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STUDY ON THE ADAPTABILITY OF SOME TRITICALE GENOTYPES TO DIFFERENT CLIMATE AND SOIL CONDITIONS

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Abstract

The paper aims to evaluate the adaptability of 25 triticale genotypes in distinct agro-climatic and pedological conditions using three experimental locations in Romania: ARDS Secuieni, ARDS Turda, and ARDS Piteşti. The study focused on determining the ability of genotypes to adapt to the variability of climatic and soil factors, emphasizing agronomic performance. The analyzed parameters included productivity, resistance to abiotic stress (drought, extreme temperatures), and the protein percentage of triticale grains. The results highlighted significant differences between genotypes in terms of adaptability to the specific conditions of each location, thus identifying genotypes with high potential for stability and productivity in variable environments. These data are relevant for selecting genotypes adapted to the agroecological diversity in Romania and contribute to developing sustainable triticale cultivation strategies.

Key words*: climatic condition, protein content, triticale, yield.*

INTRODUCTION

In recent years, all agricultural areas of Romania have been facing climate change, which significantly impacts agricultural production. Factors such as increasing temperatures, variations in precipitation, frequent droughts, and extreme weather events influence this.

The specialized literature highlights the interdependence between the main factors that influence agricultural production, emphasizing the close connection between biological material (seed, hybrid, variety, genotype, cultivar), the conditions of the crop area (relief, climate, soil), and the technology applied in the crop (Roman et al., 2011; Bîlteanu et al., 1979).

Triticale is distinguished by its ability to produce large quantities of grains and biomass compared to other grassy cereals, even in less favourable climatic and soil conditions. Due to its high adaptability, triticale can successfully replace rye and other cereals on sandy soils. It demonstrates good resistance to acidic soils with low pH and high tolerance to aluminium toxicity and drought. These characteristics have made triticale increasingly appreciated by farmers worldwide, and it is currently a crop in continuous expansion (Paiu, 2023).

In Romania, according to Gașpar and Butnaru (1985), cited by Mogârzan (2012), two cultivation zones are established for the triticale species. The first zone of favourability is represented by soils with low natural fertility, poorly supplied with mobile elements, and high acidity, where triticale ensures higher production increases than wheat, showing tolerance to diseases and the toxicity of aluminium ions.

The second cultivation area is represented by the agricultural land areas that are very favourable for the cultivation of wheat and

barley. In contrast, the triticale species find a less significant place (Mogârzan, 2012).
However, in recent times, due to climate change, the triticale species has expanded into all cultivation areas of Romania, capable of achieving higher production than other grassy cereals.

MATERIALS AND METHODS

To identify the influence of genotype, climate, and soil conditions on production and quality, 25 Romanian winter triticale cultivars were tested in three different crop areas in Romania: the Moldavian Plateau (ARDS Secuieni), the Transylvanian Plateau (ARDS Turda), and the Getic Plateau (ARDS Pitesti).
At A.R.D.S. Secuieni, the experience was located on a cambic chernozem soil type, weakly acidic (pH = 6.14), with a low humus content, poorly supplied with nitrogen, well supplied with phosphorus (77 ppm) and potassium (221 mg/kg) (Enea et al., 2023; Pochiscanu et al., 2017).
Analyzing the temperatures recorded during the vegetation period of triticale species, ARDS Secuieni recorded an average deviation of 5.1°C compared to the multiannual average (7.3°C) for the same period (Figure 1).

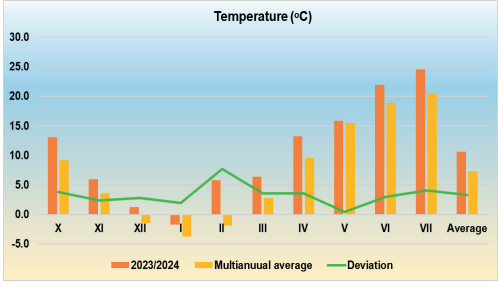

Figure 1. Monthly temperatures and multiannual average recorded at ARDS Secuieni during the vegetation period of the triticale species

February was the warmest month, recording an average temperature of 5.8°C compared to the multiannual average of -1.9°C. The average deviation of 7.7°C characterized February as warm, while May was characterized thermally as usual, with a deviation from the multiannual average of 0.4°C (Figure 1).
Figure 2 shows that at A.R.D.S. Secuieni, the analyzed period was unfavourable to the growth and development of the triticale species because there was a rainfall deficit compared to the multiannual average of -124.4 mm.
The lack of rainfall in the April-May period dried the siblings and pollen, resulting in lower production (Figure 2).

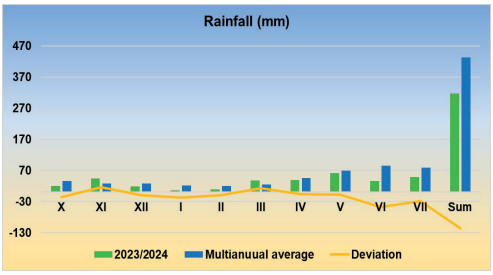

Figure 2. Monthly precipitation and multiannual average recorded at ARDS Secuieni during the vegetation period of the triticale species

At A.R.D.S. Turda, the soil on which the experiment was located is of the chernozem type characterized by an average content in humus (3.36-3.73%), moderate-good in total nitrogen (0.177-0.205%), poor-medium in mobile phosphorus (11-35 ppm) and very good in mobile potassium (220-320 ppm), and the soil reaction is slightly acidic to neutral (pH = 6.6.84) (Chețan et al., 2024).
At ARDS Turda, temperatures recorded during the triticale species' vegetation period deviated from the multiannual average of 3.5°C (Figure 3).

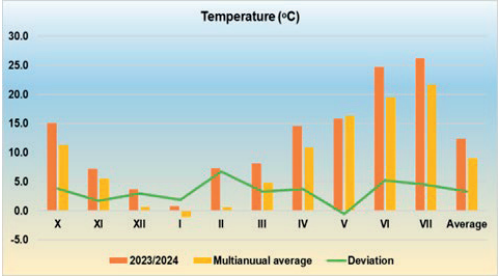

Figure 3. Monthly temperatures and multiannual average recorded at ARDS Turda during the vegetation period of the triticale species

February was the warmest month, with a deviation of 7.6°C compared to the multiannual average, which determined an accelerated start to crop vegetation (Figure 3).

The rainfall regime recorded at A.R.D.S. Turda was dry during the triticale species' vegetation period, with a deviation from the multiannual average of -116.3 mm (Figure 4).

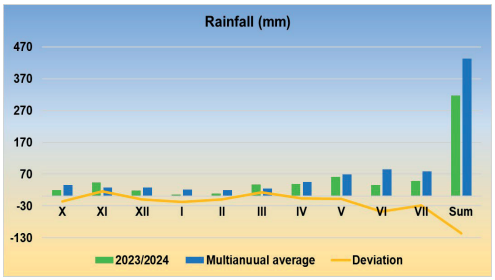

Figure 4. Monthly precipitation and multiannual average recorded at ARDS Turda during the vegetation period of the triticale species

Although precipitation exceeded the multiannual average recorded in November and March, their lack of critical phenophases caused the drying of the siblings and pollen.
The soil at ARDS Pitesti, on which the research was carried out, is a typical luvosol characterized as being poorly supplied with nitrogen (Nt = 0.130% mg/kg) and moderately supplied with potassium (KAL=89 mg/kg); poorly fertile, with a humus content in the arable horizon of 1.96%; acidic, with pH values (in aqueous suspension) of 5.02 (Gheorghe and Ghiorghe, 2024).
At ARDS Pitesti, during the analyzed period, an increase in average monthly temperatures of 3.3°C was recorded compared to the multiannual average (9°C), characterizing the vegetation period of the triticale species as very warm (Figure 5).

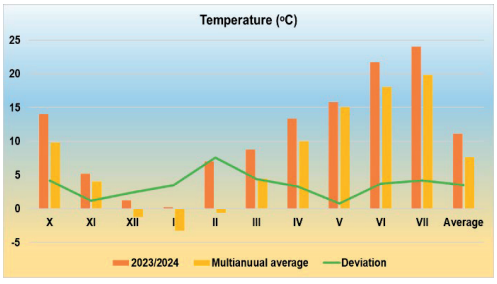

Figure 5. Monthly temperatures and multiannual average recorded at ARDS Pitesti during the vegetation period of the triticale species

As in the other two crop areas, February was the warmest month, with a deviation from the multiannual average of 6.7°C (Figure 5).
Precipitation recorded during the triticale growing season at ARDS Pitești had a negative impact on plant growth and development, with a deviation of -246.2 mm compared to the multiannual average (570.5 mm) (Figure 6).

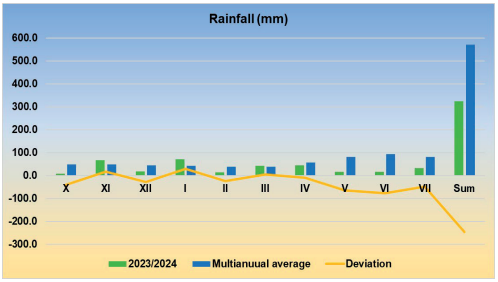

Figure 6. Monthly precipitation and multiannual average recorded at ARDS Pitesti during the vegetation period of the triticale species

The prolonged lack of precipitation starting in April led to a severe drought, causing crop plants to go through the development stages rapidly.
The Utrifun variety was chosen as a control due to its genetic stability, constant agronomic behavior, popularity in the tested crop areas, specific characteristics, and ability to reduce experimental variability. Thus, it provides a reliable reference point for comparing the efficacy and performance of other triticale genotypes.
The results were processed using the variance analysis method.

RESULTS AND DISCUSSIONS

Climate and soil conditions influenced the studied triticale genotypes. The results provide insight into their behaviour in various agroecological conditions, contributing to selecting the most suitable variants for cultivation in the targeted areas.
Thus, under the conditions at ARDS Secuieni, the yields of the studied genotypes ranged between 4767 kg/ha (Negoiu) and 8390 kg/ha (17241T1) (Figure 7).

When the yields obtained by the triticale genotypes were compared with the control, the Utrifun variety, at ARDS Secuieni, the Haiduc and Negoiu varieties obtained yields increases statistically interpreted as negatively significant and negatively distinctly significant, with yields ranging between 4767 kg/ha and 5042 kg/ha (Figure 7).
Yield increases were statistically interpreted as significant at the genotypes 18013T, 18061T, 18339T, and 07320T1 (Figure 7).
The genotypes 16512T2, 16026T1, 17300T1, and 18031T achieved average yields ranging between 7375 kg/ha and 7492 kg/ha. The yield increases were statistically interpreted as distinctly significant compared to the control (Figure 7).
Under the ecological conditions at ARDS Secuieni, the best results were obtained by the Zvelt genotypes, with an average yield of 7933 kg/ha and 17241T1, with an average output of 8390 kg/ha. Compared to the control, the yield increases obtained by these genotypes were statistically interpreted as being very significant (Figure 7).

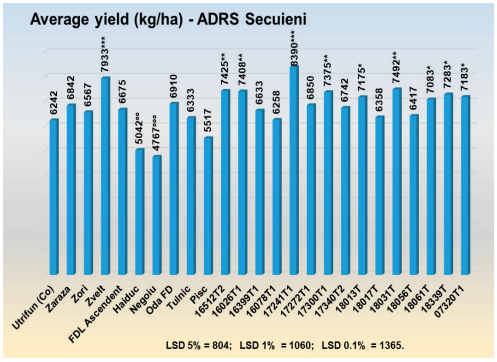

Figure 7. Average yield recorded at ARDS Secuieni

Under the conditions at ARDS Turda, the average yields obtained by the 25 triticale genotypes had values ranging between 5625 kg/ha (Tulnic) and 10158 kg/ha (18061T) (Figure 8).
The yield increases of the Tulnic and Haiduc varieties were statistically interpreted as being negatively significant (5787 kg/ha) and negatively distinctly significant (5625 kg/ha) compared to the experimental control (Figure 8).

Of the total triticale genotypes studied, 12 varieties achieved yield increases statistically interpreted as being very significant (Zaraza, 16512T2, 16399T1, 16078T1, 17241T1, 17272T1, 18013T, 18017T, 18031T, 18056T, 18061T, 18339T) compared to the control (Figure 8).

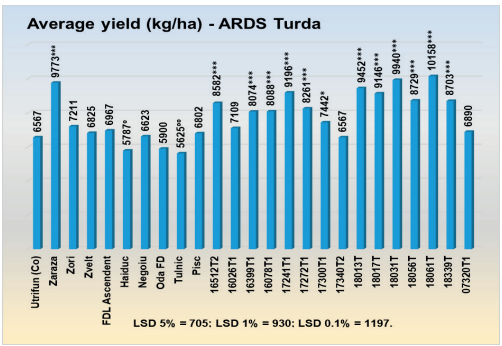

Figure 8. Average yield recorded at ARDS Turda

The agro-climatic conditions of 2024 were not favorable for triticale species under the conditions of ARDS Pitești.
Of the three crop areas, the area of influence of ARDS Pitești was droughty, with a deviation from the multiannual average of -246.2 mm (Figure 6).
The average yields obtained at ARDS Pitești were between 5133 kg/ha (18056T) and 6935 kg/ha (Zvelt) (Figure 9).
Figure 9 shows that most of the genotypes studied achieved yield increases statistically interpreted as negatively very significant compared to the control, the Utrifun variety, which achieved an average yield of 6838 kg/ha.

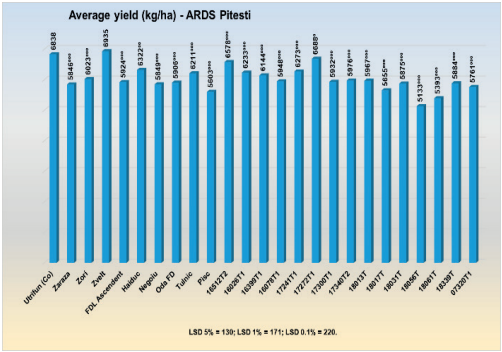

Figure 9. Average yield recorded at ARDS Pitesti

On average, the triticale genotypes studied in the three crop areas achieved yields ranging between 5717 kg/ha (Haiduc) and 7953 kg/ha (17241T1) (Figure 10).
The triticale varieties Haiduc and Negoiu achieved yield increases statistically interpreted as negatively very significant (Figure 10).

Higher yield increases than the control, statistically interpreted as highly significant, were obtained in the variants sown with the genotypes Zaraza, 16512T2, 17241T1, 18013T, 18031T, and 18061T (Figure 10).

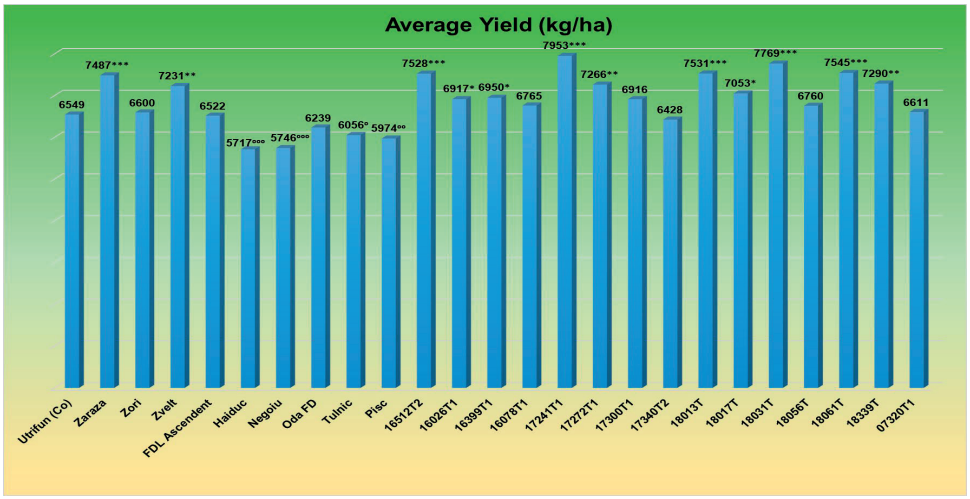

Figure 10. The average yield achieved by the studied triticale genotypes

Protein content is an important indicator of the quality of agricultural products.
Thus, the studied genotypes responded differently depending on the pedo-climatic cultivation conditions.
In the three test centers, the protein content was between 14.6% (16078T1) and 17% (18056T) at ARDS Secuieni, between 9.4% (07320T1) and 11.3% (Tulnic) at ARDS Turda and between 12.4% (Zaraza) and 15.3% (Zvelt) at ARDS Pitesti (Figure 11).
The studied genotypes achieved an average protein content between 12.5% (Zaraza, 07320T1) and 14% (18056T) (Figure 11).

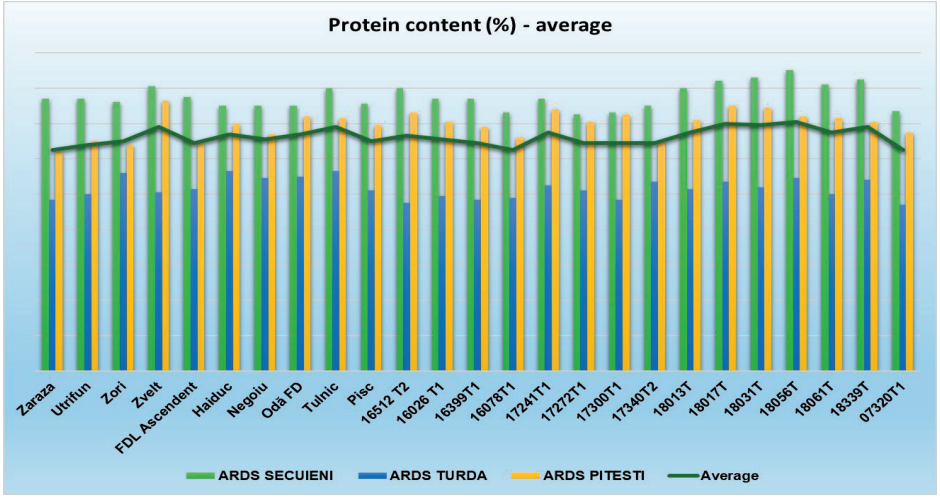

Figure 11. The average protein content obtained by the studied genotypes

CONCLUSIONS

Following the above, we can conclude that drought is occurring in the three crop areas due to high temperatures, which negatively influence crop plant growth and development.
Based on the results, the new triticale genotypes stand out for their high yield capacity. Among the genotypes studied, the 17241T1 line stands out, which achieved an average yield of 7953 kg/ha.
Line 18056 T recorded the maximum average protein content (14.1), and the minimum was recorded in the case of variants sown with the Zaraza variety (12.5%).

ACKNOWLEDGEMENTS

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