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Effect of weed management practices on nutrient uptake by direct seeded rice

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ABSTRACT

Three sowing dates viz.05 June, 20 June and 05 July and six weed management practices viz pendimethalin 1.5 kg ha^{-1}(PE), pendimethalin 1.0 kg ha^{-1} + anilophos 0.4 kg ha^{-1}(PE), pretilachlor 0.75 kg ha^{-1} (PE), fenoxaprop-p-ethyl 0.06 kg ha^{-1}(15 DAS) followed by 2,4-D 0.5 kg ha^{-1} (30 DAS), anilophos 0.4 kg ha^{-1} (10 DAS) and two hand weedings (20 and 40 DAS) with weed free and weedy check treatments were evaluated in direct seeded unpuddled rice at Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar during wet season of 2006 and 2007. Echinochloa colonum among grasses and Commelina benghalensis, Caesulia axillaris among non-grasses and Cyperus rotundus among sedges were the predominant weed species in the experimental plot. Highest nutrients uptake by crop (27.1, 8.1 and 68.4 kg ha^{-1} and 29.0, 8.1 and 69.1 kg ha^{-1} nitrogen, phosphorus and potassium during 2006 and 2007, respectively) was recorded from 20 June sown rice crop over rest two sowing dates (05 June and 05 July) during both the years. Use of herbicides increased nutrient uptake by rice and decreased nutrient uptake by weeds. Uptake of Nutrients was higher by rice and lowest by weeds with hand weedings and pre-emergence application of pendimethalin @ 1.0 kg ha^{-1} + anilophos @ 0.4 kg ha^{-1} over rest of the treatments. Reduction in grain yield of rice due to uncontrolled weeds in weedy plots was 70.4 per cent during 2006 and 67.4 per cent during 2007.

Keywords: *direct seeded rice, weed management, date of sowing, nutrient uptake*

Weeds cause major problem in rice production, which do not only compete with crop but also hinder quality (Moody, 1989). Heavy infestation of weeds is one of the major constrains for successful cultivation of direct seeded rice. Weeds that emerge simultaneously with crop deplete considerable amount of costly fertilizer and native plant nutrients, which result in lower yield. Effective control of weeds is, therefore, vitally important. The yield loss due to weeds is high as 40-100 per cent in direct seeded rice (Choubey *et al.,* 2001). Among the controllable components of environment, sowing time is a non-monetary input, but greatly affects the productivity of rice. Several studies have shown that late sowing of rice (after onset of monsoon) gave higher grain yield due to less infestation of weeds (Mane and Raskar, 2002). However, very late sowing upto some extent could reduce the vegetative and reproductive growth period of rice, resulting into low crop yield. Though hand weeding was found to be effective, but it is very expensive. Moreover, heavy demand of labour during peak period and its scarcity necessitates the use of alternative method of weed control. Chemical weed control being cost effective and less labour dependent is recommended to overcome this constraint under direct seeded rice. Considering above facts, present study was undertaken to study the effect of weed management practices on nutrient uptake by direct seeded unpuddled rice and associated weeds under different sowing dates.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* seasons of 2006 and 2007 at Crop Research center, G.B. Pant University of Agriculture and Technology, Pantnagar to study the effect of various weed management practices on nutrients uptake by direct seeded unpuddled rice and associated weeds under different sowing dates. The field experiment, was laid out in split-plot design with 3 replications, included 3

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Table1. Nitrogen, phosphorus and potassium uptake (kg ha^{-1}) by crop at 60 DAS as influenced by different treatments

Treatments	Rate of application (kg ha^{-1})	Time of application (DAS)	Nitrogen		Phosphorus		Potassium		Crop dry wt (g)		Grain yield (t ha^{-1})	
			2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Date of sowing												
05 June	–	–	24.03	25.67	6.76	7.27	59.46	61.42	211.76	213.80	2.16	2.38
20 June	–	–	27.10	29.07	8.10	8.08	68.40	69.12	228.97	231.73	2.48	2.70
05 July	–	–	25.50	26.85	7.33	7.63	64.00	64.14	218.19	220.69	2.24	2.42
	S.Em.±		0.35	0.58	0.33	0.15	1.45	1.09	4.21	4.33	0.03	0.01
	CD at 5%		1.37	2.26	1.30	0.60	5.70	4.27	16.44	16.94	0.13	0.06
Weed management treatments												
Pendimethalin	1.5	1	26.09	28.01	7.38	8.12	65.01	66.10	218.64	221.52	2.77	3.07
Pendimethalin + Anilophos	1.0 + 0.4	1	29.58	31.17	9.17	9.39	74.88	76.01	242.16	245.06	3.09	3.28
Pretilachlor	0.75	1	22.94	25.44	5.87	6.36	56.11	56.89	196.72	198.94	1.99	2.23
Fenoxaprop-p-ethyl + 2,4-D (EE)	0.06+0.5	15+30	25.23	26.65	6.62	7.12	62.22	62.90	214.11	215.91	2.12	2.38
Anilophos	0.4	10	22.26	22.67	5.32	5.77	54.06	54.85	192.78	195.04	1.80	2.02
Two hand weedings	–	20 & 40	37.00	40.22	12.63	12.22	94.72	96.14	310.50	312.33	3.32	3.43
Weed free	–	–	39.35	43.60	14.26	14.43	99.56	104.9	325.52	227.96	3.42	3.56
Weedy check	–	–	10.09	10.75	2.45	3.05	27.25	28.18	109.37	112.55	1.01	1.14
S.Em.±	0.67	1.03	0.73	0.34	1.87	2.09	6.93	7.07	51.0	42.4		
CD at 5%	1.90	2.94	2.07	0.98	5.30	5.93	19.65	20.05	144.7	120.4		

DAS = Days after sowing, EE = Ethyl ester

dates of sowing (05 June, 20 June and 05 July) and 6 weed management practices (Table1). The soil was loamy, medium in organic matter (0.67%), medium in available phosphorus (17.0 kg ha^{-1}) and medium in available potassium (181.25 kg ha^{-1}), with pH 7.5. Seeding of rice variety Govind was done in lines at 20 cm. apart with 50 kg seed ha $^{-1}$ with recommended dose of fertilizer i.e.120 kg N, 80 kg P_2O_5 and 60 kg K_2O ha^{-1} in both the years. The half dose of N, entire P_2O_5 and K_2O were applied as 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. All the cultural practices were followed in accordance with recommended package of practice. The dry weight of weeds was recorded at 60 DAS by placing a quadrate of 0.50 x 0.50 m randomly at two places of each plot. N, P and K contents of plant and weed samples were determined by Microkjeldhal, Vanadomolybdo yellow colour and Flame photometer methods (Jackson, 1973), respectively. Log (X+1) transformation was used to analyze the data in respect of weeds.

RESULTS AND DISCUSSON

The predominant weed species present in the experimental plot were *Echinochloa colonum* among grasses, *Commelina benghalensis* and *Caesulia axillaris* among non-grasses and *Cyperus rotundus* among sedges. The Seeding time and weed management treatments had significant influence on removal of N, P and K by weeds (Table 2). In both the years, 05 July sown crop recorded significantly lesser amount of nutrients uptake by weeds than 05 June and 20 June due to lesser density and dry weight of total weeds. The population and dry weight of total weeds was significantly higher in 05 June as compared to 05 July sown crop due to stale seed bed effect on weeds. The removal of N, P and K by total weeds was maximum in weedy check. The N, P and K uptake by weeds was recorded significantly lower in hand weeding twice over rest of treatments in both the years. All the herbicidal treatments brought down uptake of these nutrients by weeds. The herbicides controlled the weeds effectively and therefore, resulted in significantly low nutrient removal by weeds than weedy check. Among the herbicidal treatments, removal of nutrients by weeds

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Table2. Nitrogen, phosphorus and potassium uptake (kg ha^{-1}) by weeds at 60 DAS as influenced by various treatments

Treatments	Rate of application (kg ha^{-1})	Time of application (DAS)	Nitrogen		Phosphorus		Potassium		Density of weeds (No. m^{-2}) at 60 DAS		Total weed dry weight (g m^{-2})	
			2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Date of sowing												
05 June	–	–	3.39 (44.7)	3.21 (36.9)	2.15 (10.9)	1.99 (9.0)	2.98 (27.9)	2.81 (23.4)	3.73 (62)	3.71 (59)	5.17 (312.0)	5.01 (272.2)
20 June	–	–	3.32 (41.7)	3.13 (34.1)	2.07 (10.1)	1.89 (8.2)	2.91 (26.1)	2.72 (21.5)	3.54 (50)	3.61 (52)	5.10 (302.0)	4.93 (253.0)
05 July	–	–	3.22 (37.3)	3.00 (29.1)	1.97 (8.8)	1.78 (7.0)	2.79 (23.0)	2.60 (18.6)	3.36 (41)	3.48 (44)	4.99 (271.1)	4.79 (222.3)
	S.Em.±		0.01	0.01	0.013	0.01	0.015	0.01	0.02	0.02	0.01	0.01
	CD at 5%		0.04	0.04	0.05	0.04	0.05	0.04	0.7	0.07	0.04	0.04
Weed management treatments												
Pendimethalin	1.5	1	3.33 (27.3)	3.09 (21.3)	1.86 (5.4)	1.65 (4.2)	2.85 (16.5)	2.63 (13.0)	3.62 (37)	3.80 (44)	5.34 (209.6)	5.12 (168.5)
Pendimethalin + Anilophos	1.0 + 0.4	1	3.20 (23.9)	3.01 (19.5)	1.71 (4.5)	1.54 (3.7)	2.72 (14.3)	2.54 (11.8)	3.29 (34)	3.60 (37)	5.21 (185.1)	5.04 (155.8)
Pretilachlor	0.75	1	3.70 (39.8)	3.48 (31.9)	2.28 (8.8)	2.08 (7.0)	3.23 (24.5)	3.03 (19.9)	4.00 (56)	4.00 (54)	5.69 (296.8)	5.49 (244.2)
Fenoxaprop-p-ethyl + 2,4-D (EE)	0.06+0.5	15+30	3.64 (37.7)	3.44 (30.7)	2.21 (8.2)	2.02 (6.6)	3.17 (23.1)	2.98 (19.0)	3.85 (46)	3.93 (51)	5.64 (282.8)	5.46 (236.3)
Anilophos	0.4	10	4.05 (56.7)	3.83 (45.3)	2.73 (14.5)	2.52 (11.6)	3.60 (35.8)	3.39 (28.9)	4.16 (64)	4.13 (63)	6.00 (404.8)	5.80 (331.7)
Two hand weedings	–	20 & 40	2.45 (10.8)	2.17 (7.9)	1.06 (1.9)	0.86 (1.3)	1.99 (6.4)	1.73 (4.7)	3.25 (26)	3.53 (34)	4.44 (85.2)	4.15 (64.2)
Weed free	–	–	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Weedy check	–	–	4.62 (101.6)	4.48 (88.3)	3.23 (27.0)	3.18 (23.4)	4.16 (63.6)	4.03 (56.0)	4.68 (109)	4.66 (106)	6.54 (695.1)	6.42 (619.7)
	S.Em.±		0.02	0.03	0.02	0.03	0.02	0.03	0.03	0.04	0.02	0.03
	CD at 5%		0.06	0.08	0.07	0.08	0.07	0.08	0.09	0.13	0.07	0.08

DAS = Days after sowing, EE = Ethyl ester, (Original values are given in parenthesis)

was minimum where pendimethalin 1.0 kg ha^{-1} + anilophos 0.4 kg ha^{-1} (PE) was applied. Pendimethalin 1.0 kg ha^{-1} (PE) was the next best in decreasing nutrients uptake by weeds. Singh and Namdeo (2004) reported that the nutrient uptake in rice was the maximum due to twice hand weedings followed by pendimethalin + 2,4-D.

Delay in sowing from 05 June to 20 June caused an increase in nutrients uptake by crop due to reduced population and dry weight of weeds to the extent of 11.3, 16.5 and 13.1 percent and 11.7, 10.0 and 11.1 percent N, P and K in 2006 and 2007, respectively. However, delay in sowing from 20 June to 05 July caused reduction in nutrients uptake by 5.9, 9.5 and 6.4 per cent and 7.6, 5.6 and 7.2 percent N, P and K in 2006 and 2007, respectively. Reduction in nutrients uptake by crop due to delay in sowing can mainly be attributed to reduced dry matter accumulation by crop

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plants (Table 1). All weed control treatments recorded significantly higher N, P and K uptake by crop plants than weedy check (Table 1). Highest N, P and K uptake recorded in twice hand weeding which was found significantly higher over rest of the treatments in both the years. Among the herbicidal treatments, maximum uptake of all the three nutrients by rice crop was obtained with pre-emergence application of pendimethalin 1.0 kg ha^{-1} + anilophos 0.4 kg ha^{-1} due to less weed infestations. The uptake of N, P and K in this treatment was recorded 5.6, 9.5 and 6.4 and 7.6, 5.6 and 7.2 per cent higher in 2006 and 2007, respectively than weedy check. Pendimethalin 1.5 kg ha^{-1} (PE) was the next best herbicide treatment in increasing nutrient uptake by rice. Application of herbicides controlled weeds effectively and made available more nutrients to rice crop and consequently resulted in higher yield. Similar findings have also been reported by (Rana *et al.,* 2000).

On the basis of result, it can be concluded that to get higher nutrient uptake by rice (grown though direct seeded in unpuddled condition) the crop should be sown around June 20, because earlier sown crop infested more with weeds and reduced the dry matter accumulation by crop plants and in late sown crop however, the weed infestation was less but due to reduction in vegetative period, less infestation of weeds could not compensate the yield of rice. Weeds can be effectively controlled either by pendimethalin @ 1.0 kg ha^{-1} + anilophos @ 0.4 kg ha^{-1} applied as pre-emergence or through two hand weedings (20 and 40 DAS) for higher nutrient uptake. Single herbicide could not perform better in any of the date of sowing during both the years. Without controlling the weeds, the loss in grain yield plots was recorded as 70.4 percent during 2006 and 67.4 percent during 2007 from weedy plots.

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