

## ABSTRACT OF THE DOCTORAL THESIS

### PHYSIOLOGICAL AND BIOCHEMICAL RESEARCHES ON SOME SWEET CHERRY CULTIVARS IN THE CONTEXT OF CLIMATE CHANGE

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In recent decades, climate change has become an observed reality, defined as "long-term changes in average meteorological values that have come to redefine Earth's local, regional, and global climates". The major effect of climate change on fruit tree crops can be attributed to extreme weather conditions, increasing temperature (global warming), variations in precipitation and an increase in the frequency of cold waves, frost days, drought and floods.

The production of a fruit crop is dependent on the climate factor, an important environmental variable. Several researchers from around the world have thus studied the influence of climate on the global ecosystem as one of the phenomena with the greatest impact on the growth, development and productivity of different species.

Among the species of fruit trees cultivated in our country, the sweet cherry (*Prunus avium* L., Genus *Prunus*, Family *Rosaceae*) is considered one of the most valuable, due to the precious properties of its fruits, also constituting the first link in the annual chain of production of fruits. It meets in our country optimal conditions for the manifestation of its agrobiological potential, with the possibility of exploiting the hilly steppe and silvo-steppe areas. The accentuated dynamics of this species was conditioned by the economic importance given by the nutritional, technological and commercial properties of the fruit, finding in Romania the optimal conditions for the development of its agrobiological potential. The precocity of the species, the production yield and the lack of alternation of fruiting give this fruit species a priority place in the cultivated area, with continuous expansion trends.

Trends and directions in the case of horticultural research of sustainable cultivation of the sweet cherry culture in recent years mainly follow the impact of climate change as well as the key physiological processes in the production cycle of cherries.

The current and perspective situation, as well as the results of previous researches, were stimulating factors for the continuation and deepening of research on the sweet cherry species in the area of our country.

The doctoral thesis entitled "**Physiological and biochemical research on some sweet cherry cultivars in the context of climate change**" integrates the physiological and biochemical characteristics of some sweet cherry cultivars from the Research Station for Fruit Growing in Iași in order to highlight the degree of favorability under the circumstances of the climatic conditions in perpetual change.

The study was carried out in the period 2021-2023 and aimed at improving the zonal assortment of cherry, through a better understanding of the physiological mechanisms involved

in the culture of fruit trees in the context of current climate changes, for which the following objectives were established:

- Identifying the influence of climatic factors on physiological processes in sweet cherry trees in different phenological stages during the growing season;
- Evaluation of the impact of increasingly changing climatic conditions on the main phenophases, the ability to adapt as well as the improvement of the agro-productive potential of some sweet cherry cultivars;
- The study of the dynamics of the accumulation of the main biochemical compounds in sweet cherry fruits during their growth, development and maturation, under the impact of the current climatic conditions;
- The use of specific research methods in order to evaluate some physiological and biochemical processes in some sweet cherry cultivars in the current agroclimatic context.

The experimental researches were carried out within a comparative microculture contest located in the Experimental Site of the Iasi Research Station for Fruit Growing and the biological material used is represented by three sweet cherry cultivars with distinct fruit ripening periods, of which two Romanian cultivars, created and approved at RSFG Iași and one of foreign origin, of international relevance.

The doctoral thesis is structured in two parts and includes seven chapters to which the bibliographic part and appendices are added. The work includes a number of 11 tables, 81 figures and over 200 bibliographic titles.

**Part I** of the work includes the introduction and the current state of knowledge from the specialized literature regarding sweet cherry culture and the influence of climatic conditions on the physiological and biochemical processes of the species in two general chapters (I-II).

**Chapter I** consists of three main sub-chapters and summarizes the importance and spread area of cherry culture, the biochemical and physiological bases of the growth of aerial organs in sweet cherry in the context of climate change and the changes in the physical and biochemical properties of the fruit during the ripening process.

At the same time, this chapter presents the vegetation and fruiting stages as well as the main physiological processes involved in sweet cherry culture.

**Chapter II** has two main sub-chapters and includes a synthesis of research on the issue addressed, with special reference to the requirements of sweet cherry culture in relation to ecological factors and the evaluation of current climate changes as a stress factor on physiological processes. This chapter presents the current state of research in the identification and evaluation of stress factors on physiological processes in the sweet cherry tree species, as well as their adaptation and mitigation strategies.

**Part II** of the thesis includes the results of own research and is structured in five general chapters (III-VII).

**Chapter III** describes the ecological framework in which the research was carried out in terms of geographical location, geomorphological and environmental factors and the quantification of agroclimatic resources for sweet cherry culture during the years of study.

The institutional and organizational framework where the researches were carried out is represented by the Research Station for Fruit Growing Iași, which is placed from an agricultural point of view in the 11<sup>th</sup> Fruit tree growing Region (Moldova Plain). The quantification of the climatic conditions during the study years within the RSFG Iași in the area where the study was

carried out falls within the context of global warming by increasing the average annual temperature, anomalous distribution or major deficit of precipitation, but at the same time it also corresponds to the limit requirements of the sweet cherry on top by agroclimatic factors.

**Chapter IV** presents the purpose, objectives, biological material and research methodology of the study. The research carried out in the period 2021-2023 in order to develop the doctoral thesis aimed to evaluate some ecophysiological and biochemical processes of some sweet cherry cultivars from RSFG Iași in the context of current climate changes. The biological material used is represented by 3 cultivars of sweet cherry from the national and international assortment (*Van*, *Andreiaș* and *Margonia*) grafted on a rootstock of great vigor (*Prunus mahaleb* L.) and directed in the form of an improved vase-type crown. The studied cultivars from the experience are organized according to variants of three repetitions, the arrangement being in randomized blocks.

In order to fulfill the objectives proposed in the realization of the doctoral thesis, physiological and biochemical determinations and analyzes were carried out regarding the water regime and the development of the photosynthesis process of the sweet cherry cultivars taken in the study, as well as the evolution of the fruit quality during the ripening process, in correlation with meteorological and phenological factors. Also, the general research methodology included the bibliographic study, the observation in order to record the phenological stages of BBCH (Meier, 2001) in which the laboratory determinations and analyzes were carried out, the case study on climatic resources, as well as the statistical analysis and the synthesis of the obtained results.

**Chapter V**, entitled "**Results obtained regarding the physiological processes involved in cherry culture**" includes the own data obtained and the statistical interpretation of the rate of dehydration, of the total water content and stomatal conductance, of the content of chlorophyll pigments and flavonoids at leaf level, the light regime at the canopy level, as well as the interdependence between climatic factors and the processes of transpiration and photosynthesis. The experimental protocol was based on the factorial association between two sampling positions from the crown level (inner, outer), totaling six variants, in three phenological stages: (after Meier, 2001): full flowering (65 BBCH), fruit growth, at about half final size (75 BBCH) and fruit ripening (89 BBCH).

In the synthesis of the results obtained regarding the water regime during the study, it was highlighted that the rate of dehydration at the foliar level increased progressively from the flowering phenophase to the ripening of the fruits, and the experimental samples of leaves from the outside of the crown showed a rate of dehydration more intense compared to the leaves inside the crown. The hydration status at leaf level recorded values above 50% and depended on climatic conditions and less on cultivar or phenophase. The values obtained highlight a water content between 65.97% (*Van* cultivar) and 70.70% (*Margonia*). Stomatal conductance also intensifies during the fruit ripening phenophase.

Between the two years of the study, it was found that in 2023 the transpiration process was reduced compared to 2022, but it remained constant throughout the entire growing season in all experimental variants, although from a climatic point of view they were quantified much less quantitative precipitation. Positive, distinct and highly significant correlation coefficients were obtained in establishing the interdependence relationship between climatic factors and the water regime.

The comparative analysis of the photosynthetic activity during the growing season highlights a progressive increase but with significant differences between the two years studied in the fruit ripening stage, the climatic conditions of 2023 requiring an intensification of physiological processes.

The sweet cherry leaves of the studied cultivars become photosynthetically competent from the beginning of their growth and during the growing season, the chlorophyll content has maximum values in the phenophase of fruit ripening. The total content of chlorophyll pigments determined by the spectrophotometric method followed an upward trend from the flowering stage (11.01  $\mu\text{g/mL}$ ), followed by the period of fruit growth (12.63  $\mu\text{g/mL}$ ) and the ripening period (20.57  $\mu\text{g/mL}$ ). The *Margonia* cultivar stood out for its maximum light absorption capacity and its utilization in order to adapt to climatic stress factors as well as to obtain a qualitative and quantitative production.

With regard to the content of flavonoid pigments, the three sweet cherry cultivars manifested themselves differently in relation to the activity of resistance mechanisms to water and thermal stress in the three phenophases. The three cultivars had values between 3.0 and 5.0  $\mu\text{g/mL}$  during the fruit ripening period, which expresses a good capacity to adapt the leaf apparatus to the water and thermal stress conditions that occurred during the period of vegetation of the two years (2022-2023).

