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YIELD POTENTIAL OF DIRECT SEEDED RICE (*ORYZA SATIVA* L.) AS INFLUENCED BY DIFFERENT SEEDING TECHNIQUE AND WEED MANAGEMENT PRACTICES

KAUSHAL KUMAR*[1], U. N. SHUKLA[1], MAHENDRA SINGH[1], SMITA SINGH[1], RAGHUVIR SINGH[2] AND ANIL KUMAR PANT[3]

[1]Department of Agronomy, Institute of Agricultural Sciences, BHU, Varanasi - 221 005 INDIA
[2]Department of Agronomy, S.V.P.U.A. and T., Meerut - 250 110 (U. P) INDIA
[3]Department of Farm Engineering, Institute of Agricultural Sciences, BHU, Varanasi - 221 005, INDIA
e-mail: singhkaushalbhu@gmail.com

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***Corresponding author**

ABSTRACT

A field experiment was conducted during *kharif* season 2007-08 at Crop Research Center of SVPUAT, Meerut and Uttar Pradesh to find out the suitable crop establishment method and weed management practices in rice. Effective tiller, (297.98), grain/panicle (143.84), grain yield (3711 kg/ha), straw yield (5808 kg/ha) and harvest index (38.98 %) produced higher under broadcast in puddled condition. Among weed management practices, higher number of productive tillers/m^2, panicle length (28.79 cm), grains/panicle (148.3), test weight (22.48 g) and grain yield under butachlor @1.5 kg a.i. as pre-emergence followed by almix @ 4 g a.i./ha as post-emergence. Straw yield (5989 kg/ha) was significantly higher under butachlor @1.5 kg a.i. as pre-emergence followed by one hand weeding at 20-25 DAS (days after sowing).

INTRODUCTION

Non availability of irrigation water, inadequate labour and high wages during the peak period of farm operations invariably delay in planting of rice as well as weeding operations. Furthermore, decline in water Table; increasing costs of diesel and electricity along with co-incidence of climatic changes have aggravated the problem for rice grower (Rosegrant *et al*. 2002). These problems not only confined over location bases but also affect vast area of rice growing countries, hence there is an urgent need to mitigate these problems either by modification of cultural practices or adopt integrated approach for managing labour as well as water crisis under rice cultivation. Farmers are willing to switch from transplanting to direct seeding which is gaining popularity now days as it is cheap alternative to combat water problems and less labour intensive. Direct seeding of rice is accomplished by three methods *viz.,* water seeding, wet seeding and dry seeding (Farooq *et al.,* 2011). Direct seeding can reduce the labour and water requirement, shorten the duration of crop by 7-10 days than the transplanted crop, allowing timely sowing of succeeding wheat (Kumar *et al.,* 2007) and provide comparable grain yield. The direct seeding technique offers a useful option to reduce limitations of transplanted paddy. However, crop weed competition in the system is more severe, reducing grain yield by 20-95% (Mandal *et al*., 2011) and yield reduction up to 48, 53 and 74% in transplanted, direct seeded in flooded conditions and direct seeded in dry soils, respectively (Hussain *et al*., 2008). Pendimethalin, butachlor, oxadiazon and nitrofen are among the herbicides which have been tested worldwide for controlling weeds and improving the yield of direct seeded rice (Farooq *et al.,* 2011). Suitable methods of seeding coupled with cost effective weed management practices will improve the performance of direct seeded rice. The present investigation was conducted to study the yield potential of direct seeded rice as influenced by different seeding technique and weed management practices with objective to find out suitable seeding techniques and herbicide for effective yield attributes and yields of direct seeded rice.

MATERIALS AND METHODS

A field experiment was conducted at Crop Research Center, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut during 2007-08, located in sub-tropical and semi-arid region of 29º05′ 19′′ N latitude, 77º41′ 50′′ E longitude with an elevation of 237 meters from the mean sea level. Approximately 800 mm average annual rainfall is received by south-west mansoon. The meteorological trends during crop period were depicted in Fig 1. The soil of experimental plot was sandy-loamy textural class (42% sand, 38% silt and 20% clay) with pH of 7.8, low organic carbon (0.48 %) and available nitrogen (225.75 kg/ha), and medium in phosphorus (13.5 kg/ha) and potassium (181.0kg/ha).

Alkaline permanganate method (Subbiah and Asija, 1956) for available nitrogen (N), Olsen's method (Watanabe and Olsen, 1965) for phosphorus (P_2O_5), Neutral normal Ammonium Acetate extract using flame photometer (Hanway and Heidel, 1952) for potassium (K_2O) and Walkely and Black method (Jackson,1967) for organic carbon were used.

Technical details

The field experiment was conducted in split-plot design with thrice replication. The treatments comprises of three seeding technique *viz*. line sowing (S_1), broadcast in non-puddled condition (S_2), broadcast in puddled condition (S_3) were assigned as main plot treatments and six weed management practices *viz*. weedy(W_1), weed free(W_2), pendimethalin @ 1.0 kg/ha pre-emergence fb one hand weeding at 20-25 DAS (W_3), pendimethalin @ 1.0 kg/ha pre-emergence fb almix @ 4 g/ha post-emergence (W_4), butachlor @ 1.5 kg/ha pre-emergence fb one hand weeding at 20-25 DAS (W_5) and butachlor @ 1.5 kg/ha pre-emergence fb almix @ 4 g/ha as post-emergence (W_6) were assigned in sub-plots,

Materials used during experiment, data collection and analysis

Rice variety 'Pusa basmati-1' was taken for study. The sources of nitrogen, phosphorus, potassium were applied through urea, diammonium phosphate (DAP) and muriate of potash (MOP), respectively to all the plots uniformly. A half of the total nitrogen along with total quantity of P_2O_5 and K_2O was applied as basal during sowing time and remaining nitrogen was applied as top dressing in two equal splits at 30 and 60 days after sowing. Foliar spray of $ZnSO_4$ @ 0.5 with two percent urea was applied at 30 days after sowing. Observation on growth, yield attributes and yield of rice were recorded. Data were analyzed as per standard statistical procedure suggested by Gomez and Gomez (1984) to draw a valid conclusion. Again estimation of correlation coefficients were worked out to understand the relationship among traits by using the Mini-Tab programme based on concept developed by Dewey and Lu (1959)

RESULTS AND DISCUSSION

Productive tillers/m^2 were recorded significantly higher under broadcast in puddled condition, which was 19.28 and 43.62% higher over line sowing and broadcast in non-puddled condition, respectively. Panicle length and 1000 grain test weight differs significantly and recorded higher under broadcast sowing in puddled condition followed by line sowing (Table 1). The availability of puddled soil and lesser losses of water with poor weed dynamics might be favour better crop management resulted in efficient growth and development that stimulates production of higher yield attribute. Similar results were also reported by Mahajan *et al*. (2004). However, the difference between broadcast in puddled and line sowing were at par with each others in respect to 1000- grain weight was mainly due to efficient utilization of input by rice under line sowing as well as puddled condition also, but significant to broadcast in non-puddled condition. Yield is the function of yield attributes and dry matter partitioning into grains (Fig. 2). It was found that higher grains/ panicle (143.84), grain yield (3711 kg/ha) and harvest index (38.98%) of rice was also significantly superior under broadcast in puddle condition over line sowing and broadcast in non-puddled condition method of seeding, whereas maximum straw yield was recorded under broadcast in non-puddled condition. It was found that grain yield under broadcast in puddled condition showed 13.27 and 29.52% higher than line sowing and broadcast in non-puddled condition, respectively. The synthesis of photosynthates and their translocation in the metabolic activity to produces more grains per panicle as an indicator of yield expression. The

Table 1: Growth, Yield attributes and Yield of direct seeded rice as influenced by different seeding technique and weed management practices

Treatments	Effective tillers/m^2	Panicle length (cm)	Grain/ panicle	1,000 grain wt (g)	Grain (kg/ha)	Straw (kg/ha)	Harvest index (%)
seeding technique							
Line sowing	249.81	27.71	132.12	21.97	3276	5464	37.48
Broadcast in non-puddled condition	207.40	27.28	122.43	21.83	2865	4959	36.61
Broadcast in puddled condition	297.98	28.47	143.84	22.47	3711	5808	38.98
CD (P=0.05)	16.00	0.84	4.30	0.45	57	165	0.90
Weed management practices							
Weedy	110.20	25.27	107.30	20.35	2063	4242	32.72
Weed free	361.37	30.36	162.48	22.99	4238	6573	39.20
Pendimethalin 1.0 kg/ha fb 1 HW at 20-25 DAS	199.71	26.70	118.15	22.14	2755	4680	37.05
Pendimethalin 1.0 kg/ha fb Almix 4 g/ha at 20-25 DAS	240.88	27.37	125.31	22.12	3148	5014	38.56
Butachlor 1.5 kg/ha fb 1HW 20-25 DAS	289.34	28.42	135.17	22.46	3544	5989	37.17
Butachlor 1.5 kg/ ha fb Almix 4 g/ha 20-25 DAS	308.89	28.79	148.3	22.48	3955	5966	39.86
CD (P=0.05)	21.59	1.48	6.97	0.72	078	259	1.53

Table 2: Interaction effect of seeding technique and weed management practices on grain yield

Weed management practices	Seeding technique			Mean
	S_1	S_2	S_3	
W_1	20.37	17.44	24.06	20.63
W_2	42.30	37.65	47.19	42.38
W_3	27.23	24.29	31.15	27.55
W_4	31.59	27.38	35.47	31.48
W_5	35.26	30.70	40.35	35.44
W_6	39.77	34.44	44.44	39.55
Mean	32.76	28.65	37.11	-
SEm ±		0.46		
CD (P=0.05)		1.36		

Table 3: correlation coefficient between growth, yield attributes and yield of rice

	Effective tillers/m^2	Panicle length (cm)	Grain/panicle	1,000 grain wt (g)	Grain (kg/ha)	Straw (kg/ha)
Effective tillers/m^2	1.000					
Panicle length (cm)	0.985	1.000				
Grain/panicle	0.968	0.979	1.000			
1,000 grain wt (g)	0.934	0.905	0.843	1.000		
Grain (kg/ha)	0.994	0.979	0.979	0.908	1.000	
Straw (kg/ha)	0.972	0.976	0.967	0.849	0.971	1.000

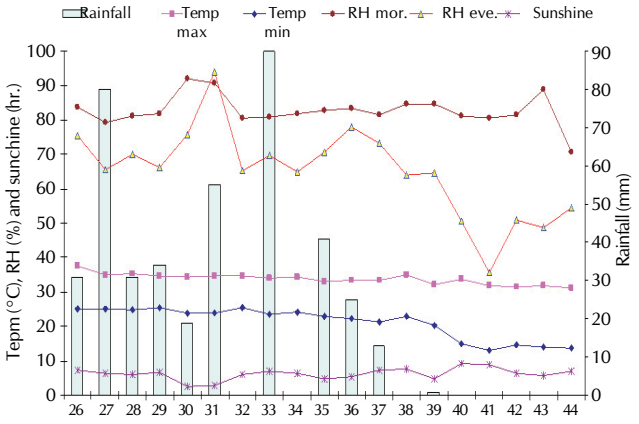

Figure 1: Meteorological trends during rice growing period

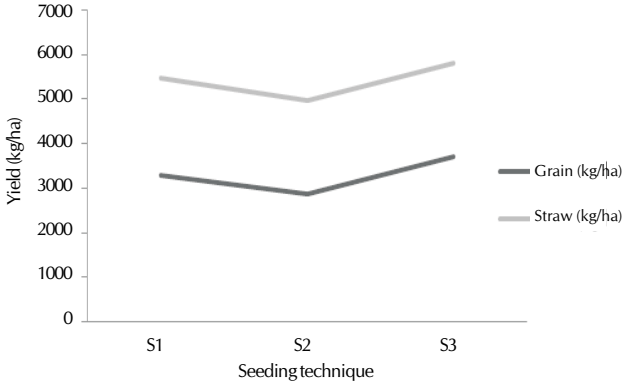

Figure 2: Effect of seeding techniques on grain and straw yield of rice

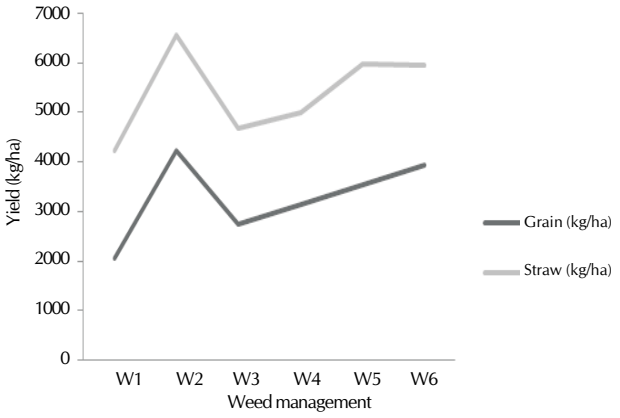

Figure 3: Effect of weed management practices on grain and straw yield of rice

findings are in corroboration with those reported by Singh *et al*. (2005) and Kaushal *et al*. (2012).

Among weed management, significantly higher number of productive tillers/m^2 was recorded under butachlor @1.5 kg a.i./ha + almix @4 g a.i./ha, but it was at par with application of butachlor @1.5 kg a.i./ha + one hand weeding. However, butachlor @ 1.5 kg a.i. + almix @ 4 g a.i./ha recorded significantly more panicle length (28.79 cm), grains/panicle (148.3) and 1000-grains weight (22.48 g) and showed its superiority over weedy (Table 1), whereas 1000-grain weight remained at par among treatments. The application pre-emergence followed by post emergence herbicide that control weed dynamic as the crop in advanced stages and reduces the crop-weed competition. Butachlor check the early germination of weeds, while almix control all kind of weeds that emerges after 20 days after sowing and act as broad spectrum. Due to sequential management of weeds by effective herbicidal combinations, the population of weeds was lesser in quantity that invite congenial condition for rice to utilizes inputs and resources in efficient ways under direct seeded rice. The findings are in agreement with the findings of Shekhar *et al*. (2004). Significantly higher grain yield (3955 kg/ha) and harvest index (39.86 %) was recorded under application of pre and post-emergence herbicide *i.e.* butachlor @1.5 kg a.i./ha + almix @4 g a.i./ha as compared to weedy plot. The comparative improvement in yield over W_1, W_2 and W_3 treatment were 43.55%, 25.63% and 11.59%, respectively. The rice crop might be enjoy nearly weed free condition and availed all resources for production of higher no. of yield attributes and yield under butachlor @1.5 kg a.i./ha + almix @4 g a.i./ha. The results were also in line with the earlier finding of Kaushal *et al*. (2012). Conversely, significantly higher straw yield (5989 kg/ha) was recorded under integration of herbicide application (butachlor 1.5 kg a.i./ha as pre-emergence) followed by one hand weeding over all the treatment. Present findings are confirmed with the results obtained by Singh *et al*. (2004), Kalyanasundaram and Kumar (2006). Interactive effect of seeding techniques and weed management on grain yield of rice was found significant (Table 2). It was observed that rice seed sown as broadcast in puddle condition under sequential application of butachlor @1.5 kg a.i./ha + almix @4 g a.i./ha caused significant improvement on grain yield. Effect of weed management practices on grain and straw yield of rice were depicted in Fig. 3.

Correlation between rice yield and yield traits is reflected from direct effect of the trait which will help for identifying the traits that contribute directly to improve yield. Correlation matrix between yield attributes and yield of rice were studied to show the association among traits and revealed a significant and positive correlation (Table 3). The grain yield of rice was positively correlated effective tiller/m^2 (r = 0.994), panicle length (r = 0.979), grain/panicle (r = 0.979) and 1000 grain weight (r = 0.908). Test weight (1000 grain weight) which was yield determined attributes also significant and positively correlated with other growth and yield attributing characters

The present investigation confirmed that seeding techniques well performed and produced higher yield attributes to the added herbicides. It was found that seeding technique broadcast in puddled condition produced higher yield attributes that resulted in more grain yield over line sowing and broadcast in non-puddled condition under application of butachlor @ 1.5 kg a.i./ha as pre-emergence followed by almix @ 4 g a.i./ha as post-emergence. Correlation matrix among traits (yield attribute and yield) showed significant and positively correlated with each other. Hence, from the above discussion, it may conclude that broadcast in puddled condition well responds with sequential application of butachlor @ 1.5 kg a.i./ha as pre-emergence followed by almix @ 4 g a.i./ha as post-emergence to achieved comparable yield attributes and yield of rice.

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