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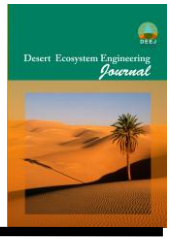

Investigating the Possibility of Sand Dunes' Stabilization via Industrial Wastewater and Soil Microorganisms

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Extended abstract

Introduction: located in the dry belt of the earth, Iran has more than 164 million hectares of drylands. As the rate of wind erosion has significantly increased in recent years, applying sand dunes' stabilization methods seems essential. Therefore, this study sought to identify the soil bacteria affecting the microbial-induced carbonate precipitation and evaluate different amounts of potash wastewater (SSR400 solution) as a cheap solution for stabilizing sand dunes.

Materials and methods: To investigate the possibility of sand dunes' stabilization via industrial wastewater and soil microorganisms, two experiments were designed and performed in 2019 at Yazd University. The first experiment was performed to screen the soil bacteria in those Iran's desert areas with the highest ability to hydrolyze urea. The tested bacteria included four bacterial isolates from the Eshtehard desert, six bacterial isolates from Iran's central desert, and *Sporosarcina pasteurii* bacteria. The second test was performed to evaluate the stabilization of sand dunes as a two-factor factorial in a completely randomized design with three replications. The first factor included the use of mulch at 0.5, 1, 2 and, 1/3 soil saturation (SP) levels. The second factor was the mulch type that was examined in eight levels: no bacteria, *Pseudomonas fluorescens*, *Sporosarcina pasteurii*, *Phormidium tenue*, *Oscillatoria tenuis*, b4, distilled water, and potash wastewater (SSR400 solution). Data analysis and statistical calculations were performed using SASV9 and EXCEL software. Also, the mean comparison was performed by the protected LSD test at a 5% probability level.

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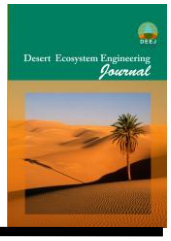

Result: The results of the urea hydrolysis ability test showed that the bacteria in urea hydrolysis had a significant difference in the level of one percent probability. Comparison of the mean results suggested that *Sporosarcina pasteurii* with an average of 3223.3 µs/min of electrical conductivity (EC) had the highest ability to hydrolyze urea. In the next rank, the bacteria isolated from the Eshtehard desert's soil (b2) with 2421.3 µs/min of electrical conductivity and the bacteria (b4) with 2072.3 micro Siemens per minute belonged to Iranian central deserts' soil. Moreover, the results of comparing b2 bacterium's 16S rRNA sequence with other bacteria in the NCBI gene bank's database indicated that the ribosomal RNA sequence of the 16S b2 isolate was 99% similar to the sequences of *Pseudomonas fluorescens*. On the other hand, the analysis of the variance of the second experiment's data showed that the type and amount of mulch application and the interaction of the two had a significant effect at the level of 1% probability on compressive strength and tuber diameter, making the particle's percentage greater than 0.84 mm. Following the application of *Sporosarcina pasteurii* at the rate of 1/3 soil saturation, the highest compressive strength and the highest percentage of particles larger than 0.84mm were observed to be 4.4 kg/cm2 and 97.5%, respectively. Moreover, the compressive strength of potash wastewater (SSR400 solution) and *Pseudomonas fluorescens* after applying 1/3 soil saturation was 3.88 and 3.85 kg/cm2, respectively. The highest tuber's diameter at a rate of 5.5 cm was obtained with the application of potash wastewater (SSR400 solution) at a rate of 1/3 of soil saturation. Also, the tube's diameter after applying potash wastewater (SSR400 solution) at the rate of 2 and 1 Lit/m^2 was found to be 4.99 and 4.11 cm, respectively. Also, applying *Pseudomonas fluorescens* and potash wastewater (SSR400 solution) in 1/3 soil saturation led to the creation of 96.4% and 94.4% of particles larger than 0.84 mm, respectively.

Discussion and Conclusion: The study's results showed that those bacteria with a high ability to hydrolyze urea and deposit calcium carbonate could play an influential role in increasing soil firmness. It was also found that the properties of the calcium, magnesium chloride and calcium nitrate in the potash wastewater (SSR400 solution) increased the adhesion of soil' particles and the soil's stabilization. These solutions increased the surface tension of the soil and strengthened the bond between the soil's particles. Moreover, the calcium ion in potash wastewater (SSR400 solution) effectively softened soil's colloids and reduced erosion.

Generally, the qualitative urea hydrolysis test results indicated that while *Sporosarcina pasteurii* had a high ability in the hydrolysis of urea and the sand dunes' biological stabilization-related traits, *Pseudomonas fluorescens* was less able in these regards. Moreover, as a mineral mulch, wastewater (SSR400 solution) showed an excellent ability to stabilize sand dunes. However, it should be noted that the very high salinity of this solution can cause many problems in desert lands. Therefore, it is necessary to reduce the solution's salinity before recommending it as mulch. Also, as the application of 1/3 soil saturation increased stabilization in all mulch types, it could be argued that increasing the volume of mulch application per square meter can improve the stabilization of sand dunes. However, due to the limitations of using mulch in desert lands, including water shortages and the difficulty of transporting such solutions to desert areas, applying less amount of the selected mulch may improve soil erosion.

Keywords: Sand dunes, Wastewater, Microorganism, Mulch, Microbial induced carbonate precipitation, screening.