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Soil remediating measures for improving growth and production in an olive orchard grown in highly sodic soils

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Introduction

The increasing world population leads to a decrease in freshwater available for agriculture. Replacing freshwater by reclaimed wastewater for irrigation of cultivated lands, is a possible solution. Reclaimed wastewater is of higher salinity and sodicity than freshwater, thus making it low-quality water. Long-term irrigation with such water may turn the soil sodic, the consequences of which are deterioration of soil structure and related hydraulic properties. This could become a major problem in orchards, where the small volume of soil is exposed to the irrigation water and may ultimately harm orchard's production. Therefore, Use of soil amendments in orchards to mitigate soil sodicity should be considered.

Aim

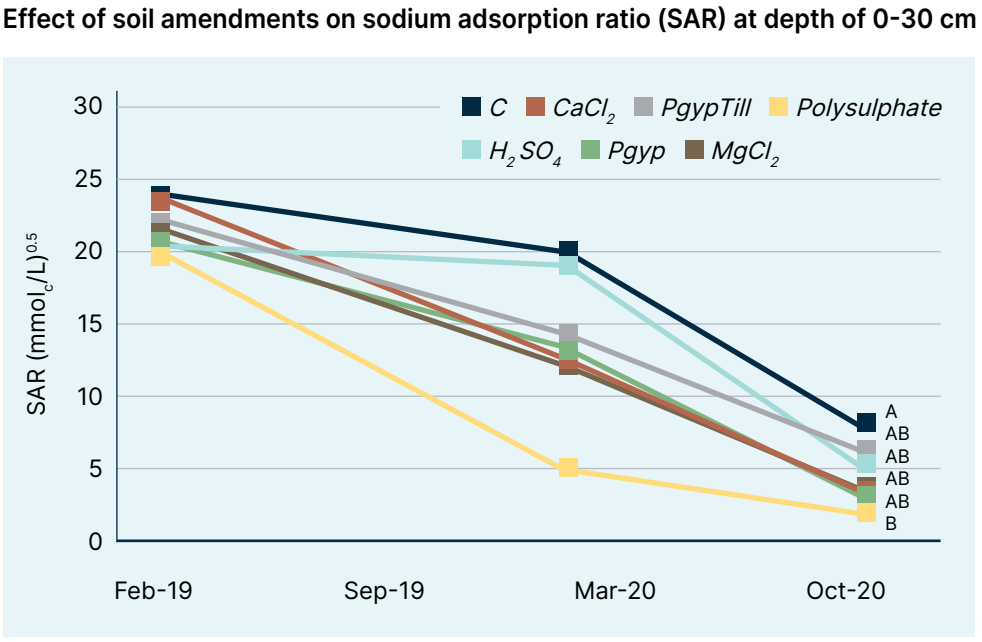
To examine effects of a number of soil amendments on reducing soil sodicity level, improving its structure and subsequently orchard performance.

Methods

The experimental site comprised an intensively grown olive orchards (cv. Barnea), where long term irrigation with low-quality water and high clay content soil led to soil solution sodium adsorption ratio (SAR) of 30 $(mmol_c/L)^{0.5}$. For the last two years the orchard was irrigated with reclaimed wastewater of improved quality. We studied five amendments (each in 5 replicates): $CaCl_2$ (9,080 L/ha, 0.05M), $MgCl_2$ (10,370 L/ha, 0.05M) and sulfuric acid (12,960 L/ha, 0.07M) were applied via the irrigation system, while Polysulphate (23 ton/ha) and Gypsum (7.85 ton/ha) were added to the soil surface prior to the rainy season, and a Control that received no amendment. Soil samples were collected twice a year from each plot from depths 0-30 cm. Electrical conductivity (EC) and concentration of cations (Na, K, Mg and Ca) in saturated soil extracts were determined, and sodium adsorption ratio (SAR) was calculated.

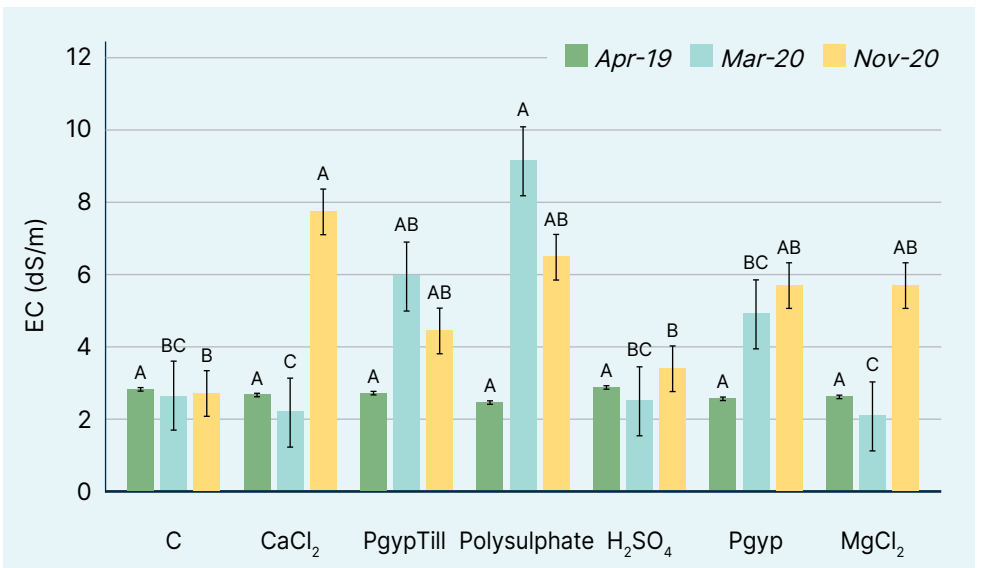
Results

Effect of soil amendments on sodium adsorption ratio (SAR) at depth of 0-30 cm



After just one year of application, amending with Polysulphate decreased the SAR significantly at depth of 0-30 cm to 2.04 compared with Control. Levels not connected by same letter are significantly ($p<0.05$) different.

Effect of soil amendments on electrical conductivity at depth of 0-30 cm



Amending with $CaCl_2$ significantly increased the EC to high levels in November 2020 compared with Control. Similarly, amending with Polysulphate increased the EC in March 2020. For a given sampling date, bars labeled with the same letter do not differ significantly at $p<0.05$.

Conclusions

Our initial results suggest that remediation of soil sodicity in orchards, through the use of amendments, is possible especially with Polysulphate. Yet, the use of these amendments could result in high levels of EC that lead to toxicity and osmotic stress in the tree. Thus, it is recommended to reduce the amount of soil remediating agents that are applied in the orchard. At this stage, no significant effect on trees growth or productivity was observed.