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Comparative Study of the Technological Potentialities of the Ancient and Recent Algerian Hard Grains

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Abstract: Winter wheat cereal crop remains still difficult as it is facing several technical and climatic constraints. All these constraints have a negative influence on yield and on quality of durum wheat in Algeria. In this complicated context, we only can point out priorities that have been identified by agriculture research field, which is naturally seed production of high quality by local varieties. These genotypes will be further of better grain and semoulina level. For this purpose, a trial of a diversified germplasm has been studied. The quality parameters have been essentially qualitative ones (paste and semoulina), by using a small amount of grains (NIRS, non destructive method). The present research will discuss results on high variability which, by the way, seems to be linked to the interaction Genotype- Environment, but also to the genetic potential as well, capable to determine qualitative abilities of the varieties. This method, resolutive and rapid at the same time, may constitute supplementary issue in the selection of quality criteria in wheat.

Key words: NIRS, wheat, protein, quality, selection

INTRODUCTION

The professional literature of the beginning of the century counts numerous studies on the determination of the quality of the flour and the value so molds that on the value of diverse varieties. The analysis of the quality of the wheat was transformed into a very vast field of research.

The wheat cultivated in Algeria, was mainly a wheat of hard in strong content in proteins but in weak yield. The world average content in proteins of the wheat is about 10 p 100. The Algerian wheat in an average about 13 p 100 and can reach for certain varieties 20 p 100.

The research actions which can serve as point of departure for the valuation of this local germoplasme are similar to those who are the object of extensive researches throughout the world.

The culture of winter cereal remains still difficult to master so much that this one remains confronted and subjected to several climatic or technical constraints.

All these chances have a fatal influence on the yield and the quality of the hard wheat in Algeria.

In this complex context, we can only loosen the priorities identified by the sector of the research in Agriculture and which is naturally the production of seed of high quality by local varieties which remain in semolina yield and of raised enough grains.

First research which aimed at the creation of new varieties began with the improvement of the quality and the yield (Benbelkacem *et al*., 1993).

During this last decade, the fruit of the works on the varietal selection on cereal, high lights from national essays, varieties of hard wheat combining a good technological quality and in high yield (Benbelkacem *et al*., 1993); as the results were obtained by Larbi *et al*. (1993) for the varieties Vitron and Waha, we have, respectively 43.1 and 42.8 q ha^{-1}.

The cereal production evolved these last 2 years in proportions considered considerable; it reached 40 million quintals, in 2003-2004 and 42.7 million quintals in 2004-2005 (Assabah, 2006). It turns around 30 million quintals today on average, not enough to cover all the national consumer needs (Assabah, 2006).

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The world production of wheat for the campaign 2005-2006 is of the order of 609 million tons, is a decline of 15 million tons with regard to the season of front, the production of the Maghreb in hard wheat registered too a fall of less than 35 million tons (Assabah, 2006).

So, the improvement of the yield and the quality of the hard wheat passes by the varietal creation and the choice of reliable criteria. Among these criteria, the stability of the yield, the tolerance to the water deficit (Ait-kaki, 1993) the resistance in the diseases and a good technological quality remain the most popular (Benbelkacem *et al*., 1993).

It would indeed be necessary, to urge the agronomic research to improve the local varieties by studying exactly the local constraints and it cannot be made without the help of the producers: The stake is double, on one hand they allow to test the new varieties and to value on the other hand the local genotypes recognized for their wealth in proteins and thus of good qualities.

Among the quality criteria, the semolina value of a hard wheat is defined as the capacity to give a raised yield in semolina of definite purity (Abecassis, 1991) depends on several groups of factors.

So, the choice of the consumer bases itself on several criteria of or the necessity of selecting varieties possessing the required qualities that is to say the semoulier looks for varieties with high specific weight and the pastier looks for semolinas pure and not contaminated and with the quality of proteins of which is satisfactory.

It is in this context, that our study intervenes to look for the potentialities of the ancient varieties with regard to the acquired news.

For that, the present research aims at analyzing and at comparing the kernel yield as well as their constituents, besides the content of proteins, for the varieties of hard wheat put in production and selected for these last 10 years, with regard to those developed for a very long time considered as witness.

MATERIALS AND METHODS

Plant material: Two samples of Algerian hard wheat (*Triticum durum* desf.) resulting from 2 different regions were studied (Table 1): The first sample includes 24 varieties of hard wheat with different degrees of age. These varieties are all pure lineages maintained for several years in the experimental station of El Khroub (Constantine, Est of Algeria), going from those who date 1920 such as Beliouni and Djennah khatifa and those of 1930 as Bidi 17 and Hedba 3 until the new selections (Table 1).

Table 1: Origines and dates of harvest of hard grains studied

Varieties	An	Date	Harvest
Hedba3	Ancien	1930	Khroub2004
Tr. polonicum	Ancien	1930	Khroub2004
Bidi 17	Ancien	1930	Khroub2004
Montpellier	Ancien	1930	Khroub2004
Djennahkhat	Ancien	1920	Khroub2004
Oued Zenati	Ancien	1961	Khroub2004
Mbb	Ancien	1961	Khroub2004
Romani	Ancien	1930	Biskra2004
Bidi2	Ancien	1930	Biskra2004
Inrat69	Recent	1974	Khroub2004
Vitron	Recent	1995	Khroub2004
Tassili	Recent	1995	Khroub2004
Sahel	Recent	1995	Khroub2004
Waha	Recent	1995	Khroub2004
Tell76	Recent	1995	Khroub2004
Bi17/wa//bi17	Crois	1995	Khroub2004
T. pzb//ghov	Crois	1995	Khroub2004
Bidi17/syrica	Crois	1995	Khroub2004
Hed/t. polo	Crois	1993	Khroub2004
Oze/omrabi	Crois	1995	Khroub2004
Hed3/gdov	Crois	1992	Khroub2004
T. polzb//chc	Crois	1996	Khroub2004
Bidi17/khrou76	Crois	1996	Khroub2004

These varieties were sowed in the Khroub (high east internal Algerian plains) possessing an annual pluviometric average of 450 mm, according to an experimental device in blocks randomized in 4 repetitions.

The elementary plot of land including 6 lines of 5 m of length spaced out by 0.2 m and by 1.2 m of wide.

The second sample includes only 2 hard varieties of wheat stemming from the region of the South Algeria (Biskra), Bidi 2 and Romani. The climate of Biskra is a Saharan, dry climate in summer and very pleasant in winter. The pluviometry is on average between 120 and 150 mm year^{-1}. The average temperature over all year is 20.9°C. They were planted according to the same experimental device as the first sample.

All the seeds used in this analysis result from the harvest 2004.

Methods: This analysis was realized in, the experimental station of Mauguio (I.N.R.A.) at Montpellier from France, during period going from December 1st, 2004 still January 15th, 2005.

A new spectroscopique method while using the analysis spectrometry, a Near Infrared Reflectance Spectrocsopy (NIRS) which allows to predict diverse qualitative parameters (pasters and semolina) by using that a small quantity of grains.

In this study several parameters were studied: The specific weight, the proteins content, the thousand-kernel weight and the semolina yield.

For every studied variety we realized 3 repetitions.

The spectrometry in the near infrared reflectance is an analytical technique more and more spread for the fast control of the quality of cereal. Mostly not destructive, it requires that a fast preparation of the sample and it allows the fast and not expensive determination of several parameters.

The Near Infrared Reflectance Spectrometry (NIRS) is a comparative by using calibrations in which the spectral data of samples known are put in correlation with the analytical reference values, the spectrometry can predict, for an unknown lot, the level of the parameter by basing itself only on the spectral imprint of the sample.

For the analysis of the constituents of seeds, which bases on the direct measure of the interaction between constituents chemically defined and the radiation (content in proteins, moisture content), the error of prediction is generally weak although by definition, always superior to that of the reference method (0.3 for proteins against 0.2 in reference method) (Ripetti-Ballester *et al*., 2000).

The statistical analyses were used to compare our samples (SAS, 1985). The spectres corresponding to 25 varieties harvested on whole grains in big cells and mini small dishes, with a NIR system 6500 working by reflectance, of 400 in 2500 nm, with a step of 2 nm.

Four repetitions were realized in big cells and three in mini small dishes for every variety.

The calibration was made from 400 spectres corresponding in 5 years and various places, by means of the software ISI NIRS II (Williams and Norris, 2001).

A mathematical treatment (ACP on spectre) transforming the raw data into first by-product was applied to the spectral data of samples. A correction of a possible drift of spectres (diverse mathematical processes), was also applied to the data (Ripetti-Ballester *et al*., 2000).

On the other hand a statistical study was realized by using the SAS system by applying the processes GLM (analysis of the variance) and CORR (matrix of the correlations).

RESULTS AND DISCUSSION

The results (Table 2) obtained in big cells according to the spectral data of all the studied varieties, for the technological parameters (semoulina yield, content of proteins, specific weight and the weight of one thousand grains), important in the quality determination of grains, allow to highlight:

- The total semolina yield (rdt) varies of 83.05% of Ms for the variety Bidi 17/khroub76*2 in 74.41% of ms for Vitron.
- The content of proteins (Prot) is very high at the variety Vitron (20.37), Med ben bachir (18.00) and Oued Zenati (17.99) with regard to T. Polonicum// gdovz 578/swan who is 12.98., As shows it Baker and Kosmolak (1977) where the interaction between the genotype and the environment is significant seen that the genotype has a wide effect on the quality of the gluten the environment has an effect on the content in proteins. And on the other hand the temperature and the nitrogen increase percentage of proteins and affect negatively the weight of grains (Daniel and Triboi, 2000).

Table 2: Genotype mean values for the measured quality parameters

Varieties	Specifique weight	Proteins	Weight of 1000 g	Semolina yield	Labo weight of 1000 g
Hedba 3	85.532	16.723	43.428	80.543	57.36
Bidi 17/Waha/Bidi 17	89.581	13.982	46.000	78.659	48.56
Triticum Polonicum	87.664	17.241	47.638	80.945	58.08
T.olonicumzb//gho vz 578/swan	91.033	13.180	44.944	80.352	50.52
Bidi17	82.503	16.959	32.784	76.468	45.32
Montpellier	88.537	17.216	49.930	82.137	51.48
Inrat 69	86.937	17.137	45.112	80.251	54.28
Djennah khatifa	84.526	17.357	34.597	75.958	48.56
Bidi17/syrica	88.545	13.901	48.331	80.388	57.68
Oued zenati	86.714	17.717	47.808	80.724	55.48
Vitron	82.394	19.728	32.297	74.804	44.84
Tassili	88.721	14.469	46.252	79.542	50.48
Sahel	90.921	13.500	45.853	80.349	52.16
Hedba3/T.polonicum.zb	89.161	13.359	44.142	79.163	50.28
Oued zenati/omrabish	91.932	15.854	51.791	80.453	54.36
Waha	89.770	14.427	43.979	81.375	49.52
Hedba3/gdovz 619	83.958	15.977	39.631	78.009	47.88
T.polonicumzb//chc/cando	86.484	12.756	44.786	78.100	52.28
Mbenbachir	86.147	18.350	50.196	80.425	46.72
Tell 76	88.812	15.931	41.827	80.079	50.40
Bidi17/khroub76*2	92.060	15.432	53.422	83.273	53.08
Romani	88.272	13.796	50.464	77.334	47.44
Bidi2	88.687	17.534	45.529	79.199	51.20

Table 3: Classification of the varieties according to the analysis of the variance Tableau N°3: Classification des variétés d'après l'analyse de la variance

Classes	Specific weight	Proteins	Weight of 1000 G	Semolina yield
A	Bidi17/kh76*2	Vitron	Bidi17/kh76*2	Bidi17/kh76*2
(A-B)	Oued zenati/omrabi	Mbb	Romani	T. polonicum
		Oued zenati	Montpellier	Montpellier
		T. polonicum	Ouedzenati/omrabi	Mbb
(B-C)	PoloZb/ghvz/swan	Bidi17	Mbb	Oued zenati
		Bidi2		Waha
		Djennahkhatifa		Inrat69
		Inrat 69		Bidi17/syrica
(C-D)	Sahel	Montpellier	Bidi17/syrica	Oued zenati/omrabi
	Tassili	Hadba3	Oued zenati	
	Montpellier		T. polonicum	
	Hedba3/T.polonicum			
	Bidi17/waha /bidi17			
(D-E)	Waha	Hedba3/gdvz619	PoloZbghvz/swan	Tassili
	Bidi2	Oued zenati/omrabi	Bidi17/waha/bidi17	Bidi2
	T. polonicum	Tell 76	Sahel	Hadba3
	Bidi17/syrica	Bidi17 /kh76*2		Sahel
	Tell 76			
(E-F)	T. polonzb/ch/cando	Waha	Inrat69	Tel 76
	Oued zenati	Tassili	Tassili	PoloZb /ghvz/swan
		Bidi17/waha/bidi17	Bidi2	T. polonzb/ch/cando
		Bidi17/syrica	Waha	Hadba3/T. polonicum
			Hedba3/T.polonicum	
(F-G)	Inrat69	Romani	T. Polozb/ch/cando	Bidi17/waha/bidi17
	Romani		Hedba3	Hedba3/gdvz 619
	Mbb		Tell76	
(F-G-H)	Hedba3	Sahel	Hedba3/gdvz619	Romani
	Djennah khatifa	T. polonzb/ch/cando	Djennah khatifa	Bidi17
	Hedba3/gdvz 619	Hedba3/T. polonicum	Bidi17	Djennah khatifa
(H-I)	Bidi17	PoloZb /ghvz/swan	Vitron	Vitron
	Vitron			

- The specific weight (Ps) varies too of 94.08% for the variety Bidi 17/khroub76*2, 93.32% for the variety Oued-Zenati/omrabi sh and reflect a good semoulina quality because of the high weight of grains.
- As for the weight of 1000 grains (Pmg), reflects too a big variation in the results data by all the varieties and the obtained values of which are close to those given in reference (Pmg lab), we have, respectively for the variety bidi17/khroub76*2, 53.44 (Pmg lab = 53.08), Montpellier with 51.26% and Pmg lab = 51.48%.
- The new variety Bidi 17/khroub76*2 shows itself very interesting as well for the semoulina yield, the specific weight and the weight of one thousand grains, it would be thus sensible to include it in the programs of improvement of the semoulina quality, also the vitron variety possesses the cntent of proteins the most raised with regard to the other genotypes.
- Other varieties, are recent for most part (stemming from crossings) are not very interesting from point of view semolina yield, that the content in proteins and with which most part of the crossings were realized to improve the yield without forgetting so much the content of proteins, important criteria for the quality of grains in Algeria.

The statistical analysis by basing itself on the average of the repetitions for every sample and by using the process GLM (test of Student-Newman Keuls), allowed a classification of these varieties (Table 3).

These results which confirm the complexity of the biochemical bases of the quality and show naturally that the judgment a new wheat for this objective must be made from an experiment led on several places.

Hazemoune (2000) in its research works shows in spite of the introduction of new varieties of hard wheat with high yield, the local genotypes (Hedba 3, Bidi 17, Oued-Zenati and MedBenBachir) which are little productive, remain the best adapted in hydrique deficit.

So the study carried out by Benbelkacem and Khellou (2000) on the constituents of the yield shows the stability of the yield for local genotypes as Hedba3 and Bidi 17 but who remain low with regard to those obtained by variety introduced as Vitron, besides a very high content in proteins of the order of 20.10 (Table 4).

The most efficient to mobilize the nitrogen. For this criterion, Vitron shows himself exceptional because she is capable of allying a strong return and a strong content in proteins.

The ancient varieties present contents in high proteins (MedBenbachir 18.37, Oued-Zenati 17.94) and

Table 4: Averages of the parameters of quality and proteins

	An	Proteine	Rdt agro	Pro. rdt agro	Iso
Hedba3	Ancien	17.01	28.87	491.15	17.3210162
Tr. polonicum	Ancien	17.51	30.13	527.54	16.5929204
Bidi 17	Ancien	17.24	28.03	483.19	17.8359096
Montpellier	Ancien	17.29	28.77	497.34	17.3812283
Djennahkhat	Ancien	17.37	18.83	327.05	26.5486726
Oued Zenati	Ancien	17.88	25.90	463.14	19.3050193
Mbb	Ancien	18.14	27.90	506.11	17.9211470
Romani	Ancien	13.75	23.07	317.06	21.6763006
Bidi2	Ancien	17.41	26.70	464.97	18.7265918
Inrat69	Recent	17.30	32.00	553.57	15.6250000
Vitron	Recent	20.10	39.30	790.03	12.7226463
Tassili	Recent	14.52	27.50	399.29	18.1818182
Sahel	Recent	13.49	30.20	407.40	16.5562914
Waha	Recent	14.68	37.87	555.95	13.2042254
Tell76	Recent	15.64	31.53	493.30	15.8562368
Bi17/wa//bi17	Crois	14.39	36.00	518.06	13.8888889
T. pzb//ghov	Crois	13.06	31.17	407.04	16.0427807
Bidi17/syrica	Crois	14.12	34.83	491.97	14.3540670
Hed/t.polo	Crois	13.39	24.83	332.51	20.1342282
Oze/omrabi	Crois	15.69	33.43	524.73	14.9551346
Hed3/gdov	Crois	16.30	34.20	557.43	14.6198830
T. polzb//chc	Crois	13.30	28.13	374.04	17.7725118
Bidi17/khrou76	Crois	15.27	35.40	540.46	14.1242938

rather weak yield (15.6 q ha^{-1} Djennah khatifa, 21.3 q ha^{-1} Romani) with regard to the recent varieties (Vitron 49 q ha^{-1}, Inrat 39.2 q ha^{-1}, Waha 45.9 q ha^{-1}).

The content in proteins was not strongly improved notably by the crossings realized these last years and we can wonder about the fact that Vitron, who seems exceptional, is little used as parent, values which join those obtained by Amir *et al.* (2004) working on the quality of the hard wheat or the most important rate was obtained by the variety Vitron (Fig. 1).

On this study we observed contents in proteins very important for certain varieties (Vitron, Med Ben bachir, Oued-Zenati, Triticum.Polonicum), a semolina yield very high (Bidi17/khroub76*2, Oued-Zenati, Triticum. Polonicum, Montpellier, Med ben Bachir) suiting to the specific weight and the weight of one thousand grains (Bidi17/Khroub76*2, Oued-Zenati/Omrabi).

It emerges from it from these results that:

The (recent) variety bidi17/khroub76*2: A variety with big grains, resistant to the mitadinage and of which the weight of one thousand grains (Pmg) is very high, the specific weight is raised, a very high semolina yield and an average content of proteins.

The (ancient) variety med benbachir: A high content of proteins, a high weight of one thousand grains (pmg) and an average specific weight, is a variety with big grains, resistant to the mitadinage with a high semolina yield.

The (ancient) variety triticum polonicum: A variety with big grains, resistant to the mitadinage, possess a high semolina yield, an average weight of one thousand grains (pmg), an average specific weight and a high content of proteins.

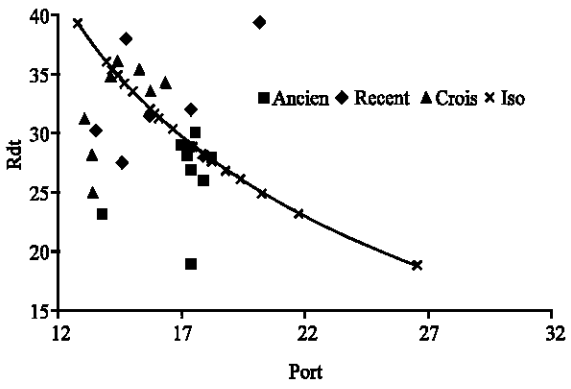

Fig. 1: Relation between the yield and the proteins

The variety montpellier (ancient): A variety with big grains, resistant to the mitadinage, possess a high semolina yield, a high weight of one thousand grains (pmg) and an average specific weight and a high content of proteins.

The (ancient) variety oued-zenati: A high content of proteins, is a variety with average grains, resistant to the mitadinage, with an average semolina yield, an average weight of one thousand grains(pmg), an average specific weight and a high content of proteins.

The (ancient) variety Inrat 69: A high content of proteins is a variety with average grains, resistant to the mitadinage, with an average semolina yield, an average weight of one thousand grains(pmg) and an average specific weight.

The (recent) variety oued zenati/omrabish: A variety with big grains, possess an average semolina yield, a high weight of one thousand grains(pmg) and a high specific weight and an average content of proteins.

The (recent) variety vitron: A variety with small grains, resistant to the mitadinage, possess a very high content of proteins but a weight of one thousand grains(pmg) and a very low specific weight (Fig. 1).

- Both varieties Beliouni and Djennah Khatifa, is the most (ancient) varieties, with small grains, resistant to the mitadinage, with a very high content of proteins, but weight of one thousand grains(pmg) and weight specific and a semolina yield very low.
- Two other varieties native of the Algerian South (Biskra)
- Bidi 2: Which is a variety with big grains, resistant to the mitadinage, possess a very high content of proteins but an average semolina yield, a weight of 100 grains and a low specific weight.
- Romani: Which is a variety with big grains, very sensitive to the mitadinage, possess a very low content of proteins, at semolina yield, in weight of 100 grains and in specific weight.

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