

## Microbial solubilization of P and Arbuscular mycorrhizal fungi use for yield and phosphate uptake in improvement of nodulation and yield of [*Vicia faba* L.]

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### ABSTRACT

The influence of a phosphate solubilizing bacterium (*Bacillus polymyxa*) and arbuscular mycorrhizal fungus (*Glomus fasciculatum*) on growth of *Vicia faba* L. (Broad bean) and phosphorus uptake were studied. Green house experiments were conducted using both sterilized and unsterilized garden soil (sandy loam). Mycorrhiza and P-solubilizing bacteria inoculated to sterilized soil produced significantly higher growth, dry matter, increase in nodule number and P uptake in shoot. Moderate or lower growth response was observed among the plants grown in unsterilized soil and either PSB or AM inoculated. On the contrary uninoculated plants in sterilized garden soil did not show good growth and higher total P uptake. A synergistic effect was recorded with increased plant dry matter, nodule number and P uptake in the treated with both the inoculums in sterilized soil.

**Key words :** Microbial solubilization, AMF, Arbuscular mycorrhizal fungi, *Vicia faba* L., Broad bean

### INTRODUCTION

*Vicia faba* L. (broad bean) is a legume, native to North America and now widely cultivated in India. The plants bears flat pods containing 4-5 seeds. Most of these plants are generally grown in nutrient deficient soils. Recent research on plant nutrition through PSB and AM fungi have amply demonstrated that these organisms play an important role in uptake of nutrient from the marginal soils. Research in the last two decades has established that dual inoculation of phosphate solubilizing bacteria and AM fungi stimulates plant growth (Siqueria and Poula, 1986; Raju *et al.*, 1988). Phosphate solubilizing bacteria solubilize insoluble P and help plants to absorb and translocate more soluble phosphate (Azcon-Aguliar *et al.*, 1986). No research work was directed on *Vicia faba* so far. Hence, the present study investigated the efficiency of phosphate solubilizing bacteria and VA-mycorrhizal fungi on the growth and P uptake of broad bean plants.

### MATERIALS AND METHODS

The Green house experiments were conducted in the Post Graduate Department of Botany, Karnataka University, Dharwad. *Bacillus polymyxa*, a phosphate solubilizing bacterium, was procured from the Department of Agril. Microbiology U.A.S. Dharwad. The AM fungus *Glomus fasciculatum* was multiplied with Sudan grass (*Sorghum vulgare* var. *Sudanese*) as a host plant. Soil based AM fungal inoculum was established and maintained in pot culture.

Seedlings were raised in earthen pots containing 6

kg of sterilized and unsterilized garden soil. The soil separately used in the experiment was a sandy loam with a pH; of 6.7, EC; 0.13 d s/m, organic carbon; 0.38%, available N; 199 kg/ha, available K; 204 kg/ha and available P; 4.6 kg/ha. One week old seedlings of *Vicia faba* L. were inoculated with PSB and AM fungi, around the root system. PSB (0.5mg) and mycorrhizal colonized chopped root bits (5g) and 5g soil of the host plants which consisted of spores (approximately 158/250g soil) and external hyphae was used as the inoculum singly or in combination. The treatments were

- Un-inoculated control
- *Bacillus polymyxa* alone
- *Glomus fasciculatum* alone
- *B. polymyxa* + *G. fasciculatum*

The following observations were recorded on 60 days old seeding grown in green house.

Plant height, dry weight of shoot and nodule number were recorded and P uptake in shoots was determined. The per cent of AM colonization of *Vicia faba* roots was estimated according to Phillips and Hayman (1970). The extra matrical chlamydo spores were isolated by adopting wet sieving and decanting technique outlined by Gerdemann and Nicolson (1963). Phosphorus content of shoots was estimated by vanadomolybdate phosphoric yellow colour method outlined by Jackson (1973).

### RESULTS AND DISCUSSION

The data in terms of plant height, dry matter and P uptake recorded at 60 days of plant growth in both

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**Table 1 : Effect of PSB and AM inoculation on growth, dry matter, nodule number and P uptake of 60 days old *Vicia faba* L. in sterilized garden soil**

Treatments	Plant height (cm)	Shoot dry weight (g/pl.)	% Root colonization	Spore count/50g soil	Nodule number/ plant	Root dry weight (g/plant)	P uptake in shoot (ppm)
Un-inoculated (control)	9.7	3.1	-	-	0.51	0.891	39
PSB	26.2	9.3	24.3	31.3	4.3	2.101	97
AM	26.8	9.3	42.4	57.2	2.9	7.101	95
PSB+AM	43.1	14.8	46.8	58.5	11.3	9.175	107
C.D. (P=0.05)	2.09	0.27	0.05	0.01	0.04	0.10	0.06

**Table 2 : Effect of PSB and AM inoculation on growth, dry matter, nodule number and P uptake of 60 days old *Vicia faba* L. in unsterilized garden soil**

Treatments	Plant height (cm)	Shoot dry weight (g/pl.)	% Root colonization	Spore count/50g soil	Nodule number/ plant	Root Dry weight (g/plant)	P uptake in shoot (ppm)
Un-inoculated (control)	7.6	2.5	-	-	0.4	0.562	28
PSB	19.8	6.7	24.3	33.2	3.4	0.968	59
AM	17.3	5.9	37.2	46.7	3.1	0.971	71
PSB+AM	27.5	9.8	49.6	51.5	8.4	0.984	98
C.D. (P=0.05)	2.03	0.13	0.04	0.01	0.02	0.09	0.04

sterilized and unsterilized soils are presented in Table 1 and 2.

AMF colonization, spore population was greatly improved by simultaneous inoculation of PSB and AMF. This kind of variation has been observed in both inoculated and un-inoculated plants.

The bacterium *Bacillus polymyxa* in combination with *Glomus fasciculatum* gave a significant increase in plant height, per cent AMF colonization, spore population and P uptake in sterilized than unsterilized soils. The response was higher due to mixed inoculation than single inoculation indicating the synergistic effect of two organisms. The results indicated that dual inoculation could be used for better growth and production of root nodules in *Vicia faba* plants in greenhouse condition. Interaction between AM fungi and certain rhizospheric microorganisms results in synergistic effect leading to the growth and enhancement of various plant growth parameters (Bagyaraj, 1984). Similar interactions between PSB and AMF observed in the present study are in confirmation with results of earlier workers (Barea *et al*, 1975; Sattar and Gaur, 1989) on lavender, maize and lentils. The present study concludes that PSB under specific conditions mobilized unavailable form of soil and fertilizer P and AM fungus provided soluble nutrients to plants, which improved plant nutrient

uptake and growth.

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