

*Original Contribution***VARIATION OF AGRONOMIC TRAITS AMONG INTRODUCED WINTER BREAD WHEAT CULTIVARS****G. Desheva^{1*}, M. Sabeva¹, M. Zacharieva²**¹Department of Plant Genetic Resources, Institute of Plant Genetic Resources “Konstantin Malkov”, Sadovo, Bulgaria²National Agricultural University La Molina (UNALM), Lima, Peru**ABSTRACT**

Five Romanian and eight Serbian cultivars were evaluated in the conditions of South Bulgaria for nine agronomic traits. Hierarchical Cluster Analysis (HCA) permitted to group the cultivars in two main clusters divided each one in three sub-clusters. The most distant, according to the complex of studied characters, were the cultivars Gruia and Rusiya and the closest ones Gruia and Litera, Faur and Boema, Evropa 90 and Gora. A Principal Component Analysis (PCA) allowed identifying cultivars of potential interest as parental lines for further use in winter bread wheat breeding, as Boema (short stem, high number of grains per spike), Gora (high grain lysine content) and Rusiya (high number of spikelets per spike and thousand kernel weight).

Key words: cluster analysis, principal component analysis (PCA), winter bread wheat

INTRODUCTION

Wheat is one of the most popular crop in the world and have paramount importance for feeding of people of the planet. It is subject to extremely large in scale research and breeding work. Narrowing the range of genetic variation as a result of using of conventional breeding selection practices is however limiting the chance of improving its productivity (1) and there is an increased need of diversifying the set of parental lines used in breeding programs (2-5). In this regard the collection, evaluation and use of appropriate genetically different germplasm in breeding programs is a prerequisite for the success of selection (6-9). A good knowledge of the variation of useful characteristics in the introduced germplasm is however also needed (10-13). Grouping of accessions helps in the direct introduction of varieties in production or use in plant breeding (selection of parental forms) (14). The aim of this study was to better characterize and group a set of winter bread wheat cultivars from Rumania and Serbia using agronomic traits for their further use in breeding programs.

MATERIALS AND METHODS*Plant Material*

Thirteen winter bread wheat varieties were

examined (**Table 1**). They included five cultivars from Rumania, eight from Serbia and one check from Bulgaria.

Experimental conditions

The present study was conducted in the experimental field of the Konstantin Malkov Institute of Plant Genetic Resources at Sadovo, Bulgaria during the 2011-2012 and 2012-2013 growing seasons. The experiment was carried out in a randomized block design in four replications on a 10 m² plot size. Normal agronomic and cultural practices were applied to the experiment throughout the growing seasons.

Plant measurements

Ten randomly selected plants from each cultivar were harvested at maturity for biometric measurements. Data recorded included plant height (X1), spike length (X2), number of spikelets per spike (X3), number of grains per spike (X4), grain weight per spike (X5) and thousand kernel weight (X6).

Protein content in grain (X7) was estimated by the method of Kjeldahl according to BDS ISO 1871 (15) and lysine content in grain (X8) was determined by method of Ermakov et al. (16). Lysine content in percentage of protein (X9) was calculated.

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Table 1. List of accessions included in the investigation

№	Cultivar	Origin
1	Enola	Bulgaria
2	Gruia	Romania
3	Faur	Romania
4	Litera	Romania
5	Boema	Romania
6	Golosa	Romania
7	Gordana	Serbia
8	Zvezdana	Serbia
9	Rusiya	Serbia
10	Evropa 90	Serbia
11	Renesansa	Serbia
12	Gora	Serbia
13	Rapsodiya	Serbia
14	Lyllyana	Serbia

Statistical analysis

Average data of two growing seasons were used. Statistical analyses were performed using the statistical program SPSS 19.0. Hierarchical Cluster Analysis (HCA) based on the Between-groups linkage method using Squared Euclidian distance and Principal Component Analysis (PCA) were applied to group the cultivars according to the similarities and dissimilarities among them with respect to the studied agronomic characters.

RESULTS AND DISCUSSION

Plant height varied from 66 cm to 91 cm (**Table 2**). The accessions with the shortest stem were Gordana (66 cm), Boema (66.5 cm) and Faur (67.5 cm), while Evropa 90 and Gora had the tallest stems (91 cm and 89.5 cm, respectively). Gruia had the longest spike. Eight accessions showed significant differences with the check Enola for this trait. Spike length had the highest coefficient of variation (CV=16.43), suggesting that this trait is more susceptible to change under the influence of environmental factors (17). Boema and Renesansa had a bigger number of grains per spike than the check. Grain weight per spike was closely associated to grain yield as reported by Dimova et al. (18). The Serbian cultivar Lillyana had the highest grain weight per spike, together with the highest thousand kernel weight (2.69 g and 44.90 g, respectively). The Romanian cultivar Boema and the Serbian Renesansa also had a higher grain weight per spike compared to the check. On the other hand Zvezdana (from Serbia) had the lowest grain weight per spike (1.68 g) and Grua (from Romania) the smallest grain (thousand kernel weight 33.02 g).

A limited variation was noted for grain protein content (CV=3.62%). The highest grain protein

content was observed in the Serbian cultivar Gordana (15.43%) and the lowest in the Romanian cultivar Golosa (13.32%). Grain lysine content was positively associated with the percentage of lysine in proteins. The highest values of both traits were noted in the cultivar Gora (0.40% and 2.89%) and the lowest in the cultivars Zvezdana (0.28% and 1.94%), Boema (0.30% and 2.14%) and Renesansa (0.33% and 2.19%). According to Chinnaswamy et al. (19), USDA (20) and Dimitrov et al. (21), grain protein content is a good predictor of wet gluten content.

The grouping of accessions according to the mean values of the studied characters and using the Hierarchical Cluster Analysis allowed distinguishing two main clusters. In cluster I were included the Romanian cultivars (with the exception of Golosa) as well as Zvezdana and Gordana from Serbia and the local check Enola. The remaining accessions were grouped in the second cluster. Cluster I was divided into three subgroups. The first subgroup contained Gruia, Litera, and Enola. The second subgroup is composed by the shortest cultivars Faur, Boema and Gordana. The cultivar Zvezdana characterized by the lowest grain weight per spike and lysine concentration formed a separate subgroup. Cluster II was divided also into three subgroups. In the first subgroup were included the cultivars Renesansa and Lillyana, having high grain weight per spike. The second subgroup consisted of Golosa and Rapsodiya. The tallest cultivars Evropa 90, Gora and Rusiya formed the third subgroup. The most phenotypically distant cultivars were Gruia and Rusiya and the closest were Gruia and Litera, Faur and Boema, Evropa 90 and Gora.

Table 2. Characteristics of winter bread wheat cultivars originated from Rumania and Serbia (2011-2013)

Cultivar	Plant height (cm)	Spike length (cm)	Number of spikelets per spike	Number of grains per spike	Grain weight per spike (g)	Thousand kernel weight (g)	Protein content (%)	Lysine content (%)	% lysine in % protein
Енола	72,0	14,3	20,8	53,3	2,12	39,70	14,10	0,36	2,53
Gruia	72,0	14,2	20,0	58,5	1,94	33,02*	13,80	0,33	2,40
Faur	67,5	13,8	19,0	59,7	2,56	42,84	14,59	0,35	2,40
Litera	73,5	13,6	19,2	60,4	2,16	36,12	13,79	0,33	2,34
Boema	66,5	11,9*	18,4	64,9*	2,64*	40,42	14,13	0,30	2,14*
Golosa	79,5	13,0	18,2	45,7	1,85	40,45	13,32	0,32	2,41
Gordana	66,0	8,1*	20,0	57,0	2,15	37,84	15,43	0,37	2,41
Zvezdana	71,5	9,9*	18*	49,0	1,68	34,29	14,53	0,28*	1,94*
Rusiya	87,0	10,9*	22,4	56,1	2,41	43,89	14,52	0,36	2,48
Evropa 90	91,0*	11,1*	19,2	57,4	2,23	38,95	14,17	0,33	2,33
Renesansa	86,5	10,2*	20,4	64,4*	2,63	40,51	14,80	0,33	2,19*
Gora	89,5*	10,5*	19,6	51,6	1,96	37,25	13,94	0,40	2,89*
Rapsodya	84,0	12,6	17,8*	51,8	2,06	39,51	13,99	0,35	2,49
Lillyana	79,5	9,8*	16,2*	59,9	2,69*	44,90	14,25	0,35	2,41
LSD 0,05	16,28	2,32	2,73	9,74	0,52	5,44	3,10	0,07	0,22
Mean	77,57	11,71	19,23	56,41	2,22	39,26	14,24	0,34	2,38
Std. Error of Mean	2,36	0,51	0,40	1,49	0,09	0,91	0,14	0,01	0,06
Std. Deviation	8,83	1,92	1,51	5,58	0,32	3,40	0,51	0,03	0,21
Variance	77,96	3,70	2,29	31,10	0,10	11,56	0,27	0,00	0,05
Minimum	66,00	8,10	16,20	45,70	1,68	33,02	13,32	0,28	1,94
Maximum	91,00	14,30	22,40	64,90	2,69	44,90	15,43	0,40	2,89
CV %	11,38	16,43	7,87	9,89	14,44	8,66	3,62	8,79	9,01

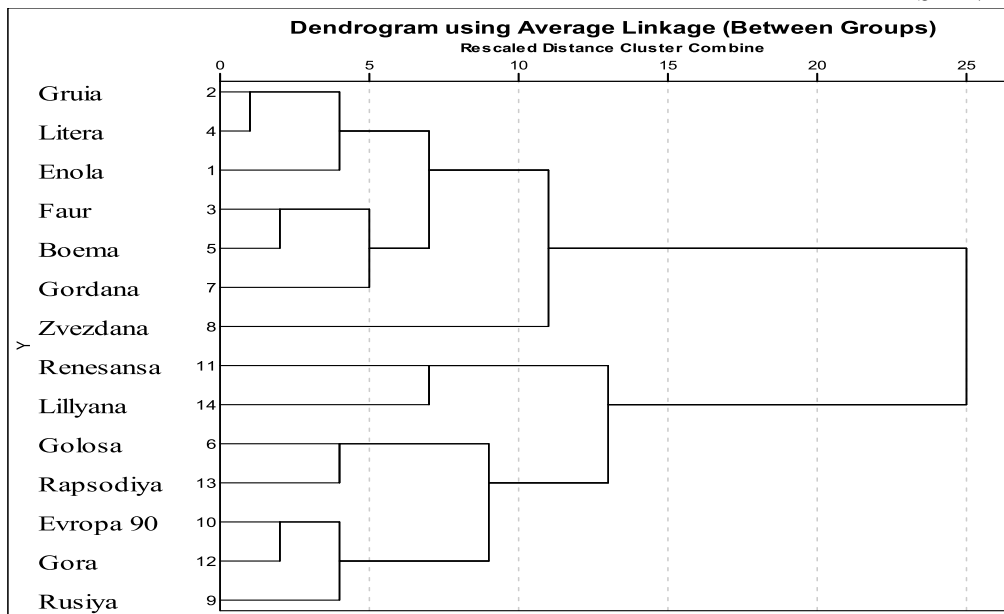


Figure 1. Grouping of 14 winter bread wheat cultivars by Between-groups linkage method

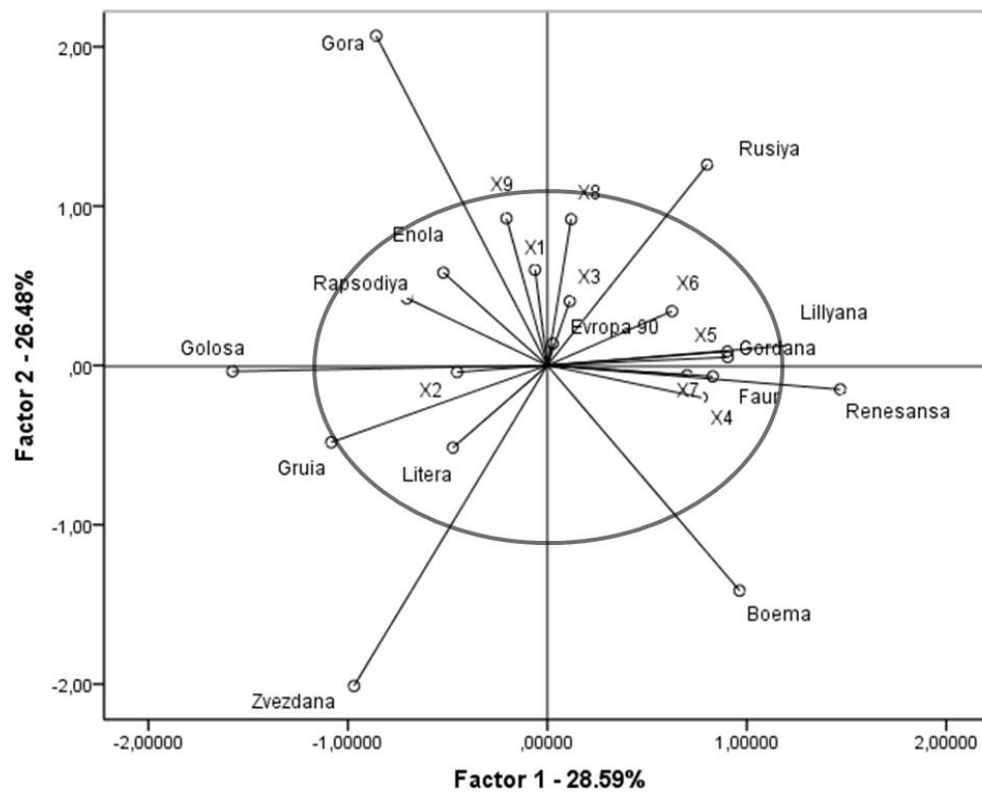


Figure 2. Projection of the investigated characters and cultivars on the factor plane (1 x 2)

Table 3. Weighted factors (PC1 and PC2) of descriptive characteristics on the rotated matrix with two factors

Characters	PC1	PC2
X1		0,60
X2	-0,45	
X3		0,40
X4	0,77	
X5	0,90	
X6	0,62	
X7	0,70	
X8		0,92
X9		0,92

CONCLUSION

1. Spike length, grain weight per spike and plant height, were the most variable characters during the period of investigation.
2. Hierarchical Cluster Analysis and Principal Component Analysis allowed identifying characters that better differentiated the studied cultivars.
3. The Romanian cultivar Boema and the Serbian cultivars Rusiya and Gora can be recommended as donors of different important agronomic traits for winter bread wheat improvement.

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