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PHENOTYPIC ANALYSIS OF TOLERANCE TO ABIOTIC STRESESS IN TRITICALE GENOTYPESS

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Triticale (x *Triticosecale* Wittmack.), the first synthetic cereal, is derived from a cross between wheat (*Triticum aestivum* L.) and rye (*Secale cereale* L.). Developed in the 19th century, triticale offers significant potential for increasing yields of products for human consumption and animal feed in various agroecological regions, including those with climatic and soil conditions that are less favourable for other cereals. Most (83%) of the land planted with triticale is located in Europe. Poland is the world leader in terms of triticale production area. Triticale exhibits a wide range of genetic responses to biotic and abiotic stressors. Heat stress and drought are the main threats not only to sustainable yield but also have a serious impact on grain quality due to reduced accumulation of carbohydrates, gluten, and proteins. Combining morphophysiological approaches is one of the most effective strategies for improving triticale's tolerance to abiotic stressors. The purpose of this study was to evaluate the response to and the mode of inheritance of the trait of tolerance/sensitivity to stress caused by high temperatures and water deficit in triticale genotypes.

Winter triticale genotypes, parental lines (P_1, P_2), and hybrids resulting from their reciprocal crosses: P_1 – L3201-05 (1); P_2 – L3226-30 (2); F_2 – (P_1 x P_2) – L3866-70 (3) și F_2 – (P_2 x P_1) – L3861-65 (4) were investigated under conditions of high-temperature stress and moisture deficit during the early growth stage. The seeds were sterilized, pregerminated, and placed in Petri dishes for 6 days at an optimal temperature of 22°C. Heat stress (*HS*) was induced after 5 days under optimal conditions by exposing the seeds to 45°C for 4 hours, followed by a 24-hour acclimation period at 22°C (Kolupaev, 2023). The moderate and high water deficit (*WD*) was induced by an aqueous solution (16% and 20%) of PEG 6000 (Mansour, 2020). Phenotypic variability was analyzed for the following traits: germination potential (*GP*) %, and dry weight of roots and stems at 80 °C (*DWR* and *DWS*, mg/plant). The plant vigour

(*PVI*) and integral tolerance index (*TI*) were calculated according to the methods described by Qadir, 2018, and Raja, 2017.

The *GP* trait showed only resistance in response to *HS*, but high, moderate, and low tolerance (84.6–70.9%) to WD. The *DWR* trait exhibited tolerance, high tolerance, and moderate tolerance to *WD* (up to 79.5%), and only moderate tolerance to thermal stress. Both parents showed low sensitivity to *DWS*: P_1 in the case of *HS* and P_2 in the case of *WD*. The *DWS* trait was strongly affected, showing the highest sensitivity in response to both stressors.

Cluster analysis (*k-means*) based on the variability of the integral tolerance (*IT*) index for the traits *GP*, *DWR*, *DWS*, *DWP*, and *PVI* revealed advanced *HS* tolerance in genotypes 2 and 4, with the maternal factor playing a key role in triticale's response. Therefore, L3226-30 and L3861-65 may be involved in the improvement of triticale under high-temperature conditions. Genotypes 1, 2, and 3 exhibited higher mean values for the *IT* trait in response to *WD* treatment, mediated by 16% PEG. Genotypes L3201-05, L3226-30, and L3866-70 can be included in breeding programs to improve resistance to moderate water deficit, with the tolerance of L3866-70 being inherited from both parents. Only triticale L3201-05 (1) can be used to improve tolerance to severe *WD* stress.

Keywords: Heat stress; phenotypic variability; water deficit; winter triticale.

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