DEEJ (2021) 10 (30) 1-16

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir

Evaluating the efficiency of bio-soil windbreaker device for wind erosion control: A Case Study of Chaharmahal and Bakhtiari Province, Junqan District

Davood Namdar Khojasteh[1*], Salman Zareh[2]

Received: 10/02/2020 Accepted: 08/02/2021

Extended Abstract

Introduction: As serious problems especially in Iranian border provinces, wind erosion and dust storm exert harmful effects on human health and the environments, including reducing soil fertility, increasing desertification, etc. So far, a variety of efforts such as using polymers and mulch, vegetation, oil emulsions, microorganisms have been done to reduce wind erosion and stablize the soil. However, none of tham have proved effective due to special circumstances that exist in Iran. Therefore, using modern thechnologies for controlling wind erosion and reducing wind speed in Iran seems necessary. In this research which sought create a bio-soil windbreak to control wind erosion and reduce wind velocity, a new device called “Ridging device” was used to build a ridge or windbreak.

Material and methods: The ridging device comprises of three main parts, including the digginh of soil part, mixing soil- polymer part, and the ridge maker part. This machine digs the soil from within 30 cm depth, transfer it to the conveyor where polymer (polymer suspension) is added, and finally pours the mixture of soil- polymer into the ridge maker part. As a result of the pressure exerted by two plates embedded in the ridgid maker part, a ridge with a penetration resistance of 1.5 kg per square centimeter and an aggregate stability of 80% is created. Moreover, The penetration resistance of the ridge also increases with increasing polymer concentration. Through the settings placed at the end of the ridge maker part, the height and width of the ridge could be adjusted based on soil conditions, the region’s climatic conditions, initial soil moisture, and other conditions. To investigate the effect

[1]. Assistant Professor, Department of Soil Science, Faculty of Agriculture, Shahed University, Tehran; d.namdar@shahed.ac.ir
[2]. Assistant Professor, Department of Reclamation of Arid and Mountainous Regions, Tehran University, Tehran
DOI: 10.22052/deej.2021.10.30.1

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir

of the ridges on reducing wind velocity, the latter was recorded at heights (Z) of 0.05 m, 0.1 m, 0.2 m, 0.4, and 0.6 m above the surface, and at distances (x) of -2.5H, -1.25H, -0.62H, 0.62H. 1.25H, 2.5H. 3.75H, 5H, 6.25H, 7.5H, 10H, and 12.5H from the ridge. It should be noted that for simulateing wind erosion reduction with the ridge, a wind erosion measuring device with a speed of 15.6 m/s was used under laboratory conditions. The wind speed was measured with an AN-4330 Anonometer.

Results and disscution: The results of the wind velocity profile showed that the wind velocity increased with increasing distance from the soil surface and reached its initial constant value (15.6 m/s) at a distance of 20 cm from the soil surface. The study also found that the ridge effectively reduced wind speed in such a way that by increasing the distance from the ridge, the wind speed also increased and reached a constant trend at 10 to 12 times the height of the ridge. Moreover, it was found that the region's wind erosion threshold speed was 6.52 ms-1 and the distance between the ridges was 20 m. Therefore, to control erosion with this method, 500 meters of the ridge per hectare is requires. One of the advantages of this device is that constructing a ridger and controlling wind erosion is less costly compared to other techniques. Another important advantage of this ridger device over other living and non-living windbreaks is the accessible regional raw materials used in its construction. Generally, this ridge device is durable for four to five years, and it is constructed with low costs and no damages to the environmnt. This technique has no adverse effects on the environment and is very environmentally friendly. Given that the device is first of its kind, further studies are required for upgrading its design and function. Moreover, considering the special circumstances of Iran, effective policies and studies are needed for reducing air pollution and dust concentration in line with Iran's sustainable development.

Conclusion: Existence of nearly 30 million hectares of areas affected by wind erosion in Iran and various environmental stresses such as water shortage, soil salinity, erosive winds, etc., makes it necessary to use efficient methods such as mechanical windbreaks to control these areas. On the other hand, soil ridge is a very cheap thoough efficient mechanical windbreak that can be accessed and implemented in any area. The application of the windbreak device introduced in this study would be an effective step in using cheaper and faster windbreaks. This device ican create a ridge of desired size up to a maximum height of 70 cm in a short time, and thus greatly help control wind erosion. Finally, it is suggested that the performance of the device be evaluated in areas with different soil texture, climatic conditions, and topography

Keywords: Biopolymer, Sediment, Wind Reduction, Soilloss.