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Effect of Polyacrylamide Polymer on Wind Erosion Control of Sandy Soil in Azadegan Plain

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Introduction: Wind erosion is the most important agent of environmental degradation, poverty of soil, air pollution and the dust spread. Wind erosion is causing a lot of damage to crops, buildings, facilities and vehicles. The first step of the wind erosion control is the stabilization of soil particles. Soil stabilizing methods to control wind erosion can be classified into mechanical, biological and chemical stabilization. Mechanical soil stabilization type is relatively time-consuming and costly. Biological stabilization is a traditional way that exhibits a long-term validity but sandy soil cannot provide essential water and nutrition elements needed by plant. Recently, chemical stabilization such as high-molecular-weight anionic polyacrylamide (PAM) has attracted the attention of researchers because of its advantages in easy and quick construction, and the improvement of the growing conditions for plant. However PAM has been mainly used to control water erosion and there is still little available information regarding the effectiveness of PAM on preventing soil loss by wind erosion. The main objective of this study was to investigate the feasibility of using PAM in wind erosion controlling. Also, effects of PAM on some soil physical and chemical properties and their temporal variability were evaluated.

Materials and Methods: In this study polyacrylamide polymer was used as a restoration of soil and soil structure stabilizer on sandy soil of Azadegan Plain (Khuzestan province, Iran). Consequently, an experiment was conducted as factorial based on completely randomized design with three replicates. The experimental treatments were consist polyacrylamide polymer (PAM) at three levels (0, 0.5, and 1 %), soil moisture at two levels (80% FC and dry) and time duration at three levels (15, 30 and 45 days). The emulsion of PAM was sprayed homogeneously on the soil surface. After passing each time treatment, penetration resistance and some physical and chemical properties of soil was measured. Finally after doing all measurements, the treatment with maximum penetration resistance were selected and the sample was prepared for wind tunnel testing. The wind erosion experiments were conducted in a wind tunnel. Soil samples were located in removable trays. The width and length of the trays was 30 and 100 cm, respectively. The wind erosion experiments were performed under wind velocity of 12 m s^{-1} according to the actual situation of study area.

Results and Discussion: The results indicated that in comparison to control, soil acidity decreased at both levels of the polymer with increasing time. The decreasing of soil acidity in wet treatments was more than dry treatment. The lowest amount of pH was obtained in the 30-day wet treatment at 1% polymer level. The results show from the 30th day onwards, soil pH increased, which is probably due to the polymer degradation. With passing time, soil electrical conductivity (EC) at both levels of the polymer (0.5 and 1%) increased and decreased respectively after 30 days. These observations are probably because after 30 days the properties of polymer-hydrophilic units gradually decrease and water adsorption was reduced or that soil soluble salts were adsorbed by polymer particles. The results also showed with passing time, *Mean Weight-Diameter* of *Soil* Aggregates (MWD) increased and then after 30 days declined. The largest MWD was observed in 30 days treatment at 1% polymer level. After thirty days, its effect has probably diminished due to polymer degradation. Furthermore, the results showed no significant difference of bulk density among treated soil with different level of polymer, but application of polymer caused to decrease bulk density comparison to control. Polymer application increased soil penetration resistance significantly. Using 1% of polymer increased it to 6 kg/m^2. The results also indicated that the soil resistance at first increased with time and then decreased significantly. The amount of soil penetration resistance at 45-day was less than 15-day. The results of wind tunnel with a maximum 12 m/s wind velocity showed that application of the polymer reduced the erosion of sands samples to zero.

Conclusion: The research results indicated that PAM application increased soil penetration resistance and MWD. The polymer could improve the structure of soil aggregates and increase the amount of dry-stable aggregates and therefore decrease soil bulk density. Spraying PAM solution on the surface of soil significantly

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decreased the wind erosion amounts. Therefore, this inexpensive and easily usable polymer can be considered as a soil stabilizer to control wind erosion in arid and semiarid areas.

Keywords: Penetration resistance, Soil moisture, Time, Wind tunnel