EVALUATION OF DIFFERENT RHIZOBIA INOCULATION METHODS IN COMMON BEAN (*Phaseolus vulgaris* L.)

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Key Words: N_2 fixation, ^{15}N method, grain yield.

INTRODUCTION

Improvement of N_2 fixation will depend on the selection of superior plant genotypes and *Rhizobium* strains. Indeed, symbiotic N_2 fixation results from the interactions of the leguminous host with a compatible species of *Rhizobium*. The amount of plant N derived from fixaton is determined by the genetic constitutions of both symbionts and the environment, as well as all possible interactions among these components.

Studies have been performed to evaluate the effects of rhizobial inoculation on common bean, and most of the results have shown no response of common bean to inoculation (Graham and Halliday, 1977). This might be due to: the presence of a large population of rhizobia in the soil, host plant with low N_2 fixation potential, and environmental factors which affect the efficiency of the inoculation.

Studies also indicated that the secondary nodulation is very important for N_2 fixation in bean (Wolyn et al. 1989). Consequently, it is important that the inoculated rhizobia reach the secondary roots.

The objective of this study was to evaluate methods and time of application of the inoculant on common bean, and their contribution to nitrogen fixation by beans.

MATERIAL AND METHODS

The experiment was conducted in randomized complete block design with four replications with the following treatments: rhizobia inoculation on the seed; granular inoculation; rhizobia inoculation incorporated into the soil, and uninoculated control. All the above treatments received a side dressing inoculation applied at 47 days after the emergence of the plants. A non nodulating soybean line was used as a non-fixing control.

The seed and the granular inoculation was done using the equivalent of 50 mg of rhizobia inoculum containing 1.5×10^7 cells of rhizobia/seed. The incorporated inoculum was applied as solutions of 6 g of inoculum dissolved in 10 l of H_2O, applied on the planting furrows, and as side dressing in furrows 10 cm from the plant canopy.

The ^{15}N was applied in 2 m of the central row of the plot as solution containing 10 g of $(NH_4)_2SO_4$ with 10% of enrichment.

Samples were taken from 5 plants at 88 and 102 days after planting, which correspond, to the R_7 and R_9 growth stages. The following traits were evaluated: percent of N, ^{15}N excess, total N content, N derived from the air and N_2 fixed. The latter were measured using the isotope dilution method technique (Hardarson and Danso, 1990).

REUSLTS AND DISCUSSION

The type of inoculation significantly affected the percent of N derived from the air (Ndfa) and the grain yield (Table 1). When the inoculum was incorporated, 65% of the nitrogen at R_7 was derived from N_2 fixation (Table 1).

Even though the soil where the experiment was carried out had a large native rhizobial population, the seed and incorporated inoculation had a positive response in comparison with control without inoculum (Table 1).

The large percentage N_2 fixed in the treatments receiving incorporated inoculation might be due to higher nodule occupancy formed by the inoculant on secondary roots. Previous studies have shown the importance of the secondary nodulation on the N_2 fixation potential of common bean (Wolyn et al. 1989). On the other hand, rhizobia has been reported to have low motility in soil (Madsen and Alexander 1982), and (particularly) *Rhizobium tropici* usually form high proportions of the nodules on the crown region, compared to the secondary roots (Pereira et al. 1989).

In this study inoculation treatments produced higher proportion of N derived from the N_2 fixation and grain yields than the uninoculated control. The inoculum incorporated into the soil might have enhanced the nodulation of secondary roots. Common bean could therefore respond to inoculation of rhizobia with high grain yield production under right conditions.

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Table 1. Grain yield[1] and N_2 fixation related traits[2] of black bean cultivar WBR 22-50 grown during the dry season, Goiás, Brazil, 1989.

TREATMENT	PERCENT OF		Ndfa	SHOOT N CONTENT	GRAIN YIELD
	N	^{15}N exc.	(%)	(mg/pl)	
Seed inoculum	2.10	0.194	58.3	322.5	2695
Granular inoculum	1.81	0.300	34.9	322.3	2486
Inoculum incorporated	1.93	0.180	65.1	321.5	3249
Control	1.78	0.270	41.5	491.6	1757
LSD	ns	ns	16.5	ns	299

[1] Evaluated at R_9 growth stage.
[2] Evaluated at R_7 growth stage.