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EFFECT OF GLOMUS MOSSEAE ON GROWTH AND CHEMICAL COMPOSITION OF CAJANUS CAJAN (VAR. ICPL-87)

Kavita Singh Chaudhary[1], Ph. D. & Rohit Kumar Singh[2], Ph. D.

[1]*Astt. Prof- Microbiology, Government P.G.College, Noida, U.P.,*

[2]*Astt. Prof (Chemistry), Pt JLN College, Banda*

Abstract

Effect of Glomus mosseae on growth and chemical composition of Cajanus cajan was investigated with different spore densities by placing the spores along with seed. Root colonization with the fungus has resulted in an increased vegetative growth, total chlorophyll content and uptake of nutrients viz., nitrogen, phosphorous, potassium, calcium and magnesium compared to non-mycorrhizal plants. Two hundred spores per plant was found to be optimum for root colonization and for obtaining maximum vegetative growth. Mycorrhizal plants recorded increased weights of fresh root, shoot and dry shoot over non-mycorrhizal plants.

Keywords- *Glomus mosseae, Mycorrhiza, Cajanus cajan, root colonization*

Introduction

Endomycorrhizal fungi have been shown to increase the ability of roots to absorb more nutrients than non-mycorrhizal plants (Daft and Nicolson, 1969). Various studies conducted in the past corroborate this hypothesis (Daft and Nicolson, 1969; Sitraramaiah and sikora, 1981). In the present study experiments were conducted to determine the response of *Cajanus cajan* plants to different mycorrhizal spore levels of *G. mosseae* and also the chemical composition of mycorrhizal and non-mycorrhizal *Cajanus cajan* plants. Pigeon pea (*Cajanus cajan*) is a annual legume, grown in various states of India. It is considered to be an important source of protein. The cultivated area of pigeon pea (*Cajanus cajan*) is rapidly expanding in various parts of our country. About 80% of the world production 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 soils of low fertility, Manjunath and Bagyaraj (1984) also reported that the improvement in nodule number and mass, acetylene reduction activity, shoot/root dry matter and total N and P uptake when mycorrhizal fungi is inoculated with pigeon pea. It was considered worthwhile to screen and select an efficient mycorrhizal fungus which can be used for inoculating pigeon pea in order to improve plant growth and yield at low input cost.

Materials and Methods

The composition of soil used for conducting the experiments was as follows- Sand 33.3%, silt 49%, clay 17.7%, bulk density 1.39 g/cm^3, moisture holding capacity 28.6% at 1/3 atmosphere, organic matter 3.1%, pH 7.6, free ions 1.8 %, CEC (meg/100g) 17.00 and Ca: Mg ratio 4:2. The Endomycorrhizal fungus *Glomus mosseae* was multiplied on *Cajanus cajan* (cv. D 744 82 K) in damped sand in glasshouse. Mycorrhiza free plants were cultured as controls in the same way. Chlamydospores were recovered from the mycorrhizal culture by wet sieve method of Gerdemann and Nicolson (1963). The suspension was adjusted to give spore concentration of 50,100,200 and 400 Chlamydospores. The spores were placed along with the *Cajanus cajan* in the centre of one kilogram potted soil. Only one plant was maintained per pot. Non-mycorrhizal plants received mycorrhizal free water suspension collected from rhizospore soil. There were 10 replications for each treatment. The experiment was terminated 45 days after planning. Fresh and dry shoot and root weights were recorded. The roots were washed with water and root volume was determined by water displacement method. The chlorophyll content was estimated spetrophotametrically according to the method of Arnon (1949). The roots were stained with acid fuchain in lactophenol (Phillips and Hayman, 1970). The percent mycorrhizal colonization was calculated by using the method of Krishna and Dart (1984).

Total nitrogen was estimated by microkjeldhal method (Bremner, 1965). Phosphorous and potassium from the diacid extract were estimated by Vanadomolybdo phosphoric yellow colour method (Allen, 1989) or flame photometer, calcium and magnesium in diacids extract were determined by ETDA method (Jackson, 1973).

Results and Discussion

Vegetative growth of mycorrhizal and non-mycorrhizal plants- Maximum fresh root weight was recorded in *Cajanus cajan* plants colonized with the mycorrhizal fungus at spore density of 400/pot. The results were highly significant at spore density of 50,100,200 and 400 when compared to non-mycorrhizal plants. The increase in fresh root weight at 50 spores was about 281.05% when compared to non-mycorrhizal plants and maximum increase in fresh root weight 396.43% was obtained at the highest 400 spores. The increase in fresh root also could be correlated with increased number of mycorrhizal spores.

The differences in fresh root weight between mycorrhizal and non-mycorrhizal plants were highly significant. The plants supplied with the Endomycorrhizal fungus showed four to five times fresher shoot weight than non-mycorrhizal plants (Table 1). There was an increase of 263.76% and 341% in fresh shoot weight at spore density of 50 and 400 mycorrhizal spores respectively when compared to non-mycorrhizal control *Cajanus cajan* plants (Table1). The increase in fresh shoot weight of *Cajanus cajan* plants at higher level spores of 200 and 400 were also highly significant.

There was constant increase in dry shoot weight when the spore density increased from 50 to 400 and the differences were significant at different spore densities. Mycorrhizal plants produced four to five times more dry weight with an increase of 276% and 430% over non-mycorrhizal plants. Maximum dry shoot weight was recorded with 400 spores. There were no significant differences and spore density of 50 an 100 but dry weights differed significantly with non-mycorrhizal plants at spore density of 200 and 400. There was a correlation of increased root volume (246%) was recorded at mycorrhizal spore density of 400 spores. The per cent increase in root volume was 192, 155 and 110% at spore densities 200, 100 and 50 respectively. The difference in root volume of *Cajanus cajan* plants were highly significant at spore density of 100, 200 and 400 spore/pot. The results of this study clearly indicated that increased vegetative growth of *Cajanus cajan* plants with increased mycorrhizal spore density of 50 and 400 per plant. Daft and Nicolson (1969) found a positive correlation in tomato growth at different mycorrhizal spore densities. Similar results were reported earlier by Sitraramaiah and sikora (1981). They found that increased mycorrhizal spore density of *G. mossae* from 50 to 1300 spores/pot increased the vegetative growth of cotton plants.

Inoculation with increased density of spores resulted in an increased total chlorophyll content (chlorophyll ‘a’ and chlorophyll ‘b’). Maximum chlorophyll content was recorded from plants inoculated with 400 spores. The total chlorophyll ‘a’content was increased from 19% at spore density of 50 spores to 25% at spore density of 400 spores compared to non-mycorrhizal plants. At 200 spore density the increase was 29% (Table 2). Similar results were in chlorophyll ‘b’ content also. As the spore density increased from 50 to 400 the chlorophyll ‘b’ content also increased. Maximum per cent increase 42% was recorded at 400 spores per plant. However, the ratio of chlorophyll ‘a’ and ‘b’ remained the same (2:2:1) for a non-mycorrhizal plants and the plants inoculated with mycorrhizal fungus at 50 spores, but it decreased to 1:9:1 at other higher spore density (100, 200 and 400 spore/plant).

Mycorrhizal root colonization

The mycorrhizal root colonization of *Cajanus cajan* roots at spore density of 50 was 60% and at 100 spores/plant was 65%. At higher spore density of 200 and 400 there was increased root colonization of 71 and 80%, respectively. Maximum root colonization was found at 400 spores/plant (80%) (Table 1). The per cent root colonization was maximum (35%) at 400 spores/plant. Sitarmaiah and Sikora (1981) reported a close relationship between initial inoculum spore concentration and root colonization. However, Daft and Nicolson (1969) tested 3 to 225 mycorrhizal spore concentrations per plant and found that all spore concentration stimulated tomato vegetative growth.

Chemical Composition

At spore concentration of 50 spores/plant there was 21% increase in nitrogen content of *Cajanus cajan* plants. The increased nitrogen content was 49, 72 and 90% at 100, 200 and 400 spore/ml, respectively (Table 3). Phosphorous content was also increased by 20.37% at 50 spores. At 100 and 200 spores phosphorus level the increase was 24.07 and 35 percent. the increase was maximum (70%) at spore density of 400. There were striking difference in potassium content between mycorrhizal and non-mycorrhizal plants. The potassium content was 58% more at 50 chlamydospores and increased to 91% at 400 chlamydospore level. There was a 55% increase in calcium content at 50 mycorrhizal spore level and increased to 69 and 100% at 200 and 400 mycorrhizal spores respectively. The percentage in magnesium content at spore density of 50 was 50% over non-mycorrhizal plantsand it increased to 100% spore density of 200 and 400 (Table 3). Hatting, et al. (1973) indicated that the mycelia net work of *G. mosseae* enabled to remove more minerals from a large soil volume extending beyond the immediate vicinity of the root surface.

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Effect of *G.fasciculatum* at different spore levels on root colonization and vegetative growth of *Cajanus cajan*

No. of mycorrhizal spores added along with Cajanus cajan seed	**Total root infection (%)**	**Length of root infection (%)**	**Root Volume (ml)**	**Fresh root weight (g)**	**Fresh shoot weight (g)**	**Dry shoot weight (g)**
0 (Control)	-	-	3.4	1.69	3.98	0.75
500	60	18	7.2 (112)	6.44 (281)	14.52 (265)	2.81 (275)
100	65	23	8.6 (153)	6.92 (309)	14.97 (276)	2.82 (276)
200	71	33	9.9 (191)	7.30 (332)	15.78 (296)	3.58 (377)
400	80	35	11.8 (247)	8.39 (396)	17.52 (340)	3.97 (429)
S.Em	-	-	1.14	0.92	1.64	0.31
C.D. at 1%	-	-	4.70	3.85	6.54	1.28
C.D. at 5%	-	-	2.80	2.80	4.75	0.93

Figures in parenthesis indicate per cent increase over non-mycorrhizal plants.

Table 2. Effect of *G.fasciculatum* at different levels of leaf chlorophyll content of *Cajanus cajan*

Number of mycorrhizal spores added along with Cajanus cajan seed at the time of sowing.	Chlorophyll content of *Cajanus cajan* levels			
	a	b	a+b	a:b
0 Control	1.244	0.556	1.800	2.2:1
50	1.467 (18)	0.657 (18)	2.124 (18)	1.2:1
100	1.474 (18)	0.749 (35)	2.223 (23)	1.9:1
200	1.485 (19)	0.761 (37)	2.246 (25)	1.9:1
400	1.548 (24)	0.788 (42)	2.336 (30)	1.9:1

Figures in parenthesis indicate percent increase over control (non-mycorrhizal plants).

Table 3. Effect of *G.fasciculatum* on chemical composition of *Cajanus cajan*

Concentration of mycorrhizal spores	Chemical composition				
	N(%)	P(%)	K(%)	Ca(%)	Mg(%)
0 Control	1.09	0.054	0.88	0.27	0.08
50	1.32	0.65	1.39	0.42	0.12
100	1.63	0.067	1.46	0.41	0.13
200	1.88	0.073	1.61	0.51	0.16
400	2.07	0.092	1.68	0.54	0.16

Figures in parenthesis indicate percent increase over control (non-mycorrhizal plants).