Dispersive Potential a tool for soil specific structural management under irrigation with saline sodic water

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Dispersive Potential is a tool/criteria designed as a unifying concept that determines the tendency of clay particles to disperse. It is based on the difference between osmotic pressure at the threshold point (Ptec) and the pressure at the point in the soil solution concentration to achieve complete flocculation (Psol) (Marchuk and Rengasamy, 2012; Rengasamy and Sumner, 1998) expressed as:

$$\llbracket P_{dis}=P_{tec}-P_{sol} \text{ for } P_{sol}<P_{tec}; P \rrbracket \quad _tec=3.6\times(45\times C_{Ca}+27\times C_{mg}+1.8\times C_K+C_{Na})$$

The concept of dispersive potential has been published (Rengasamy and Olsson, 1991); however its utility and practicality with regards to continued use of marginal quality water for irrigation has not been fully examined (Marchuk and Rengasamy, 2012). This study aims to validate the management practicality and accuracy of Dispersive Potential via calculation and application of amendment requirements to maintain soil stability while eliminating soil specific response variables.

Five soils of contrasting properties were treated with solutions of different SAR (5, 10, 15, and 30) and EC (2 and 4 dS/m) to assess the changes in hydraulic conductivity. Infiltration decreased and ESP increased with the increase of SAR irrespective of EC. Visible soil structural deterioration was observed after soil was removed.

Dispersive Potential values calculated for the treated soils were used to determine the amount of gypsum required to improve the structural stability and infiltration in soils treated with SAR solutions.

Application of gypsum significantly improved soil structure and infiltration rate, which was 4 times greater. ESP values decreased significantly (ranging from 40% - 60% decrease), demonstrating that the surface applied gypsum amount, determined by Dispersive Potential was capable of amending soils irrigated with saline-sodic water.

This study positions Dispersive Potential as a realistic approach to site-specific management of saline-sodic water for irrigation, in lieu of predictive capability and is be less laborious and costly than current threshold electrolyte concentration semi-empirical models (Ezlit et al., 2013).