Effects of Date of Planting and Planting System on Tomato Yield in the Isabela Area[1]

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ABSTRACT

Two tomato cultivars and two experimental lines were included in six bi-monthly trials and two planting systems at the Isabela Experiment Substation on a Coto clay (Typic Haplorthox, clayey, kaolinitic, isohyperthermic) from July 1972 to May 1973. The results of these trials show that date of planting had a significant effect upon yield and number of marketable tomatoes. Highest yields were obtained in January, intermediate in November and March, and lowest in July, September and May. Environmental factors of temperature and rainfall were considered as the main limiting factors for these differences.

The ground planting system outyielded significantly the trellis planting system used in these trials. The Isabela area is close to the coast, very windy throughout the year; thus plant and fruit damage is considerably higher in trellis than in the ground system. Besides, the production costs of the trellis system, on account of the labor-demanding practices, make it economically less competitive than the ground planting system.

The tomato cultivars (Tropic and Tropi-Red) and experimental lines (S-486 and S-488) used in these trials performed similarly throughout all experiments in this study.

INTRODUCTION

Vegetable production in Puerto Rico had a farm value of $11.4 million in 1974-75. Tomatoes registered a farm value of $1.368 million for this same period. However, to satisfy the domestic demand for this vegetable, 71.1% of the total consumption was imported mainly from the United States. There is no doubt as to the potential economic importance of this crop to Puerto Rico. The Experiment Station research program with vegetables is at present geared toward the development of a technological package which includes all aspects of management for maximum production in potential growing areas like Isabela.

Vegetable crops such as tomatoes, are promising material for intensive production practices in northwestern Puerto Rico. Tomatoes have been under study during the last two decades in this area at the Isabela Substation, yet little information is available on the yield response of different cultivars to a range of different seasons of the year and planting systems.

The purpose of these experiments was to determine the best planting seasons and planting system for the Isabela area, in order to obtain the most profitable yields of marketable tomatoes.

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MATERIALS AND METHODS

In 1972 and 1974, cultivars Tropic and Tropi-Red and experimental lines S-486 and S-488 were grown in two different planting systems and six different planting dates on a Coto clay (Typic Haplorthox, clayey, kaolinitic, isohyperthermic) on the Isabela Experiment Substation. Variables were arranged in four replications of a split-plot design with planting systems as main plots and planting dates as subplots.

The two planting systems tested were (a) ground, and (b) trellis. Seeds were sown directly on the field and diphenamide was applied as a pre-emergent herbicide at the rate of 13.34 kg/ha immediately after planting. For the trellis system, a heavy wire was strung over the row between anchor posts placed at the ends of the row. Between anchor posts the wire was supported by posts at a height of 1.37 m to 1.52 m above the top of the bed. A strong bending twine was tied loosely in a non-slip knot at the base of each plant. The twine was then spiraled loosely around the main stem and tied to the overhead wire. This process is repeated as the plant grows, continuing the spiral upwards. In this way the plant is supported in an upright position. Fertilizer 10-10-8 at the rate of 2242 kg/ha was banded in two applications; the first when plants were 4 weeks old, and the second at flowering.

The planting date treatments consisted of six bi-monthly plantings starting from July 1972 and ending in May 1973. Each sub-plot consisted of two rows 15.2 m long. The spacing was 1.37 m between rows and 84 cm between plants. Spacing between plants was established by seeding heavily and then thinning to the desired spacing within the row when seedlings were 45 cm tall. Fruits were harvested weekly throughout the season. Insecticide (diazinon) and fungicides (Dithane 14-45, Daconyl and Kocide) were applied.

RESULTS

Table 1 shows the analyses of variance for yield of marketable tomatoes and number of fruits combined across planting dates. Means for the planting systems, date of planting and varieties are presented in table 2.

Planting date effects were highly significant for yield (table 1), indicating that the varieties did not perform consistently across the six dates of planting (fig. 2). Since the interaction of planting dates × planting systems was relatively small and the interaction of planting date × varieties in planting systems was also small, the significant planting date effect was associated with more favorable weather during the winter (January, table 2) rather than with changes in the relative performance of treatments across planting dates. Tomatoes respond in fruit yield to lower temperature and low rainfall during flowering and fruiting. Planting date effects for number of marketable fruits were also highly significant and the

interactions with planting date also showed significance. These differences are most probably due to the fact that cultivars Tropic and Tropi-Red produced bigger fruits than experimental lines S-486 and S-488, as shown in table 2.

The effects of planting system differed significantly for yield and number of marketable fruits, and the difference could be attributed to a better performance by the ground planting system. Averaged across cultivars, yield and number of marketable fruits were maximized when plants were grown in the ground planting system. This planting system performed consistently better during the six planting dates as shown in table 2 and figure 1.

Cultivars within planting systems performed consistently over planting dates in yield. Differences were non-significant over all planting systems

TABLE 1.—*Analyses of variance for yield (mt/ha), and number of marketable fruits for combined 6-month planting data*

Source of variation	D.F.	Yield	Number of fruits
Planting dates (P.D.)	5	125639.34**[1]	125066.34**
Planting system (P.S.)	1	73339.27**	1142992.69**
P.D. × P.S.	5	15725.87*[2]	79291.41*
Replications (R.) in P.D.	18	42929.58**	352039.14**
R. in P.D. × P.S.	18	1769.57	28059.34
Varieties in P.S.	6	1583.90	679913.87**
Varieties in ground	3	1683.17	1031971.58**
Varieties in trellis	3	1484.64	321189.48**
P.D. × Var. in P.S.	30	4906.08	68402.15**
P.D. in ground	15	7542.05	88084.29**
P.D. in trellis	15	2270.12	48720.01
R. in P.D. × Var. in P.S.	108	5399.98	32533.31

[1] Significant at the 1-% level.
[2] Significant at the 5-% level.

and within each date of planting. The mean yield for Tropic, Tropi-Red, S-486 and S-488 was 18.7, 18.1, 18.9 and 18.3 mt/ha over planting dates and planting systems, respectively, (table 2). However, the planting date × cultivars in planting system was highly significant for number of marketable fruits in the ground system of planting. This difference is mostly due to the larger number but smaller size of fruits as a result of this planting system. The average number of fruits for the ground system was 180,228, and for the trellis, 138,550.

DISCUSSION

The data presented herein show that date of planting had a significant effect upon yield and number of marketable fruits in tomatoes. Highest yields were obtained in January, intermediate in November and March,

TABLE 2.—*Mean values for yield and number of marketable tomatoes obtained for two planting systems at six planting dates at the Isabela area*

	Tomato cultivars and experimental lines				
	Tropic	Tropi-Red	S-486	S-488	Average
	Mean yield in mt/ha				
July					
G	9.5	12.0	15.8	16.7	13.5
T	10.6	12.4	13.9	11.9	12.2
September					
G	22.5	18.1	10.9	12.8	16.1
T	16.2	11.7	8.5	7.9	11.1
November					
G	26.5	25.0	20.0	22.8	23.6
T	20.2	18.9	12.2	16.1	16.8
January					
G	35.5	33.4	35.0	33.3	34.3
T	28.4	23.7	28.6	27.6	27.1
March					
G	15.6	22.3	27.3	19.0	21.1
T	21.3	18.9	23.1	21.4	21.2
May					
G	8.6	10.7	21.1	18.9	14.8
T	9.7	10.0	11.2	11.0	10.5
Average	18.7	18.1	18.9	18.3	
	Mean number marketable fruits in thousands fruits/ha				
July					
G	82	102	180	189	138
T	86	91	155	115	112
September					
G	147	133	128	148	139
T	112	90	102	91	99
November					
G	177	180	211	226	199
T	142	140	134	164	145
January					
G	202	228	326	298	225
T	165	155	273	247	210
March					
G	140	148	285	253	206
T	190	152	270	239	146
May					
G	83	102	270	232	171
T	100	91	147	133	118
Average					
G	138	148	233	224	
T	132	119	179	164	

and lowest in July, September and May. Climatological data during the last 40 years in the Isabela area show that the average rainfall precipitation and day and night temperatures are lowest during December, January and February (table 3).

These environmental factors are favorable for tomato production. The weed, disease and pest problems are minimized during these months. On the other hand, yield is significantly reduced during the hot humid months of May and July, when weeds, insects, and diseases are more abundant. Besides, high night temperatures have an adverse effect on tomato fruit setting.

The ground planting system outyielded significantly the trellis system. Even though in some tomato growing areas in the States the trellis system offers economic advantages because premium prices are obtained for trellis tomatoes, we think that the trellis system is not desirable for

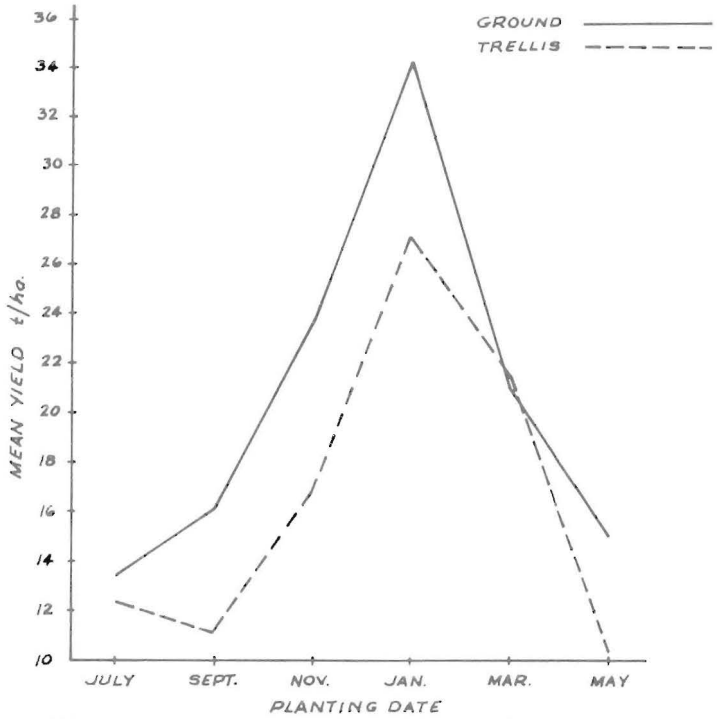

FIG. 1.—Effect of planting date and planting system on the mean yield of four tomato cultivars.

the Isabela area. This is a windy coastal area, and a lot of wind damage is done to the plant and the fruit. In addition, this system requires a lot of labor-demanding practices and other high level operations that considerably increase production costs; therefore, the net returns are significantly lower than with the ground system.

The commercial cultivars Tropic and Tropi-Red and experimental lines S-486 and S-488 performed similarly, as an average, over all experiments conducted in this study. The latter two produced larger numbers of fruits but smaller tomatoes than those of Tropic and Tropi-Red.

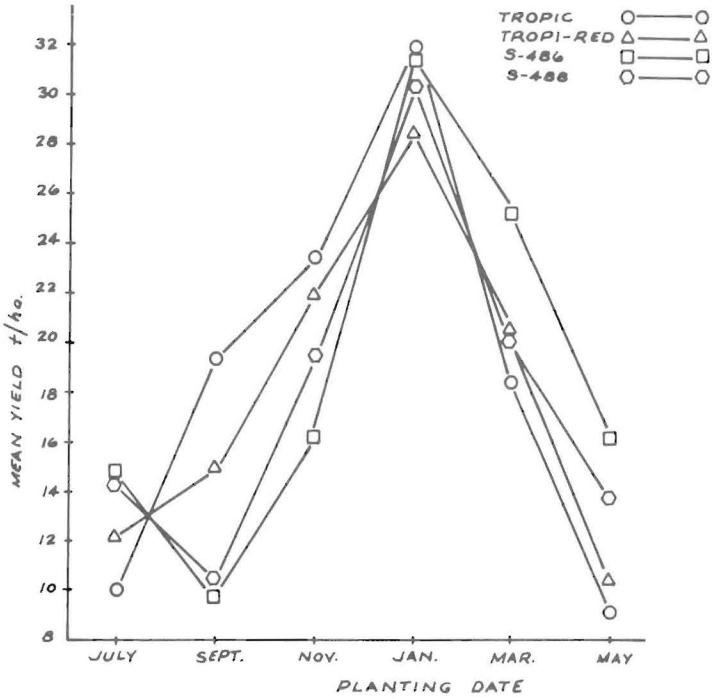

FIG. 2.—Effect of planting date on the mean yield of tomato cultivars Tropic and Tropi-Red and experimental lines S-486 and S-488.

TABLE 3.—*Mean rainfall, minimum and maximum temperatures from December to March at the Isabela Substation. Averages of 45-year data.*

	Dec.	Jan.	Feb.	Mar.
Rain, mm	120.4	8.69	80.0	86.0
Maximum	28.3 C	27.8 C	27.8 C	28.3 C
Minimum	20.0 C	18.3 C	17.8 C	18.3 C
Mean	24.4 C	23.3 C	22.8 C	23.3 C

RESUMEN

En este trabajo se presentan los resultados de seis experimentos en los que se estudió el efecto de época y método de siembra en los cultivares de tomate Tropic y Tropi-Red y las líneas experimentales S-486 y S-488, sembrados en la Subestación de Isabela en una arcilla Coto, un Oxisol, de julio de 1972 a mayo de 1973. En este período se hicieron seis siembras bimestrales y se sembraron siguiendo dos sistemas de siembra: directa en el campo y emparrado.

Los resultados revelaron que la época de siembra tuvo un efecto significativo en la producción y número total de tomates comerciales. La producción mayor se obtuvo en enero, la intermedia en noviembre y marzo y la más baja en mayo, julio y septiembre. Los efectos ambientales de lluvia y temperatura fueron los factores limitativos en los meses de baja producción.

El método de siembra directa en el campo superó significativamente al de emparrado en la producción de tomates en el área de Isabela. Se atribuyen estos resultados al hecho de que el campo experimental está localizado cerca de la costa y durante la mayor parte del año las corrientes de aire causan un mayor daño a las frutas y las plantas cuando se emparra. Además, los costos de producción aumentan considerablemente cuando se utiliza el segundo sistema.