THE POTENTIAL OF MAGNETITE-BASED NANOCOMPOSITES IN NANOPHYTOREMEDIATION OF SOILS POLLUTED BY POLYETHYLENE

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CZU:579.64+631.4 https://doi.org/10.52757/imb22.35

The Republic of Moldova suffers from the problem of environmental pollution by plastics, including by the low-density polyethylene (LDPE). The accumulation of plastics by plants has negative consequences for the food security and sustainable development of the agriculture. It is suggested that over time soil pollution by plastics can threaten the successful functioning of the entire agricultural system.

The negative consequences of soil pollution by plastics impose the need of developing measures of remediation. Due to the lack of efficient chemical and physical methods for destroying plastics in soil, the attention has recently been directed towards developing biological degradation techniques, including the ones based on application of phytoremediation and nano-phytoremediation. However, the potential of these techniques in the cases of soil pollution by LDPE is understudied. The aim of this work was to estimate the potential of the magnetite-based nanocomposites in the nano-phytoremediation of soils contaminated by LDPE.

According to the obtained results, under the conditions of the vegetative experiments the LDPE treated by different magnetite-based nanocomposites and then introduced into a soil collected from the landfill near Slobozia-Dușca (contaminated with different pollutants including LDPE) did not have toxic effects on the development of soybean plants. More than that, the plants from the variant where the soil was treated with the LDPE covered by the $MgFe_2$/PVPmax nanocomposite and where the seeds were inoculated by a specific rhizobia strain had the highest dry mass that was statistically different from most variants: respectively, +44.4% and +19.4% as compared to the absolute and "inoculated" controls, and +38.0% as compared to the variant where the LDPE was without nanocomposites and the seeds – without inoculation. Also, the covering of LDPE by this nanocomposite significantly stimulated the root length (up to +62.2% comparing to the absolute control) and contributed to a 42.8% increase in the efficiency of seed inoculation by specific rhizobia (increased the mass of the root nodules). It was observed that the endosymbiosis with rhizobia was not possible without prior seed inoculation by a specific strain, implying that the soil was absolutely toxic to the aboriginal rhizobia.

Conclusions:

1. The magnetite-based nanocomposites were not toxic for the tested legume plants and for their endosymbiosis with the tested rhizobia strain.
2. The $MgFe2/PVP_{max}$ nanocomposite had a considerable potential in the matters of nanophytoremediation of the LDPE contaminated soils, manifested via significant stimulation of the growth of the legume plants and of their endosymbiosis with the specific rhizobia.

The presented data were obtained within the research project "Microbial tools for degradation of non-recyclable plastics waste", registered under code 20.80009.7007.03 in the State Program for 2020-2023, funded by the National Agency for Scientific Research and Development of the Republic of Moldova.