

Effect of Planting Distance on Yield and Agronomic Characteristics of Red Kidney and Native White Beans in an Oxisol^{1, 2}

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ABSTRACT

The effect of planting distance on yield and yield components of two field bean varieties (27R, a red kidney bean imported from Trinidad, and Bonita, a selected native white bean) were evaluated in a Coto clay, a Tropeptic Haplothox. Planting distances included 30, 45, and 60 cm between rows. Mean yield differences between varieties and between planting distances were not significant. However, a field-wide average of around 2200 kg/ha was obtained, a satisfactory yield under prevailing conditions. Plant and pod weight did not differ between varieties, but with the 60 cm distance between rows they were heavier than with 30 cm and 45 cm. Bonita produced more pods than 27R; the lower number occurred with the 30 cm distance. Bonita produced an average of 5.5 seeds/pod; 27R, only 3.8. Both varieties appeared to be free of insect or disease damage.

INTRODUCTION

Dry beans offer vast possibilities in the humid and subhumid tropics as an important source of dietary protein. Both the native white bean and the red kidney bean types are favorites in the Puerto Rican diet. They are consumed daily, often twice a day, together with rice. Little is known, however, about their cultivation requirements in tropical environments. In a previous paper, Lugo-López et al. (5) reported on the response of native white beans to N fertilizers. This and the previously mentioned study on N fertilization were conducted as part of an overall project to develop a technological package of practices for dry bean production in the deep, well drained, acid, relatively infertile soils of the tropics. Previous experience with other legume crops under Puerto Rico conditions has pointed to the importance of increased plant populations, which under adequate levels of management can lead to increased yields (7).

This paper reports on an experiment conducted to evaluate the effect

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of planting distance on yields and yield components of two field bean types.

MATERIALS AND METHODS

An experiment was conducted at the Isabela Substation farm on a Coto soil, a Tropeptic Haplorthox, clayey, kaolinitic, isohyperthermic (4), with pH 5.0; CEC, 13 meq, and Ca saturation, 25%. It is high in Mn and low in available P. Mean annual rainfall is about 1658 mm. Evaporation from a Class A pan is approximately 6 mm/day during the summer and 4 mm/day during the winter. The mean annual maximum temperature is 29.4° C while the mean minimum temperature is 18.9° C. Solar radiation ranges from an average of 300 langley's/day in the winter to 600 in the summer. The elevation is about 122 m above sea level.

The experiment followed a split-plot design with six replications. Planting distances of main plots were 30, 45, and 60 cm between rows. The corresponding plant populations were 444,000, 296,000, and 222,000 plants/ha. Subplots were planted with two field bean varieties: 27R, a red kidney type, originally from Turrialba, Costa Rica, introduced to Puerto Rico from seedstock from Trinidad; and Bonita, a selection of a native white bean (3,6). Plots were 3.65 m × 1.52 m. Weeds were controlled with a preemergent application of Dacthal⁴ at the rate of 13.5 kg/ha. The whole field received a blanket application of 1121 kg/ha of a 10-10-8 fertilizer prior to planting. Seeds were sown on November 26, 1975. The crop of 27R was harvested on February 9, 1976, at 75 days of age, and that of native white beans was harvested 8 days later.

Data were taken on dry bean yields, number of seeds/10 pods, weight of 10 plants, and number and weight of pods/10 plants. All data were statistically analyzed.

RESULTS AND DISCUSSION

Table 1 gives data on yield and other agronomic characteristics for the white and red kidney beans at the three planting distances. There were no significant differences in mean yields between varieties and between the three planting distances. Both produced around 2200 kg/ha, irrespective of planting distance. These are good yields for 27R and compare very well with the highest yields (total) i.e., 1100 kg/ha reported under the conditions prevailing at Trinidad (2). For Bonita, these yields are excellent (3). In 1944, González-Ríos and Riollano (3)

⁴ Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade names does not constitute a guarantee or warranty of materials by the Agricultural Experiment Station of the University of Puerto Rico or an endorsement over materials not mentioned.

compared the performance of native white beans at 30 cm vs. 60 cm between rows. Plants within the row were spaced at 15 cm. Yield increases between 15 and 45% were obtained in the closer planting distances.

Beans appear to respond to length of day (3). Evidently the relatively short, cool, and dry days of the winter season at Isabela favored growth, flowering, pod development, and seed production in both types of beans.

TABLE 1. —Yield and other agronomic characteristics of red kidney and native white beans grown on an *Oxisol*

Variety	Values for indicated parameter at indicated planting distance ¹			
	30 cm	45 cm	60 cm	Mean
	<i>Yields, kg/ha</i>			
27R	2224	2188	2136	2183
Bonita	2316	2306	2181	2268
Mean	2270	2247	2158	2225
	<i>Seed/10 pods, no.</i>			
27R	37 a ²	39 a	38 a	38 a
Bonita	56 b	53 b	57 b	55 b
Mean	46	46	48	47
	<i>Weight of 10 plants, g</i>			
27R	165	213	270	216
Bonita	154	174	275	201
Mean	159 b	193 b	272 a	208
	<i>Weight of pods/10 plants, g</i>			
27R	119	146	188	148
Bonita	103	130	210	151
Mean	111 b	138 b	199 a	149
	<i>Pods/10 plants, no.</i>			
27R	49 d	56 c	64 b	56 a
Bonita	88 c	115 b	140 a	114 b
Mean	68	85	102	83

¹ Only sets of values where there are significant differences are lettered.

² Values in columns, and rows followed by the same letter do not differ significantly at the 5% level according to Duncan's multiple range test. Lettered values are compared vertically for varieties and horizontally for mean planting distances.

The varieties did not differ significantly as to the weight of 10 plants and pod weight, but in both cases pod and plant weight at 60 cm were heavier than those at either 45 or 30 cm. Mean differences were highly significant.

Bonita produced significantly more pods than 27R. The lower number of pods occurred at the 30 cm planting. Again, Bonita was by far

superior to 27R as to the number of beans/pod (55 vs. 38), the differences being highly significant. Planting distance did not affect this relationship.

In a previous study, Bastidas-Ramos and Camacho (1), obtained better yields at plant population levels of 220,000/ha as compared to 110,000, 126,000, and 700,000. They maintain that this level of competition allows plants to make a more efficient use of such inputs as soil moisture, fertility, and light. In these studies, increasing the level of competition between plants led to increased plant height, but yields/plant and pods/plant decreased.

In general, while plants and pods were heavier and pods more numerous with increasing distances between rows, yields of dry beans of both cultivars remained unaffected. Planting closer is more expensive since more seed is required. However, this reduction in cost may be offset by the more frequent weeding needed as spacing between rows is increased.

RESUMEN

Dos variedades de habichuelas (27R, colorada tipo diablo, importada de Trinidad y Bonita, una selección nativa de tipo blanco) se compararon en cuanto a rendimientos y sus componentes. Se sembraron a tres distancias entre hileras: 30, 45 y 60 cm. La 27R se cosechó a los 75 días y la Bonita, 8 días más tarde. No se registraron diferencias significativas entre variedades ni entre distancias entre hileras. Sin embargo, se obtuvo un rendimiento de alrededor de 2200 kg./ha., rendimiento que se considera satisfactorio dentro de las condiciones en que se realizó el experimento y para los Oxisols, que son suelos profundos, de buen desagüe, ácidos y relativamente infértiles. No hubo diferencias significativas en el peso de las plantas y de las vainas que puedan atribuirse a las variedades, pero sembradas a 60 cm ambas eran más pesadas que a 30 y a 45 cm. Bonita produjo 5.5 semillas/vaina; 27R, sólo 3.8. Ambas variedades parecen ser resistentes a enfermedades e insectos que prevalecen en el invierno en Isabela.

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