

Effect of VAM and Phosphorous on seedling growth of *Cajanus cajan* (var.ICPL.87) in Bundelkhand region, India

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ABSTRACT

Bundelkhand is one of these regions in India where the rural population and forest dwellers form a considerable part of the population. It is located and occupied the heart of the country. Seedling growth and vigour of *Cajanus cajan* raised in polybags were evaluated after inoculating nursery soil mixture with three culture of VAM along with 3 levels of fertilizer, phosphorous(0,300 and 500 mg/polybags), VAM inoculated seedlings grew faster and healthier than seedlings, Among VAM culture *Glomus mosseae* was found to be efficient when combined with P at 300 mg/polybag, it's efficiency was greater and produced robust seedlings with longer root and shoot as well as higher drymatter and P uptake. However, when P was applied at 500 mg/polybag in combination with cultures, VAM colonization appreciably decreased and no improvement in growth of seedlings was observed.

Key words: VAM Fungi, Phosphorous, *Cajanus cajan*, seedling growth

INTRODUCTION

Pigeon pea (*Cajanus cajan*) is an annual legume, grown in various states of India. It is considered to be an important source of protein. The cultivated area of pigeon pea is rapidly expanding in various parts of our country. About 80% of the world population of pigeon pea comes from India. According to Bagyaraj et al. (1989) the VA mycorrhizal fungi can improve legume growth through increased the way of phosphorous especially in soil of low fertility. Manjunath and Bagyaraj (1984)

also reported that the improvement in nodule number and mass, acetylene reduction activity, shoot/root, drymatter and total N and P uptake, when mycorrhizal fungi is inoculated with pigeon pea. *Cajanus cajan* seedlings require phosphorous (P) for its sturdy growth but mere application of P fertilizer was not much effective for seedlings due to sparse root system. Earlier researchers have documented that the inoculation of VAM is beneficial to crops by way of mobilizing nutrient especially P (Lambert and Cole 1980, Hayman 1983, Bolan 1991: Verma and Schuepp 1995, Sekar et al. 1997)

VAM has been found to associate with plants in natural communities accounting for more than 1000 genera representing about 200 families. *Cajanus cajan* is one among them. Hence, selection of a most

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suitable strain of VAM to *Cajanus cajan* is necessary for most effective utilization of added P by growing seedlings. In view of this present investigation was carried out.

METHODOLOGY

For raising *Cajanus cajan* seedlings nursery soil mixture was prepared by mixing clay loam soil and sand at 1:1 ratio. The soil mixture has neutral pH (7.6) and low electrical conductivity (0.15 dsm-1). The status of available N (52 ppm) and P (3.7 ppm) was low whereas available K was medium (93 ppm). Then it was autoclaved at 1.4 kg/cm² pressure for 1 hour at two successive days. In high density polythene bags (30cm x 20cm size). 5kg of sterilized air dry nursery soil mixture was filled. A common dose of 50 mg N/polybag as urea and 40 kg/polybag as muriate of potash was imposed in all the bags.

The treatment combinations included two factors viz, VAM culture and P levels. The three VAM cultures maintained on maize seedlings namely *Glomus mosseae*, *Glomus fasciculatum*, *G. constrictum* were tested against uninoculated control. P was applied in three levels viz, 0, 300 and 500 mg/polybags as single superphosphate. The Phosphorous and VAM inoculum containing infected root segments of maize and 40 viable spores/g of soil were thoroughly incorporated in nursery soil mixture before filling into bags. The experiment was setup in factorial completely randomized design with 9 replications.

Seedlings (15 days old) grown under sterile conditions were transplanted into polybags. At 45 days after planting, seedlings length, shoot length and drymatter. Based on the P content (Jackson, 1973), P uptake of seedlings was calculated. VAM infection percentage was also made (Phillips and Hayman, 1970). The data were analyzed

statistically as per the method of Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

The result clearly indicated that *Cajanus* seedlings depended much of P for its growth, further the effect of added P on seedlings increased when it was applied in combination with VAM. Uninoculated seedlings without P produced (Table 1) least drymatter (0.63g), shortest root length (19.2 cm) and shoot length (20.1 cm), when P was applied in graded levels seedlings growth rapidly increased. At 500 mg/polybag the increased in growth accounted for 2.5 cm in shoot length and 0.15 gm in drymatter over control but the root length did not change. With respect to P uptake, an increase of 0.48 mg/seedlings was estimated over the control (0.78 mg/seedlings).

In the absence of P inoculation of VAM cultures influenced seedlings growth significantly. Among them, *G.mosseae* was found to be lightly effective, recording the longest root (25.1 cm) and shoot (20.8 cm) as well as the highest dry matter (0.95 g). The efficiency of this culture might have resulted due to its ability to colonize roots extensively, as observed from the highest infection percentage (75%). The results are in agreement with the findings of Sekar et al. (1997). The other two culture viz. *G.fasiculatum* and *G.constrictum* were found to be inferior in influencing seedling growth, but significantly superior to uninoculated control. Similar differences on influence of VAM strain have been reported to Powell et al. (1980). This distinguishable performance of various VAM strains on P uptake could be attributed to the variations in the capability and competence of strains to form mycorrhizae rapidly and extensively in the rhizosphere (Abbott and Robson, 1982).

At all VAM inoculated treatments spectacular increase in growth parameters, P uptake and colonization were found with the combination of P at 300 mg/polybag. However when P was applied at 500 mg/polybag along with VAM culture no significant improvement was noticed. This could be due to the reason that 300 mg/polybags might have been optimum for the growth and P application beyond this level did not respond well in the case of *Cajanus cajan*. It could be also noted that the colonizing activity of VAM was much inhibited by P at 500 mg/polybag which when compared to 300 mg/polybag which would have limited absorption of nutrient particularly P leading to poor growth. Earlier experimental evidence showed that when initial soil P concentration was very low, even small addition of P tremendously increased colonization (Bolan et al., 1984). In spite of this, when heavy dose of P was applied it reduced root volume and in consequence it decreased the surface area colonized by AM (Smith, 1982; Thompson et al., 1990).

In the present study, study and vigorous *Cajanus cajan* seedlings were produced by the combined application of P as superphosphate at 300 mg/polybag and *G.mosseae*. The seedling had the highest dry matter (1.20 gm/shoot length; 30.6 cm) and root length (28.4 cm) which were 65.7, 37.0, and 40.0 percent higher than the seedlings grown with P (300 mg /polybag) alone. The P uptake of seedlings was 3.55 which were three times higher than the seedlings which received P at 300 mg/polybag alone.

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Table 1: Combined effect of VAM cultures and P on growth, P uptake and VAM colonization in *Cajanus cajan*

VAM Culture	P levels Mg/polybags	Root Length (cm)	Shoot Length (cm)	Dry Matter (g/seedlings)	P Uptake (mg/seed- lings)	AM Infection
Uninoculated	0	19.2	20.1	0.63	0.78	0
	300	21.0	22.8	0.72	1.13	0
	500	21.2	23.8	0.80	1.27	0
	Mean	20.5	22.6	0.72	1.06	0
<i>G.mosseae</i>	0	23.5	29.5	0.80	1.36	78
	300	29.4	31.6	1.20	3.55	84
	300	28.4	20.5	0.85	3.31	69
	Mean	25.1	30.8	0.95	2.74	77
<i>G.fasiculatum</i>	0	22.7	27.5	0.77	1.30	63
	300	25.8	30.8	0.98	2.34	70
	300	23.8	29.6	0.90	2.49	56
	Mean	24.1	29.3	0.93	1.39	63
<i>G.constrictum</i>	0	23.6	24.4	0.82	1.39	62
	300	26.2	30.5	0.95	2.22	67
	500	22.1	29.7	0.81	2.08	58
	Mean	24.0	28.2	0.86	1.89	62
CD (P = 0.05)	VAM	0.96	1.22	0.06	0.06	0.61
	P	0.82	1.40	0.05	0.05	0.50
	VAM x P	1.65	NS	0.23	0.10	1.05