Под эгидой Нанотехнологического общества России создан консорциум "АгроНаноИндустрия", который осуществляет комплексное сопровождение инновационных проектов в сфере агробизнеса на всех этапах их жизненного цикла.

Under the auspices of the Nanotechnological Society of Russia the Agronanoindustry consortium, which provides complex support of innovative projects in the field of agribusiness at all stages of their life cycle, is created.

Эффективность развития современного агробизнеса в большей мере зависит от разработки и внедрения наукоемких технологий на всех этапах производства и переработки продукции сельского хозяйства и животноводства. Одним из важнейших приоритетов в этом направлении являются агронанотехнологии, которые все в большем объеме используются в сельском хозяйстве и пищевой промышленности, производстве и переработке продукции АПК, сельскохозяйственном машиностроении, техническом сервисе и обеспечении экологической безопасности.

Научная новизна агронанотехнологий заключается в том, что рассматриваемые процессы и действия происходят в нанометровом диапазоне пространственных размеров. В отличие от традиционных технологий, для агронанотехнологий характерен "индивидуальный" подход, при котором внешнее управление достигает отдельных атомов и молекул, что позволяет создавать из них как "бездефектные" материалы с принципиально новыми физико-химическими и биологическими свойствами, так и новые классы биосистем с характерными нанометровыми размерами.

Приводимые экспертами международной исследовательской организации ЕТС Group данные об эффективности применения агронанотехнологий в земледелии ряда ведущих экономик мира свидетельствуют, что в среднем урожайность вырастает в 1,5–2 раза почти у всех продовольственных (картофель, зерновые, овощные и плодово-ягодные) и технических (хлопок, лен) культур. Эффект здесь достигается благодаря более активному проникновению микроэлементов в растение за счет наноразмера частиц и их нейтрального (в электромагнитном смысле) статуса. В частности, ожидается положительное влияние наномагния на ускорение фотосинтеза у растений и, как результат, на увеличение продуктивности сельхозпродукции, а также нанонемерийорганических биостимуляторов в растениеводстве, которые повышают холодостойкость, выносливость к жаре и засухе, помогут благополучно выйти из стрессовых погодных ситуаций (возвратные заморозки, резкие перепады температуры и т.д.), усилют защитные функции растений к болезням и вредителям. Также нанотехнологии применяются при посеве подсолнечника, табака и картофеля, хранении яблок в регулируемых средах, озонировании воздуха. В животноводстве и птицеводстве, при приготовлении кормов нанотехнологии обеспечивают повышение продуктивности в 1,5–3 раза, сопротивляемость стрессам, уменьшение падежа в два раза. Наноустройства, которые могут имплантироваться в растения, животных, позволяют...
The effectiveness of modern agricultural business is increasingly dependent on the development and introduction of high technologies at all stages of production and processing of agricultural and livestock products. One of the most important priorities in this area are agricultural nanotechnologies that are increasingly being used in agriculture and food industry, production and processing of agricultural products, agricultural machinery, technical service and environmental security.

The scientific novelty of agricultural nanotechnologies lies in the fact that their processes and actions occur in the nanometer size range. Unlike traditional technologies, agricultural nanotechnologies implement “individual” approach, in which external management reaches individual atoms and molecules enabling the creation of “defect-free” materials with fundamentally new physical-chemical and biological properties and of new classes of biological systems with nanometer characteristic dimensions.

According to data of the international research organization, the ETC Group, about the effectiveness of agricultural nanotechnologies in agriculture of a number of leading economies of the world, the average productivity grows by 1.5-2 times for almost all food (potatoes, grain crops, vegetables and fruits) and technical (cotton, flax) cultures. The effect is achieved through increased penetration of microelements in the plant due to the nano-size of the particles and their neutral (in the electrochemical sense) status. In particular, it is expected that nano-magnesium will have a positive effect on the acceleration of photosynthesis in plants and, as a result, on the increase in the productivity of agricultural products, and nano-organic silicon biostimulants in crop production will increase the cold resistance, tolerance to heat and drought, will help to successfully deal with stressful weather situations (repeated frost, sudden changes in temperature, etc.), will strengthen the protection of plants against diseases and pests. Nanotechnologies are also applied in post-harvest processing of sunflower, tobacco and potatoes, storage of apples in controlled environments, ozonation of air. In the livestock, poultry farming and preparation of feed, nanotechnologies improve productivity in 1.5–3 times, increase resistance to stress reducing mortality in two times. Nano-devices that can be implanted into the plants and animals, enable to automate many of the processes and to transmit in real time the necessary data.

In general, innovative projects in the field of agronanoindustry allow to achieve the following results:

- increased production safety and product quality;
- reducing costs on farming of plants and animals;
- improved quality of seed grain;
- reduction in the incidence of plants and animals and improved resistance to pests;
- increased plant yield;
- obtaining environmentally friendly (safe) products.

Taking into account the global trend for the use of nanotechnology in the agro-industrial sector, as well as the results achieved by the Russian scientists and small and medium agribusiness in this area, under the auspices of the Nanotechnological Society of Russia (NTSR), the Agronanoindustry consortium, which provides complex
support of innovative projects in the field of agribusiness at all stages of their life cycle, was established. Russian and foreign scientific and educational centers, the companies engaged in coordinated business activities on joint implementation of projects in the field of agronanoindustry have become or may become in the future consortium members.

Overall, the Agronanoindustry consortium allows to implement SMFLIP (System of Manage Full Lifecycle Innovation Project) conception for the production of highly efficient, innovative, ecological agriculture and livestock products based on nanotechnology, which involves innovative project engineering, marketing and covers all the main stages in the development and implementation of technologies and products, including:

• interaction with authorities and third parties in all issues of current activities of the consortium in the particular project (projects), including with customer for signing contracts and receiving payment for the work performed;
• arrangement of financing of the consortium partners at all stages of the full life cycle of project (projects).

This approach corresponds to a new stage of development of agrarian science and agricultural production, which should provide the maximum reduction of dependence of the volume and quality of products on subsidies and unfavorable factors affecting the environment. For example, Tatarstan’s companies are implementing in the framework of Agronanoindustry consortium the innovative-investment project “Highly innovative ecological products for agriculture and livestock based on nanotechnology” that allows to obtain the following advantages:

• short cycle of main production of highly competitive, ecological agricultural products;
production, which should ensure maximum reduction of the vegetation period, which is important for all regions of Russia;

- avoidance of the chemicalization of the production process;
- low waste (less than 1%);
- low market cost of the products.

For example, the humic organic preparation for root and foliar feeding of vegetables, flowers, ornamental deciduous plants, berry bushes and fruit trees, lawn grasses is developed. The production of humic organic preparation is based on the physical-mechanical impact (hydroblow) in the resonator on the natural humic caustobolith with obtaining of the nanostructured product that differentiates it from existing humic preparations. This product is a high-efficiency concentrated fertilizer with the effect of protecting plants from diseases, a means of new growth and regeneration of soils. Its use in some areas of the Republic of Tatarstan has allowed to increase the yield of crops by 22–39%, to increase the seed germination capacity by 7-14%, to reduce the ripening by seven days.

Another example of effective product created using nanotechnology is humic-protein organic concentrate aimed to optimize ration of ruminant and monogastric farm animals including all the food elements for any technologies of their keeping, including those used in feed additives for cows, pigs, chickens, broilers and other animals. Manufacturing of humic-protein organic concentrate includes obtaining preliminary product with unique properties by splitting of polysaccharides of rye on the atomic-molecular level to sugars and by extraction of biogenic elements of high-moor peat up to 80% with the use of bioresonator. Additional components of the concentrate are blended consistently to achieve science-based standards. The feeding rate of the concentrate depends on the animal species, age, productivity, structure of the ration and provision with the nutritional...
and biologically active substances, and is 10–20% by weight of mash or grain mixture. Before feeding the mixture may be milled and mixed thoroughly, for example, using DOSE mini-feed plant.

The inclusion of humic-protein organic concentrate in the rations of animals allowed to achieve the following results:

- optimization of rations of feeding of agricultural animals in all necessary nutrients;
- rapid recovery after calving and increased metabolism;
- increased animal productivity by 12-18% and reduction in feed costs by 8-10%.

The Agronanoindustry consortium is a pilot platform for the promotion and commercialization of the above-listed products as well as of other innovative projects in the field of agronanoindustry, developed by Russian and foreign scientists. For example, Russian scientists have created a nanotechnology that might be used in the livestock and poultry farming for the formation of a microclimate in premises where animals and birds are keeping. These nanotechnologies allow to replace energy-intensive supply-and-exhaust ventilation system by electrochemical air purification with ensuring the regulatory parameters of the microclimate: temperature, humidity, gas composition, microbial contamination, dust level, air velocity, eliminating odors, preserving the heat of animals.

Environmental nanotechnology of electro-preserving of silage of green fodder by electro-activated preservative that replace expensive organic acids, which require strict safety measures, is also developed and implemented in Russia. This nanotechnology increases the safety of the fodder up to 95%. Nanoparticles of iron and of other micronutrients are included in the composition of the premixes to enhance the viability of animals and their productivity.
In general, according to experts, application of nanotechnology in agriculture for growing grain, vegetables, plants and animals, and in food production for the processing and packaging will lead to the arise of an entirely new class of food – agronanoproducts, which will eventually displace the genetically modified products.

According to the conventional scientific terminology, the product can be called "agronanoproduct" if at the cultivation, processing, processing of agricultural product or its packaging the nanotechnology was used, or nanomodification of product was carried out. Future developments of agronanoproducts promise to make more perfect the production and packaging processes of foods, to improve their taste and give them new nutritional properties. It is also predicted the emergence of "functional" products that contain drug or additional nutrients. The introduction of new technologies will increase productivity and reduce food prices. The use of agronanoproducts will become ubiquitous in the next 15-20 years.

Given the relevance of developments of modern agronanoproducts and their impact on the development of agriculture and livestock in Russia and in the world, it is needed as a priority to increase investments for their implementation, including:

- development of industry strategy of R&D aimed at accelerating achievement of the planned indicators of development of agricultural production;
- interaction and cooperation with numerous Russian and foreign centres, including in the framework of the Agronanoindustry consortium;
- creation of the system of personnel training for project management in agronanoindustry and innovative agribusiness.

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