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Production Efficacy of Six Rice Cultivars Against Various Herbicides Applied for Weed Control in Direct Wet-Seeded Rice (*Oryza sativa* L.) Culture

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Abstract: Six varieties namely IR-6, IR-9, KS-282, Bas-370, Bas-198 and Bas-385 were sown at seed rate of 100 kg ha^{-1}.Two herbicides viz. Acelor @ 250 ml ha^{-1} and Rifit @ 1 l ha^{-1} were applied as post emergence (30 days after seeding) to all plots except weedy check (control). Weeds were affectively controlled with herbicides application. Maximum number of tillers m^{-2} (340.2), number of panicles m^{-2} (329.8), 1000-grain weight (25.50 g), highest paddy yield (7.50 t ha^{-1}) and straw yield (19.24 t ha^{-1}) were observed in KS-282. Acelor @ 250 ml ha^{-1} controlled weeds more effectively and gaveminimum weed population m^{-2} (15.28), maximum number of tillers m^{-2} (330.7), number of panicles m^{-2} (319.0), number of spikelets per panicle (139.2), 1000-grain weight (21.99 g), paddy yield (6.48 t ha^{-1}) and harvest index (31.39 %).

Key words: *Oryza sativa*, herbicides, wet-seeded culture, panicles, spikes, paddy, harvest index.

Introduction

Rice (*Oryza sativa* L.) has been the most important food for millions of people and has the highest production among the world's major cereals although the area where it is grown less than that of wheat (Shad, 1983). Rice is the staple food and is next to wheat in this respect. But its importance for Pakistan as one of the major agricultural commodity cannot be over emphasized. A break through have been achieved in raising the yield of rice crop through transplanted rice culture but due to lowering of benefit cost ratio, productivity per unit area and per unit time, rising costs of inputs, unavailability and costly labour, compaction of soil structure due to puddlings and failure of nursery due to various factors i.e. unfavourable weather conditions, nutrient deficiencies, toxicities and plant protection problems, the trust of farmers in this system has been shaken. Nursery rising in transplanted rice means engaging the field for nearly a month earlier for transplanting and it requires additional expenditure and intensive care unlike direct seeded rice culture. Furthermore any abnormality in nursery raising adversely affects not only the productivity of the rice crop alone rather than the productivity of the entire rice-based cropping system. Under direct seeding, however, the major constraint in achieving the high yield potential is severe weed competition. Due to narrow spacing and flooding, hand weeding and mechanical hoeing is difficult and herbicides offer more practical, effective and economic means of controlling weeds (Nadeem, 1998). In direct seeding, weed infestation greatly reduces the yield. Yield reduction due to weed infestation depends on the type of rice culture, method of planting and cultural practices. Yield reduction in upland paddy due to weed competition was as higher as 90% (Ghosh and Sharma, 1997) and in these conditions the yield reduction ranged from 10-70% (Kumar and Gill, 1982). Various methods are used for weed control such as cultural, biological, mechanical and chemical etc. The later weed control method is becoming popular because it is most efficient means of reducing weeds competition with minimum labor cost (Baloch, 1994). Besides weed control through chemicals, use of different varieties is also one of the most effective ways of weed control (Chaudhry and Movillon, 1996). It was observed that herbicides application and hand weeding significantly increased the rice yield while the weed biomass was decreased (Awan *et al.*, 1993). Awan *et al.* (2000) also observed that weeds of rice were effectively controlled with herbicides application.

Keeping in view the specific climatic conditions of D.I.Khan and the importance of rice as a cash crop as well as an export commodity, the present study had been initiated so as to determine the suitable variety and effective herbicide for weed control in direct wet-seeded rice culture for the area.

Materials and Methods

The research project was carried out in 1999 at Agriculture Research Institute, D.I.Khan. Split-plot arrangements were used in this study with RCBD. Area of each sub-plot was 3 x 5 m^2. The detail of experimental treatments is as under:

Main Plots (Herbicides):	Sub-Plots (Varieties):	
H1-Acelor @ 250 ml ha^{-1}.	V1 = IR-6.	V4 = Bas-370.
H2-Rifit @ 1 l ha^{-1}.	V2 = IR-9.	V5 = Bas-198.
H0-Weedy Check (Control).	V3 = KS-282.	V6 = Bas-385.

Experimental field was prepared by ploughing, harrowing and use of cultivator. Fertilizer was applied @ 120-90-60 kg ha^{-1} of N, P_2O_5 and K_2O in the form of urea, diammonium phosphate and sulphate of potash, respectively. Seeds were selected at specific gravity of 1.13 in salt water, prepared by dissolving about ½ kg of salt in 10 lit. of water. The seeds that sink in salt water were selected for sowing and other light, floated and unviable seeds were discarded. After rinsing the salt water, the seeds were immersed in water for 24 hs. and then under moist gunny bags for 36 hs. to a pigeon breast like shape. Seeds were used @ 100 kg ha^{-1}. Pre-germinated seeds were broadcasted in water. All the herbicides were applied at the post emergence stage.

The following observations were recorded during the course of study:

1. Weed population m^{-2}.
2. Number of tillers m^{-2}.
3. Number of Panicles m^{-2}.
4. Spikelets per panicles.
5. Plant height (cm).
6. 1000-Grain weight (g).
7. Paddy yield (t ha^{-1}).
8. Straw yield (t ha^{-1}).

The data was analyzed by using the Analysis of Variance Techniques (Steel and Torrie, 1984) and Duncan's Multiple Range Test (Duncan, 1955) was used to see the differences among the treatment means. The analysis was performed by using "MSTATC" programme.

Results and Discussion

Weed population per m^2: The data on weed population m^{-2} (Table 1) showed that different varieties gave significant

Table 1: Effect of Different Varieties and Herbicides on Direct Wet Seeded Rice.

Varieties	Herbicides Used			Means
	H1 (Acelor)	H2 (Rifit)	Ho (Check)	
	Weed Population m^{-2}			
V1 = IR-6	19.33 cg	37.00 ad	49.67 ab	35.33 a
V2 = IR-9	30.00 af	10.33 eg	44.00 ac	28.11 a
V3 = KS-282	05.00 fg	28.33 bf	36.00 ad	23.11 a
V4 = Bas-370	31.67 ae	16.00 dg	27.33 bf	25.00 a
V5 = Bas-198	00.33 g	09.00 eg	53.67 a	21.00 a
V6 = Bas-385	05.33 fg	12.33 dg	17.67 dg	11.78 b
Means	15.28 b	18.83 b	36.06 a	
	Number of Tillers m^{-2}			
V1 = IR-6	334.0 ac	331.3 ad	335.3 ac	333.7 a
V2 = IR-9	342.3 ab	333.7 ac	339.3 ab	338.4 a
V3 = KS-282	347.7 a	341.7 ab	331.3 ad	340.0 a
V4 = Bas-370	318.7 cf	309.3 f	315.3 df	314.4 c
V5 = Bas-198	329.7 be	321.7 cf	318.7 cf	323.3 b
V6 = Bas-385	311.7 f	304.7 f	313.7 ef	310.0 c
Means	330.7 a	323.7 b	325.6 ab	
	Number of Panicles m^{-2}			
V1 = IR-6	325.7 b	320.7 b	319.7 b	322.0 a
V2 = IR-9	325.0 b	327.0 b	321.7 b	324.6 a
V3 = KS-282	333.7 ab	330.7 ab	325.0 b	329.8 a
V4 = Bas-370	284.3 cd	282.3 cd	269.3 d	278.7 b
V5 = Bas-198	364.0 a	298.3 bd	280.3 cd	314.2 a
V6 = Bas-385	281.3 cd	309.4 bc	267.3 d	286.1 b
Means	319.0 a	311.4 ab	297.2 b	
	Number of Spikelets per Panicle			
V1 = IR-6	119.0 h	122.0 gh	118.7 h	119.9 d
V2 = IR-9	125.3 fh	125.3 fh	118.3 h	123.0 cd
V3 = KS-282	136.3 cg	130.3 eh	119.7 h	128.8 c
V4 = Bas-370	150.7 ag	148.7 ad	139.3 cf	146.2 ab
V5 = Bas-198	158.3 a	155.7 ab	142.7 be	152.2 a
V6 = Bas-385	145.7 ad	142.7 be	134.7 dg	141.0 b
Means	139.2 a	137.4 a	128.9 b	

Means not sharing a common letter(s) in their respective group are significant at 5%.

Table 2: Effect of Different Varieties and Herbicides on Direct Wet Seeded Rice.

Varieties	Herbicides Used			Means
	H1 (Acelor)	H2 (Rifit)	HO (Check)	
	Plant Height (cm)			
V1 = IR-6	121.7 d	121.7 d	116.3 d	119.9 c
V2 = IR-9	122.3 d	125.3 d	118.3 d	122.0 c
V3 = KS-282	125.7 d	127.7 d	119.7 d	124.3 c
V4 = Bas-370	155.7 ac	155.7 ac	146.7 c	152.7 ab
V5 = Bas-198	160.0 ab	163.7 a	151.3 bc	158.3 a
V6 = Bas-385	151.7 bc	153.3 ac	146.7 bc	150.4 b
Means	139.5 a	141.2 a	133.1 b	
	1000-Grain Weight (g)			
V1 = IR-6	26.73 a	24.17 a	25.20 a	25.37 a
V2 = IR-9	26.93 a	25.47 a	23.07 a	25.16 a
V3 = KS-282	26.80 a	25.27 a	24.43 a	25.50 a
V4 = Bas-370	17.53 b	16.30 b	16.93 b	16.92 b
V5 = Bas-198	17.60 b	18.07 b	16.80 b	17.49 b
V6 = Bas-385	16.33 b	16.53 b	15.30 b	16.06 b
Means	21.99 NS	20.97	20.29	
	Paddy Yield (t ha^{-1})			
V1 = IR-6	7.76 a	7.68 a	5.98 c	7.14 b
V2 = IR-9	7.96 a	7.87 a	5.86 c	7.21 b
V3 = KS-282	7.97 a	7.91 a	6.62 b	7.50 a
V4 = Bas-370	4.97 ef	4.89 f	3.91 g	4.59 d
V5 = Bas-198	5.27 de	5.32 d	3.96 g	4.85 c
V6 = Bas-385	4.96 ef	4.82 f	3.84 g	4.54 d
Means	6.48 a	6.42 a	5.03 b	
	Straw Yield (t ha^{-1})			
V1 = IR-6	19.23 b	19.34 b	16.13 c	18.24 b
V2 = IR-9	19.31 b	19.21 b	16.34 c	18.29 b
V3 = KS-282	19.99 b	21.54 a	16.19 c	19.24 a
V4 = Bas-370	09.79 d	09.93 d	07.86 e	09.20 c
V5 = Bas-198	09.97 d	09.89 d	07.91 e	09.26 c
V6 = Bas-385	09.77 d	09.83 d	07.76 e	09.12 c
Means	14.68 a	14.96 a	12.03 b	

Means not sharing a common letter(s) in their respective group are significant at 5%.

results but these variations were very minute. Minimum number of weeds (11.78) was found in V6 (Bas-385) while the maximum number of weeds (35.33) was recorded in V1 (IR-6). Statistically the results of all the cultivars except Bas-385 remained non-significant with each other. Similarly the herbicides effect on weed population was significant over the control treatment. Minimum weeds (15.28) were observed in H1 (Acelor) whereas maximum weeds (36.06) were present in Ho (Weedy check). Acelor treated plots gave minimum number of weeds because less space was available due to more number of tillers as compared to check. Gogoi and Kalita (1990) also reported that herbicides application reduced population and dry matter.

Number of tillers m^{-2}: The data on the said parameter (Table 1) revealed that the effect of different varieties on the tillers per m^2 was significant. Maximum number of tillers (340.0) was found in KS-282 while the minimum (310.0 tillers) was recorded in Bas-385. Similarly the effect of herbicides on tillers m^{-2} was also significant. Maximum tillers (330.7) were obtained in H1 (Acelor) and minimum (323.7) was in H2 (Rifit). It may be due to less weed population in H1 (Acelor). The interaction of varieties and herbicides was statistically significant.

Number of panicles m^{-2}: The data about number of panicles m^{-2} (Table 1) depicted that the effect of different varieties on the said parameter was significant. Maximum panicles (329.8) were found in V3 (KS-282) and minimum (278.7) was recorded from Bas-370. Similarly the effect of herbicides on the panicles was statistically significant. Maximum panicles were obtained from Acelor (319.0) against the minimum of 287.2 panicles found in Weedy check. The interaction of both the factors was also significant. These results are supported by Awan *et al.* (2000) who reported that herbicides application controlled the weeds and increased the panicles m^{-2}.

Number of spikelets per panicle: Data regarding spikelets per panicle (Table 1) depicted that the effect of different varieties on the said parameter was statistically significant. Maximum spikelets (152.2) per panicle were recorded from Bas-198 while minimum number of spikelets was noted as 119.9 per panicle in IR-6. Significant differences were also observed in case of herbicides. Maximum and minimum spikelets per panicle were taken as 139.2 & 128.9 from Acelor and Weedy check plots, respectively. The interaction between varieties and herbicides also showed significant variations. Awan *et al.* (2000) also observed similar results.

Plant height (cm): Plant height of rice (Table 2) revealed significant differences for various varieties. Maximum height (158.3 cm) was noted in Bas-198 whereas the minimum was recorded in IR-6 (119.9 cm). Similarly the effect of different herbicides on plant height was significant. Tallest plant (141.2 cm) was observed in Rifit against the minimum of 133.1 cm height from weedy check. Interaction between both the factors had also some effect on plant height. Qayyum *et al.* (1989) checked better weed control, high yield and plant height with Machete than Ronstar. They also reported high

yield of IR-8 than IR-6 and Bas-370.

1000-grain weight (g): The effect of different varieties on 1000-grain weight was significant (Table 2). Maximum grain weight (25.50 g) was noted in V3 (KS-282) whereas the minimum weight was recorded from V6 (Bas-385) with 16.06 g weight. Similarly the effect of herbicides on 1000-grain weight was statistically non-significant. However, maximum weight (21.99 g) was found in H1 (Acelor) against the minimum of 20.29 g obtained from weedy check. The interaction of herbicides and varieties had also significant effect on 1000-grain weight.

Paddy yield (t ha^{-1}): Data on paddy yield (Table 2) revealed that the effect of varieties on paddy yield remained significant. The highest paddy yield (7.50 t ha^{-1}) was taken from V3 (KS-282) while Bas-385 (V6) produced the minimum yield of 4.54 t ha^{-1}. On the other hand, the effect of different herbicides on the paddy yield was also significant. Maximum yield was given by Acelor (6.48 t ha^{-1}) and the lowest yield was observed in Weedy check plots (5.03 t ha^{-1}) on account of severe weed infestation in these plots. Both the factors (Varieties + Herbicides) interacted significantly between each other. These results coincide with the findings on Nayyar (1998) and Awan *et al*. (2000). They observed an increase in the yield after the various herbicides application.

Straw yield (t ha^{-1}): The effect of different varieties on the straw yield was significant (Table 2). Maximum as well as the minimum yield was noted as 19.24 & 9.12 t/ha from KS-282 and Bas-385, respectively. On the next side, the findings were also remained significant. Highest yield (14.96 t ha^{-1}) was taken from H2 (Rifit) treated plots while the lowest yield (12.03 t ha^{-1}) by weedy check plots. The interaction of varieties and herbicides had also significant effect of the straw yield.

It can be concluded from the above findings that weeds were effectively controlled in V3 (KS-282) along with the application of Acelor. It gave higher yield than the other treatments. Therefore, KS-282 and Acelor seems to be a suitable combination for the general growers of the area like D.I.Khan, Pakistan

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