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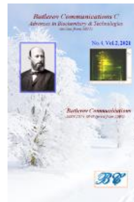

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Investigation of hierarchical relationships between biochemical characteristics of vetch shoots in the presence of nickel ions in the medium

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Abstract

The paper presents the results of cluster analysis of data on alterations in the biochemical parameters of vetch (*Vicia sativa* L.) shoots under conditions of increasing concentrations of nickel chloride in the medium in order to detect hierarchical relationships between the characteristics of the object. For sequential analysis, we used the results of alterations in both indicators of oxidative stress (the content of hydrogen peroxide and the value of lipid peroxidation – LPO) and low molecular weight (ascorbic acid, proline, chlorophyll, carotenoids, flavonoids) and high molecular weight (enzymes – catalase and guaiacol peroxidase) antioxidants. It was found that hydrogen peroxide and proline, catalase and peroxidase, respectively, formed first-order clusters (without using such characteristics as the content of photosynthetic pigments and flavonoids). The inclusion of data on the content of chlorophyll, carotenoids, and flavonoids in the system somewhat complicated the picture. In this case, the primary cluster between the content of hydrogen peroxide and proline was not disturbed, but primary clusters were formed between guaiacol peroxidase and flavonoids, catalase and chlorophyll. The second-order cluster was formed by carotenoids with a primary cluster between chlorophyll and catalase. In both cases (using only a part of the biochemical characteristics or using all the characteristics of an object) LPO formed a cluster of the penultimate level, as a reflection of the fact that LPO is the result of the interaction of both reactive oxygen species and antioxidants of different nature. In both cases, ascorbic acid participated in the formation of the final cluster of the system. Based on the results obtained, which are consistent with the results of principal component analysis and correlation analysis, it was concluded that proline, apparently, does not participate in the neutralization of hydrogen peroxide. In this case, catalase and guaiacol peroxidase, using hydrogen peroxide as a reaction substrate, perform different

functions in vetch shoots under conditions of increasing concentrations of nickel chloride in the medium. In this case, catalase takes an active part both in the process of neutralization of hydrogen peroxide (r = -0.69) and in the protection of membranes from lipid peroxidation (r = -0.41). Guaiacol peroxidase is not actively involved in these processes. This apparently reflects the specificity of the manifestation of oxidative stress in vetch shoots under conditions of an increasing concentration of nickel chloride in the medium.

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