DOI: 10.46793/SBT30.04NP

EFFECT OF ORGANIC BIOSTIMULANTS ON MORPHOLOGICAL PARAMETERS OF ONION (*Allium cepa* L.)

Nenad Pavlović[1], Dragan Stepanović[1], Ljiljana Bošković-Rakočević[1], Jelena Mladenović[1], Ivana Živković[2], Dalibor Tomić[1], Milan Šević[1]*

Abstract: The effect of organic biostimulants on the morphological parameters of onions (*Allium cepa* L.) in organic cultivation was investigated. Treatments included solutions based on yeast, algal extracts and fulvic acids. The greatest plant height (96.8 cm) and a significant statistical difference were obtained in the plants treated with yeast solution, while ProAlgin affected the number of leaves (11.8) and Fulvimax the neck thickness (2.35 cm). The results confirm the positive effects of biostimulants on the quality and growth of plants and underline their potential for sustainable agriculture.

Keywords: onion, biostimulants, morphological parameters

Introduction

The onion (*Allium cepa* L.) is a biennial monocotyledonous plant and one of the oldest vegetable species. It originates from Asia and can be used fresh all year round due to its great variety and adaptability. The onion, the young plant or the leaves are used either as stews, salads or side dishes and can also be dried or pickled. It is known to contain sulfur-containing amino acids as well as many vitamins and minerals (Ђуровка, 2008). In addition, the presence of various secondary metabolites, including flavonoids, phytosterols and saponins, has been demonstrated (Marrelli et al., 2018). Since ancient times, onion has been used as a remedy for gastrointestinal disorders, to improve heart function, to regulate blood sugar, as a poultice for inflammatory processes and for rheumatism (Ђуровка, 2008). Onion extract is also used as a disinfectant.

Organic farming is an integrated agricultural system aimed at sustainability, improving soil fertility and biodiversity while prohibiting the use of synthetic pesticides, antibiotics, synthetic fertilizers, genetically modified organisms and growth hormones. It is based on crop rotation, green manuring, composting and biological pest control (Dardić i sar., 2010). By combining

[1]University of Kragujevac, Faculty of Agronomy, Cara Dušana 34, Čačak, Serbia (nenadpavlovic@kg.ac.rs)

[2]Institute for Vegetable Crops, Karadjordjeva St. 71, 11420 Smederevska Palanka, Serbia

tradition, innovation and science, the health of animals, plants, soil and people is maintained while improving the environment and quality of life.

In the last three decades, several technological innovations have been proposed to improve the sustainability of agricultural production systems by significantly reducing the use of synthetic agrochemical products such as pesticides and fertilizers. One promising and ecologically defensible innovation is the use of natural plant biostimulants that improve flowering, plant growth, fruit formation, plant productivity and nutrient use efficiency while increasing tolerance to a variety of abiotic stress factors (Colla and Rouphael, 2015). Scientists from different parts of the world are working on researching the effects of biostimulants on vegetable crops. For example, research with potatoes (*Solanum tuberosum*) and lettuce has shown that biostimulants based on fulvic and humic acids had a significant impact on increasing the yields of these crops (Taha et al., 2016; Akimbekov et al., 2020). Almond plants showed significant shoot growth and an increase in leaf area when biostimulants from algae or microbial fermentation of cereals were applied (Saa et al., 2015). Abd Allah . (2022) found that a biostimulant based on algal extract improved the morphological parameters of onions, resulting in higher yields with a reduction in the amount of nitrogen fertilizer.

The aim of this study was to determine the effects of different types of biostimulants available on the Serbian market on the production quality of onions.

Materials and methods

The trial was conducted in spring/summer 2024, from March 11 to July 9, i.e. from sowing to onion harvest. The trial was conducted on a private farm in Velika Lomnica, in the municipality of Kruševac. It was designed in a randomized block system with three replicates. The trial consisted of 5 treatments with 10 plants per replicate, and the planting scheme for the crops was 30x10 cm (Figure 1). The plant material used for the research was the "Holland Yellow" variety. The plants were treated with the recommended dosage of organic biostimulant solutions during the growing season. All treatments were applied via the leaves and were carried out a total of 5 times during the growing season. The control group was not treated with biostimulants. The following biostimulants were used in this experiment:

Fulvimax 80 – Treated at a concentration of 1 g L^{-1} water.

Trainer – Treated with a concentration of 3 ml L^{-1} water.

ProAlgin – Treated with a concentration of 2 g L^{-1} water.

Yeast solution – Treated with a concentration of 4 g dry yeast + 4 g sugar per 1 L of water.

Control – Treated with pure water.

The technology for growing the onions followed the principles of organic plant production. 75 days after sowing, the first measurements were taken for the following parameters: plant height, number of leaves and neck thickness.

The data obtained were analyzed with Microsoft Excel spreadsheet software using the LSD (Least Significant Difference) test. The LSD test is the simplest method for comparing the arithmetic mean values of observed samples. The results are presented in table.

Results and discussion

Analyzing the parameter of total plant height, it was observed that the tallest plants were those treated with the yeast solution (96.8 cm), while the shortest plants were the control group, which was not treated (89.1 cm). The next most influential treatment for plant height was the Trainer treatment (90.7 cm). Based on the calculated LSD test at both significance levels (0.05 and 0.01), a statistically significant difference was found at the 0.05 level between the yeast solution treatment and the control, while no statistically significant differences were observed between the other treatments for the analyzed parameter (Table 1).

Table 1: Mean values for plant height, number of leaves, and neck thickness by treatment

Treatments/Plant traits	Plant height	Number of leaves	Neck thickness
Fulvimaks	89.2	11.3	2.35
Trainer	90.7	11.2	2.20
Proalgin	89.9	11.8*	2.30
Yeast solution	96.8*	11.0	2.24
Control	89.1	10.2	2.17
LSD 0.05	*6.393*	*1.501*	*0.991*
LSD 0.01	*8.841*	*2.063*	*1.370*

The positive effect of yeast extract on the vegetative properties of plants can be attributed to its natural content of cytokinins, enzymes, amino acids,

vitamins and minerals (Bevilacqua et al., 2008), which have a positive influence on cell division and elongation, nucleic acid synthesis and the formation of proteins and chlorophyll. Waniese et al. (2023) found that the application of yeast extract leads to an increase in onion yield and vegetative parts, which correlates with the results of this study. Foliar spraying in combination with soil application of Azomin significantly increased plant height, number of leaves, fresh and dry plant weight, average bulb weight, bulb diameter, total bulb yield, protein content and TSS% in the bulb compared to other treatments (Khalel and Fatimah,, 2019).

The highest number of leaves was observed in onion plants treated with the biostimulant proalgin (11.8), while the lowest number was recorded in the untreated control plants (10.2). Based on the LSD test at both significance levels (0.05 and 0.01), a statistically significant difference (0.05) was found between the proalgin treatment and the control group. No statistically significant differences were found between the other treatments for this characteristic (Table 1). Proalgin contains an algae extract that has shown significant stimulating effects on plant growth parameters. Algae are rich in essential amino acids, vitamins and plant growth hormones (auxins, cytokinins and gibberellins) that promote root system development, mineral uptake, shoot growth, photosynthesis and crop yield (Abd Allah, 2022). Research by Dineshkumar et al. (2020) confirmed the positive influence of seaweed extract on vegetative parameters of onion quality, which is consistent with the results of this study.

The greatest neck thickness was observed in onion plants treated with the biostimulant Fulvimax (2.35 cm), while the least neck thickness was observed in untreated plants (2.17 cm, control). The next treatment with the greatest effect on neck thickness was Proalgin (2.30 cm). Based on the LSD test at both significance levels (0.05 and 0.01), no statistically significant difference was found between treatments for the trait analyzed (Table 1). Biostimulants containing fulvic acid promote growth stimulation in the aerial parts of the plant during the early stages of development. Foliar spraying with natural stimulants had a significant effect on neck and bulb diameter, as shown by the studies of Elmasry and Marey (2024).

Conclusion

Based on the research carried out on the effects of various biological biostimulants on the morphological parameters of onions, it was found that the application of biostimulants has a positive effect on the growth and

development of organically grown plants. The most significant effects were observed in plants treated with yeast solution. Here, the greatest plant height (96.8 cm) was measured, indicating the potential of cytokinins, enzymes and vitamins to improve plant growth. In addition, the biostimulant ProAlgin, which contains algae extracts, showed a significant effect on the number of leaves (11.8), while Fulvimax resulted in the greatest bulb neck thickness (2.35 cm). The control group, which was not treated with biostimulants, showed the weakest results in all parameters observed, confirming the effectiveness of the application of organic biostimulants.

The results suggest that biostimulants can be an important tool for sustainable and organic agriculture, especially in organic farming, and that they contribute to improving yields and product quality with minimal use of synthetic inputs. Further research is needed to determine the optimal dosages and application methods under different growing conditions.

Acknowledgement

The research was financed by the Ministry of Education, Science and Technological Development, Republic of Serbia, project ref. number 451-03-66/2024-03/200088 and 451-03-66/2024-03/ 200217.

References

Abd Allah M. (2022). Influences of Spraying Algae Extract Fertilizer and N Application on Growth, Productivity and Quality of Onion, Assiut Journal of Agricultural Sciences, 53(1), pp. 90-99.

Akimbekov N., Qiao X., Digel I., Abdieva G., Ualieva P., Zhubanova A. (2020). The Effect of Leonardite-Derived Amendments on Soil Microbiome Structure and Potato Yield. Agriculture. 2020; 10(5):147.

Bevilacqua A., Corbo M.R., Mastromatteo M., Sinigaglia M. (2008). Combined effects of pH, yeast extract, carbohydrates and di-ammonium hydrogen citrate on the biomass production and acidifying ability of a probiotic Lactobacillus plantarum strain, isolated from table olives, in a batch system. World J. Microbiol Biotechnol., 24: 1721-1729.

Colla G., Rouphael Y. (2015). Biostimulants in horticulture. Scientia Horticulturae. 196. 1-2. 10.1016/j.scienta.2015.10.044.

Dardić M., Gverić D., Pucar R. (2010). Organska proizvodnja povrtnog bilja, Banja Luka, , Grafid, Sandnes Stiftelsen Dubrovnik, predstavništvo Banja Luka, 171 str.

Dineshkumar R., Subramanian J., Arumugam A. (2020). Exploring the Microalgae Biofertilizer Effect on Onion Cultivation by Field Experiment. Waste Biomass Valor 11, 77–87.

Ђуровка М. (2008). Гајење поврћа на отвореном пољу, Нови Сад, Пољопривредни факултет, 251 стр.

Elmasry H. M., Marey R. A. (2024). Vegetative growth, yield, and quality of onion as influenced by nitrogen rates and natural stimulators. Egyptian Journal of Soil Science, 64(1).

Khalel Abde Monnem S., Fatimah I. S. (2019). "Influence of foliar spray and soil application of three amino acids compounds in growth and yield of onion (*Allium cepa* L.)." (2019): 531-534.

Marrelli M., Amodeo V., Statti G., Conforti F. (2018). Biological Properties and Bioactive Components of *Allium cepa* L.: Focus on Potential Benefits in the Treatment of Obesity and Related Comorbidities. Molecules. 24(1):119.

Saa S., Olivos-Del Rio A., Castro S., Brown P. H. (2015). Foliar application of microbial and plant based biostimulants increases growth and potassium uptake in almond (*Prunus dulcis* Mill. D. A. Webb). Front. Plant Sci. 6:87.

Taha A., Omar M., Ghazy M. (2016). Effect of Humic and Fulvic Acids on Growth and Yield of Lettuce Plant. Journal of Soil Sciences and Agricultural Engineering. 7. 517-522.

Waniese M.A., Abou El Salehein E.H., Hassan A.A.E.H., Al-Sharkawy H.M., (2023). Effect of some natural bio-stimulants on growth and bulb quality of onion. International Journal of Chemical and Biochemical Sciences (ISSN 2226-9614). 24(6) (2023): 631-638.