RESEARCH ON THE INFLUENCE OF THE PRECEDING CROP ON THE YIELDS OF THE TRITICALE CROP UNDER THE CONDITIONS OF A.R.D.S. SECUIENI

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Abstract

One of the important factors contributing to increased yield is represented by crop rotation, which by alternation can reduce or prevent infestation with weeds, pathogens, plant and soil pests, but can improve the texture and structure of the soil so that the next crop can capitalize these benefits. Considering that the grain yield of straw cereals is influenced by the number of ears per surface unit, the number of grains per ear but also by the individual weight of the grain, this study was carried to determine which preceding crop favorably influences the yiled of grains to the triticale crop. The experience was placed in the experimental field at A.R.D.S. Secuieni, and followed the influence of three preceding plants: soybeans, sunflower and corn on grain yield at two triticale varieties: Haiduc and Utrifun. Following research, the best average yields were obtained when the triticale was cultivated after corn and soybeans. Of the two varieties of triticale, Utrifun stood out for its superior yields, with average values between 6213 kg· ha^{-1} and 8277 kg· ha^{-1}.

Key words: triticale, yields, precedind crop

The cultivation of triticale is a requirement of the current agriculture, which consists of the exploitation of less productive surfaces for wheat and corn, acidic surfaces, affected by drought, waterlogging, and poor in nutrients. Although the main destination of triticale grains is use in animal nutrition, laboratory tests have indicated that it can also be used in baking (in human nutrition), by applying a special technology (Ittu *et al*, 1986, 1988, 2001, 2004).

After a decade of genetic manipulation and breeding, triticale stands out as a crop with high biomass and productivity potential, generally exceeding that of wheat. Its high productivity is most likely derived from high carbon assimilation rates related to stomatal physiology and probably a low respiration rate. Being a derivative of rye, triticale has always been considered to be relatively resistant to abiotic stress. The last review of triticale's adaptation to abiotic stress, published by Jessop (1996), highlighted its general and specific ability to harsh growth and development conditions.

The multi-year results of the field experiments are influenced by the different conditions of the rainfall and thermal regime, as well as by the physical and chemical characteristics of the soil. Climate changes in the last period of time have accentuated these extreme variations, with serious consequences on agricultural production (Săulescu *et al*, 2006).

The triticale species is characterized by the ability to withstand unfavorable biotic and abiotic environmental factors and, as a consequence, by the ability to achieve good yields in marginal regions (Martinek *et al*, 2008).

Triticale (*Triticosecale* Wittmack.) is a potential cereal to provide better yield under wet stress conditions. It performed better than wheat in terms of yield, plant height, and other characteristics with a very high level of resistance to wheat diseases. All this evidence demonstrates that triticale can compete with long-duration cereal crops such as wheat in many situations, including drought. The yield could be increased by selecting plants with taller plant height and more spikelets (Zaheer, 1991).

The potential advantage of triticale over wheat in obtaining biomass and high grain yields was confirmed in a study in Spain (Estrada-Campuzano *et al*, 2012).

It has been reported that triticale can perform better than wheat on poor-quality soil (Kavanagh, 2015, Ayalew *et al*, 2018). To date,

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triticale is mainly grown as a fodder grain, cover crop, and for biogas production (Randhawa *et al*, 2015).

Although triticale contains gluten, it may play a role in the growing health food market due to its health benefits with its good balance of essential amino acids, minerals, and vitamins (Glamoclija *et al*, 2018, Zhu, 2018).

The advantages that this species confers are the ability to achieve high grains yield and biomass in a wide variety of pedoclimatic conditions and with crops technologies with lower inputs compared to other winter cereals. These advantages have made triticale a crop increasingly appreciated by farmers, currently in continuous expansion (Ittu *et al*, 2007).

MATERIAL AND METHOD

The research was carried out during 2022/2023 in the experimental field at A.R.D.S. Secuieni (Agricultural Research and Development Station Secuieni), having the coordinates of 26°5' east longitude and 46°5' north latitude. The soil on which the research was done is a typical cambic chernozeum (phaeozeum), characterized as being well supplied in phosphorus (P2O5 - 39 ppm), calcium and magnesium, medium supplied in active humus (2.3%) and nitrogen and poorly supplied in potassium (K2O - 161 ppm) with a slightly acidic pH of 6.29% (Leonte et. al., 2021).

The purpose of the experience was to establish the influence of the preceding plant on yield and yield indices. To achieve the proposed goal, two varieties of Romanian autumn triticale (Haiduc and Utrifun) cultivated after three different predecessor plants as a botanical family (soybean, corn, and sunflower) were tested.

The cultivation technology, due to the pedological drought that has been manifesting in the last years in the Central area of Moldova, consisted of performing the basic work of the land with the heavy disc, followed by the leveling and shredding of the soil through passes with the combinator. No basic fertilization was applied, and sowing took place in the third decade of October (24.10.2022).

In the last years, climatic conditions led to the accentuation of the pedological drought in the area of influence of the unit, and the period of growth and development of crop plants was characterized as being dry and hot.

The thermal regime recorded during the vegetation period of winter cereals was predominantly warm and very warm.

On average, the temperatures recorded between October 1, 2022 and July 31, 2023 were 2.0ºC higher than the multiannual average (7.3ºC). This deviation is due to the high temperatures in the autumn and winter months, atypical of the area of influence of the unit (*table 1*).

Table 1

Temperatures (ºC) and multiannual average (1962-2022) recorded at A.R.D.S. Secuieni, in the 2022/2023 year

Monthly	X	XI	XII	I	II	III	IV	V	VI	VII	Average
2022/2023	11.5	5.0	0.8	2.4	1.0	6.0	8.1	15.4	19.9	22.6	9.3
Multiannual average	9.2	3.6	-1.5	-3.7	-1.9	2.8	9.6	15.4	18.9	20.4	7.3
Deviation	2.3	1.4	2.3	6.1	2.9	3.2	-1.5	0.0	1.0	2.2	2.0

The conditions for the growth and development of crop plants were negatively influenced by the large rainfall deficit recorded between October 1, 2022 and July 31, 2023, a period characterized as being very dry. The amount of recorded rainfall was 301.9 mm, which is -127.7 mm less than the multiannual amount for the same period, which is 429.6 mm (Table 2).

During the triticale vegetation period, only in April, there was a positive deviation of 24.0 mm compared to the multiannual average (44.9 mm). This deviation was due to the snow cover recorded in the first decade of April (*table 2*).

Table 2

Rainfall (mm) and multiannual average (1962-2022) recorded at A.R.D.S. Secuieni in the 2022/2023 year

Monthly	X	XI	XII	I	II	III	IV	V	VI	VII	Sum
2022/2023	19.8	41.8	19.0	13.2	12.6	7.6	68.9	21.0	29.8	68.2	301.9
Multiannual average	36.9	27.7	25.4	19.6	19.2	26.3	44.9	64.3	84.7	80.6	429.6
Deviation	-17.1	14.1	-6.4	-6.4	-6.6	-18.7	24.0	-43.3	-54.9	-12.4	-127.7

RESULTS AND DISCUSSIONS

One of the most important indices in obtaining high yields is represented by the number of ears per surface unit (Skuodiene R., Nekrošiene R, 2009).

According to Bîlteanu Ghe., (1998), the premise of a high grain yield based on a large number of ears per surface unit must be obtained from more plants, less twinned than, from fewer plants but strongly twinned.

Similar studies on triticale crop were carried out at Moara Domneasca Farm by Dumbrava, M., *et al*, (2016), characterizing the species as being much more adaptable to climatic conditions than wheat and corn, exploiting soil resources differently depending on the predecessor plant.

Taking into account this index, namely the number of ears per square meter, the triticale varieties reacted differently depending on the preceding plant.

The number of ears/square meter was influenced by the preceding plant but also by the variety. The highest density was recorded in the varieties sown after corn and soybeans, with an average of 605 ears/square meter for the Utrifun variety. Also, the lowest density, of only 481 spikes/square meter, was also obtained by the

Utrifun variety, when it was cultivated after the sunflower (*figure 1*).

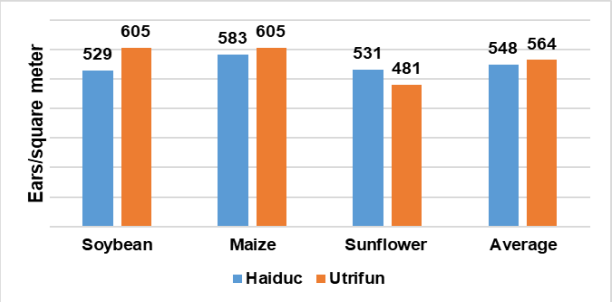

Figure 1 **The number of ears/square meter recorded in two studied triticale varieties**

The grain/ear weight was higher in the case of the varieties sown with the Utrifun variety regardless of the previous crop after which it was grown. The triticale variety Utrifun recorded the highest average value, of 1.45 g/ear in the variant sown after soybeans, and the lowest value was recorded in the case of the variant sown after sunflower, of 1.22 g/ear (*figure 2*).

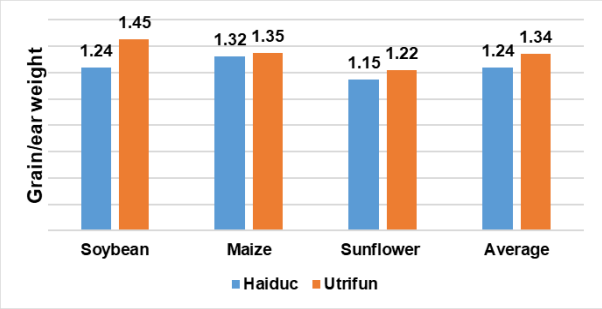

Figure 2 **Grain/ear weight recorded in two studied triticale varieties**

On average, the Utrifun variety obtained higher values in terms of the number of grains per ear. The Haiduc variety registered a number of 37.1 grains/ear in the case of the variant sown after sunflower and the lowest value, of only 33 grains/ear, was recorded in the case of the variant sown after soybeans (*figure 3*).

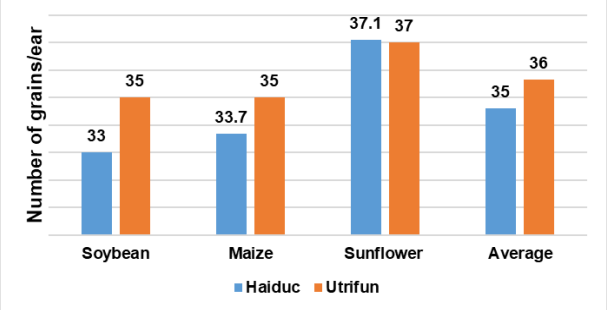

Figure 3 **Number of grains/ear recorded in two studied triticale varieties**

The mass of a thousand grains (TGW) is an important index in the analysis of cereal grains, its values being influenced by the applied technology, variety, and also by climatic conditions.

In the research from A.R.D.S. Secuieni, the TGW had values between 36.5 g (Haiduc) and 40.5 g (Utrifun) (*figure 4*).

The highest values of thousand grain weight (TGW) were obtained in the variants sown after maize in both autumn triticale varieties. The lowest values were obtained in the variants sown after sunflower (*figure 4*).

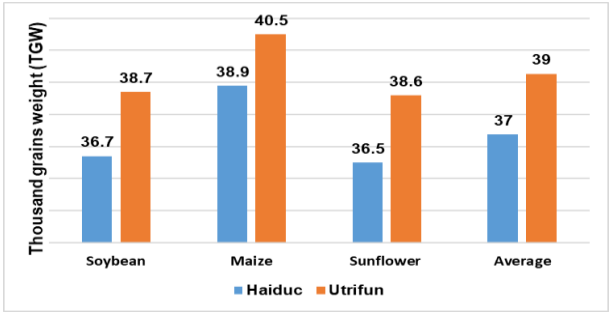

Figure 4 **Average values of thousand grains weight (TGW) obtained by two varieties of triticale**

The hectoliter mass of cereals is currently a very important indicator for the milling industry because in the milling units, the total extraction of flour is established according to the value of this indicator. Although the triticale crop is not yet known for its use in baking, it is still used to obtain flour pasta and biscuits.

In the bakery industry, it is known that wheat intended for obtaining flour must have a hectoliter mass of at least 78 kg/hl. In the specialized literature, it is known that the hectoliter mass of triticale has values between 70-76 kg/hl, but as can be seen in *figure 5*, by using a favorable precursor plant this index can reach higher values, as in the case of the Utrifun variety grown after soybeans.

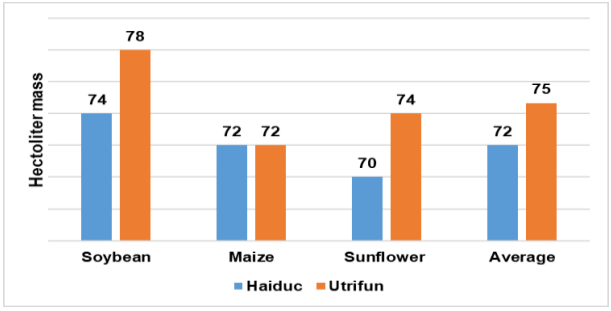

Figure 5 **Hectoliter mass recorded in two varieties of triticale**

The grain yield is influenced by the crop technology applied, the variety but also by the climate and soil conditions.

The yields obtained in the 2022/2023 year at A.R.D.S. Secuieni had values between 5463 kg ha^{-1} and 8277 kg ha^{-1} (*figure 6*).

The highest grain yields were obtained, on average, in the case of variants sown after corn. The highest grain yield was obtained by the Utrifun variety, of 8277 kg ha^{-1} in the case of the variant sown after soybeans, and the lowest production was achieved in the variants sown after sunflower of 6213 kg ha^{-1} (*figure 6*).

The Haiduc variety obtained lower average yields than the Utrifun variety, of 6258 kg ha^{-1}. The highest average grain yield of the Haiduc variety was obtained in the varieties sown after corn (7263 kg ha^{-1}) and the lowest average yield was obtained in the case of the varieties sown after sunflower (5463 kg ha^{-1}) (*figure 6*).

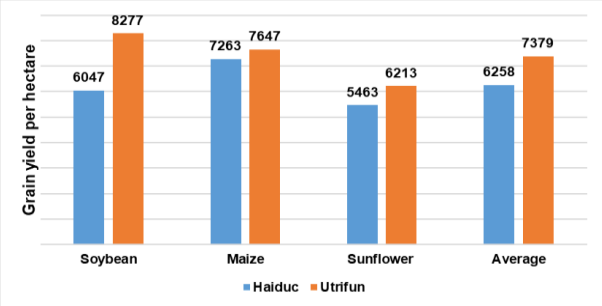

Figure 6 **Grain yield per hectare obtained according to the predecessors plant**

CONCLUSIONS

Following the results obtained, we can draw the following conclusions:

- the 2022/2023 year was characterized as very hot and dry during the vegetation period of winter cereals, and the snow in the first part of April negatively influenced the yields obtained;
- grain yield is influenced by the variety, and the climatic conditions, but also to a large extent by the preceding plant;
- the Utrifun triticale variety has the ability to obtain higher grain yields regardless of the preceding plant;
- soybean or corn crops can be used as a precursor plant to obtain higher yields;
- the lowest grain yields were obtained in the variants sown after sunflower (5463 kg ha^{-1}), therefore crop rotation must be taken into account.

REFERENCES

Ayalew, H., Kumssa, T.T., Butler, T.J.; Ma, X.-F., 2018 – *Triticale Improvement for Forage and Cover Crop Uses in the Southern Great Plains of the United States*. Front Plant Sci. 9, 1130.

Bîlteanu, Ghe., 1998 – *Fitotehnie, Editura Ceres, București*

Dumbravă. M., Ion, V., Epure, L.I., Băşa, A.G., Ion, N., Duşa, E.M., 2016 – *Grain yield and yield components at triticale under different technological conditions*. Agriculture and Agricultural Science Procedia, 10, 94-103.

Estrada-Campuzano, G., Slafer, G.A., Miralles, D.J. 2012 – *Differences in yield, biomass and their components between triticale and wheat grown under contrasting water and nitrogen environments*. Field Crops Res. 128:167–179.

Glamoclija, N., Starcevic, M.; Ćirić, J.; Sefer, D.; Glisic, M.; Baltic, M.; Markovic, R.; Spasic, M.; Glamoclija, D., 2018 – *The importance of triticale in animal nutrition*, VL 18 Veterinary. J. Repub. Srp. (Бања Лука-Banja Luka). 18, 73–94.

Ittu, Gh., Săulescu, N.N., Tapu, C., Ceapoiu, N., 1986 – *Triticale variety TF2 (xTriticosecale Wittmack)*. Annals of ICCPT Fundulea, LIV: 43-55.

Ittu, Gh., Săulescu, N.N., 1988 – *Improving tolerance to aluminum toxicity in triticale*. Applied theoretical genetic problems, XX (2): 67-74.

Ittu, Gh., Săulescu, N.N., Ittu, Mariana, Mustăţea, P. 2001 – *Advances in triticale breeding programm from R.I.C.I.C*. Fundulea. Romanian Agricultural Research, 16: 1-4.

Ittu, Gh., Săulescu, N.N., Ittu, M., Mustăţea, P., 2004 – *Soiul de triticale Stil (xTriticosecale Wittmack).* An. INCDA. Fundulea, LXXI: 17-25.

Ittu, Gh., Săulescu, N.N., Ittu, Mariana, Mustăţea, P. 2007 – *Achievements in triticale breeding (x Triticosecale Witt.).Annals of N.A.R.D.I.* Fundulea, LXXV: 73 – 82.

Jessop, R.S., 1996 – *Stress tolerance in newer triticales compared to other cereals*. In: Guedes-Pinto, H., Darvey N., Carnide, V.P. (eds), Triticale: Today and Tomorrow. Developments in Plant Breeding. Kluwer Academic Publishers, Dordrecht, The Netherlands, 419–428.

Kavanagh, V.; Hall, L., 2015 – *Biology and Biosafety; Triticale*, Ed.; Springer: Berlin/Heidelberg, Germany, 3–13.

Leonte, A., Agapie, A., Pintilie, P.L., Druțu, A.C., Amarghioalei, G., Eșanu, S., 2021 - *Research regarding the influence of nitrogen and phosphorus fertilizers on winter wheat, in the pedoclimatic conditions in Central of Moldavia*. Journal Life Science and Sustainable Development, 2(2), 52–57

Martinek, K., Vinterova, M., Buresova, I., Vyhnanek, T., 2008 – *Agronomic and quality characteristics of triticale (x Tricosecale Wittmack) with HMW glutenin subunit*s 5+10. Journal of Cereal Science, 47: 68-78.

Randhawa, H.; Bona, L.; Graf, R., 2015 – *Triticale Breeding Progress and Prospect;* Triticale, E.F., Ed.; Springer: New York, NY, USA, 15–32.

Săulescu, N.N., Ittu, G., Mustăţea, P., Păunescu, Gabriela, Stere, Ioana, Nistor, Gh., Rînchiţă, L., Voinea, I., 2006 – *The behavior of some Romanian winter wheat varieties in contrasting conditions of water supply*. Problems of theoretical and applied genetics, XXXVIII, 1-2: 21-29.

Skuodiene, R., Nekrošiene, R, 2009 - *Effect of preceding crops on the winter cereal productivity and diseases incidence*, Acta Agriculturae Slovenica, Volume 93, Issue 2, 2009, Pages 169-179

Zaheer, A., 1991 – *Co-heritability among yield and yield components in wheat*. Sarhad J. Agric., 7(1): 65-67.

Zhu, F., 2018 – *Triticale: Nutritional composition and food uses.* Food Chem. 2018, 241, 468–479.