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ECONOMIC RESEARCH OF BIOTECHNOLOGIES TRANSFER IN RUSSIA'S AGRICULTURE

Nikolai Ivanovich KUZNETSOV, Nadezhda Viktorovna UKOLOVA, Sergey Vladimirovich MONAKHOV, Juliya Anatolyevna SHIKHANOVA, Ivan Dmitrievich ESKOV

Saratov State Agrarian University, Saratov, Russia, 410012, Teatralnaya Square, 1, Emails: nikolai.i.kuznetsov@mail.ru, nadya_ukolova@bk.ru, monahovsv@mail.ru, juliya-shikhanova@yandex.ru

Corresponding author: nikolai.i.kuznetsov@mail.ru

Abstract

The authors consider the mechanism of technologies transfer for the production of high-tech products in modern agriculture in Russia. The peculiarities of biotechnological clusters construction in Russia's economy and the leading countries of the world economy are considered. The features of interaction and principles of biotechnological clusters creation in modern conditions are shown. For example, the transfer of technologies that use integrated biological plant protection systems is based on the possibilities of modern biotechnology that contribute to reducing environmental pollution and increasing the production of environmentally friendly agricultural products. In the article, the authors substantiate that the principle of close interaction between 1) the scientific environment, 2) educational institutions, 3) experimental farms and 4) agricultural organizations, is the basis for the transfer of technologies for the production of high-tech products in modern agriculture. The article shows the peculiarities of technology transfer with the activity of large high-tech companies (including transnational companies) as initiators of the development and mass use of new technologies in agriculture. In the article, using the example of the use of biological plant protection systems, the experience of transferring technologies for the production of high-tech products in agriculture in the Saratov region and other regions of Russia was examined. The research made it possible to form a unified technology transfer system that uses biological plant protection systems in the production of high-tech products, based on business structures, research centres and the necessary infrastructure. In their study, the authors come to the conclusion that the introduction and mass use of new technologies for the production of high-tech agricultural products will contribute to the effective development of the agrarian sector of the Russian economy, increasing the competitiveness of Russian agricultural products in world markets.

Key words**:** *development economics, bio-technology, bio-economics, bio-clusters, plant protection, technology transfer, biological systems*

INTRODUCTION

The current level of development of agrarian science in Russia and in the world makes it possible to use the opportunities of the newest methods of agricultural biotechnology, which make it possible to significantly reduce the cost of manufactured products, and also successfully test them in practice, promoting mass use.

New technologies of cultivation of agricultural crops allow to minimize negative influence of a person on the environment. However, not all agricultural producers use these technologies for various reasons. One of the main reasons is high production costs, low economic effect, and lack of technical and technological opportunities for production.

The requirements of the world's leading agrarian countries are aimed at increasing the production of environmentally friendly products, reducing the use of chemicals and their impact on the environment. For example, in the European Union, the directive No. 1907/2006, which is the basis of the REACH program, was adopted and is being actively applied [13]. This directive is aimed at reducing the use of chemicals in the production of agricultural products. At the same time, organic agricultural products must have a low cost and compete on an equal

footing with the products produced using chemicals.

In recent years, agriculture has been actively developing biological plant protection products, which are an alternative to the use of chemical plant protection products. From an economic point of view, the use of chemical protection should be more beneficial than the use of biological protection. However, the damage they cause to the environment is more significant and will require considerable restoration costs in the future.

Theoretical and methodological basis of the research was the works of scientists of Russian and world agrarian science. In the economic part of the study, the works of many scientists of modern economic science, such as Kozakova [7], Krochmal-Marczak [8], Sessa [15], Dyrdonova [4], Kovalenko [6]. The scientific works of prominent Russian scientists of agrarian science are devoted to the development of the biological methods use and plant protection systems, such as the works of Kandibin [5], Pavlyushin [11, 12], Shternshis [16] and other scientists.

MATERIALS AND METHODS

The methodology of the study included the formulation and conduct of an economic study of the transfer of technologies for the production of high-tech products in Russia, using integrated biological plant protection systems. The study was conducted in accordance with traditional methods of conducting economic research, as well as using special methods to assess the effectiveness of agro-ecosystems.

The main methods of investigation were the following ones: dialectical method, analysis and synthesis methods, graphical method, computational-constructive method, economic-statistical method and others.

The conceptual basis of the research is the adopted Strategy of scientific and technological development of the Russian Federation [3]. This Strategy provides for the transition to a highly productive and environmentally friendly agriculture, the development and implementation of systems for the rational use of chemical and biological protection of agricultural plants. As well as the Federal Scientific and Technical Program for the Development of Agriculture for the years 2017-2025 [14], the State Program for the Development of Agriculture and Regulation of the Agricultural Products, Raw Materials and Food Markets for 2013-2020 [17] and the Comprehensive Program for the Development of Biotechnology in The Russian Federation for the period up to 2020 [2].

RESULTS AND DISCUSSIONS

At the heart of the transfer of technologies for the production of high-tech products in modern agriculture lies the principle of close interaction between 1) the scientific environment provided by research centres of the appropriate profile, 2) educational institutions training and retraining specialists, 3) pilot farms, where new technologies are tested and 4) agricultural organizations, where mass introduction of production technologies is carried out.

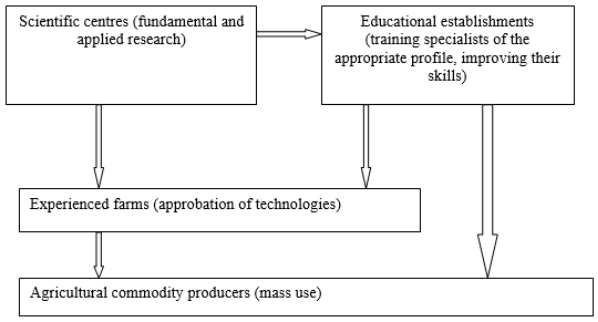

Fig.1. Mechanism of new technologies transfer in agriculture.
Legend: the arrows on the diagram show the transfer of technology.
Source: Authors' design.

Technology transfer in Russia's agriculture can be represented in the form of a scheme (Fig.1). The existing mechanism of technology transfer allows successfully and efficiently introduce new technologies from the stage of development of technology to mass use by agricultural commodity producers.

At the same time, large holding companies of the agrarian sector of the economy, as a rule,

have scientific subdivisions and experimental production, which allow them to develop and introduce new technologies into mass production within the company. This technology transfer option provides competitive advantages for large companies in comparison with medium and small organizations, and also improves the efficiency of their activities.

Small agricultural organizations (farmers) are trying to use new technologies to minimize costs and to be able to compete with large companies. From their point of view, the additional costs for the maintenance of scientific units are almost impossible, and therefore cooperation is most effective for them within the framework of associations or directly with large scientific institutions. For example, the association of peasant farms and production cooperatives "Vozrozhdenie", created in the Saratov region, facilitates the adaptation of small farms to the changing conditions of economic activity, the introduction of new technologies into mass production. And the activities of the Association "Agrarian Education and Science", within which the leading scientific and research institutions of the agrarian profile of the region are concentrated, ensures the development of new technologies and their approbation.

Another way of transferring technologies in agriculture is the activity of high-tech companies (including transnational) producers of biological products that have experimental production. The major producers of biologics in Russia are FGBU "Russian Agricultural Centre", "Sibbiofarm" LLC, "Vedabio" LLC and others. For mass introduction of the developed technologies, they conclude direct contracts with agricultural commodity producers for the supply of necessary drugs or equipment (Fig.2) or use distribution companies.

In modern agriculture, in our opinion, the most effective way of transferring technologies is to use the cluster approach and on this basis to build clusters that include scientific and educational institutions, financial and credit institutions, organizations that provide information and consulting services, enterprises of production infrastructure, trade and intermediary organizations, resource providers, producers of products [10].

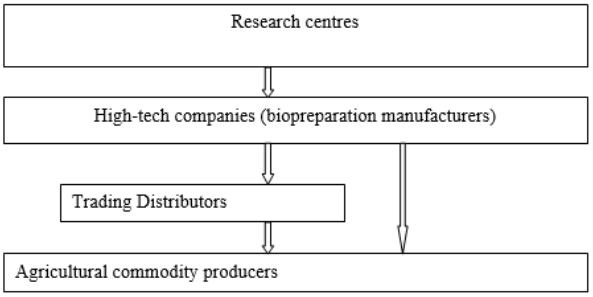

Fig.2. Mechanism of technology transfer in agriculture on the basis of high-tech companies (on the example of development and use of biological products for the production of environmentally friendly agricultural products)
Legend: the arrows on the diagram show the transfer of technology.
Source: Authors' design.

The cluster approach for technology transfer is actively used in Germany, which is most clearly manifested in the biotechnological direction. Germany is actively developing biotechnology. In Germany there are well-known and promising biotechnological clusters. Munich and Berlin-Brandenburg belong to the leading biotechnological clusters of Europe [4].

In Russia there are also examples of successful construction of biotechnological clusters. The biotechnological cluster has certain principles and specifics of creation, the main ones are (Fig.3):

1.Self-organization of clusters. The development of the cluster, as a rule, occurs as a self-organizing system, which dynamically develops and changes.

2.Corporatism. All the arising disagreements in the cluster are expedient to be solved taking into account the opinion of all cluster members based on trust and reciprocity.

3.Long-term cooperation. This principle is based on the long-term cooperation of all cluster members in order to achieve the most effective use of available resources and opportunities.

4.Geographical principle. In order to maximize profits, all participants in the cluster must be geographically close to each other.

5.Dynamism of a cluster. This principle is largely based on the fact that the flexibility of the cluster is its one of the main advantages and it allows the cluster to change depending on changes in the market.

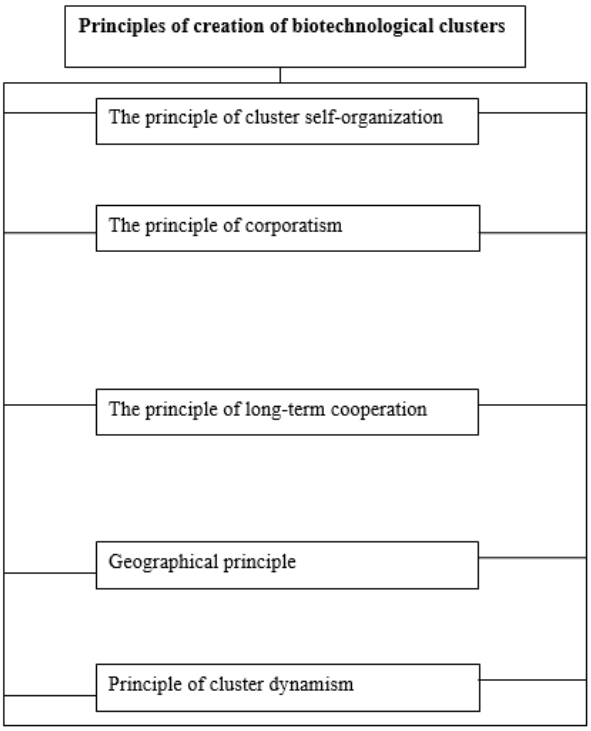

Fig.3. Basic principles of biotechnological clusters creation
Source: Authors' design.

An example of the successful construction of biotechnological clusters in Russian regions is the biotechnological cluster of the Kirov region [1] created in 2008 in the form of a non-profit partnership. This cluster includes various enterprises and organizations united by a technological process and a unified economic development strategy.

In the agriculture of the Saratov region, the Agrarian University has an active role, which includes a number of scientific laboratories in which fundamental and applied research in the field of biotechnology is conducted, and two large structural divisions in which the approbation of new technologies is being carried out: the Agrocentre and the UNPO "The Volga region". So, scientists of the Agrarian University successfully tested a number of biologics: Gamair was used from spot on leaves, black leg, late blight, alternaria, bacterial decay, scab, moniliosis, bacterial cancer, vascular bacteriosis, tracheomycosis wilt. It also restored useful microflora in the soil and in plants; Bitoksibatsillin has not only insecticidal properties, but repellent, that is, a repellent effect. Due to its odour, the drug repels pests from the treated area, thereby reducing the number of oviposition; Lepidocid - used to combat silkworm caterpillars, scoops and other butterflies - pests; Averesectin was introduced against mites, nematodes and the Colorado beetle. These drugs are successfully used in agricultural enterprises and farms in the region.

In the Saratov region, integrated biological systems of plant protection in vegetable growing of protected soil are actively used. Such enterprises as OJSC Volga, JSC Sovkhoz-Vesna use biological plant protection systems based on the use of existing biological laboratories. Widely produced bioagents: phytoselius for fighting against a spider mites, enkarziya against a greenhouse whitefly in the production of tomatoes and other products of the vegetable-growing industry.

Saratov Agrarian University is the leader of agrarian education in Russia, which allows to train highly qualified specialists of the appropriate profile, providing the needs not only of the Saratov region, but also of other regions of Russia. The educational activity of the Agrarian University is an integral part of the technology transfer mechanism in the regional agro-industrial complex and facilitates the transfer of technologies for the production of high-tech products.

Large companies of biopreparation manufacturers actively cooperate with scientists from leading scientific institutions and organizations of the agricultural profile, which allows them to successfully develop their business by providing technology transfer at the level of a research institution - a high-tech company. So, the company "Sengenta", which is one of the leaders of the Russian segment of the plant protection products market, has an active development of biologics as its development priority. Successfully applied modern biopreparations in plant growing are preparations Vertimec

and Isabion. Vertimek is a preparation of a group of insecticacaricides of biological origin, has an intestinal-contact effect. It is used when it is necessary to protect almost all types of garden, berry and flower crops from a wide range of pests, especially from ticks, thrips and miner insects. Isabion is a biological fertilizer of the latest generation, of wide application, consists of a complete set of amino acids.

The branch of the Federal State Unitary Enterprise "Rosselkhozentr" in the Saratov region has a bio-factory and a production plant for the production of biological plant protection products. The products are intended for pre-seed treatment of seeds, as well as protection of crops against pests, fungal and bacterial diseases in the open and closed ground. Such drugs as Rizotorfin, Risoplan, Rizoagrin and Flavobacterin show high efficiency in the cultivation of crops. With their use, the yield of agricultural crops is increasing by 10-40 percent. For example, the cost of processing 1 hectare of a biological fungicide Risoplan is 3.5 - 5 US dollars (depending on the rate of consumption 0.5-1 l / ha), and treatment with an average of 16.7 USD / ha and more.

Currently, an integrated plant protection system should be understood as a system of management measures for intra- and interpopulation relations within the agroecological system and its constituent agrobiocenoses. In this case, the use of active plant protection products is regulated by the stage distribution of harmful objects, by the time and method of their most safe application to useful bio-objects. This method is most suitable from the point of view of environmental protection. First of all, it became clear that the problems of combating harmful species can not be solved without taking into account the connection of these species with other organisms, that any impact on agrobiocenosis leads to a change in the number of all, including useful, organisms. Integrated methods of plant protection include the selection of such means of suppressing pests that would not only preserve but also activate the activities of beneficial organisms. In other words, the integrated method of plant protection is a system of management measures for intrapopulation and interpopulation relations within a particular agrobiocenosis. This is its fundamental difference from previous systems.

The growth of the use of biological plant protection products and microbiological fertilizers in the crop sector of Russian agriculture should reach 32 percent by 2020 (Fig.4).

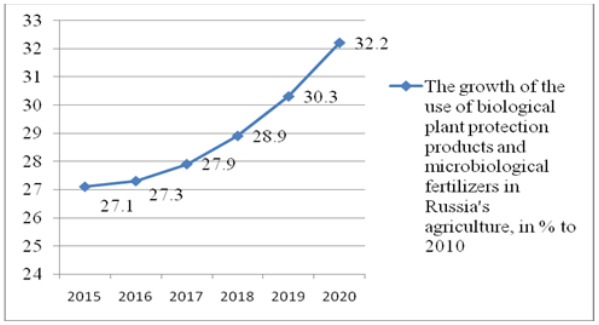

Fig.4. The diagram of the growth in application of biological plant protection products and microbiological fertilizers in Russia's agriculture, in % to 2010.

Source: Compiled by the authors on the basis of research data [17].

All of the above enumerated allows us to form a unified technology transfer system that uses biological plant protection systems in the production of high-tech products. The basis of this technology transfer system will be 1) business structures, 2) research centres represented by universities and research institutes, 3) administrative, production and social infrastructure.

In the studies by C. Sessa and A. Ricci [15] the importance of the process of exchanging technologies for the production of high-tech products for the development of the world economy was stressed out. The scenario of development of the world economy predicted by them is characterized by a high level of cooperation and use of new production technologies.

In the study by Ja. Kozakova [7], she presents the experience of developing organic farming in Slovakia. The development of production of ecologically clean products allowed to enlarge the area occupied by this product since 1991 by more than 12 times. And also

significantly increase the export of these products outside the country.

Another aspect of the development of environmentally friendly production is the introduction of quality control in the production of agricultural products in the EU countries [8].

In the study by G.L. Kovalenko and O.A. Maslennikova [6], they substantiated the statement that the transfer of technology for the production of high-tech products for national economies is an important factor providing a competitive advantage in world markets in modern conditions.

In the study by N.I. Kuznetsov [9], he concluded that the development of biotechnology in Russia will enhance the status of the Russian state as a country with a high level of development of science and use of high technologies.

CONCLUSIONS

In conclusion of the conducted economic research it is necessary to draw the following conclusions.

The modern approach to conducting agricultural production in the world's leading agrarian countries is based on the fact that environmental safety is a more important criterion than economic profitability. This is reflected in the growth in the volume of production of environmentally friendly agricultural products in the world, reducing the chemicals influence on the agroecosystem, and increasing the proportion of biological plant protection products.

The active use of biological plant protection products in Russia's agriculture will increase the volume of environmentally friendly products. It will promote the growth of exports of these products to foreign markets.

Transfer of technologies that use biological plant protection systems in the production of high-technology crop production will provide competitive advantages to Russian agriculture in the world food markets.

The application of biological plant protection systems will reduce the negative impact on the environment from agricultural production.

An important role in the system of technology transfer in the production of high-tech products in agriculture should be given to major research centres and leading educational institutions.

The introduction and mass use of new technologies for the production of agricultural products will contribute to the effective development of Russia's agriculture, and will also promote the development of agrarian science.

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