INDIRECT SELECTION FOR COMMON BEAN LINES TOLERANT TO LOW NITROGEN AVAILABILITY

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INTRODUCTION

Although common bean is a leguminous crop, the plant nutrient demand is not sufficiently met by symbiotic nitrogen (N) fixation (Alves, 2002). Nitrogen application is therefore in most cases indispensable. In Brazil common bean is grown by farmers who use no nitrogen fertilizers as well as by rural entrepreneurs who apply high quantities. It is important to identify lines tolerant to low N availability and/or that are responsive to the applied nutrient. It is desirable to verify whether selection under high N can also identify lines tolerant to low nitrogen availability.

MATERIAL AND METHODS

The experiments were conducted at two sites in the southern state of Minas Gerais: Lavras (21° 14' S, 44° 59' W and mean altitude of 919 m asl) and Ijaci (21° 10' S, 44° 55' W and mean altitude of 805 m asl), sown in February 2007.

One hundred lines of common bean of the Universidade Federal de Lavras (UFLA) were evaluated in two different but contiguous experiments, with the same cultural treatments, differing only in nitrogen fertilization. In the first, 80 kg ha^{-1} of P_2O_5, 80 kg ha^{-1} of K_2O and no N was applied. In the second, the same quantity of phosphorus and potassium, plus 100 kg ha^{-1} of N was split-applied: 1/3 at sowing, 1/3 on the 20th day after sowing (DAS), and the last 1/3 on the 30th DAS. The experimental design was a 10 x 10 triple lattice and each plot consisted of two rows of two meters.

The grain yield data were processed by analysis of variance per N level at each location, and by joint variance analysis per location. The genetic and phenotypic parameters were estimated based on the yield data. With the data means, the nitrogen response index (α_i) was estimated by the expression proposed by Thung (1990), that is: $\alpha_i = (N_{1i} - N_{2i})/Q$, where: N_{1i} and N_{2i}: mean yield of line i in the presence and absence of nitrogen , respectively. Q: quantity of applied N (Q = 100 kg ha^{-1}).

RESULTS AND DISCUSSION

Significant differences were detected between the lines ($P \leq 0.10$) in all experiments. The estimates of genetic variance (σ^2_G) reinforce the existence of variation between the same (Table 1). The F test of the source of variation levels was also significant ($P \leq 0.01$). In the mean, the response of the lines was 7.3 kg grain per kg of applied N. This estimate varied from -5.5 - 16 kg grain per kg of applied N.

The interaction N levels-by- lines was also significant ($P \leq 0.01$), indicating that the performance of the lines was not coincident in presence and absence of the nutrient. This interaction can also be

visualized by means of estimates of the genetic correlation (r_{Gxy}). Especially in Ijaci, these estimates were of small magnitude (Table 2).

The existence of variability in the lines and the h^2 estimates is an indicator of the success with selection. The selection gain estimates with N (SG_x) as well as without N (SG_y) were higher than 5%. The estimate of correlated response ($RC_{y/x}$) in the environment without N by the selection performed in the environment with N was also significant, but lower than the estimate of direct selection (Table 2). The reason was that the estimates of the genetic correlation with and without N were of small magnitude (Falconer & Mackay, 1996). These results are similar to those of Banziger et al. (1997), indicating that the gain would be greater if selection for N lack- tolerant lines was performed in low N- environments.

Table 1. Estimates of the genetic variance (σ^2_G) in the lines and heritability (h^2) in the environments with (h^2_x) and without (h^2_y) nitrogen, at the two evaluation sites.

Environments	σ^2_G	LL[1/]	UL[1/]	h^2 (%)	LL	UL
Lavras with N	1109.132	855.025	1496.764	20	-15	43
Lavras without N	5348.251	4122.945	7217.416	57	38	69
Ijaci with N	4987.790	3845.067	6730.977	45	21	61
Ijaci without N	1022.109	787.939	1379.327	33	4	53

[1/]LL and UL - lower and upper limits of the of confidence intervals, at 5% probability.

Table 2. Estimates of genetic correlation (r_{Gxy}) between the performance of lines in the environment with and without N, expected selection gains in the presence (SG_x) and absence (SG_y) of nitrogen and correlated response by indirect selection ($RC_{y/x}$), at the two evaluation sites.

Locations	r_{Gxy}	SG_x (%)	SG_y (%)	$RC_{y/x}$ (%)
Lavras	0.57	5.26	24.96	8.49
Ijaci	0.44	13.43	7.48	3.83

REFERENCES

ALVES, V.G. Resposta do feijoeiro a doses de nitrogênio no plantio e cobertura e à inoculação de sementes com rizóbio. 2002. 46f. Dissertação (Mestrado em Fitotecnia) – Curso de pós-graduação em Agronomia, Universidade Federal de Lavras.

BANZIGER, M.; BETRÁN, F.J.; LAFFITE, H.R. Efficiency of high-nitrogen selection environments for improving maize for low-nitrogen target environments. Crop Science, Madison, v.37, n.4, p.1103-1109, 1997.

FALCONER, D.S.; MACKAY, T.F.C. Introduction to quantitative genetics. 4.ed. England: Longman, 1996. 463p.

THUNG, M. Phosphorus: a limiting nutrient in bean (Phaseolus vulgaris L.) production in Latin America and field screening for efficiency and response. In: El Bassam et al. (Ed.). Genetic aspects of plant mineral nutrition. Kluwer, Dordrecht, Netherlands, 1990. p.501-521.