RECURRENT SELECTION IN RED BEAN BREEDING

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During the mid 1990s, the Bean Breeding Program of the Universidade Federal de Viçosa (UFV) also included red type bean breeding as part of its research, because of the great importance of this type of bean for Zona da Mata region of Minas Gerais State. This type of grain is well-accepted commercially and is considered the most valuable in this region. However, cultivars available have not met the producers' expectations for being more susceptible to major bean diseases or have not met commercial acceptance. Thus, the development of high yielding lines, resistant to major diseases and displaying well-accepted grains is of fundamental importance. But, to combine into one single line various phenotypes of interest is not an easy task, since it involves a great number of genes. In this case, the main alternative is the use of recurrent selection. This methodology has been applied successfully in bean breeding in the state of Minas Gerais (Ramalho et al., 2005; Silva et al., 2007). Thus, the objective of this work was to evaluate the second cycle of recurrent selection in red bean breeding and to select the best families for recombination.

The experiments were conducted at the Experimental Field of the Department of Plant Sciences - UFV, located in Coimbra-MG, Brazil, at 690 m of altitude (20°45' S and 42°51' W).
After the recombination of the best families of the first cycle of recurrent selection, 20 segregating populations were obtained. These populations were advanced in bulk up to the F_5 generation in order to make the red grain pattern uniform, since three lines of the purple type grains (BRS Timbó, VR-2 and VR-3) were introduced into the crossing group. Within each population, 19 plants were selected taking into account the commercial aspect of the grain. These plants constituted the $F_{5:6}$ families, which, together with 20 controls, were evaluated during the 2007 winter season in a simple 20 x 20 lattice. Each plot had one 2 m line. In the next generation ($F_{5:7}$), 2008 dry season, the best families of each population were evaluated together with nine checks in a 13 x13 triple lattice design. Each plot had two 2 m lines. In both trials were evaluated: grain yield, grain aspect and plant architecture (scores from 1 to 5). Rust severity scores were also attributed (1 to 6) during the 2007 winter season as well as angular leaf spot scores (1 to 9) during the 2008 dry season. In the score scale, 1 refers to best grain aspect, best plant architecture and absence of disease. In all the cases, the scores were attributed by more than one appraiser.

There were significant differences ($P<0.01$) among the families for all the characters evaluated. The variability among the families was also confirmed by the estimates of heritability (h^2) that, in all situations, were different from zero, at 95% of probability, with a limit inferior to positive h^2. The family x crop interaction was significant ($P<0.01$), indicating that the families did not present consistent performance in the two seasons for grain yield, plant architecture, and grain aspect. These facts showed the importance of evaluations in different environments.

Table 1 presents the means of 20 families selected for recombination. It is important to emphasize that a family of each population was selected to allow that all genitors are represented in equal proportion. The crossings were performed in a conic scheme so that each family participates in two crossings. Thus, twenty populations will be obtained again, constituting the third cycle of evaluation and selection. It is important to emphasize again the occurrence of variability in the population, showing that, after two cycles of recurrent selection, variability is still being observed and that selection progress may be obtained.

Table 1 - Means of grain yield (kg/ha), grain aspect, plant architecture, angular leaf spot and rust severity of the 20 families selected for recombination and acquisition of the third cycle of recurrent selection (C_{II}) compared to the control Ouro Vermelho.

Family	Yield	Grain aspect	Architecture	Angular leaf spot	Rust
284RVCI-2-2	3611	1.8	3.7	5.2	1.5
285RVCI-1-20	3964	1.4	3.8	3.9	3.0
286RVCI-6-44	3754	1.9	3.8	5.8	2.5
287RVCI-5-62	3414	1.7	3.9	4.1	1.2
288RVCI-10-86	4155	1.6	4.2	4.4	2.4
289RVCI-4-99	3717	2.1	4.1	4.0	2.8
290RVCI-12-126	3771	2.3	3.7	5.1	3.0
291RVCI-17-150	4206	1.6	3.6	6.4	2.5
292RVCI-7-159	3438	1.6	4.3	4.5	3.0
293RVCI-17-188	3723	2.0	4.4	4.6	2.6
294RVCI-9-199	3811	2.5	3.0	6.1	2.6
295RVCI-5-214	3968	1.9	3.6	5.2	2.5
296RVCI-16-244	3453	1.7	3.8	3.7	3.0
297RVCI-12-259	4127	2.1	4.3	3.9	2.0
298RVCI-3-269	3701	1.9	3.6	3.6	2.0
299RVCI-11-296	3490	1.7	3.6	5.1	3.4
300RVCI-9-313	3916	1.7	3.8	4.2	2.2
301RVCI-19-342	3285	2.3	3.7	6.8	2.0
302RVCI-12-354	3952	2.7	4.0	5.1	2.5
303RVCI-4-365	3943	1.9	3.5	5.7	1.1
Mean families	3770	1.9	3.8	4.9	2.4
Ouro Vermelho	3427	1.6	3.8	5.3	3.6

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