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# APPLICATION OF BIOSTIMULANTS IN HORTICULTURE

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## ABSTRACT

*Biostimulants are products that contain a "cocktail" of beneficial microorganisms or products of their metabolism that synergistically stimulate certain physiological processes in the plant. The paper monitored and analyzed the impact of biostimulants on the basic morphometric characteristics of decorative plants. The first biostimulant is based on a pure culture of nitrogen-fixing microorganisms, and the second on a mixed culture of nitrogen-fixing and phosphomineralizing microorganisms. The results we obtained indicated that the applied biostimulants significantly influenced the growth of the above-ground and underground parts of decorative plants.*

*Key words: biostimulants, microorganisms, horticulture*

## INTRODUCTION

The concept of sustainable agriculture implies biologically correct production, while at the same time preserving the agro-ecological balance, in which, in addition to applied agrotechnical measures, microorganisms are also of increasing importance (Cvijanović et al., 2006). Microorganisms, as a mandatory component of every agroecosystem, participate in the creation and maintenance of soil fertility, supply plants with food, and serve as indicators of changes in biological activity in a certain ecosystem (Milošević et al., 1998).
Biostimulants are products that contain a "cocktail" of beneficial microorganisms or products of their metabolism (natural biochemical compounds and nutrients) that simultaneously and synergistically stimulate certain physiological processes in the plant (Jukić, 2021). Biostimulants based on cultures of nitrogen-fixing microorganisms ensure the nutrition of plants with nitrogen from the air, increase their yield and protein quality in grains, due to the greater presence of essential amino acids, enrich the soil with nitrogen for subsequent crops and do not pose a threat to human health and their environment (Kapor, 2009).
Numerous studies have proven that nitrogen-fixing microorganisms secrete peptides, polysaccharides and lipids, which improve soil aggregation, which leads to faster and easier transport of water and air through the soil (Heijenen, 1994; Sturz, Novak, 2000). Nitrogen fixers, on the one hand, take nitrogen from the atmosphere, synthesize phytohormones and antibiotics, which protect plants from phytopathogenic fungi and produce vitamin Biotin and group B vitamins, while phosphomineralizers mineralize organic phosphorus compounds in the soil and deliver available phosphorus to the plant, and in addition produce entomotoxins (Kapor, 2009). In addition, in the last few years it has been confirmed that biostimulants can improve vigor, stimulate vegetative growth, improve absorption and distribution of nutrients within the plant, increase antioxidant capacity and improve tolerance to biotic and abiotic

stresses, consequently improving plant yield and fruit quality (García-Sánchez et al., 2022). Fadiji et al. (2022) state that the application of microbial biostimulants can provide a long-term and cost-effective solution for plant productivity and losses caused by changing climate factors, as well as help in optimizing human inputs in the agroecosystem.
The aim of this research was to examine the influence of biostimulants on the basic morphometric characteristics of decorative plants and to draw conclusions about the effectiveness of their effects.

## MATERIAL AND METHODS

During our experiment, two ornamental plant species, camellias and cypresses, were monitored. In the trial, two variations of biostimulants were used in addition to the control group (soil untreated with biostimulants). The first biostimulant (Enteroplantin) was based on a pure culture of nitrogen-fixing bacterium *Klebsiella planticola*, while the second biostimulant (Slavol) consisted of a mixed culture of nitrogen-fixing and phosphomineralizing bacteria: *Azotobacter chroococcum*, *A. vinelandi*, *Derxia sp*., *Bacillus megatherium*, *B. lichenyformis* and *B. subtilis*. The plants were irrigated every 15 days with 30 $cm^3$ of the respective biostimulants, along with simultaneous foliar treatment, while the control group was irrigated with the same amount of water. Sampling of plant material for determining basic morphometric parameters of aboveground and underground plant parts was conducted in April, during the experiment setup, and subsequently in June, August, and October.

## RESULTS AND DISCUSSION

Experimental data on the impact of biostimulants on the morphometric characteristics of camellias and cypresses showed that the applied biostimulants, along with climatic characteristics, had a significant influence on the growth of the aboveground parts and roots of the tested plants (Tables 1, 2).

**Table. 1. The influence of biostimulators on the length of the aboveground part and roots of camellia**

| | CONTROL | | | | BIOSTIMULANT I | | | | BIOSTIMULANT II | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | April | June | August | October | April | June | August | October | April | June | August | October |
| The length of the aboveground part of the plant (cm) | 16.0 | 28.0 | 27.5 | 35.0 | 17.0 | 29.0 | 46.5 | 47.0 | 16.0 | 29.0 | 29.0 | 38.0 |
| The length of the plant's roots (cm) | 9.0 | 15.5 | 21.0 | 20.0 | 9.5 | 16.5 | 21.0 | 21.5 | 9.0 | 15.5 | 21.5 | 23.0 |

The applied biostimulants significantly influenced the increase in the aboveground part of the camellia plant during the studied vegetation period (Table 1), but they did not have a significant impact on root growth. The length of the aboveground part of the untreated plant in August was 27.5 cm, while the plants treated with biostimulant I measured 46.5 cm. These differences are also observed in October, where the length of the control plant was 35 cm, while the plants treated with biostimulant I measured 47 cm. Differences between the tested variations of biostimulatnts and the control group are not noticeable in the length of the camellia's roots.

**Table. 2. The influence of biostimulators on the length of the aboveground part and roots of cypress**

| | CONTROL | | | | BIOSTIMULANT I | | | | BIOSTIMULANT II | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | April | June | August | October | April | June | August | October | April | June | August | October |
| The length of the aboveground part of the plant (cm) | 19.0 | 21.0 | 44.0 | 55.0 | 19.5 | 27.0 | 46.0 | 60.0 | 19.0 | 26.0 | 45.5 | 57.5 |
| The length of the plant's roots (cm) | 7.0 | 7.0 | 25.5 | 55.0 | 8.0 | 18.0 | 39.5 | 70.5 | 7.0 | 15.0 | 25.5 | 56.0 |

In comparison to the control group, the growth of the aboveground part of cypresses was noticeable as early as June and continued throughout the plant's vegetation phases (Table 2). The length of the aboveground part of the control group was 21 cm, while in the variations treated with biostimulant, it measured 27 cm and 26 cm, respectively. Unlike the first plant species, the biostimulants resulted in an increase in the root length of cypresses.
The applied biostimulants influenced the increase in the aboveground part of camellia plants during vegetation. In this regard, biostimulant I stands out as its application stimulated an average 29% increase in the aboveground part compared to the control group. This can be attributed to a balanced plant nutrition and improved mineral nutrition, as evidenced by the works of other authors (Govedarica et al., 1998; Đukić et al., 2007; Gecić et al., 2007). This effect, in addition to increased nutrition with readily available nitrogen, can also be explained by the ability of nitrogen-fixing bacteria to produce physiologically active substances such as auxins, gibberellins, cytokinins and vitamins.
However, the applied biostimulants did not significantly affect the root growth of camellias. In comparison to the control group, the growth of the aboveground part of cypresses in the variations treated with biostimulants was noticeable in June and continued throughout the plant's vegetation phases. Overall, the growth of the aboveground part of cypresses in the biostimulant-treated variations was approximately 10% to 7% higher than in the control group. Unlike camellias, biostimulant I resulted in an increase in the root length of cypresses in all stages of the plant's development.
The pronounced effect of introduced nitrogen-fixing bacteria from the applied biostimulants on the growth of the aboveground and underground parts of the tested plants is consistent with the results of other authors (Najdenovska, 2001; Đorđević et al., 2005; Raičević, 2006).

## CONCLUSION

The results of our research have shown that the applied biostimulants had a significant impact on the growth of the aboveground and underground parts of the tested plants. Considering that the application of biostimulants can provide long-term solutions for plant growth and productivity, as well as mitigate losses caused by global climate change, further research on the application of biostimulants in different plant cultures would be of great importance in agricultural production.

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