YIELD GENETIC GAIN AT NATIONAL LEVEL OF CARIOCA COMMON BEANS FROM THE EMBRAPA BREEDING PROGRAM - 1993 TO 2008

L.C. Faria[1], P.G.S. Melo[2], L.C. Melo[1], H.S. Pereira[1], M.J. Del Peloso[1], J.B.F. Trovo[1] and A. Wendland[1]

[1]Embrapa Arroz e Feijão, Brazil; and [2]Universidade Federal de Goiás, Brazil
Corresponding author: lcfaria@cnpaf.embrapa.br

The continuous demand for improved bean cultivars, with high yield and resistance to restrictive production factors have guided Embrapa breeding program in Brazil. In the last 25 years 48 cultivars of various commercial types, with an average of 1.9 cultivars per year, were released. The assessment of genetic breeding programs carried out in species of economic importance through the estimate of the genetic progress is a method used by breeders to measure intended goals. Some research work had been carried out to estimate common bean genetic gains at state level, but never at national level. After more than 20 years from the beginning of that program, an estimate has not been done yet. Those estimates are important to assess the efficiency of the program, and to organize data base banks to support further strategic planning. Therefore, the objective of this work was to estimate the genetic gain of the commercial type carioca dry beans breeding program carried out by Embrapa Rice and Beans Research Center in a period of 16 years, from 1993 to 2008.

Data were obtained from the national trials network denominated 'VCU' from Embrapa beans breeding program, carried out in the most common planting seasons: "wet", "dry" and "winter", among 1993-2008. Each cycle of VCU comprises two years tests with lines selected in the previous intermediary trials in such way that the group of lines tested is changed every two years. Data used were from yields ($kg.ha^{-1}$) of 104 genotypes selected in the previous 16 years in 532 trials. The experimental design used was a completely randomized block with three or four replicates arranged in four meters long plots with four meters long rows, spaced 0.5 m, with 12 plants per meter. All individual trial data were submitted to the analysis of variance and to the corresponding analysis of residues, aiming to detect data discrepancies using PROC GLM – SAS. Furthermore, joint analyses were performed including all trials data within each biennial cycle, using the PROC GLM – SAS procedure. To calculate genetic gain estimated it was used the genotypes general mean of each evaluation cycle for the proposed Breseghello's (1995) weighed method, who used the Weighed Minimum Squares (WMS) to estimate environmental deviations. The method involving balanced weigh uses matrix V, where variance and covariance coefficients are based on the number of observations in each mean which participated in the calculation and use of the Mean Squares of the annual Error. The genetic gain estimate was obtained using the computer program MATLAB version 6.5, 2002. The annual program genetic gain estimate and its percentage for the referred period was calculated regarding the average of the first trial cycle.

On Table 1 are shown the biennial genetic gain estimates and the percent accumulated regarding average of the genotypes tested in the first trial period (93/94). The biennial genetic gain varied considerably, oscillating from -2.34 to 242 $kg.ha^{-1}$/cycle. Those negative gains in some cycles showed a setback in yield due to change of genotypes based on yield associated to other desirable traits. Negative and positive values also indicated that gains obtained in one cycle hardly ever occur in the following cycle, suggesting stabilization in the posterior cycle. The estimated genetic gain of the Embrapa Rice and Beans breeding program was 12 $kg.ha^{-1}$ $.year^{-1}$ (0.67% per year), not significant by t test, indicating absence of yield genetic gain in that period for carioca grain type.

However, according to Melo et al. (2007) there was significant improvement in other characteristics, such as erect plant architecture and resistance to lodging, that contributed to harvest losses reduction; improved grain quality that favored consumer preference; and better disease resistance, that reduced production costs.

Table 1. Estimate of annual average genetic gain regarding the average of genotypes tested in the first biennial cycle, and accumulated genetic gain between pairs of biennial cycles.

Cycle pairs	Biennial genetic gain ($kg.ha^{-1}$)	Gain/ mean deviation	Biennial genetic gain (%)	Accumulated biennial genetic gain (%)
93/94-95/96	-2,34	-0,23	-0,12	-0,23
95/96-97/98	50,56	4,48	2,59	2,36
97/98-99/00	-100,24	-8,38	-5,13	-2,77
99/00-01/02	242,00	17,43	12,40	9,63
01/02-03/04	-90,24	-6,40	-4,62	5,01
03/04-05/06	16,84	1,91	0,86	5,87
05/06-07/08	43,97	4,32	2,25	8,12
Biennial genetic gain ($kg.ha^{-1}$)				12,32
Biennial genetic gain (%)				0,67 n.s.[1]

[1]not significant by t test.

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