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Influence of seeding and weed control methods on the productivity of puddle seeded rice

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Abstract

A field investigation was carried out during *kharif* 2004 to 2006 at Palampur with nine treatment combinations of three seeding methods (drum seeding at 70-80 kg/ha, drum seeding at 70-80 kg/ha + green manuring with *Sesbania* and broadcasting at 100 kg seed/ha) and three weed control methods [farmer's practice, butachlor 1.50 kg/ha/pretilachlor 0.75 kg/ha+safflor followed by (*fb*) *halod* and cyhalofop butyl 90 g/ha (15 DAS) *fb* 2, 4-D 1.0 kg/ha (30-35 DAS)] for their effect on weeds and productivity in puddle seeded rice. Broadcast seeding significantly reduced population of *Echinochloa* and *Scripus sp.* in 2004. Cyhalofop butyl fb. 2, 4-D and butachlor fb. *halod* were significantly superior to farmers practice of hand weeding twice (25 & 45 days) in decreasing the count of *Echinochloa, Cyperus sp.* and *Cynotis sp.*, but were poor on *Eriocolon sp.* Cyhalofop butyl fb. 2, 4-D was superior to butachlor fb. *halod* or handweedig twice in reducing the count of *Scripus* sp. in 2006. Drum seeding increased rice grain yield by 8.3% over drum seeding along with green manuring and 2.3% over broadcast seeding. Cyhalofop butyl fb. 2, 4-D gave higher grain yield than butachlor in all the three years and hand weeding twice in 2005 and 2006. Cyhalofop butyl increased rice yield by 12.1% over butachlor fb. *halod* and 7.2% over hand weeding twice.

Key words: Seeding method, weeds, butachlor, cyhalofop butyl, rice.

Introduction

Where plenty of irrigation water is available, puddle seeding and transplanting are the general methods for planting rice. The former is more popular where labour is scarce. International Rice Research Institute (IRRI) researchers are of the opinion that there is no significance difference in yield of transplanted and direct seeded rice if good management practices are used with each method. Broadcasting of pre-germinated seeds onto the puddle field is generally practiced in puddle seeded rice. Weeding is a problem if broadcast seeding is used. Broadcast seeded rice also had a greater tendency to lodge because of poor root development and anchorage. The weeding problem is less in row seeding because it allows the use of mechanical weeders. Development of manually operated aerobic rice drum seeder makes it feasible to seed rice in rows for ease in weeding with mechanical weeder. Butachlor is very popular herbicide in rice and is a better replacement/substitute to manual weeding (Paradkar *et al.*,1997; Angiras and Rana, 1998a&b; Porwal,1999). Integration of *halod* (an interr cultural operation in standing rice crop) with the pre-emergence application of butachlor is more effective against weeds (Angiras and Rana 1998b, Rana and Angiras 1999). Farmers also require some alternative post-emergence herbicide treatment if by one or the other reason pre-emergence

application of butachlor is skipped. Under such situations cyhalofop butyl has emerged as an important tool for early post -emergence applications. Cyhalofop is a grass herbicide does not take care of broadleaf weeds. Therefore, combined or sequential application of 2, 4-D nicely takes care of the mixed flora of weeds in rice. Keeping the above facts in mind the present investigation was undertaken to study the effect of pre and post emergent herbicidal activity on the productivity of puddle seeded rice under different seeding techniques.

Materials and Methods

A field experiment was conducted during the three consecutive *kharif* seasons of 2004, 2005 and 2006 at Palampur. The soil of the experimental field was silty clay loam in texture, acidic in reaction (pH 5.6) and medium in available N (326 kg N ha^{-1}), P (19.8 kg ha^{-1}) and K (214.8 kg ha^{-1}). Nine treatment combinations of 3 seeding methods (drum seeding at 70-80 kg seed/ha, drum seeding at 70-80 kg seed/ha + green manuring with sesbania and broadcasting at 100 kg seed/ha) and 3 weed control methods [farmer's practice of hand weeding twice (25 & 45 DAS), butachlor 1.50 kg ha^{-1} (pre) *fb halod* and cyhalofop butyl at 90 g ha^{-1} *fb* 2, 4 –D at 1.0 kg ha^{-1}] were tested in randomized block design with three replications. Rice was sown on June 25, 28 and 12 during 2004, 2005 and 2006, respectively. In case of drum seeding – row seeder spaced at 20 cm row spacing was used. The drum was mounted on two wheels which were placed at both ends. Pre-germinated seeds (soaking for 48 hours in water followed by incubation for 36-48 hours) of paddy c.v, HPR 957 were filled in the drums and the drum seeder was manually dragged on the field after draining the water to saturation. In broadcasting method pre-germinated seeds were uniformly broadcasted onto the puddle fields. During the first four to five days after seeding, the field was kept moist but not flooded followed by, 1-2 cm of water upto 15 days. There onwards the water level was increased to 5 cm until 60days after sowing and then frequently irrigated until 20 days before crop maturity. Application of herbicides was made with power sprayer using 700 L water per hectare. *Halod* [An intercultural operation in standing rice crop with bullocks drawn plough(manually in the present case) in impounding water with thinning /gap filling with the seedlings from the same field], was carried out after 25 days after seeding. The crop was fertilized with 90 kg N, 40 kg P_2O_5 and 40 kg K_2O/ha. Half N and whole of the P_2O_5 and K_2O were applied as basal. The remaining half N was topdressed in two equal splits at tillering and panicle initiation stages of the crop growth. For rest of the management practices the recommended package of practices of the University was followed. Weed count and dry weight were recorded at 60 and 90 DAS from two randomly selected spots (0.25 m^2) in each plot and expressed as number/m^2 and g m^{-2}, respectively. The data on count and dry weight of weeds were subjected to $\sqrt{x+1}$ (square root transformation) for statistical analysis. Yields were harvested from net plot.

Results and Discussion

Weed flora

Echinochloa crusgalli, Cyperus iria, Cynotis axillaris, Scirpus sp. and *Ageratum conyzoides* were the predominant weeds found growing in association with rice crop. At maximum population stage, *Echinochloa, Cyperus* and *Scripus sp.* were the important weeds constituting 30.6, 21.4 and 20.4 per cent, respectively of the total weed flora during the period of investigation. *Cynotis* and *Ageratum* showed their little infestation constituting 2.6 and 0.9 per cent, respectively of the total weed flora. The former had shown its invasion during 2004 and 2005, while the later during 2004 only. The other weeds *viz. Eriocolon* and *Ammania* as a whole representing 26.1 per cent of the total weed population. *Eriocolon* and *Ammonia* were also presents towards the maturity of the crop at 90 DAS. It is also to mention that weed competition was more severe in the initial year and decreased progressively thereafter.

Effect on weeds

a) Seeding methods

Seeding methods brought about significant variation in the count of *Echinochloa crusgalli* at 60 DAS during 2004 and 2005 and *Scripus* and other broad-leaved weeds during 2004 (Table 1-2). Probably owing to higher seeding rate and thereby plant population, broadcast seeding resulted in significantly lower count of *Echinochloa* and *Scripus* during 2004. But broadcast seeding was at par with drum seeding at 70-80 kg seed/ha in influencing the count of broadleaved weeds during 2004. Drum seeding at 70-80 kg seed/ha along with green manuring with *daincha* was better than drum seeding at 70-80 kg seed/ha in decreasing the count of *Echinochloa* and *Scripus* in 2004. Drum seeding was dominated by other broadleaf weeds in 2004. Drum seeding + green manuring was better than both drum seeding alone and broadcast seeding alone in decreasing the count of *Echinochloa crusgalli* in 2005. Seeding methods resulted in the significant variation in the total count and dry weight of weeds in 2004 and 2006 (Table 3). Broadcast seeding resulted in lowest total count and dry weight of weeds in 2004 , but had highest count and dry weight of weeds in 2006. Drum seeding and drum seeding + green manuring were statistically equal in influencing the total weed count both during 2004 and 2006. While drum seeding was better than drum seeding + green manuring in influencing total weed dry weight in 2004, it was exactly opposite in 2006 and later was better than the former.

b) Weed control methods

Cyhalofop butyl fb. 2, 4-D and butachlor fb. *halod* resulted in significantly lower count of *E. crusgalli* over hand weeding twice at 60 DAS in 2006 and 90 DAS during 2005 and 2006. Similarly cyhalofop butyl fb. 2, 4-D and butachlor fb. *halod* were superior to hand weeding twice in reducing the count of *Cyperus* sp. in all the three years and at 90 DAS in 2005. Superiority of butachlor/ pretilachlor fb. *halod* over hand weeding twice in controlling *Echinochloa* and other weeds in puddle seeded rice has been

Table 1. Effect of treatments on count of grassy weeds in puddle seeded rice

Treatment	*Echinochloa*					*Cyperus*					*Cynotis*		
	60 DAS			90 DAS		60 DAS			90 DAS		60 DAS		90DAS
	2004	2005	2006	2005	2006	2004	2005	2006	2005	2006	2004	2005	2005
Seeding methods													
Drum seeding 70-80 kg/ha	8.1 (68.4)*	3.9 (16.8)	1.2 (0.8)	4.2 (17.7)	1.6 (2.3)	6.4 (48.0)	2.6 (7.1)	1.0 (1.7)	2.3 (5.3)	1.5 (1.9)	1.1 (0.4)	1.5 (2.2)	1.3 (1.3)
Drum seeding 70-80 kg/ha + green manuring with sesbania	7.5 (61.3)	2.4 (6.2)	1.5 (2.2)	3.9 (17.3)	1.0 (0.1)	5.6 (32.8)	3.0 (10.6)	1.0 (1.3)	3.1 (9.3)	1.1 (0.2)	1.4 (1.3)	1.7 (2.6)	1.3 (0.8)
Broadcast seeding 100 kg/ha	6.5 (47.1)	4.09 (16.4)	1.2 (0.8)	3.3 (11.5)	1.0 (0.1)	6.0 (40.0)	2.6 (7.5)	1.1 (4.4)	3.6 (13.3)	1.0 (0.1)	1.1 (0.4)	1.2 (0.8)	1.4 (1.3)
CD (0.05)	0.6	1.3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed Management													
Cyhalofopbutyl 90 g/ha (15 DAS) + 2, 4-D 1.0 kg/ha (35 DAS)	6.6 (47.5)	3.1 (11.5)	1.0 (0.0)	3.8 (15.5)	1.0 (0.3)	4.6 (20.0)	1.9 (4.0)	0.8 (1.2)	2.9 (8.8)	1.1 (0.2)	1.1 (0.4)	1.2 (0.8)	1.1 (0.4)
Butachlor 1.5 kg/ha/Pretilachlor + Safener 0.75 kg/ha (7 DAS) + *halod*	7.1 (55.5)	3.9 (15.5)	1.0 (0.0)	3.7 (14.2)	1.2 (1.6)	6.4 (48.0)	2.8 (7.5)	1.1 (0.4)	2.9 (8.8)	1.2 (1.0)	1.1 (0.4)	1.6 (2.6)	1.0 (0.0)
Hand weeding twice (25 & 45 DAS)	8.3 (73.7)	3.3 (12.4)	1.9 (4.0)	5.7 (16.8)	1.4 (0.9)	7.0 (52.0)	3.5 (13.7)	2.4 (6.2)	3.2 (10.2)	1.2 (0.9)	1.4 (1.3)	1.6 (2.2)	1.8 (3.1)
CD (P=0.05)	NS	NS	0.72	0.8	0.2	1.1	1.2	0.1	0.2	NS	NS	NS	0.6

*Values given in the parentheses are the original means. Data transformed to square root transformation. DAS- days after sowing

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Table 2. Effect of treatments on count of broadleaved weeds in puddle seeded rice

Treatment	*Ageratum*	*Eriocolon*	*Ammania*	*Scripus*			*Other weeds*				
	60 DAS	90 DAS		60 DAS			60 DAS			90 DAS	
	2004	2005	2006	2004	2005	2006	2004	2005	2006	2005	2006
Seeding methods											
Drum seeding 70-80 kg/ha	1.0 (0.0)*	6.0 (40.0)	2.0 (4.0)	4.5 (20.0)	4.7	4.5 (25.7)	2.9 (9.3)	6.7 (45.7)	1.6 (2.6)	6.7 (46.6)	1.5 (1.7)
Drum seeding 70-80 kg/ha + green manuring with sesbania	1.5 (2.2)	5.7 (36.0)	1.5 (2.2)	2.9 (10.6)	3.9	2.6 (12.8)	6.1 (44.8)	6.0 (39.1)	1.5 (2.6)	6.0 (36.8)	1.3 (1.2)
Broadcast seeding 100 kg/ha	1.1 (0.4)	5.0 (27.5)	1.4 (1.3)	1.6 (4.4)	3.9	4.2 (20.8)	2.3 (6.6)	5.6 (33.3)	1.8 (4.0)	5.9 (34.6)	1.8 (2.8)
CD (P=0.05)	NS	NS	-	1.16	NS	NS	1.7	NS	NS	NS	NS
Weed Management											
Cyhalofopbutyl 90 g/ha (15 DAS) + 2, 4-D 1.0 kg/ha (35DAS)	1.0 (0.0)	6.7 (47.5)	1.9 (4.0)	2.6 (9.7)	4.6	1.3 (2.2)	2.0 (4.8)	5.6 (36.0)	2.0 (4.4)	5.6 (31.3)	1.3 (1.2)
Butachlor 1.5 kg/ha/Pretilachlor + Safner 0.75 kg/ha(7 DAS) + *halod*	1.2 (0.8)	5.8 (37.3)	1.6 (2.2)	3.0 (11.5)	4.0	4.9 (28.8)	3.9 (20.4)	6.4 (4.3)	1.7 (3.5)	7.2 (53.3)	1.5 (1.7)
Hand weeding twice (25 & 45 DAS)	1.4 (1.7)	4.1 (18.6)	1.4 (1.3)	3.4 (13.7)	3.9	5.0 (28.4)	5.3 (35.5)	6.4 (40.8)	1.2 (1.3)	5.8 (33.3)	1.8 (2.9)
CD (P=0.05)	NS	1.1	NS	NS	NS	1.55	NS	NS	NS	0.9	0.2

*Values given in the parentheses are the original means. Data transformed to square root transformation. DAS- days after sowing

Table 3. Effect of treatments on total weed count, total dry weight and grain yield of puddle seeded rice

Treatments	Total weed count (No m^{-2})			Total dry weight (g m^{-2})			Grain yield (kg/ha)		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
Seeding methods									
Drum seeding 70-80 kg/ha	11.9 (147.5)*	10.6 (115.1)	6.6 (44.0)	12.8 (174.7)	5.8 (35.1)	2.6 (6.3)	1632	2811	3264
Drum seeding 70-80 kg/ha + green manuring with sesbania	12.4 (153.3)	10.0 (102.6)	6.8 (45.7)	13.8 (208.2)	5.2 (28.8)	2.0 (3.4)	1426	2622	3071
Broadcast seeding 100 kg/ha	9.6 (100.4)	9.4 (89.7)	8.2 (67.5)	10.1 (108.7)	4.7 (22.9)	3.5 (11.8)	1737	2616	3176
CD (P=0.05)	1.2	NS	0.7	0.5	NS	0.3	167	182	76
Weed Management									
Cyhalofopbutyl 90 g/ha (15 DAS) + 2, 4-D 1.0 kg/ha (35DAS)	11.8 (145.3)	10.6 (115.5)	7.0 (49.7)	14.3 (223.2)	4.2 (20.0)	2.5 (6.7)	1644	2965	3326
Butachlor 1.5 kg/ha/Pretilachlor + Safner 0.75 kg/ha(7 DAS) + *halod*	11.3 (139.1)	10.7 (116.0)	7.4 (55.3)	12.5 (171.2)	5.3 (28.3)	2.9 (8.2)	1508	2580	2990
Hand weeding twice (25&45 DAS)	10.7 (116.8)	8.7 (76.0)	7.2 (52.7)	9.8 (97.2)	4.2 (37.6)	2.6 (6.6)	1642	2503	3102
CD (P=0.05)	NS	1.2	NS	1.3	1.1	NS	113	201	119

*Values given in the parentheses are the original means

reported (Angiras and Rana, 1998 b and Rana and Angiras, 1999). The morphological similarity of these weeds with that of rice crop make weeding difficult and they are often overlooked, that is why herbicides might be better than hand weeding. However, cyhalofop butyl fb. 2, 4-D was superior to butachlor fb. *halod* on *Cyperus* sp. at 60 DAS in 2004 and 2006. Count of *Scripus* sp. was significantly lower in cyhalofop butyl fb. 2, 4-D treated plots than both butachlor fb. *halod* and hand weeded plots at 60 DAS in 2006. Cyhalofop butyl fb. 2, 4-D and butachlor fb. *halod* remaining at par resulted in significantly lower count of *Cynotis*, but both were poor on *Eriocolon* than hand weeding twice at 90 DAS in 2005. Butachlor fb. *halod* had significantly higher count of other broadleaved weeds at 90 DAS in 2005 but both were superior to hand weeding in 2006.

Hand weeding twice resulted in significantly lower total weed count and dry weight than both butachlor fb. *halod* and cyhalofopbutyl fb. 2, 4-D during 2005. But cyhalofop butyl fb. 2, 4-D was equal to hand weeding twice in reducing total weed dry weight in 2005.

Effect on yield attributes and yield

Broadcast seeding resulted in significantly higher rice grain yield over drum seeding + green manuring with daincha. It indicated that simultaneously growing of green manuring may not always have immediate positive effect on rice productivity. However, drum seeding was equal to broad cast seeding in 2004 but was better in 2005 and 2006. Superiority of direct seeding has also been advocated by Mazid and Johnson (2006). On an average drum seeding at 70-80 kg seed/ha increased rice grain yield by 8.3% over drum seeding and green manuring and by 2.3 % over broadcast seeding. The higher yield under drum seeding at 70-80 kg/ha might be owing to comparatively better growth and yield attributes viz. plant height, effective plant population, length of panicle and spikelets/panicle (Table 4).

As for as weed control methods are concerned, cyhalofop butyl fb. 2, 4-D was better than butachlor fb. *halod* in all the three years and hand weeding twice in 2005 and 2006. The superior performance of cyhalofop-butyl fb. 2,4-D was because of better weed killing ability and thereby higher growth and yield contributing traits of puddle seeded rice. On an average cyhalofop butyl increased rice grain yield by 12.1% over butachlor fb. *halod* and 7.2% over hand weeding twice.

Table 4. Effect of treatments on yield attributing characters in puddle seeded rice

Treatments	Plant height (cm)			Length of panicle (cm)			Effective tillers/m^2			Spikelets/panicle		
	2004	2005	2006	2004	2005	2006	2004	2005	2006	2004	2005	2006
Seeding methods												
Drum seeding 70-80 kg/ha	85.2	97.5	96.2	16.3	19.6	20.7	72.2	77.6	77.2	9.1	10.2	10.3
Drum seeding 70-80 kg/ha + green manuring with sesbania	84.3	96.2	95.3	15.4	19.2	20.2	68.8	77.5	76.4	8.4	9.6	9.9
Broadcast seeding 100 kg/ha	85.6	94.5	93.4	15.2	17.7	18.9	70.4	73.1	72.5	8.6	9.8	9.9
CD (P=0.05)	NS	NS	NS	0.5	0.5	0.4	3.2	3.3	3.4	0.8	0.7	0.2
Weed Management												
Cyhalofopbutyl 90 g/ha (15 DAS) + 2, 4-D 1.0 kg/ha (35DAS)	85.8	97.1	95.9	16.1	19.8	20.1	72.4	77.4	77.4	9.2	10.8	10.7
Butachlor 1.5 kg/ha/Pretilachlor + Safener 0.75 kg/ha(7 DAS) + *halod*	84.8	94.9	94.9	15.1	18.2	19.8	70.0	77.2	75.2	8.9	9.4	9.9
Hand weeding twice (25 & 45 DAS)	84.5	96.2	94.1	15.7	18.5	19.9	69.0	73.6	73.5	8.0	9.4	9.5
CD (P=0.05)	NS	NS	NS	0.4	0.5	0.2	2.9	3.4	3.3	0.5	0.4	0.5

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