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BIOSTIMULANTS WITH AMINO ACIDS USED FOR IMPROVING SEED GERMINATION AND SEED VIGOR INDEX IN EGGPLANT

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Abstract
Eggplant seed production is an important activity in breeding and cultivars maintaining of this species. Our research paper presents the influence of foliar treatments with biostimulants with amoni acids applied during the vegetation period, on the dynamics of seed germination, the percentage of germinated seeds and seed vigor index at eggplant. Biological material consist of two Romanian eggplant cultivars, Luiza and Belona. Four treatments were carried out, at 14 days interval, starting from the fruit setting. Three biostmulants were used for the treatments, Florone, Florabax and Rerum. After the fruit harvesting at physiological maturity, the seeds were extracted and used for assessing the germination dynamics in the laboratory. The seeds were placed on Petri dishes at 20^{O}C for 16 hours and 30^{O}C for 8 hours. After 14 days, germinated seeds were analysed for evaluation of sprouts, to calculate seed vigor index. Our results concluded that foliar treatments applicated in vegetation period with Florabax and Rerum can improve the seed germination process and have a positive influence on the percentage of germinated seeds and seed vigor index at eggplant.

Keywords: seed germination, seed production, Solanum melongena.

1. INTRODUCTION

Seed production is a basic concern of research institutes to increase or to mentain a biological value of cultivars. The introduction of new cultivars and the maintenance of older varieties, known and demanded by vegetable producers, is a current objective. In parallel, it is necessary to develop seed production technologies and conservative selection schemes, depending on the particularities of new species, cultivars and hybrids (Echim and Scurtu, 2020). The production of commercial seeds for eggplant is carried out in specialized farms, starting from the basic seed of open pollinated varieties or inbred parental lines of hybrids, according to the national legislation for the seeds production (Munteanu, 2003).

Obtaining as much seed as possible is in direct correlation with obtaining healthy plants. The seed must have a proper germination, according to legislative standards. Any disturbing factor for plant development, during any phenophase, can have a negative influence on seed formation (Munteanu, 2003; Tudor et al., 2009; Echim and Scurtu, 2020).

Eggplants react well to foliar or soil fertilization, having high nutritional requirements, especially regarding nitrogen and potassium. Nitrogen consumption in eggplant is very high during fruit

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growth, but the excess can have undesirable effects, especially if it is applied in large quantities before flowering (Munteanu, 2003; Tudor et al., 2009). Foliar fertilizers have the advantage that nutrients are more easily assimilated and metabolized by plants than those from fertilizers applied to the soil (Fageria et al., 2009).

A large number of amino acids have different roles and are involved in current physiological processes in plants. They increase the resistance of plants to drought, through the mechanism of closing and opening the stomata. Also, they are involved in permeability of cell membranes and the transport of ions, in maintaining the osmotic pressure in the cells and can help remove heavy metals from plants (Rai, 2002; Baquir et al., 2019). Another important role that amino acids have is the implication in plant growth and early yield. Also, they can increase disease resistance and some of them are involved in the formation of chlorophyll (Baquir et al., 2019).

Positive results were obtained regarding the use of foliar treatments with amino acids at eggplant that led to an increase of plant length, number of leaves, fruit weight and fruit yield (El-Nemr et. al., 2015). At the same time, foliar treatments with amino acids have a positive influence on the chemical composition of leaves and fruits. These led to the increase of nitrogen, potassium, zinc and total chlorophyll in leaves and vitamin C, carbohydrates and protein in fruits (Al-Khaqani and Aboohanah, 2021).

It has been known for a long time that some macro and micro elements have an important role in flowering and fruit setting in vegetables crops. Phosphorus deficiency leads to late flowering and fruiting of plants. Boron has positive effects by favoring a faster germination of pollen (Maier, 1969). Moreover, eggplants are sensitive to boron and molybdenum deficiency (Munteanu, 2003). In this species, boron has a positive influence on the increase in the number of flowers and fruits per plant (Solanki et al., 2017).

Specialized literature does not offer many information referring to the effects of foliar treatments with biostimulants with amino acids in seeds, both in eggplant and in other species. Therefore, this scientific research aims to study the influence of foliar treatments with biostimulants with amino acids formulated with macro and microelements on the quality of eggplant seeds.

2. MATERIALS AND METHODS

The experiment was carried out in open field, at Research and Development Institute for Vegetable and Flower Growing Vidra, between May and October 2020. The quality of the seeds was analyzed in the breeding and seed production laboratory of the same institute, in February 2021.

Seedlings from two Romanian eggplant cultivars, Belona and Luiza, were used as biological material. The seedlings were planted on the ground mulched with black polyethylene film, on the 15th of May. The current experiment is a bifactorial one, and the placement of the variants in the field was organised in split plot design, with three replications. The area of an experimental plot was 11.2 m^2, with a number of 40 plants. It was 8 meters long and 1.4 meters wide. The distances between rows were 70 cm, and between plants per row were 40 cm, resulting a density of 35000 plants/ha.

The first experimental factor is represented by the cultivar used, with two graduations, Belona and Luiza. The second factor is represented by the treatments that were carried out, with four graduations. No foliar treatments were applied to the control variant. For the other variants, three commercial products with amino acids in their composition were used for foliar treatments: Florone, Florabax and Rerum. Florone contains 4% free amino acids, 1% N, 10% P_2O_5, 10% K_2O, 0.25% B, 0.20% Mo, and was used in concentration of 0.5 ml/L. Florabax has a composition of

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10.5% P_2O_5, 8% B, 10% Mo, 8% free amino acids, being used at a concentration of 1.5 g/L. The chemical composition of the Rerum product consists of 0.5% N, 0.5% P, 0.5% K, 0.15% Fe, 0.075% Zn, 0.075% Mn, 0.075% Cu, 0.03% B, 0.015% Co, 0.015% Mo, 20% ASFAC BCO-4, 20% free amino acids, 0.15% MgO and was used in concentration of 5 ml/L.
Four foliar treatments with these biostimulants were carried out at intervals of 14 days, between 20th of June and 30th of July. The treatments were applied starting with fruit setting.
General maintenance works were carried out during the vegetation period to all experimental variants, which consisted in: mechanical and manual harrowing (two mechanical and two manual harrows), watering, phytosanitary treatments and basic fertilizing, in autumn and spring (Munteanu, 2003). In addition, depending on the experimental variants, were applied specific foliar treatments with biostimulants.
The fruits were harvested at physiological maturity. The harvested fruits were left to become soft for four days and after that, the seeds were washed (Tudor et al., 2009).
The seeds obtained on each variant were germinated, according to SR 1634/1999 Romanian standard. Germination was carried out on filter paper, in Petri dishes, with 100 seeds per dish, in three replications, for each variant. The seeds were incubated for 14 days, at an alternant temperature of 30°C for 8 hours and 20°C for 16 hours. The percentage of germinated seeds was determined daily, in order to calculate the germination speed index, according to the formula: GSI = G1/N1 + G2/N2 + ... + Gn/Nn (Maguire, 1962), where G1, G2... Gn is the number of germinated seeds and N1, N2... Nn is the number of days that have passed since sowing in Petri dishes.
On the 14th day, the final germination percentage was determined. After 14 days, the germs were detached from the filter paper and were weighed and measured in order to calculate seed vigor index, according to the formula: SVI = the length of the germ (cm) x final germination percentage (%) (Abdul and Anderson, 1973).
The data obtained from the measurements were processed by specific statistical-mathematical methods, and the significance of differences between variants was evaluated using the Duncan's Multiple Range Test performed at $P \leq 0.05$.

3. RESULTS AND DISCUSSIONS

Table 1 shows the influences of foliar treatments with biostimulants on the germination percentage per days in eggplant, in Belona and Luiza cultivars.
At both varieties, germination started on the second day after placing on filter paper.
On the 3rd and 4th day, there are no significant differences between the treated and untreated variants, in any of the two cultivars, regarding the percentage of germinated seeds.
Treatments with the Florabax product determined significant differences regarding the percentage of germinated seeds in the Belona cultivar on the 6th and 10th days. Also, treatments with Florabax at Belona caused significant increases in the number of germinated seeds, between the 7th and 11th days. However, until the end of the 14 days, there were no significant differences in the percentage of germinated seeds in the Belona cultivar.
In the Luiza variety, treatments with Florone caused significant increases in the percentage of germinated seeds on the 10th and 11th days, but until the 14th day this treatment did not show important differences compared to the control variant.

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Treatments with Florabax significantly increased the percentage of germinated seeds in Luiza cultivar starting with the 5th day after sowing, and treatments with Rerum, starting from the 7th day.

Tabel 1. Germination dynamics, final germination percentace and germination speed index in eggplant treated with biostimulants

		Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13, 14 FGP	GSI
		%	%	%	%	%	%	%	%	%	%	%	%	%/day
V1	Belona untreated	0.00 a	16.67 a	34.00 a	45.33 bc	49.33 c	52.00 c	55.33 d	57.33 d	60.00 f	62.67 e	66.67 d	66.67 c	39.60 c
V2	Belona treated with Florone	0.67 a	19.33 a	30.67 a	45.33 bc	49.33 c	54.67 bc	58.00 cd	60.67 d	62.67 ef	64.67 de	68.67 cd	68.67 c	40.79 bc
V3	Belona treated with Florabax	0.67 a	19.33 a	34.67 a	47.33 bc	56.00 bc	62.00 ab	64.67 bc	68.00 bc	69.33 cd	70.67 cd	72.00 cd	72.00 bc	44.39 bc
V4	Belona treated with Rerum	0.00 a	17.33 a	35.33 a	53.33 ab	57.33 b	60.67 abc	62.67 bcd	66.00 cd	68.00 cde	68.67 cde	70.00 cd	70.00 c	43.97 bc
V5	Luiza untreated	0.00 a	19.33 a	37.33 a	48.67 bc	56.00 bc	58.67 bc	60.67 bcd	62.00 cd	64.67 def	66.00 de	68.67 cd	69.33 c	43.09 b
V6	Luiza treated with Florone	0.00 a	21.33 a	38.00 a	52.67 ab	57.33 b	62.67 ab	67.33 ab	68.00 bc	72.67 bc	73.33 bc	74.00 bc	76.00 bc	46.50 ab
V7	Luiza treated with Florabax	0.67 a	20.67 a	34.67 a	61.33 a	66.00 a	70.00 a	74.67 a	78.67 a	82.00 a	82.67 a	83.33 a	84.00 a	51.18 a
V8	Luiza treated with Rerum	0.00 a	17.33 a	32.00 a	39.33 c	62.00 ab	69.33 a	72.67 a	76.00 ab	76.00 ab	78.67 ab	79.33 ab	79.33 ab	46.27 ab

FGP = Final germination percentage, GSI = Germinated speed index
Values followed by different letters within each column are significantly different based on Duncan multiple range test (P≤0.05)

The final germination percentage was significantly influenced only in the case of the Luiza variety, in the case of the variants treated with Florabax and Rerum. The treatments with Florabax increased the percentage of germinated seeds by 21.15%, and the treatments with Rerum, by 14.42%.
The germination speed index was not influenced by the treatments used at Belona cultivar. In the case of the Luiza cultivar, this index increased significantly with 18.77% following the treatments applied with Florabax.
Table 2 shows the results regarding the influence of treatments with biostimulants on the sizes of the germs, obtained after the germination of the seeds, and measured on the 14th day after sowing.

Tabel 2. The influence of treatments with biostimulants on germs and seed vigor index

		Shoots weight	Roots weight	Total weight of germ	Shoots length	Roots length	Total length of germ	Seed vigor index
		mg	*mg*	*mg*	*cm*	*cm*	*cm*	
V1	Belona untreated	20.33 b	11.28 a	31.60 a	2.99 d	3.67 a	6.66 b	443.82 d
V2	Belona treated with Florone	23.31 ab	10.20 a	33.51 a	3.03 cd	3.99 a	7.02 ab	480.78 cd
V3	Belona treated with Florabax	23.93 ab	10.52 a	34.45 a	3.15 bcd	3.90 a	7.05 ab	507.13 bcd
V4	Belona treated with Rerum	23.42 ab	11.18 a	34.60 a	3.95 a	3.84 a	7.79 a	545.80 abc
V5	Luiza untreated	22.69 ab	9.95 a	32.64 a	3.20 bcd	3.76 a	6.96 a	481.53 cd
V6	Luiza treated with Florone	25.34 a	11.45 a	36.79 a	3.45 bc	4.05 a	7.50 a	567.75 ab
V7	Luiza treated with Florabax	24.04 ab	13.12 a	37.15 a	3.06 cd	4.17 a	7.24 ab	608.55 a
V8	Luiza treated with Rerum	24.60 ab	11.52 a	36.11 a	3.51 b	4.22 a	7.73 a	612.79 a

Values followed by different letters within each column are significantly different based on Duncan multiple range test (P≤0.05)

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The weight of the shoots, roots and entire germ was not significantly influenced by any of the treatments used, in any cultivar. Also, the length of the roots was not significantly influenced.
The length of the shoot and the length of the entire germ increased significantly at the Belona cultivar, in the case of using Rerum treatments. The length of the shoots, roots and germs was not influenced by the treatments, in the case of the variety Luiza.
Seed vigor index was significantly increased by all the treatments used in the Luiza variety, but its value in the Belona variety increased significantly only in the case of Rerum treatments. Anyway, also in the case of the Luiza cultivar, treatments with biostimulant Rerum gave the highest increases in the seed vigor index. It increased by 27.25%, compared to the untreated variant at the Luiza cultivar, and by 22.97%, compared to the untreated variant at the Belona cultivar. At Belona, the seed vigor index increased as a result of the better development of the germs, which increased more in the case of Rerum treatments. The seed vigor index, at Luiza cultivar, had higher values as a result of the increase in the percentage of germinated seeds.
Treatments with biostimulants with amino acids have increased the quality of the seeds on eggplant, but the varieties can respond differently to treatments.
The positive answer can be due to the fact that amino acids are involved in several processes in the development of plants, from fruit setting, to seeds formation (Baquir et al., 2019), which can lead to a higher seed quality.

4. CONCLUSIONS

Treatments with biostimulants with amino acids can influence the percentage of germinated seeds and also the vigor of eggplant germs. However, different cultivars may respond differently to treatments.
The percentage of germinated seeds was significantly influenced by the treatments with Florabax and Rerum, but only at Luiza cultivar. Also, the germination speed index increased significantly only in Luiza treated with Florabax.

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