Influence of different substrates on the quality properties of tomato seedlings(*Lycopersicon esculentum* Mill.)

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Abstract

The aim of this research was determination of influence of different substrates on some quality properties of seedling tomato (*Licopersicon esculentum*), hybrid Optima F1. As a control was used commercially substrate, Gramoflor Profi 100%, and 5 combinations with it and other enhancers, such as: T1 – Gramoflor Profi + Zeo min 2:1, T2- Gramoflor Profi + Zeopullus 2:1, T3- Orgalife 100% чист, T4- Orgalife + Zeo min 2:1, T 5- Orgalife+ Zeopullus 2:1. Seedling height, stem diameter and number of leaves were monitored. According to the obtained data for the examined property, the height of the seedling was determined as the highest average height in the treatment T1 of 19.1cm. High statistically significant differences ($p < 0.01$) exist between T1 and T2 treatments.Based on the obtained results for the property average tree diameter from all three measurements, it was determined that the control and treatment T1 have the same average tree diameter of 3.5mm. Statistical analysis of data on this property showed highly significant differences ($p < 0.01$) between control and treatment T1. Regarding the quality, the average number of leaves was determined to be 7.6 in the treatment T1. From the obtained data, there are statistically significant differences ($p < 0.05$) between the control and T3, while statistically significant differences ($p < 0.01$) there are between the control with T1, and the control with the treatment T4, also statistically significant differences ($p < 0.01$) there is between T2 and T1, treatment T2 with T3 and between T2 and T4.

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Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the latest reviews and economically most famous horticultural crops in our country. The tomato is a botanical plant of the family *Solanaceae*, with a Latin name *Lycopersicon esculentum* L. (Mill). Tomato production is mainly through seedling. Modern tomato production technology is based on the use of top quality seedlings, in terms of morphological, physiological and health characteristics that meet the highest standards. The success of the overall production depends primarily on the production of healthy and quality seedlings. Quality tomato seedlings should be grown in adequate conditions, such as: optimal climatic conditions (relative humidity in the area of the root system, air temperature, light regime, etc.), quality seeds (germination energy and seed germination), the choice of an adequate substrate, etc.

Seedling production is usually obtained in protected areas or in warm beds, and the most common is the container method of production, which allows the root system to be protected and kept in a limited space until planting on the surfaces. (Damjanović *et al.*, 1994). The container method allows the roots not to be damaged, to provide the plants with the necessary nutrients for normal growth and development in the critical transition period during transplanting, when the plants are exposed to stress and lag behind in growth. (Pavlović *et al.*, 1997). During intensive production, irrational fertilization often occurs, which causes consequences for the quality of crops, as well as water and surface pollution.

From the modest production experience of vegetables and flower species in a substrate mixed with worms and organic waste, the effect as beneficial on the growth and development in obtaining seedlings has been confirmed, without knowledge of the further stages. (Edwards and Burrows, 1988, Wilson and Carlile, 1989, Subler *et al.,* 1998, Atiyeh *et al.*, 1999). Protected areas with the use of vermicompost increase the level of germination, growth and yield of tomatoes and peppers even when the necessary nutrients are provided (Atiyeh *et al.*, 2000, Atiyeh *et al.* a,b, 2001). In 2008, Tzortzakis and Economakis found that plants grew faster with the use of organic media than the use of inorganic media. The aim of this research was determination of influence of different substrates on some quality properties of seedling tomato (*Lycopersicon esculentum*), hybrid Optima F1.

Material and method of work

Experimental section

The experiment was set on April 20, 2019, in the Skopje Region at the locality Jurumleri, with the tomato seed (*Lycopersicon esculentum* Mill.) hybrid Optima F1 from the producer Seminis, by sowing one seed in styrofoam containers, after which the seedlings are dipped in plastic pots with a diameter of 8cm.

For the seeding and picking was used commercial substrate and their combination with the improvers:
Control, Gramoflor Profi
T1 - Gramoflor Profi + Zeo min 2:1,
T2 - Gramoflor Profi + Zeopullus2:1,
T3 - Orgalife 100%,
T4 - Orgalife + Zeomin 2:1,
T5 - Orgalife + Zeopullus2:1

The following characteristics have been confirmed in the used fertilizers:
Gramoflor Profi from the producer Gramoflor GmbH & Co. KG • Germany, according to its purpose is used for early vegetable production, provides high water retention, in addition to the basic elements N, P and K, contains traces of: B, Mn, Zn, Fe, Mo and Cu; Orgalife (humus) fertilizer from the manufacturer Organikanova is processed manure from red California worms in solid condition.

Analyses

Fertilizers and property enhancers from the manufacturer TMB DIAMOND were used, as follows: Zeo min calcium-magnesium fertilizer and soil improver with trace elements and natural zeolite; Zeo pullus 2015 is a unique blend of refined chicken manure and natural zeolite. This combination allows the storage of nutrients in the area of the root system and improves their availability to plants. To determine the quality of the seedlings, 15 plants from each treatment were analyzed and the following

parameters were measured: length of plant without roots (mm); stem thickness (mm) and number of true leaves. Temporal measurement of biometric characteristics began after 37 days of sowing (26.05.) Or when the hypothalamus with the cotyledons penetrated the surface of the substrate (BBCH 07), and the next four measurements were performed every 7 days, (02.06,) sprouting - the cotyledons penetrate the surface of the substrate (BBCH 09), (09.06,) the beginning of leaf development (BBCH 1), the formation of the first true leaf at the base (BBCH 11) and the formation of the third leaf at the base (BBCH13). Standard care measures were applied during the seedling production period. Analysis of variance and LSD test at the level of $p < 0.05$ and $p < 0.01$ was used for data processing.

Results

The obtained results for the height of plants during the vegetation showed the highest average plant height of 19.1cm in the treatment T1, and the lowest height in the plants from the treatment T2 of 7.4cm, or a determined difference of 11.7cm (Table 1).

Based on the obtained results for the property of average tree diameter from all three measurements, it was determined that the control and treatment T1 have the same average tree diameter of 3.5mm, and the lowest was determined in the treatment T2, is diameter of 2.3mm (Table 1).

Table 1. Plant height (cm), stem diameter (mm), number of leaves.

Treatment	days / phase of vegetation					Просек / Average
	44	51	58	65	72	
	BBCH 07	BBCH 09	BBCH 10	BBCH 11	BBCH 13	
Plant height(cm)						
Control	3,3	6,0	12,3	18,7	23,0	12,7
T1	4,3	7,9	16,8	30,0	36,5	19,1*
T2	1,6	4,1	8,4	9,8	13,0	7,4
T3	3,1	5,5	11,6	20,3	32,9	14,7*
T4	3,0	6.0	13,9	20,3	29,0	14,6*
Average	3,1	6,0	12,6	19,9	26,9	13,7
Average treatments	3,3	6,0	12,6	20,2	27,8	
LSD 0,05	5,76					
0,01	7,94					
Stem diameter(mm)						
Control ∅	2,6	2,8	3.3	4,2	4,8	3,5
T1	2,1	3,1	3,2	4,3	4,6	3,5
T2	1,2	1,9	2,0	2,9	3,4	2,3
T3	1,8	2,4	2,9	3,9	4,4	3,1
T4	1,7	2,4	3,1	3,8	4,4	3,1
Average	1,9	2,5	2,9	3,8	4,3	3,1
Average treatments	1,7	2,5	2,8	3,7	4,2	
LSD 0,05	0,24					
0,01	0,33					
Number of leaves						
Control∅	4,6	5.0	6,3	8,0	7,3	6,2
T1	4,9	6,8	7,6	9,4	9,5	7,6
T2	3,3	5,6	6,0	7,8	7,9	6,1
T3	4,1	6,1	7,3	8,3	9,6	7,1
T4	4,4	6,2	7,4	9,4	8,6	7,2
Average	4,3	5.9	6,9	8,6	8,6	6,9
Average treatments	4,2	6,2	7,1	8,7	9,0	7,0
LSD 0,05	0,68					
0,01	0,93					

The highest average number of leaves of 7.6 in the treatment T1, and the lowest number of 6.1 in the treatment T2 (Table 1).

Discussion

In the research, the impact of fertilization for the treated treatments starts from the second measurement or the 54th day and continues until the end of the vegetation. Statistical analysis of this property showed statistically significant differences ($p<0,05$) between treatment T1 with control, then treatment T3 with treatment T2, and between treatment T4 with treatment T2. Highly statistically significant differences ($p<0.01$) are between treatments T1 with T2. Statistical analysis of data on average tree diameter showed highly significant differences ($p<0.01$) between control and treatment T1, control with T3 and control with T4, then treatment T1 with treatment T2, treatment T1 with T3 and treatment T1 with T4.

The number of true leaves per plant is an important indicator of the quality of the tomato seedlings and it also reflects on the early ripening of the tomato,

because the number of leaves formed on the main stem is directly related to the appearance of the first flowering branches on which the first fruits (Pavlović, 1996). In our research we found the highest average number of leaves of 7.6 in the treatment T. Statistically significant differences ($p<0,05$) from the obtained data are found between control and T3, while statistically significant differences ($p<0.01$) are found between T1 and control, T4 treatment and control, treatment T2 and T1, treatment T2 with T3 and between T2 and T4.

Zeolites are widely used in agriculture either for growing plants in the open field, or as a substrate for application under greenhouse conditions (Tsintskaladze *et al*., 2016). Zeolites are a good source for the slow release of materials from certain minerals needed as macro or micro nutrients for plants, and its combination with peat and perlite is one of the best growing media (Eghtedary-Naeini *et al*., 2016). Yılmaz *et al*., (2014) point out that peat mixtures; Peat and zeolite (20% and 100% v / v), significantly improve germination, plant height, stem diameter, mass and dry matter content of cucumbers.

It has been proven that zeolite in combination with other substrates can retain macro and micro elements, as well as K and N from mineral fertilizers, which reduces its loss, promotes its availability and functions as a slow-release fertilizer in cereals such as are *Triticum aestivum* and *Avena sativa* (Orha *et al*., 2015). This fact is of great importance for tomatoes and other vegetable crops, because K has a very important function in pH stability, enzyme activation, photosynthesis, protein synthesis, cell elongation and stoma opening (Najafi-Ghiri, 2014, Orha *et al*., 2015).

The research of Manolov *et al*., 2006, showed that zeolite in combination with perlite (1: 1 v / v), stimulates greater dry matter, root length and greater leaf mass in tomatoes and cucumbers.

Also, in our research the combination of commercial substrate with Zeo-min containing zeolite had positive effect the water-air regime, the level of phosphorus utilization and evaporation of nitrogen and enabled the production of quality tomato seedlings on the basis of all the examined properties.

Conclusion

This study was conducted to determine the impact of commercial substrate, wormwood and their combinations by adding enhancers such as Zeo min 2: 1 and Zeo pullus 2: 1 on the quality properties of tomato seedlings.

The results of the study showed that the T1 treatment, which used a combination of commercial substrate Gramoflor Profi in combination with the enhancer Zeo min in a ratio of 2: 1, showed the best results in terms of all tested properties. According to the obtained data, the highest average height of tomato seedlings of 19.1cm is achieved in the treatment T1 (Gramoflor Profi + Zeo min 2: 1), and the lowest stem height of 7.4cm has T2 (Gramoflor Profi + Zeopullus 2: 1).

Based on the property, the diameter of the stem can be noticed that in T2 the diameter is the smallest of 2.3mm, in the treatments T3, T4 is 3.1mm, and in the control and T1 is 3.5mm.

The average number of leaves in our study ranged from 6.1 in T2 to 7.6 in T1 treatment. Based on the presented data, we can conclude that the use of commercial substrate in combination with enhancers such as Zeo-min (calcium-magnesium fertilizer and trace element enhancer) containing zeolite improves the water-air regime, raises the level of phosphorus utilization and prevents the evaporation of nitrogen which enables the production of quality tomato seedlings on the basis of all the examined properties.

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