

EVALUATION OF RHIZOBIAL STRAINS FOR ROOT NODULATION, GROWTH AND YIELD, IN CHICKPEA (*CICER ARIETINUM*) UNDER NATURAL CONDITIONS

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Abstract

The study was carried out to determine the effect of two rhizobial strains (i)Thal 8 and (ii)TAL 620, on three varieties of chickpea(*Cicer arietinum*) differ in nodulation capacity viz ICC 4948 High nodulating (HN), ICC 4948 Low nodulating (LN), ICC 4948 Non-nodulating (NN) . Seeds were inoculated with peat, as a carrier based inocula of rhizobial strains and sown in earthen pots during the mid November ,under natural conditions. Data on growth and yield parameters were recorded and analysed. Results showed that rhizobium inoculation significantly increased the number of nodules, weight of nodules, plant height, weight of shoots and weight of pods per plant. The study reveals that rhizobial strain Thal 8 being more efficient as compared to TAL 620, can be used to increase root nodulation and yield in chickpea (*Cicer arietinum*).

Introduction

Chick pea (*Cicer arietinum*) is a member of family fabaceae one of the most important pulse crop grown in Pakistan, with in a wide range of climates. (Sanker and Doesthale, 1981). It is the fifth most important legume crop in the world, following soyabean, groundnut, dry bean and dry pea (FAO 1989).

The plant is very sensitive to excess moisture, high humidity and cloudy weather which adversely affect its yield through limited flower production (Kay, 1979).

Although chickpea is by far the most widely grown legume crop in Pakistan, very little is known about its capacity for nitrogen fixation. It helps in the maintenance of soil fertility level by deriving part of its nitrogen from symbiotic nitrogen fixation. Chickpea possesses a taproot system and primary and secondary roots usually develop large lobed nodules containing rhizobia, which fix atmospheric nitrogen symbiotically .It has medicinal as well as nutritional value that make chickpea an extremely important food item.

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Rhizobium

Rhizobium is the symbiotic bacteria, which fixes the nitrogenous compounds from atmospheric nitrogen. It has been observed that chickpea inoculation with *Rhizobium* results in significant increase in number of nodules, nodule dry weight and nitrogen accumulation (Sattar et al 1993)

Legume yield and N accumulation are directly related to the magnitude and efficiency of symbiotic nitrogen fixation occurring in root nodules (Sexena et al, 1990) Interaction between roots of leguminous plants and bacteria leads to the formation of a unique plant organ, the nodule, in which the differentiated bacteria fix atmospheric nitrogen. The development of nodule proceeds through several distinct steps in a specific order.

Growth of chickpea is dependent upon nodulation by effective rhizobial strain varieties that are non-nodulating will be deficient in nitrogen and will have low production of biomass and grains. ICRISAT Asia center (IAC) commenced a programme in 1983 to select high nodulating varieties of chickpea as a strategy to improve both stability and potential yield (Rupela 1994)

Materials and Methods

Seeds of chickpea were obtained from International Crops Research Institute of Semi Arid Tropics (ICRISAT) India. Two strains of *Rhizobium* Thal 8 and TAL 620 were obtained from NARC Islamabad. Seeds were sterilized with 0.1 % mercuric chloride solution for about 2 minutes, thoroughly rinsed with distilled water, and inoculated with peat as carrier based inoculums of *Rhizobium leguminosarum*.

Method of inoculation

Seeds were moistened with sugar solution (48%). There after the carrier based inocula of rhizobial strains (TAL 620) and (Thal 8) were spreaded separately over the seeds and were mixed thoroughly for uniform coating. Seeds were sown in earthen pots filled with mixture of sand and clay in 1: 3 ratio. Four plants per pot were allowed to grow during the mid November under natural condition.

Strains

S1= TAL 620

S2=Thal 8

S0=No strain

Varieties

V1=Normal nodulating

V2-High nodulating

V3=Non nodulating

Summary of treatments and parameters

S. No.	Treatments	Parameters
1.	V1S1=Normal nodulation inoculated with TAL 620	Height of shoot per plant
2.	V1S2=Normal nodulation inoculated with Thal 8	Fresh weight of shoot per plant
3.	V1S0=Normal nodulation i-e non inoculated	Fresh weight of root per plant
4.	V2S1=High nodulation inoculated with TAL 620	Number of nodule per plant
5.	V2S2=High nodulation inoculated with Thal 8	Weight of nodule per plant
6.	V2S0= High nodulation l-e non inoculated	Number of flowers per plant
7.	V3S1=Non nodulation inoculated with TAL620	Number of pods per plant
8.	V3S2=Non nodulation inoculated with Thal 8	Weight of pods per plant
9.	V3S0=Non nodulation l-e non inoculated	-

The data of the said parameters were recorded and analyzed statistically.

Result and discussion

The ANOVA (Analysis of Variance) and DMRT (Duncons Multiple Range Test) of all the parameters mentioned above showed significant differences among all the treatments (see ANOVA & DMRT table). The weight of shoot, root, nodule, pod while the numbers of nodules, flower and pods, per plant revealed that two strains of *Rhizobium* Thal 8 and TAL 620 increase the growth and yield of the plant. Plants inoculated with Thal 8 showed maximum increase in all the above-mentioned growth and yield parameters as compared to TAL 620 & control. High nodulating (V2) variety inoculated with Thal 8 showed maximum growth and yield as compared to control and that inoculated with TAL 620, while the normal nodulating (V1) variety and non nodulating (V3)

Variety showed less growth and yield per plant as compared to the high nodulating variety and control.

Inoculation of the plants with *Rhizobium* has increased the growth and yield of the plants as compared to non-inoculated plants. This is in accordance with the previous findings where inoculation of plants with specific and effective strains of *Rhizobium* species had a positive effect on the plant biomass and the height of all inoculated plants as compared to control (Lal et al; 1992)

Maximum increase in growth and yield of plants in high nodulating variety inoculated with Thal 8 may be due to the vigorous vegetative growth mediated by the increased hormone production of growth promoting hormones (Banik et al; 1988). Significant differences were observed among all the yield parameters. Crop yield was found to be increased due to *Rhizobium* inoculation. Okon et al; (1996) observed that field inoculation with *Azospirillum brasilense* increased nodule, plant growth parameters and seed yield of naturally nodulated *Cicer arietinum*.

Conclusion

It is inferred from the present findings that *Rhizobium* strain Thal 8 can be implicated to enhance the growth and yield. High nodulating variety (V2) may be used for cultivation because of the high nodulating capacity to increase the soil fertility as well as the ability of higher yield.

ANOVA and DMRT Summary of all the parameters with average values

S.No.	Treatment	Number of flowers per plant	Height of shoot per plant	Number of pods per plant	Weight of root per plant	Weight of shoot per plant	Weight of pod per plant	Number of nodule per plant	Weight of nodule per plant
1.	V1S1	1.167CD	23.867BC	.833AB	1.120D	1.220CD	1.300B	9.400CD	1.280CD
2.	V1S2	1.000D	21.667C	1.500C	1.860AB	1.520BC	2.160A	12.20BC	1.780B
3.	V1S0	1.333CD	25.250BC	1.167B	1.260CD	1.140D	1.320B	7.600D	1.120D
4.	V2S1	3.333A	29.750A	2.167D	1.700B	1.320BCD	1.160B	19.20A	1.500BC
5.	V2S2	4.833ABC	30.500A	2.333AB	2.140A	2.400A	2.400A	20.40A	2.620A
6.	V2S0	2.333BCD	26.500AB	1.833C	1.540BC	1.360BCD	1.340B	13.40B	1.300CD
7.	V3S1	2.667ABC	20.133BC	1.167A	1.100D	1.180CD	1.320B		
8.	V3S2	1.833BCD	24.067BC	1.667D	1.560BC	1.640B	2.280A		
9.	V3S0	3.667AB	22.217C	1.333AB	1.160D	1.280CD	1.582B		
10.	LSD	2.187	4.273	0.321	0.365	0.349	0.378	3.791	0.357

All such means, which share a common english letter, are non significantly different, otherwise they differ significantly at $P < 0.05$

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