BIOSTIMULANTS EFFECTS ON PHOTOSYNTHESIS PROCESS TO BASIL PLANTS

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Abstract

Biostimulants are natural or synthetic substances that can be applied to seeds, plants, and soil. These substances cause changes in vital and structural processes in order to influence plant growth through the improvement of tolerance to abiotic stresses and increase seed and/or grain yield and quality. In addition, biostimulants reduce the need for fertilizers. Sweet basil is one of the most widespread spices in the world. Its dried leaves are used commonly as a flavoring in many food products. Biostimulants have the capacity to improving quality and quantity of essential oils from basil plants by stimulating physiological processes such as photosynthesis. This research was conducted to determine the effects of two biostimulants on photosynthesis processes of two basil cultivars, in greenhouse conditions. This study was carried in 2021 at the ICAM (*Research Institute for Agriculture and Environment*) Iasi under greenhouse condition. The biological material was represented by two basil cultivars (*Ocimum citriodorum* and *Ocimum basilicum var. gigante napoletano*). The bifactorial experience was conducted in a pots experiment in randomized blocks with three repetitions. The application of biostimulants (*Bactamin* and *Terra-Sorb*) was done every seven days by foliar spraying throughout the vegetation period. Research was focused on the influence of biostimulants on the photosynthesis process. Plants treated with biostimulants had higher values of the total chlorophyll content compared to the control group, which demonstrates an intensification of the photosynthesis process. The yield of the *Bactamin* stimulator gives better results in terms of the increase in chlorophyll content in the varieties studied and as a result, will also increase the production in essential oil.

Key words: basil, biostimulants, photosynthesis

Biostimulants are among the natural preparations that improve the general health, vitality and growth of plants. These substances protect plants against diseases caused by certain pathogens. The main active substances used in such preparations are fulvic acids, hydrolyzed proteins, nitrogen-containing compounds, seaweed extracts, fungi and beneficial bacteria (Du Jardin P., 2015).

The use of natural preparations that are not harmful to the environment began to become increasingly important as soil degradation processes and air pollution began to increase progressively, thus providing an overview of the importance and influence of various natural biostimulants. of plants on both yield and crop quality (Dobrek M. *et al*, 2019).

In small concentrations, these substances are efficient, enhancing nutrition efficiency, abiotic stress tolerance, and crop quality traits, regardless of its nutrients content. These substances when applied exogenously have similar actions to the groups of known plant hormones, whose main ones are auxins, gibberellins, and cytokinins (Yaronskaya E. *et al*, 2006).

Sweet basil is one of the most widespread spices in the world. Its dried leaves are used commonly as a flavoring in many food products. A number of different types of basil oil have found and achieved economic importance (Makri O. *et al*, 2008). Biostimulants have the capacity to improving quality and quantity of essential oils from basil plants by stimulating physiological processes such as photosynthesis (Moghaddam A. *et al*, 2011).

MATERIAL AND METHOD

This study was carried in 2021 at the ICAM (*Research Institute for Agriculture and Environment*) Iasi under greenhouse condition, and the laboratory analyzes were performed in the plant physiology laboratory within IULS Iasi, Romania.

The biological material was represented by two basil cultivars (*Ocimum citriodorum* and *Ocimum basilicum var. gigante napoletano*). The bifactorial experience was conducted in a pots

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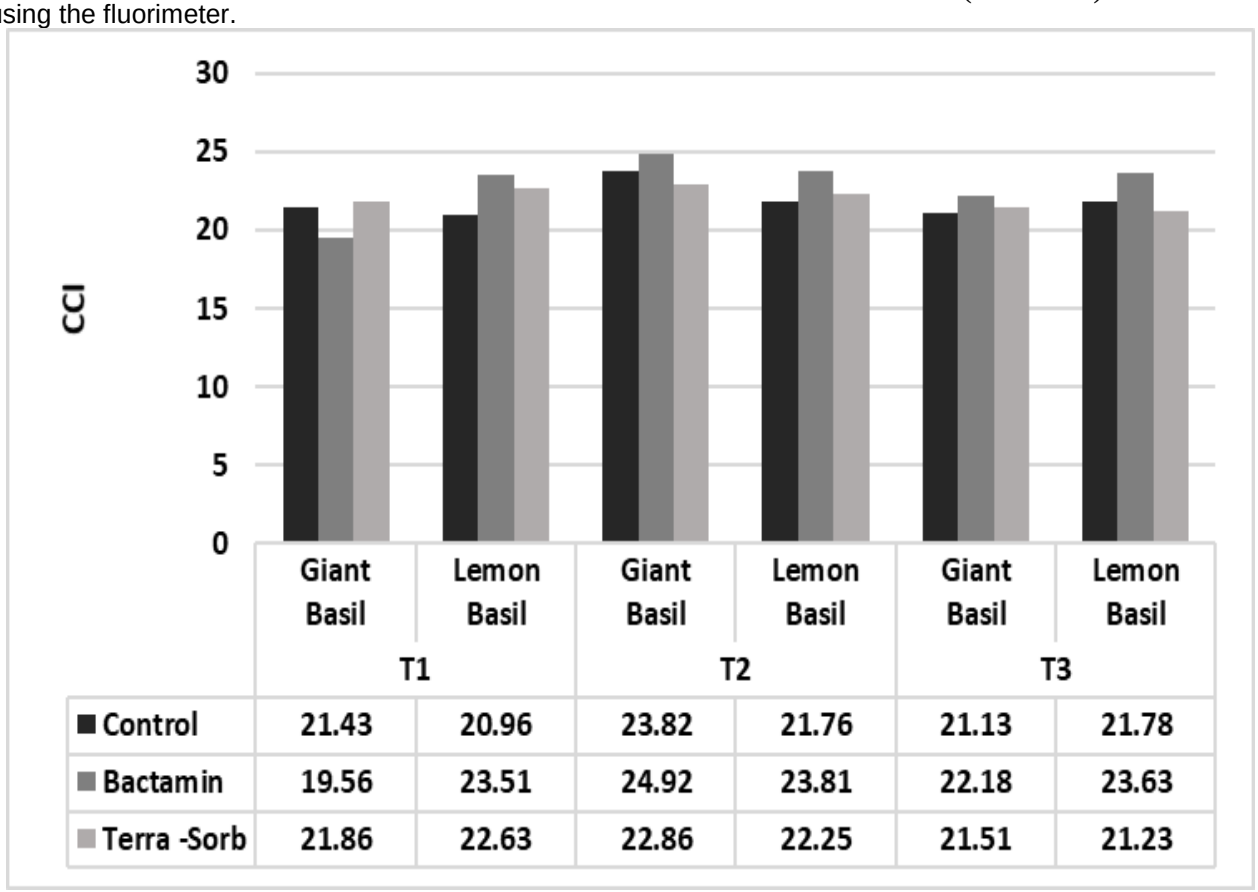
experiment in randomized blocks with three repetitions. The application of biostimulants (*Bactamin* and *Terra-Sorb*) was done every seven days by foliar spraying throughout the vegetation period (3 treatments T1, T2, T3). Research was focused on the influence of biostimulants on the photosynthesis process. This physiological process was monitored by the total chlorophyll content of the leaves measured with the CCM device, we also determined the content of chlorophyll pigments and leaf flavonoids by the spectrophotometric method and also during the vegetation period we also monitored the fluorescence of the chlorophyll using the fluorimeter.

RESULTS AND DISCUSSIONS

The average amount of chlorophyll was measured at intervals of seven days after the application of biostimulants. Higher values of the total chlorophyll content are observed in the variants treated with biostimulants (*figure 1*). After the first treatment, the highest values were recorded for lemon basil in the version treated with *Bactamine* (23.51 CCI), and for giant basil in the version with *Terra-Sorb* (21.86 CCI)..



	T1		T2		T3	
	Giant Basil	Lemon Basil	Giant Basil	Lemon Basil	Giant Basil	Lemon Basil
Control	21.43	20.96	23.82	21.76	21.13	21.78
Bactamin	19.56	23.51	24.92	23.81	22.18	23.63
Terra -Sorb	21.86	22.63	22.86	22.25	21.51	21.23

Figure 1 **The influence of biostimulants on the total chlorophyll content expressed in CCI units**

Seven days after the application of the third treatment, the plants treated with *Bactamine* are again noticed, registering the highest chlorophyll content. The giant basil variety showed the lowest value in the control plants (21.13 CCI), and the lemon basil in the plants from the *Terra-Sorb* group (21.23 CCI) (*figure 1*)

The content of assimilating pigments was assessed by the intensity of light energy absorption with the help of 1% acetone pigment extract, determined by spectrophotometric method and expressed in absorbance units. The spectrophotometrically analysis of the pigments content to the basil leaves was performed after the application of the three treatments with biostimulants, before flowering.

The highest chlorophyll content of 662-663 nm was recorded in plants treated with growth stimulants. The lemon basil variety presented the highest content (1.75 u.a.) in plants treated with *Terra-Sorb*. The giant basil recorded the highest content in the group treated with *Bactamine* (1.45 u.a.). Although the differences regarding the chlorophyll content of 662 nm were not significant between the variants, we mention that the plants from the control group had the lowest values (*figure 2)*. These results show that biostimulants, rich in amino acids and saccharides, facilitate the absorption of light energy, which will later be transformed into potential chemical energy, thus allowing plants to increase their productive potential.

The chlorophyll content of 431-432 nm, the main component of the absorption center, with a role in capturing light energy and transferring it to the reaction center, remained under the same trend as the chlorophyll of 662-663 nm.

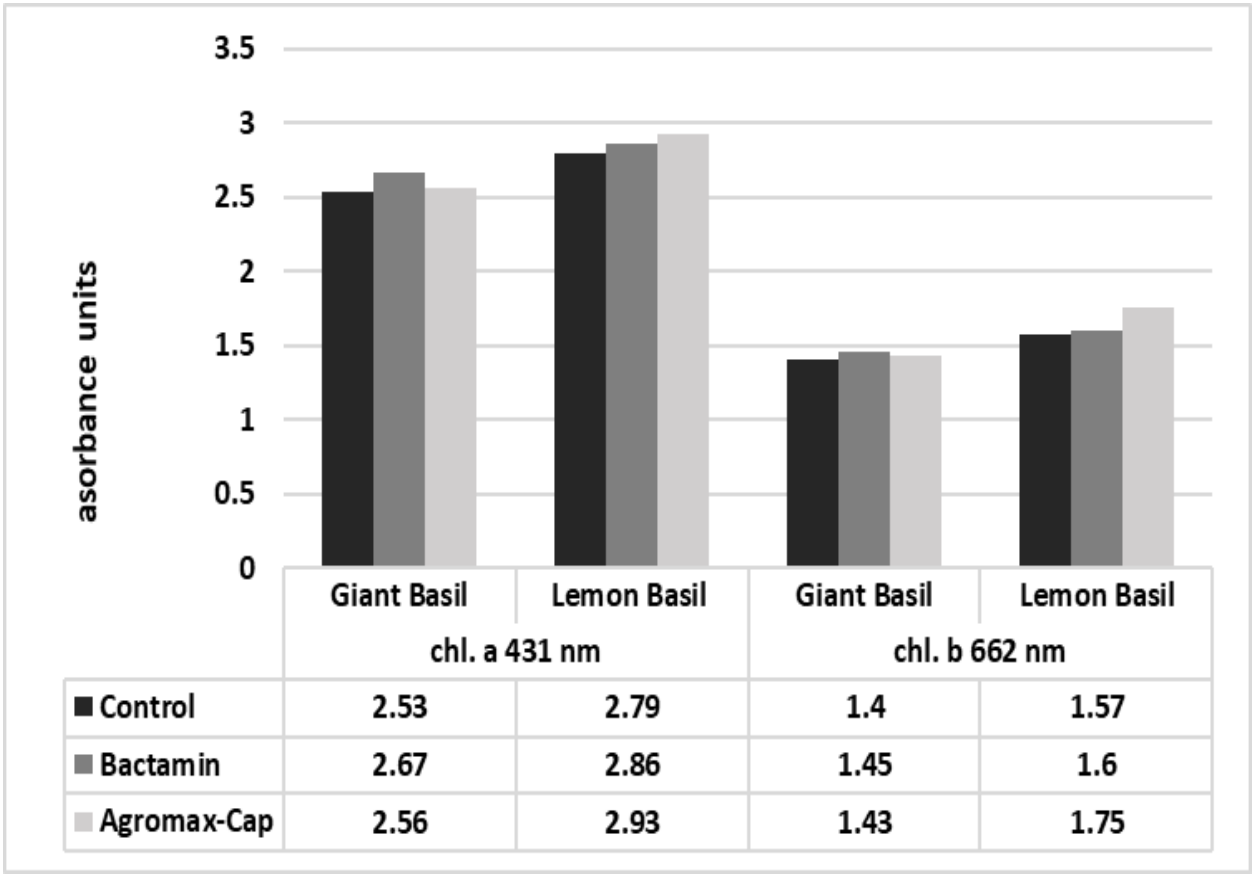
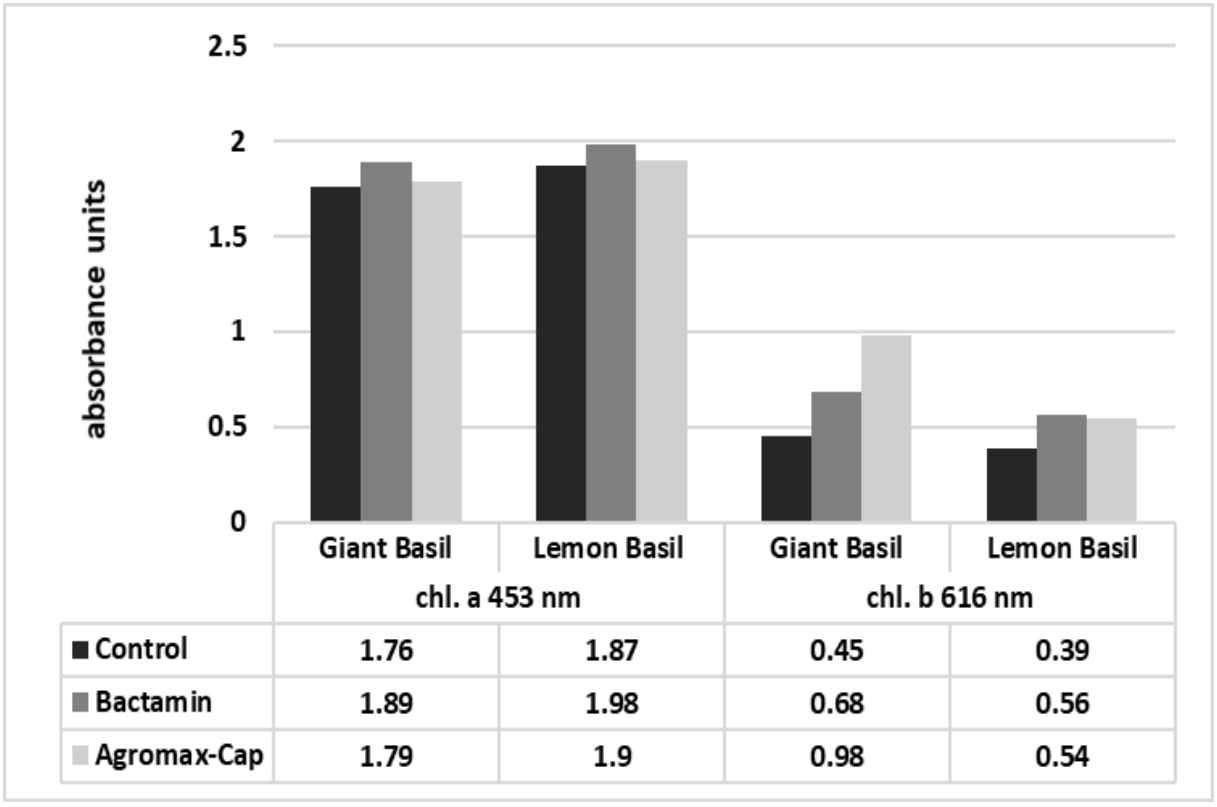


Figure 2 **The influence of biostimulants on the chlorophyll a 431 nm and chlorophyl b 662 nm**

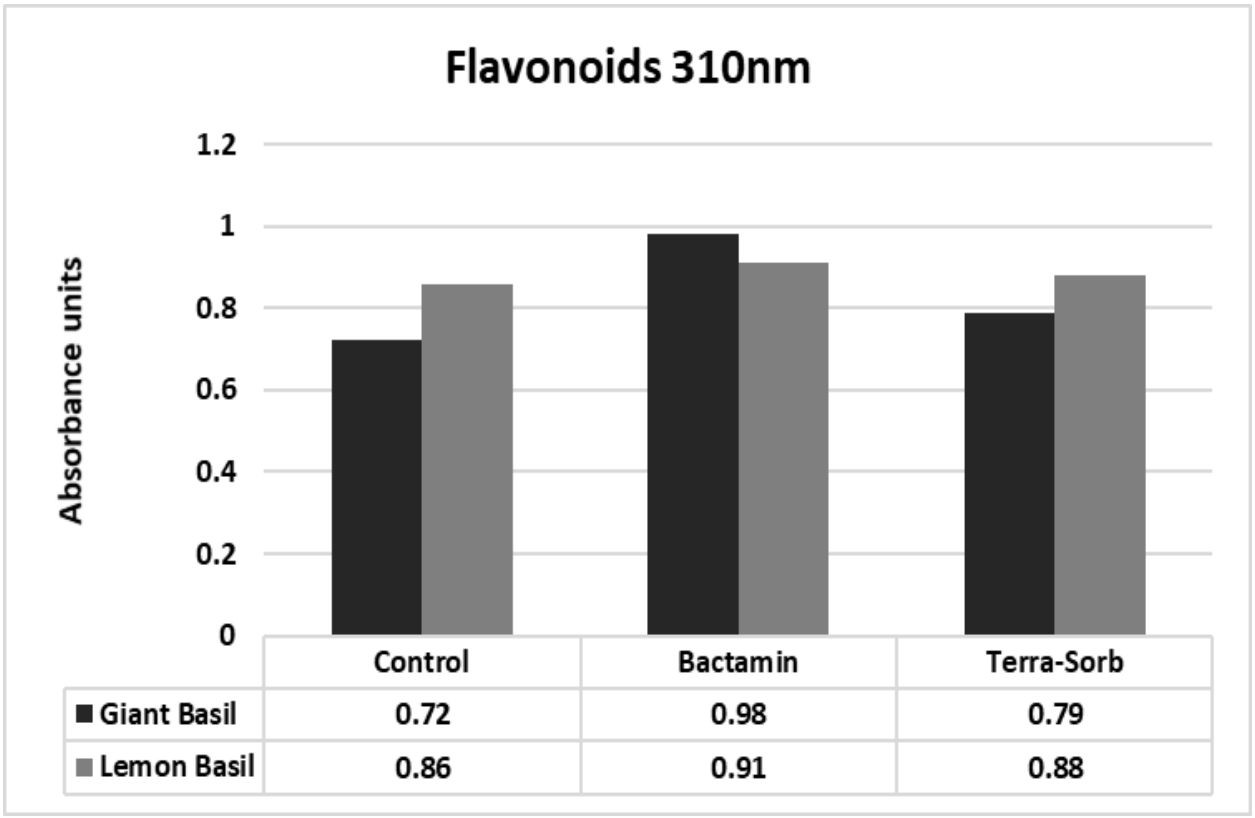
The results from the absorbance 453 nm and 616 nm (*figure 3*) of the extracts show that the three treatments with the biostimulants *Bactamine* and *Terra-Sorb* stimulate the synthesis reactions of the pigments. The proof is the higher values of the absorbance units recorded by the plants in the treated lots compared to the control variant. The highest content of flavonoid pigments was in the variant treated with *Bactamine* for both varieties of basil (0.98 u.a - *Giant basil*; 0.91 u.a - *Lemon basil*). Also, the plants from the group treated with *Terra-Sorb* within the two varieties showed values of flavonoid content higher than the control variant (*figure 4*).

The higher amount of flavonoid pigments synthesized by the two varieties of basil, in the variants treated with biostimulants, demonstrates the fact that they have a higher degree of resistance to certain biotic or abiotic stressors. It is noted in this regard the biostimulants *Bactamine* which due to the high content of beneficial microorganisms, which produce metabolites of a protein nature, strengthens the resistance of the plant, preparing it for possible periods of abiotic stress. Chlorophyll fluorescence is influenced by water supply to plants (Petcu E. *et al*, 2014), mineral nutrition and light intensity. The change of chlorophyll fluorescence properties, respectively the functioning of photosystem II (FS II) is therefore influenced by a series of abiotic factors.



	chl. a 453 nm		chl. b 616 nm	
Control	1.76	1.87	0.45	0.39
Bactamin	1.89	1.98	0.68	0.56
Agromax-Cap	1.79	1.9	0.98	0.54

Figure 3 **The influence of biostimulants on the chlorophyll a 453 nm and chlorophyl b 616 nm**



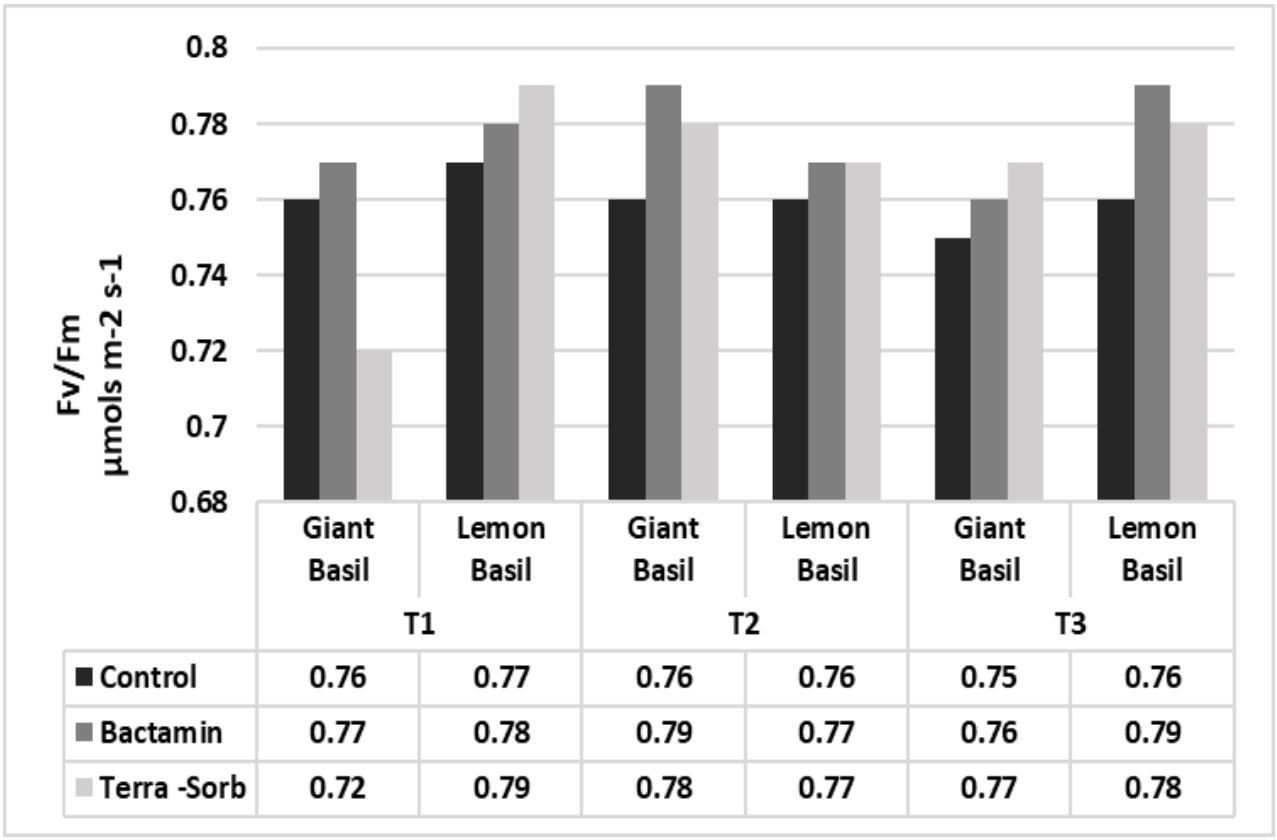
	Control	Bactamin	Terra-Sorb
Giant Basil	0.72	0.98	0.79
Lemon Basil	0.86	0.91	0.88

Figure 4 **The influence of biostimulants on the flavonoid pigments**

The measurements aimed at determining the values of the Fv / Fm ratio in which they represent the maximum quantum efficiency, the indicator of the maximum efficiency of the excitation energy transfer and are calculated using the formula: Fv / Fm = (Fm - F0) / Fm, where: F0 – minimum or initial fluorescence, which occurs when the collector antennas are open to receive light; Fm –

maximum fluorescence, recorded after exposure to the excitation source (light spot of the device). Under these conditions, all the sites of the collector antennas are closed, saturated with light quanta.

At the first measurements performed after the first treatment, the values of the Fv / Fm ratio obtained are close. However, the treated variants, in the case of both varieties of basil, have higher values compared to the control variant. For the giant basil, the sprayed variants registered the following values: 0.770µmol for the variant treated with *Bactamine* and 0.772µmol for the one with *Terra-Sorb*, and the control 0.761µmol (*figure 5*). After the third treatment, the control from both varieties had the lowest Fv / Fm ratio values, while in the treated plants, the chlorophyll fluorescence registered slightly higher values. In the giant basil the highest value was reached by the plants treated with *Terra Sorb* (0.773 µmoles), and in the lemon basil the fluorescence showed higher values in the case of plants sprayed with *Bactamine* (0.797 µmoles).



	T1		T2		T3	
	Giant Basil	Lemon Basil	Giant Basil	Lemon Basil	Giant Basil	Lemon Basil
Control	0.76	0.77	0.76	0.76	0.75	0.76
Bactamin	0.77	0.78	0.79	0.77	0.76	0.79
Terra -Sorb	0.72	0.79	0.78	0.77	0.77	0.78

Figure 5 **The influence of biostimulants on the chlorophyll fluorescence**

Exposure of basil plants to biostimulants treatments positively influenced their ability to capture light, the values of chlorophyll fluorescence being higher in the treated variants compared to control plants. These results correlate with the high values of the total chlorophyll content but also with the content of chlorophyll pigments and flavonoids in the leaves, which indicates a more intense photosynthetic yield than untreated plants, but also a higher resistance to certain stressors.

CONCLUSIONS

The results obtained after measuring the total chlorophyll content highlighted the efficiency of biostimulants in both varieties of basil, which indicates an intensification of the photosynthesis process.

Observations on the content of flavonoid pigments in the leaves showed that the highest values were obtained after treatment with *Bactamine* in both varieties of basil. This gives the plants an increased resistance to the action of stressors.

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