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Sowing time and weed management practices to enhance yield of direct-seeded rice

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ABSTRACT

A field experiment was conducted during the *Kharif* season of 2006 and 2007 at G.B. Pant University of Agriculture and Technology, Pantnagar to find out the most effective weed control method under different sowing dates in direct-seeded unpuddled rice. Highest grain yield (2.5-2.7 t/ha) was recorded from 20 June sowing. The grain yield was the highest in mechanical weedings at 20 and 40 DAS. Pendimethalin 1.0 kg/ha + anilophos 0.4 kg/ha (pre-emergence) produced significantly higher grain yield (3.1-3.3 t/ha) over rest of the herbicidal treatments. Uncontrolled weeds reduced the grain yield of rice by 67-70%.

Keywords: Date of sowing, Direct-seeded rice, Economics, Weed management, Unpuddled

Transplanting of rice seedlings is an age-old practice but in recent years, non availability of labours for transplanting at appropriate time leads to the reduction in yield of rice (Budhar and Tamilselvan 2002). Though direct-seeded rice (DSR) yield is comparable with transplanted crop, increased weed infestation is major drawback of this system. Success of DSR depends largely on effective weed control especially with chemical methods. The yield loss due to weeds is high as 40-100% in DSR (Choubey *et al.* 2001). Though the hand weeding has been found effective, yet it is very expensive. Moreover, heavy demand of labour during peak period and its scarcity necessitates the use of alternative methods of weed control. Chemical weed control being cost-effective and less labour dependent is recommended to overcome this constraint under DSR. Broad-spectrum weed flora may not be controlled by herbicide alone, as flushes of weeds come up at different stages. Sowing time is a non-monetary input, but greatly affects the productivity of rice. Several studies have shown that sowing of rice after onset of monsoon gave higher grain yield due to less infestation of weeds. However, very late sowing could reduce the vegetative and reproductive growth period of rice, resulting into lower crop yield. Hence, the present investigation was under taken to study the effectiveness of date of sowing and weed management practices on direct seeded unpuddled rice.

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MATERIALS AND METHODS

A field experiment was conducted during *Kharif* 2006 and 2007 at G.B. Pant University of Agriculture and Technology, Pantnagar to study the effect of various weed management practices under different sowing dates on direct seeded un-puddled rice. The field experiment, laid out in split-plot design with 3 replications, included 3 dates of sowing (05 June, 20 June and 05 July) and 8 weed management practices (Table 1). The soil was loamy, medium in organic matter (0.67%), available phosphorus (17.5 kg/ha) and potassium (181.2 kg/ha), with pH 7.5. Seeding of rice variety '*Govind*' was done in lines at 20 cm apart with 50 kg seed/ha. Recommended dose of fertilizer, *i.e.*120 kg N, 80 kg P_2O_5 and 60 kg K_2O/ha was applied. The half dose of N, entire P_2O_5 and K_2O were applied basal. Remaining amount of nitrogen was applied in 2 equal splits at tillering and panicles initiation stages in both the years. For the control of 'Khaira' disease (Zn deficiency), one spray of 0.5% zinc sulphate was done at 40 days after sowing. The dry weight of weeds was recorded at 90 DAS by placing a quadrate of 0.50 x 0.50 m randomly at two places of each plot. Log (X+1) transformation was used to analyze the data in respect of weeds.

RESULTS AND DISCUSSION

Effect on weeds

Echinochloa colona among grasses, *Commelina benghalensis* and *Caesulia axillaris* among non-grasses and *Cyperus rotundus* among sedges were predominant weed species in the experimental site during both the years. Seeding time and weed management treatments had sig-

nificant influence on weed population (Table 1). Sowing of crop at 20 June recorded less density and dry weight of total weeds and highest weed control efficiency than 5 June sown crop. The population and dry weight of total weeds was significantly higher in 5 June as compared to 05 July sown crop due to stale seed bed effect on weeds. It shows that weed germination might have initiated even before the onset of monsoon under dry conditions with least available water in subsoil layers. Similar results were also reported by Kathiresan *et al.* (1997). Highest weed control efficiency was observed in 5 July sown crop though being at par with 20 June and 5 June sowing dates. Two hand weedings (20 and 40 DAS) and pendimethalin 1.0 kg/ha + anilophos 0.4 kg/ha as applied pre-emergence recorded efficient control of all weeds (grasses, non-grasses and sedges) and recorded greater weed control efficiency (Table 1) as compared to weedy check as well as other weed control treatments. Bahar and Singh (2004) also reported better weed control with pendimethalin in direct-seeded rice. The population and dry weight of weeds was also reduced with the pre-emergence application of pendimethalin 1.5 kg/ha and fenoxaprop-p-ethyl 0.06 *fb* 2,4-D 0.5 kg/ha.

Effect on crop

Delay in sowing from 5 June to 20 June caused an increased in grain yield due to reduced population and dry weight of weeds to the extent of 13.2% in first year and 11.6% in the second year. Similar results were also observed by Publico and Moody (1995). However, delay in sowing from 20 June to 5 July caused 9.6% reduction in grain yield during 2006 and 10.2% during 2007 (Table 2). Similar results were also observed by Gill *et al.* (2006). The significantly higher values of yield attributing characters namely 1000-grain weight were recorded in 20 June sown crop as compared to 5 June sown crop due to less population and dry weight of weeds in 20 June sowing.

Uncontrolled weeds in weedy check plots caused an average reduction in yield to the extent of 74.4% during 2006 and 67.4% during 2007 as compared with weed free

Table 1. Effect of treatments on density and dry weight of total weeds at 30 days after sowing (DAS)

Treatment	Rate of application (kg/ha)	Time of application (DAS)	Density of weeds (no./m^2)		Weed dry weight (g/m^2)		WCE (%)	
			2006	2007	2006	2007	2006	2007
Date of sowing								
5 June	–	–	3.70 (58)	3.52 (49)	3.22 (39.2)	2.81 (30.8)	3.69 (56)	3.74 (59)
20 June	–	–	3.59 (50)	3.37 (41)	3.00 (29.6)	2.46 (21.1)	3.70 (57)	3.75 (58)
5 July	–	–	3.43 (43)	3.16 (33)	2.83 (23.5)	2.22 (15.1)	3.71 (57)	3.76 (60)
LSD (P=0.05)			0.13	0.22	0.04	0.04	0.57	0.16
Weed management								
Pendimethalin	1.5	1	3.77 (44)	3.49 (31)	2.84 (16.9)	2.21 (8.8)	4.25 (69)	4.30 (73)
Pendimethalin + anilophos	1.0 + 0.4	1	3.62 (37)	3.27 (25)	2.68 (14.0)	1.91 (6.3)	4.30 (73)	4.33 (75)
Pretilachlor	0.75	1	4.01 (54)	3.78 (46)	3.46 (31.8)	3.12 (22.8)	4.06 (57)	4.11 (60)
Fenoxaprop-p-ethyl + 2,4-D (EE)	0.06+0.5	15+30	3.92 (50)	3.68 (41)	3.37 (29.8)	3.04 (21.7)	4.09 (59)	4.13 (61)
Anilophos	0.4	10	4.14 (63)	3.93 (53)	3.73 (42.1)	3.38 (31.8)	3.74 (41)	3.84 (66)
Two hand weeding	–	20 and 40	3.43 (30)	2.97 (21)	2.27 (9.1)	0.30 (0.4)	4.48 (88)	4.50 (90)
Weed free	–	–	–	–	–	–	4.6 (100)	4.6 (100)
Weedy check	–	–	4.57 (98)	4.45 (87)	4.32 (78.2)	4.18 (67.2)	–	–
LSD (P=0.05)			0.13	0.20	0.07	0.08	0.20	0.27

Original values are in parentheses

Table 2. Effect of treatments on growth and yield of rice

Treatment	Plant height (cm) at 30 DAS		No. of tillers/m row length at 30 DAS		Crop dry weight (g) at 30 DAS		1000-grain weight (g)		Grain yield (t/ha)	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Date of sowing										
5 June	23.9	25.1	43.4	45.7	38.8	41.1	22.0	22.2	2.16	2.38
20 June	28.2	29.5	47.9	50.3	41.4	43.3	22.6	22.6	2.62	2.70
5 July	26.3	27.5	45.8	47.9	38.4	40.5	22.1	22.4	2.24	2.42
LSD (P=0.05)	2.8	2.8	1.4	1.5	NS	NS	0.4	0.2	0.13	0.06
Weed management										
Pendimethalin	28.7	29.6	50.5	54.4	42.1	43.9	22.8	23.0	2.77	3.07
Pendimethalin + anilophos	30.4	31.4	52.2	54.5	43.6	45.5	23.3	23.3	3.09	3.28
Pretilachlor	23.9	25.2	44.1	45.0	32.7	34.3	22.3	22.4	1.99	2.23
Fenoxaprop-p-ethyl + 2,4-D (EE)	25.4	26.9	44.0	45.7	38.5	42.1	22.7	22.8	2.12	2.38
Anilophos	23.5	24.9	40.2	42.9	40.4	42.3	21.4	21.9	1.80	2.02
Two hand weeding	30.7	32.8	52.2	57.4	46.6	48.5	23.4	23.3	3.32	3.43
Weed free	33.1	34.4	57.8	60.9	48.3	50.0	23.4	23.6	3.43	3.56
Weedy check	19.9	21.4	29.8	31.1	25.8	27.9	19.4	19.1	1.01	1.14
LSD (P=0.05)	2.3	2.3	3.4	3.4	3.8	4.3	0.3	0.3	0.14	0.12

plots, mainly due to high density and more dry matter accumulation by weeds in weedy check plots (Table 1). The lowest grain yield obtained in weedy check was also associated with lowest crop dry matter accumulation and 1000-grain weight (Table 2). Two hand weeding (20 and 40 DAS) and pendimethalin 1.0 kg/ha + anilophos 0.4 kg/ha applied as pre-emergence gave significantly higher grain yield than other weed control treatments due to more number of tillers per metre row length and 1000-grain weight (Table 2).

On the basis of two years study, it was concluded that sowing of direct-seeded rice around 20th June and pre-emergence application of pendimethalin 1.0 kg/ha + anilophos 0.4 kg/ha provided better weed control and higher grain yield

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