# Influence of Biofertilizers and Homobrassinolides on Nodulation, Yield and Quality of Groundnut (*Arachis hypogaea* L.)

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**Abstract**

A pot culture experiment was conducted during the pre-*kharif* season of 2008 and 2009 to find out the nodulation, yield and quality of groundnut (*Arachis hypogaea* L.) in response to biofertilizers and homobrassinolide. The experiment was laid out in compete randomized design (CRD) with four levels of biofertilizers [no inoculation, phosphate solubilizing bacteria, vesicular arbuscular mycorrhizae, phosphate solubilizing bacteria (PSB) + vesicular arbuscular mycorrhizae (VAM)] and two levels of homobrassinolides spraying [flowering and (flowering + pegging stage)]. Results revealed that inoculation of biofertilizers significantly improved nodulation and yield attributes like number of pods plant$^{-1}$, number of kernels plant$^{-1}$, kernel yield and oil content. Among the biofertilizers, combined inoculation of PSB + VAM resulted in 113.77, 51.81 and 31.21% higher kernel yield in first year and 114.60, 53.68 and 26.21% in second year over no inoculation, phosphate solubilizing bacteria, vesicular arbuscular mycorrhizae, respectively. With increase in levels of spraying of homo-brassinolide, increased growth and productivity of hybrid was observed. Spraying of homo-brassinolide at flowering+pegging stages gave 29.74% higher kernel yield in first year and 43.43% in second year than application of homo-brassinolide at flowering alone.

## 1. Introduction

Groundnut (*Arachis hypogaea* L.) is the major oilseed crop grown in India and occupies an important place in the Indian diet. Among oil seed crops, groundnut occupies first position in the acreage as well as production. Farmers often try to use chemical fertilizers in the field for crop development. But obviously the chemical fertilizers are not environment friendly. They are responsible for water, air and soil pollution and can spread cancer causing agents. Moreover, they may destroy the fertility of the soil in the long run. Scientists have developed biofertilizers to prevent pollution and to make this world healthy for everybody in a natural way. Biofertilizer contains microorganisms which promote the adequate supply of nutrients to the host plants and ensure their proper development of growth and regulation in their physiology. The benefits from inoculation with VAM and PSB have been reported in many legumes (Daft and El-Giahmi, 1976; Smith and Daft, 1977; Bagyaraj et al., 1979; Subba Rao and Krishna, 1988). Biofertilizer like phosphate solubilizing bacteria (PSB) plays a vital role in making unavailable phosphorus to available phosphorus through solubilisation of phosphates from any source of organic or inorganic or both. Another important biofertiliser, vesicular arbuscular mycorrhizae (VAM) fungi provides significant amount of nutrients to the plants such as copper, zinc, phosphorus and sulphur by making their widely extended hyphal network on the upper or lower side of the soil layer. Favorable response of PSB and VAM have been noticed by many workers (Khalil et al., 1992; Tilak and Singh, 1994). The use of PSB and VAM have opened the new vistas of phosphorus. Favorable responses of these micro-organisms have been noticed by Mukherjee and Rai (2000). Simultaneous dual inoculation of PSB and VAM has been shown to stimulate plant growth more than inoculation of either micro-organism alone in certain situations when the soil is phosphorus deficient (Barea et al., 1975). Brassinolide (BL), considered to be the most important homobrassinolide (HBR) playing a pivotal roles in the hormonal regulation of plant growth and development, was found to increase crop yield. Hence, an experiment was conducted to study the nodulation, yield and quality of hybrid groundnut (*Arachis hypogaea* L.) in response to biofertilizers and HBR.


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## 2. Materials and Methods

A pot culture experiment was conducted during *Pre-kharif* season of 2008 and 2009 at agricultural research farm, (Institute of Agriculture), Visva-Bharati, Sriniketan, West Bengal, India. The soil was slightly acidic (pH 5.9), low in available nitrogen (136 kg $ha^{-1}$), phosphorus (11.50 kg $ha^{-1}$) and medium in potassium (160.5 kg $ha^{-1}$). The experiment was laid out in compete randomized design with four levels of biofertilizers inoculation (no inoculation, PSB, VAM and PSB + VAM) and two spraying of HBR @ 0.5 ml $l^{-1}$ of water at flowering stage and flowering + pegging stage replicated three times. The earthen pots (25 cm diameter) were filled in with unsterile soil (10 kg $pot^{-1}$) and fertilized with 90.9 mg N, 256 mg $P_2O_5$ and 132.5 mg $K_2O$ $pot^{-1}$ in the form of urea, single super phosphate and murate of potash, respectively. The groundnut variety, 'TAG 24' was sown on February 15 and February 12 during 2008 and 2009, respectively. The seed was inoculated with PSB by slurry method whereas the soil was inoculated with VAM inoculum (Symbiotic Sciences, New Delhi). The VAM inoculum was placed at the seeding depth of the soil @ 2 g $seed^{-1}$ and then pre-inoculated seeds were sown according to the treatment. A light irrigation was given immediately after sowing. The plant height was recorded at 30 and 60 days after sowing (DAS). The yield parameters and yield were recorded at harvesting stage (110 days) of plant. Oil content of seed was determined by Soxhlet apparatus. The rainfall received during the cropping period 164.4 and 381.0 mm in 2008 and 2009, respectively.

## 3. Results and Discussion

### *3.1. Number of nodules plant$^{-1}$ and dry weight of nodules plant$^{-1}$*

The number of nodules $plant^{-1}$ and dry weight of nodules $plant^{-1}$ at 45 and 60 DAS are presented in Table 1. The number of nodules $plant^{-1}$ and dry weight of nodules $plant^{-1}$ was higher in the second year than the first year. Dual inoculation of PSB + VAM significantly increased the number of nodules $plant^{-1}$ and dry weight of nodules $plant^{-1}$ as compared to other treatments in both years. The results are conformity with those of Mitchell and Gregory (1972) and Smith and Daft (1977). Spraying of HBR at flowering + pegging stage recorded higher number of nodules $plant^{-1}$ and dry weight of nodules $plant^{-1}$ as compared to one spraying at flowering stage. Similar result was reported by Ramraj et al. (1997). Increased number of nodules might be due to positive effect of HBR on meristematic tissues of plant as well as in increasing number and size of cell (Prakash et al., 2008).

### *3.2. Yield attributes, yield and oil content*

Number of pods $plant^{-1}$, number of kernels $plant^{-1}$, kernel yield and oil (Table 2) were significantly influenced by biofertilizers inoculation. Combined inoculation of PSB + VAM recorded significantly higher yield attributes like number of pods $plant^{-1}$, number of kernels $plant^{-1}$ and oil (%) as compared to no inoculation, PSB and VAM inoculation. The result of pooled analysis showed that combined inoculation of PSB + VAM resulted in 114.39, 52.83 and 28.55% higher kernel yield $plant^{-1}$ over no inoculation, PSB and VAM, respectively. This increase in yield parameters by PSB + VAM inoculation might be due to increased roots, relative water content, root biomass, nodule number and dry weight that could be ascribed to a better translocation of photosynthates towards yield attributes and yield. Rose (1957) recorded similar findings. The application of HBR at flowering + pegging stage recorded maximum number of pods $plant^{-1}$, number of kernels $plant^{-1}$ and kernel yield $plant^{-1}$. The result of pooled analysis showed that two spraying of HBR increased 37.03% higher kernel yield $plant^{-1}$

Table 1: Number of nodules $plant^{-1}$ and dry weight of nodules $plant^{-1}$ as influenced by biofertilizers and HBR

| Treatments | Number of nodules $plant^{-1}$ | | | | Dry weight of nodules $plant^{-1}$ (mg ) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 |
| Biofertilizers | 45 DAS | 45 DAS | 60 DAS | 60 DAS | 45 DAS | 45 DAS | 60 DAS | 60 DAS |
| No inoculation | 13.17 | 18.17 | 27.66 | 30.83 | 16.20 | 17.70 | 36.21 | 43.15 |
| PSB | 19.66 | 25.00 | 35.00 | 39.33 | 20.73 | 22.60 | 41.61 | 47.80 |
| VAM | 20.33 | 25.33 | 35.66 | 39.83 | 23.45 | 25.68 | 45.46 | 50.56 |
| PSB+VAM | 29.17 | 34.83 | 45.66 | 50.33 | 28.10 | 30.11 | 50.76 | 55.87 |
| SEm± | 0.50 | 0.34 | 0.38 | 0.44 | 0.32 | 0.25 | 0.36 | 0.40 |
| CD (*p*=0.05) | 1.50 | 1.02 | 1.14 | 1.32 | 0.96 | 0.75 | 1.08 | 1.20 |
| HBR | | | | | | | | |
| Flowering stage | 20.25 | 25.50 | 34.50 | 38.00 | 21.89 | 23.91 | 41.79 | 74.56 |
| Flowering+pegging stage | 20.92 | 26.16 | 37.50 | 42.17 | 22.35 | 24.14 | 45.24 | 51.13 |
| SEm± | 0.36 | 0.24 | 0.27 | 0.31 | 0.23 | 0.19 | 0.26 | 0.28 |
| CD (*p*=0.05) | NS | NS | 0.81 | 0.93 | NS | 0.57 | 0.78 | 0.84 |


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Table 2: Yield attributing characters (number of pods plant$^{-1}$, number of kernels plant$^{-1}$, 100 seed weight (g) and yield as influenced by biofertilizers and HBR

| Treatments | Number of pods plant$^{-1}$ | | Number of kernel plant$^{-1}$ | | Kernel yield plant$^{-1}$ (g) | | | Oil (%) | |
|---|---|---|---|---|---|---|---|---|---|
| Biofertilizers | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | Pooled | 2008 | 2009 |
| No inoculation | 11.83 | 15.50 | 18.38 | 21.83 | 5.88 | 7.19 | 6.53 | 40.68 | 42.18 |
| PSB | 16.00 | 19.83 | 28.50 | 29.16 | 8.28 | 10.04 | 9.16 | 43.65 | 44.20 |
| VAM | 17.67 | 21.50 | 32.00 | 32.17 | 9.58 | 12.21 | 10.89 | 43.92 | 44.75 |
| PSB + VAM | 22.50 | 26.66 | 38.33 | 39.16 | 12.57 | 15.43 | 14.00 | 45.57 | 46.57 |
| SEm± | 0.35 | 0.36 | 0.48 | 0.74 | 0.24 | 0.36 | 0.21 | 0.31 | 0.30 |
| CD ($p$=0.05) | 1.05 | 1.08 | 1.44 | 2.22 | 0.72 | 1.08 | 0.63 | 0.93 | 0.90 |
| HBR | | | | | | | | | |
| Flowering stage | 14.91 | 18.50 | 26.25 | 25.91 | 7.90 | 9.21 | 8.56 | 42.78 | 43.52 |
| Flowering + pegging stage | 19.08 | 23.25 | 32.58 | 35.25 | 10.25 | 13.21 | 11.73 | 44.14 | 45.34 |
| SEm± | 0.25 | 0.25 | 0.34 | 0.52 | 0.17 | 0.25 | 0.15 | 0.22 | 0.22 |
| CD ($p$=0.05) | 0.75 | 0.75 | 1.02 | 1.56 | 0.51 | 0.75 | 0.45 | 0.66 | 0.66 |

as compared to one spraying. The increase in yield might be due to application of HBR was in consonance with the findings of Mai et al. (1989) and Prakash et al. (2006) in rice and sesame respectively. Besides increasing the yield, the oil content was significantly enhanced in the plants treated with HBR twice, i.e. at flowering + pegging stages.

## 4. Conclusion

Based on the above results and discussion, conclusion can be drawn that inoculation of PSB + VAM as well as two spraying of HBR at flowering + pegging stages had a significant influence on the number of nodules plant$^{-1}$ and dry weight of nodules plant$^{-1}$, number of pods plant $^{-1}$, number of kernels plant$^{-1}$, kernel yield and oil content (%).

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