COMPARISON OF THE BAKING QUALITY OF WINTER WHEAT VARIETIES OF SZEGED AND MARTONVÁSÁR BREEDING IN THE HAJDÚSÁG REGION

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Abstract

Winter wheat is one of the most important bread-stuffs in Hungary. In winter wheat production, quality improvement is very important in addition to increasing yields. Quality is determined basically by the genotype, but the year and the agrotechnique also have a significant influence on it. In Hungary, there are two large winter wheat breeding institutions, the Cereal Research Non-Profit Ltd. at Szeged, and the Agricultural Research Institute of the Hungarian Academy of Sciences at Martonvásár. The two breeding institutes are leading not only in the improvement of yields and disease resistance but also that of the quality parameters. We have studied the baking quality of two and two winter wheat varieties from Szeged and Martonvásár at different fertilization levels on chernozem soil in the Hajdúság in 2008. The varieties GK Békés and Mv Mazurka of recent breeding are of good baking quality and excellent quality based on their results in the control and at the higher fertilizer levels which is in harmony with their variety characteristics. The somewhat older variety Mv Verbunkos had similar results to that of modern varieties. The variety GK Öthalom grown for several decades also produced good baking quality in the control and excellent quality in the increasing fertilizer treatments. According to our results, the most favourable treatments for obtaining an excellent quality were the N120-150+PK levels except for the variety GK Békés which gave excellent quality already at the N30-60+PK fertilizer level. It can be observed that the modern varieties give excellent quality, while older varieties can produce good baking quality and excellent quality at a proper fertilization level.

Keywords: winter wheat varieties, fertilization, baking quality

INTRODUCTION

According to Láng (1997), quality is a very complex, multi-dimensional term. In the case of winter wheat, it means that we produce a marketable end-product by meeting the different criteria of growers, the milling and baking industries via the utilization of the continuously renewing variety range. Quality is a genetically determined potential of the variety which can be exploited or deteriorated by agronomical methods, but cannot be improved anyhow. Quality wheat production is the optimization of production factors according to quality parameters (Jolánkai et al., 2004). In 1951, there were only 7 registered varieties in Hungary, today, the number of varieties is over 100, thereby, professionalists have a real choice (Ragasits, 2001). According to Pepó (2000), the majority of varieties grown in Hungary are from Martonvásár and Szeged, which are supplemented by a few varieties of other Hungarian breeders and some foreign varieties. According to Peterson et al. (1998), environmental factors have a significant

effect on wheat quality. The winter wheat genotypes respond differently to environmental factors. Erdei and Szániel (1975) stated that the baking quality of flour is dependent also upon the ratio of gliadin and glutenine. The amount of gluten is not such a variety characteristic as the quality of gluten, it is much more influenced by the environmental conditions. The gluten quality of the varieties is a quite permanent quality, which is inherited recessively. The results of Juhász et al. (2003) proved that the traditional Hungarian winter wheat varieties satisfy even the German quality requirements, which are the most strict in the EU. Pepó (1998) claims that the essential factor of quality wheat production is the proper variety selection. The quality results of the variety should be evaluated combined and not separately (wet gluten content, gluten elasticity, valorigraphic value, loaf volume, etc.). In addition to these genetically determined, direct quality parameters, the indirect value assessment traits can greatly modify the quality. At variety selection, the direct and indirect value assessment traits should be considered together. The inner content value of wheat varieties is determined by the quality of the end-product produced from them. This means that from that a high-quality product can be produced efficiently from that wheat variety which was selected, grown and processed for a specific purpose (Polhallmerné, 1988).

MATERIAL AND METHOD

The field experiments were carried out at the Látókép experimental farm of the University of Debrecen CAAES RISF. The experimental farm is located about 15 km west from Debrecen on loess in the Hajdúság. The experimental soil is calcareous chernozem, it is a loam soil with almost neutral pH and medium humus content. The long-term experiment was set up in the autumn of 1983. Our study contains the results of 2008. In the small-plot experiment we set up a split-split-spot design in four repetitions. The fertilizer response of 15 winter wheat varieties was tested. The forecrop of the experiment was sweet maize. Six fertilizer levels were applied in the treatments. In addition to the control, a base dosage of N=30 kg ha^{-1}, P2O5=22.5 kg ha^{-1} and K2O=26.5 kg ha^{-1} and two-, three-, four- and fivefold dosages were applied. The total dosage of P and K fertilizers was applied in the autumn, while 50% of the N was applied in the autumn and 50% in the spring. The precipitation and temperature data of 2008 are included in *Table 1.*. In 2008, the weather was favourable in the winter and the autumn, while the spring and summer months were less favourable for winter wheat development and yield formation. As a result of stormy weather in June, lodging occurred in the stands with a larger vegetative mass.

Table 1

Main meteorological data of vegetation period (Debrecen, 2008)

	Oct.	Nov.	Dec.	Jan.	Feb.	Marc.	Apr.	May	Jun.	Total/ Average	Difference
Precipitation (mm) 2008	142.8	40.9	29.8	26.4	4.6	41.7	74.9	47.6	137.8	546.5	145.6
30 year's average	30.8	45.2	43.5	37	30.2	33.5	42.4	58.8	79.5	400.9	-
Temperature (oC) 2008	9.7	3.5	-0.6	1	3	6.2	11.4	16.8	20.6	7.96	1.02
30 year's average	10.3	4.5	-0.2	-2.6	0.2	5	10.7	15.8	18.8	6.94	-

The quality parameters were measured in the accredited Central Laboratory of the University of Debrecen CAAES FAFSEM. (Wet gluten content, valorigraphic number, gluten elasticity and falling number and flour protein content were determined according to the standards MSZ ISO 5531:1993, MSZ ISO 5530/3:1995, MSZ ISO 5531:1993 and MSZ ISO 3093:1995, ICC 159:1995 respectively.)

RESULTS AND DISSCUSIONS

Two winter wheat varieties of Szeged breeding were tested. The variety GK Öthalom is an older variety producing good baking quality (its baking quality parameters are presented in *Table 2).* The other variety from Szeged was GK Békés, which is a newer genotype giving excellent quality (quality parameters included in *Table 3*). From among the Martonvásár varieties Mv Verbunkos an older genotype producing good baking quality and Mv Mazurka, a slightly younger variety producing excellent quality were tested (baking quality parameters included in *Tables 4 and 5*). Based on the obtained results, it can be stated that the genetically determined quality of the four tested varieties was different, which was influenced by both the year and the fertilization treatment.

When studying wet gluten content, which is one of the most frequently used wheat quality parameters, we found that the highest gluten content was obtained for GK Békés (27.67%) and Mv Mazurka (27.38%) in the control treatment. Mv Verbunkos had a gluten content of 24.83% while GK Öthalom showed the lowest gluten content (20.09%). The wet gluten content of all four varieties increased with increasing fertilizer dosages. The highest gluten content was measured in Mv Mazurka (37.87%-36.92%) at the fertilizer levels $N_{120\text{-}150}$+PK. GK Békés had a relatively stable wet gluten content with the highest values measured at the fertilization levels of $N_{30\text{-}60}$+PK (34.75-35.94%) and N_{120}+PK (34.60%). This trend was probably caused by the lodging at higher fertilization levels.

Table 2

Effect of fertilization on the baking quality of GK Öthalom (Debrecen, 2008)

Gk Öthalom	Wet Gluten Content (%)	Gluten Elasticity (mm/h)	Valorigraphic Value	Falling Number (sec)	Flour Protein Content (%)
Ø	20.09	1.6	49.0	322	11.08
N30+PK	26.00	2.0	62.5	349	12.01
N60+PK	29.14	2.6	65.3	365	12.86
N90+PK	29.20	3.0	66.1	335	12.66
N120+PK	32.49	4.0	67.9	360	13.71
N150+PK	33.69	4.8	79.8	364	13.95
LSD 5%	1.96	0.66	7.89	23.46	0.52

GK Öthalom (32.49%-33.69%) and Mv Verbunkos (33.40%-33.33%) had lower wet gluten contents as a result of higher fertilizer dosages.

Table 3

Effect of fertilization on the baking quality of GK Békés (Debrecen, 2008)

GK Békés	Wet Gluten Content (%)	Gluten Elasticity (mm/h)	Valorigraphic Value	Falling Number (sec)	Flour Protein Content (%)
Ø	27.67	3.5	62.5	373	13.15
N30+PK	34.75	4.1	75.7	376	15.25
N60+PK	35.94	4.5	75.9	392	15.58
N90+PK	31.46	3.5	66.8	393	14.19
N120+PK	34.60	4.0	69.3	375	15.19
N150+PK	31.62	3.0	59.2	373	14.28
LSD 5%	7.23	1.53	13.46	28.81	2.03

In the control, all four varieties had a low gluten elasticity (1.6-3.5mm). With increasing fertilizer dosages, the gluten elasticity (4.0-6.1mm) of the varieties increased. The best gluten elasticity values were obtained for the varieties GK Öthalom (1.6-4.8mm), GK Békés (3.0-4.5mm) and Mv Verbunkos (4.3-4.9mm). The highest gluten elasticity was measured in Mv Mazurka (6.1mm) at the fertilization level of N_{150}+PK.

When studying the valorigraphic value (which is a complex quality index), we found that the best results were obtained in the case of Mv Mazurka (67.6) and GK Békés (62.5) in the control treatment. The varieties Mv Verbunkos (56.7) and GK Öthalom (49.0) had much lower valorigraphic values. Fertilization treatments had an influence also on the valorigraphic value. The highest valorigraphic values were obtained in the case of GK Öthalom (79.8) in the N_{150}+PK treatment and Mv Verbunkos (77.4) at the N_{120}+PK fertilization level. The valorigraphic value of Mv Mazurka increased with increasing fertilizer dosages (72.1-75.6). Similarly to wet gluten content, the highest valorigraphic values were measured at the

N_{30-60}+PK fertilization level for GK Békés (75.7-75.9), at higher fertilizer dosages, the values were lower (59.2-69.3), this reduction was probably caused by lodging.

Regarding the falling number, the varieties were stable. A slight change could be observed in all four varieties as a result of increasing fertilizer dosages.

Table 4

Effect of fertilization on the baking quality of Mv Mazurka (Debrecen, 2008)

Mv Mazurka	Wet Gluten Content (%)	Gluten Elasticity (mm/h)	Valorigraphic Value	Falling Number (sec)	Flour Protein Content (%)
Ø	27.38	2.2	67.6	373	12.79
N30+PK	31.84	3.2	72.1	375	14.89
N60+PK	36.51	5.2	74.5	481	16.72
N90+PK	34.49	3.7	75.4	489	15.99
N120+PK	37.87	6.1	73.2	518	17.23
N150+PK	36.92	6.0	75.6	517	16.85
LSD 5%	2.7	1.20	5.91	37.25	1.09

As the falling number determined by the genotype is greatly influenced by the weather at harvest and the weather was dry at harvest in 2008, the obtained values exceeded the required minimum value of 250sec. The falling number values of GK Békés and GK Öthalom were between 322 and 393sec, which satisfy the requirements of the baking industry. However, the falling number values of Mv Verbunkos and Mv Mazurka (398-518sec) can be described as poor in enzymes.

Table 5

Effect of fertilization on the baking quality of Mv Verbunkos (Debrecen, 2008)

Mv Verbunkos	Wet Gluten Content (%)	Gluten Elasticity (mm/h)	Valorigraphic Value	Falling Number (sec)	Flour Protein Content (%)
Ø	24.83	2.1	56.7	436	11.84
N30+PK	30.59	4.3	63.5	488	14.33
N60+PK	32.21	4.4	70.2	442	15.13
N90+PK	32.18	4.3	73.3	436	14.98
N120+PK	33.40	4.4	77.4	410	15.83
N150+PK	33.33	4.9	73.7	398	15.67
LSD 5%	1.78	0.68	7.83	29.18	0.92

When studying the protein content (which is one of the major quality parameters), it was found that the highest protein contents were obtained in the case of Mv Mazurka (12.79%) and GK Békés (13.15%) in the control, while the varieties GK Öthalom (11.08%) and Mv Verbunkos (11.84%) had lower protein content values. The increase in the protein content of the varieties had a tight correlation with the increase of nitrogen fertilization. The best protein contents at the fertilization levels $N_{120-150}$+PK were

obtained for Mv Mazurka (17.23-16.85%), GK Békés (15.19-14.28%) and Mv Verbunkos (15.83-15.67%).

In sum, it can be concluded that all the four tested varieties gave good results in 2008.. In the control treatment, the newer varieties produced good baking quality, while older varieties also achieved or approached this quality level. The best results were obtained at the fertilization levels of $N_{120-150}$+PK, where the varieties achieved or approached the excellent quality category. The varieties were stable in their quality, especially Mv Mazurka and GK Békés. The variety GK Békés was different from the other varieties as it had an excellent quality already at a lower fertilization level of N_{30-60}+PK. The varieties had a good fertilizer response, the quality parameters improved with increasing fertilizer dosages.

CONCLUSIONS

Based on the results of our experiment in the Hajdúság, we found that the tested two and two winter wheat varieties from Szeged and Martonvásár satisfied the requirements of the baking industry. The varieties GK Békés and Mv Mazurka of newer breeding were of good baking quality and excellent quality according to the results of the control and the fertilization treatments of higher dosages which is in accordance with their variety characteristics. The slightly older variety, Mv Verbunkos had similarly good results as the newer varieties. The variety GK Öthalom grown for several decades gave good baking quality in the control treatment and excellent quality as a result of higher fertilizer dosages. Wet gluten content, gluten elasticity, valorigraphic number and protein content were significantly modified by fertilization. The varieties showed a good fertilizer response. According to our results, the fertilization levels of $N_{120-150}$+PK were the most favourable for achieving excellent quality except for the variety GK Békés, which gave excellent quality already at the fertilization level of N_{30-60}+PK. The newer genotypes had a better and more stable quality. Summing up, it can be stated that both the Szeged and the Martonvásár varieties are of good quality. It can be observed that the newer varieties have an excellent quality, while the older varieties can produce good baking quality and excellent quality at proper fertilization levels. The breeding of Hungarian winter wheat varieties is increasingly focusing on achieving excellent quality and on providing inner content parameters suitable for the given utilization purpose.

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