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EVALUATION OF IRRIGATION SYSTEMS FOR RICE PRODUCTION ON ST. CROIX, USVI

Thomas W. Zimmerman, University of the Virgin Islands, Agricultural Experiment Station, St. Croix, USVI

ABSTRACT: Rice is normally grown for production under flooded paddy conditions. The Virgin Islands have limited fresh water resources that limit rice production utilizing the flooded paddy system. Three varieties of rice, 'Bengal', 'Cybonet' and 'Neptune' were grown to compare production under both drip and flood irrigation conditions. There was no visible difference in growth, flowering or maturity between the flooded paddy and drip irrigation conditions. There was no difference between treatments for plant height within a variety. The flooded paddy rice had better weed control than the drip production. 'Cybonet' shoots were shorter and matured two weeks earlier than both 'Bengal' and 'Neptune'. Rice production for 'Cybonet' was better with drip irrigation than flood irrigation, 2,565 and 2,015 lb/acre respectively. 'Bengal' had the best production, 3,720 lb/acre and benefited from flooded as compared to drip irrigation, 3,505 lb/acre. 'Neptune' did better with drip irrigation, 3,240 lb/acre, than with flooded, 2,930 lb/acre. Rice can be successfully grown in the Virgin Islands with drip irrigation and have yields comparable to a flooded paddy system.

Keywords: paddy rice, water conservation, *Oryza sativa*

INTRODUCTION

Since rice is a major cultural food staple, attention has been given to determining the potential for rice production in the US Virgin Islands. Presently, no record exists of exploring the possibility for rice production in the US Virgin Islands. However, commercial rice production does occur in the Caribbean on the larger islands of Cuba, Dominican Republic, Haiti, Jamaica and Trinidad, by utilizing flood irrigation. Sites exist on western St. Croix that are flat with heavy soils and a high water table, sites which have a strong potential for rice production. Most rice production requires flooded or paddy systems which require a substantial amount of water.

The potential for rice production on St. Croix is limited in that research is needed to justify engaging in rice farming. The fact that the Virgin Islands are in the tropics makes it a convenient site not only for rice production during the winter months, but also enables successful activity as a grow-out site for improved varieties of rice. The University of the Virgin Islands Agricultural Experiment Station has on-going research studying water usage and cropping efficiency through the use of drip irrigation. Vegetable crops have been shown to be productive and competitive with the imports when drip irrigation is used. Drip irrigation technology permits the efficient use of water and can help maximize the use of semiarid lands for agricultural use. Multiple field trials have shown the economic beneficial use of drip irrigation on vegetable and herb production in the Virgin Islands (Palada et al., 1995; Crossman et al., 1997; Palada and O'Keefe, 2001). Papayas have been shown to be productive in the semiarid Virgin Island's climate when drip irrigation is used (Kowalski and Zimmerman, 2001, 2006; and Zimmerman, 2008). The efficient use of water and substantial crop production has made drip irrigation a common practice in the US Virgin Islands. The objective of this research was to evaluate the potential for rice production in the US Virgin Islands during the dry season and compare drip irrigation to the flooded paddy system.

MATERIALS AND METHODS

Four rice cultivars, 'Bengal', 'Cybonet', 'Neptune' and 'Taipei' were grown in small plots on the western end of St. Croix. Four rows were seeded at 25' with 10" between rows. Pre-emergent herbicide was applied after planting. Drip tape irrigation with one foot emitters was installed after planting at the density of one line per two rice rows, 20". A complete fertilizer 20-20-20 with micro nutrients was applied after three weeks at 275 lb/acre. After five weeks, ammonium sulfate was applied at 125 lb/acre; 75 lb/acre urea was applied during the 6th week. All fertilizer was dissolved in water and applied through an injector. A levee was constructed, after the fertilizer was applied, enclosing a 30' square section of the rice plot for flood irrigation (Figure 1). Harvesting consisted of 20-foot sections of the two central rows for each variety and replicated three times for the drip area and once for the flooded section. Harvested rice was threshed, cleaned and dried to 12% moisture content.

RESULTS AND DISCUSSION

Planting occurred at the start of the dry season and was completed in two days. The application of fertilizer and control of weeds allowed the Caribbean sun and breezes to encourage the rice to use warmth, water and fertilizer to tiller and grow vigorously. The breezy dry winds of the island potentially reduced the diseases of the panicle and grain. The 'Taipei' variety had lower germination and a weaker stand, as compared to the three other varieties (Figure 2). Because of this difference, data was not collected for yield. A hardpan, present eight inches below the surface, caused excess water to move subsurface and accumulate in low spots.

The flooded conditions resulted in better weed control than that of the drip system. The 5-10 cm of standing water in the flooded system inhibited weed seed germination and growth. Irrigation water was discontinued two weeks before harvest (Figures 3, 4). The average amount of water used per acre for the rice production with drip irrigation was 820,000 gallons/acre (2.52 acre ft), and for flooding was 1,160,000 gallons/acre (3.56 acre ft). Drip irrigation used 340,000 gal/acre (1.04 acre ft) less water than the flooded paddy system. Because only the two middle rows of the four rows of each cultivar were harvested, a hand sickle was used (Figure 5) followed by threshing (Figure 6).

No difference was observed in the growth, plant height, date to anthesis or maturity within a variety between the two irrigation systems. 'Cybonet' was a shorter and earlier variety to flower and set seed. 'Cybonet' had more commonly empty panicles, all of which could have been due to the application of herbicide late in its development. Because the 'Cybonet' was under constant irrigation as it matured, it was continually developing tillers and panicles. This development resulted in panicles of differing maturity at harvest. At the time of harvest, there was shattering of some 'Cybonet' seed which may have reduced the overall yield data for this variety (Table 1). 'Bengal' and 'Neptune' were of similar height but 'Bengal' had the greatest yield of all varieties and treatments in the flooded plot with 3,720 lb/acre. Both 'Cybonet' and 'Neptune' had greater yield with drip irrigation than with flooding.

Table 1. Plant height and yield of three rice varieties grown under drip irrigation or flooding on St. Croix, USVI.

Variety	Height	Drip	Flood
	cm	lb/a	
'Cybonet'	38.9	2,565	2,015
'Bengal'	51.8	3,505	3,720
'Neptune'	55.1	3,240	2,930

Figure 1. Levee construction at six weeks.

Figure 2. 'Taipei' left with poor stand followed by 'Neptune', 'Cybonet' and 'Bengal' at anthesis.

Figure 3. Drip irrigation section two weeks prior to harvest.

Figure 4. Flooded section two weeks before harvest.

Figure 5. Staff and student assist with rice harvest, three replications two inner rows of 20'.

Figure 6. Threshing rice.

CONCLUSION

Rice production is possible during the dry season on St. Croix, USVI, with drip irrigation. Depending on the variety, yields with drip irrigation are similar or better than yields with flood irrigation. Drip irrigation kept the field saturated with water and allowed even application of fertilizer through an injector. Drip irrigation used significantly less water than the flooded paddy system. Rice can be successfully grown in the Virgin Islands with drip irrigation and have yields comparable to those of a flooded paddy system.

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