

## **Effect of Different Strains of Plant Growth Promoting Rhizobacteria (PGPR) on Growth and Yield of Groundnut (*Arachis hypogaea* L.)**

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### **Abstract**

A field experiment was conducted during *kharif* season of 2005 to study the effect of different strains of PGPR on growth and yield of groundnut (*Arachis hypogaea* L.). The combined seed inoculation of PGPR 1 + PGPR 2 + PGPR 4 significantly increased the plant height (32.9 cm), root length (15.30 and 24.8 cm at 30 and 60 DAS respectively), number of nodules per plant (39.00 and 46.60 at 30 and 60 DAS respectively), pod yield (1153 kg/ha), test weight (35.50 g) and shelling percentage (68.70%) compared to the seed inoculation of PGPR strains individually and untreated control.

**Key words :** PGPR Strains (1, 2, 4), Groundnut, Growth, Yield.

Groundnut (*Arachis hypogaea* L.) is an annual legume which is also known as peanut, earthnut and goobers. It is an important food, feed and oilseed crop and grown in nearly 100 countries. It is the 13th most important food crop and fourth most important oilseed crop of the world. Major groundnut producers in the world are China, India, Nigeria, USA, Indonesia and Sudan. Among oilseed crops in India, groundnut accounts for about 50% of area and 45% of oil production. In India, about 75% of the groundnut area lies in a low to moderate rainfall areas with a short period of distribution (90—120 days) and most of the groundnut production is concentrated in five states viz. Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra. These five states accounts for about 86% of the total area under groundnut cultivation. Groundnut seeds contain 40—50% fat, 20—50% protein and 10—20% carbohydrate. Groundnut seeds are also nutritional source of vitamin-E, niacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium. Monsoon variations cause major fluctuations in groundnut production in India. Groundnut is grown in different cropping systems like sequential, multiple, and intercropping (1). One group of microorganisms which are beneficial to crops is bacteria that colonize roots or rhizosphere soil of crop plants. These bacteria are referred to as plant growth promoting rhizobacteria. Kloepper

et al. (2) coined the term PGPR in the later part of the 1980s and reported the mechanism and application of PGPR in temperate annual crops production. There are several PGPR strains currently commercialized that seem to promote growth through at least one mechanism; suppression of plant disease (bioprotectants), improved nutrient acquisition (biofertilizers), phytohormone production (biostimulants). Exposure to the PGPR triggers a defense response by the crop if attacked by pathogenic organisms. PGPR produces some siderophores to scavenge heavy metal micronutrients in the rhizosphere (e.g. iron). Plants seem capable to acquire adequate micro-nutrients in the presence of these PGPR. Inoculation of a number of plant growth promoting rhizobacteria have been reported to enhance the growth and yield of many crops (3). The present study was conducted to induce growth and yield by employing different strains of PGPR. In this contest we are able to assess the performance of different strains of PGPR and variability among them.

### **Methods**

A field experiment was conducted during 2005 at Agricultural Research Station, Chintamani to study the effect of different strains of PGPR on growth and yield of groundnut. The soil of the experimental site

**Table 1.** Growth and yield of groundnut as influenced by PGPR strains.

Treatments	Plant height (cm)	Root length (cm)		Number of nodules per plant		Pod yield (kg/ha)	Test weight (g)	Shelling percentage
		30 DAS	60 DAS	30 DAS	60 DAS			
T <sub>1</sub> PGPR - 1	26.40	11.70	19.00	15.90	29.80	880	26.20	58.20
T <sub>2</sub> PGPR - 2	36.80	11.90	20.30	27.70	33.70	934	27.70	57.80
T <sub>3</sub> PGPR - 4	30.10	12.30	20.80	23.30	42.90	942	29.00	58.00
T <sub>4</sub> PGPR - 1 + 2 + 4	32.90	15.30	24.80	39.00	46.60	1153	35.50	68.70
T <sub>5</sub> Control (untreated)	26.90	10.30	17.90	14.90	26.60	830	25.60	58.00
CD at 5%	2.60	0.79	1.32	9.00	6.10	80.00	1.35	3.40
CV%	9.30	8.00	8.00	4.10	20.50	4.50	5.80	3.10

is red sandy loam having pH 5.5, organic carbon 0.42%, available P<sub>2</sub>O<sub>5</sub> 45 kg/ha and K<sub>2</sub>O 240 kg/ha. The experiment was conducted in randomized block design with four replications having plot size of 5 m × 5 m. The treatments were T<sub>1</sub> = PGPR-1 (*Pseudomonas aureofaciens*), T<sub>2</sub> = PGPR-2 (*Pseudomonas fluorescens*), T<sub>3</sub> = PGPR-4 (*Pseudomonas aeruginosa*), T<sub>4</sub> = PGPR1 + PGPR2 + PGPR4 and T<sub>5</sub> = Untreated control. The variety JL-24 seeds were sown during first week of June at a spacing of 45 cm × 10 cm. The PGPR culture was taken separately in a bucket and added binder and cane sugar to it and then mixed thoroughly with seeds, so that the culture was adhered to the seeds properly and allow it to drying in shade for 30 minutes before sowing. The recommended dose of FYM (7.5 t/ha) was applied and mixed with soil properly two weeks before sowing and N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O (25:50:25 kg/ha) applied at the time of sowing to all the treatments. The observations viz. plant height (cm), root length (cm) at 30 and 60 DAS, number of nodules per plant were recorded at 30 and 60 DAS, pod yield (kg/ha), test weight (g) and shelling percentage (%) were recorded on five plant samples and the data were subjected to statistical analysis.

### Results and Discussion

Table 1 shows that the seed inoculation with different strains of PGPR was found to increase significantly the growth and yield components of groundnut. The combined seed inoculation of PGPR-1 + PGPR-2 + PGPR-4 caused maximum plant height (32.9 cm), root length (15.3 and 24.80 cm at 30 and 60 DAS respectively), number of nodules per plant (39.00 and 46.60 at 30 and 60 DAS), test weight (35.50 g), shelling per-

centage (68.70%) and pod yield (1153 kg/ha) when compared to rest of treatments. Root zone application of PGPR-2 increased rhizosphere population of the bacteria. Certain strains of *Pseudomonas fluorescens* have been shown to provide biological control of root pathogens when applied to soil (4) since some of these strains have the ability to colonize the roots. PGPR have been reported to directly enhance plant growth by a variety of mechanisms: Fixation of atmospheric nitrogen that is transferred to the plant, production of siderophores that chelate iron and make it available to the plant root, solubilization of minerals such as phosphorus and synthesis of phytohormones (5).

The application of *Pseudomonas aureofaciens* (PGPR 1) + *Pseudomonas fluorescens* (PGPR 2) + *Pseudomonas aeruginosa* (PGPR 4) has been reported to enhance the growth, yield and net returns. This enhancement may be attributed to the involvement of ACC deaminase, siderophore production, phosphate solubilization, nodulation promotion and disease depression capability of PGPR strains (6).

Plant growth results from interaction of roots and shoots with the environment. The environment for roots is the soil or planting medium which provide structural support and water and nutrients to the plant. Beneficial interactions between roots and microbes do occur in rhizosphere and can be enhanced. Increased plant growth and crop yield can be obtained upon inoculating seeds or roots with certain specific root-colonizing bacteria plant growth promoting rhizobacteria (7).

Thus it can be concluded that combined seed inoculation of PGPR 1 + PGPR 2 + PGPR 4 along with recommended dose of fertilizers and FYM for groundnut was found to be best to produce higher economic

yield as compared to rest of the treatments.

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