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NANOTECHNOLOGY – A PERSPECTIVE FOR AGRICULTURE

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The competitiveness of agricultural production in the context of globalization of the world economy is possible only with the rapid introduction of innovative technologies. This applies both to the intensification of production processes and to improving its quality and safety, including reducing the negative impact on the environment [1-3].

Nanotechnology promises great potential for application in the development of new materials, biotechnology, microelectronics, energy and armaments [4].

Biological nanochips will help to diagnose somatic and infectious diseases, including species identification of pathogens of especially dangerous infections and toxins, materials with silver nanoparticles with antibacterial properties have been obtained. They are used in medicine to combat staphylococci and other bacteria in the form of paints, chlorine-free disinfectants, dressings, varnish for covering catheters, etc. Such materials are used in agriculture, for example in milking machines, to solve the problem of filter pollution in any air conditioners.

The directions of using nanotechnology in agriculture are associated with the reproduction of agricultural species, the processing of the final product and the improvement of its quality. Nanotechnology is already used to disinfect air and various materials, including feed and end products of animal husbandry; processing of seeds and crops in order to preserve it. They are used to stimulate plant growth; treating animals; improving the quality of feed. There is experience in the implementation of these technologies to reduce the energy intensity of production, optimize raw materials processing methods and increase the yield of final products; development of new packaging materials that allow the end product to be preserved for a long time [5,6].

Most of these are related to the food industry, using nanomaterials to package food or to identify and, in some cases, neutralize dangerous toxins, allergens or pathogens. Projects are being developed to create and improve food additives, to obtain vegetable oil with nano-additives that prevent the entry of cholesterol into the blood of mammals.

Others are aimed at developing more efficient and environmentally friendly agricultural technologies. For example, the use of nanomaterials for water purification in agroecosystems. Or their use for processing plant waste into ethanol. In animal husbandry, methods of using nano-additives are being developed in order to reduce the doses of growth factors and hormones, and neutralize pathogens at the early stages of their contact with animals.

Great hopes in the application of nanotechnology are also found in the agro-industrial complex. An increase in the production and quality of processing of agricultural raw materials, an increase in the service life of special equipment, an increase in the shelf life, obtaining high-quality food products and feed – all these tasks of agribusiness can be solved by nanotechnology [7-9].

The use of nanotechnology in vegetable growing.

Monitoring of the developed nanotechnological processes and nanomaterials confirms that the use of nanopreparations in crop production provides an increase in resistance to adverse weather conditions and an increase in the yield of finished products. For almost all industrial and food crops– potatoes, cereals, vegetables, fruits and berries, cotton and flax, the yield indicators increased by 1.5–2 times. Nanotechnologies are already being actively implemented in post-harvest processing of sunflower, tobacco and potatoes, storage of apples in controlled environments, ozonation of the air.

In the light of the latest discoveries of nanotechnology, the biological role of silicon in living organisms has been studied and the biological activity of organic silicon compounds – silatranes – has been studied. Silatranes, which are cellular formations and contain silicon, have a physiological effect on living organisms at all stages of evolutionary development from microorganisms to humans. The use of organosilicon biostimulants in plant growing makes it possible to increase cold resistance, endurance to heat and drought, helps to safely get out of stressful weather situations (recurrent frosts, sudden temperature changes, etc.), enhances the protective functions of plants against diseases and pests. The preparations remove the depressing, sedative effect of chemical reagents for plant protection during complex treatments. The ultramodern direction of nanobiotechnology (nanotechnology in biology) in crop production is the creation of cultivated plants, especially resistant to insect pests [10].

Nanotechnology in animal husbandry.

In animal husbandry, it is advisable to use nanotechnology in technological processes, where they provide an auxiliary superiority. When forming a microclimate in rooms where animals and birds are kept, their use makes it possible to replace the energy-intensive supply and exhaust ventilation system with electrochemical air purification while ensuring the regulatory parameters of the microclimate: temperature, humidity, gas composition, microbial content, dustiness, air velocity, elimination of odors while maintaining heat release from animals. Russian scientists apply in practice

environmentally friendly nanotechnology of electroconservation of silage mass of green fodder with an electroactivated preservative. This is done to replace expensive organic acids that require strict safety measures. This new nanotechnology improves feed safety by up to 95%. In livestock and poultry farming, nanotechnology provides an increase in productivity by 1,5–3 times, resistance to stress, and mortality is reduced by 2 times in the preparation of feed. Nanodevices, which can be implanted into plants and animals, allow automating many processes and transmitting the necessary data in real time.

Nanotechnology in the processing of agricultural products.

The new nanoelectric technology for combined grain drying is based on the fact that an excess moisture pressure is created in the heated grain at a temperature below the boiling point of water. As a result, the filtration transfer of moisture from the caryopsis to the surface in a droplet-liquid state is accelerated. From the surface, moisture is evaporated by hot air. Energy consumption for drying grain in comparison with traditional convection is reduced by 1,3 times or more, micro-damage to seeds is reduced to 6%, their sowing quality is improved by 5%. For low-temperature additional drying and disinfection of grain, ozone was additionally used, which reduced the number of bacteria by 24 times and reduced energy consumption by 1,5 times.

With regard to the agro-industrial complex, the introduction of nanotechnology promises an increase in the volume of agricultural products and an improvement in their quality. Nanotechnology can be applied in various branches of the agro-industrial complex: crop production, veterinary medicine, animal husbandry, processing of animal waste products and agricultural waste, processing, storage, packaging of agricultural products.

For example, currently in animal husbandry, silver nanoparticles are successfully used in filters and other parts of equipment for the dairy industry to inhibit fermentation and souring of milk. Nanoparticles of iron and other microelements are included in premixes to increase the viability of animals and their productivity. Nanotechnology is applied in food packaging and storage.

With the help of silver nanoparticles, which have an active antimicrobial effect, various types of products can be effectively disinfected. DNA technologies are actively used today, which make it possible to identify genes associated with economically valuable traits, resistance to stress, infectious diseases, as well as genes that carry recessive mutations – genetic anomalies. In general, all molecular biology can be called nanotechnology.

Abroad, the nanoindustry is developing rapidly. For example, since the end of the 90s of the last century, the analysis of the breeding value of animals in the USA, Canada, and the countries of the European Union has been carried out using molecular biology. According to the agency "Ciantifa", recorded 150 cases of the use of nanotechnology in the food industry around the

world. Another analytical agency, Helmut Kaiser, predicts that the contribution of nanotechnology to food production in the US by 2020 will amount to about $20 billion. For example, the US government is investing up to $1.2 billion in a program to introduce nanotechnology into agriculture. Ukrainian scientists have already made a great contribution to the development of nanotechnology. We have very serious developments, not only in the agricultural sector, but also in other sectors of the economy.

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