

Effect of crop–weed competition on yield and nutrient uptake by direct-seeded rice (*Oryza sativa*) in rainfed, lowland situation

G. SINGH, R.K. SINGH¹, V.P. SINGH², B.B. SINGH AND R. NAYAK

Crop Research Station, Narendra Deva University of Agriculture and Technology,
Ghaghrahat, Bahraich, Uttar Pradesh 271 901

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ABSTRACT

A field experiment was conducted during wet season of 1995 and 1996 to study the effect of crop–weed competition on weed growth, yield, and nutrient uptake by direct-seeded rice (*Oryza sativa* L.). Initial weed-free for 45 days or longer, and weedy up to 15 days after sowing resulted significantly higher rice grain and straw yields, and lower dry weight and nutrient uptake by weeds during both the years. Weed infestation for first 15 days caused no significant loss in grain yield compared to weed-free for 45 or 60 days after sowing. The season-long weedy crop resulted 57% reduction in grain yield compared to season-long weed-free. Initial weed-free for first 30 days caused 25% reduction in grain yield which was higher than loss caused by initially weedy for 30 days (22%). The uptake of nutrients (NPK) by rice crop was significantly higher in weed-free treatment. The season-long weedy depleted 35 N, 15 P₂O₅ and 45, K₂O kg/ha by weeds while rice crop under weed-free up to maturity removed 60, 26 and 80 kg/ha of N, P₂O₅ and K₂O respectively.

Key words : Crop–weed competition, Nutrient uptake, Direct-seeded rice, Rainfed lowland

Weeds in direct-seeded rice pose a serious problems in getting the higher production than in other system of rice cultivation, because seeds of weeds and rice germinate at the same time. Under good weed management direct-seeded rice is more remunerative, as it reduces the cost

of labour (De, Datta 1981; Chaudhary *et al.*, 1996) and grain yield is often higher than transplanted rice. In direct-seeded puddled rice, weeds in weedy plots remove 48.79 kg N, 43.68 kg P₂O₅, and 67.37 kg/ha K₂O (Madhu and Nanjappa, 1996). In the present-day need, an efficient use of

Present address : ¹IRRI-India office, C 18, New Friends Colony (East), New Delhi 110 065; ²APPA Division, IRRI, Los Banos, Manila, Philippines

applied nutrients by crop is important by reducing the weed competition at critical stages of crop growth. Since information on nature and extent of damage caused by weed plants in rainfed lowland rice is lacking, an experiment was undertaken to generate the information on critical duration of crop-weed competition for growth and nutrients.

MATERIALS AND METHODS

The experiment was conducted at Crop Research Station, Ghaghraghat, Bhraich, Uttar Pradesh, during wet season of 1995 and 1996. The soil was sandy loam, with pH 8.1, organic carbon 0.43, available N 235, P_2O_5 20.17 and K_2O 187 kg/ha. Ten treatments comprising 5 weedy conditions up to 15, 30, 45, 60 days after sowing (DAS) and maturity, and 5 weed-free conditions up to 15, 30, 45 and 60 DAS and

maturity, were laid out in randomized block design with 3 replications. Recommended N, P_2O_5 , K_2O @ 100, 50 and 40 kg/ha along with 20 kg zinc sulphate were applied. The entire quantity of P_2O_5 , K_2O $ZnSO_4$ and half dose of N were applied uniformly to all plots at sowing and rest of N was top-dressed in 2 splits, i.e. tillering and panicle-initiation stage of crop. Rice variety 'Mahasuri' was direct-seeded in lines at 25 cm row apart using 100 kg seed/ha. Weed-free treatments were maintained by hand-weeding. Weed samples were collected as per schedule at different stages of crop growth and oven-dried at 60°C. Grain and straw samples were drawn at threshing time from different treatments in each plot for analysis of nutrients. Nutrient uptake was calculated by multiplying the grain yield $\times$ nutrient content (%) and divided by 100. The total

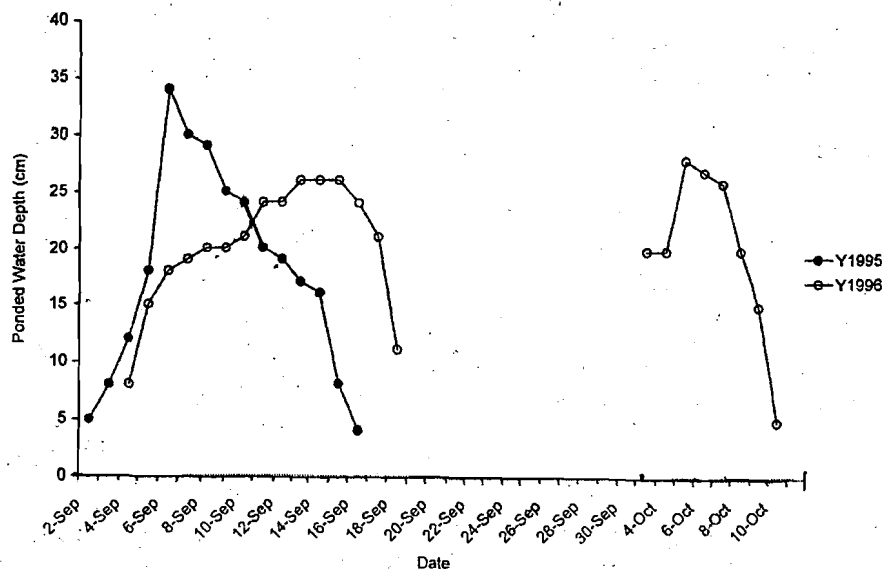


Fig. 1. Daily ponded water-fluctuation in shallow deep water situation at Ghaghraghat

Table 1. Yields and nutrients removal by rice as influenced by various crop-weed competition treatments

Treatment	Rice yield (q/ha)						Nutrient uptake (kg/ha)*								
	Grain			Straw			N			P			K		
	Y ₁	Y ₂	A	Y ₁	Y ₂	A	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
<i>Weedy up to</i>															
15 DAS	36.50	33.42	34.96	51.10	47.46	49.28	39.50	18.19	57.69	11.87	12.61	24.48	10.62	63.62	74.24
30 DAS	30.25	27.53	28.89	41.75	38.54	40.15	32.67	15.20	47.87	9.86	10.40	20.26	8.53	52.89	61.42
45 DAS	24.63	22.07	23.35	37.43	33.99	35.71	26.45	13.71	40.16	7.76	9.42	17.18	6.59	47.70	54.29
60 DAS	26.23	24.10	25.18	37.17	34.18	28.18	25.16	13.79	38.95	7.41	9.61	17.02	6.51	48.43	54.94
Maturity	16.37	16.65	16.01	27.83	27.70	21.77	18.20	10.86	29.06	5.36	7.66	13.02	4.93	37.99	42.92
<i>Weed free up to</i>															
15 DAS	24.34	20.95	22.65	39.19	33.94	36.57	25.66	13.39	39.05	7.99	9.67	17.66	7.22	48.93	56.15
30 DAS	20.04	25.73	27.89	45.06	39.11	42.09	31.42	15.32	46.74	9.37	10.99	20.36	8.00	56.23	64.23
45 DAS	35.99	34.60	35.30	51.83	50.52	51.18	39.73	17.32	57.05	11.89	13.05	24.94	10.16	48.42	78.58
60 DAS	37.53	34.86	36.20	52.54	49.46	51.00	40.41	18.23	58.94	12.96	12.85	25.81	10.86	69.96	78.82
Maturity	38.72	35.62	37.14	53.43	49.87	51.65	41.96	18.35	60.31	13.25	12.81	26.06	11.52	68.44	79.96
CD (P = 0.05)	0.17	0.20	0.19	0.33	0.35	0.34	0.23	0.38	0.61	1.65	0.92	2.57	0.27	0.82	1.09

Y₁ = 1995; Y₂ = 1996; A = average; *mean of 2 years

rainfall received in 1995 and 1996 was 799 mm and 915 mm respectively. Water started accumulating in the plot on 2 September 1995 and 4 September 1996 and reached the level of 34 cm in 1995 and 28 cm in 1996. Water remained stagnant in the field for 24 days in both the years and remained in the range of 3–34 cm depth.

RESULTS AND DISCUSSION

Weed flora

Weed flora of the experimental field consisted of grasses, viz. *Cynodon dactylon* L., *Echinochloa crus-galli* (L.) P. Beauv., *Echinochloa colona* (L.) Link, *Leptochloa chinensis* (L.) Nees; sedges, viz. *Cyperus rotundus* L., *Fimbristylis miliaceae* Vall. and *Cyperus difformis* L.; and broad leaved weeds, viz. *Caesulia axillaris*, *Cynotis axillaris* and *Commelina benghalensis*.

Grain and straw yields were significantly reduced due to weed infestation allowed from 15 to 60 days after sowing in both the years. Season-long weedy condition reduced the grain yield up to 57%. Weed-free condition beyond 45 days after sowing did not improve the grain yield significantly because the weeds emerged after 45 days did not compete with crop owing to strong canopy and higher growth of crop in terms of plant height, and dry-matter accumulation, yield attributes and yields.

Grain yield was adversely affected in plot maintained weed-free for initial 15 or 30 days, obviously because of re-emergence of weeds in large numbers under these plots resulted the higher crop-weed competition for nutrients and finally the poor yield. Initial weed-free for first 30

days caused 25% reduction in grain yield which was higher than the loss caused by initially weedy for 30 days (22%), and initially weedy for 45 days caused 37% reduction in yield compared to weed-free condition for first 45 days (5%), indicating the maximum emergence of weeds up to 45 days after sowing which caused heavy reduction in grain yield. Weed infestation for first 15 days caused no significant loss in grain yield compared to weed-free condition for 45 or 60 days after sowing, but weed infestation beyond 15 days (up to 30 days or longer) caused significant reduction in yield due to higher re-emergence of weed.

Season-long weedy condition resulted in the highest weed dry weight. Dry matter of weeds obtained in weed-free condition up to 45 and 60 days, and weedy up to 15 days was however non-significant with each other, but recorded significantly lower weed dry weight than rest of the treatments. The strong canopy cover developed in crop kept initially weed-free condition for 45 days or longer smothered the late-emerging weeds, resulted in significantly lower dry weight of weeds at these stages.

Weed-free for initially 15 and 30 days after sowing resulted higher dry weight of weeds than weedy check up to 15 and 30 days. It might be due to the higher re-emergence of weeds in the above plots.

Nutrient removal by weeds and crop

Nutrient removal by weeds was lower in weed-free plots for first 45 days or 60 days and weedy up to 15 days after sowing. It was due to lesser weed dry weight (Table 2). The results confirm the findings of

Table 2. Weed dry weight (q/ha) and nutrients uptake (kg/ha) by weeds as influenced by various crop-weed competition treatments

Treatment	Weed dry weight (q/ha)			Nutrient uptake (kg/ha)								
	1995	1996	Average	N			P			K		
				1995	1996	Average	1995	1996	Average	1995	1996	Average
<i>Weedy up to</i>												
15 DAS	8.27	10.73	9.50	7.47	9.65	8.56	2.51	3.21	2.86	10.19	13.05	11.57
30 DAS	19.89	21.62	20.76	18.02	19.50	18.76	6.82	7.22	7.02	23.93	25.92	24.93
45 DAS	25.17	27.06	26.12	22.98	24.62	23.80	9.09	9.69	9.39	30.18	32.36	31.27
60 DAS	30.49	32.09	31.29	28.05	29.46	28.76	11.59	12.07	11.83	36.37	38.16	37.27
Maturity	36.55	38.83	37.69	33.88	35.88	34.88	14.25	14.95	14.60	43.49	46.09	44.79
<i>Weed free up to</i>												
15 DAS	28.32	30.23	29.27	25.03	26.63	25.83	10.51	11.12	10.82	34.01	36.12	35.07
30 DAS	23.82	25.28	24.55	20.94	22.09	21.52	8.36	8.77	8.57	28.51	30.18	29.34
45 DAS	7.36	8.87	8.12	6.37	7.66	7.02	2.52	3.01	2.77	8.80	10.58	9.69
60 DAS	7.22	8.72	7.97	6.20	7.45	6.83	2.40	2.87	2.64	8.62	10.38	9.50
CD (P = 0.05)	0.93	0.89	0.91	0.25	0.26	0.25	0.18	0.21	0.19	1.73	0.25	1.24

Madhu and Nanjappa (1996). The uptake of nutrients by rice was higher in weed-free condition up to 45 and 60 days after sowing which was mainly due to higher grain and straw yields, and lesser weed dry weight. On the other hand, slow initial growth of weeds up to 15 days after sowing resulted lesser crop-weed competition and lower nutrient depletion by weeds. Madhu and Nanjappa (1996) also reported the lower nutrient removal by weeds in the plots kept initially weedy up to 20 DAS. Season-long weed-free treatment removed higher nutrient by rice owing to higher grain and straw yields. On an average, season-long weedy plot depleted 34.88 kg N, 14.60 kg P_2O_5 and 44.79 kg K_2O /ha. Reduction of N, P and K uptake by crop

in weedy plot was 51.81, 50.03 and 46.32% respectively compared to plots with weed-free till maturity.

Thus weed-free condition up to 45 days after sowing was sufficient to get higher yield of rice as well as lower nutrient depletion by weeds in direct-seeded rice under rainfed lowland situation.

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