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Response of rice genotypes to levels of nitrogen in lowland

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ABSTRACT

Growth and yield of low land rice genotypes differed significantly due to application of different levels of N, P and K. Uptake was remarkably improved with 120 kg N ha^{-1}. Application of incremental doses of N significantly improved the yield attributes resulting in higher grain and straw yield. Genotype IET-16983 was found significantly superior to other rice genotypes except Radha and IET 15848 in increasing the growth and yield attributes. IET-16983 recorded the maximum grains (3.77 t ha^{-1}) and straw (5.30 t ha^{-1}) yield along with improvement in N, P and K uptake.

Key words: *: Rice, nitrogen, lowland, yields, nutrient uptake*

Genetic character of a variety limits the expression of yield. Rice cultivars differ in their potential to respond to high fertility conditions. Further, the N requirement of the crop differs according to duration of the variety. Selection of suitable rice varieties and their nutrient requirement have great relevance in boosting up productivity and production of lowland rice. Keeping above points in view, the present investigation was carried out to study the growth behavior of lowland rice varieties under different nitrogen levels.

MATERIALS AND METHODS

Field experiments were conducted during wet seasons of 2002 and 2003 at Rajendra Agricultural University Farm, Pusa (Bihar). The soil was silty-clay in texture having low available N (262.52 kg ha^{-1}) and K (119.0 kg ha^{-1}) and medium level of available P (32.10 kg ha^{-1}), with pH 8.4. The experiment was laid out in split plot design with three replications and 20 treatments. The treatment combinations consisted of four levels of N (0, 40, 80 and 120 kg ha^{-1}) in main plot and five rice varieties (IET 16963, IET 15848, IET 16619, Shalibahana and Radha) in the sub-plot. The crop received an uniform dose of 40 kg P_2O_5 and 20 kg K_2O ha^{-1} applied as single super phosphate and muriate of potash, respectively to all the plots as basal. Nitrogen was applied in the form of urea in three splits i.e. 25% at puddling, 50% at active tillering and the remaining 25% at panicle initiation stage as per treatments. $ZnSO_4$ @ 25 kg ha^{-1} was applied uniformly to all the plots at puddling. The rice crop was transplanted on 10th and 18th July during 2002 and 2003, respectively years at 20 cm x 15 cm spacing with 2 seedlings hill^{-1}. Necessary plant protection measures were adopted as and when required. Growth and yield attributes were recorded at harvest. Grain and straw yield alongwith test weight were taken after threshing and perfect drying.

RESULTS AND DISCUSSION

The application of each successive dose of nitrogen from 0 to 120 kg ha^{-1} significantly increased the growth attributes viz.; plant height, number of tillers m^{-2}, dry matter accumulation and leaf area index (Table 1). The number of tillers m^{-2} increased from 217 to 288 with application of 0 to 120 kg N ha^{-1}, respectively. The corresponding dry matter and leaf area index also increased from 443 to 1159 g m^{-2} and 2.08 to 4.35, respectively. The improvement in dry matter accumulation may be owing to greater photosynthetic activity and chlorophyll synthesis as N fertilization seemed to have promoted vegetative growth. Similar results were reported by Chopra and Chopra (2000).

Yield attributes were significantly affected with levels of nitrogen (Table 1). It indicated that panicles m^{-2}, panicle weight, spikelet panicle^{-1} and 1000 grain weight were significantly higher with the application of 80 and 120 kg N ha^{-1} than 0 and 40 kg N ha^{-1}. The N

Table 1. Growth, development and yield of rice genotypes as influenced by different levels of nitrogen

Treatment	Plant height (cm)	Tillers m^{-2}	Dry-matter accumultion (g m^{-2})	Leaf area index	Productive Panicles m^{-2}	Panicle weight (g)	Spikelets $Panicle^{-1}$	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
Nitrogen (kg ha^{-1})											
0	87	217	443	2.08	201	2.22	63	22.12	1.89	2.85	39.68
40	97	265	729	2.75	250	2.44	79	23.34	3.44	5.00	40.79
80	105	279	969	4.00	268	2.57	90	24.17	4.01	5.86	40.89
120	111	288	1159	4.35	273	2.70	92	24.24	4.40	6.28	41.23
CD (P=0.05)	7	9	17	0.07	8	0.03	6	0.22	0.21	0.25	0.56
Varieties/genotypes											
IET-16983	103	276	876	3.44	266	2.54	91	23.84	3.77	5.30	41.57
IET-15848	99	254	866	3.25	248	2.48	81	23.39	3.57	5.12	41.05
IET-16619	98	256	772	3.22	240	2.45	74	23.22	3.14	4.81	39.50
Shalibahana	95	258	743	3.14	228	2.43	72	23.08	2.87	4.48	39.06
Radha	100	268	869	3.41	261	2.50	88	23.77	3.66	5.22	41.25
CD (P=0.05)	8	9	18	0.10	9	0.03	6	0.23	0.25	0.28	0.63

* Pooled of 2 years

levels of 80 and 120 kg N ha^{-1} were at par with respect to yield attributes. The increase in yield attributes may be due to better availability of nutrients under higher levels of N. The increase in growth and thereby, more assimilates resulted in higher values of yield attributes, which in turn improved the grain and straw yield and harvest index (HI). Grain yield and straw yield were favourably influenced with increase in N levels. There was significant increase in HI when N dose was increased from 0 to 120 kg ha^{-1}. Higher yield at 120 kg N ha^{-1} may be ascribed to the overall improvement in plant vigour and production of sufficient photosynthates owing to greater availability of nutrients subsequently resulting in better manifestation of yield attributes.

Genotypes had significant effect on the growth

Table 2. Nutrient content and uptake in grain and straw of rice as influenced by various treatments

Treatments	Nitrogen				Phophorus				Potash			
	Content (%)		Uptake (kg ha^{-1})		Content (%)		Uptake (kg ha^{-1})		Content (%)		Uptake (kg ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Nitrogen (kg ha^{-1})												
0	1.03	0.56	19.33	16.26	0.50	0.050	9.38	1.42	0.35	0.71	6.56	20.25
40	1.23	0.61	42.41	30.52	0.52	0.053	17.92	2.65	0.40	0.85	13.79	42.53
80	1.28	0.62	51.86	36.89	0.53	0.054	21.47	3.16	0.42	0.89	17.01	52.12
120	1.28	0.65	56.40	40.83	0.53	0.054	23.35	3.39	0.42	0.91	18.50	57.17
CD (P=0.05)	0.06	0.03	2.16	2.23	0.03	0.003	1.09	0.29	0.02	0.06	1.65	2.54
Varieties/genotypes												
IET-16983	1.24	0.64	46.78	33.93	0.54	0.055	20.37	2.91	0.42	0.86	15.84	45.60
IET-15848	1.19	0.60	42.45	30.73	0.52	0.051	18.55	2.61	0.41	0.78	14.62	39.95
IET-16619	1.16	0.58	36.43	27.89	0.52	0.051	16.33	2.45	0.38	0.76	11.93	36.55
Shalibahana	1.10	0.57	31.59	25.53	0.51	0.051	14.64	2.28	0.38	0.75	10.91	33.60
Radha	1.24	0.64	45.42	33.38	0.54	0.053	19.78	2.76	0.42	0.85	15.38	44.33
CD (P=0.05)	0.06	0.06	2.27	2.47	0.02	0.003	1.18	0.34	0.02	0.06	1.73	2.63

* Pooled of 2 years

and yield attributes (Table 1). Among the varieties, IET-16983 recorded the maximum growth and yield attributes followed by Radha. The highest grain yield (3.77 t ha^{-1}) was recorded with IET-16983 which differed significantly than that of other varieties except Radha and IET 15848. This could be attributed due to combined effect of better growth and yield attributes. Superiority of IET 16983 over all other varieties seems to be on account of higher leaf area index (LAI) and efficient translocation of metabolites towards grain formation, as evident from higher harvest index.

Maximum depletion of nutrient was observed with IET-16983 followed by Radha (Table 2). Nutrient uptake being a function of dry-matter production, this significant increase was owing to increase in grain and straw yield along with their concentration with increasing N levels. Plants absorb nitrogen proportionately from the pool of available nitrogen increased in soil by addition of higher dose of nitrogen (Patel *et al*., 1997) Bharde *et al*. (2003) reported the synergistic effect of N in availability of P and K. It is concluded that the rice variety ITE-16983 with the nitrogen dose of 120 kg N ha^{-1} may be recommended under low land condition of north Bihar plains.

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