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The Effect of the Application of Different Nutritional Substrates to the Root System in Tomato Transplants

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Abstract: Investigations were carried out with the aim of testing the trasplants tomato quality on different nutritional substrates. The containers transplants methodology of production was applied, and five nutritional substrates were investigated. The root characteristics (length and root mass) were investigated. Based on these investigations, we concluded that tomato transplants should be grown on compost or some other substrates rich in organic matters.

Key words: tomato, plant, hybrid, container, length, mass.

Introduction

Transplants production is a very complex and specific technological phase. There are many different manners of transplants production in the vegetable growing practice. The classic way of production is usually used, according to the principle of unprotected root system, where a small number of plants per unit of the surface (100-300 plants per m^2) is produced. Great root damages are caused by transplant plucking. The transplant undergoes stress and it takes it a long time to recover and take root. The classic way of production is based on higher participation of human work, large investings in materials, irrational use of seed and chemicals etc., which are all the reasons for searching for new technologies in transplant production. Nowadays, greatest attention is being paid to the development of the so-called container plants (transplants) production.

Different types of substrates are used in the production of transplants. Their composition, physical and other properties can vary to a significant extent. El-Sawah (1985), for example, presents percentage participation of compact substance, water and air in different substrates, which is 50%, 35% and 15% respectively in the normal (ordinary) soil. 35% of compact, 40% of liquid and 25% of gas phase are represented in the compost structure. Pavlovic et al. (1998) emphasizes the importance of zeolite in the transplants production. The zeolite application in the nutritional substrate improved transplants quality and early tomato productivity. The presented results show that zeolits represent an important component in the substrate preparation in the transplants production. The function of the zeolits is to improve the physico-chemical properties of those substrates.

Container transplants production is not used to a great extent in plants production in Yugoslavia. However, its advantages are more and more observed and considerable attempts have been made to apply this transplants production method more in practice. That was the immediate reason for this kind of investigation. The concrete aim of our investigations is to find convenient substrates for tomato transplants container production.

Material and Method

Styrofoam containers of 50 cm in length and 32 cm of weight were used for these investigations. Each container consisted of 103 cells. One cell volume was about $30cm^3$. There were 618 cells on the surface of $1m^2$. The following nutritional substrates were investigated:

- Compost (100 %)
- Peat + Zeoplant (80 % + 20 %)
- Lobworm + Zeoplant (80 % + 20 %)
- Humograph + Zeoplant (80 % + 20 %)
- Lignite dust substrate + Zeoplant (80 % + 20 %)

Variant at which the transplants were grown on compost (var.1) was used as the control during the investigation. That compost was taken from the warm beds which were previously used for vegetable transplants production. Humograph is improved peat, which contains the natural peat, mineral fertilizer and microelements. Lignite dust substrate is a product which originates during the charcoal combustion in the thermo-power-stations.

The zeoplant mineral component was added (improved zeolite) to organic substrates (peat, lobworm, humograph, lignite dust) and it represented a two-component system, uniting the function of the fertilization as well as the function of the conditioner. In every primary substrate, the mixtures based on the volume ratio, with the addition of 20% of zeoplant, were made. The "Balcan" hybrid (a Yugoslav hybrid) was used for the transplants investigation. It belongs to a semi-determinate type of hybrids and it is convenient for production in the plastic houses and greenhouses. It develops similar and pretty large fruits.

Transplants growing was done under the glass house conditions. During each of the three years of the investigation, sowing was done in the first decade

of February, and two seeds were sown in each cell; and better plant remained after the germination. Transplants production period lasted c. 60 days, with the adjustment of optimal micro-climatic conditions, depending upon the growth phase and development of young plants.

Tomato was measured during the full development of transplants. 150 plants were taken (3x50 plants) for every variant of the experiment (substrate). Their root was measured, respectively the length and mass of the root. The investigations were carried out during the three-year period (1994 - 1996).

Results and Discussion

The results of these investigations as far as the root length (Table 1) is concerned show different root reactions to growing in the investigated substrates. The root reached its highest length in the control variant. Namely, the length of the root was 12.6cm in that variant, where the transplants production was done on the compost substrate. The second variant was the last in view of root length, which showed that peat in the combination with zeoplant was not convenient for the root system development. Compared with the control, the length of the root was reduced as far as 4.0 cm or 31.8%. Similar result was realized in the fifth variant, where the transplants production was done in the substrate which consisted of lignite dust and zeoplant. That substrate reduced the root by 3.2cm or 25.4%. The third and fourth variants insignificantly reduced the root; namely, they reduced the root by 0.7 cm and 2.2cm (5.6% and 17.5%).

Tab. 1 The influence of the nutritional substrate composition on the transplants root length (average 1994-1996)

Nutritional substrate	Root length	
	cm.	Index
1. Compost (100 %)	12.6	100.0
2. Peat + zeoplant	8.6	68.2
3. Lobworm + zeoplant	11.9	94.4
4. Humograph + zeoplant	10.4	82.5
5. Lignite dust substrate + zeoplant	9.4	74.6
Average	*10.6*	

Similar results were realized by the root mass (Table 2). It reached 1.1 g in the control variant. The biggest deviation from the control was observed in the fifth variant, where the root mass was of only 0.2 g. Based on that, the mass of the root was reduced by 0.9 g or 82%. The third and fourth variants were the most similar to the control. The root mass was reduced in those variants by 0.7 g and 0.6 g (36.4% and 45.5%).

Tab. 2 The influence of the nutritional substrate composition on the transplants root mass (average 1994 - 1996)

Nutritional substrate	Root length	
	g	Index
1. Compost (100 %)	1.1	100.0
2. Peat + zeoplant	0.5	45.5
3. Lobworm + zeoplant	0.7	63.6
4. Humograph + zeoplant	0.6	54.5
5. Lignite dust substrate + zeoplant	0.2	18.2
Average	*0.6*	

In view of transplants root development, the best results were achieved by grown on the control variant, where the root system was the most strongly developed. In that variant, the transplants were investigated on the compost, that is on the substrate which showed the most favourable conditions for root system development. The highest amount of biogenic elements was established in the compost (Table 3). Potassium (400mg/100g), which is used for the root system invigoration, deserves the highest attention. Besides that, compost is a substrate rich in micro-elements, soil microorganisms etc. The organic matters are dominant in it (about 70%), as the potential source of biogenic elements. Other authors (El-Sawah et al.,1985 and Zdravkovic et al., 1997). also point out the positive properties of compost. As it is emphasized, compost is a mineral substrate for different plants growing.

Tab. 3 Content of easily-accessible macroelements in nutritional substrates

Nutritional substrates	Macroelements					
	ppm		mg/100g			
	NH_4 - N	NO_3 - N	P_2O_5	K_2O	Ca	Mg
1. Compost	3.1	70.7	930	400	950	200
2. Peat	9.2	11.1	200	15	813	125
3. Lobworm	9.0	237.8	1400	1300	913	625
4. Humograph	5.5	73.4	200	14	1313	30
5. Lignite dust	28.0	7.0	11	54	520	18

Fairly good conditions for normal tomato young plants root system development were supplied by lobworm + zeoplant substrate. However, the results were slightly weaker compared to the control, and the reason for that should be searched in the excessively high concentration of some nutrients (NO_3, Mg), which created such conditions that reduced the effects of this substrate. In fact, lobworm is a highly concentrated material which should be mixed with peat, zeoplant and other components. The lobworm participation in the substrate should not exceed 60-70%. The substrates used in the second and fourth variants fall behind the compost and lobworm. In the second variant, the transplants were investigated on the peat in the combination with zeoplant. In the fourth variant, the peat (humograph) was improved with some nutrients (nitrogen), which contributed to the strengthening of the root system development in the fourth variant compared to the second one. In general, peat cannot replace compost and lobworm in the transplants production, which was also pointed out by some other authors (Petrevska et al., 1997; Pavlovic et al., 1998).

The transplant, which was investigated on the lignite dust and zeoplant substrate, developed a very weak root system. The root mass reached 0.2 g only. However, the root length realized a fairly high value (9.4cm). Such disproportion between the mass and length of the root system lies in the poor nutritional value of this substrate. Namely, due to the low content of nutrient in the substrate, the root system had a tendency of increasing in lenght but it ramified weakly. Such a behaviour of tomato transplants was observed on substrates por in nutrients, which was also pointed out by other authors, such as Zdravkovic et al. (1997) and Pavlovic et al. (1998).

Based on these investigations, it can be concluded that these substrates are mostly convenient for the containers transplants production. In view of conditions, compost was most favourable, as well as the lobworm. Lignite dust, in combination with zeoplant, did not have satisfactory results.

Conclusion

Based on the testing of different nutritional substrates and their suitability for the development of the root system, the following conclusions may be drawn:

The length of the tomato transplant root shows different proportions of the root system in tomato growing on substrates of different nutritional composition. The greatest root length was determined in the plants produced on the compost substrate, and then in the ones produced on the mixture of lobworm and zeoplant substrates.

The smallest length of the transplant root was determined in the transplants grown on the mixture of peat and zeoplant substrates as well as in those produced on lignite dust substrates, which directly depended on the low nutritional composition of these substrates.

The transplant root mass was in direct proportion with the transplant root length, and thus the greatest mass was determined in the plants grown on the compost substrate, i.e. in the control variant.

The highest deviation from the control was determined in the plants produced on the lignite dust substrate, with the reduction of the mass by 82.0%. Disproportion of the root, i.e. its great length and small mass, was also determined in the plants produced on the mentioned sustrate, which directly depended on the low nutritional composition of the substrate, where the root increased in length but badly ramified.

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EFEKAT PRIMENE RAZLIČITIH HRANLJIVIH SUPSTRATA NA KORENOV SISTEM RASADA PARADAJZA

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Rezime

Ispitivanja su obavljena tokom tri vegetacione sezone paradajza sa ciljem da se testira i ispita najpogodniji hranjivi supstrat po razvijenost korenovog sistema rasada paradajza.

Ogledi su izvedeni u kontrolisanim uslovima u staklenicima Centra za Povrtarstvo u Smederevskoj Palanci. Primenjen je kontejnerski način proizvodnje rasada paradajza sa pet hranjivih supstrata. U organske supstrate dodavano je 20 % mineralne komponente Zeoplant (oplemenjeni zeolit), na bazi zapreminskog odnosa i tako pravljena smeša supstrata. U ispitivanjima je korišćen domaći hibrid Balkan, semi - determinantnog tipa, pogodan za plasteničko-stakleničku proizvodnju paradajza.

Na osnovu ovih istraživanja pokazalo se da sa aspekta pogodnosti za razvijenost korenovog sistema, rasad paradajza treba proizvoditi na supstratu od komposta, ili na nekim drugim supstratima koji su bogati sa organskim materijama.