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Effect of blue green algae, nitrogen levels and modified urea materials on yield attributes and yield of wetland rice (*Oryza sativa*)

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ABSTRACT

A field experiment was carried out during the rainy season (July–October) of 1990 and 1991 at New Delhi, to study the combined effect of slow-release nitrogen fertilizers and blue green algae on the grain and straw yields of rice (*Oryza sativa* L.). The application of urea supergranules and dicyandiamide-coated urea at 80 kg N/ha resulted a nitrogen economy of 21 and 24 kg N/ha respectively in rice with algal inoculation and 38 and 44 kg N/ha respectively without algal inoculation.

Dwarf, high-yielding varieties of rice (*Oryza sativa* L.) are highly nitrogen responsive and have increased fertilizer N demands. The current trend in fertilization of N research is to develop more efficient modified urea fertilizers for minimizing N losses. Nitrogen inhibitor dicyandiamide for blending urea has shown some promise (Vilsmeier, 1980; Amberger, 1981). Similarly, urea supergranules (USG) show higher efficiency than the prilled urea (Singh *et al.*, 1989; Prasad *et al.*, 1990).

The standing water in wetland conditions of rice-growing areas encourages the growth of blue green algae. The analysis of the blue green algae from rice fields in India shows the occurrence of some dominant nitrogen fixers. Besides fixing nitrogen, these algae exerete vitamin B_{12}, ascorbic acid and auxins, which may also improve the growth of rice plants.

The present investigation was therefore taken up to study the effects of modified urea materials with and without inoculation of blue-green algae in rice culture.

MATERIALS AND METHODS

The field experiment was conducted at the Indian Agricultural Research Institute, New Delhi, during the rainy season (July–October) of 1990 and 1991 on a clay soil of pH 7.7 (soil : solution ratio 1 : 2.5), organic carbon 0.52% and total kjeldahl N 0.06%. The experimental design was a split plot with 3 replications. The treatments consisted of the control and blue green algae inoculation applied in main plots and fertilizer N treatments in subplots. The subplot treatments comprised 4 levels (0, 40, 80 and 120 kg N/ha) as prilled urea and 2 modified urea materials [urea supergranules (USG) and dicyandiamide (DCD)-coated urea] at 80 kg N/ha.

A soil-based composite culture of blue green algae obtained from National Facility for Blue Green Algal Collections, IARI, New Delhi, was applied @ 15 kg/ha twice during the crop-growth period first 10 days after transplanting (DAT) and second 30 DAT. The DCD-treated urea was prepared by blending the urea with dicyandiamide

Table 1. Effect of blue green algae (BGA), levels and source of nitrogen on plant hight and yield-contributing characters of rice (pooled data of 1990 and 1991)

Treatment	Plant hight (cm)	Panicles/ hill	Filled grains/panicle	Panicle length (cm)	Panicle weight (g)	1,000-grain weight (g)
BGA inoculation						
No BGA	72.8	7.4	99.4	18.1	2.28	17.4
BGA	76.3	8.2	104.6	18.8	2.34	17.8
LSD (P = 0.05)	0.70	0.11	1.93	0.21	0.021	0.07
N (kg/ha)						
0	70.8	7.4	82.2	16.6	2.19	17.1
40	72.8	7.9	98.0	17.6	2.25	17.4
80	75.3	7.9	104.9	18.7	2.31	17.5
120	77.4	8.3	111.2	19.7	2.42	18.1
LSD (P = 0.05)	1.26	0.08	1.92	0.17	0.016	0.09
N source applied at 80 kg N/ha						
PU	75.3	7.9	104.9	18.7	2.31	17.5
DCU	75.0	8.1	106.0	19.0	2.33	17.7
USG	76.1	8.2	107.6	19.2	2.35	17.8
LSD (P = 0.05)	NS	0.08	1.92	0.17	0.016	0.09

(DCD) in 93 : 7 ratio using linseed oil (2 ml/ 100 g urea) as a sticker. The N treatments were imposed in 2 splits; half at 10 DAT and the rest half at 30 DAT. All plots were given 50 kg P_2O_5/ha and 50 kg K_2O/ha as single superphosphate and muriate of potash respectively.

The land was prepared for transplanting by flooding the field with water and followed by puddling and planking 3 times continously for 3 days. Rice ('Pusa 169') seedlings of 28 days age were transplanted in the second–third week of July. The plots were irrigated twice a week until the grain-filling stage and then once a week up to 10 days before harvesting. Rice crop was harvested in the last week of October in both the years.

RESULTS AND DICUSSION

Yield attributes

The algal inoculation increased the plant height at the time of harvest and other yield-

Table 2. Effect of blue green algae (BGA), levels and sources of nitrogen on straw and grain yields of rice (pooled data of 1990 and 1991)

Treatment	Straw yield (q/ha)	Grain yield (q/ha)
BGA inoculation		
No BGA	55.1	40.0
BGA	60.3	43.1
LSD (P = 0.05)	4.07	2.92
N (kg/ha)		
0	48.3	31.4
40	53.7	34.3
80	57.4	41.4
120	64.5	48.6
LSD (P = 0.05)	4.36	3.21
N source applied at 80 kg N/ha		
PU	57.4	41.4
DCU	60.4	46.8
USG	61.1	46.8
LSD (P = 0.05)	NS	3.21

attributing characters, viz. panicles/hill, filled grains/panicle, panicle length, panicle weight and 1,000-grain weight, significantly over no inoculation. Increasing the levels of fertilizer N significantly improved all the yield attributes except panicle length and 1,000-grain weight. Among the sources of N, USG and DCU produced significantly more panicles/hill, filled grains/panicle and panicle weight than prilled urea.

Yield of rice

The BGA inoculation increased grain and straw yields of rice by 3 and 5 q/ha over no inoculation (Table 2). There was a significant increase in the grain and straw yields

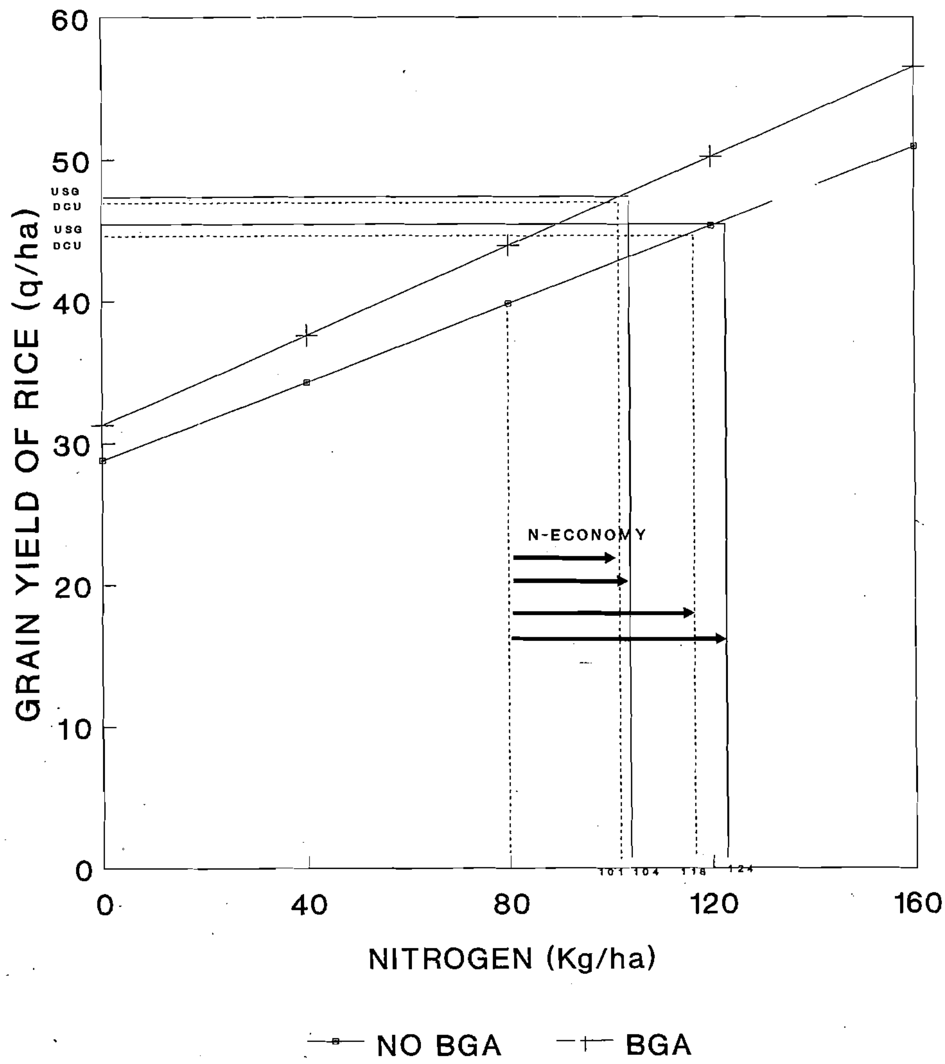

Fig. 1. Response of rice to nitrogen

of rice with an increase in level of nitrogen. The response of grain yield to urea N was linear up to 120 kg N/ha with and without algal inoculation (Fig. 1). Since the grain yield of rice with USG and DCU was significantly more than the yield obtained with prilled urea at 80 kg N/ha, the nitrogen economy by USG and DCU was worked out by putting the grain yield of rice obtained with 80 kg N/ha as USG and DCU in linear model equation, Y = a + bx fitted for grain yield obtained with different levels of N as prilled urea. It was estimated that yield obtained with 80 kg N/ha as USG and DCU was equal to that predicted with 101 and 104 kg N/ha as prilled urea with algal inoculation respectively. Similarly, in the absence of algal inoculation, the grain yield of rice with 80 kg N/ha as USG and DCU was equal to that predicted with 118 and 124 kg N/ha as prilled urea respectively.

Thus application of USG and DCU at 80 kg N/ha resulted a nitrogen economy of 21 and 24 kg N/ha respectively in rice with algal inoculation, whereas the nitrogen economy of 38 and 44 kg N/ha recorded was without algal inoculation.

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