ASPECTS REGARDING THE PHYSIOLOGICAL PARAMETERS IN SOME LOCAL POPULATIONS OF CAPSICUM ANNUUM SSP. GROSSUM UNDER STRESS CONDITIONS

CIUCĂ (PARASCHIV) ALINA-NICOLETA[1]*, DIACONU AURELIA[1], POPA DANIELA VALENTINA[2]

[1]Research-Development Station for Plant Culture on Sands Dabuleni, 217 Petre Baniță Street, Călărași, Dolj County, Romania, 207170

[2]University of Craiova, Faculty of Horticulture, 13, A. I. Cuza Street, Craiova,Dolj County,Romania

**alina22paraschiv@yahoo.com*

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ABSTRACT

In this paper are presented results regarding the physiological behavior of some local populations of Capsicum annuum ssp. grossum, cultivated compared to the control variety Cornel on sandy soils from the Research and Development Station for Plant Culture on Sands, Dăbuleni. The researches focused on the effects of thermal stress on the processes of photosynthesis and foliar transpiration, as well as on the productions made in pepper culture. The results obtained underlined the importance of correlating the physiological processes in pepper plants with environmental factors and the yields obtained. Under conditions of heat stress, all local populations analyzed showed values of photosynthesis above the values recorded at the control variant (Cornel variety). The water lost through foliar transpiration was efficiently recovered by the studied local populations, between transpiration and pepper production being established a positive correlation, significant from statistically point of view.

INTRODUCTION

The pepper culture, which lends itself to a high degree of intensification, requires a full correlation between the requirements of the species and natural factors. Environmental factors may favor or limit the possibility of capitalizing on the biological potential of the species or genotype studied, imprinting a pronounced zonal character. The need to research plant genetic resources adapted to current environmental conditions, generated by climate change, is of particular importance, especially if we refer to the area of sandy soils in southern Oltenia (area with high thermohydric stress).

The environmental factors (temperature, water, mineral substances, etc.) within the optimal limits, depending on the requirements of the plants, have a favorable action on the development of physiological processes in plants, as well as on the production obtained. If the level of these factors does not fall within the optimal limits, they represent sources of stress, which determine the appearance of physiological diseases also called physiological disorders or pathophysiologies (Ioan Burzo, 2014).

Thermal stress has physiological effects that are manifested mainly by dehydration of tissues, inhibition of the growth process and stimulation of physiological processes that cause accelerated maturation of plants. The transport of electrons in the photosynthesis process is also affected, and photorespiration is stimulated in the case of C3 photosynthetic plants. The speed of transport of substances decreases and the respiration process intensifies, correlated with the decrease of the content of reserve substances. At

the same time, high temperatures determine the sterility of pollen, the fall of flowers and the decrease of production.

According to Hall (2001), thermal stress is caused by temperature, the level of which, the duration of exposure and the rate of growth can cause damage to plants. Klueva et al. (2001) consider that the upper temperature limits at which plants can survive are between 40-55 °C and vary depending on the species and the duration of exposure.

Exposure to high temperatures can cause physiological disorders that in solano-fruit plants are manifested by rot of the pistil area or by sunburn. Exposure of peppers to temperatures higher than 38-40 °C determines, according to Rabinowitch and Sklan (1981), the generation of superoxide radicals, by the action of light on chlorophyll. The lesions are characterized by the appearance of a whitish color and small blisters on the epicarp of the fruit. In a more advanced phase there is water loss, tissue death and depression. Cell death provides good conditions for the development of parasitic microorganisms, especially for *Alternaria spp*. Rabinowitch et al. (1986) found that exposure of peppers to a temperature of 40 °C for 6 hours led to a reduction in this physiological disease.

Plants resistant to heat stress have the ability to initiate defense reactions, which allow them to survive in such conditions. Jenks and Hasegawa (2005) found that these defense reactions are triggered when the optimum temperature for plant growth is exceeded by 5-10 °C. In the area of sandy soils in southern Oltenia, in addition to thermal stress, the plants are subjected to longer or shorter periods of water stress. The sensitivity of plants to the action of water stress differs depending on the species and variety, the level of stress, its rate of change and the phenophase in which it manifests itself (Ioan Burzo and Aurelia Dobrescu, 2011).

MATERIAL AND METHOD

During the vegetation period, determinations were made with the portable device LC Pro SD (figure 1, which aimed at:

- active radiation in photosynthesis;
- rate of photosynthesis;
- air temperature;
- rate of foliar transpiration;
- stomatal conductance.

The experimental variants were represented by 4 local populations (LP) of sweet pepper and the variety *Cornel*, who was used as control variant:

V1 – LP Amărăști
V2 – LP Dobrești
V3 – LP Grădinari
V4 – LP Secui
V5 – Cornel variety

The physiology determinations were performed in two phases of vegetation, in three repetitions, and for the interpretation of the obtained data mathematical functions and analysis of variance were used.

Figure 1. LC PRO SD Portable system for determining photosynthesis

RESULTS AND DISCUSSIONS

In Romania, the negative effects of global warming, represented by the increase in air temperature and the reduction of precipitation, are strongly felt in the area of sandy soils in southern Oltenia (Ciucă Paraschiv A., 2019). The experimental determinations performed on the sweet pepper (*Capsicum annuum ssp. grossum*) highlighted a diurnal variation of the processes of

photosynthesis and foliar transpiration, the dynamics of these physiological processes being influenced by the modification of the environmental factors.

The results on the diurnal variation of photosynthesis in sweet peppers are shown in Figures 2 and 3. Under optimal temperature conditions (28.4-30.8 °C), the photosynthesis process took place after a unimodal curve, with the maximum value recorded in all variants at 12 o'clock (Figure 2). Under these conditions, the best results were recorded for the *Cornel* variety, with a maximum value of photosynthesis of 22.25 µmol $CO_2/m^2/s$.

In conditions of thermal stress, with air temperatures between 33.9 °C since the morning, and 39.5 °C at 15 o'clock, a differentiation of the analyzed genotypes was found, in favor of local populations.

The most intense photosynthetic activity, in hot weather conditions, was determined in the local population of *Dobreşti* (28.93 µmol $CO_2/m^2/s$.), (Figure 3).

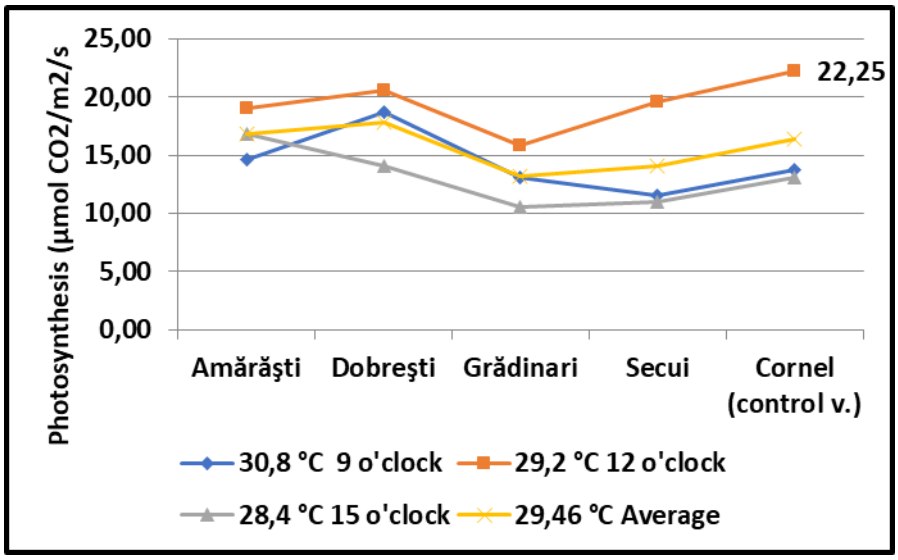

Figure 2.
Diurnal variation of photosynthesis in optimal contitions of temperature

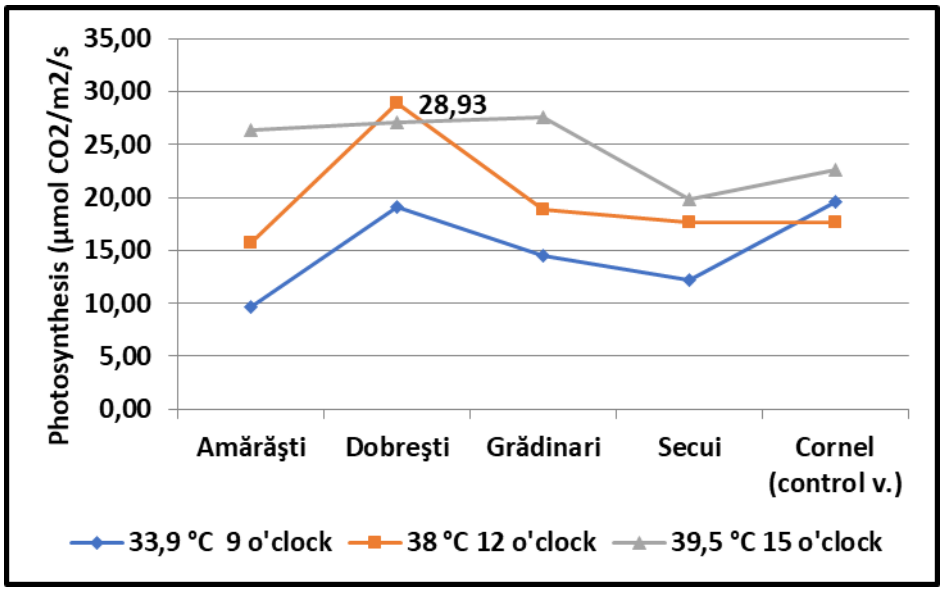

Figure 3.
Diurnal variation of photosynthesis in termal stress contitions

Regarding the diurnal variation of the transpiration depending on the cultivar and air temperature (Figure 4), it was found that temperatures below 32 °C determine the achievement with low intensity of foliar transpiration in sweet peppers, with values between 1.79 mmol $H_2O/m^2/s$ at local population of *Grădinari* at 28.4 °C and 3.37 mmol $H_2O/m^2/s$ at control variant Cornel, at 29.2 °C. With the increase of the air temperature up to 39.5 °C, the rate of foliar transpiration in sweet peppers intensified, reaching a maximum value of 8.80 mmol $H_2O/m^2/s$, a value recorded in the control variant, at 15 o'clock. Under conditions of thermal stress, the lowest average transpiration values were recorded in the local population of *Amărăşti*, which had the lowest rate of photosynthesis, and the most intense average perspiration was determined in the *Cornel* variety.

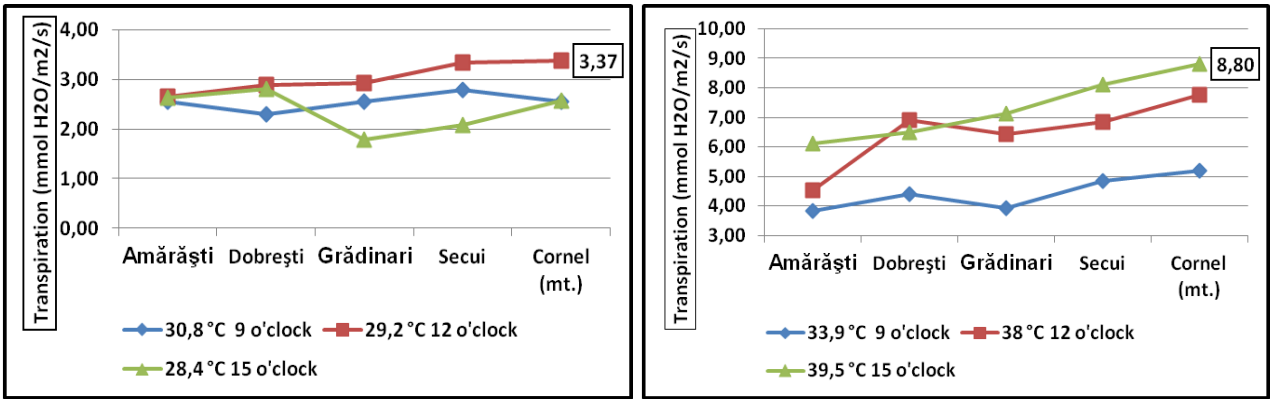

Figure 4. Diurnal variation of the transpiration depending on the cultivar and air temperature

Among the abiotic factors, temperature plays a very important role in determining the intensity of plant transpiration. In sweet pepper plants, a positive correlation was established between foliar transpiration and ambient temperature, distinctly significant, the plants intensifying their transpiration process directly proportional to the increase of air temperature above the optimum threshold of the species (figure 5).

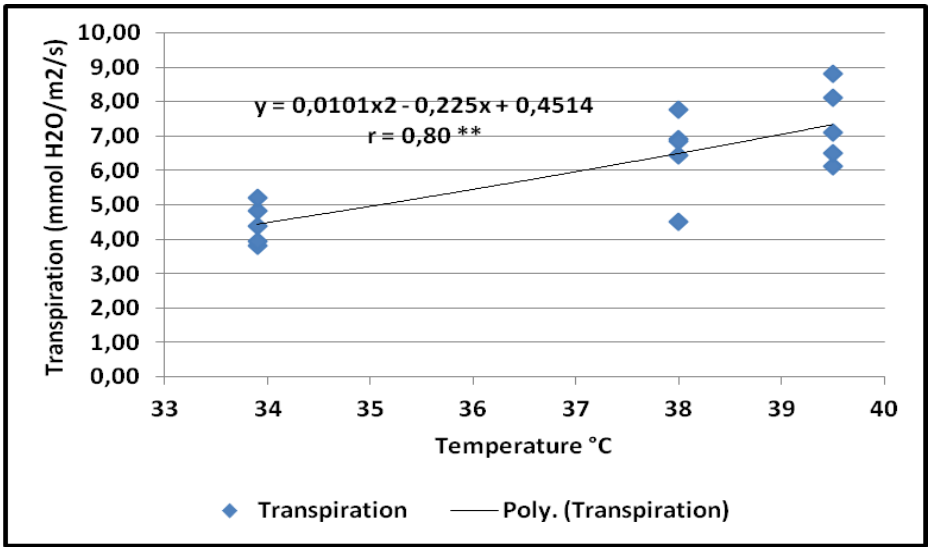

Figure 5. The correlation between plant transpiration and air temperature

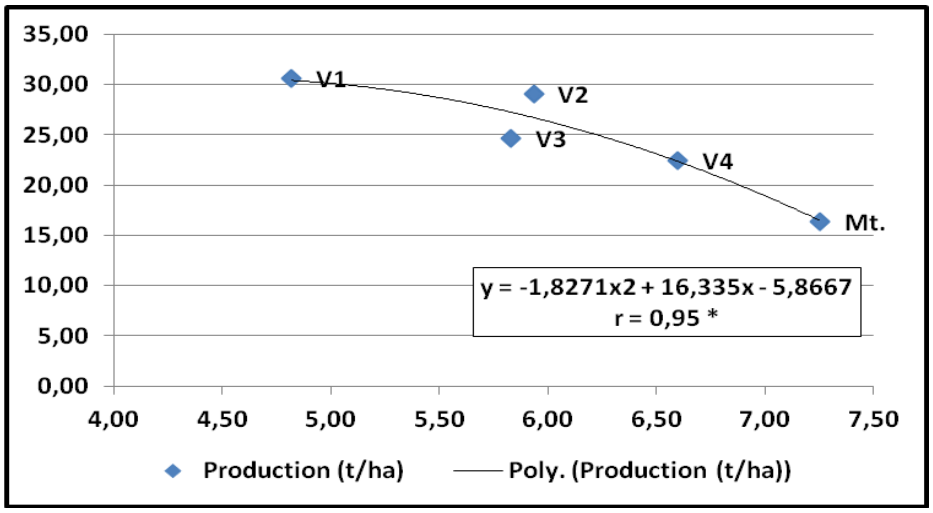

Figure 6. The correlation between plant transpiration under thermal stress and production

High water losses through plant transpiration can be effectively recovered if the accumulations of organic substances are high. However, under conditions of thermo-hydric stress there are disorders in plant metabolism that ultimately affect the level of production. For the sweet pepper studied at RDSPCS Dabuleni, a negative correlation was established between the values of transpiration under stress and the production obtained (Figure 6), statistically significant (r = 0.95 *).

From the productivity point of view, the local populations *Amărăști* and *Dobrești* stood out, in which the foliar transpiration presented the lowest values, but which photosynthesized more intensely in conditions of stress, compared to the control variant *Cornel*.

CONCLUSIONS

The physiological processes of photosynthesis and perspiration were directly influenced by any change in environmental factors.

In optimal temperature conditions, the highest values of photosynthesis were obtained in the *Cornel* variety, but at over 39 °C the local populations of *Dobrești* and *Amărăști* were noticed, with an intense photosynthetic activity, clearly superior to the control variant.

Foliar transpiration was lower in local populations, compared to the *Cornel* variety at all times of the determinations.

The local populations with the lowest transpiration obtained the highest productions, the local populations *Amărăști* and *Dobrești* standing out in this sense.

The lowest production of peppers was obtained in the control variant *Cornel*.

A statistically significant negative correlation was established between the physiological process of transpiration and the yields obtained from sweet peppers.

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