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Effect of Seed Rate, Spacing and Herbicide Use on Weed Management in Direct Seeded Upland Rice (*Oryza sativa* L.)

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ABSTRACT

A field experiment was conducted during **kharif** 2006 at the Students' Research Farm, Department of Agronomy, Punjab Agricultural University, Ludhiana on loamy sand soil to study effect of seed rate, spacing and herbicide use on weed management in direct seeded upland rice. Increasing seed rate from 40 to 60 kg/ha and row spacing from 15 to 20 cm, respectively, did not reduce the total weed population and weed dry matter at maturity. Seed rate and row spacing did not influence the grain yield significantly. However, all the weed control treatments i. e. application of pretilachlor 0.75 kg, pendimethalin 0.75 kg and thiobencarb 1.5 kg/ha significantly reduced the total weed population and weed dry matter production resulting in higher weed control efficiency as compared to weedy check. All weed control treatments produced significantly higher yield attributes which ultimately resulted in higher grain yield of paddy as compared to weedy check. Among different herbicidal treatments, thiobencarb 1.5 kg/ha produced highest grain yield of 5.51 t/ha which was at par with other weed control treatments. All weed control treatments reduced nitrogen uptake by weeds making it available to be used by the crop.

Key words : Crop geometry, weed growth, nutrient uptake, herbicides

INTRODUCTION

Direct seeded upland rice under assured irrigation conditions has lot of scope. It may prove highly beneficial in saving lot of energy in the form of labour, time, etc. Direct seeded rice is becoming popular as it eliminates many farm operations particularly nursery raising, puddling and transplanting; hence, it reduces the cost of production. Presently, rice is grown as puddled transplanted crop in Punjab which is very cumbersome and labour intensive (Anonymous, 2008). Plant population is another important yield contributing factor which will be addressed efficiently in direct seeded rice. To make rice cultivation globally competitive, it is imperative to reduce the cost of cultivation which can easily be achieved by direct seeding of rice under upland conditions. Weeds are one of the most important biological constraints limiting rice productivity. Uncontrolled weeds may cause a yield reduction of more than 90% in upland rice as compared to weed free conditions (Singh *et al.,* 1988). There is enough scope to increase the average yield of rice provided that improved package of practices are adopted. Control of weeds is one of the most important and suggestive practice for better and potential management of rice crop.

With the increase in cost of inputs, labour and cultivation, there is a general feeling that direct seeded rice may be the cheaper alternative. But the weed problem is more intense in direct seeded rice than transplanted rice. So, keeping in view the above problems, this study was conducted with the objectives of studying the effect of seed rate (plant population) and spacing on weeds and growth and yield of direct seeded upland rice and to study the effect of herbicides on weeds and growth and yield of direct seeded upland rice.

MATERIALS AND METHODS

A field experiment was conducted during **kharif** 2006 at the Students' Research Farm, Department of Agronomy, Punjab Agricultural University, Ludhiana on loamy sand soil with 80.2, 3.9 and 15.1% sand, silt and clay, respectively, testing normal in reaction, low in available N and medium in P and K. The experiment was laid out in split plot design with four replications where seed rate (40, 50 and 60 kg/ha) and row spacing (15 and 20 cm) were kept in main plots and weed control treatments (pre-emergence application of pretilachlor 0.75 kg, pendimethalin 0.75 kg and thiobencarb 1.5 kg/ha, two hand weedings at 30 and 45 DAS and weedy check) were kept in sub-plots. Herbicides were applied through sand mixture in flooded conditions (4 to 5 cm water depth) as early post-emergence (7 DAS). Pre-sprouted seeds were broadcasted after puddling in standing water. All the recommended production technology was followed to grow the crop. A gross plot

was kept with 6.0 x 4.0 m dimensions out of which a net plot of 5.0 x 3.5 m was harvested.

RESULTS AND DISCUSSION

Floristic Composition of Weeds

Weed flora of the experimental field consisted of sedges (*Cyperus rotundus*) and grasses (*Digitaria sanguinalis, Echinochloa crusgalli, Eleusine aegyptiacum* and *Eragrostis pilosa*).

Weed Population and Weed Dry Matter

The different seed rates and row spacing did not influence the reduction of total weed population and weed dry matter at 90 DAS and at maturity, respectively. All weed control treatments significantly reduced the total weed population and weed dry matter as compared to weedy check. Minimum total weed population was recorded with thiobencarb 1.5 kg/ha which was at par with two hand weedings, pendimethalin 0.75 kg and pretilachlor 0.75 kg/ha, whereas minimum weed dry matter was recorded with two hand weedings which was at par with other weed control treatments (Table 1). Singh *et al.* (1996) also reported that thiobencarb at 2.0 kg/ha proved more effective in controlling grass weeds as compared to pendimethalin and anilophos. Choudhary and Pradhan (1988) also reported that thiobencarb at 1.5 kg/ha suppressed weeds effectively in upland rice.

Weed Control Efficiency

Highest weed control efficiency (65.52%) was recorded with two hand weedings at 30 and 45 DAS and it was closely followed by thiobencarb 1.5 kg/ha. Pretilachlor 0.75 kg and pendimethalin 0.75 kg/ha recorded almost similar (61.59 and 61.93%, respectively) value of weed control efficiency (Table 1).

Crop Growth and Development

Increasing the seed rate from 40 to 60 kg/ha significantly increased the emergence count at 10 DAS (Table 2). However, row spacing and weed control treatments did not influence the emergence count. Seed rate did not influence plant height, number of tillers, crop dry matter and PARI at maturity. Row spacing did not influence the emergence count at 10 DAS, plant height, crop dry matter and PARI (photosynthetically active radiation interception) at maturity, except number

Table 1 Effect of seed rate, row spacing and weed control treatments on total weed population, weed dry matter and weed control effeciency in direct seeded upland rice

Treatment	Total weed population at 90 DAS	Weed dry matter at harvest (q/ha)	Weed control efficiency (%)
Seed rates (kg/ha)			
40	3.63 (15.3)	9.23 (85.6)	52.63
50	3.56 (12.6)	9.22 (85.4)	52.74
60	3.48 (13.4)	9.21 (85.2)	52.85
LSD (P=0.05)	NS	NS	
Spacings (cm)			
15	3.48 (13.3)	9.22 (84.4)	53.29
20	3.88 (14.2)	9.22 (84.4)	53.29
LSD (P=0.05)	NS	NS	
Weed control treatments			
Pretilachlor 0.75 kg/ha	3.34 (11.6)	7.67 (69.4)	61.59
Pendimethalin 0.75 kg/ha	3.28 (10.0)	7.63 (68.8)	61.93
Thiobencarb 1.5 kg/ha	3.10 (9.10	7.58 (64.2)	64.47
Hand weedings (30 and 45 DAS)	3.15 (9.2)	7.56 (62.3)	65.52
Weedy check	7.18 (36.4)	15.47 (180.7)	
LSD (P=0.05)	0.25	0.17	
Interactions		NS	

Figures in parentheses represent original values.
NS–Not Significant.

Table 2. Effect of seed rate, row spacing and weed control treatments on growth and development in direct seeded upland rice

Treatment	Emergence count at 10 DAS/m^2	Plant height at maturity (cm)	No. of tillers at maturity/ m^2	Crop dry matter (g/m^2)	PARI (%)
Seed rates (kg/ha)					
40	175.8	99.8	409.8	1209.0	80.70
50	198.6	99.1	411.1	1268.1	81.58
60	218.4	100.8	416.2	1364.0	83.63
LSD (P=0.05)	23.22	NS	NS	NS	NS
Spacings (cm)					
15	193.1	99.3	423.3	1295.8	83.59
20	200.9	100.6	401.4	1262.9	80.02
LSD (P=0.05)	NS	NS	13.65	NS	NS
Weed control treatments					
Pretilachlor 0.75 kg/ha	198.3	101.8	420.3	1284.1	78.94
Pendimethalin 0.75 kg/ha	198.0	101.3	429.2	1339.8	80.08
Thiobencarb 1.5 kg/ha	196.2	101.3	437.4	1452.0	81.18
Hand weedings (30 and 45 DAS)	195.4	101.1	432.9	1404.7	81.63
Weedy check	196.3	94.1	334.2	921.5	85.15
LSD (P=0.05)	NS	1.95	25.30	136.34	3.86
Interactions			NS		

NS–Not Significant.

of tillers/m^2. Significantly more tillers/m^2 were recorded with narrow row spacing. All the weed control treatments recorded significantly more plant height, more number of tillers/m^2 and crop dry matter at maturity as compared to weedy check. Tallest plant height was recorded with pretilachlor 0.75 kg/ha, while thiobencarb 1.5 kg/ha recorded maximum number of tillers/m^2 and crop dry matter. However, all the weed control treatments were at par with each other. Maximum PARI was recorded with weedy check which was statistically higher than all the weed control treatments; however, all weed control treatments were at par.

Yield Attributing Characters

Yield attributing characters such as effective tillers/m^2, panicle length, number of grains/panicle and 1000-grain weight were not influenced by seed rate. Similar results for all yield attributes except 1000-grain weight were obtained for row spacing where narrow row spacing (15 cm) produced significantly more 1000-grain weight as compared to 20 cm spacing (Table 3). Hooda (2002) also reported that 15 cm row spacing was found superior in minimizing weed competition and increasing productive tillers than 30 to 45 cm spacings, respectively. All weed control treatments recorded significantly more effective tillers/m^2, longer panicle length, more number of grains/panicle and 1000-grain weight as compared to weedy check. Thiobencarb 1.5 kg/ha recorded maximum effective tillers/m, while two hand weedings recorded more panicle length, number of grains/panicle and 1000-grain weight. However, all weed control treatments were at par with each other.

Grain and Straw Yield and Harvest Index

Seed rate and row spacing did not influence the grain and straw yield and also similar harvest index was obtained (Table 3). Singh *et al.* (2003) also reported that dry seeding in rows of 20 cm apart yielded lowest as compared to other establishment methods. All the weed control treatments produced significantly higher grain yield as compared to weedy check. Maximum (55.1 q/ha) grain yield was obtained with thiobencarb 1.5 kg/ha which was at par with all other weed control treatments. Maximum (89.8 q/ha) straw yield was obtained with two hand weedings, however, it was at par with other weed control treatments and was significantly higher than weedy check. Highest harvest index was obtained with thiobencarb 1.5 kg/ha (Table 3).

Nitrogen Uptake by Crop and Weeds

Seed rate and row spacing did not influence the

Table 3. Effect of seed rate, row spacing and weed control treatments on yield attributing characters, grain and straw yield and harvest index in direct seeded upland rice

Treatment	Effective tillers/ m^2	Panicle length (cm)	No. of grains/ panicle	1000-grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index
Seed rates (kg/ha)							
40	389.9	23.0	126.7	24.3	44.7	74.1	0.376
50	394.8	23.0	132.4	24.8	45.8	75.6	0.377
60	401.3	22.1	133.8	24.1	46.2	78.6	0.370
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	
Spacings (cm)							
15	398.6	22.9	132.8	24.8	47.2	77.8	0.378
20	392.4	23.1	128.9	24.1	43.9	74.4	0.371
LSD (P=0.05)	NS	NS	NS	0.55	NS	NS	
Weed control treatments							
Pretilachlor 0.75 kg/ha	410.4	22.6	135.1	24.3	50.6	86.7	0.369
Pendimethalin 0.75 kg/ha	417.6	23.1	137.7	24.7	53.6	86.4	0.383
Thiobencarb 1.5 kg/ha	421.8	22.9	139.9	25.1	55.1	87.6	0.386
Hand weedings (30 and 45 DAS)	420.3	23.2	142.2	25.2	54.2	89.8	0.376
Weedy check	306.1	21.5	99.5	23.1	15.4	30.0	0.339
LSD (P=0.05)	29.17	0.65	11.67	0.98	4.54	5.78	
Interactions				NS			

NS–Not Significant.

uptake of nitrogen by crop and weeds (Table 4) of nitrogen by crop was registered with two hand weedings and was at par with other weed control treatments except weedy check. Maximum (20.45 kg/ha) nitrogen was taken up by weeds in weedy check. All weed control treatments significantly reduced the uptake of nitrogen by weeds as compared to weedy check. Sanjay *et al.* (2006) also reported that 25.1 kg/ha nitrogen was taken up by weeds in unweeded plots. The weed control treatments reduced the weed density and weed dry matter as compared to weedy check resulting in more nitrogen available to the crop for growth and production. Weeds in weedy check have taken up twice the amount of nitrogen as compared to weed control treatments.

Table 4. Effect of seed rates, row spacings and weed control treatments on nitrogen uptake by crop and weeds at harvest in upland, direct seeded rice

Treatment	Nitrogen uptake	
	Crop	Weeds
Seed rates (kg/ha)		
40	151.66	12.62
50	154.45	12.62
60	160.00	12.58
LSD (P=0.05)	NS	NS
Spacings (cm)		
15	159.47	12.59
20	151.27	12.62
LSD (P=0.05)	NS	NS
Weed control treatments		
Pretilachlor 0.75 kg/ha	174.18	10.72
Pendimethalin 0.75 kg/ha	180.90	10.66
Thiobencarb 1.5 kg/ha	184.72	10.51
Hand weedings (30 and 45 DAS)	186.42	10.47
Weedy check	64.62	20.45
LSD (P=0.05)	12.79	0.49
Interactions	NS	

NS–Not Significant.

CONCLUSION

The investigation on the effect of seed rate, row spacing and herbicide use on weed management in direct seeded upland rice (*Oryza sativa* L.) clearly demonstrated that increasing the seed rate from 40 to 60 kg/ha and row spacing from 15 to 20 cm did not reduce the weed population and weed dry matter production and hence grain yield was not influenced by these treatments. All the weed control treatments i. e. pre-emergence application of pretilachlor 0.75 kg, pendimethalin 0.75 kg and thiobencarb 1.5 kg/ha as well as two hand weedings significantly reduced the total weed population

and weed dry matter production resulting in higher weed control efficiency as compared to weedy check. All weed control treatments resulted in producing significantly higher effective tillers, longer panicles, more number of grains/panicle and more 1000-grain weight as compared to weedy check. These ultimately resulted in higher grain yields of paddy as compared to weedy check. Weed control with thiobencarb 1.5 kg/ha produced highest grain yield of 55.1 q/ha which was at par with other weed control treatments. All weed control treatments reduced nitrogen uptake by weeds making it available to be used by the crop.

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