

# A Comparison of Yields of Common Beans at Physiological and Harvest Maturity<sup>1</sup>

*J. Badillo-Feliciano, I. Reyes-Soto and J. S. Beaver<sup>2</sup>*

## ABSTRACT

Two harvesting stages of two bean cultivars—Bonita (white) and Naranjito (striped)—were evaluated in a Coto soil (Tropeptic Haplorthox, clayey, kaolinic, isohyperthermic) in northwestern Puerto Rico, and in a San Antón soil (Cumulic Haplustolls; fine, loamy, mixed, isohyperthermic) in a semiarid southern plain of Puerto Rico. Both cultivars were harvested when physiologically mature and when dry. Cv. Bonita yield was higher in the two localities because of more pods per plant and more seeds per pod. Yield of physiologically mature beans was 70% higher than when dry. When unhulled beans are sold, the yield is about 75% over that of dry beans.

## INTRODUCTION

Common beans (*Phaseolus vulgaris* L.) are an important food crop in the Tropics. In many Latin American countries including Puerto Rico, beans are a staple in the diet providing consumers with a cheap source of protein. Puerto Ricans utilize beans in a particularly unique fashion. Pods are harvested at physiological maturity and shelled. The green shelled beans are then cooked with rice. Although a limited amount of research has been conducted in Puerto Rico to measure the performance of dry beans (1, 5, 6), research dealing with beans harvested at physiological maturity is almost nonexistent.

During 1979–1980, approximately 270 metric tons of physiologically mature beans were marketed locally for a retail value of almost \$250,000 (4). Nevertheless, demand for the green shelled beans remains greater than the current level of production.

The harvesting of beans at physiological maturity has several advantages. First, the growing season of beans harvested at physiological maturity is at least 15 days shorter than beans harvested at harvest maturity. As a result, the risk of crop loss due to unfavorable weather is reduced. Harvesting beans at physiological maturity also avoids losses due to late season diseases and reduces the incidence of weeds in subsequent crops since the field is ready for harrowing before many weed species are able to produce viable seed. In addition, this method might have a greater margin of profit than dry beans because the market value of unshelled pods is almost twice the value of dry beans. Beans harvested

<sup>1</sup> Manuscript submitted to Editorial Board October 18, 1983.

<sup>2</sup> Agronomist, Assistant Horticulturist, and Assistant Plant Breeder, respectively. Agricultural Experiment Station, University of Puerto Rico, Río Piedras, Puerto Rico. The authors thank Dr. Miguel A. Lugo-López for valuable suggestions during the preparation of the manuscript and Mr. Juan Vega for help in preparing the graphs.

at physiological maturity seem well suited for the small farmer who could manage intensively several crops per year. The principal disadvantage of beans harvested at physiological maturity is that they must be marketed within a few days after harvest. The objective of this research was to compare the yields of two common bean genotypes when harvested at physiological and harvest maturity. Data from this research should be useful in determining the viability of this practice under local conditions.

#### MATERIALS AND METHODS

Experiments were conducted at two locations: the Isabela Research and Development Center in a Coto soil, Tropeptic Haplorthox, clayey, kaolinitic, isohyperthermic, in northwestern Puerto Rico and the Fortuna Research and Development Center in a San Antón soil, Cumulic Haplustolls, fine, loamy, mixed, isohyperthermic, in the southern coast of the island (6).

A split plot arrangement of a randomized complete block design was utilized. Cultivars "Bonita" and "Naranjito" were the main plots and two harvest treatments were the subplots. One subplot treatment was harvested at physiological maturity and the other subplot treatment was harvested at harvest maturity. Treatments were replicated four times. The plots consisted of four rows spaced 60 cm apart and 4 m long. Seeds were sown approximately 5 cm apart within the row. The crops received a 10-10-10 granular fertilizer at a rate of 1,121 kg/ha at planting time. Dacthal 75W<sup>3</sup> was applied as a preemergent herbicide at the rate of 11.86 kg of commercial product per ha. Irrigation was used as needed. Insects and diseases were controlled through a preventive spraying program every other week using a mixture of Diazinon AG500 and Dithane M-45 at rates of 1168 ml/ha and 2.25 kg/ha of commercial product, respectively. The physiologically mature plants were harvested when yellow stripes began to appear on the pods. The harvest maturity plots were harvested when the plants had dried completely in the field. A 10-plant sample per plot was taken at the physiologically mature state. Pods were counted and shelled. Number of seeds per pod was also recorded. A 100 seed sample was taken at both harvests. One of the objectives of this research was to compare yields of the two harvest periods at the stage at which beans are sold in the market. Bean yield at physiological maturity was recorded as wet weight, and yield at harvest maturity was recorded when the beans had dried to less than 15% moisture. The experiments were

<sup>3</sup> Trade names are used in this publication solely for the purpose of providing specific information. However, it does not constitute a guarantee or warranty of materials by the Agricultural Experiment Station of the University of Puerto Rico or an endorsement over other equipment or materials not mentioned.

planted in December during two consecutive years (1979–1980 and 1980–1981). A combined analysis of variance over years and locations was performed. Means were compared using a protected L.S.D. at a 0.05% level of probability (2).

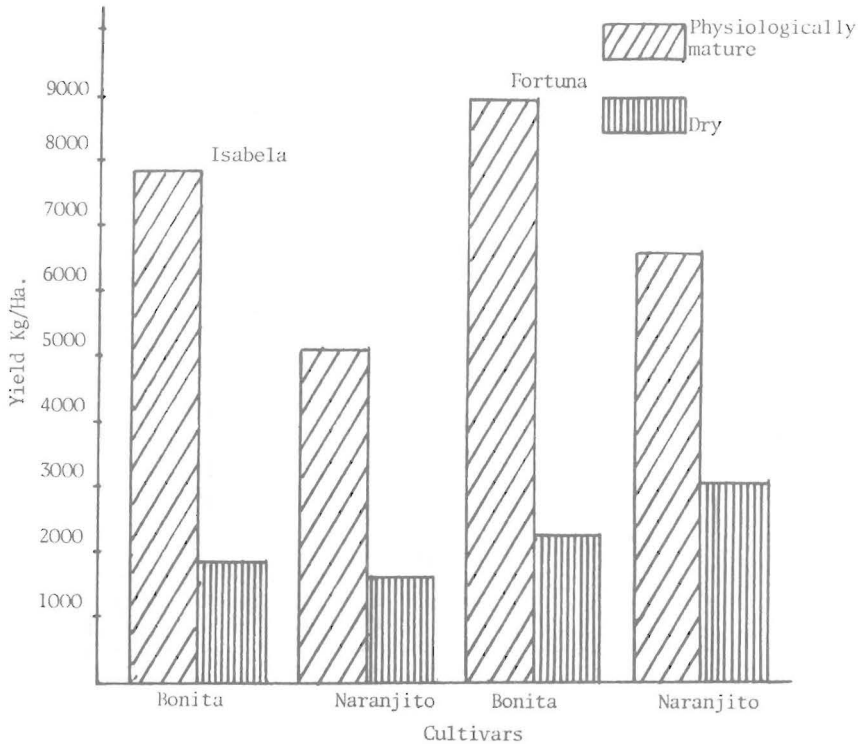


FIG. 1.—Yields at physiological and harvest maturity of bean cultivars Bonita and Naranjito grown at Isabela and Fortuna during the 1979–1980 growing season.

### RESULTS AND DISCUSSION

Yields of bean cultivars harvested at physiological maturity at Isabela during 1979–1980 were 77 and 69% higher, respectively than dry bean yields (fig. 1). At Fortuna, yields of Bonita and Naranjito harvested at physiological maturity were 75 and 53% higher, respectively than at harvest maturity. During 1970–1980 yields at physiological maturity were higher at Fortuna than at Isabela (1356 kg/ha versus 1146 kg/ha). A similar trend was observed for yields at harvest maturity.

Yields at physiological maturity of Bonita and Naranjito during the 1980–1981 growing season were 75 and 76% greater, respectively than at harvest maturity (fig. 2). At Fortuna, yields of Bonita and Naranjito

harvested at physiological maturity were 72% greater than yields at harvest maturity. On the other hand, 1980–1981 yields at physiological maturity were greater at Isabela than at Fortuna. A similar trend also was observed for yields at harvest maturity.

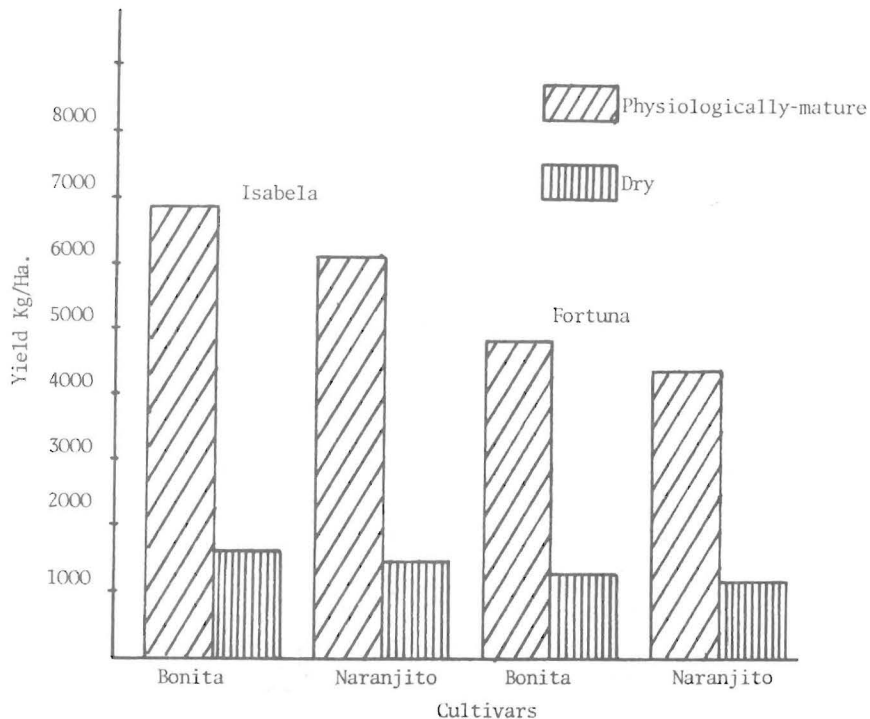


FIG. 2.—Yields at physiological and harvest maturity of bean cultivars Bonita and Naranjito grown at Isabela and Fortuna during the 1980–1981 growing season.

In general, Bonita yielded more than Naranjito. Bonita produced an average yield of 1740 kg/ha of dry seed which is considered good under local conditions. This yield average is greater than those obtained by Lugo-López et al. (6), González Ríos et al. (5), and Del Valle et al. (3). However, it is less than the yields reported by Badillo-Feliciano et al. (1). The dry bean yields of Naranjito are similar to those reported in previous research.<sup>4</sup>

Yields during the 1979–1980 growing season were higher than in 1980–1981 (fig. 1 and 2). Average seed yields at Isabela were similar in 1979–1980 and 1980–1981. On the other hand, yields at Fortuna were significantly lower in 1980–1981 when compared with 1979–1980 yields. The

<sup>4</sup> Badillo-Feliciano, J. Unpublished data, 1981.

similarity of yield levels at Isabela and Fortuna demonstrates that beans can be successfully grown on either the northern or the southern coast of Puerto Rico.

Number of pods per plant was greater for both cultivars during 1979–1980 than the 1980–1981 growing season (table 1). The Naranjito 100-seed sample weighed more than the Bonita sample at physiological maturity. On the other hand, Bonita produced more pods per plant and more seeds per pod than Naranjito.

TABLE 1.—Yield components of bean cultivars Bonita and Naranjito planted at Isabela and Fortuna during the 1979–1980 and 1980–1981 growing seasons

Cultivar	Weight of 100 seeds		Shelled		Pods/ plant	Seeds/ pod
	Physio- logically mature	Dry	Seeds	Hulls		
	g		%			
			1979–80			
			<i>Isabela</i>			
Bonita	43.84a	19.39a	52.25a	44.75a	17.9a	5.86a <sup>1</sup>
Naranjito	63.85b	31.27b	40.00b	60.00b	7.1b	4.02b
			<i>Fortuna</i>			
Bonita	28.16a	18.26a	47.1a	52.9a	24.9a	6.20a
Naranjito	42.94b	26.15b	44.1a	55.9a	22.2b	4.70b
			1980–81			
			<i>Isabela</i>			
Bonita	35.31a	14.12a	54.50a	45.50a	10.8a	5.85a
Naranjito	59.98b	25.88b	47.50b	52.50b	11.3a	4.00b
			<i>Fortuna</i>			
Bonita	35.85a	15.12a	51.02a	48.98a	6.8a	6.18a
Naranjito	49.19b	22.56b	54.45a	45.55	7.2a	4.63b

<sup>1</sup> Values in columns followed by letters in common do not differ significantly at the 5% probability level.

Beans marketed at physiological maturity are sold as whole green pods. Hulls accounted for approximately 45% and green shelled seed accounted for the remaining 55% of the whole green pod weight.

Results of this research indicate that common beans harvested at physiological maturity produce marketable yields that are between 50 to 70% higher than yields at harvest maturity. Moreover, the advantage is greater when one considers that beans at physiological maturity are sold unshelled and at least at 50% moisture. On a per unit dry matter basis the market value of beans harvested at physiological maturity is at least 2.5 times greater than beans harvested at harvest maturity. Production of beans to be harvested at physiological maturity seems to be a viable option for farmers in Puerto Rico when one considers the greater poten-

tial yields, the favorable market prices, and the lower risks involved in producing the crop. Additional research is needed to identify productive bean genotypes that are well adapted for harvesting at physiological maturity. Studies related to the most appropriate harvest stage also are needed.

#### RESUMEN

En este trabajo se informan los resultados de experimentos de campo efectuados en el Centro de Investigación y Desarrollo de Isabela, en un suelo Coto, y en el Centro de Investigación y Desarrollo de Fortuna, en uno San Antón. Se compararon dos estados de madurez para cosechar dos cultivares de habichuelas. Se usaron las cultivares Bonita y Naranjito, de semillas blancas y rayadas, respectivamente. Se utilizó un diseño experimental de parcelas pareadas y las habichuelas se cosecharon en dos épocas: cuando estaban fisiológicamente maduras y cuando estaban secas. Los resultados demuestran que la cv. Bonita produjo los más altos rendimientos, tenía más vainas por planta y mayor número de semillas por vaina. Además, los resultados demostraron que al cosecharse fisiológicamente maduras se obtuvo un rendimiento de cerca de un 70% más alto que cuando se cosecharon secas. Además, hay que señalar que en la venta de habichuelas en vaina el rendimiento es cerca de un 75% sobre el de la habichuela seca.

#### LITERATURE CITED

1. Badillo-Feliciano, J., Lugo-López, M. A. and Scott, W. 1978, Effect of planting distance on yield and agronomic characteristics of red kidney and native beans in an Oxisol, *J. Agric. Univ. P.R.* 57 (2): 145-48
2. Carmer, S. G. and M. R. Swanson, 1971. Detection of differences between means. A Monte Carlo study of five pairwise multiple comparison procedures, *Agron. J.* 63: 940-45.
3. Del Valle, R., Scott, T. W., Lugo-López, M. A., 1981. Variable response of food crops to banded and broadcast residual fertilizer P on an Ultisol, *J. Agric. Univ. P.R.* 65 (2): 181-89.
4. Facts and Figures on Puerto Rico Agriculture, 1980. Commonwealth of Puerto Rico, Department of Agriculture, Office of Agricultural Statistics, Santurce, P.R., pág. 64.
5. González-Rios, P. and Riollano, A. 1951. El mejoramiento de la habichuela blanca del país (*Phaseolus vulgaris*) por medio de la selección, *Exp. Agric. Univ. P.R. Bol.* 94.
6. Lugo-López, M. A., Badillo-Feliciano, J. and Caldach, L., 1979. Response of native white beans, *Phaseolus vulgaris* to various N levels in an Oxisol, *J. Agric. Univ. P.R.* 56 (4): 438-42.
7. — and Rivera, L. H., 1976. Taxonomic classification of the soils of Puerto Rico, 1975. *Agric. exp. Stn. Univ. P.R. Bull.* 245.