ANTIOXIDANT BIOMARKERS IN ASSESSING MAIZE GERMINATION AND SEEDLING GROWTH FOLLOWING EXPOSURE TO NEGATIVE TEMPERATURE STRESS

Maria CAUȘ[1]*, Pantelimon BOROZAN[2]
[1]Institute of Genetics, Physiology & Plant Protection, Moldova State University, Chisinau, Republic of Moldova
[2]Public Institution "National Center for Seed Research and Production", Republic of Moldova

*Corresponding author: mcaus2021@yahoo.com

https://doi.org/10.52757/bsd26.23

Background: In the current climate change environment, many breeding programs in Northern Europe are focused on developing cold-resistant maize genotypes. In this context, it is important to study and understand the morphophysiological and biochemical traits of maize that facilitate adaptation to such conditions, as the resulting information can be used for further improvement of breeding material. Therefore, five hybrids were evaluated for their response to negative temperature stress (NTS) at −4°C for 16 h before germination, followed by growth at 26°C for 7 days.
The aim of the study was to determine the role of antioxidant system components in ensuring the defensive potential of maize seedlings with different levels of resistance to a specific dose of negative temperature during the early stages of ontogenesis.
Materials and methods: Seeds of different maize hybrids used in this study were provided by the Public Institution "National Center for Seed Research and Production," Pașcani, Republic of Moldova. Before germination, maize seeds were exposed to a specific dose of subzero temperature (−4°C) for 16 h. Germination, seedling growth and development were carried out under controlled conditions with regulated air temperature. Morphological and physiological parameters, as well as antioxidant system components, including peroxidase and catalase activities, total polyphenol and flavonoid contents, ascorbic acid, and malondialdehyde (MDA), were determined in the seedlings.
Results: Data were obtained on the role of antioxidant system components in providing the protective potential of maize seedlings with varying levels of resistance to NTS. The results revealed a significant ($P<0.05$) decrease in growth parameters such as seminal root length, plant height (cm), and fresh seedling biomass (g) caused by NTS. However, a significant ($P<0.05$) increase in lipid peroxidation was observed. Changes were also recorded in the activities of antioxidant enzymes, including catalase, benzidine peroxidase, and ascorbate peroxidase, as well as non-enzymatic antioxidant compounds, such as total phenolic compounds, flavonoids, and ascorbic acid.
Conclusions: The study showed that pre-treatment of maize seeds with negative temperature (−4°C) for 16 h significantly affected germination, growth, and antioxidant metabolism in the seedlings. Antioxidant enzymes and compounds played a crucial role in protecting plants against oxidative damage. However, the hybrids responded differently depending on their genetic background.

Keywords: maize seeds, negative temperature stress, antioxidant biomarkers.

Acknowledgments: The research was carried out within the subprogram 011101 „Genetic and biotechnological approaches to the agroecosystems management under climate change", financed by the Ministry of Education and Research of the Republic of Moldova.