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ENGINEERING, ENVIRONMENT AND MATERIALS IN PROCESS INDUSTRY EEM2021

BOOK OF ABSTRACTS

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FACULTY OF TECHNOLOGY
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Phone: +387 56 260 190
e-mail: sekretar@tfzv.ues.rs.ba
web:https://eem.tfzv.ues.rs.ba/

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TRANS-GENERATIONAL EFFECT OF CARBOHYDRATE-COATED CERIUM OXIDE NANOPARTICLES IN TWO HERBACEOUS WEEDY ANNUALS

Ivana Milenković[1]*, Aleksandra Lj. Mitrović[1], Slađana Z. Spasić[1,2], Ksenija Radotić[1]

[1]*Institute for Multidisciplinary Research, University of Belgrade, Kneza Višeslava 1, 11030 Belgrade, Serbia, ivana.milenković@imsi.rs**
[2] *Singidunum University, Danijelova 32, 11010 Belgrade, Serbia*

Abstract

Cerium oxide nanoparticles ($nCeO_2$) are nanomaterial widely used in electronics, cosmetics, catalysis, and fuel additives production due to their transition between Ce^{3+} and Ce^{4+} oxidation states. Their increasing production (around 10,000 metric tons per year) makes them one of the most produced metal oxide nanoparticles which can lead to unexpected consequences to environmental health and safety. Coating $nCeO_2$ with different polymers is a very popular way to increase their suspension stability, but the data on their effect on cultivated plants are scarce. Environmental effects on morphological and physiological properties of offspring which occur during the development of the mother plant are called maternal environmental effects. Their expression depends on the offspring's environment, they are expressed throughout the life cycle of the offspring and may persist for several generations. It was suggested that components of the nonenzymatic antioxidant system might participate in the mechanism governing the maternal environmental effects. Total antioxidant activity (TAA) comprises the contribution of different non-enzymatic components with antioxidant capacity. Herbaceous weedy annuals Sinapis alba and Chenopodium rubrum were selected, as a heavy metal hyperaccumulator plant i.e. a species with strong maternal effects, respectively. The effect of uncoated (CeO_2) and glucose-, levan-, and pullulan- coated nanoparticles (G-CeO_2, L-CeO_2, P-CeO_2) treatment of Chenopodium rubrum and Sinapis alba seeds during germination, on TAA of seeds produced in two subsequent generations of plants grown in a greenhouse, were investigated. TAA was measured using the ABTS/HRP end point method. Results showed that the effect of $nCeO_2$ treatments was more expressed in Sinapis alba seeds; mainly all nanoparticles treatments during germination of mother plants resulted in the increase in TAA of produced seeds in both monitored generations. In contrast, in Chenopodium rubrum CeO_2 treatment resulted mainly in the decrease in TAA of produced seeds in both monitored generations. The presented effect was equally expressed in both generations. Among nanoparticles, L-CeO_2 showed the most pronounced effect in both generations of the plants. We showed that the effect of $nCeO_2$, applied during the early development of mother plants (germination), is visible in changes in the components of the nonenzymatic antioxidant system of produced seeds and that it persists for (at least) two generations. In other words, seed priming with $nCeO_2$ might affect changes in yield antioxidant capacity through several generations.

Key words: *CeO_2, coating, nanoparticles, plants, total antioxidative activity.*