

INFLUENCE OF DIFFERENT SUBSTRATES ON THE QUALITY OF PEPPER SEEDLINGS (*Capsicum annuum* L.)

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Abstract: The paper shows the influence of different substrates on the quality of pepper seedlings. Based on the obtained results, it can be concluded that different substrates had an impact on the biological-morphological characteristics of pepper seedlings. The best results for most of the analyzed biological-morphological characteristics of pepper seedlings, according to the results obtained by the experiment, are related to the substrates "Glistenjak", "K-Potgrond H-Black 90%" and "K-TS1-White 100%", while the worst results were achieved on the examined substrates of "Coconut Cube". The mean value for all traits was recorded on the substrate "K- Seedling substrat".

Key words: pepper seedling, substrates, quality, *Capsicum annuum*.

Introduction

Paprika (*Capsicum annuum* L.) represents one of the most significant vegetable crops in Serbia. According to data collected by the Food and Agriculture Organization (FAO), worldwide, in the last 5 years, the areas cultivated with paprika have been increasing. In Serbia, however, this trend is reversed. The area dedicated to paprika cultivation decreased by 41% in 2020 compared to the year 2016, while the total production was reduced by a staggering 53% (FAO, 2022). The reasons behind this decline should be sought in the increasing production costs, lack of labor force, low yields, low market prices for paprika fruits, and so on.

Pepper production is most commonly carried out through seedlings. The seedling period is the time when the plant goes through the stages of germination and the first four to five stages of organogenesis. The overall yield, earliness, and fruit quality depend on the quality of the seedlings (Lazić, 1993). To avoid stress, seedling production with a protected root system is employed,

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using pots, containers, nutrient blocks, etc. The roots then bind to the substrate in which they grow and from which they are transplanted. They are collectively pulled out of pots (containers), minimizing potential damage to the root system.

The substrate plays a crucial role in the production of high-quality vegetable seedlings, and to a large extent, it determines success in production. The substrate is important because it is in this medium that delicate, young plants go through their most sensitive life phase (Zeljković et al., 2017).

In today's times, there is significant interest in the impact of different cultivation systems on food quality, especially regarding its effects on human health (Zdravković et al., 2010). The demand for organically produced food is steadily increasing. The reason for this lies in consumers' desire for food from reliable sources, where the production process is environmentally safe (air, soil, water), and the produced food product is of high quality (Burt et al., 2009; Domagala-Swiatkiewicz and Maciej 2012; Kazimierczak et al., 2014). Organic production represents an area of high potential, both in terms of increasing the areas under organically cultivated products and in terms of the added value that these products generate (Ivanović and Ivanović, 2016).

The aim of this study was to determine the effect of different types of substrate mixtures available on the Serbian market on the production quality of bell pepper seedlings (plant height, stem diameter, number of leaves, total plant mass, total number of flower buds and total root volume).

Materials and methods

The experiment was set up and conducted in a greenhouse with five treatments at the Novo Selo location, Vrnjačka Banja municipality. Each treatment included 20 plants arranged in columns according to the treatments. The chosen pepper variety is "Belinda". Pepper seeds were sown in plastic containers with 66 holes. When the seedlings were ready for transplanting, 14 days after sowing in the containers, young plants were transplanted into plastic cups measuring 10 × 10 cm, filled with 5 different types of substrates. Plants that were sown and germinated in identical substrates in containers were transplanted and grown until the end of the experiment. The technology for growing young papper plants followed the principles of organic plant production. The experiment concluded when the pepper plants reached the stage for permanent transplanting (62 days from seed sowing). Four different organically certified substrates and one non-organic substrate (Klasmann "TC1-White 100%", Klasmann "Potgrond H-Black 90%", "Glistenjak", "Coconut

Cube", Klasmann "Seedling Substrat") were tested in the experiment. This research determined the impact of different substrates (a total of five) on the quality parameters of papper seedlings, including plant height, stem diameter, leaf number, total plant mass, the number of flower buds per plant, and root volume. The collected data were analyzed using Microsoft Excel software, applying the Least Significant Difference (LSD) test. The LSD test is the simplest method for comparing the arithmetic means of the observed samples.

Results and discussion

Analyzing the height of young pepper plants, stem diameter, total number of leaves, mass of young plants, total number of flower buds per plant, and root volume, it can be clearly observed that based on the calculated LSD test at the significance levels of 0.05 and 0.01, all tested substrates ("Potgrond H-Black 90%", "Glistenjak", and "K-TC1-White 100%", "K-Seedling substrat", and "Coconut Cubes") in this experiment had a statistically significant impact on pepper seedlings. Additionally, they differed significantly from each other (Table 1).

The substrates "Potgrond H-Black 90%", "Glistenjak", and "K-TC1-White 100%" had the best values for all analyzed quality parameters of pepper seedlings. In fact, the best results for the parameter of the total plant mass (31.35 g) and the total number of flower buds (9.6) were achieved by cultivating pepper seedlings on the substrate "Potgrond H-Black 90%". The best results for most other analyzed characteristics, such as plant height (30.08 cm), stem diameter (6.57 mm), total number of leaves (22.45), total plant mass (31.35 g), and total root system volume (24.2 cm³), were achieved by cultivating pepper seedlings on the "Glistenjak" substrate. Meanwhile, plants grown on "Coconut Cubes" substrate showed the lowest values for all examined properties. The substrate with intermediate values for all tested quality parameters of pepper seedlings is the "K-Seedling substrat" (Table 1).

Table 1. Mean values for analyzed properties of peppers by treatments

Treatments/Properties	Plant height (cm)	Stem diameter (mm)	No. of leaves	Total plant mass (g)	Total No. of flower buds	Total root volume (cm ³)
Glistenjak	30.08a	6.57a	22.45a	12.07a	8.40b	24.2a
Coconut Cube	4.62c	1.84c	5.70c	0.15c	0.00d	0.25b
K-TC1-White 100%	27.85a	6.10a	21.95a	9.70b	8.30b	24.05a
Potgrond H-Black 90%	31.37a	6.52a	21.65a	12.23a	9.60a	23.00a

K- Seedling substrat	16.98b	4.33b	12.50b	2.42c	2.50c	6.55b
LSD (0.05)	5.49	0.80	5.58	2.46	1.08	8.92
LSD (0.01)	7.98	1.16	8.12	3.58	1.43	12.98

Values marked with different small letters in the column significantly differ at the $P \leq 0.01$ level according to the LSD test

Examining plant growth, some authors consider it essential to enrich the substrate with compost, zeolite, and NPK fertilizers to enhance the growth and development of seedlings (Marković et al., 1994). In our research, there was no additional enrichment of the substrate, and for most tested substrates, it was not deemed necessary. Furthermore, various studies, including those by Atif et al. (2016), Damjanović et al. (2005), Gutierrez-Miceli et al. (2007), Herrera et al. (2008), and Ugrinović et al. (2018), have confirmed the significant impact of substrates on the growth and quality parameters of seedlings. Proper substrate selection is crucial for growers to produce high-quality seedlings (Gutierrez-Miceli et al., 2007; Herrera et al., 2008; Morales-Corts et al., 2014; Atif et al., 2016; Ugrinović et al., 2018; Ugrinović et al., 2021). Many studies have also confirmed that the total number of leaves per plant depends on the nutritional regime of the substrate, water regime, and other ecological factors. Plants of the same age may have different leaf numbers depending on cultivation conditions (Marković et al., 1994; Damjanović et al., 2005; Kang et al., 2011; Ugrinović et al., 2018). The number of formed flower buds per plant is crucial for yield, with agro-ecological and genetic factors influencing this trait significantly (Kang et al., 2011; Huvelink, 2005; Zdravković et al., 2012; Ugrinović et al., 2018). The substrate mixture also has a considerable impact on the growth of the root system and its mass, as confirmed by Damjanović et al. (2005) and Ugrinović et al. (2018).

Conclusion

Different substrates used in this research have a significant impact on various parameters of pepper seedling quality. Plant height, stem diameter, leaf count, total plant mass, number of flower buds per plant, and root volume are parameters that varied significantly depending on the type of substrate used.

Substrates such as "Glisenjak," "Potgrond H-Black 90%," and "K-TC1-White 100%" proved to be effective in supporting plant height, stem diameter, and leaf count, while the "Coconut Cube" substrate showed certain challenges in these aspects. On the other hand, in parameters such as total plant mass, number of

flower buds, and root volume, "Potgrond H-Black 90%", "Glistenjak," and "K-TC1-White 100%" stood out with high values.

These results emphasize the importance of selecting an appropriate substrate in the pepper seedling production process, as different substrate characteristics can directly influence plant development. Proper substrate selection can improve the growth and development of pepper plants, significantly impacting overall production.

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