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Effect of method of seeding and level of nitrogen on yield and yield attributes of rice (*Oryza sativa*) under flood-affected condition

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ABSTRACT

A field experiment was conducted during the wet seasons of 1989 and 1991 to study the effect of method of seeding and level of nitrogen on yield and yield attributes of rice (*Oryza sativa* L.). Drilling in lines before flood and transplanting of aged seedling after receed of flood resulted in significantly higher grain yield than broadcast method before flood in both the years. Application of 60 kg N/ha was on a par with 40 kg N/ha but resulted in significantly higher grain yield than 20 kg N/ha and the control. Grain yield obtained by drilling in lines and transplanting with 40 kg N/ha was equivalent to the yield obtained in broadcast method with 60 kg N/ha. The optimum economic doses of N were 38.20, 37.74 and 37.86 kg N/ha for broadcasting, drilling in lines and transplanting method of seeding respectively.

Initial crop establishment is one of the major constraints in rice (*Oryza sativa* L.) production, especially in flood-prone areas where crop suffers due to excess water at very initial stage, and such failure of the crop is a recurring feature. Besides the efforts made towards the development of flood-tolerant varieties, extensive efforts have also been made to overcome such problem through agronomic maipulations. Advance seeding by broadcast or drilling in lines before onset of flood is practiced to get better initial crop establishment. But early and continuous flood occurence causes complete destruction of crop sown before flood. Sowing by broadcast gives poor yield than drilling in lines. Under such circumstance, use of aged seedling in such areas can be considered as one of the agronomic practices resulting at least some yield against the complete failure of crop. Nitrogen plays an important role in crop production (Jain, 1984). The current soaring prices of N fertilizer and its inadequate availability warrant the most judicious and efficient use of N (Singh *et al.*, 1990). Nitrogen requirement may however differs under various seeding methods. Hence an experiment was conducted to find out the yield potential of different seeding methods and levels of N in flood-prone areas.

MATERIALS AND METHODS

A field experiment was conducted during the wet seasons of 1989 and 1991 at Ghaghraghat. Treatments consisted of 3 methods (broadcasting, drilling in lines and transplanting) and 4 nitrogen levels (0, 20,

Table 1. Yield and yield attributes of rice as affected by method of seeding and level of nitrogen

Treatment	Panicles/ m^2		Panicle length (cm)		Panicle weight (g)		1,000-grain weight (g)		Plant height (cm)		Grain yield (q/ha)		
	1989	1991	1989	1991	1989	1991	1989	1991	1989	1991	1989	1991	Mean
Method of seeding													
Broadcasting	127	135	18.8	19.2	1.96	1.98	22.7	23.1	76.1	76.3	21.52	25.97	23.75
Drilling (lines)	141	149	20.3	22.5	2.40	2.48	23.3	23.7	90.9	91.5	26.84	30.36	28.60
Transplanting	137	145	19.9	20.7	2.21	2.29	22.8	23.2	85.7	87.9	25.46	29.27	27.36
CD (P = 0.05)	5	4	0.4	0.3	0.19	0.15	0.4	0.4	5.9	6.3	0.98	0.44	0.75
N (kg/ha)													
Control	98	108	21.9	23.5	1.91	1.97	20.6	21.0	81.8	82.2	16.94	19.10	18.02
20	122	128	23.6	24.0	2.31	2.35	22.1	22.5	84.2	84.4	23.44	26.58	25.01
40	153	161	24.3	24.5	2.39	2.41	23.3	23.7	85.8	86.0	28.62	33.98	31.30
60	162	172	24.7	25.1	2.43	2.45	23.5	23.9	88.0	88.2	29.06	34.48	31.77
CD (P = 0.05)	8	10	0.5	0.6	0.58	0.60	0.4	0.6	1.3	1.5	1.13	0.51	0.87

40 and 60 kg/ha). The experiment was laid out in randomized block design with 3 replications. The site was sandy-clay loam with pH 8.2, organic carbon 0.38% and available P_2O_5 and K_2O 24.1 and 298 kg/ha respectively. Variety 'Madhukar' was direct-seeded in rows 20 cm apart and broadcast on 22 June in both years. Sowing of nursery for transplanting was done on the same day to maintain the uniformity in age of rice seedlings. Transplanting was done at 20 cm × 15 cm hill spacing using 4–5 seedlings/hill on 14 August in both the years. Nitrogen was applied as per treatments in 3 splits, one-third N at sowing + one-third at tillering and one-third at panicle-initiation stage. A dose of 30 kg P_2O_5 and 20 kg K_2O/ha was applied basal to all plots. The crop received 698 and 531 mm rainfall during 1989 and 1991 respectively.

In 1989, first flood occurred on 30 July with maximum water depth 52 cm for 8 days, followed by 50 cm for 7 days on 2 August and 48 cm for 10 days on 28 August. However, 5 frequencies were observed in 1991 with highest peak of water 40 cm for 3 days on 10 September, followed by 37 cm for 4 days on 10 August, 35 cm for 6 days on 18 August, 31 cm for 3 days on 7 September and 27 cm for 2 days on 5 August.

RESULTS AND DISCUSSION

In general, grain yield and yield attributes were better in 1991 than in 1989, because sufficient time was available for proper crop establishment due to late occurrence and less depth of flood in 1991.

Effect of method of sowing

Direct-seeded crop in lines gave significantly higher grain and straw yields than broadcast and transplanted crop in both the years (Table 1). The increase in grain

Table 2. Grain yield (q/ha) as influenced by methods of seeding and level of nitrogen interaction

Method of seeding	N (kg/ha)									
	1989					1991				
	0	20	40	60	Mean	0	20	40	60	Mean
Broadcasting	14.73	20.18	25.26	25.96	21.52	16.12	23.91	31.69	32.19	25.97
Drilling (lines)	18.92	25.82	30.95	31.68	26.84	21.10	28.59	35.67	36.10	30.36
Transplanting	17.53	24.36	29.67	30.29	25.46	20.10	27.25	34.60	35.15	29.27
Mean	16.94	23.44	28.62	29.06		19.10	26.58	33.98	34.48	
	Methods of seeding (M)		*Nitrogen (N)*		*M × N*	*M*		*N*		*M × N*
CD (P = 0.05)	0.98		1.13		1.70	0.45		0.51		0.91

yield of line-sown crop was 17.0 and 4.3% compared with the crop sown by broadcast and transplanted method respectively. The yield attributes, (panicles/m^2, panicle length, panicle weight, 1,000-grain weight and plant height) were superior with line-sown crop which resulted in higher grain yield. However, transplanted crop showed poor vigour of seedlings due to uplifting shock, or root penetration due to hard soil and poor growth, yield attributes and less grain yield due to re-flooding after transplanting compared with well-established direct-seeded crop in lines. Besides, uneven distribution of seeds and improper depth of sowing reduced the initial plants per unit area, which had left sufficient space to grow weeds in very initial stage, resulting in poor yield attributes and yield than both of direct-seeding in lines and transplanted crop.

Effect of nitrogen

Application of 60 kg N/ha being on a par with 40 kg N/ha gave significantly highest grain yield than 20 kg N/ha and the control in both years. The improvement in yield attributes (panicles/m^2, panicle length, panicle weight and 1,000-grain weight) was mainly responsible for higher yield with supply of nitrogen. Similar trend of results was observed by Agarwal *et al.* (1985). The mean response of grain yield to N was the highest (34.9 kg grain/kg N) with 20 kg N/ha and reduced as the level of N was enhanced to 40–60 kg/ha. The interaction of methods of seeding and levels of N could menifested its significant effect on grain yield in both the years. Significant improvement in grain yield was observed only up to 40 kg N/ha with all sowing methods. Yield obtained with drilling in lines or transplanting at 40 kg N/ha was equivalent to that obtained by broadcasting methods with application of 60 kg N/ha in both the years. Significantly maximum grain yield was obtained by drilling seeds in lines and fertilized with 60 kg N/ha, followed by transplanted crop at same level of fertility.

The relationship of grain yield and N levels was quadratic in nature and the equations obtained on pooled data of both years were:

$$Y = 15.12 + 9.25\,X - 1.51\,X^2 \text{ (broadcasting)}$$
$$Y = 19.77 + 9.74\,X - 1.66\,X^2 \text{ (drilling)}$$
$$Y = 19.23 + 9.62\,X - 1.61\,X^2 \text{ (transplanting)}$$

The optimum economic dose of N was 38.20, 37.74 and 37.86 kg/ha for broadcasting, drilling and transplanting respectively.

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