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# GRAPEVINE GENOTYPES IN THE CONTEXT OF CLIMATE CHANGE

*Climate change is an unprecedented challenge that human society has been facing, and the extent of its impact will largely depend on the level of awareness of the compromises that have to be reached and accepted globally. Taking into account the effectiveness of physiological processes, such as: photosynthesis, respiration, transpiration, stomatal conductance, assimilation etc., in the process of plant breeding, it is possible to identify plant genotypes with an increased potential for capturing carbon dioxide from the atmosphere, thus helping to maintain the global average temperature within limits that would not lead to an intensification of the greenhouse effect and climate change. This method can also be applied in the process of breeding different plant crops. In this case, it is necessary to apply techniques and methods of plant breeding to create plant genotypes that will be used to expand the forest areas, to stop desertification processes, to create protective forest belts, for the sustainable use of agricultural and other types of land etc., and which will be characterized by a high efficiency of the photosynthesis process under the new climatic conditions.*

***Keywords****:* $CO_2$, climate, genotype, grapevine, photosynthesis.

## Introdation

Climate change is an unprecedented challenge that human society has been facing, and the extent of its impact will largely depend on the level of awareness of the compromises that have to be reached and accepted globally. The real and alternative costs will increase with future climate change, affecting the health and economic well-being of the population. Therefore, the biggest challenge of society is to integrate sustainable strategies in the economic development.

The development of society according to the principles of “green economy” provides for the restoration and maintenance of a sustainable, long-term balance between economic development and integrity of the natural environment, in forms understanded and accepted by society. The ability of living organisms to adapt to environmental conditions is a key factor in the evolutionary process. The adaptation of plants to climatic factors means nothing more than the modification of the physiological-biochemical and morphological-anatomical characteristics of the organism in the process of ontogenesis and the creation of other new criteria in the phylogenetic process.

The adaptive potential of plants is their ability to survive, propagate and self-develop under the conditions of the ever-changing climate. Each organism has a certain ability to react to environmental factors, which is driven by the genetic code. Living organisms, during evolution, have developed certain capacities to react in response to climatic conditions. The coexistence of living organisms in a certain habitat is supported by heritability and genotypic changes. Due to genotypic changes, organisms adapt to environmental factors that are characteristic of a particular habitat. But due the development of new features, a normal existence of a newly formed genotype is possible under conditions where the initial variety could not develop normally.

The process of photosynthesis of grapevine differs from that of other plants in the level, rate and degree of response to environmental and technological factors. All the green organs of a grapevine plant perform photosynthesis, but the main role in this process is performed by the leaf mesophyll. The dependence of photosynthesis on sunlight allows evaluating the efficiency of the use of light energy by the plant organism, this principle being established in the genetic code and represented by the mechanism of light energy use and the transformation of inorganic biogenic

compounds into organic substances. The photosynthesis irradiance curve makes it possible to understand the eco-physiological characteristics of a species, and in turn, these indices give us the opportunity to compare different plant genotypes in more or less similar conditions, thus determining the productive capacity and resistance to environmental factors.

**Materials and methods**

The research object was the rhizogene interspecific genotypes of grapes (Vitis vinifera L. x Muscadinia rotundifolia Michx.): Alexandrina, Augustina, Amethyst, Nistriana, Malena, Algumax, Sarmis, etc. [1, 2], complex interspecific genotypes Regent, Viorica, Arcadia and others, intraspecific genotypes (Vitis vinifera L.) Muscat of Alexandria, Sauvignon, Koarne Neagre and others.

As a result of the study, photosynthetic activity, transpiration, respiration, assimilation, etc. were studied. To carry out the monitoring process, the PTM-48A phytomonitor was used, which allows you to perform studies in automatic mode with an interval of 10 minutes, for 24 hours. Studies were carried out on plants in the open ground at the stage before flowering, the formation (growth) of berries and in formed berries [3-6].

**Results and discussion**

Analysing light intensity and photosynthetic activity *in the pre-flowering stage of grapevine* in intraspecific genotypes (Sauvignon, Muscat de Alexandria etc.) it was found that at a light intensity of 1000-1500 μmol/m$^2$*s, the photosynthetic activity was on average 7-9 μmol (CO2)/m$^2$*s, and starting from the sunlight intensity of 1500 μmol/m$^2$*s, the intensity of photosynthetic activity was declining. In the interspecific grapevine genotypes (Ametist, Augustina, Alexandrina, Regent, Viorica etc.), at a light intensity of 1000-1500 μmol/m$^2$*s, the photosynthetic intensity was on average 10-12 μmol (CO2)/m$^2$*s, these indices of photosynthesis were maintained at an intensity of sunlight of 2000-2500 μmol/m$^2$*s.

*In the fruit development stage*, intraspecific genotypes (Sauvignon, Muscat de Alexandria etc.), at a light intensity of 1000-1500 μmol/m$^2$*s, demonstrated a photosynthetic activity of 8-10 μmol (CO2)/m$^2$*s, these indices were also maintained at the light intensity of 2000 μmol/m$^2$*s, then the intensity of photosynthesis decreased. Interspecific genotypes (Ametist, Augustina, Alexandrina, Regent, Viorica etc.) at a light intensity of 1000-1500 μmol/m$^2$*s, demonstrated a photosynthetic activity of 8-11 μmol (CO2)/m$^2$*s, these indices were maintained at a light intensity of 2000 μmol/m$^2$*s, and at a light intensity of 2500 μmol/m$^2$*s there was a decrease in the photosynthetic activity.

*In the fruit maturation stage*, intraspecific genotypes (Sauvignon, Muscat de Alexandria etc.), at a light intensity of 1000-1500 μmol/m$^2$*s, demonstrated an average photosynthetic activity of 3-6 μmol (CO2)/m$^2$*s, these indices were maintained up to a light intensity of 1700 μmol/m$^2$*s, then they were decreasing. Interspecific genotypes (Ametist, Augustina, Alexandrina, Regent, Viorica etc.), at a light intensity of 1000-1500 μmol/m$^2$*s, demonstrated an average photosynthetic activity of 8-9 μmol (CO2)/m$^2$*s, these indices of photosynthesis were maintained up to a light intensity of 2000 μmol (CO2)/m$^2$*s, and at a higher light intensity the photosynthetic activity was characterized by a slight decrease. The analysis of the transpiration rates depending on temperature fluctuations, *in the pre-flowering stage*, in the intraspecific genotypes of grapevine (Sauvignon, Muscat de Alexandria etc.) demonstrated that at a temperature of 15 °C, the transpiration rate was 4.5-6.0 mg/m$^2$*s, and at a temperature of 30 °C the transpiration rate was 25-30 mg/m$^2$*s. In interspecific genotypes (Ametist, Augustina, Alexandrina, Regent etc.), at the temperature of 15 °C, the transpiration rate was 3.75-5.25 mg/m$^2$*s, and at 30 °C, it was 23-26.5 mg/m$^2$*s.

*In the fruit development stage*, the intraspecific genotypes of grapevine (Sauvignon, Muscat de Alexandria etc.), at the temperature of 20 °C, had a transpiration rate of 4-5 mg/m$^2$*s, and at 35 °C, it was 50-55 mg/m$^2$*s. The intraspecific genotypes (Ametist, Augustina, Alexandrina, Regent etc.) at the temperature of 20 °C had a transpiration rate of 5.75-7.75 mg/m$^2$*s, and at 35 °C, it was 42.5-45 mg/m$^2$*s.

*In the fruit maturation stage*, the intraspecific genotypes (Sauvignon, Muscat de Alexandria etc.) at the temperature of 20 °C had a transpiration rate of 8-10 mg/m$^2$*s, and at 30 C –

38-45 mg/m$^2$*s. The interspecific genotypes (Ametist, Augustina, Alexandrina, Regent etc.) at the air temperature of 20 °C had a transpiration rate of 7.75-9.75 mg/m$^2$*s, and at 35 °C – 35-40 mg/m$^2$*s. The analysis of the relationship between stomatal conductance and light intensity has shown that *in the pre-flowering stage*, in the intraspecific genotypes of grapevine: Muscat de Alexandria, Coarnă Neagră etc. at a sunlight intensity of 1000 μmol/m$^2$*s, stomatal conductance was on average 0.2-0.4 mm/s, as the sunlight intensity increases to 2000 μmol/m$^2$*s, stomatal conductance decreased to 0.1-0.2 mm/s. In the interspecific genotypes: Ametist, Alexandrina, Augustina etc., at a sunlight intensity of 1000-1500 μmol/m$^2$*s, stomatal conductance was 1.5-2.0 mm/s, and at an intensity of 2000 μmol/m$^2$*s, stomatal conductance was 0.7-1.2 mm/s.

*In the fruit development stage*, in the intraspecific genotypes of grapevine: Muscat de Alexandria, Coarnă Neagră etc., at a light intensity of 1000 μmol/m$^2$*s, stomatal conductance was 0.5-0.8 mm/s, and at the light intensity of 2000 μmol/m$^2$*s, it was 0.4-0.6 mm/s. In the interspecific grapevine genotypes Ametist, Alexandrina, Augustina etc., at a light intensity of 1000 μmol/m$^2$*s, stomatal conductance was 1.5-2.2 mm/s, and at the light intensity of 2000 μmol/m$^2$*s, it was 2.5-3.5 mm/s.

*In the fruit maturation stage*, in the intraspecific genotypes: Muscat de Alexandria, Coarnă Neagră etc. at a sunlight intensity of 1000 μmol/m$^2$*s, stomatal conductance was on average 0.8-1.2 mm/s, and at the light intensity of 2000 μmol/m$^2$*s – 0.2-0.5 mm/s. In the interspecific grapevine genotypes: Augustina, Alexandrina, Ametist etc., at a light intensity of 1000 μmol/m$^2$*s, stomatal conductance was 2.5-3.5 mm/s, and at 2000 μmol/m$^2$*s, stomatal conductance was 1.5-2.5 mm/s. While studying photosynthesis and assimilation in relation to respiration in intraspecific grapevine genotypes, such as: Muscat de Alexandria, Sauvignon, Coarna Neagră etc., it was found that at the intensity of photosynthetic activity of 8-10 μmol ($CO_2$)/m$^2$*s, real assimilation was 8-9 μmol ($CO_2$)/m$^2$*s, and the activity of the respiration process was in the range of 1.0-1.4 μmol ($CO_2$)/m$^2$*s. In interspecific genotypes, such as: Algumax, Ametist, Nistreana, Augustina etc., at an intensity of the photosynthesis of 12-15 μmol ($CO_2$)/m$^2$*s, the real assimilation was 12-14 μmol ($CO_2$)/m$^2$*s, and the intensity of the respiration process was 0.8-2.0 μmol ($CO_2$)/m$^2$*s. Studies have shown that the interspecific grapevine genotypes are characterized by much better adaptive features than intraspecific genotypes in relation to climate change.

**Conclusions**

Taking into account the effectiveness of physiological processes, such as: photosynthesis, respiration, transpiration, stomatal conductance, assimilation etc., in the process of plant breeding, it is possible to identify plant genotypes with an increased potential for capturing carbon dioxide from the atmosphere, thus helping to maintain the global average temperature within limits that would not lead to an intensification of the greenhouse effect and climate change. This method can also be applied in the process of breeding different plant crops. In this case, it is necessary to apply techniques and methods of plant breeding to create plant genotypes that will be used to expand the forest areas, to stop desertification processes, to create protective forest belts, for the sustainable use of agricultural and other types of land etc., and which will be characterized by a high efficiency of the photosynthesis process under the new climatic conditions.

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## ГЕНОТИПИ ВИНОГРАДУ В КОНТЕКСТІ ЗМІНИ КЛІМАТУ

*Зміна клімату є безпрецедентним викликом, з яким зіткнулося людське суспільство, і ступінь його впливу значною мірою залежатиме від рівня усвідомлення компромисів, яких потрібно досягти та прийняти в усьому світі. Враховуючи ефективність фізіологічних процесів, таких як: фотосинтез, дихання, транспірація, продихова провідність, асиміляція тощо, у процесі селекції рослин можна виділити генотипи рослин із підвищеним потенціалом уловлюванням вуглекислого газу з атмосфери, таким чином допомагаючи підтримувати середню глобальну температуру в межах, які б не призводили до посилення парникового ефекту та зміни клімату. Цей метод також можна застосовувати в процесі селекції різних рослинних культур. У цьому випадку необхідно застосовувати прийоми та методи селекції рослин для створення генотипів рослин, які будуть використовуватися для розширення лісових площ, припинення процесів опустелювання, створення полезахисних смуг, для раціонального використання сільськогосподарських та інших видів рослин, землі та ін., і які будуть характеризуватися високою ефективністю процесу фотосинтезу в нових кліматичних умовах.*

***Ключові слова:*** $CO_2$, клімат, генотип, виноград, фотосинтез.