INFLUENCE OF SOME ORGANIC FERTILIZERS ON THE PHYSIOLOGICAL PROCESSES IN *Citrullus lanatus* (THUNB.) MATSUM. & NAKAI PLANTS CULTIVATED IN AREAS WITH SANDY SOILS

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Abstract. The physiological research was achieved in *Citrullus lanatus* (THUNB.) MATSUM. & NAKAI, Rica F1 hybrid, cultivated on sandy soil, in field conditions, at the CCDCPN, Dăbuleni, Dolj. The photosynthesis intensity recorded, during the day, the highest values at noon (12 a.m.) for watermelon plants fertilized with 30 t/ha Manure and the lowest values were recorded in the morning (8 a.m.) for plants fertilized with 30 t/ha Manure. The linear regressions performed between the photosynthesis rate and the photosynthetic active radiation, show a strong positive correlation to the plants fertilized with 2 t/ha Orgevit ($R^2 = 0.96$) and a weaker positive correlation to the plants fertilized with 30 t/ha Manure ($R^2 = 0.51$). The transpiration intensity recorded the highest values at noon (12 a.m.) for watermelon plants fertilized with 2 t/ha Orgevit and the lowest values in the morning (8 a.m.) for the plants fertilized with 30 t/ha Manure. The linear regressions performed between the photosynthetic rate active radiation and the transpiration intensity of fertilized plants, show a strong positive correlation to the plants fertilized with 4 t/ha Orgevit ($R^2 = 0.97$) and a weaker positive correlation to the plants fertilized with 60 t/ha Manure ($R^2 = 0.78$). The mature leaves of watermelon plants have the highest chlorophyll pigment content in plants fertilized with 2 t/ha Orgevit and the lowest content was recorded in plants fertilized with 4 t/ha Orgevit.

Keywords: physiological processes, photosynthesis, transpiration, watermelon plants, Orgevit.

Rezumat. Influenţa unor fertilizanţi organici asupra proceselor fiziologice la plantele *Citrullus lanatus* (THUNB.) MATSUM. & NAKAI cultivate în zone cu soluri nisipoase. Cercetările fiziologice s-au efectuat la *Citrullus lanatus* (THUNB.) MATSUM. & NAKAI, hibridul Rica F1, cultivate pe sol nisipos, în condiţii de câmp, la CCDCPN Dăbuleni, Dolj. Intensitatea fotosintezei a înregistrat, pe parcursul zilei, cele mai mari valori la prânz (12 a.m.) la plantele de pepeni verzi fertilizate cu 30 t/ha gunoi de grajd, iar cele mai mici valori dimineaţa (8 a.m.) la plantele fertilizate cu 30 t/ha gunoi de grajd. Regresiile liniare realizate între rata fotosintezei şi radiaţia fotosintetic activă, evidenţiază o corelaţie pozitivă puternică la plantele fertilizate cu 2 t/ha Orgevit ($R^2 = 0,96$) şi o corelaţie pozitivă mai slabă la plantele fertilizate cu 30 t/ha gunoi de grajd ($R^2 = 0,51$). Intensitatea transpiraţiei a înregistrat cele mai mari valori la prânz (12 a.m.) la plantele de pepeni verzi fertilizate cu 2 t/ha Orgevit, iar cele mai mici valori dimineaţa (8 a.m.) la plantele fertilizate cu 30 t/ha gunoi de grajd. Regresiile liniare realizate între rata transpiraţiei şi radiaţia fotosintetic activă, la plantele fertilizate, evidenţiază o corelaţie pozitivă puternică la plante fertilizate cu 4 t/ha Orgevit ($R^2 = 0,97$) şi o corelaţie pozitivă mai slabă la plantele fertilizate cu 60 t/ha gunoi de grajd ($R^2 = 0,78$). La frunzele mature ale plantelor de pepeni verzi cel mai ridicat conţinut în pigmenţi clorofilieni s-a înregistrat la plantele fertilizate cu 2 t/ha Orgevit, iar cel mai scăzut conţinut s-a înregistrat la plantele fertilizate cu 4 t/ha Orgevit.

Cuvinte cheie: procese fiziologice, fotosinteză, transpiraţie, plante de pepeni verzi, Orgevit.

INTRODUCTION

This paper presents the results of the physiological research carried out on watermelon plants cultivated in 2009 at the Agricultural Station of Research and Development for the Plant Culture on Sandy Soils (CCDCPN) Dăbuleni, Dolj. The physiological investigations were carried out within the national research program (PN II), No. 52147/2008, entitled: "Research on the foundation and development of technology for cultivation of watermelon grafted plants, in order to obtain biological production in sandy soils areas".

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. The sandy soils are considered poorly supplied in mineral substances and therefore in order to obtain biological watermelons, the organic fertilization of crops is necessary, in accordance with the rules of an ecological agriculture.

Organic manures can serve as alternative to mineral fertilizers (NAEEM et al., 2006) for improving soil structure (DAUDA et al., 2008) and microbial biomass (SURESH et al., 2004).

The net photosynthetic activity is subjected to seasonal changes and to diurnal changes, which are mainly influenced by the stage of shoot development, the leaf ageing, the accumulation of hormones and of carbohydrates in the leaves, as well as by the fluctuations of light, leaf temperature, air temperature and humidity (LAKSO, 1985).

The photosynthetic CO_2 assimilation of the leaves was remarkably improved by high nitrogen nutrition (CECHIN & FUMIS, 2004).

The young leaves have the highest intensity of the transpiration process and as they get older, the transpiration intensity decreases, the lower values being recorded at senescent leaves (BURZO et al., 1999).

MATERIAL AND METHODS

Under the circumstances imposed by the biological agriculture, the behaviour of the Rica F1 watermelon hybrid was studied in field condition. The Rica F1 soil is a late Sugar Baby cultivars type.

This paper presents the results of the physiological research obtained by applying the fertilization with Manure and Orgevit in different doses of application.

The Manure is considered to be a natural fertilizer, full and complex, which comes from different animal species from a mixture of straw, feed, manure and urine. It helps to improve the soil structure, the humus content and the useful microorganisms.

The Orgevit is a granular organic fertilizer, which is administered on the surface of the soil and it is then incorporated in the land. The Orgevit contains: organic matter, nitrogen, phosphate, potassium, calcium, magnesium, iron, manganese, zinc, molybdenum, cobalt, etc.

The watermelon plants on which physiological measurements were made were represented by the *Rica* F1 hybrid, cultivated on the following fertilization variants: plants fertilized with 30 t/ha Manure, plants fertilized with 60 t/ha Manure, plants fertilized with 2 t/ha Orgevit, plants fertilized with 4 t/ha Orgevit.

This paper's aim is to study physiological processes (photosynthesis rate, transpiration rate) of watermelon plants in accordance with environmental factors.

The intensity of photosynthesis and transpiration were made by using the portable photosynthesis analyser, LCpro+, system which enables automatic recording and other parameters (photosynthetic active radiations incident on the leaf surface, leaf temperature, stomatal conductance, etc.).

The obtained results were graphically represented and statistically interpreted by using of the linear regressions.

The content of the chlorophyll pigments was estimates by Minolta SPAD 502 chlorophyll meter (the use of the chlorophyll meter SPAD is a non-destructive method and permits repeated measurements).

RESULTS AND DISCUSSIONS

The physiological investigations were carried out on July 7th 2009 and consisted of analysing the diurnal dynamics of the physiological processes (photosynthesis rate, transpiration rate), of establishing correlations between these processes and the intensity of photosynthetic active radiation incident on the leaf surface and also of determining the chlorophyll pigment on *Citrullus lanatus* (THUNB.) MATSUM. & NAKAI, Rica F1 hybrid, in different organic fertilization variants.

The morphological aspect of watermelon plants cultivated in different fertilization variants is shown in figures 1-4.

Figure 1. *Citrullus lanatus* - plants fertilized with 30 t/ha Manure.
Figura 1. *Citrullus lanatus* - plante fertilizate cu 30 t/ha gunoi de grajd (original).

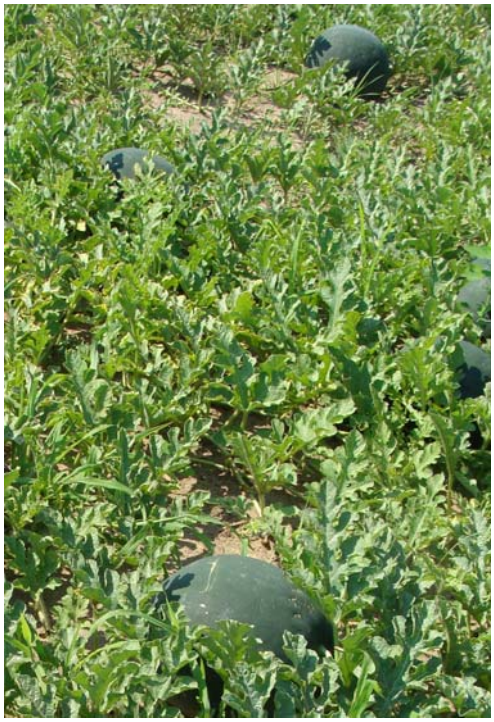

Figure 2. *Citrullus lanatus* - plants fertilized with 60 t/ha Manure.
Figura 2. *Citrullus lanatus* - plante fertilizate cu 60 t/ha gunoi de grajd (original).

Figure 3. *Citrullus lanatus* - plants fertilized with 2 t/ha Orgevit.
Figura 3. *Citrullus lanatus* - plante fertilizate cu 2 t/ha Orgevit (original).

Figure 4. *Citrullus lanatus* - plants fertilized with 4 t/ha Orgevit.
Figura 4. *Citrullus lanatus* - plante fertilizate cu 4 t/ha Orgevit (original).

The diurnal dynamics of photosynthesis of the plants presents, generally, low values in the morning correlated with low light and temperature intensity and with the reduced opening degree of the stomata, maximum values at noon correlated with the increasing light intensity and temperature and with the opening degree of the stomata and low values in the evening as a result of the decreasing light intensity, of the gradual decreasing temperature and of the decreasing of the opening degree of the stomata (Figs. 5; 6).

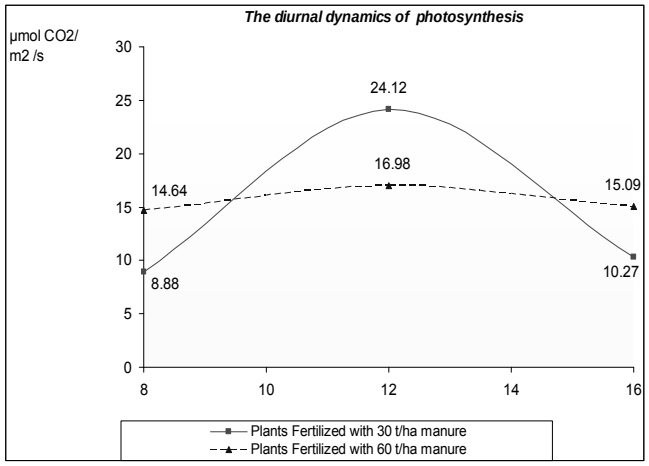

Figure 5. The diurnal dynamics of photosynthesis in *Citrullus lanatus* plants fertilized with 30 t/ha and 60 t/ha Manure.
Figura 5. Dinamica diurnă a fotosintezei la plantele *Citrullus lanatus* fertilizate cu 30 t/ha şi 60 t/ha gunoi de grajd.

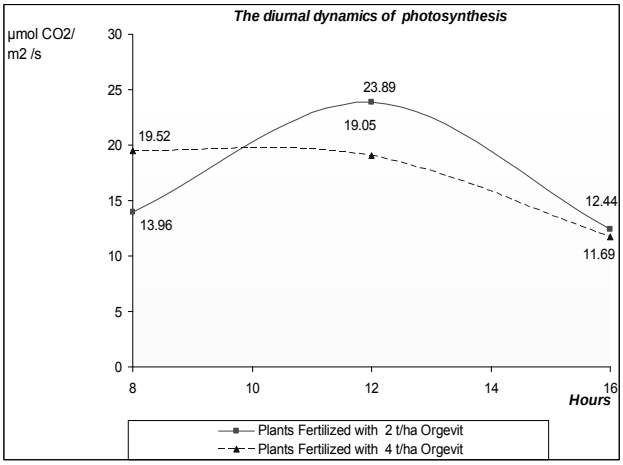

Figure 6.The diurnal dynamics of photosynthesis in *Citrullus lanatus* plants fertilized with 2 t/ha and 4 t/ha Orgevit.
Figura 6. Dinamica diurnă a fotosintezei la plantele *Citrullus lanatus* fertilizate cu 2 t/ha şi 4 t/ha Orgevit.

The diurnal dynamics of the transpiration of the plants presents low values in the morning correlated with the minimum opening of the stomata and with the decreasing of the dehydration power of the air, maximum values in the afternoon correlated with the increasing opening degree of the stomata as a result of the increasing light intensity and temperature and of the dehydration power of the air, and low values towards the evening correlated with low light intensity and temperature (Figs. 7; 8).

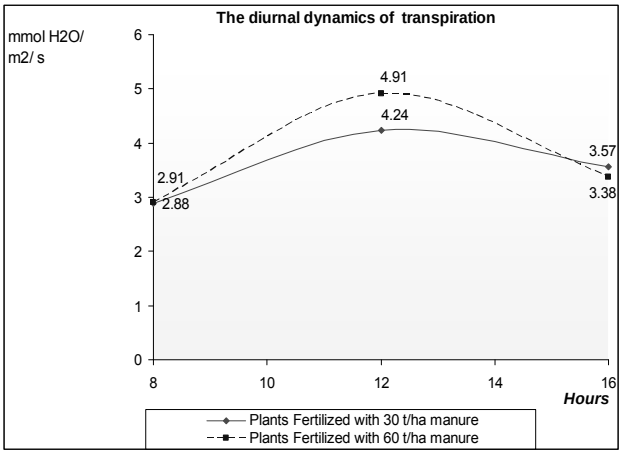

Figure 7. The diurnal dynamics of transpiration in *Citrullus lanatus* plants fertilized with 30 t/ha and 60 t/ha Manure.
Figura 7. Dinamica diurnă a transpirației la plantele *Citrullus lanatus* fertilizate cu 30 t/ha şi 60 t/ha gunoi de grajd.

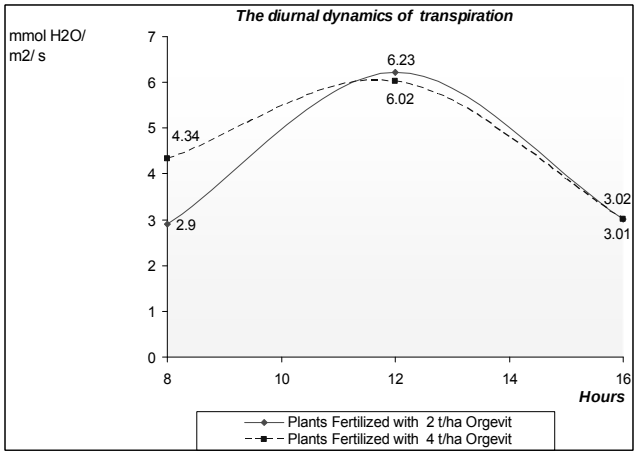

Figure 8. The diurnal dynamics of transpiration in *Citrullus lanatus* plants fertilized with 2 t/ha and 4 t/ha Orgevit.
Figura 8. Dinamica diurnă a transpirației la plantele *Citrullus lanatus* fertilizate cu 2 t/ha şi 4 t/ha Orgevit.

The photosynthetic active radiations have a great role in the photosynthesis and transpiration induction by carrying photoactive opening movements of the stomata and by increasing the temperature of the leaves. 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.

The results obtained after the tests regarding the dynamics of the photosynthetic active radiation incident on the leaf surface of Rica F1 watermelon plants grown in different fertilization variants are presented in table (Table 1).

Table 1. The photosynthetic active radiation incident on the leaf surface.
Tabel 1. Radiația fotosintetic activă incidentă pe suprafața frunzei.

Watermelon plants cultivated in different fertilization variants	**The photosynthetic active radiation (µmol/m^2/s)**		
	Hours: 8 a.m.	Hours: 12 a.m.	Hours: 4 p.m.
Watermelon plants fertilized with 30 t/ha Manure	356	1678	1405
Watermelon plants fertilized with 60 t/ha Manure	897	1539	1325
Watermelon plants fertilized with 2 t/ha Orgevit	820	1488	510
Watermelon plants fertilized with 4 t/ha Orgevit	1148	1611	495

The linear regressions performed between the intensity of the photosynthesis and the photosynthetic active radiation, show a strong positive correlation to watermelon plants fertilized with 2 t/ha Orgevit (the coefficient of determination $R^2 = 0.96$) and a weaker positive correlation to the plants fertilized with 30 t/ha manure (the coefficient of determination $R^2 = 0.51$) (Figs. 9; 10).

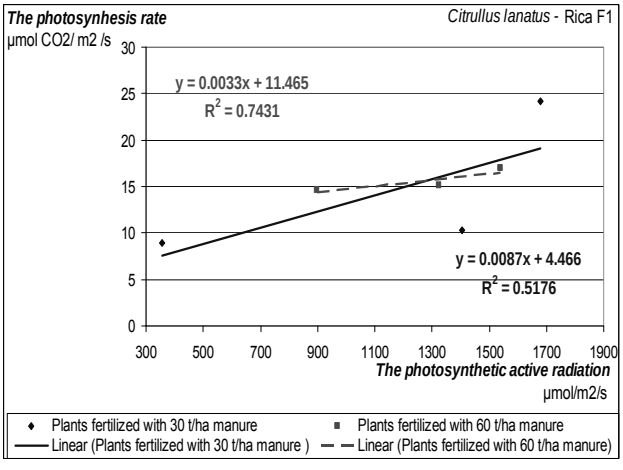

Figure 9. The correlation between the intensity of the photosynthesis and the leaf temperature in *Citrullus lanatus* plants fertilized with 30 t/ha and 60 t/ha Manure.
Figura 9. Corelații între intensitatea fotosintezei şi temperatura frunzei la plantele *Citrullus lanatus* fertilizate cu 30 t/ha şi 60 t/ha gunoi de grajd.

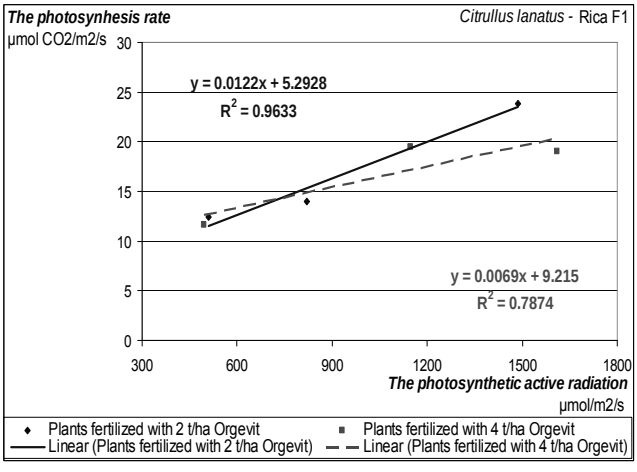

Figure 10. The correlation between the intensity of the photosynthesis and the leaf temperature in *Citrullus lanatus* plants fertilized with 2 t/ha and 4 t/ha Orgevit.
Figura 10. Corelații între intensitatea fotosintezei şi temperatura frunzei la plantele *Citrullus lanatus* fertilizate cu 2 t/ha şi 4 t/ha Orgevit.

The linear regressions performed between the intensity of the transpiration and the photosynthetic active radiation show a strong positive correlation to watermelon plants fertilized with 4 t/ha Orgevit (the coefficient of determination $R^2 = 0.97$) and a weaker positive correlation to the plants fertilized with 60 t/ha Manure (the coefficient of determination $R^2 = 0.78$) (Figs. 11; 12).

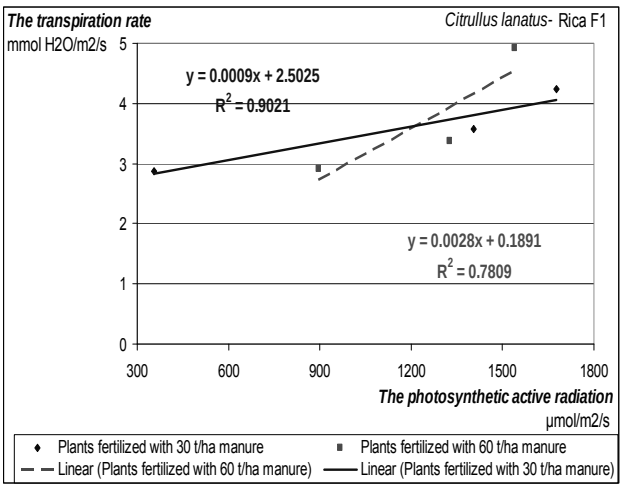

Figure 11. The correlation between the intensity of the transpiration and the leaf temperature in *Citrullus lanatus* plants fertilized with 30 t/ha and 60 t/ha Manure.
Figura 11. Corelaţii între intensitatea transpiraţiei şi temperatura frunzei la plantele *Citrullus lanatus* fertilizate cu 30 t/ha şi 60 t/ha gunoi de grajd.

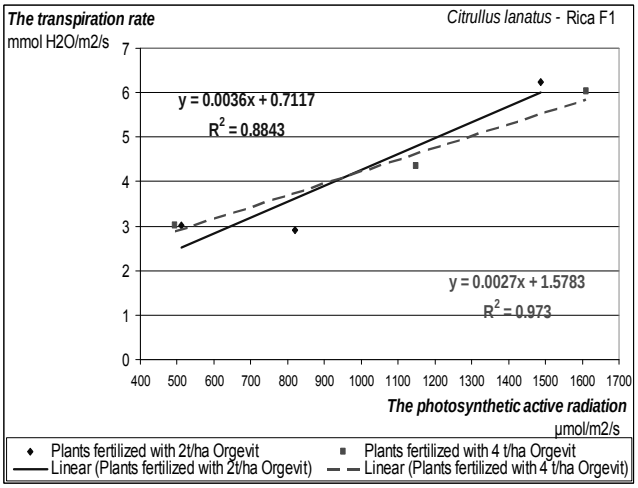

Figure 12. The correlation between the intensity of the transpiration and the leaf temperature in *Citrullus lanatus* plants fertilized with 2 t/ha and 4 t/ha Orgevit .
Figura 12. Corelaţii între intensitatea transpiraţiei şi temperatura frunzei la plantele *Citrullus lanatus* fertilizate cu 2 t/ha şi 4 t/ha Orgevit.

The temperature along with the solar radiation intensity is the main external factor which influences the photosynthesis and transpiration processes. The temperature of the plants generally depends in a large measure on the ambient air temperature, and on the transpiration intensity, which limit the temperature of the plants.

The research carried out on the dynamics of air temperature at the time of the physiological tests, show a temperature increase in the morning (8 a.m.) when the values are of 27.9 °C, an increase at noon (12 a.m.) when the values are of 35.1 °C and a slight decrease in the evening (4 p.m.) when the values are of 31.5 °C.

The chlorophyll content. The mature leaves of watermelon plants grown in different fertilization alternatives have the highest chlorophyll pigment content in plants fertilized with 2 t/ha Orgevit and the lowest content was recorded in plants fertilized with 4 t/ha Orgevit (Fig. 13).

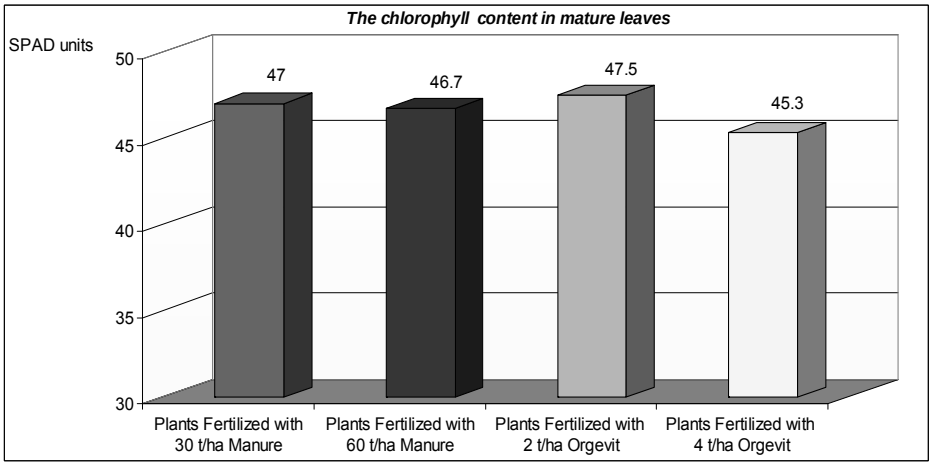

Figure 13. The chlorophyll content at the mature leaves of *Citrullus lanatus.*
Figura 13. Conţinutul în clorofilă la frunzele mature de *Citrullus lanatus*.

CONCLUSIONS

During the day the highest values of the photosynthesis intensity were recorded at noon (12 a.m.) for watermelon plants fertilized with 30 t/ha Manure (24.12 μmol $CO_2/m^2/s$) and the lowest values were recorded in the morning (8 a.m.) for the plants fertilized with 30 t/ha Manure (8.88 μmol $CO_2/m^2/s$).

The linear regressions performed between the photosynthesis rate and the photosynthetic active radiation show a strong positive correlation to the plants fertilized with 2 t/ha Orgevit ($R^2 = 0.96$) and a weaker positive correlation to the plants fertilized with 30 t/ha Manure ($R^2 = 0.51$).

During the day the highest values of the transpiration intensity were recorded at noon (12 a.m.) for watermelon plants fertilized with 2 t/ha Orgevit (6.23 mmol $H_2O/m^2/s$) and the lowest values were recorded in the morning (8 a.m.) for the plants fertilized with 30 t/ha Manure (2.88 mmol $H_2O/m^2/s$).

The linear regressions performed between the transpiration rate and the photosynthetic active radiation show a strong positive correlation to the plants fertilized with 4 t/ha Orgevit ($R^2 = 0.97$) and a weaker positive correlation to the plants fertilized with 60 t/ha Manure ($R^2 = 0.78$).

The mature leaves of watermelon plants have the highest chlorophyll pigment content in plants fertilized with 2 t/ha Orgevit and the lowest content was recorded in plants fertilized with 4 t/ha Orgevit.

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