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Effect of variety and weed management practices on productivity of deepwater rice

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ABSTRACT

On-farm farmers' participatory trials were carried out during the wet seasons of 2004 and 2005 under rainfed deepwater rice ecosystem in five different villages of Ersama Block in the Jagatsinghpur district of coastal Orissa to evaluate the effect of improved variety and integrated weed management techniques on grain yield and production economics of deepwater rice. The yield improvement due to adoption of improved variety, Durga was 76% more than the traditional variety, Bhaluki. In contrast, the adoption of integrated weed management techniques alone enhanced the grain yield to the tune of 56% over traditional weed management practices. The overall yield enhancement of rice due to adoption of improved variety along with integrated weed management practices was 157% more than cultivation of traditional variety with traditional weed management practices. The highest net monetary return (Rs. 5848 ha^{-1}) and benefit : cost ratio (1.72) was recorded in the plots where improved variety, Durga was grown with integrated weed management techniques.

Key words: *Variety, weed management practices, production potential, deepwater rice*

Weed competition is one of the prime yield limiting biotic constraints in rice. The nature, extent and intensity of weed problems in rice depends upon the type of ecosystem in which it is grown along with some other factors like land topography, hydrology, rice varieties, crop stand establishment methods, soil type and water management practices. However, the problem of weed is more critical in deepwater rice ecosystem where the land is generally dry at seeding, becomes moist with rain and is finally flooded. The various land conditions in this rice ecosystem from upland to lowland and to flooded are suited to all types of weeds. One single method of weed control is not enough under such situation. Favourable cultivars with good weed competiveness 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 plant 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 economic benefits (Ampong-Nyarko and DeDatta, 1991). Keeping this in view, an investigation was undertaken to study the effect of variety and integrated weed management techniques on the performance of rice crop in deepwater ecosystem.

MATERIALS AND METHODS

On-farm farmers' participatory trials were carried out during the wet seasons of 2004 and 2005 under deepwater rice ecosystem in five different villages of Ersama Block in the the Jagatsinghpur district of coastal Orissa. The soil of the experimental fields were sandy loam in texture having pH 5.2 – 5.7, organic carbon 0.41 – 0.52%, total nitrogen 0.052 – 0.064%, available phosphorus 13.3 – 15.2 kg ha^{-1} and available potassium 106.4 - 115.6 kg ha^{-1}. The relative contribution of improved (recommended) variety and integrated weed management (IWM) techniques 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)

Table 1. Yield performance and economics of deepwater rice as influenced by variety and weed management techniques

Treatments	Plant height (cm)	Ear bearing tiller m^{-2}	Panicle weight(g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Weed density* (nos. m^{-2})	Weed dry weight* (t ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	Benefit : cost ratio
TV + TWM	117	139	1.22	1.15	2.98	126	1.04	5792	62	1.01
TV + IWM	126	179	1.34	1.52	4.10	48	0.26	7720	200	1.03
IV + TWM	111	167	2.95	1.73	4.28	67	0.57	8632	2302	1.36
IV + IWM	134	223	3.22	2.96	5.32	23	0.11	13968	5848	1.72
CD (P=0.05)	2.4	11.2	0.12	0.58	0.72	11.2	0.07	-	-	-

TV – Traditional variety ; IV – Improved variety; TWM – Traditional weed management; IWM – Integrated weed management
*2 years' pooled data

were laid out in a randomized complete block design in ten farmers field (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, Bhaluki (Semitall, long duration-165 days and photoperiod sensitive) were directly sown during the first week of June under both the weed management practices. The IWM techniques 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 one 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 which helped in uprooting and killing of germinated weeds; 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, escaping 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, 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 a normal practice of the farmers in deepwater rice ecosystem.

The data on weed population 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.

RESULTS AND DISCUSSION

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, Echinochloa crusgalli, Leersia hexandra, Panicum repens, Cyperus iria, Cyperus rotundus, Fimbristylis miliaceae, Ludwigia parviflora, Scoparia dulcis, Alternanthera sessilis,* and *Cleome viscosa.* It was observed that the grasses constituted 46.6%, sedges 32.7% and broad leaf weeds 20.7% of the total weed population at 30 days stage. However, the major weed species recorded at 130 days stage were *Leersia hexandra, Panicum repens,* C*yperus haspan, Schoenoplectus maritimus***,** *Aeschynomene aspera, Cleome viscosa, Marsilea 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 7.1, 10.2 and 82.7% 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 (23 nos. m^{-2}) and dry weight of weeds (0.11 t ha^{-1}) were recoded in the plots (at flowering stage of the crop) where integrated weed management techniques were adopted with improved variety, Durga (Table 1).

The experimental results revealed that the improved rice variety, Durga performed better and out yielded the local variety, Bhaluki with both integrated and traditional weed management practices but the response was more with IWM techniques. Significantly highest grain yield of 2.96 t ha^{-1} was recorded in the plots where improved variety, Durga was grown with IWM techniques (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 (23 nos. m^{-2}) and weed dry matter accumulation (0.11 t ha^{-1}), better plant height (134 cm) and significantly more number of ear bearing tillers (223 m^{-2}) and panicle weight (3.22 g). Similar trend was also recorded with straw yield of rice.

The relative contribution of varieties to grain yield showed that the yield improvement due to adoption of variety, Durga was 76% more than the traditional variety, Bhaluki indicating better weed competitive ability of the improved variety, Durga. In contrast, the adoption of IWM techniques alone enhanced the grain yield of rice to the tune of 56% over traditional weed management practices, indicating the feasibility of the adoption of IWM techniques for overall enhancement of rice productivity in deepwater ecology. It was also observed that adoption of IWM techniques enhanced the grain yield by 71% in improved variety, Durga, while it was only 32% in the local variety, Bhaluki. It reflected higher response of improved variety, Durga to IWM techniques. It was also found that the overall yield enhancement of rice crop was 157% in the treatment where the improved rice variety, Durga was grown with IWM techniques in comparison to the treatment where the rice variety, Bhaluki was grown with traditional weed management practices that realized the importance of both the variety and weed management techniques for getting the maximum yield advantage under deepwater rice ecology.

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 better yield in the same treatment plots, the net monetary return was found to be higher (Rs.5848 ha^{-1}) in comparison to other treatment plots. The highest benefit: cost ratio of 1.72 was registered in the same treatment plots. Adoption of integrated weed management practices with local variety was not found to be remunerative (Table 1). It was realized that by adopting the IWM techniques with improved variety, farmers could get more benefit from deepwater rice cultivation.

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 techniques for improving the overall productivity of deepwater rice.

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