# Agronomical Evaluation of the Spanish Barley Core Collection

S Yahiaoui[1], MP Gracia[1], E Igartua[1], B Medina[1], FJ Ciudad[2], P Codesal[2], JL Molina-Cano[3], JM Lasa[1]

[1]*Department of Genetics and Plant Production, Aula Dei Experimental Station, CSIC, P.O. Box 202, E-50080 Zaragoza, Spain*
[2]*ITA, Instituto de Tecnología Agraria, Junta de Castilla y León, P.O. Box 172, E-47071 Valladolid, Spain*
[3]*Centre UdL-IRTA, Av. Rovira Roure 191, E-25198 Lérida, Spain*

**EUCARPIA Cereals Section Meeting – Lleida, November 2006**

A deep knowledge of the genetic resources is a prerequisite for their utilization in plant breeding programs. Local landraces are a potential source of new genes and alleles for plant breeding (Ceccarelli *et al.*, 1987, among others). Spanish barleys constitute an underused resource which shows distinct genetic, morphologic, and agronomic traits (Tolbert *et al.*, 1979; Lasa et al., 2001). The Spanish Barley Core Collection (SBCC) was assembled as a manageable tool to study this genetic diversity. It is constituted by 159 landrace-derived inbred lines (148 six-row and 11 two-row), plus 16 old varieties (8 two-row, 8 six-row) extensively grown in Spain in the 20th century (Igartua et al., 1998).

## Results and Discussion

The distribution of relative frequencies for the traits measured is presented in Figure 1, separately for the landraces (159) and the cultivars (26). **Large variability was observed for most of the traits studied, especially among the landrace material**. Landrace-derived inbred lines presented, on average, several negative traits compared to cultivars, such as excessive plant height, higher lodging, susceptibility to diseases, and later heading date. Most of these are typical changes observed when comparing old landraces and modern cultivars for the same region. However, later heading date for the landrace material was not expected. This shortening of the cycle may have to do with the much shorter time needed in modern agriculture to carry out harvesting operations.

Though cultivars outyielded landraces on average, when considering separately low- and high-yielding environments (Figure 1, grain yield histograms on the first row), some Spanish inbred lines showed excellent yields under low productivity conditions. Also on the positive side, some landraces were as good as the best cultivars for each trait, but for plant height, which underscores their potential to contribute positive alleles for breeding programs. The excessive plant height of Spanish materials, and their propensity to lodging was expected, as they come from a period previous to generalizations of chemical fertilization. Regarding individual genotypes, 18 of the top 20 yielding genotypes at high productivity environments were cultivars, whereas 16 of the top 20 were landrace-derived inbreed lines at low productivity environments.

This result stresses even more the differential responses recorded, consequence of an important genotype-by-environment interaction present in this study.

Genotype by environment (GxE) interaction sum of squares for grain yield doubled the sum of squares for genotypes (not shown). This large interaction was unequally distributed among genotypes. A substantial part of the interaction (for grain yield as well as for most traits) was accounted for by the **seven genetic groups assembled after a molecular marker analysis**, as it can be observed in Figure 2. Powdery mildew tolerance, heading date, and lodging were the three genotypic variables more closely related with grain yield GxE interaction. Many landraces were susceptible to powdery mildew, whereas most cultivars were resistant. The same could be said for lodging, cultivars being more lodging resistant than Spanish inbred lines, which caused a differential response in trials where lodging occurred. Heading date relationship with grain yield varies across trials. This is a common situation in Spain. In an average season, early genotypes do not have an advantage, as they do not benefit from spring rains. In seasons with lack of spring rains, early genotypes yield better than late ones. Interaction of heading date and powdery mildew with fall temperature mean a different effect of these genotypic variables on grain yield according to the temperatures experienced in the fall in the different environments.

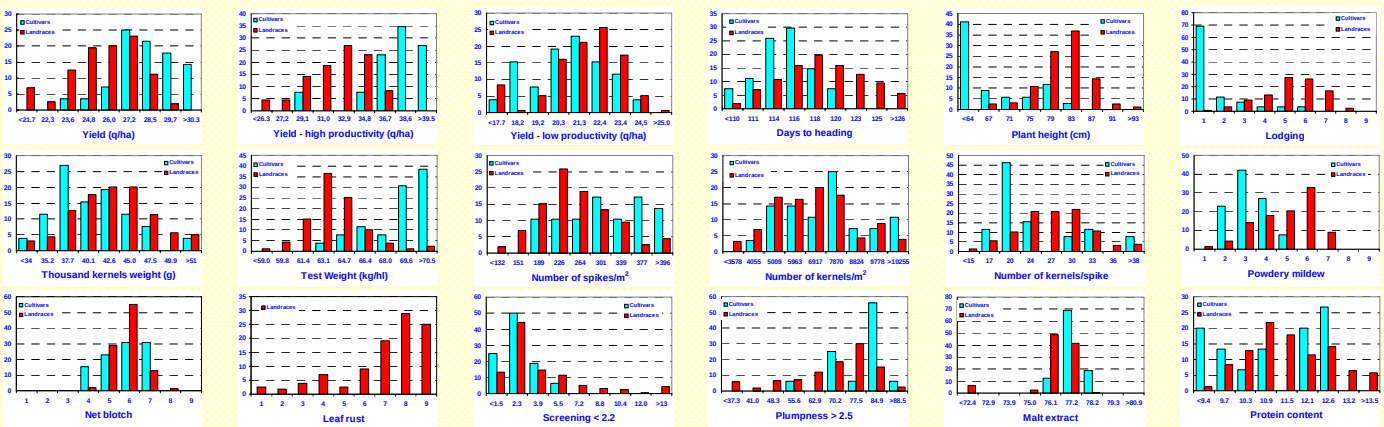


Figure 1. Distribution of traits (relative frequencies) for 159 landraces and 16 old cultivars of the Spanish Barley Core Collection, and 10 modern barley cultivars

## Materials and Methods

*Plant material:*

- 175 entries from the Spanish Barley Core Collection (SBCC)
- 10 modern barley cultivars, included as checks.

*Field trials*:

An extensive evaluation was carried out throughout the country across a range of environments (10 trials, from 5 locations across Aragón, Castilla y León, and Cataluña, over 3 years)

*Characters evaluated:*

- Agronomic traits: Yield, heading date, plant height, lodging, thousand kernel weight, test weight, spikes/m$^2$, kernels/m$^2$, kernels/spike.
- Disease resistance: Net blotch, leaf rust and powdery mildew.
- Malting quality: Kernel plumpness, screening, malt extract and protein content.
- Not all traits were evaluated at all trials.

*Climatic data:*

Climatic data from meteorological stations close to each trial were collected and used to interpret genotype by environment interaction by factorial regression.

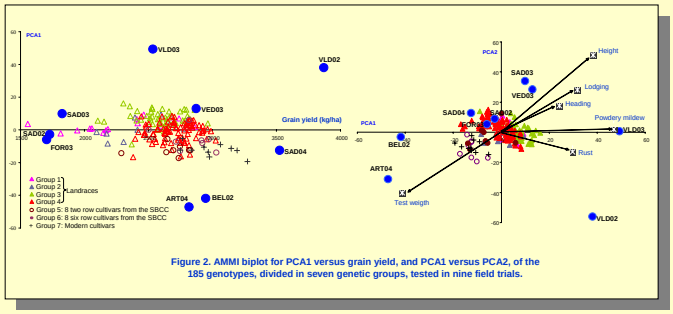


Figure 2. AMMI biplot for PCA1 versus grain yield, and PCA1 versus PCA2, of the 185 genotypes, divided in seven genetic groups, tested in nine field trials.

**Information on characterization and evaluation of the SBCC can be found in http://www.eead.csic.es/EEAD/barley**

Acknowledgments: This study was supported by INIA (project RTA01-088-C3) and by the European Regional Development Fund (ERDF).