MABED Malika
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Eberhart and Russell (1966) emphasized the need for considering both b_i and s_d^2 components of V x E in judging the phenotypic stability of a genotype. Later on, Paroda and Hayes (1971) and Paroda *et al.* (1973) emphasized that b_i should simply be regarded as a measure of response for a particular genotype, whereas the s_d^2 should be considered as a measure of stability: genotypes with lowest deviations being the most stable and vice versa.

P 488 and P 490 which had above average mean values showed considerable response to favorable environments, but had poor stability as the values of s_d^2 were significantly high. These strains yielded low under E_2 and E_4, but as the environment became more favorable, their yield increased at a rate well above the average. The cultivar K 391, having high mean values and non significant b_i and s_d^2, was relatively stable despite a better adaptation to more favorable environments.

K 392 had relatively high mean yields, unit slope, and low s_d^2. Therefore, it can be described as being generally adapted to most environments with relatively predictable yields. Other cultivars (such as P 486, Karan 92, and P 267) showed specific adaptation to one or more environments.

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Identification by Electrophoresis of Bread and Durum Wheat Varieties Grown in Algeria

Khelifi Douadi
Institut des Sciences de la Nature - Université de Constantine, ALGERIE
and
Branlard Gerard
INRA, Station d'Amelioration des Plantes, Domaine de Crouelle - 63039 Clermont-Ferrand, FRANCE

The problem of varietal identification in wheat is not new, but the usual tests (Phenic acid coloration, grain size) are not very satisfactory. Autran (1975) used gliadin electrophoresis on starch gel as the basis for a key to identify wheat varieties. He showed that environment and year did not modify electrophoretic diversity of gliadins. Bushuk and Zillman (1978) and Autran (1979) developed a new determination key using polyacrylamide gel.

Wheat varieties grown in Algeria are relatively well known in North Africa and the Middle East. This paper describes a system of identification of these varieties through analysis of the diversity of grain reserve proteins (gliadins and high molecular weight glutenins) and presents an identification key.

Materials and Methods

Materials

The following 10 bread wheat and 13 durum wheat varieties were used in the study: Anza, Arz, Blue-bird, Dougga, Florence-Aurore, Hamra, Mahon-Demias, Siete-Cerros, Strampelli, Pavon, Bidi 17, Cocorit, Hedba 3, Inrat 69, Khroub, Mohamed-Ben-Bachir, Montpellier, Oued-Zenati, Polonicum, Sahel, Tassili, Tell, Timgad.

For each of these varieties, 40 grains were analyzed individually to characterize each variety and to determine varietal purity.

Methods

Gliadin electrophoresis on polyacrylamide gel at pH 3.2

The separation of gliadins on polyacrylamide gel was carried out using the method of Bushuk and Zillman (1978) modified by Courvoisier (1984) on vertical gel. The aluminum lactate buffer was replaced by 0.008 M sodium lactate. The gel composition was also modified as follows:

Acrylamid 6.5 g; Bisacrylamid 0.325 g; Urea 5 g; Aluminum lactate 0.15 g; Potassium lactate 0.02 g; Ascorbic acid 0.22 g; Iron sulfate 1 mg; Distilled water to 100 ml.

Electrophoresis of high molecular weight glutenins subunits

The methods of protein extraction and reduction to subunits and electrophoretic separation were those used by Payne *et al.* 1979. Subunit nomenclature is that proposed by Payne and Lawrence (1983).

Results and Discussion

Wheat Variety Identification by Gliadin Polymorphism

Methodology of interpretation

According to Autran and Bourdet (1975), the reading of a diagram consists in determining the mobility and intensity of each of the bands present in the diagram. The relative mobilities of different components, revealed by electrophoresis at pH 3.2 in sodium lactate buffer, are calculated from a control band found in all the Algerian wheat varieties that have been analyzed. This band is a major component of the ϒ gliadin group and is given a mobility of 68. Thus all the diagram components have a mobility between 12 and 100. The five classes of concentration proposed by Autran and Boudet (1975) are applicable to the diagrams. These classes are defined as: absence, trace, presence, +, ++, and +++. Typical diagrams are presented in Fig. 1.

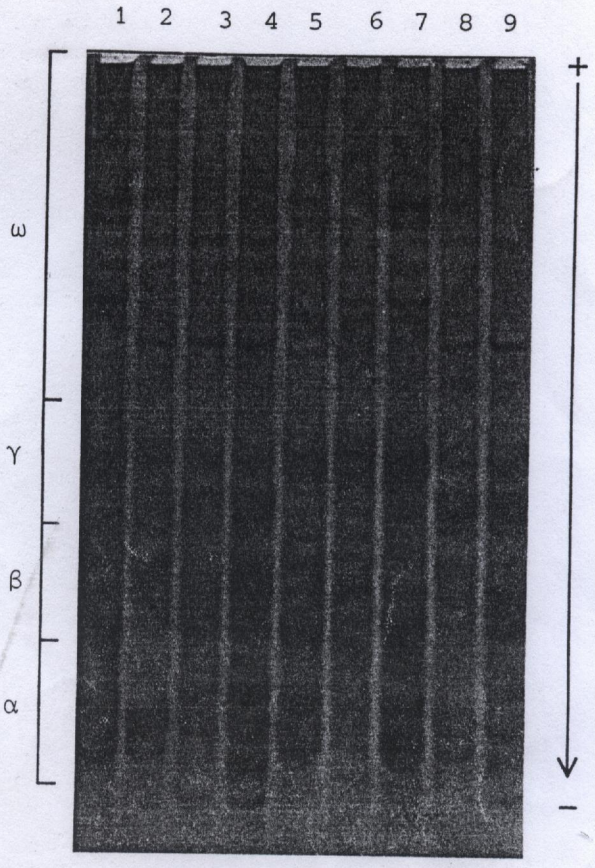
These diagrams consist of 15 - 27 visible electrophoretic bands depending on the variety. The gliadin diagrams present marked differences both qualitative and quantitative. The gliadin diagrams of bread wheat varieties are composed of 22 - 27 bands, compared with 15 - 22 for durum wheats.

Varietal purity of samples

Electrophoretic polymorphism of gliadins was used to characterize varietal purity. Among the many possible origins of impurities, the most important ones are: Mixture at threshing; and outcrossing, generally highest in warm countries. For most of the genotypes, there were no differences between the 40 diagrams for each cultivar, but a few varieties (e.g. Hebda 3 and Timgad) showed two types of diagrams.

Development of an identification table for wheat varieties:

The identification key is based on two characters: qualitative (presence or absence) and quantitative (trace, +, ++, +++). In the present model, the region of ω gliadins, with molecular weights between 45000 and 78 000 Daltons was used. These proteins correspond to genes situated on the chromosomes arms 1 D and 1 A



1,5: Florence-Aurore
3,9: Oued-Zenati
6: Siete-Cerros
2,8: Cocorit
4: Bidi 17
7: Anza.

Fig. 1. Electrophoretic diagrams of some durum and bread wheat on polyacrylamide gel.

and are generaliy wellseparated on gel. According to the electrophoretic analysis, the identification table indicates that durum wheats can immediately be distinguished from bread wheats by the fact that they have no bands in the slow ω gliadin zone (12 to 20).

The identification key (Table 1) also shows that the varieties indicated can be distinguished without ambiguity, from one or several visible differences in the diagrams, with the exception of Hedba 3 and Timgad, which appear to be mixtures.

Identification of Wheat Varieties by Glutenin Polymorphism

The electrophoregrams of high molecular weight glutenin subunits from some durum and bread wheat varieties are shown in Fig. 2.

Table 1. Identification key for bread and durum wheat varieties grown in Algeria, based on gliadin electrophoretic diagrams.

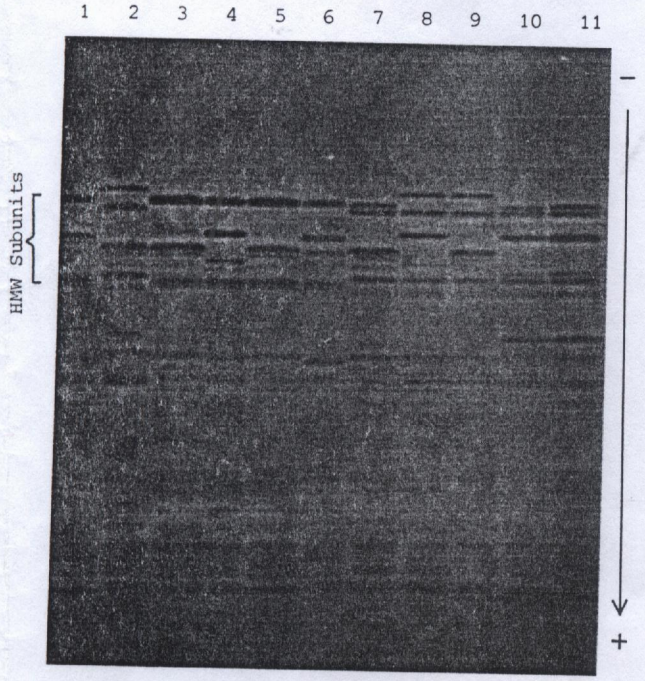
Presence of 3 components in the 12-20 mobility zone: Bread wheat type:	
- Presence of 13-17-20	
+ Presence (+ + or + + +) of 49-51.5	
* Presence (+ +) of 37	Mahon-Demias
* Absence 37	Siété Cerros
+ Presence (+ + or + + +) of 51-53	
* Presence (+ + +) of 45	Strampelli
* Absence of 45	Florence-Aurore
+ Presence (+ + +) of 50-53 and 32	Anza
+ Presence (+ + +) of 50.5-53	Dougga
+ Presence (+ + +) of 52-54	Pavon
+ Presence (+ + +) of 51-53	Blue-Bird
- Presence of 12-16-18	
+ Presence (+ + +) of 50-53 and (+ +) of 33	Arz
+ Presence (+ + +) of (54-55) and (+ +) of 39.5	Hamra
Absence of components in the 12-20 mobility zone: Durum wheat type	
- Presence of 22-26	
+ Presence of 37.5	
* Presence (+ + or + + +) of 50.5	
: Presence (+ or + +) of 28-29.5-32	INRA 69
: Presence (tr) of 27.5-35	Tassili
: Presence (+) of 32.5-33.5-35	Tell
* Presence of 52-53	
: Presence (tr or +) of 33-35	Oued Zenati
: Presence (tr) of 31.5-36.5	Montpellier
: Presence (tr) of 28-32.5	Mohamed-Ben-Bachir
: Presence (tr or +) of 27-29-36	Khroub
* Presence (+ +) of 53 and absence of 52	
: Presence (+) of 33	Hedba 3
* Presence (+ + or + + +) of 50-52	
: Presence (+) of 32-55	Bidi 17
: Presence (+ +) of 32 and absence of 55	Cocorit
: Presence (+) of 55 and absence of 32	Sahel
- Absence of 22-26	
+ Presence of 37.5	
* Presence (tr) of 28-36	Polonicum
* Presence (tr) of 33	Timgad

The different subunits observed in these varieties of quite diverse origins are few in number: 17 compared with 98 gliadins among the same varieties.

These 17 electrophoretic bands are the following: 1, 2, 2*, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, and 20. The group of 10 bread wheat varieties provides 9 distinct glutenin diagrams, as against 5 diagrams for the 13 durum wheat varieties (Table 2).

The band coded by 1 DL (2, 3, 4, 5, 10, and 12) is, of course, absent from the durum varieties. In addition, all the durum wheats carry the null allele of the gene Glu A1. Subunits 1 or 2* coded by the gene Glu A1 were not observed.

The identification of bread and durum wheat varieties grown in Algeria in 1983 was possible by observation of the electrophoretic diversity of omega gliadins. In contrast, analysis of the polymorphism of high molecular weight glutenin subunits does not permit identification of all varieties. In bread wheat, the omega gliadins, controlled by two genes, provide an electrophoretic diversity greater than that of the high molecular weight glutenin subunits, coded for by three genes. The presence of SDS masks the charge of proteins and so reduces the potential revelation of genetic diversity. Observation of high molecular weight glutenins completes electrophoretic analysis of gliadins and provides information on quality (Branlard and Dardevet 1985; Khelifi and Branlard 1987).



1: Mahon-Demias 2: Ciano (check) 3: Siete-Cerros
4: Arz 5: Dougga 6: Magnif (check)
7: Pavon 8: Strampelli 9: Blue-Bird
10–11: Florence-Aurore.

Fig. 2. Electrophoregrams of high molecular weight glutenin subunits from bread wheat varieties.

Table 2. List of high molecular weight glutenin subunits in bread and durum wheats.

Varieties	Glutenin diagrams
Bread wheat:	
Anza	2 - 7 - 8 - 12
Mahon - Demias	2 - 14 - 15 - 12
Siété - Cerros	2 - 2* - 17 - 18 - 9 - 12
Arz	2 - 2* - 7 - 8 - 12
Dougga	2 - 2* - 17 - 18 - 12
Pavon	2* - 5 - 17 - 18 - 10
Blue-bird, Hamra	1 - 5 - 17 - 18 - 10
Strampelli	1 - 5 - 7 - 8 - 10
Florence-Aurore	2* - 5 - 7 - 9 - 10
Durum wheat:	
Bidi 17, Oued-Zenati, INRAT 49 Polonicum, Khroub, Montpellier	20
Timgad, Cocorit, Tell, Sahel	6 - 8
Tassili	7 - 8
Hedba 3	14 - 15
Mohamed-Ben-Bachir	13 - 16

Conclusion

The results described should help to orientate geneticists and breeders. The uses of this identification are multiple; a particularly useful application is commercial transaction where disagreement occurs about the varietal purity of a sample. In addition, this identification should help to evaluate genetic diversity: genetic markers, distances between genotypes and variation within and among wheat populations. The dichotomic identification table should also help to distinguish a known variety from an unknown sample.

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Storage, Protein Composition, Morphophysiological, and Quality Characters of 24 Old Durum Wheat Varieties from Sicily*

G. Boggini,[1], A. Dal Belin Peruffo[2], F. Mellini,[3] and N.E. Pogna[3]

1. Istituto Sperimentale per la Cerealicoltura. Sezione di Catania.

2. Istituto di Chimica Agraria ed Industrie Agrarie. Universita di Padova.

3. Istituto Sperimentale per la Cerealicoltura. Sezione di S. Angelo Lodigiano.

Till a few decades ago cultivation of both common and durum wheat in Italy was largely based on the use of local populations which were very different from one another and suited to specific environments. Afterwards, these old local varieties (minutely described by Ciferri and Bonvicini 1960) were replaced by cultivars obtained through controlled crossing and selection. This greatly increased grain yield but it reduced the genetic variability of the grown germplasm. In fact most present cultivars of bread wheat come from only three old populations (Rieti, Gentilrosso, and Cologna) and share other common ancestors. In durum wheat, the old population "Jean Retifah" from North Africa was successfully used by N. Strampelli to select the cultivar Sen. Cappelli which has been widely grown in Italy and largely used in breeding programs abroad (Vallega and Zitelli 1973). It is worth noting that more than 80% of the registered Italian durum wheats have the cultivar Cappelli in their pedigree.

The present levelling in yield of the wheat cultivars grown in Italy is largely due to the fact that they are closely related genetically. Therefore it could be opportune to reconsider the old wheat populations as potential donors of new useful genes. With this purpose a research program has been initiated to define the morphophysiological, biochemical, and technological characters of old durum wheat populations from Sicily. In order to estimate the genetic variability within each population we have analyzed the endosperm storage proteins (gliadins and glutenins), because protein composition, as shown by electrophoresis, is not affected by environmental factors such as area of growth, year, or climate (Zillman and Bushuk 1979; Lookhart and Finney 1984) and is important in determining both nutritional and pasta-making quality of semolina.

In a previous paper (Boggini *et al.* 1985) we have analyzed the gliadin composition of 24 Sicilian durum wheat populations by means of Acid-Polyacrylamide Gel Electrophoresis (A-PAGE). However, in the present work

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we report on the glutenin composition examined by electrophoresis in presence of Sodium Dodecyl Sulphate (SDS-PAGE) as well as on some morphological and quality aspects of those populations.

Materials and Methods

The 24 wheat (*Triticum durum* Desf.) varieties used in this study were taken from the collection kept at the Experimental Institute for Cereals, Catania, Italy. They are listed in Table 1 according to the botanical classification by De Cillis (1942). Five seeds from 20 spikes chosen at random within each population were used for the electrophoretic analysis. The remaining seed were grown at Catania in 1.5 m-long head rows. The morphological and physiological characters measured on each row were: plant height, heading date, glume and awn color, and glume hairiness. The quality measurements were: 1000-kernel weight, protein content and SDS-sedimentation volume (Axford *et al.* 1979). The storage protein composition was analyzed by electrophoresis on 10% polyacrilamide gel slab in the presence of sodium dodecyl sulphate (SDS-PAGE) according to the procedure of Laemmli, as modified by Payne *et al.* (1980). The gliadin composition has been determined by electrophoresis at pH 3.1 (A-PAGE) as described previously (Boggini *et al.* 1985).

Table 1. Botanical classification of local varieties.

Triticum durum Desf.	Local varieties
Var. Leucurum Koern	Cannizzara
	Regina
	Tripolino S. Agata
Var. Leucomelan Koern	Biancuccia
	Inglesa
Var. Reichenbachii Koern	Tunisina
	Urria
Var. Melanopus Koern	Farro Lungo
	Giustalisa
	Martinella
	Realforte
	Semenzella
Var. Erythromelan Koern	Castiglione Glabro
	Cotrone
	Gioia
	Pavone
	Ruscia
	Vallelunga Glabra
	Lina
Var. Apulicum Koern	Vallelunga Pubescente
Var. Coerulescens Koern	Scorsanera
Var. Hordeiforme Koern	Russello
Var. ?	Sicilia Lutri
Var. ?	Sicilia Reste Nere

Results and Discussion

The results of the morphophysiological observations can be summarized as follows. Most varieties consisted of two or more lines which differ from one another in several aspects. The plant phenotype of eight varieties (Cannizzara, Regina, Inglesa, Tunisina, Urria, Giustalisa, Castiglione glabro and Lina) was clearly different from that described by De Cillis (1942) and in five varieties (Farro lungo, Martinella, Ruscia, Vallelunga pubescente and Scorsanera) the original phenotype was present only in few lines. Moreover, two varieties (Regina and Inglesa) and some lines belonging to Biancuccia and Urria were indistinguishable from Tripolino S. Agata. All these observations indicate that a high degree of heterogeneity exists within those varieties and that correspondence with the description by De Cillis (1942) is rather limited.

The High-Molecular Weight (HMW) glutenin subunits present in the 20 seed samples from each variety were separated by SDS-PAGE and numbered according to Payne and Lawrence's nomenclature (1983). A typical electrophoretic pattern obtained by SDS-PAGE is shown in Fig. 1. The seed samples were also analyzed by A-PAGE to check the presence of δ-gliadin bands designated 45 and 42, closely correlated with gluten strength and weakness, respectively (Damidaux *et al.* 1978).

The storage protein composition (gliadin and glutenin) of the 24 Sicilian cultivars (Table 2) is very heterogeneous: 19 varieties showed two to five different electrophoregrams. As expected, the varieties Regina, Inglesa and Tripolino S. Agata had the same electrophoretic pattern, clearly indicating their genetic equality. The HMW glutenin subunits 13+16, 6+8 and 20 were present in 20, 17 and 14 varieties, respectively. These bands are allelic forms coded by the complex locus *Glu-B1* in the long arm of chromosome 1B and the subunits united by the sign plus are controlled by genes very close together within that locus (see Payne *et al.* 1984 for a review).

The HMW subunits 6+8 and 20 are very frequent in the durum wheats grown in Italy whereas bands 13+16 are rare (Pogna *et al.* 1985), being present only in two