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EFFECT OF THE AGE AND PLANTING AREA OF TOMATO (*SOLANUM LYCOPERSICUM* L.) SEEDLINGS FOR LATE FIELD PRODUCTION ON THE VEGETATIVE BEHAVIOUR OF THE PLANTS DURING THE GROWING PERIOD

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Abstract

The aim of the study was to established the influence of age and the size of the planting area of the seedling plants grown in containers, on the vegetative behaviour of plants during the growing period in the conditions of late field production of tomatoes. The experiments were carried out during the period 2011 - 2013 on experimental field, Department of Horticulture at the Agriculturalal University – Plovdiv with cultivar 'Opal F1'. The variants with 20-25, 30-35 and 40-45 day seedlings, cultivated in containers with 40, 66 and 104 cells and planting area respectively 44, 28, 17cm^2, were tested. As a control was a used 20-25 day seedling, grown in a transplanting bed and planting area 26-28 cm2 per plant (350-380 plant / m^2). It was found that the size of the planting area and the age of the seedling plants influenced on the vegetative behaviour of plants during the growing period after planting. The processes of growth and development of the plants, during the growth period, are most intensive at the variant with 20-25 days seedlings, grown in containers with 66 cells.

Key words*: tomato seedlings, planting area, seedlings age, leaf area.*

INTRODUCTION

The use of high quality seedlings is important to realize biological potential of plants in field production of tomatoes and obtaining better economic results (Kim Yeong-Bong et al., 1999; Singh et al., 2005).

Growing seedlings in containers is an advanced technological variant winning strong recognition in the field production of vegetables (Csizinszky and Schuster, 1988; Weston, 1988; Liu and Latimer, 1995).

For late field production of tomatoes the seedling production is done on transplanting bed. Cultivation of seedlings in containers is a progressive technological option.

In Bulgaria research on container-grown tomato seedlings is scanty (Simidchiev and Kanarska, 1986) and no studies are done on the late field production of tomatoes.

There is no scientific information on vegetative behavior of the plants during the growing season when using seedlings, grown in containers.

Unclear are a number of important questions relating to the parameters of the containers and the biology of the seedlings, and the influence of these factors on the growth and development of plants during the growing season.

The aim of the investigation is to determine the influence of the age of the seedlings and the size of the provided nutritional area on the vegetative behavior of plants during the growing period.

MATERIALS AND METHODS

The experimental work was carried out during the period 2011-2013 in an educational-experimental field of the Department of Horticulture.

For the cultivation of seedlings was used standard peat-pearlite mixture with components: peat by Durpeta of Lithuania and Agroperlit in a 3: 1 by volume. Peat substrate is pre-enriched N-250 mg / l, P_2O_5 - 270 mg / l, K_2O, 270 mg / l and Fe, Cu, Mn, B, Mo, Zn - 1,2 mg / l.

The salt concentration of peat, measured in ms / cm is 1.2, and the pH - 5.5-6.5.

The sowing of seeds was carried out in 3 types of containers made from expanded polystyrene

(EPS) with 40, 66 and 104-cells, providing nutritional area of a plant, respectively 44, 28 and 17 cm^2.

In the containers was grown seedlings of three ages - 40-45 days, 30-35 days and 20-25 days. To provide this age difference of the seedlings on the day of planting, the seeds were seeded in containers at an interval of 10 days and placed under optimum conditions for germination.

The control seedlings was grown in a transplanting bed, formed of the same mixture, at a rate of 2 g/m^2, the number of transplants being 350-380/m^2 by applying thinning during the second true leaf stage.

The sowing of seed was performed the period 30.05-04.06.

Setting up, the experiment was carrying out in the scheme of the block method in four replications.

The plant was plant in a permanent place in early July, in high bed-furrow surface in two-roll band in a schema - 110 + 50/30 cm. Growing them was done at the adopted technology for late field production with attachment on low wire construction with regular branches and one stem formation, with removal of vegetation peak after shaping fourth truss.

On the field the plant was planting during the period July 1-5.

The biometric measurements were performed on the 20th, 40th and 60th day after planting with parameters: height of the stem, number of leaves, leaf area and fresh weight of stem and leaves.

The leaf area was determined empirically by the formula (Konyaev M., 1970).

The mathematical processing of the data was done by using standard software SPSS – Duncan's Multiple Range Test (Duncan, 1955) and BIOSTAT.

RESULTS AND DISCUSSIONS

The results of the biometric measurement made on the 20th day after planting (Table 1) show differences in the values of the investigated biometric indicators. From the average results can be seen that for this stage of development of the plants the height of stem is greatest (53 cm) at 40-45 day seedlings, grown in containers with 40 cells, and the smallest (31.7) at 20-25 day seedlings, grown in containers with 104 cells. The values of this indicator decrease by decreasing the age of seedlings and increasing the number of container cells.

The differences between all investigated variants for the index number of leaves are smaller.

Average for the experimental period, the formed leaf area is greatest at the variant of the third age group, grown in containers with 40 cells, which exceeded the control variant with 18.8%.

The leaf area of plants compared to the control is greater at the all variants with 66 cells - 4.9% to 7.3%. Only in the variants with 104 cells, reported values are smaller compared to the control.

Table 1. Biometric indicators of plants on the 20th day after planting average for the period

Number of cells (plant area, cm^2)	High of stem (cm)	Number of leaves	Leaf area		Fresh mass stem + leaves,	
			cm^2	% to the control	g	% to the control
40-45 day seedlings						
1. 40 (44)	53.0	13.5	1696.0	115.8	143.3	123.2
2. 66 (28)	46.0	12.0	1571.3	107.3	128.7	110.6
3.104 (17)	42.0	11.0	1274.7	87.0	108.7	93.4
30-35 day seedlings						
4. 40 (44)	48.7	12.2	1612.0	110.1	137.0	117.8
5. 66 (28)	41.7	11.4	1537.7	105.0	129.0	110.9
6. 104 (17)	35.3	11.1	1295.0	88.4	110.7	95.2
20-25 day seedlings						
7. 40 (44)	37.7	11.1	1740.0	118.8	147.0	12.4
8. 66 (28)	33.0	10.6	1536.0	104.9	121.0	104.0
9. 104 (17)	31.7	10.0	1283.0	87.6	105.3	90.6
10. control	39.3	10.2	1464.3	100.0	116.3	100.0

The basic indicator of the vegetative manifestations of plants is the size of the formed fresh vegetative mass.

For this indicator the highest average values during the experimental period were recorded in plants of the third (20-25) age group, grown in containers with 40 cells, followed by the same variant of the first (40-45) age group.

As can be seen from the results for these two variants the increase relative to the control is with 26.4% and 23.2%.

The reported values for the variant with 66 cells of the third age group are relatively high. They exceed the control with 4.0% to 10.9%. Only for variants with 104 cells the fresh phytomass is smaller compared to the control, as the average values are 4.8% - 9.4% lower. The presented results and the fact that at the

time of planting the 40-45 day seedlings has a greatest leaf area and vegetative mass, may can considered that by the 20th day after planting the biologically younger plants are growing more intensively.

The growth rate of vegetative organs is greatest between the 20th and 40th day after planting, when plants form the main part of the leaves-stem mass. This biological feature is characteristic of the later field tomatoes (Cholakov, 1987) and is related to the fact that at the end of this period, the fruits formed of first and second truss are growing intensive, which requires the synthesis of larger quantities of organic substance.

At this measurement (Table 2), the reported differences between the variants by indicators of the stem height and number of leaves of one plant are smaller.

Average for the period the values for the stem height and number of leaves are lowest at variants of the third age group, in which falls and the control.

Table 2. Biometric indicators of plants on the 40th day after planting, average for the period

Number of cells (plant area, cm^2)	High of stem (cm)	Number of leaves	Leaf area		Fresh mass stem + leaves,	
			cm^2	% to the control	g	% to the control
40-45 day seedlings						
1. 40 (44)	107.7	21.6	5260.7	106.2	597.7	102.5
2. 66 (28)	102.3	20.6	5563.3	112.3	645.7	110.7
3.104 (17)	103.7	20.1	4876.3	98.4	580.3	99.5
30-35 day seedlings						
4. 40 (44)	106.3	20.9	5283.3	106.6	605.3	103.8
5. 66 (28)	102.0	20.3	5901.0	119.1	669.7	114.8
6. 104 (17)	101.3	19.8	5330.0	107.6	605.0	103.7
20-25 day seedlings						
7. 40 (44)	102.0	19.0	5944.0	120.0	665.3	114.1
8. 66 (28)	96.7	18.8	6199.3	125.1	695.3	119.2
9. 104 (17)	84.3	18.7	5688.0	114.8	639.7	109.7
10. control	96.7	19.1	4954.0	100.0	583.3	100.0

A comparison the variants on leaf area and stem + leaves mass show several trends.

On the 40th day after planting, the values for both indicators are highest at the plants, grown in containers with 66 cells.

For the leaf area the increase relative to control is respectively 12.3%, 19.1% and 25.1% and it's highest in the third age group.

Well expressed is the advantage of variants with 66 cells in terms of indicator fresh mass stem + leaves.

Average for the period of the study, the increase compared the control is respectively 10.7%, 14.8% and 19.2% and it's highest in the third age group.

Comparison of the variants with the same number of cells of the three age groups showed an advantage for the third (20-25), in which are recorded the highest values.

Between 40th and 60th day after planting the growth rate of vegetative organs reduced (Table 3).

In the middle of this period, in all variants are formed the fruits in the fourth truss, and the most of the synthesized plastic materials are used for their grown.

In addition at the end of this period is committed removing of vegetation peak of plants. This is the reason for minor differences between the variants of the stem height and number of leaves.

The plants, grown in containers with 66 cells stand out.

At that measurement, the values of leaf area and fresh vegetative mass in those variants are greatest. The increase, relative to control for the first indicator is respectively by 0,8%, 4.2% and 12.5%, and for the second - by 1.3%, 7.4% and 13.7%.The values for the both indicator are highest at the variant from the third age group.

Table 3. Biometric indicators of plants on the 60th day after planting, average for the period

Number of cells (plant area, cm^2)	High of stem (cm)	Number of leaves	Leaf area		Fresh mass stem + leaves	
			cm^2	% to the control	g	% to the control
40-45 day seedlings						
1. 40 (44)	113.7	21.5	6027.7	96.5	786.3	95.7
2. 66 (28)	110.0	21.2	6293.7	100.8	831.9	101.3
3.104 (17)	110.0	20.3	5674.7	90.9	750.0	91.3
30-35 day seedlings						
4. 40 (44)	105.0	20.7	6054.7	96.9	818.0	99.6
5. 66 (28)	104.3	20.8	6510.0	104.2	881.7	107.4
6. 104 (17)	107.3	19.7	6100.3	97.7	850.7	103.6
20-25 day seedlings						
7. 40 (44)	105.3	19.7	6547.0	104.8	868.7	105.8
8. 66 (28)	105.3	20.0	7025.0	112.5	934.0	113.7
9. 104 (17)	104.0	19.8	6673.0	106.8	887.3	108.0
10. control	104.7	19.0	6246.0	100.0	821.3	100.0

CONCLUSIONS

The size of nutritional area and the age of seedling, grown in containers for late field production of tomatoes influenced the

vegetative behaviors of plants, during the vegetation period after planting.

On the 20th day after planting, the formed leaf area and fresh vegetative mass increases with decrease the number of container cells size. The reported values for both indicators are greater at the variant from third age group with 40 cells. The increases compared to the control are 118.8 % for leaf area and 126, 4 % for fresh vegetative mass.

The growth of leaf area and vegetative mass is greater between 20th and 40th day after planting. For the three age groups, reported values are greater at the variants with 66 cells.

At the end of the reporting period, the plants of variants with 66 cells of third age group form a large leaf area and fresh vegetative mass and increasing compared to the control is respectively with 12.5% and 13.7%.

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