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Impact of Salinity on Microbial Activity and Organic Matter Dynamics in Soils is more Closely Related to Osmotic Potential than EC

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ABSTRACT

This study was conducted to evaluate the effect of salinity and sodicity on respiration and dissolved organic matter dynamics in salt-affected soils of different texture. Four non-saline and non-sodic soils differing in texture (4, 13, 24 and 40% clay, referred to as S-4, S-13, S-24 and S-40) were leached with 1M NaCl and 1M $CaCl_2$ solutions resulting in $EC_{1:5}$ (1:5 soil:water ratio) between 0.4 and 5.0 dS m^{-1} with two levels of sodicity [$SAR_{1:5}$< 3 (non-sodic) and 20 (sodic)]. After adjusting the water content to levels optimal for microbial activity which differed among the soils, this resulted in four ranges of osmotic potential in all soils: control, > -0.55, -0.62 to -1.62 and -2.74 to -3.0 MPa. Finely ground mature wheat straw was added (20 g kg^{-1}) to stimulate microbial activity. At a given $EC_{1:5}$, cumulative respiration was lower in the lighter textured than the heavier textured soils. Cumulative respiration decreased with decreasing osmotic potential to a similar extent in all soils, with a greater decrease on day 40 than on day 10. Cumulative respiration was greater at $SAR_{1:5}$ 20 than $SAR_{1:5}$< 3 only at osmotic potentials between -0.62 and -1.62 MPa on day 40. In all soils and at both sampling times, concentrations of dissolved organic C and N were higher at the lowest osmotic potential (-2.74 to -3.0 MPa) compared to the controls without salt addition. It can be concluded that when comparing soils of different texture, osmotic potential is a better parameter to evaluate the effect of salinity on dissolved organic matter and microbial activity than $EC_{1:5}$.

Key Words: dissolved organic matter, microbial activity, osmotic potential, salinity, sodicity, soil texture

INTRODUCTION

Salt-affected soils (comprising saline and sodic soils) contain excessive amounts of salts are a serious land-degradation problem which affects over 6% of the world area (FAO-AGL, 2000). They cause poor plant growth through osmotic stress, poor soil structure and imbalanced nutrient uptake (Grattan and Grieve, 1999; Mengel and Kirkby, 2001).

Salinity has been found to negatively affect the amount and activity of soil microbial biomass and biochemical processes (Chowdhury *et al.*, 2011; Mavi and Marschner, 2012; Rietz and Haynes,