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Research Article

Soil Organic Fertilization in Long-Term Low-Input Cropping System and its Effect on the Bread Making Flour Properties Determined by Albumen-Protein Complex

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Abstract

The results of the study on the quality of flour of 20 wheat cultivars (*Triticum aestivum* L.) grown in a long-term low-input cropping system of Haplic Chernozems are reported. The cultivars were developed at Dobrudzha Agricultural Institute, General Toshevo. They were sown on two soil nutrition regimes: 1. Control - natural soil fertility and 2. Organic fertilization with ExcellOrga, produced in France. In addition to these variants we used a humine preparation Plantagra for pre-sowing seed treatment of sowing material (150 ml/100 kg seeds).

Main soil organic fertilization with ExcellOrga especially in combination with seed material treatment (SMT) positively influenced on the sedimentation values and bread volume. The average value in this variant is 42.55 ml with increasing over control variant with 3.65%. The highest and relatively stable by variants were the sedimentation values of cultivar Pchelina (51.25 ml), followed by cultivars Kiara (50.25 ml) and Galateya (46.75 ml). The bread volume in this condition exceeded the control with 3.75%. The maximum value in the trail was reached from cv. Bojana - 795 ml.

Organic fertilization lead to increasing a wet gluten content according to the control with 2.60%. The cultivates Kiara and Bojana has a leader position according to the value of this index - 23.35% and 23.25% respectively. A tendency was established for decreasing of values of wet gluten content in variants with SMT. However, an exception to the tendency the genotypes specificity is strongly expressed - cultivars Pchelina, Kosara and Kiara reacted positively to the SMT.

Flour stability is subject to highly expressed dynamics of values according to the genotype. Cultivars Enola and Katarjina were distinguished with maximum average values - 3.88 and 3.80. Soil organic fertilization increased values of this index according to the control variant with 4.60%. Valorimetric values were negatively influenced by soil organic fertilization and especially with combination with SMT.

We established also highly expressed correlations between yields (grain and protein) with chemical composition of grain, physical grain properties, rheological properties of flour and bread making qualities.

Keywords: Low-Input Cropping System; Wheat; Organic Fertilization; Bread Making Properties

Introduction

Wheat grain quality is mainly determined by endosperm texture (i.e. grain hardness), protein content, and gluten strength, which are affected by genetics and environment, as well as their interaction [1]. According to Khan [2] end-use quality of wheat is greatly dependent on flour protein content and composition. Milling and end-use quality of wheat results from the composition of the kernel, especially the endosperm. A unique feature of wheat flour is that when it is mixed with water it forms dough, a material with complex rheological properties. Gluten, an essential component of dough, is a complex protein network formed mainly by two kinds of proteins, monomeric gliadins and polymeric glutenins, which in turn are divided into high molecular weight glutenins (HMWGs) and low molecular weight glutenins (LMWGs). The visco-elastic properties and gas holding capacity of wheat flour dough are the basis for the production of a wide range of products. Variation in the composition results from the interaction between the "genotype" and the "environment". Wheat cultivars must have suitable end-use quality for release and consumer acceptability. Geleta [3] notes that most quality traits were low when grain yields were high.

The quality of wheat (*Triticum aestivum L.)* depends not only on its genetic potential for particular characters, but also on its ability to realize this potential in actual production and under different environmental conditions [4-6]. 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. The lowest values of relaxation of gluten reported with the variety Albena - 7.3 mm and the highest - with the Karat variety - 9.8 mm [7].

The main quality characteristics for wheat utilization are flour extraction, flour protein concentration and dough rheology properties [8]. The most critical factor for obtaining optimum yield and grain enduse quality requirements is the use of the adequate cultivation practice in accordance with the plant requests [9]. Ivanova., *et al.* [10] nitrogen fertilization represents not only the most important yield-stimulating procedure but also the most important variable which affects quality of the yield. Progressive increase in doses of the component is not always equivalent to its increased quality.

Increasing applications of nitrogen fertilizer to wheat resulted in an increased proportion of gliadin proteins and increased dough extensibility. The grain N% from a plot receiving 35 t/ha farmyard manure was similar to that the plot receiving 144 kh/ha N, indicating that much of the applied N was unavailable. Similar differences in grain N content, protein composition, and functional properties were observed in grain samples from commercial organic and conventional farms (Godfrey., *et al.* 2010).

The late use of N fertilisers can cause environmental problems, such as nitrate leaching into the groundwater and gaseous losses in the form of nitrous oxide, which contribute to global warming [11]. For farmers, these problems represent a monetary risk, particular in the case of unfavourable weather conditions which may limit the uptake of the supplied nitrogen and hence, the required grain protein composition might not be reached. In this case, a large amount of N remains in the soil and increases the environmental risks mentioned above grain protein composition. Therefore, the impact of a number of agrotechnical practices, such as seed material treatment, foliage during vegetation and others, is investigated in order to optimize plant nutrition and at the same time to protect the environment from the potential undesirable effects of nitrogen fertilization.

Purpose of the Study

The purpose of our study is to determine the impact of the plant low-input nutrition practices used without applying nitrogen fertilization at the beginning of early spring vegetation on a complex quality characteristic.

Material and Methods

In a stationary field trial 20 *Tr. aestivum* L. varieties developed at DAI were grown in continuous mono crop against backgrounds of natural soil fertility (Control variant) and organic fertilization ($Excel^{Orga}$). The sowing material was treated (SMT - seed material treatment) with ROMB Ltd - Sofia humine preparation Plantagra - 150 ml/100 kg seeds.

Technological methods: The grinding of the samples was carried out on a mill MLU-202 up to 70% flour. The sedimentation value of flour of the wheat samples (SDS, ml) was determined by the method of Pumpianskiy [12], the rheological properties of the flour - dough resistance (DRes, min) and the valorimetric value (Val) - according to BDS-16759-88 [13], the bread volume (Lvol) - according to the methods adopted at the DAI technological laboratory.

The expression of 6 grain quality indices which give information about various quality aspects was analyzed:

- Sedimentation value of flour (ml) (SDS) [12],
- Wet gluten content in grain (%) (WGC) [14],
- Dough resistance (min) (DRes),
- Valori meric value (valorimeter, conditional units (Val) [13],
- Breadloaf volume (LVol), determined according to the methods adopted at the DARI laboratory.

The results were processed statistically using analysis of variance (Anova), while the significance of differences between mean values was evaluated with the Waller-Duncan's HSD test, *P* < 0.05. The value of genotypic variability for traits was determined and expressed by coefficient of variation of traits as mean values for genotypes included in the research. Pearson correlation coefficients ("R coefficients") were computed and tested for significance.

Result and Discussions

End-use quality is the ability of a wheat variety to produce a specific product according to the consumer preferences. It is affected by: hardness, dough visko-elastic properties (gluten), color.

Dependent Variable	df	Control		Control + SMT		Excel^{Orga} - Control		Excel^{Orga} + SMT	
		F	Sig.	F	Sig.	F	Sig.	F	Sig.
GPC	19	428.7	0.000	85.1	0.000	57.9	0.000	73.5	0.000
SDS	19	23.6	0.000	95.1	0.000	193,0	0.000	162,7	0.000
LVol	19	7.0	0.000	16.8	0.000	12,2	0.000	44,6	0.000
WGC	19	1926.5	0.000	7416.8	0.000	81,9	0.000	5338,2	0.000
DRes	19	1089.4	0.000	99.5	0.000	2201,1	0.000	95,9	0.000
Farin	19	7857.2	0.000	19765.3	0.000	3049,4	0.000	214,0	0.000

Table 1: Analysis of the variances of the some quality indices at natural soil fertility variants and at organic soil fertilization variants (values of parameter p).

In our experiment the effect of the agronomy factors on the formation of quality was statistically significant.

The quality indices are genetically determined and are dependent on the involved genotypes but they may vary depending upon environment and agronomy practices, including fertilization. Grain protein concentration (GPC) is an essential parameter for baking quality predictions and therefore often determines the price for wheat grain. As wheat quality characteristics are defined by genotype, environment and their interaction, it is a well known strategy for farmers to increase GPC by combining high protein varieties with the application of a late dose of nitrogen fertiliser. The challenge in our experiment, in addition to prolonged monoculture cultivation, is to unlock the potential of the varieties under conditions without receiving mineral nitrogen throughout the growing season. Seed treatment with Plantagra in the soil fertility variant results in an average protein content increase of 4.2% for the varieties tested (Figure 1).

Figure 1: Average GPS values according to nutrition variants.

Soil organic in both variants, in addition to a significant increase in productivity, is characterized by an increase in the average protein content by 2.1% (Excel^{Orga} - Contol) and 2.9% (Excel^{Orga} - SMT), respectively.

The tested wheat varieties responded in a wide range with respect to the protein values in the grain in each of the variants tested (Table 2). Under conditions without the supply of nutrients with the highest GPC, the grain of the Katarzhina variety is 11.34% and this is the highest value of the index for the conditions of the year. As a result of the applied treatment, almost all the varieties reacted positively and, in addition to higher yields, also had more protein in the grain. The strongest is the positive reaction in the Stoyan, Pchelina, Sladuna, Kristi and Bozhana varieties, in which the protein content of the grain increased by 21.90%, 19.21%, 18.03%, 12.68% and 10.55%, respectively, compared to that found in the control variant.

Annual organic soil fertilization also leads to increased protein concentration in the grain. Again, the highest increase in grain protein concentration compared to control (1 var.) Was achieved in the Sladuna, Pchelina and Kristi varieties. Seed treatment in the application of systemic organic soil fertilizer (4 var.) has virtually no effect on the average protein concentration values. The response of the varieties to this agrotechnical practice is too diverse. The most common positive effect of the SMT is achieved in the varieties Kalina, Rada and Sladuna. The remaining varieties are for the most part characterized by a decrease in the GPC compared to the variant with the self-application of organic soil fertilization. The Katarjina, Kiara and Merilin varieties are characterized by the highest protein content averaged over all variants in the experiment.

No	Cultivars	1. Control	2. Control + SMT	3. Excell^{Orga} - Control	4. Excell^{Orga} + SMT
1	Aglika	9,60 f	10,03 ef	9,86 ef	9,69 de
2	Bozhana	9,95 h	11,00 k	10,63 j	10,46 jk
3	Galateya	9,52 ef	9,86 d	9,86 ef	9,55 cd
4	Dragana	10,63 j	9,69 c	9,55 cd	7,98 a
5	Enola	10,94 l	10,94 jk	10,20 gh	9,86 ef
6	Kalina	9,52 ef	10,46 h	8,38 a	9,55 cd
7	Katarjina	11,34 m	10,80 j	10,20 gh	10,12 gh
8	Karina	9,78 g	9,46 b	9,69 de	9,60 d
9	Kiara	10,80 k	10,80 j	10,55 ij	10,37 ijk
10	Kosara	9,95 h	9,69 c	9,86 ef	9,95 fg
11	Kristalina	9,60 f	10,03 ef	10,46 ij	10,37 ijk
12	Kristi	8,12 a	9,15 a	9,46 c	9,38 bc
13	Lazarka	9,46 e	9,95 de	10,03 fg	10,29 hij
14	Koprinka	8,29 b	9,06 a	8,98 b	9,29 b
15	Merilin	10,55 j	10,12 f	10,55 ij	10,89 l
16	Rada	9,78 g	9,69 c	9,06 b	10,20 hi
17	Tina	10,12 i	10,29 g	9,86 ef	10,55 k
18	Pchelina	9,06 d	10,80 j	10,89 k	10,89 l
19	Sladuna	8,21 ab	9,69 c	10,37 hi	10,89 l
20	Stoyana	8,72 c	10,63 i	9,60 cd	9,69 de

Table 2: Grain protein content according to cultivar and nutrition variants, %.

Sedimentation (SDS) is a typical index, which characterizes flour quality. Ivanova., *et al*. [10] established that under the drought conditions of 2007, the variation of SDS values were higher and the values were lower to 2008. Under the specific conditions of the year, the results obtained for the dynamics in the values of this index show a significant influence of the organic plant nutrition products used on the amplitude of their variation. The positive effect of the treatment on the SDS in the natural fertility of the test site (2 var.) is extremely strong (Figure 2). The increase

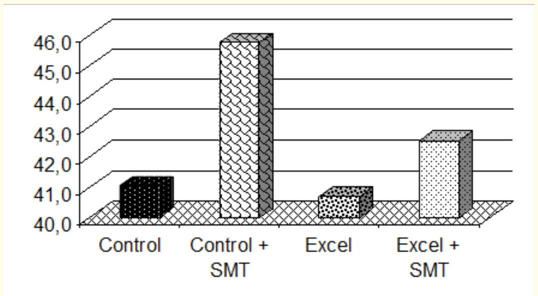

Figure 2: Average SDS according to nutrition variants, ml.

over control is an average of 11.45%. Organic fertilizer variants with and without treatment have lower average values than their corresponding natural fertility in the test site. A complete picture of the response of the varieties to the fertilizer variants is given in table 3. The variation of the values is in a very wide range - from 25 to 58 depending on the type of fertilizer variant. The results of the experiment show that the varieties of Aglika, Kosara, Kristalina, Lazarka, Merilin, Rada and Pchelina definitely react positively to organic products, regardless of the way they are applied.

Short-term stressful situations, but in crucial phases of plant development, combined with nutrition, allow for the full unfolding of the genetic potential of the varieties. In each of the variants, by their values of sedimentation, the varieties are distributed in a large set of groups (Waller-Duncan test), expressing their uniformity, similarity and difference in their reaction to their proposed conditions for growth and development.

No	Cultivars	1. Control	2. Control + SMT	3. Excell^{Orga} - Control	4. Excell^{Orga} + SMT
1	Aglika	43,00 ef	49,00 g	45,00 i	46,00 gh
2	Bozhana	53,00 i	45,00 e	43,00 h	45,00 g
3	Galateya	58,00 j	41,00 c	46,00 ij	41,00 e
4	Dragana	53,00 i	47,00 f	35,00 d	47,00 h
5	Enola	51,00 hi	54,00 ij	37,00 e	37,00 d
6	Kalina	37,00 cd	47,00 f	32,00 bc	40,00 e
7	Katarjina	32,00 ab	37,00 b	33,00 c	29,00 a
8	Karina	32,00 ab	41,00 c	47,00 j	43,00 f
9	Kiara	53,00 i	53,00 hi	47,00 j	51,00 j
10	Kosara	33,00 bc	42,00 cd	41,00 g	41,00 e
11	Kristalina	39,00 de	55,00 j	49,00 k	47,00 h
12	Kristy	38,00 d	41,00 c	31,00 b	41,00 e
13	Lazarka	33,00 bc	41,00 c	39,00 f	41,00 e
14	Koprinka	28,00 a	29,00 a	25,00 a	37,00 d
15	Merilin	28,00 a	52,00 h	47,00 j	49,00 i
16	Rada	39,00 de	55,00 j	45,00 i	46,00 gh
17	Tina	45,00 fg	41,00 c	41,00 g	52,00 j
18	Pchelina	48,00 gh	57,00 k	55,00 l	51,00 j
19	Sladuna	41,00 def	45,00 e	45,00 i	32,00 b
20	Stoyana	37,00 cd	43,00 d	31,00 b	35,00 c

Table 3: Sedimentation values according to cultivar and nutrition variants, SDS ml.

Wet gluten content (WGC) is an indirect index of wheat bread making quality, which indicates the protein content and the nutrition value on the one hand, and on the other, it guarantees the respective amount of gluten in flour. The investigated wheat varieties formed different amounts of wet gluten and valorimetric values (conditional units) depending on the nutrition variants (Figure 3).

Figure 3: Average WGC (%) and VAL (conditional units) according to nutrition variants

The results show that organic soil fertilization has a positive effect on WGC. The average increase in values is from 20.77% to 21.77%, i.e. 2.60% over the untreated control. The effect of treatment has a relatively small effect on the mean values of the index when applied in the control variant. The combination of organic soil fertilization with treatment definitely results in a decrease in the average WGC in the flour. The same is an average of 94.86% of that found in the 3 variant.

The quality of the wheat varieties tested is also characterized by another complex index VAL-valorimetric values (conditional units). Our study shows that for the conditions of the year, the highest average values for the index were obtained in the control variant without applying any additional plant nutrition practices. The fertilizer products used contribute to a significant reduction in the average values of the index.

The genetics of the varieties are at the heart of their extremely pronounced response to WGC in each of the nutrition variants (Table 4). The conditions of natural fertility of the experimental area with the highest gluten content are characterized by the Dragana - 24.60% and Bozhana - 23.00% varieties.

No	Cultivars	1. Control	2. Control + SMT	3. Excell^{Orga} - Control	4. Excell^{Orga} + SMT
1	Aglika	18,30 b	18,20 e	22,50 i	19,30 i
2	Bozhana	23,00 m	21,20 k	**25,00 l**	23,80 o
3	Galateya	18,80 c	21,00 j	21,50 ef	18,10 e
4	Dragana	**24,60 o**	22,10 n	21,90 fgh	20,90 k
5	Enola	20,60 f	20,40 i	22,20 ghi	17,10 a
6	Kalina	20,00 e	15,20 a	18,90 bc	17,80 d
7	Katarjina	21,60 j	15,70 b	21,30 e	17,70 c
8	Karina	22,10 l	21,40 l	21,60 ef	23,80 o
9	Kiara	22,20 l	**23,60 q**	23,20 j	**24,40 q**
10	Kosara	15,80 a	18,90 g	17,00 a	18,10 e
11	Kristalina	21,00 h	23,20 p	21,30 e	21,00 l
12	Kristy	20,80 g	18,10 d	19,70 d	17,50 b
13	Lazarka	21,00 h	18,20 e	21,70 efg	21,60 m
14	Koprinka	19,70 d	17,80 c	19,30 cd	18,90 h
15	Merilin	19,80 d	19,60 h	22,40 hi	19,80 j
16	Rada	21,80 k	21,20 k	23,20 j	18,80 g
17	Tina	20,50 f	22,00 m	23,90 k	21,00 l
18	Pchelina	21,40 i	**23,60 q**	19,20 cd	24,00 p
19	Sladuna	22,50 m	22,60 o	21,90 fgh	22,00 n
20	Stoyana	19,80 d	18,40 f	18,40 b	18,60 f

Table 4: Values of wet gluten according to cultivar and nutrition variants, %.

The lowest concentration of wet gluten in this variant was found in the Kosara variety - 15.80%. Under the terms of this variant, seed treatment results in a significant shift in the reaction of the varieties according to the test of Waller-Duncan.

The Kalina and Katarina varieties have the lowest WGC not only in this variant but also in the whole experiment - 15.20% and 15.70% respectively. SMT has significantly increased gluten in the Kiara and Pchelina varieties by 23.60% and in the Kristalina varieties by 23.20%. Systemic organic fertilization has a strong positive effect on the gluten content of the Bozhana variety - 25.00%. This is also the highest concentration of WGC reached for the condition of the experiment. In this variant, a much more pronounced similarity is observed in the reaction of the varieties compared to the other variants. Although with less pronounced differentiation in the values of the indicator in this variant, it is characterized by a much better similarity in the reaction of the varieties in comparison with the other variants. The variety with the highest gluten concentration in this variant is Kiara - 24.40%. At the same time, this variety is characterized by a relatively high level of gluten, which at the same time varies slightly depending on the type of fertilizer.

Valorimeter values are characterized by the most pronounced differentiation between the varieties in the two control variants - 1 variant control of natural soil fertility and 3 variant control of organic soil fertilization (Table 5). By values of this indicator, the 20 varieties are divided into 13 groups (a-m). In 1st variant, this variation ranges from 19.00 for the Koprinka variety to 65.83 conditional units (c.u.) the variety Katarjina. In organic fertilization control (3 variant), the variation ranges from 19.00 for the variety Koprinka to 51.00 (c.u.) for the Enola variety.

Seed treatment also provokes a genotypic response, despite lower levels of VAL values. The slightest variation in VAL values depending on the type of fertilizer variant was found in the varieties Marilyn and Pchelina.

No	Cultivars	Control	Control + SMT	Excell^{Orga} - Control	Excell^{Orga} + SMT
1	Aglika	28,00 f	30,00 h	25,00 f	27,00 g
2	Bozhana	32,00 h	29,00 g	38,00 m	31,00 i
3	Galateya	21,00 b	23,00 c	26,00 g	24,00 d
4	Dragana	34,00 j	26,00 e	28,00 i	25,00 e
5	Enola	45,00 l	31,00 i	51,00 n	29,00 h
6	Kalina	25,00 e	25,00 d	24,00 e	23,00 c
7	Katarjina	65,83 m	20,00 a	30,00 j	23,00 c
8	Karina	25,15 e	25,00 d	21,00 b	24,00 d
9	Kiara	33,00 i	27,00 f	32,00 k	32,00 j
10	Kosara	30,00 g	22,00 b	24,00 e	24,00 d
11	Kristalina	28,00 f	31,00 i	36,00 l	29,00 h
12	Kristy	24,00 d	20,00 a	22,00 c	23,00 c
13	Lazarka	25,00 e	23,00 c	22,00 c	22,00 b
14	Koprinka	19,00 a	20,00 a	19,00 a	18,00 a
15	Merilin	32,00 h	31,00 i	30,00 j	32,00 j
16	Rada	23,00 c	23,00 c	26,00 g	26,00 f
17	Tina	23,00 c	26,00 e	24,00 e	23,00 c
18	Pchelina	36,00 k	33,00 j	32,00 k	31,00 i
19	Sladuna	28,00 f	29,00 g	23,00 d	25,00 e
20	Stoyana	23,00 c	25,00 d	27,00 h	24,00 d

Table 5: Values valorimetric values (VAL) according to cultivar and nutrition variants, conditional units.

Dough resistance (DRes) is another quality index, which characterizes the strength of wheat dough. The variation of the values of this index according to fertilizer variants are very well expressed (Figure 4). The average dough resistance values in the natural fertility control (1 var.) and the organic fertilizer control (3 var.) were 2.21 minutes and 2.30 minutes respectively.

Figure 4: Average Dough resistance (DRes) values according to nutrition variants.

Seed treatment definitely reduces the resistance of the dough in both control variants. In each of the fertilizer variants, a significant genotypic response was detected, depending on the low-input practices used (Table 6). Throughout the study, index values ranged from 0.43 to 7.90 minutes.

Enola and Katarzhina varieties have the highest average dough resistance values - 3.88 and 3.80 min respectively. However, in the same varieties, variation in values of DRes depending on the type of variant is strongly expressed. The results show that most of the varieties tested have a slight variation in values depending on the nutrition of the plants. This applies to the average DRes values of varieties Pchelina (2.40 min), Merilin (2.23 min), Galateya (1.93 min), Sladuna (1.83 min), Kalina (1.80 min), Aglika (1.78 min), Rada (1.75 min), Kristi (1.63 min), Tina (1.58 min), Karina (1.53 min) and Lazarka (1.35 min).

The absence of nitrogen fertilization and the relatively low levels of plant nutrition underlie the lower results obtained with respect to some of the qualitative characteristics of the varieties.

No	Cultivars	Control	Control + SMT	Excell^{Orga} - Control	Excell^{Orga} + SMT
1	Aglika	1,90 g	1,80 f	1,60 d	1,80 g
2	Bozhana	1,92 g	1,70 e	2,50 j	1,80 g
3	Galateya	1,60 d	1,70 e	2,30 h	2,10 j
4	Dragana	3,70 k	1,90 g	2,10 g	1,60 e
5	Enola	4,10 l	1,90 g	7,90 l	1,60 e
6	Kalina	1,70 e	1,90 g	1,90 f	1,70 f
7	Katarjina	6,28 m	1,40 b	5,60 k	1,90 h
8	Karina	1,40 b	1,60 d	1,50 c	1,60 e
9	Kiara	2,50 i	1,70 e	2,40 i	1,90 h
10	Kosara	1,80 f	1,20 a	1,70 e	1,30 c
11	Kristalina	1,60 d	2,00 h	2,50 j	2,00 i
12	Kristy	1,70 e	1,40 b	1,70 e	1,70 f
13	Lazarka	1,50 c	1,40 b	1,30 b	1,20 b
14	Koprinka	1,30 a	1,50 c	0,43 a	1,30 c
15	Merilin	2,30 h	2,30 i	2,10 g	2,20 k
16	Rada	1,70 e	1,50 c	1,90 f	1,90 h
17	Tina	1,50 c	1,80 f	1,50 c	1,50 d
18	Pchelina	2,70 j	2,40 j	2,10 g	2,40 l
19	Sladuna	1,70 e	1,90 g	1,70 e	2,00 i
20	Stoyana	1,30 a	1,40 b	1,30 b	1,10 a

Table 6: Dough resistance (DRes) values according to cultivar and nutrition variants, min.

In many conventional experiments, many of these varieties, especially under optimal weather conditions, have shown a high level of quality potential [10,15-17].

Bread loaf (LVol) is one of the most important indices for evaluation of the bread making properties of wheat. The most pronounced positive effect on bread volume is the combination of basic organic fertilization with SMT with Plantagra (Figure 5). The increase over the control variant is 3.75%. In the other two variants, the average values are about 96% of those in the control variant.

Depending on the type of variety and fertilizer variant, the volume of bread varies from 557 ml to 795 ml (Table 7). As with the quality characteristics discussed so far, the volume of bread varies with the conditions of the nutrition regime.

Figure 5: Average Bread loaf (LVol) values according to nutrition variants, ml (cm^3/100 g flour).

No	Cultivars	1.Control	2. Control + SMT	3. Excell^{Orga} - Control	4. Excell^{Orga} + SMT
1	Aglika	680,00 cde	652,50 def	655,00 cde	745,00 j
2	Bozhana	745,00 h	657,50 ef	660,00 def	795,00 l
3	Galateya	667,50 bcd	660,00 ef	695,00 g	770,00 k
4	Dragana	695,00 def	702,50 hi	600,00 a	650,00 b
5	Enola	702,50 efg	652,50 def	655,00 cde	727,50 i
6	Kalina	685,00 de	717,50 i	617,50 ab	662,50 bcd
7	Katarjina	667,50 bcd	652,50 def	620,00 ab	717,50 ghi
8	Karina	682,50 cde	690,00 gh	647,50 cde	700,00 ef
9	Kiara	700,00 defg	630,00 bcd	655,00 cde	722,50 hi
10	Kosara	720,00 efg	632,50 cd	662,50 ef	697,50 e
11	Kristalina	617,50 a	607,50 b	650,00 cde	707,50 efgh
12	Kristy	632,50 a	637,50 cde	630,00 bc	655,00 bc
13	Lazarka	730,00 gh	675,00 fg	700,00 g	715,00 fghi
14	Koprinka	670,00 bcde	570,00 a	595,00 a	625,00 a
15	Merilin	680,00 cde	702,50 hi	635,00 bcd	702,50 efg
16	Rada	642,50 ab	650,00 de	610,00 ab	712,50 efghi
17	Tina	670,00 bcde	685,00 gh	682,50 fg	702,50 efg
18	Pchelina	650,00 abc	615,00 bc	690,00 g	675,00 d
19	Sladuna	632,50 a	620,00 bc	730,00 h	677,50 d
20	Stoyana	650,00 abc	687,50 gh	650,00 cde	667,50 cd

Table 7: Values of Bread loaf (LVol) according to cultivar and nutrition variants, ml.

Within the experiment, the varieties form bread with an average volume of 671.1 ml. Bojana and Lazarka varieties have the highest average values of this index - 714.4 ml and 705.0 ml. The next variety that shows a similarly high average volume is Galateya - 698.1 ml. Thus, these three varieties exceed the group average by 6.45%, 5.06% and 4.03%. The varieties with the least amount of bread loaf influenced by the type of fertilizer are Kristi, Tina and Stoyana with variance tolerance respectively 25.0 ml, 32.5 and 37.5 ml.

Grain quality is expressed as a complex of indices specific for each particular cultivar [18,19]. Some investigation show that there is only a weak relationship between GPC and bread volume, which is a direct measure of baking quality [20,21]. According to Khan [2] breeding for quality traits is often considered a secondary target compared to yield mainly because of quantity of seed needed and cost involved in breeding for quality traits. Acceptable end-use quality, rather than enhanced end-use quality is the goal in most of the wheat breeding programs because currently there are inadequate economic incentives to develop wheat cultivars only with enhanced end-use quality. Grain end-use quality traits, such as milling yield, dough rheology, baking, and noodle traits are among the most important in wheat breeding.

Our study enables us to obtain information on a number of quality characteristics of a large number of varieties differing significantly in a number of characteristics, under the conditions of low-input practices, mainly in the field of nutrition (Figure 6). In discussing the results obtained, we cannot but pay particular attention to the varieties and their ability to manifest themselves in the experimental setting, combined with short-term stress during the growing season. The results obtained also show that heritability in various traits of grain end-use quality traits in wheat varies widely.

Figure 6: Average values of some quality characteristics of investigated varieties.

The values of the variation coefficients indicate that the sample is the most homogeneous, i.e. the least is the dissipation of the Bread Loaf data. For this indicator, the average coefficient value is 5.83% (Table 8). The gluten CV obtained by variants in the experiment are also indicative of a slight variation. The average CV value is 10.52%. SMT lead to slightly increasing of CV values. The mean values of the SDS and VAL variation coefficients are 17.33 and 22.44, respectively, which is an indication of the mean data scattering. Variation in the values of the CV was found depending on the type of fertilizer variant, and in both indices the SMT contributes to the reduction of the values of the CV.

CV %	1. Control	2. Control + SMT	3. Exsell^{Orga}	4. Exsell^{Orga} + SMT
Protein	11.37	5.81	6.31	6.89
SDS	20,53	15,47	18,48	14,83
Bread Loaf	5,85	5,87	5,75	5,86
WGC	8,90	12,15	9,33	11,70
DRes	54,21	17,83	70,08	19,55
VAL	34,03	15,37	25,80	14,56

Table 8: Values of variation coefficients of tested indices according to nutrition variants, %.

The sample for DRes under the two control variants is highly heterogeneous - natural fertility of the site and systematic soil organic fertilization (1st and 3rd variant). SMT results in a sharp decrease in the CV values.

The organic products used reinforce the negative correlation between the grain yield and the complex of quality indicators (Table 9). This tendency is most pronounced in the variant combining organic soil fertilization and SMT.

Indices	1. Control	2. Control + SMT	3. Excel^{Orga} - Control	4. Excel^{Orga} + SMT
Protein	-,089	-,261(*)	-,287(*)	-,556(**)
SDS	-,087	-,262(*)	-,399(**)	-,438(**)
WGC	-,053	-,311(*)	-,346(**)	-,339(**)
DRes	,152	-,247	,258(*)	-,377(**)
VAL	,090	-,279(*)	,061	-,440(**)
Bread Loaf	-,141	-,118	-,052	-,286(*)

Table 9: Correlations between grain yield and investigated indices (Pearson Correlation).

**: Correlation is significant at the 0.01 level (2-tailed).

*: Correlation is significant at the 0.05 level (2-tailed).

The protein concentration in the grain is a positive correlative dependence with Val and Bread loaf in all tested nutrition variants (Table 10). The relationship is most pronounced in control variant expressing natural soil fertility.

Grain Protein concentration is positively correlated with other indicators characterizing the quality of the varieties tested. There is a trend towards a positive effect of organic soil fertilization and the application of humic acid-based products on the quality complex of common wheat [22].

Indices	1. Control	2. Control + SMT	3. Excel^{Orga} - Control	4. Excel^{Orga} + SMT
SDS	,147	,434(**)	,638(**)	,154
WGC	,085	,186	,493(**)	,341(**)
DRes	,153	,085	,343(**)	,360(**)
VAL	,673(**)	,303(*)	,293(*)	,416(**)
Bread Loaf	,659(**)	,484(**)	,506(**)	,473(**)

Table 10: Correlations between protein and some quality indices (Pearson Correlation).

**: Correlation is significant at the 0.01 level (2-tailed).

*: Correlation is significant at the 0.05 level (2-tailed).

Conclusion

Main soil organic fertilization with Excell^{Orga} especially in combination with seed material treatment (SMT) positively influenced on the sedimentation values and bread loaf. The average value in this variant is 42.55 ml with increasing over control variant with 3.65%. The highest and relatively stable by variants were the sedimentation values of cultivar Pchelina (51.25 ml), followed by cultivars Kiara (50.25 ml) and Galateya (46.75 ml). The bread loaf in this condition exceeded the control with 3.75%. The maximum value in the trail was reached from cv. Bojana - 795 ml.

Organic fertilization lead to increasing a wet gluten content according to the control with 2.60%. The cultivates Kiara and Bojana has a leader position according to the value of this index - 23.35% and 23.25% respectively. A tendency was established for decreasing of values of wet gluten content in variants with SMT. However, an exception to the tendency the genotypes specificity is strongly expressed - cultivars Pchelina, Kosara and Kiara reacted positively to the SMT.

Dough resistance is subject to highly expressed dynamics of values according to the genotype. Cultivars Enola and Katarjina were distinguished with maximum average values - 3.88 and 3.80. Soil organic fertilization increased values of this index according to the control variant with 4.60%. Valorimetric values were negatively influenced by soil organic fertilization and especially with combination with SMT.

We established also highly expressed correlations between yields (grain and protein) with chemical composition of grain, physical grain properties, rheological properties of flour and bread making qualities.

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