

Short Communication

Effect of dual inoculation with *Rhizobium* and vesicular arbuscular mycorrhiza in chickpea (*Cicer arietinum*) at varying nitrogen levels

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ABSTRACT

Field experiments were conducted for two consecutive years (*rabi* 1995-96 and 1996-97) to study the effect of various levels of N (0, 25, 50 and 75 kg ha⁻¹) with *Rhizobium* alone and in combination with vesicular arbuscular mycorrhiza (VAM) on nitrogen fixation, VAM colonization and grain yield in chickpea. Maximum number and dry weight of nodules and nitrogenase activity were found at 50 kg N ha⁻¹ in dual inoculated treatments. Nodulation and nitrogenase activity were inhibited at 75 kg N ha⁻¹. However, maximum percentage of mycorrhizal colonization and grain yield were recorded at 75 kg N ha⁻¹. Thus, higher level of N might facilitate VAM cononization and increased grain yield of chickpea in the presence of *Rhizobium* inoculation.

Keywords : Chickpea, *Cicer arietinum* (L.), *Rhizobium*, nitrogenase activity, vesicular arbuscular mycorrhiza, nitrogen, India

The beneficial effect of *Rhizobium* inoculation with vesicular-arbuscular mycorrhiza (VAM) on nutrient uptake, particularly phosphorus is well documented, which in turn is known to stimulate biological nitrogen fixation (Subba Rao *et al.* 1982). The information on the effects of various levels of nitrogen on VAM colonization is limited and contradictory (Azcon *et al.* 1982; Thompson 1986; Tilak and Dwivedi 1991). Present work was therefore, undertaken to study the effect of various levels of N on VAM colonization, nitrogen fixation and grain yield in field grown chickpea.

Field experiments were conducted in microplots (1.5 m x 1.2 m) for two consecutive years during *rabi* (October-April) 1995-96 and 1996-97 at the experimental farm, Punjab Agricultural University, Ludhiana in the subtropical region of India, to study the effect of various levels of N on VAM colonization, nitrogen fixation and grain yield in chickpea variety PBG 1. The soil was a loamy sand, low in organic carbon (0.32%) and available nitrogen (103 kg ha⁻¹), medium in available phosphorus (14.5 kg ha⁻¹) and potassium (178 kg ha⁻¹) with pH 8.2. A basal dose of 40 kg P₂O₅ ha⁻¹ was applied at sowing. Chickpea seeds were coated with recommended culture of *Rhizobium* (PAU G-33) in all treatments except the uninoculated control. There were four treatments at nitrogen rates of 0, 25, 50 and 75 kg ha⁻¹ in the form of urea. Four microplots consisting of different levels of N were inoculated with *Rhizobium* and sand + soil

(1:1) based inoculum of *Glomus fasciculatum* (Thaxter sensu Gerd.) Gerd. & Trappe. Two hundred and fifty grams of inoculum (125-150 spores per 100 g) were spread uniformly in four microplots.

Five plants were carefully uprooted from each plot at 65 days after sowing and gently washed to record nodulation. The nodules were detached and oven dried at 60°C for 24 hours and the dry weight was recorded. The nitrogenase activity of nodules with intact root system was measured by acetylene reduction assay by gas chromatography (AMIL NUCON MODEL 5560) using porapak-R column (Hardy *et al.* 1968) and percent colonization was determined according to Phillips and Hayman (1970). Grain yield was recorded at the harvesting stage. The experiment was laid out in a Randomized Block Design with four replications. The data were subjected to analysis of variance and the mean separation was done by least significance difference test.

Higher number and nodule dry weight/plant and nitrogenase activity were recorded in dual inoculated treatment at all N levels. Maximum number, dry weight and nitrogenase activity of nodules (48, 74 mg and 90.5 μ moles of C₂H₄ hr⁻¹ plant⁻¹) were recorded at 50 kg N ha⁻¹ in dual inoculated treatments. Although nodulation and nitrogenase activity decreased, significant percentage of VAM colonization and grain yield were recorded at 75 kg N ha⁻¹ i.e. 75.5% and 1680 kg ha⁻¹ were recorded at this level (Table 2).

Table 1. Number, dry weight and nitrogenase activity of nodules as influenced by inoculation with VAM and *Rhizobium* at varying levels of N (Pooled analysis)

Treatment	Number of Nodules Plant ⁻¹	Nodule dry wt. plant ⁻¹ (mg)	Nitrogenase activity (Um of C ₂ H ₄ h ⁻¹ Plant ⁻¹)
Uninoculated Control 0Kg N ha ⁻¹	20	38.0	40.5
<i>Rhizobium</i> ®	22	45.5	48.5
R+VAM 25 Kg N ha ⁻¹	25	51.0	55.5
R	28	55.0	68.0
R+VAM 50 Kg N ha ⁻¹	33	60.0	74.5
R	37	65.5	77.0
R+VAM 75 Kg N ha ⁻¹	48	74.0	90.5
R	35	62.0	70.5
R+VAM	44	70.5	85.2
C.D 5%	4.2	12.5	20.8

Table 2. Root colonization and grain yield as influenced by inoculation with VAM and *Rhizobium* at varying levels of N (Pooled analysis)

Treatments	Root colonization (%)	Grain Yield (kg ha ⁻¹)
Uninoculated Control 0Kg N ha ⁻¹	22.0	1455
<i>Rhizobium</i> (R)	28.0	1470
R+VAM 25 Kg N ha ⁻¹	35.0	1565
R	37.5	1490
R+VAM 50 Kg N ha ⁻¹	55.0	1605
R	45.0	1505
R+VAM 75 Kg N ha ⁻¹	60.0	1640
R	52.0	1530
R+VAM	75.5	1680
C.D. 5%	7.5	100.5

Tilak and Dwivedi (1991) also reported significant increase in VAM colonization and grain yield in chickpea at 100 kg N ha⁻¹.

It has been reported that higher levels of N might facilitate VAM colonization (Thompson 1986; Kumar *et al.* 1998 and Konde *et al.* 1998) and subsequently increase grain yield of chickpea in the presence of *Rhizobium* inoculation.

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