THE INFLUENCE OF SOME FOLIAR FERTILIZERS ON THE PHYSIOLOGICAL PROCESSES IN *CITRULLUS LANATUS* (THUNB.) MATSUM. & NAKAI PLANTS CULTIVATED IN THE CLIMATIC CONDITIONS OF THE OLTENIA REGION - ROMANIA

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Abstract

Researches regarding the influence of of some foliar fertilizers on the physiological processes were carried out on Citrullus lanatus (Thunb.) Matsum. & Nakai plants, Oltenia variety, cultivated in the Oltenia region - Romania. The physiological analyses carried out according to the climatic conditions on June 30th 2023, both for watermelon plants fertilized with Green-Top and also for the watermelon plants in which fertilized have not been performed.

In fertilized plants, compared to non-fertilized plants, it was observed that the intensity of physiological processes has higher values as a result of the application of foliar fertilizer with a positive effect on plants growth and development. In the fertilized plants were recorded higher values of chlorophyll content, thus existing a positive correlation between this content and the photosynthesis intensity. Fertilized plants also had a higher water content and a lower dry matter content, compared to unfertilized plants.

Key words: chlorophyll, fertilized plants, photosynthesis, transpiration, watermelons.

INTRODUCTION

The researches undertaken has the aim of presenting the influence of some foliar fertilizers on the physiological processes in *Citrullus lanatus* (Thunb.) Matsum. & Nakai plants.

Watermelons, *Citrullus* species (*Cucurbitaceae*), are native to Africa and have been cultivated since ancient times (Paris, 2015). Watermelons are among the most widely grown vegetable crops in the warmer parts of the world (Maynard, 2001; Wehner et al., 2001). Watermelon fruits are consumed at physiological maturity, being highly appreciated by consumers for their juiciness, refreshing taste and their biochemical composition, which gives them a significant therapeutic value (Chilom, 2002).

Taking into account that watermelons are frequently cultivated on sandy soils, along with technological stages, the fertilization is necessary for obtaining quantitative and qualitative production (Nicolae et al. 2011). Fertilizers are main means to get higher production in the most grown plants if they are correctly applied taking into account plant requirements, soil characteristics and weather conditions (Ciofu et al., 2003). Foliar nutrition is ideally designed to provide many elements in conditions that may be limiting production at a time when nutrient uptake from the soil is inefficient or nonexistent (Hiller, 1995). Foliar fertilization is advantageous in the sense that nutrients are absorbed through the aerial parts of plants, in controlled quantities and at certain stages, as well as from leaves into seeds (Dass et al., 2022), thus representing an ecological method that can be used to reduce negative impacts on the soil and correct nutritional deficiencies (Niu et al., 2020).

Photosynthesis was influenced both by climatic factors of the area as well as substances used to fertilize plants. Photosynthesis is a core function and its functional status has been considered an ideal physiological activity to monitor when

the health and vitality of plants is under scrutiny (Calatayud et al., 2003).
The intensity of photosynthesis and transpiration varies depending on the light radiation received by leaves, which are dependent on the position of leaves on plants (Nicolae et al., 2011).

MATERIALS AND METHODS

The physiological analyses were performed in *Citrullus lanatus* (Thunb.) Matsum. & Nakai plants, *Oltenia* variety (created at SCDCPN Dăbuleni, 2004) cultivated in the Oltenia region.
Fruit (*Citrullus lanatus*) shape is often spherical but can be globular, oval or oblong. The watermelon rind consists of two layers. The thin, glossy outer layer, or exocarp, is typically boldly striped or otherwise patterned in two shades of green. The thick inner layer of the rind, or mesocarp, is wet, white and hard. Underneath the rind is the watery fruit flesh or endocarp, the portion of the fruit that is usually eaten. In sweet dessert watermelons, the flesh of the maturing fruit becomes tender and accumulates carotenoid pigments and sucrose (Elmstrom and Davis, 1981; Brown and Summers, 1985; Soteriou et al., 2014).
Green-Top is a complex liquid foliar fertilizer that contains macro and micro elements, vitamins and amino acids. It is recommended to apply it in the phases of vegetative development and in the phases of flowering, binding and fruit formation.
Green-Top foliar fertilizer (3ml/1L water) was applied in 2 stages (in the flowering phase of the plants and in the phase of fruit formation). Physiological analyses were performed two weeks after the last fertilization (June 30th 2023) on fertilized plants, compared to unfertilized plants. The physiological processes' intensity (photosynthesis and transpiration intensity) was established with the ultra compact photosynthesis measurement system (LCi) which enables automatic recording and other parameters (photosynthetic active radiations, leaf temperature, stomatal conductance). The content in water and the content in dry matter was determined using gravimetric methods. The chlorophyll content were analysed with the Minolta SPAD 502 chlorophyllmeter. The SPAD-502 enables quick, easy measurement of the chlorophyll content of plant leaves without damaging the leaf.

RESULTS AND DISCUSSIONS

The *Oltenia* variety is a semi-late watermelon, very vigorous, tolerant to the attack of pathogens. The plants have branched stems, thin, hairy and lobed leaves. The roots are superficial, with a pivot root and other lateral roots. Watermelon plants are self-fertile and bear male and female flowers on the same plant. The flowers have colors that vary from pale to bright yellow (Figure 1).
The fruits are round-oblong, with a red, crunchy core, the outside skin is smooth, with dark green stripes (Figure 2).
The physiological analyses were performed in the fertilized watermelon plants, compared to the unfertilized watermelon plants.

Figure 1. *Citrullus lanatus* (Thunb.) Matsum. & Nakai, *Oltenia* variety - the flowering phase (Original).

Figure 2. *Citrullus lanatus* (Thunb.) Matsum. & Nakai, *Oltenia* variety - the fruit formation phase (Original).

The photosynthesis intensity presents lower values in the morning (15.58 µmol/m^2/s in the fertilized plants and 14.86 µmol/m^2/s in the unfertilized plants) due to the low light intensity and low temperature, higher values in the afternoon (22.83 µmol/m^2/s in the fertilized plants and 21.72 µmol/m^2/s in the unfertilized plants) due to the increasing light intensity and temperature and slightly lower values in the evening (22.67 µmol/m^2/s in the fertilized plants and 20.81 µmol/m^2/s in the unfertilized plants) as a result of the gradual decreasing light intensity and temperature (Figure 3).

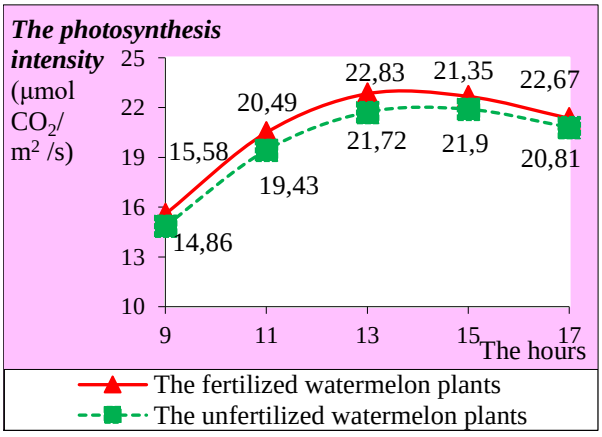

Figure 3. The photosynthesis intensity in the leaves of *Citrullus lanatus* (Thunb.) Matsum. & Nakai

The transpiration intensity in the watermelon plants shows an increase starting in the morning (4.03 mmol/m^2/s in the fertilized plants and 3.87 mmol/m^2/s in the unfertilized plants) when the opening of stomata takes place, shows a maximum value in the afternoon (6.1 mmol/m^2/s in the fertilized plants and 5.79 mmol/m^2/s in the unfertilized plants) when the temperature is higher and the air relative humidity is lower, and in the evening there is a gradual reduction in the intensity of transpiration (5.91 mmol/m^2/s in the fertilized plants and 5.64 mmol/m^2/s in the unfertilized plants) - Figure 4.

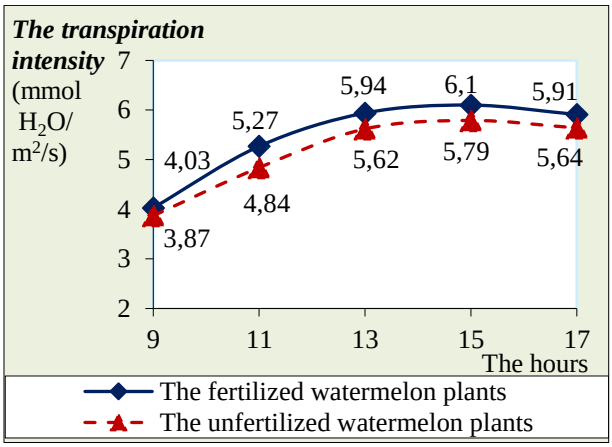

Figure 4. The transpiration intensity in the leaves of *Citrullus lanatus* (Thunb.) Matsum. & Nakai

The photosynthesis and transpiration intensity has a higher values in the fertilized plants. They are positively correlated with the photosynthetic active radiation, leaf temperature and stomatal conductance.

The photosynthetic active radiation has low values in the morning (9 a.m.) when values are 1245 µmol/m^2/s in the fertilized plants and 1306 µmol/m^2/s in the unfertilized plants, they increase and have maximum values afternoon (3 p.m.) when they are recorded 1534 µmol/m^2/s in the fertilized plants and 1597 µmol/m^2/s in the unfertilized plants and decrease towards evening (5 p.m.) when values are 1463 µmol/m^2/s in the fertilized plants and 1485 µmol/m^2/s in the unfertilized plants. Linear regression made between the photosynthesis intensity and photosynthetic active radiations shows a

positive correlation, the coefficient of determination (R^2) was 0.92 for the fertilized plants and 0.90 for the unfertilized plants; linear regression made between the transpiration intensity and photosynthetic active radiations shows a positive correlation, the coefficient of determination (R^2) was 0.93 for the fertilized plants and 0.89 for the unfertilized plants (Figure 5 and Figure 6).

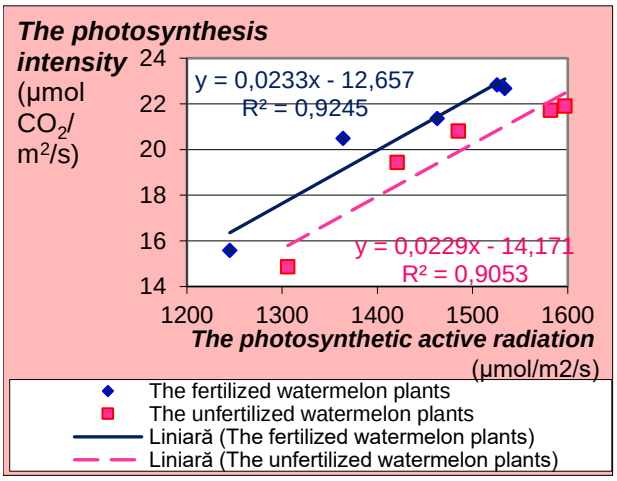

Figure 5. The correlation between the intensity of photosynthesis and the photosynthetic active radiation in *Citrullus lanatus.*

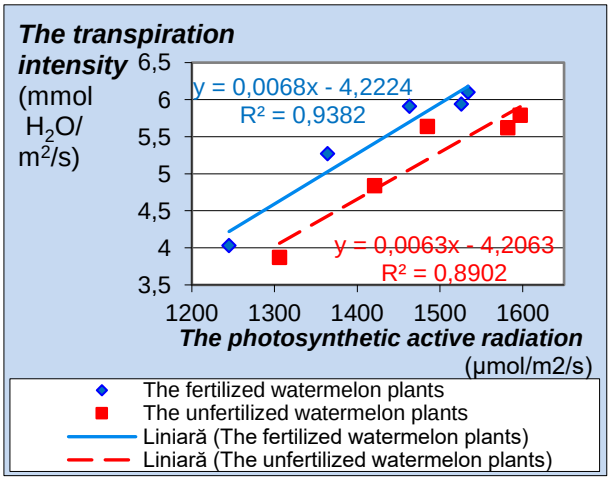

Figure 6. The correlation between the intensity of transpiration and the photosynthetic active radiation in *Citrullus lanatus.*

In watermelon plants an increase of the leaf temperature can be noticed starting in the morning (9 a.m.) when values are 27.2 °C in the fertilized plants and 27.4 °C in the unfertilized plants, they grow up until afternoon (1 p.m.) when values are 33.1 °C in the fertilized plants and 33.2 °C in the unfertilized plants and decrease towards evening (5 p.m.) when values are 31.6 °C in the fertilized plants and 31.8 °C in the unfertilized plants. Linear regression between the photosynthesis intensity and leaf temperature shows a positive correlation, the coefficient of determination (R^2) was 0.98 for the fertilized plants and 0.97 for the unfertilized plants; linear regression between the transpiration intensity and leaf temperature shows a positive correlation, the coefficient of determination (R^2) was 0.95 for the fertilized plants and 0.94 for the unfertilized plants (Figure 7 and Figure 8).

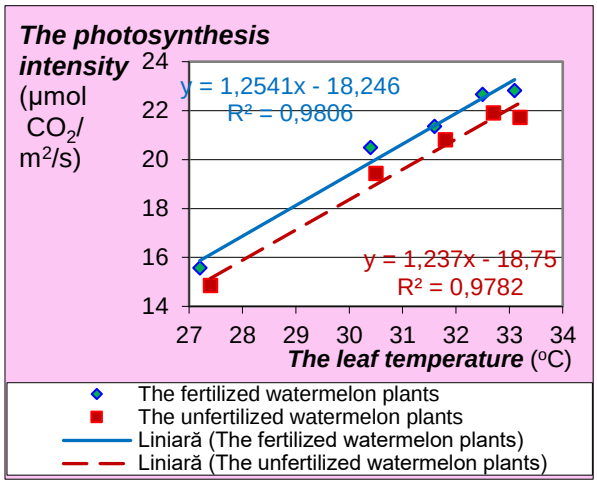

Figure 7. The correlation between the intensity of photosynthesis and the leaf temperature in *Citrullus lanatus.*

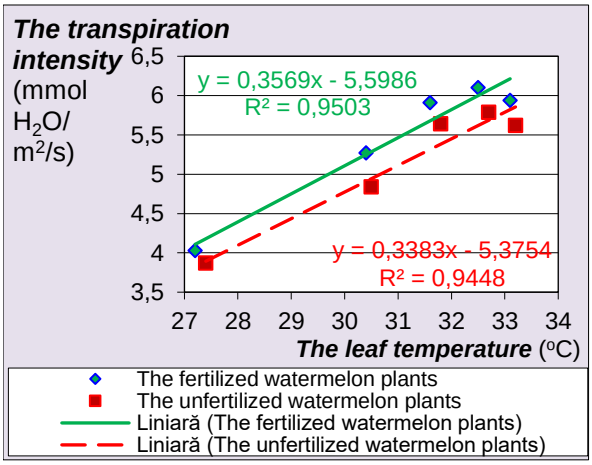

Figure 8. The correlation between the intensity of transpiration and the leaf temperature in *Citrullus lanatus.*

The stomatal conductance in the watermelon plants increases starting with the morning (9 a.m.) when values are 0.07

mol/m^2/s in the fertilized plants and 0.05 mol/m^2/s in the unfertilized plants, they grow up until afternoon (1 p.m.) when values are 0.13 mol/m^2/s in the fertilized plants and 0.12 mol/m^2/s in the unfertilized plants and decrease towards evening (5 p.m.) when values are 0.11 mol/m^2/s in the fertilized plants and 0.09 mol/m^2/s in the unfertilized plants. The photosynthesis intensity and stomatal conductance show a positive correlation, the coefficient of determination (R^2) was 0.95 for the fertilized plants and 0.90 for the unfertilized plants; the transpiration intensity and stomatal conductance show a positive correlation, the coefficient of determination ($R^{2)}$ was 0.90 for fertilized plants and 0.84 for the unfertilized plants (Figure 9 and Figure 10).

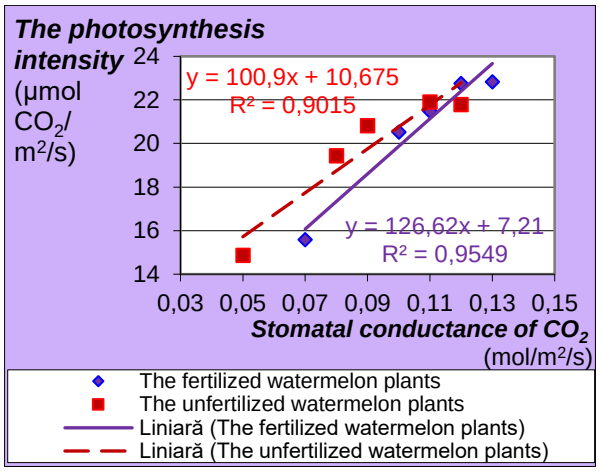

Figure 9. The correlation between the intensity of photosynthesis and the stomatal conductance in *Citrullus lanatus.*

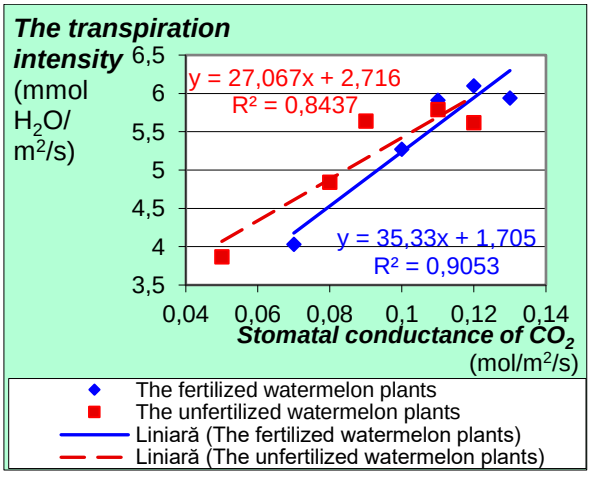

Figure 10. The correlation between the intensity of transpiration and the stomatal conductance in *Citrullus lanatus.*

In the fertilized plants it was registered a higher water content and a lower dry matter content, in comparison with the unfertilized plants (Figure 11).

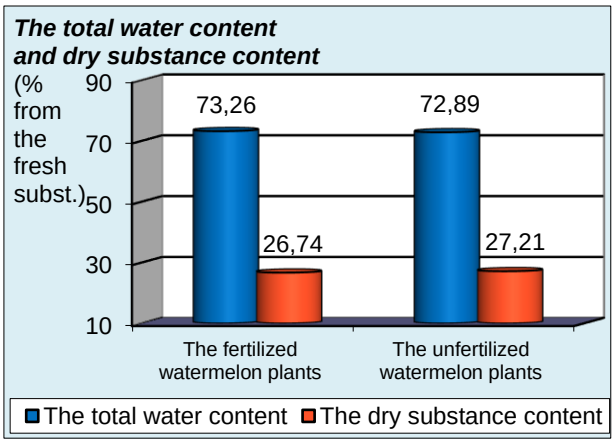

Figure 11. The water content and the dry substance content in *Citrullus lanatus.*

Chlorophyll content is an indicator that reflects the growth status of crops and can be used to optimize the timing and amount of additional fertilizer application to provide quantitative and qualitative yields.
In the fertilized plants were recorded higher values of the chlorophyll content, in comparison with the unfertilized plants (Figure 12).

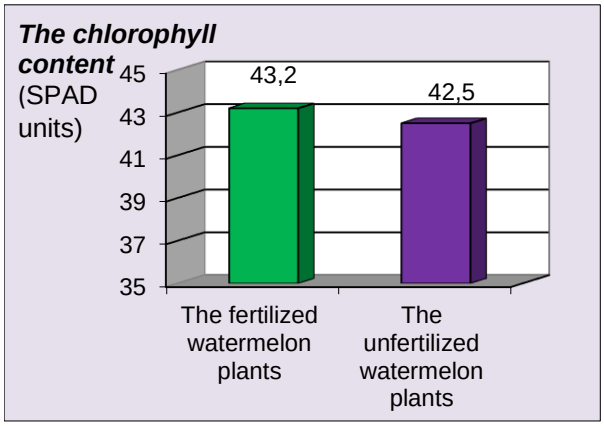

Figure 12. The chlorophyll content in *Citrullus lanatus.*

CONCLUSIONS

In the fertilized watermelon plants one can observe that the physiological processes' intensity has higher values as a result of the foliar fertilization with different types of micro and macro elements that have a positive effect on plant growth and development.

The photosynthesis and transpiration's intensity are positively correlated with the photosynthetic active radiation, leaf temperature and stomatal conductance, but present different values in the fertilized plants, compared with the unfertilized plants.

In the fertilized plants, was recorded a higher water content and an lower dry substance content. The chlorophyll content was higher in fertilized watermelon plants, compared with the unfertilized plants, thus existing a positive correlation between this content and the photosynthesis intensity.

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