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THE INFLUENCE OF FOLIAR BIOACTIV TREATMENTS ON TOMATOES SEEDLINGS

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Abstract

Tomato (Lycopersicon esculentum), the world's most important vegetable species, are known for its sensitivity regarding different stress factors such as heat, drought, lack of nutrients. Therefore, is very important to obtain tomatoes seedlings with balanced growth and development, but especially with a strong root system and increased capacity of adaptation to different conditions of stress. This paper presents the results of some researches related to foliar bioactive substance treatment of tomatoes seedling, Rio Grande cultivar, with Spraygard 1%, Razormin 0.1%, BAC Foliar Spray 0.3% and Bio Roots 0.2%. The treatments were performed in two distinct stages of development: at one, respectively two weeks after the seedlings transplantation. Analysis of recorded data indicated that all variants treated with bioactive substances are superiors comparing with the untreated control variant but Razormin 0.1%, followed closely by Bio Roots 0.2% treatments showed the best results in obtaining of tomatoes seedlings with a strong roots systems and a good development. These results are supported by an increased physiological activity.

Key words: *growth, photosynthesis, root, transpiration.*

INTRODUCTION

Abiotic stresses such as extremes temperature, drought and salinity can reduce the yield of major crops and limit agricultural production worldwide (Wang et al., 2003; Sharma et al., 2012; Hasanuzzaman et al., 2012; Hasanuzzaman et al., 2013).

Different factors of abiotic and biotic stress determine in plants an avalanche of physiological and biochemical changes, which begins with the perception of stress by the specialized receptors and ends with the resulting biomorphological expression as a result of this action. Therefore, the metabolism of the plants and the activity of some enzymes is modified, known as the fact that all the chemical processes are catalyzed by enzymes. In plants, stress triggers a wide range of responses, from gene expression and cell metabolism to changes in growth and production, but when stress is severe, the plant dies (Sharma et al., 2012). The response of plants to stress is determined by a number of factors, such as those that characterize the plant (their genotype and stage of development) and those that characterize stress (intensity, duration, repeatability, and the various synergistic effects of the interaction of several factors when it is multiple stress (Pallavi et al., 2012; Hasanuzzaman et al., 2013).

A biostimulator is an organic material that, when applied in small quantities, enhances plant growth and development such that the response of the plant cannot be attributed to the application of traditional nutrients (Shekhar Sharma et al., 2014)

Different studies have shown that seaweed extracts protect plants against a number of biotic and abiotic stresses and offers potential for field application. Further, seaweed extracts are considered an organic farming out as they are environmentally safe for the health of animals and humans (Khan et al., 2009). Recent research showed that the use of red macroalgal on crop plants can generate multiple benefits. It has been reported effects including enhanced rooting, enhanced photosynthetic activity, freezing, drought and salt tolerance, resistance to fungi, bacteria and virus, and higher crop and fruit yields (Shekhar Sharma et al., 2014). Also, in recent years, a number of exogenous protectants, such as proline, glycinebetaine, nitric oxide, silicon, selenium, salicylic acid, and polyamines have been tested and found to be beneficial in

protecting plants against damage from temperature extremes (Hasanuzzaman et al., 2012).
At this time, agricultural biostimulators suppose different compounds with diverse formulations of substances and other products, such as microorganisms, trace elements, enzymes, plant growth regulators and algal extracts that are applied to plants or soils to regulate and enhance the crop's physiological processes, in a very efficient manner (Shekhar Sharma et al., 2014).
In our country, similar research have been made on tomato and pepper seedlings that have benefited from biofertilization with Cropmax, Razormin, or of treatment with Spraygard (Chilom et al., 2000; Bălan et al., 2014; Dobrin et al., 2014). The research on eggplant seedlings reported that used of a different growth regulators (Razormin, Spraygard, BAC Foliar spray, Bio Roots) as foliar treatments, induces biochemical, physiological and metabolic changes that have led to the improvement of seed growth and development but also to the improvement of the oxidative protection system of plant and attenuate the negative impact of heat stress (Bălan et al., 2018).
The present research reported were performed on tomatoes (*Lycopersicum esculentum* Mill.), a main specie of vegetables grown in the field, in the summer-autumn crop established by seedlings. Tomato seedlings are grown in protected areas during April-May, when heat is often installed, with maximum daily and nocturnal temperatures well above optimum vegetation. It is imperative to apply a series of technological measures in order to accustom seedlings with provided variable nonfatal stress that could exist in the place of cultivation and to allow formation of "memory stress": the correct and careful directing of the vegetation factors and the application of special treatments helping not only to form this memory of stress but also supporting the growth and development of plants (Sekara et al., 2012; Mangrich and Saltveit, 2000; Knight et al., 1996; Jennings and Saltveit, 1996). It were used different growth regulators as foliar treatments on tomatoes seedlings and the comparative results were studied.

MATERIALS AND METHODS

The experiment was installed into an experimental greenhouse of the Hortinvest Research Centre - USAMV Bucharest in April-May, aimed to test the action of biofertilizers Razormin, BAC Foliar Spray and Bio Roots and of the universal adjuvant Spraygard on growth and development of tomatoes seedlings, in order to be recommended to the seedlings producers as supportive treatment of the growth rate and to improve metabolism seedlings. This could lead to shortening their age with implications for reduction of production cost.
Spraygard is a complex product that acts as safener, penetrant, dispersant, creates adhesion of the treatment solutions on the leaves. Spraygard adjuvant has an unique formula in a single coating based on the synthetic resin that is "environmentally friendly" and the polymer di-1-p-menthene and ethoxylatedalcohol by applying it on the plant and on its leaves forms a pellicle that persists 2 days up to 2 weeks, having as a side effect the reduction of perspiration and, therefore, a better water management within the plant. This fact causes the physiological chain reactions whose results are being expressed by increasing the plant resistance to stress factors such as the drought and the cold. The effect of reducing transpiration recommends to apply the product strictly on the leaves.
Razormin is an environmentally friendly bio-stimulating product, which determines a rooting effect. Their chemical composition is complex and balanced, so that induces mainly a root system development, than the development of vegetative part through cell division. It contains free amino acids and polysaccharides, which stimulate the nutrients absorption, leading to the further development of plant.
BAC Foliar is a foliar organic nutrient which stimulates chlorophyll production in the leaves.
Bio Roots is a natural fertilizer that stimulates root growth, helping plants to form healthy and vibrant root systems. It contains vitamins, enzymes, organic and humic acids that stimulate the growth of roots. It activates the growth of microorganisms in the root area and improves its development. This allows the development of a strong root system and a better adaptation of the plant to its

environment. At the same time it helps the plant to cope with diseases and pathogenic molds.

We established a monofactorial experiment with 5 variants, considering application of bioactives substances Sparygard 1%, Razormin 0.1%, BAC Foliar Spray 0.3% and Bio Roots 0.2% on tomatoes seedlings (Rio Grande) in two distinct stages: at one, respectively two weeks after the seedlings transplantation (April 23 and 30).

The experimental variants were: V1-untreated seedlings; V2-seedlings treated with 1% Spraygard; V3-seedlings trated with 0.1% Razormin; V4-seedlings treated with BAC Foliar Spray 0.3%; V5-seedlings treated with Bio Roots 0.2%.

Sowing was made on April and because heat and water were optimal provided, mass emergence of seedlings occurred after 6 days (April 11). The transplantation was done after 5 days into alveolar pallets (alveolar ø = 6 cm), in a professionally nutrient substrate KEKKILABP 75% +25% perlite. During the growth period specific agrotechnics for seedling production was applied: daily ventilation, watering, weeding. The temperature was kept at 24-26°C to 30°C at day and 22-24°C at night. A treatment with CE Bravo 0.2% was made in order to prevent seedlings fall and also to avoid a *downy mildew* attack.

Observations and measurements of plant growth were made during the development of experiments in different stages: a two and respectively three weeks after transplantation (at the end of the experiment), after 27 days to the emergence, when most of seedlings have reached the optimum for a succesfull planting.

Observations and measurements were made on seedlings growth, as follow:

- *biometric parameters of seedlings*: plant height; the number of true leaves; weight of aerial vegetative unit; seedlings total weight; root weight and volume;
- *measurements of the main physiological processes intensity* (photosynthesis, transpiration, stomatal conductance) at the end of the experiment. We used the LC pro+ photosynthesis system. The measurements were performed on the active leaves located in the middle third part of the plant.

RESULTS AND DISCUSSIONS

The results of the analysis of the first stage (one week after the first treatment) are shown in Table 1.

Since then tomato seedlings presented important nuances regarding growth as a result of the application of different treatments in the sense that, in the non-fertilized V1 variant, the plants have recorded biometric parameters and indicators far inferior to fertilized variants. The plant height recorded an amplitude of 3.2 cm, respectively, between 14.2 cm to V1 and 17.4 cm to V4. The number of leaves varied significantly, from 4.2 leaves formed at V1 to 5.2 leaves formed at V4. The leaf frequency is relatively constant, of 0.3 leaf/cm PA to V1, V3 and V4 and 0.31 leaf/cm PA to V2.

Table 1. Growth of tomatoes seedlings 7 days after the first treatment

Variant	Plants height HPA (cm)	No. of leaves	Leaves frequency (no./cm HPA)
V_1	14.2	4.2	0.30
V_2	15.4	4.8	**0.31**
V_3	16.2	4.9	0.30
V_4	**17.4**	5.2	0.30
V_5	16.0	4.8	0.30

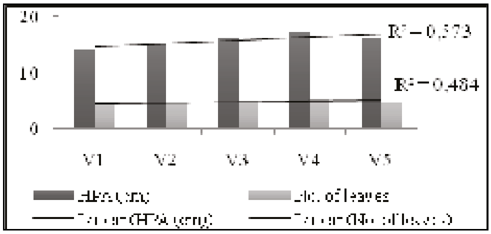

Figure 1. Influence of applied treatment on growth of tomatoes seedlings 7 days after first treatments

Context analysis highlights V4 (treated with BAC Foliar Spray 0.3%) as the variant where seedlings had the most balanced growth and the fact that the treatment applied since then has exerted a decisive influence on the growth of tomato seedlings, especially in terms of plant height (R^2 = 0.573) (Figure 1).

In order to determine the overall effect and influence of the treatments program applied on the tomatoes seedlings were made observations and measurements also one week after application of the second treatment. The results obtained are shown in Tables 2 and 3, respectively in Figures 2, 3 and 4.

Table 2. Growth of tomatoes seedlings at one week after the second treatment

Variant	No. of leaves	Plants height HPA (cm)	Roots length HR (cm)	Plants total lenght HT(cm)	Leaves frequency (no./cm HPA)
V_1	6.2	34.6	21.2	55.8	0.18
V_2	6.8	33.6	15.8	49.4	0.20
V_3	8.4	32.4	18.4	50.8	0.26
V_4	7.6	32.6	15.6	48.2	0.23
V_5	8.2	32.4	16.4	48.8	0.25

Applied treatment program determined differences regarding on the growth of tomatoes seedlings. It is noteworthy that all variants where have been applied different treatments with bioactive substances have achieved a shorter plant heights and roots lengths, compared to the untreated control variant.

Analysis of the results on the growth of seedlings showed that the best option working was V3-Razormin 0.1%. In this variant plants have achieved the best and balanced growth, all indicators analyzed had very good values (8.4 leaves formed, 32.4 cm plant height, 18.4 cm root length, total length 50.8 cm plant; 0.26 frequency leaves). In contrast, untreated V1 seedlings, although recorded the highest plant height (34.6 cm) and the largest length of the roots (21.2 cm), achieved the lowest number of leaves (6.2 leaves) and respectively the lowest frequency of leaves, 0.18. This context, for V1, shows an unbalanced growth that is based on an elongation phenomenon due to the presence of stress factors.

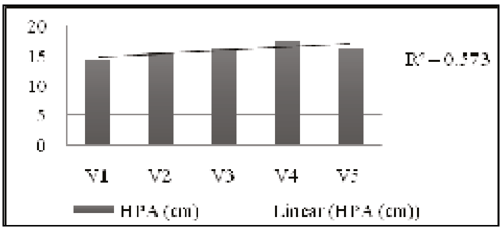

Figure 2. Influence of applied treatment on tomatoes seedlings growth one week after the second treatment

As can be seen from Figures 2 and 3, schedule treatments with bioactive substances exert a distinctive influence on the general growth of tomatoes seedlings, respectively, on the frequency leaves (R^2=0.639) and on the plant height (R^2 = 0.573).

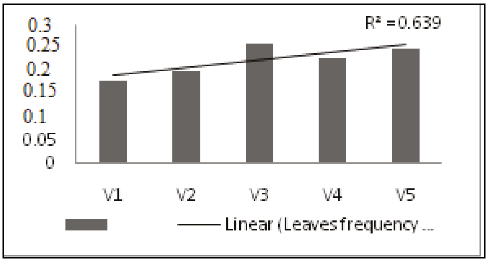

Figure 3. Influence of applied treatment on the frequency leaves of the tomatoes seedlings one week after the second treatment

Regarding on plants growth, taken together the results obtained for tomatoes seedlings morphometry, we estimate that the most balanced variant is V3 (fertilized with Razormin 0.1%) followed by V5 (Bio Roots 0.2%).

Developing of tomatoes seedlings one week after the second treatments was quantified by various indicators of mass and volume and by diameter of collet. The obtained results (Table 3; Figures 4 and 5) regarding tomatoes mass ratio highlights two situations:

1. At V3 variant all indicators recorded the highest values compare to the other variants (aerial part mass 16 g; mass root 4.5 g; 23.5 g total mass, volume roots 8.5 cm^3; 7 mm collet diameter). Good results have also recorded the seedlings treated with Bio Roots and BAC Foliar Spray.
2. In contrast, V1 variant recorded, to all most indicators, the lowest values (aerial part mass 11.5 g; 19 g total mass; volume roots 2.5 cm^3; 3.5 mm collet diameter), excluding the roots mass (7.5 g) and roots volume (8 cm^3).

Table 3. Developing of tomatoes seedlings at one week after the second treatments

Variant	Aerial part mass MPA (g)	Roots mass MR (g)	Total mass TM (g)	Roots volume VR (cm^3)	Ø collet (mm)
V_1	11.5	7.5	19.0	8.0	5.8
V_2	12.0	7.0	19.0	8.0	6.0
V_3	16.0	7.5	23.5	8.5	7.0
V_4	15.5	6.0	21.5	6.5	7.0
V_5	15.8	7.5	23.3	8.5	7.0

Also, was noticed a strong influence of the applied treatment on the aerial part mass and of the collet diameter (Figure 4).

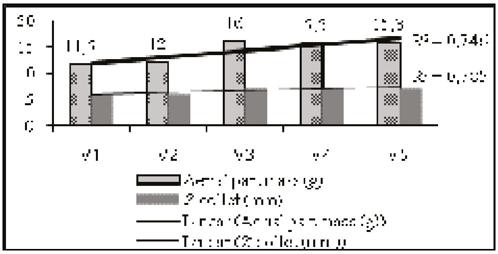

Figure 4 Influence of applied treatment on the aerial part mass and collet diameter at the second moment

The results of the physiological measurements performed on the experimental variants are shown in Table 4. As can be seen, the leaf temperature was relatively constant (27.2-28.3^{o}C) and light intensity (Q) registered the value of 1280-1360 mmol/m^2/s.

Table 4. Physiology of the tomatoes seedlings one week after the second treatment

Var.	A [µmol/ m^2/s]	E [µmol/ m^2/s]	A/E	Leaf temp.T [^{0}C]	Q [µmoli/ m^2/s]
V_1	11.35	3.11	3.65	28.3	1280
V_2	12.13	1.60*	7.58	28.3	1280
V_3	13.39	1.74	7.69	27.2	1360
V_4	12.39	1.87	6.62	27.2	1360
V_5	12.96	1.78	7.28	27.2	1360

The results analysis revealed that V3 recorded the highest values of Photosynthesis rate A = 13.39µmol/m^2/s and efficiency (A/E = 7.69) on the backgroundof a low Transpiration rate E = 1.74 µmol/m^2/s. Also, V5 recorded high values for the physiologic indicators. These results confirm the good growth and development of seedlings from these two variants.

V1 untreated recorded a very good Photosynthesis rate (A = 11.35 µmol/m^2/s) but very intense Transpiration rate (E = 3.11 µmol/m^2/s) determined a low efficiency of photosynthesis (A/E = 3.65). The intensify of physiological processes without translocation and accumulation of photoassimilated substances is, in fact, the response of plants to the action of stressors whose intensity action does not endanger the life of plants. On the overall results can be noted V4 (BAC Foliar spray) as the most balanced variant regarding physiological activities.

CONCLUSIONS

In the last few years, amid the development of integrated and biologically horticultural concepts, it has been necessary to reconsider fertilizers used in horticultural practice by introducing into the technological stream new complex substances such as phytohormones or biofertilizers, natural and non-polluting.

Treatments with bioactive substance are applied with good results in vegetable practice to accelerate or inhibit the growth of seedlings or to support plants life in various stress situations.

Tomato seedlings from the very first moment of analysis showed important nuances as a result of the application of bioactive substances treatments in sense that, in the untreated V1 variant, the plants have recorded biometric indicators far inferior to those of the treated variants and the context analysis highlights V4-fertilized with BAC Foliar Spray 0.3% as the seedlings had the most balanced growth and development.

Analysis of the results of the growth and development of tomatoes seedlings at the end of experimental period showed that the best option working was V3-Razormin 0.1%. In this variant plants have achieved the best and balanced growth and development, all indicators analyzed had very good values. This is followed by V5-Bio Roots 0.2%

Physiologic activities revealed that V3 recorded the highest values of Photosynthesis rate and efficiency on the background of a low Transpiration rate. Also, V5 recorded high values for the physiologic indicators.

These results confirm the good growth and development of seedlings in the two mentioned variants (Razormin 0.1 % and Bio Roots 0.2 %) which we recommended as support treatment to improving quality of tomatoes seedlings.

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