

Manifestations of oxidative stress in seedlings of triticale under conditions of sulfate salinity

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Abstract

The effect of the presence of sodium sulfate (120 mM) in the medium on the development of oxidative stress and the work of components of the antioxidant system in the Triticale of the winter variety "Tribune" was studied. The work was carried out with 7-day sprouts after 12, 24, 48, 72 and 96 hours of exposure in a salt solution. The following indicators were determined: hydrogen peroxide, malonic dialdehyde, catalase activity, guaiacol peroxidase and ascorbate peroxidase. Sulphate salinity caused a significant change in all these parameters. During the experiment, a 3-4-fold increase in the hydrogen peroxide content in roots and triticale shoots was observed. At the same time, the maximum content of H₂O₂ in the roots was observed already by 12 hours of the experiment, while in shoots the maximum manifested only to 72 hours. The observed increase in the content of this active form of oxygen by 12 hours was accompanied by a simultaneous increase in the amount of lipid peroxidation, which in shoots reached large values and lasted up to 48 hours, while in the roots this index decreased already by 24 hours. The activity of ascorbate peroxidase and catalase in shoots also increased by 12 hours, after which it decreased to 48 hours of the experiment. In the roots, the activity of these enzymes changed significantly less. The activity of guaiacol peroxidase in shoots after a slight increase by 12 hours was reduced by half to 24 hours. In the roots, the activity of the enzyme increased throughout the entire experiment. An analysis of the results obtained led to the conclusion that the short-term effect of sulphate salinity resulted in a more significant increase in hydrogen peroxide than in chloride salinity. At the same time, the dynamics of activity of ascorbate peroxidase, catalase and guaiacol peroxidase in triticale shoots and roots under the conditions of sulfate salinization has its own specifics in comparison with the conditions of chloride salinization.

References

- [1] I.Yu. Kudrevatich, L.S. Pilguy. Geochemical properties of topsoil around plant for the production of nitrogen fertilizers, Tula region. *Proceedings of the Samara scientific center of RAS*. **2016**. No.2-1. P.119-122. (russian)
- [2] Physiology and biochemistry of agricultural plants. Tretyakov N.N. and others: under red. N.N. Tretyakov. 2nd ed. *Moscow: Withdraw*. **2005**. 656p. (russian)
- [3] N.G. Kumar, R.N. Knowles. Change in lipid peroxidation and Lipolytic and free radical scavenging enzyme during aging and Sprouting of potato (*solanum tuberosum* L.) seed-tubers. *Plant Physiology*. **1993**. Vol.102. P.115-124.
- [4] V.K. Girov, M.N. Merzlyak, L.V. Kuznetsov. Peroxidation of membrane lipids of cold-resistant plants at negative temperatures. *Plant physiology*. **1982**. Vol.29. P.1045-1052. (russian)
- [5] X. Wang, H. Xiao, M. Yang, Z. Gao, X. Zang. The effect of salt stress on the antioxidant defense system in *Candela candelas* root. *Botanic research*. **2014**. Vol.55. P.57.
- [6] S. Keshavkant, J. Padhan, S. Parkhey, S. S. Naithani physiological and Antioxidant responses of Germinating *Cicer arietinum* Seeds to salt stress. *Plant physiology*. **2012**. Vol.59. No.2. P.232-237.

- [7] M.S. Sinkevich, N.V. Naraikina, T.I. Trunova. Processes that prevent the increase in the intensity of peroxide oxidation of lipids in cold-resistant plants during hypothermia. *Plant physiology*. **2011**. Vol.58. No.6. P.875-882. (russian)
- [8] M. Hishida, F. AscencioValle, H. Fujiyama, A. Orduño Cruz, T. Endo. Larrinaga-Mayor George. Antioxidant enzyme response to colestyramine stress in cork *Jatropha* and *J. cinerea* at seedling stage. *Plant physiology*. **2014**. Vol.61. No.1. P.59-68.
- [9] L. Goth. Simple method for the determination of catalase activity in blood serum and revision of reference range. *Clinica Chimica Acta Website*. **1991**. Vol.196. P.143-152.
- [10] N.N. Zukov. Investigation of physiological and biochemical mechanisms of salt stress in triticale in the early stages of ontogenesis. *Abstract. dis. ... kand. Biol. sciences'. Puschino*. **2013**. 22p. (russian)
- [11] I. Tarchoune, C. Sgherri, R. Izzo, M. Lachaal, Z. Ouerghi, F. Navari-Izzo. Antioxidative reactions shoo, and digitize basilicum to sodium chloride or sodium sulphate salinization. *Physiology and biochemistry of plants*. **2010**. Vol.48. P.772-777.
- [12] V.V. Ivanishchev, N.N. Zukov. Manifestations of oxidative stress in the seedlings of triticale under the short-term action of sodium chloride. *Butlerov Communications*. **2017**. Vol.52. No.11. P.123-130. ROI: jbc-02/17-52-11-123
- [13] R. Mittler, S. Vanderauwera, Suzuki N., Miller g, Tognetti VB, Vandepoele K, Gollery M, Shulaev V. and Breusegem F. V. ROS signaling: the new wave. *Trends in crop production*. **2011**. Vol.16. P.63-68.
- [14] N.N. Zukov, A.R. Garifzyanov, V.V. Ivanishchev. Dynamics of activity of antioxidant enzymes in the organs *Triticosecale* against the background of NaCl-salinity. *Izvestiya of the Tula state University. Natural science*. **2012**. Vol.2. P.285-291. (russian)
- [15] S. Sneha. Rishi effect of short-term salt stress on chlorophyll, protein and enzyme activity of catalase and ascorbate peroxidase in pearl millet. *American journal of plant physiology*. **2014**. Vol.9. P.32-37.