work; is focused on the training objectives, performing the function of introducing a set of goals and objectives into practice; embodies in a structurally-schematic form a certain amount of teaching content associated with the key concept of a collage; corresponds to modern methodical directions, based on the most progressive private methods (communication necessity and sufficiency, educational-methodological expediency, thematic-situational correlation); and also conducts a set of methods of collage, their fixed reflection.

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DETOXIFICATION ABILITY OF MAGNETITE NANOPARTICLES IN PESTICIDE CONTAMINATED SOIL

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Since the contamination and degradation of the environment cannot be completely hindered, the development and assimilation of effective technologies for the remediation and reclamation of soils and lands is an objective necessity. A rational approach to this issue is based on the optimum use of natural processes of self-purification and self-regeneration, such as bioremediation, and novel processing techniques. Trifluralin is an herbicide (toxic group III) characterized by long-term persistence in soil. It has the ability to accumulate in soil and hardly undergoes biodegradation. The toxic effect of trifluralin lies in the inhibition of the growth of roots. The use of herbicides containing trifluralin is banned in the EU. In 2012, trifluralin was excluded from the State Register of plant protection products and fertilizers permitted for use in the Republic of Moldova; however, residues of the pesticide are registered in soils of Moldova to the present day. The maximum trifluralin residues in the soils of Moldova are 0.1 mg/kg of soil. Thus, the search for methods for the purification of soils from trifluralin is an urgent problem. The aim of this study was to synthesize magnetite nanoparticles (NPs) without using a stabilizer

(nanoFe_3O_4) and NPs stabilized with biocompatible polymer poly-N-vinylpyrrolidone (nanoFe3O4/PVP) and examine the effect of the iron NPs on wheat seed germination against the background of the inhibiting (toxic) action of trifluralin. The test-objects were seeds of wheat Triticum aestivum. The length of the roots and seedlings of the wheat was used as a test-response.

In the experiment, we studied the effect of two compounds of Fe_3O_4 magnetite NPs with a size of 8-20 nm on the growth of wheat seedlings. One of the compounds (sample 2) contained a PVP stabilizer; the other (sample 1) did not. The wheat seeds were germinated on soil plates; the soil used in the experiments was contaminated with pesticides for a long time; it was taken in the territory of a former warehouse of pesticides and fertilizers in Singera, Moldova. Colloidal solutions of Fe_3O_4 magnetite NPs (samples 1 and 2) in concentrations of 10, 50, and 100 mg/kg of dry soil were used. The prepared colloidal solutions of NPs were introduced into the contaminated soil and incubated in a germination chamber at a temperature of 25^0C for 1 day (test versions 1-3) and 4 days (test versions 4-6). After this time, the wheat seeds were placed on soil plates and further incubated for 3 days. On the 4th day, the seed germination and the length of roots and shoots were estimated. The references were wheat seeds grown on plates of the reference soil containing no pesticide residues, which was taken in the vicinity of the territory of the former warehouse of pesticides in Singera (reference 1), wheat seeds germinated on plates of pesticide-contaminated soil incubated for 1 day (reference 1) and 4 days (reference 2) in a germination chamber along with test versions.

After treatment of the contaminated soil with solutions of NPs of sample 1 for 1 day, no changes in the root length of the test plants were recorded, except for a slight inhibition in the case of using a concentration of 100 mg/kg of soil. A certain stimulatory effect (33%) on the growth of the shoots was observed at a concentration of 10 mg/kg of soil. The incubation of the soil with solutions of NPs of sample 1 for 4 days contributed to an increase in the root length by 123.7-158.1% depending on the NP concentration. The length of the shoots remained at the reference level (Fig. 1). The maximum effect was observed in the case of introduction of magnetite NPs of sample 1 in a concentration of 50 mg/kg of soil; an increase in the concentration to 100 mg/kg of soil led to the weakening of the effect. After the incubation of the soil with solutions of NPs of sample 1 for 1 day, the total growth of the seedlings remained at the reference level (with a slight stimulatory effect of 14.4% at a concentration of 10 mg/kg of soil); an increase in the incubation time to 4 days

contributed to an increase in the seedling length by 12.1-36.2%, mostly owing to the elongation of the roots.

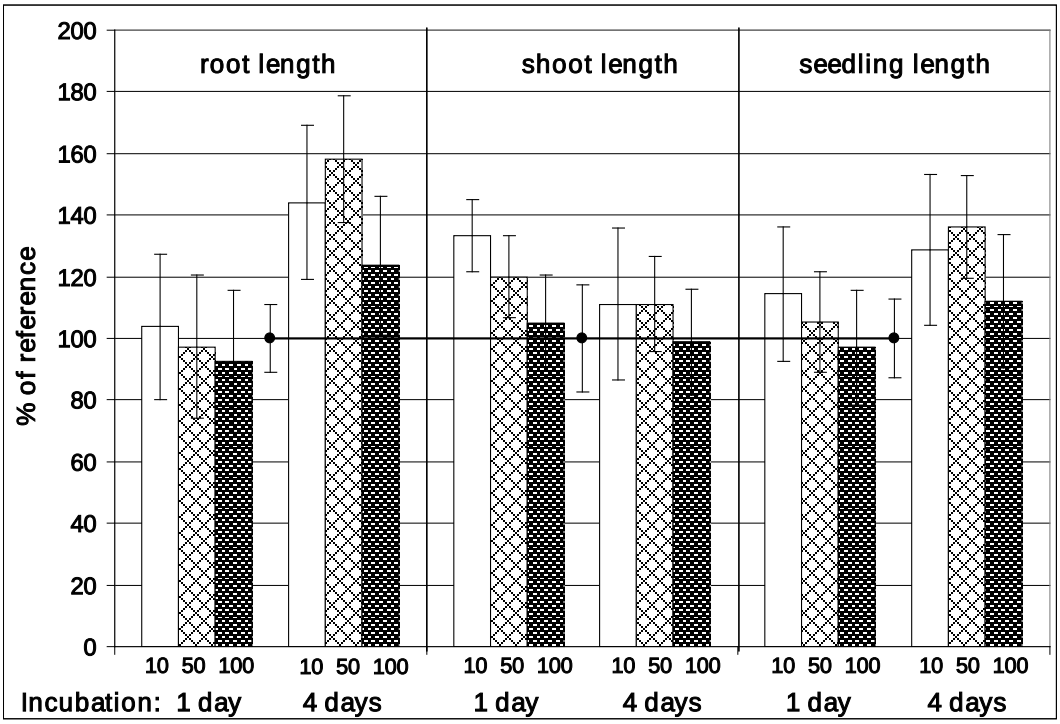

Fig. 1. Effect of Fe_3O_4 NPs (sample 1) on the seedling length of wheat inhibited by trifluralin.

The introduction of solutions of NPs of sample 2 into the contaminated soil and incubation for 1 day had the following effect on the growth of the test plants: the root and shoot lengths increased by 13.1-39.3 and 14.6-24.4%, respectively, depending on concentration; the effect of concentrations of 50 and 100 mg/kg of soil differed only slightly (Fig.2). After the incubation of the contaminated soil with solutions of magnetite NPs of sample 2 for 4 days, the stimulatory effect did not disappear; instead, it became even stronger: the root and shoot lengths increased by 49.2-78.5 and 12.7-49.1%, respectively, depending on NP concentration. With respect to the total seedling length, the incubation of the contaminated soil with solutions of NPs of sample 2 for 1 day had a positive effect (129.4-131.4% of reference 3), which became stronger with an increase in the incubation time to 4 days (145.8-165.0% of reference 2). The growth stimulation effect was evident from an increase in the length of both the roots and shoots of the wheat; the maximum effect was observed in the case of using a concentration of 50 mg/kg of dry soil and the incubation of the soil for 4 days.

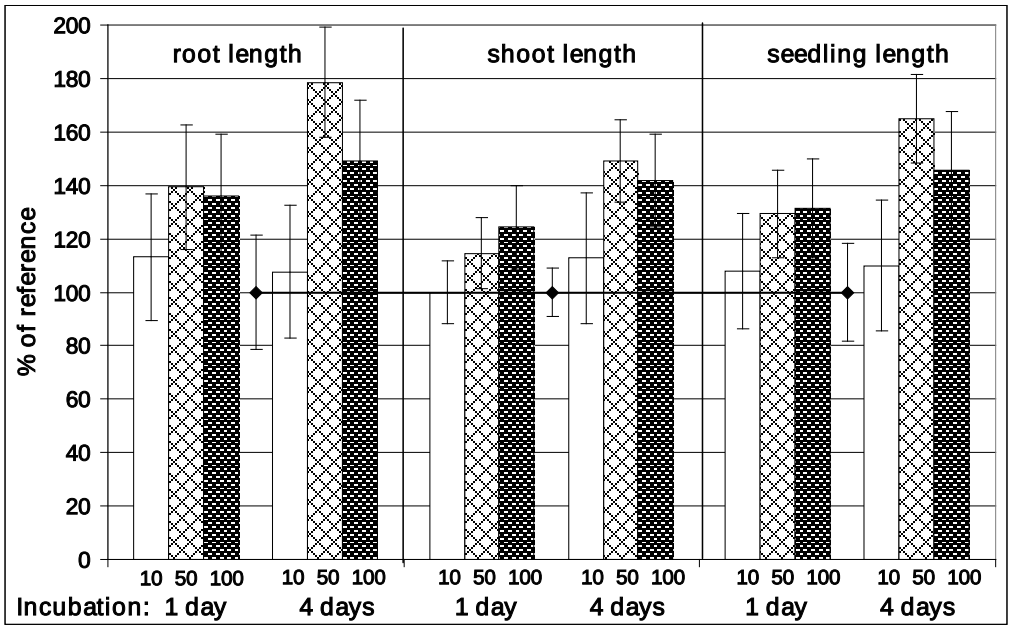

Fig. 2. Effect of Fe_3O_4 S12 NPs on the seedling length of the wheat inhibited by trifluralin.

Magnetite NPs coated with PVP used as a stabilizer and without it were prepared by chemical coprecipitation. The size of particles was 8-20 nm (sample 1) and 50-60 nm (sample 2). The stimulatory effect on the growth of wheat seedlings in the long-term pesticide-contaminated soil was evident from an increase in the length of both the roots and the shoots; the maximum effect was observed in the case of incubation of the soil with a solution of Fe_3O_4 (sample 2).magnetite NPs in a concentration of 50 mg/kg of dry soil for 4 days. An increase in the time of incubation of Fe_3O_4 iron NP solutions with the long-term pesticide-contaminated soil from 1 to 4 days leads to the occurrence of a stimulatory effect in the case of using Fe_3O_4 NPs without any stabilizer (sample 1) and to an enhancement of the growth stimulation effect in the case of Fe_3O_4 NPs with a PVP stabilizer.

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