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Evaluating the Effectiveness of Animal Nano-Fertilizer and Biological and Chemical Amendments in the Reclamation of Saline Soils

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Extended Abstract

Introduction: Saline soil contains large amounts of soluble salts. In addition to natural factors affecting soil salinization such as climate, topography, and abundance of evaporative formations in the region, the human factors that result from incorrect management of the agricultural system (such as using low-quality water for irrigation, overuse of chemical fertilizers, the frequency of irrigation, the type of irrigation system, poor soil drainage, etc.), are considered as the main causes of soil salinization (secondary salinity). According to the FAO report (2002), these regions' area is estimated to be approximately 831 million hectares, out of which 397 million hectares are saline soils, and 434 million hectares are sodic soils. As found by recent researches, the area of saline soils is estimated as 44.5 million hectares in Iran, constituting 27% of the total area of the country. Different methods including the selection of salinity-resistant plants, application of special methods of bed preparing and seed planting that minimize the accumulation of salts around the seeds, the use of larger amounts of irrigation water to leaching salts from the depth of plant roots penetration, and the use of chemical amendments such as sulfur, sulfuric acid, iron sulfate, gypsum, ammonium polyphosphate, calcium polyphosphate, etc., have already been used for reclamation of saline soils. Studies on this issue have often focused on the use of various amendments (chemical and organic matters). However, saline-sodic soils have not been studied based on nanoscale organic modifiers. Having various usages in natural resources and

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agriculture, including the remediation of soils contaminated with different contaminants such as saline-sodic soils, nanomaterials have found much application in industrial and semi-industrial laboratory scales in recent decades. Therefore, this study sought to investigate the effects of chemical, biological, and Nano-particle solutions on the modification of these soils.

Materials and Methods: The purpose of this study was the reclamation of saline and sodic soils using chemical, biological, and nanotechnology methods. The study region with an area of about 100 hectares was located in the northwest of Golestan province, between 37° 09' 18" to 37° 10' 15" Northern latitude and 54° 25' 15" to 54° 25' 30" Eastern longitude. The study was arranged in a completely randomized factorial design by using eight treatments, including 1) control, 2) gypsum, 3) gypsum and livestock manure, 4) livestock manure, 5) nano- livestock manure of 0.03%, 6) nano-livestock manure of 0.06%, 7) nano- livestock manure of 0.06% and gypsum, 8) nano- livestock manure of 0.03% and gypsum. Each treatment was repeated three times. Statistical analysis of the data was performed by one-way analysis of variance and Duncan's multi-domain test in the SPSS software.

Results: Prior to the experiment, soil samples were examined in the laboratory, and some soil parameters such as exchange sodium percentage (ESP), acidity (pH), and soil electrical conductivity (EC) were measured. After adding the amendments to the pots, they were leached for 30 days so that this amount of water was added to the soil four times (once every seven days). After leaching, each pot's ESP, EC, and pH values were measured. The results showed that nano-manure treatments of 0.06% + gypsum and nano-manure of 0.03% + gypsum (at the level of 1%) had the greatest effect on reducing the ESP, and treatments of manure and nano-manure of 0.03% had the greatest effect on reducing EC. It was also found that soil acidity had the greatest decrease under the influence of gypsum and animal manure + gypsum treatments.

Results and discussion: The results of the study indicated that the gypsum amendment, along with animal manure, had significant effects on reducing ESP, EC, and pH in micro and nanoscales. Livestock manure was also found to positively reduce ESP, EC, and pH in both nano and micro scales. The applied nano-manure at both levels of 0.06% and 0.03% had a significant effect on improving the soil condition, especially on reducing soil acidity. In general, it could be concluded that the application of organic matter (animal manure) on a nanoscale exerts a greater influence on improving the condition of saline and sodic soils in comparison to that caused via micro-scale, which will be more effective if used in conjunction with gypsum.

Keywords: Saline soils, Nano-fertilizers, Chemical and biological amendments, Golestan province, Sufikem plain.