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Aguiriano E., Ruiz M., Carrillo J.M.

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Molina-Cano J.L. (ed.), Christou P. (ed.), Graner A. (ed.), Hammer K. (ed.), Jouve N. (ed.), Keller B. (ed.), Lasa J.M. (ed.), Powell W. (ed.), Royo C. (ed.), Shewry P. (ed.), Stanca A.M. (ed.).
Cereal science and technology for feeding ten billion people: genomics era and beyond

Zaragoza : CIHEAM / IRTA
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 81

2008
pages 55-57

Variability of glutenin alleles in a sample representative of the durum wheat Spanish collection[1]

E. Aguiriano*, M. Ruiz* and J.M. Carrillo**
*Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria,
Centro de Recursos Fitogenéticos, Autovía de Aragón km 36, Apdo. 1045,
28800-Alcala de Henares, Madrid, Spain
**Escuela Técnica Superior de Ingenieros Agrónomos, Dpto. Biotecnología,
Ciudad Universitaria, 28040-Madrid, Spain

SUMMARY – A sample of 41 durum wheat Spanish landraces conserved at the CRF-INIA was analysed for glutenin alleles, located at five loci; *Glu-A1*, *Glu-B1* for high molecular weight (HMW) glutenin A-subunits and *Glu-A3*, *Glu-B3* and *Glu-B2* for low molecular weight (LMW) glutenin B-subunits. Thirty-seven genotypes were found in the 41 landraces analysed. The analogous genotypes were, however, different in other glutenin subunits and in the gliadin electrophoretic patterns. Altogether 49 alleles were identified for the five loci analysed. The most frequent alleles at each locus were *Glu-B1d*, *Glu-B2b* and the allele *a* at *Glu-A1*, *Glu-A3* and *Glu-B3*. The most polymorphic were *Glu-A3* and *Glu-B3,* with 15 and 18 alleles, respectively. A high frequency of new alleles was found. *Glu-B3* alleles linked to the gliadins γ-45 or 44 at *Gli-B1*, associated with good quality, had an accumulated frequency of 70.7%, showing that this germplasm could be a source for breeding quality.

The diversity of old varieties preserved in Gene Banks is an important source of genetic variability, and consequently, of valuable traits for wheat breeding. Samples representative of the collection variation, can help for efficient and cost-effective evaluations and to identify geographical regions as potential donors for breeding purposes. Glutenin alleles have an important association with durum wheat quality. The increase in the knowledge of their genetic variation should provide useful information for the genetic improvement of quality. In this work, a sample with 41 durum wheat Spanish landraces conserved at the CRF-INIA was analysed for glutenin alleles, located at five loci; *Glu-A1*, *Glu-B1* for high molecular weight (HMW) glutenin A-subunits and *Glu-A3*, *Glu-B3* and *Glu-B2* for low molecular weight (LMW) glutenin B-subunits.

The procedure to assemble the sample was based on an agro-ecological classification of wheat growing areas, following the method described by Igartua *et al*. (1998). Glutenin alleles were designated according to the nomenclature proposed by Payne and Lawrence (1983) for the HMW and Nieto-Taladriz *et al*. (1997) for the LMW subunits. To analyse the glutenin gene diversity several genetic parameters and the allelic frequencies were calculated (Table 1).

Thirty-seven genotypes were found in the 41 landraces analysed. The analogous genotypes were, however, different in other glutenin subunits and in the gliadin electrophoretic patterns. Altogether 49 alleles were identified for the five glutenin loci analysed. The most frequent alleles at each locus were *Glu-B1d*, *Glu-B2b* and the allele *a* at *Glu-A1*, *Glu-A3* and *Glu-B3*. The most polymorphic loci were *Glu-A3* and *Glu-B3,* with 15 and 18 alleles, respectively, though the effective number of alleles was one third (5.84 and 6.64), due to the low frequencies of the majority of alleles.

For the HMW, five alleles were found at the *Glu-A1*. The alleles *a*, *b* and *c* presented equilibrated frequencies and they cover the 95% of the varieties analysed. At the *Glu-B1* locus, the allele *e* associated with bad quality presented a very low frequency (0.05%). Ruiz *et al*., (1998) found three and eight alleles at the *Glu-A1* and *Glu-B1* loci, respectively, in 153 Spanish landraces and old cultivars which covered almost the 30% of Spanish durum wheat collection. All those alleles are included in the present sample except the less frequent allele *Glu-B1aq*. Moreover, three *Glu-B1*

[1] This work was supported by the grant RFP2004-018 from the INIA of Spain and the AGL 2003-6382 from Comision Interministerial de Ciencia y Tecnología (CICYT) of Spain. E. Aguiriano has received a pre-doctoral scholarship from the INIA.

alleles not previously found have been identified in the materials analysed in the present work. Except for the *Clu-B2* locus with only two alleles found, the LMW glutenins showed higher variability than HMW.

Table 1. Genetic parameters and allelic frequencies at each glutenin locus in the 41 Spanish landraces. New alleles are not shown

	A[a]	ne[b]	I[c]	He[d]	*a*	*b*	*c*	*d*	*e*	*f*	*h*	*i*	*o*	*an*
Glu-A1	5	3.21	1.26	0.69	0.37	0.24	0.34			0.02			0.02	
Glu-B1	9	2.54	1.45	0.61	0.07	0.05		0.61	0.05	0.07				0.05
Glu-A3	15	5.86	2.18	0.83	0.32	0.10	0.02	0.02	0.22	0.05	0.02			
Glu-B3	18	6.64	2.42	0.85	0.34	0.05		0.07		0.02	0.10	0.05		
Glu-B2	2	1.76	0.62	0.43	0.32	0.68								
Mean	9.8	4.00	1.828	0.682										

[a]Alleles per locus; [b]Effective number of alleles per locus; [c] Shannon-Weaver 's diversity index; [d] Nei's diversity index.

A high frequency of new alleles not catalogued so far, which might be associated with specific Spanish environment factors, was found. In total 20 new alleles were detected at *Glu-A3* (8) and *Glu-B3* (12). The frequencies of new alleles were low and most of them were presented in only one landrace (80%) except the *Glu-B3new-6,* which appeared in three varieties. Almost all the new alleles identified presented new glutenin bands. Some of them are shown in the Fig. 1. On the other hand, *Glu-B3* alleles linked to the gliadins γ-45 or 44 at Gli-B1, associated with good quality, had an accumulated frequency of 70.7%, showing that this germplasm could be a good source for breeding quality.

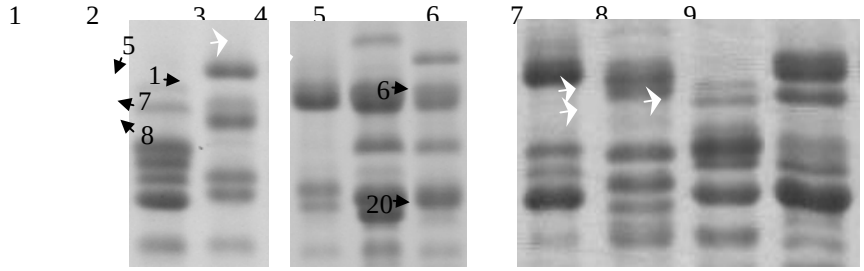

Fig. 1. B-LMW glutenin electrophoretic patterns of landraces (1,4, 5, 7, 8, 9) and test varieties (2, 3, 6): Some of new bands found are showed (white arrows). Glutenin bands of test varieties and their codes are pointed by black arrows.

Large diversity level was found in the Spanish durum wheat landraces analysed for HMW glutenins compared with other reports. Pecetti *et al*. (2001) obtained a Shannon-Weaver 's diversity index of 0.971 and 0.996 in 91 and 59 genotypes of landraces from Bulgaria and the former USSR, respectively, whereas in this work the index at the same loci was 1.357 in only 41 landraces.

Very few reports have studied the polymorphism of LMW glutenins, probably, due to the difficulty in identifying *Glu-3* alleles. All the diversity parameters calculated in this work were larger than those obtained with the same glutenin loci in 55 accessions of Algerian durum wheat landraces and old cultivars (Cherdouh *et al*., 2005). The number of different electrophoretic patterns was 33 in contrast to the 37 found in the present work. The number of alleles found was also higher in the Spanish germplasm at all the loci analysed. Comparing our results with those of Nieto-Taladriz *et al*. (1997), the Nei's diversity index for LMW glutenin alleles in a group of 88 durum wheat cultivars was lower (0.551 *vs*. 0.682), although a double number of varieties were analysed.

The results have shown that the Spanish germplasm sample analysed in the present work possesses a high and useful variation for glutenin alleles, specially after including some others detected in previous works. Also, the diversity holds in the selected sample could be an important variation source for breeding of the durum wheat quality.

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