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Original scientific paper

The influence of organic biostimulators on the growth and development of medicinal and aromatic plant species *Ocimum basilicum* L. and *Levisticum officinale* L.

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Abstract

Ocimum basilicum L. and *Levisticum officinale* L. are well known medicinal, aromatic and spicy herbs with remarkable application in cooking and medicine. In an attempt to improve their potted production and increase the yield of aboveground biomass, a vegetation experiment was conducted in the experimental field of the Institute for Medicinal Plants Research "Dr Josif Pančić" Belgrade, Serbia. Therefore, the aim of this study was to determine the effect of organic biostimulators on germination, growth and productivity of *O. basilicum* and *L. officinale* in potted production, conducted under semi-controlled conditions. Following treatments of seeds were applied: organic biostimulators Ecobooster 1 (in concentrations 10%, 30% and 50%) and Slavol S (in concentration 10%, according to manufacturer's recommendations), and control treatment (without biostimulators). A significantly higher number of seedlings was achieved in the treatments with biostimulators compared to control. The best effect on germination of *O. basilicum* and *L. officinale* seeds was achieved with Slavol S (91.3% and 72.5%, respectively) and Ecobooster 1 – conc. 50% (83.4% and 61.3%, respectively). The best effect on height of *O. basilicum* and *L. officinale* plants were achieved with Slavol S (26.2 cm; 14.4 cm, respectively) and Ecobooster 1 – conc. 30% (20.0 cm and 17.1 cm, respectively) and Ecobooster 1 – conc. 50% (21.7 cm; 19.4 cm, respectively), while the best effect on number of brunches showed Slavol S (2.3 and 5.1, respectively) Ecobooster 1 – conc. 10% (4.2 and 4.7, respectively) and Ecobooster 1 – conc. 30% (4.1 and 5.2, respectively). The best effect on the aboveground plant mass showed Ecobooster 1 – conc. 10% (5.03 and 1.74, g of absolute dry mass).

The obtained results confirmed that both organic biostimulators positively influence the observed morphological parameters in both plant species, particularly in the earlies phases of their development.

Key words: basil; lovage; Ecobooster 1; Slavol S.

Introduction

The great values of medicinal and aromatic plant (MAP) species in the traditional medicine and nutrition have been known for centuries. Nowadays, 70-80% of the human population predominantly uses herbs in the prevention and treatments of a number of diseases (Farnsworth et al., 1991), while a number of them are also enjoying status "functional food" (Kaul et al., 2012; Raina et al., 2014; Joshi et al., 2020). The market demands for MAP raw herb materials are growing, and so far it is mainly supplied from nature (Lubbe et al., 2011). Increased exploitation of MAPs from their natural habitats, untrained collectors and luck of collectors in rural areas, in addition to many legal restrictions, could be overcome only by cultivation of MAPs (Kuipers, 1997; Lange, 1998). The cultivation can be achieved in the urban area as well; in flower gardens, roof gardens, flower beds, etc. (Tuna et al., 2020).

Ocimum basilicum and *Levisticum officinale* are highly valued for their spicy, medicinal, fragrant and decorative characteristics. According to Stephens (1998), Bufalo et al. (2015) and Matlok et al. (2021), these two herbs can be also grown as potted plants, with satisfactory productivity, in case appropriate technology of their production is applied.

The aim of this study was to investigate the influence of organic biostimulators on the growth, development and yield of *O. basilicum* and *L. officinale*, grown as potted cultures.

Material and Methods

The experiment was initiated in the agricultural laboratory of the Institute for Medicinal Plants Research "Dr Josif Pančić" in Belgrade, in mid-February 2021, and it continued at the experimental field of the Institute, in Pančevo, South Banat, Serbia. The seeds of *O. basilicum* and *L. officinale* were soaked for 10 minutes in organic biostimulators, Ecobooster 1 or Slavol S. The Ecobooster 1 is composed of gibberellic acid, organic matter (2.8%), nitrogen (14%), phosphorus (2%) and potassium (5%), while Slavol S is composed of IAA (indole-3-acetic acid - an essential plant hormone that regulates its growth and development). The Ecobooster 1 was prepared in three concentrations, 10% (E_{10}), 30% (E_{30}) and 50% (E_{50}), while Slavol S (Sl) was prepared according to manufacturer's recommendations, in

concentration of 10% (Table 1).

Table 1. The treatments applied on seeds of *O. basilicum* and *L. officinale*.

Treatment	Treatment preparation
E_{10}	10 ml solution of EcoBooster 1 + 90 ml of distilled water
E_{30}	30 ml solution of EcoBooster 1 + 70 ml of distilled water
E_{50}	50 ml solution of EcoBooster 1 + 50 ml of distilled water
Sl	10 ml solution of Slavol S + 90 ml of distilled water
Control	100 ml of distilled water

The seeds of *O. basilicum* and *L. officinale* were sown in Styrofoam containers, each with 160 cells previously filled with commercial substrate Cultivo SF. Then, the containers were transferred to a Grow box, at T 24°C and under Rh 70-80% and light intensity of 2100 lux.

The rate of seed germination in each treatment was recorded on the 7 and 21 day following the sowing, after which the total germination rate per treatment was calculated according to following formula, proposed by Noman et al. (2018):

Total germination rate (%) = (number of germinating seeds / number of sown seeds) × 100

When first true leaf pair appeared (by the end of March), 30 uniform seedlings from each treatment were transplanted into 0.9 L vol. plastic pots (∅ 10 cm), which were transferred into the non-heated greenhouse (Figure 1), and left there at 30% shade, under the average daily T of 25°C and drip irrigation. When flower branches started their formation, which according to the BBCH scale suggested by Hess et al. (1997) corresponds to transition between the phase IV into phase V of plant development, the branches was counted and the plant height measured in all plants and for each treatment; this phase was assigned as ***the early growth*** (Figure 2).

Figure 1. Potted plants production in non-heated greenhouse.

Figure 2**.** Potted plants of *L. officinale* (left) *and O. basilicum* (right) in the early growth phase.

At the beginning of May, the potted plants were transferred outside the Greenhouse, where they were exposed to 40% shade and under the average daily T of 29.9°C and drip irrigation rate of 4 L water/h (Figure 3). The experiment lasted until the harvest (beginning of June), which happened when ca. 2/3 of plants were in the flowering phase. The plants height measuring and branches number counting were conducted on harvested plant material in the laboratory conditions; this phase was assigned as ***the harvest time***. Then, the harvested plant material was subjected to drying procedure (at 105ºC until the constant weight), to be able to compare the achieved yields between the treatments (g).

Figure 3. Potted plants transferred outdoors.

The obtained results were statistically analysed by the use of SPSS statistical software.

Results and Discussion

Application of organic biostimulators showed various effects on studied plant species, *O. basilicum* and *L. officinale.* The achieved effects were presented in Tables 2 and 3.

Regarding the incidence *O. basilicum* and *L. officinale* seedlings (Table 2), the most efficient was treatment with Sl; compared to the control, its application caused an increase in the incidence of *L. officinale* and *O. basilicum* seedlings by 72,62% and 19,50%, respectively.

Table 2. Incidence of seedlings observed on 21 day following the sowing (%).

Treatment	**Seedlings incidence** (%)	
	Ociumum basilicum	*Levisticum officinale*
E_{10}	78.4	51.4
E_{30}	79.1	55.5
E_{50}	83.4	61.3
Sl	91.3	72.5
Control	76.4	42.0

The increase in the incidence of seedlings achieved in the treatments with Ecobooster 1, also depended on plant species and applied concentration. Compared to the control, the greatest increase in *L. officinale* seedlings was achieved with application of E_{50} (by 45.95%) and E_{30}

(by 32.14%), though the increase achieved with E_{10} was not negligible (by 22.38%). The increase in *O. basilicum* seedlings, observed in the treatments with E_{50}, E_{30} and E_{10} was siginificantly lower compared to the control, corresponding ones in case of *L. officinale* but was noticed (by 9.16%, 3.53% and 2.62%, respectively,).

Efficacy of organic biostimulators was also confirmed in other studies conducted on medicinal plants. Parađiković et al. (2019) assumed that chemical composition and essential hormones present in organic biostimulators were responsible for positive effects on germination of *O. basilicum* seeds, while in studies of Butola et al. (2005) and Eun et al. (1997), similar positive effects on seeds with the use of similar formulations were observed in *Hypericum perforatum* and *Foeniculum vulgare*, respectively.

Table 3. Growth and productivity parameters observed at different developmental stages of potted *O. basilicum* and *L. officinale* plants.

Plant species	Treatment	Plant height (cm)		Branches (number)		Yield (g)
		Early growth phase	Harvest time	Early growth phase	Harvest time	
O. bacilicum	**E_{10}**	15±3.36c	37.13±3.53a	4.2±1.19a	5.40±0.88a	5.03±1.16a
	E_{30}	20±2.16b	35.55±1.70b	4.1±0.96a	4.47±0.88b	4.46±0.75ab
	E_{50}	21.7±2.34b	34.57±3.14b	2.2±1.56b	5.14±0.50a	4.73±1.27ab
	Sl	26.2±2.24a	34.97±2.70b	2.3±1.16b	5.13±0.50a	4.38±0.73b
	Control	13±1.66d	34.93±1.44b	2.2±1.46b	3.53±0.96c	4.29±1.38b
L. officinale	**E_{10}**	13.7±2.25d	23.75±2.83ab	4.7±1.56b	6.33±0.94a	1.74±0.54a
	E_{30}	17.1±2.46b	22.65±2.26a	5.2±1.81a	4.83±0.82b	1.27±0.54ab
	E_{50}	19.4±3.67a	23.94±2.84a	3.1±1.36c	5.33±1.01bc	1.07±2.40c
	Sl	14.4±4.16c	24.99±2.08a	5.1±1.56a	5.73±1.39ab	1.72±0.66a
	Control	11.3±3.46e	22.43±2.86b	3.0±1.26c	4.93±0.93c	1.29±0.50bc

*Mean values marked with the same lowercase letters within the same column do not differ significantly ($p < 0.05$).

In the early growth phase*,** the examined organic biostimulators achieved significant positive effects on the growth of both medicinal plant species, compared to the control. In case of *O. basilicum*, the highest effect was achieved with Slavol S, which differed from all other treatments. Slightly less than tha Slavol S and slightly higher than tha E_{10}, was achieved by E_{50} and E_{30}, equally. Regarding the number of branches in this phase, treatments with E_{10} and E_{30} caused equally the highest branching in *O. basilicum*, while in the treatments with E_{50} and Sl the branching did not differ from the control (Table 3). ***In the early growth phase of *L. officinale* the effect of treatments on plant height differed among the treatments and all differed from the control; presented in descending order, the treatment efficiency was as follows $E_{50} > E_{30} > Sl > E_{10}$. Regarding the number of branches in the early growth phase of *L. officinale*, a positive effect compared to the control was observed in all treatments except

in E_{50}, with the highest positive effect equally achieved by E_{30} and Sl (Table 3).

In the harvest phase of *O. basilicum*, the highest plant height was observed in treatment with E_{10}, which differed from all other, including control. Although all treatments had a positive effect on the branchingof *O. basilicum* and differed from the control. The highest effect with no difference between them, was achieved in treatments with E_{10}, E_{50} and Sl (Table 3). ***In the harvest phase*** of *L. officinale*, plant heights in all treatments differed from the control, and the highest were observed in $Sl=E_{50}=E_{30}$. On the other hand, apart that all treatments differed from the control, their effects on *L. officinale* branching, presented in descending order, were as follows $E_{10} > E_{30} > Sl > E_{50}$ (Table 3).

According to Shirkhodaei et al. (2014), organic biostimulators with addition of organic fertilizer, prove to be capable to accelerate the growth and development of the aboveground mass of medicinal plant species *Coriandrum sativum*. Results of our study are in accordance with results of Zeljković et al. (2014), who also reported positive effect of applied biostimulators on early growth of *O. basilicum*. They also support some other findings that medicinal plants *O. basilicum* and *L.officinale* can be successfully grown in a protected area (Stephens, 1998; Bufalo et al., 2015; Gache et al., 2019). Nazmy (2020) studied the effects of chemical compounds similar to those in biostimulators used in our study, and achieved positive effect on the growth of *O. basilicum*. Gache et al. (2019) achieved better productivity of the aboveground biomass of *L. officinale* than it was achieved in our study; this could be attributed more to the larger pots they used, which enabled them higher productivity. Recent study of Złotek et al. (2020) presented various positive effects of biostimulators on morphological parameters of *L. officinale* but also on certain bioactive components specific for this medicinal plant species.

Conclusion

Medicinal plant species *O. basilicum* and *L. officinale* can be successfully grown as potted crops under semi-controlled conditions. Their productivity can be increased by applying appropriate organic biostimulators. In both medicinal plant species, all tested organic biostimulators had a positive influence on the incidence of seedlings and growth of the aboveground plant part, especially in the early growth phase. As medicinal and aromatic plants are known for their secondary metabolites, the carriers of their healing properties, further study should be focused on the influence of organic biostimulators on phytochemical composition of the obtained yields of *O. bacilicum* and *L. officinale.*

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