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Economic Evaluation of Rice Varieties with Varying Irrigation Regimes under Aerobic Condition

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ABSTRACT

A field experiment was carried out during kharif 2010 at IARI, New Delhi to study the performance of rice varieties under aerobic condition. The results revealed that among the varieties Pusa 834 recorded significantly higher grain yield (3.38 t/ha) and straw yield (5.32 t/ha) followed by PNR 162 (grain yield-3.08 t/ha; straw yield- 4.92 t/ha). Among the irrigation regimes, -10 kPa has given highest yield of (3.29 t/ha) followed by irrigation at -20 kPa (2.97 t/ha). Significantly higher gross return (39,399 /ha), net return (19,881 /ha) and benefit cost ratio (1.02) was observed in irrigation regime at -10 kPa followed by irrigation at -20 kPa (35,571 /ha and 16,953 /ha). Pusa 834 has given the highest net return (26,111 /ha) and benefit cost ratio (1.34) followed by PNR 162 (23,815 /ha and 1.22 respectively) at -10 kPa. The lowest net return (1682 /ha) and benefit cost ratio (0.10) was obtained in Jaldi Dhan 6 at -30 kPa soil water potential.

Keywords: *Grain yield, Gross return, Net return and Benefit cost ratio.*

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food crop for more than half of the global population and influences the livelihoods and economies of several billion people. Annual rice production should be increased to meet the demand of ever growing population (George, 2018). Increasing scarcity of water has threatened the traditional rice cultivation practices all over the world (Tuong & Bouman, 2003). There is a need to develop an alternative system of rice cultivation to save the water and other inputs. Aerobic rice is a new method of growing rice characterized by direct seeding in non puddled condition (Umino et al., 1958; Urano et al., 1959). Aerobic way of growing rice saves water by eliminating continuous seepage and percolation, reducing evaporation and eliminating wet land preparation (Castaneda et al., 2007). At present not much information is available on suitable varieties which can perform better under aerobic conditions. For adopting a new method of cultivation, its economic evaluation is necessary (Xu et al., 1997; Xiaoguang et al., 2005).

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With this background, a field study was planned to assess the effect of irrigation regimes and varieties on economics of rice under aerobic condition.

MATERIALS AND METHODS

The field experiment was conducted at research farm of the Indian Agricultural Research Institute (IARI), New Delhi during *kharif* 2010. It is situated at 28o 40'N latitude and 77o 10'E longitude at an elevation of 222.6 meters above the mean sea level. The soil of experimental field was sandy clay loam with medium organic carbon (0.71%), low nitrogen (179 kg/ha), medium available phosphorus (16.3 kg/ha) and high available potassium (249.40 kg/ha). The field capacity of soil ranges from 19.35% to 21.5% (w/w) and permanent wilting point ranges from 9.42-10.35% (w/w). The treatments comprised of three irrigation regimes *i.e*. -10 (I1), -20 (I2) and -30 kPa (I3) of soil water potential in main plots and four varieties *i.e*. Jaldi Dhan 6 (V1), PNR 162 (V2), PNR 381 (V3) and Pusa 834 (V4) in sub-plots. The experiment was laid out in split plot design with three replications. The sowing was done using seed rate of 60 kg/ha and row to row distance was maintained at 20 cm. Recommended dose of fertilizers *i.e*. 120:60:40 kg N- P2O5 -K2O per hectare was applied. The entire dose of P and K and 1/3rd of N were applied at the time of sowing. The remaining N was applied in two equal splits at 30 and 60 Days after sowing. Pre-emergence herbicide pendimethalin at 0.75 kg a.i./ha was applied at 2 DAS. Hand weeding was done at 20, 35 and 50 DAS. For economic evaluation, prevailing market price was used for different outputs and inputs. The cost of cultivation was calculated on the basis of different operations performed and materials used for raising the crop including the cost of fertilizers and manure. The cost of production under different irrigation regimes includes expenses incurred on field preparation, seed, fertilizers, herbicide, land and irrigation charges, and labour cost (sowing, irrigation, fertilizer and herbicide application, weeding, harvesting, threshing). Total revenue generated by selling the grain and straw was taken as gross income. Net income was calculated by subtracting the total production cost from the gross income. The benefit - cost ratio was calculated as the ratio of net income to total production cost.

RESULTS AND DISCUSSION

COST OF CULTIVATION

Cost of cultivation was highest under irrigation at -10 kPa soil water potential (19,518 /ha) followed by irrigation at -20 kPa (18,618 /ha) as given in Table 1. The higher cost of cultivation in irrigation at -10 kPa soil water potential was due to higher irrigation cost caused by more labour charges and pumping cost under this treatment. Among the varieties, the lowest cost of cultivation incurred in Jaldi Dhan 6 (17,868 /ha). This was due to its short duration which causes less amount of irrigation water consumption. The lower cost of cultivation at lower soil water potential was earlier reported by Sah et al. (2007) and Veeresh et al. (2011) in rice. All other three varieties have the same cost of cultivation (18,618 /ha).

GROSS RETURN AND NET PROFIT

Gross returns obtained from different rice varieties have shown a greater variation under various irrigation treatments. Highest gross return was found in irrigation at -10 kPa (39,399 /ha) due to higher grain (3.38 t/ha) and straw yields (5.32 t/ha) given in Table 1. Among the varieties, maximum gross return was obtained in Pusa 834 (40,478 /ha) followed by PNR 162 (36,997 /ha). Lowest gross returns (22,869 /ha) was obtained in Jaldi Dhan 6 due to its low yield. Maximum net return was obtained from Pusa 834 variety (21,860 /ha) and lowest (5,001 /ha) with Jaldi Dhan. Among the interaction between irrigation regimes and varieties the highest return was obtained from Pusa 834 along with irrigation schedule of -10 kPa (26,111 /ha) followed by Pusa 834 at -20 kPa soil water potential (Figure 1).

BENEFIT: COST ANALYSIS

Highest benefit cost ratio was obtained in Pusa 834 among the varieties and at -10 kPa soil water potential among the irrigation regimes

(Table 1). Lowest B: C ratio was obtained for Jaldi Dhan 6 (0.28) followed by PNR 381 (0.93) among the varieties and at -30 kPa (0.89) among the irrigation regimes. Interactions between different irrigation and varieties have shown that maximum B: C ratio was obtained at - 10 kPa (1.34) with Pusa 834. The highest B: C ratio of Pusa 834 variety was due to maximum grain (3.29 t/ha) and straw yield (5.19 t/ha) with irrigation at -10 kPa soil water potential (Figure 2). Sah et al. (2007) and Veeresh et al. (2011) found that at lower soil water potential aerobic rice accrued the higher net return and benefit: cost ratio.

Table 1: Gross returns (Rs/ha), net returns (Rs/ha) and benefit cost ratio of different irrigation regimes and rice varieties

Treatment	Gross return (Rs/ha)	Cost of cultivation (Rs /ha)	Net return (Rs /ha)	B:C ratio
Irrigation regimes (I)				
I1	39399.00	19518.00	19881.00	1.02
I2	35571.00	18618.00	16953.00	0.91
I3	27295.00	17718.00	9577.00	0.54
Varieties (V)				
V1	22869.00	17868.00	5001.00	0.28
V2	36997.00	18618.00	18379.00	0.99
V3	36008.00	18618.00	17390.00	0.93
V4	40478.00	18618.00	21860.00	1.17

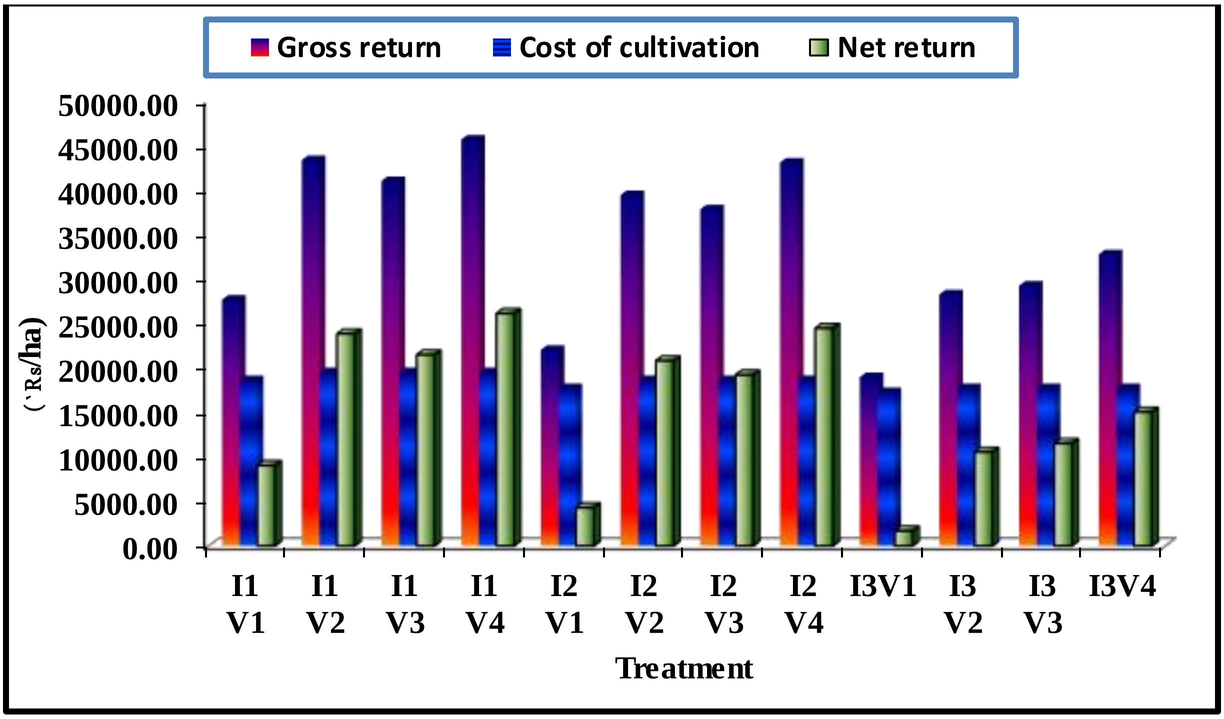

Fig. 1: Gross return (₹/ha), cost of cultivation (₹/ha) and net return (₹/ha) of aerobic rice cultivation under different treatments

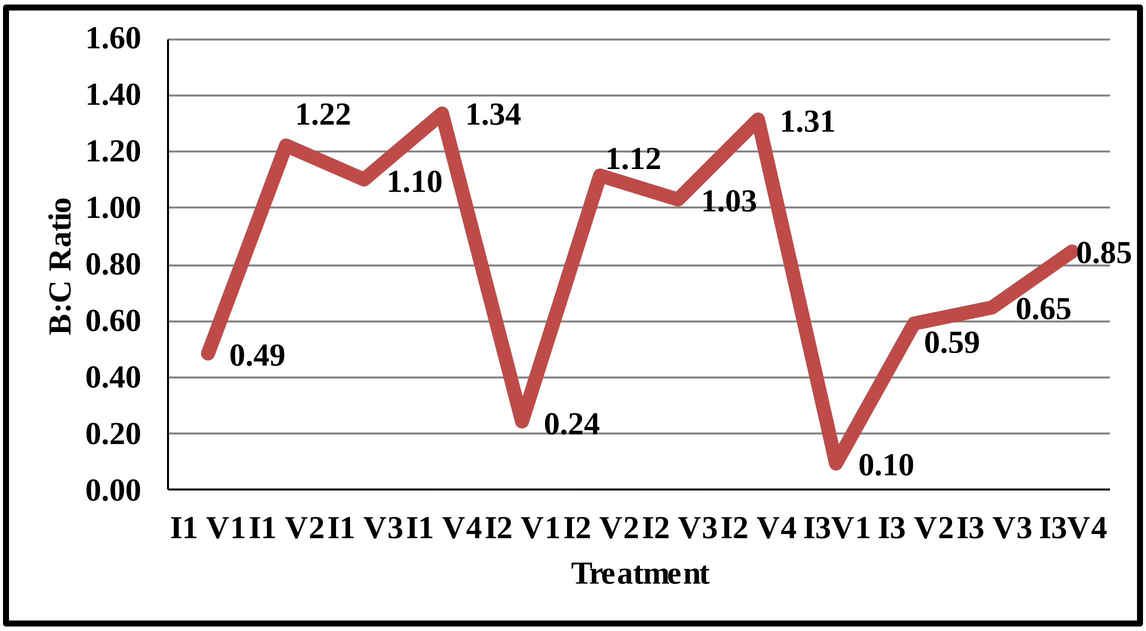

Fig. 2 B: C ratio of aerobic rice cultivation under interaction

CONCLUSION

It may be concluded that the adoption of rice variety Pusa 834 with irrigation at -20 kPa soil water potential is economically viable option under limited water availability in aerobic condition. However, Pusa 834 with irrigation at -10 kPa has given maximum net return and benefit-cost ratio. Aerobic rice systems are among the most promising approaches of water saving. In this context studies in future may be oriented in the direction of identifying suitable varieties for different agro-climatic Condition.

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