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Grain yield and economics of deepwater rice as influenced by variety and weed management

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ABSTRACT

In farmers' participatory trials carried out in five different villages of Brahmagiri Block in the Puri district of Orissa, the relative contribution of improved variety and integrated weed management practices to grain yield and economics of deepwater rice was evaluated. The yield was significantly improved due to adoption of improved variety. The improved variety, Durga produced 68% more yield than the traditional variety, Dhuia Bakui. In contrast, the adoption of integrated weed management practices alone enhanced the grain yield to the tune of 49% over traditional weed management practices. The overall yield enhancement due to adoption of improved variety combined with integrated weed management practices was 143% over cultivation of traditional variety with traditional weed management practices. The highest net monetary return (Rs. 5383 ha^{-1}) and benefit:cost ratio (1.66) was recorded in the treatment where improved variety was grown with integrated weed management practices.

Key words: *variety, weed management practice, grain yield, economics, deepwater rice*

Weeds are the major biological constraint in most rice-growing areas of the world. The problem is more critical particularly in deepwater rice field. The field is generally dry at seeding time, becomes moist with rain and is finally flooded. The various land conditions in this rice ecology from upland to lowland or to flooded are suited to all types of weeds, including upland, lowland and aquatic weed types. One single method of weed control is not enough under such situation. Favourable cultivars with good weed competition are desirable so that farmers' inputs can be minimized and their incomes maximized (Nantasomsaran and Moody, 1995). Indirect weed control practices including land preparation, time of seeding, plant population, and fertilization can further increase the competitive ability of rice and enable it to suppress weed growth. Integrated weed management by rational use of indirect and direct weed control methods not only control the weeds effectively but also reduces the total cost of weed control. Thus, a number of indirect and direct methods can be combined economically in a given situation in terms of net benefits (Ampong-Nyarko and DeDatta, 1991).

Farmers' participatory trials were carried out during the wet seasons of 2002 and 2003 under typical deepwater rice ecology in five system villages of Brahmagiri Block in the Puri district of coastal Orissa. The soil of the experimental fields were sandy loam in texture having pH 4.4–5.2, organic carbon 0.46–0.52%, total nitrogen 0.056–0.069%, available phosphorus 12.3–15.3 kg ha^{-1} and available potassium 113.4-129.6 kg ha^{-1}. The relative contribution of improved (recommended) variety and integrated weed management (IWM) practices to grain yield and production economics of deepwater rice was compared with that of traditional weed management practices adopted by the farmers with traditional (local) rice varieties. Thus, four treatment combinations (Table 1) were laid out in a randomized complete block design in ten farmers' fields (2 farmers from each village). An area of 200 m^2 was considered as one treatment plot and each farmer's field with an area of 800 m^2 was considered as one replication. Improved deepwater variety, Durga (tall, long duration-170 days and photo period sensitive) and local variety, Dhuia Bakui (Semitall, long duration-165 days and photoperiod sensitive) were directly sown during the first week of June under both weed management practices. The IWM practices included one deep ploughing one month

prior to sowing followed by proper cleaning of stubbles and weeds; preparation of stale seed bed by shallow tillage a fortnight before sowing to allow the surface weed seeds to germinate with pre-monsoon shower followed by final land preparation through shallow tillage prior to sowing; seeding in 20 cm apart rows behind plough with a seed rate of 80 kg ha^{-1} for getting optimum plant population; application of moderate dose of P_2O_5 and K_2O (20 kg each ha^{-1}) at sowing, omitting basal N application which encourages more weed growth and application of 30 Kg N ha^{-1} at 21 days after sowing (DAS); pre-emergence application of pretilachlor at 600 g ha^{-1} 3 DAS followed by post-emergence application of 2,4-D Na salt at 750 g ha^{-1} 30 DAS. These were compared with the traditional weed management (TWM) practices of broadcast method of seeding with a high seed rate of 110-120 kg ha^{-1} for maintaining high plant population to suppress weeds at early growth stages and one manual weeding at later stage of crop growth (60-70 DAS) for the removal of broad leaf and aquatic weeds. No fertilizer was used in traditional weed management plots as it is a normal practice of the farmers in deepwater rice ecosystem.

The data on weed density was recorded from a quadrate of 1 m^2 at early growth stage (30 DAS) and at flowering stage (130 DAS) of the crop while the dry weight of weeds was recorded at flowering stage. Grain and straw yield of rice along with yield attributing characters were recorded at harvest. Economics of the practices were calculated based on the price of the produce in the local market and wages prevalent in the area. The recorded data was subjected to statistical analysis.

The major weed species recorded at early vegetative stage (30 DAS) of rice crop in the plots where traditional weed management practices adopted were *Echinochloa colona, crusgalli, Leersia hexandra, Panicum repens, Cyperus iria, C.rotundus, Fimbristylis miliaceae, Ludwigia parviflora, Scoparia dulcis, Alternanthera sessilis,* and *Cleome viscosa.* It was observed that the grasses constituted 51.4%, sedges 34.1% and broad leaf weeds 14.5% of the total weed population at 30 days stage. However, the major weed species recorded at 130 days stage were *L. hexandra, P. repens, Cyperus haspan, Schoenoplectus maritimus, Aeschynomene aspera, C. viscosa, Marsilia quadrifolia, Commelina benghalensis, Trianthema monogyna, Monochoria vaginalis, Melochia corchorifolia, Pistia stratiotes, Ipomoea aquatica, Polygonum hydropiper, Brachiaria mutica* in traditional weed management plots. The mean relative density was 5.1, 4.2 and 90.7 percent for grasses, sedges and broad leaf (including aquatic) weeds at this stage.

Integrated weed management practices significantly reduced the population build up and dry matter accumulation by weeds in both the varieties. However, the response was more with improved variety, Durga. The lowest weed density of 28 no. m^{-2} and dry weight of weeds (0.18 t ha^{-1}) were recoded in the plots where integrated weed management practices were adopted with improved variety, Durga (Table 1).

The improved rice variety, Durga performed better and outyielded the local variety, Dhuia Bakui with both integrated and traditional weed management

Table 1. Yield performance and economics of deepwater rice as influenced by variety and weed management techniques (2 years' pooled data)

Treatments	Plant height (cm)	Ear bearing tiller m^{-2}	Panicle weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Weed density (no. m^{-2})	Weed dry weight (t ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	Benefit: cost ratio
TV + TWM	124	130	1.26	1.16	2.86	139	1.16	5927	197	1.03
TV + IWM	133	171	1.38	1.57	3.73	47	0.27	7959	439	1.06
IV + TWM	115	159	3.12	1.78	4.17	89	0.76	8997	2667	1.42
IV + IWM	146	211	3.29	2.82	4.94	28	0.18	13503	5383	1.66
CD (P=0.05)	3.2	13.3	0.11	0.51	0.62	12.4	0.08	-	-	-

TV – Traditional variety; IV – Improved variety; IWM – Integrated weed management techniques; TWM – Traditional weed management practices

Cost of cultivation (Rs ha^{-1}) : TV + TWM – 5730 ; TV + IWM : 7520 ; IV + TWM : 6330 ; IV + IWM : 8120

practices but the response was more with IWM practices. Significantly highest grain yield of 2.96 t ha^{-1} was recorded in the plots where improved variety, Durga was grown with IWM practices (Table 1). Higher grain yield of Durga might be due to better response of the variety with IWM practices as reflected by lowest weed population (28 m^{-2}) and dry matter accumulation (0.18 t ha^{-1}), better plant height (146 cm) and significantly more number of ear bearing tillers (211 m^{-2}) and panicle weight (3.29 g). Similar trend was also observed in respect of straw yield of rice.

The relative contribution of varieties to grain yield showed that the yield improvement due to adoption of variety, Durga was 68% more than the traditional variety, Dhuia Bakui indicating better weed competitive ability of the improved variety, Durga. In contrast, the adoption of IWM practices alone enhanced the grain yield of rice to the tune of 49 percent over traditional weed management practices due to better control of weeds as reflected on less weed density and weed dry weight (Table 1), indicating the greater feasibility of the adoption of IWM practices for overall enhancement of rice productivity in deepwater ecology. It was also observed that adoption of IWM practices enhanced the grain yield by 58 percent in improved variety, Durga, while it was only 35 percent in case of local variety, Dhuia Bakui. It reflected higher response of improved variety, Durga to IWM practices. It was also found that the overall yield enhancement of rice crop was 143 percent in the treatment where the improved rice variety, Durga was grown with IWM practices in comparison to the treatment where Dhuia Bakui was grown with traditional weed management practices indicating the importance of both the variety and weed management techniques for getting the maximum yield advantage under deepwater rice ecology.

While considering the economic feasibility of different treatments, it was found that the highest cost of cultivation (Rs. 8120 ha^{-1}) was recorded in the treatment where IWM techniques were adopted with improved variety, Durga. But due to higher yield in the same plots, the net monetary return was found to be higher (Rs.5383 ha^{-1}) in comparison to other plots. The highest benefit: cost ratio of 1.66 was registered in the same treatment. Adoption of integrated weed management practices with local variety was not found to be remunerative (Table 1). It emphasizes that by adopting the IWM practices with improved variety, farmers could get more benefit from deepwater rice cultivation.

Thus, it may be concluded from this study that the selection of appropriate variety is one of the important criteria for getting the maximum economic benefits through the adoption of integrated weed management practices for improving the overall productivity of deepwater rice.

REFERENCES

Ampong-Nyarko K and SK De Datta 1991. A handbook for weed control in rice. International Rice Research Institute. P.O. Box 933, Manila Philippines. 113p

Nantasomsaran P and Moody K 1995. Weed management for rainfed lowland rice. In: Ingram KT, ed. Rainfed lowland rice : agricultural research for high risk environments. International Rice Research Institute. P.O. Box 933, Manila Philippines. 45p