J. Agric. Sci. Mansoura Univ., 25 (8): 5321 - 5329, 2000.

EFFECT OF PLANT DENSITY AND SHOOT PRUNING ON PRODUCTIVITY OF OUTDOOR TOMATOES IN THE SUMMER SEASON
A) EARLY YIELD

El-Zawily, A.I.*; B.I. El-Sawy*; N.A. Hassan*; A. Zein and M. Kassem ****

*** Hort. Dept., Fac. Agric., Kafr El-Sheikh, Tanta Univ., Egypt**

**** Hort. Res. Inst., Agric. Res. Centre, Giza, Egypt**

ABSTRACT

The study included the effect of planting system (single and double rows), plant spacing (20 and 30 cm) and shoot pruning (without pruning, pruned to three or six shoots, pruned to six shoots topped at 3rd leaf and all shoots topped at 3rd leaf) on early yield of tomato plants cv. Castlerock. Experiments were conducted during the summer season of 1993 and 1994.

Plants grown in double rows at 20 cm spacing produced the largest early yield of total and size II (< 80 g) fruits. The highest early yield of fruits having size I (> 80 g) was likewise obtained from plants grown in double rows but at 30 cm spacing. Tomato plants grown with three shoots produced the highest early yield of total and size I fruits, and the lowest record of size II fruits. The treatment combination of planting in double rows at 20 cm spacing with plants pruned to three shoots/plant achieved the highest early yield in both seasons.

INTRODUCTION

Tomato is the most important vegetable crop in Egypt. Summer planting is the main season for outdoor tomato production; and early crop of tomatoes is a major objective for the growers as prices are usually high. Pruning and high plant density are amongst the common practices in some countries for achieving high early yield under the open field conditions. However, pruning is not practiced in open filed tomato production in Egypt.

Many investigators confirmed that side shoot removal of tomato plants grown in the open field advanced the early yield (Veselinov, 1977; Hartmann, 1978; Davis and Estes, 1993). Also, it was generally agreed that close spacing tended to increase early yield (Moldoveanu, 1976; El-Zawily, 1981; Pyzik and Dabrowska, 1989; Malash *et al.,* 1990).

For the combination of plant density and pruning, Zubeldia and Gasco (1977) reported that the highest early yield was obtained from planting system of 1.20 x 0.25 m using indeterminate tomato plants with a single stem. Moreover, Davis and Estes (1993) showed that early-season yields were highest by using a combination of early pruning (lateral shoots were 5-10 long) or delayed pruning (lateral shoots were 30-36 cm long) and in-row spacing $\leq$ 46 cm (in-row spacing treatments were 31, 46, 64, 76 and 91 cm).

The objective of this research was therefore to study the effect of planting system, plant spacing and shoot pruning on early yield and its components in tomato plants cv. Castlerock.

MATERIALS AND METHODS

The experiments were carried out in a private farm in El-Mehalla El-Koubra District, Gharbia Governorate, during the two summer seasons of 1993 and 1994. The determinate tomato cv. Castlerock was used. Texture of the experimental soil was clay.

The experiments included 20 treatments, which were the combinations of two planting systems, two spacings within the row and five shoot pruning levels. Planting systems were single row on 1 m ridges and double rows on 1.25 m ridges. Plant spacings within the row were 20 and 30 cm. Shoot pruning treatments were without pruning ($Pr._0$) as control, pruning to 3 shoots ($Pr._1$), pruning to 6 shoots ($Pr._2$), prunning to 6 shoots topped at 3^{rd} leaf ($Pr._3$), and all shoots topped at 3^{rd} leaf ($Pr._4$).

The different treatments were randomized in a split-split-plot arrangement in a randomized complete block design with four replications. Planting system treatments were assigned at random to the main plots. Each main plot was split into two spacing treatments as sub-plots, and the five pruning levels were randomly assigned to the sub sub-plots. Each experimental plot contained two ridges, each 6 meters long. Fruit yield was estimated from 12 m^2 of each sub sub-plot.

Tomato seedlings were transplanted on March 2^{nd} in both years. The pruning process started one month after transplanting and was carried out weekly to keep the required number of shoots in the different treatments. The regular cultural practices were applied whenever it was needed and as usually done by growers.

Yield of the first ten days of the harvesting period, which lasted for about 30 days, was considered as early fruit yield. Early yield was sorted to two sizes according to fruit weight; size I for fruits exceeding 80 g in weight, and size II for smaller fruits. The relative yield increase for the different testaments was also calculated.

Data were tested by analysis of variance (Little and Hills, 1972). Duncan's multiple range test was used for the comparisons among treatment means (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of planting system:

Data presented in Table (1) show that early yield as weight of fruits per plot of size I, size II and their sum was significantly higher in tomato plants grown on double rows than in plants grown on a single row in both seasons. This result is primarily a function of the increase in number of plants per unit area. In this respect, a correlation between high early yield and high plant population has been reported for some tomato cultivars under a wide range of conditions (Moldoveanu, 1976; El-Zawily, 1981; and Davis and Estes, 1993). Moreover, El-Zawily (1981) reviewed that the increase in early yield obtained from the higher plant population of tomato is primarily a function of the increase in number of fruits per unit area.

Effect of plant spacing:

Data in Table (2) indicate that, in both seasons, plants grown at 20 cm spacing produced higher early yield of both size I and size II fruits than did plants grown at 30 cm spacing). The increase in total early yield was 35.4 and 24.3% in the first and second seasons, respectively. Previous studies showed that high plant population reduced vegetative growth which, in turn, may enhance flowering and earliness (Moldoveanu, 1976; Pyzik and Dabrowska, 1989; Malash *et al.,* 1990).

Table (1): Effect of planting system on tomato early yield (1993 and 1994 seasons).

Planting system	Early yield/plot (kg/12 m^2)			Relative yield increase (%)
	Size I(> 80 g)	Size II(< 80 g)	Total	
	1993 season			
Single row	9.3	3.0	12.3	000.0
Double rows	25.3	15.7	44.0	257.7
F test	**	**	**	-
	1994 season			
Single row	12.9	4.8	17.7	00.0
Double rows	14.9	12.8	27.7	56.5
F test	**	**	**	-

** indicates significant differences at P < 0.01 according to F test.

Table (2):Effect of spacing on tomato early yield (1993 and 1994 seasons).

Spacing Treatments	Early yield/plot (kg/12 m^2)			Relative yield increase (%)
	Size I(> 80 g)	Size II (< 80 g)	Total	
	1993 season			
30 cm	15.4	7.2	22.6	00.0
20 cm	19.1	11.5	30.6	35.4
F test	**	**	**	-
	1994 season			
30 cm	13.5	6.7	20.2	00.0
20 cm	14.3	10.8	25.1	24.3
F test	**	**	**	-

** indicates significant differences at P < 0.01 according to F test.

Effect of shoot pruning:

Data in Table (3) reveal that tomato plants pruned to 3 shoots (Pr.$_1$) produced the highest early yield of total and size I (> 80 g) fruits in both seasons. The relative increase in early yield of this treatment was 29.6 and 15.8% in the first and second season, respectively. On the other hand, this treatment produced the lowest early yield of size II fruits (< 80 g) in both seasons.

Table (3): Effect of pruning on tomato early yield (1993 and 1994 seasons).

@ Pruning Treatments	Early yield/plot (kg/12 m2)			Relative yield increase(%)
	Size I(> 80 g)	Size II(< 80 g)	Total	
	1993 season			
$Pr._0$	14.7 c	9.3 ab	24.0 d	00.0
$Pr._1$	22.0 a	9.1 b	31.1 a	29.6
$Pr._2$	17.6 b	9.6 ab	27.3 b	13.8
$Pr._3$	14.8 c	9.8 a	24.6 d	2.5
$Pr._4$	17.2 b	9.0 b	26.3 c	9.6
F test	**	**	**	-
	1994 season			
$Pr._0$	12.0 d	10.1 a	22.1 b	00.0
$Pr._1$	16.4 a	9.2 b	25.6 a	15.8
$Pr._2$	14.9 b	8.0 c	22.9 b	3.6
$Pr._3$	14.0 c	8.1 c	22.1 b	00.0
$Pr._4$	12.3 d	8.5 c	20.8 c	-5.9
F test	**	**	**	-

@ Pruning treatments:
$Pr._0$ = Unpruned (Control) $Pr._1$ = Pruned to three shoots $Pr._2$= Pruned to six shoots
$Pr._3$= Pruned to six shoots topped at 3rd leaf $Pr._4$=All shoots topped at 3rd leaf.
**** indicates significant differences at $P < 0.01$ according to F test.**
Means followed by a letter in common are not significantly different at the 5% level, according to Duncan's test.

Data reveal also that the lowest early yield of total and size I fruits was produced from unpruned plants ($Pr._0$) and plants with six shoots topped at 3rd leaf ($Pr._3$) in the first season, and from unpruned plants and plants in which all shoots were topped at 3rd leaf ($Pr._4$) in the second season. The other pruning treatments occupied an intermediate position between the above-mentioned treatments which had the highest and the lowest early yield. In this concern, Davis and Estes (1993) suggested that the increment in early yield may be caused in unpruned tomato plants by continued partition of carbohydrates to vegetative growth, instead of reproductive growth, for a longer period than in pruned plants. To indicate the importance of pruning severity on early yield, Malash *et al*. (1990) reported that the highest early yield of tomatoes was obtained in plants pruned to two stems compared with one or three stems. Similar results were previously obtained by Hartmann (1978), Campos *et al*. (1987) and Davis and Estes (1993) on tomatoes and by Paksoy and Akilli (1994) on eggplant. Inversely negative results on early yield induced by pruning was obtained by Esiyok *et al*. (1994) and Hamed (1997) on sweet pepper.

Effect of the interaction between planting system and plant spacing:

Data in Table (4) show that tomato plants grown on double rows at 30 cm spacing produced the highest early yield of fruits having size I, whereas total early yield and yield of size II fruits were obtained from tomato plants grown in double rows at close spacing (20 cm). In both seasons, plants grown in single rows at wide spacing (30 cm) gave the lowest early yield. Similar results were obtained by Moldeveanu (1976), El-Zawily (1981) and Pyzik and Dabrowska (1989) on tomatoes.

Table (4): Effect of planting system and spacing on tomato early yield (1993 and 1994 seasons).

Planting System	Spacing	Early yield/plot (kg/12 m^2) Size I (> 80 g)	Size II (< 80 g)	Total	Relative yield increase (%)
		1993 season			
Single row	30 cm	7.8 b	2.3 b	10.1 b	00.0
	20 cm	10.8 b	3.7 b	14.5 b	43.6
Double rows	30 cm	23.1 a	12.2 a	35.3 a	249.5
	20 cm	27.4 a	19.3 a	46.7 a	362.4
F test		*	**	**	-
		1994 season			
Single row	30 cm	11.6 c	3.4 c	15.0 d	00.0
	20 cm	14.2 b	6.1 bc	20.3 c	35.3
Double rows	30 cm	15.4 a	10.0 ab	25.4 b	69.3
	20 cm	14.4 b	15.5 a	29.9 a	99.3
F test		**	**	*	-

****and * indicate significant differences at $P < 0.01$, $P < 0.05$, respectively according to F test. Means followed by a letter in common are not significantly different at the 5% level, according to Duncan's test.**

Effect of the interaction between planting system and shoot pruning:

Data in Table (5) reveal that tomato plants which had three shoots only ($Pr._1$) and grown under the double rows system produced the highest early yield as a total and large fruits (size I) in both seasons.

Table (5): Effect of planting system and pruning on tomato early yield (1993 and 1994 seasons).

Planting system	@ Pruning	1993 season: Early yield/plot (kg/12 m^2) Size I (> 80 g)	Size II (< 80 g)	Total	Relative yield ncrease (%)	1994 season: Early yield/plot (kg/12 m^2) Size I (> 80 g)	Size II (< 80 g)	Total	Relative yield ncrease (%)
Single row	$Pr._0$	8.7 f	2.8 e	11.5 g	00.0	11.2 h	6.2 d	17.4 f	00.0
	$Pr._1$	13.2 e	3.3 d	16.5 e	43.5	14.0 d	4.3 f	18.3 e	5.2
	$Pr._2$	9.1 f	3.3 d	12.4 f	7.8	13.1 f	5.1 e	18.2 e	4.6
	$Pr._3$	6.5 g	2.3 f	8.8 h	-23.5	15.2 c	3.9 g	19.1 e	9.8
	$Pr._4$	8.9 f	3.1 de	12.0 fg	4.3	10.9 h	4.5 f	15.4 g	-11.5
Double rows	$Pr._0$	20.6 d	15.7 b	36.3 d	215.7	12.7 g	14.0 a	26.7 bc	53.4
	$Pr._1$	30.7 a	14.8 c	45.5 a	295.7	18.8 a	14.2 a	33.0 a	89.7
	$Pr._2$	26.1 b	15.9 b	42.0 b	265.2	16.7 b	10.8 c	27.5 b	58.0
	$Pr._3$	23.2 c	17.3 a	40.5 c	252.2	12.8 g	12.3 b	25.1 d	44.3
	$Pr._4$	25.6 b	14.9 c	40.5 c	252.2	13.6 e	12.5 b	26.1 c	50.0
F test		**	**	**	-	**	**	**	-

@ Pruning treatments:
$Pr._0$ = Unpruned (Control) $Pr._1$ = Pruned to three shoots $Pr._2$= Pruned to six shoots
$Pr._3$= Pruned to six shoots topped at 3rd leaf $Pr._4$=All shoots topped at 3rd leaf.
**** indicates significant differences at P < 0.01 according to F test.**
Means followed by a letter in common are not significantly different at the 5% level, according to Duncan's test.

On the other hand, the lowest early yield was obtained from plants which had six shoots topped at the third leaf ($Pr._3$) and grown in a single row system in the first season, and from those plants which had all shoots topped at the third leaf ($Pr._4$) and grown on a single row system in the second one. These results are in accordance with those of Zubeldia and Gasco (1977).

Effect of the interaction between plant spacing and shoot pruning:

Data reported in Table (6) clarify that tomato plants pruned to 3 shoots ($Pr._1$) and grown at close spacing (20 cm) produced the highest early yield in both seasons. Such increments were 78.3 and 37.0 percent in the first and second season, respectively. On the contrary, the lowest early yield resulted from control plants (unpruned) grown under wide spacing (30 cm) in the first season, while in the second season such result was obtained from plants with six shoots topped at the third leaf and grown also under wide spacing. These results are in agreement with those obtained by Mangal and Jasim (1987) and Davis and Estes (1993).

Table (6): Effect of spacing and pruning on tomato early yield (1993 and 1994 seasons).

Spacing	@ Pruning	1993 season				1994 season			
		Early yield/plot (kg/12 m²)			Relative yield ncrease (%)	Early yield/plot (kg/12 m²)			Relative yield ncrease (%)
		Size I (> 80 g)	Size II (< 80 g)	Total		Size I (> 80 g)	Size II (< 80 g)	Total	
30 cm	$Pr._0$	12.3 f	8.0 d	20.3 i	00.0	12.2 g	8.9 d	21.1 f	0.0
	$Pr._1$	19.4 b	6.4 g	25.8 f	27.1	16.0 b	6.3 f	22.3 e	5.7
	$Pr._2$	16.6 c	7.2 h	23.8 g	17.2	14.1 d	5.6 h	19.7 g	-6.6
	$Pr._3$	13.2 e	7.5 e	20.7 i	2.0	13.3 e	6.0 g	19.3 g	-8.5
	$Pr._4$	15.6 d	7.1 f	22.7 h	11.8	11.9 gh	6.7 e	18.6 h	-11.8
20 cm	$Pr._0$	17.1 c	10.6 c	27.7 e	36.5	11.7 h	11.3 b	23.0 d	9.0
	$Pr._1$	24.5 a	11.7 a	36.2 a	78.3	16.8 a	12.1 a	28.9 a	37.0
	$Pr._2$	18.7 b	12.0 a	30.7 b	51.2	15.8 b	10.3 c	26.1 b	23.7
	$Pr._3$	16.5 c	12.1 a	28.6 d	40.9	14.7 c	10.2 c	24.9 c	18.0
	$Pr._4$	18.9 b	11.0 b	29.9 c	47.3	12.6 f	10.2 c	22.8 d	8.1
F test		*	**	**	-	**	**	**	-

@ Pruning treatments:
$Pr._0$ = Unpruned (Control) $Pr._1$ = Pruned to three shoots $Pr._2$= Pruned to six shoots
$Pr._3$= Pruned to six shoots topped at 3rd leaf $Pr._4$=All shoots topped at 3rd leaf.
**** indicates significant differences at P < 0.01 according to F test.**
Means followed by a letter in common are not significantly different at the 5% level, according to Duncan's test.

Effect of the interaction between planting system, plant spacing and shoot pruning:

Data in Table (7) show that, in both seasons, tomato plants grown under double rows, close spacing (20 cm) and pruned to three shoots (Pr.$_1$) produced the highest total early yield. On the other hand, the lowest early yield in the first season resulted from tomato plant grown in a single rows at wide spacing (30 cm) and pruned to six shoots topped at the third leaf (Pr.$_3$). However, in the second season, such result was attained from tomato plants grown also in a single row at wide spacing (30 cm) but which all their shoots topped at the third leaf (Pr.$_4$). In this connection, Zubeldia and Gasco (1997), Mangal and Jasim (1987) and Davis and Estes (1993) obtained somewhat similar results.

It could be concluded that under our conditions the highest early yield was produced from tomato plants cv. Castlerock when grown in double rows at close spacing (20 cm) and pruned to three shoots only.

Table (7): Effect of planting system, spacing and pruning on tomato early yield (1993 and 1994 seasons).

Planting system & spacing	@ Pruning	1993 season				1994 season			
		Early yield/plot (kg/12 m^2)			Relative yield increase (%)	Early yield/plot (kg/12 m^2)			Relative yield increase (%)
		Size I (> 80 g)	Size II (< 80 g)	Total		Size I (> 80 g)	Size II (< 80 g)	Total	
Single row									
30 cm	Pr.$_0$	6.5	2.7 k	9.2 q	00.0	11.1 j	5.1 k	16.2 l	00.0
	Pr.$_1$	10.9	2.1 m	13.0 n	41.3	11.7 j	3.4 l	15.1 m	-6.8
	Pr.$_2$	8.7	2.6 kl	11.3 o	22.8	11.1 k	2.9 n	14.0 n	-13.6
	Pr.$_3$	5.6	1.6 n	7.2 r	-21.7	14.0 e	2.6 o	16.6 l	2.5
	Pr.$_4$	7.1	2.4 l	9.5 q	3.3	10.1 e	3.1 m	13.2 o	-18.5
20 cm	Pr.$_0$	11.0	3.0 j	14.0 m	52.2	11.3 k	7.3 i	18.6 j	14.8
	Pr.$_1$	15.6	4.5 h	20.1 k	118.5	16.4 c	5.1 k	21.5 i	32.7
	Pr.$_2$	9.6	4.1 i	13.7 m	48.9	15.2 d	7.4 i	22.6 h	39.5
	Pr.$_3$	7.3	3.0 j	10.3 p	12.0	16.5 c	5.1 k	21.6 i	33.3
	Pr.$_4$	10.7	3.9 i	14.6 l	58.7	11.8 g	5.9 j	17.7 k	9.3
Double rows									
30 cm	Pr.$_0$	18.7	13.2 e	31.9 j	246.7	13.3 f	12.8 e	26.1 e	61.1
	Pr.$_1$	28.0	10.7 g	38.7 f	320.7	20.4 a	9.2 g	29.6 b	82.7
	Pr.$_2$	24.2	11.9 f	36.3 g	294.6	17.0 b	8.3 h	25.3 f	56.2
	Pr.$_3$	20.8	13.4 e	34.2 i	271.7	12.6 h	9.3 g	21.9 i	35.2
	Pr.$_4$	24.0	11.8 f	35.8 h	289.1	13.7 e	10.3 f	24.0 g	48.1
20 cm	Pr.$_0$	23.2	18.2 d	41.4 e	350.0	12.2 i	15.3 b	27.5 d	69.8
	Pr.$_1$	33.4	18.9 c	52.3 a	468.5	17.2 b	19.1 a	36.3 a	124.1
	Pr.$_2$	27.9	20.0 b	47.9 b	420.7	16.4 c	13.3 d	29.7 b	83.3
	Pr.$_3$	25.7	21.1 a	46.8 c	408.7	12.9 g	15.4 b	28.3 c	74.7
	Pr.$_4$	27.1	18.1 d	45.2 d	391.3	13.4 f	14.6 c	28.0 c	72.8
F test		N.S	**	**	-	**	**	**	-

@ Pruning treatments:

Pr.$_0$ = Unpruned (Control) Pr.$_1$ = Pruned to three shoots Pr.$_2$= Pruned to six shoots

Pr.$_3$= Pruned to six shoots topped at 3rd leaf Pr.$_4$=All shoots topped at 3rd leaf.

**** and N.S indicate significant differences at P < 0.01 and not significant, respectively, according to F test.**

Means followed by a letter in common are not significantly different at the 5% level, according to Duncan's test.

REFERENCES

Campos, J.P.; C.C. Belford; J.D. Galvao and P.G. Fontes (1987). The effect of stem pruning and plant population on tomato productivity. Revista Ceres, Brazil, 34(192): 198-208.

Davis, J.M. and E.A Estes (1993). Spacing and pruning affect growth, yield, and economic returns of staked fresh-market tomatoes. J. Amer. Soc. Hort. Sci. 118(6): 719-725.

Duncan, B.D. (1955). Multiple Range and Multiple F-test. Biometrics, 11: 1-42.

El-Zawily, A.I. (1981). Effect of planting system and plant density on fruit yield and quality of tomatoes (*Lycopersicon esculentum,* Mill.). Res. Bull. Fac. Agric., Zagazig Univ. No. 251: 1-13.

Esiyok, D.; F. Ozzambak and B. Ester (1994). The effect of stem pruning on the yield and earliness of greenhouse peppers (*Capsicum annum* , L.) giossum cv. Kandil and 11 B.14. Acta Hort. 366: 293-300.

Hamed, E.M. (1997). Studies on seaweed extract and shoot pruning on sweet pepper yield under plastic greenhouse. M.Sc. Thesis, Fac. Agric. Tanta Univ.

Hartmann, H.D. (1978). Influence of side shoots as sinks on the development of leaves and main stems of tomatoes. Garten-bauwissenschaft, 43(2): 66-69.

Little, T.A. and F.J. Hills (1972). Statistical methods in Agriculture Research. California Univ., Davis, p. 242.

Malash, N.M.; M.A Fatehallah; F.A. Ali and R.A. Gawish (1990). Productivity and fruit quality of some greenhouse tomato hybrids as influenced by pruning systems and planting distance. Menufiya J. Agric. Res. 15(2): 1601-1623.

Mangal, J. and A.M. Jasim (1987). Response of tomato varieties to pruning and plant spacing under plastic house. Haryana, J. Hort. Sci. 16(3-4): 248-252.

Moldoveanu, L. (1976). Agricultural techniques for early field tomatoes grown without supports. Ph.D. Thesis, Vegetable Crops Research Institute. “Maritsa”. Plovdiv, Bulgaria.

Paksoy, M. and M. Akilli (1994). The effects of different prunings on the yield and quality of eggplant cultivars grown in the greenhouse conditions. Acta Hort., 366: 287-292.

Pyzik, T. and B. Dabrowska (1989). Effect of plant density per unit area on the biology of growth, development and cropping of Beta-type tomato cultivars. Roczniki Akademii Rolniczej w poznaniu, Ogrodnic two, Warsaw, Poland.

Veselinov, E. (1977). Effect of side shoot removal on the earliness and yield of determinate tomatoes grown as early field crop. Gradinarska i Lozarska Nauka, Bulgaria, 14(5): 63-68.

Zubeldia, A. and J.L. Gasco (1977). The effect of spacing and of the number of stems on the earliness and total yield of the tomato cultivar Valenciana. Anales del Institute Nacional de Investigaciones Agrarias, Produccion Vegetal, Madrid, Spain, 7: 73-97.

تأثير الكثافة النباتية والتقليم على انتاجية الطماطم فى الحقل المكشوف فى العروة الصيفية

أ- المحصول المبكر

عبدالشفيق الزعويلى* ، بسيونى الصاوى* ، نبيل عبدالمنعم حسن* ، أحمد زين ، محمد قاسم****

*** قسم البساتين - كلية الزراعة بكفر الشيخ - جامعة طنطا**

**** معهد بحوث البساتين - مركز البحوث الزراعية - الجيزة**

أشتملت الدراسة على تأثير نظام الزراعة (ريشة واحدة ، وريشتين) والمسافة بين النباتات (20 ، 30 سم) ومستويات التقليم (بدون تقليم كمقارنة ، وترك 3 فروع جانبية ، و6 فروع جانبيه ، و6 فروع جانبية مطوشة عند الورقة الثالثة ، وجميع الفروع الجانبية مطوشة عند الورقة الثالثة) وتوليفاتهم على المحصول المبكر من الطماطم صنف كاسل روك. نفذت التجارب بالعروة الصيفية لموسمى 1993 ، 1994.

أنتجت النباتات المنزرعة على الريشتين بمسافة زراعة ضيقة (20 سم) أعلى محصول مبكر كلى وكذلك من الحجم الصغير للثمار (أقل من 80 جم) فى حين أعطت النباتات المنزرعة على الريشتين مع مسافة الزراعة الواسعة (30 سم) أعلى محصول مبكر من الحجم الكبير للثمار (أكبر من 80 جم).

أعطت نباتات الطماطم المقلمة بترك 3 فروع جانبية أعلى محصول مبكر كلى وكذلك من الحجم الكبير للثمار وأقل محصول مبكر من الحجم الصغير للثمار.

أنتجت النباتات المنزرعة على الريشتين بمسافة الزراعة الضيقة (20 سم) والمقلمة بترك 3 فروع جانبية أعلى محصول مبكر فى الموسمين.