THE ACTION OF GROWTH REGULATORS ON THE PROCESS OF PHOTOSYNTHESIS IN SUNFLOWER

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Abstract

One of the main physiological processes that are directly influenced by the action of biostimulants and which has a decisive factor in the quantity and quality of the crop is photosynthesis. That is why our study aimed to establish the main ways in which growth regulators intensify the process of photosynthesis. We followed the effect of some biostimulants on the intensity of the photosynthesis process in the sunflower crop, a crop that in recent years has remained in the top of UE countries with the largest cultivated land areas but also with high yields. The study was performed on the *NK NEOMA* sunflower hybrid, and the treatments were done with the biostimulants *Atonik* and *Terra - Sorb* in a concentration of 0.3%. Two treatments were made in two different phenophases: at the formation of the floral botton and before flowering. The evaluation of the intensity of the photosynthesis process was performed by: determining the total chlorophyll content (CCI) and by determining the content of photosynthetic pigments in the leaves, maintaining an interval of 7 days from the application of biostimulants. The results showed an intensification of the photosynthesis process in the flowering phenophase I for the variants treated with biostimulators. The group of plants treated with *Terra Sorb* is noted with the highest value, which coincides with the higher number of leaves/per plant recorded in the second phenophase studied. The obtained results demonstrate higher values of the chlorophyll a content for the variants treated with biostimulants, in both phenophases, the control group registering lower values.

Key words: sunflower, photosynthesis, biostimulants

Biostimulants are substances that ensure the metabolic balance of plants, improve vitality and at the same time provide a high resistance against the attack of phytopathogens and pests, as well as an increased tolerance to abiotic stressors. Therefore, these substances can be used successfully in agricultural crops (Carla Michelle da Silva *et al*, 2018; Magdalena Drobek *et al*, 2019).

One of the main physiological processes that are directly influenced by the action of biostimulants and that has a decisive factor in the quantity and quality of the crop is photosynthesis. (Akila N and Jeyadoss T, 2010; Sona Salem El-Nwehy *et al*, 2016).

In recent years, sunflower cultivation has remained in the top of UE countries with the largest cultivated land, but also with high yields. In 2016, according to the National Institute of Statistics, Romania ranked first in the area cultivated with sunflower and in the production obtained.

New strategies have been proposed to improve the productivity and resilience of sunflower crops to different types of biotic and abiotic stress. For this purpose, an important thing was the use of biostimulants, which are able to improve the quality parameters of the sunflower, the efficiency of fertilizers, as well as its tolerance to various stress conditions.

MATERIAL AND METHOD

The experience was organized at the Ezareni farm, within the Teaching Station of the University of Agricultural Sciences and Veterinary Medicine Iasi, in the spring of 2019 and was placed according to the method of randomized blocks with three repetitions.

During the experiment, the NK NEOMA sunflower hybrid was studied, to which two treatments were applied by spraying at a distance of 7 days.

The treatments were performed with the biostimulants Atonik and Terra - Sorb in a concentration of 0.3%. The first spray was performed when the flower button appeared, and the second spray before flowering.

The analysis of physiological parameters was performed seven days after the application of biostimulants.

NK NEOMA is a semi-early hybrid of sunflower (vegetation period 112 - 114 days) adaptable in all areas of culture in Romania, has a high production potential, which has been proven

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over the years, responding favorably to intensive cultivation conditions.

Atonik is a biostimulants based on polyphenols. It stimulates growth, increases the intensity of photosynthesis but also the degree of fertility of flowers thus ensuring a high productive potential.

Terra – Sorb foliar is an ecological biostimulant with an increased content of free amino acids (approx. 9.3%), obtained by enzymatic hydrolysis and important microelements such as

(Mn, B and Zn), together contributing to vegetative growth, but also to increasing flower fertility.

The study followed the process of photosynthesis under the direct action of biostimulants. It was evaluated by determining the chlorophyll content index and by evaluating the content of photosynthetic pigments in the leaves.

The determination of the chlorophyll content index was performed using the CCM-200 (Chlorophyll Content Meter). In this case, the chlorophyll index represents the ratio between the transmittance of chlorophyll at the wavelength of 931 nm and that at the wavelength of 653 nm.

The content of photosynthetic pigments and flavonoids in leaves was achieved by the spectrophotometric method described by Jităreanu et *al*., 2011. The method allows testing pigments with absorption in the visible spectrum, between wavelengths of 400-700 nm and close UV, respectively 330- 400 nm. The content of different types of pigments was assessed based on the light absorption capacity of the acetonic extract (1%), analyzed by computer-aided spectrophotometer.

RESULTS AND DISCUSSIONS

Dynamics of total chlorophyll content (CCI)

Following the analysis of the total chlorophyll content, an increase could be observed of this index in the variants treated with biostimulants (*figure 1*). At the formation of the flower button, the sunflower hybrid NK Neoma had the highest chlorophyll content in plants in the *Atonik* group (14.5 CCI), and in the first flowering phase in those in the *Terra Sorb* group the values recorded an average of 16.4 CCI.

The results obtained by analyzing this physiological parameter show that the total chlorophyll content increased in direct proportion to the average number of leaves/plant (*figure 2*) and also the high values of CCI, recorded in the two phenophase highlight the role of the two biostimulants in intensifying the content. total chlorophyll.

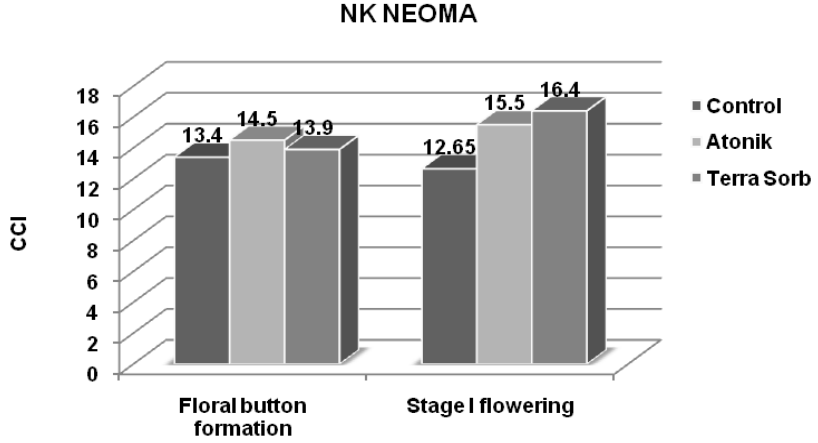

Figure 1 **Total chlorophyll content (CCI) at floral button formation and stage I flowering after application of biostimulant**

The foliar system plays a very important role in the formation of seed production (Michelle da Silva C., 2018; Dobrek M, 2019). The main role is played by the leaves of the middle floor (Bălteanu G., 2001). The leaves at the base and those at the top of the plant are less active, because the former age quickly and the others use, like the seeds, the nutrients produced by the leaves of the middle floor (Vrânceanu V., 2000; Petcu G. and Petcu E., 2008). One week after the application of the first treatment, there was an increase in the average number of leaves in the variants treated with the two biostimulants, the average being 24 leaves/plant, a trend that continues after the application of the second treatment.

By increasing the number of leaves/plant, the assimilation area increases, the photosynthesis process intensifies and therefore there is an accumulation of a larger amount of organic substances in the body of the plant.

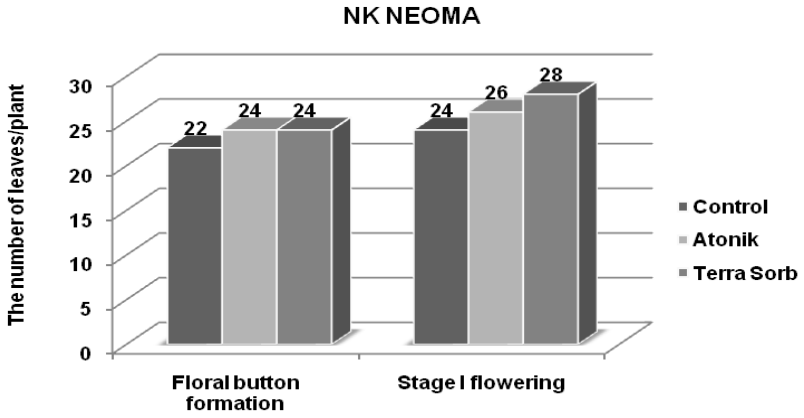

Figure 2 **The influence of biostimulants on number of leaves/plant**

Plants treated with *Terra - Sorb* recorded a higher number of leaves, which reveals that, from a physiological point of view, this biostimulants acts quite quickly on the basal meristems and as a result, the numerical growth of the leaves is more pronounced.

The results obtained from these biometric determinations in the foliar system are due to the balanced content of nitrogen, magnesium and phosphorus in the composition of the *Terra-Sorb* biostimulants which intensifies photosynthesis by participating in chlorophyll biosynthesis and stimulating photosynthetic reactions. Therefore, the plants to which this growth stimulant was applied also showed the highest chlorophyll content presented above.

Dynamics of photosynthetic pigment content in sunflower leaves

For the capture of light energy and its transformation into chemical energy in the process of photosynthesis, the primary role belongs to chlorophyll a. The absorption of light energy and it's transformation into chemical energy by triggering the transport of energizing electrons and photosynthetic phosphorylation is done by participating and SF II) (Toma L.D and Jităreanu C.D, 2007).

The photosynthetic system consists of a set of assimilating pigments, divided into an absorption and a reaction center, forming the photosynthesis unit. Chlorophyll *a 431 - 433* nm and chlorophyll *b 453 - 454* nm are components of the absorption center, and chlorophyll *a 662 - 663* nm and chlorophyll *b 616 - 617* nm are part of the reaction center (Jităreanu C.D., 2007). This is why these chlorophyll species were analyzed, and the results obtained demonstrate the variations between the control group and the variants treated with biostimulants in terms of energy capture potential depending on the amount of pigments and their absorption activity.

The highest values in light absorption from the visible spectrum and condensation in the form of potential chemical energy were found in plants treated with biostimulants.

The production is directly influenced by the intensity of photosynthesis, appreciated by the amount of photosynthetic pigments that has the ability to fix the light energy in the visible spectrum.

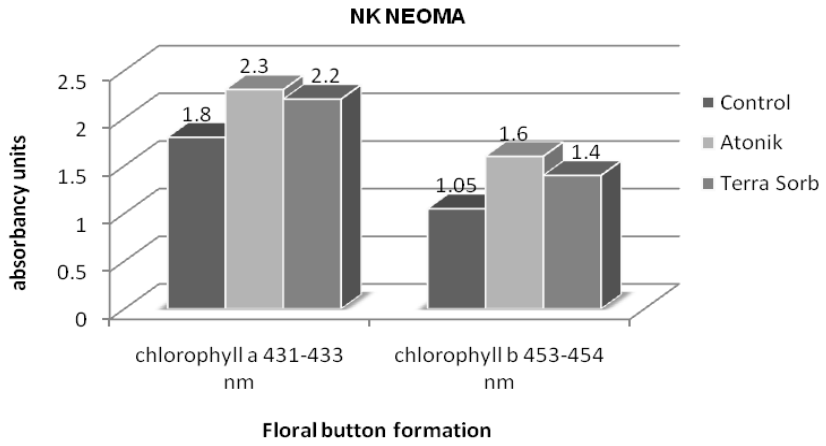

Figure 3 **The effect of biostimulants on chlorophyll content a 431 nm and b 453 nm to the floral button formation**

Spectrophotometric analysis on the content of photosynthetic pigments in sunflower leaves after the first treatment, showed the highest chlorophyll content of 431 nm in plants treated with the biostimulant *Atonik* (2.3 ua), followed by those treated with *Terra Sorb* (2.2 ua) (*figure 3*). The lowest value was recorded in the control variant (1.8 u.a.). In the phenophase of the formation of the floral button, the chlorophyll content *b 453* nm was maximum, also in the group treated with the *Atonik* biostimulant (1.6 u.a). In the period coinciding with the first stage of flowering, the same trend is maintained, the chlorophyll content of *431* nm and *b 453* nm showing the highest values in the plants to which the treatment with Atonik was applied (*figure 4*). In this situation, too, the control plants showed lower values of chlorophyll species content, which are components of the absorption center of photosynthetic systems.

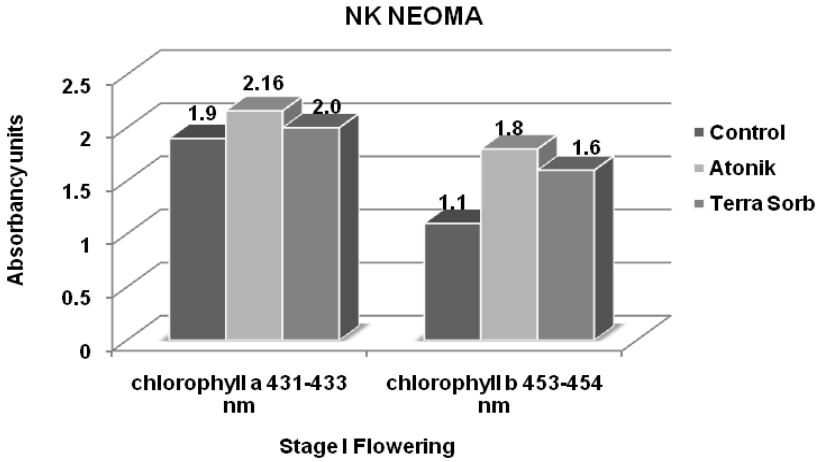

Figure 4 **The effect of biostimulants on chlorophyll content a 431 nm and b 453 nm to the stage I flowering**

The chlorophyll species of *662 nm*, component of the reaction center of photosynthetic systems, recorded high values in the variants treated with biostimulants, the maximum content during the formation of the floral button, being obtained in plants treated with Atonik (1.3 u.a) *(figure 5*).

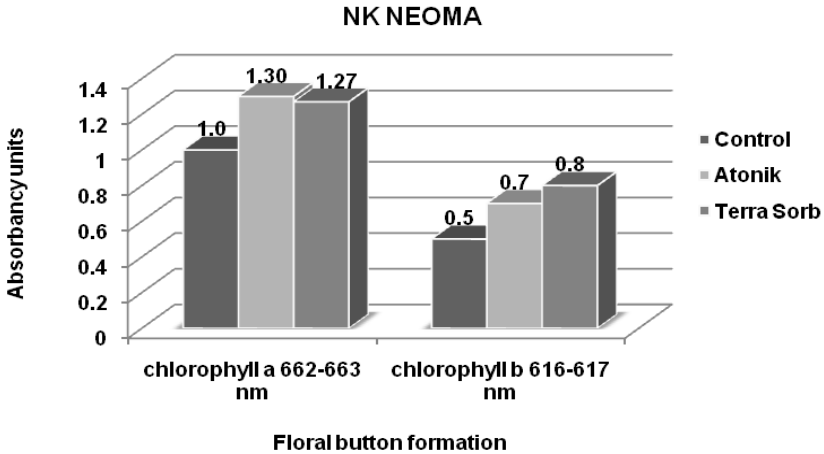

Figure 5 **The effect of biostimulants on chlorophyll content a 662 nm and b 616 nm to the floral button formation**

Note the same trend as in the case of the chlorophyll species of *431 nm*, a component of the center with a primary role in the absorption of light radiation and transfer to the reaction center.

The analysis of the chlorophyll content *b 616 n*m, which is part of the reaction center in photosynthetic systems, showed in the stage of formation of the floral button, higher values for plants in the *Terra Sorb* variant, the average being 0.8 u.a. It should be noted that in this case, the control group has the lowest content in chlorophyll *b 616*, which allows us to conclude that treatments with applied substances stimulated the activity of these pigments, creating the premises for intense photosynthetic activity.

After the application of the second treatment, in the first stage of flowering, there are slight changes in the chlorophyll content of *662 nm*, in this case the *Terra Sorb* group recording the highest values (1.18 u.a.) (*figure 6*). Changes are

also found for chlorophyll *b 616*, the highest values being evident in plants sprayed with *Atonik* (0.9 u.a.). That indicate that the assimilated substances have an intense transport to the fruits and thus a favorable prognosis in terms of production is obtained. These values classify biostimulants among the substances that can be used successfully in accelerating the process of photosynthesis and subsequently in intensifying production in sunflower culture.

The spectrophotometric method also allowed the evaluation of the content of flavonoid pigments responsible for the resistance of plants to stress factors (Moța C *et al*, 2013).

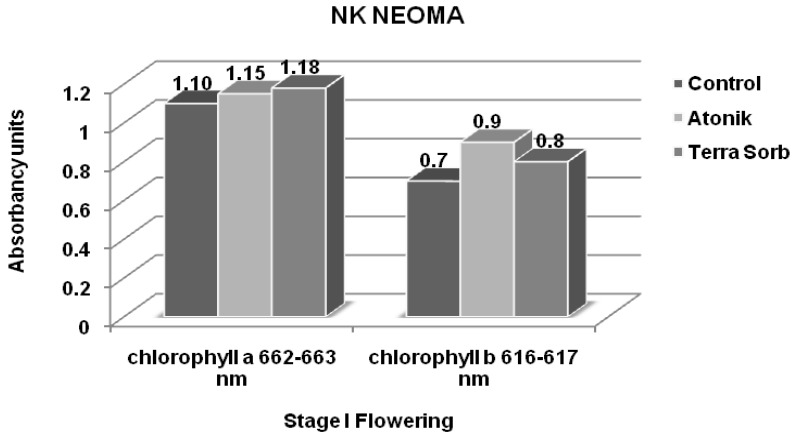

Figure 6 **The effect of biostimulants on chlorophyll content a 662 nm and b 616 nm to the stage I flowering**

Both in the formation of the floral button and in the first stage of flowering, the highest values were present in the *Terra Sorb* variant (*figure 7*), which indicates that the high content of amino acids in the chemical composition of this growth regulator increases the tolerance to abiotic stressors of the sunflower hybrid NK Neoma. Moreover, it is important to note that these high values of the flavonoid content of the variants treated with biostimulants overlap with a significant decrease in the amount of precipitation followed by a sudden rise in temperature (*figure 8*).

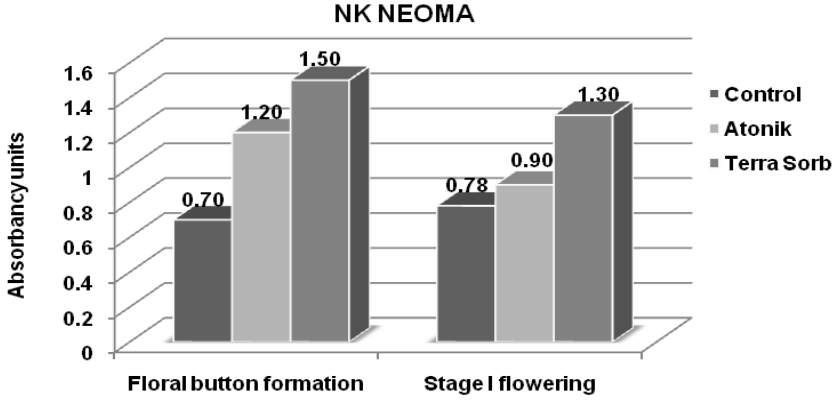

Figure 7 **The effect of biostimulants on flavonoid content**

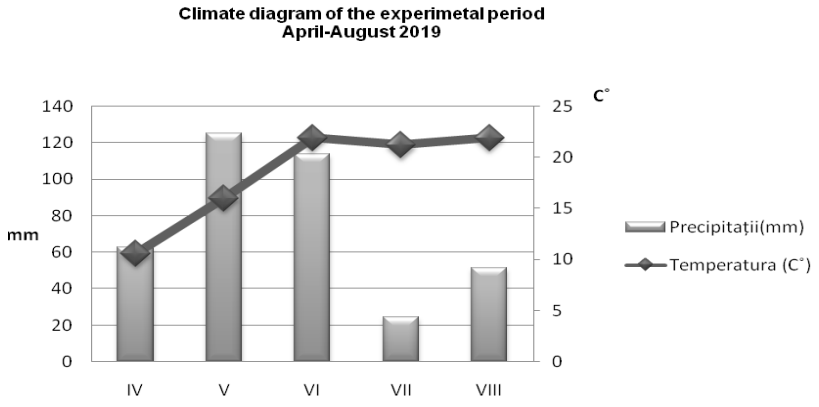

Figure 8 **Climate diagram of the experimental peiod**

CONCLUSIONS

1. The analyzes related to the foliar system showed a higher number of leaves/plant in the variants treated with the two biostimulants compared to the control group, which denotes not only a faster passage from one phenophase to another, but also an intensification of the process. of photosynthesis.

2. The observations made on the total chlorophyll content, highlighted the variants treated with biostimulants, they recorded the highest values, a result that highlights an intensification of photosynthesis.

3. Studies on the chlorophyll content of *431 nm* and the chlorophyll content of *453 nm*, which make up the light energy absorption center which it transfers to the reaction center (chlorophyll a 662 nm and chlorophyll b 616 nm) have shown that the higher values were recorded in plants treated with the *Terra Sorb* biostimulants, which indicates the intense transport of assimilated substances to the fruiting organs.

4. The content in flavonoid pigments was the highest in the variants treated with biostimulants, but the plants treated with *Terra Sorb* showed the highest values, which shows that this biostimulator has a higher degree of resistance to climatic stress factors.

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