

## SYMBIOTIC EFFICIENCIES OF DIFFERENT RHIZOBIAL STRAINS AS INOCULANT OF CHICKPEA (*CICER ARIETIUM* L.)

BY

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The experiment was conducted in pot culture method to study the efficiency of ten different strains of *Cicer Rhizobium* on nodulation and growth of chickpea (*Cicer arietinum* L.). Out of the ten strains, only four strains namely, B-69/7, B-21/3, B-50/2 and B-53/3 were found to be superior to their nodule yield (number, fresh and dry weight) and growth of the plant. Maximum and minimum number of nodules and weight of the plants were observed in the strain No. B-69/7 and B-8/2 respectively.

### INTRODUCTION

Nodulation and fixation of nitrogen by *Rhizobium* species mainly depend upon the specific relationship in between the host plant and the bacteria. Several workers (Spratt, 1919; Mc Coy, 1929; Thornton, 1930, 1952; Allen and Allen, 1940, 1950; Bond, 1984; Vincent, 1954, 1962; Caldwell, 1969; Natman, 1946, 1949, 1976; and Poi, 1986) have studied the development in leguminous plants and concluded that the relationship depends as much on genetic constitution of the host plant as also on that of bacteria and on distinctive factors including the rhizosphere. The seed inoculation of leguminous crop with efficient strains of *Rhizobium* bacterium have a most important practice adopted in our country for increasing the yield mainly in pulse crops. It has been reported (Brockwell and Gault, 1972; Patil and Medhane, 1974; Sundara Rao, 1974; Subba Rao, 1976 and Poi and Ghosh, 1986) that 10%-30% yield could be increased by seed inoculation with appropriate *Rhizobial* strain in pulse crops. In view of the above findings the different strains of *Cicer Rhizobium* were taken to make a comparative study of symbiotic performance among those strains on chickpea (*Cicer arietinum* L.) in respect of nodulation and growth of the plants.

## MATERIALS AND METHODS

The ten different strains of *Cicer Rhizobium* included in this experiment were B-8/2, B-27/3, B-69/7, B-53/3, B-21/3, B-1/3, B-28/3, B-66/6, B-38/5 and B-50/2. All the strains were grown in Yeast-Mannitol broth medium, (containing Mannitol 10.0g;  $K_2HPO_4$ , 0.5g;  $MgSO_4 \cdot 7H_2O$ , 0.2g;  $CaCl_2$ , 0.2g; NaCl, 0.1g;  $FeCl_3$ , 0.1g; yeast extract 0.4g; Distilled water, 1000 ml) for conducting this experiment. Seeds of B-108 variety of chickpea (*Cicer arietinum* L.) was used as host. The seeds were sown in the sterilized earthen pots (10 cm diameter) filled with washed sand (pH 7.0). Each pot contained five number of plants. Seedling solution containing all plant nutrients ( $CaH_2PO_4$ , 1.0g;  $K_2HPO_4$ , 0.2g; NaCl, 0.2g;  $FeCl_3$ , 0.1g, in trace amount of Copper, Molybdenum, Zinc, Boron, Manganese; distilled water 1000 ml, pH 6.5-7.0) except nitrogen was applied to the pots at three days intervals for maintaining the normal growth and vigour of the plants. Pots were irrigated periodically with sterilized tap water. Seven days old broth culture (grown at  $30^\circ C \pm 1^\circ C$ ) of different strains of *Cicer Rhizobium* were applied to the pots at the rate of 5 ml per pot just after germination of the seeds which were in sterilized pots. Three replications were taken for each strain following Randomized Block Design. Control sets were maintained without application of *Rhizobium* culture.

## RESULTS

Observations were recorded at just initiation of flowering stage of the plants. The plants were uprooted carefully and washed thoroughly with tap water for recording the data. Observations were made in respect of nodular number, fresh and dry weight of nodules and fresh and dry weight of the plants.

### *Nodular numbers*

Data obtained from the Table 1 it is observed that all the strains tried on chickpea had nodulated more or less in equal pattern varying in number per plant from 23 to 48. The average number of nodules per plant were recorded maximum in the strain No B-69/7 (48.66), followed by B-21/3 (46.00), B-50/2 (41.33), B-53/3 (40.00), B-66/7 (34.33), B-1/3 (34.00) and minimum number of nodules was obtained in the strain No. B-8/2 (23.66). Control sets did not show any nodule.

### *Nodular weight (Fresh and Dry)*

Results from the Table 1 revealed that strain No. B-69/7 showed the highest nodular fresh weight (0.669 g) as well as dry weight (0.423 g). Lower fresh weight (0.101 g) was observed in the strain No. B-8/2 as well as dry weight (0.086 g). In case of other strains, dry weight of nodules might not be correlated in all times with the fresh weight of the plants even in nodular number also.

Table 1. Effect on nodulation of chickpea (*Cicer arietinum* L.) inoculated with different Rhizobial strains (Average of three replications, each replication contains five plants)

Strains	Number of nodule per plant	Nodular weight in g/plant	
		Fresh weight	Dry weight
B-8/2	23.66	0.101	0.086
B-27/3	29.00	0.230	0.125
B-69/7	48.66	0.669	0.423
B-53/3	40.00	0.645	0.416
B-21/3	46.00	0.581	0.311
B-1/3	34.00	0.248	0.116
B-28/3	33.33	0.329	0.155
B-66/6	34.33	0.312	0.206
B-38/5	32.66	0.288	0.100
B-50/2	41.33	0.588	0.466
S. Em $\pm$	2.60	0.045	0.036
C.D.(at 5% level)	5.46	0.094	0.077

Uninoculated (i.e. without *Rhizobium*) control sets did not show any nodule.

Table 2. Effect of different Rhizobial strains on the growth of chickpea (*Cicer arietinum* L.) (Average of three replications, each replication contains five plant)

Strains	Fresh weight per plant	Dry weight per plant
	(in gram)	(in gram)
B-8/2	1.667	1.021
D-27/3	2.276	1.725
D-69/7	3.346	2.054
D-53/3	3.243	1.864
D-21/3	3.267	1.696
D-1/3	2.179	1.733
D-28/3	3.218	1.941
D-66/6	3.141	1.955
D-38/5	2.661	1.341
D-50/2	3.327	1.815
Control (without <i>Rhizobium</i> )	1.006	0.733
S. Em $\pm$	0.208	0.032
C.D. (at 5% level)	0.434	0.067

#### Fresh weight and dry weight of plants

All the strains tried in this experiment (Table-2) increased the growth of the plant in respect of fresh and dry weight of the plant over uninoculated control. Differential growth rate of plants was observed by the application of different strains of *Cicer Rhizobium*. The highest fresh weight (3.346 g) as well as dry weight (2.045 g) of plant were found when the strain No. B-69/7 was applied as inoculant. Lower fresh weight as well as dry weight were observed in the strain

No. B-8/2. Generally dry weight might not be depended accordingly to the fresh weight of the plant. On the basis of fresh weight and dry weight of the plant it was found that the better strains are B-69/7, B-21/3, B-53/3, B-28/3 and B-66/6. In control set fresh and dry weight of the plant were observed as 1.006 g and 0.773 g respectively which is significantly different from all the strains applied as inoculants.

#### DISCUSSION

In pot culture experiment the ten different strains of *Cicer Rhizobium* inoculated on chickpea (*Cicer arietinum* L.) to study the symbiotic performance regarding nodulation and growth of the plants. It is revealed that the host plant to a particular strain does not play an important role in determining the competitiveness but it is governed by the relative virulence of the rhizobial strains (Patil and Medhane, 1974; Poi, 1986). In this experiment the strain numbers B-69/7, B-21/3, B-50/2 and B 53/3 showed better performance in respect of nodulation and growth of the plants. Minimum performance was observed in the strain number B-8/2. The performance of the strains to specific host is closely associated with the effectiveness of the strain towards the host (Caldwell *et al* 1969 and Robinson, 1969). From the above findings it may be concluded that most of the nodule sites are occupied by the effective strains of *Rhizobium* species.

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