Nanocomposites and nanomaterials

Photosynthetic parameters of *Triticum sp*. under metal nanoparticles influence and drought

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Drought is a stress factor that limits the wheat productivity in many regions of its cultivation. It is known that the optimal photosynthetic efficiency is provided by the effective use of absorbed light energy, resistance to water deficiency and increased ability to dissipation of excess absorbed light energy under drought conditions. Since photosynthesis is most susceptible under these conditions, the aim of our investigation was to study the effect of metal nanoparticles (Fe, Mn, Cu, Zn) on photosynthetic parameters of wheat plants under drought action.

7-day seedlings of two wheat varieties *Triticum aestivum* (Trypil`s`ka, Favorytka) and *Triticum dicoccum Schuebl.* (Holikovs`ka) were studied. Experimental seedlings were grown on distilled water with polyethylene glycol 6000 (PEG) with an osmotic potential of -0.3 MPa and / or were treated with metal nanoparticles (NPs). Control seedlings were grown without both NPs treatment and PEG.

The growth of plants with PEG induced the decrease of relative water content in leaves (RWC) of all varieties. NPs treatment of plants promoted to the restoring of water balance in leaves of Trypil`s`ka and Favorytka varieties under these conditions.

It is widely known that leaf water deficit decreases the rate of photosynthesis as a result of destructive effect on photosystems and pigment complexes. There were clear genotypic differences in the content and ratio of photosynthetic pigments under conditions with PEG, NPs treatment and combined action of NPs and PEG.

Holikovs`ka plants responded to stress actions by the structural changes of photosynthetic apparatus (PSA) (increasing of Chl and Car content), which contributes to its structural stability. The chl / car ratio was decreased at the expense of carotenoids biosynthesis *de novo*, which is adaptive. Active accumulation of Car protects the reaction centers of PSA from photooxidation. The positive influence of NPs was more effectively manifested in PSA of more sensitive variety (Favorytka). Thus, the content of photosynthetic pigments in leaves of this variety decreased under the PEG action. The NPs treatment increased of pigments content almost to the control level under drought.

The investigation of chlorophyll fluorescence of wheat leaves demonstrated that PEG, NPs treatment and also their combined action did not cause any changes in the maximum quantum yield of PSII photochemistry (Fv / Fm). At the same time, PEG induced the decrease of photochemical quenching of Chl fluorescence (qP) and the quantum yield of electron transport (φPSII) in leaves of all wheat varieties (most of the *Favorytka* variety). The level of non-photochemical quenching (qN, NPQ) increased upon the PEG action in all varieties. The NPs treatment of plants did not induce changes of fluorescence parameters. However, the increase in qP and φPSII levels, the decrease in qN and NPQ ones were observed under conditions of combined action of PEG and NPs.

Thus, the NPs treatment of wheat plants grown with PEG decreased to a large degree the negative effect of the simulated drought as evidenced the higher efficiency of photosynthetic parameters, especially in Favorytka variety.