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Effect of Plant Spacing and Fertilizer Levels on Yield and Dry Bulb Weight of Onion cv. Texas Grano 502[1]

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ABSTRACT

The effect of five different row spacings (90, 60, 45, 38 and 30 cm) and two fertilizer levels (111 and 222 kg/ha) each of N, P_2O_5 and K_2O, on yield, dry bulb weight, and diameter of onion cultivar Texas Grano 502, were evaluated in a San Antón loam (Cumulic Haplustolls), fine-loamy, mixed, isohyperthermic on the sourthern irrigated coastal plain of Puerto Rico, and in a Fraternidad soil (Udic Chromusterts), very fine, montmorillonitic, isohyperthermic in the southwestern part of the island. The fertilizer was side-dressed in one application immediately after planting. Main results were as follows: At Fortuna yields from the 30 cm spacing were statistically superior to those from all other treatments, except those of the 60 cm spacing; the lower fertilizer level produced significantly higher yields than the higher level.

At Lajas there were no significant differences among the yields of the various treatments; 90 cm between rows seems to be the most practical planting distance. Some mechanical weeding could be possible at this spacing. There were no significant differences between the two fertilizer levels; thus the lower level could reduce fertilizer costs. There were no differences in either bulb weight or size due to plant density.

INTRODUCTION

Onions have been planted in Puerto Rico on a very low scale for many years, mainly in small, marginal plots not suitable for mechanization. The total onion production was 46.5 metric tons from 1960 through 1967 in Puerto Rico (4).

Onion annual per capita consumption in Puerto Rico increased from 3.87 kg in 1950–51 to 6.12 kg in 1972–73 (3). With a 3.2 million population in the island, the apparent total consumption for 1972–73 was 19,428 metric tons.

During 1973–74 Puerto Rico imported more than 11,000 metric tons of onions from the United States and 35 metric tons from the Dominican Republic. The net value of imports was approximately $2.4 million (2).

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The climatic conditions prevailing in the island from November through March seem to be suitable for the production of quality onions.

There is much controversy regarding the application of fertilizers. Davis (1) favors the splitting of the fertilizer in light soils; but he states that all the fertilizer should be placed in one application 10 cm under and 8 cm to the side of the seed in heavy soils.

Lower yields with each N increment at low levels of irrigation have been reported by Riekels (8), although maturity has not been affected. The decrease in yields was originally attributed to ammonium toxicity; but it was suggested that high salt concentrations could have harmed the plants. With plenty of rain, yields increased linearly with each N increment, and 267 kg/ha were needed for normal growth and maturity. The scarce rainfall in southern and southwestern Puerto Rico can probably affect yields, mainly due to high salt concentrations in some soils.

The objectives of this research were to provide information about plant density and fertilizer level appropriate for the commercial production of onions under the conditions of southern and southwestern Puerto Rico.

MATERIALS AND METHODS

One experiment was established in a San Antón soil, Cumulic Haplustolls, fine-loamy, mixed, isohyperthermic (6) at the Fortuna Substation in southern Puerto Rico November 15, 1976.

The maximum mean temperature during the experimental cycle was 30.5 and the minimum mean was 20°C. Rainfall was 45 mm; it was supplemented with 356 mm sprinkle irrigation.

Pelleted seed of the Texas Grano 502 cultivar was hand sown 8 cm apart within the row in plots 6 × 10 m. Each plot had three beds 2 m wide, from which the center one was harvested to obtain the experimental data.

At Lajas, a second experiment was established in a Fraternidad soil (Udic Chromusterts, very fine, montmorillonitic, isohyperthermic); onion plants from a seedbed prepared November 15, 1977, were planted in the field December 29, 1977. The maximum mean temperature during the experimental cycle was 29°C and the minimum mean was 17°C. Rainfall was 181 mm; it was supplemented with 250 mm sprinkle and furrow irrigation.

A split plot design with five replications was used at both locations. The treatments for both locations were 2, 3, 4, 5 and 6 rows per bed, 90, 60, 45, 38 and 30 cm between rows, with two fertilizer levels: 111 and 222 kg/ha each of N, P_2O_5 and K_2O. The fertilizer was sidedressed in one application immediately after planting. Plot size and within row distance were the same as in Fortuna.

Dacthal W-75[3] was applied immediately after planting at the rate of 8.9 kg/ha as a preemergent herbicide. One hoe cultivation was necessary before applying Tok E-25 (Nitrofen) at the rate of 4.5 kg/ha as a post-emergent herbicide.

A preventive weekly spraying program applied 1168 ml/ha of Diazinon AG500 and 2.2 kg/ha of Dithane M-45 to control insects and diseases.

Onions were harvested on March 15, 1977, at Fortuna and on March 20, 1978, at Lajas and their fresh weights taken. After being cured for 10 days onions were weighed again. A sample of 25 dry bulbs per plot was collected to measure bulb diameter.

RESULTS AND DISCUSSIONS

Table 1 shows the marketable yields obtained from the various plant densities and fertilizer levels at both locations. Yield at Fortuna, from the

TABLE 1.—*Marketable yields, in kg/ha, of onion plantings cv. Texas Grano 502 under two fertilizer levels at Fortuna and Lajas Substations. November, 1976–77*

Treatment	Between row spacing	N, P_2O_5 and K_2O levels			
		100-100-100		200-200-200	
		Fortuna	Lajas	Fortuna	Lajas
Rows/bed	cm	*Kg/ha*	*Kg/ha*	*Kg/ha*	*Kg/ha*
2	90	21,304b[1]	21,972a	16,480c	23,093a
3	60	24,882a	19,505a	21,981c	20,402a
4	45	19,461b	15,918a	17,536c	21,075a
5	38	21,927b	20,402a	17,455c	20,851a
6	30	27,890a	23,093a	22,388c	25,783a

[1] Values in columns for the same locality, followed by the same letter do not differ significantly at the 5% level for spacings; and in the row for the same locality do not differ significantly at the 5% level for fertilizer levels.

30 cm distance, was statistically higher than from the 38, 45 and 90 cm spacings (358,644; 286,915 and 143,458 plants/ha, respectively), but not higher than the 60 cm spacing (215,186 plants/ha). At Lajas, there were no significant differences in marketable yields due to increases in plant density.

Figures 1 and 2 present the relation among yields, plant density and fertilizer rates. As shown in figure 1, significantly higher onion yields were obtained when the bulbs were grown at the 100-100-100 N, P, K fertilizer level. Yields were highest at the 30 cm spacing, declining drastically at

[3] Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

the 38 cm spacing and then reaching another peak at the 75 cm spacing. Figure 2 shows the same tendency, but yields were greatly reduced at all row spacings.

The results at Fortuna are similar to those obtained by other investigators (1,5,7,9), who reported that 30 cm between rows was the best planting distance for onions. This was not the case in Lajas, however,

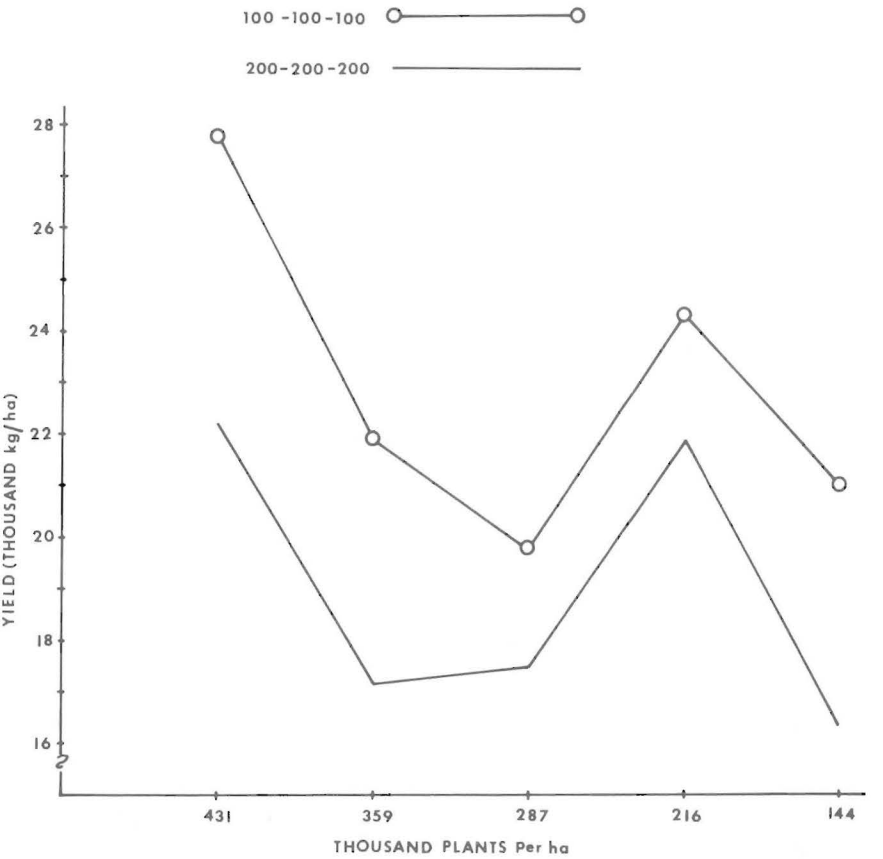

FIG. 1.—Marketable yield of onion variety Texas Grano 502 under two fertilizer levels at Fortuna.

where yields from the 90 cm spacing were excellent, but not showing significant differences when compared to those at 30 cm.

High yields obtained in this trial compare favorably with the mean average production of 35,000 kg/ha in the United States and are by far superior to the mean world onion yield of 11,136 kg/ha reported by the FAO for 1974.

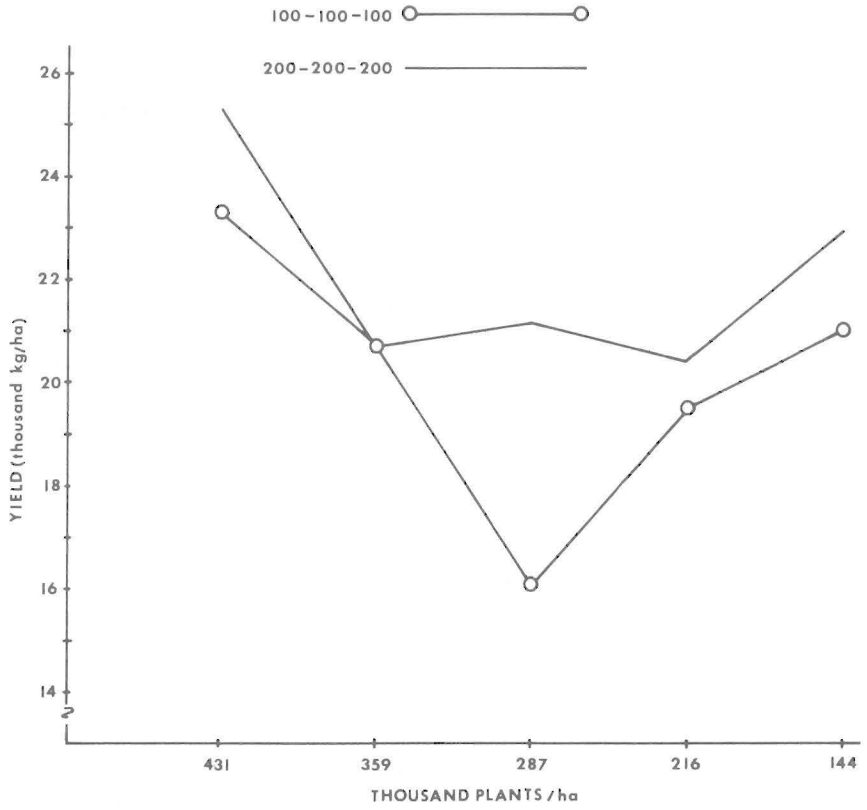

FIG. 2.—Marketable yield of onion variety Texas Grano 502 under two fertilizer levels at Lajas.

Weed competition for soil moisture, nutrients, and light reduces onion yields (10). Therefore, effective pre- and post-emergent herbicides should produce higher yields. Also, at closer spacings, weeds are effectively smothered by the onion crop.

Plant density variation affected neither dry bulb weight nor size.

RESUMEN

Una siembra de cebollas de la variedad Texas Grano 502 se estableció en la Subestación de Fortuna, en el sur de Puerto Rico, el 15 de noviembre de 1976 y otra el 29 de diciembre de 1977 en la Subestación de Lajas (suroeste de Puerto Rico).

Las distancias de siembra fueron 90, 60, 45, 38 y 30 cm entre hileras. Se aplicaron dos niveles de abono (111 y 222 kg/ha) de N, P_2O_5 y K_2O, respectivamente.

Los efectos de densidad de siembra y de los dos niveles de los tres nutrimentos sobre el rendimiento y el tamaño del bulbo fueron los siguientes:

En Fortuna, a 30 cm entre hileras los rendimientos fueron significativamente superiores a los de todos los demás tratamientos, excepto al de 60 cm. La distancia de 60 cm entre hileras parece ser la más recomendable, ya que require sólo la mitad de la semilla que se usaría a 30 cm. Además, requiere menos mano de obra y permite alguna mecanización del cultivo, lo cual es casi imposible en las siembras más densas. Los rendimientos obtenidos con 111 kg/ha de N, P_2O_5 y K_2O fueron significativamente superiores a los del nivel de 222. No hubo diferencia significativas en el peso de los bulbos que se puedan atribuir a la densidad de siembra.

En Lajas no hubo diferencias entre los rendimientos de los distintos espaciamientos. La mejor distancia entre hileras parece ser 90 cm. No hubo diferencia entre los dos niveles de abono ni entre el peso y el tamaño de los bulbos con relación a la densidad de siembra.

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