PRELIMINARY RESULTS ON THE INFLUENCE OF THE F414 BIOLOGICAL PRODUCT ON SOME PHYSIOLOGICAL INDEXES FOR PEACHES GROWN UNDER THERMO-HYDRIC STRESS

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ABSTRACT

On the peach species, *Springold* variety, research was conducted on the influence of the F414 biological product on some physiological indexes and processes carried out on the foliar level, the area of culture being characterized by an accentuated thermo-hydric stress during the summer. Photosynthetic gas exchange, foliar transpiration and stomatal conductance were determined with the portable LC PRO + apparatus, and the leaf water forms were determined gravimetrically, the results obtained being correlated with the meteorological data from the vegetation period. Applying the F414 to the *Springold* variety resulted in the formation of a pellicle on the surface of the leaves, which, together with the action of the thermo-hydric stress specific to the area, caused stomate closure, reduction of CO_2 supply, photosynthesis values being considerably lower compared to the control variant. As for foliar transpiration, the F414 product had a positive effect, the pellicle formed on the surface of the leaves, reducing the amount of water lost to the foliage. The application of this product has positively influenced drought resistance of the *Springold* variety, the percentages of the bound water being higher (5.1%) compared to the control variant (3.96%).

Keywords: *peach, thermo-hydric stress, physiological indexes*

INTRODUCTION

The current climatic changes, which, according to experts, will be more and more pronounced in the coming decades, obviously affect the biology of horticultural species, especially perennial wood species, such as, for example, fruit trees. The risk of desertification is a real phenomenon in Romania and is closely related to the evolution of the climate [8]. The values of the Thornthwaite aridity index define an arid area, increasing from north to south and south-west of Oltenia, from 45% to 50%. The highest values expressing pronounced aridity (about 65%) also cover the area of sandy soils in southern Oltenia [4]. This area, therefore, has a natural background favouring a significant drought impact on plants. The plants bear a temperature rise of 5-10 ºC above the optimal temperature, and temperatures higher than 12-15 ºC show the effects of thermal stress [7]. During the vegetation period plants are exposed not only to the effects of high temperatures but also to longer or shorter drought periods. Water is a particularly important abiotic factor that influences plant metabolism. Water stress is widespread and is the most important factor limiting production in most crop plants [1]. The response of fruit trees to water stress is lower than that of annual plants, and varies with the species, organ and production phenophase [6]. The action of the thermo-hydric stress, as well as the action of different chemical and biological substances used in phytosanitary treatments in fruit trees can be appreciated by the level with which the values of the main physiological and biochemical indicators of the plants exposed to these factors change. Bioproducts are biological means made on the basis of natural compounds (plant extracts) with complex action on crop plants, bioproducts that have been shown to be stimulants for vegetative growth [9], [10]. Taking into account these considerations, the present research has proposed to know the mode of action of the F414 biological product on peach, the Springold variety, regarding the influence of this product on some physiological indexes and processes developed at the foliar level, the area of culture (the sandy soils in southern Oltenia) being characterized by an accentuated thermo-hydric stress during the summer.

MATERIALS AND METHODS

The studies were conducted during the peach vegetation period (the year 2017) at Research – Development Station for Plant Culture on Sands, Dabuleni, Romania, within the plant physiology laboratory. *Springold* peach variety was used as study material in two experimental variants. In the first variant (control) phytosanitary treatments were applied according to the peach culture technology on sandy soils, and in the second experimental variant was additionally added treatment with the F414 biological product. Photosynthetic gas exchange, foliar sweat and stomatal conductance were determined directly in the experimental field with the LC PRO + portable device, both on the sunny side of the trees and on the shaded side. The water forms in the leaves (total water, free, bound) were determined gravimetrically in the laboratory. The results obtained were correlated with the meteorological data recorded at the weather station of Dabuleni RDSPCS, during the period April-October 2017. To determine the intensity of the thermo-hydric stress on the peach trees, the experimental determinations were made in two critical moments for the area of sandy soils in southern Oltenia, the first decade of August and September.

RESULTS AND DISCUSSIONS

Experimental determinations made on peach (*Springold* variety) have highlighted a diurnal variation in photosynthesis and foliar transpiration processes, these processes being influenced by the temperature and amount of active radiation in photosynthesis, the relative air humidity at the time of the determinations, the amount of rainfall, of treatments applied in vegetation. From the climatic point of view, the April-October 2017 period is presented in Table 1.

Table 1. *Climate conditions between April and October 2017 recorded at the RDSPCS Dabuleni weather station.*

Month	IV	V	VI	VII	VIII	IX	X
Medium temperature (°C)	12	17.8	24	24.8	24.8	20.2	13.4
Maximum temperature (°C)	29.8	29	41.2	40.8	40.4	36.9	29.4
Minimum temperature (°C)	0.4	4.7	12.9	13.3	11	6.7	2.7
Precipitations (mm)	62.8	78.6	17.4	120.8	28.8	18.2	120.4
Atmospheric relative humidity (%)	72	77	67	65	63	66	80
Sum of temperature degrees (°C)	360	551.8	720	768.8	768.8	606	415.4
Multiannual medium temperature (1956-2016)	11.8	16.8	21.6	23.1	22.4	17.8	11.4
Sum of monthly multiannual precipitations (1956-2016)	47.52	62.12	69.3	53.15	37.28	41.81	41.81

From the data presented, it can be observed that during the analyzed period, the air temperature is constantly increasing, the monthly average values exceeding the multiannual average of the temperature. Very warm were the summer months, June, July, and August, with average temperatures between 24 – 24.8 °C and maximum air temperature between 40.4 – 41.2 °C. Due to the atmospheric drought, these high temperatures led to thermo-hydric stress conditions, which influenced the fruit trees metabolism, the drought period extending until September. Although the sum of the annual rainfall was higher than the multiannual sum, they were unevenly distributed, from very small amounts of about 10 mm to 100 mm in just 2-3 days. An example of this is June, when 98.8 mm precipitations were recorded in the first three days of the month, followed by very long periods (28 days) with very high temperatures and no precipitation. Globally, one of the challenges faced by fruit production is the fact that the regional climate is increasingly unpredictable from year to year. Therefore understanding the effects of drought, extreme temperatures, light, etc. on metabolic processes in plants is very important. In correlation with the studied factors, the climatic conditions of 2017 directly influenced the development of physiological processes at the *Springold* peach variety cultivated on sandy soils. In the same area of culture, it was demonstrated that as the average temperature of this area increased, the late Jerseyland and Redhaven peach-trees began to mature their fruit about 12 days earlier, and the tendency to reduce the vegetation period is significant [2]. From a physiological point of view, the application of the F414 biological product was aimed at protecting the leaf surface from intense solar radiation by means of the hydro-active pellicle, the pellicle deposited on the leaves having a high reflectance when is dry and increased absorbance when is wet. However, in the climatic conditions characteristic of the sandy soils in southern Oltenia, the application of the F414 product led to the formation of the pellicle on the surface of the leaves which, together with the action of the thermo-hydric stress specific to the area, caused stomata closure, reduction of the supply of CO_2, and obtaining leaves with a reduced assimilation surface with repercussions on the photosynthetic yield (tables 2 and 3).

Table 2. *Diurnal variation of physiological processes at Sprindold variety cultivated under thermo-hydric stress conditions (August 2, 2017).*

Hour	Experimental variant	Prunus persica, Springold variety				
		Photosynthetic active radiation µmol/m²/s	Air temperature °C	Photosynthesisµmol $CO_2/m^2/s$	Foliar transpirationmmol $H_2O/m^2/s$	Stomatal conductance of H_2O mol/m²/s
9 o'clock	Control variant	762	30.1	12.05	2.26	0.28
	Biotreatments with F414 bioproduct	667	30.1	4.02	1.98	0.18
12 o'clock	Control variant	942	30.1	11.23	1.62	0.16
	Biotreatments with F414 bioproduct	849	31.8	5.00	1.10	0.07
15 o'clock	Control variant	877	38.7	5.16	2.48	0.05
	Biotreatments with F414 bioproduct	885	38.9	1.19	1.61	0.03

From the data presented in table 2 and table 3, it results that in both analyzed phenophases the photosynthesis process was influenced both by the climatic factors in the area and by the substances used for the treatment of fruit trees. The photosynthesis values were considerably lower at the F414-treated variant in almost all times of the determinations, as compared to the control variant. The interaction between the thermo-hydric stress and the F414 product, applied on the leaves has led to a reduction in the carbon dioxide assimilation rate as a result of the drop in conductivity of the stomata. In the area of sandy soils, temperatures above 35 °C and relative humidity below 30% act as desiccant forces on plants, increasing foliar transpiration rate [3]. In the case of leaves treated with product F414, reducing the conductivity of stomata had a positive effect on foliar transpiration, closing of stomata, reducing the loss of plant water.

Table 3. *Diurnal variation of physiological processes at Sprindold variety cultivated under thermo-hydric stress conditions (September 7, 2017).*

Hour	Experimental variant	Prunus persica, Springold variety				
		Photosynthetic active radiation µmol/m²/s	Air temperature °C	Photosynthesisµmol $CO_2/m^2/s$	Foliar transpirationmmol $H_2O/m^2/s$	Stomatal conductance of H_2O mol/m²/s
9 o'clock	Control variant	807	25,7	6,97	2,91	0,31
	Biotreatments with F414 bioproduct	746	26,4	3,66	1,87	0,14
12 o'clock	Control variant	814	24,8	4,73	0,93	0,09
	Biotreatments with F414 bioproduct	791	26,4	3,44	1,8	0,17
15 o'clock	Control variant	689	35,1	3,56	1,95	0,05
	Biotreatments with F414 bioproduct	651	35,6	7,5	2,79	0,08

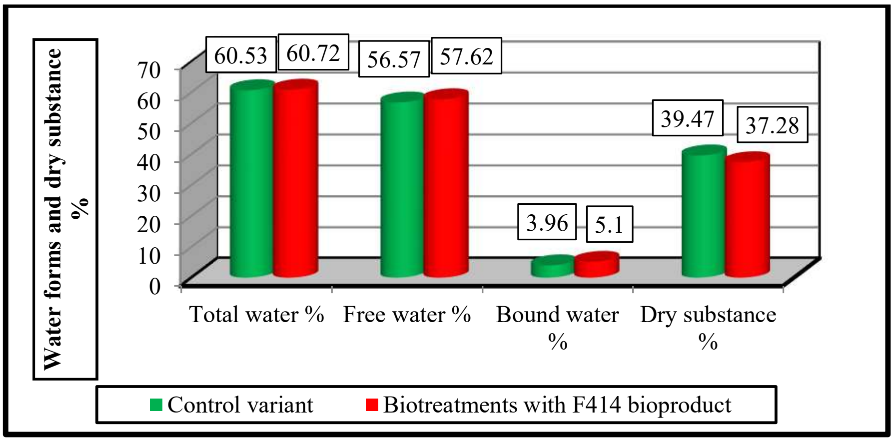

Fig. 1. *Water forms and dry substance from peach leaves grown under thermo-hydric stress*

Analyzing figure 1, it is noticeable that leaves of the *Springold* peach variety have been subjected to severe water stress. The percentage values of total water, free water and leaf-bound water were higher at the variant treated with F414. Of note is the percentage of bound water, which was 1.14% higher, indicating that application of F414 to peach has impressed increased resistance of plants to thermo-hydric stress. Similar research by Escobar-Gutierrez (1998) pointed out that the moderate water stress caused the relative water content of the peach leaves to drop from 74% to 70% and under severe water stress, the relative water content decreased to 67% [5]. Regarding the dry substance, its highest values (39.47%) were shown by the control variant, which is explained by the higher values of photosynthesis recorded in the untreated *Springold* variety with product F414.

CONCLUSION

The intensity of the physiological processes recorded at the *Springold* peach variety was influenced both by the climatic factors specific to the southern area of Oltenia and by the phytosanitary treatments applied during the vegetation period.

Under conditions of thermo-hydric stress, with temperatures above 38 ºC and insufficient rainfall, the application of the F414 biological product led to the formation of a hydroactive pellicle on the surface of the leaves, reducing the stomatal conductance of H_2O.

Stomata closure reduced the carbon dioxide assimilation rate, and photosynthesis values were considerably lower in the variant where F414 biotrataments were applied. On the other hand, the percentages of the dry substance increased directly in proportion to the photosynthesis values, being higher by 2.19% for the control variant.

As for foliar transpiration, the F414 product had a positive effect, the pellicle formed on the surface of the leaves, reducing the amount of water lost at the foliage level. The application of this product has positively influenced drought resistance of the Springold variety, the percentages of the bound water being higher (5.1%) compared to the control variant (3.96%).

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