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RESEARCH ON PRODUCTIVITY INDICES IN SOME DEMONSTRATION BATCHES OF AUTUMN WHEAT, AT SCDA BRAILA, IN THE LAST TWO AGRICULTURAL YEARS

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Abstract

At SCDA Braila, demonstration batches of autumn wheat are organized every year, with Romanian and foreign varieties, to formulate recommendations on cultivation technologies and the choice of the best performing varieties for farmers. This paper presents the productivity elements of 25 varieties of autumn wheat cultivated in the pedoclimatic conditions of the Braila Plain, in the last two agricultural years. A classification was made regarding the productivity of the 25 wheat varieties tested in the last agricultural years and recommendations were formulated for the farmers in this area. It is essential to explore solutions to reduce operational costs, diversify crops to have a market for the products obtained and invest in advanced technologies that can increase the efficiency and sustainability of agriculture.

Key words*: wheat, productivity, technology, climatic conditions, wheat varieties.*

INTRODUCTION

Wheat kernels are used primarily to produce flour, for the manufacture of bread, pasta, and pastries, but also as a raw material to produce starch, ethyl alcohol and bioethanol.
Wheat can also be used as animal feed, having a higher nutritional quality than corn.
After the industrialization of wheat grains by milling, the resulting bran can be used as concentrated feed, being extraordinarily rich in proteins and mineral salts.
The residual straw after wheat harvest represents a coarse feed, being rich in fiber, but can also be used in the manufacture of cellulose and as bedding for animals in livestock farms.
From an agronomic point of view, winter wheat is a good precursor for all species, being harvested early and leaving the land clean of weeds and the soil with an increased amount of organic matter.
In temperate zones, wheat has become the most important staple crop, with increasing demand in countries undergoing urbanization and industrialization.
Thus, wheat is considered a major source of starch and energy, but it also provides particularly important amounts for health, such as protein, vitamins, fiber, and other nutrients that can reduce cardiovascular disease, type 2 diabetes, and various forms of colorectal cancer (Shewry, 2015).
From a genetic point of view, winter wheat has a high heritability regarding the composition of beneficial elements in the caryopsis, so that plant breeders can choose to increase certain components in breeding programs, in addition to increased crop yield.
The wheat caryopses comprise three major groups of components, represented by starch, proteins, and cell wall polysaccharides (dietary fiber) and several other components beneficial to human health.
Detailed studies conducted on dietary fiber and other bioactive components in wheat grains, in 150 wheat varieties cultivated within the EU FP6 HEALTHGRAIN program, have demonstrated that the structure and chemical composition of wheat is clearly superior to other related species, such as barley, rye and oats, including transgenic species (Shewry, 2015).
Wheat is among the oldest and most extensively grown of all grain crops (Wrigley, 2009).

According to archaeological studies, wheat is believed to have been cultivated for more than 9,000 years, with its origins traced to southeastern Türkiye.
Its name was Einkorn (*T. monococcum*), and it is genetically described as a diploid with two sets of chromosomes (Feldman & Levy, 2023). At the same time, Emmer wheat (*Triticum dicoccum*) was also cultivated (Figure 1).

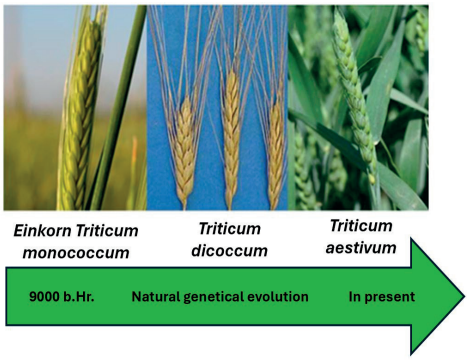

Figure 1. Wheat evolution (https://www.yara.hu/tapanyagellatas/oszi-buza/buza-tortenelmi-fejlodese/)

Winter wheat is one of the most demanding agricultural plants in terms of soil preparation. It can be said without reservation that the condition of the soil at sowing determines how the plants grow in autumn and their ability to easily get through the long winter period (Hassan et al., 2014).
The genetic evolution of wheat occurred through natural hybridization between the wild diploid species *Triticum urartu* (Wild Einkorn – *T. boeoticum*) and *Aegilops*, resulting in a new variety, a tetraploid, with four sets of chromosomes (Muhammad et al., 2023).
By cultivating this variety, farmers continued to select over the years from wheat crops that had better characteristics regarding yield and ease of harvesting.
They chose einkorn and common wheat, which were the results of natural hybridizations between Emmer wheat and the wild species *Aegilops tauschii*, which made the transition from a tetraploid to a hexaploid, which already contained six sets of chromosomes (42 chromosomes), and the yields were much higher than the original varieties, with 14 chromosomes (Mirzaghaderi, 2020).

Worldwide, wheat crops occupy 20% of the total cultivated area, according to current statistics. The latest USDA (US Department of Agriculture) report reported that the world wheat harvest in the 2023-2024 agricultural year was 789 million tons, being the most important cereal crop in the European Union and the most widespread food crop globally.
With high ecological plasticity, wheat is grown on all continents, between 45º South latitude and 66º North latitude, at an altitude from sea level to altitudes of over 3000 m.
According to recently updated statistics, the dynamics of wheat production at the level of the largest wheat producers, during the period 2016-2024 is highlighted in the Figure 2.

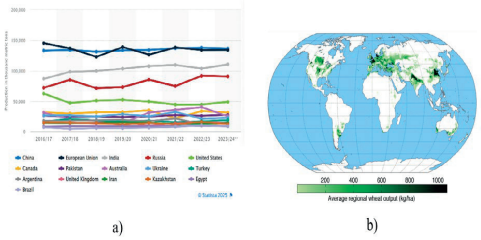

Figure 2. Wheat production (thousand tons) for the top ten producers, 2017-2024, according to Statista7, 2025 (a) and map of average global wheat production (b) (www.statista-com)

Shelterbelts have been used for centuries to improve microclimate and environmental conditions and increase crop yields (Cai, 2021).

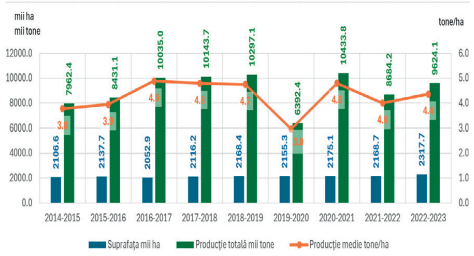

Figure 3. Graph regarding the dynamics of cultivated areas, total production and average wheat production obtained in Romania during the period 2014-2023

According to statistics carried out by the MADR Bucharest (Ministry of Agriculture and Rural Development of Romania), the Figure 3 represents the dynamics of wheat cultivated areas and the productions obtained in Romania, during the period 2014-2023, noting that the

highest average wheat production was 4.9 tons/ha in 2017, followed in descending order by 2018 and 2021 with 4.8 tons/ha, and 4.7 tons in 2019.
The lowest average production obtained was 3.0 tons/ha, in 2020, when the pedological drought was very extreme in most cultivated areas.

MATERIALS AND METHODS

Every agricultural year, at ARDS Braila, 25 wheat varieties and lines are tested in demonstration lots, along with other winter cereals, to choose the most performing genotypes adapted to the pedoclimatic conditions in interest and to provide recommendations for farmers.
The wheat varieties tested in the demonstration lots come from both Romanian and foreign germplasm, for comparison, in the classic technology of ARDS Braila.
During the two agricultural years 2022-2023 and 2023-2024, climate conditions were monitored throughout the winter wheat growing season, as well as field observations and biometric measurements, and at harvest, productivity indices were determined for all 25 varieties, compared to the average of the experience.
The experimental results were processed using the Anova test to determine the best performing wheat genotypes out of the 25 varieties tested in the two agricultural years.
Wheat varieties testing at SCDA Braila is carried out in comparative competition fields, to select the most performing genotypes in the plant breeding process.

RESULTS AND DISCUSSIONS

According to current statistics, in 2024, wheat was cultivated in Romania on an area of 2.18 million ha, and the average production per hectare was 4.99 t/ha (Figure 4).
The climatic data from the two agricultural years in which the tests took place are presented in Table 1 and Table 2.

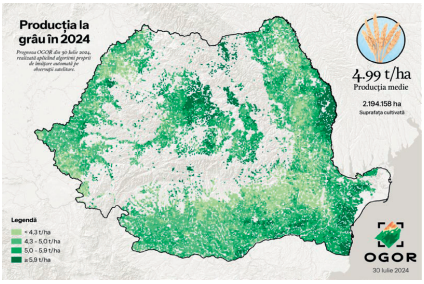

Figure 4. Map of wheat production in 2024 in different areas of Romania (www.ogor.ro)

Table 1. Climatic elements in agricultural year 2022-2023 at SCDA Braila

Climatic elements		2022				2023								TOTAL
		IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	Average
Precipitation (mm)	Month average	32	6	31	20	64	7	13	66	40	26	106	55.1	466.1
	Multiannual month average	32	30	33	36	28	27	26	35	48	62	46	39	442
	Deviation	0	-24	-2	-16	36	-20	-13	31	-8	-36	60	16.1	24.1
Temperature (°C)	Month average	17.9	13	8.1	2.9	4.4	1.4	7.9	10.4	16.6	21.6	24.7	24.7	12.8
	Multiannual month average	17.3	11.5	5.6	0.6	-2.1	-0.2	4.7	11.2	16.7	20.9	22.9	22.1	10.9
	Deviation	0.6	1.5	2.5	2.3	6.5	1.6	3.2	-0.8	-0.1	0.7	1.8	2.6	1.9

Table 2. Climatic elements in agricultural year 2023-2024 at SCDA Braila

Climatic elements		2023				2024								TOTAL
		IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	Average
Precipitation (mm)	Month average	4.5	3.4	124.0	22.87	15.9	0.3	40.4	26.1	35.0	47.3	33.2	17.2	370.1
	Multiannual month average	32	30	33	36	28	27	26	35	48	62	46	39	442
	Deviation	-27.5	-26.6	91.0	-13.1	-12.1	-26.7	14.4	-8.9	-13.0	-14.7	-12.8	-21.8	-71.9
Temperature (°C)	Month average	20.9	15.9	8.1	3.6	0.4	7.4	8.2	16.80	16.6	24.3	26.5	25.2	14.5
	Multiannual month average	17.3	11.5	5.6	0.6	-2.1	-0.2	4.7	11.2	16.7	20.9	22.9	22.1	10.9
	Deviation	3.6	4.4	2.5	3.0	2.5	7.6	3.5	5.6	-0.1	3.4	3.6	3.1	3.6

Compared to the agricultural year 2022-2023, when the deviation of the total recorded precipitation was + 24.1 mm compared to the multiannual, in the agricultural year 2023-2024 the precipitation deviation was -71.9 mm.
Regarding the average monthly temperatures recorded in the same analysed periods, deviations from the multiannual average of +1.9ºC were noted in the agricultural year 2022-2023 and +3.6ºC in the agricultural year 2023-2024.
In Figure 5 is represented an image with the experimental field from SCDA Braila.

Figure 5. Image from the experimental field with different genotypes of autumn cereals at SCDA Braila

Table 3 shows the production results of the 25 varieties tested in the agricultural year 2022-2023, and Figure 6 shows the production graph, compared to the average of the experiment.
The average o experience was 8439 kg/ha in 2023 and 9462 kg/ha in 2024, and these values represented the control for each experience.

Table 3. Production results and Anova test for the wheat varieties tested in year 2022-2023

Nr. crt.	Variants	Production kg/ha	Relative production %	Difference kg/ha	Difference signification
1	BIHARIA	10055	119	1616	***
2	Gabrio	9146	108	707	-
3	IZVOR	8984	106	545	-
4	URSITA	8958	106	519	-
5	PITAR	8941	106	502	-
6	FDL COLUMNA	8916	106	477	-
7	FDL ABUND	8744	104	305	-
8	ŞIMNIC S1412	8688	103	249	-
9	FDL EVIDENT	8620	102	181	-
10	VOINIC	8599	102	160	-
11	FDL DARNIC	8566	102	127	-
12	16286G3INC01	8529	101	90	-
13	FDL CONSECVENT	8494	101	55	-
14	OTILIA	8480	100	41	-
15	Average of experience	8439	100	0	Control
16	CARACAL 1	8368	99	-71	-
17	ŞIMNIC S1619	8336	99	-103	-
18	CARO	8269	98	-170	-
19	FDL EMISAR	8197	97	-242	-
20	DACIC	8135	96	-304	-
21	FDL ARMURA	8077	96	-362	-
22	GLOSA	7909	94	-530	-
23	FDL CONCURENT	7869	93	-570	-
24	MIRANDA	7842	93	-597	-
25	FDL AMURG	7617	90	-822	-
26	BEZOSTAIA	6629	79	-1810	○○○
	DL 5% = 872		DL 1% = 1182		DL 0,1% = 1583

The best results in demonstration plots of wheat varieties in agricultural year 2022-2023 were obtained by Biharia variety with +19% difference compared with control, and the lowest production result was obtained by the Bezostaia variety with a negative difference of -21% (Figure 6).

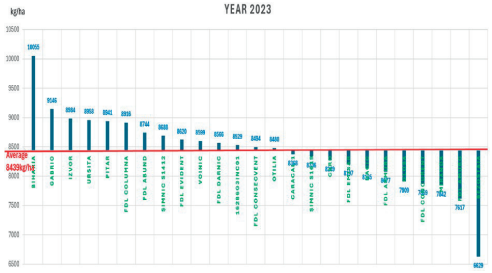

Figure 6. Production of wheat varieties tested in demonstration plots in year 2022-2023 at SCDA Braila

Table 4 shows the production results of the 25 varieties tested in the agricultural year 2023-2024, and Figure 7 shows the production graph, compared to the average of the experiment.

Table 4. Production results and Anova test for the wheat varieties tested in year 2023-2024

Nr. crt.	Variants	Production kg/ha	Relative production %	Difference kg/ha	Difference significance
1	FDL ABUND	10620	112	1158	***
2	ŞIMNIC S1412	10372	110	910	**
3	LOVRIN 9Z	10121	107	659	*
4	ŞIMNIC S1619	10083	107	621	*
5	FDL DARNIC	10033	106	571	*
6	FDL EVIDENT	9995	106	533	-
7	CEZAR	9876	104	414	-
8	A 4-10	9855	104	392	-
9	URSITA	9839	104	377	-
10	LOVRIN 90	9821	104	358	-
11	BIHARIA	9742	103	279	-
12	FDL AMURG	9691	102	229	-
13	DACIC	9633	102	171	-
14	OTILIA	9503	100	41	-
15	MIRANDA	9493	100	31	-
16	Average	9462	100	0	Control
17	FDL EMISAR	9431	100	-31	-
18	VOINIC	9383	99	-79	-
19	CARO	9100	96	-362	-
20	PITAR	9096	96	-366	-
21	GLOSA	9058	96	-404	-
22	FDL COLUMNA	8912	94	-550	0
23	IZVOR	8875	94	-587	0
24	FDL FAGUR	8735	92	-727	0
25	FDL	8041	85	-1422	000
26	BEZOSTAIA	7249	77	-2214	000
	DL 5% = 541kg/ha		DL 1% = 734 kg/ha		DL 0,1% = 983 kg/ha

The best results in demonstration plots of wheat varieties in agricultural year 2023-2024 were obtained by FDL Abund variety with +12% difference compared with control, followed by Simnic S1412 with +10%, and Lovrin 9Z and Simnic S1619, both with +7%, and the lowest production result was obtained by the Bezostaia variety with a negative difference of -23%, followed by FDL with -15%, FDL Fagur with -8%, Izvor and FDL Columna with -6% (Figure 7).

The Miranda variety stood out for its ability to adapt to drought climatic conditions, such as the year 2024, in which the precipitation deficit was -71.9 mm, and the average annual temperature had a deviation of +3.6ºC, compared to the year 2023, in which there was no precipitation deficit (+24.1 mm), and the deviation of the average annual temperature was +1.9ºC.

Thus, in the pedoclimatic conditions of 2023, compared to the average of the experiment, the Miranda variety obtained a production of 7842 kg/ha, with an insignificant negative difference compared to the average of the experiment, while in 2024, much drier than the previous year, the Miranda variety obtained a higher production compared to the control, respectively 9493 kg/ha (Figure 7).

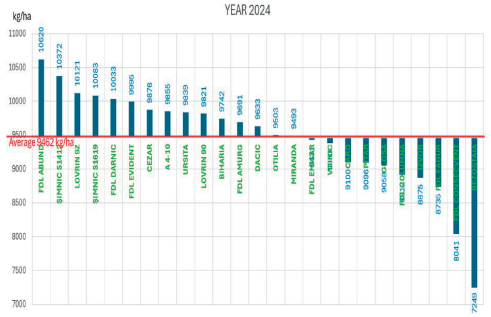

Figure 7. Production of wheat varieties tested in demonstration plots in year 2023-2024 at SCDA Braila

The best results regarding production indices in the wheat demonstration plots were obtained in 2023 by FDL Evident variety (51.31 g) followed by Glosa (50.05 g) and Voinic (47.90 g) for the mass of thousand seeds (Figure 8) and by Pitar variety (78.7 kg/hl) followed by FDL Abund (78.2 kg/hl) and Biharia (78.1 kg/hl) for hectoliter mass (Figure 9).

For the agricultural year 2023-2024, the best results for the mass of thousand seeds were obtained by Ursita variety (55.69 g), followed by Lovrin 90 (50.80 g) and Voinic (50.73 g) (Figure 10)

The best results for hectoliter mass were obtained by FDL Evident and Glosa varieties (83.0 kg/hl) and FDL Fagur (82.4 kg/hl) (Figure 11).

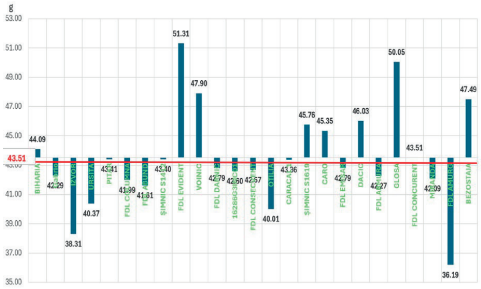

Figure 8. The mass of thousand seeds of wheat varieties tested in demonstration plots in year 2022-2023 at SCDA Braila

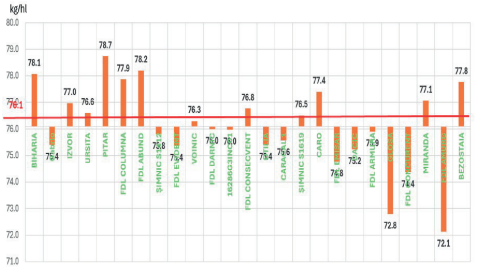

Figure 9. The hectoliter mass of wheat varieties tested in demonstration plots in year 2022-2023 at SCDA Braila

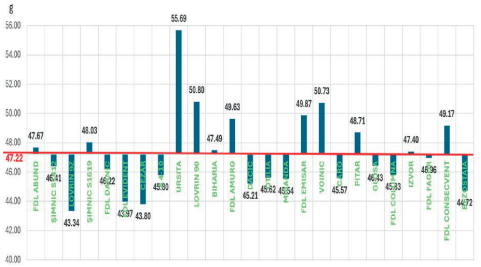

Figure 10. The mass of thousand seeds of wheat varieties tested in demonstration plots in year 2023-2024 at SCDA Braila

Figure 11. The hectoliter mass of wheat varieties tested in demonstration plots in year 2023-2024 at SCDA Braila

Being the most important cereal in human nutrition, wheat requires analysis and monitoring of quality indicators of harvested grains and research experiences to formulate a correct strategy for increasing the quantitative, but especially qualitative production of wheat crops. The most sought-after wheat varieties now are those with a high protein content, which increases the selling price of the production for the farmer producer.

The quantity and composition of protein substances (prolamins, glutens, etc.) determine the nutritional quality of the wheat grain, and their accumulation in the grains depends both on the genetics of the cultivated variety, but also on the pedoclimatic conditions, the fertilization practiced, and the treatments used.

Fertilizer application strategies and timely treatments to combat weeds, diseases and pests can increase the competitiveness and sustainability of wheat production, but genetic characteristics are the most important for competitive production.

Zoned wheat varieties are the most competitive because they already have the tolerance of the environmental conditions in which they were created and/or acclimatized.

To increase wheat productivity and the profitability of this crop, farmers must constantly adopt strategies to change and improve crop technology, by choosing the right zoned varieties, by applying fertilizers in stages, by applying phytosanitary treatments on time, to keep crops free of weeds, diseases, and pests.

Another very important thing for processing the resulting production in very good conditions is that the harvest is carried out on time, with a humidity close to STAS, and the transport and storage of the production is carried out in good, hygienic conditions in terms of temperature, humidity and non-infestation indices of the storage space.

CONCLUSIONS

- The demonstration plots organized at SCDA Braila with different wheat varieties are especially important for choosing the best genotypes from the breeder's seed for future multiplication, so that they are adapted to local soil and climatic conditions.
- Based on the results obtained in the last two agricultural years, the Abund wheat variety has already been chosen for multiplication, but demonstration batches will continue to be carried out with other new wheat genotypes.
- Cultivation technology is also of major importance, for ensuring adequate nutrition, as well as for preserving soil fertility, in the increasingly accentuated conditions of aridification and desertification, due to climate change and global warming.
- The Miranda variety is indicated in arid areas, having a similar production potential in dry years, compared to normal years in terms of precipitation.
- It is essential to explore solutions to reduce operational costs, diversify crops to have a market for the products obtained and invest in advanced technologies that can increase the efficiency and sustainability of agriculture.
- Regarding productivity indices, the best results were obtained by FDL Evident variety in 2023 and Ursita variety in 2024, for the mass of thousand seeds. The best results for hectoliter mass were obtained by Pitar variety in 2023, and FDL Evident and Glosa varieties in 2024.
- It is also crucial to support and revitalize the Romanian seed market to ensure better access to the most efficient seed material in the pedo-climatic conditions of the area.

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