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Hormetic effects of aluminium hydroxide nanoparticles (NPs) on the morphofunctional traits of common buckwheat seedlings

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Aluminium (Al) toxicity has greatly negative effects on growth and development of plants species growing on acid soils. Al influence manifests as limitation of the productivity of crop plants by 30-40%. When soil pH drops below 5.5, aluminosilicate clays and aluminium hydroxide minerals begin to dissolve, releasing aluminium-hydroxy cations and $Al(H_2O)_6^{3+}$, that then exchange with other cations. On that conditions, Al^{3+} also forms the mononuclear species $AlOH_2^+$, $Al(OH)^{2+}$, $Al(OH)_3$, and $Al(OH)_4$.

In this case Al-induced stimulation of plant growth and beneficial effects of Al in adapted to acid soil conditions crops frequently causes interest. Nowadays the Buckwheat genus (*Fagopyrum* Mill.) is one of the most studied Al resistant crops. But the mechanisms of Al-induced stimulating effects have not been explained.

Seedlings of common buckwheat were grown in 50% Knop liquid medium with Al hydroxide NPs at five different concentrations (0, 0.05, 0.25, 0.5, 0.75 and 1 mg/L). At 21 days of grown plant total length and fresh/dry weight ratio were used to determine the hormetic response. In addition, the effect of Al hydroxide NPs on photosynthetic pigments, total phenolic and anthocyanin contents were determined.

Growth stimulation and increasing of photosynthetic pigments content were observed at 0.05 and 0.25 mg/L of Al hydroxide NPs addition, while significant inhibition and decreasing were detected at 1 mg/L of Al hydroxide NPs in liquid medium. Moreover, the presence of Al hydroxide NPs induced the phenolic and anthocyanin accumulation with a dose-dependent relation. Shoot and root growth stimuli and fixed beneficial action of Al hydroxide NPs on morphofunctional traits at physiological and biochemical levels were interpreted as hormesis phenomenon.