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PRELIMINARY SCREENING OF RHIZOSPHERE MICROORGANISMS FOR THEIR PLANT GROWTH-PROMOTING ACTIVITIES AND STRESS TOLERANCE

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Abstract. Among the 65 microbial isolates obtained from the rhizosphere of soybean and black locust, 35 were able to grow on N-free Ashby's agar, Pikovskaya's agar, or both, indicating their potential for nitrogen fixation and phosphorus mobilization. Three of these isolates formed clearing zones around their colonies, with an average width of 5 mm. Five isolates demonstrated tolerance to 0.5 M NaCl and one month of desiccation. Two of them (one from the soybean rhizosphere and the other from the black locust rhizosphere) produced exometabolites that increased soybean seedling weight and length by 46 % and 19 %, respectively, when used to treat the seeds, indicating the agronomic potential of these rhizobacteria under adverse environmental conditions.
Keywords: rhizosphere, microorganisms, legumes, plant growth-promoting activities, stress tolerance.

Plant growth-promoting rhizosphere microorganisms play an important role in maintaining soil quality and enhancing plant development. Rhizobacteria ensure optimal plant nutrition, stimulate growth through the synthesis of phytohormones, regulate various physiological processes, and contribute to the suppression of phytopathogens in the root zone by secreting compounds with antibiotic activity etc (Ajeethan et al., 2026). The introduction of microorganisms with multiple plant growth-promoting activities into the plant rhizosphere to enhance crop growth and productivity is one of the effective tools in sustainable agriculture (Prisa et al., 2023). The negative impact of global climate change on the yield of crop plants vital to humanity (Alotaibi, 2023) has intensified the need to search for new, effective strains of plant growth-promoting rhizobacteria that are resistant to environmental stressors and to further incorporate them into agricultural practice as components of microbial biofertilizers. Numerous studies show that rhizosphere microorganisms can mitigate the harmful effects of abiotic and biotic stresses, particularly soil salinity and drought, which are closely associated with climate change, thereby improving plant health (Fiodor et al., 2021).

The aim of this study was to perform a preliminary characterization of microorganisms isolated from the rhizosphere of soybean and black locust. The potential for nitrogen fixation and phosphate solubilization in the tested microbial isolates as well as their tolerance to salt stress and one-month desiccation were evaluated. In addition, we investigated the effect of exometabolites produced by the selected rhizosphere bacteria on soybean seed germination and seedling growth to assess their overall plant growth-promoting activity.

Aliquots of 0,01 mL of suspensions of pure microbial cultures isolated from the rhizosphere of soybean (*Glycine max* (L.) Merr.) and black locust (*Robinia pseudoacacia* L.) were applied onto the surface of Ashby's agar, Pikovskaya's agar, and yeast extract–mannitol agar (YEM) to assess their ability to grow on these media. To evaluate the resilience of rhizosphere isolates to salinity, they were grown in YEM broth supplemented with 0.1 M, 0.3 M, and 0.5 M NaCl. Desiccation tolerance was determined accordingly to Farrow et. al.

(2018) with modifications. The number of viable microbial cells that formed colonies on agar growth medium after one month of desiccation at 28 °C was calculated. In plant experiments, soybean seeds (cv. Almaz) were treated with the supernatants of the selected microbial cultures grown in YEM broth to the stationary phase and incubated for six days at 24 °C. The germination rate of the seeds and the weight and length of the seedlings were determined.

The study involved 65 bacterial isolates from the rhizosphere of soybean and black locust maintained in the microbial collection of the Institute of Plant Physiology and Genetics of the National Academy of Sciences of Ukraine (NASU). Of these, 35 isolates showed good growth on N-free Ashby's agar, Pikovskaya's agar, or both, thereby demonstrating their ability to fix nitrogen and mobilize phosphorus from insoluble phosphates. All isolates were fast-growing microorganisms that grew well on YEM medium. They form either convex and mucoid or small and rough colonies with a diameter of 2–3 mm. A prominent clear zone was observed around the colonies of only three tested strains on Pikovskaya's agar. The width of the clear zone was about 5 mm. Evaluation of the salt tolerance of the microorganisms demonstrated that five isolates exhibited good growth in YEM broth supplemented with 0.1 M, 0.2 M, and 0.5 M NaCl after 48 h of cultivation. These isolates were also tolerant to desiccation. When the microbial cultures were subjected to desiccation for one month, the number of viable cells decreased by an average of 35 %, demonstrating their high tolerance to prolonged drying (Farrow et. al, 2018). In contrast, four isolates were sensitive to desiccation. No viable cells were detected after six days of desiccation. Rhizobacteria tolerant to salt stress and desiccation were selected to evaluate their ability to improve soybean seed germination and seedling development. None of the isolates significantly affected seed germination. However, two isolates (one from the soybean rhizosphere and the other from the black locust rhizosphere) produced exometabolites that increased the weight and length of soybean seedlings by 46 % and 19 % respectively.

Thus, two promising strains of rhizosphere microorganisms were selected during our research. They demonstrated tolerance to desiccation and high salt concentration as well as the ability to solubilize inorganic phosphate. However, further studies are required to examine their growth-promoting activity in detail and to assess the feasibility of using them in the development of microbial biofertilizers.

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