NODULATION, SEED YIELD AND DINITROGEN FIXATION IN DETERMINATE AND INDETERMINATE COMMON BEAN CULTIVARS

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Legumes form a symbiosis with nodule-forming *Rhizobium* bacteria and are able to fix their own nitrogen. Legume crops with effective nitrogen fixation can be grown with reduced input of nitrogen fertilizers. Common bean is generally regarded to be a poor nitrogen fixer and application of N fertilizers has been recommended in bean production. The success of the inoculation process may depend on a number of factors including environmental variables and the host cultivar. Substantial genotypic variability exists within common bean cultivars for nitrogen fixation (Hardarson et al. 1993; Pena-Cabriales et al. 1993). Cultivars are classified into four main groupings based on growth habit (Kelly et al. 1987) and nitrogen fixation may vary widely depending on growth habit of the genotype (Graham 1981). The objectives of the present study were 1) to compare twelve common bean cultivars for nodulation and nitrogen fixation and 2) to determine the relationship between nitrogen fixation and seed yield among growth habit types.

The study was conducted at two locations in Saskatchewan: Saskatchewan Pulse Growers (SPG) farm (Dark Brown Chernozemic soil) and Seager Wheeler Farm near Rosthern (Black Chernozemic soil) in 2000 and 2001. In both years, the sites chosen for the study had low (less than 20 kg/ha) available N in the surface 60 cm. Twelve bean cultivars representing three commercial classes and three growth habits (Table 1) were used in the study. The treatments consisted of a control with no inoculant application and an application of granular inoculant placed in the furrow. Triple superphosphate (0-45-0) at the rate of 20 kg/ha P_2O_5 was applied in the furrow at planting. No nitrogen fertilizer was applied. The study was arranged in a randomized complete block design with four replications. Data were collected on nodule dry mass and shoot dry mass at mid- podfill, and seed yield and amount on nitrogen derived from fixation at final harvest. Nitrogen fixation was determined by the natural abundance method (Bremer and van Kessel 1990).

The results report nodule dry mass and shoot dry mass data averaged over two locations and two years of experimentation. Seed yield and nitrogen fixation are based on the first year data. Nodule dry mass was significantly higher for the inoculated plots compared to control plots for all bean cultivars (Figure 1). Type II and Type III (indeterminate) cultivars had increased nodule dry mass compared to Type I (determinate) cultivars. Nodule dry mass varied little within each growth habit group. Inoculant had no effect on shoot dry mass for all cultivars (data not shown). Applying granular inoculant increased seed yield significantly over the control. This increase in seed yield was higher for Type III cultivars (30%) compared to Type I (18%) or Type II (19%) cultivars (Figure 2). The response to inoculant application varied within Type I and Type III cultivars but was the same within Type II cultivars. Granular inoculant application increased the amount of N fixed by bean plants significantly compared to control plots (Figure 4). Type III cultivars fixed significantly greater amounts of N compared to Type I or Type II cultivars. The amount of N fixed in inoculated plots ranged from 21 to 36 kg ha^{-1}. Type III cultivars were at the upper range whereas Type II cultivars were at the lower range. Results of this study show significant differences in nodulation and N_2 fixation among common bean cultivars. The differences were associated with growth habit.

Table 1. Characteristics of bean cultivars used in the study

Name of cultivar	Commercial class	Growth habit*
CDC Camino	Pinto	I
CDC Pintium	Pinto	I
CDC Pinnacle	Pinto	III
CDC Altiro	Pinto	III
CDC Bianca	Great Northern	I
AC Polaris	Great Northern	II
CDC Crocus	Great Northern	III
US 1140	Great Northern	III
CDC Expresso	Black	I
AC BlackDiamond	Black	II
CDC Nighthawk	Black	II
UI 906	Black	II

*Growth habit: I = determinate bush; II = indeterminate upright short vine; III = indeterminate postrate long vine.

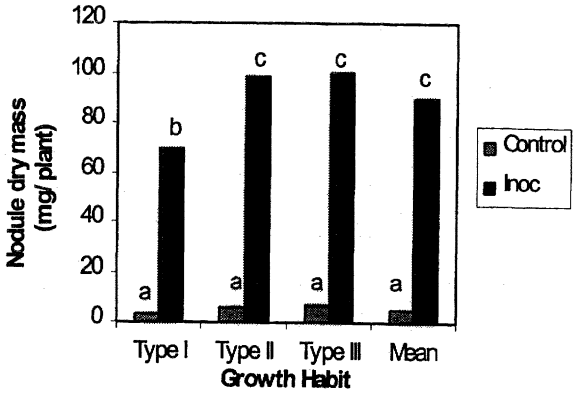

Figure 1. Effect of growth habit and inoculant on nodule dry mass

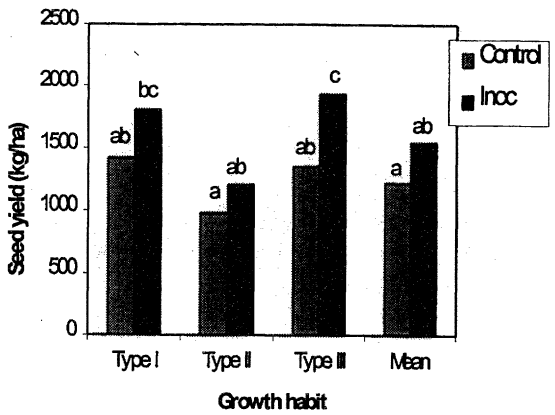

Figure 2. Effect of bean growth habit and inoculant on seed yield

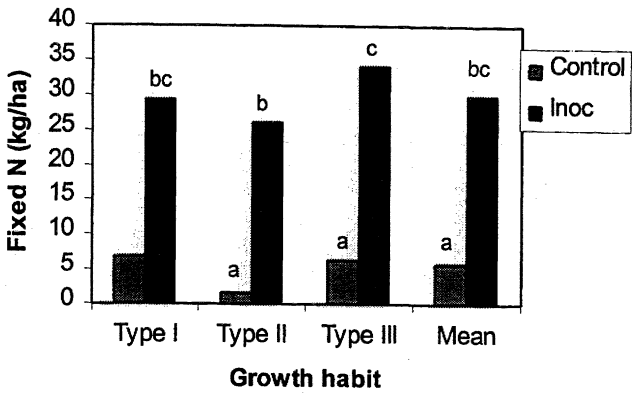

Figure 3. Effect of bean growth habit and inoculant on amount of N_2 fixed

References

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