

The Effect of the Mode of Plant Formation on the Tomato Yield Components in Plastic Houses

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Abstract: During two tomato production seasons the effect of decapitation, different ways of plant formation and effects of cultivars-hybrids on the early tomato production in plastic houses without additional heating, was studied. The experiment was performed with four replications, using four hybrids from different groups of ripening, one being of semi-determinate type of growth (Balcan) and three hybrids of indeterminate type of stem growth (Mi-10, Luna, Lido). During the experiment, the plants were grown and pinched in the same manner in four variants. Plant formation in 4+0 and 5+0 variants occurred on the one stem only, on the main stem which was decapitated over the fourth and the fifth truss. In 4+2 and 5+1 variants, the plants were formed on two stems, main and lateral. The main stem was decapitated over the fourth and fifth truss, and lateral stems over the first and the second truss. In view of yield, different hybrids responded differently all through investigations. Of the four hybrids, Balcan hybrid achieved the highest early yield of 85.9 t/ha on the average, grown in 4+2 plant forming variation on two stems. The highest total yields were achieved by the hybrids of later ripening group - Lido (on the average of 124.5 t/ha), then Luna hybrid (on the average of 117.1 t/ha), grown in 5+1 plant forming variation on the two stems, with the main stem decapitated over the fifth, and the lateral over the first truss.

Keywords: Plant formation, pinching, main stem, lateral stem, early yield, total yield.

Introduction

In the structure of protected vegetable production of Yugoslavia, tomato production is dominating, since it is one of the most important vegetable cultures. This production is highly present, with experiences, particularly expanded in plastic house production, without additional heating, meaning not many possibilities for controlling micro-climatic conditions. The key function of plastic houses is considered to be plant protection from weak, short-lived rimes and creating of convenient temperatures by heating with the sun energy. Since tomato growing in the plastic house technology is highly specific and highly extended, its improvement, as the major goal on the country's level in recent years, has been achieved by experimentation, modeling and controlling as efficiently as possible. A wide range of hybrids is used in the plastic house production, but the information about them are still insufficient in terms of characteristics for their growing in plastic houses without additional heating. Thus, a proper selection of the cultivar is the main factor, influencing earliness and yield, since the cultivar may optimally exert natural conditions and thus influence production technology to the greatest extent. Different types of hybrids, of both, indeterminate and semi-determinate type are being grown in plastic houses. Under natural conditions, tomato plants form shrub and stem with many lateral branches, which do not always give efficient production so that intervention measures to promote different modes of stem formation, need to be taken. In plastic house production we usually grow tomato on one or two stems and the main stem is usually decapitated over the fourth to sixth truss. Lateral stem remains in the axil under the first truss of the main stem, whereas the other lateral stems above the first truss are pinched. Thus, the optimal ways of plant formation have been attempted as well as a response of domestic dominant hybrids to the level of decapitation and yield structure of tomato grown in plastic houses.

Material and Method

Investigations on the effects of cultivar and the mode of plant formation on the yield structure, were conducted during two vegetation seasons in 1996 and 1997 on the experimental fields of the village Trbusani in the vicinity of Cacak. The plastic house was metal construction, of a movable type, with movements of adjacent surfaces, formed towards north-south direction. Covering was done with PVC foil, 0.22 mm thick, and tomato cultivation proceeded without additional heating. The most important domestic tomato hybrids were studied experimentally: Mi-10, Luna and Lido of indeterminate and Balcan hybrid of semi-determinate growing type that are convenient for plastic house production. The effects of the mode of tomato plant formation was followed, using the following variants:

1. (4+0) Plants were only formed on the main stem, with ordinary pinching of lateral branches, and decapitation above the fourth truss.

2. (4+2) Main stem was decapitated over the fourth and the first lateral branch over the second truss. All the remaining lateral branches were pinched as usual.

3. (5+0) Plants were formed on the main stem, with decapitation over the fifth truss, and ordinarily pinched lateral branches.

4. (5+1) Main stem was decapitated over the fifth truss and the first lateral branch over the first truss. The remaining lateral branches were pinched as usual. Tomato production was performed with transplants produced in a conventional manner. The experiments were conducted on the soil of a mildly acid reaction, high content of humus, high amounts of the total nitrogen, readily available forms of phosphorus, potassium, calcium, magnesium and low content of nitrogen nutrients. After preceding crop (Lettuce-*Lactuca sativa* L.) had been removed, the soil was prepared for planting, using fertilizer mixture, with 30 t/ha of the manure and 500 kg/ha of the mineral NPK fertilizer of the ratio 15:15:15. Transplants were planted on April 15th in both years. The experiment was arranged according to random block system with four replications, and vegetation area was 80 x 40 cm by size. Plants were grown and formed as mentioned above. Harvesting of ripe products was performed every five days at the stage of technological ripeness, and measurements were only performed on the standard, commodity products (mass over 70g). The yields until July 15 were considered as early, and those got during the end of production period, as total yields. Earliness was surveyed, using the method of determining components of early yield and by its comparing with the total yield so that the percentage of earliness was obtained.

Results and Discussion

The results of early yield, harvested until July 15 (Tab. 1) show high differences between the hybrids, then, the modes of plant forming, as well as the year of investigations. Early tomato yield increased from 46.8 t/ha in Lido hybrid, grown at 4+0 variant, grown on the one stem during 1997, to 93.7 t/ha in Balcan hybrid, grown in 1996 in 4+2 variant, grown on two stems. On the average, in each mode of plant formation and year, the highest early yield was achieved by Balcan, with 77.2 t/ha, followed by Luna, with 68.6 t/ha and Mi-10, with of 67.5 t/ha. However, Lido achieved the lowest early yield of 55.4 t/ha, being the result of a genetic trait, inducing its belonging to the later ripeness hybrid group.

Different modes of decapitation and plant formation occurring in one hybrid exhibited an outstanding effect on the hybrid Balcan, which achieved the highest early yield, averaging 85.9 t/ha in 4+2 growing variant.. It was grown on two stems, with the main decapitated over the fourth and lateral over the second truss. This and the other growing variants induced the highest early yields. All the hybrids were found to accomplish higher yields with growing on two stems, which also holds true for the variants on one stem, as well as on the main stem. Earliness of the indeterminate hybrid Lido was 45.6%, that of Luna 61.8%, that of Mi-10 65.3% and that of Balcan, belonging to the semi-determinate type,

78.6%. Balcan and Lido hybrids accomplished the highest earliness percentage of 86.6% and 48.0%, respectively in 4+2 variant, with growing on two stems. Mi-10 and Luna, which achieved the highest earliness in 4+0 variant, with growing on the one stem only.

Tab. 1 Effect of cultivar and decapitation on early tomato yield (t/ha)

Cultivar hybrid	Way of plant Forming	Early yield (t/ha)		Average	% of total yield
		1996.	1997.		
Mi - 10	4+0	75.0	59.3	67.1	72.5
	4+2	81.2	65.6	73.4	65.3
	5+0	59.3	56.2	57.7	57.7
	5+1	78.1	65.6	71.8	65.8
Average		73.4	61.6	67.5	65.3
BALCAN	4+0	81.2	71.8	76.5	84.4
	4+2	93.7	78.1	85.9	86.6
	5+0	71.8	65.6	68.7	72.0
	5+1	81.2	75.0	78.1	72.4
Average		81.9	72.6	77.2	78.6
LUNA	4+0	71.8	59.3	65.5	66.9
	4+2	78.1	65.6	71.8	61.3
	5+0	71.8	62.5	67.1	59.0
	5+1	75.0	65.6	70.3	61.1
Average		74.1	63.2	68.6	61.8
LIDO	4+0	59.3	46.8	53.0	45.4
	4+2	65.6	53.1	59.3	48.0
	5+0	53.1	46.9	49.9	41.1
	5+1	65.5	53.1	49.2	47.6
Average		60.9	49.9	55.4	45.6
Common average		72.6	61.8	67.2	61.9

	Cultivar (A)		Way of formin (B)	A x B
LSD	0.05	0.26	0.13	0.13
	0.01	0.35	0.17	0.17

The results on the total yield per hybrid and the modes of tomato plant formation (Tab.2) show the existence of high differences. Total yield ranged from 87.5 t/ha on Balcan hybrid, grown in 4+0 variant and on the one stem only, in 1997, to 129.7 t/ha in Lido, grown in 1996 in 5+1 variant and on two stems. In respect of all the years and modes of plant formation, total yield, on the average ranged from 98.2 t/ha in Balcan hybrid to 121.4 t/ha in Lido hybrid. Lido hybrid achieved the highest total yield averaging 124.5 t/ha, followed by that of Luna hybrid, averaging 117.1 t/ha in 5+1 variant, grown on two stems, whereas the main stem was decapitated over the fifth, and lateral one over the first truss. The other hybrids also achieved the highest yields, using this variant. Higher total

yields were attained in all the hybrids, with plants grown on two stems. All the hybrids indicated the lowest total yields in 4+0 growing variant, with growing on the one stem only.

Tab. 2 Influence of the cultivar and decapitation on total tomato yield (t/ha)

Cultivar hybrid	Way of plant forming	Total yield (t/ha)		Average
		1996.	1997.	
Mi - 10	4+0	96.7	88.3	92.5
	4+2	114.2	104.1	109.1
	5+0	102.0	97.8	99.9
	5+1	115.5	109.2	112.3
Average		107.1	99.8	103.4
BALCAN	4+0	93.7	87.5	90.6
	4+2	106.2	92.1	99.1
	5+0	100.0	90.6	95.3
	5+1	112.5	103.1	107.8
Average		103.1	93.3	98.2
LUNA	4+0	103.1	92.6	97.8
	4+2	121.8	108.3	115.0
	5+0	121.0	106.2	113.6
	5+1	125.0	109.3	117.1
Average		117.7	104.1	110.9
LIDO	4+0	123.1	110.2	116.6
	4+2	128.9	118.1	123.5
	5+0	125.8	116.9	121.3
	5+1	129.7	119.3	124.5
Average		126.8	116.1	121.4
Common average		113.7	103.3	108.5

	Cultivar (A)		Way of forming (B)	A x B
LSD	0.05	0.20	0.10	0.10
	0.01	0.27	0.13	0.13

Early tomato yield considerably varied among the hybrids and modes of plant formation. Thus, early yield ranged from 55.4 t/ha in Lido hybrid to 77.2 t/ha in Balcan. The results of early yield may be accounted for by the genetics of the hybrids, since they belong to differing ripening groups. Zdravkovic et al. (1997) first established early tomato yield as a poly-gene factor which is under a direct influence of the number and mass of fruits harvested in this period. Tomato hybrids responded differently to decapitation. Early hybrid of semi-determinate type (Balcan) had a good bearing potential and good reaction to decapitation. Hybrids of indeterminate type from later ripening groups (Mi-10, Luna, Lido) responded weakly to decapitation, meaning a poorer efficiency of this method, thus, their lower early yields. Regarding different modes of plant

EFEKAT NAČINA FORMIRANJA BILJAKA NA KOMPONENTE PRINOSA PARADAJZA U PLASTENICIMA

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Rezime

Tokom dve vegetacione sezone ispitivan je efekat dekapatacije, odnosno različitih načina orezivanja biljaka i sorte (hibrida) na strukturu prinosa rane proizvodnje paradajza u plastenicima. Ogledi su izvedeni u plastenicima bez dopunskog zagrevanja na zemljištu tipa smonice. U eksperimentu su upotrebljena četiri hibrida različitih grupa zrenja i različitog tipa rasta stabla: Balkan, Mi-10, Luna i Lido. Tokom uzgajanja biljke su orezivane na isti način, odnosno u četiri varijante. Orezivanje je obavljeno po sistemu 4+0 i 5+0, odnosno formiranje biljaka samo na glavno stablo, koje je dekapirano nakon četvrte, odnosno pete cvetne grančice. Zatim, po sistemu 4+2 i 5+1, odnosno biljke su formirane na glavno i bočno stablo. Glavno stablo dekapirano je nakon četvrte odnosno pete cvetne grančice, a bočna stabla posle prve odnosno druge cvetne grančice.

Rezultati ispitivanja pokazuju visoke efekte dekapatacije biljaka, kao i reakcije hibrida u pogledu strukture prinosa. Najviši rani prinos, prosečno 85.9 t/ha postigao je hibrid Balkan, formiran po sistemu 4+2. U ovoj varijanti orezivanja i ostali ispitivani hibridi ostvarili su najveće rane prinose. Najveće ukupne prinose postigli su hibridi kasnijih grupa zrenja Lido, 124.5 t/ha, a potom Luna 117.1 t/ha u varijanti formiranja biljaka 5+1, odnosno uzgojem biljaka na dva stabla, gde je glavno stablo dekapirano nakon pete, a bočno stablo nakon prve cvetne grančice.