Recurrent Selection for Increased Nodule Number in Black Bean

Department of Horticulture,University of Wisconsin-Madison, WI 53706 USA B.D.Miranda, Pedro Arraes A. Pereira and F.A. Bliss

Greater susceptibility of bean lines to infection by Rhizobium lequminosarum biovar phaseoli and the ability to support more functional nodules should lead to an increase in dinitrogen fixation. Additive gene action has been reported to be important for nodule number in common bean (Pereira et al., 1985) suggesting that recurrent selection should be effective for increasing nodule number.

Ten black bean lines were intermated in a diallel mating design to generate forty five F1 crosses which formed the base population (cycle 0). The top eleven F1 crosses (25%) were selected and randomly chain crossed to generate 22 double crosses (cycle 1). The top 22 individuals (25%) in cycle 1 were selected and randomly chain crossed to generate 22 quadruple crosses (cycle 2). In all cycles four replications (individual plants) were used and the ten original parents planted as control. Plants were grown in modified Leonard jars in a growth room without added nitrogen and inoculated with a single rhizobial strain (Kim 5). Nodule number was determined 25 days after planting.

The population mean of cycle 0 was 94 nodules/plant which was 92% of the mean of the parents (Table 1). An increase in nodule number of 10% was observed in cycle 1 when the population mean was expressed as percent of control (102%). The response of the population to selection represented a realized heritability of .30. A correlated response was observed for nodule mass which increased from 103% to 119% of control. The mass/nodule remained essentially the same after selection in contrast to the response observed in white clover, where increasing nodule number resulted in a decrease in the size of individual nodules (Mytton and Gareth Jones, 1971).

After one cycle of selection for nodule number three parents; UW21-58, UW22-03 and Porrillo Sintetico, failed to contribute gametes to cycle 1 (Table 2). The largest gametic contribution to cycle 1 was made by UW22-34 and Puebla 152, 27% and 18% respectively. These two parents were reported to have superior general combining ability for nodule number among the parents evaluated here (Pereira et al., 1985). A 4% increase was observed in the gametic contribution of UW22-34 and Puebla 152 to cycle 2, which represented a combined contribution of 53% (Table 2).

Recurrent selection is effective for increasing nodule number in common bean under the conditions described here. Research is underway to evaluate if further gains can be realized and to determine the effect of a narrowing genetic base on population improvement.

Table 1. Means of nodulation characters for populations and parents after one cycle of selection for nodule number in black bean.

		Nodule Number	Nodule Mass	Mass / Nodule
			mg.	mg.
Cycle 0				
Parents (control)	$\bar{X}$	102	134	1.38
Population	$\bar{X}$	94	138	1.53
% Control		92%	103%	111%
Selections (top 25%)	$\bar{X}$	130	153	1.18
Cycle 1				
Parents	$\bar{X}$	158	226	1.51
Population	$\bar{X}$	162	269	1.70
% Control		102%	119%	112%
Selections (top 25%)	$\bar{X}$	235	304	1.29

Table 2. Gametic contribution of the original parents after selecting the top 25% of the cycle 0 and cycle 1 populations.

	Parents									
	*B76	P152	NA	BTS	21-58	22-03	22-34	PS	RT	IP
	%									
Cycle 0 Gametic Contribution	14	18	5	14	0	0	27	0	14	9
Cycle 1 Gametic Contribution	9	22	7	14	0	0	31	0	9	9

* B76 = Bat 76; P152 = Puebla 152; NA = Negro Argel; BTS = Black Turtle Soup; 21-58 = UW21-58; 22-03 = UW22-03; 22-34 = UW22-34; PS = Porrillo Sintetico; RT = Rio Tibaji; IP = Ica Pijao.

Mytton, L.R. and D. Gareth Jones. 1971. The response to selection for increased nodule tissue in white clover (Trifolium repens L.) p. 17-25. In T.A. Lie and E.G. Mulder (eds.) Biological nitrogen fixation in natural and agricultural habitats. Martinus Nijhoff, N.Y.

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