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PARTIAL RESULTS REGARDING SOME WINTER WHEAT GENOTYPES CREATED AT ARDS TURDA AND TESTED IN THE PEDOCLIMATIC CONDITIONS OF NIRDPSB BRAȘOV

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Abstract

Wheat is not just any plant, it represents the food security of millions of people, being foremost and irreplaceable in many geographical areas. To NIRDPSB Brasov between 2020-2021 was created an experimental field with 25 winter wheat genotypes from ARDS Turda. The culture was randomized with three replicates, totaling 75 experimental variants. The research aimed to study the resistance of genotypes to thermic and hydric stress. Resistance to the attack of pathogens and behavior in terms of production/ha, TKW, hectolitre weight and humidity were also analyzed. Regarding the production on the first place was the line T.51-17 with an average production of 6557 kg/ ha and on the last place was the line T.21-16, with an average production of 3752 kg/ha. The Andrada variety (control) with a productivity of 6003 kg/ha, the lines T.45-18, T.52-18 and the Dumitra variety with yields of 5682 kg/ha, 5590 kg/ha and 5474 kg/ha respectively were also noted.

Key words: *climatic conditions, disease resistance, genotypes, production, winter wheat.*

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important cereal food crop worldwide and it accounts for 21% of the global food demand with more than 80% of the global population depending on it as a source of protein and calories (Shewry, 2009, Msundi et al., 2021).
One of the decisive factors in achieving the high-performance wheat crop is the variety. Thus, in order to be promoted in production, wheat varieties must possess a series of valuable properties: high productivity, good quality of the grains, high resistance to diseases and to the wintering, to the drought and good stability (Muntean et al., 2008).
Breeding can contribute to the achievement of these goals by focusing its efforts on increasing production potential, reducing the negative correlation between production and quality, increasing water and nutrient efficiency, reducing losses from diseases and pests (Săulescu et al., 2010).
The damage caused by diseases depends on the growth stage of the crop and the severity of the disease, which is a function of environmental conditions, virulence of the physiological race and the susceptibility of the cultivar (Roelfs et al., 1992). Diseases have been shown to reduce test weight, and consequently fungicide application resulted in a 2.5 to 2.8% increase in test weight (Paul et al., 2010; Marinciu et al., 2021).
The continual drive to match yield and quality increases is not without its challenges. Decreasing availability of suitable farm land, climate change and a variety of unpredictable abiotic and biotic stresses continually pose threats to wheat production locally and globally (Figueroa et al., 2018). Thus, the cultivation of varieties with wide adaptability to contrasting environmental conditions can reduce the risks of declining production in unfavorable years (Mustatea et al., 2008).
Increasing the stability of wheat production from one year to another is possible by creating and introducing into the field varieties that combine a high production potential and a good resistance to biotic and abiotic stress conditions (Săulescu et al., 2007; Moldovan et al., 2012).

Increasing the stability of wheat production from one year to another is possible by creating and introducing new varieties that combine a high production potential and a good resistance to biotic and abiotic stress conditions (Săulescu et al., 2006).

Major diseases of wheat in Romania are powdery mildew (*Blumeria graminis* f.sp. *tritici*), brown rust (*Puccinia recondita* f.sp. *tritici*) and the leaf spot complex, which includes brown spot (*Bipolaris sorokiniana*), yellow spot (*Drechslera tritici-repentis*) and glume spot (*Stagonospora nodorum*).

MATERIALS AND METHODS

The study was conducted to the NIRDPSB Brasov field in autumn of 2020 year, on a cambic chernozem soil, using 25 winter wheat genotypes created by ARDS Turda.

A randomized blocks design with three replications was used for all lines which totaled 75 experimental plots.

Fertilization was carried out with NPK complex (64 kg/ha a.s.) on October 1, 2020, on the field ready for sowing. Subsequently, the plants benefited from two more fractions of ammonium nitrate (NH_4NO_3): the first on 30.03.2021, representing a quantity of 52.5 kg/ha a.s., and the second on 17.05.2021, in a quantity of 33.5 kg/ha a.s.

Were made observations regarding: resistance to winter hardiness, growth rate, phenological data (heading, physiological maturity), fall resistance and sterility.

During the vegetation period, the following pathogens were detected: powdery mildew (*Blumeria graminis*), septoria (*Septoria* sp.), fusarium ear blight (*Fusarium graminearum*), brown rust (*Puccinia recondita*) and yellow rust (*Puccinia striiformis*).

During the research, no treatments were performed to control the diseases, thus offering the possibility of the appearance and development of pathogens. In this way the studied genotypes could be evaluated in terms of resistance/tolerance, obtaining an identification of valuable genotypes for this area.

At harvest, the production/plot and the humidity were determined (standard humidity 14%/production per hectare).

After the harvesting, samples were taken to determine other elements of productivity: thousand kernel weight (TKW), test weight, and to determine the quality of the grain, samples were sent to ARDS Turda.

RESULTS AND DISCUSSIONS

The climatic regime in 2020-2021, indicates a warm year with an uneven distribution of rainfalls. The amount of rainfalls summed between August 1 and December 31, 2020, is shown in Table 1. The precipitation that fell in August shows a negative deviation from MAA accentuating the pedological drought, but in September the deviation was positive. In October, the rains favored the germination and emergence of seedlings and the improvement of the soil's water supply. The average air temperature in August was higher than MAA and in September the deviation of the average temperature was positive compared to the multiannual average (2.7°C), as well as that of October (2.1°C).

The weather favored sowing in good conditions, good germination of the grains and a uniform emergence of the plants. A good evolution of the growth and development was also due to the fact that the sowing took place on October 13, 2020, a date that allowed the good evolution of the culture.

Table 1. Air temperature and rainfalls in 2020 - NIRDPSB Brasov

	Month/ Period	Average air temperature °C			Total rainfall (mm)		
		Accomplished	MAA	Deviations	Accomplished	MAA	Deviations
	January	-3,6	-5,0	1,4	4,0	25,5	-21,5
Y	February	2,2	-2,5	0,3	42,0	23,9	18,1
e	March	5,6	2,6	3,0	30,4	28,9	1,5
a	April	8,6	8,5	0,1	12,7	50,0	-37,3
r	May	12,8	13,6	-0,8	98,0	82,0	16,0
	June	17,8	16,5	1,3	120,1	96,7	23,0
2	July	19,2	18,1	1,1	104,1	99,8	4,3
0	August	19,7	17,5	2,2	53,4	76,4	-23,0
2	September	16,3	13.6	2,7	75,5	52,5	23,0
0	October	10,4	8,3	2,1	76,9	38,9	38,0
	November	2,2	3,1	-0,9	21,8	32,8	-11,0
	December	2,9	-2,2	5,1	33,8	27,0	6,8
	Average/total annual	**9,5**	**7,7**	**17,6**	**672,7**	**634,4**	**37,9**

During January-February 2021, the temperatures were higher, showing positive deviations of 4.01°C, respectively 0.1°C, and in March there was a decrease in temperature compared to the multiannual average, showing a negative deviation (-0.9°C) (Table 2). The rainfalls showed a negative deviation of -2.4 mm and -16.7 mm, in the same period and in March, the month in which the tested genotypes were sown, the precipitations showed a positive deviation of +10.3 mm.

In April, the rainfall deficit of -10.8 mm was maintained. The average temperature this month was 6.9°C and showed a negative deviation of -1.6°C. It should be mentioned that the ground was not covered with snow, except in limited areas, only between February 12-21, the snow layer was 2 cm thick.

Table 2. Air temperature and rainfalls in 2021 - NIRDPSB Brasov

	Month/ Period	Average air temperature °C			Total rainfall (mm)		
		Accomplished	MAA	Deviations	Accomplished	MAA	Deviations
Year 2021	January	-1,0	-5,0	4,0	23,1	25,5	-2,4
	February	-2,4	-2,5	0,1	7,2	23,9	-16,7
	March	1,7	2,6	-0,9	39,2	28,9	10,3
	April	6,9	8,5	-1,6	39,2	50,0	-10,8
	May	13,8	13,6	0,2	77,5	82,0	-4,5
	June	19,3	16,5	2,8	109,0	96,7	12,3
	July	21,0	18,1	2,9	71,1	99,8	-28,7
	August	19,3	17,5	1,8	100,8	76,4	24,4
	September	12,8	13.6	-0,8	32,0	52,5	-20.5
	October	7,2	8,3	-1.1	30,0	38,9	-8.9
	November	4,6	3,1	1,5	27,5	32,8	-5.3
	December	1,3	-2,2	3,5	45,5	27,0	18,5
	Average/total annual	**8,7**	**7,7**	**1,0**	**602,1**	**634,4**	**-32.3**

The winter hardiness of wheat genotypes sown in autumn 2020 was generally good, the plants entered in winter mostly tillering. This biological process continued in the spring, highlighting variants with a good tillering capacity and increased winter hardiness.
The growth rate (14.04.2021) was evaluated as good and very good (on a scale from 1 to 9; where 1 represents - very resistant and 9 - very sensitive), the values being between 1.5 and 4.
The height of the plants by genotype, started from 82.3 cm to line T.38-16 reaching up to 105 cm to T.7-18 line.
Depending on the degree of precocity, the genotypes heading between May 26 and June 5, 2021.
The number of fertile ears/sqm exceeded 587 ears/sqm toT.53-18 line, reaching up to 685 ears/sqm to T.21-18 line.
The uniformity of the plants indicated very uniform genotypes, rated with note 2 or less uniform, rated with note 5. In general, the uniformity of the field went to notes 2-3 (note 1 representing a very uniform chain and note 9 a very irregular field).
Full maturity, recorded in the first and second decades of July, was influenced by either variety, either by forced maturity due to the heat wave, or delayed due to falling rainfall and high atmospheric humidity, which encouraged certain genotypes in the development of late tillers.
The resistance of plants to falling was high (note 1-2). However, some genotypes showed a slight drop (note 2.5, average value/3 repetitions) due to the high height of the plants or the rains accompanied by strong storms.
The thousand kernel weight (TKW) and the test weight differ from genotype to genotype, being influenced by both climatic factors and variety characteristics.
TKW was between 36 grams and 50 grams (Figure 1), and the test weight was between 58.3 kg/hl - 78.5 kg/hl (Figure 2).

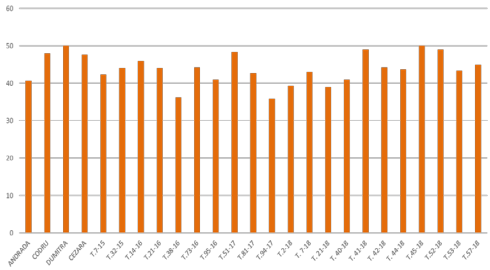

Figure 1. TKW (g) of winter wheat varieties/lines

Many genotypes showed lower values of this index, by not adapting to the unfavorable climatic conditions of the season - maturity milk - soft dough, with periods of rain, alternating with periods of drought and heat, which caused leaf loss and poor grain filling.

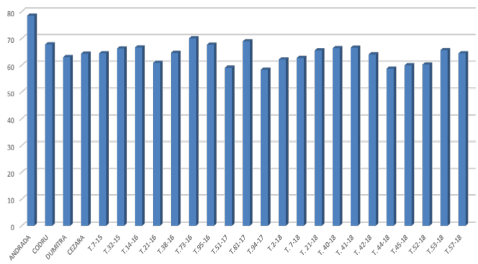

Figure 2. Test weight (kg/hl) of winter wheat varieties/lines

The evaluation of the resistance of the tested plants to the attack of different pathogens, had as starting point the assessments presented by Saulescu et al. (1990): resistance to powdery mildew, in which 1 = resistant and 9 = sensitive; resistant to *Septoria tritici* (scale 1-9); resistant to brown rust (scale 1-9); resistant to yellow rust (scale 1-9).
The climatic year 2020-2021 favored the extension of the **septoria** attack (Figures 3 and 4), which prevented the maintenance of the leaf until physiological maturity and therefore led in

most cases to the decrease of the real production capacity of the experienced genotypes, the resistance to attack being between 2.5 and 8.

Figure 3. *Septoria tritici*

Figure 4. *Septoria nodorum*

The resistance to the attack of **powdery mildew** (Figure 5) was low to medium, showing a lower aggressiveness in the genotypes T.41-18, T.45-18 and higher in the variety Andrada.

Figure 5. *Erysiphe graminis*

To the NIRDPSB Brasov in 2021, the attack of the pathogen ***Puccinia striiformis*** (Figure 6), was present at different levels, differentiating the genotypes in terms of resistance, this being between 1 in the genotype T.57-18 and 5 in the genotype T.7- 18.

The resistance to the attack of **brown rust** was also evaluated (Figure 7) demonstrating the medium to high sensitivity of the genotypes. It is noteworthy that this attack occurred in all variants in the last period of vegetation, on the parts of the leaf left green after the attack of other diseases (yellow rust, powdery mildew, septoria) or on areas left green after the leaf drying due to drought.

Figure 6. *Puccinia striiformis*

Figure 7. *Puccinia recondite*

The attack of *Fusarium* ssp., expressed in % of the number of ears analyzed, was evaluated as low to medium (5-11) or high (20), due to the favorable climatic conditions for the installation of this disease during flowering (Figure 8). The periods with long rains negatively influenced the quality of the grains, the attack being found in all genotypes experienced.

Figure 8. *Fusarium graminearum*

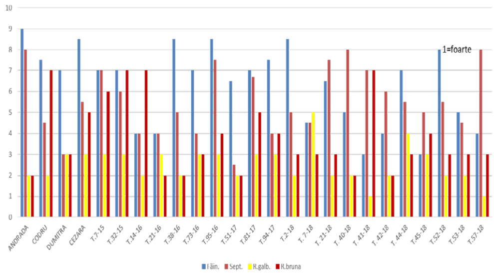

Figure 9. Resistance of autumn wheat varieties/lines to *Blumeria graminis, Septoria nodorum, Septoria tritici, Puccinia recondite* and *Puccinia striiformis attack*

The phenomenon of ear sterility was generally present at a medium level (5-9%). The Dumitra variety and the T.45-18 line with the lowest level of sterility were highlighted (Figure 10).

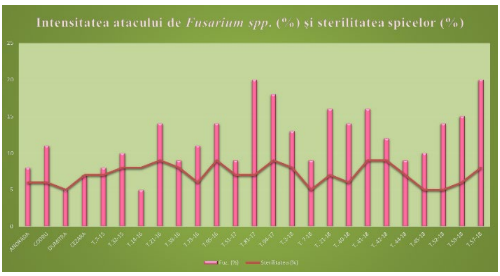

Figure 10. *Fusarium* spp. attack intensity (%) and ear sterility (%)

Yield results were different. On the first place was line T.51-17 with an average yield of 6557 kg/ha, line and on the last place was the line T.21-16 with an average production of 3752 kg/ha. Andrada variety with a yield of 6003 kg/ha, lines T.45-18, T.52-18 and Dumitra variety with yields of 5682 kg/ha, 5590 kg/ha and 5474 kg/ha, respectively, were also noted. (Figure 11).

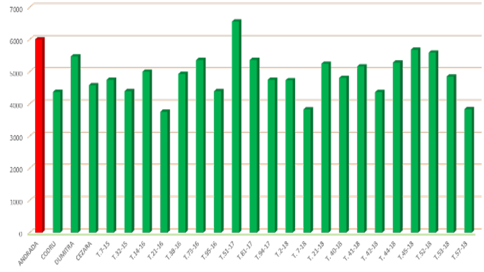

Figure 11. Grain yields (kg/ha) obtained from winter wheat varieties/lines

It can be stated that in the specific conditions of 2020-2021, with a deficit of precipitation in the autumn-winter months, and a thermal regime with differences from the multiannual average, in certain intervals, the tested variants showed a high level of production.

With alfalfa as a precursor plant and a high intake of nitrogen fertilizer, very large yields can be obtained in the area.

In the specific conditions of 2021, the studied varieties/lines gave good results, proving that, due to the increased resistance to wintering and to certain pathogens, we can speak of competitive genotypes at national and international level.

Genotypes have been highlighted that are valuable material, of perspective in the process of creating new varieties with high ecological plasticity, but also with superior quality indices, important in the milling and bakery industry.

CONCLUSIONS

Yield and quality are strongly influenced by the limiting abiotic factors (thermic and hydric stress) manifested during the experimentation period. In the conditions of 2020-2021, with periods of drought accompanied by heat, alternating with periods of low temperatures, excess humidity, the following genotypes were highlighted in winter wheat: line T.51-17 with an average production of 6557 kg/ha, the Andrada variety with an average production of 6003 kg/ha and the T.45-18 line with a production of 5682 kg/ha.

The tested genotypes had a good resistance to wintering, an intense growth rate during spring and different levels of resistance to the attack of foliar and spike diseases, being also present the phenomenon of sterility.

Productivity elements: the number of spike/m^2, the number of grains in the spike, thousand kernel weight (TKW), the test weight, led to the identification of some genotypes of winter wheat with high yield capacity, nationally and internationally competitive. The genotype T.73-16 and the Andrada variety recorded values of 70 kg/hl, respectively 78.5 kg/hl in terms of test weight and the Dumitra variety and the T.45-18 line stood out in terms of TKW (+50 g).

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REFERENCES

Figueroa, M., Hammond-Kosack, K.E., Solomon, P.S. (2018). A review of wheat diseases a field perspective. Molecular Plant Pathology 19(6), 1523–1536.

Marinciu, C. M., Șerban, G., Mandrea, V., & Săulescu, N. (2021). Cultivar and crop management effects on test weight in winter wheat (*Triticum aestivum*). *Romanian Agricultural Research*, *38*. 133–139.

Msundi, E.A., Owuoche, J.O., Oyoo, M.E., Macharia, G., Singh, R.P., Randhawa, M.S. (2021). Identification of bread wheat genotypes with superior grain yield and agronomic traits through evaluation under rust epiphytotic conditions in Kenya. *Sci Rep., 11*. 21415 (https://doi.org/10.1038/s41598-021-00785-7).

Moldovan, V., Kadar, R. & Popescu, C. (2012). Soiul de grâu de toamnă 'Andrada'. AN. I.N.C.D.A. Fundulea, *LXXX*(25), 21–28.

Muntean, L.S., Cernea, S., Morar, G., Duda, M.M., Varban, D.I., Muntean, S. (2008). *Fitotehnie*. Cluj-Napoca, RO: Editura AcademicPres, 92.

Mustățea, P., Săulescu, N.N., Ittu, Gh., Păunescu, G., Voinea, L., Stere, I., Mârlogeanu, S., Constantinescu, E., Năstase, D. (2008). Comportarea unor soiuri de grâu în condiții contrastante de mediu. *Analele INCDA Fundulea*, *LXXVI*. 7–15.

Paul, P.A., McMullen, M.P., Hershman, D.E., Madden, L.V. (2010). Meta-analysis of the effects of triazole-based fungicides on wheat yield and test weight as influenced by fusarium head blight intensity. *Phytopathology, 100*. 160–171.

Roelfs AP, Singh RP & Saari EE (1992). Rust Diseases of Wheat: Concepts and methods of disease management. Mexico, CIMMY, 81.

Săulescu, N.N., Ittu, G.H., Tapu, C., Negulescu, F., Ionescu- Cojocaru, M., Paraschivoiu, R. (1990). Soiul multilineal de grau de toamna Flamura 85. *AN. I.C.C.P.T. Fundulea, LVIII*. 9–19.

Saulescu, N.N., Ittu, Gh., Ittu, Mariana, & Mustatea, P. (2007). Cinci decenii de ameliorare a grâului la Fundulea. *AN. I.N.C.D.A. Fundulea, LXXV*. 55–72.

Săulescu, N.N., Ittu, Gh., Giura, A., Ciuca, M., Mustățea, P., Ittu, Mariana, Șerban, G. & Neacsu, F.A. (2010). Diversificarea bazei genetice ca fundament al progresului în ameliorarea grâului. *AN. I.N.C.D.A. Fundulea, LXXVIII*(l), 7–8.

Shewry, P. R. (2009). Wheat. *Journal of experimental botany*, *60*(6), 1537–153.