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Short Communication

Variability for morphological traits and high molecular weight glutenin subunits in Spanish spelt lines

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Abstract

Spelt (*Triticum spelta* L.) is hulled wheat which was widely cultivated in Spain until the first half of the 20th century and is still cultivated in Asturias (northern Spain). Much of the variability of this species has been preserved, but little evaluation has been carried out. We describe the characterization of some of these spelt lines for several quantitative traits, including plant height and awnedness.

Keywords: genetic resources; glutenins; hulled wheats

Introduction

Spelt (*Triticum spelta* L.) is the 6× alloploid produced by the hybrid between tetraploid cultivated emmer wheat (*T. dicoccon* Schrank) and the goatgrass *Aegilops tauschii* ssp. *strangulata* Coss. (McFadden and Sears, 1946; Kerber and Rowland, 1974). It is among the oldest of the European cereals (Harlan, 1981), and was widely cultivated in Spain until the end of the 1960 s, when increasing mechanization led to its substitution by bread wheats of short stature. Today, spelt only survives in marginal farming areas of Asturias, where traditional farming systems still continue. In this region, the crop is called *escanda mayor* or *Asturian fisga* and, in most cases, is grown in mixtures with emmer. Fortunately, part of the variability of this crop has been preserved in *ex situ* collections.

Our collection includes 405 accessions from the *ex situ* collections obtained from Centro de Recursos Fitogenéticos INIA (Alcalá de Henares, Spain) and National Small Grain Collections (Aberdeen, Idaho, USA). Many of these accessions date to an expedition carried out in Asturias (northern Spain) by the Swiss Federal Research Station for Agroecology and Agriculture during the 1930 s, and have been conserved in the Germplasm Bank of this Swiss Institution since 1939 (Dr G. Kleijer, pers. commun.). All accessions were typed for their high molecular weight glutenin subunit composition (Caballero *et al*., 2001), and 30 were selected for multiplication and further characterization. The aim of the present work was to study the variability for some key quantitative traits in the spelt accessions from the *ex situ* collection, as a source of future crop improvement.

Experimental

Twenty-five spelt lines were each multiplied from a single individual of each selected accession, and grouped by awnedness, awn colour, glume colour and glume hairiness (Szabó and Hammer, 1996) (Table 1). Several spikes of each plant were bagged to avoid out-crossing. Progeny

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Table 1. High molecular weight glutenin subunit composition of the spelt lines grouped by awnedness and glume colour

				HMW glutenin		
Awns	Glume colour	N° UCO	Accession	Glu-A1	Glu-B1	Glu-D1
Absence	Red	ESP-006	PI-190960	1	6 + 18′	2 + 12
		ESP-019	BG-020900	2	20	5 + 10
Presence	Blue	ESP-002	PI-348750	null	13 + 16	2 + 12
		ESP-011	PI-348432	1	13 + 16	2 + 12
		ESP-012	PI-348570	1	13 + 16	3 + 12
		ESP-014	PI-348572	1	13 + 16	2.5 + 12
		ESP-015	PI-348431	1	13 + 18	2 + 12
		ESP-018	PI-469037	2	20	2 + 12
		ESP-021	PI-348767	2	13 + 16	2 + 12
		ESP-025	PI-348728	1	13 + 16	2 + 12
	Red	ESP-003	PI-348697	1	20	2 + 12
		ESP-004	PI-591900	1	20	2 + 12
		ESP-009	PI-348672	1	13 + 16	2 + 12
		ESP-013	PI-348446	1	13 + 16	2 + 12
		ESP-017	PI-348752	1	13 + 18	3 + 12
		ESP-020	PI-348631	2	13 + 16	2 + 12
		ESP-026	PI-348627	2	13 + 18	2 + 12
	White	ESP-005	PI-591900	1	6	2 + 12
		ESP-007	PI-348612	1	13 + 16	2 + 12
		ESP-008	PI-348614	1	13 + 16	2 + 12
		ESP-010	PI-348428	1	13 + 16	2 + 12
		ESP-016	PI-348497	1	13 + 18	2 + 12
		ESP-022	PI-348429	2	13 + 16	2 + 12
		ESP-023	PI-348430	2	13 + 16	2 + 12
		ESP-024	PI-348728	2	13 + 16	3 + 12

N° UCO, accession number of the Germplasm Bank of the Department of Genetics in University of Córdoba; HMW, high molecular weight.

harvested from these spikes were grown in a plot of length 1 m in the Guadalquivir River Valley (Córdoba, Spain) using the standard agronomic practices for the region (175 kg/ha N, 90 kg/ha P and 90 kg/ha K). Ten morphological traits were measured: plant height, spike length, spike weight, distance between spikelets, number of spikelets per spike, number of grains per spike, number of grains per spikelet, grain length, thousand-grain weight, and weight of grain per spike. Mean values and coefficient of variation (CV) of each trait were computed.

Discussion

On the basis of the chosen morphological discriminators, six botanical varieties could be identified. Only one of these is unawned, having red and glabrous glumes [var. *duhamelianum* (Mazz.) Koern.]. The other five are all awned: one has blue pubescent awns [var. *caeruleum* (Alef.) Körn.]; one has white glabrous glumes [var. *arduini* (Mazz.) Körn.] and one white pubescent glumes (var. *albivelutinum* Körn.); one has red glabrous glumes [var. *vulpinum* (Alef.) Körn.] and the last has red pubescent glumes (var. *rubrivelutinum* Körn.). A representative sample of this variability found is illustrated in Fig. 1.

1 2 3 4

Fig. 1. Variation for awn and glume colour among spelt lines. 1, Awnless spike (ESP-019); 2, white spike (ESP-023); 3, red spike (ESP-020); and 4, blue spike (ESP-012).

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Table 2. Mean values for quantitative traits

	Mean ($n = 25$)	CV (%)	Without awns ($n = 2$)	With awns: Glumes white ($n = 8$)	With awns: Glumes red ($n = 7$)	With awns: Glumes blue ($n = 8$)
Plant height (cm)	139.53	10.0	132.25	144.93	136.30	138.78
Spike length (mm)	170.70	18.3	124.22	179.39	165.82	177.91
Spike width (mm)	7.85	14.7	6.96	8.09	7.79	7.90
Number of spikelets per spike	23.99	8.0	21.57	24.43	24.11	24.06
Distance between spikelets (mm)	7.13	17.1	5.72	7.34	6.87	7.52
Number of grains per spike	40.51	23.3	22.23	44.17	37.67	43.89
Number of grains per spikelets	1.68	20.6	1.03	1.81	1.57	1.82
Kernel length (mm)	7.73	6.9	7.20	7.71	7.78	7.84
Thousand grain weight (g)	33.09	16.6	33.72	34.12	29.78	34.79
Grain weight per spike (g)	1.35	30.0	0.75	1.50	1.15	1.54

Most traits were highly variable between accessions, except for plant height, number of spikelets per spike and kernel length, for which the CV was <10% (Table 2). Mean plant height was high compared to that of modern wheats cultivated in Spain. The number of spikelets per spike varied little, so that the variation in spike length was due to differences in the distance between spikelets rather than to the number of spikelets. The number of grains per spike was significantly lower in the awnless than in the awned types, but kernel weight varied little. Awnless lines had the lowest values for all the traits measured, with the exception of the thousand-grain weight. Red glumed types had significantly lighter kernels than the awnless lines. Lines with white and blue glumes were superior than the other two types, in terms of the number of spikelets per spike, the number of grains per spike and the number of grains per spikelet, and, consequently, grain weight per spike (Table 2). They also produced the tallest plants, apart from line ESP-022, and thus showed a higher tendency to lodge.

Our data confirm that spelt lines show a wide genetic variability, similar to the situation with English emmer (Van der Veen and Palmer, 1997) and Spanish emmer (Alvarez *et al.*, 2006). The presence of awnless types showing a slightly lower plant height than those currently grown in Asturias is of interest. In the collection mission of Caballero *et al.* (2007), no awnless autochthon materials were found, which suggests that genetic erosion has been occurring (Tellez-Molina and Alonso-Peña, 1952). In conclusion, these spelt materials display a wide range of quantitative variability, some of which could be useful to widen the genetic background of the crop cultivated in Asturias.

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