

Water Management Systems and Rice Yields Under Humid Tropical Conditions in Puerto Rico^{1,2}

Servando Silva, José Vicente-Chandler and Fernando Abruña³

ABSTRACT

High rice yields of 7,020 kg of rough rice/ha were produced when seed was disced into the soil followed by permanent flooding. Similarly high yields of 6,830 kg/ha were produced with the same planting method when 5 cm of irrigation water was applied weekly without permanent flooding. When pre-germinated rice was seeded in permanently flooded land, however, significantly lower yields of 5,300 kg/ha were obtained, probably because of several conditions: the adverse effects of algae, a less even stand of seedlings caused by floating germinated seed, earlier lodging of the plants, and also possibly, heavier losses of fertilizer nitrogen.

INTRODUCTION

Considerable research has been conducted on intensive rice production in Puerto Rico by Lozano and Abruña (3, 4, 5, 6), Abruña and Lozano (1, 2), Ramírez, et al. (7), Silva and Vicente-Chandler (8), and Vicente-Chandler et al. (9) including studies on fertilization, varieties, planting season, evapotranspiration, and production costs.

In irrigation studies, Silva and Vicente-Chandler (8) found that evapotranspiration with flooded rice averaged .61 cm daily under conditions typical of the humid north coast of Puerto Rico. Abruña and Lozano (2) found that when irrigation was applied only every 10 days at Gurabo, subjecting the rice to considerable moisture stress over relatively short periods, 8 short grain varieties produced similar yields, averaging 3,900 kg of rough rice/ha; 8 medium grain varieties averaged 3,670 kg/ha with varieties Brazos and Vista averaging the highest yields of 5,264 kg/ha; and 9 long grain varieties averaged 3,640 kg/ha with varieties Lebonnet, Venus, Galaxia, Gema, and Morado Criollo averaging 4,567 kg/ha.

The present study was designed to determine the effect of three water management systems on yields of intensively managed rice under conditions typical of the humid region of Puerto Rico.

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² This paper covers work carried out cooperatively between ARS-USDA and the Agricultural Experiment Station, College of Agricultural Sciences, Mayagüez Campus, University of Puerto Rico.

³ Research Technician and Soil Scientists, ARS-USDA, Agricultural Experiment Station, Río Piedras, P.R.

MATERIALS AND METHODS

The experiment was conducted on a Toa clay loam (Mollisols) at Río Piedras at an elevation of about 50 m. Treatments were replicated six times with each plot 3 m² surrounded by a small dike.

Variety Brazos (medium grain) was planted in all plots at the rate of 100 kg/ha. Fertilizer was applied at the rate of 500 kg/ha of 10-5-15 at planting, followed by 60 kg of N/ha applied as urea 6 weeks later. Propanil was applied at the rate of 1.5 kg/ha about 3 weeks after planting when required to control weeds. Plots were sprayed twice during the growing season to control insects and diseases. The experiment was planted March 3, 1982.

The crop was harvested when moisture content of the grain was about 20%. It was dried to 12% moisture, and trash was removed with an air current. Yields were expressed in kg of rough rice/ha.

Treatments were as follows: A) Pregerminated rice seeded in permanently flooded soil; B) dry seed disced into fairly dry soil followed by intermittent irrigation as required, and permanently flooded 3 weeks after planting; C) dry seed disced into fairly dry soil, and 5 cm of water applied weekly; no flooding.

RESULTS AND DISCUSSION

The following tabulation shows that high yields, 7,020 kg of rough rice/ha, were produced when the seed was disced into the soil followed by intermittent irrigation as required for 3 weeks and then by permanent flooding or by 5 cm of irrigation water applied weekly with no flooding (6,830 kg/ha). Under hot tropical conditions, periodic irrigation is required at shorter intervals than in the cool spring months of temperate regions.

<i>Treatment</i>	<i>Yields of rough rice kg/ha</i>
Pregerminated rice seeded in permanently flooded land	5,300 b ⁴
Dry seed disced into fairly dry soil followed by intermittent irrigation as required and permanently flooded 3 weeks after planting	7,020 a
Dry seed disced into fairly dry soil and 5 cm of water applied weekly, no flooding	6,830 a

⁴ Numbers followed by one or more letters in common, do not differ significantly at the P = .05 level according to Duncan's multiple range test.

Significantly lower yields, 5,300 kg/ha, were produced by seeding pregerminated rice in permanently flooded land.

A rather dense growth of algae occurred in the plots that were flooded before planting and probably adversely affected the young rice plants. This problem is much more important in the tropics, where irrigation water is much warmer and algae grow faster than in young rice fields in the spring in temperate regions. In addition, stand was less uniform because of some of the seed floated soon after germination and the plants lodged at an earlier stage probably resulting in lower yields. Also, water temperatures taken in the plots when the rice seedlings were small were as high as 32° C in the afternoon of hot sunny days; this heat could adversely affect very young seedlings. Furthermore, heavier losses of the fertilizer nitrogen applied at planting could have occurred during the first weeks when the rice plants took up little nitrogen.

The data presented indicate that under hot humid tropical conditions in Puerto Rico, rice seed should whenever possible, be disced into the soil followed by periodic irrigation as required, and by permanent flooding about 3 weeks after planting.

Flooded fields should be seeded when the weather does not permit proper preparation of the land. In this case, the water should be removed about 3 days after planting, or immediately if large quantities of seedlings start to float; intermittent irrigation should follow as required; and permanent flooding, about 3 weeks after planting. If the field is kept flooded there is better control of weeds and of some insects but algae can be a serious problem and floating of germinated seed can result in a less uniform stand. Also, water level must be uniform and not more than about 8 cm deep. Otherwise, the young rice seedlings may grow spindly.

The data show that high yields of rice can be obtained with only intermittent irrigation provided weeds are properly controlled. Such a system permits growing rice in areas where the traditional method of flooding is not possible because soils are too porous or the terrain is too steep or because of water shortage. This system saves water by reducing losses caused by percolation; it makes possible a better use of rainfall, but on the other hand it requires more use of herbicides.

RESUMEN

Se compararon distintos sistemas de regar arrozales cultivados intensivamente.

Los rendimientos más altos se obtuvieron cuando la semilla se sembró en terreno seco, se tapó con tierra y enseguida se regó intermitentemente por 3 semanas, y luego se anegó permanentemente (7,020 kg de arroz en cáscara/ha).

Se obtuvo una producción más baja, 5,300 kg/ha, cuando se sembró

semilla pregerminada en terreno inundado permanentemente. Este sistema puede practicarse cuando la condición del terreno no permite usar el sistema anterior. En tal caso es aconsejable desaguar los campos unos 3 días después de la siembra o inmediatamente, si mucha de la semilla flotase. En este caso, se debe regar a intervalos durante aproximadamente 3 semanas y luego inundar los campos permanentemente. Si los campos se mantienen inundados después de sembrar se pueden combatir mejor los yerbajos y algunos insectos, pero las algas pueden constituir un serio problema. Además, si flota mucha de la semilla la plantación no será uniforme. No deben mantenerse más de unos 8 cm de agua sobre el terreno mientras las plantitas se desarrollan.

Se obtuvo un buen rendimiento 6,830 kg/ha, regando intermitentemente durante todo el ciclo de producción. Este sistema permite sembrar arroz en terrenos que no se pueden inundar debido a su topografía o porosidad o donde no hay agua suficiente, ya que requiere menos agua. Sin embargo, es necesario combatir los yerbajos con más frecuencia.

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