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HALOPHYTIC PLANT *HALOSTACHYS BELANGERIANA* (MOQ.) BOTSCH AS A SOURCE OF PLANT GROWTH-PROMOTING ENDOPHYTIC BACTERIA

Halostachys belangeriana (Moq.) Botsch also known as Halostachys caspica C. A. Mey belongs to the Chenopodiaceae family and is distributed in deserts of Asian countries. The plant grows in severe salinity and drought conditions and its survival and growth can be associated with the activity of endophytic bacteria. The ***objective*** *of our research was to isolate and screen endophytic bacteria from Halostachys belangeriana for plant growth promotion and reveal their plant-beneficial traits.* ***Methods.*** *Halostachys belangeriana (Moq.) Botsch plants were collected from the saline soil of the Kyzylkum desert in Uzbekistan in spring. The endophytic bacteria were isolated from the tissues of plants by cutting the outer sterilized shoots and roots and putting them into the water to let bacteria come from the tissues into the water. The suspension was transferred onto Tryptic Soy Agar to let bacteria grow and form separate colonies. The colonies different in shape and color were used to get pure cultures of bacteria. The bacteria were screened using plant growth-promoting activity in Petri plates by inoculating wheat seeds with the suspension of isolated bacteria. The best plant growth promoters were identified by analyzing their 16S rRNA gene and comparing it with sequences registered in GenBank of NCBI. The strains were tested for wheat growth promotion in a pot experiment and then examined for their plant-beneficial traits: N_2-fixation, phosphates solubilization, production of indole-3-acetic acid (IAA), 1-aminocyclopropane-1-carboxylate deaminase (ACC-deaminase), and siderophores.* ***Results.*** *A total of 25 isolates of endophytic bacteria were obtained from the tissues of Halostachys belangeriana (Moq.) Botsch. Due to the high efficiency of isolates SSU-4, SSU-7, SSU-16, SSU-18, and SSU-21 in the stimulation of wheat shoot and root growth, they were chosen for identification and*

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further study of their plant growth-promoting activity. The isolates are registered in GenBank as Bacillus pumilus SSU-4 (OK559720), Bacillus endophyticus SSU-7 (OK559721), Bacillus subtilis SSU-16 (OK559722), Isoptericola halotolerans SSU-18 (OK559723) and Pseudomonas kilonensis SSU-21 (OK559724), respectively. The single inoculation of seeds with tested strains increased the root and shoot length and plant fresh weight. The coinoculation of seeds with a mixture of five strains resulted in an even more increase in plant growth parameters. It was revealed that the tested strains had at least two plant-beneficial properties. The strains B. pumilus SSU-4 and P. kilonensis SSU-21 had the ability for nitrogen fixation. All strains produced IAA; however, the most active IAA producer was P. kilonensis SSU-21. Three of five strains had phosphates solubilization ability and produced ACC-deaminase and siderophores. The strains B. pumilus SSU-4 and P. kilonensis SSU-21 possessed four of five tested plant-beneficial properties. The strains B. endophyticus SSU-7 and I. halotolerans SSU-18 had three of five tested plant-beneficial traits, and B. subtilis SSU-16 could just produce IAA and ACC-deaminase. ***Conclusions.*** *This is the first report about the isolation of plant growth-promoting endophytic bacteria from the desert halophytic plant Halostachys belangeriana (Moq.) Botsch. The most efficient plant growth-promoting strains were: B. pumilus SSU-4, B. endophyticus SSU-7, B. subtilis SSU-16, I. halotolerans SSU-18, and P. kilonensis SSU-21. After field experiments, these strains can be suggested for use as bioinoculants improving plants growth.*

Keywords: *Halostachys belangeriana, bacterial endophytes, plant growth-promotion, wheat.*

Halostachys belangeriana (Moq.) Botsch also known as *Halostachys caspica* C. A. Mey belongs to the *Chenopodiaceae* family and is distributed in deserts and salty places in China [1] and Central Asia [2]. It has been used in desert areas as high-yield forage with good nutritional properties [1]. The plant is mostly known for its antimicrobial and antioxidant properties. Yang et al. [3] reported that the ethyl acetate fraction of the crude ethanol extract of the aerial parts of *H. belangeriana* exhibited antimicrobial activity. Liu et al. [4] reported on the antimicrobial and antioxidant activities of secondary metabolites from *H. belangeriana*.

The plant grows in severe salinity and drought conditions and its survival and growth can be associated with the activity of endophytic bacteria. They provide various beneficial effects including plant growth promotion and resistance against pathogens by producing different substances such as volatile and antifungal compounds [5—7]. There are many reports about the positive effect of endophytes on their host plants, such as *Chelidonium majus* [8], *Nypa fruticans* [9], *Armoracia rusticana* [10], *Seidlitzia rosmarinus* [11], *Calendula officinalis* [12], *Cicer arietinum* [13, 14], etc.

Today there are no reports about plant growth-promoting (PGP) endophytic bacteria from *H. belangeriana*.

The purpose of our study was to isolate and screen endophytic bacteria from *H. belangeriana* for plant growth promotion and to reveal their plant-beneficial traits.

Materials and Methods. *Plants collection.* In total, six plants of *Halostachys belangeriana* (Moq.) Botsch growing at a distance not less than 10 meters were collected from the saline soil of the Kyzylkum desert in Uzbekistan in spring. The plants were cleaned from soil by rinsing in sterile water.

Endophytic bacteria isolation. The collected plants (shoots and roots) were cut into 5—6 cm pieces and sterilized by keeping them in 99.9% ethanol for 2 min and 10% sodium hypochlorite for 1 min. After that, they were rinsed in glasses with sterile water for 2 min [15]. The pieces of plants were longitudinally cut into thin slices, which in the amount of 5 g were put into tubes with 9 mL of sterile water for serial dilutions (10^1—10^5). 100 μL of suspension from each dilution was spread on Petri plates with Tryptic Soy Agar (TSA) and left in an incubator at 30 °C. Four days later, the bacterial colonies of different colors and shapes were transferred and streaked on plates with TSA for purification. The outer surface of sterilized plant pieces was checked for sterility by putting them onto TSA media and incubating for four days at 30 °C. There were no colonies after incubation. The pure cultures of

endophytic bacteria were used in screening for plant growth-promoting activity.

Screening of endophytic bacteria for the wheat shoot and root growth in Petri plates. The isolated bacterial endophytes were separately cultivated in a nutrient broth medium for 96 hr at 30 °C, and the cells concentration was adjusted up to 10^8 CFU/mL. The wheat seeds were inoculated with bacteria by soaking in bacterial suspension and transferred into sterile Petri plates with wet filter paper for germination. We used a sterile nutrient broth medium as a control. The plates were left in dark, and the day/night temperature was 25/16 °C. The shot and rootlengths were checked on the 6^{th} day. The best plant growth-promoting bacterial isolates were identified.

Bacteria identification. The bacterial DNA was isolated using the method of Dashti et al. [16]. The bacterial colonies were transferred into Eppendorf tubes with 1 mL of milli-Q water. The colonies were mixed with the water by shaking for 1 min and incubated at 90 °C for 20 min in a Dry Block Heater. The tubes were centrifuged at 12.000 rpm for 5 min. The isolated DNA was visualized using gel electrophoresis. The 16S rRNA gene of the extracted DNA was analyzed using PCR with the following primers: 27F 5'-GAGTTTGATCCTGGCTCAG-3' (Sigma-Aldrich, St. Louis, Missouri, USA) and 1492R 5'-GAAAGGAGGTGATCCAGCC-3' (Sigma-Aldrich, St. Louis, Missouri, USA) [17]. The PCR program was as follows: a primary heating step for 30 s at 94 °C, followed by 30 cycles of denaturation for 15 s at 94 °C, annealing for 30 s at 55 °C, and extension for 1.5 min at 68 °C, followed by the final step for 20 min at 68 °C. The PCR products were checked by electrophoresis using GelRed. The ABI PRISM BigDye 3.1 Terminator Cycle Sequencing Ready Reaction Kit (Applied Biosystems, USA) was used for the sequencing. The obtained sequences were compared with the sequences of the closest relatives from the GenBank of the National Centre for Biotechnology Information (NCBI) (http://www.ncbi.nlm.nih.gov/).

Test for plant growth promotion by bacterial endophytes in pots. The isolated bacterial endophytes were cultivated in the nutrient broth medium for 96 hr at 30 °C, and cells concentration was adjusted up to 10^8 CFU/mL. The wheat seeds were inoculated with bacteria by soaking them into bacterial suspension (test) and sterile nutrient broth (control) and sown into 250 mL plastic pots with sterile soil. For inoculation, we used suspensions containing single strains as well as mixtures of tested strains in equal proportions. All pots were set up randomly in five replications for each bacterial strain and their mixture. Three seeds were sown into each pot. Plants were grown at 28—30 °C on the day and 18—20 °C at night. 13 days later, the shoot and root lengths and fresh plant weight were measured.

Tests for plant-beneficial traits. The production of indole-3-acetic acid (IAA) was tested according to the method of Sarwar and Kremer [18]. Bacterial suspension was adjusted to $1 \cdot 10^8$ CFU/mL and added into flasks with 10% TSA [19] supplemented with 5 mmol/L^{-1} of L-tryptophan and cultivated at 30 °C for 24 h in the dark. The grown bacteria were centrifuged at 8000×g for 15 min, and the supernatant was poured into fresh tubes. The Salkowski reagent (mixture of $FeCl_3$ — 0.5 mol/L and H_2SO_4 — 7.9 mol/L) was added in a 1:1 volume ratio to the supernatant and left at room temperature for 30 min in the dark. The appearance of pink color indicated the production of IAA. For the measurement of IAA, a spectrophotometer at 530 nm was used. Different concentrations of IAA solutions were used to construct a standard curve.

The ability of endophytes to solubilize inorganic phosphate was tested according to Mehta and Nautiyal [20]. The bacteria were cultured on the solid NBRIP medium (%): glucose — 1, $Ca_3(PO_4)_2$ — 0.5, $MgCl_2$ — 0.5, $(NH_4)_2SO_4$ — 0.01, $MgSO_4 \cdot 7H_2O$ — 0.025, KCl — 0.02, agar — 1.5). Plates with bacteria were incubated at 28 °C for 96 days. The formation of colonies indicated the ability to use inorganic phosphate in the form of $Ca_3(PO_4)_2$ as a sole phosphate source.

Fig. 1. *Halostachys belangeriana* (Moq.) Botsch in the Kyzylkum desert, Uzbekistan

To test the strains for nitrogen fixation assay, the colonies of each endophyte were streaked onto the solid nitrogen-deficient malate medium (g/L): $CaCl_2$ — 0.02, NaCl — 0.1, $FeCl_3$ — 0.01, KH_2PO_4 — 0.4, K_2HPO_4 — 0.5, $MgSO_4 \cdot 7H_2O$ — 0.2, $Na_2MoO_4 \cdot 2H_2O$ — 0.002, sodium malate — 5, agar — 15, pH 7.2—7.4 supplemented with 50 mg/L yeast extract. The plates were incubated at 30 °C for 96 hк, and the appearance of growth indicated the ability to fix N_2. The newly grown single colonies were streaked onto plates with the same medium to confirm the ability of nitrogen fixation [21].

Siderophores production was determined by using chrome azurol S (CAS) agar. Isolates were streaked onto CAS agar and incubated at 30 °C for 96 days. The appearance of an orange halo around the bacterial colony indicated the production of siderophores [22].

The production of 1-aminocyclopropane-1-carboxylate (ACC) deaminase by bacteria was tested using ACC as a sole N-source. The endophytes were cultivated on the basal medium supplemented with 3.0 mM of ACC. We used $(NH_4)_2SO_4$ as a positive control without adding N source as a negative one [23].

Statistical analysis. The statistical significance of data was tested by the analysis of the Microsoft Excel 2010 package variance. Mean comparisons were conducted using the least significant difference (LSD) test (P=0.05). The average values of plant growth parameters, IAA production, and the standard deviation were counted on the basis of several replications.

Accession numbers. The 16S rRNA gene sequences of five chosen endophytic bacteria from *Halostachys belangeriana* (Moq.) Botsch were deposited into GenBank under the accession numbers: OK559720 — OK559724.

Results. A total of 25 isolates of endophytic bacteria were isolated from tissues of *Halostachys belangeriana* (Moq.) Botsch (Fig. 1).

The isolates were screened for plant growth-promoting activity by checking their effect on the wheat growth on Petri plates after seeds inoculation with bacteria (Fig. 2).

The inoculation of wheat seeds with bacterial endophytes increased the rate of germination. The isolates SSU-4, SSU-7, SSU-16, SSU-18, and SSU-21 appeared to be the best plant growth-promoting bacteria among tested isolates. The isolate SSU-4 increased shoot length by 1.28 and root length by 1.36 times, SSU-7 — by 1.23 and 1.32 times, SSU-16 — by 1.42 and 1.48 times, SSU-18 — by 1.37 and 1.72 times, and SSU-21 — by 1.56 and 1.84 times as compared to control.

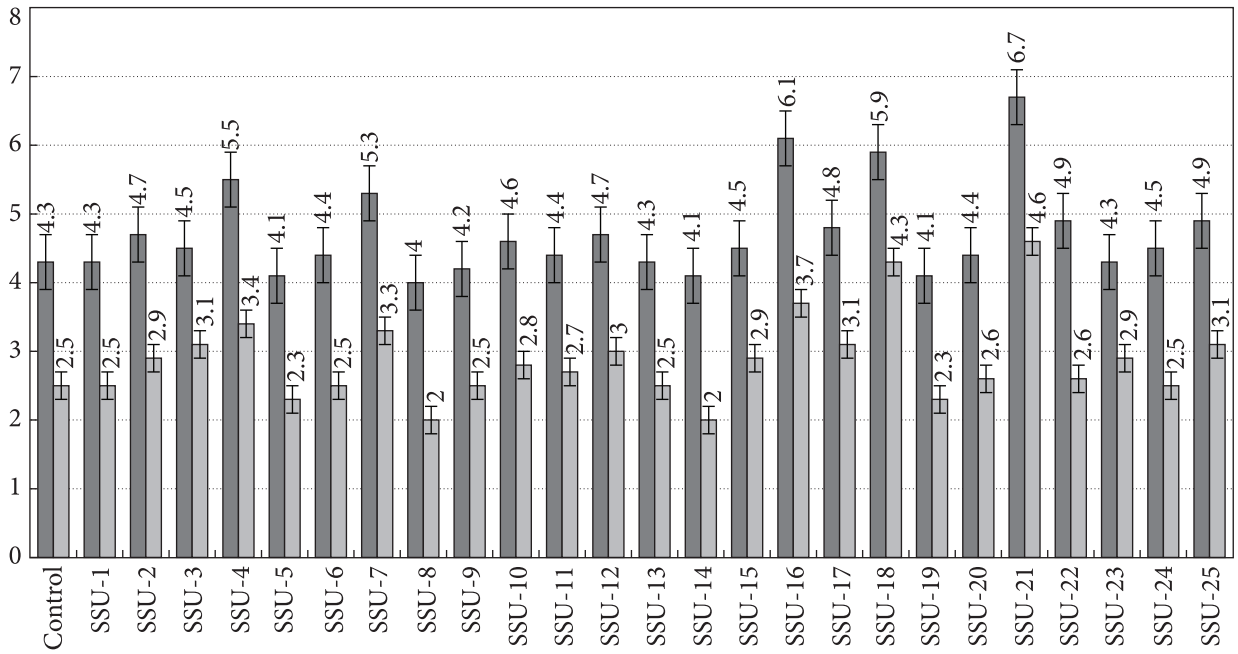

Fig. 2. The influence of endophytic bacteria on the wheat growth on Petri dishes (6 days)

Due to the high efficiency of the isolates SSU-4, SSU-7, SSU-16, SSU-18, and SSU-21 in the stimulation of wheat shoot and root growth, they were chosen for identification and further study of their plant growth-promoting activity.

The isolates SSU-4, SSU-7, SSU-16, SSU-18, and SSU-21 were identified using the analysis of their 16S rRNA gene and matching with the closest strains from GenBank of NCBI (Table 1).

The isolates were registered in GenBank as *Bacillus pumilus* SSU-4 (accession number OK559720), *Bacillus endophyticus* SSU-7 (accession number OK559721), *Bacillus subtilis* SSU-16 (accession number OK559722), *Isopteri-cola halotolerans* SSU-18 (accession number OK559723), and *Pseudomonas kilonensis* SSU-21 (accession number OK559724).

The listed bacteria were used for the inoculation of wheat seeds separately (single inoculation) and in mixtures (co-inoculation) to check their efficiency in root and shoot growth stimulation and increase in the plant fresh weight while growing in soil (Table 2).

The single inoculation of seeds with tested strains increased root and shoot length and plant fresh weight. All tested strains showed high efficiency in plant growth promotion in soil conditions. The highest plant stimulatory activity was shown by the strain *P. kilonensis* SSU-21, which increased root length by 1.51 times, shoot length — by 1.29 times and fresh plant weight — by 1.72 times as compared to control. The co-inoculation of seeds with a mixture of five strains resulted in an even more increase in root and shoot lengths and plant fresh weight. As a result, the root length increased by 1.70, the shoot length — by 1.37 and the plant fresh weight — by 1.89 times in comparison with control.

The strains *B. pumilus* SSU-4, *B. endophyticus* SSU-7, *B. subtilis* SSU-16, *I. halotolerans* SSU-18, and *P. kilonensis* SSU-21 were tested for plant-beneficial traits: fixation of nitrogen, production of IAA, ACC deaminase and siderophores, and solubilization of phosphates (Table 3).

It was revealed that the tested strains had at least two plant-beneficial properties. The strains

Table 1. **The effective plant growth-promoting endophytes isolated from *Halostachys belangeriana* (Moq.) Botsch and their closest relatives from GenBank**

Isolated strains deposited to GenBank			Closest match (16S rRNA genes) (GenBank)		
Strain	Length (bp)	Accession number	Reference strains	Accession number	Percent identity
SSU-4	1500	OK559720	*Bacillus pumilus*	MN750426.1	99.73
SSU-7	1478	OK559721	*Bacillus endophyticus*	KR085883.1	99.73
SSU-16	1543	OK559722	*Bacillus subtilis*	MT491101.1	99.74
SSU-18	1469	OK559723	*Isoptericola halotolerans*	AB489222.1	99.66
SSU-21	1480	OK559724	*Pseudomonas kilonensis*	LN995719.1	99.8

Table 2. **The influence of wheat seeds inoculation with endophytes on plants growth in the pot experiment (13 days)**

Treatment	Root length (cm)	Shoot length (cm)	Fresh plant weight (g)
Control	4.3 ± 0.4*	16.1 ± 1.9*	0.18 ± 0.02*
B. pumilus SSU-4	6.1 ± 0.5*	19.9 ± 2.0*	0.26 ± 0.02*
B. endophyticus SSU-7	5.6 ± 0.5*	18.2 ± 1.9*	0.27 ± 0.02*
B. subtilis SSU-16	6.4 ± 0.5*	17.7 ± 1.9*	0.26 ± 0.02*
I. halotolerans SSU-18	6.2 ± 0.5*	20.1 ± 2.0*	0.29 ± 0.03*
P. kilonensis SSU-21	6.5 ± 0.5*	20.8 ± 2.0*	0.31 ± 0.03*
B. pumilus SSU-4 + *B. endophyticus* SSU-7 + + *B. subtilis* SSU-16 + *I. halotolerans* SSU-18 + + *P. kilonensis* SSU-21	7.3 ± 0.6*	22.1 ± 2.1*	0.34 ± 0.03*

* — statistically significant at $P \leq 0.05$

Table 3. **Plant growth-promoting properties of the isolated bacterial endophytes**

Bacterial strains	N_2-fixation	IAA (μg/mL)	Phosphates solubiliza-tion	ACC deaminase	Siderophores production
B. pumilus SSU-4	+	118.71 ± 5.11*	+	—	+
B. endophyticus SSU-7	—	112.15 ± 5.23*	—	+	+
B. subtilis SSU-16	—	109.85 ± 5.51*	—	+	—
I. halotolerans SSU-18	—	133.48 ± 4.84*	+	—	+
P. kilonensis SSU-21	+	146.35 ± 5.17*	+	+	—

* — statistically significant at $P \leq 0.05$

B. pumilus SSU-4 and *P. kilonensis* SSU-21 had the ability for nitrogen fixation. All strains produced IAA, and the most active IAA producer was *P. kilonensis* SSU-21. Three of the five strains had phosphate solubilization ability and produced ACC-deaminase and siderophores. The strains *B. pumilus* SSU-4 and *P. kilonensis* SSU-21 possessed four beneficial properties. The strains *B. endophyticus* SSU-7 and *I. halotolerans* SSU-18 had three plant-beneficial traits, and *B. subtilis* SSU-16 could just produce IAA and ACC-deaminase.

Discussion. During the research, we ! isolated, screened, and chose five plant growth-stimulating endophytic bacteria, namely *B. pumilus* SSU-4, *B. endophyticus* SSU-7, *B. subtilis* SSU-16, *I. halotolerans* SSU-18, and *P. kilonensis* SSU-21 from tissues of *Halostachys belangeriana* (Moq.) Botsch. The strains significantly increased root and shoot length and fresh plant weight of wheat due to the inoculation of seeds with single strains, however after the co-inoculation with the mixture of strains, the results were even more significant. Kruasuwan and Thamchaipenet [24] also reported that co-inoculation of sugarcane with endophytic diazotrophs and actinomycetes significantly improved plant growth as compared to un-inoculated and single-inoculated plants. Egamberdieva et al. [25] reported the improvement of nodule formation on roots and plant growth in the case of co-inoculation of *Lupinus angustifolius* L. seeds with endophytic bacteria *Pseudomonas putida* L2 and *Stenotrophomonas pavanii* L8. It was revealed that the strains *B. pumilus* SSU-4, *B. endophyticus* SSU-7, *B. subtilis* SSU-16, *I. halotolerans* SSU-18, and *P. kilonensis* SSU-21 possessed some plant-beneficial properties such as nitrogen fixation, production of IAA, ACC deaminase and siderophores, and phosphate solubilization. Nitrogen is an essential element for plant growth but it is a stable inert gas in the form of N_2 [26]. It was reported that nitrogen-fixing endophytic bacteria can convert N_2 into ammonia, which dissolves in water and feeds the plants [27]. Endophytes-producing phytohormone IAA) increases plant root system supplying with more water and nutrients from soil [28]. Some endophytes produce organic acids which can be excreted into the soil and convert phosphate complexes into orthophosphates for plant absorption and usage. Such endophytic bacteria solubilizing phosphates were suggested to be used as biofertilizers [29]. Another plant-beneficial trait is production of ACC by endophytic bacteria. ACC is an ethylene precursor, and the enzyme ACC deaminase is involved in plant growth-promotion through cleavage of ACC and lowering ethylene level in the plant. Ethylene is a stress hormone which leads to defoliation, shortened vegetation period, and yield decrease. ACC deaminase-producing bacteria can alleviate plant stress by lowering ethylene level and prolong vegetation period, improve plants growth and yield [30]. The endophytic bacteria producing siderophores can make iron available for plant through iron chelating, which is important for plant growing in iron deficient soils [29]. The above-stated reports explain the positive effect of the strains *B. pumilus* SSU-4, *B. endophyticus* SSU-7, *B. subtilis* SSU-16, *I. halotolerans* SSU-18, and *P. kilonensis* SSU-21 on plant growth improvement.

Conclusions. This is the first report about the solation of plant growth-promoting endophytic bacteria from the desert halophytic plant *Halostachys belangeriana* (Moq.) Botsch. During the screening of 25 bacterial isolates for their plant growth-promoting activity, only 5 were left as the most effective: *B. pumilus* SSU-4, *B. endophyticus* SSU-7, *B. subtilis* SSU-16, *I. halotolerans* SSU-18, and *P. kilonensis* SSU-21. These strains showed high efficiency in wheat growth stimulation after seeds inoculation with single strains, and maximal plant growth stimulation was observed after seeds co-inoculation with a mixture of all five strains. It was shown that the strains can fix N_2, dissolve insoluble phosphates, produce IAA, ACC-deaminase, and siderophores. After field experiments, these strains can be suggested for use as bioinoculants improving plant growth.

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ГАЛОФІТНА РОСЛИНА *HALOSTACHYS BELANGERIANA* (MOQ.) BOTSCH ЯК ДЖЕРЕЛО ЕНДОФІТНИХ БАКТЕРІЙ, ЩО СТИМУЛЮЮТЬ РІСТ РОСЛИН

Halostachys belangeriana (Moq.) Botsch також відомий як *Halostachys caspica* C. A. Mey належить до родини *Chenopodiaceae* і поширений у пустелях азіатських країн. Рослина росте в умовах сильного засолення та посухи, а її виживання та зростання можуть бути пов'язаними з діяльністю ендофітних бактерій. **Метою** нашого дослідження було виділення та скринінг ендофітних бактерій *Halostachys belangeriana* для стимуляції росту рослин та виявлення їх корисних для рослин ознак. **Методи.** Рослини *Halostachys belangeriana* (Moq.) Botsc були зібрані навесні із засоленого ґрунту пустелі Кизилкум в Узбекистані. Едофітні бактерії виділяли з тканин рослин шляхом зрізання зовнішніх стерилізованих пагонів і коренів та заливання їх водою, щоб бактерії могли потрапити з тканин у воду. Суспензію переносили на триптичний соєвий агар, щоб бактерії могли рости та утворювати окремі колонії. Для отримання чистих культур бактерій використовували різні за формою та кольором колонії. Бактерії перевіряли за активністю, що стимулює ріст рослин у чашках Петрі шляхом інокуляції насіння пшениці суспензією ізольованих бактерій. Найкращі стимулятори росту рослин були визначені шляхом аналізу їх гена 16S рРНК та порівняння його з послідовностями, зареєстрованими в GenBank NCBI. Штами були перевірені на стимуляцію росту пшениці в горщику, а потім були досліджені їх корисні для рослин властивості: фіксація N_2, солюбілізація фосфатів, утворення індол-3-оцтової кислоти (ІОК), 1-аміноциклопропан-1-карбоксилат деамінази (АЦК-деаміназа) та сидерофорів. **Результати.** Усього з тканин *Halostachys belangeriana* (Moq.) Botsch виділено 25 ізолятів ендофітних бактерій. Завдяки високій ефективності ізолятів ССУ-4, ССУ-7, ССУ-16, ССУ-18 та ССУ-21 у стимуляції росту пагонів та коренів пшениці, їх було обрано для ідентифікації та подальшого вивчення їхнього стимулюючого вплива на рослини. Ізоляти були зареєстровані в GenBank як *Bacillus pumilus* SSU-4 (OK559720), *Bacillus endophyticus* SSU-7 (OK559721),

Bacillus subtilis SSU-16 (OK559722), *Isoptericola halotolerans* SSU-18 (OK559723) та *Pseudomonas kilonensis* SSU-21 (OK559724). Одноразова інокуляція насіння випробуваними штамами збільшувала довжину коренів і пагонів та свіжу масу рослини. Коінокуляція насіння сумішшю п'яти штамів призвела до ще більшого підвищення параметрів росту рослин. Виявлено, що досліджувані штами мають принаймні дві корисні для рослин властивості. Здатність до азотфіксації мали штами *B. pumilus* SSU-4 та *P. kilonensis* SSU-21. Усі штами продукували ІОК, однак найактивнішим продуцентом ІОК був *P. kilonensis* SSU-21. Три з п'яти штамів мали здатність до солюбілізації фосфатів, продукували АЦК-деаміназу та сидерофори. Штами *B. pumilus* SSU-4 і *P. kilonensis* SSU-21 володіли чотирма з п'яти перевірених корисних для рослин властивостей. Штами *B. endophyticus* SSU-7 та *I. halotolerans* SSU-18 мали три з п'яти перевірених корисних для рослин властивостей, а *B. subtilis* SSU-16 міг лише продукувати ІАА та АСС-деаміназу. **Висновки.** Це перша робота про виділення ендофітних бактерій, що стимулюють ріст рослин, із пустельної галофітної рослини *H. belangeriana* (Moq.) Botsch. Найефективнішими штамами, що стимулюють ріст рослин, були: *B. pumilus* SSU-4, *B. endophyticus* SSU-7, *B. subtilis* SSU-16, *I. halotolerans* SSU-18 та *P. kilonensis* SSU-21. Після польових експериментів ці штами можна запропонувати для використання як біоінокулянтів, що покращують ріст рослин.

Ключові слова: *Halostachys belangeriana, бактеріальні ендофіти, стимуляція росту рослин, пшениця.*