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Response of Aromatic Rice (Pusa Basmati 1) to Establishment Methods, Fertility Levels and Weed Management Practices*

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ABSTRACT

An experiment was conducted during the rainy seasons of 2003 and 2004 at Agronomy Research Farm, Allahabad Agricultural Institute-Deemed University to assess the response of rice and associated weeds to establishment methods, fertility levels and weed management practices. The experiment was laid out in three factor randomized block design comprising two establishment methods (direct wet seeding and transplanting), three levels of fertility viz., 80, 40, 40; 100, 50, 50 and 120, 60, 60 NPK kg/ha and four weed management practices viz., (W_1) anilofos @ 0.4 kg a. i./ha, (W_2) butachlor @1.5 kg a. i./ha, (W_3) two hand weedings and (W_4) weedy check. These comprised 24 treatments, which were replicated thrice. Results revealed that transplanting method of rice establishment recorded lowest number of weeds and weed dry weight resulting in significantly higher grain yield. The weed intensity and weed dry weight increased with the increase in fertility level and was maximum with 120, 60, 60 NPK kg/ha. Anilofos and butachlor brought down weed intensity, weed dry weight and NPK uptake but were not as efficient as two hand weedings. The higher net profit and BCR was observed in direct seeded plots treated with high fertilizer dose of 120, 60, 60 NPK kg/ha and anilofos. The maximum weed control efficiency was observed in transplating between establishment methods, low fertilizer dose of 80, 40, 40 NPK kg/ha between fertility levels and anilofosn among weed management practices at all the growth stages of crop. The maximum weed index of 68% was observed in weedy check plots.

INTRODUCTION

Rice is staple food crop of India growing over an area of 44.6 m ha with a production of 87 million tonnes (Anonymous, 2005). India has 12 m ha i. e. 28% of rice under direct seeding (Palaniappan and Purushothaman, 1991). In India, attempt to introduce direct seeding in farmers' field often fails owing to non-competitiveness of direct seeded rice to weeds. Weed menance is more in wet seeded rice than in transplanted rice to the extent of 50-60% and even a complete crop failure. Manual weeding in rice becomes difficult because of possible damage to rice plants, problems in differentiating grassy weeds, labour scarcity, time consuming and relatively less effectiveness. Chemical control using herbicide alone or mixtures will result in control of higher number of weed species, while weed suppression can be further achieved through crop canopy management by proper nutrient management. The objective of this study was to evaluate the infestation and losses caused by weeds in rice as affected by establishment methods, fertility levels and weed management practices.

MATERIALS AND METHODS

An experiment was conducted using rice variety Pusa Basmati 1 during rainy (**kharif**) seasons of 2003 and 2004. The soil was sandy clay loam in texture, low in nitrogen with organic carbon 0.60%, medium in available phosphorus (50 kg/ha) and potassium (235 kg/ha), neutral in reaction (pH 7.5) and EC 0.28 mmhos/cm. The experiment was laid out in three factor randomized block design comprising two establishment methods viz., (E_1) direct seeding of sprouted seeds in puddled soil and (E_2) transplanting; three levels of NPK kg/ha viz., (F_1) 80, 40, 40; (F_2) 100, 50, 50 and (F_3) 120, 60, 60 and four weed management practices viz., (W_1) anilofos (PRE) @ 0.4 kg a. i./ha, (W_2) butachlor (PRE) @ 1.5 kg a.i./ha, (W_3) two hand weedings (30 and 60 DAS) and (W_4) weedy check. These were replicated thrice. The sowing of nursery for transplanting and seeding in direct seeded plots was done on 25 and 29 June of 2003 and 2004, respectively. As per the treatment the entire quantity of phosphorus and potassium and half dose of nitrogen were applied as basal, the rest of nitrogen was applied in splits. The

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Table 1. Weed intensity (monocot and dicot), weed dry weight, WCE and weed index as affected by establishment methods, fertility levels and weed management practices

Treatment	Monoct weeds at 60 DAS ($0.25/m^2$)		Dicot weeds at 60 DAS ($0.25/m^2$)		Dry weight at 60 DAS g ($0.25/m^2$)		Weed control efficiency (%)		Weed index (%)		Grain yield (q/ha)	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Establishment methods												
Direct seeded (E_1)	2.89 (8.79)	3.03 (9.36)	3.44 (12.44)	3.49 (12.7)	2.61 (7)	2.71 (7.4)	28.97	37.18	33.07	31.67	29.22	27.83
Transplanted (E_2)	2.56 (6.81)	2.73 (7.38)	3.13 (10.33)	3.19 (10.6)	2.39 (5.65)	2.44 (6.04)	50.74	48.72	25.51	24.30	32.52	31.05
LSD (P=0.05)	0.047	0.79	0.04	0.036	0.06	0.03					0.46	0.59
Fertility levels												
low fertility (F_1)	2.65 (7.32)	2.79 (7.82)	3.17 (10.5)	3.22 (10.8)	2.45 (5.9)	2.49 (6.20)	48.56	47.36	42.73	42.79	25.00	23.83
Medium fertility F_2)	2.72 (7.75)	2.84 (8.27)	3.29 (11.3)	3.34 (11.7)	2.48 (6.31)	2.58 (6.72)	44.98	42.95	33.21	33.70	29.16	27.62
High fertility (F_3)	2.80 (8.33)	3.02 (9.02)	3.40 (12.1)	3.46 (12.5)	2.57 (6.7)	2.65 (7.24)	41.06	38.53	11.93	11.49	38.45	36.87
LSD (P=0.05)	0.057	0.09	0.05	0.04	0.08	0.04					0.56	0.72
Weed management practices												
Anilofos (W_1)	2.73 (7.03)	2.81 (7.17)	3.34 (10.7)	3.38 (10.9)	2.56 (5.8)	2.53 (6.15)	48.99	47.79	18.32	18.67	35.66	33.88
Butachlor (W_2)	2.91 (8.04)	3.02 (8.61)	3.54 (12.1)	3.56 (12.2)	2.66 (6.6)	2.73 (7.09)	42.10	40.06	36.78	30.94	30.22	28.77
Two hand weedings (W_3)	1.73 (1.41)	1.78 (2.75)	1.75 (2.61)	1.82 (2.86)	1.34 (1.3)	1.54 (1.89)	88.40	83.95	-	-	43.66	41.66
Weedy check (W_4)	3.89 (14.7)	3.92 (14.9)	4.52 (20)	4.60 (20.7)	3.45 (11.4)	3.51 (11.78)	-	-	68.07	67.73	13.94	13.44
LSD (P=0.05)	0.066	0.11	0.069	0.05	0.09	0.04					0.65	0.83

Figures within parentheses indicate the original values.
The weed data were subjected to square root transformation $\sqrt{x} + 0.5$.

sources of NPK were urea, SSP ad MOP. Fifteen irrigations were given throughout the crop duration and in each irrigation 10 cm water depth was maintained. Both direct seeded and transplanted plants matured on the same date and were harvested on 7 and 13 Nov. of 2003 and 2004, respectively. The observations on weed count and weed dry weight were recorded using least count quadrate method.The yield parameters and yields were recorded and economics was worked out.

RESULTS AND DISCUSSION

Weeds in direct seeded rice emerged simultaneously with the germination of rice, whereas in transplanted plots weed species started appearing after a week. Dominant weed flora observed was *Echinochloa coloua, E. crusgalli* and *Digitaria sanguinalis* among grasses; *Ammania baccifera* and *Commelina benghalensis* among broadleaf weeds and *Cyperus rotundus* and *C. difformis* among sedges. The weed intensity and weed dry weight were significantly influenced by establishment methods, fertility levels and weed management practices (Table 1). The weed intensity and weed dry weight were observed more in direct seeded plots (E_1) between establishment methods; higher fertility (F_3) among fertility levels and weedy

Table 2. Nutrient uptake by weeds at 90 DAT and crop at harvest as affected by establishment methods, fertility levels and weed management practices

Treatment	Nutrient uptake (kg/ha)											
	Crop						Weeds					
	N		P		K		N		P		K	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Establishment methods												
Direct seeded (E_1)	69.5	78.2	14.0	14.7	106.8	105.5	14.78	13.12	1.99	2.00	13.42	12.28
Transplanted (E_2)	76.6	84.1	14.7	15.6	113.1	110.8	9.51	7.85	1.27	1.93	8.31	6.87
LSD (P=0.05)	2.89	3.16	0.59	0.55	3.02	3.10	0.91	0.39	0.13	0.09	0.89	0.31
Fertility levels												
Low fertility (F_1)	58.0	70.0	12.4	13.5	111.3	99.8	9.59	8.73	1.29	2.01	8.62	7.94
Medium fertility (F_2)	71.3	81.1	14.5	15.2	108.9	107.5	12.18	10.44	1.63	1.73	10.30	9.52
High fertility (F_3)	83.0	92.4	16.0	16.7	119.9	117.2	14.67	12.30	1.94	2.15	13.18	11.26
LSD (P=0.05)	5.63	5.43	0.85	0.80	5.66	7.5	1.32	0.84	0.18	0.16	1.26	0.86
Weed management practices												
Anilofos (W_1)	88.1	98.9	17.0	18.1	128.1	126.4	8.99	7.07	1.19	1.22	7.40	6.11
Butachlor (W_2)	83.9	93.3	16.5	17.2	126.3	120.6	9.27	6.20	1.63	0.66	8.20	5.63
Two hand weedings (W_3)	81.7	88.4	14.6	15.8	120.5	125.3	12.37	8.28	1.68	0.69	9.40	6.32
Weedy check (W_4)	40.9	51.2	9.5	10.2	78.3	77.5	18.17	18.20	2.87	4.01	17.0	17.0
LSD (P=0.05)	3.99	3.11	0.41	0.41	3.02	5.64	0.19	0.47	0.09	0.11	1.09	0.38

Table 3. Net income and benefit : cost ratio as affected by interaction among establishment methods, fertility levels and weed management practices

Establishment methods	Direct seeding						Transplanting					
	Low fertility		Medium fertility		High fertility		Low fertility		Medium fertility		High fertility	
	Net income	BCR	Net income	BCR	Net income	BCR	Net income	BCR	Net income	BCR	Net income	BCR
Anilofos (W_1)	2128	1.09	8576	1.37	23102	1.97	9695	1.47	11177	1.51	25493	2.12
Butachlor (W_2)	855	1.03	1849	1.08	14506	1.61	6381	1.31	6606	1.30	17353	1.76
Two hand weedings (W_3)	9138	1.35	15667	1.59	23224	1.82	11701	1.47	17917	1.69	23983	1.88
Weedy check (W_4)	-16305	0.46	-11225	0.49	-10876	0.53	-4127	0.79	-3485	0.83	-3097	0.86

check (W_4) among weed management practices. Two hand weedings resulted in better control of weeds with maximum weed control efficiency. Anilofos (W_1) recorded more weed control efficiency than butachlor as it was more effective in controlling the monocot weeds which mostly infest the rice crop (Vaishya and Tomar, 2000). Due to weed infestation, the competition between crop and weeds for nutrients increased as establishment methods, fertility levels and weed management practices had a significant impact on nutrient uptake by weeds and crop (Table 2). Transplanting method outyielded direct seeding by recording higher grain yield, which was due to more uptake of nutrients. Similarly, due to more NPK uptake, the higher yield was observed in (F_3) among fertility levels and (W_3) among weed management practices. Due to more weed intensity and weed dry weight the uptake of NPK by weeds increased resulting in drastic reduction in yield as reported by Rana *et al*. (2000).The weed index was maximum in weedy check plots (68.07 and 67.9%) during both the years and recorded least value in plots treated with anilofos. Similar findings were reported by Singh *et al.* (2002).

Economics

In weedy check plots, the cost of cultivation was more than gross realization which resulted in loss (Table 3). The maximum gross realization was observed in transplated plots treated with high fertility and two hand weedings ($E_1F_3W_3$). However, higher net profit was observed in direct seeded plots treated with high fertility and anilofos ($E_2F_3W_1$). The increase in net profit with the application of anilofos was also reported by Singh *et al*. (2002).

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