INDIVIDUAL AND COMBINED EFFECT OF BACTERIAL AND ALGAL INOCULATION ON THE YIELD OF RICE

RICE field soil is a most efficient non-symbiotic nitrogen fixing ecosystem since its daily integrated nitrogen fixation is of the same order of magnitude as that of a symbiotic system. In submerged rice soils, biological nitrogen fixation is essentially an algal process[1] and artificial inoculation of the rice field soils with blue-green algae has been repeatedly found to benefit the rice crop both in terms of crop nutrition and productivity[2]. This preliminary communication deals with the effect of the commercial inocula of *Azotobacter chroococcum* and blue-green algae (obtained from Bafelab, Poona) on the growth and yield of two varieties of rice (Jaya and Tella Hamsa) under field conditions during June to November, 1975.

The experiment was laid out on a split plot design in plots of 3·75 × 2·8 m with 16 main treatments involving four levels of nitrogen (0, 50, 100, 150 kg N/ha) in the form of urea and four treatments involving (*i*) no culture, (*ii*) *A. choococcum,* (*iii*) blue-green algae and (*iv*) combination of *A. chrococcum* and blue green algae and sub treatments involving 2 varieties (Jaya and Tella Hamsa). Both the bacterial and blue-green inocula were suspended in water (600 gm in 6 litres of water) and the roots of 30 days old rice seedlings were dipped in them and transplanted in the experimental plots. The remaining portions of the inocula (@ 10 kg/ha) were sprinkled over the standing water in the respective plots, one week after transplantation.

Table I shows the influence of the inocula on plant characters. *A. chrococcum* and blue-green algae alone significantly increased the number of effective tillers over no inoculation series. Although the panicle length and number of filled grains did not significantly differ between the *A. chroococcum* and blue-green algae treatments, these characters were strikingly influenced by the combined effect of *A. chroococcum* and blue-green algae. Individual application of *A. chroococcum* or blue-green algae resulted in the increase of 14–15% in the number of filled grains over the uninoculated series, while the combined inoculation of *A. chroococcum* and blue-green algae further increased it by 4–5% over the individual inoculation. Similar trend was observed with regard to the straw yield also.

TABLE I

Straw yield, effective tiller, panicle length, number of filled grains/panicle and test weight under different culture treatments

Cultures	Mean of two varieties under 4 nitrogen levels				
	Straw yield (q/ha)	Effective tillers (M^2)	Panicle length (cm)	No. of filled grains	Test weight (gms)
No culture	$48·6_c$	$334·5_d$	$19·96_c$	$85·75_c$	$22·55_c$
A. chroococcum	$55·6_b$	$345·3_c$	$20·65_b$	$97·95_b$	$23·30_b$
Blue-green algae	$58·3_b$	$356·5_b$	$20·80_b$	$99·17_b$	$23·39_{ab}$
Azo + B.G.A.	$63·5_a$	$371·5_a$	$21·20_a$	$104·08_a$	$23·68_a$
$C.D._{0·05}$	3·52	10·30	0·31	4·20	0·314

In terms of grain yield, both the rice varieties significantly responded to increasing levels of nitrogen, although Jaya was more yielding than Tella Hamsa (Table II). While the application of *A. chroococcum* or blue-green algae significantly increased the grain yield over the uninoculated series, a combination of the two was better than the individual effect. The observed non-significant interaction between nitrogen and culture indicated the uniform beneficial effect of the cultures at every level of nitrogen. Besides nitrogen fixation, the complementing effect of growth substances produced by these microorganisms may be responsible for the combined effect of Azotobacter and blue-green algae. In the rice field ecosystem involving Azotobacter and blue-green algae, the requirements of the different components could be visua-

TABLE II

Grain yield of rice (q/ha) under nitrogen levels, cultures and varieties

Cultures	Nitrogen levels kgs/ha								
	0		50		100		150		
	T.H.	JAYA	T.H.	JAYA	T.H.	JAYA	T.H.	JAYA	Mean
No culture	36·36	39·22	46·40	49·92	53·06	65·26	58·44	73·94	$52·8_c$
A. chroococcum	42·66	46·34	52·62	60·46	58·04	70·36	60·44	76·58	$58·4_b$
Blue-green algae	44·34	45·78	54·86	59·96	60·36	72·96	65·22	79·24	$60·4_b$
Azo + B.G.A.	50·40	52·12	58·04	65·60	63·40	75·74	66·86	79·56	$63·8_a$
Mean (V × N)	43·40	45·60	52·80	59·00	58·80	71·09	62·60	77·20	
Mean (N)	44·06		56·00		64·80		70·00		

Varieties· Tella Hamsa (T.H.)—54·46 Jaya—63·30.

Results of statistical analysis

Source of variation	*Significance* (5%)	$C.D._{0.05}$
Nitrogen levels	Highly signifi ant	3·2
Cultures	Significant	3·2
Nitrogen × cultures	Not-significant	..
Varieties	Significant	1·8
Varieties × Nitrogen	Significant	3·6
Varieties × cultures	Not significant	..
Varieties × Nitrogen × culture	Not significant	..

lised to take place through a recycling machanism as suggested by Venkataraman and Neelakantan[3].

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STOMATA IN *OPHIOGLOSSUM PALMATUM* L.

THE epidermal structure of the Indian species of *Ophioglossum* was briefly described by Mahabale[1], Pant and Khare[2] have studied the mode of development of stomata in four species of *Ophioglossum* and also in *Botrychium* and *Helminthostachys*. But as far as known, the epidermal features, which are being described here under, of *O. palmatum* are completely unknown. Statistical data on stomal index and other aspects are given for the first time.

The plants of *O. palmatum* (epiphytic gaint species) were obtained from U.S.A. (Fig. 1). Other species of *Ophioglossum* described in this paper were collected from several localities from Central India : *viz.*, Gwalior, Shivpuri, Narsinghgarh, Rewa, Ambikapur, Jagdalpur, Varanasi and Nainital. Excursion to these places have yielded eight species of the genus, *viz.*, *O. costatum* R. Br., *O. nudicaule* L., *O. petiolatum* Hook., *O. lusitanicum* L., *O. gramineum* Willd., *O. polyphyllum*. A. Braun apud Seubert, *O. vulgatum* L. and *O. costonudum* n. sp. Goswami and Khandelwal. The plants of *Botrychium* Swartz and *Helminthostachys* Kaulfuss were collected from Nainital and Gorakhpur respectively.

Epidermal features from mature leaves were studied from peels of the central portion. The peels were obtained by heating the material at 60° C for 15 to 30 minutes in the mixture of hydrogen peroxide, acetic acid water (4 : 4: 2 parts respectively). These were then stained with hematoxylin and mounted in glycerine.