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Cynodon dactylon: An efficient perennial grass to revegetate sodic lands

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ABSTRACT

Sodic soils are wide-spread in semi-arid subtropical regions and characterized by high level of sodium and pH with poor physical, microbial and enzyme activities. In this study frequency (*F*), density (*D*), abundance (Ab) and important value index (IVI) of grasses naturally growing on abandoned sodic land were observed to assess sodicity tolerance ability of these grasses. The greatest IVI and visual observations showed that *Cynodon dactylon* (Bermuda grass) has maximum ability to grow on severely sodic lands and can be identified as an ecological tool in rehabilitation of degraded lands. Besides vegetation analysis, this further would be confirm by analysis of microbial and enzyme activities of rhizosphere soils. Therefore, we also observed the changes in microbial and enzyme activities of rhizosphere soils (RS) of *C. dactylon* and compared with non-rhizosphere (adjacent non-vegetated area) sodic soils (NRS) to assess its ecological suitability for reclamation of sodic soils. We collected 135 random soil samples from *C. dactylon* rhizosphere as well as adjacent non-rhizosphere bulk soil. Soil pH, exchangeable sodium percentage (ESP), sodium adsorption ratio (SAR), electrical conductivity (EC) and carbon nitrogen ratio (C:N) were significantly lower in rhizosphere soils in comparison to non-rhizosphere soils, while organic carbon (OC), total nitrogen (T-N), available phosphorus (P), microbial biomass carbon (MBC), soil respiration (SR), microbial quotient (C_{mic}:C_{org}), dehydrogenase, protease and alkaline phosphatase activities were significantly higher in rhizosphere soils. Decreases in soil sodicity (pH, ESP and SAR) and increases in soil nutrients, microbial biomass and enzyme activities suggest that *C. dactylon* can be used to restore and enhance the biological activities of abandoned sodic lands and to facilitate the further vegetation establishment.

1. Introduction

Sodic soils are wide-spread (436 million ha) in semi-arid subtropical regions of the world (Wong et al., 2009) and occupy about 249 Mha in Asia. In India sodic soils are estimated to be about 6.9 Mha and 1.63 Mha sodic soils occur only in Uttar Pradesh, a state of the country. High level of sodium and soil pH, poor nutrient availability, dispersion and swelling of clay particles, poor water infiltration rate and impeded microbial activities are the characteristics of these soils which adversely affect plant growth (Qadir et al., 2007; Shukla et al., 2011; Singh et al., 2012a). Therefore, rehabilitation of such degraded lands is important which would increase soil fertility and contribute in mitigation of global warming through sequestration of carbon in aboveground and belowground habitats (Pandey et al., 2011; Singh et al., 2012b). However, the main objective of any restoration/rehabilitation project is amelioration of physical and chemical characteristics of the soil and ensuring the building of sustainable ecosystems (Hobbs and Norton, 1996; Costanza, 2012). According to The Society for Ecological Restoration, the definition of ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (Harris, 2003). In this context, we identified *Cynodon dactylon* (*Cynodon*, thereafter) as an ecological tool to ameliorate degraded lands and can be used to assess recovery status. *Cynodon* is a perennial grass, colonizing well on sodic lands at irregular intervals, and creates a dense green mats in metres of area. Grass multiplies or propagates through seeds, runners and rhizomes. Seeds of *Cynodon* when get acclimate to sodic condition they initiate their growth. Furthermore, we observed the growth of other grasses (*Desmostachya bipinnata*, *Eragrostis tenella* and *Chloris barbata*) in the premises of *Cynodon*, while there was no any grass on adjacent sodic soils. This strikes us to investigate the properties of *Cynodon* rhizosphere soils and adjacent bare sodic soils (termed non-rhizosphere soils).

Several grasses have been used as a bioremediation tool to ameliorate a variety of sodic and saline-sodic soils. Some workers have favoured the inclusion of *Cynodon* (Qadir et al., 2007) as the first crop to accelerate soil amelioration. In general, grasses are more

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