

# Performance of Eight Cowpea (*Vigna unguiculata*) Cultivars on an Oxisol in Northwestern Puerto Rico<sup>1</sup>

José Badillo-Feliciano and Raúl Abrams<sup>2</sup>

## ABSTRACT

Eight cowpea cultivars were evaluated for three years on the basis of yield and adaptability to the climatic conditions prevailing in northwestern Puerto Rico. Tests were conducted on a Coto clay (Oxisol) at the Isabela Substation, Puerto Rico. The cultivars tested were the brown-colored B 54; the black "eye" peas Pequeño, Costa Rica and Frijol Gordo; the black cowpea Centa 105; and the cream-colored cultivars Climax, Sin Fibra and Zipper Cream. Maximum mean adjusted yield of 2197 kg/ha over three crops, were obtained from cv. B 54. The black "eye" pea cvs. Pequeño, Costa Rica and Frijol Gordo yielded 2066, 1960, and 1743 kg/ha, respectively. Cv. Centa 105 yielded 1583 kg/ha. The cream-colored cvs. Climax, Sin Fibra and Zipper Cream yielded 1479, 1427, and 1829 kg/ha, respectively. The largest and heaviest individual seed was obtained from cv. B 54, while those of cv. Climax were the smallest. The largest number of pods per plants were obtained from cvs. Pequeño, Frijol Gordo, and Costa Rica while the least number of pods per plant were obtained from cvs. Sin Fibra, Zipper Cream and Climax. Cv. Sin Fibra produced the largest number of grains per pod. All cultivars seem to have good adaptability under the conditions prevailing in northwestern Puerto Rico.

## INTRODUCTION

The cowpea (*Vigna unguiculata*) is a warm-season annual herbaceous legume which was produced and consumed in the past, but is now almost unknown in Puerto Rico. However, the dry grain averages 23 to 25% total protein, 57% carbohydrates, 1.3% fat and 3.5% minerals (3). Its protein is comparatively rich in lysine and tryptophan, amino acids which are usually deficient in cereal grains. Cowpeas with good management practices are as good or better producers than the field beans (*Phaseolus vulgaris*) (1, 2). They are tolerant to extended drought periods and are extremely tolerant to low soil pH. Spain et al. (6) obtained significant yield responses under the conditions prevailing at Carimagua, Colombia, on a soil with pH 4.3, only to the first 0.5 tons/ha of lime increment. They noticed that cowpeas were more tolerant to high soil acidity than field beans. This evidence suggests that cowpeas may be a suitable crop for the acid Oxisols of the tropics. Also this crop will fit well into traditional mixed cropping systems.

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<sup>2</sup> Associate Agronomist and Plant Breeder, Director of the Agricultural Experiment Station, respectively, Mayagüez Campus, Río Piedras, P.R. Dr. Carlos Cruz and Mr. Edgar Cardona, Associate Entomologist and Research Assistant, respectively, tested and evaluated the cultivars for insect damage. Dr. M. A. Lugo-López's valuable suggestions are deeply appreciated.

The objective of this work was to evaluate high yielding materials and determine their adaptability to climatic conditions prevailing in northwestern Puerto Rico.

#### MATERIALS AND METHODS

The experiments were conducted at the Isabela Substation, located about 120 m above sea level. The mean annual maximum temperature is 29.4° C while the mean minimum temperature is 18.9° C. The mean annual rainfall is about 1658 mm with showers from November to January and a dry spell generally extending from mid-January to April.

The soil is Coto, a Tropectic Haplorthox, clayey, kaolinitic, isohyperthermic (4). It has an exchange capacity of around 13 meq and 25% Ca saturation. It is high in Mn, low in P and with a pH of 4.8.

The experiments were planted October 24, 27 and 19 of 1975, 1976 and 1978, respectively. Harvesting of dry pods was generally about 80 days after planting. The experiments followed partially balanced incomplete block designs with eight treatments (cultivars) replicated four times. The plots were 3.03 × 3.03 m with 0.75 m alleys between plots. Each plot consisted of four rows 75 cm apart with plants spaced 30 cm within the row, for a total of 40 plants per treatment per replicate. The cultivars tested were Costa Rica, Pequeño, B 54, Sin Fibra, Zipper Cream, Climax, Centa 105 and Frijol Gordo.

The crop received a 10-10-10 fertilizer at the rate of 1121 kg/ha at planting time. Crop protection was provided by spraying several times with Lannate<sup>3</sup> at the rate of 2.47 qt/ha plus Dithane M45 at the rate of 2.24 kg/ha. Supplemental irrigation was applied as needed.

Data were taken on number of plants per plot, weight of four plants, number of pods in the four plants, weight of seeds, weight of 10 pods, number of seeds in ten pods, weight of seed in the 10 pods, total weight for the plot and seed moisture. Data were accumulated for three years.

#### RESULTS AND DISCUSSION

The brown-colored cultivar B 54 was consistently the top yielder during the series of trials ranging from 1837 to 2402 kg/ha for a 3-year average of 2197 kg/ha (table 1). Yields from cvs. B 54, Pequeño and Costa Rica did not differ statistically in two of the three years; while yields of Pequeño, Costa Rica and Frijol Gordo were not significantly different during the 3 years. Pooled data from the 3 years showed that cv. B 54 outyielded cv. Pequeño by 131 kg/ha (not significant), cv. Costa Rica by 237 kg/ha (significant), and cv. Frijol Gordo by 454 kg/ha (significant).

<sup>3</sup> 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 latter is the cultivar preferred by most of the local farmers. B 54 has an average of 26.2 pods/plant with 12.03 seeds per pod (tables 2 and 3). The brown dry seeds (23.30 grams/100 seeds) are significantly larger than all other cultivars. (table 4). The plant is vigorous, slightly prostrate, with very few guides. Blooming took place about 54 days after planting. It is tolerant to disease and insect attacks (table 5) and is highly resistant to attacks by the bean leaf beetle *Cerotoma ruficornis*. Table 5 shows that pod infestation by the cowpea curculio, *Chalcoedermus ebeninus* is low. Although counts of leafhopper of the genus *Empoasca* were relatively high (3.42 per leaflet 35 days after planting), foliar damage was not serious. Leafhopper counts dropped to less than one nymph per leaflet 50 days after planting.

Mean yields of the black "eye" cvs. Pequeño, Costa Rica and Frijol Gordo were over 1700 kg/ha (table 1). The yield from cvs. Pequeño and

TABLE 1.—Dry yields<sup>1</sup> (kg/ha) of eight cowpea cultivars from three crops planted on an Oxisol at the Isabela Substation, Isabela, P.R.

Cultivars	Yield for indicated crop years			Adjusted means— 3 years
	1975-76	1976-77	1978-79	
B 54	2295a <sup>2</sup>	1837a	2402a	2197a
Pequeño	1991a,b	1695a,c	2007b	2066a,c
Costa Rica	1970a,b	1586a,c,d	2015b	1960b,c
Frijol Gordo	1768b,c	1490a,c,d	1752b,c	1743d,e,f
Centa 105	1494c	1419b,c,d	1542c,d	1583f,g
Climax	1483c,d	1337b,c,d	1408d	1494g
Sin Fibra	1277d	1289b,d	1486d	1427g
Zipper Cream	2061a,b	1289b,d	1837b	1829b,e

<sup>1</sup> Dry weight at 11% moisture.

<sup>2</sup> Means in any column followed by the same letters do not differ significantly at the 5% probability level.

Costa Rica did not differ statistically; however, both cultivars significantly outyielded Frijol Gordo. The three cvs. have smooth white coats with a rather large black "eye." This is the type of cowpea preferred by local consumers. All of them average over 30 pods/plant (table 2) with the number of seeds varying from 11 to 13/pod (table 3). Mean dry seed weights were 13.41, 14.32 and 17.17 gram/100 seeds for cvs. Pequeño, Costa Rica, and Frijol Gordo, respectively (table 4). The cvs. are vigorous erect plants with violet pod tips. Blooming occurs at about 58, 53 and 50 days after planting in the case of Pequeño, Costa Rica, and Frijol Gordo, respectively. Plants suffered from moderate attacks by leafhoppers and bean leaf beetles and were slightly damaged by leafhoppers. The Pequeño pods were free of cowpea curculio damage (table 5). Frijol Gordo suffered extremely serious insect damage.

TABLE 2.—*Mean number of pods/coupea plant from three crops planted on an Oxisol at the Isabela Substation, Isabela, P.R.*

Cultivars	Number of pods for indicated crop years		
	1975-76	1976-77	1978-79
B 54	28.53a,c <sup>1</sup>	21.88c,d	28.20a
Pequeño	37.05a	29.69a,b,c	26.11a,b
Costa Rica	29.59a,c	35.31a	27.69a,b
Frijol Gordo	35.10a	30.88a,b	29.59a
Centa 105	28.90a,c	24.31b,c,d	24.16a,b
Climax	24.83b,c	29.50a,b,c	22.93a,b
Sin Fibra	21.16b,c	21.63c,d	20.75b
Zipper Cream	27.05a,c	18.94d	23.51a,b

<sup>1</sup> Means in any column followed by the same letter do not differ significantly at the 5% probability level.

TABLE 3.—*Number of seeds in ten pods from eight coupea cultivars from three crops planted on an Oxisol at the Isabela Substation, Isabela, P.R.*

Cultivars	Number of grains in 10 pods for indicated years		
	1975-76	1976-77	1978-79
B 54	115.5a,c	109.3b,d	136.1a,b,c
Pequeño	118.6a,c	116.6b,c,d	130.0a,b,c
Costa Rica	114.2a,c	119.0b,c,d	114.5b
Frijol Gordo	108.8b	95.8b,d	121.6b,c
Centa 105	117.0a,c	122.0a,c,d	119.4b
Climax	128.5a,c	138.7a	150.2a
Sin Fibra	123.3a,c	132.2a,c	142.5a
Zipper Cream	132.9a	129.7a,c	142.5a,c

<sup>1</sup> Means in any column followed by the same letters do not differ significantly at the 5% probability level.

TABLE 4.—*Mean weight of 100 dry coupea grains from eight cultivars planted for three crop years on an Oxisol at the Isabela Substation, Isabela, P.R.*

Cultivars	Weight for indicated crop years		
	1975-76	1976-77	1978-79
B 54	23.17a	22.61a	24.11a
Pequeño	15.06d,e,f	11.80c	13.38d
Costa Rica	15.19d,e	13.96c	13.82d
Frijol Gordo	17.85c	16.58b	17.07c
Centa	15.57d	13.16c	15.56c,d
Climax	12.10e	12.40c	13.12d
Sin fibra	16.58c,d	13.07c	13.85d
Zipper Cream	19.78b	18.22b	20.67b

<sup>1</sup> Means in any column followed by the same letters do not differ significantly at the 5% probability level.

The black cv. Centa 105 yielded an average of 1583 kg/ha for the three crops (table 1), which was not statistically different from the yields of Frijol Gordo, the cultivar used as control. Centa 105 averaged 25.8 pods per plant with 12 seeds/pod (table 2 and 3). The dry seeds are black (table 4) and of medium size (14.76 g/100 seeds). Dry seeds of Centa 105 are similar to small dry field beans. This characteristic is valuable since they can thus be marketed as a substitute for dry black beans. The plant is vigorous, with few guides, and blooms about 53 days after planting. Resistance to insects and diseases was noted. An average of only 0.85 leafhopper nymph/leaflet was detected 50 days after planting, and cowpea curculio damage was very low at that stage (table 5).

Mean yields of the cream-colored cvs. Climax, Sin Fibra and Zipper Cream were 1479, 1427 and 1829 kg/ha respectively. These are considered acceptable yields. However, these cultivars have a different type of seed:

TABLE 5.—*Relative infestation by insects of eight cowpea cultivars planted on an Oxisol at the Isabela Substation, Isabela, P.R.*

Cultivar	Average leafhopper nymph/ leaflet		Evaluation for visual damage <sup>1</sup>		
	Days after planting 35	50	<i>Empoasca</i> spp	<i>Cerotoma</i> <i>ruficornis</i>	<i>Chalcodermus</i> <i>ebenus</i>
B 54	3.42	0.95	1.62	1.25	1.73
Pequeño	3.05	1.17	1.87	2.50	0.00
Costa Rica	3.00	1.17	1.75	1.12	1.79
Frijol Gordo	4.25	1.30	2.12	1.62	2.38
Centa 105	2.52	0.85	1.87	1.50	0.60
Climax	3.72	1.12	1.87	2.37	1.06
Sin Fibra	3.15	2.27	2.00	1.50	1.71
Zipper Cream	2.27	1.15	2.37	2.00	0.92

<sup>1</sup> Based on a 1-5 scale; where 1 = normal, 5 = heavy damage.

cream-colored without a pronounced "eye." Cv. Climax dry seeds are round and small (12.54 gms/100 seeds). Cv. Sin Fibra dry seeds are kidney-shaped and medium-sized (14.50 gms/100 seeds). Cv. Zipper Cream dry seeds are round and relatively large (19.56 gram/100 seeds) (table 4). The three cultivars had the lowest average number of pods/plant (21-23) but the highest number of seeds/pod (over 13) (table 2). In general, all three cultivars suffered moderate attacks from insects (table 5). Plants of cvs. Climax and Zipper Cream are vigorous and of prostrate growth habit; Zipper Cream has guides, but Sin Fibra grows erect with only a few guides.

This study indicates that cultivar B 54 seems to be the best suited for commercial production in Oxisols under the conditions prevailing in northwestern Puerto Rico. It produces consistently higher yields (table

1) or significantly heavier seeds (table 4) and is a vigorous plant, fairly resistant to insects and diseases. Cultivars Pequeño, Costa Rica and Frijol Gordo, preferred by local consumers, also appear to be promising for northwestern Puerto Rico.

The possibilities of Centa 105 for a limited specialty market, should be considered because of its black and medium-sized seeds, which can be used as a substitute for small dry black beans.

The yields of cowpeas, as measured in the three experiments herein reported, compare very favorably with yields of dry field beans (*Phaseolus vulgaris*) grown under the same conditions (1, 2, 5). Their high protein content, their richness in lysine and tryptophan, as well as the generally vigorous growth habit, make the cowpea an attractive and useful crop for the tropics. Furthermore, because of their recognized tolerance to drought and to extremely high soil acidity, as well as their capacity to fix atmospheric nitrogen, the cowpeas can be valuable in crop rotation in the weathered, highly leached, extremely acid and relatively infertile Oxisols of the humid tropics.

#### RESUMEN

Se estudió por tres años el comportamiento de ocho cultivares de frijoles (*Vigna unguiculata*) en un suelo Coto arcilloso (Oxisol) en la Subestación Experimental de Isabela. Los rendimientos más altos se obtuvieron con la cv. B 54 (2197 kg/ha). Esta es un frijol de testa color marrón. Las cvs. Pequeño, Costa Rica y Frijol Gordo del tipo "Ojinegros" le siguieron con rendimientos de 2066, 1960 y 1743 kg/ha, respectivamente. La cv. Centa 105, de testa negra, produjo 1583 kg/ha. Las de testa crema Sin Fibra, Zipper Cream y Climax, produjeron sobre 1200 kg/ha. Las semillas más grandes y pesadas se obtuvieron de la cv. B 54 mientras que las más pequeñas fueron las de cv. Climax. Todas las cultivares parecen adaptarse bien a las condiciones prevalecientes en el noroeste de Puerto Rico.

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