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Research Article

# Effect of Saline Water on Physicochemical Properties of Soil Used in Plastic Nursery Bags of Three Months Olive Sprouted Cuttings under Tunnel Conditions

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**Abstract**

The quality of irrigation water has the potential to significantly affect soil structural properties. The study was carried out at NARC Islamabad during August, 2017 to October, 2017 to investigate the effect of saline water on the soil characteristics as well as ionic concentrations in 4 olive varieties i.e. Uslo, Coratina, Carolea and Moraila having 3 months sprouted olive cuttings under different saline water treatments in tunnel. Six levels of saline water were artificially developed (ECw=0,2,4,6,8,10dSm-1). Completely randomized design was applied with three replications. Olive cuttings were irrigated with six saline water three times in a week. Results of this study indicated that soil pH was mentioned no differences with saline water irrigations among three olive varieties. However minute changes in soil pH were noted. Soil ECe was increased as well as the salinity of irrigation water was increased. Soil Na determined increasing trend as the salinity of irrigation water increased. Decreasing trend in soil K was noticed against the increasing of salinity levels by saline irrigation waters. Soil Ca+Mg described the increasing behavior as the salinity of irrigation water increased. $Na^+$ in leaf olive tissues showed increasing behavior as the salinity of irrigation water increased. No difference was observed among three olive varieties. In leaf olive tissues showed increasing trend as the salinity of irrigation water increased. But the increasing trend is very minute as compared to the increase in $Na^+$.

**Keywords:** Uslo; Coratina; Carolea; Moraila olive varieties; Saline water and soil characteristics and ionic concentration

## Introduction

Saline irrigation water contains dissolved substances known as salts. Salinization is one of the most serious types of land degradation as well as and a major obstacle to the optimal utilization of land resources [1]. Approximately 952 million ha are estimated to be salt affected and this area is increasing year after year all over the world [2]. Soil salinity (electrical conductivity: EC>4 $dSm^{-1}$) is a major abiotic stress which limits plant growth and development, causing yield loss in crop species [3]. Salt-affected soils are identified by excessive levels of water-soluble salts, especially sodium chloride (NaCl) [4]. Salinity is causing decline in soil productivity and crop yield which results in severe degradation. Olive is considered moderately tolerant to salinity [5], although the response of plants to saline stress is a genotypic dependent characteristic [6,7]. However, tolerance to NaCl in olive is mostly related to the salt exclusion mechanism at the root level, which prevents sodium (Na+) accumulation in leaf tissue as well as the ability of the olive to maintain an essential potassium (K+)/ Na+ ratio [6]. Indiscriminate flood irrigation with poor drainage facilities, deep plowing of marginal and naturally saline soils, overexploitation of groundwater, recycling of drainage outflows for irrigation, and mono-cropping of high water consumptive crops are the major factors accelerating secondary soil salinization in Mediterranean regions and in Central Asia [8].

Salinity is a major abiotic stress limiting growth and productivity of plants in many areas of the world due to increasing use of poor quality of water for irrigation and soil salinization. One of the most detrimental effects of salinity stress is the accumulation of Na+ and Cl- ions in tissues of plants exposed to soils with high NaCl concentrations. Entry of both Na+ and Cl- into the cells causes severe ion imbalance and excess uptake might cause significant physiological disorder(s). High Na+ concentration inhibits uptake of K+ ions which is an essential element for growth and development that results into lower productivity and may even lead to death [9]. Secondary salinization is the consequence of a not optimal irrigation water management and of the use of saline water for irrigation. This problem is particularly critical in arid and semi-arid regions where total water availability is limited and good quality water is addressed to high-valued uses, and thus poor quality waters, including wastewaters [10,11]. Salinity stress represents a worldwide increasing environmental problem for crop production [12]. Cracked green "seasoned" Manzanilla is a table olive specialty that is progressively gaining the favor of consumers and increasing its production, which reached 7,000,000kg in 2005/2006 season [13]. Olive trees are mainly grown in semiarid regions with Mediterranean climate, where scarce and irregular rainfall causes low yields. Around the Mediterranean Basin, olive trees have been traditionally cultivated in dry lands. However, the water demand for irrigation is increasing in olive orchards, because of enhanced yields and profits [14].

## Material and Methods

The quality of irrigation water has the potential to significantly affect soil structural properties. The study was carried out at NARC Islamabad during August, 2017 to October, 2017 to investigate the effect of saline water on the soil characteristics as well as ionic concentrations in 4 olive varieties i.e. Uslo, Coratina, Carolea and Moraila having 3 months sprouted olive cuttings under different saline water treatments in tunnel. Six levels of saline water were artificially developed (ECw=0,2,4,6,8,10dSm$^{-1}$). Completely randomized design was applied with three replications. Olive cuttings were irrigated with six saline water three times in a week.

## Results and Discussions

### Effect of saline water on physicochemical properties of soil

**Table 1:** Effect of saline water on physicochemical properties of soil.

| Treatments | Soil pH | | | | Soil ECe (dSm$^{-1}$) | | | | Soil Na (meql$^{-1}$) | | | | Soil K (meql$^{-1}$) | | | | Soil Ca+Mg (meql$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | V1 | V2 | V3 | V4 | V1 | V2 | V3 | V4 | V1 | V2 | V3 | V4 | V1 | V2 | V3 | V4 | V1 | V2 | V3 | V4 |
| T1 | 7.03 | 7.03 | 7.50 | 7.50 | 0.29 | 0.29 | 0.345 | 0.34 | 13.7 | 13.7 | 4.0 | 4.0 | 2.1 | 2.1 | 3.4 | 3.4 | 6.4 | 6.4 | 3.0 | 3.0 |
| T2 | 7.69 | 7.69 | 7.80 | 7.80 | 0.70 | 0.70 | 0.494 | 0.49 | 33.6 | 33.6 | 7.3 | 7.3 | 7.1 | 7.1 | 2.1 | 2.1 | 3.6 | 3.6 | 2.0 | 2.0 |
| T3 | 7.91 | 7.91 | 7.96 | 7.96 | 1.19 | 1.19 | 0.616 | 0.62 | 22.1 | 22.1 | 9.3 | 9.3 | 3.6 | 3.6 | 3.9 | 3.9 | 3.6 | 3.6 | 5.0 | 5.0 |
| T4 | 8.10 | 8.10 | 8.10 | 8.10 | 1.99 | 1.99 | 1.14 | 1.14 | >50 | >50 | >50 | >50 | >50 | >50 | >50 | >50 | 2 | 2.0 | 2.0 | 2.0 |
| T5 | 8.25 | 8.25 | 8.26 | 8.26 | 1.23 | 1.23 | 1.23 | 1.23 | 29.6 | 29.6 | 27.6 | 27.6 | 6.4 | 6.4 | 5.9 | 5.9 | 2.2 | 2.2 | 1.4 | 1.4 |
| T6 | 8.47 | 8.47 | 7.55 | 7.55 | 1.11 | 1.11 | 2.93 | 2.93 | 30.0 | 30.0 | 6.0 | 6.0 | 6.1 | 6.1 | 4.4 | 4.4 | 2.4 | 2.4 | 1.6 | 1.6 |

Before Plantation Soil pH=7.61, Soil ECe (dSm$^{-1}$)=0.194, Soil Na (meql$^{-1}$)=1.0, Soil K (meql$^{-1}$)=2.4 Soil Ca+Mg (meql$^{-1}$)=1.8.

Data regarding soil pH was mentioned in (Table 1) showing no differences with saline water irrigations to three olive varieties. However minute changes in soil pH were noted. Soil ECe mentioned in (Table 1) indicating variations among treatments of using saline water as irrigations but among olive varieties no difference was observed. Soil ECe was increases as well as the salinity of irrigation water was increased. Soil Na data was presented in (Table 1). Soil Na explained the increasing behavior as the salinity of irrigation water increased. No difference was observed among three olive varieties. Soil K was influenced by saline water application in this study (Table 1). Decreasing trend was noticed against the increasing of salinity levels of saline irrigation waters. Soil Ca+Mg described the increasing behavior as the salinity of irrigation water increased. No difference was observed among three olive varieties (Table 1). Saline irrigation water contains dissolved substances known as salts. Salinization is one of the most serious types of land degradation as well as and a major obstacle to the optimal utilization of land resources [1].

### Ionic concentration in olive leaf tissues

$Na^+$ in leaf olive tissues showed increasing behavior as the salinity of irrigation water increased. No difference was observed among three olive varieties (Table 2). $K^+$ in leaf olive tissues showed increasing trend as the salinity of irrigation water increased. But the increasing trend is very minute as compared to the increase in Na+. However no difference was noticed among three olive varieties (Table 2). However, tolerance to NaCl in olive is mostly related to the salt exclusion mechanism at the root level, which prevents sodium ($Na^+$) accumulation in leaf tissue as well as the ability of the olive to maintain an essential potassium (K+)/Na+ ratio [6]. One of the most detrimental effects of salinity stress is the accumulation of Na+ and Cl− ions in tissues of plants exposed to soils with high NaCl concentrations. Entry of both Na+ and Cl− into the cells causes severe ion imbalance and excess uptake might cause significant physiological disorder(s). High Na+ concentration inhibits uptake of K+ ions which is an essential element for growth and development that results into lower productivity and may even lead to death [9].

## Conclusion

This study concluded that soil pH was showed a minute change. Soil ECe was increased as well as the salinity of irrigation water was increased. Soil Na determined increasing trend as the salinity of irrigation water increased. Decreasing trend in soil K was noticed against the increasing of salinity levels by saline irrigation waters. Soil Ca+Mg described the increasing behavior as the salinity of irrigation water increased. Na+ in leaf olive tissues showed increasing behavior as the salinity of irrigation water increased. No difference was observed among three olive varieties (Table 2). $K^+$ in leaf olive tissues showed increasing trend as the salinity of irrigation water increased. But the increasing trend is very minute as compared to the increase in $Na^+$.

**Table 2:** Leaf Analysis before the conductance of the experiment and after the harvest of the experiment.

| Treatments | Leaf Na (meql$^{-1}$) | | | | | | | | Leaf K (meql$^{-1}$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | V1 | | V2 | | V3 | | V4 | | V1 | | V2 | | V3 | | V4 | |
| | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After | Before | After |
| T1 | 1.3 | 1.3 | 1.2 | 1.1 | 1.4 | 1.2 | 1.1 | 1.1 | 6.5 | 8.3 | 5.9 | 8.0 | 6.2 | 8.8 | 6.0 | 9.2 |
| T2 | 1.2 | 2.5 | 1.2 | 2.6 | 1.1 | 2.8 | 1.3 | 2.7 | 6.2 | 8.7 | 6.0 | 8.3 | 6.2 | 8.0 | 6.0 | 8.9 |
| T3 | 1.1 | 3.9 | 1.3 | 3.7 | 1.2 | 3.9 | 1.2 | 4.1 | 5.9 | 7.9 | 5.9 | 7.9 | 5.7 | 8.2 | 5.8 | 7.8 |
| T4 | 1.4 | 4.9 | 1.2 | 5.1 | 1.1 | 5.2 | 1.1 | 5.4 | 6.1 | 8.1 | 6.1 | 8.0 | 6.2 | 8.3 | 6.3 | 9.4 |
| T5 | 1.1 | 8.1 | 0.9 | 8.4 | 1.0 | 8.6 | 0. 8 | 8.8 | 6.6 | 8.4 | 6.6 | 8.2 | 6.6 | 8.2 | 6.1 | 8.3 |
| T6 | 1.2 | 9.9 | 1.0 | 10.1 | 0.9 | 10.2 | 1.2 | 10.4 | 6.0 | 8.7 | 6.0 | 8.5 | 6.0 | 8.5 | 6.2 | 8.6 |

T1=ECw=0dSm$^{-1}$, $T_2$=ECw=2dSm$^{-1}$, $T_3$=ECw=4dSm$^{-1}$, $T_4$=ECw=6dSm$^{-1}$, $T_5$=ECw=8dSm$^{-1}$, $T_6$=ECw=10dSm$^{-1}$,
V1=Uslo, V2=Coratina, V3=Carolea, V4=Morailo.

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