RESEARCH ARTICLE OPEN ACCESS

Dissemination of the Research Results Obtained with a View to the Zoning and Acclimatization of Wheat Varieties and Hybrids in Romania

Emanuela Lungu[1,2], Trifan Daniela[1], Mocanu Florin[2], Daniel George Șerban[1,2], Florina Loredana Șerban[1,2], Maria Magdalena Turek-Rahoveanu[1]

1"Dunarea de Jos" University of Galati, Romania,
https://www.ugal.ro/
2 Agricultural Research and Development Station of Brăila, Romania
https://www.scdabraila.ro/
Corresponding author: Emanuela Lungu, "Dunarea de Jos" University of Galati, Romania, Email: marcuemanuela73@yahoo.com

--************************----------------------------------

Abstract:

The food that satisfies both economically and nutritionally the consumer's requirements is wheat flour bread. The average production of agricultural crops is determined to a large extent by the quality of the seeds to be sown and the climatic conditions of the area.

Knowing the production results and the productivity elements according to the climatic factors in the Northern Baragan area, Brăila is important for a judicious area of them in the region, but also to specify the place they must occupy in the structure of the varieties. for each area.

Climatic conditions also have a very important influence on production, but also the dependencies between the average productions of the 12 varieties of wheat under the conditions of Brăila. This aspect confirms that there are differences in sensitivity between them in terms of productive potential and that they were judges chosen for the experiment.

Keywords — **winter wheat, productivity, climatic factors.**

--************************----------------------------------

I. INTRODUCTION

Wheat is one of the most produced cereal worldwide being situated on the second place behind maize. Wheat has a large food share and, grains constituting a staple food for approximately 40 % of the world's population. Being a species with wide adaptability, wheat has a cultivation area from 60º north latitude to 45º south latitude in different pedoclimatic conditions ensuring stable and quality harvests (Oproi, 2018).

For the marketing year 2023-24, the total global production of wheat was 785 million tons. China, India, and Russia are the three largest individual wheat producers in the world, accounting for about 41% of the world's total wheat production. (worldpopulationreview.com)

Wheat is recognized as one of the main sources of calories and protein as well given the fact that about 82-85% of the world's population depends on wheat to provide the necessary calories and protein (Chaves., 2013).

Because of the high nutritional value, wheat grains are used in the food industry for producing of bread, providing about 20% of the total calories consumed by humans.The flour resulted from the wheat grains can be utilized in production of pasta, biscuits, or other bakery products and in industry as well for the producing of starch, alcohol, etc. (Contoman, 2005).

The wheeat grains can be succesfully used as a fodder for dairy or meat production being rich in sugars (40-45%) and crude protein (14-15%). The biomass resulting from wheat harvesting (straw) can be used in energy production, animal fodder or bedding, as well as for the paper industry. At the same time, wheat grains have the advantage that they can be easily transported over long distances and represent an important source of commercial exchanges on the world market (Ion V., 2010).

Romania is an important area of wheat cultivating, with approximately 2 million hectares cultivated anually. The vast areas occupied by wheat, as well as the people's interest in the cultivation of this plant, are due to the high ecological plasticity, Romania being an area with mostly qualitative soils and a climate that ensures good growing conditions for the wheat crop (Bîlteanu Gh., 2003).

Although wheat cultivation is so important both globally and in Romania, there are also a series of challenges caused by demographic growth and pronounced climate change. The fact that the world's population is constantly growing shows that the need for food, implicitly for products obtained from wheat, is greater. Also, the challenge of climate change leads to finding new solutions to increase wheat production and improve the quality of the harvest. These two elements can be achieved both through agrotechnical elements such as the use of certain sowing densities, the use of certain fertilizers and certain substances in the fight against diseases and pests. Also, improving the characteristics of the plant and the wheat grain through genetic methods plays an essential role in obtaining rich wheat harvests with superior consumption quality. To counter these challenges, continuous research and a large volume of work are needed, these being two basic conditions.

II. MATERIALS AND METHODS

A. *Natural testing conditions*

The soil, characteristic of the area, is a weak moderately calcium-supplied chernozem in the upper part of the profile and strongly carbonated in the lower part (19.3%), with medium humus content (2.4–3.1%) in the upper horizons and only 1.6% in the transition horizon. Total nitrogen content varies between 0.14–0.25%, mobile phosphorus content 174–225 ppm, and mobile potassium 24.0–26.0 mg/100 g soil in the arable layer and with a PH of 7.9–8.4.

As physical and hydrophysical indices, the soil has an apparent density of 1.10–1.31 g/cm³, with a field capacity of 22.9 – 25.2 %, a wilting coefficient of 6.7–10.2 %, a hygroscopicity coefficient of 3.7–6.4 % and a minimum ceiling of active humidity of 13.8–17.4 %.

B. *The main climatic elements of the 2021-2024 period*

During the agricultural years 2021-2024, the average precipitation was 399.2 mm per year, 42.8 mm less than the multiannual value of 442 mm. The largest negative difference compared to the multiannual average was recorded in February (-20.7 mm) and the largest positive difference was recorded in September (25.9 mm), which is a positive aspect, as the wheat sowing period is in the first part of October. In terms of temperatures, the average of the experimental years is higher than the multiannual average. The difference observed in Table 1 demonstrates that the average temperature of the years in which the study was conducted is higher by 2.4 °C compared to the multiannual average of 10.9 °C. Overall, it is noteworthy that precipitation was reduced by 42 mm compared to the multiannual period, and the average temperature was higher than the multiannual period, with the wheat crop still benefiting from good climatic conditions

Climatic elements		First part			Second part of agricultural year									TOTAL AVERAGE
		Oct	Nov	Dec	Jan	Febr	March	Apr	May	June	July	Aug	Sep	
Precipitations (mm)	Monthly average 2021-2024	14,2	60,7	28,9	28,8	6,3	22,4	39,1	33,1	35,5	49,4	33,0	47,9	399,2
	Multiyear monthly average	30	33	36	28	27	26	35	48	62	46	39	32	442
	Deviation	-15.8	27.7	-7.1	-0.8	-20.7	-3.6	4.1	-14.9	-26.5	3.4	-6.0	25.9	-42.8
Temperature (°C)	Monthly average 2021-2024	13,0	8,1	3,0	2,0	4,3	6,6	12,5	17,0	22,9	25,3	24,9	19,6	13,3
	Multiyear monthly average	11.5	5.6	0.6	-2.1	-0.2	4.7	11.2	16.7	20.9	22.9	22.1	17.3	10.9
	Deviation	1.5	2.5	2.4	-4.1	4.5	1.9	1.3	0.3	2.0	2.4	2.8	2.3	2.4

Fig. 1 Precipitations and temperature regime in the 2021-2024 period

C. *The biological material used*

It was represented by a number of 12 local and foreign wheat varieties. They are described as follows:

1.Glosa-variety was registered in 2005 and was obtained at N.A.R.D.I. Fundulea. The Glosa variety has an average height of 85 - 95 cm and it is resistant to powdery mildew, medium sensitive to brown rust and medium resistant to yellow rust, septoria and fusarium. The Glosa variety is characterized by very good bakery quality.

2.Ursita-the newest variety registered by N.A.R.D.I. Fundulea, and is based on a line originating from triticale and wheat it baking quality.

3.Otilia-registered in 2013, with the average height of the plant of 75-92 cm. Otilia variety has good resistance to lodging, winter temperature, drought and heat. This variety is resistant to yellow rust and septoriosis and medium resistant to brown rust and powdery mildew and it has a medium level of resistance to Fusarium wilt and good resistance to sprouting of grains in the ear.

4.Pitar-variety registered in 2015 at N.A.R.D.I. Fundulea is characterized as an intensive variety with high production potential and very good baking quality. The wheat plant shows very good resistance to lodging, winter, drought and heat. It also shows resistance to brown rust, powdery mildew and medium resistance to septoria, yellow rust, fusarium.

5.Dacic-one of the newest varieties in the A.R.D.S. Lovrin portfolio. It is a typical autumn variety with very good winter resistance, without plant loss or leaf damage. It was obtained through repeated genealogical selection from a hybrid combination between two very important varieties for Romania, the Dropia and Fundulea 4. The Dacic variety presents a very good genetic resistance to the main diseases of the plant: powdery mildew, fusarium and rusts. (scdalovrin.com)

6.Getic-characterized as a medium-sized wheat variety with very good tillering. This variety stands out as very resistant to lodging, frost and powdery mildew, brown rust, yellow rust, fusarium and septoriosis is very high. (scdalovrin.com)

7.Andrada-registered in 2012 is characterized as an intensive variety, resistant to wintering, very resistant to lodging, the sprouting of grains in the ear. From the point of view of the protein content, it is 12.73%, and the gluten is of a special quality indicated by the value of the gluten index. The recorded average productions fall within the range of 7100-9300 kg/ha. (scdaturda.ro)

8.Cezara-approved in 2020 pending patenting. This variety of winter wheat has a very good resistance to wintering, good resistance to lodging, due to a large extent to the shorter height; presents the stay-green character of the leaves, achieves production increases of 10-15% compared to competing varieties, under the same technological conditions. (scdaturda.ro)

9.Codru-early and productive variety with a large grain that has a tillering capacity of 1.5-3.5 tillers/plant; It stands out due to its very good resistance to wintering and lodging; This variety is characterized from a morphological point of view by the white spike, medium-high waist, between 75-100 cm; The grains have a mass index of 1000 grains of 42 - 52 g; The vegetation period of this variety is 265-270 days. (scdaturda.ro)

10.Trublion-new genetic variety, semi-early, awnless, with high production potential, and very good baking capacity. This variety shows remarkable tolerance to the main foliar and ear diseases. The recommended sowing density in optimal conditions is 350-400 b.g./m², which provides an average harvest density of over 650-700 harvestable ears/m². (saaten-union.ro)

11.Katarina- a variety of wheat, awnless, very suitable for baking with a protein content of 13%.

This variety stands out for its very good vigor at sunrise, especially in the first period of vegetation. Resistance to ear diseases is high, especially to Fusarium. (saaten-union.ro)

12. Hyxperia- It is a new variety of wheat on the Romanian market that promises very good quality characteristics along with economically profitable productions.

These variants were sown in parcels of 10 m² in three replications: 350 g/m², 550 g/m² and 750 g/m².

In this experiment, the results regarding the morpho-productive characters of wheat and the results regarding quality indices were monitored with measurements in the field and laboratory procedure.

The morpho-productive characters studied were: Plant height, spike length, spike mass, number of grains per spike, grains weight per spike, thousand grain weight, hectoliter mass and grain yield.

Wheat quality indices were represented by the protein content of wheat grains, the wet gluten content of wheat grains and the Zeleny sedimentation index of wheat grains

III. RESULTS

A. The morpho-productive characters

1) **Plant height:** Plant height is an important morphological character, being one of the phenotypic characters that can provide primary estimative information regarding the production capacity of a genotype. The analysis of the variability of this character in relation to external or crop management factors that can influence the expressivity of this character, in this case plant density, represents a first step in evaluating the morpho-productive performances of wheat genotypes.

Plant height is a specific character for each genotype, but like any quantitative character it is influenced by environmental conditions, especially those during the period of growth and vegetative development of the plant. (Liu, 2022) In the analysis of the influence of the variety factor on this character (Table 1), it is observed that during the three experimental years the variation of this character was between 70.22 cm for the Trublion variety and 86.93 cm for the control variety Glosa. Compared to the height of the Glosa variety, the plant heights of the studied varieties were very significantly

lower, the Duncan test allowing the hierarchy according to the average value recorded by each variety.

TABLE 1 INFLUENCE OF THE VARIETY FACTOR ON THE PLANT HEIGHT

No.	Variety	Plant height (cm)	%	Difference (±)	Significance
1.	Glosa	86.93	100 (Ct.)	Ct.	Ct.
2.	Ursita	83.07	95.6	-3.85	000
3.	Otilia	80.96	93.1	-5.96	000
4.	Pitar	81.30	93.5	-5.63	000
5.	Dacic	81.52	93.8	-5.41	000
6.	Getic	79.67	91.6	-7.26	000
7.	Andrada	79.33	91.3	-7.59	000
8.	Cezara	73.89	85.0	-13.04	000
9.	Codru	78.33	90.1	-8.59	000
10.	Trublion	70.22	80.8	-16.70	000
11.	Katarina	75.04	86.3	-11.89	000
12.	Hyxperia	77.89	89.6	-9.04	000

Dl 5%- 1.83 Dl 1 %-2.42 Dl 0.1 %-3.11

Fig. 1 Measuring the wheat plants in the field

Compared to the sowing density of 550 g/m², the use of the other two sowing norms - 350 g/m² and 750 g/m² respectively - have a negative influence on the plant height character, reducing it by 1.78 cm and 0.33 cm respectively, these differences being not statistically assured (Table 2).

TABLE 2 INFLUENCE OF THE DENSITY FACTOR ON THE PLANT HEIGHT

No.	Sowing density (g/m²)	Plant height	%	Difference (±)	Significance
1.	D_2-550 g/m²	79.26	100 (Ct.)	Ct.	Ct.
2.	D_1 -350 g/m²	79.73	100.6	0.47	-
3.	D_3-750 g/ m^2	78.08	98.5	-1.21	-

Dl 5%- 1.31 Dl 1 %-1.84 Dl 0.1 %-2.60

2) Number of grains per spike: The number of grains per spike is one of the main elements of wheat productivity (Isham, 2021), recently this component of productivity has been used as a tool to increase genetic gain (Shearman et al., 2005).

The genetic factor has a major influence on the character number of grains per spike (Table 3). Being one of the characters positively correlated with production capacity, the specific performances of the genotypes analyzed regarding the number of grains per spike could be a primary indicator regarding their production capacity.

On the other hand, considering the moment when the primordia of this character are established, in the phenophase of straw elongation, this productivity element could also represent a criterion of the adaptability of the genotypes to the limiting conditions of the three experimental years.

Compared to the average number of grains per spike recorded in the Glosa variety, four of the genotypes studied registered significant negative differences (Codru), distinctly significant (Ursita and Dacic) and very significant (Getic) for the mentioned character.

TABLE 3 INFLUENCE OF THE VARIETY FACTOR ON THE NUMBER OF GRAINS PER SPIKE

No.	Variety	Number of grains per spike	%	Difference (±)	Significance
1.	Glosa	45.58	100 (Ct.)	Ct.	Ct.
2.	Ursita	42.38	93.0	-3.20	00
3.	Otilia	45.18	99.1	-0.40	-
4.	Pitar	44.58	97.8	-1.00	-
5.	Dacic	42.51	93.3	-3.07	00
6.	Getic	40.87	89.7	-4.71	000
7.	Andrada	43.82	96.1	-1.76	-
8.	Cezara	44.02	96.6	-1.56	-
9.	Codru	42.98	94.3	-2.60	0
10.	Trublion	47.24	103.7	1.67	-
11.	Katarina	45.96	100.8	0.38	-
12.	Hyxperia	49.38	108.3	3.80	***

Dl 5%- 2.18 Dl 1 %-2.87 Dl 0.1 %-3.68

It is worth noting the very significant positive upper value for the number of grains per spike of the Hyxperia wheat hybrid, whose performance exceeded the control variety by 8.3%, suggesting that the maximum degree of heterozygosity of the respective genotype gives it an increase in productivity compared to the other genotypes.

TABLE 4 INFLUENCE OF SOWING DENSITY FACTOR ON THE NUMBER OF GRAINS PER SPIKE

No.	Sowing density (g/m²)	Number of grains per spike	%	Difference (±)	Significance
1.	D_2-550 g/m²	45.58	100 (Ct.)	Ct.	Ct.
2.	D_1 -350 g/m²	42.38	93.0	-3.20	00
3.	D_3-750 g/ m^2	45.18	99.1	-0.40	-

Dl 5%- 1.48 Dl 1 %-2.01 Dl 0.1 %-2.70

Regarding the influence of the density factor on the number of grains per spike (table 5), it can be observed that reducing the sowing rate to 350 bg m² shows a very significant positive influence compared to the control density, the increase in the number of grains per spike being in this situation 10.7%. In contrast, increasing the number of germinable grains per unit area to 750 bg m² has the effect of increasing the number of grains per spike by 3.2%, this difference however not being statistically assured.

3) ***Grains weight per spike:*** The weight of grains per spike, as the final element that enters into the determinism of grain production, is an element that encompasses a series of components whose development takes place mainly in the early ontogenetic stages (Protić et al., 2013).

TABLE 5 INFLUENCE OF THE VARIETY FACTOR ON THE GRAINS WEIGHT PER SPIKE

No.	Variety	The grains weight per spike	%	Difference (±)	Significance
1.	Glosa	2.07	100 (Ct.)	Ct.	Ct.
2.	Ursita	1.94	93.9	-0.13	-
3.	Otilia	2.11	102.2	0.04	-
4.	Pitar	2.03	98.4	-0.03	-
5.	Dacic	1.94	93.7	-0.13	-
6.	Getic	1.85	89.5	-0.22	-
7.	Andrada	2.40	116.0	0.33	-
8.	Cezara	2.08	100.5	0.01	-
9.	Codru	1.93	93.2	-0.14	-
10.	Trublion	2.10	101.7	0.03	-
11.	Katarina	2.13	103.2	0.07	-
12.	Hyxperia	2.33	112.6	0.26	-

Dl 5%- 0.36 Dl 1 %-0.48 Dl 0.1 %-0.61

Regarding the influence of the genotype factor on the grain weight per spike character, during the three experimental years it was quite reduced, the differences in the mean values compared to that of the control variety not being statistically assured (table 5).

Although in the case of the analysis of variance no significant differences were reported compared to the control variant, from the point of view of the grain weight per spike character, the Andrada variety differs from the other genotypes in terms of the heredity of this character through a more intense phenotypic manifestation, respectively the Getic line stands out unfavorably due to the lower genetic determinism of this character.

TABLE 6 INFLUENCE OF SOWING DENSITY FACTOR ON THE GRAINS WEIGHT PER SPIKE

No.	Sowing density (g/m²)	The grains weight per spike	%	Difference (±)	Significance
1.	D_2-550 g/m²	2.20	100 (Ct.)	Ct.	Ct.
2.	D_1 -350 g/m²	2.21	100.6	0.01	-
3.	D_3-750 g/ m^2	1.92	87.0	-0.29	00

Dl 5%- 0.19 Dl 1 %-0.26 Dl 0.1 %-0.35

During the three experimental years, the plant density of 750 g/m² had a distinctly significant negative influence on the grain mass per spike character compared to the control density used (table 6). The use of a reduced density (350 g/m²) determined a 0.6% increase in grain mass per spike compared to the control density, but this difference was not statistically significant.

4) ***Grain yield:*** Grain yield is a complex trait with additive genetic determinism and low heritability (He et al., 2010, Wang et al., 2019) with a multitude of factors contributing to its achievement, the expressivity of which is influenced by environmental conditions. The previously studied productivity elements aimed to elucidate as much as possible the genetic determinism and the influence of external factors on the production components.

Regarding the influence of the genetic factor on production capacity, also during the three years of study, environmental conditions tested their adaptability to various limiting situations so that the genetic component played an essential role (table 7).

TABLE 7 INFLUENCE OF THE VARIETY FACTOR ON THE GRAIN YIELD

No.	Variety	Grain yield	%	Difference (±)	Significance
1.	Glosa	7384.56	100 (Ct.)	Ct.	Ct.
2.	Ursita	7191.22	97.4	-193.33	-
3.	Otilia	7331.67	99.3	-52.89	-
4.	Pitar	7199.96	97.5	-184.59	-
5.	Dacic	7413.04	100.4	28.48	-
6.	Getic	7537.15	102.1	152.59	-
7.	Andrada	7013.22	95.0	-371.33	0
8.	Cezara	6996.85	94.7	-387.70	00
9.	Codru	6886.74	93.3	-497.81	000
10.	Trublion	6657.85	90.2	-726.70	000
11.	Katarina	6897.89	93.4	-486.67	00
12.	Hyxperia	7428.30	100.6	43.74	-

Dl 5%- 292.01 Dl 1 %-385.40 Dl 0.1 %-495.24

Thus, compared to the control variant-Glosa variety, the production level of the other genotypes studied was lower in the case of eight genotypes (Ursita, Otilia, Pitar, Andrada, Cezara, Codru, Trublion and Katarina).

Distinctly significant and very significant negative differences could be recorded in the case of the Cezara and Katarina genotypes, respectively Codru and Trublion, while the difference in production of the Andrada variety compared to that of the Glosa variety was significant.

A positive reaction compared to that of the control variety in terms of production capacity was observed in the case of the Getic, Hyxperia and Dacic genotypes, however, the differences recorded were not statistically assured.

TABLE 8 INFLUENCE OF SOWING DENSITY FACTOR ON THE GRAIN YIELD

No.	Sowing density (g/m²)	Grain yield	%	Difference (±)	Significance
1.	D_2-550 g/m²	7762.18	100 (Ct.)	Ct.	Ct.
2.	D_1 -350 g/m²	7124.72	91.8	-637.45	0
3.	D_3-750 g/ m^2	6597.71	85.0	-1164.46	000

Dl 5%- 550.84 Dl 1 %-773.20 Dl 0.1 %-1091.57

During the three years of study, the influence of the density factor was significant (table 8). Compared to the control density of 550 g/m², the use of the other graduations of the density factor had negative influences on the level of plant production. In the case of the density of 350 g/m², the reduction in the level of production was 8.2% compared to that of the variant with 550 g/m² , while the use of 750 g/m² determined a decrease in production by 1164.46 kg/ha, from a statistical point of view the two differences being significant and very significant compared to the control variant.

B. Wheat quality indices

1) ***The protein content of wheat grains:*** The quality of wheat grains is mainly determined by two elements - protein content and gluten content.

As in the case of the other studied components, the protein content of wheat grains is a complex character whose variability is influenced by genetic determinism, respectively by external factors (crop management factors - fertilizers in particular, respectively the interaction with environmental factors).

During the three years of study, the influence of the genetic factor had a major influence on the protein content of the grain (Table 9).

Compared to the average protein content of the grain of the control variety, all other genotypes analyzed recorded very significant negative differences ranging from 0.43% for the Pitar variety to 1.63% for the Hyxperia wheat hybrid.

Analyzing the group of genotypes according to their origin, it can be observed that in the case of the other genotypes created by the National Institute for Agricultural Research and Development from Fundulea, the variation in the protein content of the grain was between 0.43 and 0.70% compared to that of the control variety.

TABLE 9 INFLUENCE OF THE VARIETY FACTOR ON THE PROTEIN CONTENT OF WHEAT GRAINS

No.	Variety	The protein content of wheat grains	%	Difference (±)	Significance
1.	Glosa	13.50	100 (Ct.)	Ct.	Ct.
2.	Ursita	12.81	94.8	-0.70	000
3.	Otilia	13.06	96.7	-0.44	000
4.	Pitar	13.07	96.8	-0.43	000
5.	Dacic	12.58	93.2	-0.92	000
6.	Getic	12.69	94.0	-0.81	000
7.	Andrada	12.68	93.9	-0.82	000
8.	Cezara	12.69	94.0	-0.81	000
9.	Codru	12.71	94.2	-0.79	000
10.	Trublion	11.90	88.2	-1.60	000
11.	Katarina	12.32	91.3	-1.18	000
12.	Hyxperia	11.87	87.9	-1.63	000

Dl 5%- 0.16 Dl 1 %-0.21 Dl 0.1 %-0.27

A larger difference was recorded in the case of genotypes (Dacic and Getic) from the Agricultural Research and Development Station in Lovrin (0.81 and 0.92% respectively) and those from the Agricultural Research and Development Station in Turda (Andrada- 0.82, Cezara and Codru- 0.82).

The largest differences compared to those of the Glosa variety were found in the case of the foreign varieties Trublion- 1.60%, Katarina- 1.18% and the wheat hybrid Hyxperia -1.63%.

TABLE 10 INFLUENCE OF SOWING DENSITY FACTOR ON THE PROTEIN CONTENT OF WHEAT GRAINS

No.	Sowing density (g/m²)	The protein content of grain wheat grains	%	Difference (±)	Significance
1.	D_2-550 g/m²	12.79	100 (Ct.)	Ct.	Ct.
2.	D_1 -350 g/m²	13.09	102.3	0.30	*
3.	D_3-750 g/ m^2	12.10	94.6	-0.69	000

Dl 5%- 0.22 Dl 1 %-0.31 Dl 0.1 %-0.43

Regarding the influence of the density factor on the protein content of the grain in the three experimental years, the use of the density of 350 g/m had a beneficial effect, determining an increase in the protein content of the grain by 2.3 % compared to the average value of the control variant, the difference recorded being significant (table 10).

In contrast, the use of the density of 750 g/m² had a negative influence on the protein level of the grain, the difference compared to the average value of the protein content of the grain at the density of 550 g/m² being very significant.

If we compare the average values of the densities at 350 g/m² and that at 750 g/m², we can see that the difference between the two experimental graduations is 0.99% protein in the grain in favor of the density of 350 g/m².

2) ***The gluten content of wheat grains:*** The functional properties of wheat are determined by the gluten content of the grains (Sliwinski et al., 2004). Gluten proteins, namely glutenins and gliadins, are responsible for the rheological properties of dough (Zhou et al., 2020; Takač,2021).

From this point of view, the gluten content of wheat grains is an important indicator of the harvest, the destination of the harvest depending on its level. As during the three years of study, the influence of the genotype factor on the wet gluten content of the grains was major, the level of experimentation of the analyzed character depending largely on the genetic constitution.

Compared to the control variant, the average values for the gluten content of the grains of the studied genotypes recorded very significant negative differences ranging from 1.67% for the Otilia variety and 5.81% for the Trublion variety.

TABLE 11 INFLUENCE OF THE VARIETY FACTOR ON THE GLUTEN CONTENT OF WHEAT GRAINS

No.	Variety	The gluten content of wheat grains	%	Difference (±)	Significance
1.	Glosa	31.04	100 (Ct.)	Ct.	Ct.
2.	Ursita	28.80	92.8	-2.24	000
3.	Otilia	29.37	94.6	-1.67	000
4.	Pitar	28.49	91.8	-2.55	000
5.	Dacic	27.70	89.2	-3.34	000
6.	Getic	27.16	87.5	-3.88	000
7.	Andrada	28.35	91.3	-2.69	000
8.	Cezara	28.74	92.6	-2.30	000
9.	Codru	28.56	92.0	-2.48	000
10.	Trublion	25.23	81.3	-5.81	000
11.	Katarina	28.71	92.5	-2.33	000
12.	Hyxperia	25.53	82.2	-5.51	000

Dl 5%- 0.42 Dl 1 %-0.55 Dl 0.1 %-0.70

Plant density had a specific influence on the accumulation of protein fractions in the grain (table 12). Thus, reducing the level of compatibility between plants (density of 350 g/m²) had a positive influence on the gluten content, determining its increase by 4% compared to the control variant. Using a density of 750 g/m² has a negative effect on the wet gluten content in the grain, the difference compared to the control variant being 1.90%.

TABLE 12 INFLUENCE OF SOWING DENSITY FACTOR ON THE GLUTEN CONTENT OF WHEAT GRAINS

No.	Sowing density (g/m²)	The gluten content of grain wheat grains	%	Difference (±)	Significance
1.	D_2-550 g/m²	28.39	100 (Ct.)	Ct.	Ct.
2.	D_1 -350 g/m²	29.54	104.0	1.15	*
3.	D_3-750 g/ m^2	26.49	93.3	-1.90	000

Dl 5%- 0.83 Dl 1 %-1.16 Dl 0.1 %-1.64

3) ***The Zeleny sedimentation index of wheat grains:***

The sedimentation index or Zeleny index, or Zeleny test, is a chemical method specific to wheat for determining or predicting the quality of wheat grains, establishing the destination of the harvest.

This method involves measuring the sedimentation of a quantity of flour in a lactic acid dilution, the sedimentation of the respective suspension being closely associated with the characteristics or level of glutenins, respectively the quality of the flour (Colombo et al., 2008).

TABLE 13 INFLUENCE OF THE VARIETY FACTOR ON THE ZELENY SEDIMENTATION INDEX OF WHEAT GRAINS

No.	Variety	The Zeleny index (ml)	%	Difference (±)	Significance
1.	Glosa	49.68	100 (Ct.)	Ct.	Ct.
2.	Ursita	45.35	91.3	-4.33	000
3.	Otilia	48.29	97.2	-1.39	00
4.	Pitar	44.54	89.7	-5.14	000
5.	Dacic	45.15	90.9	-4.53	000
6.	Getic	43.69	88.0	-5.99	000
7.	Andrada	44.64	89.9	-5.04	000
8.	Cezara	48.54	97.7	-1.14	0
9.	Codru	45.79	92.2	-3.89	000
10.	Trublio	37.57	75.6	-12.11	000

	n				
11.	Katarina	45.84	92.3	-3.83	000
12.	Hyxperia	39.39	79.3	-10.29	000

Dl 5%- 0.94 Dl 1 %-1.25 Dl 0.1 %-1.60

Reduced performances from this point of view can be observed in the case of the Getic perspective line, the Hyxperia hybrid wheat and the Trublion variety, whose average value for the Zeleny index deviates from that of the Glosa variety by 5.99 ml; 10.29 ml and 12.11 ml respectively.

TABLE 14 INFLUENCE OF SOWING DENSITY FACTOR ON THE ZELENY SEDIMENTATION INDEX OF WHEAT GRAINS

No.	Sowing density (g/m²)	The Zeleny index (ml)	%	Difference (±)	Significance
1.	D_2-550 g/m²	45.56	100 (Ct.)	Ct.	Ct.
2.	D_1 -350 g/m²	46.43	101.9	0.87	-
3.	D_3-750 g/ m^2	42.63	93.6	-2.94	000

Dl 5%- 1.43 Dl 1 %-2.01 Dl 0.1 %-2.83

During the three years of study, plant density had a significant influence on the intensity of the sedimentation index (Table 14).

Compared to the average value of the Zeleny index at the sowing density of 550 g/m², the use of a density of 350 g/m² had a positive effect on the Zeleny index, determining an increase in this qualitative parameter by 1.9 %, a difference not statistically significant. However, when a density higher than the control was used (750 g/m²) the effect on the sedimentation index was negative, the difference (2.94 ml) compared to the average value of the sedimentation index of the control variant (45.56 ml) being very significant.

IV. CONCLUSIONS

The wheat variants used in the experiment were 12 in number: Glosa, Ursita, Otilia, Pitar, Dacic, Getic, Andrada, Cezara, Codru, Trublion, Katarina and Hyxperia. These variants were sown in three repetitions: 350 g/m², 550 g/m² and 750 g/m²

During the agricultural years 2021-2024, from the climatic point of view, precipitation was reduced by 42 mm compared to the multiannual period, and the average temperature was 2.4ºC higher than the multiannual period, with the wheat crop still benefiting from good climatic conditions.

During the three years of the study, the wheat variants recorded an average production of 7161 kg/ha, the most productive variety being Getic with 7537 kg/ha, exceeding the control Glosa by 2.1%, respectively 152 kg/ha. The sowing density of 550 g/m², which was also the control variant, recorded the highest production over the three years of the study compared to the 350 g/m² and 750 g/m² variants. The production for the density of 550 g/m² was 7762 kg/ha

Wheat quality indices were represented by the protein content of wheat grains, the wet gluten content of wheat grains and the Zeleny sedimentation index of wheat grains, these being some important indices regarding the utilization for bread production.

According to the studies conducted, the Glosa variety presented the highest values of protein content, gluten content and Zeleny sedimentation index.

The use of a density of 350 g/m² brought the highest protein content (13.09 %) and gluten (29.5 %) and also the highest Zeleny sedimentation index (46.4 %)

ACKNOWLEDGMENT

The experience described in this paper was carried out within the Agricultural Research and Development Station Brăila with the help of the research team from this institution. I would like to thank the organizers of the International Conference

On "Management, Engineering, Sciences and Humanities" (MESH-2025) and "Laescuela Education" for the opportunity to participate in this unique program for the field of research. I would like to thank the support offered by the Doctoral School within UGAL Galați.

REFERENCES

[1] A. Colombo, G.T. Pérez, P.D. Ribotta, A.E. León, A comparative study of physicochemical tests for quality prediction of Argentine wheat flours used as corrector flours and for cookie production, Journal of Cereal Science, Volume 48, Issue 3, 2008, Pages 775-780, https://doi.org/10.1016/j.jcs.2008.05.003.

[2] Bîlteanu Gh., 2003- Fitotehnie – vol. I – Cereale și leguminoase pentru boabe, Ed. Ceres București: 169 – 178.

[3] Chaves MS, Martinelli JA, Wesp-Guterres C, Graichen FAS, Brammer S, Scagliusi SM, Da Silva PR, Wiethölter P, Torres GAM, Lau EY, 2013 - The importance for food security of maintaining rust resistance in wheat. Food Security 5:157-176.

[4] Contoman M., 2005. Bazele ecotehnologice ale culturilor agricole. Editura Fundației Universitare culturilor agricole, Ed. Fundației Universitare „Dunărea de Jos„ Galați.

[5] He, Z. H., Xia, X. C., and Bonjean, A. P. A. (2010). Wheat Improvement in China. Mexico: CIMMYT, 51–68.

[6] Ion V., 2010. Fitotehnie – Manual învățământ la distanță, București.

[7] Isham K., Wang R., Zhao W. D., Wheeler J., Klassen N., Akhunov E., et al.. (2021). QTL mapping for grain yield and three yield components in a population derived from two high-yielding spring wheat cultivars. Theor. Appl. Genet. 134, 2079–2095. 10.1007/s00122-021-03806-1.

[8] Protić, R. Todorović, G., Protić, N., Kostić, M., Delić, D., Filipović, M., Filipović, V. andUgrenović, V. (2013). Variation of grain weight per spike of wheat depending onvariety and seed size. Romanian agricultural research, 30, 51–55.

[9] Shearman VJ, Sylvester-Bradley R, Scott RK, Foulkes MJ. Physiological processes associated with wheat yield progress in the UK. Crop Science. 2005;45(1):175–85. PubMed PMID: WOS:000226435300022.

[10] Sliwinski E., Kolster P., Prins A., Van Vliet T. (2004a). On the relationship between gluten protein composition of wheat flours and large-deformation properties of their doughs. J. Cereal Sci. 39 247–264. 10.1016/j.jcs.2003.10.006.

[11] Takač, V.; Tóth, V.; Rakszegi, M.; Mikić, S.; Mirosavljević, M.; Kondić-Špika, A. Differences in Processing Quality Traits, Protein Content and Composition between Spelt and Bread Wheat Genotypes Grown under Conventional and Organic Production. Foods 2021, 10, 156. https://doi.org/10.3390/foods10010156.

[12] Wang, Y., Hou, J., Liu, H., Li, T., Wang, K., Hao, C., et al. (2019). TaBT1, affecting starch synthesis and thousand kernel weight, underwent strong selection during wheat improvement. J. Exp. Bot. 70, 1497–1511. doi: 10.1093/jxb/erz032.

[13] Zhou Z, Zhang Z, Jia L, Qiu H, Guan H, Liu C, Qin M, Wang Y, Li W, Yao W, Wu Z, Tian B, Lei Z. Genetic Basis of Gluten Aggregation Properties in Wheat (Triticum aestivum L.) Dissected by QTL Mapping of GlutoPeak Parameters. Front Plant Sci. 2021 Jan 28;11:611605. doi: 10.3389/fpls.2020.611605. PMID: 33584755; PMCID: PMC7876098.

[14] https://scdalovrin.com/ziua-porumbului-si-a-florii-soarelui-2024/platforma-demo-cereale-paioase/soiuri/

[15] https://scdaturda.ro/andrada/

[16] https://scdaturda.ro/cezara/

[17] https://scdaturda.ro/codru/

[18] https://worldpopulationreview.com/country-rankings/wheat-production-by-country

[19] https://www.incda-fundulea.ro/fise/grau.html

[20] https://www.saaten-union.ro/grau/grau-de-toamna/katarina/