

Brief information about the project

Name of the project	AP26198317 «Development of biotechnology for protecting agricultural crops from phytopathogens based on the use of microbial antagonists and their metabolites.»
Relevance	The project aims to develop an innovative biotechnology for crop protection against phytopathogens based on the use of microbial antagonists and their metabolites. The project's original idea is to create two types of protective biopreparations that provide both preventive and therapeutic effects. A comprehensive characterization of antagonistic strains and their individual antifungal compounds will enable the maximum utilization of beneficial microorganisms' potential to increase the yield of essential crops under adverse conditions. The three developed application methods for the biopreparations (seed coating before sowing, plant spraying during different growth phases, and soil application as a root additive) will ensure their high effectiveness.
Purpose	The development of an innovative technology for the biological protection of agricultural crops, based on the use of microbial antagonists and their metabolites, to improve agrocenoses, reduce pesticide load, and produce environmentally safe crop products.
Objectives	1) Optimization of growth conditions for antagonistic strains and selection of methods for isolating antifungal metabolites. 2) Detection and characterization of microbial metabolites with antifungal activity. 3) Obtaining and testing experimental samples of microbial preparations with antifungal properties.
Expected and achieved results	1) The growth conditions for antagonistic strains will be optimized and methods for isolating antifungal metabolites will be selected. 2) Microbial metabolites with antifungal activity will be detected and characterized. 3) Experimental samples of microbial preparations with antifungal properties will be obtained and tested. Project results will be published in Kazakhstani and international peer-reviewed scientific journals indexed in Scopus and/or the Science Citation Index Expanded of the Web of Science database. Participation in national and international seminars and conferences will be planned, ensuring the exportability and international competitiveness of scientific and educational achievements. Growth conditions for antagonist strains ensuring high levels of antifungal metabolite synthesis were optimized. A two-stage cultivation scheme for <i>Janthinobacterium lividum</i> Blue 1 was developed taking into account the temperature dependence of violacein synthesis. The first stage of <i>J.lividum</i> Blue 1 cultivation was conducted in a

	shaker incubator at 180 rpm and 25°C for 2 days until the culture reached the active growth stage. The second stage consisted of culturing a 2-day <i>J.lividum</i> Blue 1 culture under stationary conditions in the absence of light at various temperatures: 4°C, 25°C, and 30°C. At 30°C, violacein was not synthesized. The maximum pigment yield was observed at 25°C. In addition to temperature, the initial pH of the medium influenced the intensity of violacein synthesis. The greatest accumulation of biomass and pigment in <i>J.lividum</i> Blue 1 was observed at an initial pH of 7.0. At pH values below 6.0, pigment synthesis was inhibited, despite maintaining biomass. The following optimal cultivation conditions were selected for the <i>J.lividum</i> Blue 1 strain: an initial pH of 7.0 and a temperature of 25°C. To determine the optimal growth temperature for <i>T. pinophilus</i> T14, cultivation was carried out at 26, 28, and 30°C. Fermentation was carried out in a shaker incubator at 180 rpm. The EPS yield was highest at 28°C, amounting to 1.74 g/L. At 30°C, biomass increased, but polysaccharide yield did not. A temperature of 26°C resulted in a 1.2-fold decrease in biomass and EPS. The initial pH of the medium significantly influenced polysaccharide synthesis. Cultivation was carried out under semi-submerged conditions. A decrease in pH to 6.0 and an increase to 8.0 resulted in a decrease in biomass and EPS yield by ~20%. Optimal growth and EPS production were observed at a pH of 7.0. Therefore, the optimal cultivation conditions for the <i>T. pinophilus</i> T14 strain were an initial pH of 7.0 and a temperature of 28°C.
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Usage	The results obtained during the project will meet social demand and positively impact the development of science and technology. The developed technologies will be applied in agriculture and contribute to the implementation of Kazakhstan's Strategic Plan until 2025 by promoting export-oriented production, human capital development, the leading role of the private sector, and realizing the developmental potential of the country's regions. Moreover, the primary goal of Kazakhstan's economic development until 2025 is a qualitative and sustainable economic rise, based on increasing business and human capital competitiveness, technological modernization, institutional environment improvement, and minimizing the negative impact of human activities on nature.
Priority compared to real-world alternatives	The innovative biopreparations developed will have high commercialization potential for use in crop production, as their production and application represent a resource-saving, environmentally safe, and low-cost technology. Currently, there are no analogs on the domestic market.
List of publications with links to them	
Patents	