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Performance of double transplanted rice under different planting densities and dates in lowland situation

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ABSTRACT

Field experiment was conducted in lowland situation at Jorhat (Assam) during late *kharif* seasons of 2012 and 2013 to study the performance of double transplanted rice under 3 planting dates (10, 20 and 30 September) with 2 spacings (15 cm x 10 cm and 20 cm x 10 cm) and 3 seedling rates (1, 2 and 3 seedlings/hill). Results revealed that grain and straw yields as well as all the yield attributes decreased significantly and consistently with delaying the planting dates from 10 September to 30 September during both the years. On an average, the reduction in grain and straw yields was 81.5 and 30.1 per cent, respectively. Both the spacings could not influence the yield and yield attributes during both years but had higher values in wider spacing of 20 cm x 10 cm over the narrower spacing of 15 cm x 10 cm. Planting of 3 seedlings/hill produced the highest grain and straw yields. The net return and benefit-cost ratio were recorded highest on 10 September planting with the use of 3 seedlings/hill.

Key words: Double transplanting, Lowland, Planting dates, Seedling number, Spacing.

INTRODUCTION

Rice is grown in diverse eco-system from highlands to very lowlands in Assam depending on weather conditions. The majority of cultivated area under rice is occupied during rainy (*kharif*)season which is known as *sali* rice. The lowlands are generally not fit for growing other crops except rice due to high level of inundation of land upto the end of September. Under such situation, farmers are compelled to go for transplanting of rice in late season. In these areas long duration photoperiod sensitive varieties with over aged seedlings are planted. The double transplanting of rice is an age old practice followed in the lowlands of Assam which avoids ill effects of over aged seedlings in the nursery and useful in seedling scarcity situations. Moreover, double transplanted rice seedlings have thicker culm and better growth for early establishment in the main field as compared to the nursery raised seedling of the same age group (Ghosh, 2006 and Ashem *et al.*, 2010). The variety 'Gitesh' is one of the recommended varieties of rice suitable for late transplanting in lowlands of Assam. Considering the advantages of double transplanted rice the present study was undertaken to see the performance of double transplanted rice in relation to sowing dates and different planting densi ties such as row spacings and number of seedlings per hill.

MATERIALS AND METHODS

Field experiment was conducted in lowland situation at the Instructional-cum-Research Farm of Assam Agricultural University, Jorhat during late *kharif* seasons of 2012 and 2013. The treatments consisted of 3 planting dates (10, 20 and 30 September) allocated in main plots and combinations of 2 spacings (15 cm x 10 cm and 20 cm x 10 cm) and 3 seedling rates (1, 2 and 3 seedlings/hill) in sub-plots in a split-plot design with 3 replications. The soil was sandy-loam in texture having 0.53 per cent organic carbon and available N, P and K of 250.2, 9.0 and 85.6 kg/ha, respectively with a pH 5.2. Both the years, double planted rice seedlings of 60 days old (30 + 30 days) were kept ready as per treatment by adjusting the sowing dates in the first nursery and subsequently in second nursery by uprooting the 30 days old nursery seedlings from the first nursery and transplanting at closer spacing of 10 cm x 10 cm in puddled field. The double planted seedlings of 60 days were transplanted in the main field as per planting dates, spacings and seedling rates. The characteristics of double planted seedlings before each of the transplanting dates were recorded (Table 1). The water depth in the experimental field on the first date of transplanting (10 September) was 20.5 cm and 21.6 cm during 2012 and 2013, respectively. The field reached to saturated condition after 15 October during both the years. A uniform dose of 20-10-10 kg N, P_2O_5 and K_2O/ha was top dressed in the second week of October in each year. Irrespective of transplanting dates, the crop was harvested in the last week of December. The rainfall received during the growing period of crop in 2012 and 2013 was 175.0 and 285.7 mm, respectively. The mean maximum and minimum temperature during 2012 ranged from 33.7°C to 23.7°C and 25.9°C to 8.5°C, respectively and during 2013, it ranged from 30.9°C to 19.0°C and 24.4°C to 7.0°C respectively.

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RESULTS AND DISCUSSION

Date of planting: Delaying the transplanting dates from 10 September to 30 September the grain and straw yields as well as harvest index decreased significantly and consistently upto 30 September (Table 2). The decrease in grain and straw yields was associated due to decrease in all the yield attributing characters *viz.*, panicles/m^2, filled grains/panicle and 1000 grain weight (Table 3). On an average, the decrease in grain yield with every 10 days successive delay from 10 September upto 30 September was 43.9 and 67.1 per cent, respectively. The corresponding decrease in straw yield was 20.1 and 12.5 per cent. The harvest index value as well as net returns and benefit-cost ratio also decreased with delay in transplanting dates. Reduction in yield in delayed planting might be attributed to the effect of low (8.5°C and 7.0°C), which affected the growth of plants and lesser assimilation of photosynthates in grains. The quality of seedlings in respect of growth and dry matter production was also better in earlier transplanting date (10 September) which gradually declined (Table 1) and which may also be another reason for reduction in yield in late transplanting. The results corroborate the earlier findings of Singh (1989), Patel (1999), Nayak *et al.* (2003), Ghosh (2006) and Saikia (2016).

Spacing: Both the spacings could not influence the yield and yield attributes of rice except the plant height and length of panicle when wider row spacings of 20 cm x 10 cm produced higher values of these characters (Table 2 and 3). This might be due to more inter row competition of rice with double planted seedlings at closer spacing of 15cm x 10 cm over 20 cm x 10 cm spacing as the double planted seedlings are more robust and established easily even under delayed transplanting conditions (Table 1). Similarly, higher harvest index, net returns and benefit-cost ratio were also recorded with wider spacing of 20 cm x 10 cm over the narrower spacing of 15 cm x 10 cm. Similar results were also reported by Chandrakar and Chandravanshi (1988), Choudhury *et al.* (1995), Patel (1999), Nandini and Singh (2000), Singh *et al.* (2003), Nayak *et al.* (2003) and Singh and Singh (2005).

Table1: Characterization of seedling quality of rice variety 'Gitesh' used for double transplanting.

Seedling quality	10 September		20 September		30 September	
	2012	2013	2012	2013	2012	2013
Length (cm)						
Shoot	65.4	68.8	56.5	64.8	50.5	54.6
Root	23.5	25.4	19.2	20.8	14.5	16.8
Dry matter (g/tiller)						
Shoot	4.13	4.19	2.50	2.57	2.07	2.11
Root	1.63	1.31	0.95	0.85	0.75	0.70
Tillers/hill	9.0	8.4	8.4	8.6	7.0	7.6

Table 2: Effect of treatments on growth and yield attributes of rice.

Treatment	Plant height (cm)		Panicles/m2		Length of panicle (cm)		Filled grains /panicle		1000 grain weight (g)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Date of transplanting										
10 September	84.4	95.7	356.2	235.5	21.6	21.8	137.9	153.4	19.6	19.5
20 September	71.6	80.8	265.5	226.8	19.9	20.8	97.3	128.0	18.6	18.5
30 September	63.3	70.6	195.7	210.1	18.8	20.3	71.5	72.2	17.7	16.6
S.Em(±)	2.273	1.341	5.925	3.955	0.126	0.179	4.651	3.272	0.149	0.278
CD (P=0.05)	8.93	5.26	23.26	15.53	0.49	0.70	18.26	12.85	0.59	1.09
Spacing (cm)										
15 x 10	71.6	81.4	279.4	225.2	19.8	20.7	99.5	115.5	18.6	18.1
20 x 10	74.6	83.4	265.5	223.0	20.5	21.2	105.0	120.2	18.6	18.2
S.Em(±)	0.560	0.552	7.015	2.389	0.129	0.124	2.302	2.102	0.089	0.095
CD (P=0.05)	1.62	1.59	NS	NS	0.37	0.36	NS	NS	NS	NS
Seedlings/hill										
1	68.7	80.2	231.65	210.5	20.0	20.9	97.9	115.4	18.4	17.7
2	73.5	82.6	279.2	229.2	20.1	20.9	101.6	117.4	18.6	18.3
3	77.1	84.4	306.6	232.7	20.3	20.8	107.2	120.7	18.9	18.5
S.Em(±)	0.686	0.676	8.591	2.925	0.157	0.152	2.819	2.575	0.108	0.117
CD (P=0.05)	1.98	1.95	24.81	8.45	NS	NS	NS	NS	0.30	0.34

NS = Non-significant

Table 3: Effect of treatments on grain and straw yields (t/ha), harvest index (%) and economics.

Treatment	Grain yield (t/ha)			Straw yield (t/ha)			Harvest index (%) (mean)	Net returns (Rs./ha) (mean)	Benefit-cost ratio (mean)
	2012	2013	Mean	2012	2013	Mean			
Date of transplanting									
10 September	2.65	3.10	2.87	6.68	6.86	6.78	29.74	37,895	3.17
20 September	1.38	1.83	1.61	5.04	5.81	5.42	22.90	17,635	1.48
30 September	0.57	0.51	0.53	4.39	5.08	4.74	10.06	755	0.06
S.Em(±)	0.055	0.105	0.073	0.334	0.199	0.189	-	-	-
CD (P=0.05)	0.21	0.41	0.28	1.31	0.78	0.74	-	-	-
Spacing (cm)									
15 x 10	1.51	1.79	1.65	5.33	5.86	5.59	22.79	18,195	1.49
20 x 10	1.56	1.83	1.69	5.42	5.98	5.69	22.90	19,315	1.65
S.Em(±)	0.046	0.044	0.027	0.119	0.148	0.078	-	-	-
CD (P=0.05)	NS	NS	NS	NS	NS	NS	-	-	-
Seedlings/hill									
1	1.22	1.51	1.32	4.65	5.49	5.07	20.66	12,935	1.08
2	1.56	1.86	1.71	5.48	5.64	5.56	23.52	19,275	1.61
3	1.77	2.08	1.92	5.99	6.62	6.31	23.33	23,175	1.94
S.Em(±)	0.037	0.036	0.033	0.098	0.121	0.095	-	-	-
CD (P=0.05)	0.11	0.10	0.09	0.28	0.35	0.27	-	-	-

NS = Non-significant

Table 4: Interaction effect of transplanting date and number of seedlings/hill on grain and straw yields (t/ha) (mean of 2 years).

Date of transplanting	Seedlings/hill			Seedlings/hill		
	1	2	3	1	2	3
		Grain yield (t/ha)			Straw yield (t/ha)	
10 September	2.51	2.85	3.26	5.89	6.94	7.49
20 September	1.23	1.72	1.88	5.10	4.83	6.33
30 September	0.43	0.51	0.63	4.21	4.91	5.09
		S.Em(±)	CD (P=0.05)		S.Em(±)	CD (P=0.05)
Difference between 2 planting dates at same seedling number		0.122	0.353		0.328	0.95
Difference between 2 seedling numbers at same or differentplanting dates		0.079	0.23		0.23	0.67

Seedling rate: Grain and straw yields as well as all the growth and yield attributing characters of rice increased significantly with increasing the number of seedlings planted per hill from 1 to 3 seedlings. On an average, the increase in grain yield with 3 seedlings/hill over 1 and 2 seedlings was 31.3 per cent and 10.9 per cent, respectively. The corres ponding increase in straw yield was 19.6 per cent and 11.9 per cent. The increase in grain and straw yields by trans planting higher number of seedlings/hill may be due to better yield attributing characters. The lowest yield and other yield attributing characters were recorded when 1 seedling/hill was planted. In double transplanted rice tillers are separated out from the hills after uprooting in second nursery and before planting in the main field. At the time of separation of tillers before transplanting in case of 1 seedling/hill the tillers were disturbed and sometime only tertiary tillers may be used which had got less strength and produced less tillers per unit area as compared to the use of primary or secondary tillers when 2 and 3 seedlings/hill were used. As such, seed ling mortality may be high and less productive which do not happened when 2 or 3 seedlings/hill were used. Transplanting 2 or 3 seedlings/hill gave better stand and insurance against the seedling mortality as reported by Singh and Singh (2009). The average net profit and benefit-cost ratio were also highest when 3 seedlings/hill were transplanted.

Interaction effect: The interaction effect between date of planting and number of seedlings/hill on mean grain and straw yield was significant (Table 4). Grain and straw yields decreased significantly with delay in planting dates from 10 September to 30 September irrespective of number of seedlings/hill. However, the straw yield was at par on 20 and 30 September when either 1 or 2 seedlings/hill were planted. Grain and straw yields increased significantly with increasing the number of seedlings/hill from 1 to 3 seedlings under all the three dates of sowing. However, the differences between planting of 2 and 3 seedlings/hill in respect of grain yield had no any significant difference on 20 September planting date and all the number of seedlings/hill on 30

September. Similarly the straw yield obtained by using 1 or 2 seedlings/hill on 20 September as well as 2 or 3 seedlings/ hill on 30 September were found to be at par. In all the planting dates, 3 seedlings/hill recorded the highest grain and straw yield.

CONCLUSION

The present study showed that planting of double transplanted rice seedlings on 10 September at 20 cm x10 cm spacing using 3 seedlings /hill produced the highest grain and straw yields with maximum economic returns.

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