World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:18, No:02, 2024

Biological Soil Crust Effects on Dust Control Around the Urmia Lake

Authors : Abbas Ahmadi, Nasser Aliasgharzad, Ali Asghar Jafarzadeh

Abstract : Nowadays, drying of the Urmia Lake as a largest saline lake in the world and emerging its saline bed from water has caused the risk of salty dune storms, which threats the health of human society and also plants and animal communities living in the region. Biological soil crusts (BSCs) as a dust stabilizer attracted the attention of Soil conservation experts in recent years. Although the presence of water by the impenetrable lake bed and endorheic basin can be an advantage to create BSCs, but the extraordinary of the lake bed salinity is a factor for prevention of its establishment in the region. Therefore, the present research work has been carried out to investigate the effects of inoculating the Cyanobacteria, algae and their combination to create BSCs for dust control. In this study, an algae attributed to Chlamydomonas sp and a cyanobacteria attributed to Anabaena sp isolated from the soils of Urmia Lake margin were used to create BSC in four soil samples which collected from 0-10 cm of the current margin (A), the previous bed (B), affected lands by lake (C) and Quomtappe sand dune (D). The main characteristics of the A, B and C soil samples are their highly salinity (their ECe are 108, 140 and 118 dS/m, respectively) and sodicity. Also, texture class of the soil A was loamy sand, and other two soils had clay textures. Soil D was Non-saline, but it was sodic with a sandy texture class. This study was conducted separately in each soil in a completely randomized design under four inoculation treatments of non-inoculated (T0), Algae (T1), cyanobacteria (T2) and equal mixture of algae and cyanobacteria (T3) with three replications. In the experiment, the soil was placed into wind tunnel trays, and a suspension containing microorganisms mixed with the trays surface soil. During the experiment, water was sprayed to the trays at the morning and evening of every day. After passing the incubation period (30 days), some characteristics of samples such as pH, EC, cold water extractable carbohydrate (CWEC), hot water extractable carbohydrate (HWEC), sulfuric acid extractable carbohydrate (SAEC), organic matter, crust thickness, penetration resistance, wind erosion threshold velocity and soil loss in the wind tunnel were measured, and Correlation between the measured characteristics was obtained through the SPSS software. Analysis of variance and so comparison between the means of treatments were analyzed with MSTATC software. In this research, Chlorophyll, an amount, was used as an indicator of the microorganism's population in the samples. Based on obtained results, the amount of Chlorophyll a in the T2 treatment of soil A and all treatments of soil D was significantly increased in comparison to the control and crust thickness showed increase in all treatments by microorganism’s inoculation. But effect of the treatments was significant in soils A and D. At all treatment’s inoculation of microorganisms in soil A caused to increase %46, %34 and %55 of the wind erosion threshold velocity in T1, T2 and T3 treatments in comparison to the control, respectively, and in soil D all treatments caused wind erosion threshold velocity became two times more than control. However, soil loss in the wind tunnel experiments was significant in T2 and T3 treatments of these soils and T1 treatment had no effect in reducing soil loss. Correlation between Chlorophyll a and salinity shows the important role of salinity in microbial growth prevention and formation of BSCs in the studied samples. In general, according to the obtained results, it can be concluded that salinity reduces the growth of microorganisms in saline soils of the region, and in soils with fine textures, salinity role in prevention of the microbial growth is clear. Also, using the mix of algae and cyanobacteria together caused the synergistic growth of them and consequently, better protection of the soil against wind erosion was provided.

Keywords : wind erosion, algae, cyanobacteria, carbohydrate
Conference Title : ICAEWE 2024 : International Conference on Arid Environments and Wind Erosion
Conference Location : Dubai, United Arab Emirates
Conference Dates : February 12-13, 2024