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Influence of Biostimulants on Growth and Development of Bell Pepper (*Capsicum annuum* L.)

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Abstract The effect of four different biostimulants was investigated in this study. Biostimulants Radifarm®, Megafol®, Benefit® and Viva® were applied according to manufacturer's advice. Pepper hybrid Vedrana F1 was used to evaluate the effect of biostimulants on yield parameters. All the parameters tested including average fruit yield per plant, largest fruit weight, smallest fruit weight and average fruit number per plant were affected by biostimulant treatment sometime during the investigation period. Treated plants had higher yields and fruit weight. The study suggested hat biostimulants positively affect pepper yield parameters.

Key words: biostimulant, fruit, pepper, yield.

Introduction

The development of new production technologies has resulted in current pepper hybrids giving their maximum yields. However, intensive production and unfavourable environmental conditions can induce plant stress and reduced performance rather than large fruits, high yields and regular harvest. In such cases, plants can be assisted through treatments with different growth promoters such as biostimulants.

Biostimulants consist of polysaccharides, amino acids, carbohydrates, glycosides and proteins. Most of the biostimulants are meat industry by-products and are completely environment and health friendly. Biostimulants can be applied at different growth stages of plants depending on biostimulant type. For example,

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biostimulants based on amino acids proline and tryptophan can be used to reduce consequences of environmental stress. Proline is a free radical scavenger and can help the plant to overcome the stress as shown in an investigation by Vinković *et al*. (2007).

Parađiković *et al*. (2008) reported the positive effect of treatment with biostimulants Radifarm® and Megafol® on growth and development of tomato, reflected in increasing fresh mass of investigated parameters compared to control plants.

The aim of this study was to evaluate the effect of four different biostimulants on growth and development of bell pepper.

Material and Methods

This study was conducted during 2009 under glasshouse conditions at Staklenici d.o.o. in Magadenovac, Croatia. The material used included pepper hybrid seeds Vedrana (Enza Zaden, NL) and biostimulants Radifarm®, Megafol®, Benefit® and Viva® (Valagro s.p.a., Italy; Greece).

Sowing was performed on 25th February in polystyrene plug trays. Temperatures during the day were between 16-18°C and daily temperatures were around 22-24°C. Emergence occurred seven days after sowing. Two and four weeks after sowing biostimulant Radifarm® was applied by watering at a concentration of 0.25%. Each plant was watered with 60 ml of solution. Biostimulant Radifarm® is highly recommended for root development, being based on amino acids arginine and asparagine. The biostimulant Megafol® was applied by spraying at a concentration of 0.20% three and five weeks after sowing to promote foliar growth and development. Megafol® is based on amino acids proline and tryptophan.

Plants were transplanted on 5th April into plastic pots of 4 L volume filled with cocopeat from Sri Lanka having good water and air capacity (around 75% of micro pores) and being recommended for use in the hydroponic system of production.

On the following day, biostimulant Radifarm® was applied at the same concentration. Each plant received 250 ml of solution. Seven days after transplanting Megafol® was applied (0.20%). There were two additional applications of Megafol® every seven days, with the final application of Megafol® being on 26th April.

The treatment with the above two biostimulants was immediately followed by the use of Benefit® and Viva®. A total of three applications of Benefit® and two applications of Viva® were made at recommended time intervals after fruit set. Benefit® was applied at a concentration of 0.30% by spraying and Viva® at a concentration of 0.25% by watering.

Benefit® is composed mostly of nucleotides which stimulate cell division and specific amino acids (glycine, alanine, aspartic acid and glutamic acid) which induce acceleration of major metabolic reactions, particularly protein synthesis, and provide the cell with greater resistance to different types of stress.

Viva® increases plant growth activities through a synergic action on root system, a high setting ratio and good uniformity of fruit growth and ripening.

Plants were fertigated with standard nutrient solution according to Sonneveld (1991) as described by Adams (2002). After transplanting and till the end of trial which occurred on 10th June daily temperatures were between 22-36°C and during the night between 13-21°C. Glasshouse was only heated in the part where

the sowing process was conducted, whereas the production parts of the glasshouse were not heated at the time.

The parameters tested included average fruit yield per plant, largest fruit weight, smallest fruit weight and average number of fruits per plant. There were a total of 3 harvests during the trial.

First harvest was performed on 25th May, second on 2nd June and third on 10th June.

The trial involved treated and untreated (control) plants i.e. two treatments, each in five replications with 10 plants per replication in a randomized block design.

The data obtained were statistically analyzed using analysis of variance.

Results and discussion

The statistical analysis of data obtained in the first harvest showed that the average fruit yield per plant was significantly affected by treatment with biostimulants (p=0,01) (Table 1). The highest yield was 522 g plant^{-1}, as obtained in treated plants, and the lowest was 335.7 g plant^{-1} (control plants). Fruit weight was highest (185 g) in treated plants and lowest (162 g) in the control. Also, this parameter was highly affected (p=0.01) by biostimulant application.

The lowest fruit weight was significantly affected by biostimulant treatment (p=0.01). The biggest of the small fruits were produced by treated plants (125 g) (Table 1). Treated plants had significantly more fruits per plant (p=0.01).

Tab. 1. Pepper yield parameters as affected by treatment with biostimulants during the first harvest

Treatment	Replication	Average fruit yield per plant (g)	Largest fruit weight per plant (g)	Smallest fruit weight per plant (g)	Average fruit number per plant
Biostimulants	I	425.9	185	122	3.1
	II	469.2	183	123	3.2
	III	482.2	177	127	3.2
	IV	522.0	178	124	3.5
	V	519.7	180	125	3.1
Average		**483.8^{a}**	**180.6^{b}**	**124.2^{c}**	**3.22^{d}**
Control	I	420.2	168	112	2.7
	II	427.2	170	116	2.8
	III	446.9	162	111	2.8
	IV	360.4	166	110	2.9
	V	335.7	168	109	27.
Average		**398.08^{a}**	**166.8^{b}**	**111.6^{c}**	**2.78^{d}**

Values with the same letter differ significantly

In the second harvest only the smallest fruit weight was significantly affected (p=0.05) by the treatment with biostimulants. In this case, control plants had the smallest fruits (Table 2).

At the end, during the final harvest, the average fruit yield per plant and largest fruit weight were significantly affected (p=0.01) by biostimulants application. The smallest fruit weight and average number of fruits per plant did not show statistical differences (Table 3).

Tab. 2. Pepper yield parameters as affected by treatment with biostimulants during the second harvest

Treatment	Replication	Average fruit yield per plant (g)	Largest fruit weight per plant (g)	Smallest fruit weight per plant (g)	Average fruit number per plant
Biostimulants	I	172.3	149	114	1,3
	II	276.4	153	115	2,1
	III	325.3	174	123	2,3
	IV	255.0	161	121	1,8
	V	280.0	160	120	2,1
Average		**261.8**	**159.4**	**118.6[a]**	**1.92**
Control	I	218.4	138	109	1,7
	II	291.7	171	113	2,1
	III	340.5	177	93	2,5
	IV	215.2	150	93	1,7
	V	285.3	150	109	2,4
Average		**270.2**	**157.2**	**103.4[a]**	**2.08**

Values with the same letter differ significantly

Table 3. Pepper yield parameters as affected by treatment with biostimulants during the third harvest

Treatment	Replication	Average fruit yield per plant (g)	Largest fruit weight per plant (g)	Smallest fruit weight per plant (g)	Average fruit number per plant
Biostimulants	I	448.0	273	157	2.3
	II	420.0	254	162	2.5
	III	414.0	256	153	2.0
	IV	409.0	274	149	2.1
	V	424.0	261	152	2.4
Average		**423.0[a]**	**263.6[b]**	**154.6**	**2.26**
Control	I	399.0	242	147	2.6
	II	382.0	238	152	2.2
	III	400.0	243	164	1,9
	IV	380.0	234	145	1,8
	V	375.0	212	155	1,8
Average		**387.2[a]**	**233.8[b]**	**152.6**	**2.06**

Values with the same letter differ significantly

In previous studies, the effect of biostimulants was described in many different ways and species. Biostimulants improve and help the plant during the germination phase as described by Yilidirim *et al*. (2007). Also, Vernieri *et al*. (2002) showed that these types of biostimulants facilitate root growth and development and can be applied throughout the growing season.

Conclusion

This study shows the positive effect of biostimulant treatment on fruit yield and fruit size. The two parameters show the possibility of using biostimulant treatment to obtain higher marketable yields due to fruit enlargement. There is a need for further investigations on biostimulant effect, especially due to the results of high yields obtained during the first harvest, implying that the plants overcame the transplanting stress sooner as compared to control plants.

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UTICAJ BIOSTIMULATORA NA RAST I RAZVOJ PAPRIKE (*Capsicum annuum* L.)

- originalni naučni rad -

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Rezime

U istraživanju je ispitivan uticaj četiri različita biostimulatora Radifarm®, Megafol®, Benefit® i Viva® na rast i razvoj hibridne paprike Vedrana F1. Biostimulatori su primenjeni prema uputstvu proizvođača. Praćeni parametri tokom ogleda su bili prinos ploda po biljci, masa najvećeg ploda, masa najmanjeg ploda i prosečan broj plodova po biljci. Sva ispitivana svojstva su bila pod uticajem tretmana sa biostimulatorima u određenom vremenu trajanja ogleda. Tretirane biljke imale su viši prinos i veću masu ploda u odnosu na netretirane biljke (kontrola). Na kraju istraživanja može se zaključiti da biostimulatori pozitivno utiču na ispitivane parametre prinosa ploda paprike.