Brief information about the project

Name of the project	AP19679444 «Development of a long-acting biopreparation based on a polymer matrix with effective microorganisms for agricultural plant growth promotion».
Relevance	The project is aimed at studying biosurfactants of indigenous microorganisms of Western Kazakhstan fields for a basic understanding of oil recovery processes. The main idea: selection of indigenous microorganisms and optimal conditions for their effective use to reduce the viscosity of residual oil, in general, enhance oil recovery from mature reservoirs of Western Kazakhstan oil fields. Before being used in a model experiment, indigenous microorganisms and their biosurfactants will be studied in the laboratory.
Purpose	To develop an innovative long-acting biopreparation based on a microbial polymer matrix including an association of effective microorganisms and protective- nutritional additives to promote growth and protect agricultural plants from phytopathogens and salt stress.
Objectives	1) Creation of an association of microorganisms with agronomically valuable properties and development of a biotechnological scheme for polymer synthesis. At the first stage, a new association of effective microorganisms with agronomically valuable properties will be created. When creating an association, it is important to consider the type of relationship between microorganisms, physiological characteristics and needs of co-cultures. Therefore, the biocompatibility of strains will be determined and optimal conditions for their co-cultivation will be selected. The biological activity of single strains and the created association will be evaluated according to the parameters: synthesis of phytohormones, biocontrol properties against phytopathogens, phosphate-mobilizing activity and halotolerance. At the next stage, a biotechnological scheme for synthesizing pullulan and polyhydroxyalconate as a basis of the polymer matrix will be developed. Furthermore, the nutrient medium for cultivation will be optimized to increase the productivity of biopolymer producers and reduce the cost of the finished product. To do this, the precursor substances of polymers and the main components of the medium, including by-products of various industries (molasses, oilcake, and beet pulp), will be selected. In addition, methods of isolation and purification of biopolymers that significantly impact their physico-chemical properties will be perfected. 2) Production of biopreparation based on a polymer matrix with effective microorganisms that promote plant growth. To create a polymer matrix, the physico-chemical and mechanical properties of the biopolymers as its basis

	will be determined. Due to the fact that hydrophobic properties of polyhydroxyalkanoate can be used as a prolonging agent, but limit its use due to the low rate of biodegradation, we will develop an innovative approach to obtaining a polymer matrix. For this purpose, the copolymerization of hydrophobic polyhydroxyalkanoate with hydrophilic pullulan will be carried out, reducing the degradation time of the polymer matrix and providing a prolonged effect of the biopreparation. At the next stage, experimental samples of the biopreparation will be obtained. So, optimal concentrations of protective-nutritional components (fungicides, organomineral additives) will be selected, and a method of their immobilization, together with the association of microorganisms into the created polymer matrix, will be perfected. An essential stage in developing a long-acting biological product is the preservation of the viability and biological activity of microorganisms. In this regard, the survival rate of microorganisms on the polymer matrix, the stability of biological properties, storage period, and technological parameters of the biopreparation (solubility, hygroscopicity, ability to stay on seeds, roots, and in the soil) will be determined. 3) Development of methods of application of experimental samples of the biopreparation and evaluation of the effectiveness of their action on agricultural crops. Methods of application of experimental samples of the biopreparation will be developed: seed coating before sowing, spraying plants in different phases of vegetation, and introducing them into the soil as a root additive. For a complex assessment of the effect of the biopreparation, step-by-step studies will be carried out: model vegetation experiments in a climatic chamber and subsequent small-scale field experiments. Stimulation of plant growth under the influence of a biopreparation will be evaluated by the sowing qualities of seeds, the intensity of plant growth processes, yield, physico-chemical and technological indicators of grain quality. An increase in the adaptive potential of plants due to application of biopreparation will be demonstrated in model experiments when growing plants under phytopathogenic load and salt stress conditions.
Expected and achieved results	It is planned to get the following results: - an association of microorganisms with agronomically valuable properties will be created and biotechnological scheme for polymer synthesis will be developed. - a biopreparation based on a polymer matrix with effective microorganisms that promote plant growth will be produced; - methods of application of experimental samples of the biopreparation will be developed and the

	effectiveness of their action on agricultural crops will be evaluated. Research carried out within the framework of the project will be an integrated approach to solving fundamental and applied issues in the field of agrobiotechnology, microbial synthesis of biologically active substances, improvement of fermentation processes using microbial cell immobilization methods, development of optimal commercial forms of biopreparations, biopolymer chemistry. The developed innovative biopreparation has a high potential for commercialization for application in crop production, since its production and use is a resource-saving, eco-friendly and low-cost technology, and there are no analogues on the domestic market. The use of this biopreparation will contribute to increasing the yield, improving the quality of agricultural products, avoiding the use of several expensive pesticides, increasing soil fertility, improving soil microbiota, reorienting farms to produce environmentally safe products, significantly reducing the chemogenic load and improving the environmental situation in Kazakhstan. The results of the project will be of applied importance, associated with the creation of high-quality competitive domestic biopreparations that meet high consumer requirements and provide a reduced load on agrophytocenoses. The scientific and technical potential of the project will make it possible to contribute to the study of the mechanisms of biological activity of microorganisms, the physico-chemical characteristics of microbial polymers, the kinetics of degradation of biopolymers, and the dynamics of the release of microorganisms and their metabolites from the obtained forms of long-acting preparations.The results obtained will be published in domestic and foreign journals indexed in Scopus and/or Web of Science, presentations are planned at leading international Kazakhstan and foreign scientific conferences, which will contribute to the integration of members of the research group into the global scientific space, increase competitiveness, and expand the field joint research with foreign colleagues.
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List of publications with links to them	
Patents	-