

Effect of farmyard manure and nitrogen fertilizer on performance of rice (*Oryza sativa*) under intermediate deepwater condition

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ABSTRACT

A field experiment was conducted during 1992 and 1993 at Cuttack, to study the effect of combined use of farmyard manure (0 and 10 t FYM/ha) and urea fertilizer (0, 20 and 40 kg N/ha at sowing and/or top dressing at active tillering) on direct-sown 'Gayatri' rice (*Oryza sativa* L.) grown in up to 52-58 cm water depth. Adverse effects on growth vigour of rice plants due to initial drought and flooding were tolerated better with FYM application than that without or with N fertilizer alone. The grain yield response due to FYM was higher in the absence of N fertilizer (1.12-1.76 t/ha) than when N fertilizer was also applied (0.69-1.34 t/ha). Application of 10 t FYM/ha resulted in either same or significantly higher grain yield than with 40 kg N/ha applied basally through urea fertilizer. Top dressing of 20-40 kg N/ha through urea supergranule placement resulted in no additional advantage in the FYM-treated plots, suggesting continued N supply throughout the crop growth period with organic manuring. The yield potential of rice was realized with 10 t FYM/ha applied along with 20 kg N/ha at sowing under these drought-cum-flood prone lowland conditions.

Key words : Deepwater, Farmyard manure, Flooding, Grain yield, N fertilizer, Rice, Top dressing

Rainfed lowland rice (*Oryza sativa* L.) is generally subjected to drought in the early growth stages and excessive flooding in the later stages in eastern India. Basal fertilization with N promotes the initial vigour of plants, leading to better tolerance to excess water stress (Reddy *et al.*, 1985). Top dressing of urea fertilizer to supplement the N requirement during grand growth period of

the crop is not feasible due to uncontrolled flood water. Various coated materials have been tried in the past to slow down the release of N from urea (Panda *et al.*, 1988), but such fertilizers have not become popular because of their inconsistent response, higher cost and non-availability for wider use. Combined use of organic manures and urea fertilizer checks N losses, conserves soil N

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by forming organo-mineral complexes and thus ensures continued N availability to the rice plants (Sharma and Mittra, 1988). In this study, the effect of such integrated N supply using farmyard manure and N fertilizer was investigated on direct sown rice under intermediate deepwater conditions.

MATERIALS AND METHODS

An experiment was conducted at the Central Rice Research Institute, Cuttack during the rainy seasons (May - December) of 1992 and 1993 on an alluvial sandy clay loam soil of Mahanadi delta, having pH 6.8, organic C 0.83%, total N 0.09%, available P 22 kg/ha and available K 128 kg/ha. Treatments included farmyard manure (FYM) at 0 and 10 t/ha (50% moisture basis) along with varying N fertilizer levels (0, 20 and 40 kg N/ha) applied basally and/or top dressing. Twelve treatment combinations were arranged in randomized block design with 3 replications.

A long-duration (165 days), photosensitive rice 'Gayatri' was direct-sown on 27 May 1992 and 4 June 1993 in relatively dry soil using 400 seed/m² (80 kg/ha) at 20 cm row spacing. Well decomposed FYM (1.6% N, 11:1 C : N ratio) was broadcast-incorporated into the soil a week before sowing. Basal dose of N through prilled urea along with 8.7 kg P/ha and 16.7 kg K/ha was given in the plough furrow. Top dressing of N was done through urea supergranule (USG) placement (3-4 cm deep) between crop rows at active tillering stage (40 days of growth) when water depth in the field was < 20 cm. In the second year, the crop was grown in an adjoining field in order to avoid the residual effect of FYM applied in the first year.

RESULTS AND DISCUSSION

Flooding patterns and crop growth

Germination of rice occurred within a week of sowing following receipt of pre-monsoon showers. In 1992, water accumulation in the field was delayed considerably up to 34 days after germination (DAG) but was accompanied by a rapid rise up to the maximum depth of 52 cm within a fortnight. However, the water level receded to < 20 cm within 5 days, and fluctuated between 15 and 30 cm during major part of the crop growth period. In 1993, water accumulated early from 14 DAG and rose immediately up to 30 cm due to continuous rains (342 mm) for 4 days in the third week of June. However, the water level receded within a week to < 10 cm and rose thereafter to 42 cm at 32 DAG, and to a peak depth of 58 cm in the first and third week of August. There was a gradual recession of water from the beginning of October towards crop maturity in December in both years.

In 1992, the rice seedlings grew well in the early stages owing to regular rains and delayed accumulation of water in the field. However, in 1993, the young plants experienced drought immediately after germination for nearly 2 weeks which caused drying and mortality of seedlings. The adverse effect was less pronounced in FYM-grown plants than in those grown with N fertilizer alone. Thereafter, when the crop got submerged completely for 4-5 days, better growth in terms of taller plants and more dry matter accumulation in the FYM treatments enabled greater tolerance and faster recovery from the excess water stress. This indicated that organic manuring helped in mitigating the adverse effects of drought and flooding

in the initial stages of crop growth. At maturity, the plants with FYM application were significantly taller than those without FYM, and the differences were more pronounced in 1993 than in 1992 (Table 1). Plant height also increased with N fertilizer but the effect was significant in 1993 only.

Yield performance

The grain yield of rice increased significantly with application of FYM and N fertilizer in both years (Table 1). In 1992, the grain yield was comparatively more without FYM (+0.33 t/ha) but was less with application of 10 t FYM/ha (-0.33 t/ha) than in 1993. In other words, the advantage due to FYM was more in 1993 (+1.42 t/ha) than in 1992 (+0.76 t/ha). This was attributed to better drought and submergence tolerance of the

FYM-grown plants in the initial stages in 1993. In 1992, the crop did not experience any moisture stress in the initial stages and submergence of the land also occurred at a much later stage (34 DAG). This resulted in higher number of tillers and thereby panicles/m² but was accompanied by lower panicle weight. On the other hand, the panicle number was lower in 1993 due to early drought and submergence but the panicle weight increased conspicuously. The mean grain yield response was significant up to 40 kg N/ha in 1992 but in 1993, 40 kg/ha was superior to 20 kg N/ha only when applied in 2 equal splits at sowing and active tillering stage.

Interaction between FYM and N fertilizer levels revealed that the highest grain yield could not be obtained with application

Table 1. Mean effect of farmyard manure and N fertilizer on growth and yield attributes of rice under intermediate deepwater conditions

Treatment	Plant height at maturity (cm)		Panicles/m ²		Panicle weight (g)		Grain yield (t/ha)		Straw yield (t/ha)	
	1992	1993	1992	1993	1992	1993	1992	1993	1992	1993
<i>Organic manuring</i>										
No FYM	104	96	169	156	1.70	1.93	2.94	2.61	4.86	4.62
10 t FYM/ha	110	116	214	174	1.94	2.41	3.70	4.03	6.89	6.13
CD (P = 0.05)	4	4	12	9	0.09	0.15	0.18	0.14	0.49	0.38
<i>N fertilizer (kg/ha)</i>										
0*-0**	106	100	176	153	1.61	1.91	2.84	2.73	4.52	3.95
20-0	108	104	195	162	1.80	2.10	3.29	3.27	5.55	5.39
40-0	109	106	196	172	1.82	2.25	3.62	3.51	6.48	5.51
0-20	105	105	191	159	1.78	2.27	3.09	3.27	5.73	5.42
0-40	111	111	187	169	1.97	2.26	3.39	3.45	6.35	5.64
20-20	105	111	203	175	1.94	2.26	3.70	3.69	6.63	6.33
CD (P = 0.05)	NS	7	21	16	0.15	0.27	0.32	0.39	0.85	0.65

*Basal application through prilled urea, **top dressing at active tillering through USG placement

Table 2. Interaction between FYM and N fertilizer levels on grain yield of rice (t/ha) under intermediate deepwater conditions

N fertilizer (kg/ha)	1992		1993	
	No FYM	10 t FYM/ha	No FYM	10 t FYM/ha
0*-0**	2.28	3.40	1.85	3.61
20-0	2.83	3.75	2.49	4.05
40-0	3.38	3.85	2.93	4.08
0-20	2.65	3.53	2.45	4.09
0-40	2.97	3.80	2.74	4.16
20-20	3.53	3.86	3.21	4.16
CD (P = 0.05)	0.45		0.55	

*Basal application through prilled urea, **top dressing at active tillering through USG placement

of N fertilizer alone, and organic manuring was essential for realizing the yield potential of rice (Table 2). The effect of FYM application was more pronounced on plants grown without N than those fertilized with N and *vice versa*. The increase in grain yield due to FYM was higher (+ 1.12-1.76 t/ha) when N fertilizer was not applied, but along with N, such increase was of lower magnitude (+0.69-1.34 t/ha). This indicated that combined use of FYM and N fertilizer complemented each other towards meeting the N requirement of rice plants. When FYM was not applied, the response to N fertilizer was significant up to 40 kg N/ha. However, the effect of 20 and 40 kg N/ha applied along with 10 t FYM/ha was at par. In 1992, the grain yield with 40 kg N/ha applied basally through urea fertilizer was on a par with application of 10 t FYM/ha but in 1993, FYM alone gave significantly more yield than N fertilizer. Application of 10 t FYM/ha contributes 30-75 kg N/ha in rice under varying soil and hydrological conditions, besides leaving a significant re-

sidual effect on the succeeding crops (Sharma, 1995). In the absence of FYM application, basal N fertilization proved to be more beneficial than top dressing. However, split application of 40 kg N/ha - 50% each at sowing and active tillering was comparatively better than single basal application, particularly in 1993. On the other hand, in the presence of FYM application, top dressing of N resulted in no additional advantage over the single basal dose. This confirmed that FYM application ensured continued N supply throughout the growth period of rice under excess water conditions. Mean data of the 2 years also indicated that grain yield was much higher with FYM than with N fertilization, irrespective of dose and time of N application. The highest yield of about 4 t/ha could be realized only when FYM and N fertilizer were applied together.

These results indicate that in flood-prone lowlands where top dressing of N fertilizer is not feasible, organic manuring with FYM at 10 t/ha along with 20 kg N/ha through urea

fertilizer at sowing is beneficial for higher productivity of rice.

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