Nanochemistry and biotechnology

NANOMATERIALS BASED ON NATURAL MINERALS AS A WAY OF IMPROVING THE EFFICIENCY OF BACTERIAL PREPARATIONS IN PLANT CULTIVATION

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It was demonstrated that nanomaterials, based on natural minerals, have considerable stimulating impact on physiological and biochemical activity of microorganisms. Due to their contact interaction, bacteria are covered with nanoparticles, which is accompanied with considerable increase in cell survival when exposed to negative environmental factors. The interaction of nitrogen-fixing bacteria *Azotobacter vinelandii* IMV B-7076 and phosphate-mobilizing bacteria *Bacillus subtilis* IMV B-7023 with nanoparticles of such clay mineral as bentonite was used by us to create a highly efficient complex granulated bacterial preparation Azogran for plant cultivation, which is stable during long-term storage. Its effect is evident in improving the growth and development of coniferous, decorative, flower, and other plants and considerable enhancing the yielding capacity of vegetables and industrial crops [1].

The interaction of these bacterial strains and nanoparticles of expanded vermiculite was used to create a free-flowing form of Azogran preparation, which is also stable with keeping and convenient for inoculation of cereal seeds [2]. The application of this preparation in agroecosystems of spring barley and winter wheat allows enhancing their yielding capacity by 16 and 20%, respectively, and improving grain quality.

While inoculating plant seeds with microbial preparations, maximal adhesion of cells to the surface of seeds should be ensured. The use of adhesives is suggested to solve this task, for instance, treacle, casein, carboxymethyl cellulose, and other rather expensive substances as well as some chemical compounds are used, which may have negative impact on the germination of seeds and the condition of environment.

It was shown by us that a promising way of improving the adhesion of these bacteria to plant seeds is the application of nanoparticles of natural minerals. The nanoparticles of bentonite and palygorskite were used by us to create the adhesive agent which promotes enhanced adhesion of bacteria to the surface of the seeds. It was demonstrated that its application (bentonite mostly) in the concentration of 10–20% leads to evident improvement of plant seeds inoculation, increasing the number of bacteria on the seeds from $9.8 \cdot 10^4$ cells/g to $4 \cdot 10^5$ cells/g. It also results in considerable increase in the bacteria survival rate on the seeds. For instance, after seven days of keeping the inoculated seeds the number of bacteria there on with previously applied nanoparticles of bentonite was an order higher compared to the indices in the control variant. The application of this nanomaterial while inoculating seeds with the complex bacterial preparation improved its germination capacity, the growth of root system and sprouts of plants.

The results obtained testify to the promising future of the elaborated new form of a complex bacterial preparation, based on the interaction of nitrogen-fixing bacteria *Azotobacter vinelandii* IMV B-7076 and phosphate-mobilizing bacteria *Bacillus subtilis* IMV B-7023 with nanoparticles of bentonite or palygorskite, which will combine its stability during long-term storage and the ability to improve the adhesion of these bacteria to the surface of plant seeds with considerable increase in their yielding capacity.

1. Kurdish I.K. 2010. Introduction of microorganisms in the agroecosystems. Naukova dumka: Kyiv. Ukraine. -253p.
2. I. Kurdish, A. Roy, I. Skorochod et al. Free-flowing complex bacterial preparation for crops and efficiency of its use in agroecosystems// Journal of Microbiology, Biotechnology and Food Science. -2015.doi.10.15414/jmbfs. 2015.4.6.527-531.