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CLIMATE CHANGE'S IMPACT ON SANDY SOILS AND ON THE GRAFTED WATERMELONS ADAPTATION

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Abstract

Starting from the fact that the principles of agro-ecology become fundamental principles for the development of a green economy, especially in the context of current climate change, the effective capitalization of the ecological conditions of an agricultural area is one of the main objectives of agricultural science and practice. Identifying and formulating adaptive technological solutions can guide any producer to capitalize different climate and soil conditions. The sandy soils in Southern Oltenia offer less favourable ecological conditions, and the cultivation of watermelons is now profitable enough for such conditions. Growers are, however, interested in getting the most productive yields, early and profitable, even under the conditions of climate change. The current paper quantifies the grafting of watermelons in the conditions of the sandy soils of Dăbuleni, with poor soil supply, with meteorological drought phenomena and agricultural drought risk, in terms of quality and quantity of production under the climatic conditions in 2015-2017. The results, correlated with the climatic conditions, recommend the cultivation of grafted watermelons, offering the producers in the area a niche of ecological adaptation, ensuring the resistance of plants to abiotic, thermo-hydric stress factors, and improving the resistance to low temperatures, heat and drought.

Keywords: *climate change, niche of ecological adaptation, abiotic stress, grafted watermelon.*

INTRODUCTION

The global climate change is a reality, present on all government, academic and scientific agendas, generating harmful effects on communities, population health and on the environment. The year 2014 was officially declared by NASA as the warmest year, with the highest temperatures recorded since 1880 (Rotman, 2015). The potentially damaging effects of increasing temperatures and precipitation uncertainty are felt not only at the soil production capacity level (Dodocioiu, 2005), but also in its sanogenic state (Popa and Coyne, 2007). The phenomenon of desertification has become a key issue for land management, due to climate change and vicious anthropogenic actions (Bordun and Cimpeanu 2017; Ochieng et al., 2016).

Recent studies have shown that the presence of increased CO_2 in plants (from 0.04% to 0.1-1.0%) stimulates the acceleration of metabolism and photosynthesis, reduces the respiration, closes the stomata and stops the transpiration. In the last years, the researches generated the apparition of CO_2-based natural fertilizers, which increase the CO_2 concentration within plants from 0.04% to 0.1-1.0%, exerting double action: accelerate metabolism and photosynthesis, slow down the respiration, close stomata and stop perspiration; all of these stimulate the plant productive efficiency (Becherescu et al., 2017).

The climate change in the area of sandy soils in Romania has increased significantly in recent years through extreme climatic events, including heat waves, drought and floods, which are expected to become more frequent and intense.

Recording such stressful atmospheric factors requires the re-evaluation of the adaptive horticultural species to the prolonged action of the abiotic stress. The sandy area in southern Romania is recognized for the "*Dăbuleni watermelon*" brand - the most famous watermelon brand in the country, due to the distinctive organoleptic qualities given by the soil and the sun that burns the sands in this area (Ciupureanu et al., 2016; Agerpress, 2014).

Its maintenance requires the reconsideration of technological links applied under conditions of thermal stress and drought or floods.

One way to avoid or reduce the production losses caused by unfavourable climatic conditions would be the grafting on the rootstock which is capable of reducing the effect of external demands. ***Grafting can remove the adverse effects of climate change***, stimulating the agronomic, physiological and biochemical performance of the cultivated watermelons (Leea et al., 2010; Schwarz et al., 2009). Grafting can be considered as an important link in the production of green and yellow watermelons for the organic farming (Toma et al., 2011; Dinu et al., 2006) and as an alternative to soil disinfection with methyl bromide, a chemical product banned globally in the agricultural practice (Toma et al., 2011; Dinu and Soare, 2015). In our country the grafting of watermelons is less applied. The first researches in the field were carried out in 1980 by Răduică Şt. at the Buzau GreenHouses Enterprise. Subsequently, researches were carried out at the Faculty of Horticulture in Craiova (Dinu and Cimpoiasu 2006), the Faculty of Horticulture Bucharest (Hoza et al., 2017) and the Research and Development Institute for the Industrialization and Marketing of Horticultural Products - Horting Bucharest. Since 2000, researches have been carried out at the Research-Development Center of Field Crops on Sandy Soils, Dăbuleni within the framework of the national research programs on the grafting of green watermelons, with the objective of obtaining new cultivars of grafted watermelons (Toma et al., 2011, 2016), establishing some methods for increasing the early production or the influence of different rootstocks (Ciuciuc, 2003, 2007, 2016).

The current study aims at assessing the capacity of adaptation of grafted watermelon plants in the context of climate change, also taking into account the local tendency to cultivate watermelons with a role in the profit and social welfare sustainability of the South of Romania. The paper presents partial results from a complex study in the climatic conditions recorded in the years 2015-2017 regarding the physiological reactions - the rate of photosynthesis and the rate of perspiration, recommendding the cultivation of grafted green melons, offering the producers in the area a niche of ecological adaptation.

MATERIALS AND METHODS

The experiment was placed at the Research-Development Center of Field Crops on Sandy Soils, Dăbuleni (43°48' North latitude and 24°5' East longitude) on sandy soil with coarse texture, colloidal clay content below 12% and reduced humus by 0.1-1.6%.

The biological material was represented by two autochthonous cultivars of watermelon, *Romanța* and *Oltenia*, grafted on the rootstock of the *Lagenaria siceraria* species (Macis F1). The crop was set up by seedling produced in a multiplier greenhouse, planted in the field between April 28 and May 5, depending on the climatic conditions of the crop year.

The rows were at a distance of 2 m and the plants were at a distance of 1 m, ensuring a density of 5000 plants/ha. The experiment was placed in randomized blocks in 4 repetitions, with 10 plants/repetition. There was applied the technology specific to watermelon culture in the field.

For the analysis of physiological indices, the LC-PRO + portable analyzer for photosynthesis was used. During the 2015-2017 period, the average temperatures in the air, the maximum and minimum temperatures and the amount of precipitation were recorded for each meteorological year at the CCDCPN Dabuleni - Agro Expert type weather station.

The three years of research have been very different in terms of climate. The climatic conditions between April and July are of importance for the green watermelons culture, but especially the temperatures in the last decade of April and the first decade of May are important for the watermelons, a period corresponding to the optimal seedlings planting in the field period, as well as to their harvesting period, namely the first and second decades of May. The intensity of the photosynthesis process was carried out with the LCi-SD Ultra Compact Photosynthesis System (ADC BioScientific, England), which monitors the concentration of carbon dioxide and water in the foliar and atmospheric surface using an IR detector. The device creates a closed enclosure of known dimensions at the surface of the foliar tissue, and the CO_2 concentration in the enclosure is compared with the reference value of the gases in the atmosphere. The results for photosynthesis are expressed in μmol $CO_2/m^2/s$-1. Also with this device was recorded the perspiration parameter (mole H_2Om-2 s -1).

RESULTS AND DISCUSSIONS

The main climatic factors that characterize the psamosoil area in Southern Oltenia from an eco-pedological point of view, for a period of 35 years (1980-2016), recorded at the weather station are shown in Table 1 below.

Table 1. Climatic factors that characterize the psamosoil area in Southern Oltenia (1980-2016),

Climate element/ year	Temperature (^{0}C) Average (^{0}C)	Absolute average (^{0}C)	Absolute Minimum (^{0}C)	Rainfall (mm)	Humidity (%)
1	2	3	4	5	6
1982	10.9	36.0	-11.0	522.1	84
1983	10.9	35.5	-13.0	386.2	80
1984	11.6	36.6	-14.7	626.0	84
1985	9.2	40.8	-24.8	417.3	76
1986	10.6	26.0	-16.0	538.1	81
1987	11.0	41.6	-11.8	543.8	83
1988	11.2	40.5	-14.4	552.1	82
1989	11.7	35.8	-16.2	449.1	77
1990	11.7	36.4	-22.0	430.4	81
1991	10.5	35.3	-16.2	600.4	83
1992	11.8	36.8	-14.4	331.1	70
1993	10.2	39.6	-23.6	330.2	76
1994	12.6	39.5	-12.7	441.0	73
1995	11.5	34.7	16.2	538.9	75
1996	11.1	40.2	-17.3	535.6	75
1997	10.8	36.5	-22.0	521.8	74
1998	11.8	38.6	-17.8	649.8	76
1999	12.2	39.9	-17.2	616.1	79
2000	13.0	42.8	-17.2	286.0	74
2001	12.6	39.0	-16.0	593.4	92
2002	12.8	33.6	-16.7	470.1	81
2003	12.2	37.0	-13.8	460.9	-
2004	12.3	36.5	-17.2	437.9	-
2005	12.2	36.8	-23.0	701.5	-
2006	11.5	40.4	-	518.5	-
2007	13.3	43.5	-12.6	641.6	75
2008	12.2	38.4	-22.0	411.0	73
2009	12.1	37.8	-17.3	548.6	80
2010	11.1	38.5	-24.5	710.3	79

The recorded data show that the existing water resources are insufficient for the optimal growth and development of green watermelon plants, the drought being predominant throughout the vegetation period.

The analysis of thermal and hydric resources has highlighted a tendency of drought increase in the recent decades, with unfavourable effects on agriculture, especially in Southern Oltenia.

In 2015, the third decade of April was very warm for this period, but also with precipitations of 53.4 mm, which fell immediately after the planting of the watermelon seedlings in the field, accompanied by hailstones - Table 2.

Table 2. Climate conditions April to July 2015 - 2017

Month	*Specification*	***Temperature (^{0}C)***			***Rainfall (mm)***		
		2015	***2016***	***2017***	***2015***	***2016***	***2017***
April	Decade I	8.5	16.0	11.1	14	9.4	28.0
	Decade II	14.5	16.0	11.7	0	12.0	33.4
	Decade III	14.5	13.1	13.2	53.2	38.8	1.4
	Media	12.5	15.0	12.0	S = 67.2	S = 60.2	S = 62.8
	Minimum	-0.4	0.8	0.4			
	Maximum	29.4	31.4	29.8			
May	Decade I	19.1	13.7	16.0	13.4	67.8	24.8
	Decade II	19.5	16.4	19.4	1.6	17.2	27.8
	Decade III	19.0	20.3	18.0	37.4	19.4	26.0
	Media	19.2	16.9	17.8	S = 52.4	S = 104.4	S = 78.6
	Minimum	8.6	5.5	4.7			
	Maximum	30.2	32.9	31.4			
June	Decade I	21.3	20.2	22.2	19.4	23.0	12.0
	Decade II	22.8	24.0	22.1	83.2	30.2	5.4
	Decade III	17.5	26.6	27.7	31.6	0	0
	Media	20.5	23.6	24.0	S = 134.2	S = 53.2	S = 17.4
	Minimum	10.2	16.9	12.9			
	Maximum	36.1	37.7	41.2			
July	Decade I	24.4	24.3		7.6	20.8	
	Decade II	25.3	24.1		2.4	10.8	
	Decade III	24.7	25.8		1.0	0	
	Media	24.8	24.8	11.1	S = 11.0	S = 31.6	
	Minimum	**12.5**	**11.4**	**11.7**			
	Maximum	**39.8**	**38.0**	**13.2**			

The month of May 2015 was very warm, with average temperatures of 19.2^{0}C and June recorded high temperature fluctuations, with the month average below the multiannual average of the month.

We can conclude that the 2015 climatic year was a less favourable year for the culture of green watermelon, which was reflected in the yields.

Regarding the month of April 2016, although it recorded high temperatures, **a record for this month** (the average of the first two decades is 16^{0}C), the temperatures decreased significantly in the third decade, the average for this decade being 13.1^{0}C, which has delayed the planting of green watermelons in the field.

A very high temperature amplitude can be observed, the maximum being 31.4^{0}C, and the minimum being 0.8^{0}C, considered disturbing for the plants (Figure 1).

In 2017, the months of June and July were particularly hot with a maximum of 41.2^{0}C in June amid a small amount of precipitation, *being declared the drought phenomenon*.

The recorded temperatures are according to the heat necessity of the green watermelons, as a heat - loving plant.

The green watermelons bear more easily the drought, high heat, low humidity in the atmosphere and soil with the lowest hydrothermal coefficient of 0.7- 0.8. The effects of drought have been reported also by other authors on other crops (Babeanu et al., 2008).

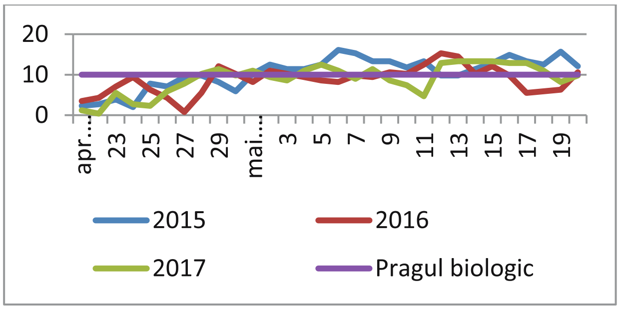


Figure 1. The daily minimum temperatures from April 21 to May 20 (2015-2017)

The normal course of physiological and biochemical processes, essentially the plant growth and development, can only take place in the presence of a certain amount of water.

The water is the predominant element of all the substances that form part of the plant body. This explains why the success of a crop is closely related to the presence of water, which can become a limiting factor, especially if it is taken into account that under normal conditions its existence depends entirely on the precipitation regime in an area.

During the studied period, it was necessary to irrigate the culture in order to satisfy the water needs.

The physiological determinations of the green watermelon plants were performed during the fruit formation phase and there were based on the analysis of the diurnal dynamics of some physiological indices (rate of photosynthesis, transpiration rate and incident photosynthetically active radiation on the leaf surface), and the correlation between them for the grafted plants in comparison to the ungrafted plants (Table 3 and Table 4).

The rate of photosynthesis is determined by the intensity of the photosynthesis process and varies depending on the action of some physiological parameters and the morphological characteristics of the plants.

The photosynthesis of the green watermelon plants follows generally a one-dimensional curve. This has a minimum in the morning that correlates with low light intensity, temperature, and maximum decrease of stomata opening. After midday, a maximum is correlated with the increase in light intensity, temperature and the degree of stomata opening, and a minimum in the evening as a result of diminishing the intensity of the light, the gradual decrease of the temperature, the chloroplast loading with synthesized organic substances, as well as decreasing the degree of opening of stomata.

In this study, **the diurnal flow of photosynthesis** at the *Romanza* cultivar of grafted watermelon plants is similar to that of the ungrafted plants, with slightly higher values throughout the day (Table 3).

It is noted that in the morning (9.00 o`clock) the photosynthesis in grafted plants has values of 12.46 μmol/m$^2$/s, and in ungrafted plants of 10.30 μmol/m$^2$/s, it increases until noon (12.00 o`clock) when the photosynthesis at the grafted plants is 17.74 μmol/m^2/s and 15.38 μmol/m^2/s in the ungrafted plants and decreases slightly in the evening (17.00 o`clock) when the photosynthesis of the grafted plants is 15.41 μmol/m^2/s, and 14.10 μmol/m^2/s for the ungrafted plants. It is observed that the grafted plants of *Oltenia* variety had a much more intense variation of photosynthesis than the grafted plants of the *Romanza* variety.

The value recorded at 9.00 o`clock was 19.33 μmol/m^2/s compared to 12.46 μmol/m^2/s at the same hour of the morning. And during the day the values of *Oltenia* variety were higher than at the grafted plants of the *Romanza* variety. This proves that in the climatic conditions specific to the Southern Oltenia, the *Oltenia* variety has a greater affinity than the *Romanza* variety for the *Macis F1* rootstock, giving to plants higher power to synthesize the nutrients and to capitalize the CO_2 in the atmosphere.

Table 3. The dynamics of the rate of photosynthesis in grafted green watermelon

Variety	Photosynthesis rate ($\mu mol\ CO_2/m^2/s$)			Photosynthetically active radiation ($\mu mol/m^2/s$)		
	9.00	**12.00**	**17.00**	**9.00**	**12.00**	**17.00**
Romanza ungrafted	10.3	15.38	14.10	1006	1890	1805
Romanza grafted	12.46	17.74	15.41	1070	1650	1808
Oltenia ungrafted	10.18	17.53	15.61	1158	1431	1918
Oltenia grafted	19.33	24.69	18.27	1189	1745	1766

The researches on the dynamics of the **incident photosynthetically active radiation** on leaf surface in green watermelon plants (Table 3) underline that *Romanza* has an increase from morning (9.00 o`clock) when values of 1070 $\mu mol/m^2/s$ in grafted plants are recorded and 1006 $\mu mol/m^2/s$ in ungrafted plants, then a growth until noon (12.00 o`clock) when there are recorded 1650 $\mu mol/m^2/s$ in grafted plants and 1890 $\mu mol/m^2/s$ in ungrafted plants, and it was observed that it has values equal or higher than those recorded at noon for the evening (17.00 o`clock) when theoretically this photosynthetically radiation should be decreasing, the incident photosynthetically active radiation was 1808 $\mu mol/m^2/s$ for grafted plants and 1805 moles/ m^2/s for ungrafted plants.

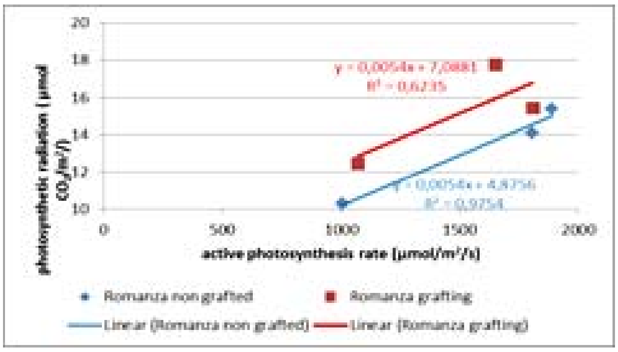
The grafted plants, compared to the ungrafted plants, record higher values of *incident photosynthetically active radiation intensity* on the leaf surface during the morning and evening. In the *Oltenia* variety, the *incident photosynthetically active radiation* on the leaf surface shows an increase starting at 9.00 o`clock in the morning when 1189 $\mu mol/m^2/s$ are recorded in grafted plants and 1158 $\mu mol/m^2/s$ are recorded in ungrafted plants, the increase continuing also at noon (12.00 o`clock) when 1745 $\mu mol/m^2/s$ are recorded in grafted plants and 1431 $\mu mol/m^2/s$ are recorded in ungrafted plants when this increase is quite obvious towards the evening (17.00 o`clock) when the grafted plants record 1918 $\mu mol/m^2/s$, and the ungrafted ones record 1766 $\mu mol/m^2/s$, slightly higher than at noon. This may be explained by the fact that in the afternoon when the temperature should fall, this fact did not happen and for this reason the plants had a high active photosynthetically radiation at 17.00 o`clock. Comparing the two varieties, it can be observed that both the grafted and ungrafted plants obtain values slightly increased or decreased, with no differences between them. The photosynthetic activity remains strictly dependent on seasonal and diurnal changes (fluctuations of light intensity, leaf temperature, temperature and atmospheric humidity (Lakso, 1985, Gruia et al., 2011, Milică et al., (1982) show that the optimal temperatures for an intense photosynthesis range between 20^0C and 37^0C, with some variation depending on the species.

The diurnal variation of the photosynthetic intensity correlates with the active photosynthetic radiation, the correlation coefficient (Pearson) having different values for the grafted plants, compared to the unallowed plants (r = 0,78 in the grafted plants; r = 0,98 in the non-grafted plants). These correlation coefficients show that there is a very strong positive correlation between the rate of photosynthesis and the active photosynthetic radiation, but in the grafted plants the correlation coefficient **r** is smaller.

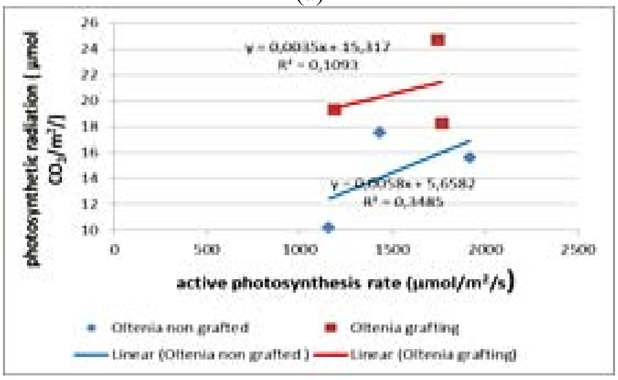
Linear regressions between photosynthetic rate and active photosynthetic radiation reveal a good correlation between the two factors analyzed, the coefficient of determination (R^2) being 0.62 for grafted plants and 0.97 for non-salted plants (Figure 2).

The determination coefficient R^2 indicates that variation of daytime photosynthesis is dependent on the variation of active photosynthetic radiation in the proportion of 98% in grafted plants and 78% in non-grafted plants.

The correlation coefficient (Pearson) in the *Oltenia* variety has different values for grafted plants, compared to unallocated plants (r = 0.33 for grafted plants and r = 0.59 for non-grafted plants).



(a)



(b)

Figure 2. Correlation between photosynthesys rate and photosynthetically active radiation in *Romanza* (a) and *Oltenia* (b) cultivars

A positive correlation is observed between the rate of photosynthesis and the active photosynthetic radiation, in the correlated coefficient of grafting plants having a lower value than the unaltered ones. Linear regressions between the two factors highlight a good correlation, the determination coefficient (R^2) being 0.10 for grafted plants and 0.34 for non-grafted plants (Figure 2).

This coefficient indicates that variation of daytime photosynthesis is dependent on 10% photosynthetic radiation variation in grafted plants and 34% on non-grafted ones.

The transpiration rate is determined by the intensity of the transpiration process, which varies depending on certain physiological parameters and plant characteristics.

Due to the concurrent action of external and internal factors, the transpiration of the green watermelon plants follows an unimodal curve that exhibits a minimum in the morning correlated with a minimal opening of the stomata and diminishing the air dehydration power, a maximum after lunch correlated with the photoactivity increase of the degree of opening of the stomata as a result of the increase of the light intensity, the temperature and the dehydration power of the air and a minimum towards the evening correlated with the decrease of the light intensity and temperature.

The photosynthetically active radiation represents the part of the electromagnetic spectrum that induces photosynthesis and includes radiations with a wavelength ranging between 400 and 700 nm (Pazuki et al., 2017).

They play a role in inducing photosynthesis, as well as transpiration by determining photoactive stomatic opening movements and by increasing the temperature of the leaves.

The temperature, together with the intensity of solar radiation, is the main external factor that influences the photosynthesis and transpiration processes.

The temperature of plants generally depends largely on the ambient air temperature, as well as on the intensity of transpiration that limits the plant temperature.

The increase in the temperature of the environment leads to an increase in the temperature of the leaves, which is correlated with the increase of the transpiration intensity. The temperature also acts on the transpiration of plants by increasing the atmospheric vapors deficiency, the leaf temperature and the permeability of the water protoplasm.

By increasing the air temperature, the relative humidity of the air decreases, as a result the difference between the pressure of the water vapors in the environment and that of the substomatic chamber increases, which leads to the increase of the transpiration process.

As the relative humidity of the air decreases, the water vapors pressure deficiency increases, correlated with the intensification of the transpiration process. The plant water deficiency decreases the intensity of the transpiration.

The moderate soil humidity determines the water absorption by the roots, transporting it to the leaves and consequently intensifying the transpiration process.

The researches on the air temperature dynamics at the moment of carrying out the physiological analyses (Table 4) show an increase from morning (9.00 o`clock) when values of 27.9°C are recorded, at noon (13.00 o`clock) when the values are of 36.2°C, a further increase of the temperature in the evening (17.00 o`clock) when the values are of 38.7°C, and after which the temperature begins gradually to decrease.

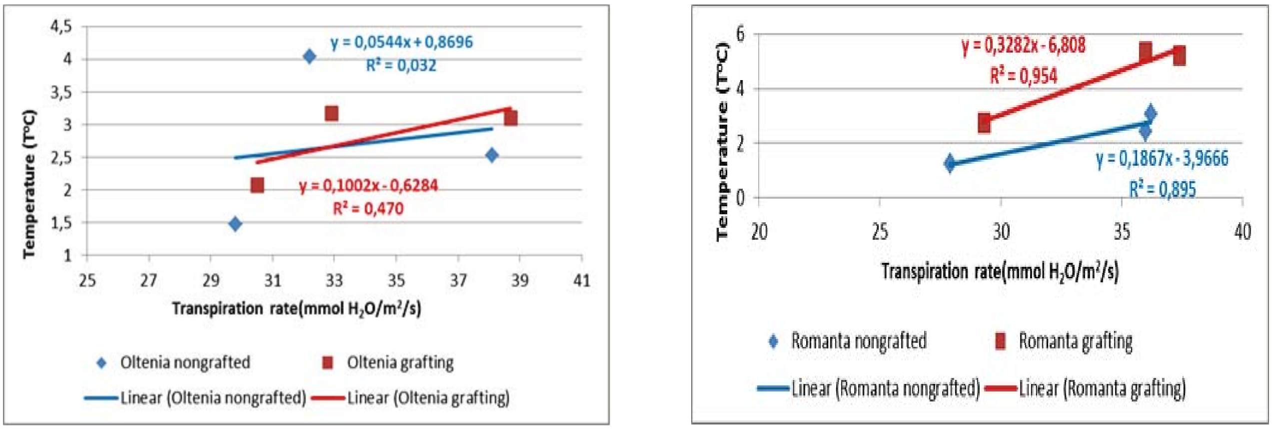
The diurnal green watermelon plants transpiration has generally a minimal value in the morning, correlated with the low light intensity, low temperature and air dehydration power decrease, a maximum after noon correlated with the photo activity degree increase in stomata opening due to the growth of the light intensity, air temperature and dehydration power, and a minimum towards evening correlated with the reduction in the degree of opening of the stomata as a result of the decrease of the light intensity and temperature.

The values recorded in grafted plants in both varieties are higher or equal than those recorded in ungrafted plants (table 4, figure 3).

Also in this study correlations and regressions were made between the rate of transpiration and the active photosynthetic radiation both for the grafted plants and for the non-grafted for the two varieties, *Romanza* and *Oltenia* (figure 4).

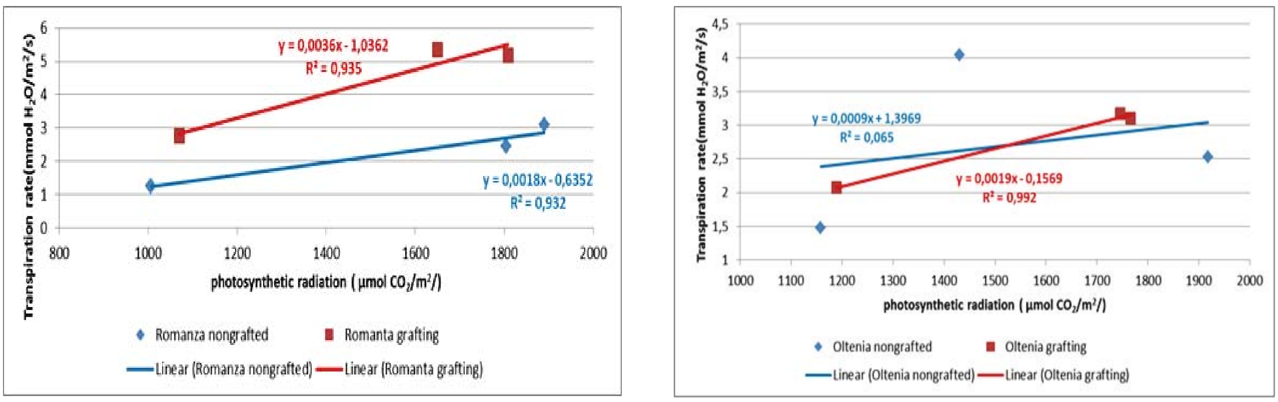
Table 4. The daily variation of foliar transpiration in the varieties of the grafted green watermelons

Variety	T°C	Foliar transpiration (mmol $H_2O/m^2/s$)	T°C	Foliar transpiration (mmol $H_2O/m^2/s$)	T°C	Foliar transpiration (mmol $H_2O/m^2/s$)	Daily average transpiration rates (mmol $H_2O/m^2/s$)
	9.00 o`clock		**13 o`clock**		**17 o`clock**		
ungrafted *Romanza*	27.9	1.25	36.2	3.09	36.0	2.45	2.26
grafted *Romanza*	29.3	2.75	36.0	5.34	37.4	5.19	4.42
ungrafted *Oltenia*	29.8	1.48	32.2	4.04	38.1	2.53	2.35
grafted *Oltenia*	30.5	2.07	32,9	3.17	38.7	3.10	2.78



(a) (b)

Figure 3. The correlation between transpiration rate and temperature in *Oltenia* (a) and *Romanza* (b) watermelon plants



(a) (b)

Figure 4. The correlation between transpiration rate and active photosynthetic radiation in Romanza and Oltenia watermelon plants

The diurnal variation of the perspiration intensity correlates with the photosynthetic radiation, the correlation coefficient (Pearson) in the *Romanza* variety did not have different values for the grafted plants compared to the non-salted plants (r = 0.96 for grafted plants; r = 0.96 to non-salted plants). This shows the existence of a positive correlation between transpiration rate and active photosynthetic radiation.
Linear regressions between transpiration rate and active photosynthetic radiation reveal a good correlation between the two factors analyzed, the coefficient of determination (R^2) being 0.93 for both grafted plants and non-salted plants (Figure 3).
The R^2 determinant determines that variation in daytime sweating is dependent on the 93% high photoprotectant radiation variation, both for grafted plants and non-grafted plants.
The correlation coefficient (Pearson) in the *Oltenia* variety did not have very different values for grafted plants, compared to non-grafted ones (r = 0.99 for grafted plants; r = 0.25 for non-grafted plants).
This shows the existence of a positive correlation between transpiration rate and active photosynthetic radiation. Linear regressions between transpiration rate and active photosynthetic radiation highlight a good correlation between the two factors analyzed, the coefficient of determination (R^2) being 0.99 in the grafted plants and 0.06 in the non-grafted ones (Figure 4).
The R^2 determinant shows that variation of daytime sweat is dependent on the variation of active photosynthetic radiation in a very large proportion of 99% in both grafted plants and 25% in non-salted plants.
This is probably due to the root system very well developed for grafted plants, which absorb a large amount of water and mineral salts.
The existing correlations between environmental factors and physiological parameters can serve for the compositional determination of grafted or ungrafted varieties, with an increased rate of adaptation to climate change, thus avoiding production losses.

CONCLUSIONS

As a result of the researches carried out, it is advisable, under the conditions of the obvious climatic changes, to choose the species and varieties with maximum photosynthetic potential because they are drought tolerant and resistant.
In the fruit maturing phase, which corresponds to June and July, the climatic conditions were favourable for the culture of the green watermelons (144.2 mm precipitation, maximum temperatures of 36.1°C - 39.20°C).
During the intense growth of plants and fruits, normal temperatures were recorded for that period of time, and the soil moisture was maintained at normal values of rainfalls through irrigation.
Comparing the two studied varieties, we can observe that both the grafted and ungrafted plants have a photosynthetic activity which remains strictly dependent on the seasonal and diurnal changes, the values obtained being slightly high or low, with no differences between them.
The foliar transpiration rate is higher for the varieties of the grafted green watermelon grown on sandy soils under the influence of the air temperature and soil.
By plant grafting and advised choosing of the cultivar, you can reduce the growing season of the crop without affecting the nutritional quality of the fruit, avoiding the very high temperatures and drought period that can influence both production and quality.
The stimulation of the cultivation of the grafted green watermelon in Southern Romania remains directly dependent on the existence of irrigation systems in the area, *offering to the producers a niche of ecological adaptation*.
It can be concluded that it is still difficult to determine strictly the individual effect of environmental factors on the cultivated plants, since in nature it is not possible to modify a factor without changing other factors.
The challenges of climate change and variation require the development of technological solutions on the adaptation measures at local, regional or national level, only by adopting low cost and environmental friendly policies.

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REFERENCES

Becherescu Alexandra, Horgoş A., Dinu Maria, Popa D., Drăgunescu Anca, 2017, Photosynthetic stimulation and its influence on the productive output increase in tomato hybrids, JOURNAL of Horticulture, Forestry and Biotechnology, Volume 21(2), 146- 153, www.journal-hfb.usab-tm.ro

Babeanu C., Constantin C., Tuta C., 2008. The effects of water stress on antioxidant system in wheat leaves. Annals of the University of Craiova, The Chemistry Series, XXXVI: 75-78

Bordun C., (Floarea-Gabrian), Cîmpeanu SM., 2017, Remote sensing for desertification monitoring in Braila County. Scientific Papers. Series E. Land Reclamation, Earth Observation & Surveying, Environmental Engineering, 5:163-168.

Ciuciuc Elena, 2003 – Cercetări privind influenţa vârstei răsadului de pepeni verzi şi pepeni galbeni asupra timpurietăţii şi producţiei. Lucrări ştiinţifice SCDCPN Dăbuleni, vol. XV:191-196

Ciuciuc Elena, Toma V., Croitoru Mihaela, 2007 – Cercetări privind influenţa altoirii asupra pepenilor verzi cultivaţi în diferite condiţii de protejare. Lucrări ştiinţifice SCDCPN Dăbuleni, vol. XIV: 114 -124.

Ciuciuc Elena, 2016 – The study quantitative and qualitative characters in selection process conservative at the Oltenia watermelon. Sustenable exploitation of environmental resources in areas with sandy soils - Anals of the Research-Development Center of Field Crops on Sandy Soils, Dăbuleni, vol. 20H Ed. SITECH, ISSN 2360-0829, ISSN-L 2360-0829, pg.15-20.

Ciupureanu MG., Popa DV., Ciuciuc E., Pintilie I., Dinu M., 2016. Production characteristics of a watermelon variety grown under the pedoclimatic conditions of Southern Oltenia. Journal of Horticulture, Forestry and Biotechnology 0(1):78-82.

Dinu M., Cimpoiaşu V.M., 2006 The grafting of *Cucumis melo* L. by pin pricking. the technological stages. Analele Universității din Craiova, Facultatea de Agricultură, Montanologie, Cadastru, 2006, pag. 93-96.

Dinu Maria, Soare Rodica, 2015. Noţiuni teoretice şi practice de legumicultură ecologică. Editura Universitaria Craiova.

Dodocioiu Ana Maria, 2005 - Nitratii un pericol? Studiu in judetul Dolj. Editura Sitech.

Gruia M., Baciu A., Cosmulescu S.,2011. The environmental factors and their influences on main physiological processes on apple trees. JOURNAL of Horticulture, Forestry and Biotechnology, 15(2):152-156.

Hoza G., Doltu M., Dinu M., Becherescu, AD., Apahidean Al.I., Bogoescu M., 2017. Response of Different Grafted Eggplants in Protected Culture. Not Bot Horti Agrobo, 45(2): 473- 480.

Lakso A., 1985. The effects of water stress potential on physiological processes in fruit crops. Acta Horticulturae (ISHS). 171: 275-290.

Leea JM., Kubotab C., Tsaoc SZ., Bied Z., Echevarriae H., Morraf L., Oda M., 2010. Current status of vegetable grafting: Diffusion, grafting techniques, automation, Scientia Horticulturae, Volume 127(2): 93-105.

Milică C.I., Dorobanțu N., Nedelcu P., Baia V., Suci T., Popescu F., Teșiu V., Molea I., 1982. Fiziologia vegetală, Editura Didactică și Pedagogică, București, pag.133-185.

Ochieng J., Kirimi L., Mathenge M., 2016. Effects of climate variability and change on agricultural production: The case of small scale farmers in Kenya, NJAS - Wageningen Journal of Life Sciences,77: 71-78.

Pazuki A, Aflaki F, Pessarakli M, Gurel E, Gurel S (2017) Plant Responses to Extended Photosynthetically Active Radiation (EPAR). Adv Plants Agric Res 7(3): 00260. DOI: 10.15406/apar.2017.07.00260

Popa D., Coyne M., 2007. Soil Microbiology: The Life Beneath Your Feet, Instant Publisher.com, U.S.A.

Rotman AL., 2015. Global Warming Between Reality, Approach and Acceptance. Scientific Papers. Series E. Land Reclamation, Earth Observation & Surveying, Environmental Engineering, 4:19-24.

Schwarz D., Rouphael Y., Colla G., Venema J.H., 2010. Grafting as a tool to improve tolerance of vegetables to abiotic stresses: Thermal stress, water stress and organic pollutants, Scientia Horticulturae, Volume 127(2): 162-171.

Toma V., Diaconu A., Ciuciuc E., Croitoru M., Ploae M., Rățoi I., Nanu Șt., Lascu N., Hănescu V., Șandru L., 2011. Cultura ecologică a pepenilor verzi cu plante altoite pe solurile nisipoase. Editura SITECH, Craiova.

Toma Vasile, Rățoi Iulian, Vladu Cristina Emanuela, 2016, Cercetări privind comportarea unor cultivaruri de pepeni verzi pe solurile nisipoase din sudul Olteniei / Research on behaviour of cultivars of watermelon on sandy soils from southern Oltenia, Sustainable Exploitation of Environmental Resources in Areas with Sandy Soils, Annals of the Research - Development Center for Field Crops on Sandy Soils, Dabuleni, vol.20^{th} , pg 126-139.

https://www.agerpres.ro/economie