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Effect of Different Levels and Time of Nitrogen Application on Growth, Yield and Nutrient Uptake in Aerobic Rice (*Oryza sativa*)

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Abstract

Field experiment was conducted during *Kharif* season of 2004 and 2005 to study the effect of levels and time of nitrogen application on growth and yield of aerobic rice (*Oryza sativa* L.). The pooled data of two years research results revealed that application of 125 kg N/ha recorded significantly higher plant height (85.51 cm), total dry matter production (123.99 g/hill), productive tillers/hill (31.31), filled spikelets/ panicle (148.00) grain yield (7.61 t/ha), uptake of total nitrogen (203.10 kg/ha), phosphorus (86.07 kg/ha) and potassium (120.46 kg/ha).
Key words : Aerobic rice, Nutrients uptake, Yield, Nitrogen levels, Application time.

After varietal improvement, fertilizer usage is the principal factor attributed for yield improvement in rice. Adequate supply of essential plant nutrients is essential for getting good yield of rice. Much of the nutrients required by the rice crop come from the soil, but it is insufficient to meet the nutrient requirements for higher rice yield. The use of fertilizer is essential to fill the deficit between crop needs for nutrients and the supply of nutrients from the soil. In India about 67% of rice soils are estimated to be deficient in adequate nitrogen and rice crop has become a major consumer of nitrogen fertilizer. Rice consumes about 40% of total fertilizer nitrogen used in India. Efficiency of applied fertilizer nitrogen is low, ranges from 20—25% in aerobic soil. Aerobic soil has higher rate of percolation than flooded soil. So the highly mobile nitrate ions are easily lost through leaching. Hence, effective nitrogen management such as rate and synchronized N application with the crop requirement in real time plays an important role in increasing response to added fertilizers and thereby, improving the grain yield of rice varieties including hybrids. Among the factors governing nitrogen use efficiency, the rate and time of application of nitrogen plays an important role. Hence, keeping these things in view the present field investigation was undertaken to know the optimum levels and time of nitrogen application on growth and yield of aerobic rice.

Methods

A field experiment was carried out during *kharif* season of 2004 and 2005 at Zonal Agricultural Research Station, Visweswariah canal farm, Mandya, Karnataka. The soil was red sandy loam in texture having pH 6.98, medium in available N (298 kg/ha), P (26.13 kg /ha) and K (149.32 kg/ha). The experiment consisted of three levels of nitrogen as main plot (75,100 and 125 kg/ha) and three different time of nitrogen application (there splits—50% basal + 25% at 30 DAS + 25% AT 60 DAS ; four splits —25% basal + 25% at 30 DAS + 25% at 60 DAS + 25% at 90 DAS ; and five splits 10% as basal + 20% at 15 DAS + 20% at 30 DAS + 25% at 45 DAS + 25% 60 DAS) laid out in split plot design with three replications. Over night soaked seeds of cultivars KRH-2 (Karnataka rice hybrid) was manually dibbled at 1 seed/hill at a inter and intra row spacing of 25cm × 25 cm. Crop was sown on 8 of August during both both the years. The crop was nourished with 50 kg phosphorus and 37.5 kg potassium per hectare using single super phosphate and muriate of potash as a source respectively at the time of sowing. The remaining 12.5 kg potassium per hectare was top dressed at panicle initiation stage.Nitrogen was applied using urea as a source as per treatments. The crop was irrigated once in 5 days depending upon soil moisture to a depth of 5 cm.

Table 1. Plant height and Total dry matter production of aerobic rice as influenced by levels and time of nitrogen application recorded at harvest. S_1 – 3 splits (50 % basal + 25% at 30 DAS + 25% at 60 DAS), S_2 – 4 splits (25% basal + 25% at 30 DAS + 25% at 60 DAS + 25% at 90 DAS), S_3 – 5 splits (10% as basal + 20% at 15 DAS + 20 % at 30 DAS + 25% at 45 DAS + 25% 60 DAS).

Treatments	Plant height (cm) 2004	Plant height (cm) 2005	Plant height (cm) Pooled	Total dry matter production (g/hill) 2004	Total dry matter production (g/hill) 2005	Total dry matter production (g/hill) Pooled
Levels of Nitrogen (kg/ha)						
N_1—75	67.37	70.99	69.18	59.37	70.72	65.04
N_2—100	79.08	83.08	81.58	101.69	119.86	110.78
N_3—125	82.68	88.35	85.51	117.17	130.80	123.99
SE ±	1.96	2.30	1.07	4.26	2.93	3.38
CD (P = 0.05)	6.03	7.08	3.30	13.13	9.03	10.41
Time of Nitrogen Application						
S_1 — 3 splits	77.60	83.13	80.37	91.00	107.30	99.15
S_2 — 4 splits	72.31	75.19	73.75	90.69	108.74	99.72
S_3 — 5 splits	78.21	84.11	81.16	96.53	105.34	100.93
SE ±	1.39	2.41	1.59	2.87	3.84	2.70
CD (P = 0.05)	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS

Weeds were controlled by application of pre-emergence herbicide pyrazo sulfuronethyl at 0.025 kg a.i./ ha at 3 days after sowing with spray solution of 750 liters/ha. The required cultural practions and plant protection measures were followed as and when required based on recommended package. Observations on growth, yield parameters and grain yield was recorded at the time of harvest and data was statistically analysed. The nutrient uptake by crop was worked out by following standard procedure.

Table 2. Productive tillers, filled spikelets and grain yield of irrigated aerobic rice as influenced by levels and time of nitrogen application recorded at harvest. S_1— 3 splits (50% basal + 25% at 30 DAS + 25% at 60 DAS), S_2 —4 splits (25% basal + 25% at 30 DAS + 25% at 60 DAS + 25% at 90 DAS), S_3—5 splits (10% as basal + 20% at 15 DAS + 20% at 30 DAS + 25% at 45 DAS + 25 % 60 DAS).

Treatments	Productive tillers (No./ hill) 2004	Productive tillers (No./ hill) 2005	Productive tillers (No./ hill) Pooled	Filled spikelets (No. panicle) 2004	Filled spikelets (No. panicle) 2005	Filled spikelets (No. panicle) Pooled	Grain yield (t/ha) 2004	Grain yield (t/ha) 2005	Grain yield (t/ha) Pooled
Levels of Nitrogen (kg/ha)									
N_1 —75	18.19	21.04	19.61	104.11	111.12	106.67	6.52	6.74	6.63
N_2—100	25.87	32.85	29.36	128.33	141.78	135.06	7.35	7.44	7.39
N_3—125	28.06	34.55	31.31	140.56	155.44	148.00	7.52	7.70	7.61
SE ±	1.15	1.04	0.75	3.52	3.50	3.51	0.10	0.17	0.09
CD (P = 0.05)	3.54	3.20	2.31	10.84	10.63	10.73	0.31	0.52	0.28
Time of Nitrogen Application (S)									
S_1—3 splits	24.40	30.36	28.38	114.89	127.00	120.61	6.94	7.29	7.12
S_2—4 splits	23.43	27.04	25.64	125.56	137.22	131.06	7.13	7.32	7.22
S_3—5 splits	26.00	29.30	26.67	122.56	134.06	128.06	7.31	7.37	7.34
SE ±	0.91	1.18	0.91	4.23	4.26	4.24	0.19	0.24	0.1
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Uptake of total nitrogen, phosphorus and potassium (kg/ha) in irrigated aerobic rice as influenced by levels and time of nitrogen application at harvest. S_1—3 splits (50% basal + 25% at 30 DAS + 25% at 60 DAS), S_2—4 splits (25% basal + 25% at 30 DAS + 25% at 60 DAS + 25% at 90 DAS), S_3—5 splits (10% as basal + 20% at 15 DAS + 20% at 30 DAS + 25% at 45 DAS + 25% 60 DAS).

Treatments	Nitrogen			Phosphorus			Potassium		
	2004	2005	Pooled	2004	2005	Pooled	2004	2005	Pooled
Levels of Nitrogen (kg/ha)									
N_1—75	128.54	128.67	128.61	56.58	56.31	56.44	70.80	96.46	83.63
N_2—100	181.87	167.57	173.72	82.82	74.35	78.58	101.08	110.32	105.70
N_3—125	207.75	199.64	203.70	86.83	85.30	86.07	116.72	124.21	120.46
SE ±	4.08	3.58	2.88	1.14	2.56	1.73	3.24	2.62	2.48
CD (P = 0.05)	12.47	11.03	8.87	3.51	7.88	5.33	9.98	8.07	7.64
Time of Nitrogen Application (S)									
S_1—3 splits	166.82	158.63	162.72	73.57	70.10	71.83	94.23	106.51	100.36
S_2—4 splits	174.65	168.08	171.36	75.01	70.59	72.80	95.89	112.09	103.96
S_3—5 splits	176.60	167.18	171.28	77.64	75.27	76.46	100.75	112.70	106.73
SE ±	3.24	3.88	2.85	1.91	2.01	1.96	2.91	2.41	2.07
CD (P = 0.05)	NS	NS	NS	NS	NS	Ns	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS

Results and Discussion

Significant difference was observed in morphological parameters viz., plant height and dry matter production of rice crop up to harvest with application of different levels of nitrogen and time of nitrogen had no significant influence on morphological parameters and grain yield. The pooled data revealed that application of 125 kg N/ha recorded significantly higher plant height (85.51 cm) and total dry matter production (123.99 g/hill). This might be due to nitrogen improves root growth and producing taller plant coupled with production of more number of leaves and leaf area that eventually causes interception of photo synthetically active radiation and greater photosynthesis by crop resulted in higher dry matter production. (Table 1). These results are in conformity with those of Belder et al. (1).

The productive tillers/hill and filled spikelets/ panicle were significantly higher with application of 125kg N/ha (31.31 and 148.00 respectively) but were at par with application of 100 kg N/ha (29.36 and 135.06 respectively) on pooled data analysis (Table 2). The enhanced values in productive tillers and filled spikelets might be due to higher leaf area and DMP leading to higher photosynthetic rate and accumulation of more assimilates which led to increased sink size. These results are in conformity with those of Thomas et al. (2).

In pooled data analysis application of 125 kg N/ ha recorded significantly higher grain yield (7.61 t/ ha). This might be due to better growth and yield attributes, which resulted in higher grain yield. Similar results were reported by Singh and Singh (3). The uptake of total nitrogen (203.10 kg/ha), phosphorus (86.07 kg/ha) and potassium (120.46 kg/ha) were significantly higher with application of 125 kg N/ ha in pooled analysis (Table 3). The nitrogen uptake in turn increaed was due to increased availability of nitrogen in soil and resulted in higher absorption of nitrogen by the crop at higher nitrogen levels. The initial build up of vigorous growth might have resulted in higher photosynthetic rate, leading to better uptake of nutrients throughout the crop growth period. This is in accordance with findings of Gunri et al. (4).

The time of nitrogen application and interaction between the time and leves of a nitogen found non significant with respect to plant height, total dry matter production productive tillers, filled spikelets grain yield and nutrients uptake during both the years of study and pooled analysis.

The present study revealed that application of 100 kg N/ha in three splits found optimum and economical for aerobic rice which recorded grain yield on par with 125 kg N/ha and nitrogen application in five splits respectively.

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