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PRODUCTIVITY OF THE PLANTS FOR LATE FIELD TOMATO PRODUCTION DEPENDING ON THE AGE AND PLANTING AREA OF THE SEEDLING

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Abstract

The main aim of this study was to be established productivity of tomato plants, grown in conditions of late field production, depending of age and planting area of the seedling. The experiments were carried out during the period 2011 - 2013 on experimental field, Department of Horticulture at the Agriculture University – Plovdiv with cultivar Opal F_1. 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 used 20-25 day seedlings, grown in a transplanting bed and planting area 26-28 cm^2 per plant (350-380 plant / m^2). The yield of standard fruits was the highest in variant with 20-25 day seedlings, grown in containers with 66 cells. There were not significantly different in the quality parameters of the fruits during harvesting stage.

Kay words: *tomato seedlings, planting area, seedlings age, standard yield, quality of fruits*

1. INTRODUCTION

The late field production of tomatoes provides a real opportunity for extending the marketing of fresh fruits, which have significantly higher biological value and better taste than processed at the same time in greenhouses (Murtazov, 1984). A significant part of the harvested product direction in this production is produced by post-harvest ripening of the preserved standard size green fruits harvested before the fall of the first autumn frosts (Ignatov, 1976; Cholakov, 1987a). With good organization and proper conditions the post-harvest ripening may continue to December (Dimitrov, 1968). This was associated with significantly longer period of consumption of fresh tomatoes from field production and increasing its efficiency.

The motive for this study is that the latest scientific information on late field production of tomatoes in our country is from the period of 80 years of the last century (Belichka, 1981; Cholakov, 1987b; Osmanzay, 1988), and after this period, technological complex for growing tomatoes at home and abroad won a number of new and progressive elements, one of which is a container nursery (Simidchiev and Kanazirska 1986; Vavrina, Arenas, 1997 Mugnai et.al., 1998; Zhao Rui and Chen JunQin, 2004; Singh et.al., 2007).The application of this technology option for late field production of tomato requires clarification of several important issues, which in this field production has not been the subject of study and are closely related to the biological activities of plants and final economic results.

The purpose of this study is to determinate the influence of plant age and size the nutritional area with container growing seedlings of tomato for late field production on yield and fruit quality also on the studied parameters associated with market and biological value.

2. MATERIAL AND METHODS

The experimental work was during the 2011-2012 period with cultivar Opal F_1. The sowing of seeds were done in 3 types of Styrofoam containers with 40, 66 and 104 cells, providing a planting area per seedling of 44, 28 and 17 cm^2. In containers, loaded with standard peat-pearlitic mixture was a grown seedling of three ages - 40-45 days, 30-35 days and 20-25 days. We used 20-25-day old seedlings for control, grown in a transplanting bed 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. 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. It was definitely the yield of standard fruit by months and total for the harvest period by performing harvests twice a week, sorting the fruits of the standard and non-standard determinting their mass. To establish the quality of production is determined morphological characteristics of fruits and content of main chemical

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components by analyzing 10 fetus option. The subject of study were the following the parameters: height, diameter, shape and average mass per fruit, number of seminal chambers and thickness of the pericarp, determined three times during the growing period by analyzing the 10 fruits of each variant. To determine the average weight of the fruits through the harvest period in one of the repetitions at each harvest than the total mass of the collected fruits were identified and their number. Biochemical characteristics of fruit with indicators - absolutely dry matter, total sugars, titratable acidity, ascorbic acid, total pigments, lycopene, were performed in the technology laboratory of IZK "Maritza" - Plovdiv (Genadiev, A. et al., 1969; Manuelyan X, 1991). Fruits, harvested in September and October were carried out sensory evaluation by five-point scale in increments of 0.25 according to an established methodology in technological laboratory IZK "Maritsa".

3. RESULTS AND DISCUSSION

Fruit yield is the main determinant and indicator of economic efficiency of production, and the effectiveness variants being investigated.

The information, on the distribution of yield by month is important in terms of the seasonal dynamics of purchase prices and in relation with rhythmic and balanced supply the market with fresh produce consumption. The results relating to the yield of standard products in August (Table 1) showed significant differences between the three experimental years, and the quantity of harvested fruits during that month is highest in 2011.

Table 1. Yield of standard fruits, kg/da, during August by years and average for the period 2011-2013

Variant №	Number of cells (plant area, cm^2)	2011			2012		
		kg	% to the control	% to the total standard yield	kg	% to the control	% to the total standard yield
40-45 day seedlings							
1	40 (44)	2296 a	352,1	30,8	524 a	476,4	8,5
2	66 (28)	1002 d	153,7	14,5	200 d	181,8	3,2
3	104 (17)	580 gh	89,0	8,3	160 ef	145,5	2,4
30-35 day seedlings							
4	40 (44)	2175 b	333,6	29,9	428 b	389,1	7,0
5	66 (28)	1065cd	163,3	16,2	172 e	156,4	2,5
6	104 (17)	868 e	133,1	11,6	132 fg	120,0	2,0
20-25 day seedlings							
7	40 (44)	1125 c	172,5	14,4	248 c	225,5	3,3
8	66 (28)	710 f	108,9	8,4	132 fg	120,0	1,5
9	104 (17)	514 h	78,8	7,1	68 h	61,8	1,0
10	control	652 fg	100,0	8,9	110 g	100,0	1,5
	GD 5%	81.3			13.3		
	GD 1%	110.4			18.9		
	GD 0.1%	147.9			26.5		
Legend: a,b,c.. Duncan's multiple range test (P<0.05)							

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The measured yield during that month, depending on variants, varies between 514 and 2 296 kg / da and constitutes from 7.1 to 30.8% of total standard yield. Compared to this year, resulting in the same month of 2012, the standard yield (68-524 kg / da) is 3.6 to 7.6 times lower and is 1.0 to 8.5% of the standard yield.

Table 1. Yield of standard fruits, kg/da, during August by years and average for the period 2011-2013

Variant №	Number of cells (plant area, cm^2)	2013			Average for the period		
		kg	% to the control	% to the total standard yield	kg	% to the control	% to the total standard yield
40-45 day seedlings							
1	40 (44)	832 a	275,5	11,3	1217,3	343,2	17,4
2	66 (28)	670 b	221,9	8,2	624,0	175,9	8,9
3	104 (17)	558 c	180,5	8,3	432,7	122,0	6,1
30-35 day seedlings							
4	40 (44)	785 a	259,9	10,8	1129,3	318,4	16,4
5	66 (28)	560 c	185,4	7,2	599,0	168,9	8,5
6	104 (17)	448 d	148,3	6,8	482,6	136,1	7,0
20-25 day seedlings							
7	40 (44)	577 bc	191,1	6,7	650,0	183,3	8,2
8	66 (28)	424 d	140,4	4,6	422,0	119,0	4,8
9	104 (17)	305 e	101,0	3,9	295,7	83,4	4,0
10	control	302 e	100,0	3,8	354,7	100,0	4,7
	GD 5%	109.8					
	GD 1%	147.7					
	GD 0.1%	196.9					
Legend: a,b,c.. Duncan's multiple range test (P<0.05)							

The big difference between the two years is associated with two main reasons - shortening of the main sub-periods of plant growth in 2011 and an extremely low rate of fructification of the first inflorescence (33.3 to 65.2) in 2012. The lower, as compared to 2011 is the standard yield in August 2013 - 302-832 kg / da, which represents a decrease of 1.1-2.1 times and 3.8 to 11.3% compared to the total standard yield.

The average results show that, for the three age groups the quantity of the harvested fruit in August was highest in the variants with 40 cells, in which the plants begin sooner to bear fruits and previously reached phenophase reddening of the first fruit. Reported this month standard yield was highest (1217,3 kg / da) in plants from the first age group grown in containers with 40 cells. This quantity is 243.2% greater than that obtained in the control, and constitutes 17.4% of total yield standard. Noted may not be considered as an advantage of this option from an economic point of view, because in this month the supply of tomatoes on the market is very large, and purchase prices are very low. Increasing the number of container cells within each age group leads to reduce the resulting in August standard's yield. Comparison of the variants in the group by years show, that the differences between them are statistically significant. The yield decreases with decreasing the age of seedlings due to the late initiation-harvesting period. The comparison variants with the same number of cells of the three age groups showed good statistical significant, with the exception of 2013 (variants 1 and 4). The standard yield in August was the lowest when using 20-25 days seedlings, grown in containers with 104 cells. The quantity of

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harvested fruits from 295, 7 kg / da is 16.6% less in comparison with the control and represents 4.0% compared to the total standard yield.

The main part of standard fruits in late field production of tomatoes is prepared on September. The results of this study (Table 2.) indicated that the amount of the yield of fruits in this month is greatest in 2013 and according to variants varies from 5142 to 6277 kg / da. The harvested fruits were at least in the variant with 40 cells from the first age group in 2012. Only in the third age group, differences between all variants are statistics significant, during the three years.

The average of results shows that the tested variants do not differ significantly in percentage of September compared to the total standard yield. Received from 3 986.3 to 5 356, 3 kg / da fruits represent between 57.8% and 63.3% of the total yield, formed by mature bush and post-harvest repining fruit. Only in the third age group, the one reported in September was higher in comparison with the control. Stands out in the variants with 66 cells in which the increase was 15.8%, and the difference with all variants of the group, including the control is good and very good warranted during the three years.

In all variants of the first and second age group of the quantity, production produced in September is less in comparison with the control. Within these two groups, the low-yield variant is with 40 cells.

Table 2. Yield of standard fruits, kg/da, during September by years and average for the period 2011-2013

Variant №	Number of cells (plant area, cm^2)	2011			2012		
		kg	% to the control	% to the total standard yield	kg	% to the control	% to the total standard yield
40-45 day seedlings							
1	40 (44)	3787 f	84,0	50,8	3315 e	87,3	54,0
2	66 (28)	4020 e	89,2	58,4	3534 de	93,0	56,5
3	104 (17)	4494cd	99,7	64,6	3698 cd	97,3	55,0
30-35 day seedlings							
4	40 (44)	3416 g	75,8	46,9	3479 de	91,6	56,6
5	66 (28)	3588 fg	79,6	54,7	3788 c	99,7	56,0
6	104 (17)	4902 b	108,7	65,4	3488 de	91,8	53,1
20-25 day seedlings							
7	40 (44)	4389 d	97,3	56,3	4170 b	109,8	55,6
8	66 (28)	5350 a	118,7	63,2	4442 a	116,9	51,5
9	104 (17)	4631 c	102,7	63,9	3878 c	102,1	56,1
10	control	4509cd	100,0	61,3	3799 c	100,0	52,6
	GD 5%	217.0			176.0		
	GD 1%	293.8			238.6		
	GD 0.1%	391.7			320.0		
Legend: a,b,c.. Duncan's multiple range test (P<0.05)							

Table 2. Yield of standard fruits, kg/da, during September by years and average for the period 2011-2013

Variant №	Number of cells (plant area, cm^2)	2013			Average for the period		
		kg	% to the control	% to the total standard yield	kg	% to the control	% to the total standard yield
40-45 day seedlings							
1	40 (44)	5098 fg	91,6	69,4	4066,7	87,9	58,3
2	66 (28)	5359 cde	96,3	68,3	4304,3	93,1	61,5
3	104 (17)	5187 efg	93,2	69,0	4459,7	96,4	63,1
30-35 day seedlings							
4	40 (44)	5064 f	91,0	69,8	3986,3	86,2	57,8
5	66 (28)	5303 def	95,3	68,3	4226,3	91,4	60,1
6	104 (17)	5142 efg	92,4	69,2	4510,7	97,5	62,9
20-25 day seedlings							
7	40 (44)	5838 b	104,9	68,2	4799,0	103,8	60,4
8	66 (28)	6277 a	112,8	68,8	5356,3	115,8	61,3
9	104 (17)	5454 cd	98,0	69,0	4654,3	100,6	63,3
10	control	5565 c	100,0	70,0	4624,3	100,0	61,6
	GD 5%	221.6					
	GD 1%	299.2					
	GD 0.1%	399.6					
Legend: a,b,c.. Duncan's multiple range test (P<0.05)							

The October yield is important from both an economic and social point of view, because in this month the supply of fresh tomatoes in the market decreases and purchase prices are increasing. Presented in Tab. 3 results have shown that the standard yield in October was the highest in 2012 and lowest in 2011. Average for the three-year period the studied variants provided a yield of 1 405.7 to 2 187 kg / da, which forms between 20.1 to 25.4% of the total standard yield. Averaged results highlight the advantage of the variant with 20-25 days seedlings grown in containers with 66 cells. In October, it provides 2 187kg / da, which represent 25% of the standard yield and with 20.3% of yield over by the control.

Table 3.Yield of standard fruits, kg/da, during October for the period 2011-2012

Variant №	Number of cells (plant area, cm^2)	2011			2012		
		kg	% to the control	% to the total standard yield	kg	% to the control	% to the total standard yield
40-45 day seedlings							
1	40 (44)	1123 f	73,0	15,1	1836 e	85,1	29,9
2	66 (28)	1540bc	100,1	22,4	2002 d	92,8	32,0
3	104 (17)	1512bc	98,2	21,7	2234 b	103,6	33,2
30-35 day seedlings							
4	40 (44)	1393de	90,5	19,1	1698 f	78,7	27,6
5	66 (28)	1525bc	99,1	23,3	2190 bc	101,5	32,4
6	104 (17)	1314 e	85,4	17,5	2173 bc	100,7	33,1
20-25 day seedlings							
7	40 (44)	1613ab	104,8	20,7	2127 c	98,6	28,4
8	66 (28)	1682 a	109,3	19,9	2837 a	131,5	32,9
9	104 (17)	1454cd	94,5	20,1	1974 d	91,5	28,6
10	control	1539bc	100,0	20,9	2157 c	100,0	29,8
	GD 5%	87.5			94,7		
	GD 1%	118.8			132,3		
	GD 0.1%	158.3			170,9		
Legend: a,b,c.. Duncan's multiple range test (P<0.05)							

Table 3.Yield of standard fruits, kg/da, during October by 2013 and average for the period 2011-2013

Variant №	Number of cells (plant area, cm^2)	2013			Average for the period		
		kg	% to the control	% to the total standard yield	kg	% to the control	% to the total standard yield
40-45 day seedlings							
1	40 (44)	1258 d	71,6	17,1	1405,7	77,3	20,1
2	66 (28)	1651 bc	94,0	21,0	1731,0	95,3	24,7
3	104 (17)	1465 c	83,4	19,5	1737,0	95,6	24,6
30-35 day seedlings							
4	40 (44)	1208 d	68,8	16,7	1433,0	78,9	20,8
5	66 (28)	1646 bc	93,7	21,2	1787,0	98,3	25,4
6	104 (17)	1498 c	85,3	20,1	1661,7	91,4	23,2
20-25 day seedlings							

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7	40 (44)	1822 b	103,8	21,3	1854,0	102,0	23,3
8	66 (28)	2042 a	116,3	22,4	2187,0	120,3	25,0
9	104 (17)	1780 b	101,4	22,5	1736,0	95,5	23,6
10	control	1756 b	100,0	22,1	1817,3	100,0	24,2
	GD 5%	191.3					
	GD 1%	259.5					
	GD 0.1%	344.8					
Legend: a,b,c.. Duncan's multiple range test (P<0.05)							

In the same age group increased from the control by 2% was report in variants with 40 cells. For all other variants, the yield of ripe fruits on bush in October was lower with 1.7% to 22.7%. The quantity of the harvested fruits in October is at least when using the 40-45 and 30-35 day seedlings grown in containers with 40 cells.

In late field production, part of the standard fruits is prepared by post-harvest ripening of green fruits, harvested before the first autumn frost (Ignatov, B., 1976, Cholakov D., 1987). Obtained this way fruits have a very good taste and relatively high biological value. They are the marketed and realized on higher prices, which increase the economic efficiency of production. Late field production of tomatoes is more efficient when the quantity of suitable for the ripening tomatoes fruits is greater. The data in Tabl.4 show that with decreasing the age of the seedlings the quantity of green fruits, which have reached the standard-sized, increased and within the average of three years is greater in the variant with 66 cells – 1 209 kg / da and the difference with the control and the other variants in the group is 3.5 to 14.9%.

The yield of post-harvest repining fruits is important for the total standard yield. Comparisons of results by year's show that the post-harvest repining fruits are most in 2012. The quantity of this fraction from the standard yield is at least in 2013, in which the plants have formed the highest total standard yield. The reason for that was unusual for the area in early autumn frost, fell during 6 October. As a result, more than 50 % of standard green fruits were damaged, which significantly reduced the quantity of fruits laid down for post-harvest ripening, and hence the process of repining.

The average results of the experimental period (Table 4) show that 56.6% to 64.1% from those laid down of post-harvest ripening fruits reached the maturity consumptive and can to be marketed as standard products. Only the use of a 20-25 day seedlings grown in containers with 66 cells, the yield of post-harvest repining fruits is 8.6% higher than the control. In all other variants, the post-harvest repining fruits are from 6.0 to 59.2% less. Within each age group, there is an increase of the absolute values with increase the number of cells of the containers. Partial exception of the third age group in which the values of variant with 66 cells was higher compared with those reported in variant with 104 cells for containers and is highest for experiments. The analysis of the results by year and performed mathematical treatment proved good or very good statistical reliability of the differences between these variants and all others including the control. The differences between the control and other variants on the first and second age groups and within the three years are statistically significant. Due to the very small quantity of post-harvest repining fruit in 2013 - reported an average yield during the experimental period accounted for only 4.2% -9.1% of the total standard yield. This percentage is growing with decreasing age of the seedlings and increases number of cells, and it is highest in the control followed by variant with 104 cells of the third age group. For all three age groups, the proportion of the post-repining fruit compared to the total standard yield was lowest in the variant with 40 cells.

Table 4. Yield of post harvest repining fruits, kg/da, by years and average for the period 2011-2013

Variant №	Number of cells (plant area, cm^2)	Post harvest repining fruits, kg			Average for 3 years					
		2011	2012	2013	Green fruits for post-harvest ripening		Post harvest repining fruits, kg	% to the control	% to laid down	% to the total standard yield
					kg	% to the control				
40-45 day seedlings										
1	40 (44)	252 f	466f	154 f	508,1	43,5	290,7	40,8	57,2	4,2
2	66 (28)	326de	519ef	200 e	578,5	49,5	348,3	48,9	60,2	5,0
3	104 (17)	367cd	632d	243 d	731,0	62,5	414,0	58,1	56,6	5,9
30-35 day seedlings										
4	40 (44)	301 ef	538e	197 e	579,7	49,6	345,3	48,4	59,6	5,0
5	66 (28)	376cd	613d	258 d	722,0	61,8	415,7	58,3	57,6	5,9
6	104 (17)	414 c	772c	292 c	851,5	72,8	492,7	69,1	57,9	6,9
20-25 day seedlings										
7	40 (44)	665 b	952b	325 b	1051,7	90,0	647,3	90,8	61,5	8,1
8	66 (28)	726 a	1221a	377 a	1209,0	103,5	774,7	108,6	64,1	8,9
9	104 (17)	669 b	994b	347 b	1117,8	95,7	670,0	94,0	59,9	9,1
10	control	652 b	1163a	324 b	1168,2	100,0	713,0	100,0	61,0	9,5
	GD 5%	54.9	60.6	24.1						
	GD 1%	73.9	81.4	34.1						
	GD 0.1%	98.5	107.9	45.5						
Legend: a,b,c.. Duncan's multiple range test (P<0.05)										

The total economic productivity has considerable influence on biological production and is a major indicator of the plants. The results of Table 5 show that the combination of environmental and technological factors to realize the biological potential of plants of the studied variants were most favorable in 2013, when it recorded the highest total standard yield for the experimental period.

Table 5. Total standard yield, kg/da, by years and average for the period 2011-2013

Variant №	Number of cells (plant area, cm^2)	2011		2012	
		kg	% to the control	kg	% to the control
40-45 day seedlings					
1	40 (44)	7458 c	101,4	6141 f	84,9
2	66 (28)	6888 d	93,7	6255 f	86,5

3	104 (17)	6953 d	94,6	6724 de	93,0
30-35 day seedlings					
4	40 (44)	7285 c	99,1	6143 f	85,0
5	66 (28)	6554 e	89,1	6763 de	93,6
6	104 (17)	7498 c	102,0	6565 e	90,8
20-25 day seedlings					
7	40 (44)	7792 b	106,0	7497 b	103,7
8	66 (28)	8468 a	115,2	8632 a	119,4
9	104 (17)	7268 c	98,9	6914 d	95,6
10	НА ЛЕХА (К)	7352 c	100,0	7229 c	100,0
	GD 5%	262,5		236,7	
	GD 1%	356,3		318,2	
	GD 0.1%	472,9		426,1	
Legend: a,b,c.. Duncan's multiple range test (P<0.05)					

Table 5. Total standard yield, kg/da, by years and average for the period 2011-2013

Variant №	Number of cells (plant area, cm^2)	2013		Average for the period	
		kg	% to the control	kg	% to the control
40-45 day seedlings					
1	40 (44)	7342 e	92,4	6980,3	93,0
2	66 (28)	7880 c	99,2	7007,7	93,3
3	104 (17)	7453 de	93,6	7043,3	93,8
30-35 day seedlings					
4	40 (44)	7254 e	91,3	6894,0	91,8
5	66 (28)	7767 c	97,7	7028,0	93,6
6	104 (17)	7380 e	92,8	7147,6	95,2
20-25 day seedlings					
7	40 (44)	8562 b	107,7	7950,3	105,9
8	66 (28)	9120 a	114,8	8740,0	116,4
9	104 (17)	7886 c	99,2	7356,0	98,0
10	НА ЛЕХА (К)	7947 c	100,0	7509,3	100,0
	GD 5%	242,4			
	GD 1%	329,5			
	GD 0.1%	437,5			
Legend: a,b,c.. Duncan's multiple range test (P<0.05)					

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The average for the three-year period, only the plants of the third age group grown in containers with 66 and 40 cells, the total standard yield was respectively by 16.4% and 5.9% higher than the control. The reported differences, between the control and the other two variants, as well as between themselves are statistic significantly. The plants from the first age group have almost the same total yield, which is lower to control with 6.2 - 7.0%. The differences with it are statistically significant in 2012. For the experimental period, the recorded standard yield is lowest at the variant with 40 cells from second age group and the difference with the control is 8.2%. Within this group, the yield has increased by increasing the number of cells, and the difference with the control in the other two variants decreased to 6.4% and 4.8%.

An important moment in evaluating the effectiveness of each technology option is its impact on the market, technological and nutritional quality of products intended for human consumption or for processing. Morphological characteristics of the fruits are essential for their market value. Determination is indicative of the average weight of the fruit, but a more comprehensive assessment should consider the signs of shape, fining, thickness of the pericarp and others.

Summary of the three measurements in the harvest period by the years and average for experimental periods, the results (Tabl.6) showed no significant differences between values of variants in studied morphological parameters.

Table 6a. Morphological characteristics of the fruits

Variant №	Number of cells (plant area, cm^2)	Average mass of one fruit, g				Thickness of the pericarp,mm			
		2011	2012	2013		2011	2012	2013	
40-45 day seedlings									
1	40 (44)	130	173	160	154,3	8,6	8,7	8,8	8,7
2	66 (28)	133	162	164	153,0	8,3	8,7	8,7	8,6
3	104 (17)	132	171	160	154,3	8,1	9,1	8,7	8,6
30-35 day seedlings									
4	40 (44)	138	171	152	153,7	8,4	8,3	8,7	8,5
5	66 (28)	147	173	168	162,7	9,0	8,7	8,5	8,7
6	104 (17)	140	173	151	154,7	8,2	8,3	8,3	8,3
20-25 day seedlings									
7	40 (44)	137	173	156	155,3	8,7	8,7	8,4	8,6
8	66 (28)	142	170	164	158,7	8,7	8,8	8,6	8,7
9	104 (17)	132	166	156	151,3	8,2	9,0	8,2	8,5
10	На леха (К)	137	168	168	157,7	8,2	8,8	8,8	8,6
	GD 5%	2.90	3.27	4.01		0.42	0.58	0.43	
	GD 1%	4.07	4.46	5.58		0.67	0.72	0.68	
	GD 0.1%	5.93	6.07	7.09		0.90	0.92	0.89	

Table 6 b. Morphological characteristics of the fruits

Variant №	Number of cells (plant area, cm^2)	I=H/D (form)				Number of seminal chambers				
		2011	2012	2013	average for the period	2011	2012	2013	average for the period	
40-45 day seedlings										
1	40 (44)	0,83	0,79	0,78	0,80	3,0	3,5	3,3	3,3	4,25
2	66 (28)	0,80	0,79	0,77	0,79	3,3	3,3	3,0	3,2	4,28
3	104 (17)	0,82	0,77	0,79	0,79	3,1	3,6	3,0	3,2	4,20
30-35 day seedlings										
4	40 (44)	0,83	0,78	0,79	0,80	3,1	3,4	2,8	3,1	4,16
5	66 (28)	0,81	0,77	0,77	0,78	3,2	3,4	3,3	3,3	4,19
6	104 (17)	0,80	0,78	0,78	0,79	3,2	3,5	2,9	3,2	4,21
20-25 day seedlings										
7	40 (44)	0,80	0,78	0,78	0,79	3,3	3,3	3,0	3,2	4,17
8	66 (28)	0,81	0,78	0,77	0,79	3,3	3,5	3,2	3,3	4,23
9	104 (17)	0,81	0,78	0,79	0,79	3,6	3,3	3,4	3,4	4,16
10	control	0,81	0,77	0,76	0,78	3,4	3,5	3,2	3,4	4,08

The mass of one fruit -151,3-162,7 g, average for the period, is with highest rates in variants with 66 cells of the second group, and the lowest - in variants with 104 cells of the third age group. The average mass of a fruits is the largest (168 g) in 2013 at the variants with 66 cells in the second age group and the smallest (130 g) - in 2011, at the variants with 40 cells from the first group.

There are minimal differences by the form of fruits between the variants. The values of determine the form index (I = H/D), which range from 0.80 to 0.83 in 2011, from 0.77 to 0.79 in 2012, from 0.76 to 0.79 for 2013 and from 0.78 to 0.80 on average for the period show, that the formation of study plants the ripe fruits are prevailing flat-round shape. There is no significant change on the number of seminal chambers of the fruits of different variants. The obtained values on average for the period of 3.1-3.4 – showed that fruits are with less seminal chambers that match the characteristics of the variety, given by its author (Danailov, 2001). This applies to the thickness of the pericarp, which in the years between 8,1-9,1 mm, and the average for the experimental period - between 8,3-8,7 mm.

The production quality of tomatoes and his biological value is determined not only by the morphological characteristics of fruits and organoleptic qualities, but also by the content of main nutrients. The results of the chemical analysis of the bush ripe fruits (Table 7) do not show a significant difference between variants by content of the analyzed indicators. This applies both to the totals of all three analyzes, performed during the harvest period in each year well as the average for the three-year period. The comparison of the last indicates that the absolute dry weight between 5.29 to 5.64%, the content of total sugars is in the range of 3.19 to 3.41%, while that of vitamin C, from 21.32 to 22.71 mg,%. The total acidity was lowest (0.40) in the version with 40 cells of the first age group and highest (0.51) in the version with 104 cells of the third age group.The ratio between total sugars and total acids defining etc. sucrose acid index is from 6.22 at variant № 9 to 8.22 at variant № 1. Considering that the optimum values of this parameter in tomatoes for fresh consumption are between 5 and 7 (Manuelyan and Todorov, 1991), as well as the values obtained in the test, it can be noted that, except for the variants under № № 1, 2, 4 and 5, all other fruits are a harmonious blend of the two components. This is a prerequisite for good taste. The minor differences between the versions of the total content - dyes and Lycopene and there is a weak increase of these constituents in the fruits of the variants of the third age group. Studied

variants do not differ significantly by overall sensory evaluation of repining fruits (4.16 to 4.28) in the five-point system. The lowest values are at the control (4.08), but they are within the range of rates (0.25), which has been applye in the formation of assessments of individual indicators of sensory evaluation.

Table 7 a. Biochemical characteristics of the fruits

Variant №	Number of cells (plant area, cm^2)	Absolute dry matter (%)				Total sugars (%)				Total acids (%)			
		2011	2012	2013	Average for the period	2011	2012	2013	Average for the period	2011	2012	2013	Average for the period
40-45 day seedlings													
1	40 (44)	5,57	5,20	5,55	5,44	3,48	3,11	3,29	3,29	0,38	0,45	0,36	0,40
2	66 (28)	5,69	5,33	5,70	5,57	3,66	3,26	3,32	3,41	0,42	0,46	0,48	0,45
3	104 (17)	5,31	5,27	5,70	5,43	3,13	3,17	3,37	3,22	0,41	0,48	0,52	0,47
30-35 day seedlings													
4	40 (44)	5,36	5,30	5,80	5,49	3,56	3,21	3,42	3,40	0,39	0,46	0,50	0,45
5	66 (28)	5,36	5,10	5,40	5,29	3,49	3,13	3,28	3,30	0,39	0,48	0,50	0,46
6	104 (17)	5,10	5,27	5,50	5,29	3,33	3,18	3,35	3,29	0,43	0,5	0,48	0,47
20-25 day seedlings													
7	40 (44)	5,61	5,40	5,90	5,64	3,30	3,31	3,47	3,36	0,45	0,48	0,50	0,48
8	66 (28)	5,49	5,30	5,90	5,56	3,13	3,21	3,48	3,27	0,47	0,48	0,50	0,48
9	104 (17)	5,19	5,40	5,65	5,41	3,10	3,26	3,22	3,19	0,5	0,5	0,52	0,51
10	control	5,39	5,23	5,60	5,41	3,30	3,23	3,22	3,25	0,43	0,51	0,48	0,47

Table 7 b. Biochemical characteristics of the fruits

Variant №	Number of cells (plant area, cm^2)	Vitamin C (mg, %)				Total dyes (mg, %)				Lycopene (mg, %)			
		2011	2012	2013	Average for the period	2011	2012	2013	Average for the period	2011	2012	2013	Average for the period
40-45 day seedlings													
1	40 (44)	21,37	26,54	22,71	23,54	5,32	5,42	5,46	5,40	4,75	4,88	4,94	4,86
2	66 (28)	21,45	26,87	21,78	23,37	5,28	5,36	5,84	5,49	4,99	4,96	5,24	5,06
3	104 (17)	20,80	26,18	22,24	23,07	5,27	5,43	5,46	5,39	4,81	4,99	4,94	4,91
30-35 day seedlings													
4	40 (44)	21,11	26,29	21,32	22,91	5,35	5,86	5,14	5,45	4,83	5,41	4,70	4,98

5	66 (28)	21,95	25,06	22,24	23,08	5,33	5,19	5,53	5,35	5,08	4,58	4,90	4,85
6	104 (17)	19,8	25,03	22,24	22,36	5,20	5,11	5,56	5,29	5,00	4,44	4,96	4,80
20-25 day seedlings													
7	40 (44)	19,72	25,18	22,24	22,38	5,68	5,87	5,56	5,70	5,27	5,40	5,03	5,23
8	66 (28)	19,32	25,40	22,71	22,48	5,72	5,47	5,56	5,58	5,38	4,96	5,12	5,15
9	104(17)	20,23	25,10	22,00	22,44	5,83	5,71	5,27	5,60	5,29	5,05	4,76	5,03
10	control	18,25	24,77	20,62	21,21	5,11	4,95	5,00	5,02	4,56	4,29	4,71	4,52

4. CONCLUSIONS

Growing seedlings in containers for late field production of tomatoes, in depending on the duration of the seedling period and the number of container cells, defining the size of nutritional area of the seedlings plants, from 3.8 to 11.3% of standard production is obtained in August, from 68.2 to 70.0% - in September, from 16.7 to 22.5% - in October and from 4.2 to 9.1% by post harvest repining of the fruits.

The yield is greatest at 20-25 days of planting seedlings grown in containers with 66 cells in nutritional area per plant 28 cm2. In this variant, the resulting total yield of a standard fruits from 8740 kg / da is 14.6% higher in comparison with the control. In it is the largest and quantity of post harvest repining fruits and of the harvested in October, that are realized in higher market prices.

The container grown seedlings does not substantially alter the morphological characteristics and biochemical value of fruit and their overall sensory evaluation.

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