The Synergistic Effect Of VAM Fungi With *Rhizobium* On The Growth And Yield Of *Cicer Arietinum.L*

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Abstract

The study was initiated to determine the influence of VAM fungi on a *Rhizobium*-legume interaction in the green house condition. The pot experiment was conducted during rabi season with Annigeri-1 seed variety of *Cicer arietinum.L*. The different inoculations (single and dual) of *Rhizobium* and *Glomus fasciculatum* were incorporated. During the period of experiment samples were analysed for nodule numbers, dry weight of nodules, grain yields, phosphorus uptake and percent VAM infection. The results revealed that dual inoculation of *Rhizobium* with *Glomus fasciculatum* enhanced seed yield of chickpea.

KEYWORDS: VAM, *Rhizobium, Cicer arietinum.L, Glomus fasciculatum*, Crop yield, *Rhizobium*-legume interaction.

Introduction

India is the largest producer and importer of the leguminous crop (Shakya et al. 2008). Chickpea is one of the world's most important but less-studied leguminous food crop with 740-Mb genome size (Khan, R., Farhatullah and Khan, H., 2011). Chickpea ranks third among pulses, fifth among grain legumes, and 15th among grain crops of the world (Upadhyaya, 2003). Legumes have the ability to form two type of symbiotic association with micro-organisms; one with *Rhizobium* bacteria which is involved in the fixation of atmospheric nitrogen and the other with vescicular arbuscular mycorrhizal (VAM) fungi, which is concentrated with the uptake of phosphorus and other nutrients. Mycorrhizal fungi have been reported in roots of chickpea plants, improving the growth and yield of these plants, especially in phosphorus deficient soils (Zaidi, et al. 2003). Many workers have reported enhancement of phosphate uptake and growth of leguminous plants by vesicular arbuscular mycorhizal fungi (Ezawa *et al*. 2000, Arihara

and Karasawa 2000, Meshram et al, 2000, Joner 2000, Izagirre 2000, Guriqbal et al. 2001, Mamatha et al. 2002, Atimanav and Adholeya 2002)

AM is the most common type of mycorrhizal association, occurring over 2/3 of land plants (Hodge, 2000). There are evidences for simultaneous inoculation of legumes with *Rhizobium* and VAM fungi caused a synergistic beneficial effect. Following the dual inoculation, an increase in growth and nutrition uptake has been observed in pigeon pea, cowpea and soybean. De-Aguilar et al. (1979) reported that application of VAM fungi and *Rhizobium* acted as biological fertilizer for *Medicago sativa* in normal condition. In this paper the synergistic effects of *Rhizobium* and VAM on the yield pattern of chickpea have been given. The gram-negative soil bacteria such as *Rhizobia* have ability to cause infection in root tissues of the compatible host plant of legume and start the formation of nitrogen fixing nodules (Stougaard, 2000; Prell and Poole, 2006). It is the site for symbiotic nitrogen fixation formed as a result of series of interactions between *Rhizobium* and leguminous plants. Most *Rhizobium* isolates can nodulate more than one host plant species, while several different bacterial species are often isolated from a single legume host plant (Cooper, 2007). Rhizobia have four main types of surface polysaccharides which play their role at different stages of symbiotic development as well as including root colonization, host recognition, infection thread formation and nodule invasion.

A successful symbiosis and nitrogen fixation may be attained, if the conditions of *Rhizobium* inoculants remain optimized (Zahran, 2001). The isolation and screening of highly effective and competitive strains from native rhizobial population to be used as inoculums could be much beneficial under field conditions (Chatel and Greenwood, 1973). Based on these potent reviews, the aim of the research was to examine VAM fungi on a *Rhizobium*-legume interaction in the green house condition.

Materials and Methods

Collection, isolation, purification and authentication of *Rhizobium* culture were done by methods commended by Vincent (1970). Multiplication of rhizobial culture was done by " yeast extract mannitol" technique. The mother culture of *Glomus fasciculatum* was procured from department of microbiology GKVK and was multiplied on manure in 1:2:1 proportion. The most viable and efficient isolates of *Rhizobium* and mycorrhizal culture was applied at the time of sowing the seeds of Annigeri-1 variety of *Cicer arietinum*, at the rate of 2 gm per plant to be tested. One test plot was treated with standard doze of N (40Kg/ha), P (40kg/ha) and K (30kg/ha) which was uniformly applied to all test pots. The experimental design was in SPD with four replicates and four treatments. The four treatments involved in the study are; T_1-control, T_2-Rhizobium, T_3-inoculation with *Rhizobium + Glomus fasciculatum.*

RESULTS

The impact of *Rhizobium* and VAM inoculation on growth patterns of chickpea is given Table-1. Maximum number of nodules, dry weight of nodules, grain yield, P uptake and per cent VAM infection was recorded in combination of *Rhizobium* and VAM inoculation i.e. T_4 when compared to T_1 (control), T_2 (*Rhizobium*) and T_3 (*Glomus fasciculatum*).

Table 1: **Growth parameters of chickpea affected by different treatments with *Rhizobium* and *Glomus fasciculatum***

Sr. No	TREATMENTS	NODULE NO	NODULE DRY WEIGHT (Mg/pl)	PLANT DRY WEIGHT (g/5.4 m2)	GRAIN YEILD	P UPTAKE	% VAM INFECTION
1	T_1-CONTROL	14.20	7.20	22.04	250.00	15.20	25.80
2	T_2-RHIZOBIUM	35.20	24.60	34.02	450.00	18.80	37.60
3	T_3-GS FASCICULATUM	17.00	8.40	31.32	380.00	33.60	51.80
4	T_4-RHIZOBIUM+GS FASCICULATUM	40.60	26.20	46.06	592.00	45.40	60.60

DISCUSSION

The results clearly indicate that the synergistic combination of *Rhizobium* with *Glomus fasciculatum* showed the anticipating improvement in growth parameters as well as in the biomass when compared with single inoculation of *Rhizobium* and *Glomus fasciculatum* alone. On the basis of present investigation and results obtained use of bio-fertilizers are highly recommended in agro-foresting ecosystem which is eco-friendly, cost-effective and alternative to synthetic fertilizers. Root nodules formed by *Rhizobium* sp. under field condition were larger than the nodules formed in the plants under pot condition (Akhtar and Siddiqui, 2008). Higher nitrogen fixation by large size nodules may account for reduced development (Barker and Huisingh, 1970).

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