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Effect of planting time and nitrogen level on physiological parameters and grain yield of hybrid rice

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ABSTRACT

Experiment conducted at I.G.A.U., Raipur during wet season to find out the combined effect of planting times and nitrogen levels on hybrid rice indicated that planting of hybrid rice on 20th July and 5th August were at par to produce significantly higher crop growth rate (CGR), net assimilation rate (NAR), leaf area index (LAI), leaf production rate (LPR) and grain yield than that of planting on 20th August. The application of nitrogen up to 150 kg ha^{-1} significantly increased LPR, LAI and N concentration in third leaf as compared to other levels of nitrogen (50 and 100 kg ha^{-1}). The grain yield increased significantly with the application of 100 kg N ha^{-1}.

Key words: *Hybrid rice, planting time, nitrogen level, yield*

Rice hybrids have potential to produce 10-15 per cent more yield than inbred varieties (Mahadevappa, *et al*., 1996). However, agronomical strategies to achieve the target yield for different agro climatic conditions needs to be developed. Growth and development process associated with higher grain yield of hybrid rice include more vigorous and extensive root system (Li, 1981, Yang and Sun, 1988), higher growth rate during vegetative stage (Yamauchi, 1994), greater sink size (Kabaki, 1993), greater carbohydrate translocation from vegetative plant parts to the spikelets (Song *et al*., 1990) and longer leaf area index (LAI) during the grain filling periods. The planting times greatly influences these characters of hybrid rice. The role of nitrogen to obtain higher yield has been widely accepted (Shivay and Singh, 2003). The hybrid rice generally requires more nitrogen than conventional rice. The nitrogen efficiency in hybrid rice is also greater than conventional rice (Yang, 1987). Hence, an attempt was made to study the effect of planting times and N levels on physiological parameters, nitrogen content and yield of hybrid rice.

MATERIALS AND METHODS

The experiment was conducted during wet season at I.G.A.U., Raipur, Chhattisgarh. The soil was clay loam, having pH 6.8 and organic carbon 0.42 per cent. The available nitrogen, phosphorus and exchangeable potassium were 210, 23 and 310 kg ha^{-1}, respectively. The treatments consisted of three planting dates (20th July, 5th August and 20th August) and 3 nitrogen levels (50, 100 and 150 kg ha^{-1}). The split plot design with three replications was used to conduct the experiment keeping date of planting in main plot and N levels in sub plots. The rice hybrid 'PA 6201' was used as test crop. The nitrogen was given as per the treatments, while 75 kg P_2O_5 and 60 kg K_2O were uniformly applied to the crop. One third of nitrogen and entire dose of P_2O_5 and K_2O were given as basal dressing and remaining N was equally top dressed at maximum tillering and panicle initiation stage of the crop. One seedling of hybrid rice was transplanted at spacing of 20 cm x 15 cm.

RESULTS AND DISCUSSION

Crop growth rate (CGR) increased only up to 60 days after transplanting (DAT) and thereafter, decreased with crop age (Table 1). It might be due to accumulation of food material through photosynthesis during growth period of the crop and then it distributed towards the root and shoot. Net assimilation rate (NAR) decreasesed with advancement in crop age (Ramamoorthy *et al*., 1997). Hybrid rice planted either 20th July or 5th August produced similar crop growth rate (CGR), Net assimilation rate and Relative growth

Table 1. Effect of planting times and nitrogen levels on crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR)

Treatments	CGR g day^{-1}			RGR g g^{-1}day^{-1}			NAR g cm^{-2}day^{-1}	
	0-30 DAT*	30-60 DAT	60-90 DAT	0-30 DAT	30-60 DAT	60-90 DAT	0-30 DAT	30-60 DAT
Date of plantings								
20th July	0.29	0.62	0.55	0.060	0.056	0.017	0.046	0.025
5th August	0.28	0.61	0.56	0.061	0.053	0.016	0.045	0.024
20th August	0.25	0.51	0.51	0.057	0.044	0.016	0.038	0.023
CD (P=0.05)	NS	0.08	0.02	0.002	0.003	NS	0.005	NS
Nitrogen levels (kg ha^{-1})								
50	0.24	0.51	0.50	0.055	0.042	0.015	0.035	0.023
100	0.27	0.58	0.55	0.060	0.049	0.017	0.043	0.025
150	0.31	0.65	0.57	0.065	0.055	0.017	0.051	0.024
CD (P=0.05)	0.02	0.06	0.04	0.005	0.005	NS	0.006	NS

*DAT – Days after transplanting

rate (RGR) at 30 DAT which were superior to 20th August planting (Table 1). The crop growth increased in early planting possibly due to favourable environmental conditions, such as temperature and relative humidity during its different phenophases compared to late planting. The rice hybrid planted either on 20th July or 5th August were at par and had significantly higher leaf production rate (LPR) and leaf area index (LAI) the hybrid planted on 20th August (Table 2). Om *et al*. (1999) also reported the reduction of leaf area ratio with delayed planting of hybrid rice. The N content in third leaf significantly increased on 20th July planting as compared to later planting at 30 and 60 DAT (Table 2). This may be due to the fact that delay planting reduces root morphological and physiological characteristics. Yang (1987) also reported significantly positive correlation of N uptake by rice with root morphological and physiological characters. Further, increase in crop age to 90 DAT, 20th July planting gave the similar N content to that of 5th August planting. Grain yield under planting on 20th July or 5th August were at par and found to be significantly better than that of planting on 20th August. Higher CGR, NAR, LPR and LAI at earlier planting might have favoured the higher grain yield than delayed planting of hybrid rice. These results are in conformity with those reported by Om *et al*. (1999).

Table 2. Effect of date of plantings and nitrogen levels on leaf production rate (LPR), leaf area index (LAI), nitrogen content in third leaf and grain yield of hybrid rice

Treatment	LPR (leaves day^{-1})		LAI			N content in third leaf			Grain yield (t ha^{-1})
	0-30 DAT	30-60 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	
Date of plantings									
20th July	1.19	0.49	1.82	5.30	4.82	3.50	2.60	1.27	5.92
5th August	1.16	0.49	1.83	5.21	4.66	3.24	2.52	1.25	5.74
20th August	1.05	0.50	1.57	4.98	2.75	2.68	2.26	1.05	5.09
CD (P=0.05)	0.07	NS	0.22	0.11	0.33	0.08	0.06	0.06	3.59
Nitrogen levels (kg ha^{-1})									
50	1.01	0.28	1.38	4.78	2.93	2.96	1.92	1.05	4.75
100	1.15	0.51	1.73	5.18	4.19	3.17	2.68	1.22	5.8.
150	1.24	0.69	2.11	5.53	5.11	3.29	2.78	1.30	6.13
CD (P=0.05)	0.08	0.15	0.19	0.31	0.28	0.06	0.09	0.04	4.03

Table 3. Effect of interaction between transplanting dates and nitrogen levels on the leaf area index

Nitrogen levels (kg ha^{-1})	At 30 DAT			At 60 DAT			At 90 DAT		
	Transplanting dates			Transplanting dates			Transplanting dates		
	20th July	5th August	20th August	20th July	5th August	20th August	20th July	5th August	20th August
50	1.42	1.50	1.23	4.91	4.92	4.50	3.44	3.21	2.15
100	1.84	1.83	1.52	5.31	5.15	5.09	4.90	4.83	2.84
150	2.22	2.17	1.95	5.68	5.56	5.35	6.16	5.94	3.26
CD (P=0.05)		0.33			0.45			0.51	

Table 4. Effect of interaction between transplanting dates and nitrogen levels on the grain yield

Nitrogen levels (kg ha^{-1})	Grain yield (t ha^{-1})		
	Transplanting dates		
	20th July	5th August	20th August
50	5.05	4.93	4.28
100	6.23	6.05	5.34
150	6.50	6.23	5.65
CD (P=0.05)		3.78	

CGR up to 60 DAT, RGR, NAR, LPR, LAI and N content in third leaf were significantly higher with increasing N levels up to 150 kg ha^{-1} (Table 1 and 2). On the other hand, application of 100 kg ha^{-1} was found statistically similar to 150 kg ha^{-1} for grain yield of hybrid rice. The finding of Shrivastava and Tripathi (1999) was almost similar.

The interaction effect between transplanting and nitrogen levels on leaf area index was significant (Table 3). Transplanting on 20th July and 150 kg N ha^{-1} were significantly better than 20th August but at par with 5th August planting. Interaction of transplanting dates and nitrogen levels were found to be significant with regard to grain yield (Table 4). Transplanting on 20th July and 5th August planting with 50, 100 or 150 kg N ha^{-1} recorded identical grain yield. Application of nitrogen either 100 or 150 kg ha^{-1} were comparable and produced significantly higher grain yield than 50 kg N ha^{-1} in all the transplanting dates.

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