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FERTILISING SYSTEMS AND YIELD QUALITY IN WINTER WHEAT IN THE CONDITIONS OF THE DS IN TIMISOARA

SISTEMUL DE FERTILIZARE ŞI CALITATEA PRODUCȚIEI LA CULTURA DE GRÂU DE TOAMNĂ ÎN CONDIȚIILE DE LA SD TIMIŞOARA

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Abstract: *The studies and research at the base of the present paper aimed at improving the fertilising system in winter wheat in the soil and climate conditions of the DS in Timisoara. For different winter wheat cultivars with different yielding potential, there are different fertilisers and new agricultural technologies; with changing economic and soil and climate conditions, we need to improve and optimise fertilisation systems. The experimental variants we applied (N_{0-200} on PK_{0-150}) ensured considerable statistically ensured increase in yield compared to the control. Crop quality analysed from the point of view of gluten and protein content also shows the positive impact of the fertiliser rates applied.*

Rezumat: *Studiile şi cercetările care au stat la baza prezentei lucrări au avut ca scop perfecționarea sistemul de fertilizare la cultura de grâu de toamnă în condițiile pedoclimatice de la SD Timişoara. În condițiile în care sunt cultivate soiuri de grâu cu potențial diferit de producție, sunt utilizate diferite sortimente de îngrăşăminte, noi tehnologii agricole, pe fondul condițiilor economice şi pedoclimaterice în schimbare, se impune perfecționarea şi optimizarea sistemelor de fertilizare. Variantele experimentale practicate N_{0-200} pe fond PK_{0-150} au asigurat sporuri însemnate de producție, asigurate statistic, față de varianta martor nefertilizată. Calitatea recoltei, analizată prin prisma conținutului de gluten şi proteină exprimă de asemenea influența favorabilă a dozelor de îngrăşăminte administrate.*

Key words: *fertilizing system, fertilizers, yield, quality, winter wheat*
Cuvinte cheie: *sistem de fertilizare, îngrăşăminte, producție, calitate, grâu*

INTRODUCTION

Numerous researchers are persuaded that applying fertilizers reasonably plays an essential, determining role in obtaining quantitative and qualitative plant yields, i.e. food, but their efficient use is possible only when knowing in detail soil features from the point of view of plant nutritious medium, of crop nutritious requirements, and of the interaction between fertilizers, cultivars, and plants (HERA 2002) (1, 2).

At present, they are studying methods of applying fertilizers to increase the coefficient of valorising nutrients as well as new chemical fertilizers to apply on the soil and on the leaves that ensure the necessary plant consumption with a view to improving food quality, to ensure food resources and environmental protection. (1, 3 and 4)

In the present paper, we present results concerning the impact of mineral fertilizing on yield and quality in winter wheat with a view to improve the fertilizing system.

MATERIAL AND METHODS

We tested, in the context of our research, the impact of some different assortments of simple (urea) and complex (NPK 15:15:15) mineral fertilizers in different rates and combinations on yield and quality in winter wheat.

The biological material was represented by the *Alex* winter wheat cultivar, a cultivar adapted for Western Romania and with a high yielding potential.

Research was carried out during the period 2006-2007 at the DS in Timisoara, plot A 363 with the following topographic coordinates: N 45° 28' 30.9'', E 21° 7' 9.8''. The land in the plot area is plane, with the type of cambic phaesiom representative for the area and favourable to winter wheat.

Results were processed through proper statistic methods, variance analysis, statistic analysis (linkage distance) to capture the impact of independent variants (fertilizer rates) on yield and quality.

RESULTS AND DISCUSSIONS

The agricultural year 2006-2007 was characterized by a slightly deficitary precipitation regime, i.e. 554.4 mm compared to the multi-annual average of the area, 600.4 mm. The deficit was relatively evenly distributed over the two decades, the first one with 20.2 mm and the second one with 25.8 mm.

Weather conditions were favourable to winter crops ever since the beginning of the vegetation period; the crops continued to develop normally until winter came. In the first months of 2007, the level of precipitations was good, slightly exceeding. During the month of April, there was a deficit of precipitations which, associated with temperatures that were high for the period, affected plant growth and development and had a bad impact on straw cereal size.

The agricultural year 2007-2008 was characterized by a slightly exceeding precipitation regime, i.e. 634.5 mm compared to the multi-annual average of the area, 600.4 mm.

Average yields for the experimental period as shown in table 1 are between 2,122.00 kg/ha and 5,863.00 kg/ha.

Analysed for the two experimental years, results show the different way in which the fertilizers applied were valorised. In 2007, yield oscillated between 1,952.00 kg/ha in the control variant and 5,233.75 kg/ha in the $P_{150}K_{150}N_{200}$ variant, with high yields in other experimental variants too ($P_{150}K_{150}N_{150}$ – 5,150.00 kg/ha, $P_{150}K_{150}N_{100}$ – 4,585.00 kg/ha, $P_{100}K_{100}N_{150}$ – 4,563.75 kg/ha, etc.).

More favourable weather conditions in the agricultural year 2007-2008 facilitated proper valorisation of the fertilizers applied, so that, at the level of the experimental field and winter wheat crop on the whole, they were higher than in the previous year.

Average yields varied between 2,242 kg/ha in the control variant and 6,590 kg/ha in the variant fertilized with $P_{150}K_{150}N_{150}$, with high yield also in other experimental variants ($P_{150}K_{150}N_{200}$ – 6,552,25 kg/ha, $P_{150}K_{150}N_{100}$ – 5,898.75 kg/ha, $P_{100}K_{100}N_{150}$ – 5,907.50 kg/ha, $P_{100}K_{100}N_{200}$ – 5,361.25 kg/ha and $P_{50}K_{50}N_{200}$ – 5,302.25 kg/ha).

As for winter wheat yield quality, it was analysed from the point of view of the moist gluten, dry gluten, and raw protein contents.

In 2007, there were high values of gluten content in the variants fertilized with $P_{150}K_{150}N_{150}$, $P_{150}K_{150}N_{200}$, $P_{150}K_{150}N_{100}$, $P_{100}K_{100}N_{150}$, and $P_{150}K_{150}N_{200}$ as well as in other variants, but with smaller differences compared to the control (table 2 and figure 1).

In 2008, moist gluten content was between 16.86% in the control and 24.01 in the variant fertilized with $P_{150}K_{150}N_{200}$, with high values in other experimental variants ($P_{150}K_{150}N_{150}$, $P_{150}K_{150}N_{100}$, $P_{100}K_{100}N_{150}$, and $P_{100}K_{100}N_{200}$) (table 2 and figure 2).

Raw protein content was between 11.06% in the control and 15.44% in the variant fertilized with $P_{100}K_{100}N_{100}$ (Table 3 and Figure 3). There was a positive correlation between protein content and fertilizer rates, which was confirmed by the experimental results we obtained.

Table 1

Experimental data concerning winter wheat yield (*Alex* cultivar) in the soil and climate conditions of the DS in Timisoara (average values for the period 2007-2008)

Factor A	Factor B		Yield level (kg/ha)	Relative values (%)	Differences	Significance
P_0 K_0	Mt	N_0	2122.00	100.00	-	-
	V1	N_{50}	2652.00	124.98	530.00	*
	V2	N_{100}	3087.25	145.49	965.25	***
	V3	N_{150}	3374.25	159.01	1252.25	***
	V4	N_{200}	3466.00	163.34	1344.00	***
P_{50} K_{50}	V5	N_0	2448.75	115.40	326.75	-
	V6	N_{50}	3331.25	156.99	1209.25	***
	V7	N_{100}	4001.25	188.56	1879.25	***
	V8	N_{150}	4342.25	204.63	2220.25	***
	V9	N_{200}	4723.25	222.58	2601.25	***
P_{100} K_{100}	V10	N_0	2768.75	130.48	646.75	**
	V11	N_{50}	3677.75	173.32	1555.75	***
	V12	N_{100}	4395.00	207.12	2273.00	***
	V13	N_{150}	5158.50	243.10	3036.50	***
	V14	N_{200}	4963.00	233.88	2841.00	***
P_{150} K_{150}	V15	N_0	3001.75	141.46	879.75	***
	V16	N_{50}	4028.00	189.82	1906.00	***
	V17	N_{100}	5241.75	247.02	3119.75	***
	V18	N_{150}	5863.00	276.30	3741.00	***
	V19	N_{200}	5789.75	272.84	3667.75	***

DL 5% = 473.022; DL 1% = 629.11; DL 0.1% = 818.32

Table 2

Experimental data concerning moist and dry gluten content (*Alex* cultivar) in the soil and climate conditions of the DS in Timisoara (average values for the period 2007-2008)

Factor A	Factor B		Moist gluten		Dried gluten	
			2007	2008	2007	2008
P_0 K_0	Mt	N_0	16.58	16.82	6.82	7.02
	V1	N_{50}	16.91	17.02	7.68	7.55
	V2	N_{100}	17.53	17.61	8.68	8.12
	V3	N_{150}	18.75	18.20	8.85	9.04
	V4	N_{200}	19.48	18.96	9.26	9.16
P_{50} K_{50}	V5	N_0	17.43	17.27	7.81	7.85
	V6	N_{50}	17.81	17.77	8.87	8.55
	V7	N_{100}	19.43	19.28	9.56	9.62
	V8	N_{150}	20.03	19.88	10.93	10.47
	V9	N_{200}	21.60	20.77	11.06	11.06
P_{100} K_{100}	V10	N_0	21.10	21.06	7.92	8.41
	V11	N_{50}	21.80	20.25	8.84	8.87
	V12	N_{100}	22.43	21.46	10.85	10.63
	V13	N_{150}	23.06	23.17	11.23	11.72
	V14	N_{200}	23.54	23.11	11.82	11.79
P_{150} K_{150}	V15	N_0	21.64	20.55	8.77	8.51
	V16	N_{50}	22.55	22.87	11.30	10.27
	V17	N_{100}	23.60	23.71	14.90	12.97
	V18	N_{150}	24.80	23.95	13.70	13.41
	V19	N_{200}	25.01	24.01	13.20	13.18

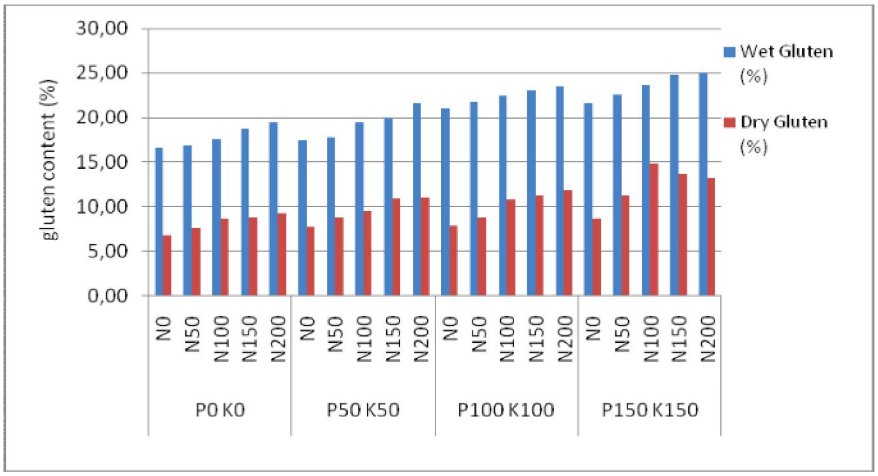

Figure 1. Moist and dry gluten content in winter wheat (*Alex* cultivar) depending on the experimental variants during the agricultural year 2006-2007

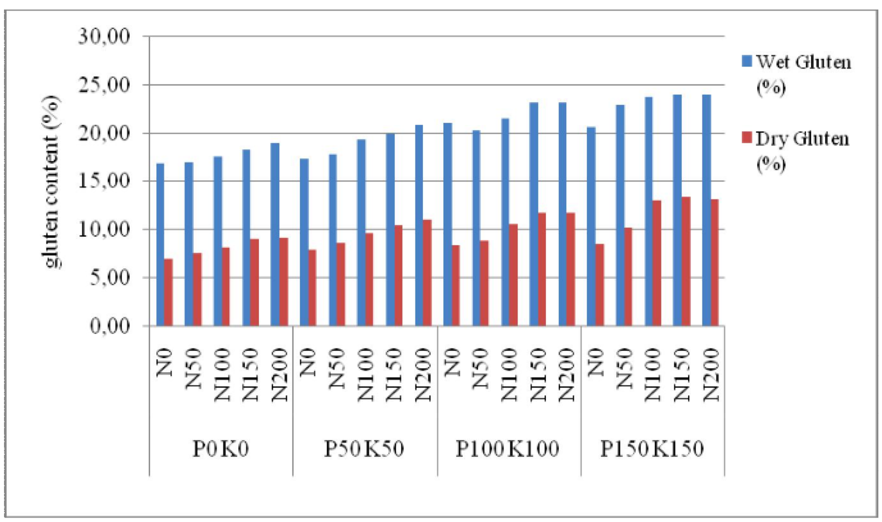

Figure 2. Moist and dry gluten content in winter wheat (*Alex* cultivar) depending on the experimental variants during the agricultural year 2007-2008

We analysed experimental data through proper statistic methods (linkage distance) which pointed out close yield and quality results (within the difference limits) obtained in different fertilisation variants.

Both statistic approach (linkage distance) and mathematical modelling pointed out the correlation between fertilisation variants and yield and quality, but the most important thing was the possibility of obtaining comparable results through combinations of different rates of fertilisers with practical recommendations.

Table 3

Variation of total nitrogen and raw protein content in winter wheat grains (*Alex* cultivar) depending on the fertilisation variant

Fertilization variant		Quality features	
Factor A (P, K)	Factor b (N) (kg/ha)	N_{tot} (%)	PB (%)
P_0K_0	N_0	1.77	11.06
	N_{100}	2.20	13.75
	N_{200}	2.27	14.19
$P_{100}K_{100}$	N_0	2.00	12.50
	N_{100}	2.47	15.44
	N_{200}	2.33	14.56

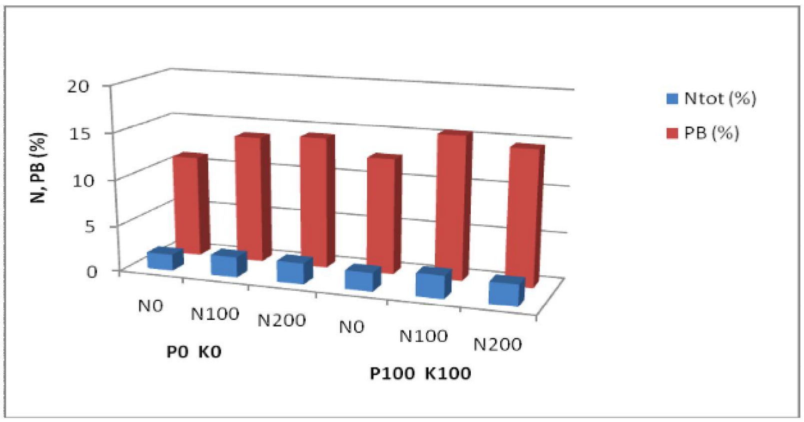

Figure 3. Variation of total nitrogen and raw protein content in winter wheat grains (*Alex* cultivar) depending on the fertilisation variant

CONCLUSIONS

Research carried out pointed out the different impact of fertilizer assortment and rate used in fertilizing winter wheat in the soil and climate conditions at the DS in Timisoara.

Yield increases when fertilized with nitrogen were between 638.75 kg/ha and 1,635.00 kg/ha in 2007, and between 1,592.50 kg/ha and 4,287.00 kg/ha in 2008.

Phosphorus and potassium fertilizers contributed to yield increases between 185.00 kg/ha and 605.00 kg/ha in 2007 and between 1,312.00 kg/ha and 2,026.75 kg/ha in 2008. High yield differences between the experimental years were due to climate conditions, particularly deficitary precipitations in 2007.

NPK balanced fertilisation ensured much higher yields with significant increases compared to the control.

Analysis of yield results generated by the fertilisation variants from the point of view of the linkage distance pointed out multiple fertilisation solutions in order to obtain comparable results.

It is possible to establish a combination of fertilizer rates and to harmonise fertilizing systems depending on real technical and economic conditions.

Experimental data supply multiple solutions for comparable results from a quantitative point of view, which means different possibilities for practical applications.

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