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# Aqueous Chemical Co-Precipitation of Iron Oxide Magnetic Nanoparticles for Use in Agricultural Technologies

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**Abstract:** Magnetic nanoparticles of iron oxides were obtained by precipitation from aqueous solutions of iron chlorides ($Fe^{2+}/Fe^{3+}$). It is shown that, depending on the use of various technological techniques in their synthesis (ultrasound, bubbling with argon, heating, the addition of oleic acid), nanoparticles 5-40 nm in size, spherical or plate-like, with a specific surface area of 52-92 $m^2/g$, are formed corresponding to maghemite or solid solutions of maghemite with magnetite. The latter, in particular, are synthesized with a shell of oleic acid. Aqueous suspensions of nanoparticles (0.00001 to 100 mg/L) were used for the pre-sowing treatment of seeds of spring barley, cabbage, and salad crops, as well as for foliar treatment (0.001 to 1 mg/L) of vegetative cucumber and lettuce plants. It was found that these nanoparticles do not possess fungicidal and bactericidal activity against pathogens (*Xanthomonas campestris* pv. campestris (Pammel) Dowson) of cabbage vascular bacteriosis, barley dark brown spot, and root rot (*Cochliobolus sativus* (S. Ito & Kurler ex.) Drechs. Dastur), but exhibit weak fungicidal activity in certain concentrations, in particular, against the causative agents of blackleg in white cabbage. Presowing seed treatment, in general, has a positive effect on germination and morphometric parameters of different plants. These parameters significantly depend on the concentration of nanoparticles in suspensions, their phase composition, and the presence or absence of an inert shell on the surface. Foliar treatments of cucumber and lettuce seedlings with suspensions of synthesized nanoparticles improved the morphometric and biochemical parameters of plants, which together provide a tendency to increase their productivity, which is more pronounced at a nanoparticle concentration of 0.01 mg/L. In the future, it is possible to further enhance the phytoprotective effect of iron oxide nanoparticles, which will reduce the dose load of persistent agrochemicals and pesticides on the environment.

**Keywords:** nanoparticles; magnetite; maghemite; precipitation; pre-sowing treatment; foliat treatment; morphometric parameters.