

STUDYING THE PROTECTIVE POTENTIAL OF NATIVE EPIPHYTIC MICROORGANISMS ISOLATED FROM FRUITS AND VEGETABLES

Egamberdiyeva Marjona Xusniddin qizi
Republic of Uzbekistan Karshi State Technical University
egamberdiyevamarjona286@gmail.com

Yaxyayeva Munavvar Abdukaxxarovna
Institute of Microbiology of the Academy
of Sciences of the Republic of Uzbekistan
munavvaryakhyayeva076@gmail.com

Abstract

The article studies the antagonistic activity and protective potential of native epiphytic microorganisms isolated from fruit and vegetable crops grown in the Shahrisabz district of the Kashkadarya region against phytopathogens. Based on the results obtained, the scientific foundations for reducing the proportion of chemical pesticides in agriculture and technologies for creating environmentally friendly biological preparations are highlighted.

Keywords: Epiphytic microorganisms, biological preparation, antagonism, phytopathogens, chemical pesticides, Shahrisabz region, fruits and vegetables, environmental safety.

Introduction

ИЗУЧЕНИЕ ЗАЩИТНОГО ПОТЕНЦИАЛА МЕСТНЫХ ЭПИФИТНЫХ МИКРООРГАНИЗМОВ, ВЫДЕЛЕННЫХ ИЗ ФРУКТОВ И ОВОЩЕЙ

Эгамбердиева Маржона Хусниддин кизи
Республика Узбекистан Каршинский государственный технический университет
egamberdiyevamarjona286@gmail.com

Яхьяева Мунаввар Абдукаххаровна²
Институт микробиологии
Академии наук Республики Узбекистан
munavvaryakhyayeva076@gmail.com

MEVA VA SABZAVOTLARDAN AJRATILGAN MAHALLIY EPIFIT MIKROORGANIZMLARNING HIMOYA POTENSIALINI O'RGANISH

Egamberdiyeva Marjona Xusniddin qizi
O'zbekiston Respublikasi Qarshi davlat texnika universiteti
egamberdiyevamarjona286@gmail.com





Yaxyayeva Munavvar Abdukaxharovna²
O'zbekiston Respublikasi Fanlar akademiyasi
Mikrobiologiya instituti
munavvaryakhyayeva076@gmail.com

Annotatsiya

Maqolada Qashqadaryo viloyatining Shahrisabz hududida etishtiriladigan meva va sabzavot ekinlaridan ajratib olingan mahalliy epifit mikroorganizmlarning fitopatogenlarga qarshi antagonistik faolligi va himoya potentsiali o'rganilgan. Olingan natijalar asosida qishloq xo'jaligida kimyoviy pestitsidlar salmog'ini kamaytirish va ekologik toza biologik preparatlar yaratish texnologiyasining ilmiy asoslari yoritilgan.

Kalit so'zlar: Epifit mikroorganizmlar, biopreparat, antagonizm, fitopatogenlar, kimyoviy pestitsidlar, Shahrisabz hududi, meva va sabzavotlar, ekologik xavfsizlik.

Аннотация

В статье изучены антагонистическая активность и защитный потенциал местных эпифитных микроорганизмов, выделенных из плодовых и овощных культур, выращиваемых на территории Шахрисабзского района Кашкадаринской области, против фитопатогенов. На основе полученных результатов освещены научные основы снижения доли химических пестицидов в сельском хозяйстве и технологии создания экологически чистых биологических препаратов.

Ключевые слова: Эпифитные микроорганизмы, биопрепарат, антагонизм, фитопатогены, химические пестициды, Шахрисабзский регион, плоды и овощи, экологическая безопасность.

Introduction

Currently, in the production of agricultural products, chemical pesticides are mainly used to protect plants from diseases and pests. This leads to the pollution of soil and water resources, the accumulation of toxic residues in food products, and an increase in the resistance of phytopathogens to chemical preparations.

In this regard, the creation of effective and safe biological preparations based on local microflora adapted to the unique soil and climatic conditions of our republic, particularly epiphytic microorganisms living on the surface of fruits and vegetables, is one of the most important tasks of today. Studying the microbiological diversity of the Shahrisabz oasis is of great scientific and practical importance in this regard.

The regular use of pesticides in intensive agriculture leads to the destruction of beneficial microorganisms in the soil and a sharp increase in the resistance of various pathogens to chemicals in agricultural crops [1].

The excessive and improper use of chemical pesticides causes the degradation of soil ecosystems, the pollution of water bodies, and the transfer of toxic residues into the bodies of humans and animals through agricultural products. This poses a serious threat to global food security [2].

Epiphytic microorganisms living symbiotically on the surface of plants act as a natural barrier against phytopathogens. Their antagonistic activity, namely competition for the environment, production of antibiotics and hydrolytic enzymes, serves as a primary source for creating sustainable biological alternatives to chemical fungicides [3].

The sharply continental climate of Uzbekistan and the unique characteristics of irrigated meadow-grey soils are important factors in shaping the species composition of microorganisms. Strains of microflora adapted to local conditions are distinguished by their high ecological plasticity and competitiveness, which ensures the effectiveness of biological preparations created on their basis under production and field conditions [4].

Bacterial strains isolated from the epiphytic microflora of fruit and vegetable crops have the ability to inhibit the development of phytopathogenic fungi by 60-80 %. This allows for a significant reduction in the proportion of chemical pesticides in agriculture [5]

The unique microclimatic conditions of each oasis and region shape a unique species diversity of microbiocenoses. Searching for unique microorganism strains from the diverse landscapes and agricultural zones of the Kashkadarya and Zarafshon oases, and investigating their biochemical characteristics, provides new promising sources for biotechnology and agricultural practice [6].

The complex of epiphytic microorganisms covering the surface of fruit and vegetable crops serves as the first biological barrier between the plant and the pathogen. Studying and isolating the natural antagonistic potential of these microorganisms is the fundamental basis for creating effective and safe biotechnologies for protecting agricultural crops from diseases [7].

Objects and methods of research

As the research object, various fruit and vegetable samples collected from agricultural fields and gardens in the Shahrisabz district, along with epiphytic bacterial and fungal strains isolated from them, were used. The methods include determining the antagonistic activity of pure cultures isolated from fruits and vegetables against phytopathogenic fungi and bacteria, as well as studying the morphological, physiological, and biochemical characteristics of the strains.

The fungicidal effect and antagonistic activity of epiphytic strains against postharvest pathogens were evaluated in vitro under laboratory conditions. The pathogens were inoculated onto nutrient agar, and a suspension of the tested epiphytic strains was dropped into the center or around the pathogen inocula. The experiments were incubated in a thermostat at a controlled temperature of 28-30°C and humidity.

Results and discussion

In order to determine the strains of epiphytic microorganisms isolated from the Shahrisabz region and their antagonistic activities, microbiological studies were carried out on the surface of fruit and vegetable samples collected from various agricultural zones and gardening areas of the Shahrisabz district. As a result, a total of 42 strains of epiphytic microorganisms were isolated. It was determined that the species composition of the isolated strains mainly consists of bacteria belonging to the genera *Bacillus*, *Pseudomonas*, and *Enterobacter*, as well as antagonistic fungi such as *Trichoderma* and *Candida*.

The antagonistic activity of all isolated strains against major phytopathogens widely distributed in agricultural crops, such as *Fusarium oxysporum*, *Verticillium dahliae*, and *Alternaria alternata*,

was screened under laboratory conditions. The antagonistic activity against phytopathogens- namely, the ability of beneficial microorganisms, such as bacteria and fungi, to inhibit the growth of harmful microflora- is mainly carried out by species of *Bacillus*, *Pseudomonas*, and *Trichoderma*.

Among the antagonistic agents, the main ones, such as strains of *Bacillus subtilis* and *Bacillus pumilus*, show high antifungal activity against *Alternaria alternata* and other fungi. *Pseudomonas aeruginosa* and *Pseudomonas stutzeri* effectively combat *Fusarium* species. Meanwhile, *Trichoderma* species significantly suppress the development of *Fusarium oxysporum* and *Verticillium dahliae*. According to the mechanisms of antagonistic activity, antibiosis involves the production of special substances - namely, antibiotics and toxins that stop the growth of pathogens. In this process, they crowd out pathogens by capturing nutrients and living space in the environment, and demonstrate the ability to secrete special enzymes that break down fungal cell walls, such as chitinase and glucanase.

According to the results of the conducted studies, as a result of screening, the strains were divided into groups based on their ability to inhibit the growth of pathogens (Figure 1).

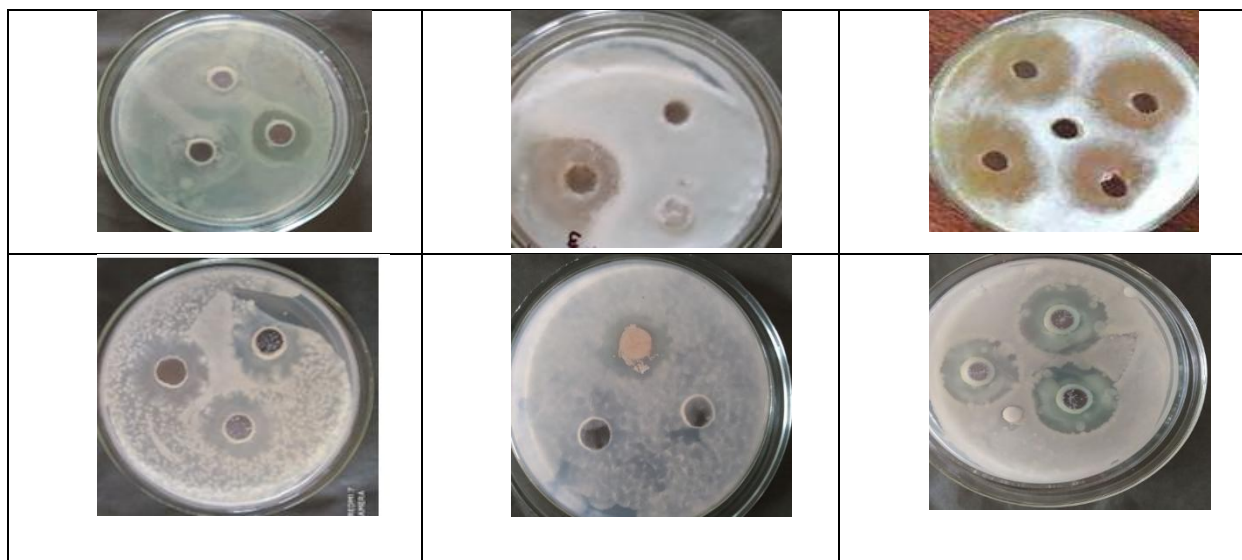


Figure 1. Effect of epiphytic bacteria on phytopathogenic fungi.

In this case, those showing high antagonistic activity had an inhibition zone of more than 20 mm, accounting for 19,05 % (8 strains) of the total strains. Those showing moderate activity had an inhibition zone of 10-20 mm, corresponding to 45,2 % (19 strains) of the strains. The remaining 35,8 % (17 strains) showing low or no activity were excluded from the next stages of research due to the lack of the required level of antagonistic properties.

The obtained results showed that among the epiphytic microbiocenosis formed in the unique climatic conditions of the Shahrissabz oasis, there are many local strains with high activity in combating phytopathogens. Among them, 8 promising strains showing the highest antagonistic and enzymatic activity were cultivated using deep cultivation methods in subsequent liquid nutrient media, and were selected as the main objects for physiological, biochemical, and field studies. The high competitiveness of these strains is explained by their natural adaptation to the sharp temperature and drought conditions of the region.

It was found that the selected epiphytic strains significantly inhibit the growth of hazardous phytopathogens widely spread in agricultural crops.

Based on the isolated active strains, the formulation of local biological preparations in dry and liquid forms was developed. Their shelf-life and effectiveness were proven under laboratory conditions.

It was demonstrated that the application of the created biological preparations makes it possible to reduce the amount of chemical fungicides and bactericides by 25-45 %. This not only improves the ecological environment but also lowers the cost of production and enhances its export potential.

Conclusions

Epiphytic microorganisms isolated from fruits and vegetables of the Shahrizabz region possess a high protective potential and demonstrated themselves as effective antagonists against phytopathogens.

The technology of biological preparations created on the basis of local strains makes it possible to sharply reduce the negative impact of chemical pesticides in protecting agricultural crops from diseases. The introduction of such biological methods into production serves to develop sustainable agriculture and ensure food security.

References

1. Aktar, M. W., Sengupta, D., & Chowdhury, A. (2009). "Impact of pesticides use in agriculture: their benefits and hazards." *Interdisciplinary Toxicology*, 2(1), P. 3-7. DOI: 10.2478/v10102-009-0001-7
2. Pimentel, D. (2005). "Environmental and Economic Costs of the Application of Pesticides Primarily in the United States." *Environment, Development and Sustainability*, 7(2), P. 230-235. DOI 10.1007/s10668-005-7314-2
3. Compant, S., Duffy, B., Nowak, J., Clément, C., & Barka, E. A. (2005). "Use of plant growth-promoting bacteria for biocontrol of plant diseases: principles, mechanisms of action, and future prospects." *Applied and Environmental Microbiology*, 71(9), R. 4952-4956 <https://doi.org/10.1128/AEM.71.9.4951-4959.2005>
4. Sattarova, R. K., & Khoshimova, M. S. (2020). "Microbial biodiversity of soils and plants in Uzbekistan and its practical application in agriculture." *Uzbekistan Biological Journal*, Tashkent, №3, R. 15-18 <https://www.academy.uz/en/journals/ozbekiston-biologiya-jurnali>
5. Pal, K.K., & Gardener, B.M. (2006) "Biological Control of Plant Pathogens" *The Plant Health Instructor*, DOI: 10.1094/PHI-A-2006-1117-02. R. 4-8. DOI: 10.1094/PHI-A-2006-1117-02.
6. Tursunov, A. A., & Mavlonov, G. T. (2019). "Ecological and microbiological features of oasis agrocenoses in Uzbekistan." *Central Asian Journal of Plant Protection*, 1(2), R. 87-90.
7. Ph. Rakhlaru et el. "Endophytic and Epiphytic Microorganisms as Biocontrol Agents: Mechanisms, Applications, and Metagenomic Approaches in Tomato Cultivation" *Molecules*, 2025 Sep 19 ;30 (18) :3816. doi:10.3390/molecules30183816

