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THE ECONOMIC EFFICIENCY OF SOME CEREALS UNDER THE INFLUENCE OF CLIMATE CHANGES IN THE CENTRAL AREA OF MOLDOVA, ROMANIA

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Abstract

Cereals are essential for human nutrition. Unfortunately, the worldwide demographic evolution (continually increasing) makes it difficult to maintain the security of this food source. To overcome this situation, increasing the yield of these species is necessary. The aim of the present research is to make a comparative economic analysis between different varieties of winter barley, winter wheat and triticale varieties in the period 2018-2023 at Agricultural Research and Development Station (ARDS) Secuieni, Neamt County, Romania. The economic indicators taken into consideration were: yield, production value, production cost, total expenditures, gross and net profit. The data were processed and statistically interpreted based on variance analysis, coefficient of variation, using Microsoft Excel and ANOVA 2013 programs. The results regarding yield showed that on the first place is winter wheat with an average yield of 7,413 kg · ha^{-1}, the second place is winter barley with an average yield of 6,340 kg · ha^{-1}, and the last place is triticales, with an average yield of 6,145 kg · ha^{-1}. From an economic point of view, winter wheat is on first place, with a net profit of approximately double compared to the other two cereals. The net profit was 3,109 lei · ha^{-1} for winter wheat, 1,766 lei · ha^{-1} for winter barley, and 1,635 lei · ha^{-1} for triticale.

Key words**:** *advantage, barley, triticale, wheat, economic efficiency*

INTRODUCTION

Cereals are essential for human nutrition. Unfortunately, the worldwide demographic evolution (continually increasing) makes it difficult to maintain the security of this food source. To overcome this situation, increasing the yield of these species is necessary. Given the increased importance of these species, research must continue in this regard because the yield of winter cereals especially winter wheat must cope with the high demand worldwide [7]. Solutions must be found, in particular, to reduce the negative impact of global climate change on the yield of winter cereals [13, 14].

In our country, winter cereals represent the predominant species in agriculture. Due to this fact, the essential objective in the cultivation of these species is to obtain a main yield (grains/seeds) as high as possible per surface unit but which also possesses a superior quality for use in the three major directions, namely: human consumption, animal feed, and industrialization. In recent years, the yield of winter cereals varieties has increased considerably in many regions of the world, including Romania [2, 6, 4], a fact due

both to the improvement of genetics as well as the adaptation of crop technology to these species according to the new climatic conditions and according to the new varieties created.

Effects produced by climate change: drought, floods, and desertification affect agricultural activity.

Winter cereals have certain bioclimatic requirements, influencing the vegetative processes and yield. These bioclimatic requirements are about the main climatic factors: light, temperature, and rainfall. The annual fluctuation of climatic factors determines the variability of productions from one year to another, and their analysis is the basic criterion for adopting measures to prevent, mitigate, or combat the damage caused to agriculture [3].

The constantly changing climatic conditions have negative influences on the physiological mechanisms of the development of cereals, which are disturbed especially by the prolonged droughts that are more and more frequent in our country [1]. Analyzing the latest studies carried out in our country, we can see a decrease in the size of cereals, the values of the productivity elements, and, of course, the yield.

The identification of more valuable varieties than the existing ones is a major objective in scientific research, it is known that the variety participates directly in increasing yield, using other technical measures more effectively [11]. The assessment of drought tolerance in different pluviometric conditions allows the varieties to be ranked according to this in each environment (with stress or non-stress). In various studies carried out in our country, Romanian varieties have been identified that show tolerance to environmental conditions, one of them being the Glosa wheat variety [5].

Agricultural production, which also includes the cultivation of winter cereals, especially wheat, is the main activity of the Romanian rural society [12]. For Romanian farmers to face the new climate changes, it is necessary to know the factors that help to form agricultural production, which are: the use of seeds from higher biological categories, the use of varieties that show adaptability to the conditions of the area, the establishment/ expansion of irrigation systems, access to new agricultural research, increasing the level of training of agricultural personnel, intensive application of fertilizers and pesticides [8].

Taking into account this aspect, at A.R.D.S. Secuieni, over a period of five years (2018 - 2023), a wide range of winter cereal varieties were observed, the results obtained for some of them being detailed in this paper. In addition to grain yield, it was also evaluated the stability of yield and the economic efficiency of crops under the new environmental conditions.

MATERIALS AND METHODS

The results presented in this paper come from comparative crops with Romanian varieties of winter cereals, placed in the experimental field, one for each species in winter wheat, barley and triticale. The method of fielding these comparative crops was that of the balanced square grid, in three repetitions, the soil type used being the typical phaeozem (chernozem) cambic. The soil on which the comparative crops were placed is characterized as being well supplied in phosphorus (P_2O_5 - 39 mg · kg^{-1}) and mobile potassium (K_2O - 161 mg · kg^{-1}), moderately supplied with nitrogen, the soil nitrogen index being 2.1, weakly acidic, with pH values (in aqueous suspension) of 6.29 and poorly fertile, with a humus content of 2.3% [10]. Fertilization was carried out with 100 kg active substance · ha^{-1} fractionated nitrogen - 40 kg active substance when preparing the germinal bed and 60 kg active substance · ha^{-1} and with 40 kg P_2O_5 · ha^{-1} applied in spring.

Given that these winter cereal varieties have been tracked over the past five years, which have been characterized as hot and dry, the yield variability has been driven to a large extent by climatic conditions.

From a climatic point of view, the period 2018 - 2022 was characterized as hot and very dry.

a) Air temperature. From a thermal point of view, the five years analyzed were characterized as atypical for all field crops, all of them being warm, registering deviations

from the multiannual average between 1.0 °C (2019 - 2020 and 2020 – 2021) and 1.5 °C (2021 - 2022).

Analyzing the average temperatures recorded during the analyzed period (2017 - 2022), we observe an accelerated air warming by 1.4 °C, compared to the multiannual average (1962 - 2022) (Fig. 1).

Analyzing the temperatures recorded in the last five springs, we observe an accelerated air warming by 0.2 °C to 0.9 °C, compared to the multiannual average (1962 - 2019). The greatest air warming is observed in March, which shows an increase in temperature by 0.9 °C. On average, an air warming of 0.4 °C was observed in spring (Fig. 1).

Analyzing the temperatures recorded in the last five summers, we observe an accelerated air warming by 0.7 °C – 2.1 °C, compared to the multiannual average (1962 – 2019).

On average over the last five years, a summer air warming of 1.4 °C was observed, with the highest air warming observed in June (1.4 °C) and August (2.1 °C), July being warmer by 0.7 °C (Fig. 1).

In the last five years, the autumn months have recorded air warming between 0.9 °C and 1.5 °C compared to the multiannual average. The October and November were warmer with 1.4-1.5 °C above the multiannual average (Fig.1).

The winter between 2017 to 2022 showed a strong air warming between 2.3 °C and 3.0 °C compared to the multiannual average. The February was the warmest, registering a deviation from the multiannual average of 3.0 °C (Fig. 1).

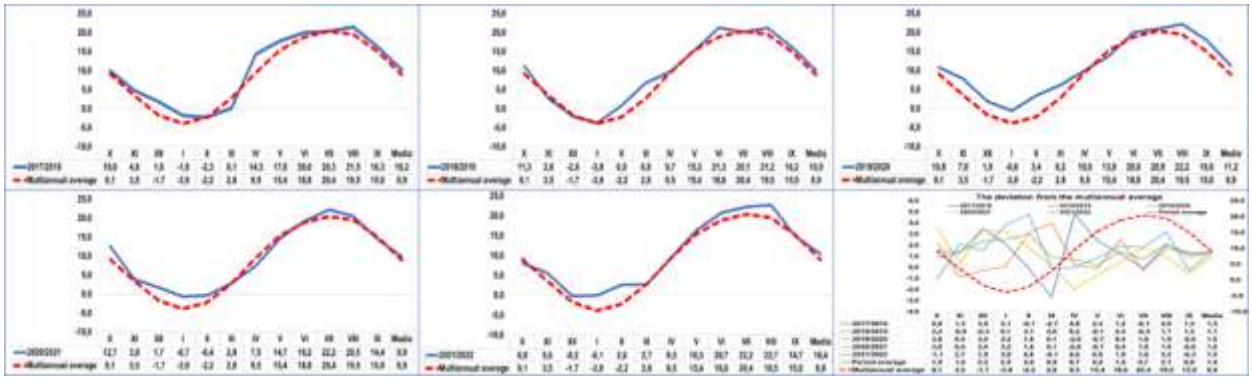

Fig. 1. Temperatures recorded at A.R.D.S. Secuieni in the period 2017 – 2022 and their deviation from the multiannual average (1962 – 2022)
Source: Own design.

b) Atmospheric rainfall. From a pluviometric point of view, in the period 2017 - 2022, a general trend of decrease in the amount of rainfall during the plants vegetative period was observed. The distribution of rainfall over the growth stages of agricultural plants was extremely uneven.

From a pluviometric point of view, the five years analyzed were characterized differently, the first being considered normal, having a deviation from the multiannual average of 3%. The other four years analyzed were characterized as dry and very dry, with the deviations recorded being between 21 % (2018 – 2019) and 52 % (2021 – 2022) (Fig. 2).

From a pluviometric point of view, spring, during the analyzed period, was characterized as being very dry, recording an average deviation of 35 % compared to the multiannual average. March and May were characterized as drought, with deviations from the multiannual average of 26 - 27 %, and April it was very dry, with the deviation reaching 51 % (Fig. 2). The low amounts of rainfall registered in the spring months caused difficulties in the soil preparation and led to an uneven emergence of spring crops, and also negatively influenced the development of autumn crops.

The last five summers (2018 - 2022) were characterized as dry, registering an average deviation compared to the multiannual

average of 22 %. While June was characterized as normal from a pluviometric point of view (5 % deviation), July and August were excessively dry with deviations between 25 % and 44 % (Fig. 2).
Autumn, was characterized as dry, with the average deviation of 30 % from normal. September and October were characterized as dry, with deviations between 22 % and 30 %, and November was very dry with an average deviation of 39 % (Fig. 2).
The winter between 2017 to 2022 was characterized as being less dry, the deviation being 20 %. December was normal from a pluviometric point of view (2 % deviation), January was excessively dry (49 % deviation), and February was less dry (19 %) (Fig. 2).

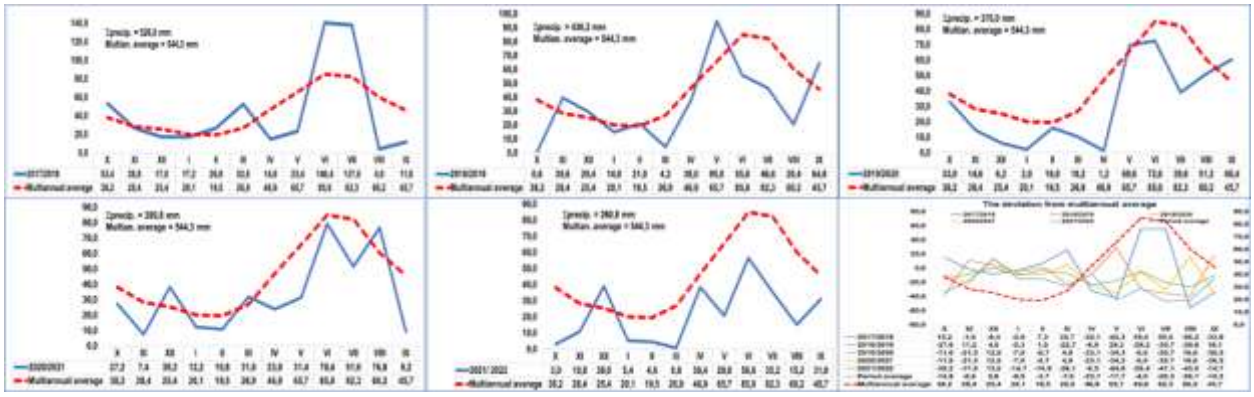

Fig. 2. Rainfall at A.R.D.S. Secuieni in the period 2017 – 2022 and their deviation from the multiyear average (1962 – 2022)
Source: Own design.

During the experiment, the technology specific to the area was respected [15], and the data obtained were processed and statistically interpreted according to the variance analysis method, and the yield stability was valued based on the coefficient of variation [9], using Microsoft Excel and ANOVA 2013 programs.

RESULTS AND DISCUSSIONS

- In winter barley, the variability of yield according to climatic conditions was extremely high, the amplitude of yield/variety being between 2,332 kg · ha^{-1} (Andreea) and 3,148 kg · ha^{-1} (Univers). The most favorable year for barley was 2022, when the average yield was 7,591 kg · ha^{-1}, in this year the yield variation was smaller and was between 7,352 kg · ha^{-1} (Dana) and 7,814 kg · ha^{-1} (Univers). 2021 also offered favorable conditions for the growth and development of barley, a year in which an average yield of 7,003 kg · ha^{-1} was achieved, the yield variation being this year between 6,493 kg · ha^{-1} (Univers) and 7,312 kg · ha^{-1} (Andreea). The climatic conditions of the years 2019 and 2020 were extremely unfavorable to barley, with the average yield obtained in these years being only 5,155 kg · ha^{-1} and 5,244 kg · ha^{-1}, respectively (Table 1).
On average, over the five years of experimentation, the yield was between 6,063 kg · ha^{-1} (Dana) and 6,820 kg · ha^{-1} (Cardinal). Compared to the control, the average experience (6,340 kg · ha^{-1}), the Cardinal variety achieved a very significant increase in yield, while the Andreea variety achieved a significant negative yield difference (Table 2).

Table 1. Yields at winter barley in the pedoclimatic conditions from A.R.D.S. Secuieni, during 2018 - 2022 period

Variety/ Year	Yield (kg · ha^{-1})				Average (kg·ha^{-1})
	Dana	Cardinal	Univers	Andreea	
2018	5,874	8,212	7,414	5,323	6,706
2019	5,684	5,100	4,666	5,169	5,155
2020	4,356	6,045	5,481	5,095	5,244
2021	7,244	6,964	6,493	7,312	7,003
2022	7,352	7,781	7,814	7,417	7,591
Average	6,102	6,820	6,374	6,063	6,340
Amplitude (kg · ha^{-1})	2,996	3,112	3,148	2,322	2,895

Source: Own calculation.

Regarding the adaptability of the varieties to the area conditions, we can say that all four

varieties show good adaptability, the coefficients of variation being between 10 and 20 %.

Table 2. The average yields obtained for winter barley and the yield variability in the pedoclimatic conditions from A.R.D.S. Secuieni, 2018 - 2022 average

Variety	Average yield (kg · ha^{-1})		Difference from the control	Significance	VC (%)
	kg/ha	%			
Dana	6,102	96	-238		18.2
Cardinal	6,820	108	480	***	16.6
Univers	6,374	101	34		18.4
Andreea	6,063	96	-277	o	17.6
Average	6,340	100	Control		17.7
LSD 5 % (kg · ha^{-1}) LSD 1 % (kg · ha^{-1}) LSD 0.1 % (kg · ha^{-1})			263 379 466		

Source: Own calculation.

Among these varieties, the highest yield stability was presented by the Cardinal variety (16.6 %), which also achieved the highest average grain yield (Table 2). From an economic point of view, winter cereals are productive species and involve average expenses for cultivation. The results obtained during the analyzed period show us that winter barley is a profitable crop, even in adverse environmental conditions. Although, in calculating the economic efficiency, we did not take into account the subsidy received per hectare, it can be seen from Table 3 that the net profit was positive, its values being influenced by the cultivated variety. It stands out with a net profit of 2,088 lei · ha^{-1}, the variant sown with the Cardinal variety.

Table 3. Economic efficiency of winter barley yield results, 2018 – 2022

Variety	Yield (kg·ha^{-1})	Production value (lei · ha^{-1})	Total expenses (lei · ha^{-1})	Production cost (lei · kg^{-1})	Gross profit (lei · ha^{-1})	Net profit (lei · ha^{-1})
Dana	6,102	4,882	2,970	0.49	1,912	1,606
Cardinal	6,820	5,456	2,970	0.44	2,486	2,088
Univers	6,374	5,099	2,970	0.47	2,129	1,789
Andreea	6,063	4,850	2,970	0.49	1,880	1,580
Average	6,340	5,072	2,970	0.47	2,102	1,766
Sale price*: 0.8 lei · kg^{-1}						

**The average selling price of barley practiced at A.R.D.S. Secuieni in the period 2018 - 2022*
Source: Own calculation.

The yields obtained in winter wheat varied both according to the cultivated variety and according to the climatic conditions which were extremely variable from one year to another. The yield range was between 2,391 kg · ha^{-1} (Pitar) and 4,341 kg · ha^{-1} (Glosa).

Table 4. Yields at winter wheat in pedoclimatic conditions from A.R.D.S. Secuieni, during 2018 – 2022 period

Variety/Year	Yield (kg · ha^{-1})				Average (kg·ha^{-1})
	Glosa	Miranda	Pitar	Otilia	
2018	9,688	7,296	7,361	7,774	8,030
2019	7,215	5,916	6,809	6,937	6,719
2020	5,347	5,958	5,780	6,375	5,865
2021	8,714	8,376	7,373	7,973	8,109
2022	8,330	7,851	8,171	9,016	8,342
Average	7,859	7,079	7,099	7,615	7,413
Amplitude (kg · ha^{-1})	4,341	2,418	2,391	2,641	2,948

Source: Own calculation.

Although the climatic conditions of the analyzed years were less favorable to the growth and development of winter wheat, the average yields achieved were higher than 7 to · ha^{-1}.

The most favorable year for winter wheat was 2022, when the average yield was 8,342 kg · ha^{-1}, the variation of yield being between 7,851 kg · ha^{-1} (Miranda) and 9,016 kg · ha^{-1} (Otilia) (Table 4).

The average of winter wheat yields obtained between 2018 and 2022 ranged from 7,079 kg · ha^{-1} (Miranda) to 7,859 kg · ha^{-1} (Glosa).

Compared to the average yield of the experience (Control), the variant sown with the Glosa variety obtained a distinctly significant increase in yield, but the variants sown with the Miranda and Pitar varieties showed significant negative production differences.

The coefficients of variation were between 10 and 20 %, which indicates the good adaptability of these varieties to the conditions of the area. The variants sown with the Pitar

and Otilia varieties (11.1 % and 11.9 %) stand out with the highest yield stability (Table 5).

From an economic point of view, winter wheat manages to be a profitable crop even in less favorable climates.

The calculated net profit was positive for all tested variants, its values being influenced by the cultivated variety.

It stands out with a net profit of 4,103 lei · ha^{-1}, the variant sown with the Glosa variety (Table 6).

Table 5. The average yields obtained at winter wheat and the yield variability in the pedoclimatic conditions from A.R.D.S. Secuieni, 2018 - 2022 average

Variety	Average yield (kg · ha^{-1})		Difference from the control	Semnification	VC (%)
	kg · ha^{-1}	%			
Glosa	7,859	106	446	**	18.9
Miranda	7,079	95	-334	o	14.0
Pitar	7,099	96	-314	o	11.1
Otilia	7,615	103	202		11.9
Average	7,413	100	Control		14.0
LSD 5 % (kg · ha^{-1}) LSD 1 % (kg · ha^{-1}) LSD 0.1 % (kg · ha^{-1})			298 429 510		

Source: Own calculation.

Table 6. Economic efficiency of winter wheat yield results, 2018 – 2022

Variety	Yield (kg·ha^{-1})	Production value (lei · ha^{-1})	Total expenses (lei · ha^{-1})	Production cost (lei · kg^{-1})	Gross profit (lei · ha^{-1})	Net profit (lei · ha^{-1})
Glosa	7,859	7,073	2,970	0.38	4,103	3,447
Miranda	7,079	6,371	2,970	0.42	3,401	2,857
Pitar	7,099	6,389	2,970	0.42	3,419	2,872
Otilia	7,615	6,854	2,970	0.39	3,884	3,262
Average	7,413	6,672	2,970	0.40	3,702	3,109
Sale price*: 0.9 lei · kg^{-1}						

**The average selling price of winter wheat practiced at A.R.D.S. Secuieni in the period 2018 - 2022*
Source: Own calculation.

At triticale, the average annual yields were lower than winter wheat and winter barley, with favorable conditions for the crop, only the 2017-2018 year being noted, when the average yield was 7,606 kg · ha^{-1} (Table 7).

Table 7. Yields at triticale in the pedoclimatic conditions from A.R.D.S. Secuieni, during 2018 - 2022 period

Variety/ Year	Yield (kg · ha^{-1})				Average (kg · ha^{-1})
	Plai	Haiduc	Tulnic	Utifun	
2018	6,507	7,163	8,291	8,464	7,606
2019	5,704	6,470	6,520	6,250	6,236
2020	4,961	8,682	6,754	4,679	6,269
2021	4,770	3,956	4,273	5,818	4,704
2022	5,488	4,948	6,657	6,552	5,911
Average	5,486	6,244	6,499	6,353	6,145
Amplitude (kg · ha^{-1})	1,737	4,726	4,018	3,785	3,567

Source: Own calculation.

The 2020 – 2021 year had the worst conditions for the growth and development of triticale, the average yield in this year being only 4,704 kg · ha^{-1}. The lowest amplitude of yield was observed at Plai variety, with a value of 1,737 kg · ha^{-1}, while in the Haiduc variety it reached up to 4,726 kg · ha^{-1} (Table 7).

The average yields of triticale obtained between 2018 and 2022 varied depending on the cultivated variety, and were between 5,486 kg · ha^{-1} (Plai) and 6,499 kg · ha^{-1} (Tulnic).

In the variant sown with the Tunic variety, a significant increase was achieved compared to the average experience, and in the variant sown with the Plai variety, a very significant negative yield difference.

Table 8. The average yields obtained at triticale and the yield variability in the pedoclimatic conditions from A.R.D.S. Secuieni, 2018 - 2022 average

Variety	Average yield (kg · ha^{-1})		Difference from the control	Sign.	VC (%)
	kg · ha^{-1}	%			
Plai	5,486	89	-659	ooo	11.2
Haiduc	6,244	102	99		26.6
Tulnic	6,499	106	354	*	19.8
Utrifun	6,353	103	208		19.4
Average	6,145	100	Control		19.3
LSD 5 % (kg · ha^{-1}) LSD 1 % (kg · ha^{-1}) LSD 0.1 % (kg · ha^{-1})			310 442 558		

Source: Own calculation.

With the exception of the Haiduc variety, all the tested varieties stood out for their good stability in the conditions of the area (Table 8).

The Plai variety showed the best stability at the conditions of the area, with the coefficient of variation having value of 11.2% (Table 8).

The climatic conditions of the last five years have negatively influenced the triticale crop, with yields decreasing greatly. However, from an economic point of view, triticale manages to be a profitable crop and under these conditions, the net profit calculated for this crop was positive for all the tested variants, its values being influenced by the cultivated variety. It stands out with net profits between 1,701 lei · ha^{-1} and 1,873 lei · ha^{-1}, the variants sown with the varieties Haiduc, Tulnic and Utrifun (Table 9).

Table 9. Economic efficiency of triticale yield results, 2018 – 2022

Variety	Yield (kg·ha^{-1})	Production value (lei · ha^{-1})	Total expenses (lei · ha^{-1})	Production cost (lei · kg^{-1})	Gross profit (lei · ha^{-1})	Net profit (lei · ha^{-1})
Plai	5,486	4,389	2,970	0.54	1,419	1,192
Haiduc	6,244	4,995	2,970	0.48	2,025	1,701
Tulnic	6,499	5,199	2,970	0.46	2,229	1,873
Utrifun	6,353	5,082	2,970	0.47	2,112	1,774
Average	6,145	4,916	2,970	0.48	1,946	1,635
Sale price*: 0.8 lei · kg^{-1}						

**The average selling price of triticale practiced at A.R.D.S. Secuieni in the period 2018 - 2022*
Source: Own calculation.

Making a comparison between the three species, we can make a ranking according to the obtained yields as follows: on first place is winter wheat with an average yield of 7,413 kg· ha^{-1}, on the second place is winter barley with an average yield of 6,340 kg·ha^{-1}, and on last place triticale, with an average yield of 6,145 kg·ha^{-1}. The same was observed in terms of yield stability, which was 14 % at winter wheat, 17.7 % at winter barley and 19.3 % at triticale (Table 10).

Table 10. Average yields obtained for winter cereals, yield variability and the net profit obtained in pedoclimatic conditions from A.R.D.S. Secuieni, average 2018 – 2022

Variety	Average yield		VC (%)	Net profit (lei · ha^{-1})
	kg · ha^{-1}	%		
Barley	6,340	96	17.7	1,766
Wheat	7,413	112	14.0	3,109
Triticale	6,145	93	19.3	1,635
Average	6,633	100	17.0	2,170

Source: Own calculation.

From an economic point of view, winter wheat ranks first, with a net profit of approximately double compared to the other two cereals. The net profit was 3,109 lei · ha^{-1} for winter wheat, 1,766 lei · ha^{-1} for winter barley and 1,635 lei · ha^{-1} for triticale (Table 10).

CONCLUSIONS

The climatic conditions of the 2020 – 2021 and 2021 – 2022 years were favorable for winter barley cultivation, with the average yields obtained being 7,352 kg · ha^{-1} and 7,591 kg · ha^{-1}, respectively. The climatic conditions of the 2019 and 2020 years were extremely unfavorable to winter barley, the average yield obtained in these years being only 5,155 kg · ha^{-1} and 5,244 kg · ha^{-1}, respectively. On average over the five years of experimentation, yield was between 6,063 kg · ha^{-1} (Dana) and 6,820 kg · ha^{-1} (Cardinal). Regarding the adaptability of the varieties to the conditions of the area, we can say that all four varieties show good adaptability, the coefficients of variation being between 10 and 20 %. With a net profit of 2,088 lei · ha^{-1}, the variant sown with the Cardinal variety stood out.

Although the climatic conditions of the agricultural years analyzed were less favorable for the growth and development of winter wheat, the average yields achieved

were higher than 7 to · ha^{-1}, in all the years of experimentation. The most favorable year for winter wheat was 2022, when the average yield was 8,342 kg · ha^{-1}. The average at winter wheat yields obtained between 2018 and 2022 ranged from 7,079 kg · ha^{-1} (Miranda) to 7,859 kg · ha^{-1} (Glosa). The coefficients of variation were between 10 and 20 %, which indicates the good adaptability of the tested varieties to the conditions of the area. At winter wheat, the variant sown with the Glosa variety stood out with a net profit of 4,103 lei · ha^{-1}.

At triticale, the average annual yields were lower than in winter wheat and barley, with favorable conditions for the culture, only the 2017 - 2018 agricultural year was notable, when the average yield was 7,606 kg · ha^{-1}. The agricultural year 2020 - 2021 had the worst conditions for the growth and development of triticale, the average yield this year being only 4,704 kg · ha^{-1}. The average yields of triticale obtained between 2018 and 2022 varied depending on the cultivated variety, between 5,486 kg · ha^{-1} (Plai) and 6,499 kg · ha^{-1} (Tulnic). With the exception of the Haiduc variety, all the tested varieties stood out for their good stability in the conditions of the area. The variants sown with the Haiduc, Tulnic and Utrifun varieties stand out with net profits between 1,701 lei · ha^{-1} and 1,873 lei · ha^{-1}.

Making a comparison between the three species, we can make a ranking according to the yields obtained as follows: on first place is winter wheat with an average yield of 7,413 kg · ha^{-1}, on second place is winter barley with an average yield of 6,340 kg · ha^{-1}, and in last place is triticale, with an average yield of 6,145 kg · ha^{-1}. The same was observed in terms of yield stability, which was 14 % for winter wheat, 17.7 % for winter barley and 19.3 % for triticale.

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REFERENCES

[1]Berca, M., Robescu, V. O., Horoiaș, R., 2023, Management of winter cereal crops from sowing to flowering – scientific and economic considerations. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, vol. 23(2), 83 – 88.

[2]Calderini, D. F., Slafer, G. A., 1998, Changes in yield and yield stability in wheat during the 20th Century. Field Crop. Res. 57: 335 - 347.

[3]Constantin (Oprea), D. M., Ionac, N., Grigore, E., Lüftner, G. D., Ilea, R. G., 2023, The variability and influence of precipitation on the winter wheat in the Extra-Carpathian area of the Meridional and Curvature Carpathians (Romania). Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 23(2), 181 – 186.

[4]Del Pozo, A., Matus, I., Serret, M. D., Araus, J. L., 2014, Agronomic and physiological traits associated with breeding advances of wheat under high - productive Mediterranean conditions. The case of Chile. Envirnomental Experimental Botany. 103: 180 - 189.

[5]Dunăreanu, I. C., Bonea, D., 2023, Evaluation and comparison of drought tolerance in some wheat varieties based on selection indices. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 23(2), 223 – 228.

[6]Engler, A., Del Pozo, A., 2013, Assessing long and short run trends in cereal yields: the case of Chile between 1929 - 2009. Ciencia e Investigación Agraria. 40: 397 - 410.

[7]Fischer, C., Gonzalez, M. A., Henchion, M., Leat, P., 2007, Trust and economic relationships in selected European agrifood chains. Acta Agriculturae Scandinavica, Section C - Food Economics, 4 (1), 40-48.

[8]Iorga, A. M., Stoicea, P., Dobre, C., Soare, E., Chiurciu, I., 2023, Study on the perception of romanian farmers regarding the factors that influence the development of agriculture. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 23(2), 315 – 324.

[9]Jităreanu, G., 1994, Experimental technique. Lithograph course - Ion Ionescu Agronomic University from Brad Iași, Faculty of Agriculture, pp. 167.

[10]Leonte, A., Agapie, A., Pintilie, P.L., Druțu, A.C., Amarghioalei, G., Eșanu, S., 2021, Research regarding the influence of nitrogen and phosphorus fertilizers on winter wheat, in the pedoclimatic conditions in Central of Moldavia. Journal Life Science and Sustainable Development Lovrin, 2(2), 52-57.

[11]Leş, M., Oproiu, E., 1987, The behavior of some winter wheat varieties under the conditions of Secuieni. 25 years of scientific activity, tribute volume S.C.A.

Secuieni. Agronomic Research in Moldova, Vol. XX, No. 1 (77), 43 - 46.
[12]Lipianu, S., Zală, C. R., Istrate, R., Ciontu, C., 2023, Research on winter wheat, corn and sunflower crops protection in Ilfov county respecting national legislation. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 23(2), 371 – 378.
[13]Lobell, D., Burke, M., Tebaldi, C., Mastrandrea, M., Falcon, W. P., Naylor, R. L., 2008, Priorizing climate change adaptation needs for food security in 2030. Science 319, 607 - 610.
[14]Lobell, D., Gourdji, S. M., 2012, The influence of climate change on global crop productivity. Plant Physiol. 160, 1686 - 1697.
[15]Trotuș, E., Mîrzan, O., Naie, M., Leonte, A., Buburuz, A. A., Isticioaia, S. F., Popa, L. D., Lupu, C., Pintilie, P. L., Pleșcan, I., 2020, Technologies for cultivation of some field crops for the Central area of Moldova (Tehnologii de cultivare a unor plante de câmp pentru zona Centrală a Moldovei). « Ion Ionescu de la Brad » Publishing House, Iasi, pp. 23 – 53.