

INOCULATION EFFECT ON N₂ FIXATION IN *Phaseolus vulgaris* L. IN LOW-LAND SOIL IN BRAZIL

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The "cerrado" region of central Brazil contains many river floodplains and other lowland soils which are suitable for irrigated agricultural production during the dry season. These areas are characterized by high temperatures and high light intensity, and are usually planted to flooded rice during the rainy season. The utilization of these areas offers the possibility of increasing agricultural production by fitting an additional crop into the cropping pattern. A system of sub-irrigation is under development to grow leguminous crops such as soybean and common bean (*Phaseolus vulgaris* L.). The use of nitrogen (N) fertilizer in lowland areas is more difficult because of the heavy structure of the soil, and losses by denitrification can be significant.

Common bean is the main source of vegetable protein in Brazil, but yields are usually low due to minimal inputs. Recent studies have demonstrated that the periodic inundation of lowland areas decreases the survival of rhizobia in the soil, providing an opportunity to use symbiotic N₂ fixation through inoculation with *Rhizobium leguminosarum* biovar *phaseolias* as a source of N for the bean plants.

The present study was conducted to evaluate the response of 8 bean lines to rhizobial inoculation and N fertilization. The experiment was planted at the Rio Formoso Cooperative, Formoso do Araguaia, Goiás, Brazil, in a randomized complete block design with a split plot layout and 4 replicates. Source of N was the main plot treatment and bean line was the subplot factor. Treatments included: 1) rhizobial inoculation, 2) rhizobial inoculation + 40 kg N/ha at 25 days after emergence (DAE), 3) 20 kg N at planting + 40 kg N at 25 DAE, and 4) control (neither inoculation nor N). The bean lines utilized were: WBR 22-03, WBR 22-08, WBR 22-50, and WBR 22-55 (Bliss et al., 1989), EMGOPA 201-Ouro (a recently released cultivar), and LM 21135, ICA Col 10103, and TC 1558-1 (promising materials selected by other Brazilian research programs). Rhizobial strain CIAT 899 was applied as a granular peat inoculum in the furrow at planting.

The response to inoculation was highly significant (Table 1). Plants receiving no inoculum formed no nodules, indicating an absence of native rhizobia in the soil. Nodule dry weight of WBR 22-55 and EMGOPA was higher with only inoculum than with inoculum + side-dressed N. The other lines showed an increase in nodule mass with the side-dress application of N, indicating that in some lines N fertilizer applied during the vegetative stage of plant growth may have a stimulatory effect on nodule formation.

Across lines, the effect of rhizobial inoculation on grain yield was highly significant, resulting in 48 and 12% yield increases relative to the control and N treatments, respectively (Table 2). Yields of lines WBR 22-50 and WBR 22-55 increased with the side-dress application of N (Table 2), indicating host plant variability in response to combined N.

In this study some bean lines relying solely on N₂ fixation had higher yields than when combined N was applied. Although yields were low due to problems with soil preparation and insect damage to the root systems, these lowland areas offer a possibility for the use of N₂ fixation as the sole source of N for beans, without concomitant yield reductions.

References

- Bliss, F.A., P.A.A. Pereira, R.S. Araujo, R.A. Henson, K.A. Kmiecik, J.R. McFerson, M.G. Teixeira, and C.C. da Silva. 1989. Registration of five high nitrogen fixing common bean lines. *Crop Sci.*: In Press.

Table 1. Dry weight of nodules at R₄ growth stage of 8 common bean lines grown in lowland soil at Formoso, Goiás, Brazil. Values are means of 4 replicates.

Bean lines	Control	Rhizobia	Rhizobia + N (0+40 kg/ha)	N (20+40 kg/ha)
WBR 22-03	0	48	57	0
WBR 22-08	0	74	82	0
WBR 22-55	0	133	51	0
WBR 22-50	0	61	129	0
EMGOPA 201-Ouro	0	92	32	0
LM 21135	0	77	158	0
ICA Col 10103	0	54	111	0
TC 1558-1	0	38	73	0
\bar{X}	0	72	87	0
LSD 0.05			54	

Table 2. Grain yield of 8 common bean lines grown in lowland soil at Formoso, Goiás, Brazil. Values are means of 4 replicates.

Bean lines	Control	Rhizobia	Rhizobia + N (0+40 kg/ha)	N (20+40 kg/ha)
WBR 22-03	382	439	361	470
WBR 22-08	193	362	264	421
WBR 22-55	212	521	675	423
WBR 22-50	276	427	556	482
EMGOPA 201-Ouro	301	625	421	505
LM 21135	299	569	493	517
ICA Col 10103	323	877	659	441
TC 1558-1	251	462	260	516
\bar{X}	280	535	461	471
LSD 0.05*			81	

* For comparisons within columns.