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AGRONOMIC CHARACTERS OF SOME FOREIGN WINTER BREAD WHEAT CULTIVARS (*TRITICUM AESTIVUM L.*)

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Abstract: The study is carried out in the experimental field of Institute of Plant Genetic Resources “Konstantin Malkov” - Sadovo, Bulgaria during 2015-2017 growing seasons. Seven Italian, seven Czechian, two Francian, two Portugal and two Polish cultivars were evaluated for six agronomic traits. In general the evaluated foreign cultivars had later date to heading than the national standard Enola. An exception was cultivar Bilancia which had the same length of vegetative growth phase as Enola. Bohemia had the longest spike. Italian variety Alcione had the highest number of spikelets per spike. The Czech cultivars Bohemia and Seladon and Polish variety Kobra Plus had the highest thousand grain weight. Relatively the highest yield was recorded for Jordao and Coa from Portugal and Carisma from Italy. K-means cluster analysis permitted to group the cultivars in four clusters. The standard variety Enola with other six cultivars was grouped into second cluster including 35% of total genotypes. The maximum average inter-cluster distance was found between cluster I and cluster III. So, the crossing between these two highly diverse cluster parents would be fruitful for getting heterosis cross combination. The results of this study will support efforts of utilization of foreign cultivars in winter bread wheat breeding programs.

Keywords: winter bread wheat, cultivars, agronomic characters, k-means cluster analysis.

INTRODUCTION

Wheat is the world’s most widely grown crop with a global production of over 600 million tons produced from about 210 million hectares in many different countries in Europe, Asia, North Africa and the Americas. The area sown with wheat has doubled over the last 50 years and production per hectare has increased almost three times. This increase in production is due partially to the efforts of the national and regional breeding programs, most

of which are in the public domain, in producing improved cultivars. Wheat is also the world's most widely traded food grain with about 105 million tons or about 18% of world production traded each year (Anonymous, 2007).

Wheat is subject to extremely large scale research and breeding work. Breeding of adapted and suitable new varieties is critical to improve livelihoods and ensure that national industries remain competitive. Narrowing the range of genetic variation as a result of using of conventional breeding selection practices which are limiting the chance of improving its productivity and there is an increased need of diversifying the set of parental lines used in breeding programs (Hailegiorgis, 2011; Graybosch and Peterson, 2010; Lanning et al., 2010). In this regard the collection, evaluation and use of appropriate genetically different germplasm in breeding programs are a prerequisite for the success of selection. The formation of the current gene pool of wheat and their wild relatives, its planned and targeted research has been and is a major priority in the researching activity (Desheva, 2014). A good knowledge of the variation of useful characteristics in the introduced germplasm is however also needed (Corbellini et al., 2002).

The objective of this study was to assess the agronomic characters of some foreign winter bread wheat (*Triticum aestivum* L.), maintained both in field and base collections in IPGR-Sadovo.

MATERIALS AND METHODS

The study is carried out in the experimental field of Institute of Plant Genetic Resources "Konstantin Malkov" - Sadovo, Bulgaria during 2015-2017 growing seasons. (Table 1). Twenty bread wheat varieties were examined (Table 1). They included 7 cultivars from Italy, 7 from Czech Republic, 2 from France, 2 from Portugal, 2 from Poland, and 1 from Bulgaria used as standard. Sowings were made in the optimal time for this area: 10-15 October.

The cultivars were sown in a randomized block design in four replications on a 10 m^2 plot size. Normal agronomic and cultural practices were applied to the experiment throughout the growing seasons. The agronomic characters were taken after harvesting the plants. From each accession, 20 plants were collected for biometrical measurements. Data were recorded for plant height (cm), spike length without awns (cm), number of spikelets per spike, thousand grain weight (g), and grain yield per ha(t/ha). Length of vegetative growth phase (from 1 January to heading) was also recorded. The mean data from all characters were used to analysis of variance according to Lidansky (1988).

Statistical analyses were performed using the statistical program SPSS 13.0. K-means clustering analysis was applied to group accessions according to similarity on the basis of investigated traits.

Table 1. List of accessions included in the study

№	Name of variety	Species	Subspecies	Country of origin
1	Enola	Triticum aestivum L.		BGR
2	Ines	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	CZE
3	Bohemia	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	CZE
4	Baletka	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	CZE
5	Secese	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	CZE
6	Seladon	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	CZE
7	Silueta	Triticum aestivum L.		CZE
8	Coa	Triticum aestivum L.	var.aestivum	PRT

№	Name of variety	Species	Subspecies	Country of origin
9	Jordao	Triticum aestivum L.	var.aestivum	PRT
10	Andalou	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	FRA
11	Muza	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	POL
12	Kobra Plus	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	POL
13	Alcione	Triticum aestivum L.	var.aestivum	ITA
14	Bilancia	Triticum aestivum L.	var.aestivum	ITA
15	Carisma	Triticum aestivum L.	var.aestivum	ITA
16	Delfino (P 204 A)	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	ITA
17	Esperia	Triticum aestivum L.	var.aestivum	ITA
18	Gemini	Triticum aestivum L.	var.lutescens (Alef.) Mansf.	ITA
19	Primoasi	Triticum aestivum L.	var.milturum (Alef.) Mansf.	ITA
20	Accor	Triticum aestivum L.	var.aestivum	FRA

RESULTS AND DISCUSSION

The data from Table 2 show that in general the cultivars of foreign origin had later date to heading than the national standard Enola. An exception was cultivar Bilancia which had the same length of vegetative growth phase as Enola. Cultivar Seladon ended its vegetation growth latest. Plant height varied between 65 cm and 105 cm. The cultivars Bohemia and Muza had significantly the highest plant height than the standard, while cultivar Gemini being the shortest. Spike length without awns was the most variable character (CV=16,10%) suggesting that this trait is more susceptible to change under the influence of environmental factors (Desheva and Kachakova, 2013, Desheva et al. 2016). Bohemia had the longest spike. Number of spikelets per spike varied from 14 to 24. Italian variety Alcione had the highest number of spikelets per spike. The mean value of thousand grain weight was 37,9 g. The Czech cultivars Bohemia and Seladon and Polish variety Kobra Plus had the highest thousand grain weight. On the other hand Primoasi (from Italy) had the lowest (Table 2).

The yield is the most important economic characteristic, polygenic inherited and strongly influenced by environmental factors (Ristic et al., 2009, Gorjanovic et al., 2010, Zecevic et al., 2010, Popovic et al., 2012, Hirzel and Matus, 2013; Sikora et al., 2013, Garrido et al., 2013). According to Stagnary et al. (2008) genotype had a great effect on grain yield. Grain yield per hector varied between 4,52 t/ha and 7,12 t/ha. Relatively the highest yield was recorded for Jordao, Carisma and Coa. They exceeded the standard Enola by yield with 26%, 23% and 22%, respectively (Table 2).

Table 2. Means for 6 traits in 20 foreign cultivars, 2015-2017

№	Cultivars	Length of vegetative growth phase	Plant height, cm	Spike length without awns, cm	Number of spikelets per spike	Thousand grain weight, g	Grain yield per ha, t/ha
1	Enola-St	115,5a	82,5b-f	9,5ab	19,0abc	39,0abc	5,65a
2	Ines	124,5a	95,0fg	8,5ab	20,0bc	37,5abc	5,18a
3	Bohemia	125,0a	105,0g	11,0b	18,0ab	42,0c	5,47a
4	Baletka	120,5a	85,0c-f	9,0ab	21,0bc	35,0ab	5,73a
5	Secese	123,0a	85,0c-f	8,5ab	19,0abc	39,0abc	6,18a
6	Seladon	128,5a	92,5e-g	9,5ab	20,0bc	42,0c	5,32a

№	Cultivars	Length of vegetative growth phase	Plant height, cm	Spike length without awns, cm	Number of spikelets per spike	Thousand grain weight, g	Grain yield per ha, t/ha
7	Silueta	123,5a	82,5b-f	7,5a	17,5ab	37,0abc	4,64a
8	Coa	117,5a	87,5d-f	8,5ab	17,0ab	39,0abc	6,91a
9	Jordao	117,0a	82,5b-f	8,5ab	16,0ab	35,5ab	7,12a
10	Andalou	123,0a	72,5a-d	9,0ab	19,0abc	38,0abc	4,99a
11	Muza	126,0a	105,0g	9,5ab	21,0bc	40,0bc	6,51a
12	Kobra Plus	127,5a	92,5e-g	8,5ab	19,0abc	38,5abc	5,67a
13	Alcione	119,5a	70,0abc	9,0ab	24,0c	35,5ab	4,52a
14	Bilancia	115,5a	72,5a-d	8,0a	16,0ab	38,0abc	6,37a
15	Carisma	119,0a	77,5a-e	8,5ab	20,0bc	35,0ab	6,95a
16	Delfino	116,0a	75,0a-d	7,5a	17,0ab	39,0abc	6,61a
17	Esperia	118,0a	72,5a-d	7,0a	18,0ab	39,5abc	6,91a
18	Gemini	117,0a	65,0a	8,0a	21,0bc	38,0abc	5,55a
19	Primoasi	117,0a	67,5ab	7,5a	18,0ab	34,0a	6,08a
20	Accor	119,5a	75a-d	8,0a	14,0a	36ab	6,57a
	Means	**120,7**	**82,1**	**8,6**	**18,7**	**37,9**	**5,95**
	CV,%	**3,44**	**14,05**	**16,10**	**11,93**	**5,87**	**13,30**

Means in the same column followed by the same letters are not significantly different ($p \leq 0.05$), according to Duncan's test.
CV, % - Coefficient of variation

Twenty wheat genotypes were categorized into four clusters using K-means clustering analysis. In the first cluster, four genotypes were classified including 20% of total genotypes. The standard variety Enola with other six cultivars was grouped into second cluster including 35% of total genotypes. The third cluster included 3 genotypes. Six genotypes were classified in cluster IV accounting 30% of total genotypes (Table 3). Average inter-cluster distance was found maximum between cluster I and cluster III (225,948) (Table 4). So, the crossing between these two highly diverse cluster parents would be fruitful for getting heterosis cross combination (Fikre et al., 2015). The intra cluster distance is minimum in cluster IV (58,933) which contains 6 genotypes. It indicated that genotypes in this cluster are genetically related (Table 4).

Table 3. Distribution of 20 common winter wheat genotypes into four clusters based on K-means cluster analysis

Cluster	Number of genotypes	Name of cultivars	Distance
I	4	Coa	9,791
		Jordao	15,266
		Carisma	4,791
		Esperia	10,290
II	7	Enola-St	16,839
		Ines	33,469
		Bohemia	17,874
		Baletka	22,718
		Seladon	21,035
		Kobra Plus	17,305

Cluster	Number of genotypes	Name of cultivars	Distance
		Gemini	24,301
III	3	Silueta	10,841
		Andalou	27,255
		Alcione	21,102
IV	6	Secese	21,549
		Muza	29,005
		Bilancia	8,780
		Delfino	23,013
		Primoasi	33,606
		Accor	19,490

Table 4. Inter and intra cluster distances based on K-means cluster analysis

Clusters	I	II	III	IV
I		146,623	225,948	58,933
II	146,623		80,674	87,864
III	**225,948**	80,674		167,051
IV	**58,933**	87,864	167,051	

The average of characters for each cluster and the difference between each cluster with the total mean (Diff) are presented in Table 5. The genotypes classified into first cluster are characterized with the lowest mean value of length of vegetative growth phase and the highest mean value of grain yield per ha. The mean value of the plant height, thousand grain weight and spike length without awns in the second cluster were the highest compared with the total means of all genotypes. (Table 5). The third group comprises 3 cultivars – Silueta from Czech Republic, Andalou from France and Alcione from Italy. The genotypes in this cluster were in the highest rate with respect to number of spikelets per spike (20,17), and the lowest to plant height and grain yield per ha. The genotypes into fourth group (87101518 from France, 87101579 from Germany, 87101497 from Sweden and 87101606 from Russia) had the highest mean values for length of spike (11,90 cm) and thousand grain weight (55,14 g). The sixth cluster included 22,92% of total genotypes. The average values of traits- length of vegetative growth phase, plant height, spike length without awns and number of spikelets per spike, in fourth group were less than total means of all genotypes (Table 5).

Table 5. The average of characters for each cluster and difference between each cluster and the total mean (Diff.)

Characters	Clusters				Total means
	I	II	III	IV	
Length of vegetative growth phase	**117,88**	122,64	122,00	119,50	120,70
Diff.	-2,83	1,94	1,30	-1,20	
Plant height, cm	80,00	**88,21**	**75,00**	80,00	82,10
Diff.	-2,10	6,11	-7,10	-2,10	
Spike length without awns, cm	8,13	**9,14**	8,50	8,17	8,6
Diff.	-0,48	0,54	0,10	-0,43	
Number of spikelets per spike	17,75	19,71	**20,17**	17,50	18,78
Diff.	-1,03	0,93	1,39	-1,28	

Characters	Clusters				Total means
	I	II	III	IV	
Thousand grain weight, g	37,25	**38,86**	36,83	37,67	37,90
Diff.	-0,65	0,96	-1,07	0,23	
Grain yield per ha, t/ha	**6,97**	5,50	4,71	6,38	5,95
Diff.	1,02	-0,45	-1,24	0,43	

CONCLUSION

The cultivars Bohemia and Seladon from Czech Republic, Kobra Plus Jordao and Coa from Portugal, Alcione and Carisma from Italy, can be recommended as donors of different important agronomic traits for winter bread wheat improvement.

K-means cluster analysis allowed to identify characters that better differentiated the studied cultivars.

REFERENCES

1. Anonymous. Global strategy for the *ex situ* conservation with enhanced access to wheat, rye and triticale genetic resources. International Maize and Wheat Improvement Center (CIMMYT) Apdo. Postal 6-641, 06600 Mexico, DF MEXICO. 2007.

2. Corbellini M, Perenzin M, Accerbi M, Vaccino P, Borghi B. Genetic diversity in bread wheat, as revealed by coefficient of parentage and molecular markets, and its relationship to hybrid performance. Euphytica. 2002; 123:273-285.

3. Desheva G. Morphological and agronomical characterization of common wheat landraces (*Triticum aestivum* L.) from the National wheat collection of Bulgaria. Emirates Journal of Food and Agriculture. 2014; 26(2):164-169.

4. Desheva G, Sabeva M, Zacharieva M. Variation of agronomic traits among introduced winter bread wheat cultivars. Trakia Journal of Sciences.2016; 2:171-175.

5. Desheva G, Kachakova, S. Correlations between the main structural elements of yield in common wheat cultivars. Plant Science. 2013; 50:5-8.

6. Fikre G., Alamerew S, Tadesse Z. Genetic Variability Studies in Bread Wheat (*Triticum Aestivum* L.) Genotypes at Kulumsa Agricultural Research Center, South East Ethiopia. Journal of Biology, Agriculture and Healthcare.2015; 5(7):89-98.

7. Garrido M, Román L, Silva P, Castellaro G, Cortázar VG, Acevedo E. Characterization of genetic coefficients of durum wheat *(Triticum turgidum* L. ssp. *durum)* 'Llareta-INIA' and 'Corcolén-INIA' Chilean J. Agric. Res. 2013; 73(2): 91-98.

8. Gorjanovic B, Kraljevic-Balalic M, Jankovic S. Environmental Effects on Associations among Nitrogen Use Efficiency Traits in Wheat. Cereal Research Communications. 2010; 38(1):146-153.

9. Graybosch RA, Peterson CJ. Genetic improvement in winter wheat yields in the Great Plains of North America, 1959-2008. Crop Sci. 2010; 50(5):1882-1890.

10. Hailegiorgis D, Mesfin M, Genet T. Genetic Divergence Analysis on some Bread Wheat Genotypes Grown in Ethiopia. J. Central Eur. Agric. 2011; 12(2):344-352.

11. Hirzel J, Matus I. Effect of soil depth and increasing fertilization rate on yield and its components of two durum wheat varieties. Chilean J. Agric. Res. 2013; 73(1):55-59.

12. Lanning SP, Kephart GR, Carlson GR, Eckhoff JE, Stougaard RN, Wichman DM, Martin JM, Talbert LE. Climatic change and agronomic performance of hard red spring wheat from 1950 to 2007. Crop Sci. 2010; 50:835-841.

13. Popovic, V., M. Malesevic, DJ. Glamoclija, S. Vuckovic, M. Tatic (2012): Effect of agro-ecological factors on wheat seed production. Scientific Journal of Univerzity of Szeged. Hodmezovasarhely, *6*, (2), pp. 150-157.

14. Ristic Z, Momcilovic I, Bukovnik U, Prasead V, Fu J, Ridder B, Elthon T, Mladenov N. Rubisco activase and wheat productivity under heat-stress. Journal of Experimental Botany. 2009; 60(14):4003-4014.

15. Sikora V, Filipovic V, Berenji J, Popovic V. Agro-biological traits of genotypes of common millet (*Panicum miliaceum* L.) in regular and stubble crop. Field and Vegetable Crops Research, Novi Sad. 2013; 50 (2):16-23.

16. Stagnari F, Codianni P, Pisante M. Agronomic and kernel quality of ancient wheats grown in central and southern Italy. Cereal Res. Commun. 2008; 36: 313-26.

17. Zecevic V, Boskovic J, Dimitrijevic M, Petrovic S. Genetic and phenotypic variability of yield components In wheat (*Triticum aestivum* L.). Bulgarian Journal of Agricultural Science. 2010; 16(4): 422-428.