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EFFECT OF COMBINED INOCULATION OF *Rhizobium sp* AND PHOSPHOBACTERIA AT DIFFERENT LEVELS OF PHOSPHORUS IN GROUNDNUT

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ABSTRACT

A field trial was conducted at the Agricultural Research Station, to study the effect of combined inoculation of *Rhizobium* strain Tt9 with a phosphobacterium, *Bacillus megaterium* var. *Phos phaticum* (PB 1) at different levels of phosphorus in groundnut (Co 1). Maxiumum crop growth, nodulation, plant dry weight and yield were obtained in treatments which received hundred per cent chemical fertilizer. The combined inoculation of *Rhizobium* and phosphobacteria at 50 per cent gave a comparable yield to 100 per cent phosphorus level with no bacterial inoculation indicating a saving of 50 per cent chemical fertilizer.

KEY WORDS : Rhizobium, Phosphobacteria, Combined Inoculation

The essential plant nutrient, Phosphorus, is present as insoluble inorganic and organic compounds in the soil. This is also true for cheap natural sources like rock phosphate, bone meal, basic slag which are being advocated in the event of acute shortage of chemical fertilizers. On the other hand, a large portion of the available phosphorus present in super phosphate and other chemical fertilizers is converted chemically and microbiologically to insoluble forms soon after application to soil. The problem of primary agricultural importance concerns the availability of all the cited insoluble forms of phosphorus to the plant roots. One group of microorganisms namely the phosphorus solubilizing microorganisms (PSM) play a major role in the solubilisation of insoluble phosphates mainly by production of organic acids like acetic, lactic, formic, gluconic acid etc. and bring them to solution (Sperber, 1958). Another group of workers (Sundara Rao, 1968; Hayman, 1975) presented evidance for the role of enzymes like phytases and phosphatases in bringing unavailable forms of phosphorus into solution.

Groundnut, is one of the major oil seed crops of Tamil Nadu. The increase in the yield of groundnut due to the symbiotic association of *Rhizobium* is well established. Combined inoculation of *Rhizobium* and phosphobacteria gave an enhanced yield in groundnut (Kundu and Gaur. (1980). In this study, an attempt was made to find out the role of dual inoculation of *Rhizobium* and phosphobacteria in saving chemical fertilize groundnut.

METERIALS AND MATHODS

A field trial was carried out at the Agricultu Research Station. Aliyarnagar, Coimbatc district to study the effect of selected *Rhizobi* strain Tt9 in association with Phosphoabacter *(Bacillus megaterium* var. *Phosphaticum)* (PB 1) groundnut variety Co. 1 at different levels phosphorus. The treatments details are as follows:

Phosphorus
No
Uninoculated control

Tt 9
PB 1
Tt 9 + PB 1

50 Per cent Phosphorus (17.5 kg super phosphate / ha
Uninoculated control
Tt 9
PB 1
Tt 9 + PB 1

100 Per cent Phosphorus (35 kg super phosphate / ha

Uninoculated control

Tt 9
PB 1
Tt 9 + PB 1

Table 1. Effect of combined inoculation of *Rhizobium* and phosphobacteria on the growth, nodulation, dry mattr yield, total nitrogen and phosphorus content of groundnut at 60 DAS

Treatments	Shoot length (cm)	Root length (cm)	Plant dry wt (g/pl)	Nodule number (No./pl)	Nodule dry wt (g/pl)	Total nitrogen (%)	Total phosphorus (%)
No phosphorus							
Uninoculated control	35.17	11.80	2.13	34.0	0.34	2.70	0.23
Tt9	40.32	11.66	3.40	52.0	0.57	2.91	0.23
PB-1	36.28	12.42	3.08	48.0	0.48	2.85	0.26
Tt9 + PB-1	42.10	12.70	3.44	52.6	0.60	2.92	0.25
50 per cent phosphorus							
Uninoculated control	40.46	13.05	3.18	49.0	0.49	2.89	0.25
Tt9	45.11	13.34	3.40	56.0	0.60	2.91	0.25
PB-1	46.95	12.74	3.46	51.0	0.51	2.89	0.28
Tt9 + PB-1	49.90	13.50	3.54	58.0	0.60	2.93	0.28
100 per cent phosphorus							
Uninoculated control	46.83	14.55	3.52	54.0	0.54	2.90	0.29
Tt9	48.81	15.21	3.58	58.0	0.63	2.92	0.28
PB-1	47.07	14.43	3.42	54.0	0.54	2.90	0.34
Tt9 + PB-1	51.50	15.65	3.64	60.0	0.61	2.95	0.34
CD (P = 0.05)	3.97	0.78	0.15	5.88	0.08	0.03	0.03

* - Values represent mean of three replications; DAS : Days after sowing

The treatments were replicated thrice in randomised block design. Seeds of groundnut were sown after seed bacterisation of the above treatments. For combined inoculation equal quantity of peat based inoculum (100 g each) of *Rhizobium* and phosphobacteria were used. Normal irrigation schedules and nitrogen and micronutrients doses were given.

Shoot length, root length, plant dry weight, nodule number, nodule dry weight, total nitrogen content, and total phosphorus content were estimated at peak crop growth stage (60 days after sowing). Pod yield, hundred pod weight, shellling percentage and 100 kernal weight were recorded at harvest.

RESULTS AND DISCUSSION

Individual inoculation of *Rhizobium* produced significantly better responses over unioculated control and phosphobacterial inoculation (Table 1). Maximum growth, nodule number, nodule dry weight (Table 1) plant dry weight, total N content and pod yield (Table 2) were obtained in treatments with 100 per cent P. Even while the crop response was maximum at 100 per cent P level, the crop response to combined inoculation of *Rhizobium* and phosphobacteria at 50 per cent P level were on par with uninoculated control at 100 per cent P level. These results indicated that a saving of 50 per cent inorganic phosphatic fertilizer on combined inoculation of *Rhizobium* and phosphabacteria. Other parameters such as 100 pod weight, kernal weight and shelling percentage did not exhibit a significant difference either to individual or combined inoculation (Table 2).

The increase in crop growth due to combined inoculation in the present study might be due to growth regulators produced by *Rhizobium* and *Bacillus* and also might be due to the solubilisation of insoluble phosphates by production of various organic acids by *B. megaterium* (Sperber, 1958). It has also been reported that plant hormones might play a role in the infection mechanism of *Rhizobium* (Nutman, 1965; Shena Khanova, 1979). Hence, the enhanced nodulation of ground nut also be attributed to the growth regulating substances produced by *Bacillus sp.*. Similar enhancement in the dry matter production by combined inoculation of phosphate solubilising and nitrogen fixing microorganisms were also reported by

Table 2. Effect of combined inoculation of *Rhizobium* and phosphobacteria on the yield of groundnut (Var : Co 1) at different levels of phosphorus

Treatments	Pod yield (kg/ha)	% increase over control	100 pod weight (g)	100 kernel weight (g)	Shelling (%)
No phosphorus					
Uninoculated control	2157	-	81.66	29.33	4.66
Tt9	2365	8.79	84.00	29.33	53.33
PB-1	2399	10.08	86.66	32.00	57.00
Tt9 + PB-1	2582	16.46	85.00	33.60	58.00
50 percent phosphorus					
Uninoculated control	2499	13.68	82.00	29.66	52.33
Tt9	2707	20.31	88.33	30.33	61.66
PB-1	2589	16.68	81.66	28.33	53.66
Tt9 + PB-1	2823	23.59	85.00	29.60	57.00
100 percent phosphorus					
Uninoculated control	2815	23.37	83.33	31.66	58.33
Tt9	2898	25.56	84.66	28.55	55.00
PB-1	2798	22.90	84.66	29.33	58.00
Tt9 + PB-1	2982	27.66	86.00	35.60	57.30
CD (P = 0.05)	324.87	-	NS	NS	NS

* - Values represent mean of three replications; NS : Not significant

Kalugasalam (1981). The combined inoculation of *Rhizobium* and phosphobacteria at 50 per cent level produced pod yields on par with uninoculated control at 100 per cent P application indicating a 50 per cent saving in phosphatic fertilizers. Similar results have been reported by Surendra *et al* (1993) in black gram with phosphobacterial inoculation. Gunasekaran and Natarajan (1991) also reported that compined inoculation of *Rhizobium* and VAM fungi at 50 per cent P level was comparable with uninoculated control at 75 and 100 per cent P levels.

Thus the present study indicated that the combined inoculation of *Rhizobium* and phosphobacteria not only improved the nitrogen status of the crop but also resulted in 50 per cent saving of phosphatic fertilizers applied to groundnut.

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