

Production potential and economics of hybrid rice during *boro* season under new alluvial zones of West Bengal

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ABSTRACT

A field experiment was conducted during the *boro* season of 2002-03 and 2003-04 on sandy clay loam soils of Instructional farm, B.C.K.V., Jaguli, Nadia, W.B. to study the effect of irrigation and different weed management practices on weed growth, yield potential, CU, WUE and finally economics of Hybrid rice. The experiment was laid out in split plot design with 4 levels of irrigation as main plots and 5 weed control treatments as subplots and replicated thrice. The hybrid cultivar ProAgro 6444 was used. Continuous submergence of 5+2 cm depth of water considerably reduced the weed-crop competition and increased the grain yield and decreased the dry matter production of total weeds over 3 days after disappearance of ponded water. Crop under continuous submergence along with unweeded control consumed maximum water use (153 cm) whereas, irrigation 3 days after disappearance of ponded water along with weed free check (fort night interval) gave the maximum water use efficiency (16.31 kg/ha/mm), it must be due to lowest water use with comparatively higher yield of rice under this treatment. Whereas, herbicide treatment of Pyrazosulfuron Ethyl along with continuous submergence recorded maximum benefit: cost ratio of 1.94:1.

Key Words: Hybrid rice, irrigation, weed management, yield potential, economics, consumptive use, water use efficiency.

India has the largest acreage under rice (44.6 mha) with a production of about 90 m tonnes, next to China. It is estimated that the rice production demand in 2010 will be 100 m tonnes and in 2025, the demand will be 140 m tonnes (The Hindu Survey of Indian Agriculture, 2004). Hybrid vigor in rice can profitably be used to increase its productivity by 14-28% over available best varieties India (Siddiq, 1993). In rice fields, varying soil moisture regimes, like continuous submergence to drier situation are followed. Singh and Singh (1998) recorded least weed growth and maximum crop yield under continuous submergence. The germination and emergence of weed seeds are closely related with the moisture status and depth of water standing on the soil. Thus a full proof irrigation management is important for controlling weeds in transplanted hybrid rice cultivation during *boro* season. Irrigation management not only controls weed growth but also decides the efficiency of applied herbicide to the crop (Moody, 1978). Hand weeding, though it is laborious, expensive and time consuming, is still one of the most effective methods of controlling weeds in our country. However, the chemical method of weed control is a better alternative and also advantageous over hand weeding particularly under intensive cropping systems. Improper water and weed management practices are important factors that control the ultimate yield of rice crop. Since there is lack of information on these aspects in the present

agro-climatic situation, the present investigation was undertaken to study the effect of different irrigation levels and weed management practices on yield potential, weed growth, consumptive use, water use efficiency and economics of hybrid rice in *boro* season.

MATERIALS AND METHODS

The field study was conducted during two consecutive dry seasons of 2002-03 and 2003-04 (May-Dec) at the Instructional farm, B.C.K.V., Jaguli, Nadia, W. B. having sandy clay loam soil, low in nitrogen, medium in phosphorus and high in potassium content with neutral soil pH. The experiment was laid out in split plot design with 3 replication and 20 treatment combinations. The main plots consisted of 4 irrigation levels, viz., continuous submergence with 5+2 cm irrigation water (I), irrigation at 1 day after disappearance of ponded water (I), irrigation at 2 days after disappearance of ponded water (I) and irrigation at 3 days after disappearance of ponded water (I), while subplot treatments consisted of 5 weed management practices, viz., unweeded control (W), weed free check at fort night interval (W), pre-emergence application of Pyrazosulfuron Ethyl (PSE) 10% WP @ 25 g ha⁻¹ at 7 DAT (W), pre-emergence application of Pretilachlor 50 EC @ 400 g ha at 3 DAT (W) and hand weeding twice at 25 and at 45 DAT (W). The hybrid rice variety (ProAgro 6444) was transplanted at 20X15 cm

apart accommodating 1 seedling per hill. Full doses of Phosphorus and Potash were applied as basal. 1/4th of the N was top dressed at 10 DAT, rest half N was top dressed at 25 DAT i.e., at active tillering stage and the rest 1/4th N was top dressed at 60 DAT i.e., at panicle initiation stage. Attempts were made to maintain different weed management practices and irrigation schedules as per different treatments.

Weed control efficiency (WCE) was computed using the following standard formula:

$$\text{WCE} = \frac{\text{Weed dry weight in unweeded check plot} - \text{Weed dry weight in treated plot}}{\text{Weed dry weight in unweeded check plot}} \times 100$$

RESULTS AND DISCUSSION

Weed Flora

The predominant weed associated with the crop were *Echinochloa crus-galli*, *Cynodon dactylon*, *Leersia hexandra*, *Cyperus rotundus*, *Fimbristylis miliacea*, *Ludwigia parviflora*, *Monochoria vaginalis*, *Marsilea quadrifolia* etc.

Weed dry weight at harvest

Due to lack of oxygen under continuously submerged condition, most of the weeds could not germinate and thereby low dry matter production of weeds were reported during both the years of investigation. Bhan (1983) also reported lower emergence of weeds due to continuous submergence.

Effects of different weed control treatments as compared to unweeded check (Table 1) were more pronounced in the weed-free check followed by hand weeding twice (25 and 45 DAT). Among the herbicidal treatments, Pyrazosulfuron ethyl (W) was equally effective and significantly superior over Pretilachlor (W) for controlling dry matter production of weeds. Weed control efficiency was also highest (81.55%) in the weed-free check (W) followed by hand weeding twice (W), pyrazosulfuron ethyl (W) and pretilachlor (W), respectively.

Yield potential

Yield of hybrid of hybrid rice was significantly affected by different levels of irrigation as well as by different weed management practices (Table 1). Continuous submergence produced significantly higher grain yield than other drier treatments except the minimum drier treatment (1 day after disappearance of water).

Among the drier treatments, minimum drier condition (1 day after disappearance of ponded water) responded significantly over maximum drier condition (3 days after disappearance of ponded water). Higher grain yield was recorded in the weed-free check (W) followed by hand weeding twice (W), these were statistically at par. This finding corroborates the findings of Choubey *et al.* (1998). Among the herbicidal treatments, Pyrazosulfuron ethyl (W) was found superior over Pretilachlor. However minimum value was obtained under unweeded control due to highest crop-weed competition.

Consumptive use and water use efficiency

Crop under continuous submergence coupled with unweeded control received 37.5 number of irrigations and recorded the maximum water use (153 cm), (Table. 2). Increased gap of cyclic submergence with intensity of weed infestation utilized less water as evapotranspiration resulting in lower value of water use. As a result irrigation at 3 days after disappearance of ponded water along with unweeded control recorded the minimum water use (42.5 cm).

Water use efficiency was also influenced by different levels of irrigations and methods of weed control. The highest value of WUE (16.31 kg ha⁻¹ mm⁻¹) was recorded under irrigation that under the same treatment combination, the highest yield was obtained with minimum water use. However, lowest value was noticed under irrigation at 1 day after disappearance of ponded water along with unweeded check.

Economics

Levels of irrigation in combination with methods of weed control directly influenced production economics of hybrid rice. The benefit: cost ratio was obtained under continuous submergence along with pre-emergence application of Pyrazosulfuron ethyl 10% WP @ 25 g ha⁻¹ at 7 DAT treatment combination followed by continuous submergence along with pre-emergence application of Pretilachlor @ 400 g ha⁻¹ at 3 DAT treatment combination. It was found that with the same irrigation levels when herbicides were combined, found to be more remunerative than manual weeding as the cost of manual weeding had become expensive than chemicals towards controlling the weeds.

Table 1. Effect of water and weed management practices on dry weight of weeds, weed control efficiency and grain yield of hybrid rice at harvest (Pooled of 2 years)

Treatments	Total dry weight of weeds (g m ⁻²) at harvest	Weed control efficiency (%) at harvest	Grain yield (t ha ⁻¹)
Levels of irrigation			
I	14.79		8.79
I	14.96		8.43
I	15.29		8.20
I	15.82		7.79
S.Em+-	0.145		0.386
C.D (P=0.05)	0.365		0.969
Methods of weed control			
W	33.93		5.72
W	6.26	81.55	7.53
W	12.98	61.74	6.81
W	15.49	54.35	6.71
W	7.41	78.16	7.14
S.Em+-	0.218		0.377
C.D (P=0.05)	0.524		0.907

Table 2. Effect of treatment combinations on consumptive use (cm), water use efficiency (kg ha⁻¹ mm⁻¹) and benefit: cost ratio of hybrid rice (Mean of 2 years)

Treatment	Combination	Consumptive use	Water use Efficiency	Benefit: Cost ratio
I	W	153	4.02	1.71:1
	W	123	6.68	1.47:1
	W	133	5.62	1.94:1
	W	143	4.54	1.79:1
	W	127	5.96	1.72:1
I	W	92.5	6.26	1.57:1
	W	67.5	11.62	1.36:1
	W	80	8.38	1.92:1
	W	87.5	7.20	1.71:1
	W	72.5	10.35	1.68:1
I	W	77.5	7.39	1.53:1
	W	50	14.38	1.16:1
	W	62.5	10.67	1.87:1
	W	70	7.50	1.34:1
	W	42.5	16.31	1.09:1
I	W	60	10.73	1.77:1
	W	65	8.88	1.45:1
	W	50	13.58	1.43:1

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