

Soil salinity as influenced by irrigation systems used for urban agriculture in a semi-arid environment of the North West Province, South Africa

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Abstract:

As is the case with many sub-Saharan African countries, the intensity of urban agriculture in South Africa has increased over the past 15 years. Due to the semi-arid nature of Mafeking, the capital city of the North West province, irrigation has become an important component of horticultural crop production systems in urban and peri-urban areas of the city. This study was prompted by concerns from both municipal officials and farmers that the irrigation systems being used were affecting the quality of soil and yields of crops through salts that accumulate in the soil. The objective of the study was therefore to compare the amount of soluble salts that had accumulated in the profiles of a Hutton (Ferralsol) soil form in adjacent fields that had been under sprinkler, basin and drip irrigation systems for the past 15 years. A field where crops were grown under rain fed conditions over the same period was used as control. Top soil (0-10 cm) and subsoil (10-20 cm) samples were collected with an auger and analyzed for soluble salts, pH and EC.

The ANOVA showed significant influence ($P < 0.05$) of both irrigation systems and soil depth on the amount of soluble salts, pH and EC of the soils. The irrigation systems significantly increased ($P < 0.05$) Irrigation significantly increased ($P < 0.05$) the salt concentration (mg/kg) within the profile compared to the control for Ca (792 vs 464), Mg (398 vs 196), K (274 vs 164), Na (19.3 vs 9.8), pH (7.13 vs 6.3) and EC (22.1 vs 7.9 mS/m). This observation was consistent in both the top (0-10 cm) and sub (10-20 cm) soil depths. There were significant differences ($P < 0.05$) among the irrigation systems with respect to the distribution of the salts within the profile. Except for Na, the concentration of the other salts (Ca, Mg, K) was higher in the top than subsoil layers while the pH and EC were not significantly different. Basin irrigation had consistently accumulated highest amounts of Na, Mg, K and Na followed by drip and sprinkler systems. The pattern for pH and EC was basin>drip>sprinkler>control. Sprinkler irrigation was the only system which showed increased pH and EC at the 10-20cm depth compared to 1-10 cm depth. A comparison with municipal thresholds indicated that the levels of sodium under basin system were nearing the safe tolerable limits.

It was concluded that the irrigation systems are affecting the soil quality and points to the need for proper monitoring of the quality of water being used and strict adherence to good irrigation management practices especially appropriate irrigation scheduling. The use of soil amendments, especially animal manure, to improve the structure of the soil is also necessary.

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