PATTERNS OF CHANGES IN LEAF WATER CONTENT OF TRITICALE (×TRITICOSECALE) UNDER MODERATE AND DROUGHT CONDITIONS

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Abstract: *This study investigates the patterns of changes in leaf water content of triticale (×Triticosecale) under moderate and drought conditions. The main objective was to determine the characteristics of plant water regime and the factors influencing it under different environmental conditions.*

Experimental studies were conducted by growing triticale plants under two contrasting conditions: optimal moisture (moderate) and water deficit (drought). A comparative analysis of leaf water content was carried out.

The results showed that under drought conditions, the water content in leaves significantly decreased, leading to a reduction in physiological processes, particularly transpiration and water exchange intensity. In contrast, under moderate conditions, leaf water content remained relatively stable, ensuring normal plant growth and development.

Keywords: *Triticale (×Triticosecale), leaf water content, water regime, drought stress, moderate conditions, adaptation, physiological processes, water deficit*

INTRODUCTION

Global climate change has intensified drought conditions in agroecosystems, making water deficiency one of the main limiting factors in crop production. Therefore, scientific research is focused on studying drought tolerance in crops, their growth and development under water-deficient conditions, and their morphobiological, ecological, physiological, and phytochemical characteristics.

Particular attention is being paid to increasing the adaptability of promising cereal crops to environmental stress factors, improving their growth and development, enhancing productivity under water deficit conditions, and developing drought-resistant varieties suitable for different ecological environments.

The aim of this study was to determine the physiological basis of drought tolerance in triticale varieties cultivated under the conditions of the Samarkand region.

Triticale (×Triticosecale) is a hybrid crop obtained by crossing wheat and rye and is currently classified as an independent botanical genus (Mergoum et al., 2019).

Initially, triticale was cultivated in drought-prone and saline regions (Australia, China, Spain), and later expanded to moderate humid regions (Europe, Canada), warm and humid areas (Brazil), and cold or drought-prone environments (Russian Federation). The main producing countries include Poland, Germany, France, Belarus, Hungary, Sweden, Lithuania, Russia, China, and Australia (Gagiu, 2020).

The chemical composition of triticale grain is similar to that of wheat and rye, often showing intermediate values. Due to the presence of rye proteins, triticale flour has lower gluten content, resulting in lower bread-making quality compared to wheat (Agil et al., 2014). However, triticale remains an important alternative food crop, especially in regions where wheat cultivation is limited by environmental conditions (Oettler, 2005).

Triticale is characterized by high productivity and greater tolerance to abiotic stress compared to wheat, making it valuable for both grain and forage production (Blum, 2014). It is widely used as animal feed and increasingly in food and alcohol industries (Mergoum, 2009). Recently, triticale has also been considered a potential bioenergy crop, with research focusing on biomass conversion into biofuels such as bioethanol and biogas (Randhawa et al., 2015).

Water deficiency is currently one of the major limiting factors in crop production worldwide. Understanding physiological mechanisms of drought tolerance is essential for breeding programs aimed at improving stress resistance. Triticale's drought tolerance is associated with early flag leaf development and efficient water uptake by its root system.

Materials and Methods

The study was conducted under the conditions of the Zarafshan Valley. Triticale varieties were grown under two environmental conditions: moderate (optimal moisture) and drought (water deficit).

Leaf water content was measured at different times of the day (06:00, 08:00, 14:00, evening) and at different growth stages (tillering, stem elongation, heading, flowering, grain filling). Comparative analysis was performed between varieties and environmental conditions.

Results and Discussion

The results showed that leaf water content in triticale varieties was highest in the early morning (06:00–08:00), decreased during the daytime (up to 14:00), and partially recovered in the evening. This pattern was observed across all varieties and growth stages.

Under drought conditions, leaf water content decreased significantly compared to moderate conditions.

During the flowering stage, the average daily leaf water content ranged from 81.6% to 83.7% under moderate conditions, with a daily fluctuation range of 3.6–4.8%. Under drought conditions, it ranged from 79.6% to 81.8%, with a fluctuation range of 4.5–4.7%.

Among the varieties, under moderate conditions, the Farhod variety showed relatively higher leaf water content across all growth stages. Under drought conditions, the Valentin variety maintained relatively higher water content.

In contrast, the Odissey variety exhibited the lowest leaf water content under both environmental conditions throughout all growth stages.

Overall, the results indicate that leaf water content in triticale depends on both biological characteristics and environmental factors.

Conclusion

The study demonstrated that drought conditions significantly reduce leaf water content in triticale, affecting physiological processes. However, varietal differences indicate varying levels of drought tolerance. These findings are important for selecting drought-resistant varieties and improving cultivation practices under water-limited conditions.

Table 1. Leaf Water Content in Triticale Varieties (%)

№	Variety	Developmen-tal phase	SWS		WL	
			Daily average (water content %)	Daily change range	Daily average (water content %)	Daily change range
1	Farhod	Tillering phase	80,3	5,7	78,2	4,9
2	Odissey		78,4	5,0	76,9	4,5
3	Valentin		79,2	5,1	78,6	5,0
4	Svat		80,1	5,4	77,9	4,8
5	Tixon		79,5	5,2	77,4	4,6
1	Farhod	Stem elongation phase	82,1	3,4	80,1	3,6
2	Odissey		80,9	2,6	78,9	3,4
3	Valentin		81,0	2,9	80,4	3,7
4	Svat		81,8	3,3	79,6	3,6
5	Tixon		81,2	3,1	79,3	3,5
1	Farhod	Heading phase	81,8	4,7	80,2	4,6
2	Odissey		79,7	4,2	78,7	4,4
3	Valentin		80,7	4,3	80,4	4,7
4	Svat		81,4	4,5	79,9	4,5
5	Tixon		81,1	4,4	79,3	4,6
1	Farhod	Flowering phase	83,7	4,8	81,4	4,7
2	Odissey		81,6	3,6	79,6	4,5

3	Valentin		82,6	4,4	81,8	4,7
4	Svat		83,3	4,7	81,0	4,6
5	Tixon		82,8	4,6	80,6	4,6
1	Farhod	Grain filling phase	78,1	5,4	76,4	5,7
2	Odissey		76,4	4,3	75,2	5,3
3	Valentin		76,8	4,4	77,3	5,9
4	Svat		77,4	4,7	76,1	5,6
5	Tixon		77,2	4,4	75,5	5,6

Note: *SWS – stable water supply; WL – water limited; **statistically significant at $p < 0.05$.

REFERENCES:

1. Mergoum M, Sapkota S, El-Fatih A. ElDoliefy A, Naraghi M, Pirseyedi S, Mohammed S. Alamri M.S and AbuHammad W (2019) Tritikale (x Triticosecale Wittmack) Breeding Springer Nature Switzerland AG 2019. 405 J. DOI:10.1007/978-3-03023108-8_11
2. Gagiu V. (2020) Tritikale crop and contamination with mycotoxins under the influence of climate change - global study Journal of Hygienic Engineering and Design 551.583(498)pp 30-45
3. Agil R. et al. Determination of water-extractable polysaccharides in triticale bran Journal of Food Composition and Analysis (2014) pp 12-17. https://doi.org/10.1016/j.jfca.2014.02.004
4. Oettler G. (2005). The fortune of a botanical curiosity-Tritikale: past, present and future. J. Agric. Sci. 143, 329–346
5. Blum A. (2014) The abiotic stress response and adaptation of Tritikale — A review. Cereal Res. Commun. 42, 359–375.
6. Mergoum M. Singh P.K., Peña R.J., Lozano-del Río A.J., Cooper K.V., Salmon D.F., Gómez Macpherson H. Tritikale: A "New" Crop with Old Challenges. Cereals. - New York: Springer, 2009. - P. 1-21.
7. Randhawa H.S., Bona L., Graf R.J. (2015). Triticale Breeding—Progress and Prospect. In: Eudes, F. (eds) Triticale. Springer, Chapter 2015, pp 15-32
8. Watanabe E., Arruda K.M.A., Kitzberger C.S.G., Scholz M.B. , Coelho A.R., Physico-chemical properties and milling behavior of modern triticale genotypes Emir. J. Food Agric., 31 (2019), pp. 752-758.

DOI: https://doi.org/10.9755/ejfa.2019.v31.i10.2015

9. Zhu F. Tritikale: Nutritional composition and food uses. Food Chem. 2018 Feb 15; 241:468-479. DOI: 10.1016/j.foodchem.2017.09.009