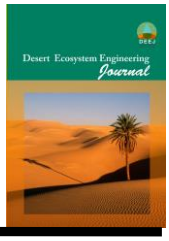
DEEJ (2023) 11 (37) 70-55

University of Kashan

Desert Ecosystem Engineering Journal

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



# Investigating the Effects of Mineral Mulch on Chemical Properties of Kashan Rig Boland's Sand

**Salman Zare[1], Mohammad Jafari[2], Hasan Ahmadi[2], Ali Tavili[3], Hasan Rouhipour[3], Reza Khalil Arjomandi[4], Maryam Mombeni[5], Masoumeh Salehi Morkani**

Received: 13/04/2022 Accepted: 12/09/2022

**Extended Abstract**

**Introduction:** as one of the most critical environmental challenges in recent decades which has engendered environmental pollution worldwide (33, 3, 2), wind erosion occurs due to increased velocity and turbulence of the wind when blown on a cover-free surface (11), inflicting lots of economic and social damage on various sectors.
There are several methods used to reduce wind erosion, including biological methods (seeding and planting), mechanical methods, and the methods used for strengthening the surface cover such as the application of different types of mulch (oil, polymer, biological, and mineral mulches) (21). In this regard, mulching should, as a last resort, be able to pass rainwater, penetrate into the ground, and maintain moisture while having sufficient required adhesive strength.

Non-petroleum materials have increasingly been used in recent years to improve the stability of buildings, aggrandize the diameter of soil aggregates, and stabilize the soil against wind erosion. However, choosing a material as a soil stabilizer against wind erosion, replacing new mulch instead of oil mulch while considering the aforementioned factors, and taking the biodegradability of the non-petroleum materials into account are other crucially important factors to note in this regard. Therefore, this study sought to investigate the effect of mineral mulch (a combination of $CaCl_2$ and $MgCl_2$) on soil properties.

**Materials and Methods:** The study area covered the sand dunes of the Rigboland desert located in Aran and Bidgol city, Isfahan. The mineral mulch used in the study was a stabilizing solution obtained from the evaporation of the brine of Iran's central desert in the Khorobiabank region, known as the SS400 soil stabilizing solution (27). Chemical analysis of the solution indicated that it contained 30% CaCl2, 15% MgCl2, 5% NaCl, KCl, Ca (NO3) 2, and 50% water whose pH ranged between 5 and 6, with an average specific gravity of 1.5 g / cm3.
On the other hand, in March 2012, mulch was sprayed directly to the natural field with three replications on three mounds of incomplete Barkhan-type sand dunes in Rigboland Aran and Bidgol regions to evaluate the influence of mineral mulch on soil's chemical properties (Figure 4). To this end, samples of aeolian deposits were collected from three different depths of the hills in the study area with three replications (0-5 cm for the first replication with and without mulch; 5-10 cm for the second replication; and 10-20 cm for the third replication) prior to performing mulching. Finally, some samples were collected once more at the end of the experiment in May 2014 from the same three depths. It should be noted that 15,000 liters of mulch were applied per hectare.

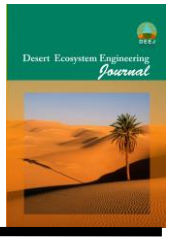
1. Assistant professor, Department of Reclamation of Arid and Mountainous Regions, Natural Resources Faculty, University of Tehran, Karaj; zaresalman@ut.ac.ir
2. professor, Department of Reclamation of Arid and Mountainous Regions, Natural Resources Faculty, University of Tehran, Karaj.
3. Associate Professor, Forest and Rangeland Research Institute, Tehran.
4. Senior Expert, International Desert Research Center, University of Tehran.
5. PhD in Desertification, Office of Desert Affairs, Natural Resources and Watershed Management Organization, Tehran.
6. Master student, Department of Reclamation of Arid and Mountainous Regions, Natural Resources Faculty, University of Tehran, Karaj.

DEEJ (2023) 11 (37) 1-14

University of Kashan

Desert Ecosystem Engineering Journal

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



**Results and Discussion:** The results of paired T-test performed on the characteristics of different soil depths suggested that the mulched aeolian deposits did not differ significantly in both control and treatment groups in terms of N, CaSO4.2H2O, P, Cl, and OM characteristics in at all the depths studies (P> 0.01). However, the application of mineral mulch significantly increased the EC, pH, Ca, K, and CaCO3 at all depths, and N and Mg at the first and second depths (P <0.01).

Mulches with different compositions and origins may increase or decrease the root's ability to absorb elements. In this regard, the current study found that mineral mulch significantly increased the soil's pH (P <0.01), which could be justified if the Na and CaCO3 added to aeolian deposits as a result of applying such a mulch are taken into account.

Furthermore, hydrolysis of Na and the dissolution of CaCO3 which eventually lead to the formation of hydroxyl anions could be regarded as the main cause of such an increase in the aeolian deposits' pH under treatment mulch. Moreover, the comparison of the deposits' pH made as a result of sampling with and without mulch revealed that the deposits' pH would be higher if they are sampled with mulch, which can be justified according to the explanations provided above. On the other hand, some studies have reported that the aeolian deposits' PH increased when treated with mulch (17), which is consistent with the results obtained in this study. However, the finding does not correspond with the results reported by some researchers (20 and 4).

The significant increase in EC capability at different depths of the treatment group compared to those of the control group clearly confirms the influence of mulch on increasing the soil's EC. Moreover, examining the soil's EC capability at the evaluated depths showed a decreasing trend caused by the washing and transfer of the mulch-included solutes to lower depths, where the rate of ion transfer decreased with an increase in the soil's depth.

Also, mineral mulching significantly increased the soil's K (P <0.01), which could be justified by considering the type and the origin of the mulch used, taking into account the fact that the initial solution was prepared by using the materials collected from the study area contained high amount potassium, a limited portion of which still remained active even after it was extracted from the solution (what remained from the solution afterward was used as mulch), causing a significant change in the amount of potassium in the soil. This finding is consistent with the results reported by some researchers (10, 13, and 14) who argued that mulch increased P and K in the soil.

**Conclusions:** Considering the findings of this study in terms of the influence of mulch on the aeolian deposits' componential elements and important chemical properties, including the deposits' response, electrical conductivity, sodium absorption ratio, and the percentage of the exchanged sodium, all of which showed an increasing trend that led to salinization and alkalization of the deposits, and consequently to physiological dryness, and taking into account the fact that the mulch exerted no influence on the percentage of the aeolian deposits' organic matter as the most important and effective factor in improving the physical, chemical, and biological conditions of the deposits, it could be argued that the mulch used in this study had no positive effect on the aeolian deposits studied. Therefore, this mulch is not recommended for stabilizing sand dunes and controlling dust.

**Keywords**: Wind Erosion, Sand dunes, Desertification, Organic matter, Mulch.

DEEJ (2023) 11 (37) 1-14

University of Kashan

Desert Ecosystem Engineering Journal

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