ANALYSIS OF CROP ELEMENTS OF TRITICALE TREATED WITH POULTRY MANURE

Edit Kosztyuné Krajnyák[1] – István Henzsel[2] – Shukhrat Shokirov[3] – Ilhom Abdurahmanov[3] – Mukhitdin Akbarov[3] – Zokhid Mamatkulov[3] – Ulugbek Kuziev[3] – Khojiakbar Khasanov[3] – Nozimjon Teshaev[3] – Khakberdiev Obid[3] – Khafizova Zulfiya[3] – Susana Mondici[4] – Ioan Radu Şugar[5] – Dominik László Sztojka[1] – Béla Szabó[1] – Eszter Petró Hajnal[1] – Judit Csabai[1]

[1]University of Nyíregyháza, Institute of Engineering and Agricultural Sciences, Department of Agricultural Sciences and Environmental Management, H-4400 Nyíregyháza, Sóstói Str. 31/b
e-mail: krajnyak.edit@nye.hu

[2]University of Debrecen, IAREF, Research Institute of Nyíregyháza,
H-4400 Nyíregyháza, Westsik Vilmos Str. 4-6.
henzsel6@gmail.com

[3]Department of Geodesy and Geoinformatics, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers (TIIAME) - National Research University, Tashkent, Uzbekistan

[4]Agricultural Research and Development Station (ARDS) Livada, 7 Baia Mare Street, Livada, Romania.
e-mail: scdalivada@yahoo.com

[5]Department of Engineering and Technology Management, Faculty of Engineering, Northern University Center of Baia Mare, Technical University of Cluj-Napoca, 62A Victor Babes Street, 430083 Baia Mare, Romania;
e-mail: ioan.sugar@imtech.utcluj.ro

https://doi.org/10.71066/FTTMK.2.05

Introduction

The domestic significance of triticale is defined by its ability to be reliably cultivated even on poor-quality, acidic soils. While for many decades it was comparable to rye in this regard, modern breeding has resulted in significantly higher yield potential, while maintaining excellent tolerance to extreme weather conditions and water scarcity. These characteristics justify investigating fertilization strategies that simultaneously increase yield, improve grain quality, and promote long-term soil sustainability. Our study aimed to determine whether granulated poultry manure (PM) offers a viable alternative to conventional mineral fertilizers and what practical conclusions can be drawn regarding its application in cultivation technology.

Literature review

Triticale (×*Triticosecale*) is an artificial hybrid created in Europe in the 1870s by crossing wheat and rye; it became a widely cultivated crop starting in the 1950s (Biczó, 2012). The primary goal of breeding was to develop a cereal that combined high protein content and baking qualities with stress tolerance – such as cold and drought resistance and stable yields on poorer soils (Benedek & Kiss, 2017). Triticale is cultivated primarily as a feed crop. Due to its high protein content (11–13%) and favorable amino acid composition –particularly its high lysine and methionine levels – it serves as a valuable ingredient in swine and poultry feed (Szalai et al., 2018). Furthermore, triticale plays an increasingly important role in climate change adaptation, as it is capable of delivering stable yields despite shifting precipitation patterns and rising temperatures (Oláh et al., 2021; Soós & Makszim, 2024). Poultry manure plays a key role in sustainable crop production, as it offers a unique combination of macro- and micro-nutrients and organic matter that stimulates soil biological activity. In the cultivation of cereals – including triticale – the application of poultry manure not only increases crop yields but also improves nutritional quality (Szabó, 2019; Makszim, 2021). Grain development results from the coordinated progression of vegetative and reproductive growth stages. In the case of triticale, the following phenophases play a decisive role:

- Tillering: The main shoots and lateral shoots develop during the plant's initial vegetative stage; later, they form the basis of the spikes (Horváth & Papp, 2020).

- Spike development: At the beginning of the reproductive stage, the development of the spikes and the formation of grain primordia commence. The number of spikes depends largely on nutrient availability, particularly the amount of nitrogen (Smith et al., 2020).
- Grain formation: The number and quality of grains within the spike are determined. The effect of fertilization is particularly significant at this stage, as nitrogen and phosphorus promote the full development of the grains (Benedek & Kiss, 2017).
- Ripening: The final mass and internal quality characteristics of the grains develop during this stage. Nutrient availability, water and light conditions, as well as environmental stress factors, directly influence crop quality (Lipiec et al., 2021).

Triticale yield components serve to measure quantitative and qualitative parameters and are directly linked to cultivation technology and fertilization:

- Number of spikes: The number of spikes per plant unit depends on tillering and nutrient supply. High-nitrogen fertilization generally results in a greater number of spikes (Smith et al., 2020).
- Grain number: The number of developing grains within a spike directly influences yield. Optimal nitrogen and phosphorus supply enhances full grain development (Horváth & Papp, 2020).
- Thousand-kernel weight: Thousand-kernel weight indicates the individual mass of the grains and is an important quality indicator. The application of organic fertilizers, particularly poultry manure, generally increases the thousand-kernel weight (Benedek & Kiss, 2017).
- Grain yield: The actual yield resulting from the combination of the number of spikes and the number of grains. Adequate nutrient supply and a stress-free environment increase grain yield (Antal, 2009).

The yield potential of triticale is favorable: in Hungary, the average yield is 4–7 t ha^{-1}, but higher yields can be achieved in good years and with favorable nutrient supply (Kovács, 2017).

Materials and methods

We established our experiment at the University of Nyíregyháza's experimental farm, on a 10-ha experimental field over two consecutive growing seasons (2023/2024 and 2024/2025). The crop used in the experiment was the 'GK Maros' triticale variety. Developed by Gabonakutató Nonprofit Kft., 'GK Maros' is known as a medium-early maturing variety with high yield potential and good winter hardiness. Due to its excellent adaptability to the local continental climate, it is frequently selected for both experimental and commercial cultivation (Gabonakutató Nonprofit Kft., 2023).

Half of the experimental field (5 ha) was treated in the autumn, prior to sowing, with granulated poultry manure (Bio-Fer Natur™). Bio-Fer Natur™ is manufactured and distributed by Baromfi Coop Kft. The fermented poultry manure (PM) has an NPK content of 4-3-3% (w/w), meaning it provides 40 kg ha^{-1} of nitrogen, 30 kg ha^{-1} of phosphorus, and 30 kg ha^{-1} of potassium (based on the application rate of 1 tonne ha^{-1} used in the experiment). During the production of Bio-Fer Natur™ (Baromfi Coop Kft., 2023), fresh poultry manure undergoes a controlled microbiological fermentation process in an enclosed environment. In this process, natural bacterial cultures (primarily *Bacillus* and *Lactobacillus* strains) partially break down the organic matter, thereby reducing ammonia emissions and unpleasant odors.

Fermentation stabilizes organic matter, eliminates pathogenic microorganisms, and improves the rate of nutrient availability in the manure. The resulting product has a uniform structure – either granular or finely crumbly – making it easy to apply with spreading equipment, and it exerts its effect when incorporated into the soil. Bio-Fer Natur™ has a high organic matter content (60–70%); consequently, it boosts the soil's humus content, which helps enhance microbial activity.

During the study, all operations (soil preparation, sowing, crop maintenance, and harvesting) were carried out in the same way in both years under investigation, so that the effect of fertilization could be clearly evaluated.

The experimental plots were harvested on June 27, 2024, and June 30, 2025. Plant samples were collected in five replicates from randomly selected 1 m² areas within both the poultry manure-treated and control plots. The triticale plants were cut at a stubble height of 10 cm and then bundled. Following drying, the collected plant samples (5 treated, 5 control) were processed at the Crop Production Laboratory of the University of Nyíregyháza. The spikes were separated from the triticale stems, and the above-ground biomass was measured. During the measurement of yield components, the number of spikes was counted. A manual thresher was used to thresh the triticale spikes. After threshing, the grain mass and thousand-kernel weight were measured.

In presenting the background of the experimental methodology, we considered it important to outline the soil and climatic characteristics of the study years. Due to their mode of formation, the acidic sandy soils of the Nyírség region are generally poor in humus, colloids, and nutrients. Their humus content typically ranges from 0.5% to 2.0%, with values exceeding 2.0% considered high. Furthermore, the low pH (4.0–5.4) hinders nutrient retention and uptake by plants. The sandy soil under study is characterized by low water-holding capacity, though its good aeration favors root development. The soil warms up rapidly, resulting in quick germination following sowing. The region features a temperate continental climate, which is generally favorable for the cultivation of small-grain cereals.

The annual average temperatures during the years under study (Table 1) exceeded the long-term average (9.7 °C), ranging from 11.5 °C to 13.2 °C. Throughout the August-to-July period, recorded temperatures were – almost without exception – above the long-term average. The years examined were warmer than average, resulting in more rapid development for the triticale. Autumn temperatures promoted good emergence and the onset of tillering, while higher spring temperatures favored vigorous plant growth. The 2023/2024 and 2024/2025 growing seasons in the Nyírség region were characterized by a long, warm autumn and a mild winter, with only a few brief spells of frost. Weather conditions favored the overwintering of autumn-sown cereals, including triticale. The gradual warming between February and March enabled early plant development.

Table 1. Temperature data for the years under study and the long-term average (1870–2002) in Nyíregyháza

Months	**2023-2024**	**2024-2025**	**Multi-year average (1870-2002)**
August	22.7	23.9	19.8
September	19.1	18.3	15.5
October	13.4	10.6	9.9
November	5.6	3.0	4.2
December	2.5	2.2	-0.4
January	1.0	2.6	-2.4
February	7.8	0.0	-0.1
March	9.4	7.8	4.6
April	13.7	12.8	10.7
May	17.5	14.1	15.9
June	21.2	22.1	19.0
July	24.1	21.1	20.6
Average	**13.2**	**11.5**	**9.7**

Source: University of Nyíregyháza Ferenctanya - Meteorological Station, Multi-year average (1870-2002) (OMSZ, 2024)

A comparison of precipitation data recorded during the growing seasons of the years under study (Table 2) reveals that the annual precipitation totals (623.2–694.9 mm) significantly exceeded the long-term average (564.5 mm), with an excess of more than 60–130 mm. Significant differences were observed in the monthly distribution of precipitation. In the 2023/2024 season, lower autumn precipitation was recorded (6.4 mm, 30.8 mm, and 76 mm), resulting in sluggish germination and shoot growth; conversely, in the autumn of 2024/2025, substantial rainfall occurred in September and October (149 mm and 102.6 mm), which favorably influenced the initial development and growth of the triticale. In the spring of 2025, high precipitation levels were recorded in March (95.2 mm) and May (66.9 mm), greatly promoting spring shoot growth and tillering. Unfortunately, the spring of 2024 began with low precipitation, which had a severe impact on stem elongation and tillering effects that subsequently manifested in both vegetative and reproductive development.

Table 2. Precipitation data for the years under study and the long-term average (1870–2002) in Nyíregyháza

Months	**2023-2024**	**2024-2025**	**Multi-year average (1870-2002)**
August	5.0	16.0	65.0
September	6.4	149.0	43.0
October	30.8	102.6	44.0
November	76.0	50.2	46.5
December	113.6	18.2	40.5
January	45.0	38.2	29.5
February	10.4	26.0	30.0
March	13.4	95.2	30.0
April	49.8	13.9	39.5
May	65.8	66.9	54.0
June	182.4	17.7	76.0
July	24.6	101.0	66.5
Total	**623.2**	**694.9**	**564.5**

Source: University of Nyíregyháza Ferenctanya - Meteorological Station, Multi-year average (1870-2002) (OMSZ, 2024)

Results and their evaluation

Small-plot trials conducted during the 2023/2024 and 2024/2025 seasons provided an opportunity to evaluate the effect of poultry manure treatment on triticale under two different sets of environmental conditions. The amount and distribution of precipitation during the 2023/2024 growing season had an adverse effect on triticale development. In contrast, the more favorable precipitation distribution of the 2024/2025 season – as reflected in the meteorological data – allowed the effect of the poultry manure to manifest more markedly.

Table 3 presents the above-ground biomass – measured across five replicates from 1 m² plant samples – for our small-plot field experiment over the two years studied. Data from the 2023/2024 season clearly demonstrate that, under unfavorable precipitation conditions, the above-ground biomass in poultry manure-treated plots declined, averaging 561.7 g. That year, the average results for the control plot exceeded those of the poultry manure-treated plots (636.5 g) by more than 13%. Based on the results from the 2024/2025 growing season, it was found that the average above-ground biomass of the control plot samples (across five replicates) nearly reached 800 g. In contrast, the poultry manure-treated samples produced an average above-ground biomass of nearly 1,300 g.

In the 2023/2024 season, the poultry manure treatment produced 11.8% lower biomass than the control plot (561.7 g vs. 636.5 g). From a technical standpoint, this can be attributed to the low precipitation, which prevented the poultry manure from breaking down and becoming available to the plants. In the 2024/2025 season, the effect of the poultry manure became evident, resulting in a 60% increase compared to the control (1,273.6 g vs. 793.9 g); the nutrients in the manure had become accessible to the triticale. This indicates that weather conditions in the second year were far more favorable for the triticale than in the first.

Table 3. Analysis of above-ground biomass (g) in control and treated plots during the 2023/2024 and 2024/2025 growing seasons (per 1 m², with 5 replicates)

	Above-ground biomass (g) 2023/2024					
Number of replicates	1.	2.	3.	4.	5.	Average (g)
Control plot	384.7	154.1	1 135.9	675.2	832.7	636.5
Treated plot (PM)	410.9	327.1	657.7	683.7	729.3	561.7
	Above-ground biomass (g) 2024/2025					
Number of replicates	1.	2.	3.	4.	5.	Average (g)
Control plot	820.4	767.8	705.2	721.3	955.0	793.9
Treated plot (PM)	1 508.2	815.1	1 394.4	1 527.5	1 122.9	1 273.6

The results regarding yield components are summarized in Table 4. In the 2023/2024 growing season, the effect of the poultry manure treatment was not observed. The average number of spikes was 254.4 in the control plots, whereas 245.4 were counted in the treated plots. A difference was noted in grain weight: compared to the control's average of 229.6 g, the area treated with poultry manure yielded 205.2 g. Regarding thousand-kernel weight, average values slightly exceeding 38.0 g were measured in both cases (control and treated); however, the poultry manure treatment did not yield a positive effect.

In the 2024/2025 growing season, the average number of spikes harvested from the control plot across five replicates was 283.6, whereas in the plot treated with poultry manure, it was nearly double that figure at 555.8. Measurements of grain mass obtained after threshing showed that the poultry manure-treated plot outperformed the control plot, with an average yield of 546.0 g compared to 314.7 g. Although no major difference was observed regarding the thousand-kernel weight, the manure treatment did result in a higher thousand-kernel weight (44.9 g) for the triticale seeds. For all parameters examined, the results clearly demonstrated that poultry manure increased the number of spikes, grain mass, and thousand-kernel weight.

Table 4. Analysis of yield components in control and treated plots for the 2023/2024 and 2024/2025 growing seasons (per 1 m², with 5 replicates)

	Control plot 2023/2024					
Number of replicates	1.	2.	3.	4.	5.	Average
Number of spikes (pcs)	209	221	295	249	298	254.4
Seed weight (g)	154.5	60.5	360.8	263.2	308.2	229.4
Thousand-kernel weight (g)	32.3	33.4	46.1	39.2	41.6	38.5
	Treated plot (PM) 2023/2024					
Number of spikes (pcs)	216	273	262	221	255	245.4
Seed weight (g)	173.7	99.3	233.5	252.5	267.0	205.2
Thousand-kernel weight (g)	38.7	32.2	39.8	39.7	40.5	38.2

	Control plot 2024/2025					
Number of replicates	1.	2.	3.	4.	5.	Average
Number of spikes (pcs)	282	286	223	285	342	283.6
Seed weight (g)	259.3	355.8	282.5	288.5	387.4	314.7
Thousand-kernel weight (g)	44.6	44.5	43.4	44.0	47.2	44.7
	Treated plot (PM) 2024/2025					
Number of spikes (pcs)	554	447	387	530	861	555.8
Seed weight (g)	627.9	338.8	647.1	657.7	458.5	546.0
Thousand-kernel weight (g)	40.1	39.4	53.9	47.2	43.7	44.9

After analyzing the yield components, yield was estimated by extrapolating the 1 m² plot data to a per-hectare basis. The table below (Table 5) presents the results of the 1 m² small-plot experiment, extrapolated to a 1-hectare basis.

Based on data from the 2023/2024 growing season, the control plot showed better results than the treated area. The estimated yield for the control area, calculated on a per-hectare basis, approached 2.3 tonnes ha^{-1}. For the plot treated with poultry manure, the estimated yield was lower than that of the untreated plot (2.052 tonnes ha^{-1}). Data from the 2024/2025 growing season show significant improvement compared to the previous year. The plot treated with poultry manure produced a yield more than 2.3 tonnes ha^{-1} higher (5.46 tonnes ha^{-1}) than the control plot (3.147 tonnes ha^{-1}). That year, the poultry manure treatment proved highly effective, resulting in a higher yield compared to the control.

Table 5: Analysis of estimated yield results for the 2023/2024 and 2024/2025 growing seasons in control and treated plots

	2023/2024 growing season	
	Seed weight per m² / average of 5 replicates	Estimated yield
Control plot	229.6 g	2.296 tonnes ha^{-1}
Treated plot (PM)	205.2 g	2.052 tonnes ha^{-1}
	2024/2025 growing season	
	Seed weight per m² / average of 5 replicates	Estimated yield
Control plot	314.7 g	3.147 tonnes ha^{-1}
Treated plot (PM)	546.0 g	5.460 tonnes ha^{-1}

Conclusions

The effect of poultry manure on crop yields is well known. However, previous observations have shown fluctuations in its effectiveness. Earlier experiments also suggested that the impact of poultry manure varies depending on weather conditions and soil parameters (Irinyiné et al., 2019; Csabai et al., 2020, Csabai et al., 2022). In areas with unfavorable soil conditions and a constant risk of drought, organic triticale cultivation can yield between 1.1 and 2.8 tonnes ha^{-1} (Kosztyuné, 2023).

The spring drought of the 2023/2024 season inhibited the tillering process, thereby limiting the effectiveness of the fertilizer. Nutrient release and plant uptake are substantially reduced under water-deficient conditions.

The 2024/2025 growing season was wetter than average, with precipitation exceeding the long-term average by more than 130 mm. Rainfall during the autumn months had a beneficial effect on the initial growth and development of the triticale. In the spring, the heavy rainfall in March favored shoot growth and tillering. The effect of the poultry manure was evident in both above-ground biomass production and yield formation. These findings indicate that, given the wetter-than-average conditions, the poultry manure mineralized effectively and exerted a strong influence, as the above-ground biomass and yield components significantly exceeded the values measured in the control plots. However, further studies and a higher number of replicates are required to fully assess the impact of poultry manure in relation to weather conditions, soil quality parameters, and long-term application.

Summary

Our study aimed to examine the effect of fermented poultry manure on triticale during the 2023/2024 and 2024/2025 growing seasons and to determine the crop's above-ground biomass and yield components. Overall, a comparison of the results from the two years indicates that the effectiveness of poultry manure depends primarily on precipitation distribution. The spring drought of 2023/2024 inhibited shoot growth, tillering, and both vegetative and reproductive development, whereas the balanced and abundant rainfall of 2024/2025 favored above-ground biomass accumulation and yield components, resulting in a significant increase in yield. The findings demonstrate that the effectiveness of organic fertilization depends on environmental conditions that support nutrient release and uptake.

Keywords: triticale, poultry manure, yield components, biomass

Acknowledgements

The presentation received support from project 2022-1.2.2-TÉT-IPARI-UZ-2022-00023, AL-6222052520 "Supporting organic and conventional farming with Geospatial methods, "funded by the NKFI (NRDI), Hungary and Innovative Development Agency, Uzbekistan.

References

Antal, J. (2009). Növénytermesztéstan I. Mezőgazda Kiadó, Budapest.

Baromfi Coop Kft. (2023). Bio-Fer Natur™ fermentált baromfitrágya – Termékleírás és műszaki adatlap. Debrecen. Elérhető: http://bio-fer.hu/bio-fer-natur/

Benedek, P. & Kiss, T. (2017). A tritikálé termesztése és felhasználása. AgrárUnió, Budapest.

Biczó, I. (2012). A tritikálé termesztése és jelentősége Magyarországon. DE MÉK Közlemények, Debrecen.

Csabai, J., Irinyiné Oláh, K., Gonda, V., Márta-Kergyik, É., Cziáky, Z., Tarek, M., Aka Sağliker, H., Klimiene, A., Petrus, A. & Mészáros, O. (2020). Relation-analysis, between the yield, capsaicin content, using different nutrient supplementation methods at cultivation various chili peppers. In Complex rural economic development and sustainability research, development of the service network in the Carpathian basin: proceedings of the intarnational scientific conference Nutriment-farming researches at University of Nyíregyháza, EFOP-3.6. 2.-16-2017-00001: Nyíregyháza, Hungary, March 12, 2020 (pp. 7-14). Nyíregyháza: University of Nyíregyháza.
https://hdl.handle.net/20.500.14172/2973

Csabai, J., Braun, B., Hörcsik Zs, T., Kolesznyk, A., & Irinyiné Oláh, K. (2022). Alternatív trágyaszerek és szerkezetjavító anyagok hatása, a talaj fizikai és kémiai tulajdonságaira. Bujdosó, Zoltán (szerk.) XVIII. Nemzetközi Tudományos Napok [18th International Scientific Days]: A „Zöld Megállapodás"–Kihívások és lehetőségek. Gyöngyös, Magyarország: Magyar Agrár-és Élettudományi Egyetem Károly Róbert Campus, 122-128.

Gabonakutató Nonprofit Kft. (2023). GK Maros tritikálé – fajtaismertető. Szeged.
Elérhető: https://www.gabonakutato.hu

Horváth, Z. & Papp, Z. (2020). Kalászos gabonák agrotechnikája és tápanyagellátása. Agrártudományi Közlemények, 79(1), 45–53.
Irinyiné Oláh, K., Lipcsei, D., Ragány, B., Aka Sağliker, H., Cziáky, Z., Vigh, Sz., Tarek, M. & Csabai, J. (2019). Szerves trágyaszerek és talajjavító anyagokhatása a chili paprika növekedés-dinamikájára. „Komplex vidékgazdasági és

fenntarthatósági fejlesztések kutatása, szolgáltatási hálózatának kidolgozása a Kárpát-medencében" EFOP-3.6.2.-16-2017-00001 azonosító számú projekt Tápanyagutánpótlás a fenntartható homoki gazdálkodásban szakmai konferencia. March 27, 2019 (pp 1-6.)

Kosztyuné Krajnyák, E. (2023). Szöszös bükköny (*Vicia villosa* Roth.) jelentősége a fenntartható homoki gazdálkodásban (The importance of the hairy vetch (*Vicia villosa* Roth) in sustainable sand management) Thesis. University of Debrecen

Kovács, G. (2017). A tritikálé termesztéstechnológiai fejlesztése hazai viszonyok között. Agrofórum Extra, 66, 45–50.

Lipiec, J., Kus, J. & Nosalska, A. (2021). Nitrogen and water interaction effects on triticale yield components. Plant, Soil and Environment, 67(5), 235–243.

Makszim Györgyné Nagy, T. (2021). A területfejlesztés aktuális kérdései Szabolcs-Szatmár-Bereg megyében. In Tóth, C. (Ed.), Őshonos- és tájfajták – ökotermékek – egészséges táplálkozás – vidékfejlesztés: Minőségi élelmiszerek – egészséges környezet – fenntartható vidéki gazdálkodás. Az agrártudományok és a vidékfejlesztés kihívásai a XXI. században Nyíregyházi Egyetem, Műszaki és Agrártudományi Intézet. (pp. 327–334).

Nyíregyházi Egyetem (2025). Ferenctanyai Tangazdaság – Meteorológiai állomás adatai (2024/2025). Nyíregyháza. Elérhető: https://www.sulinet.hu/oroksegtar/data/telepulesek_ertekei/Nyiregyhaza/pages/004_ny_eghajlata.htm?fbclid=IwAR03kIPUduMFa3gSEJ_BQVS2zaiPbTw81Za02Odrlpjrmp_7Br2MXI-BYt0

Oláh, L., Bencze, S. & Jolánkai, M. (2021). A klímaváltozás hatásai a tritikálé termesztésére. Növénytermelés, 70(2), 95–104.

Országos Meteorológiai Szolgálat (OMSZ) (2024). Éghajlati adatsorok és sokéves átlagok (1870–2024), Nyíregyháza állomás. Elérhető: https://www.met.hu

Smith, J., Thomas, R. & Peterson, D. (2020). Nitrogen effects on grain yield and quality of triticale. European Journal of Agronomy, 112, 125936.

Soós, A., & Makszim, G. N. (2024). Károsodott környezeti elemek, kihívás előtt álló mezőgazdaság–mielőbbi megoldás a paradigmaváltás [Damaged environmental elements, agriculture facing challenges–paradigm shift as soon as possible solution]. Mezőgazdasági Technika, 65(1), 2-7.

Szabó, D. (2019). A szerves trágyák és a tápanyag-hasznosulás összefüggése tritikáléban. Debreceni Egyetem Agrártudományi Közlemények, 89(1), 61–68.

Szalai, T., Oláh, L. & Bencze, S. (2018). A tritikálé takarmányozási értéke és beltartalmi jellemzői. Növénytermelés, 67(4), 241–249.

ANALYSIS OF CROP ELEMENTS OF TRITICALE TREATED WITH POULTRY MANURE

[1]Edit Kosztyuné Krajnyák, [2]István Henzsel, [3]Shukhrat Shokirov, [3]Ilhom Abdurahmanov, [3]Mukhitdin Akbarov, [3]Zokhid Mamatkulov, [3]Ulugbek Kuziev, [3]Khojiakbar Khasanov, [3]Nozimjon Teshaev, [3]Khakberdiev Obid, [3]Khafizova Zulfiya, [4]Susana Mondici, [5]Ioan Radu Șugar, [1]Dominik László Sztojka, [1]Béla Szabó, [1]Judit Csabai

[1]University of Nyíregyháza, Institute of Engineering and Agricultural Sciences, Department of Agricultural Sciences and Environmental Management, H-4400 Nyíregyháza, Sóstói Str. 31/b
krajnyak.edit@nye.hu

[2]University of Debrecen, IAREF, Research Institute of Nyíregyháza,
H-4400 Nyíregyháza, Westsik Vilmos Str. 4-6.
henzsel6@gmail.com

[3]Department of Geodesy and Geoinformatics, TashkentInstitute of Irrigation and Agricultural MechanizationEngineers (TIIAME) - National Research University,Tashkent, Uzbekistan

[4]Agricultural Research and Development Station (ARDS) Livada, 7 Baia Mare Street, Livada, Romania.
e-mail: scdalivada@yahoo.com

[5]Department of Engineering and Technology Management, Faculty of Engineering, Northern UniversityCentre of Baia Mare, Technical University of Cluj-Napoca, 62A Victor Babes Street, 430083 Baia Mare,Romania;
e-mail: ioan.sugar@imtech.utcluj.ro

Summary

Our study aimed to examine the effect of fermented poultry manure on triticale during the 2023/2024 and 2024/2025 growing seasons and to determine the crop's above-ground biomass and yield components. Overall, a comparison of the results from the two years indicates that the effectiveness of poultry manure depends primarily on precipitation distribution. The spring drought of 2023/2024 inhibited shoot growth, tillering, and both vegetative and reproductive development, whereas the balanced and abundant rainfall of 2024/2025 favored above-ground biomass accumulation and yield components, resulting in a significant increase in yield. The findings demonstrate that the effectiveness of organic fertilization depends on environmental conditions that support nutrient release and uptake.

Keywords: triticale, poultry manure, yield components, biomass