Cabernet Sauvignon is 152.9±1.5 cm^2 per leaf, during the maturity stage – 167.7±1.8 cm^2/leaf, and in the cane ripening stage – 182.9±2.0 cm^2/leaf. For clone 348 Merlot, these values are 217.9±1.7 cm^2/leaf and 258.1±2.2 cm^2/leaf, respectively. This parameter increases, regardless of the growth stages, for clone 348 Merlot compared to clone R5 Cabernet Sauvignon, leading to an increase in the size of the leaf surface of the shoots and vines by 1.3-1.4 times.

Table 6.8. Content of Assimilation Pigments in the Leaves of of Vines in the Second Year After Reconstruction, mg/g of dry matter, 2014.

Clone	ch.a	ch.b	ch.a+ ch.b	caroten.	ch.a/ch.b	ch.a+ ch.b/caroten.
Fruit set						
Cl R5	7.298±0.08	4.134±0.05	11.432±0.11	1.501±0.02	1.8/1	7.6/1
Cl 348	8.634±0.08	4.548±0.05	13.182±0.11	1.981±0.02	1.9/1	6.7/1
Maturity						
Cl R5	5.855±0.06	2.715±0.02	8.570±0.10	1.621±0.01	2.2/1	5.3/1
Cl 348	7.328±0.08	2.997±0.02	10.325±0.11	3.503±0.03	2.5/1	3.0/1
Cane Ripening						
Cl R5	5.490±0.06	2.764±0.02	8.254±0.10	1.567±0.02	2.0/1	5.3/1
Cl 348	6.441±0.07	2.729±0.02	9.170±0.11	2.068±0.02	2.4/1	4.4/1

Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

The content of assimilation pigments, their ratio and state, and the dynamics of chlorophylls and carotenoids in grapevine leaves are indicators of the photosynthetic activity of plants. In grapevines, the content of assimilation pigments (chlorophylls and carotenoids) in leaves and their ratio change during ontogenesis depending on varietal characteristics (tab. 6.8).

It has been established that during the period of fruit set, in the leaves of clone R5 Cabernet Sauvignon from the reconstructed plantings, the concentration of chlorophyll a is 7.298±0.08, chlorophyll b is 4.134±0.05, the sum of chlorophylls a+b is 11.432±0.11, and carotenoids are 1.501±0.02 mg/g of absolutely dry biomass. The concentration of assimilation pigments in the leaves of the clone 348 Merlot increases by 1.1-1.2 times compared to the clone R5 Cabernet Sauvignon. Additionally, the Chlorophyll Index (chlorophyll a/chlorophyll b) increases, while the Pigment Index (chlorophyll a+b/carotenoids) decreases.

In subsequent phases, there is a decrease in chlorophyll levels, but the level of carotenoids increases, especially in the Merlot clone 348. Carotenoids serve as additional pigments in photosynthesis and, at the same time, play a protective role by shielding chlorophyll molecules from irreversible light-induced oxidation [305].

Parameters of Leaf Photosynthetic Activity include the developing Leaf Surface Area, the content of Plastid Pigments in the leaves, and the increase in Plant Organ Biomass per shoot, which is presented in Table 6.9.

It is shown that during the growth stage of fruit set, the Leaf Surface Area of clone R5 Cabernet Sauvignon shoots is 40.1±0.4 dm^2/shoot, while that of clone 348 Merlot shoots is 46.0±0.4 dm^2/shoot.

It contains 229.6±2.2 mg/shoot and 280.6±2.3 mg/shoot of chlorophyll and 20.1±0.2 g/shoot and 21.3 21.3±0.2 g/shoot of absolutely dry biomass, respectively.

Table 6.9. Indicators of Photosynthetic Activity in Grape Plants in the Second Year After Reconstruction, 2014.

Clone	Leaf Area, dm^2/shoot	Chlorophyll Content, mg/shoot	Leaf Biomass, g/shoot	
Fruit set				
Cl R5	40.1±0.4	229.6±2.2	20.1±0.2	
Cl 348	46.0±0.4	280.6±2.3	21.3±0.2	
Clone	**Leaf Area, dm^2/shoot**	**Chlorophyll Content, mg/shoot**	**Leaf Biomass, g/shoot**	**Shoot Productivity**
Maturity				
Cl R5	45.4±0.5	244.7±2.5	28.6±0.3	145.9±2.4
Cl 348	49.6±0.5	342.5±2.5	33.2±0.3	199.2±2.5

Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

These indicators noticeably increase during the berry ripening phase, especially in the case of the clone 348 Merlot variety. It is worth noting a high correlation between the parameters of Photosynthetic Activity and Shoots Productivity (grape mass per shoot).

I. Tarchevsky [324] believe that the most accurate representation of the development capacity of the photosynthetic apparatus can be obtained through data on the chlorophyll content in all plant organs, and the pigment content can be used as an indicator determining the potential photosynthetic productivity of wheat. The authors believe that determining the development capacity of the photosynthetic apparatus based on chlorophyll content can be used to characterize the potential ability to yield not only in individual plants but also in the entire crop. I. Tarchevsky et al. [325] introduce the "Chlorophyll Index," which expresses the total chlorophyll content in crop plants, normalized per unit area, in g/m² or kilogramme per hectare.

Table 6.10. Chlorophyll Parameters of Grapevine Clones in the Second Year After Reconstruction, 2014.

Clone	Chlorophyll Parameters			
	Chlorophyll Content		Chlorophyll Index	
	mg/shoot	g/vine	g/m^2	kg/ha
Fruit set				
Cl R5	229.6±2.4	6.7±0.1	1.98±0.02	19.7±0.2
Cl 348	280.6±2.4	7.6±0.1	2.25±0.02	22.4±0.2
Maturity				
Cl R5	244.7±2.5	7.4±0.2	2.19±0.03	21.9±0.2
Cl 348	342.5±2.5	9.7±0.2	2.87±0.03	28.6±0.3

Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

Research conducted on annual crops [182] also demonstrated a close relationship between chlorophyll accumulation, biomass formation, and the productivity of grain crops. They established a high correlation between chlorophyll indicators and the yield of annual cereal crops.

In our study, we used Chlorophyll Indicators to characterize the Photosynthetic Activity of the investigated grapevine clones and their connection to Shoot Productivity (tab. 6.10). It was found that the Chlorophyll Index, which characterizes the accumulation of chlorophyll per unit leaf area of vines (g/m^2) and vineyards (kg per hectare), is high and amounts to 2.19±0.03 g/m^2 and 21.9±0.2 kg per hectare (clone R5 Cabernet Sauvignon); 2.87±0.03 g/m^2 and 28.6±0.3 kg per hectare (clone 348 Merlot).

6.2.3. Productivity of Vineyards

Enhanced photosynthetic activity of the investigated grapevine clones leads to an increase in their productivity. It has been determined that for clone R5 of the Cabernet Sauvignon variety, the mean number of clusters is 36.3 per vine with a mean weight of 121.8 grams; the yield is 4.42 kilograms per vine or 13.04 tons per hectare (tab. 6.11). The sugar content is 226 g/dm^3, and titratable acidity is 8.3 g/dm^3.

For clone 348 of the Merlot variety, these indicators are higher and amount to a mean cluster weight of 167.5 grams, a yield of 5.66 kilograms per vine or 16.70 tons per hectare. The sugar content is 228 g/dm^3, and titratable acidity is 8.2 g/dm^3.

Table 6.11. Yield and Harvest Quality Indicators of Grapevine Clones in the Second Year After Reconstruction, 2014.

Clone	Number of Clusters, pcs./vine	Weight of Clusters, g	Yield,		Mass Concentration, g/dm^3	
			kg/ vine	tons/ hectare	Sugars	Titratable Acids
Cl R5	36.3±0.3	121.8±1.8	4.42±0.09	13.04±0.17	226±2	8.3±0.01
Cl 348	33.8±0.3	167.5±2.0	5.66±0.09	16.70±0.19	228±2	8.2±0.01

Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

Therefore, the studied clones under the production conditions at the SC "Tomai-Vinex" SA enterprise in the first two years after reconstruction are characterized by high yield and product quality. This confirms the positive aspects of vineyard reconstruction, including the transition from dangling shoot positioning to vertical shoot positioning with dense planting of vines. The agronomic practice of training system – shoot positioning significantly influences the canopy parameters of the R5 clone of the Cabernet Sauvignon variety and the 348 clone of the Merlot variety when cultivated in the soil-climatic conditions of the South of the Republic of Moldova. Vertical shoot positioning leads to an increase in the length of annual shoot growth, parameters of leaf photosynthetic activity, chlorophyll content, enhancement of leaf photosynthetic activity, and accumulation of biomass, ultimately contributing to the productivity increase of the vineyards of clones under study.

6.3. Conclusions for Chapter 6

1. The vineyard reconstruction carried out in 2013-2014, involving changes in the type of supports, the vineyard canopy management techniques, and a complex of agronomic practices, led to an increase in shoot growth parameters, leaf surface area, enhanced photosynthetic activity of leaves, and shoot productivity. The indicators of the chlorophyll index increase by 1.2 times, and the photosynthetic potential increases by 1.3 times.
2. The total length of the vine's growth by the end of the vegetation period is 44.2 meters per vine for clone R5 Cabernet Sauvignon and 46.0 meters per vine for clone 348 Merlot. The volume of Annual Growth for clone R5 Cabernet Sauvignon is 2.2 dm^3 per vine, while for clone 348 Merlot, it increases to 2.6 dm^3 per vine.
3. A strong correlation was observed between photosynthetic activity indicators and shoot productivity (cluster weight/shoot). The chlorophyll index, which characterizes the accumulation of chlorophyll per unit leaf area of grapevine plantations (in g/m^2, kg/ha), is high and amounts to 2.2 g/m^2 and 21.9 kg/ha (clone R5 Cabernet Sauvignon); 2.9 g/m^2 and 28.6 kg/ha (clone 348 Merlot).
4. It has been determined that for clone R5 of the Cabernet Sauvignon variety, the mean number of clusters is 36.3 per vine with a mean weight of 121.8 grams; the yield is 4.42 kilograms per vine. The sugar content is 226 g/dm^3, and titratable acidity is 8.3 g/dm^3. For clone 348 of the Merlot variety, these indicators are higher and amount to a mean cluster weight of 167.5 grams, a yield of 5.66 kilograms per vine. The sugar content is 228 g/dm^3, and titratable acidity is 8.2 g/dm^3.
5. The reconstruction of grapevine plantations, associated with changes in the the shoot training system, leads to changes in the Phytometric Indicators of the Vine Canopy, an increase in the Growth Parameters of Shoots and the Assimilation Surface, and an enhancement of Leaf Photosynthetic Activity, which ultimately contributes to the increased Productivity of the studied clones.

7. MONITORING OF THE GROWTH, DEVELOPMENT AND PRODUCTIVITY OF GRAPEVINE CLONES

7.1. Shoot Growth and Development

During the period from 2015 to 2021, we conducted monitoring of the growth, development, and productivity of Cl R5 Cabernet Sauvignon and Cl 348 Merlot clones in reconstructed vineyards. These studies aimed to obtain valuable data on how these clones adapt to new conditions after vineyard reconstruction. An analysis of various aspects of their growth was carried out, including the dynamics of annual shoot growth, leaf formation, as well as yield parameters and the quality of the obtained produce. These observations allowed us to better understand which factors influence the successful development of these Cl R5 Cabernet Sauvignon and Cl 348 Merlot clones in new conditions and which agronomic methods may be most effective for their cultivation. The obtained results will help optimize grape cultivation practices and increase the yield and quality of the produce in the future.

Studying the formation of the above-ground part of the grapevine, is an important aspect of understanding how grape plants adapt to their environment and how comfortable they are in their habitat. One of the key indicators that allows the evaluation of this adaptation is the growth and development of grapevine annual shoots. Based on this data, conclusions can be drawn about the development of grapevine canopies. Therefore, studying the characteristics of this process in European grapevine clones under the conditions of the ATU Gagauzia is a relevant research topic.

Various factors such as meteorological conditions, vine canopy architecture, training systems, other agronomic practices, and genetic characteristics of clones can influence the growth and development of Annual Growth. Understanding these factors will help optimize the cultivation methods of European clones in the Autonomous and increase both yield and product quality.

Within the scope of the study, we conducted monitoring of the growth and development characteristics of the Annual Growth of clone R5 Cabernet Sauvignon and clone 348 Merlot from 2015 to 2021 in the conditions of the ATU Gagauzia. Using the example of the SC «Tomai-Vinex» SA agricultural enterprise, we analyzed the influence of these factors on the development of grapevines and their potential for producing high-quality grapes. The length of the Annual Growth depends on factors such as the number of shoots formed on the vine and their length. Throughout the entire period of research (2015-2021), it was found that the clone R5 Cabernet Sauvignon forms 29.7±0.3 shoots per vine, while the clone 348 Merlot forms 25.7±0.3 shoots per vine (tab. 7.1).

Table 7.1. Monitoring the Development of Annual Growth of Grapevine Clones.

Years of Research	Number of Shoot, pcs./vine			Shoot Length, cm		
	Cl R5	Cl 348	Mean	Cl R5	Cl 348	Mean
2015	30.3±0.2 c	25.2±0.2 g	27.8±0.6 C	142.1±1.7 ef	160.6±1.9 bc	151.4±2.5 BC
2016	31.3±0.2 ab	27.6±0.2 e	29.5±0.4 A	148.3±1.9 de	165.5±2.0 b	156.9±2.4 B
2017	31.6±0.1a	28.1±0.2 de	29.9±0.4 A	167.5±1.9 b	186.9±1.9 a	177.2±2.6 A
2018	31.4±0.2 ab	27.8±0.2 e	29.6±0.4 A	164.8±1.8 b	183.9±2.2 a	174.4±2.6 A
2019	30.7±0.2 bc	26.6±0.2 f	28.7±0.5 B	138.1±2.0 f	154.1±2.0 cd	146.1±2.3 C
2020	24.0±0.2 h	20.4±0.2 i	22.2±0.4 E	69.5±1.6 i	77.6±2.0 hi	73.6±1.6 E
2021	28.9±0.2 d	24.3±0.2 h	26.6±0.5 D	83.8±1.9 h	93.5±1.7 g	88.7±1.7 D
Mean	29.7±0.3 A	25.7±0.3 B	27.7±0.3	130.6±4.4 B	146.0±4.9 A	138.3±3.3
ANOVA						
F_{Clone}	1697.6***			F_{Clone}	232.7***	
F_{Year}	434.9***			F_{Year}	935.5***	
$F_{Clone*Year}$	5.6***			$F_{Clone*Year}$	3.0**	

Years of Research	Annual Growth Length					
	m/vine			th.m/ha		
	Cl R5	Cl 348	Mean	Cl R5	Cl 348	Mean
2015	43.1±1.5 de	40.5±0.5 e	41.8±0.8 C	127.7±2.1 cd	119.4±1.6 d	123.6±1.6 C
2016	46.4±1.9 bcd	45.7±0.7 cde	46.1±1.0 B	136.9±1.7 b	134.8±2.0 bc	135.9±1.3 B
2017	52.9±2.1 a	52.5±0.7 a	52.7±1.1 A	156.1±2.0 a	154.9±2.1 a	155.5±1.4 A
2018	51.7±1.9 ab	51.1±0.8 abc	51.4±1.0 A	152.7±1.5 a	150.8±2.4 a	151.8±1.4 A
2019	42.±1.6 de	41.0±0.5 de	41.7±0.8 C	125.1±1.7 d	120.9±1.5 d	123.0±1.2 C
2020	16.7±0.5 g	15.8±0.4 g	16.3±0.3 E	49.2±1.6 f	46.7±1.1 f	48.0±1.0 E
2021	24.2±1.0 f	22.7±0.4 f	23.5±0.6 D	71.4±1.7 e	67.0±1.2 e	69.2±1.2 D
Mean	39.6±1.7 A	38.5±1.6 A	39.1±1.1	117.0±4.6 A	113.5±4.7 B	115.3±3.3
ANOVA						
F_{Clone}	3.2*			F_{Clone}	13.8***	
F_{Year}	269.5***			F_{Year}	1085.0***	
$F_{Clone*Year}$	0.2ns			$F_{Clone*Year}$	0.9ns	

Years of Research	Volume of Annual Growth					
	cm^3/shoot			m^3/vine		
	Cl R5	Cl 348	Mean	Cl R5	Cl 348	Mean
2015	76,8±0,7 ef	99,9±2,3 d	88,4±2,9 D	2,33±0,04 ef	2,52±0,07 e	2,42±0,05 D
2016	82,1±1,3 e	107,6±1,8 c	94,9±3,1 C	2,57±0,05 e	2,97±0,06 d	2,77±0,06 C
2017	113,7±2,1 bc	146,7±2,2 a	130,2±4,1 A	3,60±0,08 b	4,12±0,07 a	3,86±0,08 A
2018	93,5±1,4 d	119,5±2,1 b	106,5±3,2 B	2,94±0,06 d	3,32±0,05 c	3,13±0,06 B
2019	72,9±1,3 f	93,7±1,0 d	83,3±2,5 E	2,24±0,05 f	2,49±0,03 ef	2,37±0,04 D
2020	18,4±1,1 i	23,4±1,4 i	20,9±1,1 G	0,45±0,03 h	0,48±0,03 h	0,46±0,02 F
2021	35,1±0,9 h	45,8±1,1 g	40,5±1,4 F	1,02±0,03 g	1,11±0,03 g	1,06±0,02 E
Mean	70,4±3,7 B	90,9±4,8 A	80,7±3,1	2,16±0,12 B	2,43±0,14 A	2,30±0,09
ANOVA						
F_{Clone}	608,6***			F_{Clone}	93,5***	
F_{Year}	1173,2***			F_{Year}	1013,4***	
$F_{Clone*Year}$	19,0***			$F_{Clone*Year}$	5,8***	

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

In this case, the length of shoots was higher for the clone 348 Merlot, reaching 146.0±4.9 cm. It was noted that the maximum values of these indicators were recorded in 2017: for the clone R5 Cabernet Sauvignon, the number of shoots per vine was 31.6±0.1 with a length of 167.5±1.9 cm, and for the clone 348 Merlot, it was 28.1±0.2 shoots per vine with a length of 186.9±1.9 cm.

Indicators of both the number and length of shoots directly influence the development of Annual Growth. In the conditions of the Southern Region of the Republic of Moldova, at the SC "Tomai-Vinex" SA farm, the studied clones exhibit the following characteristics. The length of the Annual Growth for Cl R5 is 39.6±1.7 m/vine, and for Cl 348 Merlot it is 38.5±1.6 m/vine. A weak but significant difference was found between the experimental variants (F_{Clone} 3.2^{*}). At the same time, strong and significant differences were observed depending on the year of the study for this indicator (F_{Year} 269.5^{***}), with no interaction between the factors detected ($F_{Clone*Year}$ 0.2ns).

The length of Annual Growth per hectare is as follows: for clone Cl R5 Cabernet Sauvignon - 117.0±4.6 thousand m/ha, for clone Cl 348 Merlot - 113.5±4.7 thousand m/ha. Strong and statistically significant differences were observed for this indicator depending on the experimental variants (F_{Clone} 13.8^{***}) and the year of research (F_{Year} 1085.0^{***}), with no detected interaction between the factors ($F_{Clone*Year}$ 0.9ns).

We calculated the Volume of Annual Growth per shoot and vine. The results for this indicator are as follows: for clone Cl R5 Cabernet Sauvignon - 70.4±3.7 cm³/shoot, for clone Cl 348 Merlot - 90.9±4.8 cm³/shoot. As seen from the data, clone Cl 348 significantly surpasses clone Cl R5 Cabernet Sauvignon, which can be attributed to the larger diameter of the shoots of this clone. The highest results were observed in 2017, while the lowest was in 2020, which amounted to: for clone Cl R5 Cabernet Sauvignon - 18.4±1.1 cm³/shoot, for clone Cl 348 Merlot - 23.4±1.4 cm³/shoot. These values are significantly lower than the average indicators for the entire research period, by 3.8-3.9 times. This indicates that the dry conditions of 2020 had a significant negative impact on the development of the Volume of Annual Growth per shoot the studied grapevine clones.

In terms of the Volume of Annual Growth per vine, clone's Cl R5 Cabernet Sauvignon and Cl 348 Merlot had the following values: 2.16±0.12 m³/vine and 2.43±0.14 m³/vine, respectively. Notably, this indicator is also higher for clone Cl 348 Merlot. In 2017, this indicator reached the following results: 3.60±0.08 m³/vine for Cl R5 Cabernet Sauvignon and 4.12±0.07 m³/vine for Cl 348 Merlot. It has been revealed that the Volume of Annual Growth per vine shows strong and statistically significant differences depending on the experimental variants (F_{Clone} 93.5^{***}), years of research (F_{Year}

1013.4***), and the interaction between factors ($F_{CloneYear}$ 5.8***). This suggests that the parameter of Volume of Annual Growth per vine is strongly influenced by the genetic characteristics of clones, the conditions of the research years, and the interaction of these factors.

Our study provided valuable data on the Above-Ground Growth of European clones Cl R5 Cabernet Sauvignon and Cl 348 Merlot in the conditions of the Autonomous Territorial Unit of Gagauzia. Analyzing the development of Annual Growth over the period from 2015 to 2021 allowed us to understand how various factors, such as meteorological conditions and genetic characteristics of the clones, influence the growth and development process of the studied grapevine clones.

7.2. Growth and Development of Leaf Area

The important indicators of grapevine development include leaf area, which plays a key role in the plant's life processes. Leaves perform several crucial functions, including photosynthesis, transpiration, and gas exchange, significantly influencing the overall productivity of grapevines.

The growth of the Leaf Area directly influences photosynthesis, the primary process that provides the plant with nutrients. The more leaves and surface area there are, the more the plant can assimilate light and carbon dioxide, ultimately leading to increased overall biomass and yield. Transpiration, or the evaporation of water through the leaves, is also dependent on the size of the leaf surface. This process plays a crucial role in regulating the plant's water balance, its resistance to stress, and its overall health. Thus, in the life of a grapevine, the leaf plays one of the primary roles, and studying the patterns of its growth, leaf area formation, dependent on both genetic factors and environmental conditions, is a highly relevant issue.

We conducted monitoring of Leaf Area development parameters in European grapevine clone's Cl R5 Cabernet Sauvignon and Cl 348 Merlot at the SC "Tomai-Vinex" SA farm.

From Table 7.2, it can be seen that during the research period (2015-2021), the number of leaves on the shoot of the studied grapevine clones varies depending on the clones (F_{Clone} 113.0***) and the conditions of the research years (F_{Year} 69.4***). The highest number of leaves was recorded in 2017: 35.4±0.8 leaves/shoot (Cl R5 Cabernet Sauvignon) and 31.2±0.7 leaves/shoot (Cl 348 Merlot), indicating favourable conditions for grapevine growth during that period. In 2018, the leaf count was also above average: 35.4±0.8 leaves/shoot (Cl R5 Cabernet Sauvignon) and 31.2±0.7 leaves/shoot (Cl 348 Merlot). However, there was a decrease in leaf count in 2019 and 2020. Thus, the number of leaves in 2020 was 24.3±0.4 leaves/shoot in clone Cl R5 Cabernet Sauvignon and 22.8±0.4 leaves/shoot in clone Cl 348 Merlot.

Table 7.2. Monitoring the Development of Leaf Area Parameters of Grapevine Clones.

Years of Research	Number of Leaves, leaves/shoot			Leaf Area, cm^2/leaf		
	Cl R5	Cl 348	Mean	Cl R5	Cl 348	Mean
2015	29.1±0.5 b-e	26.4±0.6 efg	27.7±0.5 BC	122.4±4.7 e	171.4±3.4 b	146.9±0.5 C
2016	30.4±0.6 bc	27.6±0.6 def	29.0±0.5 B	141.5±3.7 cd	198.1±5.4 a	169.8±0.5 B
2017	35.4±0.8 a	31.2±0.7 b	33.3±0.7 A	151.8±4.4 c	212.5±3.9 a	182.2±0.7 A
2018	34.8±0.7 a	30.7±0.7 bc	32.7±0.7 A	145.5±3.8 c	203.7±2.2 a	174.6±0.7AB
2019	29.6±0.6 bcd	25.7±0.6 fg	27.7±0.6 BC	122.3±3.5 e	171.2±2.6 b	146.7±0.6 C
2020	24.3±0.4 gh	22.8±0.4 h	23.5±0.3 D	89.4±2.4 f	125.2±3.3 de	107.3±0.3 E
2021	28.1±0.5 c-f	25.4±0.4 fgh	26.8±0.4 C	102.7±3.8 f	143.8±2.7 c	123.3±0.4 D
Mean	30.2±0.5 A	27.1±0.4 B	28.7±0.3	125.1±2.9 B	175.1±3.8 A	150.1±3.2
ANOVA						
F_{Clone}	113.0***			757.3***		
F_{Year}	69.4***			115.9***		
$F_{Clone*Year}$	1.4ns			4.1**		
Years of Research	**Leaf Area, dm^2/shoot**			**Leaf Area, m^2/vine**		
	Cl R5	**Cl 348**	**Mean**	**Cl R5**	**Cl 348**	**Mean**
2015	35.6±1.8 fgh	45.2±1.2 d	40.4±1.5 C	10.8±0.3 fg	11.4±0.3 f	11.1±0.2 C
2016	43.0±1.7 def	54.7±1.4 bc	48.9±1.7 B	13.5±0.4 de	15.1±0.4 cd	14.3±0.3 B
2017	53.7±2.3 c	66.3±1.7 a	60.0±2.0 A	17.0±0.5 abc	18.6±0.7 a	17.8±0.5 A
2018	50.6±2.2 cd	62.5±2.1 ab	56.5±2.0 A	15.9±0.5 bc	17.4±0.6 ab	16.7±0.4 A
2019	36.2±1.5 e-h	44.0±1.7 de	40.1±1.4 C	11.1±0.4 f	11.7±0.5 ef	11.4±0.3 C
2020	21.7±0.7 i	28.5±1.1 hi	25.1±1.0 E	5.2±0.2 i	5.8±0.2 i	5.5±0.2 E
2021	28.9±1.7 ghi	36.5±1.2 efg	32.7±1.3 D	8.3±0.3 h	8.9±0.2 gh	8.6±0.2 D
Mean	38.5±1.4 B	48.2±1.6 A	43.4±1.2	11.7±0.5 B	12.7±0.54 A	12.2±0.4
ANOVA						
F_{Clone}	118.9***			31.5***		
F_{Year}	112.1***			260.5***		
$F_{Clone*Year}$	1.6ns			2.8*		
Years of Research	**Leaf Area, th. m^2/ha**			**LAI, m^2/m^2**		
	Cl R5	**Cl 348**	**Mean**	**Cl R5**	**Cl 348**	**Mean**
2015	31.8±0.7 f	33.6±0.7 f	32.7±0.5 D	3.18±0.10 f	3.36±0.09 ef	3.27±0.07 D
2016	39.7±0.9 de	44.5±0.7 cd	42.1±0.8 C	3.98±0.11 de	4.45±0.13 cd	4.21±0.10 C
2017	50.1±2.5 ab	55.0±1.5 a	52.6±1.5 A	5.01±0.15 bc	5.50±0.19 a	5.25±0.13 A
2018	46.9±1.6 bc	51.3±1.4 ab	49.1±1.1 B	4.68±0.14 c	5.14±0.17 ab	4.91±0.12 B
2019	32.8±0.6 f	34.5±1.0 ef	33.6±0.6 D	3.26±0.11 f	3.44±0.13 ef	3.35±0.09 D
2020	15.4±0.3 h	17.2±0.6 h	16.3±0.4 F	1.54±0.07 h	1.70±0.06 h	1.62±0.05 F
2021	24.6±0.5 g	26.2±0.5 g	25.4±0.4 E	2.45±0.08 g	2.61±0.05 g	2.53±0.05 E
Mean	34.5±1.6 B	37.5±1.4 A	36.0±1.1	3.44±0.14 B	3.74±0.16 A	3.59±0.11
ANOVA						
F_{Clone}	21.7***			31.4***		
F_{Year}	271.3***			260.4***		
$F_{Clone*Year}$	0.8ns			2.81*		

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

Analyzing the Leaf Blade Area parameter over the research period, it is observed that the highest value of this parameter was recorded in 2017 - 182.2±0.7 cm²/leaf (tab.7.2). This suggests favourable conditions for the growth and development of the Leaf Blade Area during that period. In the subsequent years, 2018 and 2016, the Leaf Blade Area were 174.6±0.7 cm²/leaf and 169.8±0.5 cm²/leaf, respectively, both exceeding the average value. Conversely, in 2015, 2019, and 2021, the Leaf Blade Area was below average, measuring 146.9±0.5 cm²/leaf, 146.7±0.6 cm²/leaf, and 123.3±0.4 cm²/leaf, respectively. Particularly noteworthy is the year 2020, with the minimum Leaf Blade Area value of 107.3±0.3 cm²/leaf. The research has shown that the clone Cl 348 Merlot is characterized by the highest Leaf Blade Area, measuring 175.1±3.8 square centimetres per leaf, whereas the average leaf blade area for clone Cl R5 Cabernet Sauvignon over all years of the study was 125.1±2.9 square centimetres, which is 1.4 times smaller. Statistical analysis confirms the significance of differences in Leaf Blade Area across the experimental variants (F_{Clone} 757.3^{***}), research years (F_{Year} 115.9^{***}), and their interaction ($F_{CloneYear}$ 4.1^{**}). These findings highlight the impact of varying climatic conditions throughout the research period and the varietal traits of clones on the development of grapevine Leaf Blade Area. Higher precipitation years and Clone 348 exhibit an increase in this parameter. These results facilitate more effective vineyard management by considering the factors investigated.

Since the shoot is the primary biological unit of the grapevine agroecosystem, the indicator of leaf area development on the shoot is extremely important. We have found that this indicator amounted to 38.5±1.4 dm³/shoot for Cl R5 Cabernet Sauvignon and 48.2±1.6 dm³/shoot for Cl 348 Merlot over the research period. This means that the leaf area per shoot for clone Cl 348 Merlot is 1.3 times higher than for clone Cl R5 Cabernet Sauvignon. The highest development results for this indicator were observed in 2017 and 2018, while the lowest were recorded in 2020, and compiled at 25.1±1.0 dm³/shoot.

It was found that the studied clones are characterized by the following development of Leaf Area per vine and per hectare: for Cl R5 Cabernet Sauvignon - 11.7±0.5 m²/vine, 34.5±1.6 thousands of m^2 per hectare and for clone Cl 348 Merlot - 12.7±0.54 m²/vine, 37.5±1.4 thousands of m^2 per hectare. The maximum values were achieved in 2017 and amounted to 18.6±0.7 m²/vine, 55.0±1.5 thousands of m^2 per hectare for clone Cl 348 Merlot and 17.0±0.5 m²/vine, 50.1±2.5 thousands of m^2 per hectare for Cl R5 Cabernet Sauvignon. Statistically significant differences were identified depending on the experimental variants and years of research, while the interaction between factors was slightly lower.

The Leaf Area Index (LAI) of grapevines is used to assess the physiological condition of plants and their photosynthetic activity. The highest Leaf Area Index value was recorded in 2017 at 5.50±0.19 m^2/m^2 for Cl 348 Merlot and 5.01±0.15 m^2/m^2 for Cl R5 Cabernet Sauvignon. The results from 2018, 5.14±0.17 m^2/m^2 for Cl 348 Merlot and 4.68±0.14 m^2/m^2 for Cl R5 Cabernet Sauvignon, also indicate a high level of photosynthetic activity in those years. However, the low values of the Leaf Area Index in 2020 and the relatively below-average values in 2015, 2019, and 2021 underscore the impact of unfavourable factors, such as drought, on the development of grapevine plants during these periods. The average Leaf Area Index value over the entire period for Cl R5 Cabernet Sauvignon is 3.44±0.14 m^2/m^2, which is 0.3 m^2/m^2 less than for Cl 348 Merlot. The statistical significance of differences in the Leaf Area Index, confirmed by ANOVA analysis, emphasizes the importance of considering this parameter when planning and optimizing grape-growing processes in the agroecological conditions of ATU Gagauzia.

The data we obtained on the Leaf Area Index (LAI) of clones for the period 2015-2021 represent valuable information for grape-growing practices and scientific research. Higher values of the Leaf Area Index indicate better development of the grapevine canopy, signalling more favourable conditions for photosynthesis and overall plant health. Conversely, lower values suggest unfavourable conditions such as drought or other stresses affecting the grapevine.

Thus, it is important to note that the heterogeneity of meteorological conditions in the ATU Gagauzia significantly influences the development of the Leaf Area in the grapevine plantations of clone R5 Cabernet Sauvignon and Cl 348 Merlot. Years with favourable conditions contributed to more active Leaf Area growth, while periods with less favourable conditions, such as 2019 and 2020 (characterized by a decrease in precipitation and an increase in summer temperatures), hurt the development of the Leaf Surface Area of grapevines. This aspect is crucial for understanding long-term trends and planning grape-growing activities in the region. It plays a key role in enhancing the resilience of the grape-growing industry in ATU Gagauzia amid changing meteorological conditions.

7.3. Productivity of Vineyards

We monitored the changes in the productivity of these clones over the following years (2015-2021) (fig. A.10.13, fig. A.10.14). The parameters of grapevine yield represent quantitative characteristics of plant productivity. These parameters include the number of clusters, cluster weight, fruit yield per vine, yield per hectare, mass concentration of sugars, and titratable acidity. Studying and analyzing these parameters assist grape growers in optimizing vineyard care processes, predicting harvests, and improving the quality of the produced wine.

The data presented regarding the number of clusters per vine from 2015 to 2021 are essential for evaluating the productivity of grapevines across different years (tab. 7.3). The highest number of clusters was recorded in 2017, with 38.9±0.1 clusters/vine for Cl R5 Cabernet Sauvignon and 36.1±0.1 clusters/vine for Cl 348 Merlot, indicating favourable conditions for grape yield development during that period. It is noteworthy that clone R5 Cabernet Sauvignon produces more clusters per vine compared to clone 348 Merlot by a factor of 1.1. Elevated values were also observed in 2018 and 2016, indicating generally good yields in those years.

Table 7.3. Monitoring the Dynamics of Yield Parameters of Grapevine Clones. SC «Tomai-Vinex» SA.

Years of Research	**Number of Clusters, pcs./vine**			**Weight of Clusters, g**		
	Cl R5	**Cl 348**	**Mean**	**Cl R5**	**Cl 348**	**Mean**
2015	37.3±0.1 b	32.4±0.1 e	34.9±0.6 D	100.8±1.4 f	138.7±1.9 b	119.8±4.5 C
2016	38.5±0.2 a	35.5±0.1 c	37.0±0.4 B	125.5±1.7 de	172.6±1.8 a	149.1±5.5 B
2017	38.9±0.1 a	36.1±0.1 c	37.5±0.3 A	130.5±1.8 cd	179.5±1.6 a	155.0±5.7 A
2018	38.7±0.1 a	35.8±0.1 c	37.3±0.3 AB	125.3±2.0 de	172.4±1.6 a	148.9±5.5 B
2019	37.8±0.2 b	34.2±0.1 d	36.0±0.4 C	98.0±1.2 f	134.8±1.3 bc	116.4±4.3 C
2020	29.5±0.2 g	26.2±0.1 h	27.9±0.4 F	55.9±0.8 i	76.9±1.8 h	66.4±2.6 E
2021	35.6±0.1 c	31.3±0.1 f	33.5±0.5 E	86.5±1.5 g	118.9±1.6 e	102.7±3.9 D
Mean	36.6±0.4 A	33.1±0.4 B	34.8±0.3	103.2±3.0 B	142.0±4.1 A	122.6±3.0
ANOVA						
F_{Clone}	3396.4^{***}			F_{Clone}	2170.1^{***}	
F_{Year}	1714.9^{***}			F_{Year}	810.7^{***}	
$F_{Clone*Year}$	22.1^{***}			$F_{Clone*Year}$	21.8^{***}	
Years of Research	**Yield, kg per vine**			**Yield, tons per hectare**		
	Cl R5	**Cl 348**	**Mean**	**Cl R5**	**Cl 348**	**Mean**
2015	3.76±0.11 d	4.49±0.08 c	4.13±0.11 C	110.9±2.0 f	132.6±1.5 e	121.8±2.8 C
2016	4.83±0.09 bc	6.13±0.06 a	5.48±0.16 B	142.5±2.8 cd	180.8±1.7 b	161.7±4.7 B
2017	5.08±0.10 b	6.48±0.11 a	5.78±0.18 A	149.8±2.6 c	191.2±2.0 a	170.5±5.0 A
2018	4.85±0.07 bc	6.17±0.09 a	5.51±0.16 B	143.0±2.8 cd	182.1±2.0 ab	162.6±4.8 B
2019	3.70±0.09 d	4.61±0.07 c	4.15±0.12 C	109.3±2.3 f	136.0±1.6 de	122.7±3.4 C
2020	1.65±0.06 f	2.01±0.05 f	1.83±0.05 E	48.6±0.8 i	59.4±1.5 h	54.0±1.5 E
2021	3.08±0.10 e	3.72±0.06 d	3.40±0.09 D	90.8±1.4 g	109.8±2.0 f	100.3±2.5 D
Mean	3.85±0.14 B	4.80±0.18 A	4.33±0.12	113.6±4.1 B	141.7±5.3 A	127.6±3.6
ANOVA						
F_{Clone}	470.8^{***}			F_{Clone}	616.3^{***}	
F_{Year}	598.1^{***}			F_{Year}	784.9^{***}	
$F_{Clone*Year}$	11.8^{***}			$F_{Clone*Year}$	16.7^{***}	

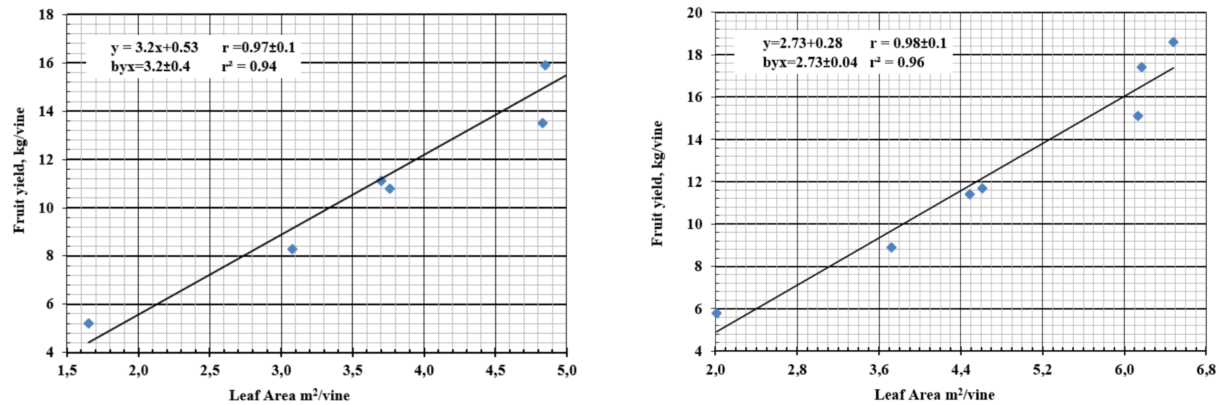
*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

However, in 2020, there was a significant decrease in cluster number to 29.5±0.2 clusters/vine for clone R5 Cabernet Sauvignon and 26.2±0.1 clusters/vine for clone 348 Merlot. Additionally, in 2019 and 2021, a moderate decrease was observed. These results may suggest unfavourable conditions for yield development during those periods. The mean number of clusters over the entire period is 36.6±0.4 clusters/vine for clone R5 Cabernet Sauvignon and 33.1±0.4 clusters/vine for clone 348 Merlot. Highly statistically significant differences in the number of clusters per vine were identified depending on the experimental variants (F_{Clone} 3396.4***), the year of research (F_{Year} 1714.9***), and the interaction between factors ($F_{Clone*Year}$ 22.1***).

The cluster weight is one of the key indicators of grape yield. We found that the clone R5 Cabernet Sauvignon exhibits the formation of a greater number of clusters in the agro-ecological conditions of ATU Gagauzia compared to clone 348 Merlot, whereas there is an inverse relationship observed in terms of cluster weight (fig. A 10.16, fig. A 10.17). Thus, the mean cluster weight for clone R5 Cabernet Sauvignon and clone 348 Merlot throughout the 2015-2021 research was 103.2±3.0 grams and 142.0±4.1 grams, respectively (tab. 7.3). The highest cluster weight was recorded in 2017: 130.5±1.8 grams for clone R5 Cabernet Sauvignon and 179.5±1.6 grams for clone 348 Merlot, which is 1.4 times higher. Statistical significant differences in cluster weight were found across different years of research and among experimental variants, as well as interactions between these factors.

The variation in cluster weight over the years of the research has influenced the fruit yield per vines of the examined clones. On mean over the research period, the yield of clone R5 Cabernet Sauvignon was 3.85±0.14 kg/vine, while for clone 348 Merlot it was 4.80±0.18 kg/vine, which is 1.2 times higher. The highest fruit yields were observed in 2017: for clone R5 Cabernet Sauvignon - 5.08±0.10 kg/vine, and clone 348 Merlot - 6.48±0.11 kg/vine.

The highest vineyard yield was achieved in 2017: the clone R5 Cabernet Sauvignon amounted to 149.8±2.6 centners/hectare, and the clone 348 Merlot - 191.2±2.0 centners/hectare. Similar high yields were also recorded in 2016 and 2018, indicating favourable productivity during these years. However, there was a significant decrease in yield in 2020. The vineyard yield of the studied clones sharply declined this year, reaching 48.6±0.8 centners/hectare (Cl R5 Cabernet Sauvignon) and 59.4±1.5 centners/hectare (Cl 348 Merlot), which is directly associated with unfavourable weather conditions. In 2021, there was a recovery of vineyard yield after the drought; however, the vineyard yield did not reach the mean values for the years of the research.



Cl R5 Cabernet Sauvignon **Cl 348 Merlot**

Fig. 7.1. Monitoring the Relationship between Leaf Area and Yield of Grapevine Clones, (2015-2021).

We analyzed the relationship between Leaf Area and fruit yield per vine for the grapevine clones studied in the conditions of the ATU Gagauzia (fig. 7.1). The results of the analysis are presented by the regression equation and correlation coefficient. The equation for clone R5 Cabernet Sauvignon, y=3.2x+0.53, indicates that each additional square meter of Leaf Area (x) leads to an increase in fruit yield (y) of 3.2 kg per vine. Similarly, for clone 348 Merlot, the equation y=2.73x+0.28 indicates that an increase in leaf area per square meter results in an increase in yield of 2.73 kg per vine. The confidence interval confirms the statistical significance of the correlation and provides a high degree of confidence in the results. The correlation coefficients, r = 0.97±0.1 (Cl R5 Cabernet Sauvignon) and r = 0.98±0.1 (Cl 348 Merlot), indicate a strong linear relationship between Leaf Area and fruit yield per vine for the clones under study. A correlation coefficient close to 1 indicates a strong positive relationship between Leaf Area and vine yield. The high coefficients of determination, $r^2 = 0.94$ (Cl R5 Cabernet Sauvignon) and $r^2 = 0.96$ (Cl 348 Merlot) suggest that 94% and 96% of the variation in vine yield, respectively, is explained by changes in Leaf Area, confirming the model's good explanatory power. Additionally, the standard error of the estimate (b_{yx}=3.2±0.4 and b_{yx}=2.73±0.04) indicates the stability of the slope estimate for the regression line.

The obtained results provide valuable information for grape growers, which they can utilize to optimize vineyard management practices. Increasing Leaf Area can be a crucial method for enhancing yield, and this analysis emphasizes the key role of Leaf Area in grape yield formation. These findings offer a useful foundation for developing effective vineyard management strategies, which can significantly improve overall grapevine productivity. Thus, grape growers can apply the findings of this study in the development and implementation of strategies for optimal vineyard management.

Increasing Leaf Area stands out as an effective method for boosting yield, making this aspect important to consider in vineyard care planning.

Table 7.4. Monitoring the Dynamics of Grapevine Clone Harvest Quality.

Years of Research	**Mass Concentration, g/dm^3**					
	Sugars			**Titratable Acids**		
	Cl R5	**Cl 348**	**Mean**	**Cl R5**	**Cl 348**	**Mean**
2015	230±2 d	232±2 d	231±2 D	8.2±0.11 b	8.1±0.09 b	8.2±0.07 B
2016	250±2 bc	255±2 b	253±2 B	8.9±0.15 a	8.9±0.13 a	8.9±0.10 A
2017	235±3 d	238±2 d	237±2 CD	8.9±0.14 a	8.8±0.11 a	8.9±0.09 A
2018	237±2 d	240±2 cd	239±2 C	8.1±0.09 b	8.2±0.08 b	8.2±0.06 B
2019	234±3 d	238±2 d	236±2 CD	6.1±0.07 c	6.0±0.08 c	6.1±0.05 C
2020	281±3 a	290±2 a	286±2 A	6.0±0.11 c	6.0±0.12 c	6.0±0.08 C
2021	251±3 bc	260±2 b	256±2 B	8.2±0.14 b	8.2±0.14 b	8.2±0.10 B
Mean	245±2 B	250±2 A	248±2	7.8±0.14 A	7.7±0.14 A	7.8±0.10
ANOVA						
F_{Clone}	23.7^{***}			F_{Clone}	0.4ns	
F_{Year}	135.3^{***}			F_{Year}	241.1^{***}	
$F_{Clone*Year}$	1.8ns			$F_{Clone*Year}$	0.4ns	

*Ns: not significant, *: significant at p≤0.1, **: significant at p≤0.01, ***: significant at p≤0.001*

The analysis of sugar mass concentration and titratable acidity in grape berry juice from the studied clones from 2015 to 2021 has revealed interesting trends (tab. 7.4). The highest sugar mass concentration was recorded in 2020, reaching 281±3 g/dm^3 (Cl R5 Cabernet Sauvignon) and 290±2 g/dm^3 (Cl 348 Merlot), with similarly elevated values observed in 2016 and 2021. The mean sugar mass concentration over the entire period was 245±2 g/dm^3 for the clone R5 Cabernet Sauvignon and 250±2 g/dm3 for the clone 348 Merlot. Statistically significant differences in sugar mass concentration were identified depending on the experimental variants (F_{Clone} 23.7^{***}) and the year of the research (F_{Year} 135.3^{***}), with no interaction detected between these factors ($F_{Clone*Year}$ 1.8ns).

Differences in the mass concentration of titratable acids in the juice of the studied clones were not detected (F_{Clone} 0.4ns). However, a statistically significant difference was found depending on the year of the study (F_{Year} 241.1***). However, there was a decrease in titratable acid levels in 2018 (8.2±0.06 g/dm^3), and noticeable reductions were observed in 2019 and 2020 (6.1±0.05 g/dm3 and 6.0±0.08 g/dm^3, respectively). The mean mass concentration of titratable acids for the entire period is 7.8±0.10 g/dm^3. This data highlights the variability of grape quality parameters, influenced both by the cultivated clone and by the study period, year by year. It provides crucial information for winemakers, enabling them to adjust their wine production methods based on the chemical composition of grapes in individual years.

The productivity of grapevine plantations is determined by the number of developed shoots (per hectare) and the productivity of shoots, which is directly influenced by the average cluster weight. At the same time, the growth pattern of clusters and their productivity depend on a complex set of meteorological conditions (precipitation, temperature) that vary from year to year.

The productivity of shoots has been observed to depend on the genetic traits of the clones (F_{Clone} 1105.0***). For clone R5 Cabernet Sauvignon, it varies within the range of 68.7±2.5 g/shoot to 160.8±3.4 g/shoot, while for clone 348 Merlot, it ranges from 98.7±2.2 to 230.7±4.6 g/shoot (tab. A 7.2). The significant variability in shoot productivity is related to growing conditions that vary across the years of the research (F_{Year} 336.3***). In years with favourable meteorological conditions (2016, 2017, 2018), the shoot productivity reaches 154.5±3.2, 160.8±3.4, 154.4±2.4 g/shoot (Cl R5 Cabernet Sauvignon) and 222.0±2.6, 230.7±4.6, 222.2±4.2 g/shoot (Cl 348 Merlot), respectively (fig. 7.2). In the subsequent years, there has been a significant change in weather conditions, characterized by decreased precipitation and increased monthly temperatures. In most cases, there was a soil-air drought. Under these unfavourable conditions, the shoot productivity of the studied clones decreased by 2.2-2.3 times (in 2020). A direct correlation was established between shoot productivity and the amount of precipitation, while an inverse correlation was found between shoot productivity and monthly temperature means.

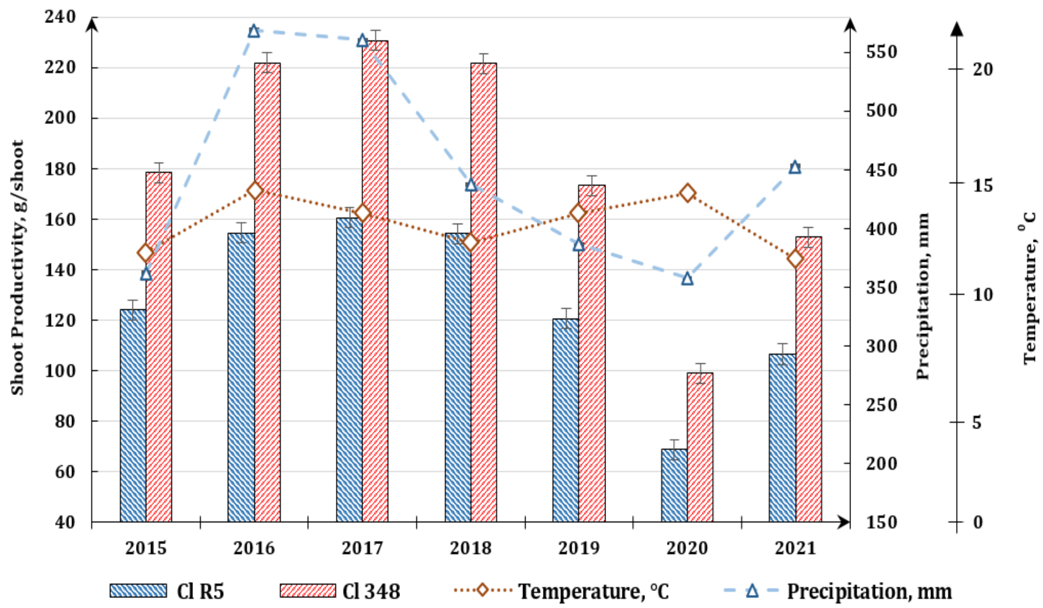


Fig. 7.2. Dynamics of Shoot Productivity in Studied Clones Depending on Meteorological Conditions.

Therefore, the productivity of the vineyard for clone R5 of Cabernet Sauvignon and clone 348 of Merlot in SC "Tomai-Vinex" SA is influenced by the agroecological conditions of their cultivation. The reconstruction of vineyards carried out in 2013, involved changes in the type of supports, vineyard canopy management techniques, and a complex of agronomic practices (mechanized care for vines, fertilization, chemical means of protection, etc.), which allows for yields of up to 149.8±2.6 centners per hectare for Cabernet Sauvignon Cl R5 and 191.2±2.0 centners per hectare for Merlot Cl 348, with the quality of the produce meeting technological requirements (fig. A. 8.7). However, the dependence of shoot growth, photosynthetic activity, and the productivity of vines on meteorological conditions leads to changes in the morpho-anatomical and physiological growth parameters of shoots and leaf areas, affecting their photosynthetic activity. In certain years (2019-2021), there is a depression in growth processes and photosynthetic activity in plants, resulting in reduced grapevine plantation productivity.

7.4. Conclusions for Chapter 7

1. In favourable years, the shoot productivity of the studied grapevine clones increases by 1.9 times. The vineyard reconstruction conducted allows for yields of up to 15.0 tons per hectare for clone R5 Cabernet Sauvignon and 19.0 tons per hectare for clone 348 Merlot, with product quality meeting technological requirements.
2. The productivity of the vineyard for clone R5 of Cabernet Sauvignon and clone 348 of Merlot in the ATU Gagauzia is influenced by the agroecological conditions of their cultivation. The dynamics of shoot productivity changes in the studied clones at SC "Tomai-Vinex" SA demonstrate its dependence on meteorological conditions, which vary inadequately from year to year.
3. The dependence of shoot growth, photosynthetic activity, and the productivity of vines on meteorological conditions leads to changes in the morpho-anatomical and physiological growth parameters of shoots and leaf areas, affecting their photosynthetic activity. In certain years (2019-2021), there is a depression in growth processes and photosynthetic activity in plants, resulting in reduced grapevine plantation productivity. In dry years (2019-2021), shoot productivity and crop yields decrease by up to two times. A direct correlation has been established between shoot productivity and the amount of precipitation, while an inverse correlation has been noted between shoot productivity and average annual temperature values.

8. ECONOMIC EFFICIENCY OF GRAPE PRODUCTION IN SC «TOMAI-VINEX» SA

8.1. Analysis of the Economic Efficiency of Grape Production Depending on the Different Quality of Vines

Grapevine cultivation is an important branch of the agro-industrial complex and despite its relatively small share of total agricultural land, it plays a significant role in the socio-economic development of the ATU Gagauzia. Additionally, this sector has a substantial impact on budgetary processes.

An analysis of economic indicators characterizing the economic efficiency of grape production has allowed us to identify the real dynamics of the efficiency level in this sector, using the example of SC "Tomai-Vinex" SA (fig. A. 8.6). As a result, we have a proven relationship between the economic efficiency of grape production and marketing and the employed grapevine clones and different quality of vines, stemming from different quality of the planting stock used for vineyard establishment. The analysis of economic efficiency was conducted over the last seven-year period of grapevine cultivation (2015-2021).

Theoretical and methodological aspects of economic efficiency are common to all sectors of agriculture, including viticulture. However, this sector has specific characteristics that have a certain influence on its evaluation of efficiency.

In viticulture, in addition to cost-based indicators, natural indicators such as yield and gross harvest are used. The yield of vineyards is one of the factors contributing to the growth of viticulture efficiency, reflecting the degree of land utilization efficiency and resulting from production intensification. The efficiency of agricultural production is characterized by income from sales, production costs, profit, and the level of profitability.

The profit of production (P) is the difference between revenue from sales (R) and all expenses for its production and sales (E):

$$\mathbf{P = R - E} \qquad (8.1)$$

The achieved efficiency of production is assessed by the profitability level indicator. The profitability level (PL) is the percentage ratio of profit (P) to expenses (E):

$$\mathbf{PL = (P / E) * 100\%} \qquad (8.2)$$

Table 8.1. Economic Efficiency of Grape Production Depending on the Different Quality of Vines. Clone R5 Cabernet Sauvignon onto BxR Kober 5BB.

Variants	Year	Yield, center per hectare	Price of 1 centner of production, lei	Revenue from product sales, lei	Production and sales costs, lei	Profit, lei (P)	Profitability level, % (Pr)
CG	2015	10.59	4500	47655	34765.5	12889.5	37.1
	2016	13.07	4700	61429	36981.5	24447.5	66.1
	2017	14.81	5100	75531	37814.5	37716.5	99.7
	2018	14.40	4200	60480	38430.0	22050.0	57.4
	2019	10.84	4600	49864	38478.0	11386.0	29.6
	2020	4.42	5800	25636	38328.0	-12692.0	-33.1
	2021	8.30	8000	66400	42235.0	24165.0	57.2
EG 1	2015	13.84	4500	62280	36228.0	26052.0	71.9
	2016	17.40	4700	81780	38930.0	42850.0	110.1
	2017	17.93	5100	91443	39218,5	52224.5	133.2
	2018	17.20	4200	72240	39690.0	32550.0	82.0
	2019	13.38	4600	61548	39621.0	21927.0	55.3
	2020	5.19	5800	30102	39471.0	-9369.0	-23.7
	2021	9.75	8000	78000	42887.5	35112.5	81.9
EG 2	2015	11.95	4500	53775	35377.5	18397.5	52.0
	2016	16.03	4700	75341	38313.5	37027.5	96.6
	2017	17.32	5100	88332	38944.0	49388.0	126.8
	2018	15.74	4200	66108	39033.0	27075.0	69.4
	2019	11.73	4600	53958	38878.5	15079.5	38.8
	2020	4.78	5800	27724	38728.5	-11004.5	-28.4
	2021	8.97	8000	71760	42536.5	29223.5	68.7
EG 3	2015	11.25	4500	50625	35062.5	15562.5	44.4
	2016	14.60	4700	68620	37670.0	30950.0	82.2
	2017	15.96	5100	81396	38332.0	43064.0	112.3
	2018	15.10	4200	63420	38745.0	24675.0	63.7
	2019	10.46	4600	48116	38307.0	9809.0	25.6
	2020	4.25	5800	24650	38157.0	-13507.0	-35.4
	2021	7.97	8000	63760	42086.5	21673.5	51.5
EG 4	2015	10.13	4500	45585	34558.5	11026.5	31.9
	2016	12.84	4700	60348	36878.0	23470.0	63.6
	2017	13.60	5100	69360	37270.0	32090.0	86.1
	2018	11.40	4200	47880	37080.0	10800.0	29.1
	2019	8.63	4600	39698	37483.5	2214.5	5.9
	2020	3.52	5800	20416	37333.5	-16917.5	-45.3
	2021	6.61	8000	52880	41474.5	11405.5	27.5
EG 5	2015	8.82	4500	39690	33969.0	5721.0	16.8
	2016	9.93	4700	46671	35568.5	11102.5	31.2
	2017	11.65	5100	59415	36392.5	23022.5	63.3
	2018	9.44	4200	39648	36198.0	3450.0	9.5
	2019	7.20	4600	33120	36840.0	-3720.0	-10.1
	2020	3.24	5800	18792	36690.0	-17898.0	-48.8
	2021	6.07	8000	48560	41231.5	7328.5	17.8

It has been established that the economic indicators of grape production at SC 'Tomai-Vinex' SA are highly dependent on the yield of vineyards and the prices of products that vary from year to year (tab. 8.1). To assess the efficiency of grape production for clone R5 of Cabernet Sauvignon variety, the yield indicators in tons per hectare were used. In the control variants from 2015 to 2018, when grafted onto BxR Kober 5BB stock, the yield ranged from 10.59 to 14.40 tons per hectare. In variants EG 1, EG 2, EG 3 (on vines grown from grafted vines using 1st-3rd cuttings from the base of the stock cane), the yield increased to 15.96 to 17.93 tons per hectare, especially in favourable meteorological conditions, as seen in the year 2017. In EG 4 and EG 4 (on vines grown from grafted saplings using 4th and 5th cuttings, from the top-cane of stock), the yield of the vines remained at the control level or decreased. Thus, the prolonged effect of the variability of grafted saplings on the growth, development, and productivity of vineyards is observed, which is reflected in the economic efficiency indicators. At a grape selling price of 5100 lei per ton in the control variant, the revenue from product sales (R) amounted to 75,531 lei. With production and sales costs of 37,814.5 lei per hectare, the profit amounted to 37,716.5 lei per hectare, and the level of profitability was 99.7%. In the EG 1, EG 2, EG 3 (1st-3rd cuttings), the profitability level increased to 133.2%, 126.8%, and 112.3%, respectively. In the Experimental Group 4 and Experimental Group 5 (when cultivating vines from grafts onto cuttings from the top zone of the cane stock, 4th and 5th cuttings), the profitability decreased by 1.2 and 1.6 times compared to the control variant, respectively.

In 2018, due to the low selling price of the product (4200 lei per ton) and increased costs, the profitability level in the control variant was 57.4%, which decreased by 1.7 times compared to 2017. The decrease in profitability levels was also observed in other experimental variants, but the previously identified pattern of increased profit and profitability levels vines when using grafted saplings from the top zone of the stock cane for grafting remained consistent.

In the subsequent years (2019-2021), due to unfavourable meteorological conditions (soil-air drought), there was a decrease in grape yield, profit from product sales, and profitability levels regardless of the experimental options. In 2020, negative indicators of economic efficiency (profit, profitability) were observed for all experimental options. However, in 2021, there was an increase in grape yield, and with the increased selling price (8000 lei per ton), profits and profitability will increase, reaching 24,165 lei per hectare and 57.2% in the Control Group (CG); 35,112.5 lei per hectare and 81.9% (CG 1); 29,223.5 lei per hectare and 68.7% (CG 2).

A similar pattern in economic efficiency indicators is observed when operating the vineyards of clone R5 of the Cabernet Sauvignon grown onto the RxR 101-14 rootstock.

We have shown that the grape yield of clone R5 of the Cabernet Sauvignon variety also varies depending on the different quality of the vines, which is observed in the variants using scion materials with and without tendrils (tab. 8.2).

Table 8.2. Economic Efficiency of Grape Production Depending on the Different Quality of Scion Materials. Cl R5 Cabernet-Sauvignon onto BxR Kober 5BB.

Experimental Variants	Year	Yield, center per hectare	Price of 1 centner of production, lei	Revenue from product sales, lei	Production and sales costs, lei	Profit, lei (P)	Profitability level, % (Pr)
Without Tendril H_2O	2015	9.53	4500	42885	34288.5	8596.5	25.1
	2016	12.06	4700	56682	36527.0	20155.0	55.2
	2017	12.35	5100	62985	36707.5	26277.5	71.6
	2018	11.7	4200	49140	36665.0	12475.0	34.0
	2019	9.35	4600	43010	37207.5	5802.5	15.6
	2020	3.68	5800	21344	35656.0	-14312.0	-40.1
	2021	7.66	8000	61280	38447.0	22833.0	59.4
With Tendril H_2O	2015	10.52	4500	47340	34734.0	12606.0	36.3
	2016	13.19	4700	61993	37035.5	24957.5	67.4
	2017	14.49	5100	73899	37670.5	36228.5	96.2
	2018	13.7	4200	57540	37565.0	19975.0	53.2
	2019	10.23	4600	47058	37603.5	9454.5	25.1
	2020	4.46	5800	25868	36007.0	-10139.0	-28.2
	2021	8.62	8000	68960	38879.0	30081.0	77.4
Without Tendril Calovit	2015	9.92	4500	44640	34464.0	10176.0	29.5
	2016	12.7	4700	59690	36815.0	22875.0	62.1
	2017	13.26	5100	67626	37117.0	30509.0	82.2
	2018	12.53	4200	52626	37038.5	15587.5	42.1
	2019	9.84	4600	45264	37428.0	7836.0	20.9
	2020	4.2	5800	24360	35890.0	-11530.0	-32.1
	2021	8.21	8000	65680	38694.5	26985.5	69.7
With Tendril Calovit	2015	11.58	4500	52110	35211.0	16899.0	48.0
	2016	14.47	4700	68009	37611.5	30397.5	80.8
	2017	16.13	5100	82263	38408.5	43854.5	114.2
	2018	15.24	4200	64008	38258.0	25750.0	67.3
	2019	10.6	4600	48760	37770.0	10990.0	29.1
	2020	5.04	5800	29232	36268.0	-7036.0	-19.4
	2021	9.5	800	76000	39275.0	36725.0	93.5

For instance, in 2017, the yield in the control variants was 12.35 tons per hectare (without tendrils, H_2O) and 14.49 tons per hectare (with tendrils, H_2O), with profitability levels of 71.6% and 96.2%, respectively. In variants using scion material with tendrils, there is a significant increase in the parameters of vineyard productivity, profit, and profitability, especially when using a calovit solution.

In this variant, profitability increases by 1.3 times. In unfavourable years (2019-2021), regardless of the experimental variants, a decrease in yield, profit, and profitability is observed. In some years (2020), the indicators of economic efficiency acquire negative values.

Consequently, the analysis of economic efficiency parameters in the production of clone R5 of Cabernet Sauvignon shows the dependence of these indicators on the one hand on the quality of the stock and scion materials and on the other hand on meteorological conditions that do not adequately develop during the years of the research. Long-term research conducted by us has shown that using grafted vines obtained from the first meter from the base of the stock cane and scion with tendrils increases the productivity and profitability of grapevine plantations.

8.2. Economic Efficiency of Grapevine Clones Production under the Conditions of SC «Tomai-Vinex» SA

The research on the parameters of the economic efficiency of grape production at SC 'Tomai-Vinex' SA was conducted from 2015 to 2021 in the reconstructed vineyards of the R5 clone of Cabernet Sauvignon and the 348 clone of Merlot grown onto BxR Kober 5BB stock.

During the economic analysis, several factors were taken into account, including grapevine yield, production costs, market demand, and price dynamics over the entire period of the study. Analyzing and interpreting these factors provides a comprehensive understanding of the economic efficiency of grape production at the SC "Tomai-Vinex" SA enterprise.

The R5 Cabernet Sauvignon and 348 Merlot clones are characterized by distinctive growth traits, which further contribute to their economic value. The analysis conducted during the research period revealed differences in their growth parameters, photosynthetic activity, and productivity. These characteristics of the studied clones can serve as a basis for developing vineyard management strategies aimed at maximizing their potential and ensuring sustainable production practices.

The analysis showed that the studied clones possess a high productivity potential and resilience to changing environmental conditions, ensuring stable yields even in less favourable years. We have established that in favourable years, the studied clones demonstrate good yield performance, reaching 14.0-15.0 tons per hectare (for clone R5 Cabernet Sauvignon) and 18.0-19.0 tons per hectare (for clone 348 of Merlot) (tab. 8.3). They are characterized by high sugar accumulation, sufficient for producing high-quality red table wines. With such productivity indicators, the level of profitability reaches 101.6% and 145.3%, respectively.

Table 8.3. Economic Efficiency of Grapevine Clones Production in the Conditions SC «Tomai-Vinex» SA

Clone	Year	**Yield, center per hectare**	**Price of 1 centner of production, lei**	**Revenue from product sales, lei**	**Production and sales costs, lei**	**Profit, lei (P)**	**Profitability level, % (Pr)**
Cl R5	2015	11.09	4500	49905	34990.5	14914.5	42.6
	2016	14.25	4700	66975	37512.5	29462.5	78.5
	2017	14.98	5100	76398	37891.0	38507.0	101.6
	2018	14.3	4200	60060	37835.0	22225.0	58.7
	2019	10.93	4600	50278	37918.5	12359.5	32.6
	2020	4.86	5800	28188	36187.0	-7999.0	-22.1
	2021	9.08	8000	72640	39086.0	33554.0	85.8
Cl 348	2015	13.26	4500	59670	35967.0	23703.0	65.9
	2016	18.08	4700	84976	39236.0	45740.0	116.6
	2017	19.12	5100	97512	39754.0	57758.0	145.3
	2018	18.21	4200	76482	39594.5	36887.5	93.2
	2019	13.6	4600	62560	39120.0	23440.0	59.9
	2020	5.94	5800	34452	36673.0	-2221.0	-6.1
	2021	10.98	8000	87840	39941.0	47899.0	119.9

Cl R5 - Clone R5 of Cabernet Sauvignon
Cl 348 - Clone 348 of Merlot

The obtained indicators of the economic efficiency of cultivating the R5 Cabernet Sauvignon and 348 Merlot clones in the agro-ecological conditions of the southern region of the Republic of Moldova, as exemplified by the SC 'Tomai-Vinex' SA enterprise, underscore their suitability for the region and enhance their value for producers aiming for a reliable return on investment. The use of these clones can contribute to increasing grape production in the region and to the establishment of a sustainable agricultural sector.

According to data from M. Cuharschii [216], M. Cuharschii, V. Ciobanu [35], M. Cuharsci, N. Taran, B. Gaina [36], M. Cuharschii, S. Ungureanu, A. Botnarenco [37], European grapevine clones are characterized by high biological and economic productivity, which is confirmed by our research conducted in the agroclimatic conditions of the ATU Gagauzia.

However, in unfavourable years (2019-2021) due to harsh meteorological conditions (soil-air drought), the productivity of vineyards sharply declines. In 2020, despite the increase in purchase prices for the sold grape production, the level of profitability decreased sharply and acquired negative values.

8.3. Conclusions for Chapter 8

1. The profitability of producing grape-grafted planting stock can be increased by using the following strategies: using for grafting cuttings from the base of the rootstock cane (1st–2nd cuttings), which achieve a profitability level of 126.8-133.2%; utilizing scions with tendril; and applying pre-stratification treatment of grafted cuttings with a Calovit solution, increase a profitability level to 114.2%;

2. At planting on a permanent location, the prolonged effect of grafted saplings's different quality on the growth and productivity of vineyards is observed. It is shown that in favourable weather years (2017) the level of profitability in the control variant is 99.7%, increasing by 12.6-33.5% when used for planting grafted vines onto 1^{st}-3^{rd} cuttings from the base of the stock cane. In the variant used scion with tendrils and treatment with calovit solution the level of profitability increased compared to the control in 1.3-1.7 times;

3. A comparative study of the productivity of plantations of clones R5 of Cabernet Sauvignon and clone 348 of Merlot in the agroecological conditions of ATU Gagauzia indicates their high biological and economic productivity in reconstructed vineyards. The level of profitability reaches 101.6% and 145.3%, respectively.

GENERAL CONCLUSIONS

1. Analysis of the development indicators of the viticulture industry of the ATU Gagauzia, which is part of the grape and wine region with the protected geographical indication "Valul lui Traian", conducted over the past 25 years showed that the fruit-bearing area of vineyards decreases annually by an average of 500 hectares, while the gross grape harvest decreases by an average of 270 tons/year. The reserve for growth in the yield of vineyards of the Autonomy is about 2.5 tons/ha.
2. For the first time in the conditions of ATU Gagauzia, a prolonged effect of the quality of cuttings and grafted vines on the growth and development of grapevines in their permanent place has been established. In the case of the R5 clone of the Cabernet Sauvignon variety grown at SC "Tomai-Vinex" SA, the fruiting period begins in the fourth year after planting and depends on the rootstock variety. When grafted onto RxR 101-14 in the control variants, the yield is 1.38 kg per vine, and onto BxR Kober 5BB, it is 1.69 kg per vine. An increase in yield of 7.8-21.5% was observed when cuttings from the base and middle zones of the rootstock canes were used for grafting, compared to the control variants
3. It was found that during the full fruiting period (2015-2021), the mean Shoot Load, Growth, and Development of Annual Growth in clone R5 Cabernet Sauvignon vines depend on agroecological conditions and vary by year. In favorable meteorological years (2017), when grown on BxR Kober 5BB rootstock, the number of developed shoots ranged from 40.1 to 46.5 per vine, and the Volume of Annual Growth ranged from 4.4 to 5.7 dm^3 per vine, depending on the experimental variant. These indicators increased in variants using cuttings taken from the base of the rootstock canes (1st and 2nd cutting). A similar trend was also observed in clone R5 Cabernet Sauvignon grafted onto RxR101-14 rootstock.
4. It has been established that by the end of the vegetation period, the Leaf Surface Area of the clone R5 Cabernet Sauvignon onto BxR Kober 5BB in the control variant (2017) amounts to 48.2 dm2 per shoot and 21.3 m2 per vine. When using cuttings from the base of the rootstock canes for grafting, the Leaf Surface Area of the plants increases by 1.1-1.2 times and noticeably decreases when using cuttings from the top zone of the rootstock canes. When grafted onto RxR 101-14, there is some reduction in the size of the Leaf Surface Area, but the observed pattern among the experimental variants remains consistent;

5. A strong direct correlation has been identified between Leaf Surface Area Development and Shoots' Productivity. The correlation coefficients are high, ranging from r=0.96 to 0.98. Interestingly, when grafted onto RxR 101-14, compared to BxR Kober 5BB, Leaf Surface Area and Shoot Productivity indicators decrease by 1.1-1.2 times. Shoot productivity in the control variants amounts to 109.7-135.7 g per shoot, and when using 1st-3rd cuttings from the base of the rootstock canes, it increases to 114.0-148.6 g per shoot;
6. For the first time, it was determined that the yield of clone R5 Cabernet Sauvignon depends on the Shoot Load of the vines, Shoot Productivity, and meteorological conditions of the year. In the control variants (2015-2018), when grafted onto BxR Kober 5BB, the yield ranged from 4.09 to 5.69 kg per vine. It increases by 1.1-1.2 times when using 1st-2nd cuttings from the base of the rootstock cane. The sugar content varies within the range of 224 g/dm3 to 258 g/dm3 (BxR Kober 5BB) and 238 g/dm3 to 265 g/dm3 (RxR 101-14), with titratable acidity of 8.0 g/dm3 to 9.1 g/dm3 and 7.5 g/dm3 to 9.1 g/dm3, respectively;
7. Changes in the training system and canopy management of grapevines from a hanging shoot positioning to a vertical shoot positioning system contribute to an increase in Leaf Surface Parameters and its Photosynthetic Activity. In favourable years, the Leaf Area Index reaches 5.5 m^2/m^2, Chlorophyll Content is 9.7 g/vine, the Chlorophyll Index is 2.87 g/m^2, and Shoot Productivity is 160.6 g/shoot for clone R5 Cabernet Sauvignon and 230.8 g/shoot for clone 348 Merlot, which is 1.3-1.4 times higher than in non-reconstructed plantations.
8. The monitoring of the productivity of the studied clones (2015-2021) conducted in the conditions of the SC "Tomai-Vinex" SA has shown that they are characterized by high yield and product quality. In favourable years (2017), the yield of the clone R5 Cabernet Sauvignon reaches 15.0 ton per hectare with a sugar mass concentration of 235 g/dm3 and titratable acidity of 8.9 g/dm3; the clone 348 Merlot yields up to 19.1 ton per hectare with a sugar mass concentration and titratable acidity of 238 g/dm3 and 8.8 g/dm3, respectively. In unfavourable years (2019-2020), the productivity of the vineyards decreased by 1.4-2.8 times. A negative correlation coefficient has been established between the productivity of grapevine plantations and the amount of annual precipitation (r=0.81);
9. The analysis of the economic efficiency parameters of grape production for clone R5 Cabernet Sauvignon revealed their dependence on the quality of scion and rootstock materials, as well as on meteorological conditions, which were unfavorable during 2019-2021. In favorable

meteorological years, profit and profitability levels increase, reaching 57,656.0 lei/ha and 145.0%, respectively.

RECOMMENDATIONS FOR PRODUCTION

1. To enhance the survival rate of of grafted saplings in permanent locations and establish high-yielding and profitable grape plantations, it is essential to use high-quality planting material obtained by:
    - utilizing rootstock cuttings collected from the first two metres of the base of the stock canes (1^{st}, 2^{nd}, and 3^{rd} cuttings) for grafting;
    - grafting scion cuttings with tendrils, followed by pre-stratification treatment of the apical part of the grafted cuttings with a growth stimulant such as Calovit.
2. Long-term studies conducted at SC "Tomai-Vinex" SA suggest planting clone R5 Cabernet Sauvignon variety and clone 348 Merlot variety grafted onto the Kober 5BB rootstock. These combinations are characterized by high agronomic and biological productivity as well as excellent product quality.
3. To achieve a high-quality and full grape harvest from clone R5 Cabernet Sauvignon and clone 348 Merlot under the conditions of ATU Gagauzia, with dense planting (2.5 m x 1.35 m), it is recommended to use a vertical shoot positioning system.

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341.*Энциклопедия виноградарства*, т.3. Кишинев: Главн.Ред.Молд.Сов.Энциклопедии. 1987, 549с.
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APPENDIX

Appendix 1.

Quality Certificates of Saplings and Vineyard Planting Plans

0000500

REPUBLICA MOLDOVA
MINISTERUL
AGRICULTURII ȘI INDUSTRIEI PRELUCRĂTOARE

LICENȚĂ

Seria 02 Nr. 4

din 25.02.2002 199

Termen valabil 25.02.2007 199

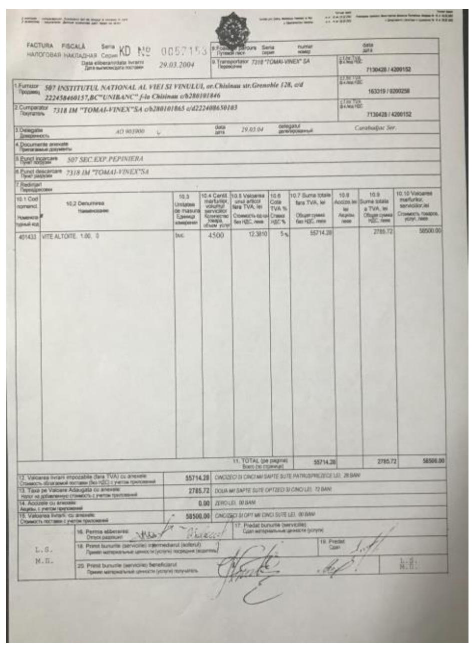
Genul de activitate
Producerea si comercializarea materialului de inmultire si saditor pomicol, bacifer si viticol

Agentul economic
Intreprinderea Mixta "TOMAI - VINEX" Societate pe Actiuni
Nr. de inregistrare 177016623 din 16.09.1998. Cf 7130428.
Sediul: MD-6116, Republica Moldova, r-l Ceadir-Lunga, s. Tomai

Conditii de activitate
1. Se permite producerea si comercializarea materialului de inmultire si saditor viticol.
2. Materialul de inmultire si saditor produs trebuie sa corespunda cerintelor documentatiei tehnico-normative in vigoare.
3. Soiurile de culturi viticole, ce se afla in procesul de inmultire, trebuie sa fie inregistrate in "Registrul soiurilor de plante al Republicii Moldova".
4. Sa dispuna de un contract cu autorul soiului sau cu reprezentantul acestuia in Republica Moldova.

Viceprim-ministru Dmitrii TODOROGLO

Figure. A 1.1. Planting Material and Grapevine Propagation Material Production License. SC «Tomai-Vinex» SA.



FACTURA FISCALĂ Seria KD № 0057153
НАЛОГОВАЯ НАКЛАДНАЯ Серия
Data eliberarii/data livrarii 29.03.2004

9. Transportator 7318 "TOMAI-VINEX" SA — 7130428 / 4200152

1. Furnizor 507 INSTITUTUL NATIONAL AL VIEI SI VINULUI, or.Chisinau str.Grenoble 128, c/d 222458460157,BC"UNIBANC" f-la Chisinau c/b280101846 — 163319 / 0200258

2. Cumparator 7318 IM "TOMAI-VINEX"SA c/b280101865 c/d2222408650103 — 7130428 / 4200152

3. Delegatie AO 903900 data 29.03.04 delegatul Carababac Ser.

4. Documente anexate

5. Punct incarcare 507 SEC.EXP.PEPINIERA

6. Punct descarcare 7318 IM "TOMAI-VINEX"SA

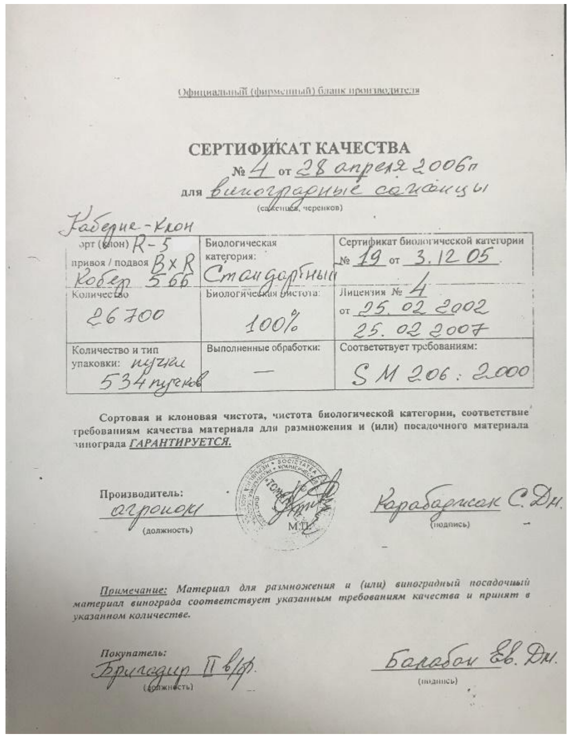
7. Redirijari

10.1 Cod nomencl.	10.2 Denumirea	10.3 Unitatea de masura	10.4 Cantit. marfurilor	10.5 Valoarea unui articol fara TVA, lei	10.6 Cota TVA %	10.7 Suma totala fara TVA, lei	10.8 Accize, lei	10.9 Suma totala a TVA, lei	10.10 Valoarea marfurilor, serviciilor, lei
401433	VITE ALTOITE 1.00, 0	buc.	4500	12.3810	5 %	55714.28		2785.72	58500.00
					11. TOTAL (pe pagina)	55714.28		2785.72	58500.00

12. Valoarea livrarii impozabile (fara TVA) cu anexele	55714.28	CINCIZECI SI CINCI MII SAPTE SUTE PATRUSPREZECE LEI, 28 BANI
13. Taxa pe Valoare Adaugata cu anexele	2785.72	DOUA MII SAPTE SUTE OPTZECI SI CINCI LEI, 72 BANI
14. Accizele cu anexele	0.00	ZERO LEI, 00 BANI
15. Valoarea livrarii cu anexele	58500.00	CINCIZECI SI OPT MII CINCI SUTE LEI, 00 BANI

16. Permis eliberarea
17. Predat bunurile (serviciile)
18. Primit bunurile (serviciile) intermediarul (sofierul)
19. Predat
20. Primit bunurile (serviciile) beneficiarul
L.S. M.П.

Figure. A 1.2. Purchase Invoice for Grapevine Scion Cuttings (Cl R5 of Cabernet Sauvignon variety and Cl 348 of Merlot variety). SC «Tomai-Vinex» SA.



Официальный (фирменный) бланк производителя

СЕРТИФИКАТ КАЧЕСТВА

№ 4 от 28 апреля 2006г

для виноградные саженцы

(саженцев, черенков)

Каберне-клон

Сорт (клон) R-5 привоя / подвоя BxR Кобер 5ББ	Биологическая категория: Стандартный	Сертификат биологической категории № 19 от 3.12 05.
Количество 26700	Биологическая чистота: 100%	Лицензия № 4 от 25. 02 2002 25. 02 2007
Количество и тип упаковки: пучки 534 пучков	Выполненные обработки: —	Соответствует требованиям: SM 206 : 2000

Сортовая и клоновая чистота, чистота биологической категории, соответствие требованиям качества материала для размножения и (или) посадочного материала винограда *ГАРАНТИРУЕТСЯ.*

Производитель:

агроном

(должность)

М.П.

(подпись)

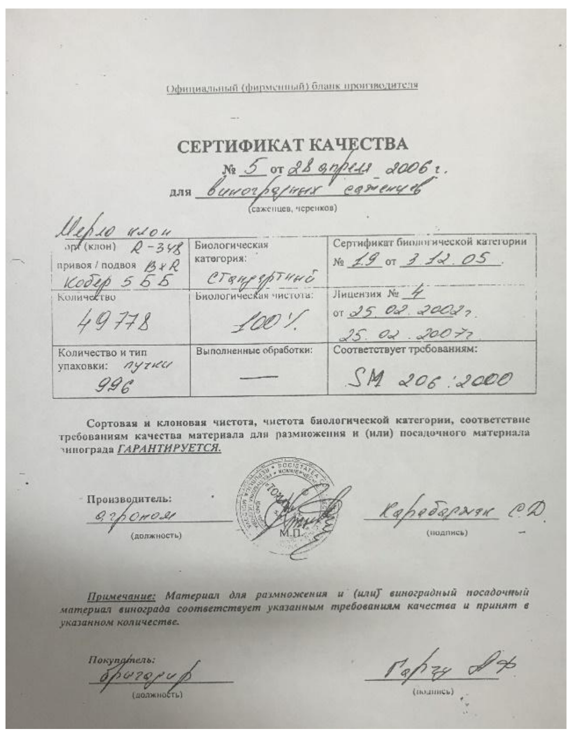
***Примечание:* Материал для размножения и (или) виноградный посадочный материал винограда соответствует указанным требованиям качества и принят в указанном количестве.**

Покупатель:

Бригадир II в/ф.

(должность)

(подпись)



Официальный (фирменный) бланк производителя

СЕРТИФИКАТ КАЧЕСТВА

№ 5 от 28 апреля 2006 г.

для виноградных саженцев

(саженцев, черенков)

Мерло клон

Сорт (клон) R-348 привоя / подвоя BxR Кобер 5ББ	Биологическая категория: стандартный	Сертификат биологической категории № 19 от 3.12.05.
Количество 49778	Биологическая чистота: 100%	Лицензия № 4 от 25.02.2002 г. 25.02.2007 г.
Количество и тип упаковки: пучки 996	Выполненные обработки: —	Соответствует требованиям: SM 206:2000

Сортовая и клоновая чистота, чистота биологической категории, соответствие требованиям качества материала для размножения и (или) посадочного материала винограда *ГАРАНТИРУЕТСЯ.*

Производитель:

агроном

(должность)

М.П.

(подпись)

***Примечание:* Материал для размножения и (или) виноградный посадочный материал винограда соответствует указанным требованиям качества и принят в указанном количестве.**

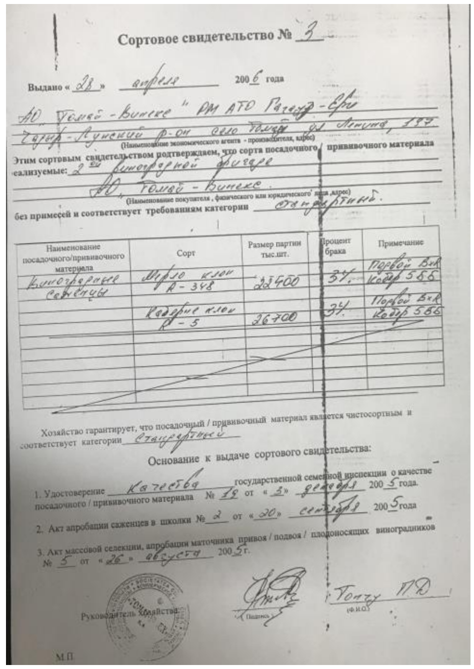
Покупатель:

бригадир

(должность)

(подпись)

Figure. A 1.3. Certificates of Quality for Grapevine Grafted Saplings. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB and Cl 348 Merlot onto BxR Kober 5BB. SC «Tomai-Vinex» SA.



Сортовое свидетельство № 3

Выдано « 28 » апреля 2006 года

АО „Томай-Винекс" РМ АТО Гагауз-Ери
Чадыр-Лунгский р-он село Томай ул. Ленина, 197
(Наименование экономического агента - производителя, адрес)

Этим сортовым свидетельством подтверждаем, что сорта посадочного / прививочного материала реализуемые: 2-ой винограрной бригаде
АО „Томай-Винекс".
(Наименование покупателя, физического или юридического лица, адрес)

без примесей и соответствует требованиям категории стандартный.

Наименование посадочного/прививочного материала	Сорт	Размер партии тыс.шт.	Процент брака	Примечание
Виноградные саженцы	Мерло клон R-348	22400	3%	Подвой BxR Кобер 5ББ
	Каберне клон R-5	26700	3%	Подвой BxR Кобер 5ББ

Хозяйство гарантирует, что посадочный / прививочный материал является чистосортным и соответствует категории стандартный

Основание к выдаче сортового свидетельства:

1. Удостоверение качества государственной семенной инспекции о качестве посадочного / прививочного материала № 19 от « 3 » декабря 2005 года.
2. Акт апробации саженцев в школки № 2 от « 20 » сентября 2005 года
3. Акт массовой селекции, апробации маточника привоя / подвоя / плодоносящих виноградников № 5 от « 26 » августа 2005 г.

Руководитель хозяйства: (Подпись) Томчу П.Д. (Ф.И.О.)

М.П.

Figure. A 1.4. Certificate of Variety for Grapevine Grafted Saplings. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB and Cl 348 Merlot onto BxR Kober 5BB. SC «Tomai-Vinex» SA.

МИНИСТЕРСТВО СЕЛЬСКОГО ХОЗЯЙСТВА
И ПИЩЕВОЙ ПРОМЫШЛЕННОСТИ
РЕСПУБЛИКИ МОЛДОВА

НАЦИОНАЛЬНЫЙ ИНСТИТУТ ВИНОГРАДА И ВИНА

Шифр 9981

РАБОЧИЙ ПРОЕКТ

Создания многолетних насаждений
в СП "Томай-Vinex" с. Томай, района Чадыр-Лунга
Республики Молдова

Часть 1 Агроэкономическое обоснование и организация территории.

Книга 1 Общая пояснительная записка, приложения, чертежи.

Директор центра виноградарства и проектирования НИВиВ — М.С. Кухарский

Главный инженер проекта — Н.М. Тома

Кишинев, 2002 год

Figure. A 1.5. Project for Establishing Perennial Plantations. SC «Tomai-Vinex» SA. Planting 2005.

1. ПАСПОРТ ПРОЕКТА

1.1 Экспликация земель по проекту

Наименование показателей	Общая площадь, га
Виноградники	55,71
Дороги	8,30
Лесополосы	0,88
Залужение	0,04
Итого	64,93
Коэффициент использования земель	0,86

1.2 Агропоказатели проекта.

сорт	Площадь, га	Подвой	Схема посадки	Потребность саженцев тыс.шт	Проектная урожайность т/га
1	2	3	4	5	6
Всего по проекту	55,71	-	-	-	-
Виноградники	55,71	-	-	148,81	7,77
Технические сорта	55,71	-	-	148,81	7,77
Средние сорта	28,38	-	-	82,56	6,9
Пино черный	15,04	БхР Кобер 5ББ	2,75x1,25	43,75	6,0
Алиготе	13,34	БхР Кобер 5ББ	2,75x1,25	38,81	7,9
Поздние сорта	27,83	-	-	66,25	8,7
Изабелла	10,76	-	2,75x1,5	26,08	9,5
Каберне Совиньон	16,57	БхР Кобер 5ББ	2,75x1,5	40,17	8,1

Figure. A 1.6. Project Passport for Establishing Perennial Plantations. SC «Tomai-Vinex» SA. Planting 2005.

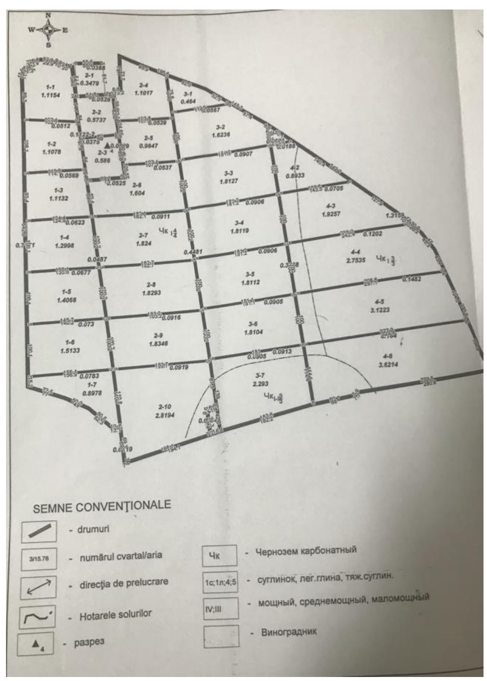
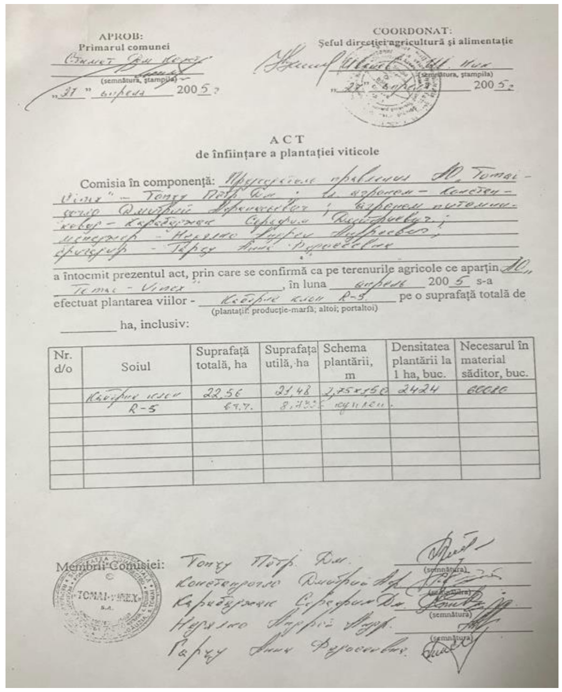


Figure. A 1.7. Scheme of Grapevine Plantations. SC «Tomai-Vinex» SA.



APROB:
Primarul comunei
(semnătura, ştampila)
„27" ______ 2005

COORDONAT:
Şeful direcţiei agricultură şi alimentaţie
(semnătura, ştampila)
„27" ______ 2005

ACT
de înfiinţare a plantaţiei viticole

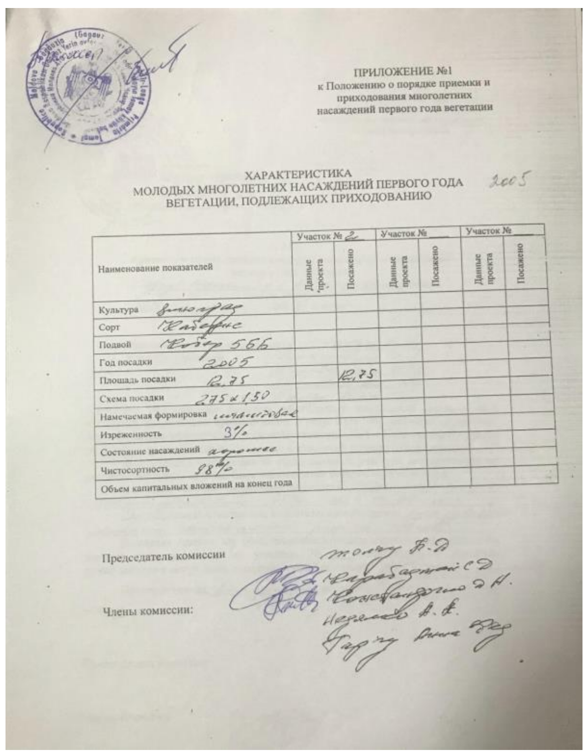
Comisia în componenţă: [illegible]

a întocmit prezentul act, prin care se confirmă ca pe terenurile agricole ce aparţin SC „Tomai - Vinex" ______, în luna ______ 2005 s-a efectuat plantarea viilor - ______ pe o suprafaţă totală de
(plantaţii: producţie-marfă; altoi; portaltoi)
______ ha, inclusiv:

Nr. d/o	Soiul	Suprafaţă totală, ha	Suprafaţa utilă, ha	Schema plantării, m	Densitatea plantării la 1 ha, buc.	Necesarul în material săditor, buc.
	[illegible] R-5	22,56	21,48	2,75x1,50	2424	[illegible]

Membrii Comisiei:
(semnătura)
(semnătura)
(semnătura)
(semnătura)

Figure. A 1.8. Act of Planting Grapevine Plantations. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB. SC «Tomai-Vinex» SA, Planting 2005.



ПРИЛОЖЕНИЕ №1
к Положению о порядке приемки и приходования многолетних насаждений первого года вегетации

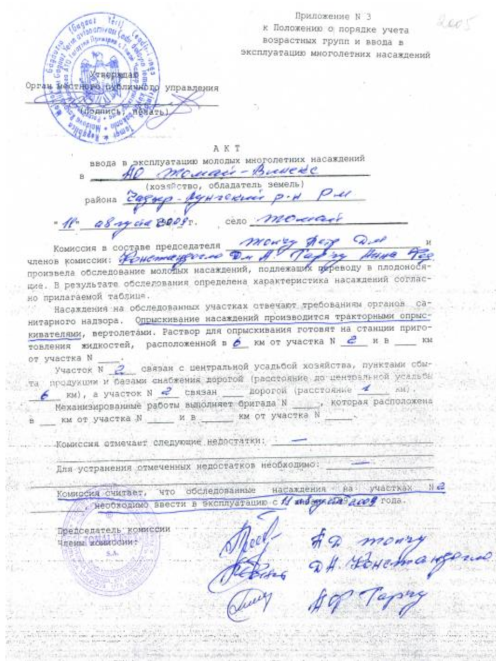
ХАРАКТЕРИСТИКА
МОЛОДЫХ МНОГОЛЕТНИХ НАСАЖДЕНИЙ ПЕРВОГО ГОДА ВЕГЕТАЦИИ, ПОДЛЕЖАЩИХ ПРИХОДОВАНИЮ 2005

Наименование показателей	Участок № 2		Участок №		Участок №	
	Данные проекта	Посажено	Данные проекта	Посажено	Данные проекта	Посажено
Культура виноград						
Сорт Каберне						
Подвой Кобер 5ББ						
Год посадки 2005						
Площадь посадки 12,75		12,75				
Схема посадки 275x150						
Намечаемая формировка [illegible]						
Изреженность 3%						
Состояние насаждений хорошее						
Чистосортность 98%						
Объем капитальных вложений на конец года						

Председатель комиссии

Члены комиссии:

Figure. A 1.9. Characteristics of Young Grapevine Plantations. First Year of Planting. Clone R5 Cabernet Sauvignon onto BxR Kober 5BB. SC «Tomai-Vinex» SA, 2005.



Приложение N 3
к Положению о порядке учета
возрастных групп и ввода в
эксплуатацию многолетних насаждений

Утверждаю
Орган местного публичного управления
(подпись, печать)

А К Т
ввода в эксплуатацию молодых многолетних насаждений
в АО Томай-Винекс
(хозяйство, обладатель земель)
района Чадыр-Лунгский р-н РМ
«11» августа 2009 г. село Томай

Комиссия в составе председателя ______ и членов комиссии: ______ произвела обследование молодых насаждений, подлежащих переводу в плодоносящие. В результате обследования определена характеристика насаждений согласно прилагаемой таблице.

Насаждения на обследованных участках отвечают требованиям органов санитарного надзора. Опрыскивание насаждений производится тракторными опрыскивателями, вертолетами. Раствор для опрыскивания готовят на станции приготовления жидкостей, расположенной в 6 км от участка N 2 и в ____ км от участка N ____.

Участок N 2 связан с центральной усадьбой хозяйства, пунктами сбыта продукции и базами снабжения дорогой (расстояние до центральной усадьбы 6 км), а участок N 2 связан ____ дорогой (расстояние 1 км).

Механизированные работы выполняет бригада N ____, которая расположена в ___ км от участка N ____ и в ____ км от участка N ____.

Комиссия отмечает следующие недостатки: —

Для устранения отмеченных недостатков необходимо: —

Комиссия считает, что обследованные насаждения на участках N 2 необходимо ввести в эксплуатацию с 11 августа 2009 года.

Председатель комиссии
Члены комиссии:

Figure. A 1.10. Commissioning Act of Young Perennial Plantations.
Clone R5 Cabernet Sauvignon onto BxR Kober 5BB. SC «Tomai-Vinex» SA, 2009.

Агропромышленное Агентство "MOLDOVA - VIN"
Республики Молдова
Национальный Институт Виноградарства и Виноделия

Шифр 6018
Лицензия №22
от 10.11.2000 г.

РАБОЧИЙ ПРОЕКТ
создания виноградников и маточника подвойных лоз
в С.П. "**Tomai-Vinex**", с. **Томай**, района **Чадыр-Лунга**
Республики Молдова

Раздел I. Агроэкономическое обоснование и организация территории.

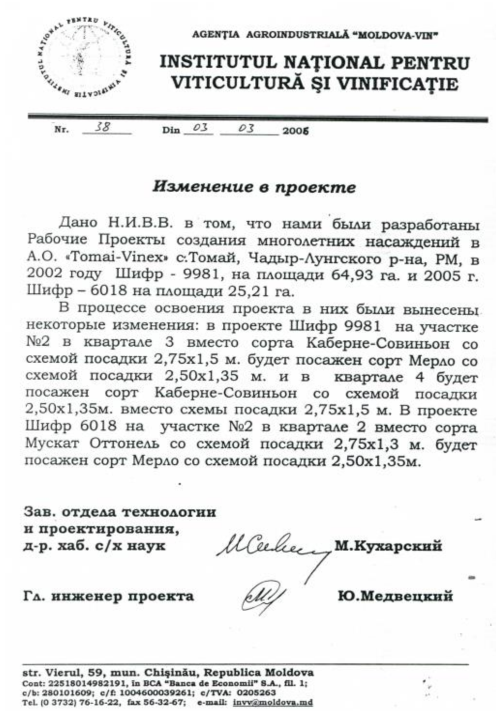
Раздел II. Технологические карты.

Раздел III. Сметная документация.

Генеральный директор НИВиВ — К. Даду
Нач. отдела проектирования — М. Кухарский
Главный инженер проекта — Ю. Медвецкий

Кишинэу, 2005 год

Figure. A 1.11. Project Passport for Establishing Perennial Plantations.
SC «Tomai-Vinex» SA. Planting 2006.



AGENȚIA AGROINDUSTRIALĂ "MOLDOVA-VIN"

INSTITUTUL NAȚIONAL PENTRU VITICULTURĂ ȘI VINIFICAȚIE

Nr. 38 Din 03 03 2006

Изменение в проекте

Дано Н.И.В.В. в том, что нами были разработаны Рабочие Проекты создания многолетних насаждений в А.О. «Tomai-Vinex» с.Томай, Чадыр-Лунгского р-на, РМ, в 2002 году Шифр - 9981, на площади 64,93 га. и 2005 г. Шифр – 6018 на площади 25,21 га.

В процессе освоения проекта в них были вынесены некоторые изменения: в проекте Шифр 9981 на участке №2 в квартале 3 вместо сорта Каберне-Совиньон со схемой посадки 2,75x1,5 м. будет посажен сорт Мерло со схемой посадки 2,50x1,35 м. и в квартале 4 будет посажен сорт Каберне-Совиньон со схемой посадки 2,50x1,35м. вместо схемы посадки 2,75x1,5 м. В проекте Шифр 6018 на участке №2 в квартале 2 вместо сорта Мускат Оттонель со схемой посадки 2,75x1,3 м. будет посажен сорт Мерло со схемой посадки 2,50x1,35м.

Зав. отдела технологии и проектирования, д-р. хаб. с/х наук — М.Кухарский

Гл. инженер проекта — Ю.Медвецкий

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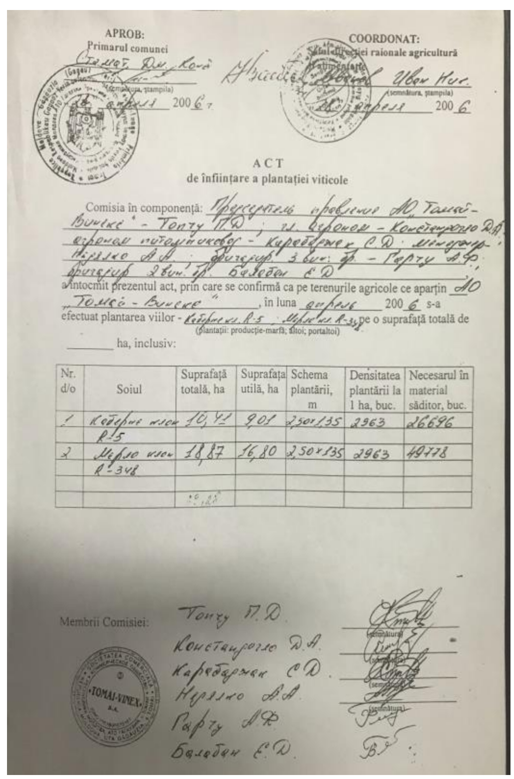
Figure. A 1.12. Amendment to the Perennial Plantation Establishment Project. SC «Tomai-Vinex» SA. Planting 2006.



APROB:
Primarul comunei
(semnătura, ștampila)
200 6

COORDONAT:
Șeful direcției raionale agricultură și alimentație
(semnătura, ștampila)
200 6

ACT
de înființare a plantației viticole

Comisia în componență: Председатель правления АО „Томай-Виникс" - Топту П.Д.; гл. агроном - Константогло Д.А.; агроном питомниковод - Карабаджак С.Д.; мелиоратор Мирзенко А.А.; бригадир 3 вин. бр. - Гарту А.Ф.; бригадир 2 вин. бр. Балабан Е.Д.
a întocmit prezentul act, prin care se confirmă ca pe terenurile agricole ce aparțin АО „Томай - Виникс", în luna апрель 200 6 s-a efectuat plantarea viilor - Каберне кл. R-5, Мерло кл. R-348 pe o suprafață totală de (plantații: producție-marfă; altoi; portaltoi)
_______ ha, inclusiv:

Nr. d/o	Soiul	Suprafață totală, ha	Suprafața utilă, ha	Schema plantării, m	Densitatea plantării la 1 ha, buc.	Necesarul în material săditor, buc.
1	Каберне клон R-5	10,41	9,01	2,50x1,35	2963	26696
2	Мерло клон R-348	18,87	16,80	2,50x1,35	2963	49778

Membrii Comisiei:
Топту П.Д.
Константогло Д.А.
Карабаджак С.Д.
Мирзенко А.А.
Гарту А.Ф.
Балабан Е.Д.

Figure. A 1.13. Act of Planting Grapevine Plantations. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB and Cl 348 Merlot onto BxR Kober 5BB. SC «Tomai-Vinex» SA, Planting 2006.

Meteorological Conditions in the Years of Research

Table A 2.1. Mean Monthly Temperature Values (t,^{0}C)
(according to the data from the Agro-Industrial Complex of the ATU Gagauzia).

Months	Mean long-term	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
January	-2.3	-2.8	-3.8	1.6	-6.4	3.8	-1.6	-1.1	-4.2	-2.0	-2.7	-1.9	-0.5	-0.9	-2.5	-4.6	-0.3	-1.4	3.1	1.1
February	-1.1	-5.9	0.5	-2.1	-2.5	0.8	2.0	1.5	-0.5	-3.0	-7.5	1.6	-0.1	1.6	5.6	0.3	-0.1	2.8	4.3	1.2
March	3.1	0.8	5.8	2.5	2.9	6.2	7.1	3.8	3.6	3.5	4.3	2.7	8.1	5.1	6.6	7.7	2.8	7.4	8.5	4.1
April	9.7	8.3	10.7	9.7	10.2	10.1	10.8	11.4	10.6	9.4	12.7	12.0	11.6	10.4	13.4	9.4	14.7	10.4	10.8	8.6
May	15.7	19.8	14.8	16.1	15.3	17.8	15.1	15.9	16.5	16.2	18.7	18.7	16.3	17.2	15.7	16.2	18.5	17.0	15.3	15.7
June	19.5	21.3	18.9	18.6	19.8	22.5	20.4	20.9	20.4	20.1	22.7	21.1	19.5	20.9	21.5	21.2	22.0	23.4	22.0	19.9
July	21.3	21.3	21.3	22.1	22.0	25.2	21.7	24.3	22.9	23.0	26.0	21.6	23.1	23.9	23.4	22.2	22.5	22.8	24.0	24.1
August	21.0	23.0	21.2	21.4	22.3	24.1	23.9	21.9	25.0	22.0	23.6	22.4	23.5	24.6	23.3	23.0	24.0	23.6	24.2	22.6
September	16.1	16.0	16.6	18.7	17.1	16.5	15.8	18.2	16.5	19.2	18.8	15.1	18.1	20.4	18.7	19.2	18.0	18.4	20.5	16.0
October	10.4	9.8	12.3	10.9	11.9	11.8	12.5	11.9	8.0	9.4	13.4	11.2	10.5	10.2	9.1	11.5	13.5	12.9	15.5	10.0
November	4.3	5.8	5.6	4.4	6.1	3.3	5.5	6.6	10.5	2.5	6.2	9.1	4.8	7.4	4.9	6.7	3.5	9.1	5.4	7.4
December	-0.3	0.3	2.5	1.3	3.0	0.3	2.0	-0.7	-1.3	2.8	-2.3	0.4	0.5	2.0	-0.1	4.0	-0.1	4.0	3.5	2.5
Mean per year	**9.8**	**9.8**	**10.5**	**10.4**	**10.1**	**11.9**	**11.3**	**11.2**	**10.7**	**10.3**	**11.2**	**11.2**	**11.3**	**11.9**	**11.6**	**11.4**	**11.6**	**12.5**	**13.1**	**11.1**

Table A 2.2. Precipitation Indicators (mm)
(according to the data from the Agro-Industrial Complex of the ATU Gagauzia).

Months	Mean long-term	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
January	27.0	40.0	63.0	30.0	27.0	34.1	19.3	20.7	34.4	27.0	26.1	49.4	41.6	21.1	40.3	10.8	14.7	37.4	8.0	31.2
February	32.0	32.0	29.0	38.9	11.3	20.5	2.4	23.5	64.4	5.9	11.8	27.3	8.6	30.4	11.3	40.2	41.3	15.7	21.5	7.3
March	27.0	2.0	22.0	24.0	46.8	33.3	35.1	39.3	26.1	6.7	6.6	27.2	18.1	57.3	28.1	25.8	42.4	4.0	4.2	29.4
April	37.0	40.0	41.0	17.4	36.1	27.9	31.3	10.4	23.0	50.7	14.7	13.2	31.7	25.8	25.2	86.9	0.0	25.8	7.1	32.3
May	50.0	34.0	103.0	57.5	50.1	16.4	34.1	30.5	69.6	27.9	54.2	8.1	46.0	10.9	64.2	27.4	39.6	41.7	28.3	85.5
June	68.0	90.0	53.0	78.6	101.4	125.6	91.6	29.5	117.1	59.5	43.3	67.2	47.5	27.6	161.4	87.1	40.5	86.6	54.4	92.7
July	57.0	101.0	58.0	62.8	15.1	0.3	35.0	60.8	88.6	41.2	31.1	71.4	19.4	30.8	5.7	123.6	144.1	17.3	54.0	67.4
August	52.0	22.0	52.0	52.0	75.5	63.5	9.7	17.3	35.9	15.4	64.4	19.4	31.4	10.9	27.4	13.8	12.8	70.3	10.8	10.4
September	45.0	22.0	42.0	71.5	85.3	14.1	62.4	44.3	50.3	16.2	15.1	165.8	11.5	3.1	49.7	1.7	53.6	43.5	23.6	5.0
October	24.0	42.0	19.0	15.6	13.3	34.6	26.1	41.0	74.8	26.0	48.8	35.4	43.6	73.4	96.9	74.9	5.1	28.3	65.4	7.0
November	37.0	7.0	47.0	60.6	10.5	68.1	10.3	8.8	12.0	0.0	12.3	21.3	74.5	70.6	39.9	27.6	24.3	5.4	29.0	15.3
December	36.0	19.0	28.0	35.7	3.2	62.7	39.8	71.4	49.9	18.8	123.5	2.6	41.9	0.4	19.2	40.6	19.2	10.5	51.5	69.8
Sum per year	**492.0**	**451.0**	**557.0**	**544.6**	**475.6**	**501.1**	**397.1**	**397.5**	**646.1**	**295.3**	**451.9**	**508.3**	**415.8**	**362.3**	**569.3**	**560.4**	**437.6**	**386.5**	**357.8**	**453.3**

Appendix 3.

The State of the Viticulture Industry in the Southern Grape-Wine Region

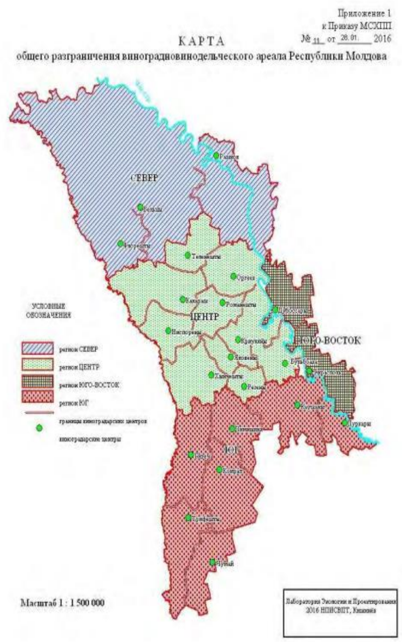


Figure. A 3.1. General Map Delimitation of the Grape-Wine Area of the Republic of Moldova (Appendix to Order No. 11 dated 28.01.2016 of the Ministry of Agriculture and Food Industry).

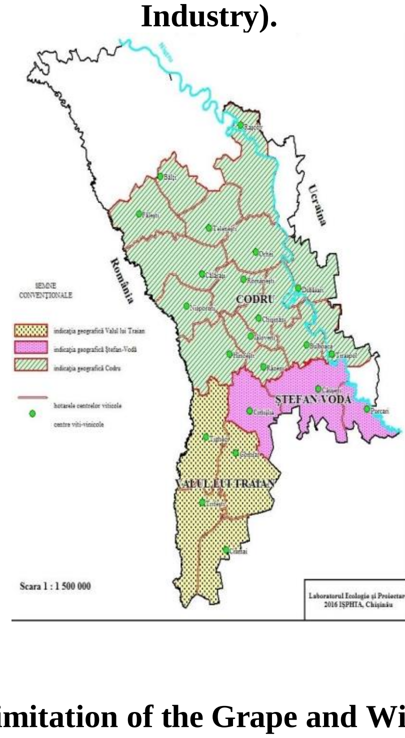


Figure. A 3.2. General Map Delimitation of the Grape and Winegrowing Area of the Republic of Moldova (Appendix to Order No. 12 dated 28.01.2016 of the Ministry of Agriculture and Food Industry).

Unitățile administrative componente a IGP ”Valul lui Traian”

Denumirea Zonei Geografice	Denumire (raion)	Suprafața Totală, (ha)	Suprfața totală a terenurilor agricole, (ha)	Suprafaț a totală a viilor, (ha)	Localități (commune, sate)	Soiuri
1	3	4		5	6	7
“VALUL LUI TRAIAN”	Leova	77.500	57.071	4.718	Leova, Iargara, Meșeni, Băiuș, Cociulia Nouă, Hîrtop, Beștemac, Pitești, Borogani, Cazangic, Frumușica, Seliște, Ceadîr, Cneazevca, Cîzlar, Colibabovca, Covurlui, Cupcui, Filipeni, Hănășenii Noi, Nicolaevca, Orac, Romanovca, Sărata Nouă, Sărata-Răzeși, Sărăteni, Victoria, Sărățica Nouă, Cîmpul Drept, Sîrma, Tigheci, Cuporani, Tochile-Răducani, Tomai, Tomaiul Nou, Sărățica Veche, Vozneseni, Troița	
	Cantemir	87.000	49.602	5.660	Cantemir, Antonești, Baimaclia, Cania, Capaclia, Chioselia, Ciobalaccia, Victorovca, Cîietu, Dimitrova, Cîrpești, Cîșla , Șofranovca, Cociulia, Cotangalia, Enichioi	
	Cahul	154.200	6.630	15.000	Cahul, Cotihana, Alexandru Ioan Cuza , Alexanderfeld, Andrușul de Jos, Andrușul de Sus, Badicul Moldovenesc, Baurci, Moldoveni, Borceag, Bucuria, Burlacu, Spicoasa, Burlăceni, Greceni, Brînza, Chioselia Mare, Frumușica, Cotihana, Colibași, Crihana Veche, Cucoara, Chircani, Cîșlița-Prut, Doina, Iasnaia Poleana, Rumeanțev, Găvănoasa, Nicolaevca, Vladimirovca, Giurgiulești, Huluboaia, Iujnoe , Larga Veche, Larga Nouă, Lebedenco, Hutulu, Ursoaia, Lopățica, Lucești, Manta, Pașcani, Moscovei, Trifeștii Noi, Pelinei, Sătuc, Roșu, Slobozia Mare , Taraclia de Salcie, Tartaul de Salcie, Tudorești, Tătărești, Vadul lui Isac, Văleni, Zîrnești, Paicu, Tretești	
	Taraclia	67.400	146.600	402	Taraclia, Albota de Jos, Hagichioi, Hîrtop, Albota de Sus, Roșița, Aluatu, Sofievca, Balabanu, Budăi, Cairaclia, Dermengi, Cealîc, Samurza, Cortenul Nou, Corten, Musaitu, Novosiolovca, Tvardița, Valea Perjei, Vinogradovca, Chirilovca, Ciumai , Mirnoe, Salcia , Orehovca	
	UTA Gagauzia	184.800	`	30.923	Comrat, Ceadîr-Lunga, Vulcănești, Avdarma, Baurci, Beșalma, Beșghioz, Bugeac, Carbalia, Cazaclia, Chiriet,-Lunga, Chirsova, Cioc-Maidan, Cișmichioi, Chioselia, Rusă, Congaz, Congazcicul de Sus, Congazcicul de Jos, Dudulești, Copceac, Cotovscoe, Dezghingea, Etulia, Etulia Nouă, Ferapontievca, Gaidar, Joltai, Svetlîi, Alexeevca, Tomai	
Total VALUL LUI TRAIAN:		570.900	259.903	43.203		

*Parlamentul RM, LEGE Nr. 764 din 27.12.2001 privind organizarea administrativ-teritorială a Republicii Moldova
Publicat : 29.01.2002 în Monitorul Oficial Nr. 16 art Nr : 53

Figure. A 3.3. The Structure of the Region with the Protected Geographical Indication "Valul lui Traian."

Table A 3.1. Indicators of Grape Cultivation in Farms of All Categories, ATU Gagauzia, 1997-2021

Year	Area, hectares	Gross harvest, tons	Yield, tons per hectare
1997	16816	37089	2.21
1998	15685	29838	1.90
1999	14914	31535	2.11
2000	12653	53000	4.19
2001	12459	33539	2.69
2002	12265	46668	3.80
2003	11911	44909	3.77
2004	12573	57402	4.57
2005	12284	40249	3.28
2006	12201	29480	2.42
2007	11739	24320	2.07
2008	9187	31958	3.48
2009	8226	26567	3.23
2010	8242	13961	1.69
2011	5852	25173	4.22
2012	5874	21329	3.63
2013	4841	36714	7.58
2014	4820	32095	6.66
2015	4876	28582	5.86
2016	4943	33577	6.79
2017	4900	39162	7.99
2018	4841	53715	9.27
2019	6622	44847	6.77
2020	4491	21999	4.90
2021	5379	31329	7.10
Mean	*228594*	*869037*	3.80

Source: Data from the Main Directorate of the Agro-Industrial Complex of the ATU Gagauzia

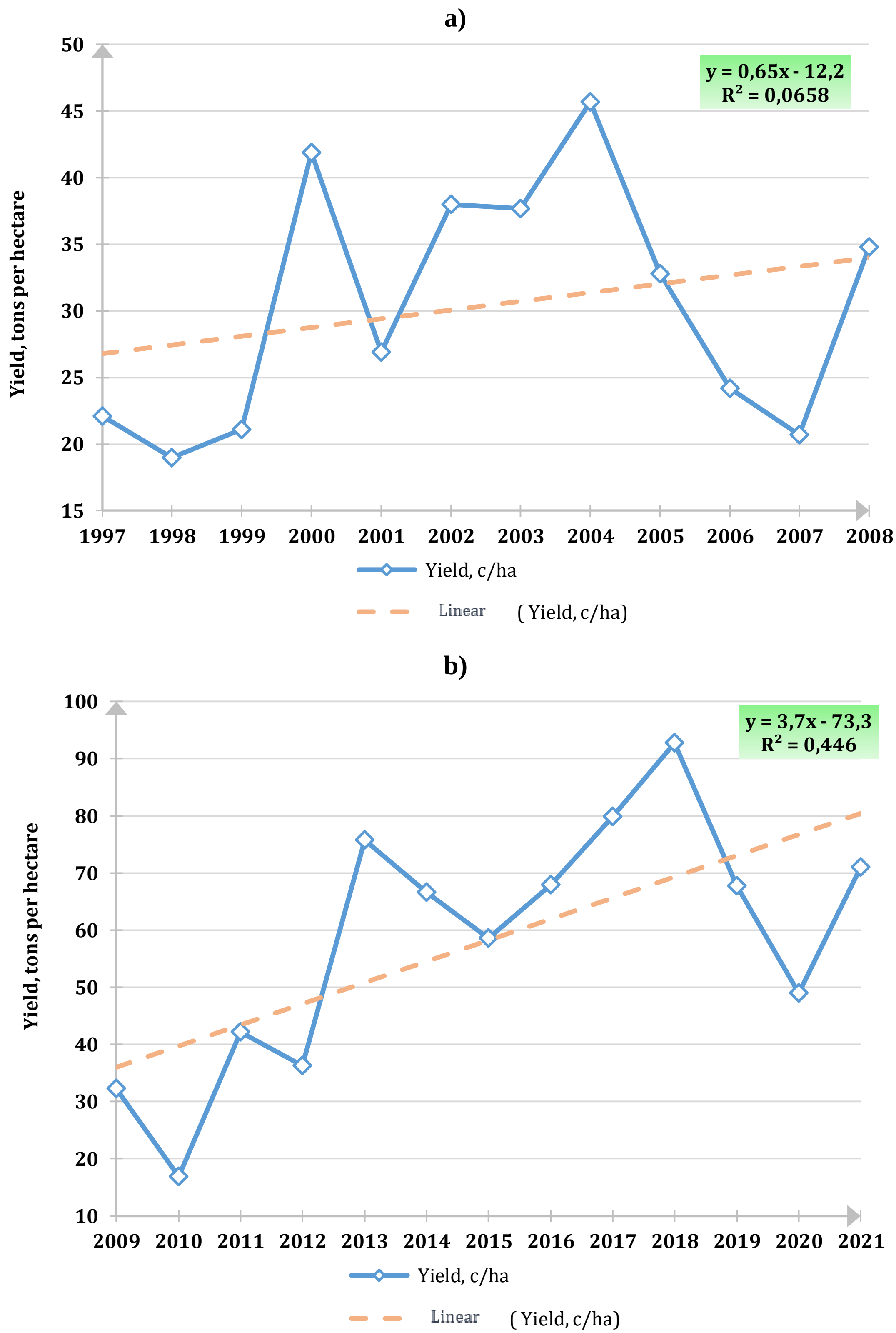


Figure. A 3.4. Dynamics of Grapevine Yield. ATU Gagauzia.
a) 1997-2008
b) 2009-2021

Table A 3.2. Grape Production Indicators in Agricultural Enterprises of ATU Gagauzia

Year	Area, hectares	Gross harvest, tons	Yield, tons per hectare
	Comrat District		
2009	4348	13920	3.20
2010	5334	8425	1.58
2011	3579	14468	4.04
2012	3412	10808	3.17
2013	2492	17387	6.98
2014	2587	16844	6.51
2015	2592	18441	7.11
2016	2472	16848	6.82
2017	2399	18826	7.85
2018	2412	22980	9.53
2019	2634	24333	9.24
2020	2644	14247	5.39
2021	2574	20405	7.93
Mean	*3036.8*	*16764*	*5.52*
	Ceadir-Lunga District		
2009	2513	6502	2.59
2010	1585	1607	1.01
2011	934	2762	2.96
2012	953	3290	3.45
2013	920	6171	6.71
2014	777	5169	6.65
2015	1114	5199	4.67
2016	1004	5260	5.24
2017	1053	7835	7.44
2018	1002	9018	9.00
2019	1757	6258	3.56
2020	544	2452	4.51
2021	587	3891	6.63
Mean	*1134.1*	*5031.8*	*4.44*
	Vulcanesti District		
2009	1365	6145	4.50
2010	1323	3883	2.93
2011	1339	7445	5.56
2012	1509	7232	4.79
2013	1429	13157	9.21
2014	1457	10082	6.92
2015	1170	4942	4.22
2016	1467	11469	7.82
2017	1448	12501	8.63
2018	1427	12870	9.02
2019	2231	14256	6.39
2020	1303	5321	4.08
2021	1253	7033	5.61
Mean	*1440.1*	*8948.9*	*6.21*

ATU Gagauzia			
2009	8226	26567	3.23
2010	8242	13915	1.69
2011	5852	24675	4.22
2012	5875	21329	3.63
2013	4841	36715	7.58
2014	4821	32095	6.66
2015	4876	28582	5.86
2016	4943	33577	6.79
2017	4900	39162	7.99
2018	4841	44868	9.27
2019	6622	44847	6.77
2020	4491	21999	4.90
2021	4415	31329	7.10
Mean	*5611.2*	*30743.1*	*5.48*

Source: Data from the Main Directorate of the Agro-Industrial Complex of the ATU Gagauzia

Appendix 3.3.

Calculation of Potential Grape Yield in ATU Gagauzia

The calculation of Potential Grape Yield indicators in the regions of ATU Gagauzia is carried out based on the data from Table A 3.2, covering 13 years.

$\kappa = \sqrt{T}$ (T – Number of years in the analyzed period),

$\kappa = \sqrt{13} = 3.61 \approx 4$,

in this study we use k = 4 out of analyzed 13 years for further calculations. P is the product of the highest yields for "k" years, so we use 4 years with the highest yields.

The Yield Growth Reserve ($\boldsymbol{\Delta_q}$) is found as the difference between the Potential Productivity Level ($\mathbf{q_{pot}}$) and the Actual Yield ($\mathbf{q_a}$) using the formula:

$$\boldsymbol{\Delta_q = q_{pot} - q_a}$$

From the analyzed period for ATU Gagauzia, the highest yields (Table A 3.2.) are as follows: 2013 – 7.58 tons per hectare; 2017 – 7.99 tons per hectare; 2018 – 9.27 tons per hectare; 2021 – 7.10 tons per hectare (t/ha).

$\mathbf{q_{pot}} = \sqrt[4]{7.58 \cdot 7.99 \cdot 9.27 \cdot 7.10}$ = 7.95 t/ha (estimated Potential Productivity Level);

$\boldsymbol{\Delta_q}$ = 7.95 t/ha – 5.48 t/ha = 2.47 t/ha (Yield Growth Reserve).

The highest yields in the Comrat District (Table A 3.2.) are as follows: 2017 – 7.85 t/ha; 2018 – 9.53 t/ha; 2019 – 9.24 t/ha; 2021 – 7.93 t/ha.

$\mathbf{q_{pot}} = \sqrt[4]{7.85 \cdot 9.53 \cdot 9.2. \cdot 7.93}$ = 8.60 t/ha; $\boldsymbol{\Delta_q}$ = 8.60 t/ha – 5.52 t/ha = 3.08 t/ha.

The highest yields in the Ceadir-Lunga District (Table A 3.2.) are as follows: 2013 – 6.71 t/ha; 2014 – 6.65 t/ha; 2017 – 7.44 t/ha; 2018 – 9.00 t/ha.

$\mathbf{q_{pot}} = \sqrt[4]{6.77 \cdot 6.65 \cdot 7.44 \cdot 9.00}$ = 7.39 t/ha; $\mathbf{\Delta_q}$ = 7.39 t/ha – 4.44 t/ha = 2.96 t/ha.

From the analyzed period in the Vulcanesti district, the highest yield indicators (Table A 3.2) are as follows: 2013 – 9.21 t/ha; 2016 – 7.82 t/ha; 2017 – 8.63 t/ha; 2018 – 9.02 t/ha.

$\mathbf{q_{pot}} = \sqrt[4]{9.21 \cdot 7.82 \cdot 8.63 \cdot 9.02}$ = 8.65 t/ha; $\mathbf{\Delta_q}$ = 7.39 t/ha – 4.44 t/ha = 2.96 t/ha.

Table A 3.3. Indicators of Grape Production Stability in Agricultural Enterprises of the ATU Gagauzia (1997-2020).

Indicator Name	Harvested Area, hectare	Gross Harvest, tons	Yield, ton per hectare
on average for 1997-2020			
On Average per Year	9301	34905	3.75
Annual Standard Deviations	4030	10978	2.22
Coefficient of Variation, %	43.3	31.5	5.92
Range of Variation	11996	43441	7.58
on average for 1997-2008			
On Average per Year	12891	38332	2.97
Annual Standard Deviations	2020	10240	0.90
Coefficient of Variation, %	15.7	26.7	3.10
Range of Variation	7629	33082	2.67
on average for 2009-2020			
On Average per Year	5711	31477	5.51
Annual Standard Deviations	1326	11022	2.30
Coefficient of Variation, %	23.2	35.0	4.19
Range of Variation	3422	39754	7.58

Source: Author's calculations

Table A 3.4. Indicators of Grape Cultivation in SC «Tomai-Vinex» SA, 2001-2021.

Year	Area, hectares	Gross Harvest, tons	Yield, tons per hectare
2001	418.0	12289.2	2.94
2002	350.6	10553.1	3.01
2003	381.6	12859.9	3.37
2004	403.1	11649.6	2.89
2005	491.0	15761.1	3.21
2006	351.0	10916.1	3.11
2007	381.0	26670.0	7.00
2008	381.0	28498.8	7.48
2009	143.0	8808.8	6.16
2010	142.0	5112.0	3.60
2011	129.0	7482.0	5.80
2012	143.0	14142.7	9.89
2013	143.0	20391.8	14.26
2014	132.0	17529.6	13.28
2015	132.0	12936.0	9.80
2016	124.0	15264.4	12.31
2017	124.0	21613.2	17.43
2018	144.0	24840.0	17.25
2019	155.0	11315.0	7.30
2020	170.0	8806.0	5.18
2021	170.0	14467.0	8.51
Mean	*238.5*	*14852.7*	*6.23*

Source: Data from the Accounting Department of SC «Tomai-Vinex» SA

Appendix 4

Biological and Technological Features of Grafted Vine Saplings Production in SC "Tomai-Vinex" SA.

Table A 4.1. Basic Quality Indicators of Cuttings, Depending on Their Layout Along the Length of the Stock Cane. SC "Tomai-Vinex" SA, 2004.

Variants	Mass of 100 Cuttings, kg	Content in 100 cuttings	
		Dry matter, kg	Carbohydrates, g
BxR Kober 5BB			
CG	1.58±0.03	0.99±0.02	128.5±1.8
EG 1	1.82±0.04	1.18±0.03	148.3±2.1
EG 2	1.71±0.04	1.11±0.03	157.5±2.2
EG 3	1.64±0.04	0.98±0.02	140.9±2.1
EG 4	1.58±0.03	0.99±0.02	138.4±1.9
EG 5	1.13±0.02	0.70±0.01	81.1±1.7
RxR 101-14			
CG	1.67±0.03	1.08±0.03	140.2±2.0
EG 1	1.96±0.04	1.27±0.04	158.5±2.2
EG 2	1.88±0.04	1.23±0.03	151.8±2.2
EG 3	1.68±0.03	1.09±0.03	133.9±1.9
EG 4	1.52±0.03	0.99±0.02	127.8±1.8
EG 5	1.31±0.02	0.85±0.01	113.1±1.8

Table A 4.2. The Carbohydrate Content in 100 pieces of Rootstock Cuttings, Depending on Their Positioning Along the Length of the Stock Cane, SC «Tomai-Vinex» SA, 2004.

Variants	Carbohydrate Content, %				Total Carbohydrates
	Monosaccharides	Disaccharides	Total Sugars	Starch	
BxR Kober 5BB					
CG	3.70±0.07	2.30±0.03	6.00±0.12	6.98±0.12	12.98±0.22
EG 1	3.13±0.06	2.29±0.03	5.42±0.11	7.15±0.13	12.57±0.22
EG 2	3.60±0.07	3.00±0.04	6.60±0.12	7.59±0.14	14.19±0.23
EG 3	4.06±0.08	3.10±0.04	7.16±0.13	7.22±0.13	14.38±0.23
EG 4	4.08±0.08	2.98±0.04	7.06±0.13	6.92±0.12	13.98±0.22
EG 5	3.92±0.07	1.52±0.02	5.44±0.10	6.15±0.11	11.59±0.21
RxR 101-14					
CG	4.28±0.08	1.78±0.02	6.06±0.13	6.93±0.12	12.99±0.22
EG 1	3.50±0.07	1.60±0.02	5.10±0.10	7.38±0.13	12.48±0.23
EG 2	3.48±0.07	1.72±0.02	5.20±0.11	7.14±0.13	12.34±0.23
EG 3	3.50±0.07	1.84±0.03	5.34±0.11	6.94±0.12	12.28±0.21
EG 4	4.06±0.08	1.96±0.03	6.02±0.12	6.77±0.11	12.79±0.22
EG 5	4.85±0.08	2.04±0.04	6.89±0.13	6.41±0.11	13.30±0.22

Table A 4.3. Scion Budburst of Grafted Grape Cuttings, Depending on their Layout Along the Length of the Stock Cane. End of Stratification. SC «Tomai-Vinex» SA, 2004.

Variants	Number of Grafted Cuttings						
	pcs.				%		
	produced	budburst	non-budburst	defective	budburst	non-budburst	defective
				BxR Kober 5BB			
CG	500	204	294	2	40.8	58.8	0.4
EG 1	470	176	288	6	37.4	61.3	1.3
EG 2	492	220	269	3	44.7	54.7	0.6
EG 3	560	169	387	4	30.2	69.1	0.7
EG 4	406	150	250	6	36.9	61.6	1.5
EG 5	380	127	239	14	33.4	62.9	3.7
				RxR 101-14			
CG	460	102	354	4	22.2	76.9	0.9
EG 1	495	132	360	3	26.7	72.7	0.6
EG 2	462	94	365	3	20.3	79	0.7
EG 3	460	91	364	5	19.8	79.1	1.1
EG 4	432	91	338	3	21.1	78.2	0.7
EG 5	425	96	324	5	22.6	76.2	1.2

Table A 4.4. The Influence of Different Quality of Scion Cuttings and Treatment with Calovit on Budburst Processes. End of Stratification. Clone R5 Cabernet Sauvignon onto BxR Kober 5BB. SC «Tomai-Vinex» SA, 2004.

Variants	Number of Grafted Cuttings						
	pcs.				%		
	produced	budburst	non-budburst	defective	budburst	non-budburst	defective
without tendrils H_2O	550	170	372	8	30.9	67.6	1.5
with tendrils H_2O	550	255	291	4	46.4	52.9	0.7
without tendrils Calovit	550	71	469	10	12.9	85.3	1.8
with tendrils Calovit	550	214	330	6	38.9	60.0	1.1

Survival Rate of Grafted Saplings, Growth, and Development of Young Vines

Table A 5.1. Survival Rates of Grafted Vine Saplings in Permanent Location, Based on Their Quality. First Year After Planting. SC «Tomai-Vinex» SA, 2005.

Variants	Survival Rates, %	
	Cl R5 Cabernet Sauvignon onto BxR Kober 5BB	Cl R5 Cabernet Sauvignon onto RxR 101-14
CG	96.1	96.1
EG 1	97.4	100.0
EG 2	97.4	97.4
EG 3	96.1	97.4
EG 4	86.8	94.7
EG 5	85.5	89.5

Table A 5.2. The Impact of Different Quality Saplings on the Degree of Young Vines Development. Third Year AfterPlanting. SC «Tomai-Vinex» SA, 2007.

Variants	Number of Vines, %		
	Vigorous Vines	Medium Vines	Weak Vines
Cl R5 Cabernet Sauvignon onto BxR Kober 5BB			
CG	34.9	47.6	17.5
EG 1	44.5	38.9	16.6
EG 2	39.0	44.4	16.6
EG 3	37.5	43.8	18.7
EG 4	32.1	36.3	31.6
EG 5	29.3	31	39.7
Cl R5 Cabernet Sauvignon onto RxR 101-14			
CG	37.6	41.6	20.8
EG 1	45.9	36.7	17.4
EG 2	42.3	38.8	18.9
EG 3	38.5	40.2	21.3
EG 4	30.1	35.3	34.6
EG 5	23.5	34.3	42.2

Table A 5.3. The Impact of Grafted Saplings Quality on Formed Degree of Grapevine. Fourth Year of Planting. SC «Tomai-Vinex» SA, 2008.

Variants	Number of Vines, %			
	Cl R5 Cabernet Sauvignon onto BxR Kober 5BB		Cl R5 Cabernet Sauvignon onto RxR 101-14	
	I group	II group	I group	II group
CG	56.2	43.8	55.3	44.7
EG 1	75.6	24.4	69.7	30.3
EG 2	68.3	31.7	62.1	37.9
EG 3	55.9	44.1	57.4	42.6
EG 4	51.7	48.3	52.2	47.8
EG 5	40.8	59.2	41.4	58.6

Table A 5.4. The Impact of Grafted Sapling Quality on the Development of Productivity Elements in Young Vines. Fourth Year of Planting. SC «Tomai-Vinex» SA, 2008.

Variants	No. of Shoots, pcs./vine		Fruiting Shoots, %	No. of Flower Clusters, pcs./vine	Coefficients	
	total	with flower clusters			K_1	K_2
			Cl R5 Cabernet Sauvignon onto BxR Kober 5BB			
CG	31.2	6.0	25.2	80.8	43.2	1.4
EG 1	35.2	9.0	26.2	74.4	42.4	1.2
EG 2	34.8	4.0	30.8	88.5	50.0	1.4
EG 3	36.2	8.4	27.8	76.8	44.6	1.2
EG 4	27.6	6.4	21.2	76.8	36.0	1.3
EG 5	28.6	6.8	21.8	76.2	33.2	1.2
			Cl R5 Cabernet Sauvignon onto RxR 101-14			
CG	34.0	7.2	26.8	78.7	40.9	1.2
EG 1	35.8	8.2	27.6	77.1	43.2	1.2
EG 2	38.6	10.8	27.8	72.0	43.2	1.1
EG 3	34.4	6.4	28.0	81.4	45.6	1.3
EG 4	33.8	5.4	28.4	84.0	39.4	1.2
EG 5	27.4	5.4	22.0	80.3	33.2	1.2

K_1 – *fruiting coefficient*
K_2 – *fruitfulness coefficient*

Growth and Productivity of Fruiting Vineyards

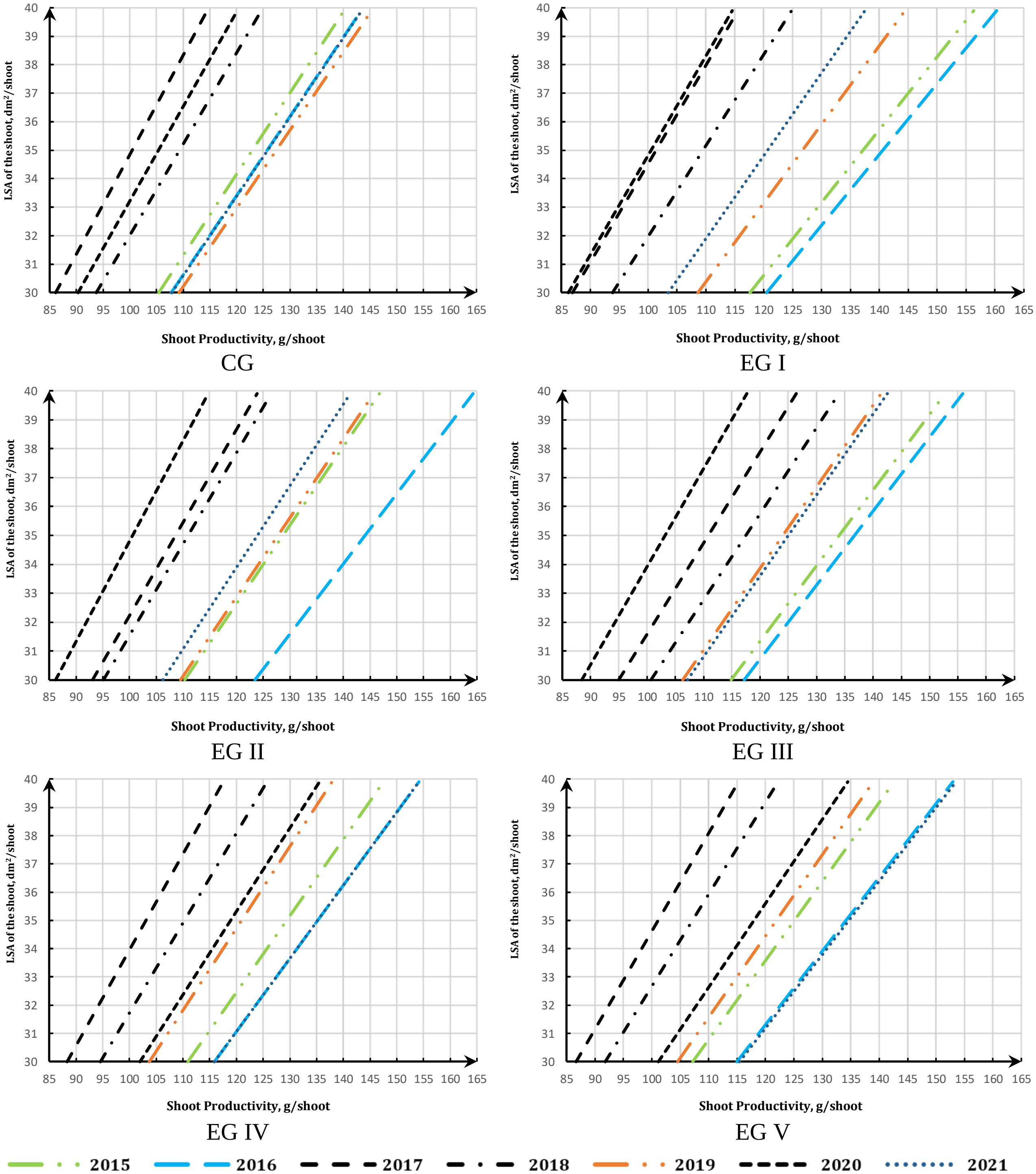


Figure A 6.1. Relationship Between Shoot Leaf Surface Area and its Productivity. Clone R5 Cabernet Sauvignon onto BxR Kober 5BB. SC "Tomai-Vinex" SA.

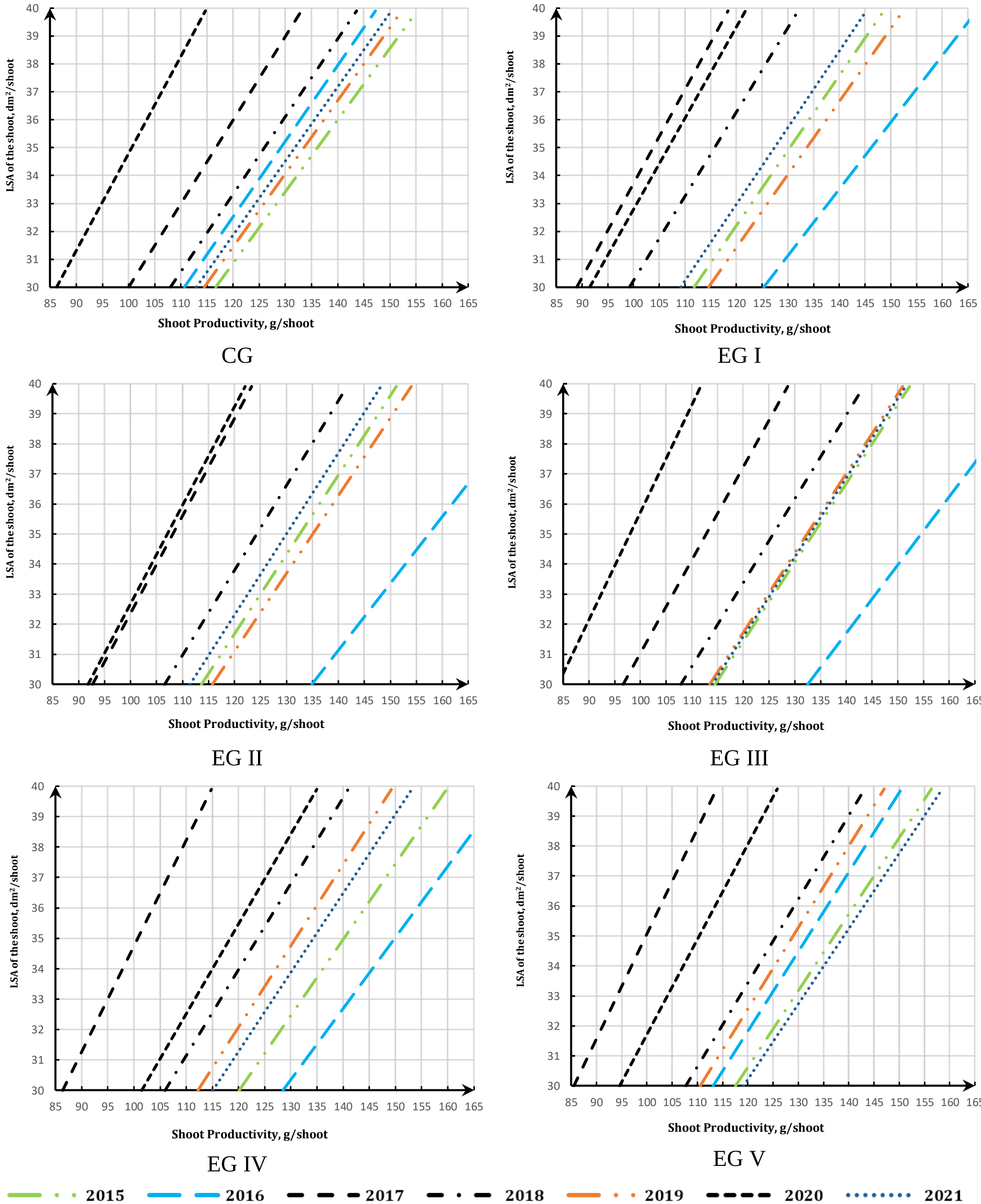


Figure A 6.2. Relationship Between Shoot Leaf Surface Area and its Productivity. Clone R5 Cabernet Sauvignon onto RxR 101-14. SC "Tomai-Vinex" SA.

Appendix 7

Reconstruction of Vineyards in SC «Tomai-Vinex» SA

Table A 7.1. Changes in Leaf Growth Parameters in the First Year of Reconstruction. SC «Tomai-Vinex» SA, 2013.

Clone	Recon.	Morphological Leaf Parameters, cm		
		Length, cm	Width, cm	Thickness, µm
		Fruit set		
Cl R5	before	8.35±0.21	11.25±0.33	139.5±3.37
	after	9.31±0.24	12.44±0.22	142.2±2.47
Cl 348	before	8.96±0.19	12.35±0.31	139.5±2.72
	after	10.50±0.25	13.9±0.27	150.5±2.23
		Maturity		
Cl R5	before	9.15±0.18	12.6±0.28	150.3±3.05
	after	9.79±0.18	13.6±0.27	153.8±2.09
Cl 348	before	9.72±0.21	12.4±0.24	140.0±1.71
	after	12.8±0.25	17.0±0.31	152.0±1.91

Table A 7.2. Monitoring the Shoot Productivity of Grapevine Clones. SC «Tomai-Vinex» SA.

Years of Research	Shoot Productivity		
	Cl R5	Cl 348	Mean
2015	124.2±3.5 e	178.5±4.4 bc	151.3±6.8 B
2016	154.5±3.2 d	222.0±2.6 a	188.2±8.0 A
2017	160.8±3.4 cd	230.7±4.6 a	195.7±8.5 A
2018	154.4±2.4 d	222.2±4.2 a	188.3±8.1 A
2019	120.6±3.3 ef	173.1±2.0 b	146.9±6.3 B
2020	68.7±2.5 h	98.7±2.2 g	83.7±3.8 D
2021	106.5±3.4 fg	153.1±2.9 d	129.8±5.8 C
Mean	127.1±3.8 B	182.6±5.4 A	154.8±4.1
ANOVA			
F_{Clone}	1105.0***		
F_{Year}	336.3***		
$F_{Clone*Year}$	9.6***		

Appendix 8

Acts of Implementation

SC «Tomai-Vinex» SA
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ACT OF IMPLEMENTATION

of Scientific Research Findings on the Title: Development and Implementation of Modern Grape Production Technologies in the Agro-Ecological Conditions of the ATU Gagauzia

Title of the Implemented Proposal: Utilization of Different Quality of the Rootstock Material for Grapevine Grafting

Implementation Site: Mother rootstock vineyard, nursery, SC «Tomai-Vinex» SA, ATU Gagauzia, Ceadir-Lunga district, Tomai village, 2004-2005.

The Implemented Proposal: Utilization of Rootstock Cuttings of BxR Kober 5BB and RxR 101-14 Varieties, from the First Two Meters Layout Along the Stock Cane, for Grafting.

The Practical Significance and Effectiveness of Implementation.

Increase in the output of grafted grape saplings by 8.9%. Revenue from grafted sapling production by 97,600 lei.

Chief Executive Officer
SC «Tomai-Vinex» SA — Constantin SIBOV

SC «Tomai-Vinex» SA
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ACT OF IMPLEMENTATION

of Scientific Research Findings on the Title: Development and Implementation of Modern Grape Production Technologies in the Agro-Ecological Conditions of the ATU Gagauzia

Title of the Implemented Proposal: Utilization of Different Quality of the Scion Material for Grapevine Grafting

Implementation Site: Nursery, SC «Tomai-Vinex» SA, ATU Gagauzia, Ceadir-Lunga district, Tomai village, 2005.

The Implemented Proposal: Utilization of Scion Cuttings from the R5 Clone of Cabernet Sauvignon Variety with Tendrils for Grafting, followed by Treatment of the Apical Part of the Grafted Cuttings with a Solution of Calovit.

The Practical Significance and Effectiveness of Implementation.

Increase in the output of grafted grape saplings by 9.7%. Revenue from grafted sapling production by 84,500 lei.

Chief Executive Officer
SC «Tomai-Vinex» SA — Constantin SIBOV

Figure. A 8.1. Acts of Implementation of Scientfic Research Results in the Production of Grafted Grapevine Saplings.

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ACT OF IMPLEMENTATION

of Scientific Research Findings on the Title: Development and Implementation of Modern Grape Production Technologies in the Agro-Ecological Conditions of the ATU Gagauzia

Title of the Implemented Proposal: Planting Grafted Vine Saplings obtained from Different Quality Rootstock Material in Permanent Location

Implementation Site. Grapevine plantations clone R5 of Cabernet Sauvignon, SC «Tomai-Vinex» SA, ATU Gagauzia, Ceadir-Lunga district, Tomai village, 2005-2009.

The Implemented Proposal. Utilization for planting grapevine plantations of grafted grapevine saplings of the R5 clone Cabernet Sauvignon variety. Grafting was performed onto rootstocks of BxR Kober 5BB and RxR 101-14 varieties. Saplings were grown using rootstock cuttings from the first two meters from the base of the rootstock cane.

The Practical Significance and Effectiveness of Implementation. The use of strong grafted saplings leads to the development of vines characterized by vigorous growth and the formation of the vine shape. The onset of the fruiting period in the vines is accelerated. By the fourth year after planting, there is an increase in yield by 11.2%.

Chief Executive Officer
SC «Tomai-Vinex» SA Constantin SIBOV

Figure. A 8.2. Act of Implementation of Scientific Research Results in the Planting Grafted Vine Saplings Obtained from Different Quality Rootstock Material in Permanent Location

SC «Tomai-Vinex» SA

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ACT OF IMPLEMENTATION

of Scientific Research Findings on the Title: Development and Implementation of Modern Grape Production Technologies in the Agro-Ecological Conditions of the ATU Gagauzia

Title of the Implemented Proposal: Planting Grafted Vine Saplings obtained from Different Quality Scion Material in Permanent Location

Implementation Site. Grapevine plantations clone R5 of Cabernet Sauvignon, SC «Tomai-Vinex» SA, ATU Gagauzia, Ceadir-Lunga district, Tomai village, 2005-2009.

The Implemented Proposal. Utilization for planting grapevine plantations of grafted grapevine saplings of the R5 clone Cabernet Sauvignon onto BxR Kober 5BB. Grape saplings were obtained by grafting scion cuttings with Tendrils, followed by Treatment of the Apical Part of the Grafted Cuttings with a Solution of Calovit.

The Practical Significance and Effectiveness of Implementation. Using experimental saplings for planting vineyards contributes to the development of vigorous vines. The onset of the fruiting period in the vines is accelerated. By the fourth year after planting, there is an increase in yield by 15.0 centners per hectare.

Chief Executive Officer
SC «Tomai-Vinex» SA　　　　　　Constantin SIBOV

Figure. A 8.3. Act of Implementation of Scientific Research Results in the Planting Grafted Vine Saplings Obtained from Different Quality Scion Material in Permanent Location

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ACT OF IMPLEMENTATION

of Scientific Research Findings on the Title: Development and Implementation of Modern Grape Production Technologies in the Agro-Ecological Conditions of the ATU Gagauzia

Title of the Implemented Proposal: Reconstruction of Existing Grapevine Clones Plantations.

Implementation Site: Grapevine plantations clone R5 of Cabernet Sauvignon and clone 348 of Merlot, SC «Tomai-Vinex» SA, ATU Gagauzia, Ceadir-Lunga district, Tomai village, 2013.

The Implemented Proposal: Establishment of a new trellis and support system with 4 wire tiers and a Vertical Shoot Position (VSP). The first wire tier is at trunk height, the second at 20-25 cm above the first, the third at 35-40 cm above the second, and the fourth at 35-40 cm above the third. The trunk of each vine is straightened and brought into a strictly vertical position. For this purpose, one or two support posts are installed near each trunk as needed. New intermediate posts are set at a height of 1.8m, while the anchor posts are set at a height of 2m at a 45-degree angle opposite the row direction and secured with anchor tie-downs. All wire tiers are tensioned using the Gripple device system, ensuring the structural strength of the trellis and enabling it to withstand the load of the total mass of green shoots and clusters.

The Practical Significance and Effectiveness of Implementation. The photosynthetic activity of plants has improved, linked to increased values of the Leaf Area Index, photosynthetic potential of the Leaf Surface, and photosynthetic active radiation use efficiency, directly associated with the increased yield of vines and the quality of the produced grapes. The economic effect results in an increase in the obtained production (grapes) by 30.38 tons from the experimental plot.

Chief Executive Officer
SC «Tomai-Vinex» SA Constantin SIBOV

Figure. A 8.4. Act of Implementation of Scientific Research Results in the Reconstruction of Existing Grapevine Clone Vineyards

SC «Tomai-Vinex» SA

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ACT OF IMPLEMENTATION

of Scientific Research Findings on the Title: Development and Implementation of Modern Grape Production Technologies in the Agro-Ecological Conditions of the ATU Gagauzia

Title of the Implemented Proposal: Modernization of Grapevine Clones Cultivation Technology.

Implementation Site: Grapevine plantations clone R5 of Cabernet Sauvignon and clone 348 of Merlot, SC «Tomai-Vinex» SA, ATU Gagauzia, Ceadir-Lunga district, Tomai village, 2014.

The Implemented Proposal: Implementation of mechanized vineyard management system using modern equipment for performing the following labor-intensive processes: Pre-pruning of Grape Vines; Shredding Grape Canes; Removal of Suckers and Lateral Shoots; Multiple Passes of Shoot Thinning; Defoliation of Leaf Canopy in the Fruit Zone; Inter-row and Intra-row Cultivation of Vineyards; Combined Deep Plowing with Fertilizer Application.

The Practical Significance and Effectiveness of Implementation. Labour costs for vineyard and soil maintenance have been significantly reduced, leading to a decrease in the production cost by 250,000 lei.

Economic impact after technology implementation: increased grape production by 60.80 tons. The average yield has increased to 139 centners per hectare from the experimental plot.

Chief Executive Officer
SC «Tomai-Vinex» SA Constantin SIBOV

Figure. A 8.5. Act of Implementation of Scientific Research Results in the Modernization of Grapevine Clones Cultivation Technology

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Certificate of Confirmation of Provided Data

Economic indicators of grape production are a key aspect for understanding the efficiency and sustainability of the grape growing and winemaking business. This document confirms that the economic indicators of grape production at SC "Tomai-Vinex" SA have been provided to the researcher, Dr. Assoc. Prof. Serghei CARA, for further analysis and calculations. They are reliable and correspond to the real data of our production.

The provided indicators include:

- Yield of grape plantations by varieties;
- Price of realized products;
- Revenue from product sales;
- Costs of production and realization.

Profitability and level of profitability were calculated jointly with representatives of the accounting department of SC "Tomai-Vinex" SA.

The joint calculations of the researcher, Dr. Assoc. Prof. Serghei CARA and the accounting department of the economic indicators of grape production by clones, including the studied experimental variants, contributed to a deeper understanding of the financial aspects of grape production at the SC "Tomai-Vinex" SA enterprise. This partnership has allowed us to develop well-founded decisions aimed at improving the efficiency and competitiveness of the enterprise.

Chief Accountant
SC "Tomai-Vinex" SA **Liudmila CEBANOVA**

Figure. A 8.6. Certificate of Confirmation of the Provided Data on the Economic Indicators of Grape Production at SC «Tomai-Vinex» SA

APROB:
Director general I.Ş.P.H.T.A
_________ Constantin Dadu
„29" noiembrie 2019

Proces-verbal

Nr 4 din 29.11.2019 a comisiei de degustare a Institutului Ştiinţifico-Practic de Horticultură şi Tehnologii Alimentare, laboratorul „Biotehnologii şi Microbiologia Vinului"

mun. Chişinău 29.11.2019

Preşedintele comisiei: **Taran Nicolae** – Dr. hab., profesor universitar, Director adjunct ştiinţa;

Membrii comisiei: **Soldatenco Eugenia** – Dr. hab., cercetător ştiinţific principal, lab. „Biotehnologii şi Microbiologia Vinului",

Soldatenco Olga – Dr., conf., şef laborator „Biotehnologii şi Microbiologia Vinului

Urîtu Dionisie – Dr., şef laborator " Standardizare şi Expertiză"

Sandu Vasile - cercetător ştiinţific, lab. „Biotehnologii şi Microbiologia Vinului",

Glavan Pavel- cercetător ştiinţific, lab. „Biotehnologii şi Microbiologia Vinului",

Grosu Olga- cercetător ştiinţific, lab. "Oenologia şi VDO",

Scopul: 1. Aprecierea comparativă a portaltoiului asupra calităţii vinurilor roşii seci.

1. Merlot cl.348 (Berlandieri x Riparia Kober 5BB) - culoarea rubiniu-închisă, limpede, aroma curată, de fructe roşii, gust moale, curat. Nota -7.90 puncte
2. Cabernet – Sauvignon R5 (Berlandieri x Riparia Kober 5BB) - culoarea roşu-închis, aroma cu nuanţe de ciorchini, extractiv, armonios. Nota-7.80 puncte.
3. Cabernet – Sauvignon R5 (Riparia x Rupestris 101-14) - culoarea roşu-închis, aroma cu nuanţe de fructe roşii, gust moale, plin, echilibrat. Nota-8.00 puncte.

Concluzii:

1. În urma aprecierii organoleptice toate vinurile roşii seci s-au evidenţiat cu o aromă complexă, de fructe roşii, gust armonios, tipic şi au obţinut nota medie de 7,9 puncte.

2. În urma aprecierii organoleptice a vinurilor roşii seci, mostra Cabernet – Sauvignon R5 (Riparia x Rupestris 101-14)- s-a evidenţiat cu o aromă curată, cu nuanţe de fructe roşii, gust moale, plin, echilibrat şi a obţinut cea mai înaltă nota organoleptică de 8,00 puncte.

Preşedintele comisiei: Dr. hab., prof. univ., Taran Nicolae

Secretar: Dr., conf., Soldatenco Olga

Figure. A 8.7. Minutes of the Tasting Commission Meeting. Wine Tasting from Grape Clones from Experimental Plots

Appendix 9

Project Certificates

Agenția pentru Inovare și Transfer Tehnologic
a Academiei de Științe a Moldovei

CERTIFICAT

de înregistrare a proiectului de transfer tehnologic

13.824.14.184T

"Tehnologia de optimizare a producției de struguri în SC «Tomai-Vinex» SA."

Conducătorul proiectului: **dr. Serghei CARA**
Instituția executoare: **Rezident al Incubatorului de Inovare „INOCENTER", Tomai-Vinex SA**
Numărul și data înregistrări în registrul de stat: **Nr. 184T din 30.05.2013**

Director General al AITT,
Roman CHIRCA

Figure. A 9.1. Certificate of Project No. 184T "Optimization Technology for Grape Production at SC «Tomai-Vinex» SA, 2013.

AGENȚIA PENTRU INOVARE ȘI TRANSFER TEHNOLOGIC A ACADEMIEI DE ȘTIINȚE A MOLDOVEI

CERTIFICAT

Nr. 196T

În temeiul Hotărârii Consiliului Suprem pentru Știință și Dezvoltare Tehnologică al AȘM nr. 215 din 25.09.2014
se confirmă înregistrarea în registrul de stat a proiectului de transfer tehnologic

" Reconstruirea și modernizarea producerii soiurilor-clone pentru vin, vița de vie în condițiile SC „Tomai-Vinex" SA",

Realizat de compania SC "Tomai-Vinex" S.A.,
Rezident al Incubatorului de Inovare "InnoCenter"

Conducatorul proiectului: **dr. Serghei CARA**
Cifrul proiectului – **14.824.05.196T**

Data eliberării: **26 septembrie, 2014**

Director general al AITT
Roman CHIRCA

Chișinău 2014, Republica Moldova

Figure. A 9.2. Certificate of Project No. 196T "Reconstruction and Modernization of the Production of Grapevine Clone Varieties the conditions of SC «Tomai-Vinex» SA, 2014.

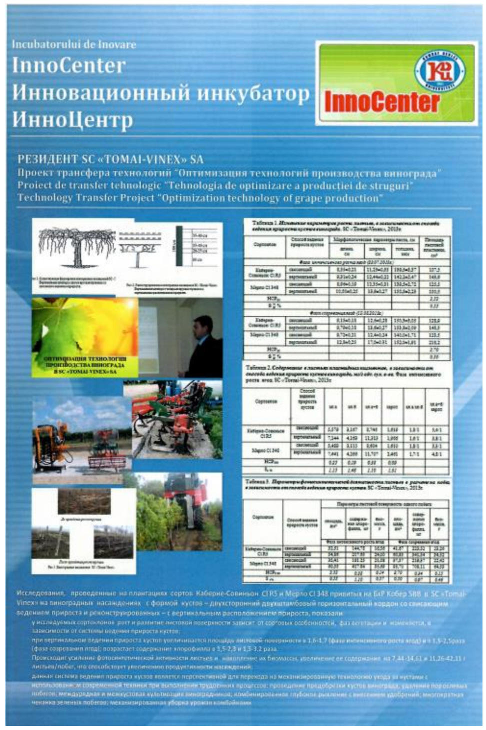

Figure. A 9.3. Project "Optimization Technology for Grape Production at SC «Tomai-Vinex» SA, 2013.

Figure. A 9.4. Project "Implementation of Innovative Technology for Energy Resource Saving in the Production of Wines with Geographical Indication and Protected Designation of Origin", "Tomai-Vinex" SA, 2017.

Figure. A 9.5. Diploma received at the International Exhibition Invent-Invest 2017. Project "Implementation of Innovative Technology for Energy Resource Saving in the Production of Wines with Geographical Indication and Protected Designation of Origin", Romania, 2017.

SC «Tomai-Vinex» SA
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ADEVERINȚĂ

mun.Comrat **20 ianuarie 2014**

Prin prezenta se adeverește că ***CARA Serghei***, doctor în agricultură, lector superior universitar al catedrei de Fitotehnie, Universității de Stat din Comrat, a activat în calitate de *director științific proiectului* **Nr. 184T «Tehnologia de optimizare a producției de struguri în SC „Tomai-Vinex" SA», 2013.** (Proiect – transfer tehnologic).

Conducătorul Organizației
SC „Tomai-Vinex" SA SIBOV C.

Figure. A 9.6. Confirmation of project management No. 184T.

SC «Tomai-Vinex» SA
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ADEVERINȚĂ

mun.Comrat **12 ianuarie 2015**

Prin prezenta se adeverește că ***CARA Serghei***, doctor în agricultură, conferențiar universitar interimar al catedrei de Fitotehnie, Universității de Stat din Comrat, a activat în calitate de *director științific proiectului* **Nr. 196T «Reconstruirea și modernizarea producerii soiurilor-clone pentru vin de vița de vie în condițiile SC „Tomai-Vinex" SA»,2014.** (Proiect – transfer tehnologic).

Conducătorul Organizației
SC „Tomai-Vinex" SA SIBOV C.

Figure. A 9.7. Confirmation of project management No. 196T.

Appendix 10

Illustrations of the Thesis

Figure. A 10.1. Grapevine Nursery. Planting Grafted Cuttings, Care, and Sapling Uprooting. Виноградная школка. SC «Tomai-Vinex» SA, 2004г.

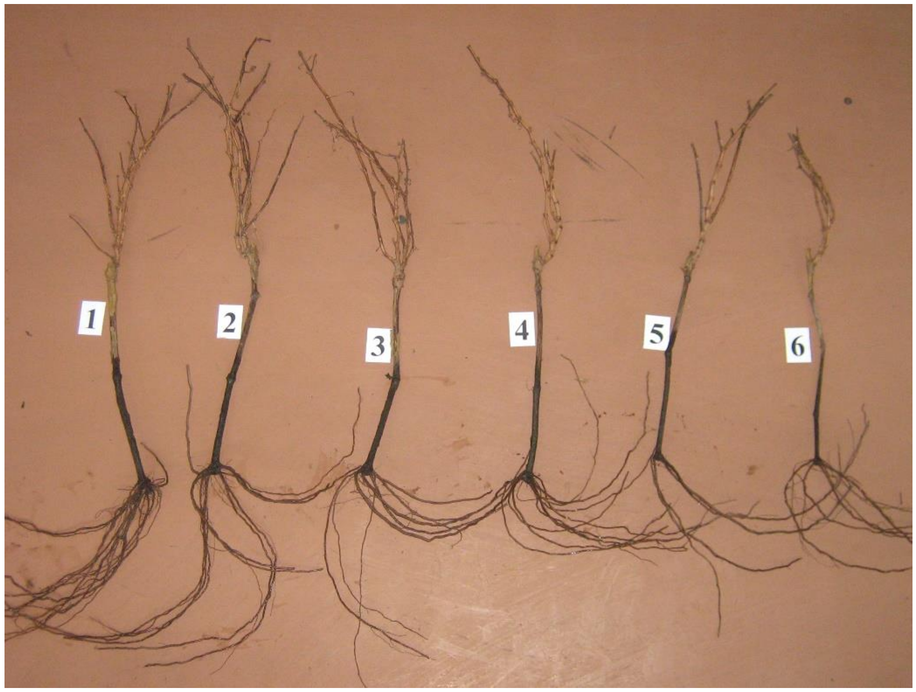

Figure. A 10.2. Grafted grape saplings Cl R5 Cabernet Sauvignon onto BxR Kober 5BB, from cuttings along the length of the rootstock cane. Experimental variants: 1 – CG; 2 – EG 1; 3 – EG 2; 4 – EG 3; 5 – EG 4; 6 – EG 5. SC «Tomai-Vinex» SA, 2004.

Figure. A 10.3. Grafted grape saplings Cl R5 Cabernet Sauvignon onto BxR Kober 5BB. Experimental variants: 1 – ***scion without tendrils H_2O*****; 2 –** ***scion with tendrils H_2O*****; 3 –** ***scion without tendrils Calovit*****; 4 –** ***scion with tendrils Calovit*****. SC «Tomai-Vinex» SA, 2004.**

Figure. A 10.4. Preparation and Planting of Grape Saplings. SC «Tomai-Vinex» SA, 2005.

Spring. Second Year After Planting, 2006.

Spring. Third Year After Planting, 2007.

Figure. A 10.5. Training and Pruning of Young Vines. SC «Tomai-Vinex» SA.

In Spring After Pruning

Summer Green Operations

Figure. A 10.6. Training of Young Vines. Third Year After Planting. SC «Tomai-Vinex» SA, 2007г.

Figure. A 10.7. Reconstruction of Vineyards. Autumn.
SC «Tomai-Vinex» SA, 2013.

Figure. A 10.8. Vineyards after Reconstruction. Spring.
SC «Tomai-Vinex» SA, 2014.

**Figure. A 10.9. Growth and Development of Investigated Grapevine Clones.
SC «Tomai-Vinex» SA, 2018.**

Before Pruning

After Pruning

Figure. A 10.10. Pruning of Fruiting Vines in the Experimental Plot. SC «Tomai-Vinex» SA, 2019.

Figure. A 10.11. Conducting Agrobiological Records on Fruiting Grapevine Plantations. SC «Tomai-Vinex» SA, 2019.

Figure. A 10.12. Determining the Dynamics of Leaf Surface Area Growth in Investigated Vineyards. SC «Tomai-Vinex» SA, 2019.

Figure. A 10.13. Harvesting Grapevine Plantations in Experimental Plots. SC «Tomai-Vinex» SA, 2021 г.

Figure. A 10.14. Vines After Harvest. Experimental Plot. SC «Tomai-Vinex» SA, 2021.

Figure. A 10.15. Grape Clusters. Cl R5 Cabernet Sauvignon. Experimental Plot. SC «Tomai-Vinex» SA.
1 - After Reconstruction; 2 - Before Reconstruction.

Figure. A 10.16. Vines, Clusters, and Leaves of Cl R5 Cabernet Sauvignon. Experimental Plot. SC «Tomai-Vinex» SA, 2021.

Figure. A 10.17. Vines, Clusters, and Leaves of Cl 348 Merlot. Experimental Plot. SC «Tomai-Vinex» SA, 2021.

Figure. A 10.18. Conducting Laboratory Analysis at the Agrolaboratory of Comrat State University, 2021.

Appendix 11.

ANOVA Analysis Results

Experiment Scheme I (Cl R5 Cabernet Sauvignon onto BxR Kober 5BB).

General Linear Model: N of Shoots versus Group; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Group	5	5396,7	1079,35	2633,23	0,000
Year	6	6479,7	1079,94	2634,69	0,000
Group*Year	30	774,4	25,81	62,97	0,000
Error	378	154,9	0,41		
Total	419	12805,7			

General Linear Model: Shoot Length versus Group; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Group	5	35595	7119,1	187,58	0,000
Year	6	471349	78558,2	2069,93	0,000
Group*Year	30	2001	66,7	1,76	0,009
Error	378	14346	38,0		
Total	419	523291			

General Linear Model: Growth m.vine versus Group; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Group	5	23289	4657,8	8911,11	0,000
Year	6	112075	18679,2	35736,04	0,000
Group*Year	30	2173	72,4	138,60	0,000
Error	378	198	0,5		
Total	419	137735			

General Linear Model: Growth, th.m/ha versus Group; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Option	5	138154	27631	8539,47	0,000
Year	6	654178	109030	33696,24	0,000
Option*Year	30	12283	409	126,54	0,000
Error	378	1223	3		
Total	419	805839			

General Linear Model: Volume, cm3/shoot versus Option; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Year	6	324356	54059,3	4993,27	0,000
Option	5	18219	3643,8	336,56	0,000
Option*Year	30	3861	128,7	11,89	0,000
Error	378	4092	10,8		
Total	419	350528			

General Linear Model: Growth dm3.vine versus Group; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Group	5	88,053	17,611	1856,10	0,000
Year	6	655,882	109,314	11521,33	0,000
Group*Year	30	18,993	0,633	66,73	0,000
Error	378	3,586	0,009		
Total	419	766,514			

General Linear Model: Volume, m3/ha versus Option; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Year	6	3854,53	642,421	11552,34	0,000
Option	5	517,61	103,522	1861,59	0,000
Option*Year	30	111,75	3,725	66,98	0,000
Error	378	21,02	0,056		
Total	419	4504,90			

General Linear Model: N L/Shoot versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	1551,8	310,354	161,52	0,000
Year	6	3496,0	582,660	303,24	0,000
Options*Year	30	102,7	3,425	1,78	0,008
Error	378	726,3	1,921		
Total	419	5876,8			

General Linear Model: cm2/leaf versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	89	17,9	0,56	0,732
Year	6	171816	28636,1	894,57	0,000
Options*Year	30	36	1,2	0,04	1,000
Error	378	12100	32,0		
Total	419	184042			

General Linear Model: dm2/shoot versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	2562,1	512,41	256,98	0,000
Year	6	31663,9	5277,32	2646,62	0,000
Options*Year	30	309,9	10,33	5,18	0,000
Error	378	753,7	1,99		
Total	419	35289,6			

General Linear Model: m2/vine versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	1796,1	359,22	392,01	0,000
Year	6	8117,5	1352,92	1476,41	0,000
Options*Year	30	180,7	6,02	6,57	0,000
Error	378	346,4	0,92		
Total	419	10440,7			

General Linear Model: th.m2/ha versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	10531,5	2106,31	1097,13	0,000
Year	6	47551,4	7925,24	4128,11	0,000
Options*Year	30	1058,5	35,28	18,38	0,000
Error	378	725,7	1,92		
Total	419	59867,1			

General Linear Model: LAI versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	105,83	21,1663	393,01	0,000
Year	6	476,43	79,4048	1474,38	0,000
Variants*Year	30	10,49	0,3497	6,49	0,000
Error	378	20,36	0,0539		
Total	419	613,11			

General Linear Model: N of Clusters versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	6327,2	1265,43	103,29	0,000
Year	6	8204,6	1367,43	111,61	0,000
Variants*Year	30	744,7	24,82	2,03	0,001
Error	377	4618,8	12,25		
Total	418	19892,1			

General Linear Model: Weight of Clusters versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	28156	5631,1	152,04	0,000
Year	6	323691	53948,5	1456,58	0,000
Variants*Year	30	6108	203,6	5,50	0,000
Error	377	13963	37,0		
Total	418	371992			

General Linear Model: Yield, vine versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	231,18	46,236	576,89	0,000
Year	6	925,96	154,327	1925,55	0,000
Variants*Year	30	35,96	1,199	14,96	0,000
Error	377	30,22	0,080		
Total	418	1223,63			

General Linear Model: Yield, ha versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	135713	27142,6	598,84	0,000
Year	6	543604	90600,7	1998,92	0,000
Variants*Year	30	21176	705,9	15,57	0,000
Error	377	17087	45,3		
Total	418	717766			

General Linear Model: Sugar versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	9906	1981,2	63,43	0,000
Year	6	192833	32138,9	1028,95	0,000
Variants*Year	30	4044	134,8	4,32	0,000
Error	377	11775	31,2		
Total	418	218448			

General Linear Model: Titr.Acid versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	7,081	1,4163	40,95	0,000
Year	6	477,806	79,6344	2302,36	0,000
Variants*Year	30	2,346	0,0782	2,26	0,000
Error	377	13,040	0,0346		
Total	418	500,827			

General Linear Model: SP versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	34931	6986,1	126,25	0,000
Year	6	373646	62274,3	1125,42	0,000
Variants*Year	30	11612	387,1	7,00	0,000
Error	378	20916	55,3		
Total	419	441105			

Experiment Scheme I (Cl R5 Cabernet Sauvignon onto RxR 101-14)

General Linear Model: N of Shoots versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	3383,6	676,73	1308,86	0,000
Year	6	8133,4	1355,57	2621,81	0,000
Options*Year	30	255,4	8,51	16,46	0,000
Error	378	195,4	0,52		
Total	419	11967,9			

General Linear Model: Shoot Length versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	33968	6793,5	169,81	0,000
Year	6	378293	63048,9	1576,01	0,000
Options*Year	30	1989	66,3	1,66	0,018
Error	378	15122	40,0		
Total	419	429372			

General Linear Model: Growth m.vine versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	16854	3370,7	4905,45	0,000
Year	6	86764	14460,6	21044,60	0,000
Options*Year	30	1507	50,2	73,09	0,000
Error	378	260	0,7		
Total	419	105384			

General Linear Model: Volume, cm3/shoot versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	14718	2943,5	275,70	0,000
Year	6	251975	41995,8	3933,52	0,000
Options*Year	30	2645	88,2	8,26	0,000
Error	378	4036	10,7		
Total	419	273373			

General Linear Model: Volume, dm3.vine versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	59,497	11,8993	1953,45	0,000
Year	6	465,013	77,5022	12723,10	0,000
Options*Year	30	11,476	0,3825	62,80	0,000
Error	378	2,303	0,0061		
Total	419	538,288			

General Linear Model: Volume, m3/ha versus Options; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Options	5	349,63	69,925	2082,36	0,000
Year	6	2728,48	454,747	13542,30	0,000
Options*Year	30	66,51	2,217	66,02	0,000
Error	378	12,69	0,034		
Total	419	3157,31			

General Linear Model: N L/Shoot versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	1561,65	312,330	130,41	0,000
Year	6	2690,27	448,378	187,22	0,000
Variants*Year	30	71,02	2,367	0,99	0,487
Error	378	905,30	2,395		
Total	419	5228,23			

General Linear Model: cm2/leaf versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	66	13,3	0,13	0,987
Year	6	150756	25125,9	236,93	0,000
Variants*Year	30	36	1,2	0,01	1,000
Error	378	40086	106,0		
Total	419	190944			

General Linear Model: dm2/shoot versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	2372,1	474,42	167,32	0,000
Year	6	23163,7	3860,61	1361,60	0,000
Variants*Year	30	205,8	6,86	2,42	0,000
Error	378	1071,8	2,84		
Total	419	26813,3			

General Linear Model: m2/vine versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	1214,2	242,850	351,20	0,000
Year	6	5855,0	975,830	1411,22	0,000
Variants*Year	30	116,0	3,867	5,59	0,000
Error	378	261,4	0,691		
Total	419	7446,6			

General Linear Model: th.m2/ha versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	7101,3	1420,26	612,38	0,000
Year	6	34443,2	5740,53	2475,16	0,000
Variants*Year	30	678,8	22,63	9,76	0,000
Error	378	876,7	2,32		
Total	419	43100,0			

General Linear Model: LAI versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	71,136	14,2273	347,10	0,000
Year	6	344,024	57,3373	1398,85	0,000
Variants*Year	30	6,814	0,2271	5,54	0,000
Error	378	15,494	0,0410		
Total	419	437,468			

General Linear Model: N of Clusters versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	4522,0	904,40	432,20	0,000

Year	6	11876,7	1979,46	945,96	0,000
Variants*Year	30	421,5	14,05	6,71	0,000
Error	378	791,0	2,09		
Total	419	17611,2			

General Linear Model: Weight of Clusters versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	25064	5012,8	123,93	0,000
Year	6	269349	44891,5	1109,86	0,000
Variants*Year	30	8905	296,8	7,34	0,000
Error	378	15289	40,4		
Total	419	318607			

General Linear Model: Yield, vine versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	161,66	32,333	350,25	0,000
Year	6	767,93	127,988	1386,46	0,000
Variants*Year	30	26,78	0,893	9,67	0,000
Error	378	34,89	0,092		
Total	419	991,27			

General Linear Model: Yield, ha versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	94929	18985,9	358,20	0,000
Year	6	451346	75224,4	1419,22	0,000
Variants*Year	30	15802	526,7	9,94	0,000
Error	378	20035	53,0		
Total	419	582113			

General Linear Model: Sugar versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	8863	1772,6	53,53	0,000
Year	6	131960	21993,3	664,15	0,000
Variants*Year	30	3055	101,8	3,07	0,000
Error	378	12517	33,1		
Total	419	156395			

General Linear Model: Titr.Acid versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	5	9,410	1,8821	44,75	0,000
Year	6	587,651	97,9419	2328,67	0,000
Variants*Year	30	3,300	0,1100	2,62	0,000
Error	378	15,898	0,0421		
Total	419	616,260			

Experiment Scheme II

General Linear Model: No Shoots versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	1225,15	408,385	554,49	0,000
Year	6	3184,79	530,799	720,70	0,000
Variants*Year	18	62,12	3,451	4,69	0,000
Error	252	185,60	0,737		
Total	279	4657,67			

General Linear Model: Shoot Length versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	30204	10067,9	227,71	0,000
Year	6	314439	52406,6	1185,29	0,000
Variants*Year	18	4311	239,5	5,42	0,000
Error	252	11142	44,2		
Total	279	360096			

General Linear Model: m/vine versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	11643	3881,0	476,07	0,000
Year	6	64245	10707,5	1313,44	0,000
Variants*Year	18	1604	89,1	10,93	0,000
Error	252	2054	8,2		
Total	279	79546			

General Linear Model: th.m.hec versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	54811	18270,5	181,79	0,000
Year	6	386059	64343,1	640,21	0,000
Variants*Year	18	8677	482,1	4,80	0,000
Error	252	25327	100,5		
Total	279	474874			

General Linear Model: cm3/shoot versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	13608	4535,9	363,39	0,000
Year	6	231750	38625,0	3094,39	0,000
Variants*Year	18	3787	210,4	16,86	0,000
Error	252	3146	12,5		
Total	279	252290			

General Linear Model: dm3.vine versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	44,623	14,8742	639,91	0,000
Year	6	405,428	67,5713	2907,03	0,000
Variants*Year	18	13,192	0,7329	31,53	0,000
Error	252	5,858	0,0232		
Total	279	469,100			

General Linear Model: m?.hec. versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	264,79	88,264	671,10	0,000
Year	6	2383,44	397,239	3020,36	0,000
Variants*Year	18	77,83	4,324	32,88	0,000
Error	252	33,14	0,132		
Total	279	2759,20			

General Linear Model: N of Leaves versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	1321,4	440,470	623,52	0,000
Year	6	2377,4	396,231	560,89	0,000
Variants*Year	18	162,2	9,012	12,76	0,000
Error	252	178,0	0,706		
Total	279	4039,0			

General Linear Model: cm2.leaf versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	62	20,8	0,62	0,605
Year	6	114349	19058,2	563,23	0,000
Variants*Year	18	27	1,5	0,04	1,000
Error	252	8527	33,8		
Total	279	122966			

General Linear Model: dm2.shoot versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	2218,2	739,41	209,87	0,000
Year	6	21438,4	3573,06	1014,14	0,000
Variants*Year	18	430,1	23,90	6,78	0,000
Error	252	887,9	3,52		
Total	279	24974,6			

General Linear Model: m2.vine versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	881,6	293,863	483,60	0,000
Year	6	4575,1	762,509	1254,82	0,000
Variants*Year	18	152,2	8,456	13,91	0,000
Error	252	153,1	0,608		
Total	279	5762,0			

General Linear Model: LAI versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	51,795	17,2651	483,47	0,000
Year	6	268,795	44,7992	1254,50	0,000
Variants*Year	18	8,930	0,4961	13,89	0,000
Error	252	8,999	0,0357		
Total	279	338,520			

General Linear Model: N of Clusters versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	1115,13	371,710	160,32	0,000
Year	6	3468,29	578,049	249,32	0,000

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants*Year	18	69,02	3,835	1,65	0,048
Error	252	584,26	2,318		
Total	279	5236,70			

General Linear Model: W.of Clusters versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	7035	2345,1	66,17	0,000
Year	6	186133	31022,1	875,28	0,000
Variants*Year	18	2347	130,4	3,68	0,000
Error	252	8931	35,4		
Total	279	204447			

General Linear Model: Yield versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	46,941	15,6471	180,21	0,000
Year	6	458,880	76,4800	880,82	0,000
Variants*Year	18	8,726	0,4848	5,58	0,000
Error	252	21,881	0,0868		
Total	279	536,428			

General Linear Model: Sugar versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	4907	1635,6	55,17	0,000
Year	6	127529	21254,8	716,91	0,000
Variants*Year	18	1686	93,7	3,16	0,000
Error	252	7471	29,6		
Total	279	141592			

General Linear Model: Acid versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	0,696	0,2321	17,84	0,000
Year	6	273,436	45,5726	3501,31	0,000
Variants*Year	18	1,079	0,0599	4,60	0,000
Error	252	3,280	0,0130		
Total	279	278,491			

General Linear Model: Yield c/h versus Variants; Year

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	3	27594	9197,9	180,29	0,000
Year	6	269624	44937,4	880,83	0,000
Variants*Year	18	5127	284,8	5,58	0,000
Error	252	12856	51,0		
Total	279	315201			

Experimental Scheme III

General Linear Model: No Shoots versus Variants; Years

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	1	568,03	568,029	1697,62	0,000
Year	6	873,09	145,514	434,89	0,000
Variants*Year	6	11,17	1,862	5,56	0,000
Error	126	42,16	0,335		
Total	139	1494,45			

General Linear Model: Shoot Length versus Variants; Years

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	1	8331	8331,4	232,71	0,000
Year	6	200952	33492,0	935,47	0,000
Variants*Year	6	643	107,2	3,00	0,009
Error	126	4511	35,8		
Total	139	214438			

General Linear Model: Diameter versus Variants; Years

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	1	0,12421	0,124206	10,47	0,002
Year	6	1,64474	0,274123	23,11	0,000
Variants*Year	6	0,00388	0,000646	0,05	0,999
Error	126	1,49427	0,011859		
Total	139	3,26709			

General Linear Model: m/vine versus Variants; Years

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	1	46,6	46,63	3,23	0,075
Year	6	23316,7	3886,12	269,51	0,000
Variants*Year	6	17,2	2,87	0,20	0,977
Error	126	1816,8	14,42		
Total	139	25197,4			

General Linear Model: th.m.hec versus Variants; Years

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	1	432	431,9	13,84	0,000
Year	6	203118	33852,9	1084,96	0,000
Variants*Year	6	176	29,3	0,94	0,469
Error	126	3931	31,2		
Total	139	207657			

General Linear Model: cm3/shoot versus Variants; Years

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	1	14832	14832,0	608,59	0,000
Year	6	171550	28591,6	1173,18	0,000
Variants*Year	6	2773	462,2	18,96	0,000
Error	126	3071	24,4		
Total	139	192225			

General Linear Model: dm3.vine versus Variants; Years

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	1	2,543	2,5434	93,51	0,000
Year	6	165,369	27,5615	1013,36	0,000
Variants*Year	6	0,945	0,1575	5,79	0,000
Error	126	3,427	0,0272		
Total	139	172,284			

General Linear Model: m?.hec. versus Variants; Years

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Variants	1	22,18	22,185	93,76	0,000
Year	6	1439,08	239,846	1013,71	0,000
Variants*Year	6	8,22	1,369	5,79	0,000
Error	126	29,81	0,237		
Total	139	1499,29			

General Linear Model: No Leaves versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	2081,2	2081,17	113,04	0,000
Year	6	7666,7	1277,78	69,40	0,000
Variants*Year	6	155,5	25,91	1,41	0,217
Error	126	2319,8	18,41		
Total	139	12223,2			

General Linear Model: Leaf A. versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	497652	497652	757,25	0,000
Year	6	456795	76133	115,85	0,000
Variants*Year	6	16306	2718	4,14	0,001
Error	126	82805	657		
Total	139	1053559			

General Linear Model: Leaf S. versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	17777	17777,3	118,92	0,000
Year	6	100508	16751,3	112,06	0,000
Variants*Year	6	1445	240,9	1,61	0,149
Error	126	18836	149,5		
Total	139	138567			

General Linear Model: Leaf V. versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	258,7	258,68	31,46	0,000
Year	6	12851,8	2141,97	260,47	0,000
Variants*Year	6	139,1	23,18	2,82	0,013
Error	126	1036,2	8,22		
Total	139	14285,7			

General Linear Model: Leaf H. versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	1471	1470,8	21,66	0,000
Year	6	110550	18425,0	271,33	0,000
Variants*Year	6	304	50,7	0,75	0,613
Error	126	8556	67,9		
Total	139	120881			

General Linear Model: No Clus. versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	2519,3	2519,34	3396,38	0,000
Year	6	7632,6	1272,09	1714,94	0,000
Variants*Year	6	98,3	16,38	22,09	0,000
Error	126	93,5	0,74		
Total	139	10343,7			

General Linear Model: W. Clus. versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	296105	296105	2170,09	0,000
Year	6	663672	110612	810,65	0,000
Variants*Year	6	17856	2976	21,81	0,000
Error	126	17192	136		
Total	139	994826			

General Linear Model: Y. Vine versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	172,00	171,997	470,83	0,000
Year	6	1310,98	218,497	598,12	0,000
Variants*Year	6	25,76	4,293	11,75	0,000
Error	126	46,03	0,365		
Total	139	1554,77			

General Linear Model: Y. Hec. versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	151029	151029	616,32	0,000
Year	6	1154022	192337	784,88	0,000
Variants*Year	6	24538	4090	16,69	0,000
Error	126	30876	245		
Total	139	1360466			

General Linear Model: Sugars versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	6429	6429,4	23,68	0,000
Year	6	220408	36734,7	135,30	0,000
Variants*Year	6	2967	494,4	1,82	0,100
Error	126	34210	271,5		
Total	139	264014			

General Linear Model: Acids versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	0,25	0,247	0,38	0,540
Year	6	949,00	158,167	241,06	0,000
Variants*Year	6	1,42	0,237	0,36	0,902
Error	126	82,67	0,656		
Total	139	1033,34			

General Linear Model: LAI versus Variants; Years

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	22,48	22,485	31,40	0,000
Year	6	1118,70	186,449	260,40	0,000
Variants*Year	6	12,08	2,013	2,81	0,013
Error	126	90,22	0,716		
Total	139	1243,48			

General Linear Model: SP versus Variants; Year

Analysis of Variance

Source	DF	Seq SS	Seq MS	F-Value	P-Value
Variants	1	566776	566776	1104,95	0,000
Year	6	1034848	172475	336,25	0,000
Variants*Year	6	29393	4899	9,55	0,000
Error	126	64631	513		
Total	139	1695647			

Appendix 12.

Statistical Data Analysis

Table A 12.1. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB.

Group	Year	Repet	N of Sh.	Shoot Length	Annual Growth		Annual Growth Volume			N L/ Shoot	Leaf Area				LAI	N of Clus.	W. of Clus.	Yield		Sugar	Titr. Acid	SP
					m.vine	th.m/ ha	cm^3/ shoot	dm^3/ vine	m^3/ha		cm^2/ leaf	dm^2/ shoot	m^2/ vine	th. m^2/ha				per vine	per hec.			
CG	2015	1	41.0	130.9	51.1	123.9	69.1	2.64	6.40	26.2	118.0	31.7	12.6	30.2	3.05	42.9	100.0	4.29	10.40	237.5	8.1	104.3
CG	2015	2	40.4	138.8	53.0	128.5	70.0	2.76	6.69	26.9	117.6	30.2	12.5	29.3	3.03	43.1	95.2	4.10	9.95	226.7	8.4	101.5
CG	2015	3	40.1	124.4	50.7	122.9	65.7	2.81	6.81	27.0	117.1	28.5	11.4	31.9	2.76	48.6	99.4	4.83	11.62	231.4	8.2	120.4
CG	2015	4	41.7	124.5	52.4	127.0	65.7	2.70	6.54	25.8	116.0	32.1	13.2	29.4	3.20	46.9	99.2	4.65	11.28	227.5	8.4	111.5
CG	2015	5	40.0	126.8	51.2	124.1	65.0	2.81	6.81	26.3	113.2	32.6	12.5	31.3	3.03	44.1	96.1	4.24	10.27	230.2	8.4	106.0
CG	2015	6	38.2	121.4	53.3	129.2	64.1	2.72	6.59	26.7	116.7	31.1	11.4	29.3	2.76	42.5	99.1	4.21	10.21	241.0	8.3	110.2
CG	2015	7	39.2	131.8	53.9	129.3	68.6	2.64	6.40	26.0	117.6	31.7	13.2	32.0	3.20	40.9	100.3	4.10	9.94	231.5	8.2	104.6
CG	2015	8	41.5	132.4	50.6	122.7	68.0	2.80	6.79	26.8	117.9	30.3	11.8	29.8	2.86	44.8	93.0	4.17	10.10	231.2	8.3	100.5
CG	2015	9	40.9	139.3	52.5	127.3	73.1	2.67	6.47	26.7	118.1	31.9	13.4	29.8	3.25	45.1	94.7	4.27	10.35	233.0	8.4	104.4
CG	2015	10	41.0	120.7	53.3	129.2	63.7	2.69	6.52	25.6	113.8	27.9	12.0	29.0	2.91	49.1	99.0	4.86	11.78	230.0	8.3	118.5
CG			**40.40**	**129.10**	**52.20**	**126.4**	**67.3**	**2.72**	**6.60**	**26.4**	**116.6**	**30.8**	**12.4**	**30.2**	**3.01**	**44.8**	**97.6**	**4.37**	10.59	**232.0**	**8.3**	**108.20**
CG	2016	1	39.9	130.8	54.4	131.9	70.7	3.01	7.30	27.3	132.8	36.8	14.7	37.1	3.56	42.9	126.7	5.44	13.19	250.9	8.8	137.1
CG	2016	2	40.5	129.7	54.7	132.6	70.1	3.00	7.27	27.5	133.5	35.9	14.8	36.7	3.59	41.5	134.6	5.58	13.52	253.0	8.7	137.8
CG	2016	3	40.2	147.7	55.5	134.1	79.9	2.98	7.22	28.1	134.3	36.2	15.7	36.0	3.81	50.6	111.4	5.77	13.99	252.4	9.2	143.5
CG	2016	4	40.1	126.6	55.1	133.6	68.5	3.10	7.51	27.3	132.6	37.1	14.5	35.4	3.51	43.4	116.8	5.07	12.46	247.6	9.2	126.4
CG	2016	5	41.4	143.1	55.9	135.5	77.4	3.00	7.27	27.6	134.8	37.3	15.1	35.7	3.66	41.9	129.7	5.44	13.19	248.1	8.6	131.4
CG	2016	6	40.1	137.9	56.3	136.5	74.6	2.93	7.10	27.5	133.4	36.7	14.4	36.4	3.49	41.5	128.0	5.31	12.87	247.0	9.2	132.4
CG	2016	7	41.7	139.0	55.5	134.5	75.2	2.92	7.08	27.3	132.8	37.3	15.5	37.1	3.76	43.6	127.8	5.57	13.50	251.6	8.7	133.6
CG	2016	8	42.4	138.3	55.0	133.3	74.8	2.91	7.05	27.4	133.8	35.7	15.5	36.7	3.76	45.1	114.1	5.15	12.48	254.1	8.8	121.5
CG	2016	9	41.3	128.4	56.1	136.0	69.4	2.91	7.05	27.0	133.0	35.9	15.2	36.9	3.68	38.1	134.1	5.10	12.36	247.0	9.1	123.5
CG	2016	10	42.4	126.5	54.5	132.1	68.4	3.10	7.51	28.0	130.0	37.1	14.6	36.0	3.54	41.4	130.8	5.42	13.14	248.3	8.9	127.8
CG			**41.00**	**134.80**	**55.30**	**134.0**	**72.9**	**2.99**	**7.24**	**27.5**	**133.1**	**36.6**	**15.0**	**36.4**	**3.64**	**43.0**	**125.4**	**5.39**	13.07	**250.0**	**8.9**	**131.50**
CG	2017	1	43.4	142.3	67.2	162.9	94.5	4.48	10.86	31.3	145.5	45.0	20.5	47.0	4.97	46.2	132.0	6.10	14.79	231.1	9.0	140.6
CG	2017	2	45.8	156.5	66.6	161.4	104.1	4.56	11.05	32.0	145.3	44.7	19.5	48.8	4.73	42.3	137.0	5.80	14.17	234.7	8.9	126.6
CG	2017	3	43.6	155.7	67.6	163.9	103.5	4.53	10.98	31.6	145.2	45.9	20.2	47.9	4.90	45.4	142.2	6.46	15.66	237.0	8.8	148.2
CG	2017	4	44.1	150.8	67.1	162.7	100.2	4.46	10.81	29.7	144.4	44.7	19.7	48.3	4.78	49.7	119.1	6.07	14.72	233.8	9.1	137.6
CG	2017	5	43.8	143.7	66.2	160.5	95.5	4.40	10.67	31.7	142.6	45.2	19.9	48.1	4.82	45.7	135.7	6.20	15.03	235.6	8.7	141.6
CG	2017	6	44.0	152.8	67.6	163.9	101.5	4.56	11.05	31.2	146.3	45.5	19.9	49.7	4.82	53.2	120.4	6.40	15.51	236.5	9.0	145.5
CG	2017	7	44.2	148.4	66.0	160.6	98.6	4.33	10.50	32.1	142.6	45.2	19.6	49.1	4.75	46.5	129.5	6.02	14.59	238.9	9.0	136.9
CG	2017	8	43.7	150.9	68.4	165.8	100.3	4.57	11.08	30.5	145.8	45.4	19.7	47.2	4.78	45.7	141.1	6.45	15.63	233.7	8.8	147.6
CG	2017	9	43.8	161.6	68.0	164.8	107.4	4.40	10.67	30.4	143.2	44.0	19.6	48.8	4.75	43.9	130.6	5.73	13.89	233.7	8.7	130.8
CG	2017	10	45.6	160.3	68.3	165.6	106.5	4.36	10.57	30.5	145.1	44.4	20.4	47.1	4.94	50.4	115.4	5.82	14.11	235.0	9.0	127.6
CG			**44.20**	**152.30**	**67.30**	**163.2**	**101.2**	**4.47**	**10.82**	**31.1**	**144.6**	**45.0**	**19.9**	**48.2**	**4.82**	**46.9**	**130.3**	**6.11**	14.81	**235.0**	**8.9**	**138.30**
CG	2018	1	43.3	157.7	65.5	158.8	85.2	3.34	8.10	32.3	138.9	42.2	18.1	44.8	4.39	44.7	136.5	6.10	14.70	234.8	7.8	140.9
CG	2018	2	42.7	147.0	64.1	155.4	79.5	3.65	8.85	30.4	137.2	43.0	18.5	45.1	4.48	46.7	130.5	6.10	14.79	237.8	8.2	142.9
CG	2018	3	42.3	151.7	64.3	155.9	82.0	3.53	8.56	30.5	140.2	41.1	17.6	43.6	4.27	46.1	134.0	6.18	14.90	239.2	8.3	145.1
CG	2018	4	43.5	157.1	63.8	154.7	85.0	3.51	8.51	32.2	139.7	40.8	17.7	43.3	4.29	49.2	125.0	6.15	14.91	236.9	7.9	141.4
CG	2018	5	43.8	145.6	65.2	158.0	78.7	3.47	8.41	30.4	137.2	42.6	18.7	45.2	4.53	52.6	111.2	6.08	14.74	240.8	7.9	138.8
CG	2018	6	42.0	142.9	63.8	154.7	77.3	3.33	8.07	30.1	137.8	43.4	18.7	45.7	4.53	42.7	136.1	5.81	14.08	239.3	8.1	138.3
CG	2018	7	42.8	144.5	64.1	155.4	78.1	3.42	8.29	30.4	139.8	43.3	18.3	44.8	4.44	41.3	123.9	5.12	12.41	235.7	7.9	119.6
CG	2018	8	43.2	159.1	64.3	155.0	86.0	3.59	8.70	30.2	137.6	42.4	18.7	44.5	4.53	47.0	112.3	5.28	12.88	229.5	7.9	122.2
CG	2018	9	43.5	146.5	65.4	158.5	79.2	3.55	8.61	29.4	138.5	41.6	18.4	43.5	4.46	50.7	120.8	6.12	14.83	231.4	8.1	140.7
CG	2018	10	43.9	145.9	65.5	158.8	78.9	3.47	8.47	30.1	139.1	43.6	18.3	42.5	4.44	53.0	122.7	6.50	15.76	244.6	8.0	148.1
CG			**43.10**	**149.80**	**64.60**	**156.5**	**81.0**	**3.49**	**8.46**	**30.6**	**138.6**	**42.4**	**18.3**	**44.3**	**4.44**	**47.4**	**125.3**	**5.94**	14.40	**237.0**	**8.0**	**137.80**
CG	2019	1	41.3	123.7	52.5	127.1	65.3	2.63	6.38	26.3	118.0	30.7	12.5	29.8	3.03	46.8	98.4	4.61	11.17	234.3	6.1	111.6
CG	2019	2	40.3	131.8	51.7	125.3	69.1	2.75	6.67	24.7	116.5	29.2	12.4	28.9	3.01	43.0	105.7	4.54	11.00	236.8	5.9	112.7
CG	2019	3	41.5	128.5	51.4	124.6	67.8	2.73	6.62	25.4	114.7	27.5	11.3	31.5	2.74	42.5	101.7	4.32	10.47	232.7	5.8	104.1
CG	2019	4	41.8	115.7	52.6	127.5	61.1	2.61	6.33	25.6	117.3	31.1	13.1	29.0	3.18	46.0	98.5	4.53	10.98	240.2	6.2	108.4
CG	2019	5	42.2	119.7	50.8	123.1	63.2	2.84	6.88	26.2	115.3	31.6	12.4	30.9	3.01	44.8	90.2	4.04	9.96	242.6	5.9	95.7
CG	2019	6	40.9	135.2	50.8	123.1	71.4	2.65	6.42	25.9	114.6	30.1	11.3	28.9	2.74	42.6	100.3	4.27	10.35	227.2	6.0	104.4
CG	2019	7	41.2	128.9	52.4	127.0	68.0	2.83	6.86	26.1	117.8	30.7	13.1	31.6	3.18	51.2	92.2	4.73	11.47	243.5	6.0	114.8
CG	2019	8	41.0	120.8	51.6	125.1	63.8	2.63	6.38	24.6	116.0	29.3	11.7	29.4	2.84	46.5	102.8	4.78	11.59	230.3	6.1	116.6
CG	2019	9	40.4	122.6	50.9	123.4	64.7	2.85	6.91	24.8	117.4	30.9	13.3	29.4	3.22	45.2	92.7	4.19	10.16	225.7	6.0	103.7
CG	2019	10	41.4	128.1	52.3	126.8	67.6	2.81	6.81	26.4	117.4	26.9	11.9	28.6	2.88	44.4	104.5	4.64	11.25	226.7	6.1	113.0

CG			**41.20**	**125.50**	**51.70**	**125.3**	**66.2**	**2.73**	**6.62**	**25.6**	**116.5**	**29.8**	**12.3**	**29.8**	**2.98**	**45.3**	**98.7**	**4.47**	10.84	**234.0**	**6.0**	**108.50**
CG	2020	1	32.0	65.5	19.5	47.3	16.7	0.57	1.38	23.2	86.2	18.6	6.1	13.8	1.48	30.0	53.0	1.59	3.85	303.8	5.9	49.7
CG	2020	2	32.6	63.1	19.8	48.2	16.1	0.59	1.43	22.6	83.5	19.1	6.3	13.9	1.53	33.0	52.0	1.72	4.17	291.4	6.2	52.8
CG	2020	3	30.9	62.2	20.1	48.7	15.9	0.50	1.21	22.2	86.6	18.7	6.0	14.7	1.45	41.0	48.9	2.10	5.09	290.5	5.9	68.0
CG	2020	4	31.9	63.4	19.3	46.8	16.2	0.47	1.14	22.8	84.0	20.0	6.2	15.2	1.50	30.7	52.8	1.62	3.93	299.9	6.1	51.8
CG	2020	5	30.6	65.8	20.4	49.4	16.8	0.43	1.04	21.6	84.4	19.2	6.1	14.7	1.48	28.2	58.7	1.65	4.00	297.7	5.9	53.9
CG	2020	6	30.7	65.7	20.3	49.2	16.8	0.53	1.28	23.2	85.2	18.6	6.2	14.2	1.50	25.2	63.0	1.59	4.06	297.6	6.1	52.8
CG	2020	7	31.0	61.1	20.5	49.7	15.6	0.49	1.19	21.5	84.8	18.6	6.3	15.0	1.53	31.5	61.0	1.92	4.65	288.9	5.8	61.9
CG	2020	8	31.8	60.3	20.0	48.5	15.4	0.52	1.26	22.1	84.9	20.0	6.2	15.3	1.50	32.3	58.2	1.88	4.56	293.5	6.1	59.1
CG	2020	9	30.8	64.3	20.3	49.2	16.4	0.51	1.24	23.5	85.5	19.3	6.0	15.4	1.45	29.3	59.0	1.73	4.19	306.6	6.0	56.2
CG	2020	10	32.7	63.6	19.8	48.0	16.2	0.50	1.21	23.3	85.9	19.9	5.6	14.8	1.36	44.8	52.4	2.35	5.70	300.1	6.0	71.9
CG			**31.50**	**63.50**	**20.00**	**48.5**	**16.2**	**0.51**	**1.24**	**22.6**	**85.1**	**19.2**	**6.1**	**14.7**	**1.48**	**32.6**	**55.9**	**1.82**	4.42	**297.0**	**6.0**	**57.80**
CG	2021	1	37.1	77.7	28.7	69.6	30.7	1.22	2.91	24.7	98.7	25.0	9.7	21.5	2.35	47.0	81.6	3.97	9.62	253.0	8.1	107.0
CG	2021	2	37.2	76.9	29.0	70.0	30.9	1.08	2.62	26.1	96.8	25.5	9.8	23.3	2.38	36.6	85.9	3.14	7.62	258.4	8.4	84.4
CG	2021	3	37.3	77.4	27.9	67.6	30.6	1.04	2.52	25.7	97.7	24.2	9.6	24.2	2.33	39.4	85.5	3.37	8.17	248.6	8.1	90.3
CG	2021	4	38.2	72.3	29.1	70.5	28.6	1.14	2.76	25.1	97.2	26.3	9.3	21.6	2.25	33.8	92.8	3.14	7.61	254.3	8.4	83.2
CG	2021	5	36.8	77.2	28.7	69.6	30.5	1.12	2.71	25.5	98.7	26.0	9.0	23.3	2.18	39.7	83.6	3.32	8.05	248.2	8.0	90.2
CG	2021	6	38.4	72.8	28.1	68.1	28.8	1.17	2.84	26.3	96.3	26.2	9.6	22.9	2.33	35.8	89.7	3.21	7.78	260.7	8.4	83.6
CG	2021	7	37.7	76.8	28.1	68.1	30.4	1.23	2.98	27.1	98.4	25.2	9.6	23.8	2.33	48.6	76.0	3.70	8.97	253.0	8.1	98.1
CG	2021	8	36.5	76.7	29.1	70.5	30.4	1.08	2.62	26.3	96.7	25.8	9.4	24.2	2.28	42.2	78.5	3.31	8.02	253.6	7.9	90.7
CG	2021	9	37.7	75.8	28.5	69.1	30.0	1.09	2.64	25.0	98.4	24.1	9.2	22.2	2.23	41.8	74.9	3.13	7.71	256.6	8.4	83.0
CG	2021	10	38.1	78.4	28.8	69.8	31.0	1.17	2.84	28.2	99.1	25.7	9.8	24.0	2.38	43.1	90.5	3.90	9.45	243.6	8.2	102.4
CG			**37.50**	**76.20**	**28.60**	**69.3**	**30.2**	**1.13**	**2.74**	**26.0**	**97.8**	**25.4**	**9.5**	**23.1**	**2.30**	**40.8**	**83.9**	**3.42**	8.30	**253.0**	**8.2**	**91.30**
EG 1	2015	1	44.4	145.9	59.0	143.0	78.9	3.27	7.93	30.2	119.1	33.7	14.5	35.6	3.51	42.4	122.5	5.19	12.59	216.9	8.5	116.9
EG 1	2015	2	42.8	145.2	60.7	147.0	78.5	3.26	7.90	29.5	115.1	33.8	14.8	36.6	3.59	50.9	113.3	5.77	13.98	222.6	9.3	134.4
EG 1	2015	3	43.1	133.7	62.0	150.3	72.3	3.17	7.68	27.2	118.5	34.9	14.0	36.4	3.39	48.2	127.7	6.16	14.92	221.0	9.2	142.9
EG 1	2015	4	43.3	143.7	61.9	150.1	77.7	3.39	8.22	26.9	117.9	33.1	14.9	36.2	3.61	51.1	127.5	6.52	15.79	225.2	8.3	150.6
EG 1	2015	5	44.4	147.6	60.8	147.4	76.0	3.38	8.19	30.6	117.9	34.1	14.9	33.6	3.61	46.4	121.0	5.61	13.61	219.6	8.8	126.4
EG 1	2015	6	42.9	134.1	61.3	148.6	72.5	3.16	7.66	27.6	118.8	34.9	14.9	37.1	3.61	44.6	128.9	5.75	13.94	222.9	9.4	134.0
EG 1	2015	7	42.8	148.3	61.4	148.8	75.2	3.37	8.17	29.6	116.5	32.2	14.1	34.1	3.42	46.5	113.8	5.29	12.83	227.9	7.8	123.6
EG 1	2015	8	43.0	133.4	61.5	149.1	72.1	3.32	8.05	28.4	116.1	33.1	14.7	33.7	3.56	45.3	117.2	5.31	12.87	231.4	8.1	123.5
EG 1	2015	9	44.3	134.6	62.2	150.8	72.8	3.28	7.95	27.9	114.4	33.9	14.7	35.2	3.56	47.5	112.0	5.32	12.97	222.9	7.6	120.1
EG 1	2015	10	44.0	138.5	60.2	145.9	74.9	3.00	7.27	29.5	114.5	31.7	14.5	35.6	3.51	51.1	121.1	6.19	15.00	229.6	8.0	140.7
EG 1			**43.50**	**140.50**	**61.10**	**148.1**	**75.1**	**3.26**	**7.90**	**28.7**	**116.9**	**33.5**	**14.6**	**35.4**	**3.54**	**47.4**	**120.5**	**5.71**	13.85	**224.0**	**8.5**	**131.30**
EG 1	2016	1	44.2	141.2	64.6	156.6	78.2	3.57	8.65	30.7	136.7	38.6	18.9	45.4	4.58	54.3	140.8	7.65	18.54	243.5	9.1	173.1
EG 1	2016	2	44.2	155.7	65.8	159.5	86.2	3.62	8.77	31.2	130.4	40.5	16.3	43.6	3.95	43.7	151.2	6.61	16.02	240.3	9.2	149.5
EG 1	2016	3	43.9	149.0	66.0	160.0	82.5	3.58	8.68	31.7	133.9	41.7	19.7	42.2	4.78	47.9	158.2	7.58	18.31	250.1	9.1	172.7
EG 1	2016	4	44.4	154.1	65.1	157.8	85.4	3.54	8.58	31.4	136.7	39.1	16.7	43.5	4.05	46.7	154.5	7.21	17.48	239.1	9.5	162.0
EG 1	2016	5	42.9	150.1	66.4	161.0	83.1	3.80	9.21	29.2	135.3	39.3	19.9	42.9	4.82	46.8	141.1	6.60	16.00	248.6	9.5	153.8
EG 1	2016	6	44.8	154.7	64.7	156.8	85.7	3.64	8.82	30.2	132.7	40.8	20.1	43.7	4.87	54.0	142.2	7.85	19.03	253.0	9.4	175.2
EG 1	2016	7	43.6	138.9	65.4	158.5	76.9	3.70	8.97	30.1	132.1	42.1	16.6	42.8	4.02	44.4	155.3	6.89	16.70	244.3	9.4	158.0
EG 1	2016	8	43.1	139.5	64.4	156.1	77.3	3.71	8.99	28.5	128.8	41.9	17.7	42.2	4.29	48.4	152.0	7.35	17.82	240.4	9.5	170.5
EG 1	2016	9	44.2	152.5	66.3	160.7	84.5	3.53	8.56	28.7	138.4	41.7	16.2	44.5	3.93	47.1	151.3	7.13	17.28	241.4	9.2	161.3
EG 1	2016	10	43.7	155.3	66.3	160.0	86.2	3.62	8.77	31.8	133.8	40.8	17.2	42.5	4.17	44.7	155.4	6.94	16.82	249.3	9.1	158.8
EG 1			**43.90**	**149.10**	**65.50**	**158.7**	**82.6**	**3.63**	**8.80**	**30.4**	**133.9**	**40.7**	**17.9**	**43.3**	**4.35**	**47.8**	**150.2**	**7.18**	17.40	**245.0**	**9.3**	**163.50**
EG 1	2017	1	47.4	162.9	79.0	191.5	115.4	5.81	14.08	35.8	148.3	51.7	25.6	58.4	6.21	53.0	139.0	7.50	18.18	225.1	9.3	158.2
EG 1	2017	2	46.2	175.1	80.4	194.0	124.1	5.84	14.16	34.4	141.9	51.8	24.3	58.6	5.89	53.1	146.4	7.79	18.87	234.2	8.9	166.0
EG 1	2017	3	47.5	163.1	77.7	188.3	115.6	5.52	13.38	33.8	148.6	51.2	23.6	57.1	5.72	45.9	152.2	6.99	16.94	226.4	9.0	147.4
EG 1	2017	4	45.5	180.8	80.5	195.1	128.1	5.59	13.55	35.8	145.8	50.3	23.1	59.2	5.60	50.8	144.6	7.35	17.82	233.3	9.0	161.5
EG 1	2017	5	45.7	168.0	80.9	196.1	119.0	5.83	14.13	36.6	147.5	52.7	25.4	56.9	6.16	44.4	154.2	6.85	16.60	221.2	9.1	149.9
EG 1	2017	6	45.9	173.6	81.4	197.3	123.0	5.80	14.06	36.8	140.5	50.7	22.2	57.8	5.38	51.9	141.8	7.36	17.84	233.3	9.0	160.3
EG 1	2017	7	46.7	184.2	81.9	198.5	130.5	5.77	13.99	35.9	146.2	51.9	22.8	57.4	5.53	50.9	154.0	7.84	18.90	222.7	9.2	167.9
EG 1	2017	8	47.1	163.9	79.9	193.7	116.1	5.47	13.26	33.7	145.9	50.2	23.1	58.4	5.60	47.6	145.4	6.92	16.77	227.4	9.2	146.9
EG 1	2017	9	45.8	175.2	81.9	198.5	124.1	5.56	13.48	34.6	144.6	49.7	24.7	56.9	5.99	49.9	157.8	7.88	19.10	220.3	9.2	172.1
EG 1	2017	10	47.2	181.2	80.4	194.9	128.2	5.73	13.89	35.1	142.8	52.8	23.5	57.3	5.70	48.5	155.6	7.54	18.28	236.1	9.0	159.7
EG 1			**46.50**	**172.80**	**80.40**	**194.8**	**122.4**	**5.69**	**13.80**	**35.3**	**145.2**	**51.3**	**23.8**	**57.8**	**5.78**	**49.6**	**149.1**	**7.40**	17.93	**228.0**	**9.1**	**159.00**
EG 1	2018	1	44.1	165.4	74.7	181.1	96.0	4.49	10.88	35.1	131.6	47.6	22.6	51.6	5.48	43.4	150.1	6.51	15.78	238.3	8.3	148.0
EG 1	2018	2	45.3	170.3	75.1	182.0	98.9	4.38	10.62	35.6	138.1	47.0	19.4	50.9	4.70	52.1	147.5	7.75	18.75	233.2	8.1	171.1
EG 1	2018	3	44.6	169.9	75.5	184.3	98.2	4.20	10.18	33.1	141.5	47.4	21.5	52.1	5.21	49.4	149.2	7.37	17.86	235.0	7.9	165.2
EG 1	2018	4	43.8	174.1	75.7	183.5	101.1	4.48	10.86	34.2	145.2	50.7	20.7	50.3	5.02	47.9	140.5	6.73	16.31	223.9	8.2	153.7
EG 1	2018	5	44.9	176.8	75.5	183.0	102.6	4.28	10.37	35.8	139.5	47.4	21.9	52.7	5.31	53.0	142.0	7.53	18.25	221.0	8.2	166.0
EG 1	2018	6	44.4	179.1	75.6	183.3	104.0	4.21	10.21	34.2	138.7	47.7	22.0	52.1	5.33	44.3	147.1	6.52	15.80	228.1	8.3	146.8
EG 1	2018	7	45.0	179.2	74.6	180.8	104.0	4.50	10.91	34.6	132.8	49.0	21.4	53.2	5.19	43.3	150.9	6.54	15.85	234.9	8.4	145.3
EG 1	2018	8	44.5	158.6	77.0	186.6	92.1	4.46	10.81	35.3	144.2	48.1	21.7	50.5	5.26	50.4	152.4	7.68	18.62	222.2	8.2	172.6

EG 1	2018	9	43.5	162.0	75.0	181.8	94.1	4.29	10.40	34.5	134.5	49.8	22.9	53.3	5.55	52.0	137.3	7.20	17.45	228.4	8.4	165.5
EG 1	2018	10	43.9	163.6	75.3	182.5	95.0	4.46	10.81	34.7	143.1	47.3	20.2	52.1	4.90	49.2	146.0	7.19	17.43	235.0	8.0	163.8
EG 1			**44.40**	**169.90**	**75.40**	**182.9**	**98.6**	**4.38**	**10.61**	**34.7**	**138.9**	**48.2**	**21.4**	**51.9**	**5.19**	**48.5**	**146.3**	**7.10**	17.21	**230.0**	**8.2**	**159.80**
EG 1	2019	1	44.7	137.6	61.0	147.9	78.5	3.62	8.77	28.8	116.2	35.8	15.9	38.1	3.85	48.8	117.9	5.75	13.94	216.0	6.3	128.6
EG 1	2019	2	43.0	148.4	62.5	151.5	84.2	3.60	8.73	29.8	115.6	34.9	14.5	38.6	3.51	55.6	101.5	6.35	15.30	224.5	6.1	146.0
EG 1	2019	3	43.5	151.5	64.1	155.0	85.9	3.38	8.19	29.5	114.6	35.6	15.8	37.3	3.83	53.9	101.8	5.49	13.32	221.0	6.2	126.2
EG 1	2019	4	44.7	143.4	63.4	153.7	81.3	3.52	8.53	29.9	114.9	33.2	16.0	37.2	3.88	47.1	110.5	5.20	12.60	222.7	6.1	116.3
EG 1	2019	5	43.3	143.7	64.4	156.1	81.5	3.70	8.97	28.3	118.9	33.2	15.5	36.3	3.76	42.0	123.9	4.92	11.93	226.4	6.5	113.6
EG 1	2019	6	43.9	150.5	63.0	152.7	85.4	3.57	8.65	29.5	118.7	33.5	15.2	36.0	3.68	54.1	104.0	5.63	13.65	220.4	6.3	128.2
EG 1	2019	7	43.4	130.0	64.2	155.6	73.7	3.74	9.07	30.1	116.9	36.9	14.8	35.9	3.59	44.8	123.3	5.53	13.40	231.3	6.4	127.4
EG 1	2019	8	43.2	148.6	62.8	152.2	84.3	3.67	8.90	29.3	123.9	35.2	14.7	36.5	3.56	45.9	129.4	5.94	14.40	230.3	6.6	137.5
EG 1	2019	9	44.2	139.4	63.7	154.4	79.1	3.36	8.14	30.5	122.1	33.6	15.3	38.3	3.71	43.0	121.5	5.23	12.68	214.1	6.1	118.3
EG 1	2019	10	44.1	151.9	63.9	154.9	86.2	3.71	8.99	29.7	115.7	36.2	13.9	35.2	3.37	42.8	121.2	5.19	12.58	213.3	6.4	117.7
EG 1			**43.80**	**144.50**	**63.30**	**153.4**	**82.0**	**3.59**	**8.69**	**29.5**	**117.8**	**34.8**	**15.2**	**36.9**	**3.67**	**47.8**	**115.5**	**5.52**	13.38	**222.0**	**6.3**	**126.00**
EG 1	2020	1	34.9	69.7	25.5	61.8	18.8	0.64	1.55	22.4	86.5	19.6	7.5	16.5	1.82	40.7	59.0	2.40	5.82	290.5	6.6	68.8
EG 1	2020	2	35.2	75.1	25.2	61.0	19.8	0.72	1.75	24.5	85.7	21.7	6.6	17.8	1.60	43.0	49.1	2.11	5.11	275.5	6.5	59.9
EG 1	2020	3	34.6	71.2	26.0	63.0	18.8	0.70	1.70	24.9	88.0	21.8	7.5	18.6	1.82	30.9	64.5	1.99	4.82	282.8	6.6	58.4
EG 1	2020	4	34.7	74.5	26.3	63.8	19.7	0.68	1.65	24.7	86.4	20.9	7.6	18.0	1.84	45.2	53.7	2.55	6.18	282.3	6.9	73.5
EG 1	2020	5	35.8	79.9	24.6	59.6	21.1	0.58	1.41	25.2	85.5	21.9	7.8	18.1	1.89	37.5	53.3	2.00	4.93	290.0	6.5	55.9
EG 1	2020	6	36.2	66.9	25.0	60.6	17.7	0.67	1.62	24.0	87.6	20.2	7.9	18.6	1.91	32.3	63.1	2.04	4.94	280.2	6.5	56.4
EG 1	2020	7	35.4	72.0	25.6	62.1	19.0	0.66	1.60	24.2	86.9	21.6	7.3	18.8	1.88	38.9	57.6	2.24	5.43	276.4	7.0	63.3
EG 1	2020	8	36.4	65.7	25.3	61.3	17.3	0.69	1.67	23.3	88.5	21.0	7.0	17.9	1.79	34.4	61.6	2.12	5.14	282.3	6.7	58.2
EG 1	2020	9	35.6	68.7	26.4	64.0	18.1	0.67	1.62	25.6	84.0	21.5	7.2	19.7	1.75	30.1	64.1	1.93	4.75	275.5	6.9	54.2
EG 1	2020	10	36.2	74.3	25.1	60.8	19.6	0.65	1.58	23.4	87.4	20.0	7.4	16.8	1.79	34.0	58.0	1.97	4.78	274.5	6.8	54.4
EG 1			**35.50**	**71.80**	**25.50**	**61.8**	**19.0**	**0.67**	**1.61**	**24.2**	**86.7**	**21.0**	**7.4**	**18.1**	**1.81**	**36.7**	**58.4**	**2.14**	5.19	**281.0**	**6.7**	**60.30**
EG 1	2021	1	42.3	83.9	35.8	86.8	35.5	1.45	3.51	27.5	101.2	26.9	10.2	29.1	2.47	48.5	86.6	4.20	10.16	251.3	8.2	99.3
EG 1	2021	2	42.3	92.1	37.1	90.0	38.5	1.46	3.54	26.5	100.2	27.7	9.0	27.7	2.18	49.8	83.1	4.14	10.04	243.0	8.3	97.9
EG 1	2021	3	41.5	77.8	35.7	86.5	32.5	1.47	3.56	26.3	96.5	26.6	13.6	28.7	3.30	45.8	83.6	3.84	9.40	251.2	8.3	92.5
EG 1	2021	4	43.0	85.0	35.8	86.8	35.6	1.47	3.56	27.3	104.0	28.0	10.8	27.9	2.62	46.0	85.0	3.91	9.48	259.3	8.3	90.9
EG 1	2021	5	42.3	89.8	36.4	88.2	37.6	1.61	3.90	28.3	100.8	27.4	10.4	27.9	2.52	44.9	88.1	3.96	9.60	242.7	8.3	93.6
EG 1	2021	6	42.9	79.2	37.0	89.7	33.1	1.52	3.68	29.1	102.8	28.7	13.1	27.8	3.18	45.1	90.0	4.06	9.84	257.4	8.3	94.6
EG 1	2021	7	41.6	88.2	36.5	88.5	36.9	1.55	3.76	29.6	96.6	29.1	13.5	27.6	3.27	44.9	87.4	3.92	9.50	257.4	8.3	94.2
EG 1	2021	8	41.5	89.9	35.0	84.8	37.6	1.60	3.88	27.8	96.9	27.9	13.8	29.7	3.35	43.4	93.8	4.07	9.87	253.3	8.3	98.4
EG 1	2021	9	41.6	90.2	36.7	89.0	37.7	1.47	3.56	27.8	102.3	26.2	10.6	28.3	2.57	44.6	88.7	3.96	9.60	247.2	8.4	95.2
EG 1	2021	10	42.0	85.9	37.0	89.7	35.9	1.56	3.78	27.5	95.5	28.7	11.5	27.9	2.79	46.0	89.7	4.13	10.01	247.2	8.3	98.3
EG 1			**42.10**	**86.20**	**36.30**	**88.0**	**36.1**	**1.52**	**3.67**	**27.8**	**99.7**	**27.7**	**11.7**	**28.3**	**2.82**	**45.9**	**87.6**	**4.02**	9.75	**251.0**	**8.3**	**95.50**
EG 2	2015	1	41.7	126.4	55.2	133.8	73.4	2.93	7.10	27.1	114.4	30.1	13.1	33.1	3.18	46.1	111.7	5.15	12.48	230.2	8.2	123.5
EG 2	2015	2	40.9	140.7	56.5	137.0	76.1	3.17	7.68	26.4	120.7	32.9	12.9	32.6	3.13	44.9	114.4	5.14	12.45	222.8	9.0	125.0
EG 2	2015	3	40.8	127.1	56.1	136.1	68.7	2.98	7.22	27.8	120.5	33.8	14.7	32.8	3.56	47.7	103.5	4.94	11.97	224.3	8.4	121.1
EG 2	2015	4	40.9	146.8	56.6	137.2	79.4	2.82	6.84	28.3	114.0	33.2	12.8	31.9	3.10	46.0	114.8	5.28	12.80	227.2	8.0	129.1
EG 2	2015	5	42.2	131.1	55.2	133.8	70.7	3.19	7.73	27.4	111.7	30.2	12.5	32.7	3.03	46.1	104.8	4.83	11.71	223.2	8.2	114.5
EG 2	2015	6	41.5	138.5	56.9	137.9	74.9	2.94	7.13	28.9	122.4	32.4	12.9	30.6	3.13	43.4	102.2	4.44	10.75	232.2	8.0	107.0
EG 2	2015	7	42.4	134.4	55.5	134.5	72.7	3.18	7.71	28.2	112.9	32.2	13.2	33.3	3.20	40.6	111.4	4.52	10.96	223.9	8.6	106.6
EG 2	2015	8	40.5	144.3	55.0	133.3	78.0	3.00	7.27	27.1	114.4	34.0	12.6	30.9	3.05	44.2	114.5	5.06	12.27	227.8	8.7	124.9
EG 2	2015	9	42.0	133.9	57.0	138.2	72.4	3.15	7.64	27.1	122.4	31.2	15.1	33.8	3.66	44.9	107.5	4.83	11.73	223.7	9.0	115.0
EG 2	2015	10	42.1	128.8	57.0	138.2	69.7	3.19	7.73	27.7	115.2	33.1	13.7	32.7	3.32	48.1	106.2	5.11	12.38	224.6	8.9	121.4
EG 2			**41.50**	**135.20**	**56.10**	**136.0**	**73.6**	**3.06**	**7.41**	**27.6**	**116.9**	**32.3**	**13.4**	**32.4**	**3.24**	**45.2**	**109.1**	**4.93**	11.95	**226.0**	**8.5**	**118.80**
EG 2	2016	1	41.6	144.9	59.3	143.7	80.3	3.03	7.34	27.3	133.4	35.6	16.2	37.5	3.93	51.4	137.9	7.09	17.19	251.3	9.2	170.4
EG 2	2016	2	43.0	140.3	59.3	143.7	77.7	3.29	7.97	27.4	129.4	36.8	16.7	40.0	4.05	46.9	144.4	6.77	16.41	250.7	9.0	157.4
EG 2	2016	3	42.6	145.6	58.3	141.3	80.6	3.35	8.12	27.5	135.9	37.9	16.7	39.2	4.05	41.8	147.4	6.16	14.93	250.0	9.2	144.6
EG 2	2016	4	43.4	127.3	57.7	139.9	70.0	3.12	7.56	28.3	139.5	39.8	15.1	39.4	3.66	53.0	133.7	7.23	17.53	240.5	9.5	166.0
EG 2	2016	5	42.7	130.6	59.2	143.5	72.3	3.40	8.24	29.9	133.9	37.5	15.3	39.7	3.71	41.7	151.2	6.22	15.08	251.2	8.9	145.7
EG 2	2016	6	43.4	143.6	57.8	141.2	79.5	3.18	7.71	30.0	128.7	39.8	15.0	37.2	3.64	43.3	147.0	6.36	15.42	250.4	9.3	148.0
EG 2	2016	7	42.6	141.1	59.4	144.0	78.2	3.38	8.19	28.0	136.1	37.8	16.8	38.0	4.07	44.4	141.9	6.30	15.27	245.1	9.4	147.9
EG 2	2016	8	42.1	149.4	59.0	143.0	82.8	3.26	7.90	28.6	139.2	36.9	16.8	39.7	4.07	44.3	145.7	6.45	15.63	242.3	9.2	153.2
EG 2	2016	9	41.9	128.1	58.4	141.6	71.0	3.27	7.93	27.4	132.0	38.8	16.0	39.2	3.88	42.2	148.4	6.26	15.31	240.9	9.2	149.4
EG 2	2016	10	41.7	131.1	58.6	142.0	72.6	3.17	7.68	27.9	130.8	37.1	15.1	39.3	3.66	54.0	130.4	7.23	17.53	257.6	9.1	173.4
EG 2			**42.50**	**138.20**	**58.70**	**142.4**	**76.5**	**3.25**	**7.87**	**28.2**	**133.9**	**37.8**	**16.0**	**38.9**	**3.87**	**46.3**	**142.8**	**6.61**	16.03	**248.0**	**9.2**	**155.60**
EG 2	2017	1	45.8	163.1	72.0	174.5	110.7	4.79	11.61	32.2	143.7	45.5	20.2	53.0	4.90	49.2	146.9	7.23	17.53	223.4	8.9	157.9
EG 2	2017	2	46.2	154.6	73.4	177.9	105.0	5.10	12.36	32.0	141.1	47.6	21.3	50.0	5.16	48.3	144.9	7.00	16.97	231.6	9.0	151.8
EG 2	2017	3	44.8	149.0	72.6	176.0	101.2	5.08	12.31	33.5	141.7	47.3	21.1	51.6	5.11	56.0	129.9	7.49	18.12	234.4	9.0	167.2
EG 2	2017	4	44.8	170.0	73.4	177.9	115.4	4.95	12.00	32.0	141.7	47.8	21.1	52.7	5.11	54.2	133.5	7.23	17.53	234.8	9.0	161.4
EG 2	2017	5	46.0	156.8	73.1	177.2	106.5	4.82	11.68	33.6	148.9	49.0	22.0	50.6	5.33	43.7	151.6	6.61	16.20	221.8	8.8	143.7
EG 2	2017	6	45.6	156.5	72.2	175.6	106.3	4.72	11.44	32.4	146.0	46.5	21.0	51.5	5.09	44.8	151.0	6.77	16.41	230.6	9.1	148.5

EG 2	2017	7	45.1	168.2	71.1	172.3	114.2	4.74	11.49	31.7	150.1	46.5	20.6	52.7	4.99	45.4	150.1	6.82	16.53	234.6	9.2	151.2
EG 2	2017	8	45.0	160.9	72.2	175.0	109.2	5.27	12.77	33.8	146.3	47.6	22.2	53.3	5.38	51.3	138.5	7.11	17.23	228.9	8.9	158.0
EG 2	2017	9	45.1	156.9	72.0	174.5	106.5	4.85	11.76	31.8	141.5	47.9	23.0	51.2	5.58	51.7	145.2	7.50	18.18	236.5	9.0	166.3
EG 2	2017	10	44.6	165.0	73.0	177.0	112.0	4.84	11.73	33.6	150.6	49.2	22.2	54.0	5.38	49.4	154.4	7.63	18.50	223.4	9.1	171.1
EG 2			**45.30**	**160.10**	**72.50**	**175.8**	**108.7**	**4.92**	**11.92**	**32.7**	**145.2**	**47.5**	**21.5**	**52.1**	**5.20**	**49.4**	**144.6**	**7.14**	17.32	**230.0**	**9.0**	**157.70**
EG 2	2018	1	44.1	164.6	68.3	165.6	93.4	3.70	8.97	31.6	137.4	46.9	18.3	50.2	4.44	45.3	146.5	6.64	16.10	234.1	7.8	150.4
EG 2	2018	2	43.4	165.0	67.2	162.9	93.6	3.90	9.45	34.7	135.6	43.5	19.4	50.5	4.70	46.4	130.3	6.04	14.67	234.0	8.3	139.2
EG 2	2018	3	42.4	164.0	69.3	168.5	93.0	3.83	9.28	34.0	135.0	45.3	19.1	49.1	4.63	43.1	147.7	6.36	15.42	241.3	8.1	150.0
EG 2	2018	4	43.1	163.9	69.4	168.2	93.4	4.05	9.82	30.4	138.0	46.5	20.9	45.9	5.07	46.8	147.3	6.89	16.50	244.1	7.9	158.0
EG 2	2018	5	42.8	150.0	67.2	162.9	85.1	3.89	9.43	34.6	141.9	45.8	18.3	44.6	4.44	44.8	138.5	6.20	15.03	228.9	8.2	144.9
EG 2	2018	6	44.1	150.9	68.2	165.3	85.6	3.88	9.41	34.2	141.8	46.4	20.5	45.6	4.97	47.6	134.7	6.41	15.54	242.4	8.1	145.4
EG 2	2018	7	43.1	157.2	69.3	168.0	89.2	4.04	9.79	31.3	145.9	43.1	20.8	44.7	5.04	52.0	126.4	6.81	16.51	237.4	8.0	158.0
EG 2	2018	8	43.9	159.4	68.1	165.1	90.4	3.74	9.07	30.3	137.7	45.9	18.3	49.9	4.44	49.6	128.9	6.39	15.49	229.3	8.3	145.6
EG 2	2018	9	42.3	147.8	68.7	166.5	83.8	4.07	9.87	31.3	140.8	43.2	19.8	44.0	4.80	52.0	130.7	6.84	16.58	228.3	8.3	161.7
EG 2	2018	10	42.8	163.2	69.3	168.0	92.6	3.84	9.31	31.3	134.5	43.2	18.3	46.8	4.44	43.4	148.0	6.42	15.56	230.2	8.0	150.0
EG 2			**43.20**	**158.60**	**68.50**	**166.1**	**90.0**	**3.89**	**9.44**	**32.4**	**138.9**	**45.0**	**19.4**	**47.1**	**4.70**	**47.1**	**137.9**	**6.50**	15.74	**235.0**	**8.1**	**150.30**
EG 2	2019	1	41.0	128.0	54.6	132.4	67.6	3.04	7.37	29.2	123.8	32.4	11.2	32.6	2.71	47.8	111.0	5.31	12.83	219.4	6.3	129.4
EG 2	2019	2	41.7	129.6	55.3	134.0	68.4	2.83	6.86	26.2	121.1	33.1	12.9	32.4	3.13	46.8	109.3	5.12	12.41	232.7	6.0	122.8
EG 2	2019	3	41.1	128.2	54.1	131.1	67.7	2.98	7.22	26.2	114.0	31.8	13.3	33.7	3.22	44.4	104.3	4.63	11.22	230.6	6.2	112.7
EG 2	2019	4	40.6	136.2	54.5	132.5	71.9	2.82	6.84	26.0	114.8	31.0	14.9	33.2	3.61	45.3	102.0	4.62	11.20	226.3	6.3	113.8
EG 2	2019	5	41.9	138.2	55.2	133.8	72.9	2.89	7.01	27.7	110.1	31.9	14.3	31.0	3.47	48.7	102.5	5.07	12.29	220.1	6.1	121.0
EG 2	2019	6	40.1	144.7	54.8	132.8	76.4	2.84	6.88	28.0	117.1	33.4	12.4	31.9	3.01	38.2	113.9	4.35	10.54	231.0	6.3	108.5
EG 2	2019	7	39.9	140.9	55.9	135.5	74.4	2.89	7.01	29.4	111.9	32.6	12.1	32.8	2.93	43.2	105.9	4.57	11.08	227.3	6.2	114.5
EG 2	2019	8	40.8	126.1	56.0	135.7	67.0	2.82	6.84	28.4	119.7	33.6	14.5	31.7	3.51	46.4	109.8	5.10	12.36	224.4	6.2	125.0
EG 2	2019	9	41.6	137.1	54.7	132.6	72.4	3.11	7.54	27.3	112.0	32.9	12.7	30.2	3.08	44.4	112.3	4.99	12.10	220.8	6.3	120.0
EG 2	2019	10	40.3	139.0	55.9	135.5	73.4	2.89	7.01	28.5	123.6	31.5	13.2	31.9	3.20	40.8	114.0	4.65	11.27	227.4	6.3	115.4
EG 2			**40.90**	**134.80**	**55.10**	**133.6**	**71.2**	**2.91**	**7.06**	**27.7**	**116.8**	**32.4**	**13.2**	**32.1**	**3.19**	**44.6**	**108.5**	**4.84**	11.73	**226.0**	**6.2**	**118.30**
EG 2	2020	1	35.0	58.8	22.9	55.5	16.0	0.62	1.50	24.7	76.6	17.8	6.1	18.0	1.48	27.1	60.0	1.61	3.91	283.1	6.4	46.0
EG 2	2020	2	34.6	70.7	21.4	53.2	18.7	0.49	1.19	23.0	88.4	18.7	7.2	16.8	1.75	39.3	60.6	2.38	5.77	286.3	6.4	68.6
EG 2	2020	3	33.8	63.8	21.8	52.8	16.8	0.61	1.48	24.0	84.3	19.5	6.4	17.7	1.55	38.1	59.9	2.28	5.53	288.4	6.7	67.5
EG 2	2020	4	35.5	70.6	23.0	55.8	18.6	0.53	1.28	21.8	92.4	18.5	6.7	15.9	1.62	34.7	53.9	1.87	4.53	286.6	6.8	52.7
EG 2	2020	5	34.4	70.5	22.2	53.8	18.6	0.60	1.45	24.2	96.7	20.6	7.0	15.8	1.70	41.0	55.8	2.29	5.55	280.7	6.7	66.6
EG 2	2020	6	35.3	59.7	22.5	54.5	15.8	0.58	1.41	21.0	74.9	21.6	7.0	16.7	1.70	31.7	49.8	1.58	3.83	285.8	6.8	44.8
EG 2	2020	7	34.7	58.4	22.6	54.8	15.4	0.60	1.45	24.8	76.4	20.8	7.5	16.5	1.82	39.5	57.4	2.27	5.50	279.6	6.9	65.4
EG 2	2020	8	34.4	60.3	21.6	52.4	15.9	0.63	1.53	21.4	93.9	19.5	7.4	17.2	1.79	27.2	59.2	1.61	3.90	275.3	6.7	46.8
EG 2	2020	9	35.1	63.9	21.5	52.1	16.9	0.53	1.28	24.7	79.1	21.3	7.2	16.0	1.75	29.2	56.5	1.65	4.00	277.8	6.4	47.0
EG 2	2020	10	34.2	61.3	21.5	52.1	16.2	0.57	1.38	23.4	85.8	19.7	6.2	16.7	1.50	35.2	61.9	2.18	5.28	286.4	6.3	63.7
EG 2			**34.70**	**63.80**	**22.10**	**53.7**	**16.9**	**0.58**	**1.40**	**23.3**	**84.9**	**19.8**	**6.9**	**16.7**	**1.67**	**34.3**	**57.5**	**1.97**	4.78	**283.0**	**6.6**	**56.90**
EG 2	2021	1	40.4	75.2	28.6	72.0	31.0	1.34	3.25	24.7	106.5	25.3	10.3	23.8	2.50	43.0	97.2	4.18	10.00	253.3	8.2	103.5
EG 2	2021	2	39.8	71.5	28.1	78.0	29.9	1.29	3.13	26.8	105.9	25.4	11.8	24.4	2.86	44.3	90.1	3.99	9.67	242.2	8.1	100.3
EG 2	2021	3	40.7	80.7	29.2	70.8	33.8	1.34	3.25	28.2	89.5	27.1	9.6	25.4	2.33	41.1	83.3	3.42	8.29	255.1	8.2	84.0
EG 2	2021	4	40.4	73.7	28.6	75.0	30.8	1.28	3.10	25.3	89.0	26.5	11.4	26.3	2.76	43.6	84.9	3.70	8.97	257.0	8.2	91.2
EG 2	2021	5	39.8	79.1	28.7	78.9	33.1	1.17	2.84	27.9	91.2	26.7	9.2	25.4	2.23	46.8	85.0	3.98	9.65	255.4	8.3	100.0
EG 2	2021	6	39.5	66.1	28.6	74.5	27.7	1.26	3.05	26.9	89.9	27.9	11.1	26.1	2.69	39.2	82.7	3.24	7.89	250.9	8.2	82.0
EG 2	2021	7	39.5	82.0	28.1	74.0	34.3	1.31	3.18	28.6	108.0	24.9	11.0	25.2	2.67	49.6	82.5	4.12	9.99	248.7	8.2	104.3
EG 2	2021	8	39.6	81.0	29.2	70.8	33.9	1.32	3.20	27.5	91.0	25.8	9.8	26.7	2.38	38.8	87.4	3.39	8.22	248.4	8.2	85.6
EG 2	2021	9	39.9	76.0	28.9	70.1	31.8	1.28	3.10	25.4	96.7	26.1	9.3	24.6	2.25	39.6	85.1	3.37	8.17	257.6	8.2	84.5
EG 2	2021	10	39.4	80.7	28.0	77.0	33.8	1.25	3.03	26.7	109.8	26.4	11.7	25.5	2.84	43.0	84.8	3.65	8.85	251.4	8.2	92.6
EG 2			**39.90**	**76.60**	**28.60**	**74.1**	**32.0**	**1.28**	**3.11**	**26.8**	**97.8**	**26.2**	**10.5**	**25.3**	**2.55**	**42.9**	**86.3**	**3.70**	8.97	**252.0**	**8.2**	**92.80**
EG 3	2015	1	39.3	123.0	50.2	121.7	65.0	2.71	6.57	26.5	110.8	31.2	13.0	31.2	3.15	44.1	113.0	4.72	11.44	228.4	8.6	120.1
EG 3	2015	2	39.5	133.6	50.5	122.4	70.5	2.77	6.71	26.3	123.5	30.1	11.8	28.6	2.86	44.3	110.5	4.53	10.98	233.5	8.2	114.7
EG 3	2015	3	40.7	122.0	49.5	120.6	64.4	2.53	6.13	25.7	122.0	29.4	11.5	29.5	2.79	41.6	101.2	4.88	11.83	219.0	8.4	119.9
EG 3	2015	4	39.5	132.8	50.0	121.2	70.1	2.67	6.47	24.4	117.3	30.6	13.1	30.2	3.18	43.6	110.7	4.91	11.90	229.9	8.5	123.0
EG 3	2015	5	39.8	122.2	51.6	125.1	64.5	2.66	6.45	26.6	123.2	31.9	11.6	28.2	2.81	44.5	110.0	4.76	11.48	233.2	8.1	119.6
EG 3	2015	6	40.8	131.6	51.7	125.3	69.5	2.77	6.71	25.2	111.3	29.7	12.7	28.9	3.08	43.0	104.0	4.35	10.54	236.2	8.5	106.6
EG 3	2015	7	40.6	117.0	50.2	121.7	61.8	2.73	6.62	25.0	113.2	29.0	11.9	28.4	2.88	43.6	109.3	4.48	10.86	218.8	8.3	110.3
EG 3	2015	8	40.4	129.3	51.3	124.4	68.2	2.72	6.59	26.7	114.7	28.9	11.1	27.5	2.69	44.6	108.5	4.91	11.90	227.8	8.6	121.4
EG 3	2015	9	39.1	125.0	51.5	124.8	66.0	2.67	6.47	26.8	113.1	30.5	11.5	29.6	2.79	42.8	97.6	4.61	11.17	231.6	8.2	117.9
EG 3	2015	10	40.3	134.5	51.5	124.8	71.0	2.58	6.25	26.2	119.3	31.7	12.3	30.4	2.98	43.9	99.2	4.29	10.40	221.6	8.5	106.5
EG 3			**40.00**	**127.10**	**50.80**	**123.2**	**67.1**	**2.68**	**6.50**	**25.9**	**116.8**	**30.3**	**12.1**	**29.3**	**2.92**	**43.6**	**106.4**	**4.64**	11.25	**228.0**	**8.4**	**116.00**
EG 3	2016	1	41.9	143.1	55.4	134.3	77.4	3.26	7.90	25.4	127.0	37.0	16.0	35.6	3.88	40.1	138.3	5.55	13.45	249.5	8.8	132.5
EG 3	2016	2	42.6	136.8	57.5	139.4	74.0	3.00	7.27	28.7	136.3	37.6	16.0	37.7	3.88	47.8	130.0	6.22	15.08	256.2	9.2	146.0
EG 3	2016	3	42.2	129.2	55.8	135.3	69.9	3.00	7.27	29.2	125.0	37.9	16.8	38.9	4.07	43.9	132.2	5.80	14.06	249.1	9.2	137.4
EG 3	2016	4	41.4	145.0	56.8	137.7	78.4	2.97	7.20	26.8	125.8	38.0	15.4	37.9	3.73	50.8	123.2	6.37	15.41	243.4	8.9	153.9

EG 3	2016	5	42.4	139.5	55.6	134.8	75.4	3.08	7.47	28.4	138.7	36.7	15.0	38.0	3.64	46.6	131.4	6.12	14.83	252.8	8.7	144.3
EG 3	2016	6	41.1	127.8	56.2	136.2	69.1	2.94	7.13	29.2	137.2	37.8	15.5	35.3	3.76	46.4	133.1	6.17	14.96	260.1	8.9	150.1
EG 3	2016	7	42.4	130.0	56.5	138.4	70.0	3.06	7.42	26.3	134.9	35.7	14.1	38.6	3.42	45.7	130.9	5.98	14.50	244.6	8.8	141.0
EG 3	2016	8	40.9	140.5	57.4	139.1	76.0	3.03	7.34	28.0	139.3	36.1	15.4	37.6	3.73	44.1	136.3	6.01	14.57	258.3	9.3	146.9
EG 3	2016	9	41.1	132.0	56.9	137.9	71.4	3.22	7.81	27.5	130.9	37.1	13.1	38.1	3.18	46.6	130.0	6.06	14.69	256.8	9.1	147.4
EG 3	2016	10	41.0	132.1	56.9	137.9	71.4	2.99	7.25	27.7	139.7	36.0	16.8	36.3	4.07	43.0	138.6	5.96	14.45	259.2	9.1	145.4
EG 3			**41.70**	**135.60**	**56.50**	**137.1**	**73.3**	**3.06**	**7.41**	**27.7**	**133.5**	**37.0**	**15.4**	**37.4**	**3.74**	**45.5**	**132.4**	**6.02**	14.60	**253.0**	**9.0**	**144.50**
EG 3	2017	1	42.4	141.0	65.0	157.6	93.7	4.42	10.71	31.7	138.7	44.0	18.4	48.6	4.46	49.2	135.9	6.69	16.22	243.1	8.8	157.8
EG 3	2017	2	44.3	151.9	66.5	161.2	100.7	4.28	10.37	32.8	133.7	46.0	19.0	47.8	4.61	43.5	148.8	6.48	15.71	227.4	9.0	146.3
EG 3	2017	3	43.6	140.5	66.2	160.5	93.4	4.13	10.01	28.4	139.8	42.9	20.2	45.4	4.90	49.0	135.0	6.62	16.05	226.4	8.7	151.8
EG 3	2017	4	42.9	152.1	64.5	156.3	101.1	4.59	11.13	29.8	147.0	47.4	18.5	45.1	4.48	42.7	151.3	6.41	15.54	236.6	8.9	149.4
EG 3	2017	5	43.5	156.5	66.8	161.9	104.0	4.20	10.18	31.1	152.4	44.5	18.3	46.0	4.44	43.7	154.5	6.75	16.32	239.3	8.9	155.2
EG 3	2017	6	42.6	157.6	66.6	161.4	104.7	4.54	11.00	32.5	152.5	46.7	19.7	49.7	4.78	50.0	132.4	6.84	16.58	232.1	8.7	160.6
EG 3	2017	7	42.6	147.7	65.4	158.5	98.1	4.21	10.21	31.6	148.8	47.1	20.2	47.5	4.90	49.4	135.9	6.71	16.27	243.7	9.1	157.5
EG 3	2017	8	43.7	158.6	64.3	155.9	105.4	4.19	10.16	29.6	134.5	43.2	20.5	48.6	4.97	42.6	147.3	6.27	15.40	230.1	9.1	144.0
EG 3	2017	9	43.8	150.7	65.6	159.9	100.1	4.53	10.98	30.0	150.7	42.8	19.0	46.1	4.61	43.6	149.0	6.49	15.73	227.7	9.1	148.2
EG 3	2017	10	43.6	159.4	65.1	157.8	105.9	4.49	10.88	31.1	149.9	42.1	20.6	45.1	4.99	48.3	134.9	6.51	15.78	243.6	8.8	149.3
EG 3			**43.30**	**151.60**	**65.60**	**159.1**	**100.7**	**4.36**	**10.56**	**30.9**	**144.8**	**44.7**	**19.4**	**47.0**	**4.71**	**46.2**	**142.5**	**6.58**	15.96	**235.0**	**8.9**	**152.00**
EG 3	2018	1	41.3	152.7	63.1	153.0	84.6	3.58	8.68	32.7	125.9	41.6	18.8	46.5	4.56	41.7	144.3	5.93	14.37	243.1	8.0	143.6
EG 3	2018	2	41.6	147.0	62.0	150.3	81.4	3.55	8.61	27.6	132.7	40.6	17.5	43.8	4.24	49.2	130.3	6.41	15.54	229.3	8.1	154.1
EG 3	2018	3	41.5	135.4	61.8	149.8	75.0	3.28	7.95	33.0	135.4	44.6	19.1	42.1	4.63	49.0	125.6	6.37	15.44	241.4	8.2	153.5
EG 3	2018	4	42.3	147.1	62.2	150.8	81.5	3.55	8.61	30.4	127.3	42.7	18.9	40.5	4.58	43.4	150.3	6.53	15.83	228.7	8.0	154.4
EG 3	2018	5	42.4	155.1	63.1	152.0	86.1	3.48	8.44	27.7	147.0	41.8	19.8	40.9	4.80	48.3	130.4	6.30	15.27	241.8	8.2	148.6
EG 3	2018	6	42.1	149.0	62.2	150.8	82.5	3.32	8.05	30.1	143.6	43.5	15.2	42.3	3.68	44.6	132.6	5.92	14.45	245.0	8.3	141.7
EG 3	2018	7	41.6	153.5	62.7	152.0	85.0	3.50	8.48	31.8	148.5	41.0	18.0	42.2	4.36	43.2	143.6	6.21	15.05	242.9	8.2	149.3
EG 3	2018	8	41.3	158.9	62.3	151.0	88.0	3.28	7.95	30.5	145.4	43.0	15.8	43.3	3.83	44.7	137.0	6.12	14.83	237.5	8.0	148.2
EG 3	2018	9	42.4	147.5	63.8	154.7	81.7	3.55	8.61	28.9	147.9	43.7	17.0	43.1	4.12	48.7	128.5	6.26	15.17	230.5	8.1	147.6
EG 3	2018	10	42.5	144.8	61.8	149.8	80.2	3.50	8.48	32.5	131.8	40.6	17.1	45.7	4.15	44.2	140.4	6.21	15.05	229.8	8.1	146.1
EG 3			**41.90**	**149.10**	**62.50**	**151.4**	**82.6**	**3.46**	**8.38**	**30.5**	**138.6**	**42.3**	**17.7**	**43.0**	**4.30**	**45.7**	**136.3**	**6.23**	15.10	**237.0**	**8.1**	**148.70**
EG 3	2019	1	38.7	121.9	50.2	121.7	64.3	2.84	6.88	23.7	118.6	30.1	13.2	29.0	3.20	37.4	111.7	4.14	10.04	226.1	6.2	107.0
EG 3	2019	2	40.0	127.2	49.1	119.0	67.1	2.67	6.47	26.5	122.2	29.5	12.1	29.6	2.93	43.9	101.8	4.47	10.83	238.5	6.0	111.8
EG 3	2019	3	39.6	129.1	49.2	119.3	68.1	2.56	6.21	27.2	123.2	27.9	11.7	28.0	2.84	45.0	96.8	4.61	11.07	231.3	6.0	116.4
EG 3	2019	4	39.5	134.7	49.3	119.5	71.1	2.45	5.94	26.9	112.5	31.3	12.6	30.9	3.05	45.0	95.1	4.28	10.37	231.2	6.3	108.6
EG 3	2019	5	38.8	115.7	49.7	120.5	61.1	2.60	6.30	27.7	112.5	30.9	12.2	29.5	2.96	43.6	98.7	4.30	10.42	224.7	6.2	110.8
EG 3	2019	6	38.9	132.7	49.9	121.4	70.3	2.48	6.01	26.8	105.6	33.2	11.2	28.5	2.71	36.9	110.5	4.08	9.89	221.3	6.0	104.9
EG 3	2019	7	39.9	131.7	50.3	121.9	69.5	2.61	6.33	27.5	120.3	31.3	12.4	30.2	3.01	45.7	96.1	4.39	10.64	237.1	6.2	110.0
EG 3	2019	8	40.3	131.4	50.5	122.4	69.4	2.65	6.42	27.9	105.3	29.1	11.3	30.0	2.74	42.5	106.1	4.51	10.93	221.2	6.1	110.4
EG 3	2019	9	38.9	121.3	49.6	120.2	64.0	2.71	6.57	25.5	123.5	33.1	13.1	27.4	3.18	45.9	94.5	4.34	10.52	235.4	5.9	111.6
EG 3	2019	10	39.4	121.3	51.2	124.1	64.0	2.70	6.54	24.8	121.5	32.8	12.1	31.6	2.93	43.1	94.7	4.08	9.89	233.2	6.2	103.6
EG 3			**39.40**	**126.70**	**49.90**	**121.0**	**66.9**	**2.63**	**6.37**	**26.5**	**116.5**	**30.9**	**12.2**	**29.5**	**2.95**	**42.9**	**100.6**	**4.32**	10.46	**230.0**	**6.1**	**109.50**
EG 3	2020	1	30.7	63.8	19.7	47.8	16.8	0.50	1.21	22.0	86.8	20.0	6.3	14.5	1.53	36.6	54.3	1.99	4.82	296.1	6.2	64.2
EG 3	2020	2	31.1	65.1	19.9	48.2	17.2	0.47	1.14	20.7	88.0	17.8	5.3	14.3	1.28	25.6	64.4	1.65	4.01	288.1	6.5	53.1
EG 3	2020	3	31.6	64.5	20.4	48.1	17.6	0.48	1.16	22.0	82.7	19.6	6.6	15.9	1.60	28.1	58.3	1.64	3.98	283.3	6.6	51.9
EG 3	2020	4	32.0	57.3	20.0	48.5	15.1	0.50	1.21	21.6	84.9	19.5	6.4	13.6	1.55	37.0	48.9	1.93	4.68	285.1	6.6	60.3
EG 3	2020	5	30.5	72.1	20.3	49.2	19.0	0.54	1.31	20.2	83.0	19.5	5.9	14.5	1.43	32.3	61.3	1.98	4.80	301.0	6.5	64.9
EG 3	2020	6	31.6	60.9	19.7	47.8	16.1	0.52	1.26	24.8	83.3	20.1	5.0	13.3	1.21	26.8	56.3	1.51	3.66	289.9	6.5	47.8
EG 3	2020	7	31.5	64.8	19.2	46.5	17.1	0.59	1.43	22.6	85.1	18.2	4.9	15.5	1.19	29.8	51.4	1.53	3.71	292.1	6.7	48.6
EG 3	2020	8	32.0	62.6	20.4	49.4	16.5	0.58	1.41	23.5	83.6	20.8	5.9	12.5	1.43	35.1	49.0	1.72	4.17	299.2	6.3	53.8
EG 3	2020	9	31.5	54.3	19.8	48.0	14.3	0.53	1.28	23.0	85.6	17.2	6.4	15.2	1.55	31.8	56.6	1.80	4.36	290.1	6.5	57.1
EG 3	2020	10	30.5	68.6	19.6	47.5	18.1	0.46	1.12	23.8	83.0	17.1	6.7	14.8	1.62	33.9	52.5	1.78	4.31	295.1	6.6	58.4
EG 3			**31.30**	**63.40**	**19.90**	**48.1**	**16.8**	**0.52**	**1.25**	**22.4**	**84.6**	**19.0**	**5.9**	**14.4**	**1.44**	**31.7**	**55.3**	**1.75**	4.25	**292.0**	**6.5**	**56.00**
EG 3	2021	1	35.7	79.5	27.0	65.4	33.3	1.06	2.57	24.0	108.7	26.3	9.1	23.4	2.21	33.3	94.6	3.15	7.64	248.4	8.2	88.2
EG 3	2021	2	35.7	76.4	27.3	66.2	32.0	1.26	3.05	26.4	95.1	24.3	9.9	22.9	2.40	41.4	75.4	3.12	7.59	257.3	8.3	87.4
EG 3	2021	3	36.6	76.2	28.0	67.0	31.9	1.18	2.86	25.2	92.4	24.1	9.3	20.3	2.25	41.0	74.1	3.18	7.71	248.0	8.1	86.9
EG 3	2021	4	36.3	67.8	28.0	67.9	28.4	1.26	3.05	26.5	91.8	26.2	8.5	21.2	2.06	41.6	76.1	3.24	7.85	253.5	8.2	89.3
EG 3	2021	5	37.3	80.9	28.7	69.6	33.5	1.30	3.15	24.2	88.8	25.8	10.3	20.7	2.50	39.8	91.4	3.64	8.82	258.8	8.2	97.0
EG 3	2021	6	36.9	66.5	27.3	66.2	27.8	1.10	2.67	25.9	109.8	24.6	9.5	23.9	2.30	37.1	86.6	3.21	7.78	262.0	8.1	87.0
EG 3	2021	7	37.4	79.8	28.8	69.8	33.4	1.19	2.88	26.9	105.9	24.2	8.6	22.0	2.08	35.9	89.8	3.22	7.81	248.7	8.1	86.1
EG 3	2021	8	36.3	74.9	27.8	67.4	31.3	1.14	2.76	26.8	92.3	24.4	9.0	21.7	2.18	46.1	76.0	3.56	8.63	259.1	8.3	98.1
EG 3	2021	9	37.0	83.4	27.5	66.7	34.9	1.07	2.59	25.2	98.6	25.8	8.8	24.0	2.13	43.6	73.1	3.19	7.73	258.5	8.3	86.2
EG 3	2021	10	35.8	75.6	27.6	66.9	31.6	1.02	2.47	26.4	92.8	25.9	8.9	23.1	2.16	36.2	92.9	3.36	8.14	245.7	8.2	93.9
EG 3			**36.50**	**76.10**	**27.80**	**67.3**	**31.8**	**1.16**	**2.81**	**25.8**	**97.6**	**25.2**	**9.2**	**22.3**	**2.23**	**39.6**	**83.0**	**3.29**	7.97	**254.0**	**8.2**	**90.00**
EG 4	2015	1	40.0	120.8	47.7	115.6	62.2	2.49	6.04	23.9	106.2	27.5	9.5	24.5	2.30	44.6	94.8	4.23	10.25	231.7	8.2	105.8
EG 4	2015	2	38.6	120.5	47.6	115.4	62.1	2.51	6.08	24.3	123.5	28.6	12.0	30.1	2.91	47.9	88.5	4.19	10.16	228.1	8.5	108.5

EG 4	2015	3	39.7	114.9	48.8	118.3	59.2	2.51	6.08	22.2	113.8	28.3	11.4	31.0	2.76	46.0	87.8	4.28	10.37	222.6	8.4	107.8
EG 4	2015	4	39.8	127.3	48.6	117.8	65.6	2.41	5.84	25.1	114.4	29.5	12.4	27.5	3.01	44.0	97.9	4.31	10.45	235.8	8.4	108.3
EG 4	2015	5	40.0	110.8	47.7	115.6	57.1	2.38	5.77	27.0	107.5	28.0	11.9	25.1	2.88	41.0	100.8	4.13	10.01	231.4	8.5	103.3
EG 4	2015	6	39.3	128.8	48.3	116.0	66.6	2.58	6.25	23.2	110.3	30.7	10.3	25.9	2.50	38.0	105.8	3.93	9.53	236.9	8.2	100.0
EG 4	2015	7	40.0	121.4	47.0	113.9	62.5	2.42	5.87	26.3	124.1	30.2	10.2	26.7	2.47	40.0	99.6	3.98	9.65	241.7	8.1	99.5
EG 4	2015	8	38.5	129.5	48.4	117.3	66.7	2.39	5.79	23.7	118.3	28.9	11.6	26.8	2.81	40.4	104.0	4.20	10.18	223.2	8.2	109.1
EG 4	2015	9	39.5	125.3	48.2	116.8	64.5	2.57	6.23	25.7	118.1	28.1	12.4	25.3	3.01	42.3	92.4	3.91	9.55	227.8	8.6	99.6
EG 4	2015	10	38.6	115.7	46.7	113.2	59.6	2.43	5.89	26.8	122.7	27.2	11.0	31.0	2.67	45.8	100.4	4.60	11.15	240.8	8.0	119.2
EG 4			**39.40**	**121.50**	**47.90**	**116.0**	**62.6**	**2.47**	**5.98**	**24.8**	**115.9**	**28.7**	**11.3**	**27.4**	**2.73**	**43.0**	**97.2**	**4.18**	10.13	**232.0**	**8.3**	**106.10**
EG 4	2016	1	39.3	131.8	50.2	121.7	71.3	2.77	6.71	29.0	135.0	31.6	13.5	32.7	3.27	48.3	116.3	5.67	13.74	258.1	9.1	144.3
EG 4	2016	2	39.4	133.6	50.8	123.1	72.2	2.65	6.42	27.7	134.1	34.3	14.6	32.0	3.54	45.4	126.5	5.74	13.91	259.3	8.8	145.6
EG 4	2016	3	39.5	120.2	51.4	124.6	65.0	2.81	6.81	24.4	138.1	37.7	12.6	32.1	3.05	45.7	116.5	5.32	12.90	255.3	8.7	134.7
EG 4	2016	4	38.4	121.7	51.0	123.6	65.8	2.62	6.35	24.7	123.8	34.6	14.9	32.2	3.61	42.2	128.7	5.43	13.16	252.4	8.9	141.4
EG 4	2016	5	38.6	121.9	50.7	122.9	65.9	2.80	6.79	23.8	138.3	34.2	13.7	33.4	3.32	42.7	120.2	5.13	12.44	253.0	9.0	132.9
EG 4	2016	6	38.9	133.1	50.0	121.2	72.4	2.80	6.79	27.2	135.5	38.0	13.5	32.9	3.27	41.2	122.2	5.04	12.22	264.3	9.0	129.6
EG 4	2016	7	39.1	135.8	50.8	123.6	73.4	2.67	6.47	26.0	125.6	36.2	14.2	34.3	3.44	41.3	124.8	5.16	12.51	256.4	8.6	132.0
EG 4	2016	8	39.5	122.4	51.5	124.8	66.2	2.58	6.25	27.7	131.6	34.7	12.0	35.0	2.91	39.3	126.1	4.96	12.02	255.0	9.0	125.6
EG 4	2016	9	40.0	131.4	49.4	119.7	71.1	2.83	6.86	27.8	124.0	34.1	14.4	33.6	3.49	42.7	129.8	5.54	13.43	253.1	9.0	138.5
EG 4	2016	10	40.3	136.1	50.2	121.7	73.6	2.85	6.91	25.0	141.0	33.2	13.9	33.8	3.37	39.2	126.9	4.98	12.07	253.1	8.9	123.6
EG 4			**39.30**	**128.80**	**50.60**	**122.7**	**69.7**	**2.74**	**6.64**	**26.3**	**132.7**	**34.9**	**13.7**	**33.2**	**3.33**	**42.8**	**123.8**	**5.30**	12.84	**256.0**	**8.9**	**134.80**
EG 4	2017	1	41.1	152.4	60.7	147.1	99.1	3.84	9.31	30.0	144.2	43.2	17.1	45.6	4.15	45.6	122.2	5.71	13.84	228.4	8.7	138.9
EG 4	2017	2	40.8	149.7	59.0	143.0	97.0	3.88	9.41	30.5	135.1	44.9	17.1	42.8	4.15	38.9	137.1	5.33	12.92	242.7	9.0	130.6
EG 4	2017	3	42.6	134.5	59.3	143.1	87.4	3.75	9.09	31.6	140.5	43.2	18.9	42.8	4.58	38.3	140.6	5.35	12.97	242.4	9.0	127.0
EG 4	2017	4	42.3	152.4	61.0	147.9	99.1	3.75	9.09	28.4	141.7	43.6	16.8	42.5	4.07	38.5	141.2	5.44	13.19	229.2	8.7	128.6
EG 4	2017	5	41.3	140.7	60.9	147.6	91.5	4.07	9.87	29.5	147.3	41.0	18.1	43.4	4.39	38.7	140.7	5.45	13.21	240.5	8.8	132.0
EG 4	2017	6	41.2	150.5	60.8	147.4	97.8	3.91	9.48	30.3	153.2	42.5	17.6	42.1	4.27	42.5	139.7	5.94	14.33	229.0	8.6	144.0
EG 4	2017	7	42.0	136.5	60.9	147.6	88.7	4.09	9.91	28.3	148.3	41.2	18.9	43.4	4.58	47.4	125.5	5.95	14.42	236.9	8.9	141.7
EG 4	2017	8	41.5	138.0	59.9	145.2	89.7	4.03	9.77	29.6	145.5	41.4	17.1	42.1	4.15	42.7	138.1	5.89	14.28	241.8	8.7	141.9
EG 4	2017	9	42.0	150.7	60.6	146.9	98.0	3.92	9.50	28.1	135.6	41.9	18.6	43.3	4.51	42.5	133.4	5.67	13.74	242.5	8.9	135.0
EG 4	2017	10	42.2	139.6	59.9	145.2	90.7	3.97	9.62	29.0	154.3	43.2	17.6	42.5	4.27	39.9	133.5	5.33	13.10	236.6	8.8	126.3
EG 4			**41.70**	**144.50**	**60.30**	**146.1**	**93.9**	**3.92**	**9.50**	**29.5**	**144.6**	**42.6**	**17.8**	**43.1**	**4.31**	**41.5**	**135.2**	**5.61**	13.60	**237.0**	**8.8**	**134.60**
EG 4	2018	1	36.1	148.3	49.8	120.7	78.2	2.62	6.35	29.1	127.2	40.1	13.0	35.8	3.15	36.2	126.4	4.57	11.08	241.0	8.0	126.6
EG 4	2018	2	35.9	136.7	49.7	120.5	72.2	2.56	6.21	26.6	135.7	41.5	14.7	36.1	3.56	39.5	123.3	4.87	11.80	239.0	8.1	135.7
EG 4	2018	3	36.4	138.3	51.5	124.8	73.0	2.71	6.57	28.9	145.2	40.6	15.8	32.6	3.83	40.1	114.8	4.60	11.15	233.4	8.0	126.4
EG 4	2018	4	36.3	149.5	50.3	121.9	78.9	2.82	6.84	30.3	142.6	38.6	13.3	34.6	3.22	41.2	117.0	4.82	11.68	228.9	8.2	131.5
EG 4	2018	5	35.8	142.5	51.2	124.1	75.2	2.78	6.74	28.6	145.6	40.2	13.6	37.5	3.30	33.9	128.5	4.35	10.54	231.1	8.0	121.5
EG 4	2018	6	35.3	133.0	51.4	124.6	70.2	2.79	6.76	27.4	140.9	40.7	13.2	32.8	3.20	37.6	126.7	4.76	11.54	244.3	8.0	134.8
EG 4	2018	7	34.8	144.3	50.8	123.1	76.2	2.74	6.64	27.2	130.6	43.7	13.6	35.1	3.30	40.8	118.3	4.83	11.71	245.5	8.0	138.8
EG 4	2018	8	36.2	151.3	50.0	122.2	79.9	2.60	6.30	29.7	134.2	37.3	14.5	33.5	3.51	37.4	114.8	4.29	10.41	243.4	7.8	118.5
EG 4	2018	9	34.8	141.0	51.4	124.6	74.4	2.60	6.30	32.4	131.6	39.0	15.3	37.0	3.71	39.7	124.9	4.96	12.02	232.5	8.0	142.5
EG 4	2018	10	35.4	136.1	50.9	123.4	71.8	2.60	6.30	29.5	150.8	38.8	15.9	32.1	3.85	42.6	114.3	4.98	12.07	240.9	8.0	140.7
EG 4			**35.70**	**142.10**	**50.70**	**123.0**	**75.0**	**2.68**	**6.50**	**29.0**	**138.4**	**40.1**	**14.3**	**34.7**	**3.46**	**38.9**	**120.9**	**4.70**	11.40	**238.0**	**8.0**	**131.70**
EG 4	2019	1	34.4	115.0	41.5	100.6	59.1	2.21	5.32	21.1	112.4	32.9	9.6	23.5	2.33	40.3	91.0	3.67	8.90	225.9	6.0	106.7
EG 4	2019	2	34.9	127.5	42.8	103.7	65.7	2.14	5.19	24.5	112.7	29.6	9.6	24.9	2.33	36.1	95.9	3.46	8.39	224.6	6.2	99.1
EG 4	2019	3	34.4	122.0	41.6	100.8	62.8	2.11	5.11	27.7	120.9	28.4	11.2	24.6	2.71	40.3	93.0	3.75	9.09	227.1	6.1	109.0
EG 4	2019	4	34.1	111.9	42.3	102.5	57.6	2.10	5.09	26.7	123.8	27.0	10.0	26.6	2.42	38.2	97.6	3.73	9.04	233.9	6.0	108.8
EG 4	2019	5	35.3	114.8	41.4	100.4	59.1	2.24	5.43	28.0	114.6	30.1	9.9	26.8	2.40	34.1	92.4	3.15	7.68	222.1	6.1	89.2
EG 4	2019	6	35.6	120.1	42.4	102.8	61.9	2.28	5.53	27.4	125.1	27.6	10.0	24.7	2.42	36.0	97.2	3.50	8.48	238.1	6.3	98.3
EG 4	2019	7	34.2	124.2	42.9	104.9	64.0	2.19	5.31	22.3	110.0	30.8	10.3	24.9	2.50	40.0	88.4	3.63	8.80	238.3	6.3	106.1
EG 4	2019	8	35.6	127.1	41.9	101.6	65.5	2.14	5.19	26.6	110.3	30.3	10.2	22.6	2.47	38.0	98.4	3.74	9.07	236.7	6.1	105.1
EG 4	2019	9	33.9	124.6	41.1	99.6	64.2	2.13	5.16	24.0	113.3	30.5	12.0	23.7	2.91	43.1	88.1	3.80	9.21	232.8	6.1	112.1
EG 4	2019	10	35.6	120.8	42.1	102.1	62.2	2.11	5.11	27.1	119.7	29.0	10.0	27.3	2.42	32.9	97.0	3.15	7.64	240.5	5.9	88.5
EG 4			**34.80**	**120.80**	**42.00**	**101.9**	**62.2**	**2.17**	**5.24**	**25.5**	**116.3**	**29.6**	**10.3**	**25.0**	**2.49**	**37.9**	**93.9**	**3.56**	8.63	**232.0**	**6.1**	**102.30**
EG 4	2020	1	25.1	58.8	13.1	31.8	14.5	0.29	0.70	18.6	94.8	19.0	4.4	8.7	1.07	32.0	49.6	1.72	4.17	308.5	6.6	66.5
EG 4	2020	2	24.9	48.5	14.4	34.9	11.9	0.36	0.87	19.3	75.4	19.0	4.0	10.6	0.97	25.2	55.2	1.39	3.37	298.4	6.4	55.8
EG 4	2020	3	24.8	49.0	13.4	32.5	12.1	0.35	0.85	18.5	80.7	18.6	3.2	11.4	0.78	36.6	46.4	1.70	4.12	295.4	6.5	68.5
EG 4	2020	4	26.0	60.1	13.7	33.2	14.8	0.37	0.90	19.3	85.0	17.0	3.5	9.3	0.85	25.5	51.8	1.32	3.25	301.7	6.3	50.8
EG 4	2020	5	25.3	62.2	14.2	34.0	15.7	0.29	0.70	23.8	81.5	15.8	5.9	12.5	1.43	25.7	54.9	1.41	3.42	308.7	6.4	55.7
EG 4	2020	6	24.5	60.7	14.1	34.2	14.9	0.35	0.85	21.9	97.7	16.5	5.0	9.0	1.21	27.0	54.3	1.56	3.78	301.9	6.3	63.7
EG 4	2020	7	24.7	51.2	14.0	33.9	12.6	0.41	0.99	19.5	86.9	17.9	4.8	9.6	1.16	23.3	57.7	1.23	2.98	294.7	6.5	52.0
EG 4	2020	8	25.4	51.5	12.8	31.0	12.7	0.37	0.90	22.1	80.7	15.7	3.8	12.3	0.92	28.0	50.0	1.40	3.39	297.6	6.2	55.1
EG 4	2020	9	24.1	56.7	14.5	35.1	14.0	0.32	0.78	19.5	75.5	15.6	3.6	11.0	0.87	33.3	48.7	1.62	3.93	293.4	6.4	67.2
EG 4	2020	10	25.2	52.3	13.8	33.5	12.9	0.33	0.80	20.5	84.6	15.9	4.3	9.6	1.04	20.4	56.4	1.15	2.79	299.7	6.5	45.6
EG 4			**25.00**	**55.10**	**13.80**	**33.4**	**13.6**	**0.34**	**0.83**	**20.3**	**84.3**	**17.1**	**4.3**	**10.4**	**1.03**	**27.7**	**52.5**	**1.45**	3.52	**300.0**	**6.4**	**58.10**

EG 4	2021	1	31.4	63.7	20.1	48.7	24.5	0.78	1.89	20.8	86.6	19.8	5.1	17.4	1.24	36.6	68.8	2.52	6.11	248.5	8.0	80.4
EG 4	2021	2	31.7	63.2	20.9	49.3	24.1	0.88	2.13	22.1	94.2	24.8	6.5	18.9	1.58	36.4	81.6	2.97	7.00	251.7	8.1	93.6
EG 4	2021	3	31.8	70.3	20.1	48.7	27.0	0.76	1.84	24.3	100.6	20.7	8.0	17.0	1.94	36.0	74.5	2.68	6.52	260.5	8.1	84.3
EG 4	2021	4	31.3	71.9	21.3	51.6	27.7	0.71	1.72	24.1	97.9	20.8	7.5	16.4	1.82	39.1	72.8	2.85	6.91	262.1	8.1	91.1
EG 4	2021	5	30.8	65.4	20.0	48.5	25.2	0.70	1.70	23.9	97.2	23.5	6.2	16.4	1.50	31.0	82.0	2.53	6.13	262.2	8.1	82.1
EG 4	2021	6	30.2	70.1	21.0	50.9	27.0	0.84	2.04	23.3	94.6	24.4	6.8	17.0	1.65	36.0	77.6	2.97	7.20	263.7	8.1	96.0
EG 4	2021	7	31.4	57.8	21.5	52.1	22.2	0.83	2.01	22.1	98.2	24.7	7.6	16.9	1.84	35.1	81.1	2.85	6.91	259.2	8.1	90.8
EG 4	2021	8	30.8	74.8	20.6	49.9	28.8	0.81	1.96	24.3	102.4	23.9	8.8	16.8	2.13	32.1	86.2	2.77	6.71	249.2	8.1	89.9
EG 4	2021	9	30.2	66.2	19.9	48.2	25.5	0.82	1.99	24.1	98.0	23.6	7.0	16.0	1.70	30.1	83.7	2.52	6.11	246.2	8.2	83.4
EG 4	2021	10	31.4	57.6	20.6	49.9	22.2	0.79	1.91	24.0	106.3	20.6	7.8	18.4	1.89	33.6	79.7	2.68	6.50	256.7	8.1	85.4
EG 4			**31.10**	**66.10**	**20.60**	**49.8**	**25.4**	**0.79**	**1.92**	**23.3**	**97.6**	**22.7**	**7.1**	**17.1**	**1.73**	**34.6**	**78.8**	**2.73**	6.61	**256.0**	**8.1**	**87.70**
EG 5	2015	1	37.8	118.4	43.9	106.4	61.0	2.31	5.60	22.2	110.2	25.3	11.5	28.3	2.79	44.0	89.1	3.92	9.50	238.7	8.1	103.7
EG 5	2015	2	36.9	120.3	43.4	105.2	62.0	2.29	5.55	25.3	119.1	29.3	10.2	23.6	2.47	43.3	90.1	3.90	9.45	233.9	8.1	105.7
EG 5	2015	3	38.3	120.3	42.1	102.1	62.0	2.15	5.21	23.6	108.0	28.7	12.0	22.2	2.91	45.5	81.3	3.76	9.11	229.8	8.2	98.2
EG 5	2015	4	38.2	122.4	42.9	104.0	63.0	2.13	5.16	22.9	127.8	26.5	9.8	25.9	2.38	39.5	85.5	3.36	8.14	231.0	8.3	88.5
EG 5	2015	5	37.6	105.4	43.0	104.2	54.3	2.18	5.28	24.2	108.9	26.2	9.1	26.5	2.21	44.2	83.7	3.70	8.97	245.5	7.8	98.4
EG 5	2015	6	38.0	107.9	42.4	102.0	55.6	2.24	5.43	24.1	113.2	26.0	9.9	26.2	2.40	41.4	93.1	3.85	9.33	235.6	8.1	101.3
EG 5	2015	7	38.1	118.6	43.9	106.4	61.1	2.17	5.26	25.0	133.0	26.0	9.7	22.1	2.35	36.6	90.2	3.30	8.10	241.0	8.2	86.6
EG 5	2015	8	36.8	109.8	43.9	106.4	56.4	2.23	5.41	21.5	106.1	28.3	9.7	24.1	2.35	34.7	96.1	3.37	8.17	237.5	7.9	91.6
EG 5	2015	9	37.9	111.9	43.3	105.0	57.6	2.34	5.67	21.1	121.1	27.2	9.6	25.3	2.33	39.2	89.0	3.49	8.46	246.5	8.2	92.1
EG 5	2015	10	37.4	107.0	42.2	102.3	55.1	2.19	5.31	22.7	111.7	26.9	10.0	23.2	2.42	42.6	86.9	3.70	8.97	240.5	8.2	98.9
EG 5			**37.70**	**114.20**	**43.10**	**104.4**	**58.8**	**2.22**	**5.39**	**23.3**	**115.9**	**27.0**	**10.2**	**24.7**	**2.46**	**41.1**	**88.5**	**3.64**	8.82	**238.0**	**8.1**	**96.50**
EG 5	2016	1	32.6	119.7	37.4	90.7	63.0	2.02	4.90	26.3	135.9	33.5	10.0	25.7	2.42	34.5	118.4	4.08	9.89	250.4	8.7	125.2
EG 5	2016	2	31.9	118.3	36.8	89.2	62.4	2.09	5.00	24.1	135.5	31.6	12.4	26.3	3.01	36.1	114.7	4.14	10.04	260.8	8.7	129.8
EG 5	2016	3	32.4	115.5	38.7	93.8	61.0	2.00	4.85	27.6	127.0	32.4	11.8	25.8	2.86	32.3	117.7	3.80	9.22	268.0	8.7	117.3
EG 5	2016	4	31.3	113.1	37.5	90.9	59.6	1.96	4.75	25.9	135.1	37.2	9.4	22.2	2.28	33.5	114.4	3.83	9.28	250.7	8.9	122.4
EG 5	2016	5	31.8	127.1	38.0	92.8	67.1	1.98	4.80	22.6	135.7	31.6	11.2	28.2	2.71	31.4	124.3	3.90	9.45	251.2	9.0	122.6
EG 5	2016	6	31.0	127.2	37.9	91.9	67.1	2.07	5.02	26.4	129.2	37.4	11.0	24.3	2.67	36.7	122.6	4.59	11.10	260.5	8.9	147.8
EG 5	2016	7	31.7	127.9	37.9	91.9	67.5	2.03	4.92	26.6	137.5	30.7	10.9	28.3	2.64	32.6	129.1	4.21	10.21	262.8	8.8	132.8
EG 5	2016	8	31.0	122.3	37.1	89.9	64.6	1.95	4.73	24.1	120.6	32.2	10.9	27.3	2.64	35.6	116.7	4.15	10.06	265.4	8.8	133.9
EG 5	2016	9	31.1	112.1	38.7	93.8	59.2	1.93	4.68	27.9	132.4	35.2	10.1	26.6	2.45	37.7	118.4	4.46	10.81	255.6	8.7	142.0
EG 5	2016	10	32.2	110.8	38.0	92.1	58.5	1.98	4.80	22.7	137.8	35.2	9.2	24.3	2.23	29.6	128.7	3.81	9.24	254.6	8.9	118.3
EG 5			**31.70**	**119.40**	**37.80**	**91.7**	**63.0**	**2.00**	**4.84**	**25.4**	**132.7**	**33.7**	**10.7**	**25.9**	**2.59**	**34.0**	**120.5**	**4.10**	9.93	**258.0**	**8.8**	**129.20**
EG 5	2017	1	40.6	142.8	55.8	135.3	90.8	3.52	8.53	28.2	155.1	40.2	13.6	37.2	3.30	35.5	125.2	4.44	10.70	235.1	8.6	109.4
EG 5	2017	2	40.6	140.0	53.7	130.2	89.0	3.49	8.46	26.2	145.3	38.6	13.3	38.5	3.22	39.0	123.2	4.95	11.90	236.0	8.7	121.9
EG 5	2017	3	39.2	133.5	53.3	129.0	84.9	3.53	8.56	29.0	155.6	38.0	16.9	37.9	4.10	38.4	115.4	4.43	10.74	241.6	8.9	113.0
EG 5	2017	4	40.5	124.0	54.3	131.6	78.8	3.45	8.36	26.5	152.1	39.8	17.5	38.5	4.24	38.1	126.3	4.81	11.66	246.5	8.8	118.8
EG 5	2017	5	39.4	141.9	55.2	133.8	90.2	3.26	7.90	25.8	138.9	39.8	13.9	38.4	3.37	37.4	125.1	4.68	11.34	233.8	8.8	118.8
EG 5	2017	6	40.9	141.0	53.8	130.4	89.7	3.54	8.58	28.6	139.3	38.6	17.5	35.8	4.24	42.5	119.6	5.08	12.31	249.5	8.6	124.2
EG 5	2017	7	40.4	124.1	54.3	131.6	78.9	3.33	8.07	28.6	131.5	39.7	14.7	35.7	3.56	45.6	110.9	5.06	12.27	233.2	8.8	124.0
EG 5	2017	8	39.4	130.8	53.4	129.4	83.2	3.24	7.85	25.8	134.7	39.7	15.3	39.3	3.71	39.3	115.9	4.55	11.03	238.8	8.6	115.5
EG 5	2017	9	39.6	140.3	53.9	130.7	89.2	3.60	8.73	25.1	144.0	37.0	17.0	37.8	4.12	41.1	124.6	5.12	12.41	244.1	8.5	129.3
EG 5	2017	10	39.4	138.6	55.3	134.0	88.3	3.50	8.48	25.1	146.8	37.0	15.1	36.8	3.66	41.1	121.8	5.01	12.14	241.4	8.7	127.2
EG 5			**40.00**	**135.70**	**54.30**	**131.6**	**86.3**	**3.45**	**8.35**	**26.9**	**144.3**	**38.8**	**15.5**	**37.6**	**3.75**	**39.8**	**120.8**	**4.81**	11.65	**240.0**	**8.7**	**120.20**
EG 5	2018	1	32.6	125.8	43.5	105.4	66.4	2.36	5.72	29.6	132.8	34.6	13.6	28.8	3.30	36.6	108.9	3.99	9.66	242.7	8.0	122.4
EG 5	2018	2	32.6	140.8	42.9	104.0	74.3	2.19	5.31	23.6	132.0	38.2	9.4	25.5	2.28	35.7	105.2	3.76	9.11	240.2	8.1	115.3
EG 5	2018	3	33.4	126.3	44.7	107.1	66.7	2.41	5.84	26.2	146.7	37.7	14.2	26.8	3.44	38.6	106.6	4.11	9.96	232.9	8.1	123.1
EG 5	2018	4	33.3	136.3	43.1	104.5	71.9	2.24	5.43	23.6	139.3	35.5	15.0	30.2	3.64	30.3	114.8	3.48	8.60	247.1	8.0	104.5
EG 5	2018	5	33.5	131.8	42.8	103.7	69.6	2.15	5.21	25.8	139.2	35.1	11.1	30.7	2.69	34.9	117.1	4.09	9.91	248.2	8.0	122.1
EG 5	2018	6	32.4	137.8	44.5	107.9	72.7	2.50	6.06	29.9	143.3	38.5	12.3	30.7	2.98	37.4	101.5	3.80	9.21	237.9	7.9	118.8
EG 5	2018	7	32.4	123.9	43.9	106.4	65.7	2.42	5.87	30.0	129.0	39.1	10.6	33.3	2.57	34.4	114.9	3.95	9.57	247.7	7.7	121.9
EG 5	2018	8	32.4	133.0	44.0	106.7	70.2	2.16	5.24	27.9	125.5	39.0	13.7	33.1	3.32	38.2	109.2	4.17	10.10	234.9	8.1	128.7
EG 5	2018	9	31.9	137.7	43.2	104.7	72.7	2.32	5.62	25.9	149.5	39.8	12.4	30.9	3.01	35.2	107.0	3.77	9.14	231.7	8.2	118.2
EG 5	2018	10	32.5	141.6	44.4	107.6	74.7	2.20	5.33	29.2	144.5	38.0	10.3	28.4	2.50	34.7	108.8	3.77	9.14	236.7	8.0	116.0
EG 5			**32.70**	**133.50**	**43.70**	**105.8**	**70.5**	**2.30**	**5.56**	**27.2**	**138.2**	**37.6**	**12.3**	**29.8**	**2.97**	**35.6**	**109.4**	**3.89**	9.44	**240.0**	**8.0**	**119.10**
EG 5	2019	1	31.6	115.0	35.2	85.3	57.6	1.88	4.56	22.8	104.5	27.7	8.3	18.1	2.01	33.4	86.2	2.88	6.98	245.3	6.0	91.1
EG 5	2019	2	31.4	106.1	35.9	87.0	53.3	1.78	4.31	24.2	103.8	28.6	7.4	23.9	1.79	37.0	82.3	3.13	7.52	244.8	5.9	99.7
EG 5	2019	3	31.9	113.9	35.9	87.0	57.2	1.74	4.22	24.2	130.8	29.1	9.4	21.5	2.28	34.3	88.3	3.03	7.34	238.1	6.0	95.0
EG 5	2019	4	32.1	120.5	35.6	86.3	60.5	1.82	4.41	24.6	112.3	23.7	9.0	18.4	2.18	33.6	87.5	2.94	7.13	228.6	6.0	91.6
EG 5	2019	5	31.3	109.4	36.2	87.1	55.0	1.86	4.51	21.9	116.8	24.4	7.3	20.9	1.77	34.9	87.0	3.04	7.37	231.2	6.1	97.1
EG 5	2019	6	30.7	112.2	35.2	85.3	56.4	1.74	4.22	24.1	115.5	23.0	7.0	18.7	1.70	35.5	86.4	3.07	7.44	237.3	6.2	98.6
EG 5	2019	7	31.3	112.1	36.9	89.4	56.3	1.75	4.24	22.7	106.2	27.3	9.9	19.0	2.40	34.8	84.4	2.94	7.13	234.5	6.1	93.9
EG 5	2019	8	32.1	120.7	36.7	89.0	60.6	1.84	4.46	21.5	124.1	29.2	8.1	21.4	1.96	31.0	87.7	2.72	6.59	234.4	6.1	84.7
EG 5	2019	9	32.1	104.2	36.4	88.2	52.4	1.84	4.46	21.0	116.5	26.8	8.4	24.3	2.04	38.0	81.8	3.11	7.54	230.2	6.0	96.9

EG 5	2019	10	32.5	120.9	36.0	87.3	60.7	1.87	4.53	24.1	132.2	29.1	9.8	19.6	2.38	32.5	89.4	2.87	6.96	235.6	5.9	88.3
EG 5			**31.70**	**113.50**	**36.00**	**87.2**	**57.0**	**1.81**	**4.39**	**23.1**	**116.3**	**26.9**	**8.5**	**20.6**	**2.05**	**34.5**	**86.1**	**2.97**	7.20	**236.0**	**6.0**	**93.70**
EG 5	2020	1	24.3	43.3	12.7	30.8	10.3	0.35	0.85	18.0	78.4	16.2	3.3	10.4	0.80	19.1	55.5	1.06	2.80	314.7	6.4	46.0
EG 5	2020	2	24.4	48.8	12.9	31.3	11.6	0.30	0.73	18.4	75.0	17.0	3.7	11.9	0.90	26.1	56.8	1.48	3.58	321.1	6.4	60.7
EG 5	2020	3	23.6	55.0	12.5	30.3	13.1	0.27	0.65	18.5	93.1	17.9	3.5	12.0	0.85	31.0	46.7	1.45	3.51	315.5	5.9	61.4
EG 5	2020	4	24.2	52.8	11.8	28.6	12.5	0.24	0.58	21.2	95.2	18.7	3.4	8.3	0.82	24.7	52.2	1.29	3.13	313.2	6.4	53.3
EG 5	2020	5	24.1	55.3	12.3	29.8	13.1	0.28	0.68	17.5	93.6	15.6	4.5	10.3	1.09	26.0	48.1	1.25	3.03	307.6	5.9	51.9
EG 5	2020	6	22.9	57.8	11.6	28.1	13.7	0.25	0.61	23.9	79.4	17.1	4.0	9.0	0.97	27.9	48.0	1.34	3.25	321.2	5.8	58.5
EG 5	2020	7	24.1	48.0	12.2	29.6	11.4	0.34	0.82	18.7	85.8	17.7	5.0	8.9	1.21	28.3	49.5	1.40	3.39	308.5	6.3	58.1
EG 5	2020	8	23.2	53.8	12.3	29.8	12.8	0.27	0.65	23.3	80.4	18.7	2.6	9.7	0.63	29.4	48.7	1.47	3.56	314.7	5.8	63.4
EG 5	2020	9	23.1	54.0	12.2	29.6	12.8	0.23	0.56	21.5	78.0	13.3	4.2	7.9	1.02	29.5	48.2	1.42	3.44	317.6	6.1	61.3
EG 5	2020	10	23.1	49.2	12.5	30.1	11.7	0.35	0.85	17.4	84.0	14.9	4.8	7.9	1.16	21.0	53.3	1.12	2.71	325.9	5.9	48.5
EG 5			**23.70**	**51.80**	**12.30**	**29.8**	**12.3**	**0.29**	**0.70**	**19.8**	**84.3**	**16.7**	**3.9**	**9.6**	**0.95**	**26.3**	**50.7**	**1.33**	3.24	**316.0**	**6.1**	**56.30**
EG 5	2021	1	28.3	57.7	16.8	40.7	21.6	0.67	1.62	21.9	104.2	21.7	5.4	14.7	1.31	30.9	80.8	2.30	5.80	255.2	8.1	81.3
EG 5	2021	2	28.1	66.4	17.8	43.1	24.4	0.73	1.77	24.4	103.7	23.2	5.8	15.5	1.41	32.2	79.3	2.45	6.18	255.3	7.9	87.2
EG 5	2021	3	27.7	64.9	17.5	42.4	24.3	0.62	1.50	20.4	89.4	23.9	7.7	14.0	1.87	33.0	71.2	2.48	6.00	264.3	8.0	89.3
EG 5	2021	4	28.8	54.0	18.3	44.4	20.2	0.70	1.70	23.0	103.0	20.6	6.2	15.5	1.50	31.0	72.5	2.32	5.62	252.9	8.1	80.6
EG 5	2021	5	28.1	67.4	16.9	41.0	25.2	0.59	1.43	20.2	97.0	24.2	6.2	17.0	1.50	32.0	75.8	2.47	5.90	265.3	7.8	87.9
EG 5	2021	6	27.8	59.5	18.0	43.6	22.2	0.57	1.38	22.2	105.3	23.5	7.4	12.8	1.79	28.4	81.0	2.30	5.58	264.4	8.1	82.7
EG 5	2021	7	29.0	58.7	17.8	43.5	21.9	0.69	1.67	24.9	88.9	24.7	5.8	16.5	1.41	32.0	68.1	2.47	5.74	252.8	8.0	85.2
EG 5	2021	8	27.8	56.6	17.0	41.2	21.2	0.70	1.70	24.3	91.7	19.1	7.1	14.5	1.72	34.8	72.4	2.52	5.80	252.3	8.1	90.6
EG 5	2021	9	29.1	68.3	17.9	43.4	25.5	0.61	1.48	24.8	99.8	19.5	6.1	15.8	1.48	31.5	79.8	2.51	6.08	261.3	8.0	86.3
EG 5	2021	10	28.3	68.5	18.0	43.6	25.6	0.70	1.70	21.4	92.6	22.9	5.0	16.8	1.21	33.2	80.1	2.46	6.10	256.2	8.0	86.9
EG 5			**28.30**	**62.20**	**17.60**	**42.7**	**23.2**	**0.66**	**1.59**	**22.8**	**97.6**	**22.3**	**6.3**	**15.3**	**1.52**	**31.9**	**76.1**	**2.43**	5.88	**258.0**	**8.0**	**85.80**

Table A 12.2. Cl R5 Cabernet Sauvignon onto RxR 101-14.

Group	Year	Rep et	N of Sh.	Shoot Length	Annual Growth		Annual Growth Volume			N L/ Shoot	Leaf Area				LAI	N of Clus.	W. of Clus.	Yield		Sugar	Titr. Acid	SP
					m.vine	th.m/ ha	cm^3/ shoot	dm^3/ vine	m^3/ha		cm^2/ leaf	dm^2/ shoot	m^2/ vine	th. m^2/ha				per vine	per hec.			
CG	2015	1	37.7	126.0	44.1	106.9	66.5	2.32	5.62	24.2	114.8	28.6	9.9	27.0	2.60	41.6	98.8	4.11	9.96	237.1	8.4	109.0
CG	2015	2	37.8	124.5	44.8	108.6	65.7	2.36	5.72	23.2	114.0	26.9	11.1	25.9	2.69	43.7	93.6	4.09	9.91	252.2	8.1	108.2
CG	2015	3	38.4	112.3	43.9	106.4	59.3	2.28	5.53	24.9	110.8	28.1	10.1	24.3	2.45	43.6	105.2	4.59	11.06	237.2	8.2	119.3
CG	2015	4	36.3	112.3	44.6	108.1	59.3	2.33	5.65	24.8	117.1	28.5	12.0	26.0	2.91	42.4	87.8	3.72	9.02	253.3	7.8	102.5
CG	2015	5	36.7	126.6	45.9	111.3	66.8	2.32	5.62	23.8	111.0	27.6	10.5	24.5	2.55	44.4	97.6	4.33	10.50	238.7	8.1	118.0
CG	2015	6	37.6	113.4	45.6	110.5	59.9	2.30	5.58	22.3	125.1	26.5	9.8	26.0	2.38	42.4	97.1	4.12	9.98	241.9	8.2	109.6
CG	2015	7	36.6	114.4	43.1	104.5	60.4	2.32	5.62	26.0	110.4	29.5	10.9	24.6	2.64	43.4	103.3	4.48	10.87	246.7	7.9	120.0
CG	2015	8	36.5	121.4	45.8	110.0	64.1	2.36	5.72	24.6	115.9	30.0	10.0	26.6	2.30	42.4	88.7	3.76	9.12	240.9	8.0	103.0
CG	2015	9	37.3	128.4	43.3	105.3	67.6	2.44	5.91	25.6	110.5	26.5	8.8	23.6	2.13	44.3	92.1	4.08	9.89	246.0	8.2	109.4
CG	2015	10	38.1	112.7	43.9	106.4	59.5	2.45	5.94	24.6	127.4	29.8	11.9	26.5	2.88	40.8	89.8	3.66	8.88	246.0	8.1	98.0
CG			**37.30**	**119.20**	**44.50**	**107.8**	**62.9**	**2.35**	**5.69**	**24.40**	**115.70**	**28.20**	**10.50**	**25.50**	**2.55**	**42.9**	**95.4**	**4.09**	9.92	**244.0**	**8.1**	**109.70**
CG	2016	1	39.3	120.1	51.7	125.3	63.6	2.71	6.57	24.8	122.4	32.1	13.0	32.3	3.15	42.0	126.4	5.31	12.87	273.1	8.8	135.1
CG	2016	2	39.5	120.9	50.1	121.4	63.8	2.62	6.35	27.6	133.6	33.9	14.0	35.2	3.39	41.5	128.0	5.31	12.88	263.1	8.7	134.4
CG	2016	3	40.7	135.8	48.9	118.5	71.7	2.74	6.64	27.7	130.8	31.4	15.1	29.7	3.66	40.0	112.6	4.50	10.92	259.4	8.5	110.6
CG	2016	4	39.5	132.5	51.0	123.6	69.9	2.69	6.52	26.2	125.4	35.9	12.8	31.9	3.03	40.8	133.3	5.44	13.18	264.0	8.7	137.7
CG	2016	5	39.8	136.0	51.9	125.8	71.8	2.74	6.64	24.7	133.8	33.8	15.0	35.4	3.64	42.5	130.9	5.56	13.40	266.6	8.7	139.2
CG	2016	6	40.8	116.5	49.8	120.7	61.5	2.60	6.30	27.3	125.5	36.9	13.6	33.9	3.30	42.0	130.3	5.47	13.27	267.5	8.9	134.1
CG	2016	7	40.6	135.4	51.9	124.8	71.5	2.70	6.54	25.7	143.8	34.4	13.4	33.1	3.25	40.5	116.6	4.72	11.45	255.7	8.6	116.3
CG	2016	8	40.4	123.2	50.2	121.7	65.0	2.75	6.67	24.1	143.1	34.0	13.6	35.6	3.30	39.8	117.5	4.68	11.34	265.9	8.7	115.8
CG	2016	9	39.1	127.1	51.3	124.4	67.1	2.61	6.33	27.7	134.6	32.8	12.8	31.4	3.10	39.6	117.7	4.66	11.30	263.6	8.6	119.2
CG	2016	10	40.3	119.5	50.2	121.7	63.1	2.60	6.30	23.2	125.0	35.8	13.7	32.5	3.32	43.3	107.7	4.66	11.30	271.1	8.9	115.6
CG			**40.00**	**126.70**	**50.70**	**122.8**	**66.9**	**2.68**	**6.49**	**25.90**	**131.80**	**34.10**	**13.70**	**33.10**	**3.31**	**41.2**	**122.1**	**5.03**	12.19	**265.0**	**8.7**	**125.80**
CG	2017	1	40.7	148.0	60.1	145.7	94.1	3.79	9.19	27.3	150.0	39.9	17.8	41.2	4.12	48.0	130.1	6.24	15.14	246.1	9.3	153.0
CG	2017	2	41.8	130.0	61.3	148.6	82.9	3.84	9.31	30.3	152.0	40.3	16.8	40.9	4.09	44.0	131.4	5.78	14.01	241.5	8.7	138.3
CG	2017	3	42.0	136.6	61.0	147.9	86.9	3.66	8.87	29.8	132.1	40.7	16.6	40.4	4.04	46.0	132.5	6.10	14.77	231.2	8.5	144.0
CG	2017	4	42.3	149.0	59.1	143.3	94.7	3.80	9.21	27.9	150.2	41.1	17.4	42.5	4.25	46.1	122.7	5.66	13.71	239.5	8.8	133.8
CG	2017	5	41.3	145.4	58.8	142.5	92.5	3.67	8.90	27.5	144.1	40.7	17.2	42.6	4.26	45.1	117.9	5.32	12.89	235.8	8.7	128.8
CG	2017	6	41.2	148.5	58.4	141.6	94.4	3.67	8.90	30.8	133.9	40.1	17.6	41.1	4.11	46.8	132.0	6.18	14.97	242.7	9.0	150.0
CG	2017	7	42.0	150.0	58.3	141.9	95.4	3.76	9.11	27.7	143.5	41.2	16.4	41.7	4.17	43.8	127.1	5.57	13.49	244.1	8.5	132.6
CG	2017	8	43.5	135.1	59.5	144.2	85.9	3.68	8.92	27.3	131.7	41.2	16.8	40.8	4.08	46.8	110.0	5.15	12.54	240.3	8.8	118.4
CG	2017	9	42.0	140.5	58.1	140.8	89.3	3.92	9.50	31.1	132.3	40.4	16.6	40.5	4.05	47.0	112.0	5.26	12.76	244.5	9.0	125.2

CG	2017	10	42.2	131.9	58.4	141.6	83.9	3.93	9.53	29.3	140.2	41.4	17.8	42.3	4.23	43.4	129.3	5.61	13.60	234.3	8.7	132.9
CG			**41.90**	**141.50**	**59.30**	**143.8**	**90.0**	**3.77**	**9.14**	**28.90**	**141.00**	**40.70**	**17.10**	**41.40**	**4.14**	**45.7**	**124.5**	**5.69**	13.79	**240.0**	**8.8**	**135.70**
CG	2018	1	42.0	134.6	55.2	133.8	71.0	3.13	7.59	29.2	125.7	38.1	15.9	37.4	3.85	46.3	123.2	5.70	13.83	241.7	7.3	135.7
CG	2018	2	41.7	151.3	58.8	142.5	79.9	2.93	7.10	28.9	142.4	37.2	15.5	36.7	3.76	46.1	132.0	6.09	14.72	248.6	7.5	146.0
CG	2018	3	41.1	139.3	57.8	140.1	73.5	2.95	7.15	29.5	144.1	36.4	15.7	37.3	3.81	48.3	117.4	5.67	13.75	242.1	7.7	138.0
CG	2018	4	40.6	145.3	56.6	137.2	76.7	3.12	7.56	29.2	124.0	38.9	16.6	37.8	4.07	47.7	114.7	5.47	13.26	236.7	7.6	134.7
CG	2018	5	41.9	130.0	56.8	137.7	68.7	2.98	7.22	29.1	121.0	38.8	15.0	38.6	3.64	45.8	117.4	5.38	13.03	254.5	7.8	128.4
CG	2018	6	40.1	140.5	58.8	142.5	74.2	2.95	7.15	25.3	119.6	35.3	15.8	35.2	3.83	47.6	128.9	6.14	14.87	245.6	7.6	153.1
CG	2018	7	39.9	134.9	57.7	139.9	71.2	3.14	7.61	29.6	134.9	40.4	14.1	35.6	3.42	44.4	111.3	4.94	11.98	245.1	7.6	123.8
CG	2018	8	40.8	136.5	56.2	136.2	72.0	3.13	7.59	29.5	139.0	37.2	14.2	38.6	3.44	44.5	112.9	5.02	12.18	239.9	7.7	123.0
CG	2018	9	41.6	148.5	57.4	139.1	78.4	2.97	7.20	27.5	143.9	39.1	15.9	38.4	3.85	46.8	112.2	5.25	12.73	244.4	7.6	126.4
CG	2018	10	40.3	137.1	57.7	139.9	72.4	2.97	7.20	28.2	121.4	35.6	15.3	38.4	3.71	44.5	134.0	5.96	14.45	251.4	7.5	147.9
CG			**41.00**	**139.80**	**57.30**	**138.9**	**73.8**	**3.03**	**7.34**	**28.60**	**131.60**	**37.70**	**15.40**	**37.40**	**3.74**	**46.2**	**120.4**	**5.56**	13.48	**245.0**	**7.6**	**135.70**
CG	2019	1	38.7	120.0	47.5	115.1	61.8	2.34	5.67	24.3	116.6	28.7	11.6	25.7	2.81	44.5	92.6	4.12	9.96	260.7	5.8	106.5
CG	2019	2	41.0	120.5	45.3	109.8	62.0	2.35	5.70	24.9	113.9	26.4	11.1	26.8	2.69	43.5	94.0	4.09	9.91	251.5	6.3	99.8
CG	2019	3	39.6	106.1	45.7	110.8	54.6	2.29	5.55	22.3	105.7	27.6	10.0	25.2	2.42	40.9	100.3	4.10	9.94	261.1	5.7	103.5
CG	2019	4	39.5	116.9	47.6	114.4	60.2	2.43	5.89	25.8	105.4	28.4	10.6	26.2	2.57	43.8	90.5	3.96	9.61	251.1	6.1	100.3
CG	2019	5	38.8	117.0	47.5	115.1	60.3	2.43	5.89	24.7	113.6	27.7	10.8	27.1	2.62	44.6	100.6	4.49	10.88	254.2	5.8	115.7
CG	2019	6	38.9	116.3	46.4	112.5	59.9	2.34	5.67	23.7	124.2	27.6	11.9	27.0	2.88	40.1	94.0	3.77	9.14	261.2	5.6	96.9
CG	2019	7	39.9	110.8	45.4	110.0	57.1	2.38	5.77	22.9	103.9	26.2	11.5	25.5	2.79	46.8	99.0	4.63	11.23	247.9	6.2	116.0
CG	2019	8	40.3	125.0	45.1	109.3	64.4	2.43	5.89	23.6	125.1	27.3	11.2	25.3	2.71	42.9	97.2	4.17	10.11	256.0	6.3	103.5
CG	2019	9	38.9	111.6	47.0	113.6	57.5	2.43	5.89	22.8	118.5	26.9	10.9	27.3	2.64	42.6	102.6	4.37	10.59	245.9	5.6	112.1
CG	2019	10	39.4	126.8	45.5	110.3	65.3	2.34	5.67	24.0	126.1	29.2	9.4	27.9	2.25	41.3	94.2	3.89	9.43	260.4	5.6	98.7
CG			**39.50**	**117.10**	**46.30**	**112.1**	**60.3**	**2.38**	**5.76**	**23.90**	**115.30**	**27.60**	**10.90**	**26.40**	**2.64**	**43.1**	**96.5**	**4.16**	10.08	**255.0**	**5.9**	**105.30**
CG	2020	1	28.3	55.8	17.1	41.5	13.7	0.42	1.02	22.8	85.7	17.0	6.1	12.4	1.24	26.1	49.1	1.28	3.11	307.4	5.8	45.2
CG	2020	2	28.1	62.5	17.7	42.9	15.0	0.42	1.02	20.7	88.0	19.9	4.3	13.8	1.38	29.5	51.1	1.51	3.60	288.6	5.4	53.7
CG	2020	3	26.7	63.3	17.6	42.7	15.6	0.42	1.02	21.5	74.1	18.1	4.3	13.1	1.35	28.4	59.0	1.68	4.06	303.1	5.5	60.0
CG	2020	4	28.8	63.3	16.8	40.7	15.6	0.44	1.07	21.1	92.5	19.3	4.2	12.2	1.22	28.2	58.7	1.66	4.01	290.9	5.6	57.6
CG	2020	5	28.1	57.6	16.6	41.3	14.2	0.43	1.04	21.0	73.1	19.2	5.3	12.8	1.28	25.7	59.0	1.52	3.68	301.4	5.5	55.3
CG	2020	6	27.8	55.7	17.3	41.9	13.7	0.40	0.97	21.3	85.0	17.5	5.4	10.4	1.04	28.1	58.1	1.63	3.96	290.2	5.8	58.6
CG	2020	7	29.0	70.8	17.0	41.2	17.4	0.44	1.07	23.6	94.6	18.7	5.8	10.6	1.06	27.2	43.3	1.18	2.85	301.3	5.7	40.7
CG	2020	8	27.8	58.2	17.1	41.5	14.3	0.43	1.04	21.8	67.6	17.9	5.4	12.5	1.25	29.4	54.6	1.61	3.89	304.0	5.4	57.9
CG	2020	9	29.1	60.3	17.3	41.9	14.8	0.38	0.92	20.5	91.8	18.5	5.5	13.9	1.39	26.2	48.8	1.28	3.10	294.9	5.6	44.0
CG	2020	10	28.3	63.5	17.5	42.4	15.6	0.44	1.07	23.7	88.6	16.9	5.7	13.3	1.33	26.2	57.3	1.50	3.64	298.2	5.7	53.0
CG			**28.20**	**61.10**	**17.20**	**41.8**	**15.0**	**0.42**	**1.02**	**21.80**	**84.10**	**18.30**	**5.20**	**12.50**	**1.25**	**27.5**	**53.9**	**1.48**	3.59	**298.0**	**5.6**	**52.60**
CG	2021	1	34.0	75.3	26.3	63.5	29.0	1.08	2.62	24.5	91.8	23.7	8.3	22.3	2.23	39.0	77.3	3.01	7.31	264.2	8.4	88.5
CG	2021	2	35.1	78.7	25.6	62.1	30.0	1.02	2.47	24.3	105.9	24.5	8.3	20.6	2.06	40.6	79.5	3.23	7.82	257.0	7.9	92.0
CG	2021	3	35.2	76.4	25.8	62.5	29.4	0.93	2.25	24.5	107.7	22.1	8.4	20.6	2.06	39.6	80.6	3.19	7.74	268.0	7.9	90.6
CG	2021	4	33.9	68.2	24.6	59.6	26.2	0.93	2.25	24.6	97.4	23.0	7.9	21.4	2.14	36.3	83.4	3.03	7.34	266.5	8.1	89.4
CG	2021	5	34.4	69.6	25.3	61.3	26.8	0.93	2.25	25.8	94.0	25.6	8.3	21.6	2.16	37.0	77.3	2.86	7.01	257.6	8.1	83.5
CG	2021	6	33.5	80.8	24.4	59.1	31.1	0.92	2.23	25.8	84.3	25.8	8.2	19.2	1.92	40.6	77.5	3.15	7.63	261.4	7.9	94.0
CG	2021	7	34.4	76.1	25.7	62.3	29.3	0.91	2.21	26.6	84.6	24.4	8.7	20.7	2.07	37.4	82.3	3.08	7.46	263.4	8.4	89.5
CG	2021	8	33.8	79.5	25.3	61.3	30.6	0.91	2.21	25.2	104.2	26.0	8.6	18.9	1.89	39.1	84.4	3.30	8.00	251.1	8.1	97.6
CG	2021	9	33.1	63.8	25.4	61.6	24.5	1.06	2.57	24.4	97.2	23.7	8.2	17.8	1.78	38.9	83.5	3.25	7.87	252.2	8.2	98.2
CG	2021	10	34.6	70.6	24.6	59.6	27.2	1.00	2.49	26.3	99.9	25.2	8.1	18.9	1.89	37.5	88.2	3.31	8.02	268.6	8.0	95.7
CG			**34.20**	**73.90**	**25.30**	**61.3**	**28.4**	**0.97**	**2.36**	**25.20**	**96.70**	**24.40**	**8.30**	**20.20**	**2.02**	**38.6**	**81.4**	**3.14**	7.62	**261.0**	**8.1**	**91.90**
EG 1	2015	1	41.7	134.7	52.1	126.3	72.8	2.84	6.88	29.6	98.4	28.0	13.5	31.9	3.40	42.8	111.1	4.76	11.53	247.5	8.0	114.1
EG 1	2015	2	41.6	121.4	51.7	125.8	65.7	2.98	7.22	27.1	125.9	32.7	12.5	31.0	3.03	42.7	111.2	4.75	11.51	235.0	8.1	114.2
EG 1	2015	3	39.2	137.0	54.3	131.6	74.1	2.76	6.69	26.0	112.2	32.6	11.6	29.5	2.69	45.6	111.0	5.06	12.27	240.2	8.6	128.6
EG 1	2015	4	41.1	135.6	51.5	124.8	73.3	2.75	6.67	27.0	125.0	30.4	12.8	32.4	3.10	45.0	111.0	5.00	12.11	236.0	8.1	121.7
EG 1	2015	5	40.0	121.6	54.0	130.9	65.8	2.91	7.05	26.3	127.3	30.9	12.1	27.7	2.93	44.3	98.0	4.34	10.33	232.2	8.0	108.5
EG 1	2015	6	41.1	120.7	54.0	130.9	65.3	2.88	6.98	24.9	129.7	32.0	12.7	32.1	3.08	43.5	102.7	4.47	10.83	248.8	8.5	108.8
EG 1	2015	7	40.2	136.1	53.8	130.4	73.6	2.99	7.25	26.1	104.7	32.8	13.1	28.2	3.18	43.7	112.0	4.89	11.86	231.6	8.6	121.6
EG 1	2015	8	40.5	134.1	53.4	129.4	72.5	2.97	7.20	29.2	110.3	31.8	12.3	32.6	2.98	44.5	99.4	4.42	10.72	243.3	8.2	109.1
EG 1	2015	9	40.5	136.7	54.4	131.9	73.9	2.75	6.67	26.9	119.6	31.4	12.6	32.4	3.05	47.0	109.2	5.13	12.44	248.2	8.3	126.7
EG 1	2015	10	40.1	133.1	52.8	128.0	72.0	2.94	7.13	24.9	114.9	30.4	13.8	30.2	3.35	42.9	105.4	4.52	11.10	237.3	8.6	112.7
EG 1			**40.60**	**131.10**	**53.20**	**129.0**	**70.9**	**2.88**	**6.97**	**26.80**	**116.80**	**31.30**	**12.70**	**30.80**	**3.08**	**44.2**	**107.1**	**4.73**	11.47	**240.0**	**8.3**	**116.60**
EG 1	2016	1	41.6	137.4	58.2	141.1	74.3	3.24	7.85	27.3	135.8	38.6	15.8	38.0	3.70	47.5	151.2	7.18	17.41	265.2	9.3	172.6
EG 1	2016	2	43.0	133.4	58.8	142.5	72.1	3.08	7.47	28.6	149.0	37.9	16.5	37.4	4.00	47.8	148.1	7.08	17.16	250.4	9.1	164.7
EG 1	2016	3	42.6	138.3	58.1	140.8	74.8	3.26	7.90	27.8	107.9	38.2	15.1	37.6	3.66	44.5	144.3	6.42	15.57	256.2	9.2	150.7
EG 1	2016	4	43.4	149.3	58.4	141.0	80.7	3.34	8.00	31.2	151.6	38.8	16.3	40.9	4.05	47.4	141.5	6.71	16.26	262.6	9.2	154.6
EG 1	2016	5	42.7	131.3	59.1	143.3	71.0	3.25	7.70	30.8	138.6	38.5	16.2	36.6	3.93	48.6	142.5	6.93	16.79	260.2	9.0	162.3
EG 1	2016	6	43.4	135.7	60.7	147.1	73.4	3.22	7.81	26.8	144.2	39.8	16.6	40.2	4.02	47.2	138.4	6.53	15.83	257.2	9.0	150.5
EG 1	2016	7	42.6	149.0	60.4	146.4	80.3	3.23	7.83	27.0	108.3	36.4	17.6	40.8	4.27	45.0	141.0	6.35	15.43	256.2	9.1	149.4

EG 1	2016	8	42.1	135.2	60.0	145.4	73.1	3.13	7.59	27.4	130.9	34.9	15.2	36.0	3.68	46.1	141.0	6.50	15.76	266.6	9.1	154.4
EG 1	2016	9	41.9	149.2	58.1	140.8	80.7	3.03	7.34	26.7	136.7	38.8	14.2	39.9	3.44	44.2	150.4	6.65	16.11	259.8	8.8	158.7
EG 1	2016	10	41.7	132.2	59.2	143.5	71.5	3.26	7.90	30.4	124.0	35.1	16.5	40.6	4.00	44.7	146.6	6.55	15.88	265.6	9.2	157.1
EG 1			**42.50**	**139.10**	**59.10**	**143.2**	**75.2**	**3.20**	**7.74**	**28.40**	**132.70**	**37.70**	**16.00**	**38.80**	**3.88**	**46.3**	**144.5**	**6.69**	16.22	**260.0**	**9.1**	**157.50**
EG 1	2017	1	45.1	165.3	69.3	168.0	109.8	4.84	11.73	34.2	135.4	43.7	21.2	49.4	5.14	45.1	142.9	6.44	15.62	234.4	8.9	142.8
EG 1	2017	2	43.4	152.5	71.2	172.6	101.3	4.73	11.47	32.6	138.5	49.8	19.3	47.5	4.68	49.7	148.0	7.36	17.83	237.2	9.2	168.6
EG 1	2017	3	44.4	151.6	71.4	173.1	100.7	4.56	11.05	33.0	108.2	47.8	18.7	48.9	4.53	47.9	123.7	5.93	14.36	242.6	9.1	133.6
EG 1	2017	4	43.1	156.5	68.3	165.6	104.0	4.65	11.27	31.3	122.4	47.6	21.3	49.5	5.16	45.1	141.5	6.38	15.47	243.4	8.7	148.0
EG 1	2017	5	42.8	171.5	71.8	174.0	113.9	4.73	11.47	34.2	145.3	49.3	21.4	48.9	5.19	45.5	130.3	5.93	14.38	232.0	8.8	138.6
EG 1	2017	6	44.1	150.8	70.0	169.7	100.2	4.60	11.15	33.9	160.1	43.7	20.0	45.5	4.85	44.8	139.2	6.24	15.12	238.6	9.1	141.5
EG 1	2017	7	43.1	161.4	68.3	166.3	107.2	4.48	10.86	31.9	136.9	45.3	19.6	50.9	4.75	46.6	138.8	6.47	15.68	237.6	9.2	150.1
EG 1	2017	8	43.9	175.3	68.4	165.8	116.5	4.49	10.88	31.7	147.5	44.3	20.8	50.3	5.04	49.4	133.9	6.61	16.03	237.8	9.0	150.6
EG 1	2017	9	42.3	162.7	71.5	173.3	108.1	4.70	11.39	34.6	156.1	46.2	20.5	48.8	4.97	48.3	145.8	7.04	17.07	234.4	9.3	166.4
EG 1	2017	10	42.8	164.4	70.8	171.6	109.2	4.85	11.76	32.6	163.6	49.3	20.2	52.3	4.90	45.6	136.9	6.24	15.13	242.0	8.7	145.8
EG 1			**43.50**	**161.20**	**70.10**	**170.0**	**107.1**	**4.66**	**11.30**	**33.00**	**141.40**	**46.70**	**20.30**	**49.20**	**4.92**	**46.8**	**138.1**	**6.46**	15.67	**238.0**	**9.0**	**148.60**
EG 1	2018	1	41.5	166.5	67.5	163.6	92.2	3.54	8.65	29.7	145.2	45.1	16.2	42.5	4.00	46.4	143.1	6.64	16.09	244.8	7.8	160.0
EG 1	2018	2	43.6	156.8	69.9	168.3	86.9	3.77	9.14	34.8	128.5	43.0	18.9	43.3	4.58	48.7	139.4	6.79	16.46	243.6	7.7	155.7
EG 1	2018	3	42.2	171.2	66.9	162.2	94.8	3.78	9.16	33.5	138.1	45.2	19.5	47.9	4.73	50.2	134.9	6.77	16.42	228.8	7.9	160.4
EG 1	2018	4	44.2	149.3	66.6	161.4	82.7	3.86	9.36	30.7	149.5	42.5	17.5	45.3	4.24	49.0	129.0	6.32	15.32	234.5	7.9	143.0
EG 1	2018	5	43.3	155.7	67.2	162.9	86.3	3.80	9.21	32.0	109.3	41.5	19.3	40.9	4.68	49.4	145.8	7.10	17.21	245.5	7.9	164.0
EG 1	2018	6	43.3	151.9	67.6	163.9	84.1	3.85	9.33	35.2	137.6	40.6	18.0	44.9	4.36	46.3	132.3	6.13	14.85	229.3	7.3	141.6
EG 1	2018	7	43.9	153.6	69.1	167.5	85.1	3.82	9.26	30.3	145.2	42.4	17.2	44.3	4.17	46.2	136.4	6.30	15.28	247.0	7.6	143.5
EG 1	2018	8	42.8	158.1	68.3	165.6	87.6	3.90	9.45	33.3	131.9	44.1	18.3	48.5	4.44	49.5	120.7	5.97	14.48	230.0	7.8	141.0
EG 1	2018	9	42.2	156.5	69.2	167.7	86.7	3.86	9.36	30.3	104.4	39.6	19.9	47.1	4.82	44.2	129.9	5.74	13.92	244.0	7.9	136.1
EG 1	2018	10	43.0	165.4	69.7	169.0	91.6	3.62	8.77	34.2	133.3	45.0	19.2	42.3	4.65	46.1	112.5	5.19	12.78	232.5	8.2	120.7
EG 1			**43.00**	**158.50**	**68.20**	**165.2**	**87.8**	**3.78**	**9.17**	**32.40**	**132.30**	**42.90**	**18.40**	**44.70**	**4.47**	**47.6**	**132.4**	**6.30**	15.28	**238.0**	**7.8**	**146.60**
EG 1	2019	1	41.7	142.0	56.8	137.7	76.8	2.91	7.05	25.8	121.1	32.0	12.7	31.2	2.90	42.9	119.0	5.11	12.37	254.9	6.0	122.5
EG 1	2019	2	40.9	125.2	55.5	134.5	67.7	3.11	7.54	26.5	123.6	29.8	12.0	30.7	2.91	44.0	115.8	5.10	12.33	248.9	6.4	124.7
EG 1	2019	3	40.8	132.9	55.7	135.0	71.9	2.97	7.20	26.3	125.3	32.7	13.6	33.0	3.30	46.3	118.0	5.46	13.24	248.4	5.9	133.8
EG 1	2019	4	40.9	134.2	57.1	138.4	72.6	3.08	7.47	27.3	123.1	33.8	12.8	34.2	3.10	43.0	111.9	4.91	11.90	248.2	6.1	120.0
EG 1	2019	5	42.2	135.9	55.0	133.3	73.5	2.98	7.22	28.3	125.8	31.4	14.2	32.4	3.49	46.4	101.2	4.70	11.38	249.4	5.9	111.4
EG 1	2019	6	41.5	130.0	56.3	136.5	70.3	2.92	7.08	29.1	106.5	33.7	12.7	30.9	3.08	47.3	98.0	4.64	11.24	241.0	6.3	111.8
EG 1	2019	7	42.4	142.9	54.1	131.1	77.3	2.99	7.25	29.6	106.3	30.3	13.6	29.9	3.30	45.4	111.5	5.06	12.27	258.7	6.1	119.3
EG 1	2019	8	40.5	141.5	56.0	135.7	76.5	3.11	7.54	27.8	112.9	31.4	13.1	33.3	3.18	45.9	120.5	5.53	13.30	252.8	6.4	135.7
EG 1	2019	9	42.0	136.7	56.1	136.0	73.9	2.92	7.08	27.8	108.9	31.7	14.3	35.0	3.47	46.4	109.9	5.10	12.36	255.6	5.8	121.4
EG 1	2019	10	42.1	126.7	56.4	136.7	68.5	3.18	7.71	27.5	105.5	33.2	14.0	30.4	3.39	44.4	115.2	5.11	12.40	242.1	6.1	121.4
EG 1			**41.50**	**134.80**	**55.90**	**135.5**	**72.9**	**3.02**	**7.31**	**27.60**	**115.90**	**32.00**	**13.30**	**32.10**	**3.21**	**45.2**	**112.1**	**5.07**	12.28	**250.0**	**6.1**	**122.20**
EG 1	2020	1	30.2	63.9	20.0	48.5	16.3	0.54	1.31	23.1	78.4	21.7	5.8	13.7	1.41	30.5	53.0	1.62	3.92	295.9	6.4	53.6
EG 1	2020	2	30.8	61.8	19.7	48.3	15.8	0.54	1.31	24.5	79.1	21.1	5.1	12.5	1.24	32.3	56.2	1.82	4.40	287.4	5.7	59.1
EG 1	2020	3	28.9	60.3	20.3	49.2	15.4	0.54	1.31	22.2	88.0	22.0	5.7	12.1	1.38	29.8	64.3	1.92	4.64	294.2	5.9	66.4
EG 1	2020	4	29.7	72.0	20.0	48.5	18.4	0.52	1.26	23.9	84.6	17.7	4.6	12.2	1.12	31.8	53.9	1.71	4.15	282.8	6.3	57.6
EG 1	2020	5	29.5	73.1	21.0	50.9	18.6	0.49	1.25	22.8	88.8	19.5	7.3	14.2	1.77	31.3	50.0	1.57	3.82	281.4	6.1	53.2
EG 1	2020	6	30.0	73.5	20.0	48.5	18.7	0.48	1.16	23.8	89.0	17.5	5.2	16.1	1.26	31.4	59.5	1.87	4.53	297.4	5.9	62.3
EG 1	2020	7	29.2	65.3	21.0	50.9	16.7	0.47	1.20	24.4	88.8	21.9	6.5	15.3	1.58	30.2	51.9	1.57	3.80	288.5	5.9	53.8
EG 1	2020	8	29.1	74.4	20.5	49.7	19.0	0.48	1.16	23.1	90.7	17.9	6.4	15.2	1.55	31.2	63.0	1.97	4.76	294.2	6.4	67.4
EG 1	2020	9	28.5	67.8	20.8	50.4	17.3	0.55	1.33	22.3	80.2	19.3	6.9	14.2	1.67	32.9	53.4	1.76	4.26	297.5	5.8	61.8
EG 1	2020	10	30.1	77.9	20.7	50.2	19.9	0.54	1.31	21.9	81.4	18.4	4.5	15.5	1.09	31.6	62.8	1.98	4.81	280.7	5.6	65.8
EG 1			**29.60**	**69.00**	**20.40**	**49.5**	**17.6**	**0.52**	**1.26**	**23.20**	**84.90**	**19.70**	**5.80**	**14.10**	**1.41**	**31.3**	**56.8**	**1.78**	4.31	**290.0**	**6.0**	**60.10**
EG 1	2021	1	38.0	79.1	30.6	74.2	32.2	1.31	3.18	25.9	92.3	23.3	11.2	25.4	2.70	43.6	80.2	3.50	8.48	256.8	8.4	93.0
EG 1	2021	2	37.4	79.9	32.7	79.3	32.5	1.22	3.11	25.8	95.9	28.2	10.0	22.2	2.42	43.6	82.0	3.58	8.67	257.8	8.3	95.7
EG 1	2021	3	38.5	79.4	30.9	74.9	32.3	1.30	3.15	27.9	82.6	27.3	10.5	25.7	2.55	43.8	78.8	3.45	8.37	258.8	8.3	89.6
EG 1	2021	4	39.4	80.0	32.3	78.3	32.6	1.21	2.93	25.2	96.9	22.7	9.3	21.8	2.25	41.5	84.5	3.51	8.50	264.5	8.1	89.1
EG 1	2021	5	38.0	87.5	32.5	78.1	35.6	1.26	3.05	25.6	92.1	27.4	9.3	24.8	2.25	45.9	84.6	3.88	9.41	266.3	8.3	102.1
EG 1	2021	6	38.6	92.7	32.5	78.8	37.7	1.34	3.25	29.1	97.2	25.9	8.9	24.3	2.16	43.5	94.9	4.13	10.01	252.2	8.3	106.2
EG 1	2021	7	37.1	80.9	31.4	76.1	32.9	1.34	3.25	29.6	102.7	26.2	11.0	25.5	2.67	45.7	80.1	3.66	8.87	261.3	8.0	98.7
EG 1	2021	8	38.2	94.1	32.5	78.8	38.3	1.29	3.13	25.7	101.7	27.8	10.4	24.0	2.52	40.5	82.5	3.34	8.10	264.9	8.4	87.4
EG 1	2021	9	38.6	77.0	32.8	79.5	31.7	1.37	3.32	26.0	106.1	27.6	9.5	25.8	2.30	42.5	95.5	4.06	9.84	252.7	8.0	105.2
EG 1	2021	10	38.2	86.4	31.8	77.1	35.2	1.39	3.37	29.2	101.5	25.6	9.9	22.5	2.40	44.4	86.9	3.86	9.35	264.7	7.9	101.0
EG 1			**38.20**	**83.70**	**32.00**	**77.5**	**34.1**	**1.30**	**3.17**	**27.00**	**96.90**	**26.20**	**10.00**	**24.20**	**2.42**	**43.5**	**85.0**	**3.70**	8.96	**260.0**	**8.2**	**96.80**
EG 2	2015	1	39.2	116.4	49.1	119.0	61.6	2.64	6.40	22.5	116.5	27.7	12.5	27.5	3.03	43.8	112.0	4.91	11.89	236.7	8.5	124.4
EG 2	2015	2	39.0	133.9	48.9	118.5	70.7	2.64	6.40	26.9	101.7	27.9	12.8	30.3	3.10	44.7	110.0	4.92	11.92	239.3	7.9	126.2
EG 2	2015	3	38.2	127.4	51.3	124.0	67.2	2.66	6.45	28.3	127.0	31.8	10.8	27.4	2.50	41.5	111.5	4.63	11.22	234.2	7.9	121.2
EG 2	2015	4	38.1	128.0	49.0	118.8	67.6	2.64	6.40	27.1	108.3	31.1	11.0	29.1	2.67	41.6	102.3	4.26	10.32	238.8	8.2	111.8
EG 2	2015	5	39.9	130.8	50.5	122.4	69.0	2.58	6.25	26.3	102.3	30.0	12.4	29.1	3.01	43.2	110.5	4.77	11.55	244.9	8.3	119.5

EG 2	2015	6	38.7	123.9	48.7	118.0	65.4	2.69	6.40	27.0	117.2	28.9	11.1	30.4	2.69	42.8	98.6	4.22	10.23	245.2	8.1	109.0
EG 2	2015	7	38.1	128.0	50.9	123.4	67.6	2.59	6.28	25.4	120.2	30.6	10.3	27.4	2.50	41.6	97.6	4.06	9.84	244.6	8.2	106.6
EG 2	2015	8	40.0	122.3	50.0	121.2	64.6	2.53	6.13	27.3	118.4	30.5	12.8	27.7	3.10	42.8	98.0	4.19	10.17	240.9	8.5	104.8
EG 2	2015	9	39.4	138.0	48.8	118.3	72.8	2.68	6.50	24.2	126.4	31.4	11.9	27.7	2.88	40.3	105.2	4.24	10.28	246.5	8.2	107.6
EG 2	2015	10	39.4	122.3	48.8	118.3	64.6	2.55	6.18	24.0	127.0	32.1	12.4	28.4	3.01	42.7	104.3	4.45	10.80	248.9	8.2	112.9
EG 2			**39.00**	**127.10**	**49.60**	**120.2**	**67.1**	**2.62**	**6.34**	**25.90**	**116.50**	**30.20**	**11.80**	**28.50**	2.85	**42.5**	**105.0**	**4.46**	10.82	**242.0**	**8.2**	**114.40**
EG 2	2016	1	39.2	119.4	50.3	121.9	64.6	2.78	6.74	28.5	126.3	35.7	14.1	34.6	3.49	41.9	131.0	5.49	13.32	259.1	9.2	140.1
EG 2	2016	2	39.5	138.1	51.5	124.8	74.6	2.73	6.62	28.0	140.4	33.9	13.6	31.2	3.35	44.5	129.5	5.76	13.97	257.3	9.0	145.5
EG 2	2016	3	38.2	121.2	51.6	125.1	65.5	2.72	6.59	27.2	130.0	33.1	13.9	35.1	3.37	40.0	140.6	5.62	13.63	258.2	8.6	147.1
EG 2	2016	4	38.7	137.6	50.3	121.9	74.4	2.66	6.45	27.1	139.3	34.4	12.4	31.0	2.93	43.7	135.4	5.92	14.34	266.0	9.1	153.0
EG 2	2016	5	39.9	119.2	49.4	119.7	64.5	2.75	6.67	26.6	143.6	37.8	15.0	31.9	3.64	40.5	150.4	6.09	14.77	268.1	9.1	152.6
EG 2	2016	6	38.7	128.1	51.2	124.0	69.3	2.81	6.81	23.9	147.0	34.1	14.9	35.4	3.61	45.0	159.7	7.19	17.42	255.8	8.8	185.8
EG 2	2016	7	38.1	131.7	49.1	119.0	71.2	2.71	6.57	26.3	132.3	34.2	13.1	34.3	3.18	45.1	153.5	6.92	16.78	268.1	9.0	181.6
EG 2	2016	8	40.6	135.1	51.2	124.1	73.1	2.72	6.59	23.8	117.7	36.3	12.7	31.7	3.08	40.0	148.9	5.96	14.44	261.9	8.7	146.8
EG 2	2016	9	39.4	129.9	51.3	124.4	70.2	2.66	6.45	23.9	132.6	36.9	13.4	35.5	3.25	41.1	149.5	6.14	14.89	266.8	8.8	155.8
EG 2	2016	10	39.7	128.7	49.1	119.0	69.6	2.74	6.64	28.7	117.8	33.6	13.9	32.3	3.37	45.2	145.5	6.58	15.94	258.7	8.7	165.7
EG 2			**39.20**	**128.90**	**50.50**	**122.4**	**69.7**	**2.73**	**6.61**	**26.40**	**132.70**	**35.00**	**13.70**	**33.30**	3.33	**42.7**	**144.4**	**6.17**	14.95	**262.0**	**8.9**	**157.40**
EG 2	2017	1	40.8	155.0	61.3	148.7	103.0	4.04	9.79	27.4	147.4	40.3	17.1	43.0	4.15	44.7	119.0	5.32	12.89	241.2	8.9	130.4
EG 2	2017	2	42.8	142.7	63.8	154.7	94.8	4.04	9.79	27.8	130.3	45.0	16.1	39.5	3.90	43.3	129.6	5.61	13.60	236.2	9.0	131.1
EG 2	2017	3	42.7	153.3	63.7	154.4	101.9	4.01	9.72	30.1	146.8	40.1	16.3	40.0	3.95	44.8	139.2	6.24	15.12	249.9	8.6	146.1
EG 2	2017	4	42.2	145.9	61.0	147.9	96.9	4.22	10.23	28.3	142.0	42.1	19.9	46.3	4.82	43.6	127.0	5.54	13.42	251.6	8.6	131.3
EG 2	2017	5	42.8	137.1	62.6	151.7	91.4	4.21	10.21	31.1	145.8	42.4	17.0	43.8	4.12	42.3	126.6	5.36	12.98	245.7	8.8	125.2
EG 2	2017	6	41.6	144.1	61.2	148.3	95.7	4.11	9.96	30.9	129.7	43.9	16.7	46.3	4.05	45.4	147.7	6.71	16.21	246.3	9.0	159.7
EG 2	2017	7	42.4	152.7	61.0	147.9	101.5	4.15	10.06	32.9	130.5	42.7	19.3	46.1	4.68	44.9	123.4	5.54	13.43	233.9	8.9	130.7
EG 2	2017	8	41.1	156.4	62.1	150.5	103.9	4.22	10.23	32.5	146.7	41.2	19.3	44.0	4.68	47.5	134.0	6.37	15.43	232.3	9.1	155.0
EG 2	2017	9	42.9	143.7	62.7	152.0	95.5	4.05	9.82	31.3	146.6	43.5	19.7	44.2	4.78	46.2	134.3	6.20	15.04	242.0	8.5	144.5
EG 2	2017	10	41.7	142.1	60.6	146.9	94.4	4.13	10.01	28.7	148.2	44.8	17.6	40.8	4.27	44.3	143.2	6.34	15.38	240.9	8.6	152.0
EG 2			**42.10**	**147.30**	**62.00**	**150.3**	**97.9**	**4.12**	**9.98**	**30.10**	**141.40**	**42.60**	**17.90**	**43.40**	4.34	**44.7**	**132.4**	**5.92**	14.35	**242.0**	**8.8**	**140.60**
EG 2	2018	1	38.5	153.7	58.0	140.6	85.1	3.08	7.47	29.2	139.0	38.1	16.9	38.0	4.10	43.4	127.6	5.54	13.42	236.5	7.4	143.9
EG 2	2018	2	39.7	144.6	56.2	136.2	80.1	3.12	7.56	30.5	142.1	38.4	14.8	38.4	3.59	39.1	126.2	4.93	11.99	232.3	7.9	124.7
EG 2	2018	3	39.8	147.6	57.7	139.9	81.8	3.07	7.44	30.1	119.2	38.4	15.4	34.7	3.73	43.5	127.3	5.54	13.42	231.8	7.6	139.2
EG 2	2018	4	40.7	134.8	58.1	140.6	74.7	3.11	7.54	28.2	122.0	39.7	15.0	34.9	3.64	43.7	132.1	5.77	13.99	243.0	7.8	141.8
EG 2	2018	5	40.3	139.1	55.7	135.0	77.0	3.19	7.73	27.7	142.5	37.4	16.4	37.2	3.98	43.1	132.4	5.71	13.83	249.0	8.1	141.7
EG 2	2018	6	38.7	138.8	58.2	141.1	76.9	3.29	7.97	27.8	121.9	40.3	15.7	34.3	3.81	41.2	131.9	5.43	13.17	245.5	8.0	140.3
EG 2	2018	7	38.5	135.8	55.6	134.8	75.4	3.06	7.42	30.4	110.5	41.0	15.2	39.5	3.68	45.0	116.6	5.25	12.72	241.1	7.6	136.4
EG 2	2018	8	40.2	149.6	56.0	135.7	82.9	3.30	8.00	32.3	140.4	38.2	14.3	38.5	3.47	42.2	141.5	5.97	14.47	240.8	7.7	148.5
EG 2	2018	9	38.5	150.7	56.4	136.7	83.5	3.08	7.47	27.9	141.2	38.4	15.4	39.3	3.73	44.1	130.0	5.73	13.90	235.4	7.9	148.8
EG 2	2018	10	39.1	149.3	57.1	138.4	82.7	3.20	7.76	30.9	144.2	40.1	14.9	38.2	3.61	44.7	135.4	6.05	14.67	244.6	8.0	154.7
EG 2			**39.40**	**144.40**	**56.90**	**137.9**	**80.0**	**3.15**	**7.64**	**29.50**	**132.30**	**39.00**	**15.40**	**37.30**	3.73	**43.0**	**130.1**	**5.59**	13.56	**240.0**	**7.8**	**142.00**
EG 2	2019	1	39.7	127.5	49.5	120.0	67.3	2.57	6.23	26.7	115.2	29.0	12.3	26.2	2.98	43.9	109.2	4.79	11.61	248.6	6.0	120.7
EG 2	2019	2	38.1	122.4	48.3	117.1	64.6	2.48	6.01	28.8	120.4	29.3	11.7	27.8	2.84	43.0	113.5	4.88	11.83	249.0	5.9	128.1
EG 2	2019	3	39.7	128.9	50.0	121.2	68.0	2.56	6.21	28.8	116.9	30.6	10.3	27.6	2.60	41.3	102.0	4.21	10.21	249.6	5.6	106.0
EG 2	2019	4	39.0	122.4	49.5	120.0	64.6	2.62	6.35	27.2	119.2	29.0	12.2	28.5	2.96	41.9	103.9	4.35	10.55	254.3	6.1	111.5
EG 2	2019	5	38.6	122.7	48.4	117.3	64.8	2.52	6.11	24.3	121.6	28.3	11.9	29.5	2.88	42.7	90.2	3.85	9.34	246.3	6.1	99.7
EG 2	2019	6	39.8	123.6	49.8	120.7	65.2	2.74	6.64	25.6	104.7	29.1	11.8	29.6	2.86	41.5	114.3	4.74	11.50	257.8	6.0	119.1
EG 2	2019	7	38.5	134.9	48.1	116.6	71.2	2.71	6.57	23.2	107.6	30.2	12.2	27.5	2.96	43.7	103.8	4.54	11.00	258.3	6.4	117.9
EG 2	2019	8	38.9	129.3	49.8	120.1	68.2	2.57	6.23	23.9	105.3	31.2	11.1	29.4	2.69	44.3	102.5	4.54	11.01	243.1	5.9	116.7
EG 2	2019	9	38.3	129.1	48.5	117.6	68.1	2.78	6.74	25.3	123.4	30.0	11.2	26.9	2.71	44.0	102.0	4.49	10.88	252.6	5.7	117.2
EG 2	2019	10	40.4	117.2	50.1	121.4	61.9	2.46	5.96	23.2	124.7	31.3	11.3	29.0	2.74	43.7	104.6	4.57	11.08	260.4	6.3	113.1
EG 2			**39.10**	**125.80**	**49.20**	**119.2**	**66.4**	**2.60**	**6.30**	**25.70**	**115.90**	**29.80**	**11.60**	**28.20**	2.82	**43.0**	**104.6**	**4.50**	10.90	**252.0**	**6.0**	**115.00**
EG 2	2020	1	27.1	59.2	17.9	43.4	15.1	0.41	1.10	22.6	93.0	19.8	5.2	12.4	1.26	29.0	53.7	1.56	3.77	293.0	5.9	57.6
EG 2	2020	2	27.4	56.0	17.3	41.9	14.3	0.45	1.09	22.9	71.1	19.9	4.1	12.1	1.10	29.6	60.2	1.78	4.32	288.7	5.7	65.0
EG 2	2020	3	27.5	56.0	17.8	43.1	14.3	0.42	1.02	19.5	92.1	18.6	5.4	12.7	1.31	28.5	50.7	1.44	3.50	285.8	6.0	52.4
EG 2	2020	4	28.0	59.9	16.6	40.2	15.3	0.47	1.14	22.3	92.3	17.4	5.5	11.8	1.33	28.7	62.4	1.79	4.30	281.8	5.9	63.4
EG 2	2020	5	27.2	61.7	17.0	41.2	15.7	0.42	1.02	22.5	71.9	18.0	4.7	12.9	1.14	26.0	57.5	1.50	3.62	294.1	6.1	55.1
EG 2	2020	6	28.8	67.0	17.3	41.9	17.1	0.41	0.99	21.7	89.7	20.3	5.6	13.1	1.36	28.2	59.3	1.67	4.05	295.2	5.6	58.0
EG 2	2020	7	28.6	63.7	17.7	42.9	16.2	0.43	1.04	23.2	76.4	17.1	5.5	12.8	1.33	26.2	49.6	1.30	3.15	295.8	5.6	45.5
EG 2	2020	8	28.9	63.0	16.2	39.3	16.1	0.48	1.16	21.0	82.7	17.3	4.5	13.1	1.09	29.8	58.2	1.73	4.20	300.9	6.2	59.9
EG 2	2020	9	27.3	61.7	16.2	39.8	15.7	0.46	1.12	20.9	88.6	16.7	5.5	11.6	1.33	27.1	48.1	1.30	3.16	291.0	6.2	47.6
EG 2	2020	10	28.2	64.8	17.0	41.2	16.2	0.43	1.04	22.4	83.2	18.9	5.0	12.5	1.21	29.9	55.3	1.65	4.01	283.7	5.8	58.5
EG 2			**27.90**	**61.30**	**17.10**	**41.5**	**15.6**	**0.44**	**1.07**	**21.90**	**84.10**	**18.40**	**5.10**	**12.50**	1.25	**28.3**	**55.5**	**1.57**	3.81	**291.0**	**5.9**	**56.30**
EG 2	2021	1	35.4	75.6	26.9	65.2	30.8	1.06	2.57	24.7	92.0	24.2	9.1	21.9	2.25	38.5	76.2	2.93	7.11	269.5	8.0	82.8
EG 2	2021	2	36.4	77.5	26.7	64.7	31.5	1.01	2.45	24.0	96.4	25.3	9.7	20.8	2.35	40.8	89.5	3.65	8.85	268.9	8.4	100.3
EG 2	2021	3	37.1	68.8	26.6	64.5	28.0	1.15	2.79	26.0	109.1	25.1	9.2	21.8	2.23	41.3	87.3	3.61	8.74	261.7	7.9	97.3

EG 2	2021	4	36.2	71.6	26.1	63.3	29.1	1.01	2.45	25.3	95.5	24.0	8.2	21.4	1.99	40.5	85.1	3.45	8.35	270.8	8.2	95.3
EG 2	2021	5	35.7	65.3	26.3	63.8	26.8	1.13	2.74	27.9	89.0	25.8	9.6	22.6	2.33	39.4	88.3	3.48	8.43	257.8	8.3	97.5
EG 2	2021	6	36.4	80.3	27.7	67.1	32.7	1.10	2.67	26.0	91.6	26.4	9.1	22.3	2.21	41.8	79.9	3.34	8.10	264.9	7.8	91.8
EG 2	2021	7	34.6	69.9	27.6	66.7	28.4	1.16	2.81	26.5	100.8	25.8	8.5	20.3	2.06	41.5	82.8	3.44	8.33	255.0	7.9	99.4
EG 2	2021	8	36.5	79.4	25.7	62.3	32.3	1.03	2.50	27.5	87.8	26.8	9.7	24.1	2.35	41.3	82.2	3.39	8.23	254.8	8.0	92.9
EG 2	2021	9	35.3	81.0	27.4	66.4	33.0	1.11	2.69	25.4	110.7	25.3	8.5	23.3	2.06	41.0	85.7	3.51	8.52	258.3	8.2	99.4
EG 2	2021	10	35.4	74.6	26.0	63.0	30.4	1.12	2.50	26.7	96.1	23.3	8.4	20.5	2.04	39.9	80.0	3.19	7.74	268.3	8.3	90.3
EG 2			**35.90**	**74.40**	**26.70**	**64.7**	**30.3**	**1.09**	**2.62**	**26.00**	**96.90**	**25.20**	**9.00**	**21.90**	2.19	**40.6**	**83.7**	**3.40**	8.24	**263.0**	**8.1**	**94.70**
EG 3	2015	1	37.1	111.5	45.5	110.3	57.5	2.33	5.65	22.0	111.0	28.0	11.0	26.3	2.67	42.3	104.0	4.40	10.66	242.4	7.9	118.6
EG 3	2015	2	37.8	127.1	45.9	111.3	65.5	2.25	5.45	24.4	101.5	30.3	9.5	25.2	2.32	43.4	102.0	4.43	10.73	235.4	8.2	117.2
EG 3	2015	3	38.2	112.2	44.2	107.1	57.8	2.25	5.45	25.2	127.7	28.1	11.2	24.3	2.71	39.8	96.6	3.84	9.32	244.3	8.1	100.5
EG 3	2015	4	38.3	118.1	44.5	107.9	60.8	2.39	5.79	25.8	123.1	28.6	10.9	26.1	2.64	39.6	103.5	4.10	9.94	246.6	8.0	107.0
EG 3	2015	5	38.3	119.9	46.0	111.0	61.8	2.37	5.74	24.7	110.2	28.0	11.0	27.8	2.67	41.8	96.4	4.03	9.77	248.4	8.2	105.2
EG 3	2015	6	38.6	121.9	44.1	106.9	62.8	2.36	5.72	22.9	116.2	27.1	10.4	26.9	2.52	43.6	89.8	3.92	9.49	251.1	7.8	101.6
EG 3	2015	7	36.5	118.7	45.8	110.9	61.1	2.35	5.70	23.5	118.0	27.3	11.2	24.5	2.71	41.4	99.7	4.13	10.01	248.5	8.3	113.2
EG 3	2015	8	39.0	127.9	45.8	111.0	65.9	2.37	5.74	24.4	113.8	29.5	11.3	27.2	2.74	43.6	102.0	4.45	10.78	238.2	8.4	114.1
EG 3	2015	9	37.4	116.1	45.4	110.0	59.8	2.35	5.70	24.7	111.3	29.0	11.5	27.2	2.79	38.5	94.9	3.65	8.86	247.3	7.8	97.6
EG 3	2015	10	37.8	118.6	44.8	108.6	61.1	2.25	5.45	26.4	126.2	27.1	9.0	24.5	2.18	39.0	102.1	3.98	9.65	237.8	8.3	105.0
EG 3			**37.90**	**119.20**	**45.20**	**109.5**	**61.4**	**2.33**	**5.64**	**24.40**	**115.90**	**28.30**	**10.70**	**26.00**	2.60	**41.3**	**99.1**	**4.09**	9.92	**244.0**	**8.1**	**108.00**
EG 3	2016	1	37.6	121.9	48.0	116.4	64.3	2.51	6.08	23.1	117.5	35.9	12.3	29.1	2.98	38.9	148.7	5.78	14.02	266.4	8.8	153.7
EG 3	2016	2	36.9	127.2	47.6	115.4	67.1	2.48	6.01	26.3	118.5	35.6	14.1	28.5	3.42	41.8	127.6	5.33	12.93	262.2	9.0	144.4
EG 3	2016	3	38.6	129.1	48.3	117.1	68.1	2.45	5.94	26.1	143.4	34.9	12.5	32.5	3.03	39.0	143.7	5.60	13.58	265.0	8.7	145.1
EG 3	2016	4	37.4	132.7	48.3	116.1	70.0	2.43	5.89	25.3	125.2	30.9	12.2	30.5	2.96	41.4	133.9	5.54	13.44	272.6	8.6	148.1
EG 3	2016	5	36.9	115.7	47.1	114.2	61.4	2.40	6.00	26.4	132.7	36.2	14.0	28.7	3.39	42.8	133.3	5.71	13.83	258.3	8.5	153.4
EG 3	2016	6	37.0	132.7	46.9	113.7	70.0	2.59	6.28	25.4	147.3	34.0	12.9	31.4	3.13	42.2	126.6	5.34	12.95	256.4	8.7	144.3
EG 3	2016	7	37.2	131.7	46.4	112.5	69.5	2.45	5.94	24.1	145.1	34.8	12.3	31.2	2.98	42.6	126.7	5.40	13.08	260.7	8.8	145.2
EG 3	2016	8	38.0	131.4	46.4	112.5	69.4	2.60	6.30	27.5	142.8	33.6	11.3	31.4	2.74	38.2	128.9	4.99	12.13	270.6	8.6	131.3
EG 3	2016	9	37.7	121.3	47.4	114.9	64.0	2.45	5.94	25.6	126.4	30.6	13.4	32.0	3.25	40.8	154.3	6.30	15.26	263.1	8.7	167.1
EG 3	2016	10	36.7	121.3	47.6	115.4	64.0	2.59	6.28	28.2	117.1	33.5	12.0	32.7	2.91	40.3	153.3	6.18	14.98	274.7	8.6	168.4
EG 3			**37.40**	**126.50**	**47.40**	**114.8**	**66.8**	**2.50**	**6.07**	**25.80**	**131.60**	**34.00**	**12.70**	**30.80**	3.08	**40.8**	**137.7**	**5.62**	13.62	**265.0**	**8.7**	**150.10**
EG 3	2017	1	42.4	141.8	56.8	137.7	90.2	3.63	8.80	30.2	141.9	41.4	17.8	38.8	4.40	44.9	139.9	6.28	15.14	244.2	8.7	148.1
EG 3	2017	2	41.4	145.9	56.1	136.0	92.6	3.42	8.29	28.4	153.2	37.2	17.4	38.1	4.22	40.6	137.2	5.57	13.50	244.1	8.4	134.5
EG 3	2017	3	40.2	137.9	56.8	137.7	87.7	3.67	8.90	25.1	144.6	37.3	14.3	37.1	3.47	40.6	123.4	5.01	12.14	251.7	8.9	124.6
EG 3	2017	4	41.2	137.2	55.5	134.5	87.2	3.52	8.53	30.4	129.2	38.9	15.6	38.3	3.78	40.7	131.8	5.36	13.00	247.8	9.1	130.1
EG 3	2017	5	39.8	147.2	56.7	137.4	93.6	3.74	9.07	29.1	123.5	40.9	16.3	40.7	3.95	44.0	135.4	5.96	14.44	252.2	8.9	148.0
EG 3	2017	6	40.6	133.1	57.1	138.4	84.6	3.70	8.97	26.5	155.5	43.6	16.7	43.8	4.05	41.6	123.2	5.13	12.42	245.0	8.3	126.7
EG 3	2017	7	41.4	144.8	57.8	140.1	92.1	3.52	8.53	27.1	133.8	39.6	15.3	37.9	3.71	42.0	128.1	5.38	13.04	249.9	8.6	130.0
EG 3	2017	8	40.6	135.0	57.9	140.3	85.8	3.61	8.75	27.4	152.1	41.7	16.2	41.5	3.93	44.5	125.6	5.59	13.55	258.7	8.5	137.7
EG 3	2017	9	40.1	139.1	55.6	134.4	88.4	3.53	8.56	29.8	141.4	40.2	16.8	40.8	4.07	42.6	142.4	6.07	14.70	248.8	8.8	151.4
EG 3	2017	10	40.3	127.0	56.7	137.4	80.8	3.68	8.92	30.0	134.8	39.2	16.6	39.0	4.02	44.5	134.0	5.96	14.45	257.6	8.8	147.9
EG 3			**40.80**	**138.90**	**56.70**	**137.4**	**88.3**	**3.60**	**8.73**	**28.40**	**141.00**	**40.00**	**16.30**	**39.60**	3.96	**42.6**	**132.1**	**5.63**	13.64	**250.0**	**8.7**	**137.90**
EG 3	2018	1	39.1	129.6	52.9	128.2	70.1	2.78	6.74	26.5	138.2	38.4	15.1	31.4	3.68	40.1	121.1	4.86	11.79	235.8	7.8	124.3
EG 3	2018	2	37.1	141.5	51.9	125.8	76.5	2.73	6.62	30.8	132.0	36.9	13.0	34.1	3.15	43.8	117.3	5.14	12.45	234.0	7.6	138.5
EG 3	2018	3	38.3	136.8	52.8	128.0	74.0	2.86	6.93	27.7	134.9	39.8	13.7	34.7	3.32	42.8	125.6	5.38	13.03	236.3	8.1	140.0
EG 3	2018	4	38.2	133.0	52.6	127.0	71.9	2.86	6.93	25.9	115.7	33.2	15.0	32.5	3.64	40.1	128.1	5.14	12.45	245.9	7.4	134.6
EG 3	2018	5	38.5	139.8	51.1	123.9	75.6	2.76	6.69	27.2	130.0	34.7	14.0	33.4	3.39	39.4	126.1	4.97	12.04	244.5	7.5	129.1
EG 3	2018	6	39.5	127.7	51.6	125.1	69.5	2.94	7.13	25.8	112.8	39.8	14.3	34.0	3.47	42.0	129.1	5.42	13.14	250.0	7.9	137.2
EG 3	2018	7	37.8	127.8	51.6	125.1	69.1	2.78	6.74	25.6	147.8	38.1	12.1	33.2	2.93	41.8	119.6	5.00	12.12	251.8	7.5	132.3
EG 3	2018	8	37.9	139.5	51.7	125.3	75.4	2.73	6.62	28.2	120.5	35.4	14.8	36.5	3.59	41.2	117.3	4.90	11.88	244.4	7.6	129.3
EG 3	2018	9	37.3	141.2	52.8	128.0	76.4	2.92	7.08	30.6	146.6	35.3	13.5	35.5	3.27	43.8	116.7	5.11	12.39	246.0	8.0	137.0
EG 3	2018	10	38.3	145.1	51.0	123.6	78.5	2.75	6.67	29.7	142.5	35.4	14.5	34.7	3.51	41.0	136.1	5.58	13.40	251.3	7.6	145.7
EG 3			**38.20**	**136.20**	**52.00**	**126.0**	**73.7**	**2.81**	**6.81**	**27.80**	**132.10**	**36.70**	**14.00**	**34.00**	3.40	**41.6**	**123.7**	**5.15**	12.47	**244.0**	**7.7**	**134.80**
EG 3	2019	1	38.1	117.3	44.8	108.6	60.4	2.37	5.74	22.9	133.0	29.8	9.4	23.4	2.28	39.7	96.0	3.81	9.30	259.8	5.9	100.0
EG 3	2019	2	37.9	113.7	43.9	106.4	58.8	2.18	5.28	26.4	100.1	28.8	8.3	26.4	2.01	41.3	97.4	4.02	9.75	252.1	5.5	106.1
EG 3	2019	3	36.1	127.4	44.2	107.1	65.6	2.32	5.62	26.8	109.0	30.2	11.8	25.4	2.86	40.0	87.4	3.50	8.47	252.8	6.3	97.0
EG 3	2019	4	37.5	111.7	43.0	104.7	57.5	2.18	5.28	21.3	98.2	26.6	11.0	22.2	2.67	42.4	88.9	3.77	9.14	263.5	5.6	100.5
EG 3	2019	5	36.7	115.4	44.8	108.6	59.4	2.18	5.28	24.0	126.7	25.3	11.6	27.2	2.81	39.3	97.6	3.84	9.30	263.7	5.7	104.6
EG 3	2019	6	38.1	119.9	43.2	104.7	61.8	2.28	5.53	26.7	112.1	29.4	11.1	24.9	2.69	40.6	100.9	4.10	9.93	249.5	5.8	107.6
EG 3	2019	7	37.2	127.5	44.6	108.1	65.7	2.26	5.48	21.5	126.0	26.1	10.3	26.2	2.50	41.3	95.3	3.94	9.54	255.0	6.2	105.9
EG 3	2019	8	36.8	121.7	43.7	105.9	62.7	2.34	5.67	23.7	105.7	28.6	10.5	23.5	2.55	40.6	101.4	4.12	9.98	248.5	6.1	112.0
EG 3	2019	9	37.5	117.2	43.5	105.4	60.4	2.23	5.41	25.3	130.6	26.3	10.7	26.5	2.59	42.6	102.1	4.35	10.54	254.5	5.9	114.4
EG 3	2019	10	36.1	110.2	44.3	107.4	56.8	2.35	5.70	23.4	111.6	27.9	9.3	26.3	2.25	38.2	101.0	3.86	9.35	250.6	6.0	106.9
EG 3			**37.20**	**118.20**	**44.00**	**106.7**	**60.9**	**2.27**	**5.50**	**24.20**	**115.30**	**27.90**	**10.40**	**25.20**	2.52	**40.6**	**96.8**	**3.93**	9.53	**255.0**	**5.9**	**105.50**
EG 3	2020	1	26.6	69.9	15.5	37.6	17.2	0.41	0.99	20.9	80.8	17.6	4.6	11.1	1.12	25.9	61.1	1.58	3.84	285.7	5.7	59.4

EG 3	2020	2	26.1	57.3	15.9	38.5	14.1	0.41	0.99	20.1	85.8	19.9	3.9	13.3	0.95	26.6	46.8	1.24	3.02	301.0	5.5	47.5
EG 3	2020	3	27.0	57.9	16.0	38.0	14.3	0.36	0.97	18.4	85.2	18.2	5.3	11.6	1.28	23.8	47.0	1.12	2.72	287.9	5.9	41.5
EG 3	2020	4	27.3	53.3	15.5	37.6	13.4	0.39	0.95	22.3	95.3	16.5	4.9	12.1	1.19	23.1	58.3	1.35	3.26	299.2	6.0	49.5
EG 3	2020	5	26.4	62.5	16.3	39.5	15.4	0.38	1.00	22.5	89.5	19.9	5.0	12.2	1.21	26.9	54.8	1.47	3.57	304.8	5.6	55.4
EG 3	2020	6	25.1	60.7	17.0	41.2	14.9	0.40	0.97	22.9	78.2	18.7	5.2	11.1	1.26	26.8	49.2	1.32	3.20	300.2	6.1	52.6
EG 3	2020	7	26.6	65.6	15.7	38.1	16.1	0.41	0.99	21.0	89.5	16.9	5.2	11.3	1.26	25.9	52.0	1.35	3.26	285.2	5.6	50.8
EG 3	2020	8	26.8	55.3	16.5	40.0	13.6	0.36	0.96	22.7	70.6	16.6	5.0	11.4	1.21	25.5	53.2	1.36	3.29	295.7	5.9	50.7
EG 3	2020	9	26.7	59.7	15.9	38.5	14.7	0.36	0.95	19.4	75.1	18.2	4.5	11.7	1.09	26.2	51.6	1.35	3.28	304.7	6.1	50.6
EG 3	2020	10	27.4	57.8	15.7	38.1	14.2	0.38	0.92	23.8	89.0	17.5	4.4	10.2	1.07	26.3	48.0	1.26	3.06	285.6	5.6	46.0
EG 3			**26.60**	**60.00**	**16.00**	**38.7**	**14.8**	**0.39**	**0.97**	**21.40**	**83.90**	**18.00**	**4.80**	**11.60**	1.16	**25.7**	**52.2**	**1.34**	3.25	**295.0**	**5.8**	**50.40**
EG 3	2021	1	33.0	78.9	22.8	55.3	31.0	0.87	2.11	23.0	96.7	24.5	8.0	19.3	1.94	37.8	80.2	3.00	7.27	256.4	7.8	90.9
EG 3	2021	2	32.9	75.3	23.9	57.9	29.8	0.95	2.30	23.5	100.4	24.9	8.4	18.7	2.04	37.9	88.0	3.34	8.08	259.9	8.2	101.5
EG 3	2021	3	32.8	63.8	24.0	58.2	25.2	0.97	2.35	26.5	109.0	25.8	8.3	20.4	2.01	36.8	86.7	3.19	7.73	262.0	7.9	97.3
EG 3	2021	4	32.1	70.0	23.8	57.7	27.7	0.88	2.13	26.2	88.2	23.3	7.2	17.8	1.75	37.7	90.2	3.40	8.24	264.2	8.3	105.9
EG 3	2021	5	31.9	73.3	22.1	53.8	29.0	0.88	2.13	24.4	103.8	25.3	7.3	19.6	1.77	34.5	73.7	2.54	6.16	258.5	8.1	79.6
EG 3	2021	6	31.8	72.9	23.6	57.2	28.8	0.98	2.38	24.7	95.2	23.4	7.0	19.8	1.70	35.9	77.9	2.80	6.78	272.3	8.3	88.1
EG 3	2021	7	31.4	63.5	22.8	55.3	25.1	0.99	2.40	23.6	95.0	23.3	8.3	19.6	2.01	36.0	84.3	3.03	7.36	274.7	8.0	96.5
EG 3	2021	8	31.5	71.9	23.2	56.2	28.5	0.86	2.08	26.1	92.4	24.1	7.3	17.8	1.77	35.8	79.4	2.84	6.89	263.8	8.1	90.6
EG 3	2021	9	32.5	76.6	23.2	56.2	30.2	0.94	2.28	26.2	92.9	24.2	7.7	18.8	1.87	35.4	83.9	2.97	7.20	274.3	8.4	91.4
EG 3	2021	10	33.1	74.8	23.6	57.2	29.6	0.90	2.18	25.8	93.4	23.2	8.5	17.2	2.06	36.2	80.7	2.92	7.08	263.9	7.9	88.2
EG 3			**32.30**	**72.10**	**23.30**	**56.5**	**28.5**	**0.92**	**2.23**	**25.00**	**96.70**	**24.20**	**7.80**	**18.90**	1.89	**36.4**	**82.5**	**3.00**	7.28	**265.0**	**8.1**	**93.00**
EG 4	2015	1	36.5	117.6	37.7	91.4	60.6	2.05	4.97	22.9	105.4	24.9	9.4	20.6	2.28	39.6	101.2	4.01	9.71	241.7	7.8	109.9
EG 4	2015	2	36.0	108.9	38.7	93.8	56.1	1.99	4.82	24.0	122.4	27.2	8.4	23.2	2.04	37.8	100.8	3.81	9.24	246.8	8.2	105.8
EG 4	2015	3	34.4	105.5	38.9	94.3	54.3	1.94	4.70	23.5	113.8	22.7	9.2	23.6	2.23	37.3	86.6	3.23	7.83	237.8	8.2	93.9
EG 4	2015	4	36.3	114.6	37.9	91.9	59.0	2.04	4.94	20.4	114.4	23.7	9.4	20.9	2.28	38.4	89.4	3.43	8.32	250.7	8.3	94.5
EG 4	2015	5	34.9	104.0	37.3	90.4	53.6	1.86	4.51	21.4	107.5	27.5	8.4	22.2	2.04	39.0	93.3	3.64	8.82	251.5	7.7	104.3
EG 4	2015	6	35.3	117.3	39.4	94.3	60.4	2.07	5.02	22.6	110.3	25.2	9.6	22.4	2.33	37.4	87.2	3.26	7.91	244.7	8.2	92.9
EG 4	2015	7	35.1	108.2	37.9	91.9	55.7	1.99	4.82	23.3	124.1	24.7	10.4	21.1	2.52	37.7	101.8	3.84	9.30	247.5	8.1	109.4
EG 4	2015	8	34.2	115.3	38.9	94.3	59.4	2.06	4.99	19.9	118.3	27.3	9.1	23.1	2.21	39.1	101.2	3.96	9.57	250.8	8.0	113.0
EG 4	2015	9	35.7	99.1	39.5	95.7	51.0	1.80	4.36	22.9	118.1	28.3	8.6	24.3	2.08	39.0	89.9	3.51	8.50	240.3	7.8	98.3
EG 4	2015	10	34.6	98.5	38.8	94.1	50.9	1.97	4.78	22.1	122.7	26.5	8.5	19.6	2.06	39.7	96.6	3.84	9.30	248.2	7.7	111.0
EG 4			**35.30**	**108.90**	**38.50**	**93.2**	**56.1**	**1.98**	**4.79**	**22.30**	**115.70**	**25.80**	**9.10**	**22.10**	2.21	**38.5**	**94.8**	**3.65**	8.85	**246.0**	**8.0**	**103.30**
EG 4	2016	1	35.0	122.0	43.0	106.0	64.4	2.39	5.40	24.4	123.5	33.9	11.7	30.1	2.84	40.4	117.6	4.75	11.52	264.4	8.4	135.7
EG 4	2016	2	36.4	110.6	44.0	106.7	58.4	2.30	5.58	24.9	120.8	33.9	10.3	27.5	2.60	41.1	141.7	5.82	14.00	272.1	8.5	159.9
EG 4	2016	3	35.9	114.1	43.7	105.9	60.2	2.19	5.31	22.0	125.4	28.8	12.1	26.5	2.93	39.1	126.3	4.94	11.97	263.2	8.5	137.6
EG 4	2016	4	35.4	111.3	42.6	103.3	58.7	2.39	5.79	25.4	136.0	33.7	10.7	29.4	2.59	39.5	122.7	4.85	11.80	276.0	8.8	137.0
EG 4	2016	5	36.1	130.0	42.4	102.8	68.6	2.35	5.70	24.9	141.3	32.9	11.9	26.1	2.88	38.6	129.8	5.01	12.14	264.3	8.6	138.8
EG 4	2016	6	36.7	127.4	43.7	105.9	67.2	2.37	5.74	25.7	120.8	29.4	12.3	29.0	2.98	40.3	122.6	4.94	11.98	271.5	8.7	134.6
EG 4	2016	7	35.5	128.3	42.4	102.8	67.7	2.10	5.09	23.0	129.9	34.1	11.2	28.6	2.71	39.7	119.0	4.72	11.45	267.7	8.7	133.0
EG 4	2016	8	36.7	114.9	44.1	106.5	60.2	2.33	5.65	23.5	139.5	28.6	12.5	25.8	3.03	37.4	125.0	4.68	11.33	274.0	8.5	128.7
EG 4	2016	9	36.4	119.7	43.9	106.4	63.2	2.26	5.48	26.3	121.8	35.0	10.3	30.0	2.50	39.2	125.2	4.91	11.90	259.6	8.6	134.9
EG 4	2016	10	36.9	123.7	43.2	104.7	65.3	2.21	5.36	24.9	147.0	29.7	12.0	27.0	2.91	37.7	127.1	4.79	11.62	267.2	8.7	129.8
EG 4			**36.10**	**120.20**	**43.30**	**105.1**	**63.4**	**2.29**	**5.51**	**24.50**	**130.60**	**32.00**	**11.50**	**28.00**	2.80	**39.3**	**125.7**	**4.94**	11.97	**268.0**	**8.6**	**137.00**
EG 4	2017	1	39.8	140.4	51.2	124.1	86.9	3.41	8.27	29.9	146.2	36.9	15.3	39.3	3.71	38.3	119.7	4.58	11.11	250.1	8.5	115.1
EG 4	2017	2	38.5	127.1	51.1	123.9	79.0	3.35	8.12	26.4	158.1	35.4	13.9	35.5	3.37	40.7	120.3	4.90	11.87	259.7	8.6	127.3
EG 4	2017	3	40.2	136.8	52.4	127.0	85.1	3.23	7.83	25.9	133.2	37.7	16.0	35.1	3.88	39.9	115.4	4.60	11.16	246.6	8.5	114.4
EG 4	2017	4	38.4	139.7	53.0	128.5	86.9	3.32	8.05	26.5	149.5	41.6	15.4	37.0	3.73	38.1	106.9	4.07	10.00	260.1	8.7	107.3
EG 4	2017	5	39.2	132.5	53.3	129.2	82.4	3.07	7.65	26.4	157.4	39.9	13.6	35.8	3.30	38.5	118.9	4.58	11.05	252.0	8.6	116.8
EG 4	2017	6	39.9	142.2	51.6	125.2	88.4	3.34	8.10	28.4	148.7	41.2	17.1	34.1	4.15	42.8	112.8	4.83	11.70	250.3	8.5	121.1
EG 4	2017	7	39.6	122.6	52.1	126.3	76.2	3.27	7.93	26.9	125.1	36.5	13.7	35.5	3.32	42.3	107.1	4.53	10.98	263.5	8.8	114.4
EG 4	2017	8	38.6	122.5	53.0	128.5	76.2	3.17	7.68	27.5	144.9	40.7	15.3	35.0	3.71	42.8	102.2	4.37	10.60	251.2	8.3	113.2
EG 4	2017	9	39.5	136.0	51.1	123.9	84.6	3.21	7.78	28.5	121.4	36.1	13.7	36.8	3.32	38.7	118.0	4.57	11.07	257.5	8.9	115.7
EG 4	2017	10	38.3	129.2	52.2	126.5	80.3	3.06	7.42	25.6	122.5	37.0	16.0	39.9	3.88	41.9	117.7	4.93	11.95	259.0	8.6	128.7
EG 4			**39.20**	**132.90**	**52.10**	**126.3**	**82.6**	**3.24**	**7.88**	**27.20**	**140.70**	**38.30**	**15.00**	**36.40**	3.64	**40.4**	**113.9**	**4.60**	11.15	**255.0**	**8.6**	**117.40**
EG 4	2018	1	34.4	133.1	45.4	109.8	70.3	2.39	5.79	28.5	139.8	34.0	12.6	31.0	3.05	35.3	121.4	4.29	10.39	240.3	7.5	124.7
EG 4	2018	2	35.1	139.3	45.0	109.1	73.3	2.42	5.87	25.1	126.3	32.5	12.2	28.3	2.86	38.0	117.1	4.45	10.72	242.6	7.9	126.0
EG 4	2018	3	34.0	122.0	44.6	108.1	64.4	2.45	5.94	24.4	148.0	37.9	12.7	26.5	3.08	36.4	114.6	4.17	10.11	239.4	7.6	122.6
EG 4	2018	4	33.7	135.0	43.2	104.7	71.3	2.12	5.14	28.3	124.3	37.2	13.5	26.7	3.27	37.4	111.4	4.17	10.10	245.0	7.5	123.7
EG 4	2018	5	34.3	138.9	45.4	110.0	73.3	2.27	5.65	27.5	147.9	36.8	10.2	28.7	2.47	39.2	123.6	4.85	11.74	253.5	7.7	141.4
EG 4	2018	6	33.3	135.6	43.1	104.5	71.6	2.37	5.74	23.5	142.0	36.5	10.7	30.1	2.59	36.3	108.0	3.92	9.50	248.4	7.6	117.7
EG 4	2018	7	35.1	130.2	44.8	108.6	68.7	2.33	5.65	24.8	108.4	31.7	13.1	31.3	3.18	37.5	110.3	4.14	10.03	248.9	7.7	117.9
EG 4	2018	8	34.4	120.4	43.9	106.4	63.6	2.38	5.77	27.3	132.7	31.9	10.3	31.1	2.50	37.5	117.6	4.41	10.69	241.4	7.6	128.2
EG 4	2018	9	33.5	122.9	44.8	108.6	64.9	2.36	5.72	28.0	133.6	34.0	10.7	29.8	2.59	37.6	115.5	4.34	10.53	245.0	7.3	129.6
EG 4	2018	10	33.2	124.6	43.8	106.2	65.8	2.28	5.53	28.6	115.0	38.5	14.0	26.5	3.39	36.8	116.5	4.29	10.39	255.5	7.6	129.2

EG 4			**34.10**	**130.20**	**44.40**	**107.6**	**68.7**	**2.34**	**5.68**	**26.60**	**131.80**	**35.10**	**12.00**	**29.00**	2.90	**37.2**	**115.6**	**4.30**	10.42	**246.0**	**7.6**	**126.10**
EG 4	2019	1	34.4	115.3	38.7	93.7	57.7	1.84	4.46	23.3	107.9	26.9	8.6	19.9	2.20	35.5	88.0	3.12	7.57	260.8	5.7	90.7
EG 4	2019	2	33.9	115.6	38.3	92.8	58.1	1.86	4.51	22.6	111.0	24.1	8.1	22.3	1.96	37.7	95.0	3.58	8.68	257.2	5.9	105.1
EG 4	2019	3	34.1	103.4	38.7	93.8	51.9	1.88	4.56	20.7	98.1	25.9	8.5	21.0	2.06	36.0	95.5	3.44	8.33	257.5	6.1	100.9
EG 4	2019	4	34.2	117.7	38.9	94.3	59.1	1.87	4.53	25.6	111.5	25.3	9.6	23.6	2.33	36.5	97.5	3.56	8.63	264.8	5.7	104.1
EG 4	2019	5	32.3	102.7	38.2	92.6	51.6	1.85	4.48	23.7	127.1	27.1	8.9	19.7	2.16	36.5	85.3	3.11	7.55	265.1	5.6	96.3
EG 4	2019	6	34.3	113.9	37.1	89.9	57.2	1.98	4.80	24.9	133.0	27.8	9.2	24.0	2.23	35.9	90.5	3.25	7.88	252.2	6.1	94.8
EG 4	2019	7	33.4	117.7	37.1	89.9	59.1	1.91	4.63	22.9	113.0	27.3	9.3	20.1	2.25	37.3	90.5	3.38	8.18	256.2	6.0	101.2
EG 4	2019	8	32.4	105.0	37.4	90.7	52.8	1.98	4.80	21.4	105.8	26.5	9.8	21.0	2.38	37.3	90.2	3.36	8.16	252.8	6.2	103.7
EG 4	2019	9	33.6	119.8	37.9	91.9	60.2	1.99	4.82	21.3	137.5	26.4	7.9	22.5	1.91	37.8	90.2	3.41	8.26	252.9	5.8	101.5
EG 4	2019	10	34.4	115.9	37.7	91.4	58.2	1.94	4.70	23.6	108.1	27.7	9.1	22.9	2.21	36.5	87.3	3.19	7.76	260.5	5.9	92.7
EG 4			**33.70**	**112.70**	**38.00**	**92.1**	**56.6**	**1.91**	**4.63**	**23.00**	**115.30**	**26.50**	**8.90**	**21.70**	2.17	**36.7**	**91.0**	**3.34**	8.10	**258.0**	**5.9**	**99.10**
EG 4	2020	1	24.6	49.0	13.1	31.8	12.1	0.32	0.78	20.4	78.9	15.6	3.6	8.9	0.87	26.2	44.5	1.17	2.84	297.0	5.2	47.6
EG 4	2020	2	23.1	52.0	12.6	31.7	12.8	0.30	0.73	17.7	76.4	16.0	3.7	9.7	0.90	23.4	54.0	1.26	3.06	296.4	5.5	54.5
EG 4	2020	3	24.6	55.0	12.6	30.5	13.5	0.30	0.73	17.2	71.3	15.5	3.1	8.1	0.75	25.9	53.8	1.39	3.38	298.3	5.6	56.5
EG 4	2020	4	25.4	51.0	13.6	33.0	12.6	0.34	0.82	17.4	88.5	16.8	4.1	9.6	0.99	24.1	54.3	1.31	3.17	307.8	5.1	51.6
EG 4	2020	5	24.2	47.6	13.1	31.8	11.7	0.31	0.75	20.6	84.4	18.1	3.7	8.1	0.90	24.5	51.7	1.27	3.07	299.0	5.6	52.5
EG 4	2020	6	24.3	46.3	12.0	29.1	11.4	0.32	0.78	18.0	100.0	17.6	4.3	9.1	1.04	25.3	52.4	1.33	3.21	291.7	5.2	54.7
EG 4	2020	7	24.2	55.9	12.0	29.1	13.5	0.32	0.78	18.4	96.8	13.7	3.4	9.8	0.82	25.3	47.3	1.20	2.90	296.4	5.1	49.6
EG 4	2020	8	23.3	51.0	12.6	30.5	12.6	0.30	0.73	18.7	69.3	16.0	4.4	9.9	1.07	25.5	46.9	1.20	2.90	305.6	5.2	51.5
EG 4	2020	9	23.5	63.4	13.0	31.5	15.6	0.28	0.85	20.1	95.3	13.3	3.3	9.6	0.80	24.5	54.9	1.35	3.26	300.0	5.0	57.0
EG 4	2020	10	23.8	57.8	12.4	30.1	14.2	0.28	0.75	19.5	77.1	14.4	4.4	9.2	1.07	25.3	52.2	1.32	3.20	307.8	5.5	55.5
EG 4			**24.10**	**52.90**	**12.70**	**30.9**	**13.0**	**0.31**	**0.77**	**18.80**	**83.80**	**15.70**	**3.80**	**9.20**	0.92	**25.0**	**51.2**	**1.28**	3.10	**300.0**	**5.3**	**53.10**
EG 4	2021	1	28.6	66.6	18.5	44.8	25.6	0.68	1.65	21.7	97.7	21.5	7.3	14.4	1.75	32.5	77.7	2.53	6.12	261.7	7.8	88.5
EG 4	2021	2	30.0	67.6	17.9	43.4	26.0	0.65	1.58	24.6	93.5	20.0	6.0	17.5	1.45	31.2	77.9	2.43	5.89	270.9	7.9	81.0
EG 4	2021	3	28.7	52.3	18.6	45.1	20.2	0.75	1.82	21.6	105.8	22.0	6.4	13.9	1.55	32.0	80.7	2.58	6.26	262.8	7.9	89.9
EG 4	2021	4	29.5	69.1	19.1	45.7	26.6	0.68	1.65	21.3	93.2	23.5	6.1	17.3	1.48	32.6	73.0	2.38	5.77	271.7	8.1	80.7
EG 4	2021	5	29.3	64.1	17.7	42.9	24.7	0.71	1.72	19.7	86.1	23.5	5.5	14.7	1.33	34.2	72.2	2.47	5.99	264.5	8.1	84.3
EG 4	2021	6	29.0	53.2	17.4	42.2	20.5	0.78	1.89	22.5	109.0	20.3	7.4	16.6	1.79	30.4	73.3	2.23	5.43	274.2	7.9	76.9
EG 4	2021	7	29.3	63.7	18.2	44.1	24.5	0.62	1.50	23.3	98.1	22.3	6.9	16.8	1.67	33.6	70.3	2.36	5.73	273.4	8.3	80.5
EG 4	2021	8	29.0	65.5	17.9	43.4	25.2	0.69	1.67	24.2	99.7	18.7	6.3	13.4	1.53	33.5	82.4	2.76	6.69	266.4	7.9	94.4
EG 4	2021	9	30.8	59.0	18.6	45.1	22.7	0.74	1.79	24.1	87.1	22.6	6.2	15.4	1.50	34.3	83.4	2.86	6.93	263.8	8.2	92.9
EG 4	2021	10	29.8	59.9	19.1	46.3	23.0	0.66	1.60	23.0	94.8	23.6	5.9	15.0	1.43	31.7	74.1	2.35	5.69	270.6	7.9	78.9
EG 4			**29.40**	**62.10**	**18.30**	**44.3**	**23.9**	**0.70**	**1.69**	**22.60**	**96.50**	**21.80**	**6.40**	**15.50**	1.55	**32.6**	**76.5**	**2.49**	6.05	**268.0**	**8.0**	**84.80**
EG 5	2015	1	33.1	112.2	35.7	86.5	56.4	1.75	4.24	20.3	123.3	25.7	6.8	20.2	1.65	39.6	83.9	3.32	8.05	253.0	7.9	100.3
EG 5	2015	2	33.8	110.0	34.4	83.4	55.3	1.79	4.34	21.2	113.4	25.2	8.2	17.9	1.99	36.2	80.5	2.91	7.17	250.6	7.8	89.0
EG 5	2015	3	34.2	98.0	34.6	83.9	49.2	1.80	4.36	20.0	119.4	25.0	8.7	18.2	2.11	37.6	88.3	3.32	8.05	252.2	8.0	97.1
EG 5	2015	4	34.2	99.5	33.9	82.2	50.0	1.70	4.12	23.2	96.7	24.0	8.8	19.7	2.13	37.8	77.1	2.91	7.06	246.8	8.0	85.1
EG 5	2015	5	32.9	102.7	34.2	82.9	51.6	1.81	4.39	23.0	120.1	23.8	8.6	20.8	2.08	36.1	95.0	3.43	8.31	243.6	8.1	104.3
EG 5	2015	6	34.4	112.0	34.1	82.7	56.3	1.78	4.31	20.2	112.6	21.8	8.4	21.0	2.04	35.8	91.3	3.27	7.92	240.7	7.7	95.1
EG 5	2015	7	34.1	95.6	34.6	83.3	48.0	1.70	4.12	20.3	120.4	24.1	8.3	21.2	2.01	36.7	92.4	3.39	8.22	251.7	8.1	99.4
EG 5	2015	8	33.5	96.0	35.3	85.6	48.2	1.68	4.07	20.2	121.5	24.0	7.2	21.2	1.75	37.7	81.5	3.07	7.45	248.1	7.6	91.6
EG 5	2015	9	34.1	103.8	35.5	86.1	52.1	1.69	4.10	22.6	114.6	23.8	8.2	18.2	1.99	35.9	89.7	3.22	7.81	256.8	8.1	94.4
EG 5	2015	10	34.7	97.2	35.7	86.5	48.8	1.83	4.10	20.0	107.0	25.6	8.8	20.6	2.13	35.6	93.3	3.32	8.05	256.5	7.7	95.7
EG 5			**33.90**	**102.70**	**34.80**	**84.3**	**51.6**	**1.75**	**4.22**	**21.10**	**114.90**	**24.30**	**8.20**	**19.90**	1.99	**36.9**	**87.3**	**3.22**	7.81	**250.0**	**7.9**	**95.20**
EG 5	2016	1	35.1	117.9	38.0	92.1	60.7	1.86	4.51	22.9	123.5	30.4	9.0	24.2	2.18	37.0	100.8	3.73	9.04	275.5	8.8	107.0
EG 5	2016	2	34.2	119.9	37.0	89.7	61.8	2.10	4.90	22.2	120.8	31.0	9.5	25.4	2.50	36.0	103.6	3.73	9.04	270.7	8.3	109.1
EG 5	2016	3	33.3	106.0	37.9	91.9	54.6	1.89	4.58	23.3	125.4	27.4	11.6	23.4	2.61	36.2	90.8	3.29	7.97	260.5	8.3	98.8
EG 5	2016	4	33.3	112.4	39.5	95.6	57.9	2.04	4.94	22.5	132.0	28.0	10.3	24.1	2.50	38.1	93.7	3.57	8.60	263.8	8.4	107.2
EG 5	2016	5	34.5	118.9	37.2	90.2	61.2	2.04	4.94	23.3	141.3	27.4	10.2	24.7	2.47	37.7	94.7	3.57	8.65	278.3	8.6	103.5
EG 5	2016	6	35.4	110.5	37.4	90.7	56.9	1.89	4.58	22.7	120.8	27.5	9.6	26.0	2.33	38.1	108.7	4.14	10.04	269.7	8.5	116.9
EG 5	2016	7	33.7	107.3	38.0	92.1	55.3	1.93	4.68	24.6	129.9	33.2	9.2	25.4	2.23	38.8	98.0	3.80	9.22	274.0	8.6	112.8
EG 5	2016	8	33.9	102.0	38.4	93.1	52.8	1.89	4.58	23.9	139.5	30.6	11.4	27.2	2.76	39.5	107.0	4.23	10.25	266.0	8.5	124.8
EG 5	2016	9	34.2	103.3	38.9	94.3	53.2	1.96	4.75	22.9	121.8	32.9	9.0	21.2	2.18	38.6	100.5	3.88	9.40	277.6	8.6	113.5
EG 5	2016	10	33.4	115.8	37.7	91.4	59.6	1.96	4.75	19.7	147.0	28.6	11.2	23.4	2.71	40.0	107.2	4.29	10.39	263.9	8.4	126.4
EG 5			**34.10**	**111.40**	**38.00**	**92.1**	**57.4**	**1.96**	**4.72**	**22.80**	**130.20**	**29.70**	**10.10**	**24.50**	2.45	**38.0**	**100.5**	**3.82**	9.26	**270.0**	**8.5**	**112.00**
EG 5	2017	1	37.3	123.4	46.7	113.2	75.0	2.94	7.13	25.9	146.2	36.1	12.9	32.5	3.13	40.4	109.3	4.42	10.70	261.3	8.4	118.5
EG 5	2017	2	37.7	133.3	46.3	112.2	81.0	2.93	7.10	23.2	158.1	33.1	11.9	34.7	2.88	38.5	101.3	3.90	9.45	269.3	8.8	103.4
EG 5	2017	3	37.7	118.7	47.9	116.1	72.2	2.66	6.45	23.1	133.2	39.7	14.7	33.0	3.56	37.8	99.0	3.74	9.09	254.4	8.3	99.2
EG 5	2017	4	38.5	117.1	48.3	115.5	71.2	2.66	6.70	28.5	149.5	35.6	12.1	30.0	2.93	40.0	102.1	4.08	9.90	258.1	8.6	106.0
EG 5	2017	5	38.2	122.5	47.5	115.1	74.5	2.95	7.15	26.3	157.4	40.2	14.5	34.2	3.51	38.4	108.2	4.15	10.07	259.9	8.6	108.6
EG 5	2017	6	36.5	127.9	46.8	113.4	77.8	2.72	6.59	25.0	148.7	36.3	14.6	33.5	3.54	41.2	110.5	4.55	11.04	255.9	8.4	123.6
EG 5	2017	7	38.2	130.8	46.2	112.0	79.5	2.97	7.20	28.7	125.1	34.1	14.6	32.0	3.54	37.3	111.4	4.16	10.07	269.5	8.2	108.9
EG 5	2017	8	36.7	122.7	47.9	116.1	74.6	2.98	7.22	25.0	144.9	39.0	12.7	35.1	3.08	38.5	103.9	4.00	9.70	251.0	8.6	109.0

EG 5	2017	9	36.5	139.0	48.3	117.1	84.5	2.89	7.01	25.4	121.4	33.8	13.8	32.7	3.35	41.4	103.4	4.28	10.38	253.4	8.7	117.3
EG 5	2017	10	37.7	124.6	47.1	114.2	75.7	2.97	7.20	26.9	122.5	35.1	14.2	32.3	3.44	40.5	101.9	4.13	10.00	267.2	8.4	109.5
EG 5			**37.50**	**126.00**	**47.30**	**114.5**	**76.6**	**2.87**	**6.97**	**25.80**	**140.70**	**36.30**	**13.60**	**33.00**	3.30	**39.4**	**105.1**	**4.14**	10.04	**260.0**	**8.5**	**110.40**
EG 5	2018	1	32.2	118.4	39.9	96.7	61.0	2.20	5.33	23.8	139.8	32.8	11.4	25.8	2.76	36.0	110.5	3.98	9.64	244.0	7.6	123.6
EG 5	2018	2	32.8	125.3	40.8	98.9	64.5	2.05	4.97	21.6	126.3	35.4	10.7	25.9	2.66	34.3	117.6	4.03	9.78	258.4	7.5	122.9
EG 5	2018	3	32.5	120.7	39.6	96.8	62.2	2.09	5.07	27.1	148.0	34.3	11.2	27.2	2.71	36.1	104.1	3.76	9.20	244.7	7.2	115.7
EG 5	2018	4	32.4	110.1	40.1	97.2	56.7	1.98	4.80	26.8	124.3	34.4	11.5	24.5	2.79	35.4	116.7	4.13	10.01	250.1	7.4	127.5
EG 5	2018	5	33.6	122.5	40.8	98.9	63.1	2.20	5.33	26.6	140.9	31.0	11.4	28.4	2.76	35.5	104.9	3.72	9.03	255.5	7.3	110.7
EG 5	2018	6	32.6	127.9	40.1	97.2	65.9	2.19	5.31	25.7	142.0	31.0	10.6	26.3	2.57	35.7	116.2	4.15	10.06	255.3	7.6	127.3
EG 5	2018	7	32.6	130.8	41.8	101.3	67.4	2.08	5.04	22.9	115.4	30.4	11.3	27.0	2.74	37.9	102.5	3.88	9.42	249.7	7.7	119.0
EG 5	2018	8	33.2	122.7	41.7	101.1	63.2	1.97	4.78	27.9	132.7	32.4	10.3	25.9	2.50	36.7	118.0	4.33	10.50	243.1	7.3	130.4
EG 5	2018	9	33.4	132.0	40.2	97.4	67.9	2.00	4.85	26.6	133.6	34.4	10.5	28.0	2.55	34.9	110.1	3.84	9.31	246.2	7.6	115.1
EG 5	2018	10	33.7	124.6	41.0	99.4	64.2	2.12	5.14	23.0	115.0	35.9	10.1	26.0	2.45	36.5	111.4	4.07	9.86	253.0	7.8	120.8
EG 5			**32.90**	**123.50**	**40.60**	**98.5**	**63.6**	**2.09**	**5.06**	**25.20**	**131.80**	**33.20**	**10.90**	**26.50**	2.65	**35.9**	**111.2**	**3.99**	9.68	**250.0**	**7.5**	**121.30**
EG 5	2019	1	31.9	117.7	32.7	79.3	59.1	1.58	3.83	19.2	107.9	26.0	8.4	19.9	2.00	32.6	87.0	2.84	6.87	255.3	5.6	89.0
EG 5	2019	2	32.1	106.7	34.5	83.6	53.6	1.60	3.95	23.2	111.0	24.5	8.5	17.7	2.06	32.8	88.4	2.90	7.03	258.3	5.7	90.3
EG 5	2019	3	30.8	106.9	33.4	81.0	53.7	1.77	4.29	23.9	98.1	25.0	7.3	19.7	1.77	35.4	86.1	3.05	7.39	260.6	5.8	99.0
EG 5	2019	4	31.2	105.9	32.9	79.7	53.2	1.66	4.02	21.8	111.5	25.1	7.7	18.0	1.87	34.6	93.6	3.24	7.79	260.4	5.6	102.0
EG 5	2019	5	32.1	105.5	33.5	81.2	53.0	1.71	4.15	21.4	127.1	26.8	8.5	19.2	2.06	35.8	82.3	2.95	7.14	264.1	6.1	91.9
EG 5	2019	6	31.8	99.1	32.6	79.0	49.8	1.73	4.19	21.5	131.0	26.2	7.3	17.1	1.77	35.4	90.4	3.20	7.76	258.2	5.8	100.6
EG 5	2019	7	30.1	98.5	33.7	81.1	49.5	1.63	3.95	23.7	113.0	25.9	8.3	19.9	2.01	35.3	85.8	3.03	7.34	254.4	5.9	100.7
EG 5	2019	8	32.4	113.6	33.7	81.7	57.1	1.66	4.02	20.3	105.8	22.6	7.3	18.7	1.77	33.4	82.2	2.75	6.66	264.4	5.8	84.9
EG 5	2019	9	30.5	106.5	33.3	80.7	53.5	1.66	4.10	19.8	137.5	21.8	8.5	20.5	2.06	34.0	75.9	2.58	6.26	254.7	6.0	84.7
EG 5	2019	10	32.1	98.6	33.7	81.7	49.5	1.77	4.29	22.2	108.1	26.1	7.2	20.3	1.75	33.7	74.3	2.50	6.07	269.6	5.7	77.9
EG 5			**31.50**	**105.90**	**33.40**	**80.9**	**53.2**	**1.68**	**4.08**	**21.70**	**115.10**	**25.00**	**7.90**	**19.10**	1.91	**34.3**	**84.6**	**2.90**	7.03	**260.0**	**5.8**	**92.10**
EG 5	2020	1	23.1	50.0	11.0	26.7	11.9	0.27	0.65	17.3	78.9	15.6	3.2	7.8	0.78	22.2	50.9	1.13	2.74	315.2	5.0	48.9
EG 5	2020	2	22.7	51.0	10.8	26.2	12.1	0.29	0.70	18.3	76.4	15.0	2.8	7.6	0.76	22.1	49.0	1.08	2.62	325.7	4.9	47.6
EG 5	2020	3	22.7	44.5	11.8	28.6	10.6	0.26	0.63	18.1	76.3	15.5	3.7	7.3	0.73	21.4	53.1	1.14	2.75	307.8	5.2	50.2
EG 5	2020	4	23.0	42.4	10.9	26.4	10.1	0.18	0.44	17.5	88.5	16.8	3.2	8.9	0.89	20.9	48.4	1.01	2.47	322.2	5.1	43.9
EG 5	2020	5	21.9	49.0	11.8	28.6	11.6	0.23	0.56	18.7	84.4	16.1	3.3	8.1	0.81	22.2	45.1	1.00	2.43	321.1	5.4	45.7
EG 5	2020	6	23.3	49.3	11.4	27.6	11.7	0.23	0.56	18.6	95.0	14.6	2.9	8.3	0.83	21.2	51.1	1.08	2.63	311.9	5.3	46.4
EG 5	2020	7	23.0	51.9	10.9	26.4	12.1	0.31	0.70	19.0	96.8	13.7	3.5	7.9	0.79	19.7	44.1	0.87	2.11	315.8	4.9	37.8
EG 5	2020	8	21.2	47.0	11.4	27.6	11.2	0.28	0.68	17.6	69.3	16.0	4.0	8.8	0.88	20.6	53.0	1.09	2.65	313.7	4.9	51.4
EG 5	2020	9	22.6	53.5	10.8	26.7	12.7	0.30	0.73	16.1	95.3	13.3	4.0	8.9	0.89	22.0	55.4	1.22	2.95	312.6	4.9	52.9
EG 5	2020	10	21.5	59.4	11.2	27.1	14.1	0.30	0.73	18.8	77.1	14.4	3.4	8.4	0.84	20.7	52.9	1.10	2.65	314.0	5.4	51.2
EG 5			**22.50**	**49.80**	**11.20**	**27.2**	**11.8**	**0.27**	**0.64**	**18.00**	**83.80**	**15.10**	**3.40**	**8.20**	0.82	**21.3**	**50.3**	**1.07**	2.60	**316.0**	**5.1**	**47.60**
EG 5	2021	1	27.8	64.0	15.9	39.2	23.9	0.52	1.26	24.0	97.7	19.0	6.4	12.8	1.55	30.9	72.1	2.23	5.40	275.6	8.2	80.2
EG 5	2021	2	27.9	59.6	16.9	41.0	22.3	0.63	1.53	22.7	93.5	23.6	5.5	15.2	1.33	32.9	80.4	2.65	6.41	263.9	7.7	95.0
EG 5	2021	3	28.0	67.0	17.2	41.7	25.0	0.51	1.24	22.2	105.8	23.9	6.5	12.6	1.58	29.4	71.9	2.11	5.14	270.3	8.1	75.4
EG 5	2021	4	28.2	64.2	16.4	39.8	24.0	0.60	1.45	23.8	94.2	21.2	5.1	13.1	1.35	29.9	77.1	2.31	5.59	259.1	8.0	81.9
EG 5	2021	5	26.2	51.9	16.6	40.2	19.7	0.59	1.43	21.2	86.1	22.5	5.8	15.1	1.41	28.5	76.2	2.17	5.26	260.6	7.9	82.8
EG 5	2021	6	26.8	62.2	16.8	40.7	23.2	0.68	1.65	20.9	106.0	21.4	5.3	15.3	1.28	32.9	69.8	2.30	5.57	268.0	8.1	85.8
EG 5	2021	7	27.9	57.9	16.0	38.8	21.6	0.67	1.62	20.3	98.1	18.9	6.4	15.6	1.55	32.1	84.8	2.72	6.60	264.7	7.9	96.9
EG 5	2021	8	26.9	53.4	16.9	41.0	20.0	0.68	1.65	22.6	99.7	20.9	5.8	13.5	1.41	32.1	68.0	2.18	5.29	275.8	7.9	81.0
EG 5	2021	9	27.6	66.3	16.2	39.3	24.8	0.68	1.65	21.1	89.1	21.5	5.8	15.4	1.41	29.2	75.0	2.19	5.31	268.9	8.3	79.3
EG 5	2021	10	27.7	57.5	17.1	41.5	21.5	0.64	1.55	21.2	94.8	19.1	5.4	13.4	1.31	32.1	82.7	2.65	6.43	273.1	7.9	95.7
EG 5			**27.50**	**60.40**	**16.60**	**40.3**	**22.6**	**0.62**	**1.50**	**22.00**	**96.50**	**21.20**	**5.80**	**14.20**	1.42	**31.0**	**75.8**	**2.35**	5.70	**268.0**	**8.0**	**85.40**

Table A 12.3. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB (*Scheme II)*

Variants	Year	Rep et	N of Sh.	Shoot Length	Annual Growth		Annual Growth Volume			N L/ Shoot	Leaf Area				LAI	N of Clus.	W. of Clus.	Yield		Sugar	Titr. Acid	SP
					m.vine	th.m/ ha	cm^3/ shoot	dm^3/ vine	m^3/ha		cm^2/ leaf	dm^2/ shoot	m^2/ vine	th. m^2/ha				per vine	per hec.			
Without tendril H_2O	2015	1	37.2	127.8	47.5	115.1	65.2	2.43	5.89	25.4	119.2	30.3	11.5	27.9	2.79	44.0	94.4	4.15	10.06	237.0	7.8	111.6
Without tendril H_2O	2015	2	37.8	113.9	43.8	106.2	61.5	2.32	5.62	24.2	121.3	29.4	11.1	26.9	2.69	42.2	96.7	4.08	9.89	243.3	7.8	107.9
Without tendril H_2O	2015	3	38.0	123.8	47.0	114.2	65.6	2.49	6.04	24.6	111.1	27.3	10.4	25.2	2.52	42.2	94.2	3.98	9.65	241.5	7.7	104.7
Without tendril H_2O	2015	4	37.9	130.8	49.6	120.2	62.6	2.37	5.74	24.2	111.9	27.1	10.3	25.0	2.50	42.9	90.2	3.87	9.38	241.8	7.8	102.1
Without tendril H_2O	2015	5	40.1	132.2	53.0	128.5	60.9	2.44	5.91	25.9	116.2	30.1	12.1	29.3	2.93	40.8	93.5	3.81	9.24	231.5	7.7	95.0
Without tendril H_2O	2015	6	39.3	113.3	44.5	107.9	59.9	2.35	5.70	24.9	117.3	29.2	11.5	27.9	2.79	43.0	90.0	3.87	9.38	243.1	7.6	98.5
Without tendril H_2O	2015	7	37.9	119.3	45.2	129.3	60.7	2.30	5.58	25.4	114.7	29.1	11.0	26.7	2.67	39.9	100.8	4.02	9.74	240.5	7.7	106.1
Without tendril H_2O	2015	8	37.9	117.1	44.4	107.6	66.3	2.51	6.08	26.0	120.8	31.4	11.9	28.8	2.88	40.2	93.3	3.75	9.09	228.9	7.6	98.9

Without tendril H_2O	2015	9	38.9	127.6	49.6	120.2	65.6	2.55	6.18	25.4	113.2	28.8	11.2	27.1	2.71	42.2	97.8	4.13	10.01	232.1	7.7	106.2
Without tendril H_2O	2015	10	38.0	119.2	45.3	109.8	62.7	2.38	5.77	25.0	113.3	28.3	10.8	26.2	2.62	40.6	90.1	3.66	8.87	240.3	7.6	96.3
Without tendril H_2O			**38.30**	**122.5**	**47.00**	**115.9**	**63.10**	**2.42**	**5.85**	**25.10**	**115.9**	**29.10**	**11.17**	**27.10**	**2.71**	**41.80**	**94.10**	**3.93**	9.53	**238.0**	**7.70**	**102.7**
Without tendril H_2O	2016	1	37.8	124.7	47.1	114.7	65.8	2.49	6.04	25.6	130.8	33.5	12.3	29.8	2.98	37.3	121.0	4.51	10.93	238.8	8.0	119.3
Without tendril H_2O	2016	2	36.3	131.8	47.8	115.9	69.6	2.53	6.13	27.0	129.2	34.9	12.7	30.8	3.08	41.4	128.6	5.32	12.90	238.6	8.0	146.6
Without tendril H_2O	2016	3	36.3	128.5	46.6	134.1	67.8	2.46	5.96	26.4	142.4	37.6	13.6	33.0	3.30	39.0	121.7	4.75	11.51	229.5	7.9	130.9
Without tendril H_2O	2016	4	37.8	115.7	43.7	105.9	61.1	2.31	5.60	26.1	135.8	35.4	13.4	32.5	3.25	41.1	119.0	4.89	11.85	233.6	8.1	129.4
Without tendril H_2O	2016	5	37.8	119.7	45.2	109.6	63.2	2.39	5.79	24.3	123.2	29.9	11.3	27.4	2.74	39.6	123.0	4.87	11.80	221.6	8.0	128.8
Without tendril H_2O	2016	6	37.5	135.2	50.7	122.9	71.4	2.68	6.50	26.2	124.2	32.5	12.2	29.6	2.96	39.5	111.8	4.42	10.71	228.5	8.0	117.9
Without tendril H_2O	2016	7	35.6	128.9	45.9	111.3	68.0	2.42	5.87	25.7	130.3	33.5	11.9	28.8	2.88	40.6	110.2	4.47	10.84	229.4	8.0	125.6
Without tendril H_2O	2016	8	37.1	120.8	44.8	108.6	63.8	2.37	5.74	25.4	141.2	35.9	13.3	32.2	3.22	41.0	110.8	4.54	11.00	221.6	7.9	122.4
Without tendril H_2O	2016	9	35.6	122.6	43.6	105.7	64.7	2.30	5.58	26.0	132.0	34.3	12.2	29.6	2.96	41.5	116.3	4.83	11.71	235.8	8.1	135.7
Without tendril H_2O	2016	10	36.2	128.1	46.4	112.5	67.6	2.45	5.94	24.3	137.9	33.5	12.1	29.3	2.93	40.0	119.6	4.78	11.59	232.6	8.0	132.0
Without tendril H_2O			**36.80**	**125.6**	**46.20**	**114.1**	**66.30**	**2.44**	**5.91**	**25.70**	**132.7**	**34.11**	**12.51**	**30.30**	**3.03**	**40.10**	**118.2**	**4.74**	11.49	**231.0**	**8.00**	**128.8**
Without tendril H_2O	2017	1	34.8	126.7	44.1	106.9	84.2	2.93	7.10	26.5	146.5	38.8	13.5	32.7	3.27	43.0	125.9	5.30	12.85	251.7	8.4	152.3
Without tendril H_2O	2017	2	36.3	140.7	51.1	123.9	94.0	3.41	8.27	27.6	143.4	39.6	14.4	34.9	3.49	40.9	123.8	5.06	12.27	245.9	8.5	139.4
Without tendril H_2O	2017	3	36.3	137.8	50.0	121.2	91.4	3.32	8.05	28.2	152.6	43.0	15.6	37.8	3.78	38.5	112.6	4.34	10.52	254.3	8.5	119.6
Without tendril H_2O	2017	4	37.8	139.4	52.7	127.7	92.6	3.50	8.48	28.7	144.3	41.4	15.6	37.8	3.78	38.2	115.8	4.42	10.71	256.6	8.4	116.9
Without tendril H_2O	2017	5	37.8	137.7	52.1	126.3	91.5	3.46	8.39	27.3	136.7	37.3	14.1	34.2	3.42	39.2	128.3	5.03	12.19	251.8	8.6	133.1
Without tendril H_2O	2017	6	37.5	125.6	46.6	113.0	83.5	3.13	7.59	27.1	141.8	38.4	14.4	34.9	3.49	38.8	112.9	4.38	10.62	256.6	8.5	116.8
Without tendril H_2O	2017	7	35.6	130.0	46.3	160.6	86.4	3.08	7.47	28.6	141.5	40.5	14.4	34.9	3.49	37.5	124.7	4.68	11.34	257.5	8.6	131.5
Without tendril H_2O	2017	8	37.1	142.9	53.0	128.5	94.9	3.52	8.53	27.8	148.3	41.2	15.3	37.1	3.71	41.4	118.0	4.89	11.85	243.6	8.5	131.8
Without tendril H_2O	2017	9	35.6	140.8	50.1	121.4	93.6	3.33	8.07	27.0	149.2	40.3	14.3	34.7	3.47	39.3	118.3	4.65	11.27	245.9	8.6	130.6
Without tendril H_2O	2017	10	36.2	135.4	49.0	118.8	90.0	3.26	7.90	29.2	141.7	41.4	15.0	36.4	3.64	41.2	126.7	5.22	12.65	246.1	8.4	144.2
Without tendril H_2O			**36.5**	**135.7**	**49.50**	**124.8**	**90.20**	**3.29**	**7.98**	**27.80**	**144.6**	**40.20**	**14.67**	**35.54**	**3.55**	**39.80**	**120.7**	**4.80**	11.63	**251.0**	**8.50**	**131.6**
Without tendril H_2O	2018	1	36.4	130.4	47.5	115.1	72.0	2.62	6.35	28.5	145.5	41.5	15.1	36.6	3.66	39.6	117.6	4.66	11.30	248.0	8.0	128.0
Without tendril H_2O	2018	2	35.2	145.7	51.3	124.4	80.5	2.83	6.10	27.6	141.8	39.1	13.8	33.5	3.35	37.8	112.4	4.25	10.30	241.7	8.1	120.7
Without tendril H_2O	2018	3	36.2	137.0	49.6	120.2	75.9	2.75	6.67	27.9	136.8	38.2	13.8	33.5	3.35	41.1	127.3	5.23	12.68	249.5	8.1	144.5
Without tendril H_2O	2018	4	35.2	134.4	47.3	114.7	74.4	2.62	6.35	26.6	136.4	36.3	12.8	31.0	3.10	37.7	115.7	4.36	10.57	255.0	7.9	123.9
Without tendril H_2O	2018	5	36.7	136.1	49.9	121.0	75.4	2.77	6.71	26.5	136.6	36.2	13.3	32.2	3.22	37.7	126.2	4.76	11.54	252.9	8.0	129.7
Without tendril H_2O	2018	6	36.6	128.6	47.1	114.2	71.2	2.61	6.33	27.2	132.1	35.9	13.1	31.8	3.18	40.9	113.1	4.63	11.22	243.9	8.0	126.5
Without tendril H_2O	2018	7	35.1	127.4	44.1	106.9	70.6	2.48	6.01	26.7	138.6	37.0	13.0	31.5	3.15	37.1	114.5	4.25	10.30	248.9	8.0	121.1
Without tendril H_2O	2018	8	35.1	130.2	45.7	155.0	72.1	2.53	6.13	27.1	143.1	38.8	13.6	33.0	3.30	39.3	112.4	4.42	10.71	252.2	7.9	125.9
Without tendril H_2O	2018	9	35.5	142.3	50.5	122.4	78.8	2.80	6.79	26.7	138.3	36.9	13.1	31.8	3.18	37.7	115.9	4.37	10.59	253.1	8.0	123.1
Without tendril H_2O	2018	10	35.0	122.9	43.0	104.2	68.1	2.38	7.00	28.2	134.8	38.0	13.3	32.2	3.22	40.1	118.9	4.77	11.56	244.8	8.0	136.3
Without tendril H_2O			**35.70**	**133.5**	**47.60**	**119.8**	**73.90**	**2.64**	**6.44**	**27.30**	**138.4**	**37.79**	**13.49**	**32.70**	**3.27**	**38.90**	**117.4**	**4.57**	11.08	**249.0**	**8.00**	**128.0**
Without tendril H_2O	2019	1	36.4	120.3	44.1	127.1	62.0	2.26	5.48	24.5	123.4	30.2	11.0	26.7	2.67	39.7	93.8	3.72	9.02	242.0	6.0	102.2
Without tendril H_2O	2019	2	35.2	107.9	38.0	92.1	55.4	1.95	4.73	22.8	120.2	27.4	9.6	23.3	2.33	37.8	102.1	3.86	9.36	244.4	5.9	109.7
Without tendril H_2O	2019	3	36.2	124.6	45.1	109.3	64.2	2.32	5.62	24.0	107.9	25.9	9.4	22.8	2.28	41.1	90.4	3.72	9.02	226.2	6.0	102.8
Without tendril H_2O	2019	4	35.2	110.7	39.0	94.5	57.0	2.01	4.87	23.0	104.2	24.0	8.4	20.4	2.04	37.7	98.5	3.71	8.99	237.9	6.0	105.4
Without tendril H_2O	2019	5	36.7	114.3	41.9	101.6	58.9	2.16	5.24	24.2	117.0	28.3	10.4	25.2	2.52	37.7	101.1	3.81	9.24	240.3	5.9	103.8
Without tendril H_2O	2019	6	36.6	110.7	40.5	98.2	57.0	2.09	5.07	22.7	125.7	28.5	10.4	25.2	2.52	40.9	96.1	3.93	9.53	232.7	6.0	107.4
Without tendril H_2O	2019	7	34.1	114.6	39.1	94.8	59.0	2.01	4.87	22.4	121.7	27.3	9.3	22.5	2.25	37.1	100.4	3.72	9.02	225.6	6.0	109.1
Without tendril H_2O	2019	8	35.1	111.7	39.2	95.0	57.5	2.02	4.90	24.4	119.9	29.3	10.3	25.0	2.50	39.3	92.1	3.62	8.77	228.8	6.1	103.1
Without tendril H_2O	2019	9	35.5	117.2	41.6	100.8	60.4	2.14	5.19	22.8	119.6	27.3	9.7	23.5	2.35	37.7	92.5	3.49	8.46	242.6	6.0	98.3
Without tendril H_2O	2019	10	35.0	110.0	38.5	93.3	56.7	1.98	4.80	23.2	103.4	24.0	8.4	20.4	2.04	39.0	97.0	3.78	9.16	229.5	6.1	108.0
Without tendril H_2O			**35.60**	**114.2**	**40.70**	**100.7**	**58.80**	**2.09**	**5.08**	**23.40**	**116.3**	**27.21**	**9.70**	**23.49**	**2.35**	**38.80**	**96.40**	**3.74**	9.06	**235.0**	**6.00**	**105.0**
Without tendril H_2O	2020	1	25.4	46.0	11.7	28.4	11.4	0.29	0.70	20.4	84.6	17.3	4.4	10.7	1.07	27.5	52.0	1.43	3.47	315.0	6.1	56.3
Without tendril H_2O	2020	2	25.2	60.5	15.2	48.2	14.9	0.38	0.92	21.1	79.3	16.7	4.2	10.2	1.02	30.5	58.3	1.78	4.31	310.4	6.1	70.6
Without tendril H_2O	2020	3	25.5	45.9	11.7	28.4	11.3	0.29	0.70	20.3	82.3	16.7	4.3	10.4	1.04	28.6	49.7	1.42	3.44	302.1	6.0	55.7
Without tendril H_2O	2020	4	26.3	59.7	15.7	38.1	14.7	0.39	0.95	20.9	87.9	18.4	4.8	11.6	1.16	30.3	62.8	1.90	4.61	302.0	6.1	72.2
Without tendril H_2O	2020	5	26.5	57.4	15.2	36.8	14.1	0.37	0.90	21.0	92.8	19.5	5.2	12.6	1.26	28.9	52.8	1.53	3.71	316.3	6.1	57.7
Without tendril H_2O	2020	6	26.1	51.5	13.1	31.8	12.7	0.33	0.80	19.5	81.9	16.0	4.2	10.2	1.02	28.0	55.3	1.55	3.76	302.8	6.2	59.4
Without tendril H_2O	2020	7	26.8	51.1	13.7	33.2	12.6	0.34	0.82	20.2	82.5	16.7	4.5	10.9	1.09	28.2	51.4	1.45	3.51	308.8	6.1	54.1
Without tendril H_2O	2020	8	26.9	62.5	16.8	40.7	15.4	0.41	0.99	20.5	89.6	18.4	4.9	11.9	1.19	28.8	49.2	1.42	3.44	310.4	6.0	52.8
Without tendril H_2O	2020	9	27.1	61.2	16.6	40.2	15.1	0.41	0.99	19.7	79.8	15.7	4.3	10.4	1.04	27.5	48.8	1.34	3.25	306.0	6.2	49.4
Without tendril H_2O	2020	10	27.2	56.2	15.3	37.1	13.8	0.38	0.92	19.4	82.3	16.0	4.4	10.7	1.07	28.7	48.7	1.40	3.39	306.2	6.1	51.5
Without tendril H_2O			**26.30**	**55.20**	**14.50**	**36.28**	**13.60**	**0.36**	**0.87**	**20.30**	**84.30**	**17.12**	**4.51**	**10.96**	**1.10**	**28.70**	**52.90**	**1.52**	3.69	**308.0**	**6.10**	**58.0**
Without tendril H_2O	2021	1	32.7	71.0	23.4	56.7	27.0	0.88	2.91	22.4	93.5	20.9	6.8	16.5	1.65	39.0	70.3	2.74	6.64	255.2	8.3	83.8
Without tendril H_2O	2021	2	33.5	59.6	20.0	70.0	23.0	0.77	1.87	24.4	100.0	24.4	8.2	19.9	1.99	35.1	81.9	2.87	6.96	256.2	8.2	85.7
Without tendril H_2O	2021	3	32.9	68.3	22.5	54.5	26.3	0.87	2.11	22.5	101.5	22.8	7.5	18.2	1.82	38.1	87.9	3.35	8.12	266.3	8.0	101.8
Without tendril H_2O	2021	4	34.7	62.1	21.5	52.1	23.9	0.83	2.01	23.1	103.4	23.9	8.3	20.1	2.01	38.6	76.9	2.97	7.20	267.1	8.3	85.6
Without tendril H_2O	2021	5	34.0	75.0	25.5	61.8	28.8	0.98	2.00	23.2	93.8	21.8	7.4	17.9	1.79	35.1	82.2	2.89	7.01	255.4	8.1	85.0
Without tendril H_2O	2021	6	33.6	73.4	24.7	59.9	28.2	0.95	2.30	24.8	87.4	21.7	7.3	17.7	1.77	36.8	79.7	2.93	7.10	252.0	8.3	87.2

Without tendril H_2O	2021	7	33.8	60.1	20.3	49.2	23.1	0.78	1.89	23.5	100.0	23.5	7.9	19.1	1.91	34.3	77.8	2.67	6.47	264.0	8.2	79.0
Without tendril H_2O	2021	8	34.1	66.2	22.6	54.8	25.5	0.87	2.11	24.1	94.9	22.9	7.8	18.9	1.89	37.0	70.4	2.60	6.30	260.2	8.3	76.2
Without tendril H_2O	2021	9	34.7	69.8	24.2	58.7	26.8	0.93	2.25	22.5	100.7	22.7	7.9	19.1	1.91	36.1	77.6	2.80	6.79	251.5	8.2	80.7
Without tendril H_2O	2021	10	33.0	55.5	18.3	44.4	21.3	0.70	1.70	24.5	100.8	24.7	8.2	19.9	1.99	36.9	83.3	3.07	7.44	252.1	8.1	93.0
Without tendril H_2O			**33.70**	**66.10**	**22.30**	**56.21**	**25.40**	**0.86**	**2.12**	**23.50**	**97.60**	**22.92**	**7.73**	**18.74**	**1.87**	**36.70**	**78.80**	**2.89**	7.00	**258.0**	**8.20**	**85.8**
With tendril H_2O	2015	1	40.2	133.0	53.5	129.7	71.9	2.89	7.01	27.2	126.5	34.4	13.9	33.7	3.37	42.7	106.2	4.53	10.98	226.8	8.0	112.7
With tendril H_2O	2015	2	41.0	134.5	55.1	147.0	72.7	2.98	7.22	28.1	117.4	33.0	13.5	32.7	3.27	44.2	91.6	4.05	9.82	231.0	8.2	98.8
With tendril H_2O	2015	3	39.1	126.9	49.6	120.2	68.6	2.68	6.50	28.6	105.7	30.2	11.8	28.6	2.86	45.8	110.4	5.06	12.27	239.0	7.9	129.4
With tendril H_2O	2015	4	41.0	142.0	58.2	150.1	76.8	3.15	7.64	27.8	115.0	32.0	13.1	31.8	3.18	40.5	94.1	3.81	9.24	234.0	7.9	92.9
With tendril H_2O	2015	5	39.4	134.0	52.8	128.0	76.0	2.99	7.25	28.8	126.9	36.5	14.4	34.9	3.49	44.4	105.5	4.58	11.10	224.7	8.1	116.2
With tendril H_2O	2015	6	39.2	147.1	57.1	138.4	75.4	2.96	7.18	26.9	113.9	30.6	12.4	30.1	3.01	42.0	94.3	3.96	9.60	231.3	7.9	101.0
With tendril H_2O	2015	7	40.8	138.3	56.4	136.7	75.2	3.07	7.44	28.0	109.3	30.6	12.5	30.3	3.03	43.4	96.4	4.18	10.13	230.4	8.0	102.5
With tendril H_2O	2015	8	40.1	137.3	55.1	133.6	74.2	2.98	7.22	28.5	111.3	31.7	12.7	30.8	3.08	42.1	95.0	4.00	9.70	239.0	8.1	99.8
With tendril H_2O	2015	9	39.1	126.9	49.6	120.2	68.6	2.68	6.50	26.8	123.6	33.1	12.9	31.3	3.13	44.7	105.9	4.73	11.47	231.7	8.0	121.0
With tendril H_2O	2015	10	41.1	145.0	59.6	144.5	78.4	3.22	7.81	28.3	118.4	33.5	13.8	33.5	3.35	45.2	98.6	4.46	10.81	232.1	7.9	108.5
With tendril H_2O			**40.10**	**136.5**	**54.70**	**134.8**	**73.80**	**2.96**	**7.18**	**27.90**	**116.8**	**32.57**	**13.10**	**31.75**	**3.18**	**43.50**	**99.80**	**4.34**	10.51	**232.0**	**8.00**	**108.3**
With tendril H_2O	2016	1	42.9	149.8	64.3	155.9	79.1	3.39	8.10	29.8	127.1	37.5	16.3	39.5	3.95	42.7	127.3	5.44	13.19	213.9	8.4	126.8
With tendril H_2O	2016	2	39.7	132.0	52.3	126.8	85.0	3.37	8.17	27.9	131.9	36.8	14.6	35.4	3.54	44.2	125.5	5.55	13.45	231.0	8.1	139.8
With tendril H_2O	2016	3	40.6	149.8	60.8	147.4	79.1	3.21	7.78	28.1	133.1	37.4	15.2	36.8	3.68	45.8	113.3	5.19	12.58	229.4	8.1	127.8
With tendril H_2O	2016	4	41.2	138.7	57.1	138.4	73.2	3.50	8.48	27.7	144.3	40.0	16.5	40.0	4.00	42.5	122.3	5.20	12.60	220.0	8.3	126.2
With tendril H_2O	2016	5	41.1	135.9	55.9	135.5	71.7	2.95	7.15	29.8	135.1	40.3	16.6	40.2	4.02	44.4	134.8	5.99	14.52	218.1	8.2	145.7
With tendril H_2O	2016	6	40.6	135.0	54.8	132.8	71.3	2.89	7.01	27.0	128.9	34.8	14.1	34.2	3.42	42.0	128.1	5.38	13.04	231.2	8.1	132.5
With tendril H_2O	2016	7	41.9	139.9	58.6	142.0	73.8	3.09	7.49	28.9	125.3	36.2	15.2	36.8	3.68	43.4	131.6	5.71	13.84	232.0	8.2	136.3
With tendril H_2O	2016	8	39.5	129.4	51.1	123.9	79.0	3.12	7.56	29.9	135.1	40.4	16.0	38.8	3.88	42.1	130.2	5.48	13.28	217.0	8.1	138.7
With tendril H_2O	2016	9	41.9	137.6	57.7	139.9	72.6	3.04	7.37	28.1	142.8	40.1	16.8	40.7	4.07	44.7	121.7	5.44	13.19	223.9	8.3	129.8
With tendril H_2O	2016	10	40.6	143.9	58.4	160.0	86.2	3.50	8.00	27.8	131.4	36.5	14.8	35.9	3.59	45.2	110.2	5.08	12.31	213.5	8.2	125.1
With tendril H_2O			**41.00**	**139.2**	**57.10**	**140.3**	**77.10**	**3.21**	**7.71**	**28.50**	**133.5**	**38.00**	**15.60**	**37.84**	**3.78**	**43.70**	**124.5**	**5.44**	13.20	**223.0**	**8.20**	**132.9**
With tendril H_2O	2017	1	42.9	160.5	68.6	166.3	105.9	4.54	11.00	32.5	135.7	44.1	18.9	45.8	4.58	43.5	135.9	5.91	14.33	246.8	8.6	137.8
With tendril H_2O	2017	2	39.7	163.8	65.0	194.0	113.6	4.51	10.93	33.0	145.6	48.6	19.3	46.8	4.68	44.2	128.4	5.68	13.77	235.0	8.5	143.1
With tendril H_2O	2017	3	40.6	156.6	63.6	154.2	108.6	4.41	10.69	32.3	158.7	51.3	20.8	50.4	5.04	45.8	136.8	6.27	15.20	233.3	8.7	154.4
With tendril H_2O	2017	4	41.2	151.7	62.5	151.5	105.2	4.33	10.50	33.5	139.1	46.6	19.2	46.5	4.65	40.5	143.3	5.80	14.06	236.7	8.6	140.8
With tendril H_2O	2017	5	41.1	149.5	61.4	148.8	103.7	4.26	10.33	32.7	144.6	47.3	19.4	47.0	4.70	44.4	133.8	5.94	14.40	253.0	8.7	144.5
With tendril H_2O	2017	6	40.6	158.0	64.1	155.4	109.6	4.45	10.79	33.5	137.4	46.0	18.7	45.3	4.53	44.2	136.5	6.03	14.62	235.9	8.6	148.5
With tendril H_2O	2017	7	41.9	166.2	69.6	168.7	115.3	4.83	11.71	31.1	150.1	46.7	19.6	47.5	4.75	43.4	147.2	6.39	15.49	246.4	8.6	152.5
With tendril H_2O	2017	8	39.5	166.1	65.6	159.0	115.2	4.55	11.03	31.8	147.4	46.9	18.5	44.8	4.48	42.1	124.4	5.24	12.70	243.0	8.5	132.7
With tendril H_2O	2017	9	41.9	168.5	70.6	171.1	116.9	4.90	11.88	32.5	150.7	49.0	20.5	49.7	4.97	44.7	135.4	6.05	14.67	247.6	8.6	144.4
With tendril H_2O	2017	10	41.6	151.1	62.9	152.5	110.0	4.58	11.10	33.1	140.7	46.6	19.4	47.0	4.70	45.2	143.3	6.48	15.71	252.3	8.6	155.8
With tendril H_2O			**41.10**	**159.2**	**65.40**	**162.2**	**110.4**	**4.54**	**11.00**	**32.60**	**145.0**	**47.30**	**19.44**	**47.10**	**4.71**	**43.80**	**136.5**	**5.98**	14.49	**243.0**	**8.60**	**145.4**
With tendril H_2O	2018	1	40.2	172.2	69.2	167.7	91.3	3.67	8.90	31.6	145.3	46.0	18.5	44.8	4.48	44.0	124.9	5.50	13.33	233.1	8.2	136.8
With tendril H_2O	2018	2	41.0	153.9	63.1	153.2	87.3	3.58	8.68	31.6	130.3	41.2	16.9	41.0	4.10	43.5	140.3	6.10	14.79	248.0	8.1	148.8
With tendril H_2O	2018	3	39.1	162.2	63.4	184.3	98.2	3.84	9.31	32.3	144.0	46.5	18.2	44.1	4.41	43.2	142.0	6.13	14.86	245.5	8.0	156.8
With tendril H_2O	2018	4	41.0	158.9	65.1	157.8	90.1	3.69	8.94	32.4	137.8	44.6	18.3	44.4	4.44	43.2	127.4	5.50	13.33	240.7	8.2	134.1
With tendril H_2O	2018	5	39.4	152.9	60.2	145.9	86.7	3.42	8.29	32.1	138.0	44.3	17.5	42.4	4.24	40.6	132.9	5.40	13.09	233.6	8.1	137.1
With tendril H_2O	2018	6	39.2	153.2	60.1	145.7	86.9	3.41	8.27	32.3	133.2	43.0	16.9	41.0	4.10	42.2	123.8	5.22	12.65	241.2	8.1	133.2
With tendril H_2O	2018	7	40.8	153.2	62.5	151.5	86.9	3.55	8.61	31.1	136.9	42.6	17.4	42.2	4.22	41.3	128.4	5.30	12.85	243.8	8.0	129.9
With tendril H_2O	2018	8	40.1	158.9	63.7	154.4	90.1	3.61	8.75	31.2	137.7	43.0	17.2	41.7	4.17	42.3	135.2	5.72	13.87	237.8	8.0	142.6
With tendril H_2O	2018	9	39.1	149.6	58.5	141.8	84.8	3.32	8.05	32.5	137.3	44.6	17.4	42.2	4.22	40.8	144.5	5.90	14.30	241.4	8.1	150.9
With tendril H_2O	2018	10	41.1	151.0	62.1	150.5	85.6	3.52	8.53	32.9	145.5	47.9	19.7	47.8	4.78	44.9	127.6	5.73	13.89	244.9	8.2	139.4
With tendril H_2O			**40.10**	**156.6**	**62.80**	**155.3**	**88.80**	**3.56**	**8.63**	**32.00**	**138.6**	**44.37**	**17.79**	**43.15**	**4.31**	**42.60**	**132.7**	**5.65**	13.70	**241.0**	**8.10**	**141.0**
With tendril H_2O	2019	1	39.4	144.0	56.7	137.4	78.2	3.08	7.47	28.5	114.0	32.5	12.8	31.0	3.10	43.5	92.9	4.04	9.79	232.6	6.3	102.5
With tendril H_2O	2019	2	39.0	124.1	48.4	117.3	67.1	2.62	6.35	28.1	115.0	32.3	12.6	30.5	3.05	42.1	103.3	4.35	10.54	236.0	6.1	111.5
With tendril H_2O	2019	3	38.6	135.2	52.2	155.0	73.1	2.82	6.84	26.9	107.0	28.8	11.1	26.9	2.69	39.5	109.1	4.31	10.45	229.1	6.2	111.7
With tendril H_2O	2019	4	38.3	134.0	51.3	124.4	72.5	2.78	6.74	27.3	121.6	33.2	12.7	30.8	3.08	43.0	108.2	4.65	11.27	225.4	6.1	121.4
With tendril H_2O	2019	5	37.4	138.3	51.5	124.8	74.8	2.80	6.79	27.4	121.8	33.4	12.5	30.3	3.03	39.2	94.4	3.70	8.97	235.4	6.1	98.9
With tendril H_2O	2019	6	37.5	134.0	50.9	123.4	72.5	2.72	6.59	26.8	120.3	32.2	12.1	29.3	2.93	38.8	106.5	4.13	10.01	231.2	6.0	110.1
With tendril H_2O	2019	7	37.8	137.3	51.9	125.8	74.2	2.80	6.79	27.9	108.3	30.2	11.4	27.6	2.76	42.0	97.7	4.10	9.94	229.3	6.1	108.5
With tendril H_2O	2019	8	37.1	133.5	49.5	120.0	72.2	2.68	6.50	27.4	126.9	34.8	12.9	31.3	3.13	41.4	91.5	3.79	9.19	239.7	6.0	102.2
With tendril H_2O	2019	9	38.5	134.2	51.7	125.3	72.6	2.80	6.79	27.0	123.1	33.2	12.8	31.0	3.10	39.3	96.4	3.79	9.19	231.0	6.1	98.4
With tendril H_2O	2019	10	37.4	125.4	46.9	113.7	67.8	2.54	6.16	26.7	110.0	29.4	11.0	26.7	2.67	41.2	105.0	4.33	10.50	230.3	6.0	115.8
With tendril H_2O			**38.10**	**134.0**	**51.10**	**126.7**	**72.50**	**2.76**	**6.70**	**27.40**	**116.8**	**32.00**	**12.19**	**29.55**	**2.95**	**41.00**	**100.5**	**4.12**	9.98	**232.0**	**6.10**	**108.1**
With tendril H_2O	2020	1	30.5	61.1	18.6	45.1	16.0	0.49	1.19	22.0	86.9	19.0	5.8	14.1	1.41	34.3	56.8	1.95	4.73	289.0	5.8	63.9
With tendril H_2O	2020	2	30.8	65.2	20.1	61.0	17.2	0.53	1.28	23.8	83.0	19.8	6.1	14.8	1.48	33.7	52.3	1.76	4.27	301.6	6.1	57.1
With tendril H_2O	2020	3	30.3	70.7	22.2	53.8	18.7	0.57	1.38	22.2	82.3	18.3	5.5	13.3	1.33	33.6	59.5	2.00	4.85	292.9	6.2	66.0
With tendril H_2O	2020	4	30.5	54.4	16.6	40.2	14.4	0.44	1.17	23.7	87.9	20.8	6.3	15.3	1.53	35.9	52.0	1.87	4.53	288.5	6.1	61.3

With tendril H_2O	2020	5	29.9	65.9	19.7	47.8	17.4	0.52	1.26	23.7	92.8	22.0	6.6	16.0	1.60	31.4	51.4	1.61	3.90	302.2	6.1	53.8
With tendril H_2O	2020	6	29.2	63.5	18.5	44.8	16.8	0.49	1.19	22.1	81.9	18.1	5.3	12.8	1.28	34.6	46.7	1.62	3.93	302.9	5.7	55.5
With tendril H_2O	2020	7	31.4	72.0	22.6	54.8	19.0	0.60	1.45	22.7	82.5	18.7	5.9	14.3	1.43	30.2	61.5	1.86	4.51	303.2	6.1	59.2
With tendril H_2O	2020	8	30.2	71.1	21.5	52.1	18.8	0.57	1.38	23.5	89.6	21.1	6.4	15.5	1.55	32.9	48.3	1.59	3.85	287.6	5.8	52.6
With tendril H_2O	2020	9	31.3	65.0	20.3	49.2	17.2	0.54	1.31	22.4	79.8	17.9	5.6	13.6	1.36	33.1	57.9	1.92	4.65	293.6	6.1	61.3
With tendril H_2O	2020	10	31.9	59.1	18.9	45.8	15.6	0.50	1.21	23.9	82.3	19.7	6.3	15.3	1.53	34.3	64.6	2.22	5.38	288.5	6.0	69.6
With tendril H_2O			**30.60**	**64.80**	**19.90**	**49.47**	**17.10**	**0.52**	**1.28**	**23.00**	**84.90**	**19.53**	**5.98**	**14.50**	**1.45**	**33.40**	**55.10**	**1.84**	4.46	**295.0**	**6.00**	**60.1**
With tendril H_2O	2021	1	40.2	75.8	30.5	73.9	31.5	1.27	3.08	28.0	93.5	26.2	10.5	25.5	2.55	43.5	95.3	4.15	10.06	253.1	8.4	103.2
With tendril H_2O	2021	2	39.6	85.0	33.7	90.0	35.5	1.41	3.42	26.2	100.0	26.2	10.4	25.2	2.52	42.1	91.0	3.83	9.28	253.1	8.5	96.7
With tendril H_2O	2021	3	38.1	69.1	26.3	63.8	28.9	1.10	2.67	28.0	101.5	28.4	10.8	26.2	2.62	39.5	92.2	3.64	8.82	248.5	8.2	95.5
With tendril H_2O	2021	4	38.0	81.6	31.0	75.1	34.1	1.30	3.15	27.2	103.4	28.1	10.7	25.9	2.59	43.0	88.1	3.79	9.19	242.9	8.3	99.7
With tendril H_2O	2021	5	39.6	66.6	26.4	64.0	27.9	1.10	2.67	26.6	93.8	25.0	9.9	24.0	2.40	39.0	81.7	3.19	7.73	254.3	8.5	80.6
With tendril H_2O	2021	6	38.2	79.9	30.7	74.4	33.4	1.28	3.10	25.6	87.4	22.4	8.6	20.8	2.08	41.0	83.4	3.42	8.29	253.1	8.4	89.5
With tendril H_2O	2021	7	39.7	69.2	27.5	66.7	28.9	1.15	2.79	27.9	102.0	28.5	11.3	27.4	2.74	42.0	81.1	3.41	8.27	252.6	8.5	85.9
With tendril H_2O	2021	8	38.0	81.6	31.0	75.1	34.1	1.30	3.15	26.5	94.9	25.1	9.5	23.0	2.30	41.4	77.4	3.20	7.76	250.6	8.3	84.2
With tendril H_2O	2021	9	38.3	86.7	33.2	80.5	36.3	1.39	3.37	26.8	100.7	27.0	10.3	25.0	2.50	39.3	89.1	3.50	8.48	255.0	8.4	91.4
With tendril H_2O	2021	10	38.3	72.5	27.8	67.4	30.3	1.16	2.81	26.2	100.8	26.4	10.1	24.5	2.45	41.2	83.7	3.45	8.36	256.8	8.5	90.1
With tendril H_2O			**38.80**	**76.80**	**29.80**	**73.09**	**32.10**	**1.24**	**3.02**	**26.90**	**97.80**	**26.33**	**10.22**	**24.75**	**2.47**	**41.20**	**86.30**	**3.56**	8.63	**252.0**	**8.40**	**91.7**
Without tendril Calovit	2015	1	38.3	135.6	51.5	124.8	70.0	2.68	6.50	25.0	123.5	30.9	11.8	28.6	2.86	46.0	92.8	4.27	10.35	237.4	8.0	111.5
Without tendril Calovit	2015	2	40.1	137.3	55.1	133.6	67.0	2.69	6.52	25.4	117.4	29.8	11.9	28.8	2.88	43.5	106.5	4.63	11.22	242.5	8.0	115.5
Without tendril Calovit	2015	3	39.0	122.6	47.8	136.1	64.7	2.52	6.11	25.1	105.7	26.5	10.3	25.0	2.50	43.2	101.8	4.40	10.67	232.0	7.9	112.8
Without tendril Calovit	2015	4	39.0	117.1	45.7	110.8	61.2	2.39	5.79	26.2	115.0	30.1	11.7	28.4	2.84	43.2	90.3	3.90	9.45	242.1	7.6	100.0
Without tendril Calovit	2015	5	40.3	119.3	48.1	116.6	70.7	2.85	6.91	25.8	126.9	32.7	13.2	32.0	3.20	40.6	94.2	3.82	9.26	242.0	8.0	94.8
Without tendril Calovit	2015	6	38.6	123.1	47.5	115.1	65.0	2.51	6.08	27.4	113.9	31.2	12.0	29.1	2.91	42.2	95.2	4.02	9.74	229.6	7.5	104.1
Without tendril Calovit	2015	7	39.8	122.1	48.6	117.8	64.4	2.56	6.21	25.9	109.3	28.3	11.3	27.4	2.74	41.3	92.9	3.84	9.31	243.7	8.0	96.5
Without tendril Calovit	2015	8	39.7	126.0	50.0	121.2	66.5	2.64	6.40	27.0	111.3	30.1	11.9	28.8	2.88	42.3	93.6	3.96	9.60	238.8	7.9	99.7
Without tendril Calovit	2015	9	38.8	134.9	52.3	126.8	71.2	2.76	6.69	26.1	123.6	32.3	12.5	30.3	3.03	40.8	92.4	3.77	9.14	233.7	8.1	97.2
Without tendril Calovit	2015	10	39.4	133.0	52.4	127.0	70.2	2.77	6.71	26.1	118.4	30.9	12.2	29.6	2.96	44.9	96.3	4.32	10.47	238.2	8.0	109.6
Without tendril Calovit			**39.30**	**127.1**	**49.90**	**123.0**	**67.10**	**2.64**	**6.39**	**26.00**	**116.5**	**30.28**	**11.90**	**28.80**	**2.88**	**42.80**	**95.60**	**4.09**	9.92	**238.0**	**7.90**	**104.2**
Without tendril Calovit	2016	1	39.3	123.4	47.3	114.7	66.9	2.63	6.38	28.0	138.8	38.9	15.3	37.1	3.71	46.0	122.9	5.65	13.70	229.5	8.2	143.8
Without tendril Calovit	2016	2	40.1	139.1	55.8	135.0	75.2	3.02	7.32	27.5	129.2	35.5	14.2	34.4	3.44	43.4	123.5	5.36	12.99	238.5	8.1	133.7
Without tendril Calovit	2016	3	39.0	125.9	49.1	119.0	68.1	2.66	6.45	26.8	142.4	38.2	14.9	36.1	3.61	43.2	118.2	5.11	12.39	221.4	8.0	131.0
Without tendril Calovit	2016	4	39.0	130.0	50.7	122.9	70.0	2.73	6.62	25.5	135.8	34.6	13.5	32.7	3.27	43.2	120.6	5.21	12.63	228.4	8.2	133.6
Without tendril Calovit	2016	5	40.3	133.1	53.6	129.9	72.0	2.90	7.03	26.3	123.2	32.4	13.1	31.8	3.18	40.6	119.6	4.86	11.78	240.8	8.1	120.6
Without tendril Calovit	2016	6	38.6	123.8	47.8	141.2	66.9	2.58	6.25	25.9	124.2	32.2	12.4	30.1	3.01	42.2	130.4	5.50	13.33	228.4	8.1	142.5
Without tendril Calovit	2016	7	39.8	137.4	54.7	132.6	74.3	2.96	7.18	27.0	130.3	35.2	14.0	33.9	3.39	41.3	112.8	4.66	11.30	237.1	8.0	117.1
Without tendril Calovit	2016	8	39.7	126.1	50.1	121.4	68.2	2.71	6.57	26.3	141.2	37.1	14.7	35.6	3.56	42.3	123.4	5.22	12.65	222.6	8.0	131.5
Without tendril Calovit	2016	9	38.8	125.4	48.7	118.0	67.8	2.63	6.38	26.0	132.0	34.3	13.3	32.2	3.22	40.8	123.7	5.05	12.24	225.0	8.1	130.2
Without tendril Calovit	2016	10	39.4	137.8	54.3	131.6	74.5	2.94	7.13	26.7	137.9	36.8	14.5	35.1	3.51	46.0	125.9	5.79	14.03	238.3	8.2	147.0
Without tendril Calovit			**39.40**	**130.2**	**51.20**	**126.6**	**70.40**	**2.77**	**6.73**	**26.60**	**133.5**	**35.52**	**14.00**	**33.91**	**3.39**	**42.90**	**122.1**	**5.24**	12.70	**231.0**	**8.10**	**133.1**
Without tendril Calovit	2017	1	39.2	147.2	57.7	139.9	99.9	3.92	9.50	31.0	140.0	43.4	17.5	42.4	4.24	46.0	130.9	6.02	14.59	256.2	8.4	153.6
Without tendril Calovit	2017	2	41.0	150.9	61.9	149.8	102.2	4.19	10.16	28.7	150.1	43.1	17.7	42.9	4.29	43.5	125.8	5.47	13.26	245.1	8.5	133.4
Without tendril Calovit	2017	3	39.1	147.0	57.5	139.4	99.8	3.90	9.45	30.7	147.0	45.1	17.6	42.7	4.27	43.9	119.0	5.22	12.65	240.8	8.5	133.5
Without tendril Calovit	2017	4	41.0	144.1	59.1	143.3	97.8	4.01	9.72	30.7	144.1	44.2	18.1	43.9	4.39	43.2	132.9	5.74	13.91	251.0	8.4	140.0
Without tendril Calovit	2017	5	39.4	135.9	53.5	129.7	92.3	3.64	8.82	30.2	135.9	41.0	16.2	39.3	3.93	41.0	121.6	4.99	12.10	254.8	8.6	126.6
Without tendril Calovit	2017	6	39.2	138.3	54.2	175.6	93.9	3.68	8.92	30.4	138.3	42.0	16.5	40.0	4.00	42.2	123.4	5.21	12.63	259.6	8.5	132.9
Without tendril Calovit	2017	7	40.8	147.1	60.2	145.9	99.9	4.08	9.89	29.3	147.1	43.1	17.6	42.7	4.27	41.3	131.6	5.44	13.19	249.7	8.6	133.3
Without tendril Calovit	2017	8	40.1	151.0	60.6	146.9	102.5	4.11	9.96	29.1	150.0	43.7	17.5	42.4	4.24	43.0	128.6	5.53	13.40	245.0	8.5	137.9
Without tendril Calovit	2017	9	39.1	153.6	60.1	145.7	104.3	4.08	9.89	28.8	153.6	44.2	17.3	41.9	4.19	40.8	120.2	4.90	11.88	252.2	8.6	125.3
Without tendril Calovit	2017	10	41.1	141.9	58.3	141.3	96.3	3.96	9.60	29.1	141.9	41.3	17.0	41.2	4.12	45.1	138.0	6.22	15.08	245.6	8.4	151.3
Without tendril Calovit			**40.00**	**145.7**	**58.30**	**145.7**	**98.90**	**3.96**	**9.59**	**29.80**	**144.8**	**43.12**	**17.29**	**41.94**	**4.19**	**43.00**	**127.2**	**5.47**	13.27	**250.0**	**8.50**	**136.8**
Without tendril Calovit	2018	1	39.5	147.8	58.4	141.6	81.9	3.24	7.85	29.2	148.0	43.2	17.1	41.5	4.15	44.0	124.5	5.48	13.28	248.5	8.0	138.7
Without tendril Calovit	2018	2	38.8	145.1	56.3	136.5	80.4	3.12	7.56	27.2	141.3	38.4	14.9	36.1	3.61	42.2	115.4	4.87	11.80	246.6	8.2	125.5
Without tendril Calovit	2018	3	38.0	142.7	54.2	168.5	79.0	3.00	7.27	30.0	136.8	41.0	15.6	37.8	3.78	42.2	120.0	5.06	12.27	245.4	7.9	133.2
Without tendril Calovit	2018	4	38.3	139.6	53.5	129.7	80.0	3.06	7.42	30.2	136.4	41.2	15.8	38.3	3.83	42.9	125.6	5.39	13.07	246.9	7.9	140.7
Without tendril Calovit	2018	5	38.1	153.6	58.5	141.8	82.7	3.15	7.64	29.4	136.6	40.2	15.3	37.1	3.71	40.8	119.9	4.89	11.85	244.5	8.1	128.3
Without tendril Calovit	2018	6	37.5	142.7	53.5	129.7	79.0	2.96	7.18	29.9	132.1	39.5	14.8	35.9	3.59	43.0	119.4	5.13	12.44	251.1	7.9	136.8
Without tendril Calovit	2018	7	39.5	133.6	52.8	128.0	74.0	2.92	7.08	28.7	138.6	39.8	15.7	38.1	3.81	39.9	133.7	5.33	12.92	251.4	8.0	134.9
Without tendril Calovit	2018	8	39.1	140.7	56.3	136.5	77.9	3.05	7.39	30.5	143.1	43.6	17.0	41.2	4.12	40.2	127.8	5.14	12.46	244.0	8.1	131.5
Without tendril Calovit	2018	9	37.0	135.2	50.0	121.2	74.9	2.77	6.71	28.2	138.3	39.0	14.4	34.9	3.49	42.2	128.4	5.42	13.14	243.9	8.0	146.5
Without tendril Calovit	2018	10	37.2	152.0	56.5	137.0	84.2	3.13	7.59	29.7	134.8	40.0	14.9	36.1	3.61	40.6	122.3	4.97	12.05	257.7	7.9	133.6
Without tendril Calovit			**38.30**	**143.3**	**55.00**	**137.0**	**79.40**	**3.04**	**7.37**	**29.30**	**138.6**	**40.60**	**15.55**	**37.69**	**3.77**	**41.80**	**123.7**	**5.17**	12.53	**248.0**	**8.00**	**135.0**
Without tendril Calovit	2019	1	36.6	115.9	42.4	102.8	59.7	2.19	5.31	24.2	114.0	27.1	9.9	24.0	2.40	39.3	97.6	3.84	9.31	229.2	5.8	104.9
Without tendril Calovit	2019	2	37.3	134.8	50.3	121.9	67.1	2.50	6.06	26.0	115.0	29.9	11.2	27.1	2.71	41.4	105.1	4.35	10.54	234.5	6.1	116.6

Without tendril Calovit	2019	3	36.0	126.3	45.5	110.3	65.0	2.34	5.67	25.4	107.0	27.2	9.8	23.8	2.38	39.0	101.3	3.95	9.57	226.8	6.2	109.7
Without tendril Calovit	2019	4	37.6	119.5	44.3	132.5	61.5	2.31	5.60	25.9	121.6	31.5	11.8	28.6	2.86	41.1	95.0	3.90	9.45	234.0	6.1	103.7
Without tendril Calovit	2019	5	36.9	129.7	47.9	116.1	66.8	2.46	5.96	26.0	121.8	31.7	11.7	28.4	2.84	39.6	100.9	4.00	9.70	237.0	6.1	108.4
Without tendril Calovit	2019	6	37.4	117.6	44.0	106.7	60.6	2.27	5.50	24.6	120.3	29.6	11.1	26.9	2.69	39.5	101.1	3.99	9.67	240.3	5.7	106.7
Without tendril Calovit	2019	7	36.2	113.7	41.2	99.9	58.6	2.12	5.14	24.3	108.3	26.3	9.5	23.0	2.30	40.6	91.2	3.70	8.97	239.9	6.1	102.2
Without tendril Calovit	2019	8	36.1	126.4	45.6	110.5	67.0	2.42	5.87	25.5	123.9	31.6	11.4	27.6	2.76	41.0	94.0	3.85	9.33	235.2	5.8	106.6
Without tendril Calovit	2019	9	38.2	117.4	44.8	108.6	60.5	2.31	5.60	24.1	123.1	29.7	11.3	27.4	2.74	41.5	91.1	3.78	9.16	233.2	6.1	99.0
Without tendril Calovit	2019	10	37.7	124.7	47.0	113.9	64.2	2.42	5.87	25.0	110.0	27.5	10.4	25.2	2.52	40.0	105.7	4.23	10.25	239.9	6.0	112.2
Without tendril Calovit			**37.00**	**122.6**	**45.30**	**112.3**	**63.10**	**2.33**	**5.66**	**25.10**	**116.5**	**29.20**	**10.81**	**26.20**	**2.62**	**40.30**	**98.30**	**3.96**	9.60	**235.0**	**6.00**	**107.0**
Without tendril Calovit	2020	1	29.2	50.8	14.2	34.4	16.0	0.47	1.14	20.2	86.9	17.9	5.2	12.6	1.26	29.0	50.2	1.46	3.54	301.9	6.3	50.0
Without tendril Calovit	2020	2	30.2	65.7	19.8	53.2	14.5	0.44	1.07	21.0	81.8	17.2	5.2	12.6	1.26	33.0	46.7	1.54	3.73	295.0	6.1	51.0
Without tendril Calovit	2020	3	30.2	65.4	19.8	48.0	15.7	0.47	1.14	20.6	82.3	17.0	5.1	12.4	1.24	31.2	54.7	1.71	4.15	302.8	6.2	56.6
Without tendril Calovit	2020	4	29.8	64.2	19.1	46.3	16.4	0.49	1.19	20.6	87.9	18.1	5.4	13.1	1.31	32.3	62.6	2.02	4.90	296.0	6.1	67.8
Without tendril Calovit	2020	5	28.1	51.6	14.5	35.1	13.2	0.37	0.90	22.7	92.8	21.1	5.9	14.3	1.43	33.5	57.1	1.91	4.63	297.3	6.1	68.0
Without tendril Calovit	2020	6	29.5	65.6	19.4	47.0	16.7	0.49	1.19	21.6	81.9	17.7	5.2	12.6	1.26	31.2	48.9	1.53	3.71	298.0	6.0	51.9
Without tendril Calovit	2020	7	29.9	58.2	17.4	42.2	14.8	0.44	1.07	22.4	82.5	18.5	5.5	13.3	1.33	31.8	53.8	1.71	4.15	288.0	6.1	57.2
Without tendril Calovit	2020	8	29.5	61.8	18.2	44.1	15.8	0.47	1.14	21.0	89.6	18.8	5.5	13.3	1.33	32.3	63.2	2.04	4.94	294.5	6.0	69.2
Without tendril Calovit	2020	9	29.0	56.5	16.4	39.8	14.4	0.42	1.02	22.9	78.0	17.9	5.2	12.6	1.26	32.6	50.9	1.66	4.02	306.3	6.1	57.2
Without tendril Calovit	2020	10	28.6	53.2	15.2	36.8	13.6	0.39	0.95	23.0	82.3	18.9	5.4	13.1	1.31	33.1	52.9	1.75	4.24	290.2	6.0	61.2
Without tendril Calovit			**29.40**	**59.30**	**17.40**	**42.70**	**15.10**	**0.44**	**1.08**	**21.60**	**84.60**	**18.30**	**5.38**	**12.99**	**1.30**	**32.00**	**54.10**	**1.73**	4.20	**297.0**	**6.10**	**59.0**
Without tendril Calovit	2021	1	37.9	83.3	31.4	72.0	31.0	1.10	2.67	24.1	93.5	22.5	8.5	20.6	2.06	40.8	81.8	3.34	8.10	261.0	8.4	88.1
Without tendril Calovit	2021	2	36.2	66.1	23.9	78.0	28.4	1.03	2.50	25.4	100.0	25.4	9.2	22.3	2.23	39.9	88.3	3.52	8.53	259.1	8.1	97.2
Without tendril Calovit	2021	3	38.1	78.9	30.1	73.0	31.2	1.19	2.88	26.8	101.5	27.2	10.4	25.2	2.52	41.6	75.1	3.12	7.56	254.7	8.1	81.9
Without tendril Calovit	2021	4	38.4	70.0	26.9	75.0	27.7	1.06	2.57	26.6	103.4	27.5	10.6	25.7	2.57	40.5	88.3	3.58	8.68	263.3	8.3	93.2
Without tendril Calovit	2021	5	38.4	66.3	25.5	78.9	26.2	1.01	2.45	25.6	91.8	23.5	9.0	21.8	2.18	42.6	91.7	3.91	9.48	250.0	8.2	101.8
Without tendril Calovit	2021	6	38.0	75.2	28.6	74.5	29.8	1.13	2.74	27.0	87.4	23.6	9.0	21.8	2.18	39.8	75.4	3.00	7.27	252.8	8.1	78.9
Without tendril Calovit	2021	7	36.1	75.7	27.3	74.0	30.0	1.08	2.62	26.7	102.0	27.2	9.8	23.8	2.38	41.4	84.0	3.48	8.44	256.2	8.2	96.4
Without tendril Calovit	2021	8	37.7	84.7	31.9	77.3	33.5	1.26	3.05	26.7	94.9	25.3	9.5	23.0	2.30	38.3	84.5	3.24	7.85	260.2	8.1	85.9
Without tendril Calovit	2021	9	36.4	85.2	31.0	75.1	33.7	1.23	2.98	26.1	100.7	26.3	9.6	23.3	2.33	41.6	84.9	3.53	8.56	247.6	8.3	97.0
Without tendril Calovit	2021	10	36.8	74.6	27.5	77.0	29.5	1.09	2.64	25.0	100.8	25.2	9.3	22.5	2.25	41.5	76.0	3.15	7.64	255.1	8.2	85.6
Without tendril Calovit			**37.40**	**76.00**	**28.40**	**75.48**	**30.10**	**1.12**	**2.71**	**26.00**	**97.60**	**25.38**	**9.48**	**23.00**	**2.30**	**40.80**	**83.00**	**3.39**	8.21	**256.0**	**8.20**	**90.6**
With tendril Calovit	2015	1	41.2	154.4	63.6	154.2	80.0	3.30	8.00	27.9	120.0	33.5	14.0	33.9	3.39	47.1	95.9	4.52	10.96	225.7	8.0	109.7
With tendril Calovit	2015	2	42.6	136.1	57.7	139.9	73.6	3.14	7.90	28.6	117.4	33.6	14.3	34.7	3.47	46.4	104.0	4.83	11.71	233.6	7.8	113.4
With tendril Calovit	2015	3	43.1	150.4	64.8	120.6	81.3	3.20	7.80	30.0	112.2	33.7	14.5	35.1	3.51	43.8	98.8	4.33	10.50	237.5	7.7	100.5
With tendril Calovit	2015	4	42.3	132.6	56.1	136.0	75.0	3.17	7.68	29.6	115.0	34.0	14.4	34.9	3.49	42.5	98.6	4.19	10.16	228.6	7.8	99.1
With tendril Calovit	2015	5	42.1	148.2	62.4	151.3	80.1	3.37	8.17	28.9	126.9	36.7	15.5	37.6	3.76	47.1	114.0	5.37	13.02	227.5	7.9	127.6
With tendril Calovit	2015	6	41.3	135.7	56.0	135.7	73.4	3.03	7.50	28.8	113.9	32.8	13.5	32.7	3.27	45.1	103.1	4.65	11.27	230.5	7.5	112.6
With tendril Calovit	2015	7	41.4	142.4	59.0	143.0	77.0	3.19	7.73	29.1	109.3	31.8	13.2	32.0	3.20	45.6	110.9	5.06	12.27	236.8	7.7	122.2
With tendril Calovit	2015	8	41.3	145.4	60.1	145.7	78.6	3.25	7.88	29.5	111.3	32.8	13.5	32.7	3.27	46.9	114.4	5.37	13.02	226.8	7.9	130.0
With tendril Calovit	2015	9	43.1	137.8	59.4	144.0	74.5	3.21	8.10	31.0	123.6	38.3	16.5	40.0	4.00	43.4	106.4	4.62	11.20	225.6	7.7	107.2
With tendril Calovit	2015	10	42.6	143.0	60.9	147.6	77.3	3.29	7.97	28.6	118.4	33.9	14.4	34.9	3.49	45.1	108.9	4.91	11.90	227.4	8.0	115.3
With tendril Calovit			**42.10**	**142.6**	**60.00**	**141.8**	**77.10**	**3.21**	**7.87**	**29.20**	**116.8**	**34.11**	**14.39**	**34.86**	**3.49**	**45.30**	**105.5**	**4.78**	11.60	**230.0**	**7.80**	**113.7**
With tendril Calovit	2016	1	41.2	150.8	62.6	151.7	87.5	3.61	8.75	31.0	138.8	43.0	17.7	42.9	4.29	47.1	130.4	6.14	14.88	223.7	8.3	149.0
With tendril Calovit	2016	2	42.6	146.2	62.3	151.0	81.0	3.45	8.36	30.0	131.0	39.3	16.8	40.7	4.07	46.4	128.7	5.97	14.47	212.6	8.5	140.1
With tendril Calovit	2016	3	43.1	153.6	66.2	160.5	85.1	3.67	8.90	29.0	141.8	41.1	17.7	42.9	4.29	43.8	121.5	5.32	12.90	220.3	8.3	123.4
With tendril Calovit	2016	4	42.3	141.9	60.0	145.4	78.6	3.32	8.05	30.2	135.8	41.0	17.3	41.9	4.19	44.5	140.9	6.27	15.20	210.9	8.3	148.2
With tendril Calovit	2016	5	44.1	138.6	61.1	148.1	82.0	3.62	8.77	28.5	126.0	35.9	15.8	38.3	3.83	47.1	131.8	6.21	15.05	216.8	8.1	140.8
With tendril Calovit	2016	6	41.3	158.0	65.3	158.3	87.5	3.61	8.75	30.3	124.2	37.6	15.5	37.6	3.76	45.1	126.1	5.69	13.79	227.0	8.3	137.8
With tendril Calovit	2016	7	41.4	142.2	58.9	138.4	70.0	2.90	7.03	30.2	130.3	39.4	16.3	39.5	3.95	45.6	118.3	5.39	13.07	216.9	8.6	130.2
With tendril Calovit	2016	8	41.3	141.9	58.6	142.0	78.6	3.25	7.88	30.7	141.2	43.3	17.9	43.4	4.34	46.9	142.9	6.70	16.24	229.7	8.3	162.2
With tendril Calovit	2016	9	43.1	135.8	58.5	141.8	75.2	3.24	7.85	28.3	132.0	37.4	16.1	39.0	3.90	43.4	139.5	6.05	14.67	224.3	8.2	140.4
With tendril Calovit	2016	10	42.6	149.0	63.5	153.9	82.5	3.51	8.51	29.8	137.9	41.1	17.5	42.4	4.24	45.1	131.9	5.95	14.42	217.8	8.1	139.7
With tendril Calovit			**42.30**	**145.8**	**61.70**	**149.1**	**80.80**	**3.42**	**8.29**	**29.80**	**133.9**	**39.92**	**16.88**	**40.87**	**4.09**	**45.50**	**131.2**	**5.97**	14.47	**220.0**	**8.30**	**141.2**
With tendril Calovit	2017	1	42.0	167.6	70.8	171.6	118.7	4.99	12.10	36.9	147.2	54.8	23.0	55.8	5.58	47.0	147.2	6.92	16.77	235.0	8.6	164.8
With tendril Calovit	2017	2	44.0	167.3	73.6	178.2	120.0	5.28	12.80	35.1	145.9	51.2	22.5	54.5	5.45	46.4	146.9	6.82	16.53	241.5	8.5	155.0
With tendril Calovit	2017	3	42.9	175.0	75.1	182.0	124.0	5.32	12.90	37.4	147.0	55.0	23.6	57.2	5.72	43.8	147.0	6.44	15.61	240.0	8.7	150.1
With tendril Calovit	2017	4	42.4	172.4	73.1	177.2	122.1	5.18	12.56	36.2	144.1	52.2	22.1	53.6	5.36	44.5	144.1	6.41	15.54	251.1	8.6	151.2
With tendril Calovit	2017	5	44.5	184.4	82.1	199.0	130.6	5.81	14.08	36.4	135.9	49.5	22.0	53.3	5.33	47.1	135.9	6.40	15.51	249.4	8.7	143.8
With tendril Calovit	2017	6	43.7	169.3	74.0	179.4	119.8	5.24	12.70	37.0	138.3	51.2	22.4	54.3	5.43	46.4	138.3	6.42	15.56	238.7	8.6	146.9
With tendril Calovit	2017	7	44.2	175.4	77.5	187.9	124.3	5.49	13.31	36.3	147.1	53.4	23.6	57.2	5.72	46.5	147.1	6.84	16.58	241.7	8.6	154.8
With tendril Calovit	2017	8	42.5	187.4	79.6	193.0	131.0	5.57	13.50	36.0	151.0	54.4	23.1	56.0	5.60	46.9	151.0	7.08	17.16	239.5	8.5	166.6
With tendril Calovit	2017	9	42.1	185.7	78.2	159.9	131.6	5.54	13.43	35.2	153.6	54.1	22.8	55.3	5.53	43.4	153.6	6.67	16.17	246.5	8.6	158.4
With tendril Calovit	2017	10	42.7	187.5	80.1	194.2	132.8	5.67	13.74	35.5	141.9	50.4	21.5	52.1	5.21	46.0	141.9	6.53	15.83	236.6	8.6	152.9
With tendril Calovit			**43.10**	**177.2**	**76.40**	**182.2**	**125.5**	**5.41**	**13.11**	**36.20**	**145.2**	**52.60**	**22.67**	**54.93**	**5.49**	**45.80**	**145.3**	**6.65**	16.13	**242.0**	**8.60**	**154.4**

With tendril Calovit	2018	1	41.3	170.7	70.1	170.2	99.1	4.09	10.10	35.8	150.5	53.9	22.3	54.1	5.41	45.9	147.2	6.76	16.39	237.1	8.2	163.7
With tendril Calovit	2018	2	43.0	183.5	78.9	191.3	106.5	4.58	11.10	34.2	141.8	48.5	20.9	50.7	5.07	42.1	148.5	6.25	15.15	238.6	8.1	145.3
With tendril Calovit	2018	3	41.1	183.7	75.5	183.0	106.7	4.39	10.64	36.9	136.8	50.5	20.8	50.4	5.04	45.6	150.3	6.85	16.60	248.7	8.0	166.7
With tendril Calovit	2018	4	43.4	181.4	78.7	190.8	105.3	4.30	10.42	36.4	136.4	49.6	21.5	52.1	5.21	45.2	143.6	6.49	15.73	238.4	8.2	149.5
With tendril Calovit	2018	5	41.6	163.6	68.1	152.0	95.4	3.97	9.90	36.5	136.6	49.9	20.8	50.4	5.04	44.1	131.0	5.78	14.01	240.3	8.1	138.9
With tendril Calovit	2018	6	40.8	165.5	67.5	163.6	96.1	3.92	10.00	36.3	132.1	48.0	19.6	47.5	4.75	43.4	143.1	6.21	15.05	237.6	8.1	152.2
With tendril Calovit	2018	7	41.2	167.5	69.0	167.3	97.2	4.00	9.70	34.7	138.6	48.1	19.8	48.0	4.80	45.8	143.2	6.56	15.90	243.6	8.0	159.2
With tendril Calovit	2018	8	40.8	170.2	69.4	168.2	98.8	4.03	9.77	35.5	143.1	50.8	20.7	50.2	5.02	44.2	133.8	5.91	14.33	246.4	8.0	144.9
With tendril Calovit	2018	9	43.0	179.1	77.0	186.6	104.0	4.47	10.84	36.1	138.3	49.9	21.5	52.1	5.21	41.3	136.0	5.62	13.62	238.3	8.1	130.7
With tendril Calovit	2018	10	41.8	178.8	74.7	181.1	103.8	4.34	10.52	34.6	134.8	46.6	19.5	47.3	4.73	47.4	136.3	6.46	15.66	241.0	8.2	154.5
With tendril Calovit			**41.80**	**174.4**	**72.90**	**175.4**	**101.3**	**4.21**	**10.30**	**35.70**	**138.9**	**49.58**	**20.72**	**50.27**	**5.03**	**44.50**	**141.3**	**6.29**	15.24	**241.0**	**8.10**	**150.6**
With tendril Calovit	2019	1	41.9	145.7	61.0	147.9	85.0	3.56	8.63	29.4	115.8	34.0	14.2	34.4	3.44	42.7	105.0	4.48	10.86	230.0	5.8	106.9
With tendril Calovit	2019	2	42.3	147.1	62.0	150.3	79.5	3.36	8.14	32.6	115.6	37.7	15.9	38.5	3.85	44.2	103.0	4.55	11.03	233.2	6.1	107.6
With tendril Calovit	2019	3	40.3	148.0	59.6	144.5	80.0	3.22	7.81	29.6	126.7	37.5	15.1	36.6	3.66	45.8	102.4	4.69	11.37	228.9	6.2	116.4
With tendril Calovit	2019	4	40.8	152.0	62.0	150.3	82.2	3.35	8.12	30.0	108.4	32.5	13.3	32.2	3.22	40.5	109.4	4.43	10.74	226.5	6.1	108.6
With tendril Calovit	2019	5	40.1	159.0	63.8	154.7	86.0	3.45	8.36	30.7	124.4	38.2	15.3	37.1	3.71	41.4	107.9	4.47	10.84	225.7	6.1	111.5
With tendril Calovit	2019	6	39.7	141.7	56.3	121.4	70.3	2.79	6.76	29.4	118.5	34.8	13.8	33.5	3.35	42.0	98.1	4.12	9.99	235.1	5.7	103.8
With tendril Calovit	2019	7	39.8	140.9	56.1	136.0	76.2	3.03	7.34	30.5	108.4	33.1	13.2	32.0	3.20	43.4	91.7	3.98	9.65	235.2	6.1	100.0
With tendril Calovit	2019	8	40.7	157.0	63.9	154.9	84.7	3.45	8.36	31.9	120.7	38.5	15.7	38.1	3.81	42.1	92.8	3.91	9.48	226.7	5.8	96.1
With tendril Calovit	2019	9	42.0	141.0	59.2	143.5	76.3	3.20	7.76	30.6	125.8	38.5	16.2	39.3	3.93	44.7	109.2	4.88	11.83	230.7	6.1	116.2
With tendril Calovit	2019	10	40.4	158.6	64.1	155.4	85.8	3.47	8.41	30.3	113.7	34.5	13.9	33.7	3.37	45.2	92.5	4.18	10.13	228.0	6.0	103.5
With tendril Calovit			**40.80**	**149.1**	**60.80**	**145.8**	**80.60**	**3.29**	**7.97**	**30.50**	**117.8**	**35.93**	**14.67**	**35.54**	**3.55**	**43.20**	**101.2**	**4.37**	10.59	**230.0**	**6.00**	**107.0**
With tendril Calovit	2020	1	32.2	73.9	23.8	57.4	19.5	0.60	1.45	25.2	95.0	23.9	7.7	18.7	1.87	36.0	61.2	2.20	5.33	286.7	6.0	68.3
With tendril Calovit	2020	2	33.0	62.9	21.0	50.9	18.5	0.61	1.48	23.8	78.3	18.6	6.1	14.8	1.48	36.6	56.3	2.06	4.99	287.9	5.9	62.4
With tendril Calovit	2020	3	34.1	72.1	24.6	48.1	17.6	0.60	1.45	23.6	90.4	21.3	7.3	17.7	1.77	35.9	58.5	2.10	5.09	285.4	6.0	61.6
With tendril Calovit	2020	4	32.1	79.1	25.4	61.6	20.0	0.64	1.55	25.6	80.8	20.7	6.6	16.0	1.60	36.9	60.1	2.22	5.38	277.8	6.0	69.2
With tendril Calovit	2020	5	32.1	71.7	23.0	55.8	18.9	0.61	1.48	23.0	93.3	21.5	6.9	16.7	1.67	37.5	53.0	1.99	4.82	275.8	5.9	62.0
With tendril Calovit	2020	6	34.2	64.8	22.2	53.8	17.1	0.58	1.41	24.7	90.9	22.5	7.7	18.7	1.87	35.0	51.9	1.82	4.41	272.2	6.0	53.2
With tendril Calovit	2020	7	33.7	69.7	23.5	57.0	18.4	0.62	1.50	24.9	85.9	21.4	7.2	17.5	1.75	34.4	60.2	2.07	5.02	278.9	6.0	61.4
With tendril Calovit	2020	8	32.5	74.0	24.1	58.4	19.5	0.63	1.53	24.3	90.1	21.9	7.1	17.2	1.72	37.5	62.3	2.34	5.67	283.8	6.1	72.0
With tendril Calovit	2020	9	33.0	71.0	23.4	56.7	18.7	0.62	1.50	23.1	77.9	18.0	5.9	14.3	1.43	37.5	57.6	2.16	5.24	291.6	6.0	65.5
With tendril Calovit	2020	10	33.1	81.8	27.1	65.7	21.6	0.71	1.72	25.8	82.4	21.3	7.1	17.2	1.72	32.7	55.9	1.83	4.44	279.9	6.1	55.3
With tendril Calovit			**33.00**	**72.10**	**23.80**	**56.54**	**19.00**	**0.62**	**1.51**	**24.40**	**86.50**	**21.10**	**6.97**	**16.87**	**1.69**	**36.00**	**57.70**	**2.08**	5.04	**282.0**	**6.00**	**63.1**
With tendril Calovit	2021	1	39.2	79.6	31.1	75.6	33.8	1.32	3.35	26.6	93.5	24.4	9.6	23.3	2.33	42.7	93.8	4.01	9.72	246.4	8.8	102.3
With tendril Calovit	2021	2	42.0	95.1	39.9	96.7	39.8	1.50	3.64	29.0	114.0	33.1	13.9	33.7	3.37	44.2	89.0	3.93	9.53	257.0	8.5	93.6
With tendril Calovit	2021	3	39.1	86.5	33.8	67.0	36.2	1.42	3.44	27.8	101.5	28.2	11.0	26.7	2.67	45.8	82.3	3.77	9.14	245.4	8.2	96.4
With tendril Calovit	2021	4	41.0	82.9	34.0	82.4	34.7	1.42	3.44	28.1	103.4	29.1	11.9	28.8	2.88	40.5	98.5	3.99	9.67	249.4	8.3	97.3
With tendril Calovit	2021	5	39.4	78.8	31.0	75.1	33.5	1.32	3.20	26.5	91.8	24.3	9.6	23.3	2.33	44.4	85.6	3.80	9.21	257.5	8.6	96.4
With tendril Calovit	2021	6	39.2	93.7	36.7	89.0	39.2	1.48	3.59	28.0	94.4	26.4	10.3	25.0	2.50	42.0	92.8	3.90	9.45	252.8	8.4	99.5
With tendril Calovit	2021	7	40.8	81.3	33.2	80.5	34.0	1.39	3.37	28.7	102.0	29.3	12.0	29.1	2.91	43.4	80.6	3.60	8.73	249.9	8.3	88.2
With tendril Calovit	2021	8	40.1	87.9	35.2	85.3	36.8	1.48	3.59	28.4	94.9	27.0	10.8	26.2	2.62	42.1	94.7	3.99	9.67	249.3	8.3	99.5
With tendril Calovit	2021	9	39.1	95.8	37.5	90.9	39.0	1.52	3.68	28.3	100.7	28.5	11.1	26.9	2.69	44.7	85.0	3.80	9.21	251.9	8.2	97.2
With tendril Calovit	2021	10	41.1	81.4	33.5	81.2	34.1	1.40	3.39	27.6	100.8	27.8	11.4	27.6	2.76	45.2	98.7	4.46	10.81	250.4	8.4	108.5
With tendril Calovit			**40.10**	**86.30**	**34.60**	**82.38**	**36.10**	**1.43**	**3.47**	**27.90**	**99.70**	**27.80**	**11.17**	**27.05**	**2.71**	**43.50**	**90.10**	**3.92**	**9.51**	**251.0**	**8.40**	**97.9**

Table A 12.4. Cl R5 Cabernet Sauvignon onto BxR Kober 5BB (*Scheme III)*

Variants	Year	Repet	N of Sh.	Shoot Length	Annual Growth		Annual Growth Volume			N L/ Shoot	Leaf Area				LAI	N of Clus.	W. of Clus.	Yield		Sugar	Titr. Acid	SP
					m.vine	th.m/ ha	cm^3/ shoot	dm^3/ vine	m^3/ha		cm^2/ leaf	dm^2/ shoot	m^2/ vine	th. m^2/ha				per vine	per hec.			
Cl R5	2015	1	29.5	134.2	37.4	129.2	71.9	2.12	6.25	28.2	144.4	29.2	9.6	34.7	2.83	37	106.1	3.38	11.75	229	8.1	114.6
Cl R5	2015	2	29.6	134.9	38.0	134.3	73.7	2.18	6.43	28.9	103.9	30.1	9.7	30.3	2.86	37.3	102.8	3.11	11.33	218	8.2	105.1
Cl R5	2015	3	29.8	136.9	38.8	117.1	76.3	2.27	6.70	30.2	137.8	41.7	10.8	29.4	3.19	36.8	105.5	4.08	11.14	223	7.8	136.9
Cl R5	2015	4	29.8	141.1	39.6	135.0	76.9	2.29	6.76	29.1	143.1	36.7	11.7	31.6	3.45	37.4	96.3	4.08	10.27	227	8.7	136.9
Cl R5	2015	5	30.4	141.3	41.7	129.6	77.7	2.36	6.96	30.0	119.2	29.6	11.8	29.4	3.48	37.1	98.8	3.94	11.95	231	7.8	129.6
Cl R5	2015	6	30.4	143.7	43.3	117.7	77.7	2.36	6.96	27.5	103.9	39.2	11.6	34.3	3.42	37.6	103.3	4.09	10.95	244	8.3	134.5
Cl R5	2015	7	30.5	145.8	46.5	136.0	78.1	2.38	7.02	28.0	123.0	45.2	9.5	33.6	2.80	37	104.9	3.76	10.36	232	8.4	123.3
Cl R5	2015	8	30.9	146.8	46.6	129.7	78.4	2.42	7.14	30.6	111.0	29.6	9.7	33.3	2.86	38	101.3	3.96	10.53	236	8.2	128.2
Cl R5	2015	9	30.9	147.3	47.0	124.9	78.6	2.43	7.17	26.8	121.0	35.7	11.7	28.2	3.45	37.8	93.1	3.72	11.85	227	8.7	120.4
Cl R5	2015	10	31.2	149.0	52.1	123.5	78.7	2.46	7.26	31.9	116.3	38.7	11.8	33.4	3.48	37	95.9	3.5	10.77	233	7.8	112.2
Cl R5			**30.3**	**142.10**	**43.10**	**127.70**	**76.80**	**2.33**	**6.87**	**29.1**	**122.4**	**35.6**	**10.8**	**31.8**	**4.40**	**37.3**	**100.8**	**3.76**	11.09	**230**	**8.2**	**166.6**
Cl R5	2016	1	30.5	140.7	38.9	132.0	76.3	2.33	6.87	32.8	145.5	40.9	14.9	40.4	4.19	37.2	116.9	5.08	13.53	248	8.1	163.6
Cl R5	2016	2	30.5	141.7	39.5	142.4	77.5	2.36	6.96	32.7	151.0	47.6	14.2	38.5	4.34	38	130.2	4.99	13.41	245	9.2	148.4

Cl R5	2016	3	31.0	143.2	42.2	144.6	78.6	2.44	7.20	27.5	144.8	47.9	14.7	38.7	3.75	39.1	128	4.6	14.00	247	9	153.7
Cl R5	2016	4	31.3	143.8	43.7	144.8	80.1	2.51	7.40	29.3	159.9	49.7	12.7	43.1	3.63	38.5	129.7	4.81	15.03	249	9.3	133.5
Cl R5	2016	5	31.3	147.5	44.8	132.2	80.6	2.52	7.43	29.3	150.2	38.7	12.3	40.7	3.95	38.4	120.1	4.18	14.95	244	8.9	159.0
Cl R5	2016	6	31.5	148.0	44.9	136.1	82.5	2.60	7.67	30.9	132.7	49.8	13.4	42.1	3.54	39	117.9	5.01	13.58	247	8	149.4
Cl R5	2016	7	31.6	151.8	49.1	132.3	84.9	2.68	7.91	28.9	123.6	38.0	12.0	42.4	4.19	38.7	131	4.72	15.65	263	8.9	165.6
Cl R5	2016	8	31.7	152.0	50.2	130.6	86.7	2.75	8.11	29.3	140.7	36.6	14.2	37.4	4.31	38.2	128.3	5.25	13.47	263	9.1	155.8
Cl R5	2016	9	31.7	156.7	52.8	137.4	86.9	2.75	8.11	30.2	124.3	41.7	14.6	33.1	3.54	38.8	124.8	4.94	13.50	247	9.5	148.9
Cl R5	2016	10	31.9	157.6	57.9	136.6	86.9	2.77	8.17	32.9	142.0	38.9	12.0	40.3	5.63	39.1	128.1	4.75	15.38	247	9	155.2
Cl R5			**31.3**	**148.30**	**46.40**	**136.90**	**82.10**	**2.57**	**7.58**	**30.4**	**141.5**	**43.0**	**13.5**	**39.7**	**4.43**	**38.5**	**125.5**	**4.83**	14.25	**250**	**8.9**	**176.5**
Cl R5	2017	1	31.0	160.1	43.4	146.8	105.8	3.28	9.68	31.8	144.3	46.5	19.1	41.8	5.75	39.2	123.9	4.81	15.14	227	9.2	161.8
Cl R5	2017	2	31.1	161.5	44.1	146.1	106.4	3.31	9.76	37.0	164.8	57.9	15.0	43.1	4.66	39	126	5.49	15.81	242	9.4	167.8
Cl R5	2017	3	31.4	163.1	45.1	154.9	108.0	3.39	10.00	32.3	171.3	59.9	19.5	50.9	5.19	38.9	136.2	5.08	15.58	240	8.1	150.0
Cl R5	2017	4	31.4	164.1	51.1	158.7	108.8	3.42	10.09	35.7	172.5	51.5	15.8	41.9	4.60	38.5	137	5.27	14.10	229	8.4	170.9
Cl R5	2017	5	31.6	164.8	53.0	153.5	110.2	3.48	10.27	37.5	139.0	57.9	17.6	58.1	4.54	39.1	130.9	4.74	15.47	245	9	148.0
Cl R5	2017	6	31.6	166.6	56.6	157.0	116.3	3.68	10.86	37.7	157.7	45.4	15.6	40.2	5.28	38.1	127.9	5.4	14.77	230	8.9	164.3
Cl R5	2017	7	31.9	170.0	57.4	154.4	118.8	3.79	11.18	31.5	141.2	46.0	15.4	59.0	5.34	39	136.2	4.72	15.49	248	8.5	169.1
Cl R5	2017	8	31.9	170.9	58.0	161.3	119.0	3.80	11.21	37.4	145.1	63.4	17.9	57.8	4.66	38.9	127.9	5.24	13.89	233	9.5	144.2
Cl R5	2017	9	32.0	176.2	59.6	162.8	120.5	3.86	11.39	36.7	147.0	61.7	18.1	49.8	4.01	39.1	136.3	5.41	13.67	227	9.1	144.3
Cl R5	2017	10	32.1	177.7	60.7	165.5	123.2	3.95	11.65	36.0	134.7	47.2	15.8	58.4	5.04	39.2	122.7	4.63	15.88	229	8.9	166.4
Cl R5			**31.6**	**167.50**	**52.90**	**156.10**	**113.70**	**3.60**	**10.61**	**35.4**	**151.8**	**53.7**	**17.0**	**50.1**	**5.10**	**38.9**	**130.5**	**5.08**	14.98	**235**	**8.9**	**164.0**
Cl R5	2018	1	30.5	155.9	43.5	148.1	96.3	2.94	8.67	36.5	138.4	57.6	13.6	54.7	5.16	39	134.7	4.4	14.40	236	7.9	156.7
Cl R5	2018	2	30.7	158.3	45.1	156.8	87.4	2.68	7.91	36.0	126.7	56.9	17.1	48.1	5.02	38	127.3	5.11	13.52	233	8.4	159.4
Cl R5	2018	3	31.1	161.3	47.0	159.4	88.9	2.76	8.14	33.9	149.1	50.1	17.3	41.4	4.87	39	132.5	5.1	15.00	245	8	148.6
Cl R5	2018	4	31.2	162.1	47.8	152.8	89.6	2.80	8.26	32.3	157.5	49.2	17.5	50.0	4.07	38.9	126.1	4.89	13.95	229	8.7	156.6
Cl R5	2018	5	31.3	163.4	51.7	150.9	90.5	2.83	8.35	36.2	124.0	41.6	17.0	42.8	4.63	38.4	116.6	4.99	15.81	251	8.3	145.5
Cl R5	2018	6	31.3	165.3	51.7	146.9	91.2	2.85	8.41	35.9	155.8	42.8	16.5	44.2	4.69	38.2	116.2	4.65	14.09	242	7.8	151.6
Cl R5	2018	7	31.6	166.4	55.8	158.9	94.4	2.98	8.79	31.6	151.4	63.8	13.8	48.1	4.22	39	128.1	4.95	15.60	239	8.1	150.6
Cl R5	2018	8	31.9	170.0	55.8	146.1	98.2	3.13	9.23	35.4	149.6	46.0	15.7	44.9	3.63	38.7	126.3	4.64	13.56	238	7.9	133.9
Cl R5	2018	9	32.0	172.2	56.7	151.3	98.7	3.16	9.32	32.0	145.2	49.9	15.9	54.2	3.13	39.2	119.2	4.85	13.79	227	7.8	123.2
Cl R5	2018	10	32.4	173.1	61.9	155.8	99.8	3.23	9.53	38.0	157.3	48.0	14.3	40.4	2.74	38.6	126	4.88	13.28	230	8.1	134.2
Cl R5			**31.4**	**164.80**	**51.70**	**152.70**	**93.50**	**2.94**	**8.66**	**34.8**	**145.5**	**50.6**	**15.9**	**46.9**	**3.54**	**38.7**	**125.3**	**4.85**	14.30	**237**	**8.1**	**117.4**
Cl R5	2019	1	29.8	126.3	35.1	122.3	71.0	2.12	6.25	30.9	116.5	31.5	12.3	31.3	2.71	36.5	96.5	3.99	11.82	231	5.8	113.4
Cl R5	2019	2	30.2	132.4	36.7	126.7	68.5	2.07	6.11	30.9	134.6	35.8	10.6	32.4	3.48	38.4	98.2	3.72	11.47	230	5.9	114.6
Cl R5	2019	3	30.4	134.3	38.0	116.3	69.2	2.10	6.20	28.2	137.5	42.9	9.3	35.7	3.16	37.5	101.4	4.08	10.48	223	5.9	115.2
Cl R5	2019	4	30.5	134.8	38.2	126.7	70.7	2.16	6.37	33.4	111.8	34.5	12.0	31.2	3.75	38.1	94	3.58	10.07	243	6.1	108.0
Cl R5	2019	5	30.7	138.7	42.5	121.7	71.3	2.19	6.46	27.5	128.6	31.9	9.2	30.4	3.42	38	100.5	3.48	10.98	230	6	110.9
Cl R5	2019	6	30.9	139.9	44.3	134.3	72.2	2.23	6.58	29.8	131.6	38.3	11.8	34.5	3.07	37.3	95.6	3.54	10.19	231	6.3	135.1
Cl R5	2019	7	30.9	141.6	45.9	131.8	72.2	2.23	6.58	27.1	112.5	40.0	10.7	32.2	1.18	38.3	91.2	3.56	10.32	250	6.1	68.5
Cl R5	2019	8	31.1	142.5	46.5	121.1	72.9	2.27	6.70	29.2	129.6	27.8	12.7	32.1	1.53	38.1	100.2	3.36	10.35	226	6.6	75.6
Cl R5	2019	9	31.2	143.0	47.7	125.0	80.1	2.50	7.38	30.1	109.6	38.0	11.6	35.2	1.50	38.1	99.1	3.46	11.90	242	6.2	85.2
Cl R5	2019	10	31.3	147.5	49.1	125.1	80.9	2.53	7.46	29.3	110.4	41.3	10.4	32.7	1.48	37.7	103.3	4.23	11.72	234	6.1	64.0
Cl R5			**30.7**	**138.10**	**42.40**	**125.10**	**72.90**	**2.24**	**6.61**	**29.6**	**122.3**	**36.2**	**11.1**	**32.8**	**1.24**	**37.8**	**98**	**3.7**	10.93	**234**	**6.1**	**63.4**
Cl R5	2020	1	23.2	62.0	14.1	41.1	19.0	0.44	1.30	23.9	84.2	21.1	4.0	15.7	1.62	28.5	57.6	1.59	4.78	296	5.8	67.2
Cl R5	2020	2	23.4	63.0	14.9	44.0	12.5	0.29	0.86	24.6	89.5	19.5	5.2	16.1	1.53	29.5	51.5	1.77	4.84	292	5.9	63.7
Cl R5	2020	3	23.6	64.3	15.2	44.8	14.2	0.34	1.00	22.9	84.8	27.1	5.1	14.5	1.92	29	56.9	2.01	4.52	286	6.1	75.5
Cl R5	2020	4	23.6	68.8	16.1	47.5	15.5	0.37	1.09	22.7	86.8	21.6	5.0	13.8	1.62	29.9	54	1.51	4.97	290	6.4	59.6
Cl R5	2020	5	23.8	69.3	16.2	47.8	17.9	0.43	1.27	24.8	100.1	18.7	4.2	16.5	1.80	28.8	54.3	1.51	4.69	272	5.5	64.5
Cl R5	2020	6	24.1	69.6	17.1	50.4	18.5	0.45	1.33	22.9	76.3	20.9	5.5	14.4	2.77	29.8	59.8	1.62	4.68	274	6.1	112.1
Cl R5	2020	7	24.5	74.0	17.5	51.5	19.8	0.49	1.45	24.1	98.4	23.6	5.2	14.2	2.18	29.7	53.4	1.56	5.00	280	5.7	113.5
Cl R5	2020	8	24.5	74.0	18.5	54.6	21.6	0.53	1.56	24.4	84.7	22.0	6.5	16.6	2.18	30	56.9	1.85	5.40	271	5.7	122.9
Cl R5	2020	9	24.5	75.0	18.6	54.9	22.5	0.55	1.62	26.8	93.8	20.2	5.5	16.0	2.45	29.9	58.7	1.46	4.64	273	6.5	90.5
Cl R5	2020	10	24.8	75.0	18.8	55.4	22.5	0.56	1.65	25.4	95.3	22.0	6.1	16.1	2.68	29.9	55.9	1.6	5.08	276	6.3	107.9
Cl R5			**24.0**	**69.50**	**16.70**	**49.20**	**18.40**	**0.45**	**1.31**	**24.3**	**89.4**	**21.7**	**5.2**	**15.4**	**2.12**	**29.5**	**55.9**	**1.65**	4.86	**281**	**6**	**95.2**
Cl R5	2021	1	28.2	72.9	20.1	71.3	33.8	0.95	2.80	30.1	105.4	23.0	9.4	25.1	2.77	36	88.4	3.16	9.36	247	8.6	91.8
Cl R5	2021	2	28.2	75.3	21.0	76.2	31.0	0.87	2.57	28.2	91.5	24.1	7.4	27.6	2.30	35.6	87.7	3.2	9.27	245	8.2	109.2
Cl R5	2021	3	28.4	79.3	21.0	62.3	32.7	0.93	2.74	27.6	87.8	27.9	7.4	24.9	2.66	35.8	91.9	3.49	9.31	245	8.8	105.4
Cl R5	2021	4	28.4	85.2	21.8	73.1	32.8	0.93	2.74	26.1	104.0	38.5	8.3	25.8	2.36	34.9	83.2	2.57	9.56	243	8.4	116.1
Cl R5	2021	5	29.0	85.2	23.2	75.8	33.5	0.97	2.86	27.0	84.2	23.9	9.1	23.8	2.92	35.9	84.6	3.13	9.42	260	7.5	197.1
Cl R5	2021	6	29.0	86.8	26.1	66.2	36.1	1.05	3.10	29.1	104.9	28.8	7.2	24.9	3.25	35.6	84.9	2.76	8.60	245	8.5	186.9
Cl R5	2021	7	29.2	87.2	26.4	77.6	36.5	1.07	3.16	30.7	118.3	30.5	9.4	23.0	3.51	35.1	88.2	2.68	8.77	264	7.6	203.3
Cl R5	2021	8	29.3	87.5	26.7	65.9	36.7	1.08	3.19	26.1	103.9	32.9	7.8	22.0	3.39	35.3	80.2	3.2	9.58	244	8.6	172.1
Cl R5	2021	9	29.5	89.2	27.1	68.3	37.7	1.11	3.27	29.3	106.7	35.2	9.0	25.5	3.51	35.9	81.2	3.11	8.45	263	8	160.8
Cl R5	2021	10	29.8	89.4	28.6	77.3	40.2	1.20	3.54	27.0	120.6	24.1	8.0	23.6	3.01	35.9	94.7	3.46	8.48	254	7.8	177.6
Cl R5			**28.9**	**83.80**	**24.20**	**71.40**	**35.10**	**1.02**	**3.00**	**28.1**	**102.7**	**28.9**	**8.3**	**24.6**	**3.57**	**35.6**	**86.5**	**3.08**	9.08	**251**	**8.2**	**182.0**

Cl 348	2015	1	24.2	169.5	41.0	121.0	94.9	2.30	6.79	27.1	169.9	47.9	9.9	31.9	3.72	31.9	133.7	4.77	12.74	227	8	167.3
Cl 348	2015	2	24.4	157.6	38.5	113.6	92.8	2.26	6.67	27.8	155.2	45.9	11.0	33.0	3.13	32.4	132.3	4.56	13.28	233	8.4	164.6
Cl 348	2015	3	24.4	160.1	39.1	115.3	94.3	2.30	6.79	27.4	179.1	46.6	11.9	32.3	3.60	32.7	131.2	4.96	13.72	241	8	173.0
Cl 348	2015	4	25.1	152.5	38.3	113.0	91.9	2.31	6.81	23.1	162.2	43.1	11.5	31.8	4.28	32.4	143.6	4.32	13.34	224	8.7	235.0
Cl 348	2015	5	25.5	162.9	41.5	122.4	104.0	2.65	7.82	25.0	179.7	41.6	11.9	38.7	5.28	32.8	144.7	4.1	13.43	240	8.2	218.2
Cl 348	2015	6	25.5	157.3	40.1	118.3	107.5	2.74	8.08	26.8	165.4	41.9	10.2	33.8	4.45	31.9	144.6	4.53	13.78	223	7.8	228.4
Cl 348	2015	7	25.6	164.0	42.0	123.9	92.0	2.36	6.96	28.2	182.9	41.5	12.1	36.6	4.25	32.3	132.9	4.66	13.70	227	8.1	224.9
Cl 348	2015	8	25.7	166.2	42.7	125.2	105.2	2.70	7.97	26.2	168.9	51.9	12.6	32.1	3.95	32.7	136.1	4.3	12.60	234	7.9	232.7
Cl 348	2015	9	25.7	150.9	39.1	115.3	106.9	2.75	8.11	23.8	162.6	41.3	10.6	33.3	3.98	32.4	144.1	4.23	13.43	242	7.8	217.0
Cl 348	2015	10	25.9	165.0	42.7	126.0	109.5	2.84	8.38	28.1	188.3	50.1	12.2	32.9	4.51	32.5	143.8	4.48	12.58	229	8.1	214.4
Cl 348			**25.2**	**160.60**	**40.50**	**119.40**	**99.90**	**2.52**	**7.44**	**26.4**	**171.4**	**45.2**	**11.4**	**33.6**	**4.31**	**32.4**	**138.7**	**4.49**	13.26	**232**	**8.1**	**214.7**
Cl 348	2016	1	26.6	158.1	42.2	124.5	111.0	2.95	8.70	26.3	208.8	51.9	14.5	43.7	4.51	35.2	163.5	6.25	17.64	265	9.3	211.2
Cl 348	2016	2	26.9	157.1	42.3	124.8	99.9	2.69	7.94	28.7	209.5	56.9	17.9	44.4	4.93	35.2	181	5.87	18.51	264	9.2	223.4
Cl 348	2016	3	27.1	170.2	46.1	136.0	102.8	2.79	8.23	26.9	172.2	60.6	15.1	46.7	5.81	35.6	175.3	6.19	18.52	247	8.1	252.0
Cl 348	2016	4	27.3	161.0	44.0	129.8	105.4	2.88	8.50	28.7	210.1	61.5	14.4	46.0	5.16	36.1	168.6	6.14	17.38	248	8.4	220.8
Cl 348	2016	5	27.5	166.4	45.8	135.1	108.7	2.99	8.82	28.5	214.9	56.0	13.4	42.3	5.04	34.9	169.2	6.4	18.72	247	9	235.4
Cl 348	2016	6	27.6	170.2	47.0	138.7	99.0	2.73	8.05	30.4	173.2	49.3	13.5	44.2	4.63	36.1	171.3	5.99	18.53	256	8.9	239.8
Cl 348	2016	7	27.7	172.2	47.7	140.7	113.5	3.14	9.26	23.2	181.3	54.6	15.3	44.0	5.52	35.9	168.6	5.94	17.29	247	8.7	243.9
Cl 348	2016	8	27.8	171.7	47.7	140.7	114.9	3.19	9.41	28.5	191.4	48.9	14.6	49.4	4.66	35.2	180.3	5.97	17.82	252	9.4	222.5
Cl 348	2016	9	28.5	169.8	48.4	142.3	112.3	3.20	9.44	28.2	213.6	52.0	15.3	41.6	5.55	35.1	170.9	6.02	17.86	264	9.1	238.9
Cl 348	2016	10	29.0	158.3	45.9	135.4	108.5	3.15	9.29	26.1	205.6	55.7	16.7	42.8	6.25	35.7	177.3	6.48	18.53	260	8.9	230.9
Cl 348			**27.6**	**165.50**	**45.71**	**134.80**	**107.60**	**2.97**	**8.76**	**27.6**	**198.1**	**54.7**	**15.1**	**44.5**	**6.08**	**35.5**	**172.6**	**6.13**	18.08	**255**	**8.9**	**202.8**
Cl 348	2017	1	27.1	189.2	51.3	151.3	139.9	3.79	11.18	31.2	227.8	66.2	19.7	59.5	6.28	36.2	179.4	6.83	19.86	236	9.1	219.9
Cl 348	2017	2	27.4	183.2	50.2	148.1	152.6	4.18	12.33	34.0	225.9	61.4	17.5	59.9	5.07	35.6	181.9	6.05	19.34	244	8.8	226.4
Cl 348	2017	3	27.7	182.1	50.4	148.7	153.0	4.24	12.51	31.4	215.9	61.5	17.1	55.8	5.02	36.5	182.1	6.52	18.69	228	8.1	234.1
Cl 348	2017	4	27.9	197.1	55.0	162.3	138.4	3.86	11.39	29.9	217.7	63.6	15.7	55.0	5.61	36	172.8	6.69	18.25	234	8.4	241.4
Cl 348	2017	5	28.0	183.4	51.4	151.6	147.7	4.14	12.21	33.1	211.5	78.2	18.7	45.7	3.89	35.6	180.5	6.83	19.71	236	9	215.5
Cl 348	2017	6	28.0	185.0	51.8	152.8	149.5	4.19	12.36	29.7	192.9	68.0	15.8	52.1	5.10	36.4	186.1	6.23	19.33	248	8.9	239.7
Cl 348	2017	7	28.0	185.9	52.1	153.7	140.1	3.92	11.56	28.4	225.2	69.5	18.8	56.3	5.22	35.9	181.9	6.69	19.41	232	8.5	208.2
Cl 348	2017	8	28.8	179.0	51.6	152.2	154.8	4.46	13.16	34.8	204.7	61.0	21.2	49.4	4.90	35.9	169.9	6.65	18.76	237	9.2	220.5
Cl 348	2017	9	28.9	186.6	53.9	159.0	137.7	3.98	11.74	30.2	195.6	69.6	20.6	57.8	5.75	36.4	177.1	5.86	19.75	242	9.1	204.6
Cl 348	2017	10	29.2	197.5	57.4	169.3	153.3	4.48	13.22	29.7	208.2	63.9	21.3	58.6	5.25	36.5	183.3	6.42	18.10	243	8.9	222.8
Cl 348			**28.1**	**186.90**	**52.5**	**154.90**	**146.70**	**4.12**	**12.17**	**31.2**	**212.5**	**66.3**	**18.6**	**55.0**	**5.63**	**36.1**	**179.5**	**6.48**	19.12	**238**	**8.8**	**208.7**
Cl 348	2018	1	26.5	177.3	47.0	139.2	120.6	3.20	9.44	29.4	203.4	63.5	17.2	54.8	2.92	36.2	177.7	6	17.88	249	8.2	170.2
Cl 348	2018	2	27.0	177.5	47.9	141.3	122.1	3.30	9.74	33.7	205.1	61.4	17.0	53.7	4.01	35.5	175.8	6.32	18.58	230	8.4	172.1
Cl 348	2018	3	27.3	188.9	51.6	152.2	126.9	3.46	10.21	31.8	207.1	64.5	19.0	54.1	3.89	36.2	170.5	6.59	18.73	242	8	165.5
Cl 348	2018	4	27.7	186.2	51.6	152.2	122.5	3.39	10.00	27.4	205.8	56.5	13.2	45.2	3.60	35.7	170.5	5.97	17.90	232	8.7	175.4
Cl 348	2018	5	27.7	191.4	53.0	156.4	125.9	3.49	10.30	28.8	194.2	61.6	17.3	55.3	2.92	35.3	168.6	6.64	17.21	237	8.2	176.6
Cl 348	2018	6	27.9	176.3	49.2	145.1	110.4	3.08	9.09	32.7	209.7	56.5	17.7	52.7	3.19	35.8	169.4	5.81	17.51	241	7.9	179.5
Cl 348	2018	7	28.3	180.0	50.9	150.2	124.2	3.51	10.35	32.6	199.4	70.2	16.6	46.9	3.27	35.7	174.1	6.24	19.19	239	8.1	168.4
Cl 348	2018	8	28.5	177.2	50.5	149.0	110.2	3.14	9.26	30.2	191.2	76.6	19.5	45.6	3.22	36.2	182.8	5.83	18.77	236	8.4	164.1
Cl 348	2018	9	28.5	192.9	54.6	161.1	121.5	3.46	10.21	31.9	209.3	56.5	17.8	56.1	3.36	35.6	168.5	6.35	17.85	247	7.8	183.9
Cl 348	2018	10	28.6	191.3	54.7	161.4	110.7	3.17	9.35	28.3	211.9	57.4	19.1	48.2	4.04	35.8	166.1	5.97	18.48	247	8.3	175.5
Cl 348			**27.8**	**183.90**	**51.10**	**150.81**	**119.50**	**3.32**	**9.80**	**30.7**	**203.7**	**62.5**	**17.4**	**51.3**	**1.77**	**35.8**	**172.4**	**6.17**	18.21	**240**	**8.2**	**93.4**
Cl 348	2019	1	25.5	160.1	40.8	120.4	95.2	2.43	7.20	23.3	161.8	53.6	9.9	33.5	1.65	33.6	132.9	4.34	13.83	231	5.8	103.0
Cl 348	2019	2	25.8	157.4	40.6	119.8	91.2	2.35	6.94	27.0	176.0	39.5	13.6	37.1	1.71	34.5	132.5	4.44	13.11	238	5.9	105.0
Cl 348	2019	3	26.4	148.1	39.2	115.3	98.2	2.59	7.64	27.9	176.0	40.9	13.2	31.4	2.12	34.5	140.4	4.37	14.06	230	5.7	96.5
Cl 348	2019	4	26.4	160.0	42.2	124.5	96.6	2.55	7.52	26.7	173.1	53.3	12.2	34.2	1.77	34.7	130.5	4.63	13.85	239	6.1	91.7
Cl 348	2019	5	26.5	152.7	40.5	119.5	91.8	2.43	7.17	22.7	160.6	40.0	9.9	40.5	1.74	33.9	139.4	4.68	13.07	241	5.6	109.7
Cl 348	2019	6	26.8	151.3	40.5	119.5	91.7	2.46	7.26	26.4	179.8	44.1	10.8	32.3	1.56	34.3	128.3	4.81	14.02	233	6.0	91.8
Cl 348	2019	7	26.9	161.7	43.5	128.1	87.6	2.36	6.96	25.9	169.9	45.6	11.1	30.6	1.50	34.3	132.3	4.53	14.36	243	6.1	102.4
Cl 348	2019	8	27.0	144.1	39.1	115.3	94.5	2.55	7.52	24.1	160.1	42.5	10.9	32.2	1.56	34.1	135.1	4.43	13.22	243	6.4	104.3
Cl 348	2019	9	27.3	147.1	40.2	118.6	93.4	2.55	7.52	27.3	170.1	41.1	11.4	34.3	1.65	34.1	140.3	5.02	12.88	245	6.3	89.0
Cl 348	2019	10	27.4	158.5	43.4	128.0	96.8	2.65	7.82	25.4	184.4	39.1	13.7	38.6	2.80	34	136.3	4.81	13.60	237	6.1	166.0
Cl 348			**26.6**	**154.10**	**41.00**	**120.90**	**93.70**	**2.49**	**7.36**	**25.7**	**171.2**	**44.0**	**11.7**	**34.5**	**2.74**	**34.2**	**134.8**	**4.61**	13.60	**238**	**6.0**	**147.9**
Cl 348	2020	1	19.7	69.2	13.6	41.1	21.4	0.42	1.24	23.6	113.0	25.1	6.0	15.6	2.57	26.4	79.8	1.84	6.03	287	5.5	163.9
Cl 348	2020	2	19.8	84.7	16.8	49.6	26.8	0.53	1.56	22.6	115.6	28.2	5.6	17.6	2.48	26.6	82.2	2.04	6.11	288	5.9	150.0
Cl 348	2020	3	20.0	78.6	15.7	46.3	16.0	0.32	0.94	24.2	132.4	25.9	5.8	16.7	2.63	26.5	80.7	2.1	5.99	287	6.3	165.3
Cl 348	2020	4	20.0	84.9	17.0	50.2	20.0	0.40	1.18	22.8	122.5	25.2	7.2	16.8	2.83	25.7	79.7	1.93	6.01	296	6.4	156.7
Cl 348	2020	5	20.5	75.1	15.4	45.4	32.7	0.67	1.98	24.8	130.6	33.1	6.0	15.8	2.36	26	70.7	1.88	5.90	287	5.5	141.9
Cl 348	2020	6	20.6	84.7	17.1	50.4	22.4	0.46	1.36	20.8	139.1	31.5	5.9	16.1	2.48	25.7	66.9	2.26	6.37	286	6.1	146.2
Cl 348	2020	7	20.8	75.2	15.6	46.0	26.7	0.56	1.65	21.0	115.7	30.8	5.3	20.2	2.80	26.2	79.1	1.91	6.35	289	5.8	145.2
Cl 348	2020	8	20.8	68.6	14.4	42.5	23.0	0.48	1.42	22.4	116.9	25.3	5.1	20.6	2.45	26.8	78.6	2.13	6.36	298	5.7	147.8
Cl 348	2020	9	20.8	72.9	15.2	44.8	23.1	0.48	1.42	23.5	141.8	26.5	5.3	16.8	2.83	26.5	81.4	2.17	5.27	282	6.5	114.6

Cl 348	2020	10	21.0	82.1	17.2	50.7	21.9	0.46	1.36	22.1	124.1	33.5	5.6	15.5	2.86	25.6	69.9	1.87	5.01	300	6.3	105.1
Cl 348			**20.4**	**77.60**	**15.80**	**46.70**	**23.40**	**0.48**	**1.41**	**22.8**	**125.2**	**28.5**	**5.8**	**17.2**	**3.19**	**26.2**	**76.9**	**2.01**	5.94	**290**	**6.0**	**136.9**
Cl 348	2021	1	23.5	98.5	23.1	68.2	43.5	1.02	3.01	27.1	156.2	33.8	9.5	23.8	3.45	31.2	118.9	3.9	11.84	252	8.5	136.9
Cl 348	2021	2	23.8	100.0	23.8	70.2	42.1	1.00	2.95	23.8	133.6	32.9	9.3	24.5	3.48	30.9	120.6	3.52	10.46	251	8.3	129.6
Cl 348	2021	3	23.8	93.9	22.3	65.8	47.6	1.13	3.33	24.4	150.6	40.8	8.7	27.2	3.42	31.6	118.4	3.9	11.21	257	8.8	134.5
Cl 348	2021	4	24.0	85.1	20.4	61.2	45.9	1.10	3.25	25.9	128.5	42.7	8.4	27.8	2.80	31	110.8	3.6	10.82	260	8.4	123.3
Cl 348	2021	5	24.2	89.3	21.6	63.7	46.4	1.12	3.30	23.8	147.1	33.1	8.9	27.8	2.86	31.4	117.2	4	11.64	264	7.5	128.2
Cl 348	2021	6	24.5	87.4	21.4	63.2	48.3	1.18	3.48	26.8	142.7	34.8	9.6	23.4	3.45	31.3	114.3	3.84	10.13	269	8.5	120.4
Cl 348	2021	7	24.6	89.6	22.2	64.9	40.1	0.99	2.92	25.7	147.4	39.6	8.0	27.1	3.48	31.7	115.9	3.49	11.90	263	7.6	112.2
Cl 348	2021	8	24.7	94.1	23.2	68.4	47.7	1.18	3.48	25.3	136.8	32.5	8.4	26.6	4.40	31.2	126.8	3.61	10.28	264	8.6	166.6
Cl 348	2021	9	24.8	96.2	23.9	70.5	52.6	1.30	3.84	25.4	145.0	40.1	9.5	26.7	4.19	31.7	126.7	3.6	10.88	254	8.0	163.6
Cl 348	2021	10	25.1	100.9	25.1	73.9	43.8	1.10	3.25	26.1	150.2	34.7	8.3	27.4	4.34	31.0	119.4	3.71	10.64	266	7.8	148.4
Cl 348			**24.3**	**93.50**	**22.70**	**67.00**	**45.80**	**1.11**	**3.28**	**25.4**	**143.8**	**36.5**	**8.9**	**26.2**	**3.75**	**31.3**	**118.9**	**3.72**	10.98	**260**	**8.2**	**153.7**

DECLARATION OF LIABILITY

I, the undersigned, declare with full responsibility that the materials presented in the Thesis by Doctor Habilitate were obtained through my research; otherwise, I am willing to bear responsibility by applicable legislation.

Serghei CARA

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(signature)

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(date)

CV OF THE AUTHOR

PERSONAL INFORMATION Serghei Cara

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WORK EXPERIENCE

06/09/2000–01/01/2001 **Senior laboratory assistant at the experimental station**
Comrat State University, Comrat (Republic of Moldova)

28/08/2002–28/08/2003 **Assistant-lecturer Department of crop production technology**
Comrat State University, Comrat (Republic of Moldova)

29/08/2003–29/08/2010 **University lecturer of the Department of crop production technology**
Comrat State University, Comrat (Republic of Moldova)

01/09/2006–31/08/2011 **Head of the Department of crop production technology**
Comrat State University, Comrat (Republic of Moldova)

01/09/2011–31/08/2014 **Senior university lecturer of the Department of crop production technology**
Comrat State University, Comrat (Republic of Moldova)

01/09/2013– present **Dean of the Agro-technological Faculty**
Comrat State University, Comrat (Republic of Moldova)

01/09/2014– present **Associate Professor in Agronomy**
Comrat State University, Comrat (Republic of Moldova)

EDUCATION AND TRAINING

01/09/1997–01/06/2002 **Higher Education. Specialty - Agronomy** EQF level 6
Comrat State University, Comrat (Republic of Moldova)

01/01/2004–01/01/2008 **Doctorate. Specialty - Viticulture** EQF level 8
State Agrarian University of Moldova. Faculty of Horticulture, Viticulture and Vegetable Crops. Department of viticulture (Republic of Moldova)

26/03/2010 **Ph.D. in Agriculture**
Scientific and Practical Institute of Horticulture and Food Technologies (Republic of Moldova)

01/01/2019-present **Post-doctorate studies**
Scientific and Practical Institute of Horticulture and Food Technologies (Republic of Moldova)

PERSONAL SKILLS

Native language Gagauz language

Foreign languages

	UNDERSTANDING		SPEECH		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	A2	A2	A2	A2	A2
Russian	C2	C2	C2	C2	C2
Romanian	A2	A2	A2	A2	A2
Turkish	B1	B1	B1	B1	B1

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user
Common European Framework of Reference for Languages

Communication skills Comportamentul adecvat, capacitatea de a lucra în echipa, flexibilitatea în abordarea situațiilor de lucru, orientarea spre rezultat

Organizational / managerial skills Organization, planning, synthesis and analysis of work. Project leader for young specialists.

Skills acquired in the workplace Communicability, organizational skills, punctuality, responsibility, desire to learn continuously

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problemsolving
Experienced user	Experienced user	Experienced user	Experienced user	Experienced user

Knowledge of computer : MS Word, Power Point, Exel, Photosop, Internet

MORE INFORMATION

PROJECTS EXPERIENCE

2013. Project Manager of the Agency for Innovation and Technological Transfer of the Academy of Sciences of Moldova: **"Technology for optimizing grape production in SC " Tomai-Vinex" SA" 13.824.14.184T** (Project - technology transfer);

2013-2017. Project Executant. «**Organization and operation of the Innovation Incubator "InnoCenter", creation and development of its infrastructure**». Comrat State University.

2014. Project Manager of the Agency for Innovation and Technological Transfer of the Academy of Sciences of Moldova: **"Reconstruction and modernization of the production of clone vine varieties under the conditions of SC" Tomai-Vinex" SA", №196T 26.09.2014** (Project - technology transfer);

2016. Project Manager of the Agency for Innovation and Technological Transfer of the Academy of Sciences of Moldova: **«Implementation of innovative technology for saving energy resources in the production of wines with PGI and PDO», №205T 26.05.20162016.** (Project - technology transfer);

2019. Project Executant. «**Development and operation of the "InnoCenter" Innovation Incubator, creation and development of its infrastructure, through diversification of services**». Comrat State University.

2019-2020. Project Manager. Postdoctoral Programs. Cipher 19.00208.1908.16.

Theme: «**Development and implementation of modern technologies for the production of grapes in the agro-ecological conditions of the ATU Gagauzia**»;

2020-2023. Project Executant. State Project. Cipher 20.80009.5107.05. Theme: «**Utilization on an industrial scale of the oenological potential of new and domestic selection of grape varieties and clones of sanitized grapes for the production of competitive wine production on international markets**»;

2020. Project Executant. Program Erasmus+, project KA2 № 609944-EPP-1-2019-1-LT-EPPKA2-CBHE-JP. Title «Enhancing capacity of universities to initiate and to participate in clusters development on innovation and sustainability principles» (UniClaD).

EXPERT

2019. Member of the International Editorial Board of the Journal **-** International Journal of Anatolia Agricultural Engineering Sciences. Turkey.

2019. Member of the Scientific Committee **-** 2nd International Congress on Engineering and Life Science. Turkey.

2019. Member of the working team on SMART SPECIALIZION of the Regional Development Agency of ATU Gagauzia. Moldova.

2020. Member of the Specialized Council for the defense of doctoral dissertations in viticulture in the Republic of Moldova (Practical Scientific Institute of Horticulture and Food Technology).

2020. Expert of the Commission on Agricultural Sciences for the award of the Government Scholarship for Excellence and Scientific Scholarships. Moldova.

2020. Member Jury of the International Competition of Student Scientific Works Black Sea Science 2021 in the field of Food Science and Technologies. Ukraine.

2021. Member of the working team on the development of the Program of the Climate Change and Environmental Risk Profile of ATU Gagauzia 2021-2025. Moldova.

2021. Member of the Specialized Council for the defense of doctoral dissertations in viticulture in the Republic of Turkey (Practical Scientific Institute of Horticulture and Food Technology (Bolu Abant İzzet Baysal University).

AWARDS

2021. Diploma Merit for Excellence in professional Education Teaching
Government of the Republic of Moldova

2016. Diploma Merit for Excellence in professional Education Teaching
Ministry of Education Republic of Moldova

2017. Diploma Merit for Excellence in professional Education Teaching
The Governor and the People's Assembly of ATU Gagauzia

INTERNSHIPS

Moldova (2010). State Agrarian University of Moldova, department of Viticulture;

Russia (2010). IInd International Conference «Accounting and analytical tools for developing an innovative economy» Nizhny Novgorod State Engineering-Economic Institute, Knyaginino;

Russia (2010). International Scientific Conference «Main Development of technologies in agro-industrial complex», Nizhny Novgorod State Engineering-Economic Institute Knyaginino;

Turkey (2012). «The 5th Session of Turkish Language Republics Educational Program» development to the trade and economic relations between Turkey and Turkish Language States, Ankara;

Ukraine (2013). Tempus project SUCSID "Inter-university Start-up centers for students' innovations development & promotion" (530349-TEMPUS-1-2012-1-FR-TEMPUS-JPHES) between East Europe and European universities. Seminar for PC consortium members involved in Start-Up Centers creation. Kharkiv National University of Economics, Kharkiv;

Turkey (2018). Internship at Bolu Abant Izzet Baysal University, Bolu;

Belarus (2019). Exchange of experience in viticulture in the Brest region. Polessky State University, Pinsk;

Ukraine (2019). Courses of improvement qualification "Innovative technologies to provide high-quality grape raw materials for winemaking and the processing industry." State educational institution “Odessa Institute of Postgraduate Education of the National University of Food Technologies”, Odessa;

Georgia (2019). Participation in the steering committee meeting and the sessions held within the framework of the Erasmus + project “IMPROVING SKILLS IN LABORATORY PRACTICE FOR AGRO-FOOD SPECIALISTS IN EASTERN EUROPE”, Tbilisi State University, Caucasus International University, Laboratories of the Ministry of Agriculture of Georgia, Tbilisi;

Moldova (2019). Courses of improvement qualification "ArcGIS". Comrat State University, Innocentre, Comrat;

Turkey (2019). Internship in the laboratories of the Agrarian Department of the Isparta University of Applied Sciences (Isparta Uygulamalı Bilimler Üniversitesi), Isparta;

Turkey (2019). Presentation at the 2nd International Agriculture Congress, Ayas, Ankara;

Turkey (2019). Presentation at thest International Symposium on Agriculture and Food in Turkish world. Izmir;

Turkey (2020). Internship at the Horticulture Department of Agriculture Faculty of Bolu Abant Izzet Baysal University, Bolu;

Slovenia (2021). Participation in the Erasmus+ programme Capaciry Buiding «Ag-Lab» project «Improving skills in laboratory practice for Agri-Food specialists in Eastern Europe». Ljubljana, Slovenia;

Turkey (2021). Staff Training Mobility Erasmus+. Program on Vineyards and Vine Production Technologies, 20 hours in Department of Horticulture, Agriculture Faculty of Bolu Abant Izzet Baysal University, Republic of Turkey, Bolu;

Romania (2021). Internship at the Horticulture Faculty of Iasi University of Life Sciences, Iasi.

Lithuania (2023). Participation in the Erasmus+ project «Enhancing capacity of universities to initiate and to participate in clusters development on innovation and sustainability principles» (UniClad). Kaunas, Lithuania;

Turkey (2023). Staff Mobility for Teaching Erasmus+. Viticulture Program of 20 hours. Isparta University of Applied Sciences, Republic of Turkey, Isparta;

Spain (2024). Study Visit: Innovative Technologies in Agriculture, University of Córdoba. Training for Skill Enhancement at Agricultural Enterprises in Spain, Cordoba, Seville.

Romania (2024). 5th International Congress on Engineering and Life Sciences National University of Science and Technology POLITEHNICA Bucharest, the Pitești University Center.