

## ENVIRONMENTAL INFLUENCE ON COOKING TIME

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A bean breeding program is carried out at the Instituto Tecnológico Agrario de Castilla y León (ITACyL), Valladolid, Spain. The main objective of this program is to introduce resistance to halo blight [caused by *Pseudomonas syringae* pv. *phaseolicola* (Burkh.) Young et al.], common blight [caused by *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye] and *Bean common mosaic virus* (BCMV) and *Bean common mosaic necrosis virus* (BCMNV), into high quality landraces. Maintaining culinary quality of landraces, in addition to improve yield and other agronomic features, is necessary since a bean cultivar with poor culinary quality may be rejected by consumers regardless of how agronomically superior it is. A large number of traits are measured at ITACyL to characterize culinary quality of genotypes (100-seed weight, water absorption, number of hard shell seeds, tegument content and cooking time, among them).

Dry bean culinary quality is influenced by cultivar, unpredictable environmental factors and storage conditions. The objective of this study was to determine the influence of the genotype and the environment in some physical traits (100-seed weight, water absorption, number of hard shell seeds, tegument content and cooking time), and correlation between them, that could aid to reduce the number of characteristics to measure and could simplify the selection method of culinary quality.

### Materials and Methods

Twenty-five bean strains were grown in three locations in 2002 (Valladolid in experimental field of ITACyL, and León and Arévalo in grower field) and four in 2003 (same 2002, and Palencia in grower field) in Spain. Twenty-five genotypes were tested, including landraces from Spain and Portugal, selections from local landraces, new Spanish cultivars and varieties from USA and CIAT. Most of them are large or medium white-seeded Andean genotypes, but small and colored-seeded genotypes are also present. The entries were planted in 4-row plots, each 5 m long, in a row and column latinized alpha design with 3 replications. Distance between rows was 50 cm apart in Valladolid, Arévalo and Palencia, and 55 cm in León. Plants were spaced 8 cm in the row for all genotypes. Standard cultural practices were employed. At maturity, plants from the 2-central rows of the plot were harvested. One sample of dry beans from each replication was assessed for 100-seed weight, number of hard shell seeds and cooking time, and two samples for water absorption and testa content. Beans with a fresh weight equivalent to 10 g were soaking for 10-20 hours at 12°C, to obtain water absorption, testa content and number of hard shell seeds. Cooking time was determined with a 30-seed Mattson pin-drop cooker (Mattson 1946). Cooking time was calculated as a time from initial cooking until the time when 80% of pins penetrate seeds in cooker. Data were subjected to analysis of variance (proc GLM) using as environment a combination of year and location. Also, data were used to calculate the correlation matrix for the traits. All data were analyzed using a SAS statistical package (SAS Institute, 1985).

## Results and Discussion

Differences among cultivars, environments and cultivar by environment interactions, were highly significant for all the traits, as reported earlier by Balausbramanian et al. (1999) (Table 1). The location effect was larger than the genotype effect for almost all the evaluated quality traits, as has been reported earlier (Ghaderi et al. 1984, Hosfield et al. 1984), except for the number of hard shell seeds, which seems a cultivar characteristic.

Landraces, represented in the experiment by typical large and white-seeded cultivars from Iberian Peninsula, showed small number of hard shell seeds and low testa content. Also, landraces showed lower cooking time and higher water absorption.

2003 growing season was extremely hot, whereas 2002 was an atypical cool season. Results for number of hard shell seeds, testa content and seed size recorded in 2002 were more desirable than in 2003, although the harvest dates were extremely delayed and part of the harvested seed had to be discarded because of lack of commercial value. The data of this experiment indicate that temperature at seed filling stage influences on the quality traits measured.

Correlation between several traits was found, indicating that a relationship existed among some characteristics (Table 2). The number of hard shell seeds was not correlated with cooking time, because of hard shell seeds were removed before cooking. That is the reason because the correlation between cooking time and water absorption was positive, contrary to previous reports (Castellanos et al. 1995).

Table 1. Mean squares and means for quality traits of 25 genotypes grown in seven environments in Spain.

| Trait                      | Mean Squares |             |                      | Mean   |
|----------------------------|--------------|-------------|----------------------|--------|
|                            | Cultivar     | Environment | Cultivar*Environment |        |
| Number of hard shell seeds | 764.10 ***   | 141.46 **   | 105.90 ***           | 6.32   |
| Cooking time               | 625.83 ***   | 3546.62 *** | 140.29 **            | 56.93  |
| Water absorption           | 309.29 ***   | 972.19 ***  | 183.79 ***           | 114.40 |
| Testa content              | 2.43 ***     | 28.71 ***   | 0.68 ***             | 8.68   |
| Seed size                  | 1616.65 ***  | 1839.38 *** | 53.52 ***            | 40.90  |

\*, \*\*, \*\*\* Significant at 5% (\*), 1% (\*\*) and 0,1% (\*\*\*) levels

Table 2. Correlation coefficients indicating the relationship among 5 quality traits of 25 genotypes tested in seven environments in Spain.

|                            | Cooking time | Water absorption | Seed size   | Testa content |
|----------------------------|--------------|------------------|-------------|---------------|
| Number of hard shell seeds | 0.0143       | -0.1578 **       | -0.1663 *** | 0.1217        |
| Cooking time               |              | 0.2378 ***       | 0.0301      | 0.3798 ***    |
| Water absorption           |              |                  | 0.0552      | 0.1521 **     |
| Seed size                  |              |                  |             | -0.3481 ***   |

\*, \*\*, \*\*\* Significant at 5% (\*), 1% (\*\*) and 0,1% (\*\*\*) levels

## References

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