Scientific Papers. Series B, Horticulture. Vol. LX, 2016
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

FOLIAR BIOACTIV TREATMENTS INFLUENCE ON EGGPLANTS SEEDLINGS

Elena DOBRIN[1], Gabriela LUȚĂ[1] , Evelina GHERGHINA[1], Daniela BĂLAN[1], Elena DRĂGHICI [1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania

Corresponding author email: glutza@yahoo.com

Abstract

Eggplants (Solanum melongena) is known for its weak root system and for the particular sensitivity towards different stressors such as heat, water stress, nutritional stress. Therefore, is extremely important to obtain eggplants 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 eggplants seedling with Spraygard 1%, Razormin 0.1% and BAC Foliar Spray 0.3%. The treatments were performed in two distinct stages of development: at one, respectively three weeks after the seedlings transplantation. Analysis of the acquired data indicated that 0.1% Razormin treatment showed the best results in obtaining of eggplants seedlings with a strong roots systems and a good development. These results are supported by physiological and biochemical processes, which were intensely expressed at the plants in this experimental variant. Also good results in terms of quality seedlings were obtained when treated with BAC Foliar Spray 0.3% and in the case of simple application of adjuvant Spraygard 1%.

Key words*: eggplants, foliar treatments, photosynthesis, root, transpiration.*

INTRODUCTION

In recent years, it was important to reconsider treatments with bioactive substances used in horticultural practice in the context of integrated horticulture development concepts. This comes to align vegetable production in our country to the European Community directives regarding the decrease of environmental pollution through the horticultural technologies, knowing that the horticulture system involves highly intensive cultivation technology which frequently endanger their integrity and the food security.

Vegetables species like eggplant, grown in the temperate climate zone using transplants, are subjected to environmental stress which limits seedlings growth, crop productivity and quality (Sękara et al., 2012). A common consequence of the environmental stress is the increased production of toxic compounds, especially reactive oxygen species produced as result of oxidative metabolism in chloroplasts, mitochondria and peroxisomes (Kim et al., 2004). Previous researches reported that it is absolutely necessary to accomodate the seedlings with variable stress condition which they will cope in the cultivation place so that allow the achievement of "stress memory" (Jennings and Saltveit, 1994; Knight et al. 1996; Mangrich and Saltveit, 2000; Sękara et al., 2012).

In our country, similar researches have been made on pepper and tomato seedlings that have benefited from fertilization with Razormin and Cropmax, or of treatment with Spraygard (Chilom et al., 2000, Bălan et al., 2014; Dobrin et al., 2014).

The research reported in this study were performed on eggplant (*Solanum melongena*), a main specie of vegetables grown in the field, the summer-autumn crop established by seedlings. It were used different growth regulators (Razormin, Spraygard, BAC Foliar spray, Bio Roots) as foliar treatments on eggplant seedlings and the comparative results were studied.

MATERIALS AND METHODS

The experiments established in 2015, April - June, aimed to test the action of fertilizers Razormin and BAC Foliar Spray and of the

universal adjuvant Spraygard on growth and development of eggplants 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, avoidance pests and diseases attacks by strengthening the immune system of plants with implications for reduction of production cost.

The experiment was installed into an experimental greenhouse of the Hortinvest Research Centre – USAMV Bucharest.

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 ethoxylated alcohol 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 applying 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.

We established a monofactorial experiment with 4 variants, considering application of bioactives substances Sparygard 1%, Razormin 0.1% and BAC Foliar Spray 0.3% on egg-plants seedlings (Pana Corbului – an appreciate Romanian varieties) in two distinct stages: at one, respectively three weeks after the seedlings transplantation (7 May and 22 May).

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%. The experiment was installed using the block method in linear alignment with 4 repetitions. The total number of plants in the experiment was 240, each variant containing 60 plants, with 15 plants per repetition.

Sowing was made directly into alveolar pallets (alveolar ø = 5 cm) on April. Because heat and water were optimal provided, mass emergence of seedlings occurred after 12 days. The eggplants seedlings transplanting was done on April 26, in large plastic pots (400 ml) filled with professionally nutrient substrate KEKKILA BP 75% + 25% perlite. It has used this type of pots, with high volume, to counteract any imbalances that may arise in terms of installing a high or even excessive thermal and hydric conditions in the production are, specific at this time of year. During the growth period specific agrotechnics for seedling production was applied: daily ventilation, watering, weeding weeds. The temperature was kept at 22–24 ^{o}C to 28 ^{o}C at day and 18–20 ^{o}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 week and respectively five weeks after transplantation.

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 physio-logical 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;
- **determinations of the assimilatory pigments content** in the active leaves**:** c*hlorophyll* and *carotenoid pigments* were extracted in 80% acetone and determined spectrophotometrically (wavelenghts 663 nm, 647 nm and 480 nm) using the extinction coefficients and equations described by

Schopfer (1989). The results were expressed in mg/100 g fresh weight.

RESULTS AND DISCUSSIONS

The results of the analysis of the first stage (10 days after the first treatment) are shown in Table 1. Eggplant seedlings have reacted differently to the treatments applied. Plant height is quite different, from 12.4 cm (V1) to 13.6 cm from V4 - fertilized with BAC Foliar Spray, 0.3%. Also in this variant it was recorded the highest number of leaves 5, while at the untreated variant was of 4.2 leaves. The frequency is 0.34 leaves/cm PA to the V1 and 0.38 leaf/cm PA for V2. and V4.

Table 1. Growth and development of eggplant seedlings 10 days after the first fertilization

Variant	Plants height HPA (cm)	No. of leaves	Leaves frequency (nr/ cm HPA)
V_1	12.4	4.2	0.34
V_2	12.8	4.8	0.38
V_3	13.4	4.8	0.36
V_4	13.6	5.0	0.37

Context analysis at this time points out that the application of different treatments have a defining influence on plant growth and development ($R^2 \geq 0.9692$ for plant height and $R^2 \geq 0.8$ for the number of leaves formed) and allows placement variant treatment BAC Foliar Spray, 0.3% on top position, closely followed by treatment with Razormin 0.1% (figure 1).

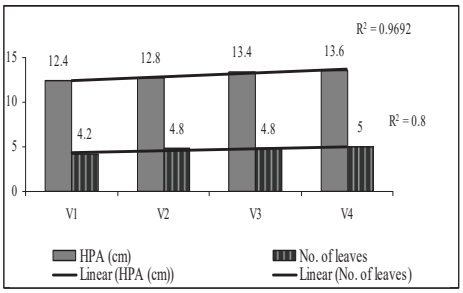

Figure 1. Influence of applied treatment on growth of eggplant seedlings ten days after treatments

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

Table 2. Growth of eggplant seedlings at two weeks after the second treatment

Variant	No. of leaves	Plants height HPA (cm)	Roots length HR (cm)	Plants total lenght HT(cm)	Leaves frequency (nr./cm HPA)
V_1	5.4	21.8	10.6	32.4	0.25
V_2	6.4	24.6	12.2	36.8	0.26
V_3	7.4	24.8	17.2	42.0	0.30
V_4	6.6	23.2	16.0	39.2	0.28

Applied treatment program determined differences regarding on the growth of eggplant seedlings. 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 the higher values (7.4 leaves formed, 24.8 cm plant height, 17.2 cm root length, total length 42 cm plant; 0.3 frequency leaves). In contrast, V1 untreated produced the smallest increase, all the analyzed indicators registering the lowest values (5.4 leaves formed, 21.8 cm plant height, 10.6 cm root length, total length of 32.4 cm plants, leaves frequency 0.25).

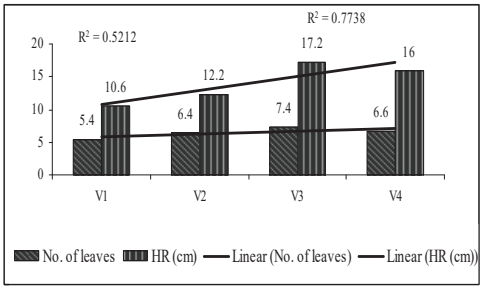

Figure 2. Influence of applied treatment on eggplant seedlings growth two weeks after the second treatment

As can be seen from Figure 2 and 3, schedule treatments with bioactive substances exert a greater influence on the growth of eggplant seedlings, respectively, a very significant influence on the growth of roots ($R^2 = 0.7738$) and a significant one on the number of leaves and on frequency leaves ($R^2 \geq 0.52$).

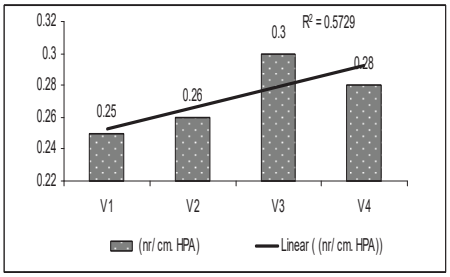

Figure 3. Influence of applied treatment on the leaves frequency two weeks after the second treatment

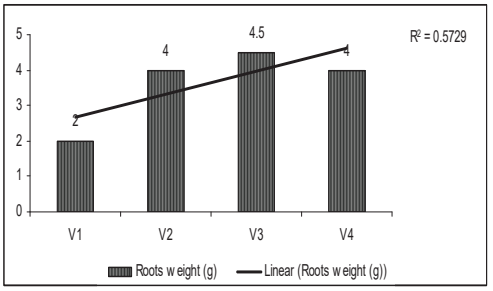

Figure 4. Influence of applied treatment on the roots weight two weeks after the second treatment

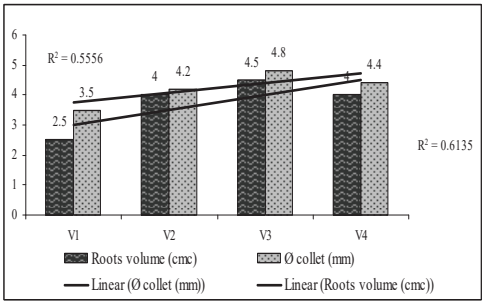

Figure 5. Influence of applied treatment on the roots volume and the collet diameter two weeks after the second treatment

Taken together the results obtained for eggplant seedlings morphometry, we estimate that the most balanced variant is V3 (fertilized with 0.1% Razormin) regarding on plants growth.
Developing of eggplant seedlings two weeks after the second treatments was quantified by various indicators of weight and volume and by diameter of collet. The obtained results (Table 3; Figure 4 and 5) regarding eggplant mass ratio highlights two situations:

1. at V3 variant all indicators recorded the highest values compare to the other variants (mass root 4.5 g; 10 g total mass, volume root 4.5 cm^3; 4.8 mm collet diameter), excluding the aerial part mass (5.5 g);

2. in contrast, V1 variant recorded the lowest values (mass root 2 g; 8 g total mass; volume root 2.5 cm^3; 3.5 mm collet diameter), excluding the aerial part mass (6 g).

Good results have also recorded the seedlings treated with BAC Foliar spray and Spraygard. A strong influence of the treatment on the development of the root system and of the collet diameter was noticed.

Table 3. Developing of eggplant seedlings at two weeks after the second treatments

Variant	Aerial part mass (g)	Roots weight (g)	Total weight (g)	Roots volume (cm^3)	Ø collet (mm)
V_1	6.0	2.0	8.0	2.5	3.5
V_2	5.5	4.0	9.5	4.0	4.2
V_3	5.5	4.5	10.0	4.5	4.8
V_4	5.5	4.0	9.5	4.0	4.4

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 (27.2–27.6 ^oC) and light intensity (Q) registered the value of 1280-1360 mmol/m^2/s.

Table 4. Physiology of the eggplant seedlings two weeks after the second treatment

Var.	A [µmol/ m^2/s]	E [µmol/ m^2/s]	A/E	GS [µmol/ m^2/s]	Leaf temp.T [^0C]	Q [µmoli/ m^2/s]
V_1	9.95	1.84	5.41	0.07	27.2	1280
V_2	6.35	0.84	7.56	0.045	27.6	1280
V_3	8.34	1.80	4.63	0.06	27.6	1360
V_4	9.08	1.57	5.78	0.06	27.2	1360

The results analysis revealed that V1 untreated variant recorded the highest values (Photosynthesis rate A = 9.95µmol/m^2/s; Transpiration rate E = 1.84 µmol/m^2/s; Stomatal conductance Gs = 0.07; A/E = 5.41) for all studied parameters. This intense physiological activity is not supported by plant growth and can be explained only by the theory that nutrition, regime of water and the temperature may be major factors of stress for seedlings of eggplant (Acatrinei, 2010; Sekara et al., 2012). The intensify of physiological processes without correlation with 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. It was also noticed V2 - Spraygard, which amid of low rates of transpiration and stomatal conductance, recorded very good photosynthetic yields.

Table 5. Assimilatory pigments of the seedlings leaves

Var.	Assimilatory pigments (mg/100 g)		
	Chlorophyll a	Chlorophyll b	Carotenoids
V_1	102.43	50.42	5.70
V_2	112.00	38.98	5.27
V_3	136.50	47.97	5.41
V_4	142.67	36.35	4.35

Biochemistry leaves are somewhat contradictory to physiology in the sense that an increased rate of photosynthesis is not necessarily correlated with an increased content of chlorophyll pigments. Thus, V1 untreated, recorded the lowest content of chlorophyll pigments (chlorophyll 102.43 mg/100 g, 50.42 mg/100 g chlorophyll b) but, due to an increase in photoprotection status, had the highest content in carotenoids pigments (5.7 mg/100 g). For other variants studied, the results were correlated with physiology and morphometry. It was again emphasized the V3, with the highest content of chlorophyll pigments and a very good photoprotective activity. V4 occupied second place, which was given mainly to synthesis of chlorophyll a (142.67 mg/100 g).

CONCLUSIONS

In horticultural tehnology were applied treatments with bioactive substances as a frequence practice for accelerating or inhibiting the growth of vegetable seedlings or plant or as a life support under different stressful conditions.
In the first stage of analysis the context results shows that treated variants have superior biometrics comparing to the control untreated variant. BAC Foliar Spray 0.3% highlights as variant in which seedlings have realised the most favorable growth.
At the second moment of analysis V3 - fertilized seedlings Razormin 0.1% it was noticed as the best option working variant. In this variant plants achieved the best and balanced growth, all indicators analyzed having higher values (7.4 leaves formed, 24.8 cm plant height, 17.2 cm root length, total length 42 cm plant; 0.3 frequency leaves). Treatments program applied of eggplant seedlings exerted at least a significant influence on the growth of eggplant seedlings, of roots, of the number of leaves and of frequency leaves.
Mass ratio analysis reveals that at V3 variant all indicators recorded the highest values compare to the other variants excluding the aerial part mass
Biochemical and physiological analysis also revealed V3 with the highest content of chlorophyll pigments and a very good photoprotective activity. V4 occupied second place, which was given mainly to synthesis of chlorophyll a.
In conclusion, the analysis of the acquired data allow to remark that treatment with Razormin 0.1% led to obtaining of eggplant seedlings with high quality and strong roots. Very good results in terms of quality seedlings were obtained when treatment with BAC Foliar Spray 0.3% was used and also with simple application of adjuvant Spraygard 1%.

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