

## Investigation of the effect of short-term salt stress with the method of cluster analysis

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### Abstract

The brief review deals with the possible application of cluster analysis to the results of physiological and biochemical research. It is shown that the construction of dendrograms may indicate the importance (and correlation) of changes in these or other indicators. Thus, the study of the manifestations of oxidative stress and antioxidant activity of protective components in triticale shoots under short-term salt stress led to the conclusion that the interconversion of reduced and oxidized glutathione plays a more significant role in the defense reactions of the organism than ascorbic acid content in the condition of salt stress. The catalase activity is most closely related to the protection of membrane structures from oxidative stress. The study of indicators of water exchange and photosynthesis revealed a close relationship between water content and osmotic potential, despite the fact that the osmotic potential was significantly changed to 12 hours of the experiment, while the water content is significantly changed only to the 72 hours of the experiment. At the same time it was shown the close relationship between the magnitude of transpiration and proline content that has been previously demonstrated in special experiments. Generalized analysis of the collected data allowed to find the relationship between such parameters as (1) the content of hydrogen peroxide, the rate of electron transport, the water content and activity of glutathione reductase; (2) the content of superoxide radical and the activity of ascorbate peroxidase; (3) the content of the main pigments of photosynthesis and the activity of guaiacol peroxidase; (4) the value of lipid peroxidation, the activity of catalase and carbonic anhydrase. The results obtained suggest that the findings generally are consistent with the known data about the physiology and biochemistry of plants. At the same time, such an analysis can detect previously unknown relationships between individual indices and explain some discrepancy values of the individual parameters for use in experiments the crude extract samples.

### References

- [1] N.N. Bureeva. Multidimensional statistical analysis with an application of "Statistics" software package. *Nyzhnii Novgorod: NNSU*. **2007**. 112p. (russian)
- [2] A.R. Fernie. Editorial overview – computational approaches in aid of advancing understanding in plant physiology. *Frontiers in plant science*. **2011**. Vol.2. P.5-7. – doi: 10.3389/fpls.2011.00078.
- [3] N.N. Zhukov, A.R. Garyfzyanov, V.V. Ivanishchev. Anti-oxidative dynamics in xTriticosecale organs at NaCl-salinization. *Izvestiya TulGU. Estestvennye nauki*. **2012**. Iss.2. P.285-291. (russian)
- [4] A.R. Garyfzyanov, N.N. Zhukov, V.V. Ivanishchev, A.A. Kosobryukhov. Regulation water metabolism in xTriticosecale in NaCl-salinity. *The Bulletin of Kharkiv National Agrarian University. Series Biology*. **2013**. Vol.1. Iss.28. P.34-43.
- [5] A.R. Garyfzyanov, N.N. Zhukov, A.A. Kosobryukhov, V.V. Ivanishchev. Functional state of photosynthetic apparatus triticale seedlings under chloride salinity. *Izvestiya TulGU. Estestvennye nauki*. **2014**. Vol.1. P.280-290.
- [6] V.V. Ivanishchev, N.N. Zhukov. Manifestations of oxidative stress in sprouts of triticale under condition of short-term exposure of sodium chloride. *Butlerov Communications*. **2017**. Vol.52. No.11. P.123-130. ROI: jbc-02/17-52-11-123
- [7] Yu.E. Kolupaev. The active oxygen forms in plants under the action of stressors: the formation and possible functions. *The Bulletin of Kharkiv National Agrarian University. Series Biology*. **2007**. Vol.3. No.12. P.6-26.

- [8] A.R. Garyfzyanov, N.N. Zhukov, V.V. Ivanishchev. Formation and physiological reactions of oxygen active forms in plant cells. *Modern problems of science and education*. **2011**. Vol.2. 21p. [https://elibrary.ru/download/elibrary\\_16903824\\_79256112.pdf](https://elibrary.ru/download/elibrary_16903824_79256112.pdf). (russian)
- [9] G.N. Chupakhina. The system of ascorbic acid in plants: monograph. *Kaliningrad: Kaliningrad. Univ.* **1997**. 120p. (russian)
- [10] Yu.E. Kolupaev, T.O. Yastreb. The physiological function of non-enzymatic antioxidants of plants. *The Bulletin of Kharkiv National Agrarian University. Series Biology*. **2015**. Vol.2. Iss.35. P.6-25.
- [11] T. Yang, B.W. Poovaiah. Hydrogen peroxide homeostasis: activation of plant catalase by calcium/calmodulin. *Proc. Natl. Acad. Sci. USA*. **2002**. Vol.99. P.4097-4102.
- [12] D.S. Veselov. Stretch growth and water exchange in water scarcity conditions. Author's abstract diss ... of the doctor of biol. sciences. *Ufa*. **2009**. 47p. (russian)
- [13] P.J. Zapata, M. Serrano, M.F. García-Legaz, M.T. Pretel and M.A. Botella. Short Term Effect of Salt Shock on Ethylene and Polyamines Depends on Plant Salt Sensitivity. *Front. Plant Sci*. **2017**. Vol.8. P.855. doi: 10.3389/fpls.2017.00855.
- [14] E.I. Koshkin. Physiology of resistance of agricultural crops. *Moscow: Drofa*. **2010**. 640p. (russian)
- [15] V.V. Ivanishchev, N.N. Zhukov. On the interrelation of water exchange and photosynthesis in triticales sprouts with short-term action of sodium chloride. *Butlerov Communications*. **2018**. Vol.53. No.3. P.35-42. ROI: jbc-02/18-53-3-35
- [16] M.A. Turan, A.H.A. Elkarim, N. Taban, S. Taban. Effect of salt stress on growth, stomatal resistance, proline and chlorophyll concentrations on maize plant. *African Journal of Agricultural Research*. **2009**. Vol.4. No.9. P.893-897.
- [17] N.L. Radyukina. The functioning of the antioxidant system of wild plant species under short-term stressors. *Diss ... Dr. of Biol. Moscow*. **2015**. (russian)
- [18] M.J. Paul, C.H. Foyer. Sink regulation of photosynthesis. *J. Exp. Bot*. **2001**. Vol.52 (360). P.1383-1400. DOI: <https://doi.org/10.1093/jexbot/52.360.1383>.