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Effect of water regime, variety and blue-green algae on rice (*Oryza sativa*)

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ABSTRACT

An experiment was conducted during the rainy season of 1992 and 1993 to find out the effect of water regime, variety and biofertilizer (blue-green algae) on rice (*Oryza sativa* L.) yield. The results indicated that the water management practice of saturation till tillering and submergence till ripening recorded significantly higher grain yield as well as water-use efficiency (WUE) compared with other treatments except continuous submergence system. Cultivar 'Kranti' gave considerably more grain yield and recorded higher value of WUE than 'IR 36'. Application of blue-green algae was found better in respect of grain yield and WUE over its control. Increase in yield by saturation till tillering and submergence till ripening, 'Kranti' and BGA were due to the improvement in yield attributes of rice.

***Key words*:** Rice, Water-use efficiency, Blue-green algae

Rice productivity can be made more economical if water-management practice is adopted judiciously. Maintenance of shallow depth of submergence after transplanting has been argued to be conducive to higher yields (Lenka, 1971). Similarly, the main reason of low yield is non-availability of suitable variety for a particular agroclimate under intensive cultivation. Use of biofertilizers, being an exploitation of renewable source of energy, is to be encouraged when the whole world is facing an energy crisis. Therefore, the present investigation was conducted to evaluate the effect of water regime, variety and blue-green algae on transplanted rice.

MATERIALS AND METHODS

The field experiment was conducted at Baronda Farm, Raipur (M.P.) in the *kharif* season of 1992 and 1993. The soil was well-drained loam being low in nitrogen, medium in phosphorus and high in potassium content. The reaction of soil was neutral.

The experiment was laid out in split-plot design with 3 replications. Water regimes

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(M_1 = Continuous saturation, M_2 = Continuous submergence, M_3= Saturation till flowering and submergence till ripening, M_5 = Submergence till tillering and saturation till ripening, and M_6 = Submergence till flowering and saturation till ripening) were assigned to main plots. The crop variety ('Kranti' and 'IR-36') and blue-green algae (0 and 10 kg/ha) treatments were assigned to sub-plots. A uniform dose of P_2O_5 and K_2O @ 50 and 25 kg/ha respectively and half dose of 50 kg N/ha were applied basal to all the treatments. The remaining 50 kg N was top-dressed in 2 equal splits, at tillering and panicle-initiation stages. Rice was transplanted in the middle of July at the rate of 2 seedlings per hill adopting 20 × 10 cm spacing. Under submergence treatment, 5 ± 2 cm water was maintained, while in saturation the excess water was drained off to maintain water required to saturate the soil.

RESULTS AND DISCUSSION

Effect of water regimes

Water regimes affected the grain yield of rice significantly (Table 1). Saturation till tillering and submergence till ripening (M_3) gave the highest grain yield compared with all other treatments except the treatment of continuous submergence (M_2) in both the years of experiment as well as in pooled mean. The straw yield, 1,000-grain weight, number of filled grains/panicle and effective tillers/plant also showed similar observations. However, results show that moisture regimes had no effect on plant height. The enhanced grain yield with M_3 was due to increased yield attributes. Secondly, this treatment might be favourably influencing the chemical environment of rice roots due to change in physico-biochemical properties of soil system. These results are in conformity with the findings of Reddy and Raju (1987), Saikia and Dutta (1989) and Raju *et al.* (1992). Further, the yield data revealed that it was not always necessary to follow continuous submergence, especially in the wet season when the humidity is high and evaporative demands are low.

Water-management system of continuous submergence (M_2) required maximum quantity of water (1,535 mm) without any significant increase in grain yield than M_3 (1,340 mm). Its WUE was also lowest (2.6 kg/ha-mm) compared with that of all other treatments. This indicated that the continuous submergence of water is needed only at certain growth stages and not throughout the crop period. The lowest yield obtained with saturation till flowering and submergence till ripening (M_4) showed that submergence after flowering did not benefit much. Further, the WUE was maximum (3.08 kg/ha-mm) in M_3 followed by continuous saturation (3.04 kg/ha-mm). It means, that higher WUE can be obtained even under continuous saturated condition.

Effect of varieties

Rice variety 'Kranti' produced significantly higher grain and straw yield than 'IR 36' during both the years. The mean yield increase with 'Kranti' over 'IR 36' was 7.1 and 10.0% for grain and straw respectively. Variety 'Kranti' showed superiority over 'IR 36' due to production of taller plants, more number of tillers and heavier grain weight as well as stiff straw (Table 1).

Table 1. Growth-yield components and yield of rice as influenced by water regime, variety and blue-green algae

Treatment	1992						1993						Pooled yield (q/ha)		Mean data on	
	Plant height (cm)	Effective tillers/ plant	Filled grains/ panicle	1,000-grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Plant height (cm)	Effective tillers/ plant	Filled grains/ panicle	1,000-grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Grain	Straw	Water used (mm/ha)	WUE (kg grain/ ha-mm)
Water regime																
M_1	73	6.4	75.2	23.7	33.1	36.9	74	7.5	78.2	23.6	34.4	41.2	33.7	39.0	1,110	3.04
M_2	76	7.8	81.8	24.8	39.3	45.9	77	8.1	85.8	25.0	40.5	46.6	39.9	46.2	1,535	2.60
M_3	77	8.1	82.2	25.3	40.5	46.6	78	8.5	87.7	25.5	42.2	48.5	41.3	47.5	1,340	3.08
M_4	72	6.1	72.1	23.2	31.8	34.9	76	7.2	75.5	23.3	33.3	39.9	32.5	37.4	1,212	2.68
M_5	75	7.1	78.5	23.9	36.7	41.8	75	7.9	81.5	24.1	37.5	44.2	37.1	43.0	1,307	2.84
M_6	76	7.2	78.7	24.4	37.8	43.8	75	8.0	82.4	24.4	38.0	44.8	37.9	44.3	1,391	2.72
CD (P =0.05)	NS	0.5	3.1	0.3	2.5	2.8	NS	0.3	3.3	0.3	2.4	3.1	2.3	2.9	-	-
Variety																
'Kranti'	78	8.1	78.3	25.2	38.5	45.6	80	7.7	81.2	25.3	39.7	46.5	39.1	46.0	1,304	3.01
'IR 36'	74	7.5	82.4	23.1	36.2	41.4	73	7.4	83.7	23.3	36.8	42.3	36.5	41.8	1,240	2.94
CD (P=0.05)	3	0.3	2.0	0.2	2.1	2.5	3	0.2	2.2	0.2	1.9	3.0	2.1	2.8	-	-
Blue-green algae																
Control	75	7.2	80.2	26.2	35.4	41.4	72	7.3	81.7	26.1	36.6	41.7	36.0	41.5	1,302	2.76
10 kg/ha	78	7.9	81.7	26.4	37.9	44.3	76	7.8	82.2	26.4	38.3	44.6	38.1	44.4	1,247	3.05
CD (P=0.05)	2	0.4	NS	0.2	2.3	2.4	3	0.3	NS	0.2	1.6	2.2	1.9	2.2	-	-

However, the number of filled grains/panicle was more in 'IR 36'. The variation in yield parameters and finally in yield can be attributed to genetical variations among the varieties (Babu, 1987; Thakur, 1993; Rao and Kumar, 1994).

There was a saving of 5.2% water by adopting rice 'IR 36' (1,240 mm) compared with the quantum of water used for 'Kranti' (1,304 mm). However, the WUE was more in 'Kranti' (3.01 kg/ha-mm) than 'IR 36' (2.94 kg/ha-mm). This indicates that the physical water-use efficiency is higher in 'Kranti' for realizing the maximum yield.

Effect of blue-green algae

Application of blue-green algae increased the grain and straw yields significantly over its control. BGA showed 7.1 and 4.6% increase in grain and, 7.0 and 6.9% in straw yield over no BGA during 1992 and 1993 respectively. The enhanced grain yield with blue-green algae was due to increased growth-yield components (Table 1). This showed that BGA incorporation provided continuous supply of N to the crop through mineralization of organic nitrogen for higher yield. Suri and Puri (1994), Gopalaswamy *et al.* (1997) and Patel (1998) also reported that algalization of rice increased the grain yield. However, blue-green algae did not affect filled grains/panicle.

The water requirement under BGA application was less (1,247 mm) compared with its control (1,302 mm). This may be due to low evapotranspiration loss of water with shading effect of BGA on rice field. Similarly, grain yield obtained per unit area per unit quantity of water was higher with BGA (3.05 kg/ha-mm) than in the control (2.76). This emphasizes the necessity of application of BGA for obtaining higher yield under low-water condition.

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