Genotypic specific features of common wheat varieties (*Triticum aestivum* L.). Yield and quality of grain.

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Abstract

The field experiment was conducted in the selected area of Dobruja region. The experiment was performed by means of a block method with four replications with predecessor sunflower. The aim of the study was to establish the grain yield and quality of four Bulgarian bread wheat varieties, grown in the region of Dobruja. The analysis of the results showed that the highest grain yield was obtained from Carat variety – 6.000 t ha^{-1}, followed by Albena – 5.300 t ha^{-1} and the lowest one – from Enola variety 5.130 t ha^{-1}. The test weight of the investigated varieties is close values, which indicates that it is in effect – largely on the weather conditions of the year, rather than the variety. The mass of 1000 grains and wet gluten content of Albena variety were highest (50.7g and 28.0%) and lowest of Enola – (46.51g and 26.0%). The lowest values of relaxation of gluten reported with the variety Albena – 7.3 mm and the highest – with the Carat variety – 9.8 mm.

Key words: wheat, grain yield, test weight, mass of 1000 grains, gluten

Introduction

The ecological and the climatic conditions in the separate regions of the country influence the development and productivity of plants (Hasanova, 2014; Nielsen et al., 2014;).

The choice of the wheat varieties and the proper regional distribution, as well as their growing by strictly following the technological practices, are of vital importance for the yield

amounts and the quality of the produce obtained (Anjum et al., 2014; Bojnanská and Mocko, 2014; Kolev et al., 2012; Neelam and Khatkar, 2013; Stankov et al., 2013; Yankov, 1012).

That necessitates the constant introduction of new varieties that are the most suitable and efficient for the separate micro regions of the country (Ivanova et al., 2013; Man et al., 2012; Kurt and Yagd, 2013).

The aim of the study was to establish the grain yield and quality of four Bulgarian bread wheat varieties, grown in the region of Dobruja.

Material and methods

A field experiment with wheat was carried out on the experimental field of the Dobrich area during the period 2004 – 2007. The test was performed by means of a block method with four replications; experimental field area – 15 m^2.

Albena, Pryaspa, Enola and Carat varieties were studied with sunflower predecessor. All the stages of the established technology for wheat growing were followed. The grain yield is determined with standard grain moisture of 13%.

The indices grain yield (t ha^{-1}); test weight (kg); mass of 1000 grains (g); wet gluten content (%); relaxation of gluten (mm) were determined.

For the purpose of determining the quantity dependence between the studied indicators, the experimental data was processed according to the Anova Method of dispersion analysis, and the differences between the variants were determined by means of the Dunkan's Multiple Range Test (Dunkan, 1995).

The period of the research is characterized with variety of temperature and rainfall conditions which enables to evaluate the reaction of the studied varieties in accordance with their quality characteristics under different agricultural and climatic conditions (fig. 1).

Characteristics features of the year 2005 are comparatively warm autumn with low moisture during the period of germination and tillering. December, January and February are wet, on which the good level of moisture is based. During the period of the spring vegetation (March-April) there was a period of drought while the period of grain filling and forming was with enough rainfall, close to the climatic rates.

During the year 2006 the rainfall is uneven, with months of high moisture (March and May) and dry January. According to the temperature, it is very close to the climatic rates, except January during which month the temperature is -3.4°C or with 3°C lower.

As far as the climate is concern the year 2007 is especially specific. It is characterized with too low rates of moisture not only during autumn – winter period but also during the period of active vegetation. The low rates of rainfall are combined with high temperatures, especially during the winter period.

The period of study (2004-2007) comprised years, which differed significantly concerning the major meteorological factors (air temperature and precipitation sum) having an effect on wheat yield and quality.

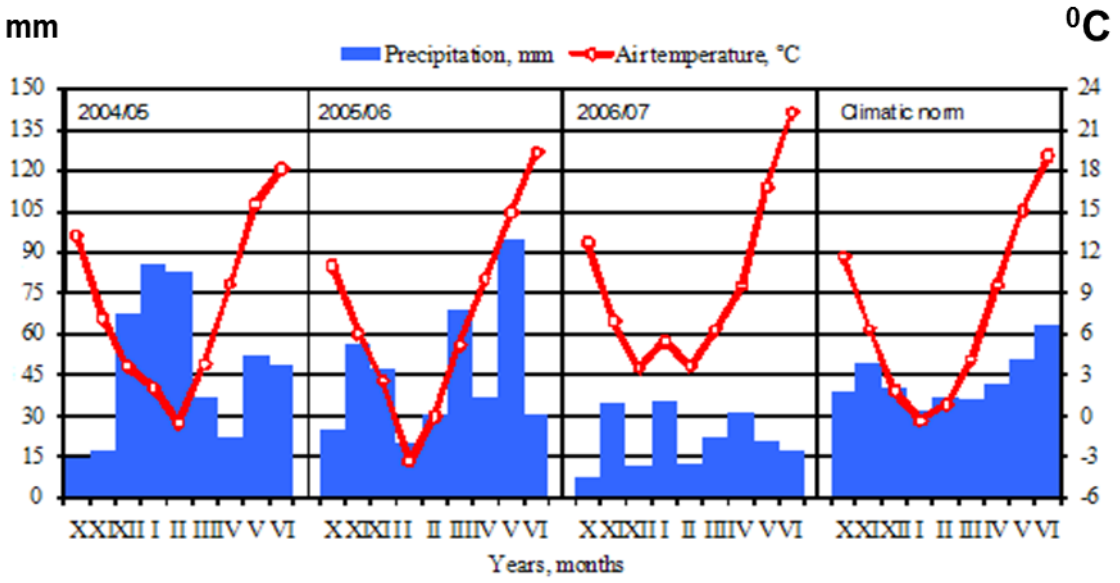

Figure 1. Meteorological data for the years of the investigation.

Results and discussion

The total analysis of the results shows that the studied varieties react in a different way according to the grain yield during the three years of the experiment (Table 1). During the separate years of the experiment the highest is the productivity from Carat – 6.100, 5.900 and 6.000 t ha^{-1} respectively for 2005, 2006 and 2007.

In the first experimental year the lowest is productivity of Albena variety – 5.300 t ha^{-1}, and in the second and the third years – from Enola variety (5.400 and 4.300 t ha^{-1}) . The differences among varieties were statistically significant.

During the period of study (2004-2007) Carat variety realized the yield of 6.000 t ha^{-1} in average and it surpassed the varieties Albena and Pryaspa by 13.2 and 13.8%, respectively. The grain yield obtained from Enola variety was 5.130 t ha^{-1} and it was less than the yields from all the other varieties included in the experiment by 2.7 to 17.0%.

Table 1. Grain yield, $t.ha^{-1}$

Variety	Years of study			Average
	2005	2006	2007	
Albena	5.300 [a]	5.700 [b]	4.900 [c]	5300
Pryaspa	5.400 [b]	5.800 [c]	4.600 [b]	5270
Enola	5.700 [c]	5.400 [a]	4.300 [a]	5130
Carat	6.100 [d]	5.900 [d]	6.000 [d]	6000
LSD 5%	80.6	95.0	295.0	

*Values with the same letters do not differ significantly

The results from analyses of variance over three years for the grain yield are presented in Table 2. It was found that the effects of varieties (V) and year (Y) on the yield were significant. The interaction (V x Y) was also statistically significant.

Table 2. Analysis of variance for grain yield for the period 2004 – 2007

Source of Variation	Sum of Square SS	DF	Mean Square MS	Sig of F	η
Varieties – (V)	4947500	3	1649166,70	0,000	59
Years – (Y)	3095000	2	1547500,00	0,000	70
Interaction (VxY)	1825000	6	304166,67	0,013	47
Residual	2100400	24	87516,67		

The test weight of the investigated varieties is close values, wich indicates that it is in effect – largely on the weather conditions of the year, rather than the variety (Table 3).

The highest values of the characteristic test weight were established in the first experimental year (2005), in the tested varieties varied from 77.2 kg (Albena) to 82.3 kg (Carat). The lowest values of the characteristic test weight were established in the last year of the study (2007), from 77.2 to 78.4 kg. It showed that the low amount of rainfall during the vegetation has a negative influence on grain formation.

Table 3. Test weight, kg

Variety	Years of study			Average
	2005	2006	2007	
Albena	77.2 [a]	78.5 [a]	78.4 [b]	78.0
Pryaspa	79.4 [a b]	80.3 [b]	77.6 [a b]	79.1
Enola	80.1 [b]	79.4 [a b]	77.8 [a b]	79.1
Carat	82.3 [b c]	79.1 [a b]	77.2 [a]	79.5
LSD 5%	3.1	1.4	0.88	

*Values with the same letters do not differ significantly

In average, during the three-year period of study, the test weight of all investigated varieties varied from 79.5 kg of the Carat variety to 78 kg of Albena variety. It showed that the drain is considered to be good for flour producing.

The mass of 1000 grains is one of the important indirect indicators, characterizing grain properties, its technological value as well as its quality regarding using it as sowing material. This indicator characterized its filling up as well as its thickness.

The mass of 1000 grains weight changes under the influence of weather conditions during the year (Table 4).

In the most favorable for wheat year (2005) the values of this characteristic were within the limits of 47.25 to 54.63 g. statistically proven, the lowest ones were those of variety Carat and the highest – of Albena. The results of the varieties Pryaspa and Enola had quite close values and they were statistically insignificant.

In the second experimental year (2006) the values of mass of 1000 grains varied from 45.97 to 51.72g , i.e. they were by 3.8 % lower in average in comparison with the previous year. Mathematical processing of data showed that variety Carat significantly fell behind Albena and Pryaspa by 7.0 and 10.7%. The lowest the values of this characteristic were realized by variety Enola – 45.97g.

In the most unfavorable (dry) for wheat year (2007) the mass of 1000 grains in the investigated varieties was from 43.44 to 48.64 g, i.e. they were by 10 and 6% lower in average in comparison with the previous years.

Table 4. Mass of 1000 grains, g

Variety	Years of study			Average
	2005	2006	2007	
Albena	54.63 [c]	50.00 [c]	47.37 [b]	50.70

Pryaspa	50.20 [b]	51.72 [d]	43.44 [a]	48.45
Enola	49.68 [b]	45.97 [a]	43.89 [a]	46.51
Carat	47.25 [a]	46.73 [b]	48.64 [b]	47.54
LSD 5%	2.18	0.22	2.26	

*Values with the same letters do not differ significantly

Out of all the investigated varieties smallest the mass of 1000 grains, in average for the three years, was established in variety Enola – 46.51 g and the biggest - formed by variety Albena – 50.70.

Meteorological conditions exert certain influence on the amount of gluten, thus the amount of gluten is the highest during the first and the third years of the experiment, and during the two years due to the dry weather during the period of filling of the grain (Table 5).

It has been established that during the drier years protein content of grain is higher, hence it follows that gluten is directly related to protein content as it itself is a protein component.

During 2006 which is characterized with good waterfall supply during the period of formation process of the grain, the amount of gluten is the lowest – 26.3 %.

In the first experimental year (2005) the wet gluten content varied from 27.0 mm in Enola and Prqaspa varieties to 29 mm in Albena. It was statistically proven that Albena variety surpassed by 5.5 % in average all the other studied varieties.

Table 5. Wet gluten content, %

Variety	Years of study			Average for the variety
	2005	2006	2007	
Albena	29,0 [c]	27,0 [c]	28,0 [c]	28.0
Pryaspa	27,0 [a]	26,0 [b]	29,0 [d]	27,3
Enola	27,0 [a]	25,0 [a]	26,0 [a]	26
Carat	28,0 [b]	27,0 [c]	27,0 [b]	27,3

LSD 5%	1.0	0.96	0.85	

*Values with the same letters do not differ significantly

In the second year of the study (2006) the lowest values of the characteristic wet gluten content were reported in Enola variety – 25.0%. Mathematical processing of data showed that this variety significantly fell behind Pryaspa and Albena by 4.0 and 8.0 % respectively.

The following indices show the influence of the variety on the amount of wet gluten. On the average for the three years of the experiment the highest is the formation of wet gluten of Albena variety – 28.0%, while the lowest is of Enola variety – 26.0%. The results obtained were statistically significant.

In addition to amount of gluten its quality is determinative too for the bread producing and baking properties of certain grain yield. The main property determinative for the quality of gluten is its relaxation.

In this study the relaxation of gluten of the four varieties during the three years of the experiment is according to standard, i.e. it is lower than the maximum of 10 mm over which standard the grain is no good for bread making. Carat variety which in 2007 shows relaxation of the gluten 10.1 mm, is an exception of this standard (Table 6).

The lowest relaxation of the gluten were obtained in the last year of the study (2007) due to the dry weather during the period of filling of the grain - 7.4 mm on the average for all the varieties.

The highest relaxation of the gluten were obtained in the second experimental year (2006) which is characterized with good waterfall supply during the period of formation process of the grain and the values of this characteristic varied from 9.1 to 9.7 mm. The lowest is the quality of the gluten formed by variety Carat when relaxation of gluten is

significant highest – 9.7 mm. The results of the varieties Pryaspa, Enola and Albena had quite close values and they were statistically insignificant.

Table 6. Relaxation of the gluten, mm

Variety	Years of study			Average for the variety
	2005	2006	2007	
Albena	6,5 [a]	9,1 [a]	6,4 [a]	7,3
Pryaspa	7,3 [b]	9,4 [a]	6,5 [b]	7,7
Enola	7,8 [b]	9,1 [a]	6,4 [a]	7,8
Carat	9,5 [c]	9,7 [b]	10,1 [c]	9,8
LSD 5%	0.81	0.21	0.95	

*Values with the same letters do not differ significantly

During the period of study (2004-2007) the studied varieties form gluten of different quality, the lowest is relaxation of Albena variety -7.3 mm while the highest is of Carat variety – 9.8 mm.

Conclusions

The highest grain yield was obtained from Carat variety – 6.000 t ha^{-1}, followed by Albena – 5.300 t ha^{-1} and the lowest one – from Enola variety 5.130 t ha^{-1}.

The test weight of the investigated varieties is close values, wich indicates that it is in effect – largely on the weather conditions of the year, rather than the variety.

The mass of 1000 grains and wet gluten content of Albena variety were highest (50.7g and 28.0%) and lowest of Enola – (46.51g and 26.3%).

The lowest values of relaxation of gluten reported with the variety Albena – 7.3 mm and the highest – with the Carat variety.

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