COOKING TIME OF COMMON BEAN: GENETIC PARAMETERS AND SELECTION OF ELITE LINES

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In common bean breeding programs, the grain cooking time (CT) is an important property, which can restrict the advance of lines in subsequent selection stages. The shorter the CT, the better, in view of the consumer demand for fast food preparation. Furthermore, the longer the CT, the greater is the loss of grain nutrients. Consequently, the development of lines with a shorter cooking time represents a breakthrough in terms of energy savings and food quality improvement. The objectives of this study were to investigate the genetic variability and select elite lines for CT, since these lines aggregate essential agronomic traits.

In preliminary tests, 140 elite lines, grouped according to their grain type were evaluated (68 with carioca grain, 30 with black, 16 with mulatinho (cream), 14 early cycle carioca and 12 with purple grain. The experiments, separated by grain type, were conducted in Santo Antônio de Goiás, in the winter growing season of 2011, in a randomized complete block design with two replications. The grain samples were used to determine the CT by the Matson method, modified by Proctor & Watts (1987). The following genetic and phenotypic parameters were estimated: genetic variance, phenotypic variance, environmental variance, heritability, and expected gain with selection. Based on the results, 17 lines with shorter CT were selected for a validation test in three environments: (Ponta Grossa/PR/dry season/2013; Santo Antônio de Goiás/GO/winter/2013, and Brasília/DF/rainy season/2013) in a randomized complete block design with two replications, to study the genotype-environment interaction and selection of the best lines. Individual and combined analysis of variance were performed and the group means tested (Scott-Knott, at 10%).

Significant differences were detected in the tests between the lines with carioca, black and mulatinho grain. The heritability estimates were 44.71% (Carioca), 65.79% (black) and 81.01% (mulatinho), all nonzero, with moderate to high magnitude, indicating the existence of variability between lines and the possibility of successful selection for CT. The gain expected with selection at a selection intensity of 20% was 8.03% (carioca), 14.54% (black) and 13.11% (mulatinho) (Table 1), confirming the genetic potential for selection of lines with shorter CT.

In the validation phase, significant differences between lines were observed in the three environments. The overall mean of the environments varied widely, with32.6 min (Ponta Grossa/PR/dry/2013), 44.8 min (Santo Antônio de Goiás/GO/winter/2013) and 41.1 min (Brasília/DF/rainy/2013), reflecting the environmental effect on CT. The analysis showed significant differences ($p \leq 0.05$) for lines, environments and line by environment interaction, which is the presence of genetic variability between lines, heterogeneity between environments, as well as the differential response of lines to different environments, as reported elsewhere (Perina et al., 2014).

The grouping test defined three groups of which nine elite lines were selected (CNFP 11976, with black grain; CNFC 15710, 15723, 15861 and 15732, carioca; CNFM 15647 and 15656 mulatinho, and CNFRx 15614 and 15602 with purple grain) with similar cooking time to that of the best controls (BRS Estilo and Jalo Precoce) and shorter CT than Pérola. No line had a shorter CT than the best control (Table 2). The mean CT of the selected lines was 17% lower than that of cultivar Pérola, highlighting the good potential to reduce grain CT.

Table 1. Estimates of genetic variance (σ^2_g), phenotypic variance (σ^2_f), environmental variance (σ^2_e), mean heritability in the narrow sense (h^2), associated error ($S(h^2)$), genetic variation coefficient (CV_g), index b, expected selection gain (SG%) and differential selection (DS) for cooking time.

	σ^2_g	σ^2_f	σ^2_e	h^2	$S(h^2)$	SG(%)
Carioca	10.10	22.59	12.49	44.71	13.31	8.03
Black	37.06	56.32	19.27	65.79	12.29	14.54
Mulatinho	14.37	17.74	3.37	81.01	9.21	13.11

Table 2. Mean cooking time (in minutes) of 17 common bean lines evaluated in three environments.

Lines	Means	Lines	Means
CNFP 11976	35.08 a	BRS Estilo	38.62a
CNFC 15710	35.39 a	CNFRx 15602	39.38a
CNFC 15723	35.45 a	CNFP 15685	41.72b
CNFM 15647	36.18 a	CNFM 15640	42.14b
CNFC 15861	36.19 a	Pérola	42.31b
CNFM 15656	36.40 a	CNFP 15684	43.11b
Jalo Precoce	37.12 a	CNFC 15628	44.84b
CNFC 15732	37.53 a	IAC Centauro	52.11c
CNFRx 15614	38.16 a	Mean	39.51

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