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Response of soybean to rhizobial inoculation, liming and nutritional management

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ABSTRACT

Field investigation conducted in the district of Bankura (West Bengal) during *kharif* 1998 and 1999 showed that application of B (10 kg ha^{-1} of Borax) and Mo (10 kg ha^{-1} of Sodium molibdate) along with recommended levels of NPK (20-40-40 kg ha^{-1}) after liming the soil and seed inoculation with *Rhizobium* resulted in maximum seed yield, oil content in seed and nodulation in soybean. The crop, however, showed greater response to Mo than to B. Rhizobial inoculation could increase seed yield by 20.71% over un-inoculated control. Liming also tended to exhibit better nodulation and higher seed yield with more oil content than control.

***Key words*:** rhizobial inoculation, liming, nutritional management, soybean

Several constraints affecting soybean productivity have been identified. Nutritional management is one such area, where adequate emphasis has not been laid out. *Rhizobium* inoculation has also been considered as an important factor for increasing yield. Besides, good response to liming in soybean has been reported in acid soils (Chatterjee *et al.,* 1972). Application of B and Mo in deficient soils also increases the seed yield of soybean (Chandel *et al.*, 1989). With this background a study was conducted to evaluate the effect of micro-and macro-nutrients along with *Rhizobium* inoculation and liming on the field performance of soybean.

MATERIALS AND METHODS

An on-farm trial was conducted at the village Bhustora under Barjora block in Bankura, West Bengal during *kharif* 1998 and 1999. The soil belonged to alfisols with sandy loam texture, pH 6.0, organic carbon 0.46%, total N 0.045%, available P_2O_5 and K2O of 11.70 and 86.00 kg ha^{-1}, respectively. The initial B and Mo content of the experimental soil were found to be 0.28 ppm and 0.024 µg g^{-1}, respectively. The experiment consisted of 7 treatments (Table 1) replicated thrice in a randomized block design. Soybean variety PK 327 was sown during first week of July at a spacing of 30 cm x 15 cm in plots of 5 m x 3 m during both the years of experimentation. Recommended levels of NPK (20 : 40 : 40 kg N : P_2O_5 : K_2O hectare^{-1}) were applied uniformly as basal to all the plots. Seeds were inoculated as per the treatment schedule with *Rhizobium japonicum* culture at the rate of 0.5 kg for 75 kg soybean seed. Lime was applied a month before sowing at 2 t ha^{-1}. Micronutrients viz., boron as borax (10.5% B) and molybdenum as sodium molybdate (9.2% Mo) were applied basally and incorporated into 0-15 cm top soil in pertinent plots with the help of spade. The crop was harvested at the end of October during both the year of experimentation. Observations on nodulation, seed yield and seed oil content was recorded.

RESULTS AND DISCUSSION

Seed inoculation with *Rhizobium* culture improved the yield of soybean to the extent of 17.6% over un-inoculated control (Table 1). This was due to better nodulation (Table 1), resulting in an increase nitrogen fixation in the soil. Thus, the higher N availability to the plants might have resulted in increased photosynthesis and finally the yield. Field response of some other pulses to rhizobial inoculation was earlier reported by Tilak (1998).

Application of lime significantly effected nodulation both at 50 DAS and at harvest (Table 1). Though liming tended to give higher seed yield and seed oil content, the

Table 1 Effect of inoculation, liming and micronutrients on nodulation, seed yield and oil content of soybean

Treatment	Number of nodules per plant						Seed yield (kg ha^{-1})			Oil content in seed (%)		
	50 DAS			At harvest								
	1998	1999	Mean	1998	1999	Mean	1998	1999	Mean	1998	1999	Mean
Control	56.60	70.75	63.67	80.99	64.79	72.33	1593	1540	1566	19.60	19.79	19.70
Inoculation	71.99	89.98	80.99	104.23	84.24	92.61	1823	1858	1841	20.10	20.3	20.20
Inoculation + Liming	74.63	90.09	82.36	105.30	83.39	93.83	1926	2065	1995	20.20	20.4	20.30
Inoculation + B	72.07	93.29	82.68	107.05	86.66	94.87	2025	1964	1994	21.40	21.66	21.53
Inoculation + Mo	77.05	96.31	86.68	108.32	85.64	97.50	2166	2180	2173	21.60	21.85	21.73
Liming + B + Mo	75.53	94.41	84.97	107.39	85.91	96.18	2138	2209	2174	21.30	21.51	21.41
Inoculation + Liming + B + Mo	79.04	98.81	88.93	109.17	87.34	99.05	2360	2407	2383	22.10	22.32	22.21
CD (P = 0.05)	11.70	14.63	-	12.34	8.27	-	572	583	-	0.83	0.84	-

DAS : Days after sowing
B : Borax ($Na_2B_4O_7$,10 H_2O) @ 10.0 kg ha^{-1}
Mo : Sodium molybdate (Na_2MoO_4, 2 H_2O) @ 2.0 kg ha^{-1}

response was not significant when compared with the control treatment. Jeswani and Baldev (1997) pointed out that liming is an important practice for the production of pulses, especially in the lateritic acid soils.

Nodulation and seed yield of soybean increased appreciably due to supply of molybdenum as compared to no application (Table 1). The beneficial effect of Mo on seed yield might be due to increased nitrogenase activity of root nodules, which is responsible for enhanced microbial N-fixation, thereby increasing nitrogen availability to plants. Deng (1990) and Dadhich *et al.* (2001) opined in the same way. Boron also exerted an enhanced influence on nodulation. Schon and Blevin (1990) reported that boron application increased all the yield attributes and yield *of* soybean. Further, the response was greater with dual application of B and Mo. However, the effect of Mo was more pronounced as compared to B.

The results clearly revealed that addition of B and Mo after liming the soil and inoculating the seed produced the highest yield of soybean as compared to these micronutrient applications without lime and/or inoculation.

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