THE EFFECT OF BIOSTIMULANTS ON THE PROCESS OF PHOTOSYNTHESIS AT THE LETTUCE

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Abstract

This study followed the effect of two organic biostimulants on the photosynthesis process in two salad varieties grown in the greenhouse. At the same time, the aim was to establish the most effective way to apply biostimulants to increase production. Application of growth regulators was done every ten days by foliar spraying and root application. The first application being made at the appearance of the first leaves, and the last application was made ten days before harvest. The biostimulants used in this study were *Wuxal Ascofol* with a high content of algae extract and *Black Jack* based on humic acids. The photosynthesis process was evaluated by determining the total chlorophyll content and by evaluating the content of photosynthetic pigments in the leaves. The study showed that the applied organic treatments stimulated the photosynthesis process in both varieties of salad, which was correlated with an increase in head of salad. Chlorophyll content of 431 nm and chlorophyll b 453 nm, components of the absorption center that capture light energy and transfer it to the reaction center recorded the highest values in the variant treated with *Wuxal Ascofol*, which shows an intense transport of assimilated to foliar system. It was also noted that the foliar application of biostimulants to lettuce gives much better results than the application at the root level.

Key words: lettuce, photosynthesis, biostimulants

Salad is grown for leaves, which are eaten mostly fresh. In recent years there has been an increase in production due to it's beneficial effects on: health, short growing season, relatively simple cultivation technology, capitalization of high-priced products and the inclusion of lettuce in various low-calorie diets.

In order to obtain high yields, both in terms of quantity and quality, plants need favorable growing conditions and a nutrition regime that ensures sufficient amounts of water, carbon dioxide, macro and microelements. In this regard, there is a growing interest in the use of biostimulants that are naturally used to increase the production of horticultural and agricultural crops (Kurepin *et al*, 2003; Rapacz *et al*, 2003).

Bioactive substances guide the growth and evolution of vegetable plants by developing plant protection systems and obtaining economically viable production (Lyszkowska *et al*, 2008; Lagunovschi-Luchian *et al*, 2016).

MATERIAL AND METHOD

Two early lettuce varieties for curly leaves were studied*: Lollo Rosso* and *Lollo Bionda*. The culture was established in the greenhouse, through the control of vegetation factors. The planting was donein pots in a homogeneous mixture of earth and peat, in a ratio of 1: 1. Biostimulants were administered in different doses: Blackjak biostimulants 2.5 ml / 500 ml water, 10 ml root / plant was administered and Wuxal Ascofol Biostimulants 3 ml / 500 ml water, was administered foliar. The two treated variants were compared with the control group watered only with water.

Experimental variants

V0- watered with water;

V1- fertigation with the Blackjak biotimulants;

V2- foliar sprays with the Wuxal Ascofol biostimulants.

Each variant included 3 repetitions. Biostimulants were applied differently every ten days. Blackjack treatment was distributed foliar, and Wuxal Ascofol to the root. The first application was made when the first leaves appeared, and the last ten days before harvest.

Blackjak is a biostimulant based on 100% natural humic acids, with a role in restoring soil fertility and accelerated rooting, by increasing the humus content, stimulating microbial activity and unlocking nutrients in the soil. As a chemical composition it is a concentrated suspension, obtained from leonardite very rich in humus.

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Wuxal Ascofol is a premium organic leaf biostimulant, with concentrated content of brown algae extract species *Ascophyllum nodosum*. The fertilizer is in the form of a suspension, making it easy to use, compared to powder fertilizers - hardly soluble. Contains seaweed, nitrogen, potassium, boron, manganese, zinc, optionally may contain - calcium, magnesium, copper, iron and bioactive compounds - cytokinins, auxins, gibberellins and betaines

The study followed the process of photosynthesis under the direct action of biostimulats. It was evaluated by determining the total chlorophyll content and by evaluating the photosynthetic pigment content of 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 by the acetonic extract (1%), analyzed on the computer-generated spectrophotometer.

RESULTS AND DISCUSSIONS

The photosynthesis process was evaluated in terms of the chlorophyll content index (CCI) and the content of photosynthetic pigments in the leaves of lettuce plants.

Dynamics of the chlorophyll content index (CCI) under the action of biostimulators

The average chlorophyll content was analyzed at intervals of ten days after the application of biostimulators, performing three readings.

The first reading of the total chlorophyll content performed 10 days after the application of the two biostimulants, indicates an increase in the values for the treated variants (*figure 1*) for both salad varieties. The *Lollo Rosso* variety showed the highest chlorophyll content in plants treated with *Wuxal Ascofal*, applied by foliar spraying, and the *Lollo Bionda* variety had a higher chlorophyll content index in the case of the root-treated *Black Jack* variant.

After 20 days on the application of biostimulants, both varieties had the highest values in the variants treated with *Black Jack*.

After the application of the last treatment, a return to the behavior that the plants showed 10 days after the application of biostimulants is observed. The *Lollo Rosso* variety stands out with the highest values of the total chlorophyll content in the variant treated with *Wuxal Ascofol* and the plants treated with *Black Jack* in the *Lollo Bionda* variant.

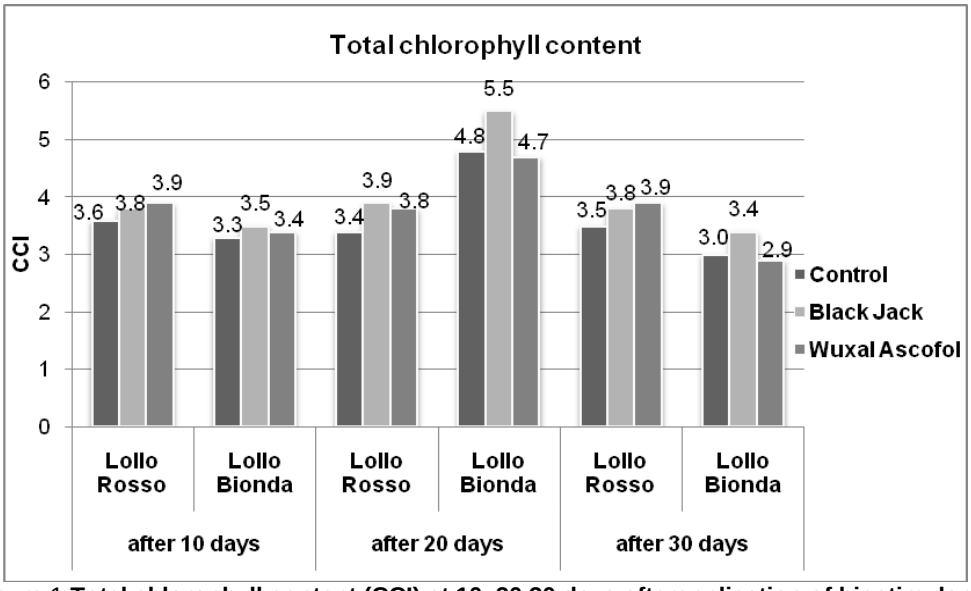

Figure 1 **Total chlorophyll content (CCI) at 10, 20,30 days afterapplication of biostimulants**

The *Lollo Rosso* variety stands out with the highest values of the total chlorophyll content, results that can be correlated with the higher number of leaves within the first phenophases analyzed (*figure 2*).

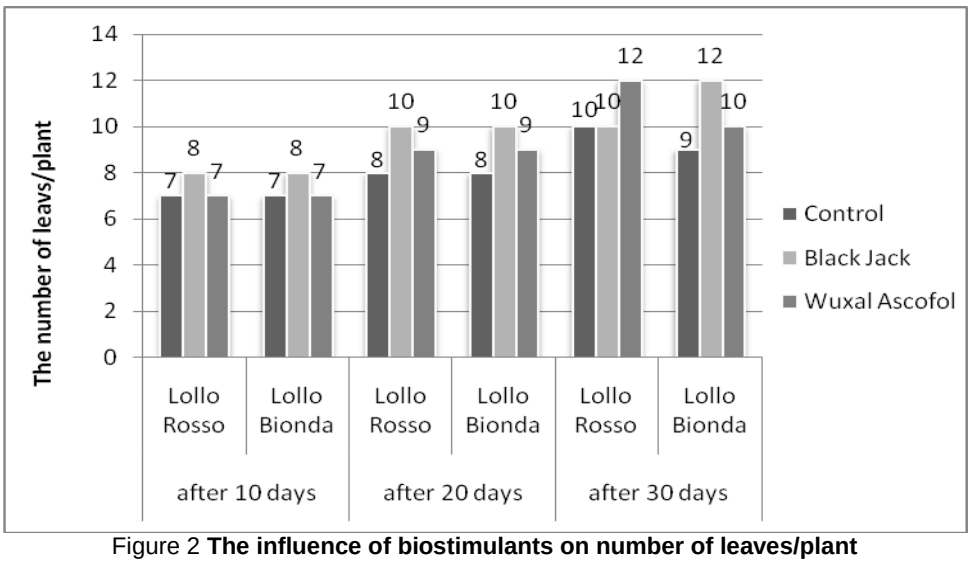

Figure 2 **The influence of biostimulants on number of leaves/plant**

Dynamics of the content of photosynthetic pigments in lettuce leaves

In the process of photosynthesis, the absorption of light energy and it's transformation into chemical energy is achieved with the participation of photosynthetic systems (SF I and SF II). The photosynthetic system consists of a complex of assimilating pigments, which consists of an absorption center and a reaction center, making up 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 components of the reaction center (Jităreanu and Marta, 2020).

The specrophotometric analysis of the content of assimilating pigments in the leaves was performed during the vegetative growth period, the stage of ten leaves. The results obtained in the variants treated with biostimulants show high values for both the components of the absorption center and for the components of the reaction center, which indicates a high storage capacity of light energy and a high potential for accumulation of organic substances that will ensure the premise. high production. The recorded values ranged between 0.5 u.a for the *Lollo Bionda* control variant variety and 1.05 u.a, for the *Lollo Rosso* group treated with *Wuxal Ascofol*.

The *Lollo Rosso* variety stands out with the highest values of the chlorophyll content of 431 nm in the variant treated with *Wuxal Ascofol* (*figure 3*), and *Lollo Bionda* in the group treated with *Black Jack*. Regarding chlorophyll *b 453* nm, both varieties behaved similarly, recording the highest values in the case of *Black Jack* plants.

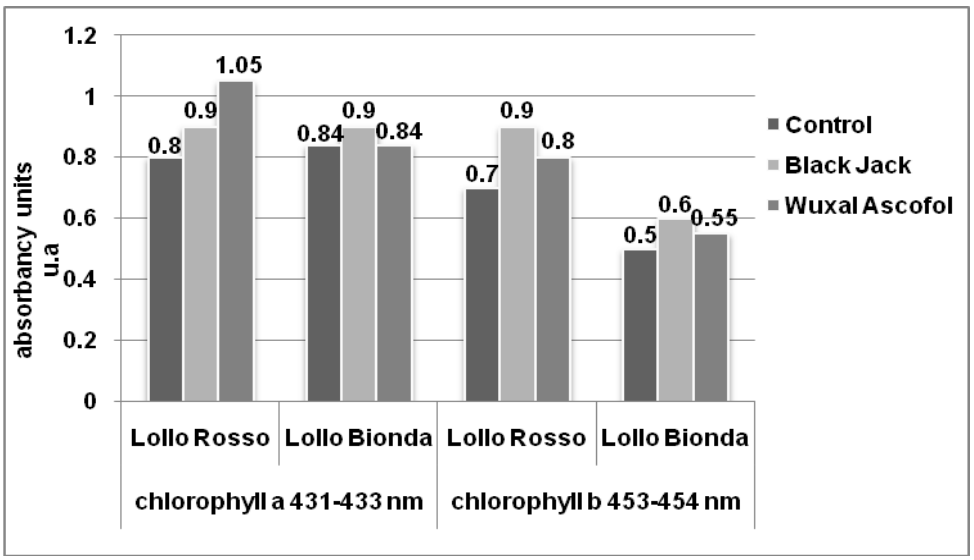

Figure 3 **The effect of biostimulants on chlorophyll content a 431 nm and b 453 nm**

Analysis of the chlorophyll content of 662 nm and chlorophyll b 616 nm components of the reaction center in the photosynthetic systems showed that the variants treated with biostimulants

also recorded higher values than the plants in the control group. The absorbance recorded for these two types of chlorophyll ranged from 0.01 to 0.8 u.a. In the case of chlorophyll at 662 nm, the response to the treatment applied for the two varieties studied was stronger for the plants sprayed with *Wuxal Ascofol*, as evidenced by the high values recorded (*figure 4*). The *Black Jack* biostimulant determined an obvious increase of the chlorophyll content of 662 nm compared to the control group. The analysis of chlorophyll *b 616* nm highlights this time the *Lollo Bionda* variety, with the highest value determined by the root application of the *Black Jack* biostimulant.

The results obtained after the analysis of the chlorophyll *a* and *b* content show significant differences between the variants treated with biostimulants and the control group. The values shown in *figure 4* show that the *Lollo Rosso* variety reacted better in terms of chlorophyll content to the treatment with *Wuxal Ascofol* administered by foliar sprays, and the *Lollo Bionda* variety to the root application treatment with the *Black Jack* biostimulant.

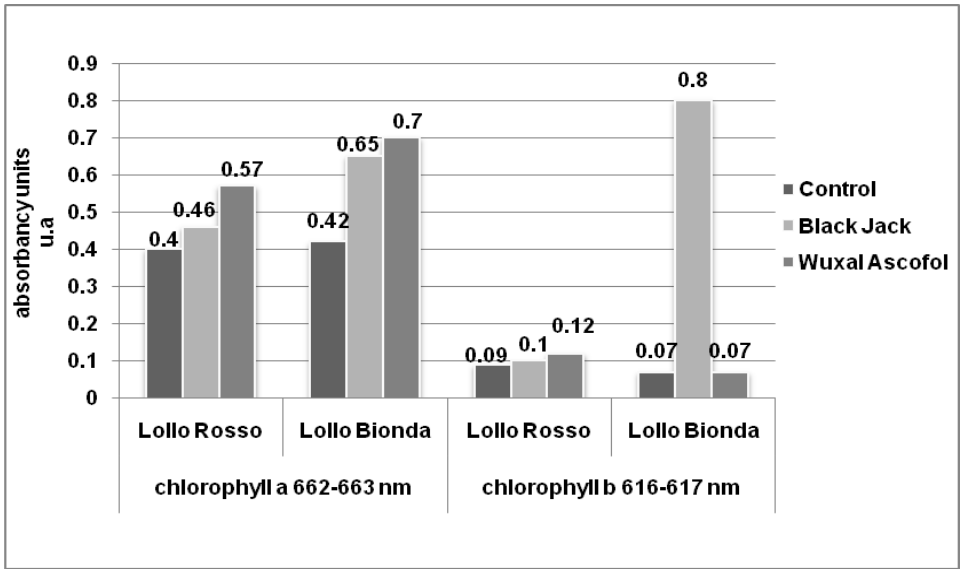

Figure 4 **The effect of biostimulants on chlorophyll content a 662 nm and b 616 nm**

The high photosynthetic intensity in plants treated with biostimulant correlates with the weight of the captains, a fact found at the end of the experiment. The higher values of the weight of the foliar system (*figure 5*) from the two varieties studied under the action of biostimulants *Blackjak* and *Wuxal Ascofol* show an intense transport of assimilates, which led to a higher weight of the captains in the plants of the treated variants.

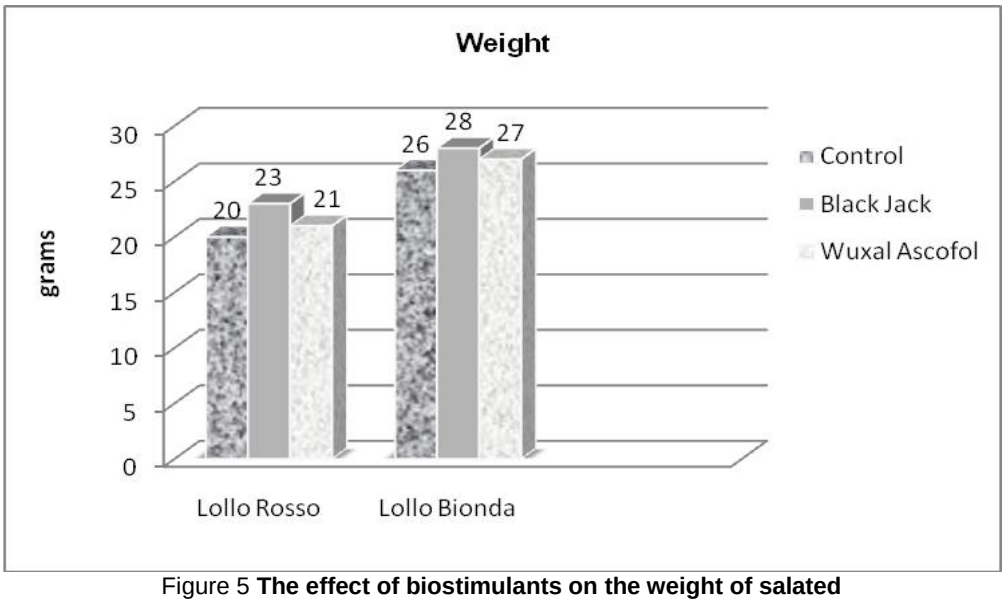

Figure 5 **The effect of biostimulants on the weight of salated**

Moreover, it is known that production is directly influenced by the intensity of photosynthesis which has the ability to fix light energy in the visible spectrum (Jităreanu and Toma, 2007). It should also be mentioned that the variants treated with biostimulants presented at harvest a firmer appearance of the leaves, a higher consistency and a longer shelf life. Biostimulant not only improve photosynthetic activity, production but also resistance to a number of abiotic and biotic factors that may interfere with the stress resistance mechanism of plants (Boehme *et al*, 2008; Kolomazník *et al*, 2012). This fact is demonstrated by the results obtained from the analysis of the content of flavonoid pigments which according to numerous studies (Lyszkowska *et al*, 2008; Moța *et al*, 2013; Dudaš *et al*, 2016) have the function of protecting the plant from stressors. The two varieties showed the highest values in the variants treated with biostimulants (*figure 6*).

When applying the Wuxal Ascofol biostimulant, the content of flavonoid pigments recorded the highest values, which demonstrates that it has a higher degree of resistance to potential biotic or abiotic stressors for the varieties studied.

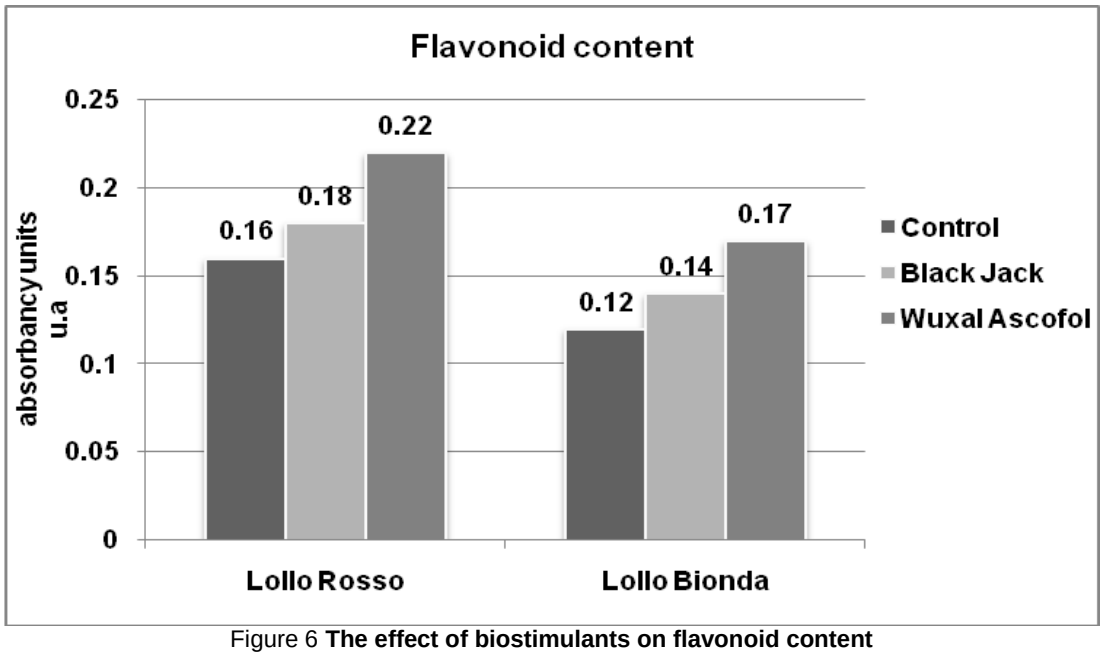

Figure 6 **The effect of biostimulants on flavonoid content**

CONCLUSIONS

Analysis of the total chlorophyll content index showed that the *Lollo Rosso* salad variety performed better in foliar application of the *Wuxal Ascofol* biostimulant, recording the highest values, while the *Lollo Bionda* variety recorded the highest chlorophyll content after root application of *Black Jack* treatment.

Variants treated with biostimulanys show high values for the components of the absorption center as well as for the components of the reaction center within the photosynthetic systems, which indicates a high storage capacity of light energy and a high potential for accumulation of organic substances that will ensure the premise of a high production.

The content of flavonoid pigments was higher in the treated variants, which indicates an increase in the degree of tolerance to stressors abiotics and biotics for the two lettuce varieties studied under the direct action of biostimulants.

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