

THE INFLUENCE OF FERTILIZATION ON THE YIELD AND QUALITY OF SOME ROMANIAN WINTER WHEAT VARIETIES UNDER THE CONDITIONS OF CENTRAL MOLDOVA

Andreea-Sabina PINTILIE, Andreea ENEA, Alexandra LEONTE, Paula Lucelia PINTILIE, Roxana Georgiana AMARGHIOALEI, Lorena Diana POPA

Agriculture Research-Development Secuieni, 377 Principala Street, Secuieni, Neamt, Romania

Corresponding author email: andreeasabina97@yahoo.com

Abstract

Breeding research for the common wheat crop has focused on quality and yield. These are closely related to each other because high yield without adequate quality or good quality without satisfactory production are not profitable for the farmer. At A.R.D.S. Secuieni, in the period 2019-2022, Romanian winter wheat varieties were tested in order to establish their yield and quality. These were influenced by the variety, the climatic conditions but also by the phase fertilization applied. On average in the three years studied, the productions had values between 7108 kg/ha (Pitar) and 8442 kg/ha (Semnal) in the case of fertilized variants and between 6201 kg/ha (Miranda) and 7669 kg/ha (Abundent) in the case of unfertilized variants. Regarding the quality of common wheat varieties, the content in protein, starch and gluten was monitored.

Key words: quality, wheat, yield.

INTRODUCTION

Common wheat (*Triticum aestivum* ssp. *vulgare* L.) is the main source of flour, used to bake bread, being cultivated on extensive areas in all areas of the globe due to its yield and quality clearly superior to other cereals. The bran obtained from the processing of wheat grains constitute a good fodder for animals (Bîlteanu et al., 1979).

Wheat grains are rich in protein and gluten, and the breeding program is aimed at increasing the content in these indices (Șerban et al., 2022).

In Romania, two of the centres dealing with the improvement of common wheat are N.A.R.D.I. Fundulea and A.R.D.S. Turda, and their creations are the subject of research carried out during 2019/2022 at A.R.D.S. Secuieni and presented in this paper.

The specialized literature describes the factors that determine the wheat quality, as being genetics, applied crop technology and environmental conditions. These factors are decisive in the growth and development of wheat. The protein accumulation is determined by higher temperatures during flowering while lower temperatures, determines a longer period vegetative that influences the starch

accumulation in larger quantities (Mogârzan, 2012; Roman et al., 2011).

The breeders, considering the growing demand for raw material for baking purposes, focused on increasing the wheat varieties yield but also on quality, these being closely related to each other (Marinciu et al., 2022).

This paper presents data on the yield results of some wheat varieties experienced in two comparative crops systems: fertilized and unfertilized.

MATERIALS AND METHODS

The A.R.D.S. Secuieni is located in the SE part of Neamt county, between the geographical coordinates of 26°5' east longitude and 46°5' north latitude, at an altitude of 205.7 m above sea level. The headquarters of the unit is located in the Secuieni commune, at a distance of approximately 10 km from the municipality of Roman and 30 km from the municipality of Bacau (<https://www.sceda.ro/>).

In order to establish the influence of fertilization on the yield and quality of the winter wheat, two monofactorial experiments were placed: an unfertilized and a fertilized one with NPK 18:46:0 in autumn and ammonium nitrate (NH₄NO₃) in the spring. The doses

applied in the autumn of NPK were 36 kg N/ha and 92 kg P₂O₅/ha and in the spring were administered 69 kg N/ha.

The behavior of 10 varieties of Romanian winter wheat were followed and determinations were made regarding the number of grains per ear, weight of grains per ear, weight of one thousand grains, hectoliter weight, yield, protein, gluten and starch content.

The method of placing experiments - randomized blocks in 3 repetitions. The experimental plots were 10 square meters (10 meters long and 1 meter wide). After elimination, the harvestable surface remained 8 square meters.

During the vegetation period no chemicals were used to combat diseases and pests.

Regarding the thermal regime recorded at A.R.D.S. Secuieni in the period 2019-2002, an increase in temperatures is observed due to the decrease in precipitation.

In the three years studied, the annual average temperatures recorded were higher than the multiannual average.

On average, temperatures have increased in the last three years by 1.2°C compared to the multiannual average (Table 1).

Table 1. Temperatures recorded at A.R.D.S. Secuieni between 2019-2022 and comparison with the multiannual average

Month	Agricultural year			Multiannual average	Average 2019/2022	Deviation
	2019/2020	2020/2021	2021/2022			
X	10.8	12.7	8.0	9.1	10.2	1.1
XI	7.8	3.9	5.6	3.5	5.2	1.7
XII	1.8	1.7	-0.2	-1.7	0.4	2.1
I	-0.6	-0.7	-0.1	-3.9	-1.3	2.6
II	3.4	-0.4	2.6	-2.2	0.9	3.1
III	6.2	2.9	2.7	2.8	3.7	0.9
IV	10.0	7.5	9.5	9.5	9.1	-0.4
V	13.9	14.7	16.3	15.4	15.1	-0.3
VI	20.0	19.2	20.7	18.8	19.7	0.9
VII	20.9	22.2	22.2	20.4	21.4	1.0
VIII	22.2	20.5	22.7	19.5	21.2	1.7
IX	18.0	14.4	14.7	15.0	15.7	0.7
Average	11.2	9.9	10.4	8.9	10.1	1.2

The pluviometric regime between 2019-2022 recorded lower values compared to the multiannual average.

The driest year was 2021-2022, with a deviation from the multiannual average of 283.5 mm (Table 2).

On average, the driest months were July and April with deviations from the multiannual average of -25.8 mm and -37.0 mm (Table 2).

Table 2. The precipitation recorded at A.R.D.S. Secuieni between 2019-2022 and the comparison with the multiannual average

Month	Agricultural year			Multiannual average	Average 2019/2022	Deviation
	2019/2020	2020/2021	2021/2022			
X	33.0	27.2	3.0	38.2	21.1	-17.1
XI	14.6	7.4	10.8	28.4	10.9	-17.5
XII	6.2	38.2	39.0	25.4	27.8	2.4
I	2.0	12.2	5.4	20.1	6.5	-13.6
II	16.0	10.8	4.6	19.5	10.5	-9.0
III	10.2	31.8	0.8	26.9	14.3	-12.6
IV	1.2	23.8	38.4	46.9	21.1	-25.8
V	69.6	31.4	20.8	65.7	40.6	-25.1
VI	72.6	79.4	56.6	85.0	69.5	-15.5
VII	39.0	51.6	35.2	82.3	45.3	-37.0
VIII	51.2	76.8	15.2	60.2	64.0	3.8
IX	60.4	9.2	31.0	45.7	33.53	-12.2
Average	376.0	399.8	260.8	544.3	365.2	-179.1

The data obtained were processed according to the variance analysis method (Leonte & Simioniuc, 2018).

RESULTS AND DISCUSSIONS

The two key components of wheat yield are the number of grains per ear and the individual weight of grains. The number of grains/ear is dependent on the ability to differentiate the fertile spikelets in the ear and the nutrition level that the plants have at their disposal at the time. From previous research it is known that the number of grains in the ear is a feature of the variety (Roman et al., 2011).

Analysing the number of grains/ear in the comparative wheat crops experimented in the conditions of A.R.D.S. Secuieni, it was found that on average, in the fertilized system, the highest number of grains/ear, of 36.0 was obtained for the variant sown with the Codru variety, and the smallest number of grains/ear, of 30.43 was obtained for the variant sown with the Pitar variety. In the unfertilized system, the change in the number of grains/ear was between 27.87 (Glosa) and 33.8 (Semnal).

The weight of the grains/ear had average values ranging from 1.22 g (Pitar) to 1.62 g (Signal) in the case of fertilized variants and between 1.04 g and 1.42 g in the same varieties and in the case of unfertilized variants.

The mass of a thousand grains (TGW) is one of the most important productivity indices and in the conditions of A.R.D.S. Secuieni was influenced by the fertilization applied, on average in the case of fertilized variants with higher values, between 36.23 g (Otilia) and 44.23 g (Andrada) and in the unfertilized

experience, between 36.71 g (Voinic) and 42.74 g (Andrada).

The hectolitre mass (HM) of wheat refers to the weight of a standardised volume of wheat, measured under given conditions (Mogârzan, 2012). The hectolitre mass values determined at the genotypes experienced ranged from 78.17 kg/hl (Miranda) to 81.30 kg/hl (Ursita) in the fertilized system and ranged from 76.57 kg/hl (Miranda) to 79.80 kg/hl (Otilia) in the unfertilized system (Table 3).

Most of the current varieties correspond under normal conditions the requirements of the market regarding hectolitric mass, but efforts are needed to improve it resistance to drought and heat, to prevent low values of HM in the conditions unfavorable to filling the grains (Marinciu et al., 2022).

Table 3. Average of the yiled indices in 2019-2022 recorded at A.R.D.S. Secuieni

Variety	Number of grains/ear		Grain weight/ear		TGW (g)		HM (kg/hl)					
	Fert.	Unfert.	Fert.	Unfert.	Fert.	Unfert.	Fert.	Unfert.				
Glosa (Mt)	31.70	27.87	3.83	1.42	1.05	0.37	41.70	39.18	2.52	80.07	78.70	1.37
Miranda	33.37	30.00	3.37	1.41	1.05	0.36	38.90	37.64	1.26	78.17	76.57	1.60
Otilia	37.27	36.87	0.40	1.30	1.24	0.07	36.23	37.19	-0.96	80.60	79.80	0.80
Pitar	30.43	29.83	0.60	1.22	1.04	0.19	41.31	40.11	1.19	79.13	77.60	1.53
Semnal	34.90	33.80	1.10	1.62	1.42	0.20	40.57	41.76	-1.19	79.37	78.80	0.57
Ursita	32.27	30.63	1.63	1.35	1.14	0.21	38.40	37.54	0.87	81.30	79.03	2.27
Voinic	31.47	31.43	0.03	1.26	1.19	0.07	37.88	36.71	1.17	80.57	79.07	1.50
Abund	35.57	32.50	3.07	1.34	1.15	0.19	38.70	38.14	0.56	78.90	77.73	1.17
Andrada	32.57	29.27	3.30	1.48	1.14	0.34	44.23	42.74	1.49	79.47	78.67	0.80
Codru	36.00	31.30	4.70	1.59	1.29	0.31	43.86	42.61	1.25	79.20	78.30	0.90
Average	33.55	31.35	2.20	1.40	1.17	0.23	40.18	39.36	0.82	79.68	78.43	1.25

The average grain yield obtained at the fertilized system showed variations from 7108 kg/ha (Pitar) to 8442 kg/ha (Semnal). Compared to the yield obtained at control, the Glosa variety, two variants achieved yield increases interpreted as distinctly significant (Voinic and Abundant) and the Semnal variety recorded a yield increase interpreted as very significant, with an increase compared to the control of 935 kg/ha (Table 4).

The yield obtained in the unfertilized system showed variations from 6201 kg/ha (Miranda) to 7669 kg/ha (Abund). Compared to the yield obtained with the control variety, the Glosa variety, three variants exceeded the control, being statistically interpreted as distinctly significant (Semnal and Abund) and significant (Ursita) (Table 4).

Table 4. The average yields obtained for autumn wheat during 2019-2022 at A.R.D.S. Secuieni

Variety	Average production 2019/2022 (Fertilized)	Difference from the control	Signif.	Average production 2019/2022 (Unfertilized)	Difference from the control	Signif.
Glosa (Mt)	7507	Mt	-	6683	Mt	-
Miranda	7444	-64		6201	-482	
Otilia	7800	292		7172	489	
Pitar	7108	-399	o	6391	-292	
Semnal	8442	935	***	7579	896	**
Ursita	7699	191		7312	629	*
Voinic	7955	447	**	6699	16	
Abund	8251	744	**	7669	986	**
Andrada	7565	58		6986	302	
Codru	7867	359		7019	336	
LSD 5%		396			566	
LSD 1%		563			805	
LSD0,1%		815			1165	

Analysing the quality of the grains, from data presented in Table 5 it can be noticed that there is a major difference between the quality of the wheat grains obtained in the fertilized system compared to those obtained in the unfertilized system.

The protein content of the grains varied on average from 12.68% (Miranda) to 14.62% (Pitar) in the fertilized system and from 11.45% to 12.65% in the same varieties in the unfertilized system.

The largest differentiation of the percentage of protein obtained in the two systems was observed in the variant sown with the Pitar variety, this being 1.97% (Table 5).

As with the protein content, a noticeable differentiation was observed in the case of the percentage of gluten, which was much higher in the fertilized variants. Thus, its variation was between 25.40% (Miranda) and 29.97% (Pitar) in fertilization system and between 22.57% and 25.38% in the same varieties at the unfertilized system. The differentiation between the two systems was higher in the case of gluten compared to protein, being maximum in the variant sown with the Pitar variety, of 4.58% (Table 5).

As for the starch content of wheat grains, it was higher in the case of unfertilized variants with values ranging from 68.72% (Pitar) to 70.07% (Miranda) and between 66.48% (Ursita) and 69.03% (Miranda) in the case of fertilized variants (Table 5).

Table 5. The average values of the quality indices registered between 2019-2022 at A.R.D.S. Secuieni

Variety	PROTEIN (%)			GLUTEN (%)			STARCH (%)		
	Fert.	Unfert.	Diff.	Fert.	Unfert.	Diff.	Fert.	Unfert.	Diff.
Glosa (Mt)	13.83	12.32	1.52	28.03	24.55	3.48	68.03	69.02	-0.98
Miranda	12.68	11.45	1.23	25.40	22.57	2.83	69.03	70.07	-1.03
Otilia	13.58	11.70	1.88	27.47	23.12	4.35	67.87	69.23	-1.37
Pitar	14.62	12.65	1.97	29.97	25.38	4.58	67.22	68.72	-1.50
Semnal	13.70	12.30	1.40	27.67	24.50	3.17	68.20	69.13	-0.93
Ursita	13.43	11.78	1.65	27.18	23.28	3.90	66.48	69.88	-3.40
Voinic	13.90	12.03	1.87	28.18	23.87	4.32	67.63	69.17	-1.53
Abund	13.48	11.95	1.53	27.27	23.67	3.60	67.92	69.03	-1.12
Andrada	13.30	11.63	1.67	26.80	23.02	3.78	68.18	69.67	-1.48
Codru	13.05	11.55	1.50	26.30	22.82	3.48	68.23	69.53	-1.30
Average	13.56	11.94	1.62	27.43	23.68	3.75	67.88	69.35	-1.47

CONCLUSIONS

As a result of the researches carried out on the adaptability of some genotypes of autumn wheat in the conditions of the Center of Moldova, the following conclusions were drawn:

-on average, in the comparative fertilized system, the largest number of grains/ear, of 36.0 was obtained at the variant sown with the Codru variety, and the smallest number of grains/ear, of 30.43, was obtained for the variant sown with the Pitar variety;

- in the unfertilized system, the number of grains/ear was between 27.87 (Glosa) and 33.8 (Semnal);

- the weight of the grains/ear had average values ranging from 1.22 g (Pitar) to 1.62 g (Semnal) in fertilization system and between 1.04 g and 1.42 g for the same varieties in the unfertilized system;

- the TGW in the fertilized system ranged from 36.23 g (Otilia) to 44.23 g (Andrada) and between 36.71 g (Voinic) and 42.74 g (Andrada) to the unfertilized system;

- the HM ranged from 78.17 kg/hl (Miranda) to 81.30 kg/hl (Ursita) in the fertilized system and ranged from 76.57 kg/hl (Miranda) to 79.80 kg/hl (Otilia) in the unfertilized system;

- the average of the yields obtained by the wheat varieties had values between 7108 kg/ha (Pitar) and 8442 kg/ha (Signal) in the fertilized system and between 6201 kg/ha (Miranda) and 7669 kg/ha (Abundant) in the unfertilized system;

- the starch content had higher values in the case of unfertilized variants with values between 68.72% (Pitar) and 70.07% (Miranda) and between 66.48% (Ursita) and 69.03% (Miranda) in the case of fertilized variant;

- the protein content of the grains varied on average from 12.68% (Miranda) to 14.62% (Pitar) in the fertilized system and from 11.45% to 12.65% in the same varieties in the unfertilized system;

- the gluten content varied between 25.40% (Miranda) and 29.97% (Pitar) in fertilization system and between 22.57% and 25.38% in the same varieties in the unfertilized system.

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