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Monitoring seasonal dynamic of soil salinity in pistachio orchard field in central Iran

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Introduction

Salinity restricts crop cultivation production in arid and semi-arid regions (Qadir et al. 2008). Getting the right plant for cultivation in saline soil is one of the biggest management challenges in saline agriculture. Pistachio is one of the strategic crops that play a key role in people's livelihoods in arid and semi-arid regions like Iran. Many farmers changed their current land use to pistachio field due to its high resistant to salt and commercial value. Using high salt tolerance plants like pistachio is right decision for saline agriculture but it should be considered that soil and water degradation could accelerate due to agricultural use of unsustainable lands. This study examines the seasonal dynamic of soil salinity in pistachio orchard field with furrow irrigation in saline agriculture in Iran.

Methodology

The study area is located in the Eyvanekey Restrict of Garmsar (figure 1). Mean annual temperature and precipitation are 16.6°C and 127 mm, respectively. Soil moisture and temperature regimes are Aridic and Mesic. Field studies were conducted by sampling designed in 105 ha pistachio field in wet and dry seasons within 1 year from November 2018 to August 2019. To investigate soil salinity variation by depth, 6 profiles were dug, and sampling was carried out at 10 cm intervals to a depth of 1 m from the soil surface. Soil profiles were resampled during three campaigns over the year. The purpose of choosing different season for sampling was evaluation the spatial distribution of ions and the temporal changes at comparable soil depths in relation to environmental and management factors.

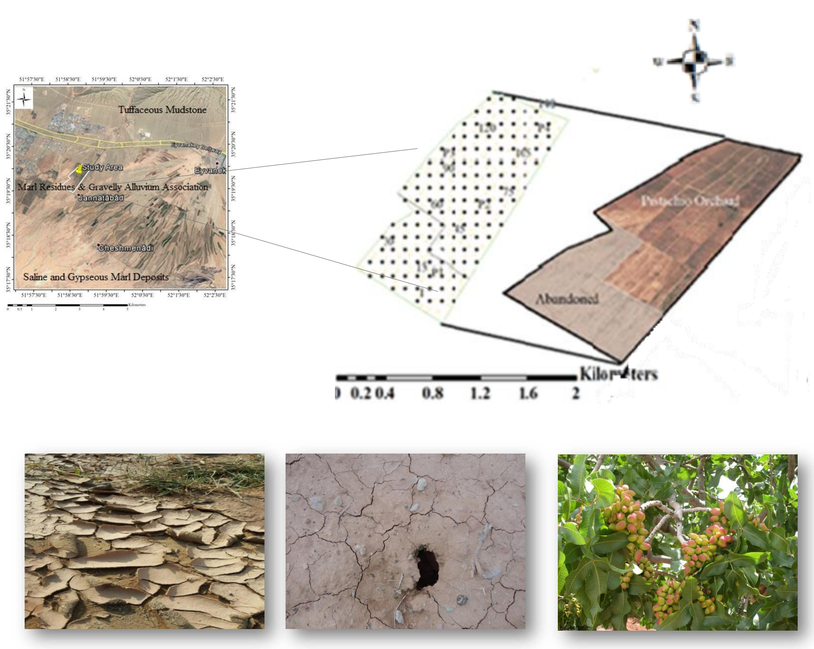

Figure 1: Location, geological composition and current land uses in the study area

Saturated extracts of soils were prepared and EC, pH, and concentrations of Na^+, Mg^{2+}, Ca^{2+}, K^+, CL^-, $SO4^{2-}$, HCO3-, and $CO3^{2-}$ were determined using standard methods (Sparks et al. 2020).

Results and Discussion

The results showed that the maximum amount of EC and dominant soluble salinity ions; Na^+ and CL^- in the first campaign, November 2018 were in surface layers (0-20 cm). Salinity ions concentration in the surface layer was a serious problem for cultivating crops but not for pistachio tress with long roots system. In the second campaign, May 2019 precipitation and irrigation caused salinity ions move from surface layer to subsoil layers. The depth of salinity ion concentration layer was in correlation with soil particle size distribution, gravel percentage, and textural discontinuities in soil profiles. In the third campaign, August 2019 due to the arid climate and high evapotranspiration in study area salinity ions moved back again to the surface layer by capillary movement (figure 2).

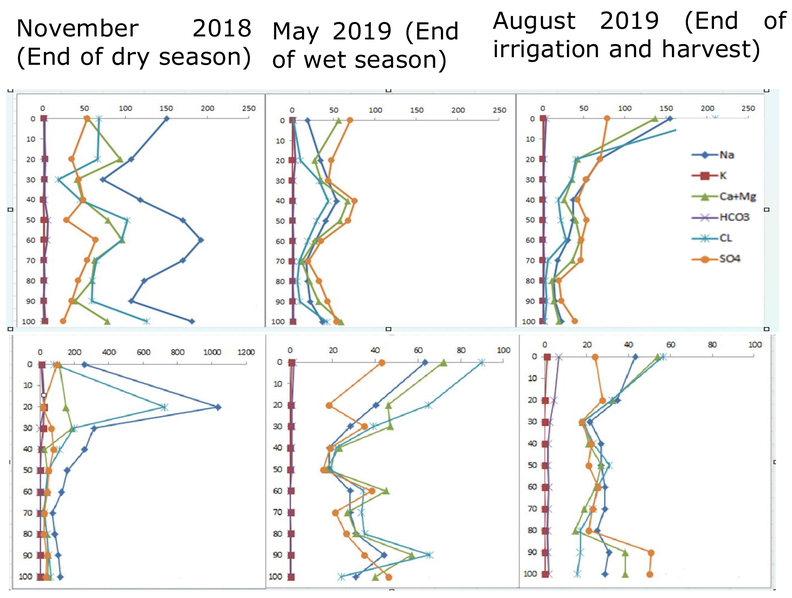

Figure 2: Salinity spatial changes during different seasons

In general, The mean value of EC in the studied profiles was 43,8 which is quite far from the suitable range for cultivating pistachio, maximum of 8 dS/m. The comparison of the mean values of soil salinity showed that salinity has increased between three and six times compared to last 20 years. Increasing average salinity in the pistachio root zone from 4 to 43,8 dS/m during the last 20 years of pistachio cultivation in the study area, the pistachio yield potential percentage decreased by almost 50%. Also, some parts of pistachio field in study area have been abandoned during the last 60 years due to severe soil salinity and yield reductions (Figure 3).

Besides the fact of salinity issue and yield reduction farmers still are continuing saline agriculture in the study area without considering soil and water degradation. According to this study, soon farmers will face severe declines in yield in all parts of the study area and they will be forced to abandon the field.

Figure 3: Salt concentration layer in soil surface of abandoned part in study area

Conclusions

characterizing soil salinity and its spatial-temporal changes is necessary to make the right management decisions in saline agriculture. Considering all measured EC and salinity ions in the soil profiles implied that soils have become severely degraded in study area due to agricultural use of unsustainable lands. Using high salt tolerance plants like pistachio trees is good decision for saline agriculture but it should be considered thar although the final product is good, but the soil and water degradation could accelerate due to agriculture use. Possible solutions to prevent rapid soil degradation include reconsidering the present forms of land use and limiting the further change of rangelands to conventional agriculture.

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