RESEARCH ON THE ECO - PHYSIOLOGICAL REACTION OF SOME VINE VARIETIES DURING THE 2011 GROWING SEASON IN THE COPOU, IASI AREA

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Abstract

Extreme weather events adversely affect the normal growth cycle of crops and productivity of agricultural systems. Recent research shows that the vine production efficiency could be reduced by abiotic stress represented by the drought, freezing temperatures and soil salinity. Various modern research projects aim to test models of abiotic stress resistance genes expression in order to discover the mechanisms of tolerance to stress and to stimulate understanding the genetic basis of this reaction, with implications for wine quality (Cramer, et al., 2005, Burzo I. şi colab., 1999, Jităreanu Carmen Doina şi colab., 2004). In this context, due to genotype - phenotype interrelations, phenotypic manifestations research (morpho-anatomical, physiological, biochemical and behavioral) related to resistance to stress abiotic vine from global warming is an urgent topicality.
Water scarcity is one of the most important abiotic stress factors and is generally accompanied by heat stress. It inhibits photosynthesis by disrupting biochemical processes of synthesis of pigments from the reaction center (Bertamini et al., 2007, Guan et al, 2004) and the photobreathing protects the photosynthetic apparatus against photodegradation in drought conditions (Guan et al., 2004).
In this paper we intended to study issues regarding the eco - physiological response to climatic conditions of 2011 of the following vine varieties: Gelu, Coarna Neagra, Moldova and Purpuriu. For this purpose, investigations regarding some indicators of the photosynthesis process were carried out: leaf morphogenesis – the leaf being the main organ of photosynthesis - and photosynthetic pigment content during growth and ripening processes of grains.

Key words: vineyard, eco-physiology, photosynthetic pigments

The present study is part of a much wider research project on the eco-physiological reaction of table grapes belonging to four different types of grape vines, in the climatic conditions of 2011 as well as the content analysis of antioxidants at the grapes studied to underline the possible correlations between the foliar pigment content and those present in the grapes.

The growth and the development of plants, the vegetation period of the species and types, their distribution at a national level and, in the end, the harvest, they all depend of the climatic conditions. The meteorological factors act together at restricting and limiting the plants' biological cycle and their production potential. The air temperature is the main factor that limits the cultivation of grape vine, the beginning and the development of the vegetation phases, the quality and the quantity of the production.

In dry periods, plants suffer from cellular and tissue dehydration and the temperature of their bodies increases. Their resistance to dryness consists in: their capacity to face overheating (the plant's capacity to resist to heat). The plants' overheating modifies the chemical features of the cellular protoplasm and of the metabolism, determining the appearance of different reactions of adjustment and defense.

The grape vine's eco-physiological reaction was established by analyzing some indicators of the photosynthesis process: the foliar morphogenesis – the leaf being the major organ of photosynthesis – and the content of photosynthetic pigments.

MATERIAL AND METHOD

The study was made on four types of table grape vines: Gelu, Coarnă neagră, Moldova and Purpuriu that were cultivated at the Viticol Center in Iasi, the S.D.E. Farm of the University of Agricultural Sciences and Veterinary Medicine in Iasi, in the climatic and vegetation conditions of 2011.

The temperatures and the amount of precipitations were registered decadally in the

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spring – autumn season and the mean temperature values as well as the sum of the monthly precipitations were related to the mean multiannual values.

The foliar morphogenesis was established by determining in dynamic foliar surface of the sterile and fertile shoots, the analyses being made with the device used for measuring the leaf's surface – the ***AM300*** *type*, a portable and compact instrument foreseen with a non–destructive measuring method.

The foliar pigment content was measured in the field and in the laboratory. In the field, the measurements were made with a ***CCM200 plus***, a portable instrument used for determining the total content of chlorophyll *a* and *b.* In the laboratory, the spectrophotometric method was used and the pigment content in the leaves was established according to the light adsorption capacity of the acetone pigment extract (1%) in the visible spectrum (400 – 700 nm) and in the near UV (320 nm).

The researches ware made in dynamic, monthly, during the vegetation season and they focused on the main phenophases: June – flowering, July – the grape growth, August – when the grapes are almost ripe, September – grape maturation.

RESULTS AND DISCUSSIONS

The evolution of the climatic factors in 2011 in the area where the Iasi vineyard is situated was characterized by temperatures higher than the multiannual mean, the deviations ranging between +0.2 ^{o}C and +1.6 ^{o}C. An exception was registered in February, when the deviation from the multiannual mean was of -0.5 ^{o}C. The precipitation level registered values lower than the normal in January – September, except for the months of April and June when an excess of 41.1 mm was registered - the normal value of the area being of 38.7 mm (Fig. 1a and b).

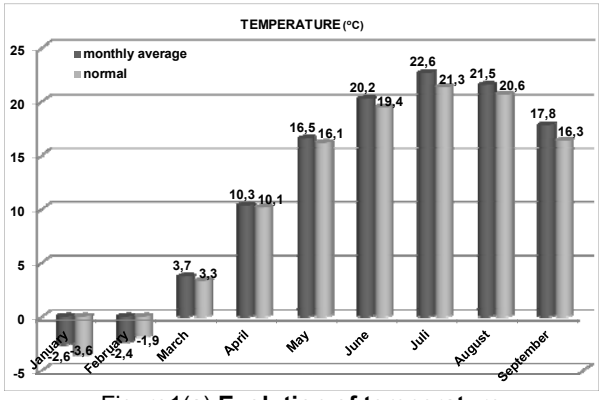

Figure1(a) **Evolution of temperature**

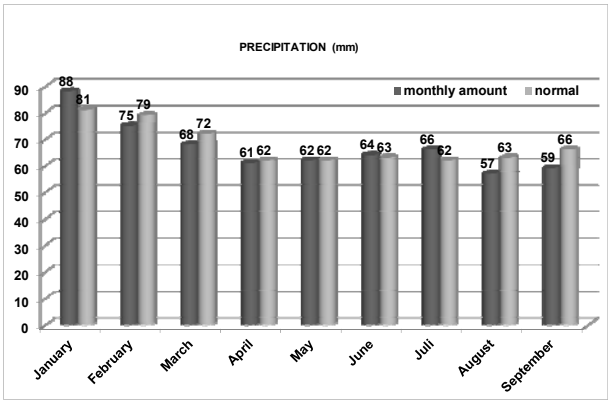

Figure1(b) **Evolution of precipitation**

Determining the mean foliar surface of the shoot at all the types of grapes analysed proved a progressive growth from the flowering stage until they are almost ripe (fig. 2).

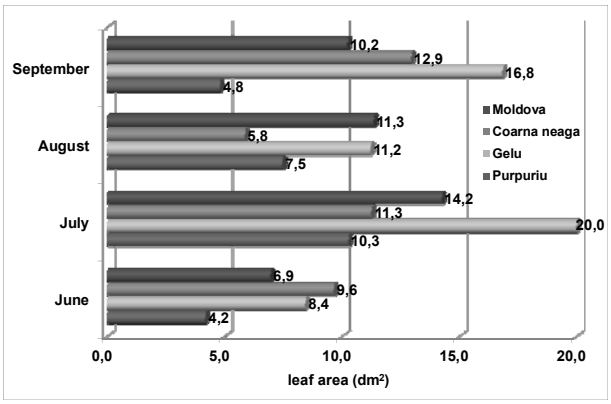

Figure 2 **Average shoot leaf area**

During the shoot's flowering and growth phases the Coarnă neagră type of grape presented the most intense foliar morphogenesis correlated with a very high growth vigor, while the Purpuriu type presented a minimum foliar morphogenesis correlated with a medium growth vigor.

During the growth phenophase of the grapes it was noticed the maximum foliar morphogenesis at the autochthonous grapevine type Gelu correlated with the high degree of precocity.

The results of the analyses made in August and September were influenced by the following technological operations: the cutting off of secondary shoots, cutting off the peaks of young shoots and defoliation that assured good correlation of nutritional competition between the leaves and the clusters and assured the necessary sun exposure during maturation.

The analysis of the foliar surface according to the shoot's type is presented in figure 3A, B, C and D.

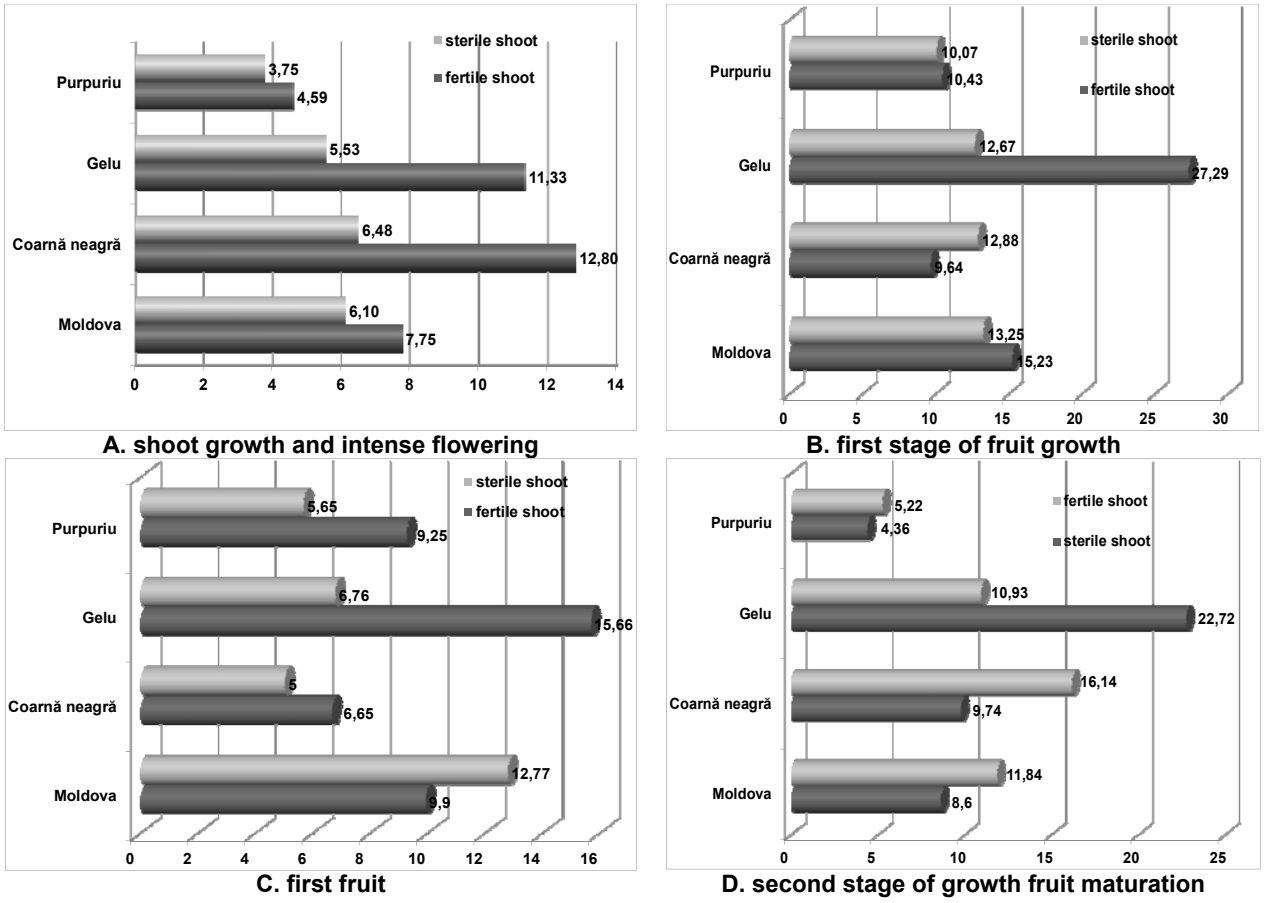

Figure 3 **Leaf area in the examined phenophases (dm^2)**

From the analyzed data results that in June the foliar morphogenesis is more intense at the fertile shoots from all the grapevine types included in the study, the maximum values being registered in the case of Coarnă neagră (fig. 3A). This result can be correlated with the very high growth vigor of this type of grapevine.

Minimum values were registered for the Purpuriu type of grapevine, it being characterized of medium vigor but very high fertility.

In June the fertile shoot from Gelu makes itself noticed, correlated with the very high degree of precocity while the other types of grapevines present moderate values, quite similar for the two types of shoots (fig. 3B). This behavior is also present in August and September, Gelu presenting a maximum foliar morphogenesis of the fertile shoot while Purpuriu recorded a minimum foliar morphogenesis correlated with the very high fertility and the sugar content of 170-180g/l.

The results of the analysis in dynamic of chlorophyll content are presented in figures 4A, B, C and D.

The Coarnă neagră type presented the maximum level of chlorophyll in June, August and September correlated with the very high growth vigor. In July, the maximum content is registered at the allochthonous type Moldova, while the autochthonous types presented very similar minimum values (fig. 4B). The behavior of the autochthonous types can be seen as an eco-physiological reaction at the incipient phases of hydric stress that appears in July while in August is registered an adjustment reaction especially at the Coarnă neagră and Gelu types, reaction that assures their resistance to the local conditions of prolonged dryness from this month.

The maximum dryness from September influences especially the chlorophyll content from Purpuriu and Gelu types of grapevines, fact that is correlated with the high degree of precocity of the autochthonous type Gelu, but also assures the high fertility level of Purpuriu that also presents the highest sugar content (fig. 4D).

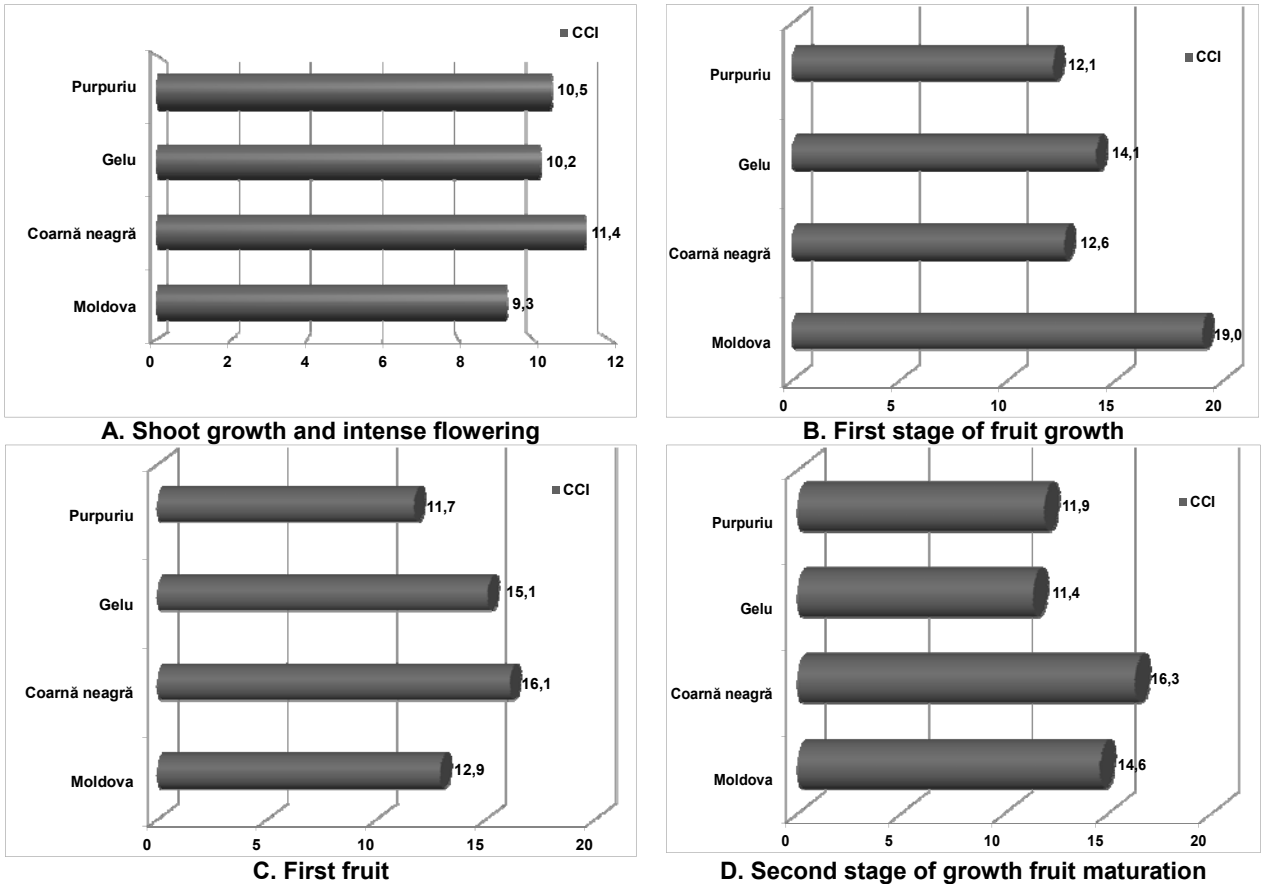

Figure 4 **Dynamic of chlorophyll content average in leaves of the four varieties of grapes, in different phenophases examined**

The analysis of the foliar pigments proves that in the intense-flowering growth phenophase, the Purpuriu type presents the lowest level of photosynthetic pigments, components of both the reaction and adsorption centers from the photosynthetic systems (Fig. 5A). It can be said that in this phenophase the autochthonous type Purpuriu that was created at Valea Călugărească registers a maximum photosynthetic efficiency due to a minimum biosynthesis of the pigments that take part at the glucides' biosynthesis in the reaction and the absorption centers.

The autochthonous types Coarnă neagră and Gelu, adapted to the conditions from the Moldova area, present a moderate content of photosynthetic pigments.

The content of flavonoid pigments is maximum at the autochthonous types and minimum at the Moldova type correlated with the adjustment of these types to the local conditions of resistance to stress.

During the growth phenophase of the grapes when they are almost ripe it is noticed a maximum content of photosynthetic pigments at the Coarnă neagră type, of Mediterranean origin, in relation to the other types created in the northern areas (Moldova) (Fig. 5B and C). This behavior can be correlated with certain genetic particularities of absorption and usage of solar energy during fruit growth. This type presents a maximum content of flavonoid pigments, correlated with the capacity to resist to the powerful sunstroke from the area of origin.

This behavior of the photosynthetic pigments is also noticed during the fruits' maturation phenophase, in the case of Coarnă neagră and becomes obvious at the Moldova type, that differentiates them from the autochthonous types Gelu and Purpuriu (Fig. 5D). At these types, the high photosynthetic efficiency allows the accumulation of high sugar quantities, especially in the case of Purpuriu.

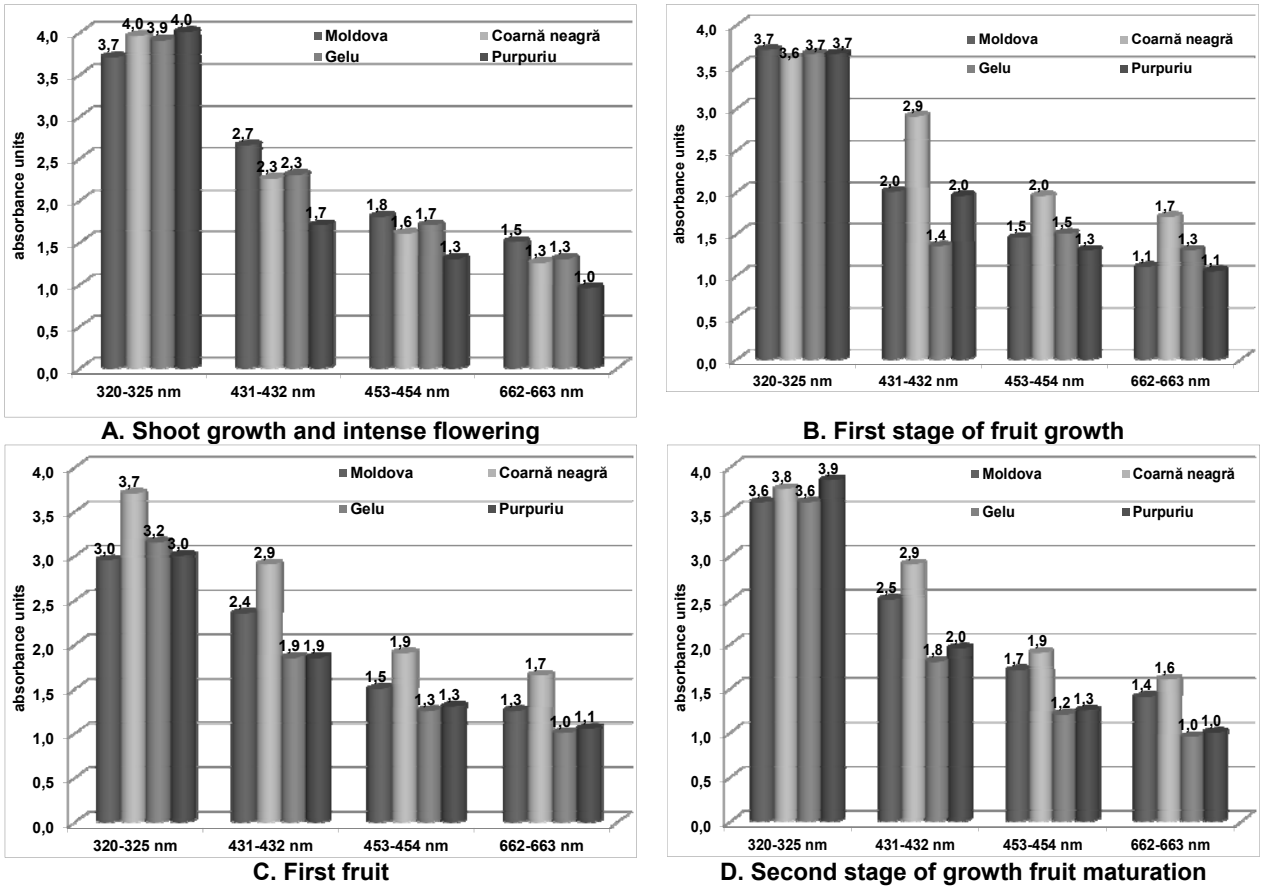

Figure 5 **The average light absorption capacity of the vine varieties studied by spectrophotometric method**

The comparative analysis of the foliar pigments content at the sterile and fertile shoots proves the existence of a higher amount of photosynthetic pigments at the fertile shoots from the Moldova and Coarnă neagră types of grapevine during the vegetative – flowering growth phenophase (fig. 6). During the growth phenophase of the grapes the content of photosynthetic pigments is greater at the sterile shoots at all the types included in the study, fact that can be correlated with the maximum photosynthetic intensity in the leaf near the cluster analyzed, from the fertile shoots that facilitates the accumulation of sugar in the fruits (fig. 7).

This behavior will continue during ripening with more moderate values (fig. 8 and 9).

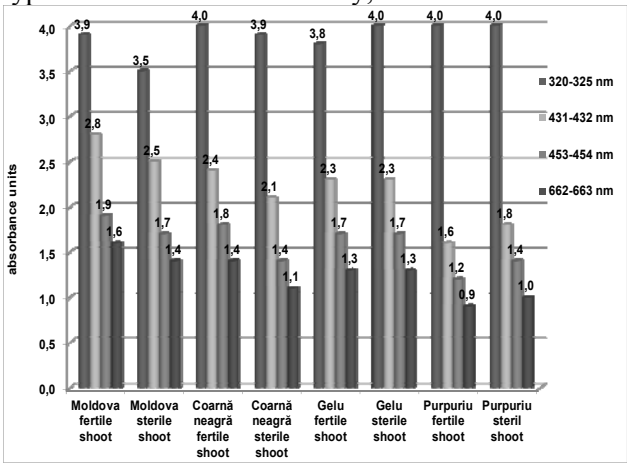

Figure 6 **The average of light absorption capacity of the vine varieties studied by spectrophotometric method, depending on the type of shoot in the shoot growth phenophase – flowering**

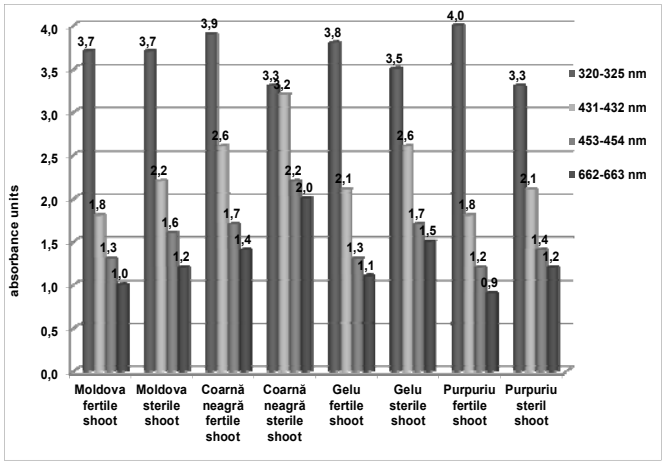

Figure 7 **The average light absorption capacity of the vine varieties, depending on the type of shoot**

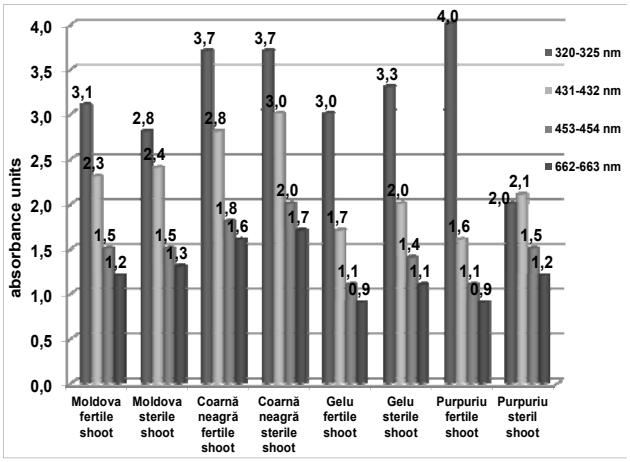

Figure 8 **The average light absorption capacity of the vine varieties, depending on the type of shoot in firstfruits phenophase**

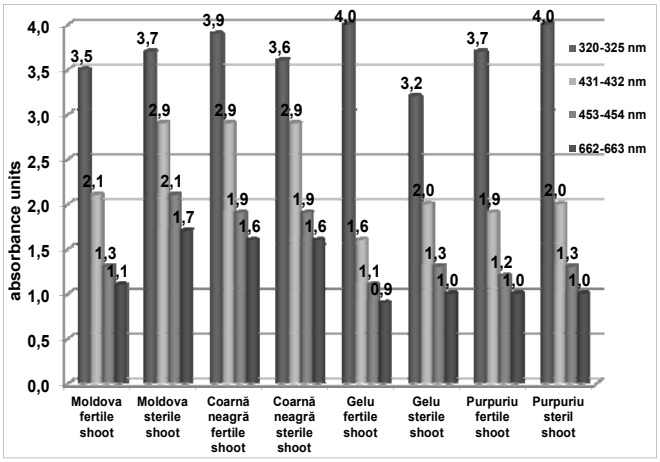

Figure 9 **The average light absorption capacity of the vine varieties, depending on the type of shoot in phenophase of ripening of the grapes**

CONCLUSIONS

The evolution of climatic conditions is characterized by drought in May, August and September and temperatures higher than the normal for the entire period of time analyzed.

The foliar morphogenesis of the four types of grapes intensifies from flowering up to the phenophase when they are almost ripe correlated with the growth vigor of each type, being more intense at the fertile shoots.

The analysis in dynamic of the chlorophyll content index as well as the analysis of the foliar pigments proves the eco-physiological reaction of the autochthonous types at the incipient phases of hydric stress registered in July while in August is registered an adjustment reaction especially at the Coarnă neagră and Gelu types that provides the necessary resistance to the local conditions of prolonged dryness from this month.

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