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Response of hybrid rice (*Oryza sativa*) to date of planting, spacing and seedling rate during wet season

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ABSTRACT

A field experiment was conducted at Bhubaneshwar during wet season of 1999 and 2000, to find out the response of hybrid rice 'Pro Agro 6201' to 3 dates of planting (16, 31 July and 16 August), 3 spacings (20 cm × 15 cm, 20 cm × 10 cm and 15 cm × 15 cm) and 2 seedling rates (1 and 2 seedlings/hill). Planting the crop on 16 July recorded the highest grain yield, which declined by 5.5 and 24.3% due to 15 and 30 days delay in planting respectively. Yield did not vary significantly due to spacing during the first year. During the second year, planting the crop with a closer spacing of 20 cm × 10 cm yielded significantly more than that with wider spacing of 20 cm × 15 cm. Planting 2 seedlings/hill was beneficial with yield advantage of 8.2% over 1 seedling/hill.

Key words : Hybrid rice, Date of planting, Spacing, Seedling rate

Hybrid vigour in rice can be profitably used to increase its productivity by 14–28% over the available best varieties in India (Siddiq, 1993). Inherited yield potentials of the rice hybrids, however can be realized by providing suitable agronomic package to the crop. Time of planting and plant density/unit area are the 2 important factors influencing yield of the crop. Determination of optimum time of planting is more important in case of hybrid rice because of its relatively higher degree of thermo-sensitivity during the flowering and grain-filling stages compared to conventional high-yielded varieties. Since hybrid rice is a new introduction to the state and not much work has been done on its agronomic requirement, the present investigation was undertaken to find out optimum time of planting, spacing and seedling rate for hybrid rice.

MATERIALS AND METHODS

The experiment was conducted during the rainy season of 1999 and 2000 at the Agronomy farm of Orissa University of Agriculture and Technology, Bhubaneshwar. Twelve treatment combinations of 2 dates of planting (16 and 31 July), 3 spacings (20 cm × 15 cm, 20 cm × 10 cm and 15 cm × 15 cm) and 2 seedling rates (1 and 2 seedlings/hill) during the first year and 3 dates of planting (16 and 31 July and 16 August), 2 spacings (20 cm × 10 cm, 20 cm × 15 cm) and 2 seedling rates (1 and 2 seedlings/hill) during the second year were evaluated in randomized block design having 3 replications. The soil was loamy sand and slightly acidic (pH 6.1), with organic carbon 0.40%, total N 0.05% and available P and K of 25.1 and 154.8 kg/ha respectively. Three-week-old seedlings of hybrid rice 'Pro Agro 6201' were transplanted on each date using uniform dose of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O/ha. Full dose of P and K in form of single superphosphate and muriate of potash, respectively along, with one-fourth N as urea was applied at planting. Half N was top-dressed 2 weeks after planting and rest one-fourth N was applied at the panicle-initiation stage. The crop was raised under irrigated condition.

RESULTS AND DISCUSSION

Date of planting

Early planting of 16 July exhibited the maximum total and effective tillers/clump, leaf-area index (LAI), leaf-area duration (LAD), dry-matter accumulation/clump and relative growth rate (Table 1). Fertile spikelets/ear and 1,000-grain weight, of the crop planted on 16 July were also maximum (Table 2). There was a progressive decline in all the growth and yield-attributing characters due to delayed planting on 31 July and 16 August. One-month delay in planting from 16 July reduced total tiller number , LAI, LAD, dry-matter accumulation and relative growth rate (RGR) by 38, 13, 18, 23 and 7% respectively. Corresponding reductions were 7.5% in effective tiller number, 15.0% in fertile spikelet number and 7.5% in 1,000-grain weight.

Effect of date of planting on growth and yield-attribut-

ing characters was reflected on grain and straw yields (Table 2). Planting on 16 July recorded the maximum grain and straw yields. A fortnight delay in planting from 16 July reduced the grain yield by 7.6 and 3.3% and the straw yield by 4.5 and 3.6% during the first and second year respectively. One day delay in planting, on an average, reduced the grain yield by 14.5 kg and the straw yield by 15 kg/ha. One-month delay in planting from 16 July reduced the grain yield by 24.3% and straw yield by 21.5%. Per day reduction in grain and straw yields was 38 and 45 kg/ha respectively. The results confirm the findings of Parihar *et al.* (1995) and Gohain and Saikia (1996) with high-yielding varieties of rice and Kumar *et al.* (1994) and Pandey *et al* (2001) with hybrid rice, who reported that earlier planting around mid-July was the best. Late planting might have exposed the crop to relatively more adverse condition in terms of water stagnation at the tillering phase and low temperature at the reproductive phase which might have pulled down the yield compared to earlier planting on 16 July.

Sterile spikelets/ear and sterility percentage on the other hand behaved differently and increased progressively as the planting was delayed from 16 July to 16 August. Planting on 31 July recorded the maximum plant height during the first year. During the second year plant height remained unaffected by dates of planting.

Spacing

All the growth and yield-attributing characters, except, LAI, LAD, sterile spikelets/ear, and sterility percentage were maximum with wider spacing of 20 cm × 15 cm and minimum with closer spacing of 20 cm × 10 cm. The reverse happened in respect of LAI, LAD, sterile spikelets/ear and sterility percentage. Grain yield did not vary markedly due to different spacings during the first year. During the second year, however closer planting with 20 cm × 10 cm spacing registered significantly more grain yield (1.6 q/ha) than that with wider spacing of 20 cm × 15 cm, because of higher plant population under the former treatment in spite of better yield-attributing characters under the latter treatment. Padmaja and Reddy (1998) and Rajarathinam and Balasubramaniyan (1999), reported significantly higher yield of hybrid rice with adoption of closer spacing of 20 cm × 10 cm and 15 cm × 15 cm than with wider spacing of 20 cm × 15 cm. Straw yield during both the years was significantly more under closer spacing of 15 cm × 15 cm and 20 cm × 10 cm than under wider spacing of 20 cm × 15 cm.

Seedling rate

Growth and yield-attributing characters responded differently to seedlings/hill. All the growth characters, except plant height were more with planting of 2 seedlings/hill than with 1 seedling/hill. But non of the yield-attributing characters, except effective tillers/clump, varied significantly due to seedling rate, although planting of 2 seedlings/hill recorded more fertile and sterile spikelets/ear, sterility percentage and 1,000-grain weight.

Maximum tiller number stage of hybrid rice 'PA 6201' was reached 36 days after planting. Thereafter a progressive decline was noted in the tiller number till maturity stage of the crop due to death of late-formed tillers. How-

Table 1. Effect of date of planting, spacing and seedling rate on growth characters of hybrid rice

Treatment	Plant height at harvest (cm)		Total tillers/hill (No.)		Effective tillers/hill (No.)		LAI at 45 DAT		LAD (days)		Dry matter/ clump at harvest (g)		RGR at 30–45 (mg/g/day)	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Date of planting														
16 July	78.4	64.4	10.3	10.6	6.0	5.4	3.78	2.69	157	124	24.1	21.8	76.2	77.3
31 July	82.4	64.3	9.6	10.3	5.8	5.2	3.48	2.61	148	116	20.3	19.6	70.3	72.2
16 August		64.1		6.6		5.0		2.34		102		16.7		72.2
CD (P=0.05)	1.3	NS	NS	0.5	NS	0.1	NS	0.04			0.9	1.0		
Spacing (cm × cm)														
20 × 15	81.3	64.8	10.7	9.7	6.2	5.3	3.42	2.50	135	112	22.1	21.1	75.0	78.5
20 × 10	79.7	63.7	9.1	8.6	5.5	5.1	4.01	2.59	173	116	19.1	17.6	70.6	69.3
15 × 15	80.2		10.1		6.0		3.46		149		25.3		74.2	
CD (P=0.05)	NS	NS	0.8	0.4	0.4	0.1	NS	0.03			0.4	0.8		
Seedlings/hill														
1	80.1	65.1	9.4	8.9	5.5	5.1	3.45	2.40	140	108	18.7	19.4	67.5	76.8
2	80.7	63.4	10.5	9.5	6.2	5.3	3.81	2.70	164	120	25.7	19.3	79.0	70.9
CD (P=0.05)	NS	1.6	0.7	0.4	0.3	0.1	NS	0.03			0.9	NS		

LAI, Leaf-area index; LAD, leaf-area duration; DAT, days after transplating

Table 2. Effect of date of planting, spacing and seedling rate on yield attributing characters and yield of hybrid rice

Treatment	Fertile spikelets/ear		Sterile spikelets/ear		Sterility (%)		1,000-grain weight (g)		Grain yield (q/ha)		Straw yield (q/ha)		Harvest index (%)	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Date of planting														
16 July	90.6	100.9	30.2	30.6	24.9[†]	23.3	23.3	22.6	34.46	47.45	45.72	62.30	41.8	42.3
31 July	86.7	96.6	33.0	34.3	27.5	26.6	21.4	21.2	31.86	45.70	45.53	60.05	41.3	41.9
16 August		85.8		41.1		32.4		20.9		35.95		48.90		40.4
CD (P=0.05)	3.1	1.1	NS	1.2	0.2	0.8	NS	1.0	1.44	0.91	0.94	0.93	NS	0.7
Spacing (cm × cm)														
20 × 15	88.0	94.4	30.3	35.0	25.2	27.1	22.3	21.6	33.28	42.23	42.54	54.62	43.5	42.0
20 ×10	87.9	91.2	32.8	35.6	27.2	27.8	21.6	21.5	32.90	42.83	45.10	59.55	42.3	41.0
15 × 15	89.5		31.6		26.3		21.6		33.35		46.24		40.9	
CD (P=0.05)	NS	0.9	NS	NS	NS	0.6	NS	NS	NS	0.75	1.15	0.76	NS	0.05
Seedling/hill														
1	89.4	93.5	30.7	35.1	25.5	27.3	21.2	21.3	32.09	41.03	43.33	55.28	41.7	41.1
2	87.9	94.1	32.0	35.5	26.9	27.4	22.5	21.9	34.23	45.03	45.92	58.88	41.5	41.9
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	1.44	0.75	0.94	0.76	NS	0.5

Table 3. Interaction effect of spacing and seedlings/hill on grain yield(q/ha) during 2000.

Spacing	Seedlings/hill	
	1	2
20 cm × 15 cm	39.10	45.37
20 cm × 10 cm	42.97	44.70
CD (P=0.05)	1.05	

ever, when 2 seedlings/hill were planted the maximum tiller number stage reached 1 week earlier than planting of 1 seedling/hill. Effective tiller number recorded at harvest was lower than the tiller number recorded at 22 days after transplanting (DAT) indicating that in hybrid rice of 125 days duration all the effective tillers are produced within 3 weeks after planting. On an average, 60% of the tillers became effective.

Both grain and straw yields were significantly more under planting of 2 seedlings/hill than planting of 1 seedling/hill. The increase in grain yield was 6.7 and 9.7% and in straw yield was 6.0 and 9.5% during the first and second year, respectively, owing to planting of 2 seedlings over 1 seedling/hill. Significantly more total and effective tillers/clump under planting of 2 seedlings/hill, contributed to more grain yield than that under planting of 1 seedling/hill. The results confirm those of Srinivasulu *et al.* (1999), who reported superiority of planting 2 seedling/hill over one seedling/hill.

Interaction

The interaction effect of spacing and seedlings/hill on grain yield was significant during the second year (Table 3). Under both 20 cm × 15 cm and 20 cm × 10 cm spacings although, 2 seedlings/hill produced significantly more grain yield than 1 seedling/hill but the increase in yield owing to planting of 2 seedlings/hill was much more (16.0%) under wider spacing than that (4.0%) under closer spacing. On the other hand, when 1 seedling/hill was planted closer spacing was decidedly advantageous over wider spacing but when 2 seedlings/hill were planted wider spacing of 20 cm × 15 cm was more advantageous than closer spacing.

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