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Influence of single and Multistrain Rhizobial Inoculants on Nodulation, Yield and Nitrogen Assimilation by Greengram (*Phaseolus aureus* Roxb)

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Field perfomance of the rhizobial inoculants, GG-2, GMBS-1, BMBS-P47 and an equal mixture of these three strains (multistrain inoculant) were studied in greengram at Coimbatore and Kaveripattinam under rainfed conditions and Bhavanisagar under irrigated condition. The nodulation, yield and nitrogen assimilation responses of greengram were observed. At all the three locations, the multistrain rhizobial inoculant performed better with significance. They produced more number of nodules per plant, higher grain yield and more nitrogen assimilation than the uninoculated control and the single strain rhizobial inoculants.

It is needless to emphasise the role of rhizobial seed inoculants in increasing the yield of pulse crops. There are several reports indicating the beneficial effects of seed inoculation with specific *Rhizobium* in enhancing nodulation, nitrogen fixation and yield of the common pulse crops of India (Rangaswami and Oblisami, 1962; Ramasami and Nair, 1965; Sundara Rao, 1971 and Oblisami, *et al.*, 1976). However, the performance of individual rhizobial strains is known to vary under different agroclimatic conditions. It is suggested that such limitation could be overcome by making use of multistrain (mixture of different efficient strains of the same inoculation group) inoculants (Vincent, 1970). In this paper, the effect of a multistrain rhizobial inoculant *vis a vis* the individual strains for greengram, on nodulation, nitrogen fixation and seed yield, in a multilocation field trail is reported.

MATERIAL AND METHODS

Three effective rhizobial strains for greengram (CO 3) *viz.*, GG-2, GMBS-1 and BMBS-P47 selected from several screening trials were multiplied separately in broth culture and peat-based inoculants were prepared following the procedure of Vincent (1970). A multistrain inoculant, mixing equal proportion of the broth cultures of the above three rhizobia in peat soil was also prepared in the same manner. The seed treatment with the rhizobial inoculants was carried out prior to sowing using 2·5 per cent jaggary solution as binding material.

The field trials were laid out at three different locations *viz.*, 1. Coimbatore (rainfed, loamy soil), 2. Kaveripattinam (rainfed, sandy soil) and 3. Bhavanisagar (irrigated, sandy loam soil) in plots of 8 m² with four

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TABLE I Influence of single and multistrain rhizobial inoculants on nodulation in greengram (Co. 3) at different locations.

Rhizobial inoculant	Coimbatore		Kaveripattinam		Bhavanisagar	
	Nodule (No/plant)	Nodule weight (mg/plant)	Nodule (No/plant)	Nodule weight (mg/plant)	Nodule (No/plant)	Nodule weight (mg/plant)
GG-2	4.25	16.25	21.0	137	19.6	157
GMBS-1	4.4	26.0	18.3	133	21.4	159
BMBS-P47	4.8	29.0	17.5	139	20.9	132
Multistrain	7.0	36.25	26.8	206	24 5	182
No inoculation	1.75	10.5	10.4	79	12.8	92
Conclusion:						
Significance (P=0.05)	*	*	*	*	*	*
CD	3.81	6.34	2.1	11.65	4.74	33.8
CV%	19.02	20.02	18.8	25.60	17.81	16.91

replications in completely randomised (design).

Five plants were carefully uprooted on the 45th day of growth and the number of nodules and their dry weight were recorded. At harvest the seed yield and dry matter production were recorded separately. Total nitrogen content of the seed and the dry matter were determined following the method of Bremner (1960), from which the total nitrogen and protein assimilated were computed.

RESULTS AND DISCUSSION

Although the number of root nodules per plant as well as the weight of nodules varied with the locations, the rhizobial seed treatments enhanced them considerably, the increase being highly significant especially with the multistrain treatment compared with the untreated control (Table I). The increase in nodulation observed at Kaveripattinam (rainfed) and Bhavanisagar (irrigated) may be due to favourable soil and climatic conditions.

Both seed yield and dry matter production varied with the location which may probably be due to the interaction between the genotype, soil and climatic conditions. Nevertheless, the rhizobial seed treatments invariably increased the seed yield, compared to the uninoculated control, except in the case of GG-2 inoculant at Kaveripattinam. Maximum increase in seed yield was recorded in all the three locations with the multistrain inoculant (Table II). Not only the total N content of the seeds

TABLE II Influence of single and multistrain rhizobial inoculant on yield and nitrogen assimilation in greengram (Co. 3) at different locations.

Rhizobial inoculants	Coimbatore (Rainfed)					Kaveripattinam (Rainfed)					Bhavanisagar (Irrigated)				
	Seed yield (kg/ha)	Yield increase over control	Dry matter production (Kg/ha)	Total N assimilated (Kg/ha)	Total protein production (Kg/ha)	Seed yield (Kg/ha)	Yield increase over control	Dry matter production (Kg/ha)	Total N assimilated (Kg/ha)	Total protein production (Kg/ha)	Seed yield (Kg/ha)	yield increase over control	Dry matter production (Kg/ha)	Total N protein production	Total protein production (Kg/ha)
GG-2	230	53.3	2126	40.15	250.94	381	—	1333	32.55	203.4	377	5.8	4912	85.28	533.0
GMBS-1	178	18.6	2128	37.22	232.72	476	20.2	15.5	36.93	230.80	502	41.0	4883	84.30	526.9
BMBS-P 47	178	18.6	2224	41.89	261.81	457	15.4	1418	36.66	229.12	444	24.7	4883	92.19	576.2
Multistrain	238	54.62	553	52.48	328.0	530	33.8	1557	46.30	289.3	543	52.55	321	108.91	680.68
No inoculation	150	—	2113	34.59	216.18	396	—	1233	29.95	187.2	356	—	5087	78.27	489.2
Conclusion :															
Significance		** (P=0.01)		* (P=0.05)		*		NS	**		NS				
CD		20.0		174		42.4		—	48.2		—				
CV%		8.7		10.4		13.5		—	13.3		—				

was enhanced due to the multistrain treatment compared with the single strains inoculants as well as the uninoculated check, but the total N fixed was also enhanced considerably irrespective of the location of the experiment, which resulted in remarkable increase in the total protein production per unit area. Increase in protein content of seeds produced from *Rhizobium* inoculated soybean plants has been recorded (Davidescu *et al.*, 1975).

The results, therefore, indicate that multistrain inoculant (containing effective strains of the same inoculation group) performed better than the single strain inoculants irrespective of the location. This may probably be due to the presence of more than one effective strain of rhizobia which perhaps provided safeguard against any loss of invasiveness in a particular culture or its inferior performance in certain situations, such as adverse soil or climatic conditions (Vincent, 1970 and Rangaswami, 1975). Such multistrain inoculants may also provide safeguard against loss of effectiveness in nitrogen fixation and possibly against phage infection (Vincent, 1970). However, the real reasons are yet to be explored.

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