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YIELD RESPONSE OF FINE RICE TO NP FERTILIZER AND WEED MANAGEMENT PRACTICES

EHSAN ULLAH*, ATIQUE-UR-REHMAN, QAISAR ARSHAD AND S. SHAMSHAD HUSSAIN SHAH

Department of Agronomy,
University of Agriculture, Faisalabad, Pakistan

Abstract

Investigations were conducted to examine the effect of plant nutrition and weed management practices on weed biomass, yield contributing parameters and grain yield of fine rice cultivar Basmati-2000. The crop was treated with N and P @ 100 and 80 kg ha^{-1}; half of it; and no fertilizer. Weed controlling practices included different weedicides; hoeing at 30 and 45 days after transplanting in addition to weedy check. Weed biomass (fresh and dry) with and without fertilizer was significantly decreased by hoeing the crop 30 and 45 days after transplanting as compared to other weed control measures. The grain yield increased significantly with N and P (100 and 80 kg ha^{-1}) and by controlling the weeds through interculture twice at 30 and 45 days after transplanting. The increase in grain yield was due to increase in number of total tillers m^{-2}.

Introduction

Rice (*Oryza sativa* L.) one of the most important cereals faces multiple problems during its growth and development processes from sowing to maturity. Out of many problems viz., low plant population, injudicious use of fertilizer, limited availability of water and presence of weeds in the field cause a great loss in the crop yield. Weeds share the plants in nutrition and water, carry insect pests and diseases, lower the quality of produce and sometimes cause complete failure of the main crop. So, it is imperative to look into the ways to control weeds. Research done in this direction has indicated that weeds could be controlled mechanically or by application of chemicals or by adopting biological measures. The decrease in grain yield, however, be averted with the use of fertilizers as a source of plant nutrition (N and P). It was concluded by Singh & Bajpai (1990) that maximum rice grain yield was obtained with the application of N and P @ 100 and 80 kg ha^{-1}, respectively. Dixit & Patro (1994) reported that with the application of 120 kg N, 60 kg P and 25 kg K ha^{-1}, produced 5.51 t grain yield ha^{-1} when the density was 6.6 plants m^{-2}.

Rana *et al.*, (2000) reported that management of weeds along with fertilizers, decreased crop weed competition and increased net income by reducing losses due to weeds, increasing fertilizer use efficiency and finally the grain yield. It was also maintained that various weed control methods along with different fertilizer levels reduced the cost of production. Rajkhowa *et al.*, (2001) found that chemicals significantly reduced the weed population and resulted in higher rice yield over weed control. Laxminarayan & Mishra (2001) concluded that hand weeding and chemical treatments reduced weed population compared to weedy check. There is, therefore, need to explore the efficacy of the method of controlling weeds with the application of fertilizers for augmenting the crop yield. The present study was therefore conducted to determine the effect of a suitable weed control method without deteriorating the soil nutrition on yield of fine rice under Faisalabad agro-ecological conditions.

*Corresponding author: E-mail: ehsanchahal@hotmail.com

Materials and Methods

A field experiment was conducted during Kharif, 2002 at the Agronomic Research Area, University of Agriculture, Faisalabad. The experiment was laid out in a randomized complete block design (RCBD) with factorial arrangement repeated thrice. Net plot size was 1.6 m x 5.0 m. Rice variety basmati-2000 was used as a test crop. The experiment comprised of three fertilizer levels i.e., control, recommended dose of NP @ 100 and 80 kg ha^{-1} and half of the recommended dose i.e., NP @ 50 and 40 kg ha^{-1}. Weed management practices included hoeing at 30 and 45 days after transplanting nursery; application of Shintachlor 50 EC @ 0.125 kg a.i. ha^{-1}; Dachlor 50 EC @ 0.125 kg a.i. ha^{-1}; Machete 60 EC @ 1.178 kg a.i. ha^{-1} in addition to weedy check.

Nursery was raised during the 2nd week of June and transplanted after one month in July. The whole nitrogen and phosphorous was applied at the time of transplanting. The weedicides were sprayed 2-3 days after nursery transplantation. Two hoeings were done 30 and 45 days after transplanting. All other agronomic practices were kept normal and uniform for all the treatments. Weed population, fresh and dry weights of weeds were recorded fortnightly from an area of one square meter. Data on various yield parameters were recorded using standard procedures and the same were analyzed statistically using Fisher's Analysis of Variance Technique. Treatments showing significant F-values were compared among themselves employing least significant difference (LSD) value calculated at 0.05 probability (Steel *et al*., 1997).

Results and Discussion

Weeds identified in the experiment were *Echinochloa colonum* (swanki grass), *Cyperus rotundus* (deela), *Dactyloctenium scindicum* (madhana), *Eclipta alba* (daryai booti), and *Sporobolus indicus* (barnyard grass).

Statistical analysis of the data alongwith summary of results on weed population, fresh and dry weights of weeds recorded m^{-2} are given in Tables1-A, 1-B and 1-C.

It is apparent from Table1-A that weeds population was significantly affected by the application of NP fertilizer and weed management practices. The interaction between the two factors, however, was non significant. Weed population owing to the availability of nutrition significantly increased in NP treated plots as compared to the control. Weed population in fertilized plots on an average was 26% higher than control plots. As regards weed management practices, population of weeds was significantly decreased by hoeing at 30 and 45 days after transplanting the crop whereas, number of weeds m^{-2} was maximum (62.7) where no weed control measure was used. Out of three weedicides, Shintachlor was more effective in weed control than that of Machete but it did not differ significantly from Dachlor. Non-significant difference was also found between T_4 and T_5 treatments where Machete and Dachlor were applied @ 1.178 kg a.i. ha^{-1} and 0.125 kg a.i. ha^{-1}, respectively. It is concluded that manual hoeing of the crop was more effective in controlling weeds as compared to the application of weedicides. Similar results were reported by Singh *et al*., (1989) who concluded that hand weeding decreased the weed population significantly.

Table 1A. Effect of NP fertilizer and weed management practices on weed population (m^{-2}).

	T1 (Control)	**T2** (Hoeing at 30&45 D.A.T.)	**T3** (Shintachlor@0.125kg a.i. ha^{-1})	**T4** (Dachlor @0.125kg a.i. ha^{-1})	**T5** (Machete @1.178kg a.i. ha^{-1})	**Mean**
F_0 (Control)	57.0	5.6	15.0	15.3	17.6	22.1b
F1 (Full doseNP@100-80 kg ha^{-1})	66.0	9.0	19.6	21.3	22.0	27.5a
F2 (Half dose NP@50-40 kg ha^{-1})	65.3	8.0	21.6	22.3	24.0	28.2a
Mean	62.7d	7.5a	18.7b	19.6bc	21.2c	

Fertilizer LSD= 1.39; Weed Control LSD= 1.80

Table 1B. Effect of NP fertilizer and weed management practices on fresh weight of total weeds in grams m^{-2}.

	T1 (Control)	**T2** (Hoeing at 30&45 D.A.T.)	**T3** (Shintachlor@0.125kg a.i. ha^{-1})	**T4** (Dachlor @0.125kg a.i. ha^{-1})	**T5** (Machete @1.178kg a.i. ha^{-1})	**Mean**
F_0 (Control)	115.0b	31.2d	76.6bcd	77.0bcd	73.1bcd	74.5b
F1 (Full doseNP@100-80 kg ha^{-1})	407.6a	51.5d	109.5b	110.0b	102.2b	156.2a
F2 (Half dose NP@50-40 kg ha^{-1})	374.8a	55.1cd	109.3b	102.3b	99.3bc	148.1a
Mean	299.1a	45.9c	98.5b	96.4b	91.5b	

Interaction LSD= 45.81; Fertilizer LSD= 20.49; Weed control LSD= 26.45

Table 1C. Effect of NP fertilizer and weed management practices on dry weight of total weeds in grams m^{-2}.

	T1 (Control)	**T2** (Hoeing at 30&45 D.A.T.)	**T3** (Shintachlor@0.125kg a.i. ha^{-1})	**T4** (Dachlor @0.125kg a.i. ha^{-1})	**T5** (Machete @1.178kg a.i. ha^{-1})	**Mean**
F_0 (Control)	33.67b	11.53f	23.89bcde	22.95cde	21.93de	22.79b
F1 (Full doseNP@100-80 kg ha^{-1})	121.67a	17.43ef	33.48b	32.20bc	30.10bcd	46.97a
F2 (Half dose NP@50-40 kg ha^{-1})	121.14a	19.05ef	32.32bc	29.90bcd	29.01bcd	46.28a
Mean	92.16a	16.00c	29.90b	28.35b	27.01b	

Interaction LSD= 9.93; Fertilizer LSD= 4.44; Weed control LSD= 5.73

The effect of NP fertilizer, weed management practices and their interaction was significant (Table 1B). Fresh weight of total weeds was highest (407.6g) in T_1F_1 combination but it was at par with that of T_1F_2 yielding 374.8g of total fresh weight of weeds per square meter. The lowest fresh weight (31.2g) of weeds was recorded in T_2F_0 combination where weeding was done twice (30 and 45 days after transplanting). It was at par with T_2F_1, T_2F_2, T_3F_0, T_4F_0 and T_5F_0 treatments and the fresh weight in these treatments varied from 31.2g to 77.0g m^{-2}. The fresh weight of weeds recorded in weedy check and without fertilizer was 115.0g m^{-2} and it was at par with T_3, T_4 and T_5 each interacting with F_0, F_1 and F_2. The weight of fresh weed biomass ranged from 99.3 to 115.0 g m^{-2}. The increase in fresh weight of weeds in fertilized plots without a weed management practice may be attributed to more nutrition available to the weeds.

Regarding dry weight of total weeds it is clear that the trend of the results was similar to that found in the total fresh weights of weeds (Table 1C). Plots showing higher fresh weight of weeds were also higher in their dry weights. Out of different weed management practices, interculture at 30 and 45 days after transplanting proved more effective in checking the weed growth with and without fertilizer than other treatments. These findings are in agreement with that reported by Saikia & Pathak (1993), Mahalle *et al.,* (1993) and Nadeem *et al*., (2006) who concluded that hand weeding gave less dry weight of weeds.

Number of total tillers m^{-2} was significantly affected by fertilizer, weed management practices and their interaction (Table 2). The number of tillers was maximum (237.8) when the crop was treated with N and P @ 100 and 80 kg ha^{-1} and it was significantly decreased at lower dose of N and P and the control. Significant increase in the number of tillers m^{-2} owing to added fertilizer was also reported by Mahmood (1995) and Thakur (1991). Out of the weed management practices manual hoeing at 30 and 45 days after transplanting caused a significant increase in the number of tillers m^{-2} over all other treatments. Treatment T_3 significantly gave higher number of total tillers m^{-2} over T_4 and T_5 treatments which in turn were at par with each other. The number of tillers m^{-2}, however, was the minimum (161.2 m^{-2}) in the control. This indicates that the tillers m^{-2} were more in the plots where weed control measures were taken as compared to the weedy check. However, the weed control was more effective in the intercultured plots and competition for nutrition between weeds and the crop plants was reduced. These findings concur with those reported by Rehman (1991) and Bajwa *et al*., (1985).

Regarding the interactive effects of fertilizer and weed management practices, the number of tillers m^{-2} was the highest (260.3) in T_2F_1 where the plots received NP @ 100 and 80 kg ha^{-1} along with hoeing at 30 and 45 days after transplanting (Table 2). It was followed by T_4F_1 treatment which in turn was at par with T_5F_2 and T_3F_1 and on an average produced 246.1 tillers m^{-2}. The number of tillers produced in T_1F_0 treatment was the lowest (138.6 m^{-2}). It is concluded that the number of tillers increased with NP used @ 100 and 80kg ha^{-1} and by hoeing the crop at 30 and 45 days after transplanting. Out of the different applications of weedicides either Shintachlor or Dachlor alongwith NP @ 100 and 80 kg ha^{-1} proved more effective in increasing the number of tillers m^{-2} as compared to other treatment combinations. The results lead to the conclusion that manual weeding alongwith NP fertilizer helped increasing the number of tillers m^{-2} in rice crop. These findings are in conformity with that reported by Nandal & Singh (1993).

Table 2. Effect of NP fertilizer and weed management practices on yield contributing parameters and grain yield.

Treatments	Total No. of tillers m^{-2}	Weight/1000 grains (g)	Grain yield (t ha^{-1})
A. NP fertilizer (kg ha^{-1})			
Control (F0)	195.2c	19.2b	1.27c
100 and 80 (F1)	237.8a	20.6a	2.30a
50 and 40 (F2)	228.4b	19.5b	2.24b
	LSD=2.0	**LSD=0.62**	**LSD=0.02**
B. Weed management			
Control (F1)	161.2d	16.5c	1.66d
Hoeing at 30&45 D.A.T. (F2)	239.3a	20.5a	2.01a
Shintachlor @0.125kg a.i. ha^{-1} (F3)	236.3b	18.3b	1.89b
Dachlor @0.125kg a.i. ha^{-1} (F4)	233.3c	18.6b	1.85c
Machete @1.178kg a.i. ha^{-1} (F5)	233.0c	18.3b	1.86bc
	LSD=2.58	**LSD=0.81**	**LSD=0.03**
Interaction (F x T)			
T1 x F0	138.6i	16.4	1.16h
T2 x F0	210.0f	19.5	1.47f
T3 x F0	215.0f	19.6	1.24g
T4 x F0	206.7f	20.2	1.23g
T5 x F0	207.7f	20.4	1.24g
T1 x F1	175.3g	19.2	1.93e
T2 x F1	260.3a	21.2	3.04a
T3 x F1	245.3bc	21.1	2.10c
T4 x F1	247.7b	20.8	2.21b
T5 x F1	241.3c	20.7	2.21b
T1 x F2	162.3h	19.9	1.89e
T2 x F2	236.7d	17.9	2.03d
T3 x F2	242.7c	20.3	2.04d
T4 x F2	241.7c	20.8	2.11c
T5 x F2	245.3bc	20.7	2.15c
	LSD=4.48	**n.s.**	**LSD=0.05**

Weight per 1000 grains was also significantly influenced by the fertilizer and weed management practices. Their interaction, however, could not reach a level of significance (Table 2). The results show that the weight per 1000 grains was the maximum (20.6g) in F_1 where the plots were treated with NP @ 100 and 80 kg ha^{-1} followed by F_2 which in turn was at par with the control. It is concluded that owing to proper grain development, weight of grains increased at higher level of fertilizer. These results support the findings of Qasim (1997) and Awan *et al*., (1984) who stated that the weight per 1000 grains was significantly higher in treated plots with N+P @ 75 kg + 75 kg ha^{-1} than the control.

Grain weight was the maximum (20.5g) in T_2 where the crop was intercultured twice during its growth period. Non- significant differences existed among all the weed management treatments and on an average the weight per 1000 grains was 18.40g. In contrast, the weight per 1000 grains was the minimum (16.5g) in the control. It revealed from the results that hand weeding helped increasing 1000 grain weight in rice as compared to other treatments. Similar results were reported by Bajwa *et al*., (1985).

Grain yield was significantly influenced by the application of fertilizer and it was maximum (2.30t/ha) in F_1 where the crop was treated with NP @100 and 80 kg/ha (Table 2). It was followed by F_2 which was significantly higher in grain yield (2.24 t/ha) than F_0 producing 1.27t/ha without fertilizer. These results suggest that with increase in fertilizer

application, there was an increase in the rice grain yield. These findings are in conformity with that reported by Kulmi (1990) and Jena *et al*., (1999).

The grain yield was also significantly affected by the weed management practices, out of which hoeing of crop at 30 and 45 days after transplanting produced the maximum i.e., 2.01t ha^{-1}. It was followed by T_3 treatment which in turn was at par with that of T_5 where Machete was applied @1.178 kg a.i. ha^{-1}. The lowest grain yield (1.66t ha^{-1}) was recorded in the control and it differed significantly from all other treatments. It is concluded that all the weedicides and interculture treatments significantly increased the grain yield over control. However, hoeing of crop at 30 and 45 days after transplanting proved a more efficient weed management practice as compared to other treatments. The results reported by Singh *et al*., (1989) and Kulmi (1990) support the findings of this study.

The interaction between the two factors was significant. The grain yield was maximum (3.04 t ha^{-1}) in T_2F_1 combination where the crop was intercultured twice and treated with 100 kg N and 80 kg P ha^{-1} followed by T_4F_1 and T_5F_1 treatments which were at par with each other and on an average produced 2.21 t of grains ha^{-1}. Treatments T_3F_1, T_4F_2 and T_5F_2 were at par with one another and their average grain yield was 2.12 t ha^{-1}. They were significantly different from T_3F_2 combination where Shintachlor was used @ 0.125 kg a.i. to control weeds and the N and P were added @ 50 kg and 40 kg ha^{-1}, respectively. The grain yield decreased significantly in much of the combinations of weed management practices and with no fertilizer. The lowest grain yield (1.16 t ha^{-1}) was obtained in T_1F_0 where crop was allowed to mature without fertilizer and checking the weeds. The results reveal that hoeing the crop twice i.e., at 30 and 45 days after transplanting with high dose of fertilizer i.e., N and P @ 100 and 80 kg, respectively proved more effective in augmenting the grain yield of rice. These results are in conformity with those obtained by Bhagat *et al*., (1991) and Prasad (1995).

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