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INDUCTION OF WHEAT PLANTS RESISTANCE TO SOIL DROUGHT BY EXOGENOUS POLYAMINES

Polyamines are low molecular weight organic compounds of a cationic nature, present in all compartments of plant cells (Bouchereau et al., 1999; Kuznetsov et al., 2006). They have a pronounced stress-protective effect and are involved in many regulatory processes in plants (Takahashi, Kakehi, 2010; Kuznetsov, Shevyakova, 2011; Kolupaev, Kokorev, 2019). The ability of exogenous polyamines to increase plant resistance to adverse factors of various nature is well-known. The formation of a cellular signal under the influence of polyamines, which includes reactive oxygen species and nitric oxide, can lead to an increase in the expression of antioxidant enzyme genes and increase their activity (Pal et al., 2015). The aim of this work was to study the effect of foliar treatment of wheat plants with solutions of putrescine and spermine on the functioning of their protective systems during drought under laboratory soil culture conditions. In the experiments, we used young wheat plants (Triticum aestivum L., Dosconala variety), which were subjected to a 4- day drought with a gradual decrease in the water content in the soil to 25% of the total moisture capacity. Spraying plants with putrescine in a concentration range of 0.25-5 mM significantly reduced the growth-inhibiting effect of drought; the effect of spermine was less effective, but also significant at $P \leq 0.05$. Putrescine significantly reduced the manifestation of water deficit caused by drought. Under the action of spermine, only a tendency towards a decrease in the water deficit of the leaves was noted. Drought caused the effect of oxidative stress, which was manifested in an increase in the content of malondialdehyde (MDA) in leaves. During the pretreatment of plants with spermine, the increase in the MDA content was partially leveled, and under the action of putrescine it was leveled almost completely. Treatment of plants with both polyamines at concentrations of 1 and 5 mM promoted preservation of the pool of chlorophylls and carotenoids in leaves under stress conditions. Moreover, when plants were treated with putrescine and spermine under drought conditions, a close to control ratio of chlorophylls a/b was noted. The proline content in leaves increased significantly under the influence of drought.

Pretreatment with 1 and 5 mM putrescine, and 5 mM spermine reduced effect of proline content growth in leaves, caused by drought. At the same time, the treatment of plants with both polyamines caused the accumulation of sugars in the leaves. Under the influence of drought, the content of anthocyanins and flavonoids absorbing in the UV-B region significantly decreased in the leaves. Pretreatment with spermine slightly mitigated the negative effect of drought on the anthocyanin content. Under the action of both putrescine and spermine, the content of flavonoids absorbing in UV-B stabilized in leaves.

Thus, the effect of increasing the drought resistance of wheat plants under the influence of exogenous polyamines under the conditions close to natural has been established. It was shown that treatment with putrescine had a more significant protective effect on wheat plants compared to spermine. Thus, one of the components of the protective action of polyamines is the influence on water metabolism (decrease in water deficit, probably due to reduction in stomatal conductance), and also the effects on the state of antioxidantive and, to a certain extent, osmoprotective systems.

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Key words: Triticum aestivum, putrescine, spermine, drought, resistance, water deficiency, osmolytes, oxidative stress