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## Productivity of 25 Varieties of Rice Grown Under Conditions of Limited Moisture<sup>1, 2</sup>

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### ABSTRACT

The productivity of 25 rice varieties was determined with moisture equivalent to about 13 cm (5 in) mo of well distributed rainfall. The short grain varieties produced similar yields, averaging 3,091 kg/ha (2,760 lb/acre) of unhulled rice. Among the medium-grain varieties, Vista produced 6,294 kg/ha (5,620 lb/acre) of unhulled rice and outyielded all but the Brazos variety. Among the long-grain varieties, LeBonnet yielded 5,253 kg/ha (4,690 lb/acre) of unhulled rice, but did not significantly outyield the Venus, Galaxia, Morado Criollo, or Gema varieties, which yielded an average of 3,730 kg/ha (3,330 lb/acre) of unhulled rice. Average yields of long-, medium- and short-grain varieties were 3,640, 3,674, and 3,091 kg/ha, respectively.

### INTRODUCTION

About 180,000 metric tons of rice are consumed annually in Puerto Rico, all imported from the United States mainland. About 65% is of the short-grain type imported from California and the remainder is of the medium- and long-grain types imported from southern United States.

Considerable research has been conducted in Puerto Rico on the performance of several varieties of rice as affected by season of the year under irrigation. Abruña and Lozano<sup>4</sup> determined the effect of season of the year on the productivity of 13 varieties of rice of the long- and medium-grain types in monthly plantings over a one-year period at Gurabo, with abundant irrigation. The semidwarf, late-maturing, medium-grain Sinaloa varieties produced the highest yields averaging 4,910 lb of unhulled rice per acre per crop. Yields of the 13 varieties tested were not markedly or consistently affected by season of the year.

<sup>1</sup> Manuscript submitted to Editorial Board January 26, 1976.

<sup>2</sup> This paper covers work carried out cooperatively between the Agricultural Research Service, USDA, and the Agricultural Experiment Station, College of Agricultural Sciences, Mayagüez Campus, University of Puerto Rico, Río Piedras, P.R.

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<sup>4</sup> Abruña, F., and Lozano, J., Effect of season of the year on yields of 13 varieties of rice growing in the humid region of Puerto Rico, *J. Agr. Univ. of P.R.*, 58(1): 11-17, 1974.

Four to 5 months were required to produce a crop depending on variety and season of the year. That experiment showed that two crops, with a total yield of about 11.2 t/ha (5 tons/acre) yearly of unhulled rice can be grown under irrigation in Puerto Rico.

Lozano and Abruña<sup>5</sup> determined the yields of eight short-grain varieties of rice in plantings made in September, December, March, and June at Gurabo, with abundant irrigation. Those varieties produced yields averaging 5,678 kg/ha (5,070 lb/acre) of unhulled rice per crop. Only 98 days were required to produce a crop, whereas most of these varieties require more than 150 days in their native Spain or California. Season of the year apparently affected the productivity of those varieties which were developed in temperate regions, and produced the lowest yields. September planting yielded an average of 4,580 kg/ha or 4,090 lb/acre of unhulled rice. June planting produced highest average yields, 7,045 kg/ha or 6,290 lb/acre, of unhulled rice. In general, the Bahía, Girona, and Amposta varieties produced the highest yields, averaging about 6,160 kg/ha (5,500 lb/acre) of unhulled rice. This experiment showed that it is possible, under irrigation, to produce 3 crops a year of short-grain varieties in Puerto Rico.

The purpose of the present study was to determine the productivity of 25 varieties of rice of different types under limited irrigation simulating moderate rainfall.

#### MATERIALS AND METHODS

The experiment was conducted at the Gurabo Substation, located about 77 m (250 ft) above sea level and with a mean annual temperature of about 27° C (80° F). Annual rainfall is about 1,524 mm (60 in) with a marked dry season generally extending from November through March.

Table 1 shows the varieties tested, including long-, medium-, and short-grain types. All varieties were replicated four times in 4 by 4 m plots using a complete block design. The rice was planted on March 15, 1975.

The soil is a Toa (Mollisol) of various textures, with an average pH 5.8 and 3.6% organic matter. Exchange capacity of the soil is 26 meq with 17 meq of exchangeable bases per 100 g soil.

Seeds were planted in rows 20 cm (8 in) apart at the rate of 112 kg/ha (100 lb/acre). All plots received 168 kg/ha (150 lb/acre) of N, 56 kg/ha (50 lb/acre) of P<sub>2</sub>O<sub>5</sub> and 168 hg/ha (150 lb/acre) of K<sub>2</sub>O in two equal applications, one half at planting and the remainder 40 days later.

The plots were sprayed twice with Diazinon<sup>6</sup> to control insects, and

<sup>5</sup> Lozano, J., and Abruña, F., Effect of planting season on yields of eight short grain varieties of rice under irrigation, *J. Agr. Univ. P.R.*, 61(1): —, 1977.

<sup>6</sup> Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of

TABLE 1. — *Yields of 25 varieties of rice grown with limited moisture at Gurabo*

Variety	Yields of unhulled rice	
	Kg/ha	Lb/acre
<i>Short grain:</i>		
Caloro	3,270	2,920
Colusa	3,237	2,890
Girona	3,158	2,820
Amposta	3,237	2,890
Bahía	2,912	2,600
Dosel	2,912	2,600
Balilla	3,405	3,040
Nano Sollana	3,755	2,460
Average	3,091	2,760
<i>Medium grain:</i>		
Chontalpa 16	2,722 b <sup>1</sup>	2,430
Chontalpa 437	2,744 b	2,450
Vista	6,294 a	5,620
Brazos	4,234 ab	3,780
Nato	3,718 b	3,320
Saturno	2,688 b	2,400
Chontalpa 736	4,066 b	3,630
Sequial	2,957 b	2,640
Average	3,674	3,280
<i>Long grain:</i>		
Bluebonnet	3,326 b	2,970
LeBonnet	5,253 a	4,690
Labelle	2,878 b	2,570
Starbonnet	3,282 b	2,930
Sunbonnet	3,058 b	2,730
Venus	3,550 ab	3,170
Galaxia	3,886 ab	3,470
Morado Criollo	3,752 ab	3,350
Gema	3,740 ab	3,340
Average	3,640	3,250

<sup>1</sup> Values with the same letter or letters do not differ statistically at .05.

rats were controlled with poison bait. Birds were kept out of the plots by plastic netting installed after the rice headed. Propanil was applied twice to control weeds at the rate of 1½ gal/acre (16.8 l/ha) diluted in 50 gal of water when weeds had their second pair of leaves.

Grain was harvested when moisture content was 20–22% and was threshed and dried to 12% moisture to determine yield.

The available water-holding capacity of this soil is 3.8 cm (1.5 in) for the upper 30 cm (1 foot) of soil where most of the rice roots are concen-

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trated. Every 10 days the soil was saturated, providing 0.38 cm (0.15 in) of water daily for evapotranspiration. If it rained the interval between irrigations was extended proportionally to the rainfall. Thus a monthly rainfall of about 13 cm/day (5 in) was simulated and well distributed.

#### RESULTS AND DISCUSSIONS

Table 1 shows that short-grain varieties, which mature in about 90 days, had the lowest yields. There were no significant yield differences among them. Yields averaging 3,091 kg/ha (2,760 lb/acre) of unhulled

TABLE 2. —*Rainfall, open pan evaporation, and irrigation applied during the course of the experiment at Gurabo*

Week ending	Rainfall		Irrigations applied	Open pan evaporation	
	<i>Mm</i>	<i>In</i>	<i>Date</i>	<i>Mm</i>	<i>In</i>
March 22	3.6	0.14	3/17	28.2	1.11
March 29	19.3	.76	3/18	26.9	1.06
April 5	89.2	3.51		38.6	1.52
April 12	22.1	.87	4/10	40.1	1.58
April 19	5.3	.21		36.3	1.43
April 26	1.3	.05	4/21	44.2	1.74
May 3	67.3	2.65		33.5	1.32
May 10	5.3	.21	5/5	41.7	1.64
May 17	6.9	.27		39.9	1.57
May 24	8.1	.32	5/20	34.0	1.34
May 31	1.0	.04		42.4	1.67
June 7	6.4	.25		39.6	1.56
June 14	36.1	1.42		45.9	1.81
July 21	33.3	1.31	6/15	39.9	1.57
July 28	4.6	.18		47.0	1.85
July 5	13.7	.54	6/28	36.6	1.44
July 12	10.7	.42		49.5	1.95
July 15	5.7	.18		24.7	.96
4 months total	330.2	12.95		644.3	25.36

rice were about 40% lower than those from the same varieties and location under abundant irrigation, as found by Lozano and Abruña (5).

Among the medium-grain varieties, Vista, which averaged 6,294 kg/ha (5,620 lb/acre) of unhulled rice, outyielded all but the Brazos variety.

Among the long-grain varieties, LeBonnet, which yielded 5,253 kg/ha (4,690 lb/acre) of unhulled rice, tended to produce the highest average yields. However, it did not significantly outyield Venus, Galaxia, Morado Criollo, or Gema varieties, which yielded an average of 3,730 kg/ha (3,330 lb/acre).

On the average, the long- and medium-grain varieties produced about 20% less in this experiment than when they were abundantly irrigated at this same location (4).

Table 2 shows that during the first 4 months after planting rainfall was 33.02 cm (12.95 in). Eight irrigations added 30.6 cm (12 in) of available water to the upper 30 cm of soil. Thus, assuming that all the rainfall (which was well distributed) was available, 63.62 cm (24.95 in) of water were available for evapotranspiration during this period. This checks well with open pan evaporation for the same 4-month period which totalled 64.43 cm (25.36 in). Thus, both evapotranspiration and open pan evaporation averaged about 0.50 cm (0.20 in) daily for the 4-month period.

This experiment shows that fairly high yields of rice can be obtained in Puerto Rico under conditions simulating a rainfall of about 13 cm (5 in) monthly. In eastern Puerto Rico there are thousands of acres of level, heavy soils suited to rice production, where rainfall averages about 17.78 cm (7 in) monthly. Rather high yields of rice could be obtained during the long rainy season in this area without irrigation.

#### RESUMEN

Se investigó el efecto del riego cada 10 o más días (dependiendo de la lluvia) sobre el rendimiento de 25 variedades de arroz. Las 8 variedades de grano corto produjeron rendimientos similares que en promedio ascendieron a 3,091 kg./ha. (2,760 lb. por cuerda) de arroz en cáscara.

Entre las variedades de grano mediano, Vista, con un rendimiento de 6,294 kg./ha. (5,620 lb. por cuerda) de arroz en cáscara, superó a las otras, con excepción de Brazos.

Entre las variedades de grano largo, LeBonnet produjo 5,253 kg./ha. (4,690 lb. por cuerda) de arroz en cáscara, pero no superó estadísticamente a Venus, Galaxia, Morado Criollo y Gema, cuyo rendimiento medio fue de 3,696 kg./ha. (3,330 lb. por cuerda) de arroz en cáscara.

En general, las variedades de granos mediano y largo produjeron aproximadamente 20% menos y las de grano corto 40% menos en este experimento con riego limitado, que cuando se regaron abundantemente en otros experimentos en Gurabo. Los resultados demuestran que regimenes de humedad restringida no afectan tanto a las variedades de grano largo e intermedio como a las de grano corto.