

A Study on Wheat Germplasm (*T. aestivum* L.) for Breeding of Grain Quality

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Abstract

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The grain quality of 38 wheat accessions from different geographic areas has been evaluated. The accessions originated from Eastern Europe have statistical significant higher values of sedimentation value and Pelschenke test than those from Western Europe.

Hierarchical cluster analysis was used to determine the similarity or diversity among the studied accessions. The unique as Lut.1985 H 165 and Albatross Odesskiy (UKR) had high sedimentation value, Pelschenke test and Quality index. The most genetic diverse were the accessions from the third cluster at level 2.5 d.u. The Kansas line SB-140-5 and CLLF/BEZ//SU92/C113645 /3/NAI60/4EMU/5/DYBR 83-6, with high quality -joint breeding of USA / TUR were genetic similar but the most diverse from the others. This gives them priority as suitable genetic material to be included in the effective breeding programs for high quality.

Key words: wheat accessions, Pelschenke test, protein, quality index, sedimentation value

Introduction

Bread wheat is a major cereal crop in Bulgaria. Creating new high quality cultivars is a permanent goal not only for national but worldwide wheat breeding programs. Applying appropriate germplasm is an important prerequisite leading to successful work. Including initial material with wide genetic background in breeding programs gives the opportunity to decrease genetic disturb and maintain long lasting

potential of species. (Dorofeev and Udachin, 1987; Boyadjieva, 1994; Rasmusson, 1996; Kronstad, 1998; Braun et al., 2000;

Rajaram, 2000). Studies on quality variability are traditional method of assessing genetic diversity. Therefore is necessary to valuate foreign and create national germplasm with high quality on the one hand and on the other to detect the suitable initial forms for wheat breeding (Boyadjieva and Mangova, 1987; Mangova

et al., 1998; Boyadjieva et al., 1987, 1999; Datcheva et al., 2000, Panayotov et al., 2005)

The study aimed at characterizing wheat accessions from different countries by quality parameters, to determine its genetic diversity and to make the breeding work more effective.

Material and Methods

Thirty eight accessions (*T. aestivum* L.) with different breeding - geographic origin and from working collection maintained at breeding department of IPGR - Sadovo were studied. Group of Western Europe – 8 originate from France, 1 originates from Italy (Table 1a). Group of Eastern Europe- 15 originate from Russia (Table 1b). Group of 14 accessions originate from different countries

(Bulgaria, CIMMIT-Mexico, Hungary, Romania, USA, and Turkey) were also studied. The accessions of the latter group showed good productive traits, as well as good resistance of biotic and abiotic stress factors (Table 1c).

Field trials

The field experiments were conducted using a harvest plot of 2 m² (four rows 2 m long; 25 cm apart and an interplant distance between 3 cm) with one replication. The high quality -variety Bezostaya 1 was also included in these experiments.

Quality assessment

Content of grain protein (N x 5.7, % dm basis) was determined by the Kjeldahl method. The micro-sedimentation value of flour was determined according to Pumpyanskii (1961) using an acetic acid

Table 1

Origin of the studied accessions

a) Western Europe; b) Eastern Europe

a) Western Europe		b) Eastern Europe	
Cultivar	Origin	Cultivar	Origin
Soissons1	France	273a9-7	Russia
Gaspard2	France	85-15at 6	Russia
FD911478	France	85-111 a 1092	Russia
FD89034-23-9	France	1027a1144-1003	Russia
FD90086-3-11	France	87-28ag38	Russia
Viking 12	France	85-108a146	Russia
Florin 13	France	85-43a87-3	Russia
Recital	France	Eika	Russia
Setta	Italy	Lut2048HG7	Russia
		Lut1985H167	Russia
		Lut2907H13	Russia
		Lut593-K11	Russia
		Lut1491K11	Russia
		Lut3630K9	Russia

Table 1c
Accessions Tested in the International Performance Nursery
CIMMIT/Ankara

Accession	Origin	Accession	Origin
Bezostaya 1	Russia	Agri/Nac/Lira	Mexico/Turkey
BG532-1	Bulgaria	Pyn/Bau	Mexico/Turkey
BG6514-1K	Bulgaria	ClIF/Bez/Su92/	USA/Turkey
BG Predela	Bulgaria	C113645/3/Na160/	
F 338	Romania	5/DyBr	
F4141-W1-133	Romania	SB-140-5	USA/ Ks
F 885	Romania	Albatross Odesskiy	Ukraine
		Odesskaya132	Ukraine
		KOIN	

glacial; Pelschenke fermentation value was determined according to Pelschenke (1953). The quality index was expressed as a ratio between the sedimentation value and the content of grain protein according to Halverson and Zeleny (1988).

Statistical analyses

It was determined T-test for establishing the difference between the groups for the qualitative indices under study. After Z score data standardization a hierarchical cluster analysis for mean values was performed taking into consideration the complex effect of the analyzed traits. The genetic similarity or diversity was calculated by determine the Euclidean distance between two objects in the multidimensional space, defined by the number of studied traits, and was illustrated by a dendrogram- Ward method.

Results and Discussions

The wheat variety Bezostaya 1 (Table 2), as well as the accessions from Russia 273a 9-7, 85-111a1092, 87-28a38, Lut.1985 H 167, the accessions from

Romania F338, F4141-W1-133, F885 and the Ukrainian accession Albatross Odesskiy had the highest sedimentation values. The mean value for the experimental period was over 50 cm³. The standard deviation was lower, so these accessions were relatively stable according to this character, except for F4141-W1-133 (ROM) and Albatross Odesskiy (UKR). Considerable variation was found between Pelschenke fermentation values. At the first position was Albatross Odesskiy with 310 min, followed by 85-108a146, Lut.2048HÅ and value of 200 min for 273 as.7 (RUS). Another 26 of them, from different geographic groups had over 100 min. Only 8 accessions showed Pelschenke fermentation value less than 100 min. For the years of experiment FD89034-23-9 (FR), Albatross odesskiy (UKR) and Florin 13 (FR) had the highest stability of this trait.

Protein content higher than 16 % possessed the accessions CLL/BEZ//SU92/ USA/TUR, Bul5327-12 (BG), KO/IN (HUN) and SB-140-5 (USA/KS). These were tested in the International Performance Nursery of CIMYT /Ankara

Table 2
Maen values of the qualitative traits of wheat accessions

	Protein	Sediment	Pelshenke	Quality Index
Bezostaya1	13.61	58.3	190.5	3.67
Soissons 1	13.06	41.5	163.3	3.32
Gaspard 2	14.91	37	105	2.43
FD911478	12.35	37.3	103	3.12
FD89034-23-9	13.61	47.3	107	3.48
FD90086-3-11	13.07	42.8	136.7	3.5
Viking12	15.29	38.3	74.3	2.81
Florin13	14.51	38.3	47	2.6
Recital	12.76	40.8	102	3.59
Setta	14.24	45.8	81.7	3.21
237a9-7	14.33	51	202.7	3.57
85-15at6	14.15	44.5	150.7	3.03
85-111a1092	13.39	53.3	196	3.33
1027a1144-1003	14.34	47	112.7	3.35
87-28ag38	14.41	54.8	191.3	3.93
85-108a146	14.08	48.8	214.7	3.76
87-43a87-3	12.84	41	176	3.14
Eika	14.72	38.8	144.7	2.83
Lut2048HG7	13.43	43	210	3.24
Lut1985H167	13.04	52.3	145	3.33
Lut2907H13	13.24	42.3	161	3.42
Lut593-K 3	15.38	46.8	147.7	3.04
Lut1491K11	13.93	42	103	3.25
Lut3630K9	14.89	43.3	114	2.91
BG5327-1	16.15	35.5	79.3	2.19
BG6514-1K	15.02	37	84.3	2.53
Predela Bg	14.73	41.5	68.7	2.85
F 338	14.37	53	134.7	3.84
F4141-W1-133	15.15	54	186.7	4.11
F 885	14.87	53.8	208.3	3.65
KO/IN	16.14	36.8	86	2.29
Agri/Nac/Lira	14.02	37.3	108	2.52
Pyn/Bau	14.04	29.5	95.3	2.25
Cllf/Bez/Su92	16.16	46	163.7	2.7
Spn/VeeSdy	14.64	40.8	149	2.92
Sb-140-5	16.11	44	151.7	2.39
Albatross odesskiy	14.13	52	310	3.67
Odesskaya 132	14.17	45	111	3.24

and some of them have been created within this program. Another 4 accessions Lut.593-KÇ (RUS), Viking 12 (F), F4141-W1-133 (ROM) and Bul.6514-1k (BG) had also high protein content- over 15 %.

It is known that wheat grain can have high protein content but with insufficient quality and vice versa, grain with lower protein content but with very good quality.

Quality index provides an indication of protein quantity and quality within the grain. The high Quality index was observed for the following accessions: F4141-W1-133, F338, and F885 of Romanian origin, almost all Russian representatives, French accessions - Recital, FD90086-3-1, FD 89034-23-9, Soissons 1, FD 11478, as well as these from Ukraine- Albatross Odesskiy and Odesskaya 132.

T-test analysis (Table 3) established the difference between wheat groups from Eastern and Western Europe, expressed by 4 quality traits. The representatives

from Eastern Europe had statistical significant higher values of sedimentation value and Pelschenke test than those from Western Europe. The differences between both groups as regards the protein content and the Quality index were not statistical significant.

Very useful information about genetic diversity or similarity of wheat presented dendrogram applying Cluster analysis. This was important for the purposes of the breeding program. Here, the 38 accessions included in the study were grouped according to the behavior of the mean values of separate quality traits. The dendrogram (Figure1) visualized the hierarchic grouping of the accessions. At cut of level 2.8 distant units eight clusters were observed.

The first cluster consisted of 7 wheat accessions - 4 French and 3 Russian. This group was characterized with lower content of crude protein in grain and medium

Table 3
T-test of the quality traits between accessions from Eastern and Western Europe

Traits/Geographic areas	Valid No	Average value	T-value	d f	P	St.dev.
Sedimentation value, cm ³						
Eastern Europe	15	46.84	2.93*	22	0.007	5.21
Western Europe	9	41.01				3.717
Pelschenke test (min)						
Eastern Europe	15	163.99	4.104*	22	0	36.67
Western Europe	9	102.22				33.91
Crude Protein, %						
Eastern Europe	15	14.05	0.831	22	0.41	0.67
Western Europe	9	13.76				1.03
Quality index						
Eastern Europe	15	3.36	1.528	22	0.14	0.35
Western Europe	9	3.12				0.42

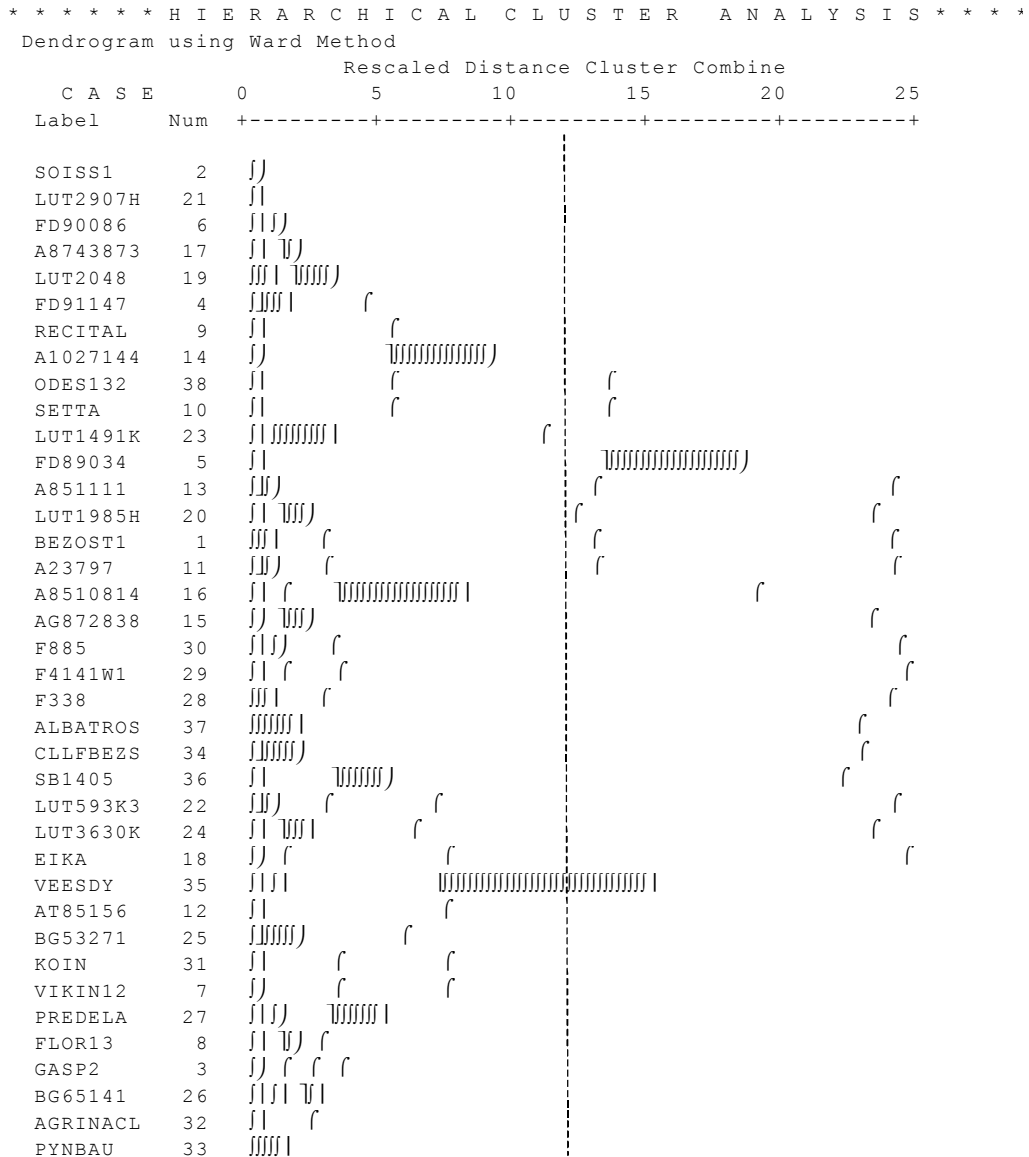


Fig. 1.

values of Pelschenke test and quality index.

At level 1.0 d.u. was second cluster grouped 5 accessions from Eastern and Western Europe.

At level 2.0 was smaller third cluster, included 3 Russian accessions 85-111 a1092, Lut1985H 167 and Bezostaya 1. These have achieved sedimentation higher than 50 cm³, and quality index between

3.33÷3.85 but crude protein was less than 14 %.

The 4-th cluster at level 2.0 d.u. consisted of the most qualitative 6 accessions from Eastern Europe. Quality index was from 3.57 for Russian 237a9-7 to 4.11 for Romanian F4141-W1-133 accession.

The most genetically similar but the most diverse from all studied accessions were in the 5-th cluster (Gllf/Bez/Su92/C113645/3/NA160/4 Emu5/Dybr and Kansas line Sb-140-5) as well as in the 7-th cluster (BG 53271, KO/IN). All representatives came from the International Performance Nursery CIMMIT/Ankara. They were described as having extremely high content of protein in grain (>16 %).

It has been mentioned that SB-140-5 and CLLF/BEZ//SU92/C113645/3/NAI60/4EMU/5/DYBR 83-6 beside their genetic diversity, had protein content over 16 %, as well as Pelschenke fermentation value over 150 min. This priority makes them suitable genetically material to be included in the breeding programs for high quality.

The five accessions made the group of 6-th cluster at level 2.0 d.u. All except one Spn/Vee//Sdynac76 (USA/TUR) originated from Russia and had medium quality, in relation to the other tested accessions.

The last 8-th cluster at level 2.5 included three French, two from joint breeding Mexico/Turkey and two Bulgarian accessions. These accessions had sedimentation value less than 40 cm³, Pelschenke test less than 100 min, respectively quality index between (2.25÷2.81).

Unique accession in separate cluster was Ukrainian Albatross Odesskiy showing the highest Pelschenke fermentation value 310 min.

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