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Influence of genotype and environments on quality of winter wheat varieties in Northern Bulgaria

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Abstract.

According to the Bulgarian official standard, the inquiry covered sixteen types from the first and second quality groups. The study set out to do three things: determine how much of an impact various environmental factors have on wheat quality indices; observe how different varieties responded to different combinations of growing conditions; and determine whether or not these varieties were able to reach their full quality potential in these particular settings. Using the Latin square approach in 5 replications, the experiment was conducted from 2004 to 2007 at the Dobrudzha Agricultural Institute – General Toshevo (DAI) and the Institute of Agriculture and Seed Science, Obraztsov Chiflik, Rouse (OCH). Test weight, sedimentation value of flour, wet gluten content in grain, valorimeric value (valorimeter, conditional units), and loaf volume were the six grain quality indices found using the procedures used in the DAI lab. These indices provide information about different aspects of grain quality. When looking at the variance in the quality indices of the wheat varieties that were studied, it was discovered that the independent impact of the genotype had the least effect. Wet gluten content and valorimetric value were the most affected by location. Character expression was most affected by year circumstances in terms of both test weight and loaf volume. The quality group's varieties were able to reach their full potential under more favorable circumstances than the second group's varieties overall. The first set of varieties did better in the face of fluctuating growth circumstances than the quality standard Pobeda, which had higher mean values. In terms of standard response, the kinds with higher indices were distinct. Demetra and Zlatina were the most vulnerable to climate change, whilst Aglika, Albena, and Preslav were the most hardy.

Keywords: **winter wheat, quality, genotype, environments, stability**

Introduction

The quality of wheat is complicated and depends on several aspects, including the levels of numerous indexes. One challenge of quality breeding is getting the indices to stay stable across different years and environments (Johansson et al., 2001; Atanasova et al., 2008; Williams et al., 2021). This includes both favorable and unfavorable environments (Tsenov et al., 2004; Hristov et al., 2010). The objectives of this study were threefold: 1) to identify the extent to which different environmental factors impact wheat quality indices; 2) to track how common winter wheat varieties react to different combinations of growing conditions; and 3) to examine how well these varieties are able to deliver on their genetic potential for quality in specific environments.
In the year 2008. Studying the varieties' performance under variable growing conditions and identifying the nature and direction of the effects of various genetic and environmental factors on the specific quality indices will be valuable for breeding (Panozzo and Eagles, 2000; Tsenov et al., 2004; Hristov et al.,

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2010). In this way, it would be possible
The introduction of novel varieties and their enhancement in breeding programs are both aided by the fluctuation of quality indices while growing each variety under varied settings (Gomez-Becera et al., 2010). Williams et al. (2008) and Gomez-Beccera et al. (2010) found conflicting results when looking at the amount of genotype influence on the variance of winter wheat quality. Is it necessary for a variety to have excellent quality in favorable circumstances before it may reach its full potential in less favorable ones? That is the eternal debate in breeding.

99 in order to investigate the interplay between genetics and environment. There were no major discrepancies between the (bi) by Finlay and Wilkinson (1963) and the ecovalence of stability by two quality groups, and the regression coefficient was significant. However, the results for wet gluten content did not provide any meaningful parameters.
In 1992, Muir and colleagues published... Genotypes were deemed to have a minimum bi value of 0.7.

semi-sensitive to settings that undergo constant change; (2) medium-stable, falling between 0.7 and 1.3; and (3) very responsive, exceeding 1.3
On most indices, save for test weight, there is a noticeable difference when dealing with various letters. The years 2004 and 2007 had the greatest test weight values. It stands to reason that the indices of the varieties belonging to the first quality group would have greater values. After doing the variance analysis, the findings were

Table 1. Analysis of variance (ANOVA) for mean squares of 16 wheat varieties

Source of variation	TW	SDS	WGC	Val	Lvol
<u>Main effects</u>					
A: Location	161.1***	1250.0***	170.4***	1058.0***	43512.5***
B: Year	205.5***	876.6***	91.6***	173.0***	72179.4***
C: Group	76.3***	2032.0***	7.9^{ns}	666.1***	39903.1***
D: Genotype	11.2***	28.9**	22.2***	48.7**	3868.2***
<u>Interactions</u>					
A x B	4.7***	94.6***	76.1***	8.4^{ns}	703.6^{ns}
A x C	7.3***	101.5***	17.3**	63.3**	2032.0^{ns}
A x D	1.1*	4.0^{ns}	1.5^{ns}	13.5^{ns}	942.4^{ns}
B x C	0.3^{ns}	15.6^{ns}	13.0**	26.4*	3650.5***
B x D	0.4^{ns}	21.5**	5.3^{ns}	9.0^{ns}	2273.9***
C x D	17.4***	172.7***	13.2**	157.4***	11036.6***

*P<0.1; **P<0.05; ***P<0.01; *ns*-not significant

There has previously been a weight test, sedimentation, and loaf volume for characteristics (22.1). On the other hand, Atanasova et al. (2008) compared the two kinds and found that they differed. We found no statistically significant groupings here. Because of the multifaceted character of wheat quality, other measures that are instructive for the accumulation of smaller levels of wet gluten are being considered by quality variety researchers. According to studies conducted by Panayotov and Rachinski (2002), Tsenov et al. (2010), and Atanasova et al. (2010), the variety Aglika had the lowest wet gluten level at 18.9. The usage — the highest 22.3 — is one factor contributing to this. The second set of results showed that the wheat types with the lowest wet gluten content were Kristy and Prelom, which originated in

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Ukraine and Russia, respectively, and were used in breeding operations to enhance wheat quality. These are high-quality sources; variation Sadovo 1 had the best value for the gluten characteristic, albeit it was present in lesser quantities. One such explanation is the persistent The two quality categories are disrupted by the new variety' enhanced output. A few cases were different. The Enola variety, which falls into the second quality category, had relatively good yields in 2009 thanks to its balanced gluten content and grain yield (Tsenov et al., 2009).gluten quantities over the studied time (44.9 cond. units), with the majority of the varieties included in this study having somewhat stable traits related to wet gluten, therefore providing an approximation of the varieties' values from the first quality group. Table 3 shows that the Albena variety, on the other hand, is derived from the first quality regression coefficient (bi). At the variety level, Varieties Progress, Pliska, and group all had mean valorimeric values. Due to their low mean values of this property and regression coefficients below 0.7 (0.656, 0.654, and 0.671, respectively), Bolyarka and Prelom are especially suited to flourish in adverse settings. Pryaspa, Albena, Preslav, and Aglika are varieties belonging to the second quality group. This adds to the mountain of information showing how complicated wheat quality is and how much of an impact both genotype and growth conditions have. The majority of the varieties studied exhibit moderate stability (bi ranging from 0.7 to Sadovo 1) in relation to the trait valorimeric value; the most stable of them is Yantar, having ecovalence values of 1.3. Wi is the most stable since it deviates the least from the Aglika and Milena types (bi = 1.25 and 1.00, respectively). standard deviation.They show that the features are very prevalent in In addition to determining gluten-stable genotypes, the valorimeric value is an indicator that highly corresponds with end-use quality (Mladenov et al., 2001; Sudaric et al., 2006). The averageAccording to Hristov et al. (2010) Additionally, as mentioned earlier, stability does not always equate to low varieties' index values, which were clearly distinguished in the mean values (Becker and Leon, 1988).

Table 3. Mean values and stability parameters of varieties from different quality groups

variety	Wet gluten content			Valorimetric value		
	mean	b_i	W_i	mean	b_i	W_i
			I group			
Pobeda	22.4[b]	1.174	21.15	40.4[ab]	1.552	121.23
Albena	21.9[b]	0.854	12.17	38.6[a]	1.020	59.67
Preslav	19.7[ab]	1.226	9.37	40.5[ab]	0.648	26.26
Milena	21.4[ab]	1.219	36.46	42.3[abc]	1.000	21.33
Aglika	18.9[a]	1.022	10.53	46.6[bc]	1.251	89.42
Progres	19.3[ab]	0.656	36.66	40.9[ab]	0.700	42.86
Zlatina	19.8[ab]	0.800	23.07	45.8[abc]	1.855	274.20
Demetra	22.3[b]	1.709	40.35	49.9[c]	0.754	161.98
Average	20.71	1.08	23.72	43.13	1.10	99.62
			II group			
Sadovo 1	22.1[b]	1.154	14.50	40.3[ab]	1.331	133.08
Enola	20.4[ab]	1.078	82.63	44.9[b]	0.963	86.11
Pliska	21.3[ab]	0.645	46.97	40.3[ab]	0.963	14.58
Pryaspa	21.5[ab]	1.229	14.30	35.0[a]	0.912	23.51
Yantar	21.1[ab]	0.860	15.44	36.8[a]	0.658	41.83
Kristi	18.1[a]	0.900	25.59	37.6[ab]	0.736	70.67
Prelom	18.4[a]	0.671	19.27	35.0[a]	0.648	28.39
Boryana	18.9[ab]	0.803	86.57	38.6[ab]	1.158	56.17
Average	20.23	0.92	38.16	38.56	0.90	56.79

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With different letters differ significantly.

Discussion

Wet gluten content and valorimeric value were the most affected by location. In particular, the circumstances of the year had an effect on the characteristics' test weight and loaf volume. The expression of sedimentation was most affected by the quality-based distribution of varieties. When looking at the variation of the indices that were studied, the independent effect of genotype was the lowest. While research by Panozzo and Eagles (2000), Tsenov et al. (2004), and Drezner et al. (2006, 2007) has shown that environmental factors have a greater impact on wheat quality indices, studies by Zhang et al. (2005) and Atanasova et al. (2008) have shown that genotype has a higher effect on sedimentation expression. The interaction quality group x genotype had the greatest influence on almost all attributes tested, out of all the factor combinations. With one notable exception, the interplay between location and year had the greatest impact on wet gluten content. Researchers have shown that while the interaction genotype x environment does have a significant impact on wheat quality parameter expression, it is less significant than the independent influences of genotype and location (Mladenov et al., 2001; Williams et al., 2008; Hristov et al., 2010). Variety development in wheat breeds is challenging.

Conclusion

while maintaining consistent high quality indices throughout a range of growth circumstances (Johansson et al., 2001; Atanasova et al., 2008; WilliamsAccording to et al. (2008), the genotype's independent effect was at its lowest. Based on the findings about the impact of valorizing on the variety of quality attributes of the 22 common winter wheat varieties studied, the effect of the varieties was determined. Atanasova et al. found that location accounted for one-third of the overall variance in wet gluten genotype, which in turn affected content and valorimeric value. Characteristics expressed in the 2010 test. This measure is unique in that it distinguishes between the two quality groups that were most impacted by the year of the research in terms of weight and loaf volume. On the other side, the ecovalence conditions. The environmental factors had a significant impact on the quality of the second group's varieties, which in turn brought forth varieties from the quality group, which had extremely high values relative to the individual varieties. With better pairings of circumstances, the variant showed promise. from wheat cultivars with much reduced ecovalence Table 3 shows that the varieties from the second group were more stable under the Pobeda quality standard (56.8 vs. 99.6), in contrast to the varieties from the first group, which had lower mean values. Variable settings have been the focus of many studies. In contrast to the norm, varieties with lower quality potential indices acted differently, as discovered by kinds with greater amounts of the. The stability of the varieties Demetra and the coefficients of the different groups are highly suggestive of how much more stable they are under stress (Tsenov et al., unstable under variable settings).

In the initial set of data, the regression coefficients for the wet glutenin content (1.08), and the valorimetric value (1.1), were both more than 1. This indicates that the varieties in this group were able to reach their full qualitative potential in environments that were more conducive to their creation. Atanasova D, Tsenov N, Stoeva I and Todorov I, 2010. were many times higher than the mean values for this group. In contrast, Aglika, Milena, and Preslav are three cultivars of Bulgarian winter wheat that have shown promising results in various climates. Bulgarian Journal showed that their quality indicators varied far less than the other kinds in the group in the Journal of Agricultural Science, 16(1), 22-29. One possible recommendation is the 2008 work by Atanasova, Tsenov, Stoeva, and Dochev. Here, the low absolute values of the x-environment interaction for many quality features of the Bulgarian winter indices are responsible for the genotype's stability; stability in wheat varieties would result from greater values. Volume: Contemporary Methods in Variety Breeding for Both Current and Future Needs As far as the trait wet gluten content and valorimetric value are concerned, the Bulgarian state standard for quality,

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Pobeda, is relatively stable at 1.174 and 1.552, respectively, and is particularly suited to more favorable combinations of growth circumstances. In 1988, Becker HC and Leon J found that this variation was relatively stable. Studying plant breeding for stability. Plant Breeding, 101, 1–23. to the ecovalence Wi levels simultaneously. From an in-grain ecovalence value perspective, the quality group varieties are more stable than the BSS 7971-2:2000–Bulgarian State Standard for test weight varieties, which have lower mean values for wet gluten content (BSS 13375–88). Aglika and Preslav are examples of such types. The Bulgarian State Standard for Valuation (BSS 16759-88) measures variables at the Pobeda level according to their average values.Individuals from Drezner, Dvojkovic, Horvat, Novoselovic, Lalic, and Babic exhibited distinct behaviors. The response of the Albena variety to D and Kovacevic J, 2006 was steady. The quality and quantity of grain produced by winter wheat are quite vulnerable to environmental variations. Variety stability in the face of environmental change was associated with trait valorimeric value, where lower mean values compared to the standard indicated more resilience. Milena, the most stable variety when considering the ecovalence and regression coefficient, had an average value. Published in 2007 by Drezner G, Dvojkovic K, Horvat D, Novoselovic D, and Lalic A. How the environment affects the agronomic and qualitative characteristics of wheat. The value of this feature is larger than that of variety Pobeda, according to Cereal Research Communications, 35 (2), 307–360. The other Wilkinson G. and Finlay KW, 1963. Adaptation study in plant breeding programs yielded varieties with levels of this characteristic that were higher than expected. Aglika, Demetra, and Zlatina are three kinds that thrive under unpredictable growth conditions, according to the Australian Journal of Agricultural Research, volume 14, pages 742–754. It is clear from these findings that Tsygankov V, Zelenskiy Y, Pena RJ, and Chakmak I, 2010 should have been used with great care when comparing the responses of the varieties to the environment in terms of their quality (Gomez-Beccera HF, Abudalieva A, Morgunov A, Abdullaev K). Given the bidirectional nature of the results for individual varieties' phenotypic correlations, G x E interactions, and broad sense indices, it is important to take the intended use of high-yielding spring bread wheats from Siberia and Kazahstan into account when making a heritability analysis of grain and flour quality characteristic selection. culture, the variety's potential, and its capacity to Volume 171, Issue 1, pages 23–38, published in Euphytica. this capacity with sufficiency and steadiness.In 2010, the authors were Hristov, Mladenov, Djuric, Kondic-Spika, Marjanovic-Jeromela, and Simic. Environmental interactions including genotype in southeast European wheat quality breeding initiatives. First published online in Euphytica, with the DOI 10.1007/s10681-009-0100-8.

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