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Spanish landraces collection of durum wheat maintained at the CRF-INIA

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SUMMARY – The tetraploid wheat collection maintained at the CRF-INIA holds 1006 accessions. Within the subsp. *turgidum*, 428 entries are Spanish materials of the conv. *durum* (Desf.) MK. and 126 are of the conv. *turgidum*. Accessions are stored in two types of collections, base and active, at -18 and -4ºC, respectively, with a moisture content <7%. These conservation conditions have shown to preserve adequately wheat germplasm. All the accessions at the CRF-INIA posses passport data about their origin, type of material, taxonomy, etc. A great part of the collection also have characterization data for different agro/mophological traits, including susceptibility to several diseases and molecular markers for gluten quality. Analysis of a group of 280 accessions have shown that Spanish landraces have, in general, intermediate growth habit, rough and large barbs, dense spikes, white and no pubescent glumes and white kernels. The high diversity found for different characters indicates that variability is also possible for some other positive traits. Therefore, valuable genes could be transferred into productive genotypes with a view to selecting lines fit to a sustainable agriculture.

Key words: Durum wheat, landraces, documentation, agro/morphological variability, Spain.

RESUME – *"Collection espagnole de variétés locales de blé dur conservées au CRF-INIA". La collection de blé tétraploïde conservée au CRF-INIA est formée par 1006 accessions. A l'intérieur de la subsp.* turgidum, *428 et 126 échantillons sont des matériels espagnols de la conv.* durum *(Desf.) MK. et de la conv.* turgidum, *respectivement. Les accessions sont stockées dans deux types de collections, base et active, à -18 et -4ºC, respectivement, avec un taux d'humidité <7%. Ces conditions se sont montrées appropriées pour la conservation du germoplasme de blé. Tous les échantillons du CRF-INIA possèdent des données de passeport en rapport avec leur origine, type de matériel, taxonomie, etc. Une grande partie de la collection a aussi des données de caractérisation pour différents caractères agro/morphologiques, incluant des sensibilités à plusieurs maladies et des marqueurs moléculaires pour la qualité du gluten. L'analyse d'un groupe de 280 accessions a montré que les variétés locales espagnoles ont, en général, un type de croissance intermédiaire, des barbes longues et rugueuses, des épis denses, des glumes blanches et sans pubescence, et des grains blancs. L'ample diversité trouvée pour différents caractères indique que l'existence de variabilité pour d'autres paramètres positifs est aussi possible. Donc, on pourrait introduire des gènes de grande valeur dans les génotypes productifs dans l'objectif de sélectionner des lignées adéquates pour une agriculture soutenable.*

Mots-clés : *Blé dur, variétés locales, documentation, variabilité agro/morphologique, Espagne.*

Introduction

Landrace varieties are an important germplasm to move towards sustainable agricultural development. These varieties have been selected over thousands of years by farmers and nature for characteristics related to local adaptation and yield stability. In the case of durum wheat landraces, several works have reported the presence of important features for crop improvement such as resistances, early maturity and quality (e.g. Porceddu *et al.,* 1975; Boggini *et al.,* 1987; Pecetti *et al.,* 1992). The genetic erosion of these varieties could lead to the extinction of valuable resources which have not been exploited. The protection and utilisation of these materials requires their conservation, evaluation and characterisation (Esquinas-Alcazar, 1987).

In Spain, work in the field of plant genetic resources is mainly carried out within the framework of the Ministry of Agriculture, Fisheries and Food's (MAPA) "Conservation and Use of Plant Genetic Resources" Program. The Centre for Plant Genetic Resources (CRF) was instituted in 1993 as part of this program. The Centre is dependent upon the National Institute of Food and Agrarian Research and Technology (INIA). The aims of CRF-INIA include the collection, conservation, characterisation and documentation of plant genetic resources.

The objectives of this work are to present the tetraploid wheat collection maintained at the CRF-INIA (conservation and documentation) and to describe the agromorphological variability of a subgroup of Spanish landrace varieties.

Materials and methods

Conservation

CRF seed collections, including durum wheat collection, are stored at low temperature and are maintained with a low moisture content (<7%). Two sets of conditions are employed depending on the type of collection: the active collection is stored at temperatures of -4ºC in resealable glass containers, and the base collection at -18ºC in sealed metallic containers. In the case of the durum wheat collection, a great part of the accessions are materials not cultivated now that they can only be found in *ex situ* collections.

Documentation

Information regarding durum wheat accessions at CRF-INIA is arranged in three groups: passport, management and characterisation/evaluation data. The passport data are structured following the descriptors agreed for European Central Crop Databases (Lipman *et al.,* 1997). They contain information about the taxonomy of the accessions, geographic origin, type of material, etc. Management data include information on where accessions are located in conservation chambers, the amount of seed held and germination details. Characterisation and evaluation data come from characterisations carried out at the CRF or by different breeders who have worked with these materials and sent their results to the CRF. This information is structured according to the descriptors utilised by the evaluators and IBPGR (1985).

All documentation collected is recorded in a relational database managed by the program MS Access and stored in a personal computer acting as a network server at CRF-INIA.

Agro/morphological characterisation at the CRF-INIA

A set of 280 accessions was characterised at CRF-INIA (40º31' N, 3º17' W, 610 m) from November 95 to June 96. The site is classified as Temperate Mediterranean (TE, Me) with (av) winter type and (M) summer type following Papadakis agro-climatic classification (INIA, 1977). Supplementary fertiliser and irrigation were applied during the crop cycle but not fungicide was supplied. Two commercial varieties "Cocorit" and "Senatore Capelli" were employed as test varieties.

The accessions, coming from 30 different Spanish provinces, were evaluated for 14 agro/morphological descriptors. Most of the descriptors employed are recommended by IBPGRI (1985). Agronomic traits (Table 1) were scored on a single whole plot basis with a plot size of 4 rows at 2 m. The rest of the morphological data was measured in the laboratory on five spikes sampled from the middle of the plot.

Table 1. Range, average and standard deviation of each metric morphological character for 280 landraces of durum wheat

Character	Range	Average	Standard deviation
Days to heading	150-176	163.7	3.66
Days to maturity	202-221	206.1	3.99
Plant height (cm)	81-157	115.9	14.90
Spike length (mm)	65-136	89.1	12.00
No. spikelets/spike	16-27	21.3	1.97

Qualitative traits were assessed according to the classes reported in Table 2. Class figures indicate the number of levels used for each character and the code adopted for germplasm documentation, which generally follows IBPGR (1985) indications. Some continuous variables as growth habit and awn length were transformed into discrete categorical classes to reduce the experimental error.

Table 2. Class frequencies of each non metric character for 280 landraces of durum wheat

Character	Class	Frequency (%)
Growth habit:		
	3. prostrate	6.79
	5. intermediate	82.86
	7. erect	10.35
Awn type:		
	1. rough	98.89
	2. smooth	1.11
Awn length:		
	1. awnless	4.66
	2. semi-awned (1-3 cm)	0.00
	3. awned (3-8 cm)	1.44
	4. large awns (>8 cm)	93.90
Awn colour:		
	1. white	19.70
	2. black in the base	69.89
	3. black	0.00
	4. red-brown	10.41
Spike density:		
	3. lax	2.16
	5. intermediate	15.41
	7. dense	51.61
	9. high dense	30.82
Glume hairiness:		
	1. absent	70.25
	2. pubescent	29.03
	3. pubescent with long hairs	0.72
Glume colour		
	1. white	54.12
	2. red-brown	34.77
	3. purple-grey/black	11.11
Kernel colour		
	1. white	79.21
	2. red	20.79
	3. purple	0.00

Results and discussion

Conservation

The proper conservation of the base and active collection accessions is assured by the revision of seed viability, carried out every ten years after seeds are introduced to cold storage. Analysis of data obtained from the routine task of monitoring seed viability had shown that the percentage of wheat accessions with no significant changes in germination ranged from 84% to 89%. Moreover, less than 5% of the studied active and base samples would need a regeneration after ten years of storage (Ruiz *et al.,* 1999), according to the FAO/IPGRI regeneration standards (FAO/IPGRI, 1994).

Documentation

The analysis of the durum wheat collection passport data indicates that, at the present time, 1006 accessions of *Triticum turgidum* L. are held, 619 Spanish materials being present. The collection is

composed of four accessions of the subsp. *dicoccoides* (Körn.) Thell., seven of the subsp. *carthlicum*, 30 of the subsp. *polonicum* (L) MK and 82 of the subsp. *dicoccon*. Within the subsp. *turgidum*, 428 entries are Spanish materials of the conv. *durum* (Desf.) MK. and 126 are of the conv. *turgidum*.

Figure 1 shows the geographical distribution of the Spanish durum wheat landraces (conv. *durum* (Desf.) MK. and conv. *turgidum*) with known origin. Although there are some provinces having no accessions, a great part of them are represented by at least one entry, including the Canary Islands not shown in the map. Because of the climatic differences among origin sites, a high morphological variation in landrace populations is expected to be found. The South of the Peninsula is the zone with the higher number of varieties, particularly Andalucia and Balearic Islands. In these regions durum wheat was cultivated as traditional crop.

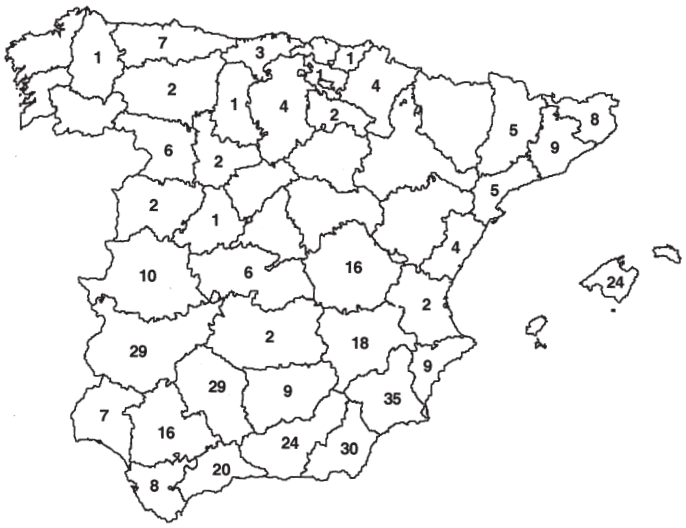

Fig. 1. Geographical distribution of the Spanish landraces of durum wheat maintained at the CRF-INIA.

Characterisation information of durum wheat has been obtained at the CRF for about 350 entries and 13 agro/morphological descriptors (INIA RF94-009 project). Furthermore, data coming from the evaluations carried out in the framework of the INIA project 7689 (co-ordinated by Dr. Soler) and other scientific studies are also available. Within these last works, a total of 400 accessions were characterised for nine morphological descriptors (characters related to spikes, etc.) and 14 agronomic traits (tillering, susceptibility to cold, lodging...). Also, more than 500 accessions have evaluation data for susceptibility to different fungi diseases as *Puccinia, Septoria, Helminthosporium,* and 277 entries posses molecular information for three endosperm protein loci. The analysis of some of these data have been published in several studies (Carrillo *et al.,* 1995; Rubiales *et al.,* 1997; Royo *et al.,* 1998; Ruiz *et al.,* 1998) showing that interesting genes for disease resistances and quality exist in the Spanish germplasm.

Agro/morphological variability

Table 1 presents the average, standard deviation and range of each metric morphological character for 280 Spanish landraces analysed at the CRF-INIA. The data indicate that these varieties hold a high variation for the metric characters. Furthermore, the extreme values found for some traits could be interesting for some breeding programs. Although quantitative characters are susceptible to environmental differences, it seems that Spanish landraces exhibit higher diversity for plant height and days to flowering and maturity than varieties from other countries (Damania *et al.,* 1996; Pecetti and Damania, 1996). The high polymorphism and distinctiveness of the Spanish materials have been also pointed out for some molecular markers (Ruiz *et al.,* 1998).The environmental variation found in Spain may have contributed to the occurrence of a wide diversity. On average, Spanish landraces are taller and later in flowering than the test variety “Cocorit”, although varieties with similar precocity were also observed.

The qualitative traits (Table 2) show less variation than the quantitative ones, most of them having a predominant class. For the character kernel colour, no purple seeds were found in the sample studied. This character is endemic to Ethiopia, where it can be found frequently (Pecetti and Damania, 1996). Also, no semi-awned accessions were detected. In general, these varieties have intermediate growth habit, rough and large barbs, dense spikes, white and no pubescent glumes and white kernels. Variability within accessions was only found for some characters as awn and kernel colour, and glume hairiness. In same cases this variability is caused by contaminations during multiplications. But, in other cases this internal variability is due to these landraces consist of mixtures of homozygous lines that might account for the yield stability of the crop. For the group of entries analysed in this work morphological variation was higher among varieties than within them. This result is similar to that obtained by Elings (1991) with Syrian durum wheat landraces. In contrast, Pecetti and Damania (1996) found that morphological variance in Ethiopian tetraploid landraces was higher within populations than among them.

Conclusions

Spanish durum wheat landraces maintained at the CRF-INIA are adequately preserved and documented, these two aspects being essential to promote the utilisation of these plant genetic resources. A great part of the collection have characterisation data for different agro/morphological traits, including susceptibility to several diseases and molecular markers for gluten quality. The high diversity found for different characters indicates that variability is also possible for some other positive traits. Consequently, valuable genes could be transferred into productive genotypes with a view to selecting lines fit to a sustainable agriculture.

References

Boggini, G., Dal Belin Peruffo, A., Mellini, F. and Pogna, N.E. (1987). Storage, Protein composition, morphophysiological, and quality characters of 24 old durum wheat varieties from Sicily. *Rachis,* 6: 30-35.

Carrillo, J.M., Vázquez, J.F. and Ruiz, M. (1995). Variability for glutenin proteins in Spanish durum wheat landraces. *Options Mediterraneennes*, *Serie A,* 22: 143-147.

Damania, A.B., Pecetti, L., Qualset, C.O. and Humeid, B.O. (1996). Diversity and geographic distribution of adaptive traits in *Triticum turgidum* L. (*durum* group) wheat landraces from Turkey. *Genet. Res. Crop. Evol*., 43: 409-422.

Elings, A. (1991). Durum wheat landraces from Syria. II. Patterns of variation. *Euphytica*, 54: 231-243.

Esquinas-Alcazar, J.T. (1987). Plant Genetic Resources: A Base for Food Security. *Review Ceres*, 118(29,4): 39-45.

FAO/IPGRI (1994). *Genebank Standards*. Food and Agriculture Organisation of the United Nations, and International Plant Genetic Resources Institute, Rome, p. 13.

IBPGR (1985). *Descriptors for Wheat (Revised)*. International Board Plant Genetic Resources, Rome, Italy.

INIA (1977). *"El Encín" Suelo y Clima*. Dpto. de Ecología, CRIDA 06 (Tajo), Madrid, Spain.

Lipman, E., Jongen, M.W.M., van Hintum, T., Gass, T. and Maggioni, L. (compilers). (1997). *Central Crop Databases: Tools for Plant Genetic Resources Management*. IPGRI, Rome, Italy/CGN, Wageningen, The Netherlands.

Pecetti, L. and Damania, A.B. (1996). Geographic variation in tetraploid wheat (*Triticum turgidum* ssp. *turgidum* convar. *durum*) landraces from two provinces in Ethiopia. *Genet. Res. Crop Evol*., 43: 395-407.

Pecetti, L., Damania A.B. and Jana, S. (1992) Practical problems in large-scale germplasm evaluation. A case study in durum wheat. *Genet. Res. Newsl*., 88/89: 5-10.

Porceddu, E., Perrino, P. and Olita, G. (1975). Preliminary information on an Ethiopian wheat germplasm collection mission. In: *Proc. Symp. Genetics and Breeding of Durum Wheat*, Scarascia Mugnozza, G.T. (ed.). University of Bari, Bari, Italy, pp. 181-200.

Royo, C., Michelena, A., Carrillo, J.M., García, P., Juan-Aracil, J. and Soler, C. (1998). "Spanish Durum Breeding Program". In: *Proc. SEWANA Durum Research Network*, ICARDA (Syria), pp. 80-87.

Rubiales, D., Moral, A. and Ruiz, M. (1997). Partial resistance to leaf rust ancient Spanish wheats. In: *Approaches to Improving Disease Resistance to Meet Future Needs: Airborne Pathogens of Wheat and Barley*, Praga, Czech Republic, 1997. COST Action 817, Research Institute of Crop Production, Praga, pp. 147.

Ruiz, M., Martin, I. and de la Cuadra, C. (1999). Cereal Seed Viability after 10 years of storage in active and base germplasm collections. *Field Crops Research*, 3813: 1-8.
Ruiz, M., Vazquez, J.F. and Carrillo, J.M. (1998). Estudio de la variabilidad de gluteninas y gliadinas en variedades locales y cultivares primitivos españoles de trigo duro. *Investigación Agraria*, 13: 291-301.