INFLUENCE OF TWO BIOSTIMULANTS APPLICATION ON GROWTH AND DEVELOPMENT OF *TROPAEOLUM MAJUS* L.

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ABSTRACT

The effect of two different biostimulants was inevstigated in this study on growth and development of nasturtium (Tropaeolum majus L.). Biostimulants Radifarm® and Megafol® were applied according manufactures advice. The experiment was conducted in 2013. It was arranged in a split - plot design with four replicates and three treatments (control, Radifarm®, Megafol®). Morphological parameters, plant height, leaf number and number of flowers were recorded regularly during growth and development of nasturtium. At the end of experiment, plants were sampled and root and above-ground fresh and dry weight and root length were recorded. Obtained results showed significantly higher values of all investigated parameters of nasturtium growth under tretament with biostimulants.The research shows that applying biostimulants in the production of Tropaeolum majus L. improves the growth and development of the root and the above-ground part.

INTRODUCTION

Nasturtium (*Tropaeolum majus* L.) is an annual herbaceous plant with stems growing to 1 meter long or more. The leaves are large, nearly round, 3 to 15 cm diameter. Flowers are found in many colors, mostly yellow, orange and red. It can be high, low, creeping and often is used as a ground cover and as the protector of the orchard from aphides. It is widely cultivated, both as an ornamental plant and as vegetable and medical plant. All its parts are edible. The flower has most often been consumed, making for an especially ornamental salad ingredient. The flowers contain about 130 mg vitamin C per 100 g, about the same amount as is contained in parsley. Moreover, they contain up to 45 mg of lutein per 100 g, which is the highest amount found in any edible plant. This plant is known because of its ornamental properties and also because its leaves and flowers are edible and used in salads, where they impart a peppery flavor due to the presence of glucosinolates (Jens and Birger, 1993).

Demands and needs for ornamental and medical transplants production are constantly growing in BiH. Consequentially, transplants producers have to improve daily their production in order to obtain transplants of high quality. In BiH, in most cases, classic production of “naked roots” transplants is being used (Hanić, 2000) which results of poor quality transplants. Intensive production and unfavourable environmental conditions can induce plant stress and reduced performance rather than large fruits, high yields and regular harvest. However, modern transplants production is based on production in different container systems (Latimer, 1991), usage of specialized substrates and application of different controlled release fertilizers (Nelson, 2003), as well as application of growth biostimulants. Biostimulants consist of polysaccharides, amino acids, carbohydrates, glycosides and proteins. Most of the biostimulants are completely environment and health friendly. Biostimulants can be applied at different growth stages of plants depending on biostimulant type. Biostimulants based on amino acids proline and tryptophan can be used to reduce consequences of environmental stress. Proline is a free

radical and can help the plant to overcome the stress as shown in an investigation by Parađiković et al. (2016). Zeljković et al. (2013) reported positive effect of treatment with biostimulant Radifarm® on growth and development of marigold (*Tagetes patula* L.) resulting in enhancement of all morphological parameters as well as nutrient status compared to control plants.

The aim of this study was to investigate the effect of two different biostimulants, Radifarm® and Megafol® on growth and development of nasturtium (*Tropaeolum majus* L.).

MATERIAL AND METHOD

This study was conducted under greenhouse conditions at Faculty of Agriculture, University of Banja Luka, BiH and the family farm Topić in Prnjavor, BiH in the April - August 2013 period. Nasturtium seeds purchased in agricultural pharmacies were sown in April in polystyrene containers in the Klasmann-Deilmann substrate. The substrate is a poorly degraded mixture of black and white peat with pH level of 5.5-6.5. Plants were kept in the greenhouse where daily temperatures were 18-20°C, and nightly 15-18°C with a relative air humidity of 60-65%. The greenhouse was regularly ventilated so that disease development would not occur. The plant emergence was occured seven days after sowing. After two weeks seedlings were ready for transplantation. Nasturtium seedlings were transplanted in garden into garden soil. In the laboratory of Soil Science, Faculty of Agriculture, University of Banja Luka chemical analysis of garden soil was conducted and its composition is given in Table 1.

Table 1

Chemical analysis of garden soil

pH		EC - electroconductivity
H_2O	KCl	2,33 mS/cm
7.80	6.88	

After transplanting biostimulant Radifarm® of the producer Valagro s.p.a. Italy was applied on the root zone by watering in the concentration of 0.25%. Biostimulant Radifarm® is highly recommended for root development, which contains polysaccharides, glycosides and proteins, and it is enriched with amino acids (arginine and asparagine), vitamins and micro-elements (Fe and Zn). It is used for mass increment and lateral root development during the first phase of plant growth, and then it stimulates formation and extension of new roots and root hairs. In this way it helps faster rooting of plantlets and recovery from stress of transplantation. On the following day, biostimulant Radifarm® was applied at the same concentration. Seven days after transplanting biostimalant Megafol® of the producer Valagro s.p.a. Italy was applied by spraying at a concentration of 0.20% to promote foliar growth and development. Megafol® is based on amino acids proline and tryptophan. There were several additional applications of Megafol® until the end of June.

Experiment was designed by split plot method in 4 repetitions with 10 plants per repetition: plants treated with biostimulant Radifarm® (treatment: factor A2), plants treated with biostimulant Megafol® (treatment: factor A3) and control plants watered just with water (control; factor A1). In the experiment were totally 120 plants of nasturtium - *Tropaeolum majus* L.

During the experiment was carried out measurements of morphological indicators of growth and development of plants (plant height, number of leaves, number of flowers and root lenght). For determination of plant adaptation, root growth and development under influence of biostimulants, plants were taken out from the soil on the end of August. Roots were cleaned from soil, rinsed in distilled water and dried with paper towels after which

root and above-ground fresh mass of each plant was recorded. Dry mass was recorded after drying the plant material on 70°C and were expressed in grams (g).

The data obtained were statistically analyzed using analysis of variance (Vukadinović, 1994).

RESULTS AND DISCUSSIONS

In order to determine the influence of two biostimulants on growth and development of nasturtium (*Tropaeolum majus* L.) through plants morphological indicators and the fresh and dry weight of roots and above-ground parts, the following results were obtained. During the experiment, measurements were made of morphological indicators of plant growth and development. Table 2. shows the average value of the indicator. Plants treatment showed better results in terms of morphological characteristics (plant height, leaf number, number of flowers, root lenght), as the average values of all investigated parameters were significantly higher than the average value of the control plants.

Table 2

Morphological indicators of growth and development nasturtium *Tropaeolum majus* L. under the influence of biostimulants

Treatment variant (A)	Plant height (cm)	Number of leaves	Number of flowers	Root lenght (cm)
Control (A1)	17.56	8.42	0.60	14.03
Treatment with Radifarm® (A2)	19.82	9.73	0.93	19.35
Treatment with Megafol® (A3)	18.12	8.87	1.74	16.34
Average	18.50	9.01	1.09	16.57
Analysis of variance - F	4.41*	11.56**	27.52**	8.76**
LSD	Plant height (cm)	Number of leaves	Number of flowers	Root lenght (cm)
0.05	1.7935	0.6301	0.3571	2.8826
0.01	ns	0.9053	0.5131	4.1416

ns = *not significant*

Plant height was under significant (p≤0.05) influence of the biostimulants. The highest recorded plant height 19.82 cm belong to variant A2 (treatment with Radifarm®), while the lowest 17.56 cm belong to the control plants (A1). Number of leaves, number of flowers and root lenght were under a very significant (p≤0.01) influence of the biostimulants. The highest average number of leaves (9.73) was determined in A2 variant (treatment with Radifarm®), and the lowest of 8.42 belong to the control plants (A1). The highest average number of flowers of the treatment with Megafol® (A3) was 1.74, while the lowest was in the control group of plants (A1 0.60). The highest root lenght 19.35 cm belong to variant A2 (tretament with Radifarm®), while the lowest belong to the control group of plants (A1 14.03 cm) (Table 2.). After analyzing the morphological indicators of growth and development of nasturtium (*Tropaeolum majus* L.) measurement of fresh and dry weight of plants were carried out and the obtained results are shown in Table 3.

Table 3

Fresh weight (FW) and dry weight (DW) of root and above-ground part of nasturtium *Tropaeolum majus* L. under the influence of biostimulants

Treatment variant (A)	Above ground part FW (g)	Above ground part DW (g)	Root FW (g)	Root DW (g)
Control (A1)	28.03	4.70	0.73	0.17
Treatment with Radifarm® (A2)	57.60	6.89	1.19	0.19
Treatment with Megafol® (A3)	40.97	6.66	0.92	0.18
Average	42.20	6.08	0.95	0.18
Analysis of variance - F	11.84**	5.31*	7.65*	0.57
LSD	Above ground part FW (g)	Above ground part DW (g)	Root FW (g)	Root DW (g)
0.05	13.7790	1.6521	0.2700	ns
0.01	19.7975	ns	ns	ns

ns = *not significant*

Fresh weight of above-ground part was under a very significant (p≤0.01) influence of the biostimulants. The highest recorded average value 57.60 g belong to the treatment with Radifarm® (A2). The lowest recorded value was 28.03 g and belong to the control variant (A1). Dry above-ground parts weight, was under significant (p≤0.05) influence of the biostimulants. The greatest value of the dry weight of above-ground parts belong to the variant A2 (treatment with Radifarm®) 6.89 g and the smallest value belong to variant A1 (control) 4.70 g. Fresh root weight, was also under significant (p≤0,05) influence of the biostimulants. Highest recorded value was in A2 variant (tretament with Radifarm®) 1.19 g and the lowest recorded value was in control group (A1 0.73 g). Statistical significance was missed in dry weight of roots (Table 3).

Biostimulants are plant extracts and contain a wide range of bioactive compounds that are mostly still unknown. These products are usually able to improve the nutrient use efficiency of the plant and enhance tolerance to biotic and abiotic stresses (Bulgari et al. 2015). 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. Similar results with several flower species have been obtained by Zeljković et al. (2011). In the phase of seed germination, biostimulants can increase seedlings fresh and dry mass of some flower species (Parađiković et al., 2008). Parađiković et al. (2009) determined, similar to this investigation, that biostimulants significantly affects on increasing of above-ground and root fresh and dry weight of *Tagetes patulus* L. Todorović et al. (2015) confirmed positive biostimulants application in the regulation of tomato productivity. Vujošević et al. (2007) examined and determined justification of natural biostimulants application and controlled release fertilizers in commercial production of Mexican marigold and Scarlet sage transplants with significantly affects on fresh mass increase, bud number, flower number and root length. Also, positive effect of biostimulants on Begonia was confirmed by Zeljković et al. (2010).

CONCLUSIONS

This study shows the positive effect of biostimulants treatment on growth parameters. Treated plants had significantly higher fresh and dry weights of roots and above ground parts and significantly higher number of leaves in comparison with control plants. Biostimulants application also increased the most important parameter for decorative species, i.e. number of flowers. Based on the above, it can be concluded that the application of biostimulants in the plantlet phase is recommendable because of beneficial effect on growth and development both the above-ground part and the root of the nasturtium. At the same time the application of biostimulants treatment ensures the plant with adequate crop nutrition throughout the year without the application of mineral fertilizers, especially considering nitrogen. There is a need for further investigations on biostimulant effect, implying that the plants overcame the transplanting stress sooner as compared to control plants.

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