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Effect of Integrated Nitrogen Management on Growth, Yield, Nutrient Uptake and Economics of Aerobic Rice (*Oryza sativa* L.)

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ABSTRACT

A field experiment was conducted at the wetland farm of S.V. Agricultural College, Tirupati during *rabi* 2008-09 to study the effect of supplementation of nitrogen through organic sources on aerobic rice. The study was laid out in a randomized block design, replicated thrice with ten treatments proposed with neem leaf and farm yard manure in combination with fertilizer nitrogen. Among all the treatments, application of 100% N through fertilizer has resulted in highest growth, yield and nutrient uptake of aerobic rice, which were however, on par with 25% N through FYM+75 % N through fertilizer (T_3) and 25% N through NLM + 75 % N through fertilizer (T_7). The maximum net returns and benefit cost ratio were recorded with 100% N through fertilizer.

Key words : Aerobic rice, Economics, Growth,Nutrient uptake, Yield.

Rice [*Oryza sativa* (L.)] is one of the important staple food crops in the world. “Rice is life” aptly describes the importance of rice in food and nutritional security particularly for the Asian countries. India is the largest producer of rice in the world with 89.13 million tonnes from 41.85 million hectares, with a productivity of 2.1 t ha^{-1} during 2009-10 (http://www.indiastat.com). In Asia, irrigated agriculture accounts for 90 per cent of total diverted fresh water, of which more than 50 per cent is used to irrigated rice. The world wide fresh water shortage and uneven distribution of rainfall necessitate the development of rice production systems that require less water.

Aerobic rice is a new concept of growing rice with reduced water requirements where fields remain unsaturated throughout the season like an upland irrigated crop. In aerobic culture, rice is potentially more water-efficient than lowland rice.

Nitrogen is an inevitable component of any fertilizer management programme and particularly it is more so, for the rice crop. Farm yard manure and green leaf manure would play an important role in crop nutrition and soil fertility in association with chemical fertilizers. To develop an integrated nitrogen management package for aerobic rice, the present investigation was carried out.

MATERIAL AND METHODS

A field experiment was conducted during *rabi* 2008 - 09 at S. V. Agricultural college, Tirupati in a randomized block design, replicated thrice with ten treatments viz., control (No nitrogen) (T_1), 100% N through fertilizer (T_2), 25% N through FYM+75 % N through fertilizer (T_3), 50% N through FYM+50% N through fertilizer (T_4), 75%N through FYM+25% N through fertilizer (T_5), 100% N through FYM (T_6), 25% N through NLM (Neem leaf manure) + 75 % N through fertilizer (T_7), 50% N through NLM+50% N through fertilizer (T_8), 75% N through NLM+25% N through fertilizer (T_9), 100% N through NLM (T_{10}).The soil was sandy clay loam in texture with pH 8.1, low in organic carbon (0.36%) and medium in available nitrogen (214 kg ha^{-1}), phosphorus (21.9kg ha^{-1}) and potassium (130 kg ha^{-1}).

The recommended dose of nutrients was 120 kg N, 60 kg P_2O_5 and 60kg K_20 ha^{-1}. Nitrogen was applied as per treatments in four equal splits *i.e.* at the time of sowing, active tillering, panicle initiation and heading stage through urea. The Nitrogen content in farm yard manure (0.67%) and neem leaf manure (0.5%) were determined and the amount of these materials required for substituting recommended dose of nitrogen as per the treatments were calculated. Entire quantity of phosphorus and

Table 1. Effect of integrated nitrogen management practices on growth parameters of aerobic rice at harvest

Treatments	Plant height (cm)	LAI	No. tillers m^{-2}	Dry matter production (kg ha^{-1})
T_1 : Control (No Nitrogen)	49.2	1.98	139	3666
T_2 : FN_{100}	67.8	4.68	306	10090
T_3 : FYM N_{25} + FN_{75}	67.6	4.24	298	9890
T_4 : FYM N_{50} + FN_{50}	62.9	3.53	264	8777
T_5 : FYM N_{75} + FN_{25}	59.0	2.80	204	7820
T_6 : FYM N_{100}	57.1	2.72	192	7525
T_7 : NLM N_{25} + FN_{75}	66.2	4.16	291	9723
T_8 : NLM N_{50} + FN_{50}	62.7	3.42	255	8552
T_9 : NLM N_{75} + FN_{25}	58.6	2.79	198	7648
T_{10} : NLM N_{100}	56.2	2.65	189	7238
SEm ±	1.08	0.17	7.27	196.89
CD (0.05)	3.2	0.52	21	585

potassium was applied as basal through single super phosphate and muriate of potash respectively. The rice variety NLR-145 was sown at the rate of 40 kg ha^{-1} (2 seedlings per hill) at a spacing of 15×10 cm. The data recorded on various parameters of crop was subjected to statistical scrutiny by the method of analysis of variance as outlined by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Integrated nitrogen management practices significantly influenced the growth, yield (grain and straw) nutrient uptake and economics of aerobic rice.

Plant growth parameters *viz.,* plant height, leaf area index, number of tillers m^{-2} and dry matter production of aerobic rice were found to be at their highest with 100% N supplied through fertilizer (T_2), which were however, on par with 25% N through FYM + 75% fertilizer N (T_3), and 25% N through NLM + 75% fertilizer N (T_7) at all the stages of crop growth (Table 1).

Under the influence of favourable N nutrition, growth of the crop was enhanced to produce increased stature of the growth components. These could be attributed to increased growth under favourable N nutrition. Nitrogen influences the plant growth and development through increased cell division, resulting in taller plants, larger leaf area and enhanced tillering, leading to increased dry matter production through larger photosynthesizing surface. Similar results were reported by Jadhav *et al.* (2004), Mankotia and Shekhar (2007) and Ramana *et al.,* (2007).

Reduced crop growth parameters were noticed with non-supply of N through any source (T_1), since the crop has to depend completely on soil nitrogen, which might not be sufficient to produce even a moderate stature of rice crop under aerobic conditions. The results obtained are in conformity with the findings of Belder *et al.,* (2005).

The highest grain yield (3682 kg ha^{-1}) was recorded with 100% N through fertilizer (T_2), which was however, on par with 25% N through FYM + 75% fertilizer N (T_3) and 25% N through NLM + 75% fertilizer N (T_7) and these were significantly superior to rest of the treatments (Table 2). The increase in grain yield was due to the cumulative effect of higher growth parameters as well as yield attributes. Similar increased yield due to conjunctive use of organic and inorganic nitrogen was reported by Dahiphale *et al.,* (2000), Solunke *et al.,* (2004) and Surendra Singh *et al.,* (2006).

Uptake of nutrients was found to be highest with 100 percent N through fertilizer (T_2), which was however on par with 25% N through FYM+75% fertilizer N (T_3) and 25% N through NLM+75% fertilizer N (T_7). This might be due to N application, which increases N uptake and also enhances P and K uptake. Integrated forms of nitrogen have supplied and retained more N, P and K in solution form for longer time by improving soil chemical condition which in return resulted in more absorption of nutrients by aerobic rice. Similar results were reported by Sharma *et al.,* (2001) and Majumdar *et al.,* (2007).

The highest net returns and benefit cost ratio were obtained with 100 per cent N through fertilizer

Table 2. Effect of integrated nitrogen management practices on yield, nutrient uptake at harvest and economics of aerobic rice

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})	Net returns (Rs ha^{-1})	Benefit costratio
T_1: Control (No-Nitrogen)	1280	3168	59.5	3.04	11.14	4419	1.41
T_2: FN 100	3682	6084	80.5	14.69	41.40	29308	3.42
T_3: FYM N25+FN75	3521	5935	79.2	14.32	40.70	27007	3.13
T_4: FYM N50+FN50	2848	5371	76.4	9.67	34.54	19259	2.45
T_5: FYM N75+FN25	2215	5004	73.6	7.85	29.12	12067	1.87
T_6: FYM 100	1942	4874	72.3	7.54	26.06	8651	1.59
T_7: NLM N25+FN75	3318	5784	78.8	14.29	39.61	24724	2.93
T_8: NLM N50+FN50	2595	5364	76.0	9.06	33.80	16443	2.21
T_9: NLM N75+FN25	1983	4993	73.0	7.83	27.16	9318	1.65
T_{10}: NLM 100	1889	4832	71.5	7.22	24.96	7528	1.50
CD(0.05)	373	319	2.2	1.13	4.56	2592	0.20

(T_2) followed by 25% N through FYM+75% fertilizer N (T_3). This was due to higher grain yields associated with these treatments ultimately enhanced economic results. The net returns and benefit cost ratio were the lowest with control (T_1).

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