

# THE EFFECT OF STAKING AND PRUNING ON TOMATO PLANTS

BY ARTURO RIOLLANO

Staking and pruning tomato plants has been a general practice among the majority of the farmers devoted to truck or market gardening in various sections of Puerto Rico. While numerous trials have been carried elsewhere to determine the relative value of these practices, experimental evidence is lacking for this Island. These trials were established to determine the effects of staking and pruning Marglobe tomato plants on yields, size, quality, and earliness of fruits under prevailing conditions at the Isabela Irrigation District. It is hoped that the information presented in this paper will be in general applicable to other sections of the Island or, at least, that it will induce some vegetable growers to make more careful observations as to the relative merits of pruning and training tomato plants in their respective areas.

## MATERIALS AND METHODS

Two trials were conducted on Coto Clay soil with the Marglobe variety at the Isabela Substation during the fiscal year 1936-37. This variety of tomatoes is grown almost exclusively in Puerto Rico, either for the local market or for shipping to the Continent during the winter season. The first trial was started on August 1936 with four treatments, namely, (a) unstaked, (b) staked, (c) unstaked and pruned, and (d) staked and pruned. Each treatment was replicated nine times in randomized blocks. The land used for this trial was prepared for surface irrigation by the furrow system commonly known as the Hawaii system. Seed was sown on August 20 in seedbeds made in the open and the seedlings transplanted to the field on September 19. Plants were set by hand  $2\frac{1}{2} \times 4$  feet apart. Square plots  $\frac{1}{100}$ th acre in area were used. Thirty-five plants were set in each plot. 8-10-15 fertilizer was applied to the furrow at the rate of one ton per acre five days before transplanting. Irrigation was applied at the

approximate rate of one acre-inch once a week whenever rainfall was less than one inch in the preceding week. A total of six applications of artificial irrigation were made while the amount of natural rainfall amounted to 13.7 inches during the crop.

In all the staking treatments each plant was tied to a wooden stake driven into the ground about 10 inches and extending from 5 to 6 feet above the ground. Tying of the plants to the stakes was done with manila hemp twine. Six times during the season this operation was practiced in order to keep plants properly tied to the stakes.

In the pruning treatments, plants were pruned to a double stem and small shoots were removed as often as necessary. Pruning was done at weekly intervals and this operation was practiced 6 times during the crop. Eight applications of Bordeaux mixture 2-3-50 plus 2 lbs. of lead arsenate were made at weekly or ten-day intervals for the control of diseases and insects. Seven pickings of fruits were made: the first on November 20 and last on December 28.

Fruit from each plot was counted and classified by weight as follows: large, weighing above .3 pound; medium, weighing from .2 to .3 pound; and small, weighing less than .2 pound. Fruit with blemishes, malformations, disease symptoms or too small for marketing purposes was classified as unmarketable. The fruit was harvested green or just beginning to turn, a stage of maturity considered safe for long distance shipment.

The second trial was established in another field after the results of the first trial were known. It was started on January 17, 1937, the first picking being made on April 6 and the last on May 19. A similar procedure was followed except that only two treatments were included, staked and unstaked, and that each treatment was replicated 8 times. This second test was carried out during the dry season and consequently 10 applications of irrigation water were made when rainfall dropped to 8.25 inches during the crop season.

The results of the first trial were calculated by Fisher's (3) method of statistical analysis while those of the second trial were analyzed by Student's method using Love's (5) modification. In the latter case odds greater than 30:1 are considered significant.

#### RESULTS

The results are presented in detail in tables 1 and 2. They have been reported in hundredweights per acre to facilitate the making of compari-

TABLE 1. *Effect of staking and pruning tomato plants on yield, size, and quality of fruit. First Trial.*

TREATMENT	LARGE (100 lbs.)	MEDIUM (100 lbs.)	SMALL (100 lbs.)	MARKETABLE FRUITS (100 lbs.)	CULLS (100 lbs.)	TOTAL YIELD (100 lbs.)
Unstaked	16.1	57.0	18.3	91.4	10.6	102.0
Staked	12.3	44.5	16.6	73.4	7.3	80.7
Unstaked and pruned	7.4	32.2	15.0	54.6	9.1	63.7
Staked and pruned	5.0	29.3	12.0	46.3	5.8	52.1
Difference for significance at 5 per cent point	2.5	14.4	2.9	7.4	2.5	8.2
Difference for significance at 1 per cent point	3.4	19.6	3.9	10.8	3.4	11.1

TABLE 2. *Effect of staking tomato plants on yield, size, and quality of fruit. Second Trial. Yields are given in hundredweights per acre.*

TREATMENT	LARGE	MEDIUM	SMALL	MARKETABLE	CULLS	TOTAL YIELD
	(100 lbs.)	(100 lbs.)	(100 lbs.)	FRUITS (100 lbs.)	(10) lbs.)	(100 lbs.)
Unstaked	52.9	63.6	19.0	138.5	17.2	155.7
Staked	43.6	57.1	15.7	116.4	11.8	128.2
Loss by staking	9.3	9.5	3.3	22.1	5.4	27.5
Per centage loss	17.5	14.3	17.4	16.0	31.4	17.4
Student's odds <sup>1</sup>	216:1	70:1	59:1	1999:1	184:1	1428:1

<sup>1</sup> Odds greater than 30:1 are considered significant.

sons in terms used by local growers. Yields obtained in these trials seem to be low if compared to those obtained in the Continent. However, these yields compare favorably with those reported by Colón Torres and Morales (1) as obtained by commercial growers in the Jayuya section of this Island.

In both trials staking reduced consistently and significantly yields of all classes of fruit when compared with the unstaked treatments. The effect of staking on total yield is decidedly detrimental when considering that this practice caused an average loss of 21.3 hundredweights of fruit per acre in the first trial and 27.5 hundredweights in the second trial. Staking increases slightly the percentage of marketable fruit but reduces greatly total yields. The apparent effect of staking upon quality of fruit is offset by the marked reduction on total yields of marketable fruit. Thus it will be observed that staking reduced the yield of marketable fruit by 18.0 hundredweights in the first trial and by 22.1 hundredweights in the second trial.

The combination of pruning and staking seems to reduce further, in a significant way, the yields of all classes of fruit. The unstaked and pruned treatment was inferior to the staked or unstaked treatment, but it was superior to the staked and pruned treatment where the lowest yields were recorded. The descending order of merit of marketable yields for unstaked, staked, and unstaked and pruned, staked and pruned will, therefore, run as follows: 91.4, 73.4, 54.6 and 46.3 hundredweights per acre respectively. For total yield the same trend is observed for the above treatments, namely, 102.0, 80.7, 63.7, and 52.1 hundredweights per acre, respectively. Considering total yields of marketable fruit, the effects of pruning and staking upon quality are significantly undesirable.

The average weight of all fruit harvested from the different treatments in both trials has been presented in table 3.

TABLE 3. *The effect of staking and pruning on size of fruit. Average weight of fruit by trials and treatments.*

	UNSTAKED	STAKED	UNSTAKED & PRUNED	STAKED & PRUNED
	(lbs.)	(lbs.)	(lbs.)	(lbs.)
First trial	0.233	0.234	0.215	0.213
Second trial	0.278	0.255		

In spite of the apparent tendency to reduce size of fruit when pruning or staking was practiced, the differences in weight recorded were not sig-

nificant. Furthermore, these differences in size must be larger in order to be of any commercial value.

The effect of staking and pruning on earliness may be studied by observing the total yields obtained with the different treatments in the first four pickings. In the first trial, as illustrated in figure 1 and table 4, it seems that pruning without staking had some favorable effect on the quantity of early fruit set by causing slightly higher yields in the

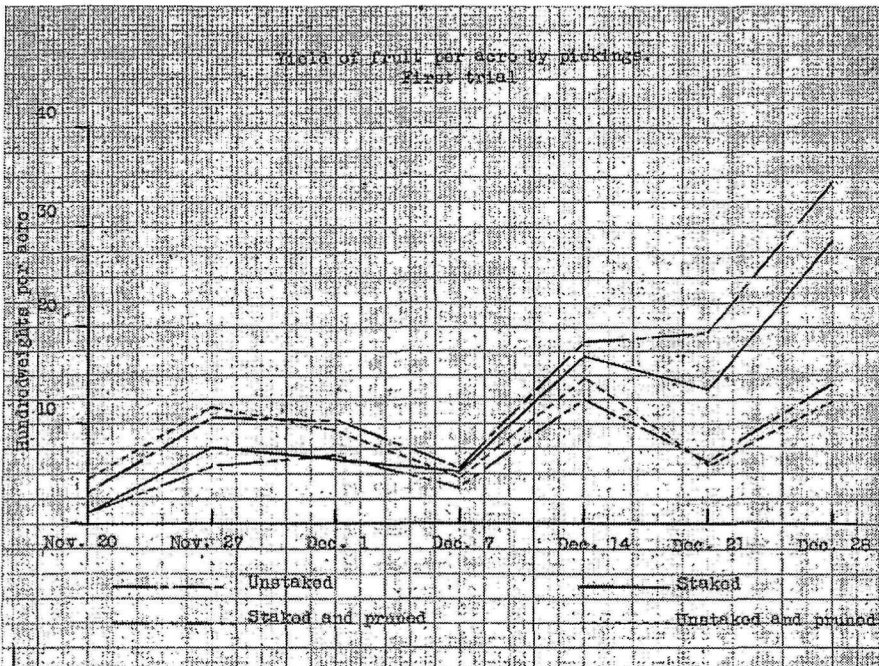


Fig. 1. The effects of pruning and staking on total yields and earliness of fruit.

pickings of November 20 and 27. When considering total yields of the first four pickings, the unstaked plots whether pruned or unpruned, were not statistically different, but each outyielded in a significant way the other two treatments. In the second trial where pruning treatments were omitted, the unstaked treatment with 106.6 hundredweights per acre in the first four pickings, had a marked and significant effect upon the quantity of early fruit set when compared with the staked treatment which produced only 75.1 hundredweights of fruit per acre during the same

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TABLE 4. *Effect of staking and pruning on earliness. First Trial.*  
*Yields in hundredweights per acre by pickings.*

DATE	UNSTAKED (100 lbs.)	STAKED (100 lbs.)	UNSTAKED & PRUNED (100 lbs.)	STAKED & PRUNED (100 lbs.)	DIFFERENCE FOR SIGNIFI- CANCE
November 20 *	3.3	1.3	4.2	1.4	
November 27	10.5	7.6	11.5	6.3	
December 1	10.3	6.8	9.7	7.1	
December 7	5.7	5.3	4.9	3.9	
Yields per acre first four pickings, 9 replicates	29.8	21.0	30.3	18.7	3.5 * 4.8 **
December 14	18.4	17.3	14.8	12.7	
December 21	19.3	13.7	6.3	6.5	
December 28	34.5	28.7	12.3	14.2	
Totals	102.0	80.7	63.7	52.1	8.2 * 11.1 **

\* Significance at 5 per cent point.

\*\* Significance at 1 per cent point.

TABLE 5. *Effect of staking on earliness. Second Trial.*  
*Yields in hundredweights per acre by pickings.*

DATE	UNSTAKED (100 lbs.)	STAKED (100 lbs.)	STUDENT'S ODDS
April 6	9.8	6.5	
April 14	31.6	19.0	
April 21	36.6	27.5	
April 28	28.6	22.1	
Yields per acre first four pickings. 8 replicates	106.6	75.1	4999:1
May 5	22.8	25.3	
May 12	13.4	14.4	
May 19	12.9	13.4	
Totals	155.7	128.2	1428:1

period of time. The results of both trials as shown in tables 4 and 5, indicate that staking is responsible for a significant reduction in the quantity of early fruit set.

Considering only the staked and unstaked treatments in both seasons, it will be observed in figures 1 and 2 that higher yields, regardless of treatment, were obtained during the last three pickings in the first trial which was established on August 1936; while in the second trial which

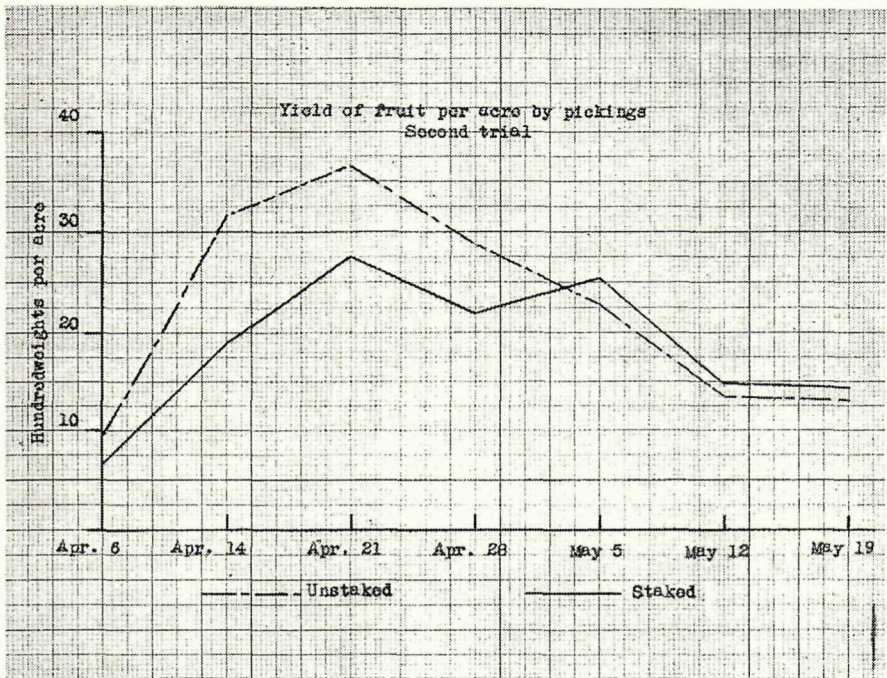


Fig. 2. The effects of staking on total yields and earliness of fruit.

was started on January 1937, the lowest yields were recorded in the last three pickings with the exception of the fifth picking of May 5th in the staked plots. This contrasted trends of yields might be attributed to seasonal effect.

#### DISCUSSION AND SUMMARY

The fact that these trials were established under irrigation by the furrow system must be clearly emphasized. In this way it seems that



the possibilities of increasing the amount of unmarketable fruit in the unstaked plants are greatly favored because a large percentage of the fruit clusters lie in direct contact with the water soaked soil when irrigation is practiced. The main argument offered by vegetable growers who stake and prune their tomatoes is that such cultural methods tend to increase marketable yields because the fruit clusters develop high above the soil, free from dirt. Nevertheless, the two trials conducted at the Isabela Substation show conclusively that pruning and staking tomato plants reduce considerably yields of marketable and total amount of fruit as long as the same number of plants are kept constant in the different practices compared. These results are in accord with the abundant evidence presented by Thompson (7) on these practices with trials he conducted in New York State and with the profuse literature he has reviewed on this subject. In the trials conducted in Australia Strickland (6) concluded that staking and pruning of unstaked plants were of doubtful value, except on limited areas.

However, the apparent conflicting results reported by other workers are due mainly to the use of less space or more plants per acre for the pruning and staking practices as compared to the untreated plots or, probably, to the wide variations in environmental conditions under which the different trials were established. Conflicting results may also follow according to Currence (2) when different varieties of tomatoes are subjected to pruning and training. He found that pruning was beneficial to Break O'Day variety and apparently detrimental to Pritchard. Even assuming that pruning and staking with twice the number of plants per acre as compared to the untreated plants, would produce equal or larger amounts of marketable fruit, the profitableness of such practices is still questionable. The added expenses involved in setting more plants per acre plus the cost of stakes, training and pruning several times during the crop, must be also considered before drawing general conclusions on the advisability of such cultural methods.

Pruning and staking had no favorable effects on the size and earliness of fruit in these two trials. In the second trial staking caused a significant decrease on the quantity of early fruit set when compared with the untreated plots. Earliness is not considered an important factor in Puerto Rico where tomatoes are grown successfully at any time of the year.

Hawthorne (4) has reported in Texas an increase in the amounts of early marketable yields from the first four pickings of pruned unstaked plants. This contrast with our results might be explained by the effect

of differences in climatic conditions. However, he found that when yields of the entire crop were considered, the unpruned plants resulted with the highest yields. Hawthorne also did not find any effect of pruning on size of fruit.

In conclusion, it may be stated that the results of our trials with pruning and staking Marglobe tomato plants plus the cumulative evidence from similar experiments conducted elsewhere, seem to indicate that such cultural methods are not conducive to the highest yields of marketable fruit. Pruning and staking under our climatic conditions have a tendency to decrease total marketable yields while not affecting favorably size, quality nor earliness of fruit.

### SUMARIO EN ESPAÑOL ESTAQUEO Y PODA DE LOS TOMATES

El estaqueo y la poda en los tomates han sido prácticas muy generalizadas entre los agricultores que se dedican a la producción de hortalizas en Puerto Rico. Se cree que con estas prácticas se aumenta la producción y se consigue una proporción más alta de fruta de mejor calidad para la exportación o para el mercado local.

Con el fin de obtener información sobre el particular, se establecieron dos experimentos con tomates bajo regadío en la Subestación Experimental de Isabela en donde se compararon los siguientes tratamientos: (a) testigo sin estaqueo o poda, (b) estaqueo sin poda, (c) poda sin estaqueo y (d) estaqueo con poda. Se utilizó el mismo número de plantas de la variedad "Marglobe" en cada tratamiento y se tomaron las precauciones necesarias para que todos los tratamientos con ocho y nueve repeticiones recibieran atención uniforme.

Los resultados de la primera prueba indicaron que el estaqueo redujo la producción total de fruta comercial en un 20 por ciento aproximadamente y cuando se practicó la poda sin estaqueo, esta reducción llegó a un 40 por ciento comparado con el testigo sin poda ni estaqueo. Además, cuando se estaqueó y se podó, la reducción fué aún mucho mayor ya que la producción total bajó al 50 por ciento aproximadamente comparado con el testigo. En la segunda prueba en que se sometió la poda, se encontró que el estaqueo redujo la producción de fruta comercial en un 22 por ciento. Aunque el estaqueo en ambas pruebas causó un pequeño aumento en la proporción de fruta comercial, esta ventaja aparente quedó compensada por los efectos en la reducción total de fruta producida. En otras palabras, cuando no se estaqueó ni se podó, se produjo una mayor proporción de rezagos o fruta inservible para la venta; pero como la producción total de fruta aumentó grandemente, el total de fruta comercial producida fué entonces mucho mayor que cuando se estaqueó o se podó.

Ni el estaqueo ni la poda tuvieron efectos favorables en cuanto al tamaño de la fruta o la producción de una cosecha temprana se refiere. En términos generales estos resultados coinciden con los obtenidos en numerosas pruebas que se han llevado a cabo en diversas regiones de los Estados Unidos y en Australia. En conclusión puede decirse que nuestras pruebas de estaqueo y la poda en los tomates de la variedad "Marglobe", unida a la evidencia acumulada en pruebas efectuadas en otros sitios, demuestran que estas prácticas son perjudiciales ya que disminuyen la producción comercial del fruto y aumentan considerablemente los gastos de la cosecha.