

WHERE ARE THE FOREIGN WHEAT CULTIVARS IN COMPETITION WITH THE ROMANIAN CULTIVARS? -EXPERIMENTS ON THE CHERNOZEM FROM CARACAL IN THE PERIOD 2019-2021

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ABSTRACT

In the period 2019-2021, 131 cultivars of winter wheat were tested on the chernozem from Caracal in a network of within- and between-annual experiments (1-12 experiments located in 1-3 years). The study was performed only on the cultivars tested in at least 3 experiments (77 cultivars), grouped in 7 categories: Romanian cultivars (17), SYNGENTA cultivars (10), LIDEA cultivars (14), LG cultivars (7), AXERREAL cultivars (7), KWS cultivars (6), cultivars of various origins (16).

Forty- four of the cultivars were tested in each of the 3 years studied, the average yields being between 10599 kg / ha for the Anapurna cultivar and 6793 kg / ha for the Bezostaia cultivar. In the top 15 were the Romanian cultivars Biharia (9843 kg / ha), Miranda (9701 kg / ha) and Abundent (9630 kg / ha).

INTRODUCTION

Wheat was one of the first plants to be cultivated and for 8,000 years was the main food of the great civilisations of Europe, West Asia and North Africa. This is probably due to wheat's good agronomic adaptability, its ease of storage and its processing into flour for making many different foods.

In Romania, wheat is one of the most important crops, ranking second in terms of cultivated area among field crops, with production increasing every year.

In 2018, Romanian agriculture ranked third in the EU, after France and Germany, in cereal production (31.9 million tonnes).

Romania ranked 4th in the EU with 10.3 million tonnes of wheat production.

Continuous diversification of the assortment of wheat varieties is one of the most effective measures to increase and stabilise harvests of this crop of particular importance for Romanian agriculture.

Climate change in recent years, with extreme weather events, has had a negative influence on the production of cereal crops, including wheat, with large fluctuations from one year to the next (Mustățea et al., 2008).

Along with climate impact a range of regional and global political and economic factors intensify food insecurity and long term vulnerability in certain regions (Paraschivu et al., 2017, 2019).

Prolonged lack of rainfall during the growing season, high temperatures and/or their coincidence with water deficit during the plant's main phenophases (flower initiation, number of grains in the wheat stalk, anthesis, time of grain formation and filling, etc.) can lead to a substantial reduction in grains' production (Racz et al., 2016).

All over the world, multi-annual studies have been carried out on the adaptability and stability of wheat varieties. In general, the relatively small yields of wheat can be explained by the negative influence of the lower water supply of the soil in the unfavorable years and the high number of weeds in the case of monoculture and 2-year rotation (Partal and Paraschivu, 2020).

Knowing how new varieties react to environmental conditions is important for the most judicious zoning of the territory and for specifying the place it should occupy in the variety structure for each area. The stability of production is given by the sum of the variety's resistance to unfavourable environmental conditions (Săulescu, 1984, 1995).

Cultivation of wheat varieties with a wide adaptability to environmental and technological conditions can reduce the risks of yield decline in unfavourable years (Voica et al. 2018).

Wheat varieties with a high production capacity must have a good resistance to the main risk factors of the Romanian climate, good tolerance to the main foliar diseases and allow the crop to grow in optimal parameters, and to obtain higher yields in terms of quantity and quality, characteristic of the variety.

The wheat variety sown in the field must adapt as well as possible to climatic conditions (withstand drought and frost) and to

the soil on which it is grown, acclimatising even on soils with low fertility, so that the quality and yield obtained are as high as possible. The choice of these wheat varieties must take all these factors into account.

Wheat cultivation in Romania in recent years has succeeded in bringing farmers increasing profits, with yields above 10 t/ha, averaging 8-9 t/ha. Wheat varieties, cultivation technology, grain fertilisation, timely treatments and the amount of rainfall are the factors on which the wheat harvest depends each year.

In general, when choosing a wheat variety, farmers should be guided by the one best suited to the conditions of their farms, and this may be a Romanian variety or a foreign variety bred for similar soil and climate conditions in another country. Farmers opt mainly for Romanian wheat varieties such as Glosa, Otilia or Izvor, but also for varieties from the portfolio of foreign producers. However, the recommendation of the producer regarding the area of cultivation is very important.

In recent years, during the testing period, the influence of climatic changes on the production results and physiological insemination of candidate varieties has been monitored in order to promote varieties with high adaptability to the existing environmental conditions.

Wheat varieties are grown on most areas in Romania, although wheat hybrids have appeared on the market in recent years.

The official catalogue of crop varieties in Romania for 2021 includes 101 varieties of *Triticum aestivum* L. subsp. *aestivum*, of which 29 are radiated (Catalog ISTIS, 2021).

The varieties developed by the National Institute for Agricultural Research and Development Fundulea hold the supremacy in terms of the share of wheat cultivated in Romania. Every year, varieties created at Fundulea occupy between 52 and 66% of the total area grown with wheat. The most widespread variety is Glosa, as it occupies between 30 and 35% of the cultivated area. It is also recorded in Hungary and Turkey precisely because of its very high ecological plasticity. It has a high production potential and at the same time a very good baking quality, manifested by a higher protein content and a stronger and more elastic gluten compared to other varieties found on the market. A recently registered variety is Pitar, an expanding variety in Romanian agriculture due to its exceptional

baking quality. It has a very good protein content, as well as a very good protein quality. (www.zi-de-zi.ro).

MATERIAL AND METHOD

In the period 2019-2021, 131 cultivars of winter wheat were tested on the chernozem from Caracal in a network of within- and between-annual experiments (1-12 experiments located in 1-3 years). The study was performed only on the cultivars tested in at least 3 experiments (77 cultivars), grouped in 7 categories: Romanian cultivars (17) (table 1), LIDEA cultivars (14) (table 2), AXEREA cultivars (7) (table 3), KWS cultivars (6) (table 3), LG cultivars (7) (table 4), SYNGENTA cultivars (10) (table 5), cultivars of various origins (16) (table 6).

Table 1

Romanian autumn wheat varieties, tested in Caracal in 2019-2021, for at least 3 experiments

ROMANIAN VARIETIES			
1	ABUNDENT	10	IZVOR
2	ADELINA	11	MIRANDA
3	AMURG	12	OTILIA
4	ARMURA	13	PAJURA
5	BALTAG	14	SEMNAL
6	BIHARIA	15	SIMNIC60
7	BOGDANA	16	URSITA
8	DACIC	17	VOINIC
9	GLOSA		

Table 2

Autumn wheat varieties from LIDEA, tested in Caracal in 2019-2021 for at least 3 experiments

VARIETIES LIDEA			
1	FLAVOR	8	SOLINDO
2	IZALCO	9	SOLVEIG
3	MONTECRISTO	10	SOMPTUOSO
4	PIBRAC (SY 113007)	11	SOPHIE
5	SOFRU	12	SORRIAL
6	SOLEHIO	13	SOSTHENE
7	SOLIFLOR	14	SOTHYS

Table 3

Autumn wheat varieties from AXEREAL and KWS companies, tested in Caracal during 2019-2021, for at least 3 experiments

VARIETIES AXEREAL		VARIETIES KWS	
1	BASILIO	1	FOXIL
2	COMPLICE	2	KWS ETERNAL
3	MUTIC	3	KWS SPHERE
4	OROLOGE	4	KWS ULTIM
5	ORTOLAN	5	KWS USUEL
6	PROVIDENCE	6	MODERN

Table 4

Autumn wheat varieties from LIMAGRAIN company, tested in Caracal during 2019-2021, for at least 3 experiments

VARIETIES LG	
1	AIRBUS
2	ALCANTARA
3	ANAPURNA
4	ANDINO
5	AVENUE
6	LG ABSALON
7	LG APILCO

Table 5

Autumn wheat varieties from SYNGENTA, tested in Caracal during 2019-2021, for at least 3 experiments

VARIETIES SYNGENTA			
1	BOLOGNA	6	MOISSON
2	FALLADO	7	SY EXALTATION
3	GABRIO	8	SY PASSION
4	HY Fi	9	SY ROCINANTE
5	INGENIO	10	SY STARLORD

Table 6

Autumn wheat varieties from other companies (Donau Saat, Saaten Union, Ciproma, RWA, TEA, etc.), tested in Caracal during 2019-2021, for at least 3 experiments

VARIETIES OF OTHER ORIGINS			
1	ACTIVUS	10	LENNOX
2	AMBURGO	11	MUSIK
3	AMICUS	12	OBIWAN
4	BEZOSTAIA	13	SILVERIO
5	EXOTIC	14	TARASCON

6	JOKER	15	TIKA-TAKA
7	KATARINA	16	LENNOX
8	KLIMA	17	TRUBLION
9	KORELI		

The comparison of the results was performed based on the t test where $t >$ or equal to the t critical leads to the determination of the significance of the differences.

Forty – four of the cultivars (14 Romanian and 30 foreign) were tested in each of the 3 years studied.

The experimental fields were $7m^2$ (7 m long and 1 m wide) and were sown in 3 trials during the experiments located on the Caracal chernozem. Drawing up the layout plans per sections allowed the tested varieties to occupy less land so that the influence of biotic and abiotic factors could be evened out.

The climatic conditions present during the three years of testing allowed high yields to be obtained, in 2020 even the highest since these experiments were carried out in Caracal.

RESULTS AND DISCUSSIONS

As shown in Tables 7, 8, 9, 10, 11 and 12, the T-test calculated for groups with different number values between the Romanian varieties and each of the other groups clearly showed that the yield increases or decreases determined are not significant. In other words, the foreign varieties are in no way more valuable from this point of view than the Romanian varieties on the Caracal chernozem.

Table 7

Productivity of LIDEA & Romanian varieties by the T-test

	Romanian varieties	LIDEA varieties
average prod (kg/ha)	9539	9510
nr.varieties	17	14
t calculated		0.106
t critical		1.699
t calculated < t critical		insignificant

Table 8

Productivity of SYNGENTA & Romanian varieties by the T-test

		Romanian varieties	SYNGENTA varieties
average prod (kg/ha)		9539	10238
nr.varieties		17	11
t calculated			0.184
t critical			1.706
t calculated < t critical			insignificant

Table 9

Productivity of AXEREAAL & Romanian varieties by the T-test

		Romanian varieties	AXEREAAL varieties
average prod (kg/ha)		9539	10469
nr.varieties		17	6
t calculated			0.382
t critical			1.714
t calculated < t critical			insignificant

Table 10

Productivity of KWS & Romanian varieties by the T-test

		Romanian varieties	KWS varieties
average prod (kg/ha)		9539	9724
nr.varieties		17	6
t calculated			0.094
t critical			1.714
t calculated < t critical			insignificant

Table 11

Productivity of LIMAGRAIN & Romanian varieties by the T-test

		Romanian varieties	LIMAGRAIN varieties
average prod (kg/ha)		9539	10468
nr.varieties		17	7
t calculated			0.360
t critical			1.714
t calculated < t critical			insignificant

Table 12

Productivity of varieties of other origins & Romanian varieties by the T-test

		Romanian varieties		Other origins varieties	
average prod (kg/ha)		9539		9146	
nr.varieties		17		16	
t calculated			0.059		
t critical			1.696		
t calculated < t critical			insignificant		

The same aspect was also noted when the Romanian and foreign varieties that were tested in each of the 3 years of testing were evaluated (Table 13).

Table 13

Productivity of Romanian varieties & Foreign varieties tested for 3 years by the T-test

		Romanian varieties		Foreign varieties	
average prod (kg/ha)		9241		9263	
nr.varieties		14		30	
t calculated	0.083				
t critical			1.684		
t calculated < t critical			insignificant		

Three Romanian varieties were placed in the category of maximum average yields: Biharia (SCDA Lovrin creation), Miranda and Abundent (both INCDA Fundulea creations). The most productive variety, on average over 3 years, was Anapurna. In the top 5 is also Avenue, the most cultivated foreign variety in the area. Three of the top five varieties come from Limagrain, a company, which as we saw earlier, had an average of 10468 kg/ha but was insignificant compared to Romanian varieties.

Table 14

Average maximum and minimum yields of autumn wheat varieties tested in 2019-2021 on the Caracal chernozem

Production category	No.	Varieties	Production Kg/ha
Maximum average yields	1	ANAPURNA	10599
	2	LG APILCO	10539
	3	SOLEHIO	10335
	4	AVENUE	10298
	5	RUBISKO	10258
	6	HY Fi	10216
	7	AIRBUS	10033
	8	EXOTIC	9850
	9	SILVERIO	9847
	10	BIHARIA	9843
	11	PIBRAC	9789
	12	MIRANDA	9701
	13	KLIMA	9689
	14	FLAVOR	9663
	15	ABUNDENT	9630
Minimum average yields	1	IZALCO	8308
	2	TIKA-TAKA	8220
	3	TRUBLION	8165
	4	SOPHIE	8146
	5	JOKER	7498
	6	BEZOSTAIA	6793

The highest yields were recorded in 2020 for the varieties: Rocinante (13843 kg / ha), Complice (13661 kg / ha), Solindo (13391 kg / ha), Obiwan (13339 kg / ha), Armura (13274 kg / ha), Sothys (13128 kg / ha), LG Apilco (13072 kg / ha). Along with the Romanian cultivar Armura, Abundent also stood out, which in 2020, in 2 experiments, recorded yields of 12977 kg / ha and 12245 kg / ha. The lowest yields were recorded by the cultivars Katarina (5801 kg / ha in 2021) and Izalco (5972 kg / ha in 2019).

Among the varieties tested, a few were highlighted (Table 15) where the lowest yields were above 8000 kg/ha).

Table 15

VARIETIES WITH YIELDS OVER 8000 KG/HA (AT LEAST 5 TESTS)

No.	Variety	Lowest production (kg/ha)	Number of tests
1	AVENUE	8380	6
2	FALADO	8191	6
3	MIRANDA	8256	6
4	MONTECRISTO	8762	5
5	SOLEHIO	8457	5
6	SOLINDO	8434	5

According to the number of tests, the average maximum and minimum yields were presented in Table 16. It can be seen that Romanian varieties with a higher number of tests have lower average yields. It is expected that foreign varieties, as they are tested for more years and have less favourable climatic conditions, will also show a decrease in these maximum yields. It can also be observed that there are foreign varieties (Bezostaia and Katarina) which despite having benefited from very good climatic conditions and fertile soil have obtained very low yields.

Table 16

Maximum and minimum average yields according to the number of tests

No.tests	Maximum average yields		Minimum average yields	
11 TESTE	GLOSA	8834	-	-
9 TESTE	URSITA	9436	VOINIC	8755
8 TESTE	IZALCO	8514	-	-
7 TESTE	ANAPURNA	10941	OTILIA	8395
6 TESTE	AVENUE	10682	IZVOR	8623
5 TESTE	SOLEHIO	10498	SOPHIE	8506
4 TESTE	GABRIO	10553	BEZOSTAIA	6981
3 TESTE	SY PASSION	11652	KATARINA	6588

The coefficient of variability of the yields obtained shows that most varieties were in the 10-20% class, which indicates their average stability (Figure 1). Stable varieties (coefficient of variability below 10%) are few and unstable varieties (coefficient of variability above 20%) are almost double in number but they are also few

compared to the total varieties tested. The correlation coefficient between the coefficient of variability of yields and the number of tests shows that the two are strongly correlated in the sense that a high number of tests leads to high variability. Therefore, Romanian varieties that have been tested much more have lower stability compared to some foreign varieties that entered the assortment more recently.

The correlation between production and hectolitre mass revealed that the two are not correlated (Figure 2). The coefficient of determination of only 1.8% shows that the two variables are practically not dependent on each other. However, with the help of the graphical representation we can identify the varieties that showed both high yield and high hectolitre mass above the uptake limit of 76 kg/hl : Epilog, Andino and SY Exception.

The test weight recorded values between 64.2 kg / ha for the Atuan cultivar and 80.3 kg / ha for the Cellule cultivar.

More than half of the varieties tested are in the 74-76 kg/hl and over 76 kg/hl classes. However, only 35% of them are above the uptake limit - 76 kg/hl (Figure 3).

Weighting the wheat varieties according to their origin and MH values showed that 76% of the Romanian varieties are in the 76-80 kg/hl range while only 17% of the foreign varieties are in this range. None of the Romanian varieties are found below 72 kg/hl.

CONCLUSIONS

Although there are differences between the yields of Romanian and foreign varieties, the t-test showed us that they are not significant for any of the groups tested.

On average over 3 years, average yields were practically equal (9241 kg/ha for Romanian varieties versus 9263 kg/ha for foreign varieties) and the t-test was also insignificant.

Biharia (created by SCDA Lovrin), Miranda and Abundent (both created by INCDA Fundulea) were the most productive Romanian varieties based on the average yields obtained on the Caracal cernoziom. Abundent, in 2020, in 2 experiments, recorded yields of 12977 kg/ha and 12245 kg/ha..

The most productive variety on average over 3 years was Anapurna. In the top 5 there is Avenue, the most cultivated foreign variety in the area. The lowest yields were recorded by the varieties Katarina (5801 kg/ha in 2021) and Izalco (5972 kg/ha in 2019).

The correlation between yield and hectolitre mass revealed that the two are not correlated. However, varieties were identified that showed both high yield and high hectolitre mass, above the uptake limit of 76 kg/hl : Epilog, Andino and SY Exception.

A weighting of wheat varieties according to origin and MH values showed that 76% of Romanian varieties fall in the 76-80 kg/hl range while only 17% of foreign varieties fall in this range. None of the Romanian varieties are found below 72 kg/hl.

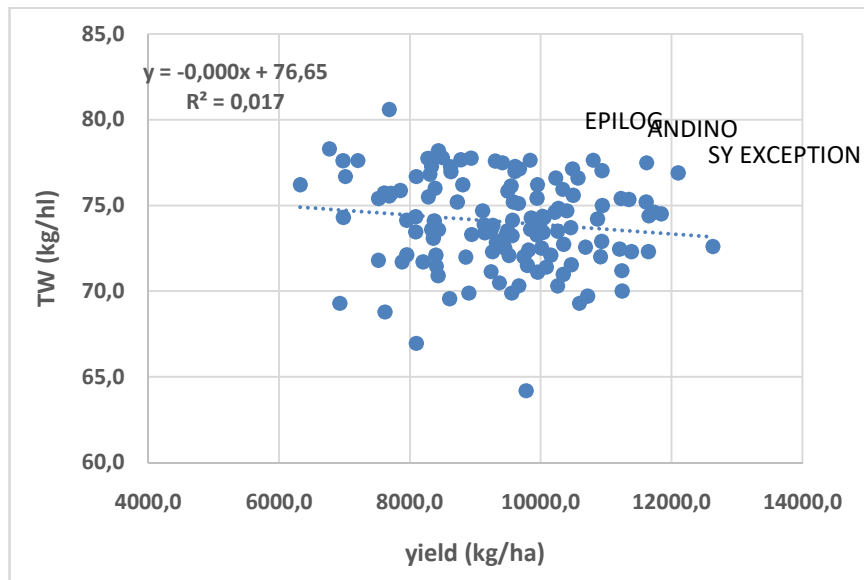


Figura 2. Yield to hectoliter mass ratio of wheat varieties tested on the Caracal chernozem

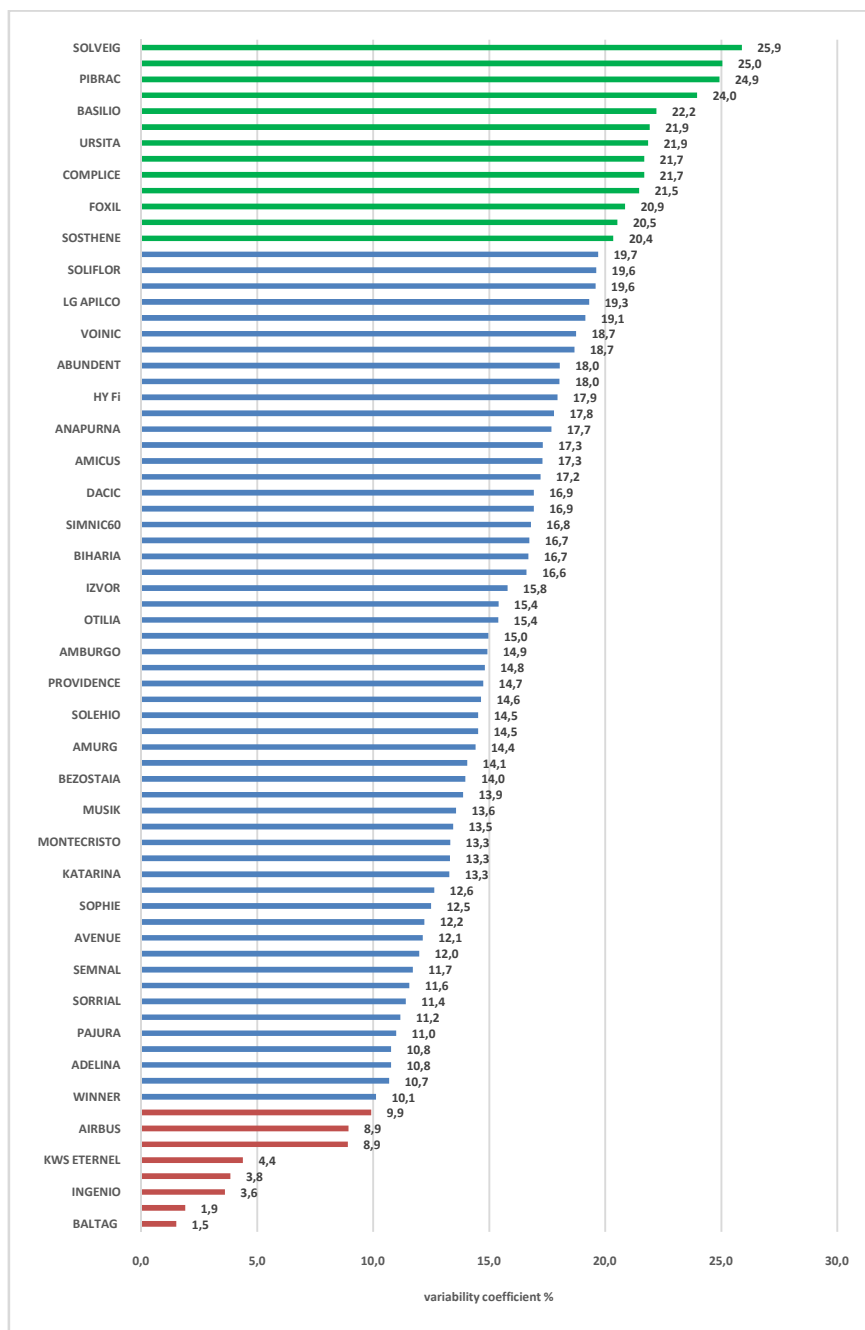


Fig.1 Coefficient of variability for the varieties tested on the Caracal chernozem



Fig.3 Percentage distribution in hectoliter mass classes of the varieties tested on the Caracal chernozem

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