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# EFFECT OF COMBINED INOCULATION OF *Rhizobium* sp., *Azospirillum* AND PHOSPHOBACTERIA IN GROUNDNUT

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**ABSTRACT**

A filed trial was conducted at the Agricultural Research station, Aliyarnagar to study the effect of combined inoculation of rhizobial strains *viz.*, Tt9 and TNAU 14 along with *Azospirillum brasilense* Sp 7 and phosphobacteria (*Bacillus megaterium var. phosphaticum*) PB 1 in groundnut var. Co.1. The combined inoculation of *Rhizobium*, *Azospirillum* and phosphobacteria produced maximum crop growth nodule number, plant nutrient content and yield compared to individual inoculation or dual inoculation of *Rhizobium* with *Azospirillum* or phosphobacteria.

KEY WORDS : *Rhizobium* sp., *Azospirillum*

Nitrogen and phosphorus are the two most essential nutrients influencing the crop growth and productivity. The increase in the demand and cost of inorganic nitrogenous fertilizers has lead to the search for cheaper sources of N. While on the other hand, a large portion of available P present in superphosphate and other chemical fertilizers is converted chemically and microbiologically to insoulble forms soon after application to soil. The role of *Rhizobium* and *Azospirillum* inoculants to fix and supply atmospheric N (Nambier, 1985) and phosphobacteria to improve the availability of P to the crop by bringing the insoulble form into the solution (Sperber, 1958) has been celarly elucidated. Lately, the combined inoculation of all the three biofertilizers in contrast to their individual application has been recommended. So the present investigation attempts to obtain information on the effect of combination of *Rhizobium Azospirillum* and phosphobacteria on the growth and yield of groundnut.

## METERIALS AND METHODS

A field trial was conducted at the Agricultural Research Station, Aliyarnagar to study the effect of combined inoculation of rhizobial strains viz., Tt9 and TNAU 14 along with *Azospirillum brasilense* Sp 7 and phosphobacteria (*Bacillus megaterium var. phosphaticum*) PB.1 in groundnut (Co.1). The details are are as follows:

Uninoculated control; TNAU 14; Tt9; SP 7; TNAU 14 + Sp 7; Tt9 + Sp 7; PB 1; TNAU 14 + PB 1; Tt 9 + PB 1; TNAU 14 + Sp 7 + PB 1; and Tt 9 + Sp 7 + PB 1

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 (containing $10^9$ CFU/g) of *Rhizobium*, *Azospirillum* and phosphobacteria were used. The treated seeds were sown in plots of size 4 x 3m with 30 x 10 cm spacing. Normal irrigation schedules and fertilizers doses were given.

Shoot length, root length, plant dry weight, number of nodules, nodules dry weight, total nitrogen content, total phosphorus content were estimated at peak growth stage (60 days after sowing). Pod yield, hundred pod weight shelling per centage and hundred kernel weight were recorded ar harvest.

## RESULTS AND DISCUSSION

The rhizobial strain Tt 9 inoculation showed significant difference in shoot length and root length over TNAU 14. This effect was more pronounced when it was inoculated along with *Azospirillum*, while the effect of combined inoculation of Tt 9 and TNAU 14 with phosphobacteria are on par. Maximum plant growth was noticed in combined inoculation of rhizobial strains with *Azospirillum* and phosphobacteria. The effect was significant in combined inoculation with Tt 9 (Table 1). This increase in plant growth due to inoculation of N

**Table 1. Effect of combined inoculation of *Rhizobium, Azospirillum* and phosphobacteria on the growth, nodulation, dry matter 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 (%) |
|---|---|---|---|---|---|---|---|
| Uninoculated control | 36.67 | 1.67 | 2.60 | 26.86 | 0.30 | 2.75 | 0.24 |
| Tt9 | 45.38 | 14.51 | 2.90 | 51.38 | 0.57 | 2.94 | 0.25 |
| TNAU 14 | 43.98 | 23.40 | 2.77 | 46.40 | 0.51 | 2.91 | 0.25 |
| Sp 7 | 41.40 | 13.38 | 2.31 | 50.30 | 0.50 | 2.85 | 0.23 |
| TNAU 14 + Sp 7 | 45.35 | 13.51 | 3.12 | 52.10 | 0.57 | 2.95 | 0.24 |
| PB-1 | 38.02 | 11.92 | 2.65 | 38.40 | 0.38 | 2.80 | 0.33 |
| Tt9 + PB-1 | 46.63 | 14.31 | 2.88 | 53.18 | 0.60 | 2.94 | 0.28 |
| TNAU 14 + PB-1 | 44.20 | 13.20 | 2.83 | 48.20 | 0.53 | 2.92 | 0.31 |
| Tt9 + Sp 7 + PB-1 | 49.66 | 15.32 | 3.23 | 58.29 | 0.66 | 2.96 | 0.29 |
| TNAU 14 + Sp 7 + PB-1 | 46.91 | 14.60 | 3.15 | 52.30 | 0.59 | 2.94 | 0.30 |
| CD (P = 0.05) | 2.36 | 1.09 | 0.05 | 4.97 | 0.04 | 0.04 | 0.02 |

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

fixing microorganisms can be attributed to either N fixed (Vander Merwe and Strijdom, 1974) or growth promoting substances produced by these microorganisms (Badenoch *et al.*, 1983). Plant dry matter produced was maximum in combined inoculation of rhizobial strains along with *Azospirillum* and phosphobacteria (Table 1). The effect was significantly pronounced incase of Tt 9 rhizobial strain. Similar effect was noticed incase of nodulation, nodule dry weight, total nitrogen and phosphorus content of the plant.

Maximum pod yield was obtained in combined inoculation of rhizobial strains with *Azospirillum* and phosphobacteria. More pod yield was recorded due to inoculation with *Rhizobium* alone or in combination with *Azospirillum* and phosphobacteria compared to uninoculated control (Table 2). Other parameters such as hundred pod weight, hundred kernel weight and shelling percentage did not exhibit significant difference either to individual or combined inoculation (Table 2).

In the present study, combined inoculation of both the *Rhizobium* strains with *Azospirillum* and phosphobacteria has produced maximum plant growth, nodule number, plant dry matter, total N and P content and yield compared to individual or dual inoculation of *Rhizobium* with *Azospirillum* or phosphobacteria and this can be attributed to the physiological changes of the plant on exposure to the action of the inoculated microorganisms. It is known that, growth regulators may effect the

**Table 2. Effect of combined inoculation of *Rhizobium, Azospirillum* and phosphobacteria on the yield of groundnut (var : Co 1)**

| Treatments | Pod yield (kg/ha) | Percentage increased over control | 100 pod weight (g) | 100 kernel weight (g) | Shelling (%) |
|---|---|---|---|---|---|
| Uninoculated control | 2523 | - | 89.66 | 30.00 | 56.00 |
| Tt9 | 2673 | 5.9 | 88.66 | 31.33 | 56.33 |
| TNAU 14 | 2648 | 4.9 | 91.66 | 32.33 | 60.33 |
| Sp 7 | 2583 | 2.3 | 87.60 | 30.00 | 55.60 |
| Tt9 + Sp 7 | 2790 | 10.5 | 88.30 | 32.33 | 57.66 |
| TNAU 14 + Sp 7 | 2757 | 9.3 | 90.66 | 33.33 | 58.66 |
| PB-1 | 2574 | 2.0 | 87.66 | 30.33 | 56.33 |
| Tt9 + PB-1 | 2698 | 6.9 | 92.66 | 32.33 | 58.33 |
| TNAU 14 + PB-1 | 2749 | 8.9 | 91.60 | 31.30 | 60.00 |
| Tt9 + Sp 7 + PB-1 | 2923 | 15.8 | 92.66 | 30.33 | 59.33 |
| TNAU 14 + Sp 7 + PB-1 | 2823 | 11.8 | 92.33 | 34.00 | 60.33 |
| CD (P = 0.05) | 174.98 | - | NS | NS | NS |

growth rate of plant organs such as root and shoot (Thinmann, 1974). It has been reported by number of workers that plant growht regulating substances of kind indole acetic acid (IAA), gibberellic acid (GA) and cytokinins produced by *Rhizobium* (Henson and Wheeler, 1976) *Azospirillum* (Tien *et al.*, 1980) and phospho bacteria (Barea *et al.*, 1976) Kalugasalam, (1981) reported that the inoculated phosphorus solubilising bacteria mediate the release of phosphorus from insoluble phosphates and fixation of atmospheric nitrogen by *Azospirillum* and *Rhizobium* in plants results in better growth, nodulation, total N and P content and yield of the crop.

The above study clearly indicated that there exists a synergistic effect between *Rhizobium*, *Azospirillum* and phosphobacteria inoculation which improves the plant growth, nodulation, plant nutrient status and yield of groundnut.

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# EFFECT OF MICRONUTRIENT CHELATES ON THE YIELD AND DRYMATTER PRODUCTION OF GROUNDNUT AND PADDY


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## ABSTRACT

Field experiments conducted to study the effect of micronutrient chelates on the yield and drymatter production of groundnut and paddy in Typic Haplustalfs and Typic Ustochrepts soils respectively revealed that the application of $ZnSO_4$ @ 25.0 kg/ha recorded the highest drymatter yield at initial stages for both the crops, while at later stages, foliar spray of CMM @ 0.5% twice at 30th and 40th DAS registered the highest pod yield in groundnut, whereas in paddy, foliar spray of 0.5% Zn chelate recorded the highest yield.


KEY WORDS : Micronutrient Chelates, Groundnut, Paddy, Yield, Drymatter, Foliar Spray

Intensive agricultural practices with prolonged use of micronutrient free high analysis fertilizers and mining of the plant nutrients through removal of produce without returning the residues to the soil resulted in wide spread micronutrient deficiency in soils. The escalating price of inorganic ... besides their ra id solubilit and unavailability to plants due to soil reactions suggest to recommend chelates as an alternate source to enhance the availability of native and applied micronutrients to plants. Hence, experiments were conducted to evaluate the efficacy of micronutrient chelates on the yield and drymatter production (DMP) of groundnut and paddy.