JOURNAL OF MULTIDISCIPLINARY SCIENCES AND INNOVATIONS

VOLUME 5, ISSUE 03
MONTHLY JOURNALS

ISSN NUMBER: 2751-4390
IMPACT FACTOR: 9,08

ANALYSIS OF SALINITY TOLERANCE OF *HALOXYLON APHYLLUM* BASED ON HALOTOLERANT PLANT GROWTH-PROMOTING RHIZOBACTERIA

E.R. Oripova

S.S. Murodova

M.A. Ne'matova

Biotechnology Department, Jizzakh Branch, National University of Uzbekistan

ANNOTATION

In this study, the rhizosphere microbiome of black saxaul (*Halophylon aphyllum*) growing in the dried bed region of the Aral Sea was analyzed, and the adaptation of the isolated strains to stress conditions was investigated through isolates tolerant to different NaCl concentrations. Bacterial isolates tolerant to 5% NaCl were obtained. Among them, the isolates Qst 4/1, Qsi 1/3 (*Bacillus firmus*), Q.sak 10/1 (*Staphylococcus succinus*), Qst 1/4, and Qst 1/2 (*Proteus mirabilis*) demonstrated growth at 14% NaCl, indicating their significant role in supporting plant growth and various physiological processes under high salinity conditions.

Keywords: black saxaul, rhizosphere bacterial diversity, NaCl, Na_2SO_4, Qst 4/1, Qsi 1/3 (*Bacillus firmus*), Q.sak 10/1 (*Staphylococcus succinus*), Qst 1/4, Qst 1/2 (*Proteus mirabilis*)

Salinization is one of the serious problems of land degradation, as high salinity slows down plant growth. Salts can accumulate in soils through natural processes, such as mineral weathering, dust deposition, and precipitation, or through artificial processes, such as irrigation (Oosterbaan, 1988). Both cases can lead to soil salinization, making it difficult for plants to absorb moisture from the soil.

Halophytes are salt-tolerant plants that can grow in areas where salt (NaCl) concentrations exceed 400 mM (Flowers, 2004; English & Colmer, 2011). In saline soil environments, halophytes play an important role in carbon sequestration, nutrient mineralization, nutrient cycling, and the improvement of the micro-environment (Cao et al., 2014; Chaudhary et al., 2015), and they may have great potential for ecosystem preservation.

Salinity stress is one of the most widespread stress factors in these regions, limiting plant growth and productivity (Etesami and Beattie, 2018; Kibria and Hoque, 2019), including halophyte plants (Komaresofla et al., 2019; Hidri et al., 2022). The direct effect of salt on plant growth is associated with nutrient imbalance, resulting from a loss of control over nutrient uptake and/or transport to the shoot, which leads to ion deficiencies. The main cause of such nutrient deficiencies may be the high abundance of ions such as Na^+ and Cl^- in the soil solution. Excessive soluble ions can reduce the activity of other essential elements in the soil and consequently decrease their availability and uptake by plants (Munns, 2002).

One of the biological solutions to combat salinity stress is the use of halotolerant (high salinity-resistant) plant growth-promoting bacteria (PGPB). These bacteria can improve plant growth and yield under stress conditions (Etesami and Maheshwari, 2018; Etesami and Glick, 2020; Amini Hajiabadi et al., 2021). The use of PGPB is also considered a potential strategy for increasing forage production in rangelands (Hungria et al., 2021; Zilaie et al., 2022). In this study, rhizosphere bacteria isolated from black saxaul (*Halophylon aphyllum*) growing in the dried bed region of the Aral Sea were examined for their growth characteristics at NaCl concentrations of 5%, 7%, 10%, 12%, and 14%. Colonies highly sensitive to salt were selected, and changes in colony diameter, morphology, and appearance were observed after 3, 6, and 10 days of incubation. Colony growth was compared with that on standard NA (nutrient agar) medium.Effect of NaCl-containing medium on the growth of bacterial isolates

Nowadays, maintaining and enhancing productivity under salinity conditions, combating land degradation, preventing erosion, and controlling desertification have become global challenges that need to be addressed. Scientific literature analyzed above has highlighted the role of rhizosphere bacteria in helping plants cope with salinity stress—one of the major stress factors affecting plant growth—as well as their ability to grow under saline conditions.

In our study, the isolated bacterial strains were screened for their growth on solid NA medium containing different NaCl concentrations (5%, 7%, 10%, 12%, 14%). The analysis of isolates tolerant to 10% NaCl concentration is presented in the following table (Figure 1).

№	**Isolate**	**NaCl concentration (%)**		
		10%	**12%**	**14%**
1	**Qsp 4/4**	++	+	-
2	**Qst 4/1**	++	-	-
3	**Qst 4/1/3**	++	+	-
4	**Qsp1/2**	++	+	-
5	**Qsi 4/1/2**	++	++	+
6	**Qsp 13/1/2**	+	-	-
7	**Qsi 1/3**	+++	+++	++
8	**Qs 14/1**	++	+	-
9	**Qs ildiz 1/3**	+++	++	++
10	**Qst 4/1**	++	+	-
11	**Qs ildiz 4/1**	+++	+	-
12	**Qst 11/1**	++	-	+
13	**Qsi 11/2**	++	+	-
14	**Qst 1/2**	+++	++	++
15	**Qs ildiz**	+++	++	-
16	**Qsak 10/1**	+++	+++	++
17	**Qst 1/3**	++	-	-
18	**Qst 11/2**	+++	+	-
19	**Qsp 1/3**	+++	+	-
20	**Qst 14/1**	+++	+	-
21	**Qst 1/4**	+++	+++	++
22	**Qst 4/2**	+++	++	+

Figure 2. Salinity (NaCl) tolerance of bacterial isolates obtained from *Halophylon aphyllum*

According to the results, five bacterial isolates demonstrated growth in a medium containing 14% NaCl, indicating their high tolerance to elevated salt concentrations. The isolates with the

JOURNAL OF MULTIDISCIPLINARY SCIENCES AND INNOVATIONS
VOLUME 5, ISSUE 03
MONTHLY JOURNALS
ISSN NUMBER: 2751-4390
IMPACT FACTOR: 9,08

potential to grow under high salinity conditions were identified as Qst 4/1, Qsi 1/3 (*Bacillus firmus*), Q.sak 10/1 (*Staphylococcus succinus*), Qst 1/4, and Qst 1/2 (*Proteus mirabilis*).

Growth of rhizosphere bacterial strains of *Halophylon aphyllum* at different NaCl concentrations. (Qst 4/1, Qsi 1/3 (*Bacillus firmus*), Q.sak 10/1 (*Staphylococcus succinus*), Qst 1/4, Qst.1/2 (*Proteus mirabilis*)

References

1. Oosterbaan R. J. Effectiveness and social/environmental impacts of irrigation projects: a critical review //ILRI Annual Report. – 1988. – T. 1988. – C. 18-34.
2. Salinity and waterlogging tolerances in three stem-succulent halophytes (*Tecticornia* species) from the margins of ephemeral salt lakes pages 379–396, (2011) Plant va Soil
3. Cao, D., Shi, F., Koike, T., Lu, Z. and Sun, J. (2014), Halophyte Plant Communities Affecting Enzyme Activity and Microbes in Saline Soils of the Yellow River Delta in China. Clean Soil Air Water, 42: 1433-1440. https://doi.org/10.1002/clen.201300007
4. Etesami H.BeattieG. A. (2018). Mining halophytes for plant growth-promoting halotolerant bacteria to enhance the salinity tolerance of non-halophytic crops. *Front. Microbiol.*9, e148. 10.3389/fmicb.2018.00148
5. KomaresoflaB. R.AlikhaniH. A.EtesamiH.Khoshkholgh-SimaN. A. (2019). Improved growth and salinity tolerance of the halophyte *Salicornia* sp. by co-inoculation with endophytic and rhizosphere bacteria. *Appl. Soil Ecol.*138, 160–170. 10.1016/j.apsoil.2019.02.022
6. MunnsR. (2002). Comparative physiology of salt and water stress. *Plant Cell Environ.*25, 239–250. 10.1046/j.0016-8025.2001.00808.x
7. EtesamiH.MaheshwariD. K. (2018). Use of plant growth promoting rhizobacteria (PGPRs) with multiple plant growth promoting traits in stress agriculture: action mechanisms and future prospects. *Ecotoxicol. Environ. Saf.*156, 225–246. 10.1016/j.ecoenv.2018.03.013
8. Amini HajiabadiA.Mosleh AraniA.GhasemiS.RadM. H.EtesamiH.Shabazi ManshadiS.et al. (2021). Mining the rhizosphere of halophytic rangeland plants for halotolerant bacteria to improve growth and yield of salinity-stressed wheat. *Plant Physiol. Biochem.*163, 139–153. 10.1016/j.plaphy.2021.03.059
9. ZilaieM. N.AraniA. M.EtesamiH.DinarvandM.DolatiA. (2022). Halotolerant plant growth-promoting rhizobacteria-mediated alleviation of salinity and dust stress and improvement of forage yield in the desert halophyte Seidlitzia rosmarinus. *Environ. Exp. Bot.*201, 104952. 10.1016/j.envexpbot.2022.104952