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IMPACT OF SEEDING DATES AND VARIETIES ON WEED INFESTATION, YIELD AND YIELD COMPONENTS OF RICE (*ORYZA SATIVA* L.) UNDER DIRECT WET-SEEDED CULTURE*

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ABSTRACT

To study the effect of different seeding dates and varieties on the yield and yield components of rice under direct wet-seeded rice culture, an experiment was conducted at Agricultural Research Institute D.I.Khan, NWFP, Pakistan, during 1999 and 2000. Mean values of the data indicated that different varieties had significant effect on dry weed biomass (g m^{-2}), panicle m^{-2}, and spikelets panicle^{-1} during both the years of the study. Varieties affected the sterility percentage, 1000-grain weight (g), paddy and straw yield (t ha^{-1}) during 1999 only. While seeding dates affected all the above mentioned parameters as well as harvest index during 1999 and 2000.

Key words: Rice, *Oryza sativa* L., weeds, direct wet seeding, seeding dates, varieties.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important food crop of the world. It has been the primary staple food for millions of people, for centuries. Rice is also the main livelihood of rural population in many Asian, African and Latin American countries (Labrada, 1998). Similarly, it is true for Pakistan as well, where it is next to wheat in this respect. In Pakistan, rice is cultivated on an area of 2.52 million hectares with a production of 5.16 million tones annually having an average yield of 2050 kg ha^{-1} (Anonymous, 2000). The importance of rice for our country is manifold, as it is an agricultural commodity that adds 20 % of the total foreign exchange to the national foreign exchange reserves (Anonymous, 2001). Though, the yield of rice per hectare in Pakistan has increased from 970 kg to 2050 kg ha^{-1} during 1999-2000 due to the introduction of high yielding IRRI rice varieties. But, still it is well below the world's average. Rice is either planted by transplanting or direct seeding methods. The transplanting however, involves costly labor, uneven planting, lesser density per unit area, compaction of soil structure due to puddling and failure of nursery due to various factors i.e. unfavorable weather conditions, nutrient deficiencies and toxicities (Sohail *et al.*, 1999). Moreover, nursery raising in transplanted rice means engaging the field for nearly a month earlier to transplanting that requires additional expenditure and intensive care unlike direct seeding. Due to these reasons, most of the farmers are no more in favor of raising rice crop through transplanting that has made shift unavoidable from transplanting to direct seeded culture. Most of the field experiments and on-farm research have proved accurate seed rate, timely seeding, efficient weed control and water management under direct seeded conditions giving as high yield as transplanted rice with comparatively lower production cost (Awan *et al* 1989 and Baloch, 1994). In some experiments even higher than transplanted rice (Shad, 1983). Weeds are the main hurdle in adopting direct seeding culture. Different cultural measures could be easier and cheaper ways to minimize weed population. Delayed seeding after a heavy rain and a dry period has been advocated by Vongsaroj (1998) for reduction of weed problem, while Puckridge *et al* (1987) observed reduction in wild rice population by delaying seeding of rice from May to June. Keeping in

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view the importance of direct seeded culture, studies were undertaken to investigate the proper time combined with the adaptable variety for raising rice crop through direct seeding to realize optimum yields with lower input costs

MATERIALS AND METHODS

A field experiment to study the yield and yield components and weed population as affected by different seeding dates and varieties of rice under direct wet seeded culture, was conducted during 1999 and 2000 at Agricultural Research Institute D. I Khan, NWFP, Pakistan During first year of the trial, the preceding crop was *Brassica napus* and during second year the experiment followed the wheat crop. Split-plot arrangements were used in Randomized Complete Block Design with three replications. Sub-plot size measured 5 x 3 m^2. Varieties (IR-6, IR-9 and KS-282) were allotted to main plots, while seeding dates were kept in the sub-plots. The first seeding was done on May 9, while the subsequent seedings were done at 10 days interval upto June 18, during the consecutive years of studies. Pre-germinated seed @ 100 kg ha^{-1} was broadcast in the moist plots. Weed density and biomass were taken using 0.25 x 0.25 m^2 quadrate randomly from 3 sites in each sub-plot 45 days after seeding, subsequently oven-drying at 80°C for 48 hours. Data recorded on weed density and dry weed biomass subsequently converted to number of weeds m^{-2} and g m^{-2}, respectively. The other data recorded were number of panicles m^{-2}, spikelets $panicle^{-1}$, sterility percentage, 1000-grain weight (g), straw and paddy yield (t ha^{-1}) and harvest index. The data thus collected were subjected to analysis of variance technique appropriate for the design The significant means were separated by Duncan's Multiple Range Test (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Dry weed biomass (g m^{-2})

The data recorded for the parameter (Table-1) revealed that D_5 (June 18) seeding gave the lowest while, D_1 (May 9) produced significantly highest weight of dry weed biomass (g m^{-2}) during both the years However, during 1999, D_4 was at par with D_2 and D_3, while during 2000, D_4 did not differ from D_1, and D_2 was at par with D_3 for the trait, statistically Variety KS-282 produced the lower dry weed biomass during 1999 and 2000, though during second year KS-282 and IR-9 were at par statistically for the dry weed biomass. This might have been due to the difference in the soil fertility under the experiments during the trial years and difference in the weed flora.

Table 1. Dry weed biomass (g m^{-2}) as affected by different seeding dates and varieties in direct wet seeded rice culture during 1999 and 2000.

1999					2000				
Dates	Varieties			Mean	Dates	Varieties			Mean
	IR-6	IR-9	KS-282			IR-6	IR-9	KS-282	
May 09	75.0 b	85.0ab	50.0 cd	70.0 a	May 09	100.0	107.0	115.0	107.0 a
May 19	56.0 c	90.0a	45.0 cd	64.0 a	May 19	86.0	110.0	93.0	96.0 b
May 29	76.0 b	82.0ab	43.0 d	67.0 a	May 29	93.0	101.0	95.0	96.0 b
June 08	40.0 d	26.0 e	20.0 ef	29.0 b	June 08	60.0	80.0	70.0	70.0 c
June 18	25.0 e	12.0 f	16.0 ef	18.0 c	June 18	56.0	68.0	65.0	63.0 c
Means	54.0 b	59.0 a	35.0 c		Means	79.0 b	93.0 a	88.0 ab	

Means followed by the same letter(s) are non-significant by DMRT at 5 % level of probability

Number of panicles m^{-2} in rice

Data recorded on the number of panicles m^{-2} (Table-2) showed that more number of panicles were observed when seeding was done on June 18 (D_5) and the minimum number of panicles were recorded in D_1 (May 9) seeding during both the years Though during 1999, D_4 did not differ from D_2 and D_3 while, D_5 was at par with D_4 statistically, for the parameter under reference. IR-6 gave the maximum number of panicles during both the years. However, during first year of the trial IR-6 was at par with KS-282 for the trait. The results agree with those reported by Awan (1988) and Gandapore (1999). The former researcher observed non significant difference between the number

of panicles produced by IR-6 and KS-282, while the later observed significant difference between the number of panicles of IR-6 and IR-9 varieties of rice.

Table 2. Number of panicles (m^{-2}) as affected by different seeding dates and varieties in direct wet seeded rice culture during 1999 and 2000.

1999					2000				
Dates	Varieties			Mean	Dates	Varieties			Mean
	IR-6	IR-9	KS-282			IR-6	IR-9	KS-282	
May 09	439 bcd	395 ef	425de	420cd	May 09	444 g	446 fg	429 gh	440 e
May 19	448 a-d	342 g	434cd	408 d	May 19	481 de	420 h	447 fg	449 d
May 29	450 a-d	361 fg	458a-d	420 cd	May 29	473 de	463 ef	472 de	477 c
June 08	466 abc	423 de	463abc	451 ab	June 08	688 b	486 d	596 c	590 b
June 18	482 a	460 a-d	474ab	472 a	June 18	773 a	600 bc	680 b	685 a
Means	457 a	396 b	449a		Means	572 a	483 c	526 b	

Means followed by the same letter(s) are non-significant by DMRT at 5 % level of probability.

Number of spikelets panicle^{-1}

The data indicated (Table-3) that D_5 (June 18) seeding gave more number of spikelets per panicle than early seeding during both the years. However, during 1999, D_1, D_2 and D_3 were at par, while D_4 and D_5 did not differ from each other for the number of spikelets. During 2000, D_1 and D_2 were at par statistically for the trait. KS-282 produced more spikelets during both the years. However, during 1999, KS-282 was at par with IR-6 and during 2000, IR-6 and IR-9 did not differ from each other for number of spikelets per panicle. This may be due to the difference in the mean temperatures, humidity, the soil and the weed flora in either year of the trial. The results agree with the findings of Hassan *et al.*, (1999) and Awan *et al.*, (2001) who observed that KS-282 produced significantly higher number of spikelets than variety IR-6, though statistically at par but numerically higher than those produced by IR-9.

Table 3. Number of spikelets panicle^{-1} as affected by different seeding dates and varieties in direct wet seeded rice culture during 1999 and 2000.

1999					2000				
Dates	Varieties			Mean	Dates	Varieties			Mean
	IR-6	IR-9	KS-282			IR-6	IR-9	KS 282	
May 09	127	124	126	126 b	May 09	120 g	116 g	133 e	123 d
May 19	130	117	133	127 b	May 19	128 f	98 h	139 d	121 d
May 29	128	121	130	126 b	May 29	120 g	132 e	153 b	135 c
June 08	133	133	134	133 a	June 08	138 d	144 c	154 ab	145 b
June 18	141	136	138	138 a	June 18	146 c	153 b	158 a	152 a
Means	131.8a	126.2 b	132.0 a		Means	130 b	129 b	147 a	

Means followed by the same letter(s) are non-significant by DMRT at 5 % level of probability.

Sterility percentage

Similar trend of sterility percentage was observed during both the years (Table-4). Minimum sterility was observed in D_5 (June 18) seeding, while D_1 (May 9) seeding gave the maximum sterile spikelets during both the years of studies. However, first three seeding dates were at par with one another statistically and D_4 and D_5 also did not differ from each other for sterility percentage during both the years. KS-282 produced minimum sterility percentage during both the years. IR-6 and IR-9 did not differ from each other statistically, during 1999, whereas during 2000, all the varieties were at par with one another for the parameter under study. Comparatively, higher sterility percentage during the second year may be due to the difference in the mean temperature and humidity during the two seasons. The results are in accordance with the findings of Javed *et al.*, (1979), Awan (1988), Hassan *et al.*, (1999) and Awan *et al.*, (2001).

Table 4. Sterility percentage as affected by different seeding dates and varieties in direct wet seeded rice culture during 1999 and 2000.

	1999					2000			
	Varieties					Varieties			
Dates	IR-6	IR-9	KS-282	Mean	Dates	IR-6	IR-9	KS-282	Mean
May 09	21.3	23.2	18.5	20.9a	May 09	28.8	29.1	27.3	28.4 a
May 19	19.9	24.7	16.3	20.3a	May 19	26.5	29.9	26.0	27.5 a
May 29	21.8	22.3	16.1	20.1a	May 29	26.9	28.2	26.1	27.1 a
June 08	13.7	12.7	11.8	12.7b	June 08	25.3	25.0	24.1	24.8 b
June 18	12.0	11.2	9.7	10.9b	June 18	24.8	24.1	23.6	24.2 b
Means	17.7 a	18.8 a	14.5 b		Means	26.5	27.3	25.4	

Means followed by the same letter(s) are non-significant by DMRT at 5 % level of probability

1000-grain weight (g)

The data in Table-5 reveal that D_4 (June 18) seeding had significantly heavier grains than all the early seeding dates during both the years of the trial. However, D_1, D_2 and D_3 were at par for grain weight during both the years, while D_4 did not differ from D_5 for the trait during 2000. KS-282 gave higher weight for 1000-grains during both the years, however, during second year this variety was different statistically from IR-6 and IR-9. These findings agree with the work reported by Awan (1988) and Hassan *et al*. (1999)

Table 5. 1000-grain weight (g) as affected by different seeding dates and varieties in direct wet seeded rice culture during 1999 and 2000.

	1999					2000			
	Varieties					Varieties			
Dates	IR-6	IR-9	KS-282	Mean	Dates	IR-6	IR-9	KS-282	Mean
May 09	25.3f	24.0g	26.3c-f	25.2c	May 09	26.7 bc	24.0fg	24.6 efg	25.1 c
May 19	27.0a-d	23.4g	26.7b-e	25.7bc	May 19	24.5 fg	26.0b-e	26.9 ab	25.8bc
May 29	25.7ef	23.7g	26.7b-e	25.3c	May 29	25.2 def	23.6g	27.1 a	25.3bc
June 08	25.7ef	26.0def	27.3abc	26.3b	June 08	26.6 bc	25.4c-f	26.1bcd	26.0ab
June 18	28.0a	26.7b-e	27.7ab	27.4a	June 18	26.0 b-e	27.5a	25.4 c-f	26.3 a
Means	26.3b	24.8 c	26.9a		Means	25.8	25.3	26.0	

Means followed by the same letter (s) are non-significant by DMRT at 5 % level of probability.

Paddy yield (t ha^{-1})

D_4 (June 18) seeding produced significantly higher paddy yield than all the seeding dates, however, it was statistically at par with D_5 during both the years (Table-6). The first three seeding dates also did not differ from each other for the paddy yield during both the years of the trial. KS-282 produced maximum yield (7.6 t ha^{-1}) during 1999, but was statistically at par with IR-6 (6.8 t ha^{-1}). Similarly, KS-282 produced higher yield (7.06 t ha^{-1}) numerically, but did not differ from those given by IR-6 and IR-9 during 2000. Comparatively, higher paddy yield obtained during 1999 than 2000 could be attributed to lower sterility percentage and dry weed biomass as well as higher weight of 1000-grain during 1999 experimentation. The results are in accordance with those of Awan (1988), Pande and Gautum (1988) and Hassan *et al*., (1999).

Table 6. Paddy yield (t ha^{-1}) as affected by different seeding dates and varieties in direct wet seeded rice culture during 1999 and 2000.

1999					2000				
	Varieties					Varieties			
Dates	IR-6	IR-9	KS-282	Mean	Dates	IR-6	IR-9	KS-282	Mean
May 09	5.7	4.3	6.7	5.6 b	May 09	5.1	5.0	5 8	5 3 b
May 19	6.3	3.8	7.2	5.8 b	May 19	6.3	4.8	6 5	5 9 b
May 29	5.8	4 7	7 2	5 9 b	May 29	5.9	5.1	6.3	5 8 b
June 08	7 8	8 2	8.5	8.2 a	June 08	7.6	7 7	8.2	7.8 a
June 18	8 2	8 5	8.7	8.5 a	June 18	7.9	8.2	8 3	8 1 a
Means	6.8ab	5 9 b	7 6 a		Means	6.6	6 2	7.1	

Means followed by the same letter (s) are non-significant by DMRT at 5 % level of probability

Straw yield (t ha^{-1})

The data in Table-7 revealed that D_4 and D_5 were at par with each other for straw yield but significantly higher than the remaining three dates during both the years. KS-282 gave significantly higher straw yield during 1999 but was at par with IR-6 and IR-9 during 2000. Higher straw yield during 1999 than that during 2000 may be due to more plant height because of different soil fertility levels between the trial years. Similar, results were reported by Hassan *et al.*, (1999) and Awan *et al.*, (2001).

Table 7. Straw yield (t ha^{-1}) as affected by different seeding dates and varieties in direct wet seeded rice culture during 1999 and 2000.

1999					2000				
	Varieties					Varieties			
Dates	IR-6	IR-9	KS-282	Mean	Dates	IR-6	IR-9	KS-282	Mean
May 09	13.5def	11 0 fg	15 9 a-d	13.5b	May 09	12 6	12 3	10 9	11.9 b
May 19	14.1c-f	9.9 g	16.9 abc	13.6b	May 19	14 9	11.2	13.2	13.1 b
May 29	14.4b-e	11.3efg	16.9 abc	14.2b	May 29	14.7	12 2	12 2	13 1 b
June 08	17 0abc	17.7ab	18.6 a	17.8a	June 08	16.4	14.9	15 7	15.7 a
June 18	17 0abc	17 2abc	18.5 a	17.7a	June 18	17:0	15.1	16 9	16.3
Means	15.2 b	13.5 c	17.3 a		Means	15 1 a	13 1 b	13 8 ab	

Means followed by the same letter (s) are non-significant by DMRT at 5 % level of probability.

Harvest Index

Similar trend of harvest index was observed during both the years (Table-8). D_4 and D_5 were at par with each other but significantly higher than D_1, D_2 and D_3 for harvest index during both the trial years. The varieties did not differ from one another during both the years. The results agree with those reported by Awan (1988) and Awan *et al.*, (2001).

Table 8. Harvest index as affected by different seeding dates and varieties in direct wet seeded rice culture during 1999 and 2000.

1999					2000				
Dates	Varieties			Mean	Dates	Varieties			Mean
	IR-6	IR-9	KS-282			IR-6	IR-9	KS-282	
May 09	24.4	28.3	29.5	29 1 b	May 09	28.7	28.9	28 8	28.8 b
May 19	29.6	27.9	29.7	29 1 b	May 19	29.5	28.9	28 7	29.0 b
May 29	28 8	29.2	29.8	29.2 b	May 29	28.9	29.4	28 9	29.0 b
June 08	31 9	31 6	31.3	31.6 a	June 08	31 7	30.6	30 5	30.9 a
June 18	32.4	32.4	31.4	32 1 a	June 18	32.2	31 6	30.8	31 5 a
Means	30.4	29.9	30 3		Means	32.2	29 9	29.5	

Means followed by the same letter (s) are non-significant by DMRT at 5 % level of probability.

CONCLUSION

It is concluded from the two year studies that no systematic trend was observed for the yield and yield components when direct seeding was done on May 9, 19 and 29 while, seeding on 8th and 18th of June affected the yield parameters significantly and also produced lower dry weed biomass KS-282 variety of rice planted during second week of June produced the highest paddy yield (t ha).

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