The Effect of Temperature on the Growth of Prospective Strains of Endophytic Bacteria from Some Halophytic Plants

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Abstract. Haloxylon aphyllum Minkw., Halostachys belangeriana (Moq.) Botsch. and Halocnemum strobilaceum (Pall.) M.Bieb are widely distributed halophyte plants in the desert regions of Uzbekistan. Their resistance to salinity stress is directly related to the activity of endophytic bacteria found in them. The evaluation of the effect of temperature on their growth and the selection of the optimum temperature for growing endophytic bacteria of halophytes are of great scientific and practical importance. Therefore, in our research, we aimed to study the effect of temperature on the growth of endophytic bacteria of halophytic plants. This article presents the results of experiments aimed at evaluating the effect of temperature on the growth of endophytic bacteria in halophytic plants.

Key words: halophyte, endophyte, bacterium, *Haloxylon aphyllum* Minkw., *Halostachys belangeriana* (Moq.) Botsch., *Halocnemum strobilaceum* (Pall.) M.Bieb., optical density.

Introduction. In the world, research is being conducted on the development of the use of microbial preparations based on the activity of plant microorganisms in the agriculture of regions affected by various stress factors. In this regard, it is important to develop competitive promising biotechnologies for practical application by researching endophytic bacteria of halophytic plants, which are widespread in saline areas and are not used in economic sectors. As a result of the stimulating properties of extremophilic endophytic bacteria of halophytes, it is important to justify scientific solutions in such directions as the isolation of endophytic bacteria from them, the

identification of bacteria, the assessment of the distribution and diversity of bacteria in plant organs, and the analysis of the stimulating properties of endophytic bacteria in the development of cultivated plants in increasing the salinity resistance and productivity of agricultural crops. acquires scientific and practical importance.

Endophytic bacteria of a number of plants and their properties stimulating plant development have been studied by foreign and local scientists. However, information about endophytic bacteria of some halophytic plants widely distributed in the desert regions of Uzbekistan is rarely found in scientific sources. Such plants include *Haloxylon aphyllum* Minkw., *Halostachys belangeriana* (Moq.) Botsch. and *Halocnemum strobilaceum* (Pall.) M.Bieb can be included.

H.aphyllum is one of the widely distributed plants in the deserts of Uzbekistan, Kazakhstan and Turkmenistan. It creates biomass in the ecosystem, stabilizes the movement of sand; maintenance of soil layer and specific microclimate, growth and development of related plants; performs important tasks such as creating living conditions for animals, supporting permanent microbial communities in the root system and endophytic microorganisms living in plant tissues. Saxovol forests are a source of fodder for farm animals and valuable fuel for the local population [6]. Treatment with endophytic bacteria isolated from H. aphyllum has been shown to promote cucumber plant growth [5].

H.belangeriana is widely distributed in the saline areas of the deserts of China and Central Asia. It is used as a high-yielding animal feed with good nutritional properties in desert areas. The antimicrobial and antioxidant properties of the plant have been noted by experts. Yang et al found that the ethyl acetate fraction of the ethanol extract from the stem of *H. belangeriana* showed antimicrobial activity [7].

H.strobilaceum is a halophyte plant distributed in the deserts of North Africa and western Asia. Acheuk et al. reported the potential of this plant crude extract as an insecticide against pest insects, the plant composition being rich in saponins, tannins, flavonoids, anthocyanins and alkaloids [1]. Handoussa et al proved that natural antioxidants from *H.strobilaceum* have anticancer activity [4]. Bobtana et al. noted that *H.strobilaceum* may be a promising phytoremediation species due to its high adaptability to live in contaminated soil and its ability to stabilize and accumulate metals in its tissues [3]. Treatment with endophytic bacteria isolated from *H.strobilaceum* has been shown to promote cotton plant growth [2].

Based on the above analysis, it should be noted that the evaluation of the effect of temperature on their growth and the selection of the optimal temperature for growing are of great scientific and practical importance in the separation of endophytic bacteria of *H.aphyllum*,

H.belangeriana and *H.strobilaceum* plants. Therefore, in our research, we aimed to study the effect of temperature on the growth of endophytic bacteria of halophytic plants.

Materials and methods. Plants *H.aphyllum, H.strobilaceum, H.belangeriana*, which are a new source of extremophilic endophytic bacteria, were selected as objects in the research (Fig. 1).

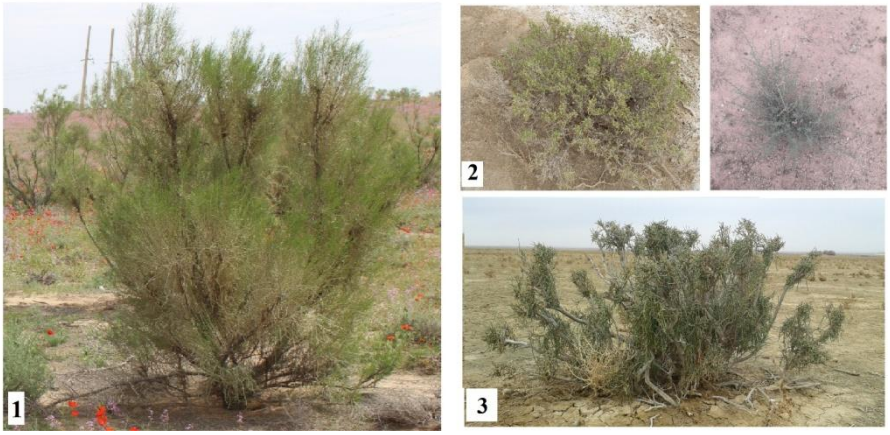

Fig. 1. **Research objects** (1-*Haloxylon aphyllum* (Minkw); 2- *Halocnemum strobilaceum* (Pall) Bieb; 3- *Halostachys belangeriana* (Moq) Botsch)

A collection of plant samples for the isolation of endophytic bacteria was formed on the basis of more than 500 segments isolated from the roots and stems of the research objects. Samples were taken from plants growing at a distance of not less than 10 meters, in the spring of 2019-2020. Roots and stems were cleaned of soil particles by washing in sterile water.

Determination of the effect of temperature on the growth rate of bacterial strains was carried out by growing bacterial strains in TSA medium at different temperatures (20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40°C) in a thermostat. After 72 hours of growth at a certain temperature, the optical density of the bacterial suspension was checked at 600 nm using a spectrophotometer (EMC-30PC-UV Spectrophotometer, Germany).

Results and discussion.In our research, more than 500 segments of the stems and roots of halophytes, including *H.aphyllum, H.belangeriana and H.strobilaceum*, which are common in South-western regions of Uzbekistan, were studied. A total of 65 isolates of endophytic bacteria grown on the surface of the nutrient medium were added to the pure culture, of which 20 isolates (HAPH1- HAPH20) were from *H.aphyllum*, 25 isolates (SSU1- SSU25) were from *H. belangeriana* and 20 isolates (HAST1-HAST20) were from *H. strobilaceum*. The effect of isolated isolates on the germination of agricultural crops seeds was studied and among them 15 effective bacterial strains were selected.

In the experiments, it was found that the effect of temperature is important in the growth of selected strains of endophyte bacteria (experimental results are presented in Figures 2-4).

As can be seen from Figure 2, endophytic bacteria of *H.aphyllum* have the ability to grow at a certain level at all temperature options (20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40°C). When analyzing the optical density of the bacterial suspension at the minimum temperature option (20°C), it was observed that this indicator was from 0.429 (in HAPH15) to 0.812 (in HAPH2) in strains of *H.aphyllum* endophytic bacteria. At the maximum temperature option (40°C), the optical density of the bacterial suspension was from 0.510 (in HAPH16) to 1.218 (in HAPH2).

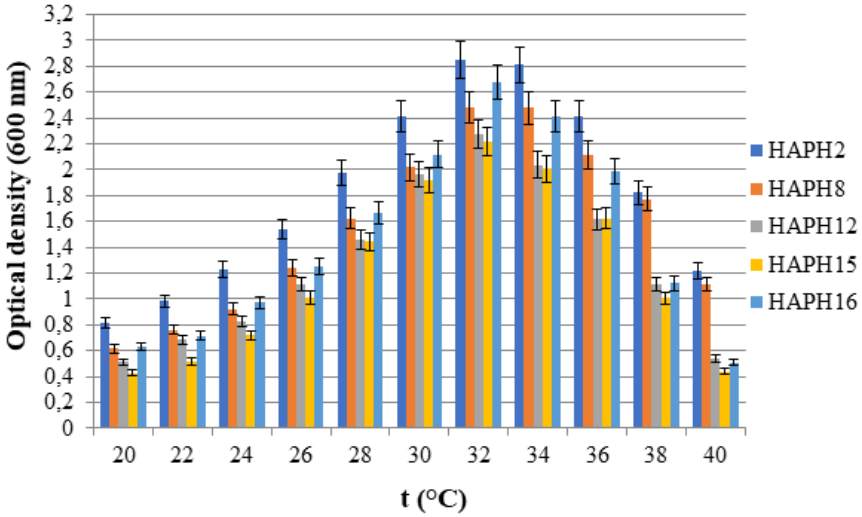

Fig. 2. Effect of temperature on growth rate of endophytic bacteria of *H. aphyllum* (n=3)

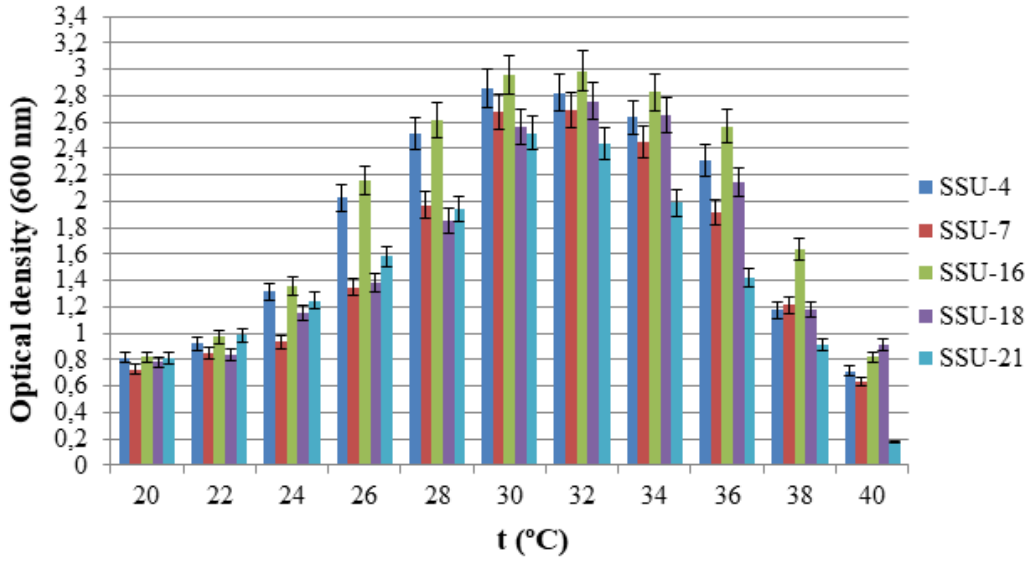

Fig. 3. Effect of temperature on growth rate of endophytic bacteria of *H.belangeriana* (n=3)

Figure 3 shows that the highest growth rate of endophytic bacteria*H. belangeriana* occurs at 30°C. Under the influence of this indicator of temperature, the optical density of the bacterial suspension had values in the range of 2.421-2.989. The maximum indicator of optimal density at 30°C belonged to strain SSU-16 (2.989), the minimum indicator belonged to strain SSU-21 (2.421).

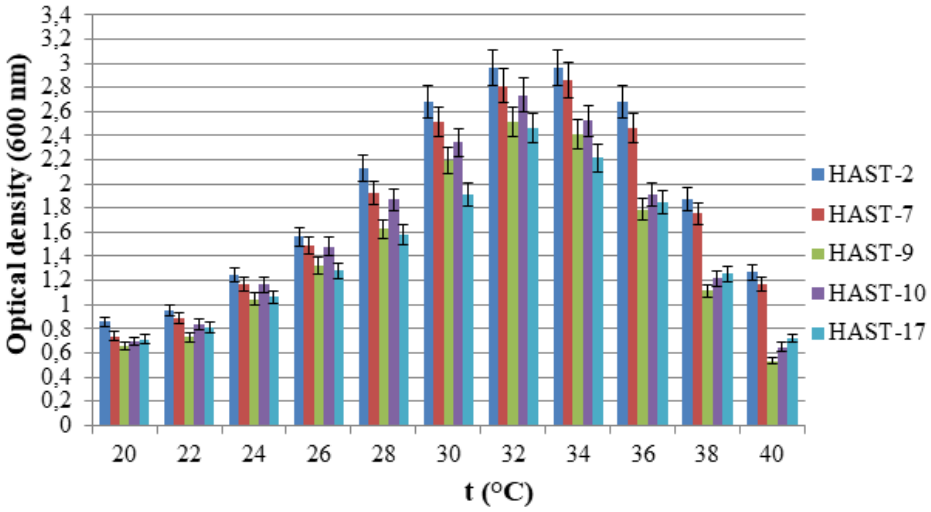

Fig. 4. Effect of temperature on growth rate of endophytic bacteria of *H.strobilaceum*(n=3)

As can be seen from Figure 4, *H.strobilaceum* endophytic bacteria can grow at a certain level in all temperature options (20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40°C). When analyzing the optical density of the bacterial suspension at the minimum temperature option (20°C), it was observed that this indicator was from 0.653 (in HAST-9) to 0.856 (in HAST-2) in strains of endophytic bacteria *H.strobilaceum*. At the maximum temperature option (40°C), the optical density of the bacterial suspension was from 0.534 (in HAST-9) to 1.270 (in HAST-2). The high rate of growth of *H.strobilaceum* endophytic bacteria occurs at 32°C. Under the influence of this indicator of temperature, the optical density of the bacterial suspension had values in the range of 2.388-2.967. The maximum indicator of the optimal density at 30°C belonged to the strain HAST-2 (2.989), the minimum indicator belonged to the strain HAST-2 (2.388).

The results of the experiment (Figures 2-4) showed that the growth characteristics of endophytic bacteria of halophytic plants improve up to 30-32°C, then the growth rate decreases inversely proportional to the increase in temperature.

Conclusions. The effect of the temperature factor on the growth of endophytic bacteria in halophytic plants is high. The growth characteristics of endophytic bacteria improve up to 30-32°C, then the growth rate decreases inversely proportional to the increase in temperature.

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