

THE JOURNAL OF AGRICULTURE OF THE UNIVERSITY OF PUERTO RICO

Issued quarterly by the Agricultural Experiment Station of the University of Puerto Rico, for the publication of articles by members of its personnel, or others, dealing with any of the more technical aspects of scientific agriculture in Puerto Rico or the Caribbean Area.

Vol. LIX

JANUARY 1975

No. 1

Effect of Fertilization on Yields of Three Varieties of Rice at Two Locations in Puerto Rico¹

Carmen T. Ramírez, Fernando Abruña, José Lozano and José Vicente-Chandler²

ABSTRACT

Intensively managed irrigated rice of 3 varieties on a Vertisol typical of large areas in the tropics responded strongly to the application of 200 pounds of nitrogen per acre but not to phosphorus fertilization. Bluebonnet and Chontalpa varieties responded to the application of 200 pounds of potassium per acre, the Sinaloa variety to 300 pounds. All varieties responded strongly to the application of 40 pounds per acre of a complete minor element mixture.

INTRODUCTION

There are no commercial rice plantings in Puerto Rico where 150,000 tons or more are consumed yearly. Recent studies have shown that high yields can be obtained here.

Abruña and Lozano³ determined the yields of 13 varieties of rice grown in monthly plantings over a one year period at Gurabo under intensive management with irrigation. Yields were not affected by season of the year, and the best varieties yielded about 5,000 pounds of rough rice per acre per crop. It was found possible to produce 2 to 3 crops of rice yearly on the same land, depending on the variety.

No research has been conducted on the effect of fertilization on yields of intensively managed rice in Puerto Rico. The purpose of this study, conducted at the Gurabo and Lajas Substations, was to find information in this respect.

¹ Manuscript submitted to Editorial Board June 24, 1974.

² Assistant Agronomist, Agricultural Experiment Station, University of Puerto Rico; Soil Scientist, Agricultural Research Service, U.S. Department of Agriculture; Research Assistant, Agric. Exp. Sta., Univ. P.R.; and Soil Scientist, ARS, USDA, Río Piedras, P.R., respectively.

³ Abruña, Fernando, and Lozano, José, Effects of Season of the Year on Yields of 13 Varieties of Rice Growing in the Humid Region of Puerto Rico, *J. Agr. Univ. P.R.*, 58 (1): 11-17, 1974.

MATERIALS AND METHODS

The Gurabo Substation is located about 250 feet above sea level. Annual rainfall is about 65 inches with a marked dry season from December through March. The soil is a Toa clay loam (Mollisol) having a pH of 5.6 and an exchange capacity of 28 m.e. per hundred grams of soil, with 18 m.e. of exchangeable bases. Organic matter content is 3.8 percent. Exchangeable K is 85 m.e. per 100 grams of soil and available P by the Bray method 3.8 ppm.

TABLE 1.—*Effect of fertilization on yields of three rice varieties growing on Fraternidad Clay at Lajas, Puerto Rico*

N	Fertilizer levels		Yields of rough rice		
	P ₂ O ₅	K ₂ O	Bluebonnet 50	Chontalpa 16	Sinaloa A-68-8C
	Pounds/acre		Pounds/acre		
0	0	0	2,310	3,050	2,500
100	100	100	2,670	4,580	5,100
0	100	100	2,430	3,420	2,730
50	100	100	3,030	3,900	3,150
150	100	100	3,560	4,190	5,340
200	100	100	4,920	5,120	6,480
150	0	100	3,070	3,840	5,450
150	50	100	3,500	3,800	5,810
150	100	0	4,070	4,040	5,770
150	100	200	4,830	4,700	5,560
150	100	300	5,140	3,980	7,430
150	100	100 + minor elements*	4,880	5,610	8,640
		LSD ⁰⁵	449	508	820
		LSD ⁰¹	603	683	1,100

* Composition in percent: Mg—2.42; Zn—3.70; CaB—0.20; Mn—11.82; Cu—3.11; Fe—2.00.

The Lajas Substation is located about 100 feet above sea level, and annual rainfall is about 40 inches, with a well defined dry season from December to May. The soil is a Fraternidad clay (a Vertisol). The pH is 6.1 and the total exchangeable capacity is 35 m.e. per hundred grams of soil with 26 m.e. of exchangeable bases. Organic matter content is 2.5 percent. Exchangeable K is 165 m.e. per hundred grams of soil and available P by the Bray method 8.5 ppm.

Mean annual temperature at both locations is about 78° F. Varieties tested were Bluebonnet 50, a long grain, tall growing variety; Chontalpa 16, a moderately tall growing variety with medium-long grain and Sinaloa A-68-8C, a variety with medium-short grain.

The rice was planted at the rate of 80 pounds per acre in rows 8 inches apart. Weeds were controlled by applications of Propanil, and insects by

spraying with Diazinon, as required. The plots were irrigated by flooding as required.

The fertilizer treatments tested are shown in table 1. Five levels of nitrogen, three of phosphorus and four of potassium were tested with an additional treatment consisting of 40 pounds per acre of a complete minor element mixture the composition of which is given in table 1. Half the fertilizer was applied before planting, the remainder 40 days later. All

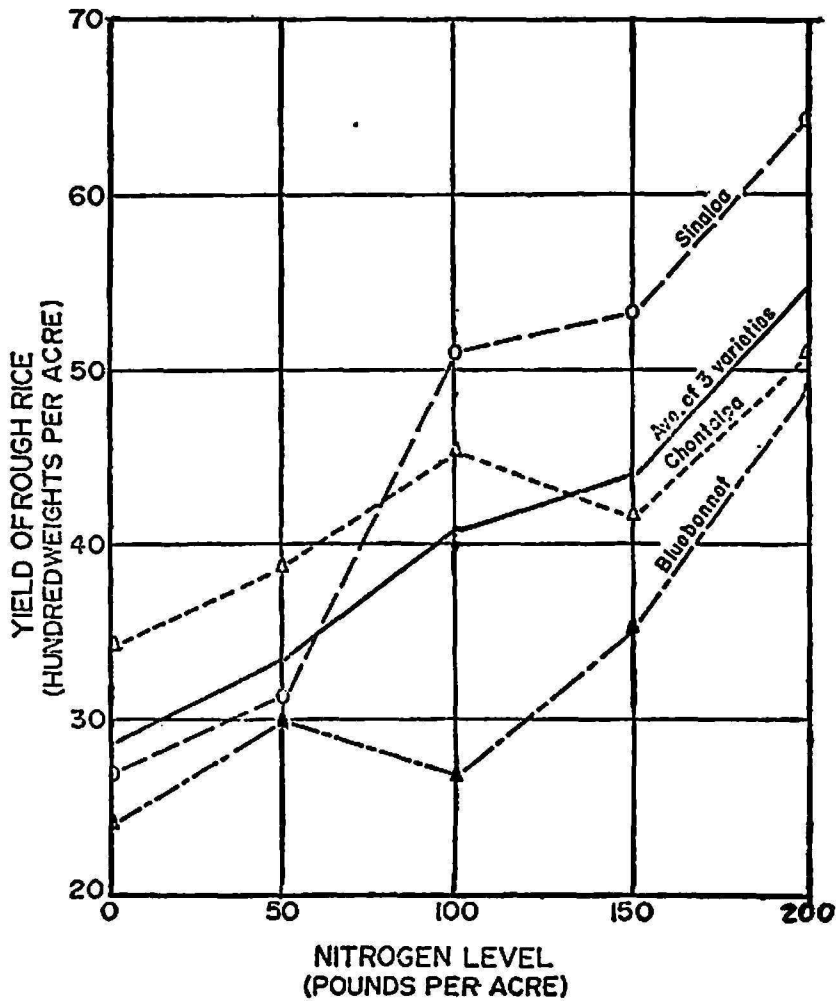


FIG. 1.—The response of three otherwise well fertilized rice varieties to applications of nitrogen at Lajas, Puerto Rico.

treatments were replicated four times with each variety. Individual plots were 12 × 12 feet and were separated by walks to reduce movement of fertilizer from one plot to another.

The experiment at Gurabo was planted in January, at Lajas in February, 1972. The grain was harvested at about 20 percent moisture and threshed and dried to 14 percent moisture.

RESULTS AND DISCUSSION

None of the rice varieties responded to fertilization on the Toa soil at Gurabo. All varieties in this experiment produced high yields, particularly

Chontalpa and Sinaloa, which averaged close to 7,000 pounds of rough rice per acre. This soil contained sufficient nutrients for the production of maximum yields and the rice plants developed an extensive deep root system which successfully foraged for nutrients in this deep soil of excellent physical condition.

At Lajas, on the other hand, all three varieties responded strongly to the application of 200 pounds of nitrogen per acre, the highest quantity tested (table 1). This response, illustrated in fig. 1, suggests that yields might have been even further increased by higher levels of nitrogen fertilizer. The Sinaloa variety was the highest yielder and responded more strongly to nitrogen fertilization than did the other two (fig. 1). Average yields for the varieties increased from about 2,900 pounds of rough rice per acre when no nitrogen was applied to 5,500 pounds when 200 pounds of nitrogen were applied per acre.

None of the rice varieties responded to phosphorus fertilization at Lajas.

The Bluebonnet and Chontalpa varieties responded moderately to the application of 200 pounds of potassium per acre, but the Sinaloa variety responded strongly to the application of 300 pounds.

All three varieties, but especially Sinaloa, responded very strongly to the application of minor elements on the Fraternidad soil at Lajas. Minor element applications increased average yields of the three varieties from 4,330 to 6,377 pounds of rough rice per acre.

Apparently this heavy Vertisol contained less available nitrogen than did the Toa clay loam at Gurabo, and uptake of phosphorus and potassium was probably limited by the poor physical condition of the soil which could restrict root development.

RESUMEN

Se determinó el efecto del abonamiento con nitrógeno, fósforo, potasio y elementos menores en tres variedades de arroz sembradas en Gurabo y Lajas.

Las variedades no respondieron al abonamiento en Gurabo en un suelo Toa, un Mollisol de excelente condición física, a pesar de que se obtuvieron rendimientos de hasta 7,000 libras por acre de arroz en cáscara.

En cambio, en Lajas las tres variedades respondieron marcadamente a las aplicaciones de nitrógeno, elevando la producción media de 2,900 libras de arroz en cáscara por acre cuando no se aplicó nitrógeno a 5,000 libras cuando se aplicaron 200 libras de este nutriente por acre.

Ninguna de las variedades respondió a las aplicaciones de fósforo.

Las variedades Bluebonnet y Chontalpa respondieron a la aplicación de 200 libras de potasio por acre mientras que la Sinaloa respondió a la aplicación de 300 libras por acre.

Todas las variedades de arroz respondieron marcadamente a la aplicación de 40 libras por acre de una mezcla de elementos menores. La aplicación de elementos menores aumentó la producción media de las tres variedades de 4,330 a 6,377 libras de arroz en cáscara por acre.