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Production of Immortelle Seedlings According to the Principles of Organic Production

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Authors' contributions

This work was carried out in collaboration between all authors. Author ZJ designed the study and wrote the first draft of the manuscript. Author BS wrote the protocol and performed the statistical analysis. Authors AV and PV managed the analyses of the study. Author AS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This paper presents the study of the influence of 3 types of organic fertiliser of industrial origin (Chap liquid, Biofert and Guano) on the most important quality parameters of immortelle seedlings.
The study was performed under protected conditions through 3 repetitions, with 10 plastic pots in each one. In the experiment were included two control: one that was not fertilised and the other one where was applied the organo-mineral fertiliser Sapro elixir.
The largest influence on the increase of the average height of the seedlings had Guano - 32.1 cm and Sapro elixir - 31.5 cm, while the lowest seedlings were measured in the non-fertilized control - 25.5 cm.
Plants with the largest above ground mass were found in variants with Guano - 17.5 g, Biofert - 16.7 g and Chap liquid - 16.1 g, while the seedlings with the lowest above ground mass were measured in non-fertilized control - 11.7 g. The differences in the above-ground biomass of

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immortelle seedlings between non-fertilised controls and all studied organic fertilisersM were also statistically justified. The plants with the more significant root biomass were found on variants with the application of Chap liquid - 29.9 g and Biofert - 29 g, while the lowest values for this parameter were determined in non-fertilized control - 17.9 g. All studied variants of fertilisation showed a significant increase in root biomass compared to non-fertilized control.

Keywords: Immortelle; organic production; seedlings; industrial organic fertilizer.

1. INTRODUCTION

Immortelle (*Helichrysum italicum* (Roth) G. Don fil.) is a perennial aromatic half-shrub that naturally grows on rocky terrains in the Mediterranean and Sub-Mediterranean region [1]. On the territory of the former Yugoslavia, immortelle grows as wild herb on the Croatian coast, Dalmatia, Herzegovina and the littoral part of Montenegro. For its growth immortelle requires a lot of light and heat, of which depends on its aromatic characteristics. It is well tolerant of high summer temperatures and drought, even long-lasting. Immortelle also is grown in conditions of the harshest winters, so in nature, it can be found at higher altitudes, from the sea level up to 1700 m [2]. It can also be grown in the continental area, up to 700 m above sea level [3].

As a consequence of the increased ecological awareness and the desire of the people to return to nature, in recent decades, the demand for products of plant origin is growing considerably in the world, especially those produced according to the principles of organic production. The increased demand for medicinal plants can no longer be supplied only with its collection in nature, and because of this, the production is increasingly moving to agricultural areas. Although the areas under medicinal plants in the world are still at a modest level, their share in intensive agricultural production has been steadily increasing. Many relevant studies indicate that such trends will continue in the future.

High demand and high purchase prices necessarily resulted in increasing of the exploitation range of immortelle in natural habitats. Unfortunately, this exploitation is mostly conducted in a way that is contrary to the principles of sustainable development, and there is a real possibility that immortelle rapidly disappears from many well-known sites [4]. Such trends would also lead to a severe disturbance of total biodiversity [5]. Since increased demand can no longer be provided only by collection from nature, cultivation of immortelle on plantations appears as the only sustainable solution [6]. High demands, very favourable agro-ecological conditions, but also a high price and high demands for essential oils have led to an intensive plantation of this medicinal plant [7]. In addition to the constantly growing global requirements, the increased surface of the plantation under immortelle is a consequence of the growing demands for raw materials with uniform quality and quantity. The exceptional quality of herbal drugs produced in these areas is another reason for the significant spreading of immortelle plantations. The constant and uncontrolled use of some synthetic products can cause unwanted effects on human health, which is also one of the reasons why the use of products of plant origin is continually increasing [8,9] and more and more consumers decide to consume herbs produced according to the principles of organic production. The demand growth trend is most expressed in developing countries. Because of that, it is believed that the future of medicinal plants is precisely in production according to the principles of organic production.

Bearing in mind that agricultural production in this region is still quite extensive, with limited use of synthetic pesticides and fertilisers, the possibility of the organic output of herbs is also very pronounced. Unpolluted land, water and air make this area ecologically acceptable for this kind of production. Besides, there are numerous habitats of autochthonous medicinal and aromatic species, and many of them have significant quantities for exploitation.

High and stable yields of raw materials of immortelle are possible only with the application of efficient nutrition systems. In this way, besides increasing the yield, more uniform quality of the produced raw material is ensured. In the organic production of immortelle fertilization is done with materials of organic origin and natural mineral fertilizers. Most commonly used organic fertilizers are manure, composted or uncomposted organic matter obtained in accordance with the principles of organic production and green manure.

The cultivation of herbs in organic production and processing, besides the main products, significant quantities of waste material are obtained, which in organic agriculture can be used as fertilizer. However, literature data on cultivation of immortelle according to the principles of organic production are very scarse. Barbarić et al. [7] Džubur [5] and state that the best yields of immortelle are achieved by fertilization with pelleted sheep manure, while good results also provide fertilization with standard cow and horse manure. According to them, the foliar fertilization with algae has an excellent influence on the immortelle yield, but on the other hand significantly reduces the quality of the essential oil.

The best and safest way to propagate immortelle is through seedling production. The production of high quality seedlings is one of the basic preconditions for successful production. Immortelle quality, besides other agrotechnical measures (weed control, diseases and pests control, irrigation, etc.) is significantly affected by fertilization [10,11]. It should be kept in mind that fertilization with a cow manure, especially if it is of poor quality, may result in unwanted increase of weediness. For these reasons, a non-adequate cow manure should be excluded from use, and fertilization should be done with fertilizers that have a permit for use in organic production [12,13]. Therefore, in the production of immortelle, organic fertilizers of industrial origin have an increasing importance.

The present tendency of increased demand for immortelle raw material from organic production imposes the need to study new production possibilities using modern nutrition systems based on a wide range of industrial fertilizers allowed for use in organic production. For these reasons, the aim of this paper was to examine the influence of different types of organic fertilizer on the most important parameters of the quality of the planting material of this more important medicinal plant.

2. MATERIALS AND METHODS

The study of the impact of different types of fertilizer on the quality of the planting material of immortelle was done in 2017 under protected condition.

The trials were performed in 3 repetitions, with 10 plastic pots in each ones. The transplantation of 4 months old seedlings into the pots was done on 1st of May, as well as fertilization.

In addition to 3 organic fertilizer types - Chap liquid (V1), Biofert (V2) and Guano (V3), besides two control variants were included in the experiment: one of that was not fertilized (K1) and the other with the application of organo-mineral fertilizer Sapro elixir (K2) that is used a lot in conventional production. Sapro agro certified for organic production was used as substrate. All fertilizers were applied on 1st of May, watering plants with 100 ml of aqueous solution. Basic data about applied fertilizers are given in Table 1.

Determination of the height of seedlings, the mass of above ground part of the plant and the root mass was performed on 1st of July. Statistical data treatment was done by a method of analysis of variance (ANOVA), and the difference between arithmetic means was performed using LSD test.

Table 1. Basic characteristics of studied fertilizers

Chemical composition	Chap liquid (V1)	Biofert (V2)	Guano (V3)	Sapro elixir (K2)
The content of organic matter in dry matter (%)	70,5	65	21-26	at least 15%
Total nitrogen (N). % (m/m)	3.62	3.5	3-5	5.9
P_2O_5 (%)	0.95	3.0	9-12	7.69
K2O (%)	4.67	2.8	1-2	11.08
Ca (%)	0.75	9.0	23-28	0.85
Mg (%)	0.40	1.0	0.5-1	0.30
pH value	7.5	6.4	6.5-7.5	5.2-7.5
Dose of application	150 ml/10 l of water	150 g/10 l of water	150 g/10 l of water	100 g/10 l of water

Table 2. Parameters of seedling quality

Variant of fertilization	Average plant height (cm)	Average weight of above-ground part of the plant (g)	Average weight of roots (g)
Control - no fertilization (K1)	25,5 e*	11,7 bc	17,9 c
Sapro elixir - organo-mineral fertilizer (K2)	31,5 ab	13,8 b	23,3 b
Chap liquid (V1)	27,5 d	16,1 ab	29,9 a
Biofert (V2)	29,5 c	16,7 ab	29,0 a
Guano (V3)	32,1 a	17,5 a	26,9 ab

** values marked with the same letters are not statistically different*

	Lsd 005	Lsd 001
Average plant height (cm)	1.856	2.532
Average weight of above-ground part of the plant (g)	3.147	4.293
Average weight of roots (g)	5.324	6.899

3. RESULTS AND DISCUSSION

From the results of the measurements given in Table 2, it can be seen that all variants of fertilizers showed a significant influence on the height of immortelle seedlings. In that respect the biggest influence had variants V3 – 32.1 cm and K2 - 31.5 cm, while the lowest seedlings were in non-fertilized control - 25.5 cm. Statistical data processing revealed a significant increase in the stem height in all fertilized variants compared to the control variant. Significant differences in the seedling heigh fertilized with organic fertilizers and non-fertilized control referred Barbarić et al. [7].

The largest above ground mass of seedlings was measured in variant V3 - 17.5 g, then on variants V2 - 16.7 g and V1 - 16.1 g. Non-fertilized control (K1) gave seedlings with the smallest above ground mass - 11.7 g. The differences in the above ground mass between all studied organic fertilizers and non-fertilized control were also statistically significant. Variant V3 had a higher yield of herb compared to the variant in which seedlings were fertilized with organo-mineral fertilizer (K2). The better efficiency of this fertilizer in comparison with Sapro elixir was also reported by Jovović et al. [14].

Plants with the largest root mass were found on variants V1 - 29.9 g and V2 - 29 g. The lowest values for this parameter were determined in non-fertilized control - 17.9 g. Compared to the control, all studied fertilizers showed a significant increase in root mass. An increase in variants V1 and V2 compared to the variant in which seedlings were fertilized with organo-mineral fertilizer (K2) was statistically justified. These results show that the studied organic fertilizers have positive influence on formation and development of the root system of immortelle seedlings, which will in the later stages of development decisively contribute to better adaptation of the plant to stressful situations, especially to drought. Increasing the root mass by using liquid organic fertilizer Shap liquid referred Jovović et al. [14].

4. CONCLUSION

Based on the conducted research on fertilization of immortelle seedlings with organic fertilizers of industrial origin can be concluded:

- All variants of fertilization showed a significant effect on the studied quality parameters of immortelle seedlings.
- The biggest influence on the increase of the average seedlings height showed Guano - 32.1 cm and Sapro elixir - 31.5 cm, while the lowest one had non-fertilized control - 25.5 cm.
- The largest above ground plants mass were found in variants with Guano - 17.5 g, Biofert - 16.7 g and Chap liquid - 16.1 g. The lowest value for this parameter was measured in non-fertilized control - 11.7 g.
- The highest root biomass were found in immortelle plants grown on variants with the application of Chap liquid - 29.9 g and Biofert - 29 g, while the lowest values were determined in non-fertilized control - 17.9 g.
- The studied fertilizers can be highly recommended as a high quality source of nutrients in organic production of immortelle.

- Given the very small number of available information related to fertilization of immortelle in organic production this research should continue in the upcoming period.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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