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Impact of Saline Water on Growth of Olive Varieties in Tunnel

Muhammad Arshadullah[1*], Syeda Sana Aamir[1], Bilal Adil[2], Hussnain Haider[2], Imdad Ali Mahmood[1], Badar-uz-Zaman[1], Syed Ishtiaq Hyder[1], Abdul Sattar Anjum[1]

[1]National Agricultural Research Centre, Park Road, Islamabad-45500, Pakistan

[2]Institute of Soil Sciences, University of Arid Agriculture, Rawalpindi, Punjab, Pakistan

Corresponding Author:** ***Muhammad Arshadullah, *National Agricultural Research Centre, Park Road, Islamabad-45500, Pakistan*

Abstract: *The study was carried out at NARC Islamabad during August, 2017 to October, 2017 to investigate the impact of salinity on growth 4 olive varieties i.e. Uslo, Coratina, Carolea and Moraila having 3 months sprouted olive cuttings under different saline water in tunnel. Six levels of saline water artificially developed (ECw= 0,2,4,6,8,10 dSm^{-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 Cortiana Olive variety attained the highest values in stem diameter, root fresh weight, root dry weight and stem dry weight growth parameters while Carolea Olive variety attained the best in roots dry weight, leaf fresh weight, leaf dry weight, shoot fresh weight, shoot dry weight and leaf area under the irrigation of different saline water. Chlorophyll contents were the highest in Uslo olive variety in all saline water application.*

Keywords: *Uslo, Coratina, Carolea , Moraila olive varieties , saline water and olive growth*

1. INTRODUCTION

Salinity is one of the most important environmental factors, limiting crop production in arid and semi-arid regions (Sepaskhah and Yarami, 2010). The deleterious effects of salinity on plant growth are associated with low osmotic potential of soil solution (water stress), nutritional imbalance, specific ion effect (salt stress), or a combination of these factors (Ashraf, 1994; Marschner, 1995). Toxicity of Na^+ in metabolic processes results from its ability to compete with K^+ for binding sites and to inactivate enzymes and essential cellular functions and, consequently, crops growing in saline soils may suffer the dual injury of Na+ toxicity and low K^+ concentrations (Munns and Tester, 2008). For most plants to tolerate salinity, Na+ and Cl^- uptake must be restricted while maintaining the uptake of macro nutrients such as K+, NO_3^- and Ca^{2+} (Tavakkoli *et al.*, 2011).

Irrigated olive orchards have expanded in the last decades in many areas of the world and in particular in the Mediterranean region, where 98 % of the world's olive oil is produced. An increasing proportion of these orchards is being irrigated with low-quality waters due to the growing competition of freshwater by other users, population growth and climate change (Cimato *et al.* 2010; Chartzoulakis, 2005). Due to the expansion of olive orchards irrigated with saline waters, a proper knowledge of response of olive to salinity is essential. However, existing data on the effects of salinity on growth and yield of olive are scarce, especially for long-term experiments under field conditions (Aragüésetal. 2005; Cimato *et al.* 2010; Gucci and Tattini 1997; Melgar *et al.* 2009; Wiesman *et al.* 2004).

Olive is considered moderately tolerant to salinity, with threshold ECe values (dS m^{-1}) that vary among authors: 4-6 (Bernstein 1964), 3-6 (Maas and Hoffman 1977), 1.2-2.5 (Hassan *et al.* 2000), 2.7 (Soltanpour and Follet 2001), and 4.0 (Aragüés *et al.* 2004). Based on the absolute slope of the response functions, Aragüés *et al.* (2004) provided a value of 12% for the growth of young olive, whereas Hassan *et al.* (2000) reported values from 3.4% to 5.2% for fruit yield of three olive cultivars. These authors also concluded that vegetative growth was more tolerant to salinity than fruit yield production.

Melgar *et al.* (2009) reported that mature trees of the tolerant cultivar Picual drip-irrigated under Mediterranean climate (mean annual precipitation around 700 mm) allowed using high saline

irrigation waters (up to 10 dS m^{-1}) for a long time (nine years) without affecting growth and yield. Winter leaching by rainfall of the salts accumulated in the root zone during the irrigation seasons was the main reason for the absence of negative effects with such high saline waters. This result clearly shows that the establishment of the salinity tolerance of olive (or any other crop) should be based on root zone soil salinity rather than irrigation water salinity. It has been reported that under salinity conditions, excessive accumulation of ions in the cytoplasm or chloroplast of mesophyll cells reduces the photosynthesis rate (Dubey, 2005).

The use of saline water for irrigation requires an adequate understanding of how salts affect soil characteristics and plant performance (Chartzoulakis *et al.* 2002). According to the incapacity to grow on high salt medium, plants have been classified as glycophytes or halophytes. Most plants are glycophytes and cannot tolerate salt stress (Parvaiz and Satyawati 2008). Consequently, salinity is an ever-present threat to agriculture, especially in areas where secondary salinization has developed through irrigation (Flowers and Flowers 2005). The deleterious effects of salinity on plant growth are associated with: (1) low osmotic potential of soil solution (water stress); (2) nutritional imbalance; (3) specific ion effect (salt stress) or (4) a combination of these factors. During the onset and development of salt stress within a plant, all the major processes such as photosynthesis, protein synthesis and energy and lipid metabolisms are affected. The earliest response is a reduction in the rate of leaf surface expansion followed by cessation of expansion as the stress intensifies but growth resumes when the stress is relieved (Parvaiz and Satyawati 2008). Hence, an effective way to use saline lands should be found by the cultivation of tolerant cultivars or other agro techniques (Tabatabaei, 2006). Attempts to improve the salt tolerance of crops have met with very limited success, due to the complexity of the trait, both genetically and physiologically influenced (Flowers and Flowers 2005). The objective of this work was to evaluate the response of olive plant growth.

2. Material and Methods

The study was carried out at NARC Islamabad during August, 2017 to October, 2017 to investigate the impact of salinity on growth of 3 months sprouted olive cuttings of 4 olive varieties i.e. Uslo, Coratina, Carolea and Moraila under different saline water in tunnel. Six levels of saline water artificially developed (ECw= 0,2,4,6,8,10 dSm^{-1}). Completely randomized design was applied with three replications. Olive cuttings were irrigated with six saline water three times in a week.

3. Results and Discussions

3.1. Saline Water on Olive Growth

Table-1 showed results of stem diameter affected by different saline waters within three olive varieties. Overall Coratina olive variety gained the highest stem diameter (8.56mm) with the irrigation of different levels of saline water.

Olive roots fresh weight was also affected by different saline waters within three olive varieties as indicated in table-1. However, Coratina olive variety gained the highest roots fresh weight (0.83gm) with the irrigation of different levels of saline water.

Saline water irrigation influenced the Olive roots dry weight was of three olive varieties as mentioned in table-1. Carolea olive variety gained the highest roots dry weight (0.21gm) under the irrigation of different levels of saline water.

Olive varieties and saline water irrigation inclined the Olive stem fresh weight (table-1). Coratina olive variety attained the top position in the stem fresh weight (20.05gm) irrigating the olive plants with different levels of saline water.

Olive stem dry weight of three olive varieties was differed with utilization of different saline water as shown in table-1.Highest olive stem dry weight (12.36gm) was attained by Coratina olive variety under irrigation by different levels of saline water.

Data indicated in table-2 regarding olive leaf fresh weight described the effects of saline water irrigations. Highest olive leaf fresh weight (2.51 gm) was received with Carolea olive variety by irrigation of different levels of saline water.

Data presented in table-2 related to olive leaf dry showed the influences of saline water irrigations. Carolea olive variety gained the highest olive leaf dry weight (1.06 gm) under irrigation of different levels of saline water.

Data regarding effect on olive shoot fresh weight by saline water was mentioned in table-2. Carolea olive variety gained the maximum olive shoot fresh weight (1.15 gm) under irrigation of different levels of saline water**.**

Olive shoot dry weight influence by saline irrigations was observed in table-2. Overall, Carolea olive variety attained the upper limit of olive shoot dry weight (0.49 gm) for different levels of saline water irrigation.

Chlorophyll contents parameter in plant growth is the main due to photosynthesis process. Chlorophyll contents data was presented in table-2 showing variation among treatments. However, the highest chlorophyll contents (77.40%) were measured by Uslo olive variety with the treatments of saline waters.

Leaf area in plant is the detrimental factor in plant growth as well as in fruit development. Leaf area data was presented in table-2 describing variation among treatments and olive varieties. Resultantly the highest leaf area (26.61cm^2) was measured by Carolea olive variety with the saline water irrigations.

Table1. *Impact of brackish water on stem diameter, stem fresh weight, stem dry weight, Root fresh weight and Root dry weight of olive plants*

Treatments	Stem Diameter (mm)				Stem Fresh Weight(g)				Stem Dry Weight(g)				Root Fresh Weight(g)				Stem Dry Weight(g)			
	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4
T1	4.67	6.81	7.32	8.64	0.61	0	0	1.17	0.20	0	0	0.30	6.42	4.06	4.70	5.75	3.62	2.0	2.01	3.08
T2	6.88	6.76	7.11	6.32	0.22	0.64	0	0.42	0.07	0.15	0	0.12	10.06	4.04	5.98	4.21	4.93	2.08	2.73	2.90
T3	4.72	6.55	4.44	7.11	0.44	0.65	0.19	0.22	0.13	0.19	0.05	0.09	3.50	2.68	6.16	5.50	1.58	1.09	3.60	2.88
T4	5.76	7.91	6.76	6.74	0.55	2.10	0	0.39	0.22	0.62	0	0.06	5.21	8.24	4.36	9.40	3.0	4.60	2.13	4.40
T5	7.61	6.11	5.89	7.89	0.10	0	0	0.24	0.03	0	0	0.09	5.34	6.84	9.78	7.12	3.75	2.68	4.63	3.67
T6	6.86	5.59	6.11	5.57	0.50	0.16	0	0.43	0.16	0.05	0	0.10	4.84	9.34	10.05	5.13	2.45	5.31	7.68	2.68

V1= Coratina V2= Leccino V3 =Nocellera V4=Frontoio

Table2. *Impact of brackish water on leaf fresh weight, leaf dry weight, Shoot fresh weight, Shoot dry weight, Chlorophyll contents and leaf area of olive plants*

Treatments	Leaf Fresh Weight(g)				Leaf Dry Weight(g)				Shoot Fresh Weight(g)				Shoot Dry Weight(g)				Chlorophyll Contents (%)				Leaf Area Cm^2)			
	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4
T1	1.29	0.36	0	2.78	0.27	0.09	0	1.58	0	0	0	1.18	0	0	0	0.31	48.1	57.9	0	67.7	19.142	21.521	0	21.586
T2	0.78	1.24	0	1.26	0.24	0.32	0	0.56	0	1.02	0	0.65	0	0.33	0	0.27	55.8	61.2	0	69.3	21.664	23.641	0	19.231
T3	1.43	2.43	0.57	1.94	0.51	1.00	0.21	0.65	0.59	1.32	0.36	0.40	0.10	0.54	0.12	0.12	68.5	50.3	39.1	68.4	16.548	17.423	18.542	17.632
T4	0.92	4.36	0	1.80	0.37	1.91	0	0.71	0	2.76	0	0.42	0	1.09	0	0.12	49.7	70.2	0	57.9	19.547	23.721	0	20.745
T5	0.30	0.88	0	1.96	0.09	0.33	0	1.05	0	0.60	0	0.24	0	0.23	0	0.10	59.2	45.1	0	60.1	20.448	24.641	0	23.965
T6	0.93	1.43	0	0.80	0.40	0.53	0	0.32	0	0	0	0.91	0	0	0	0.39	54.3	47.7	0	62.8	20.632	22.117	0	22.342

V1= Coratina V2= Leccino V3 =Nocellera V4=Frontoio

4. CONCLUSION

This experiment concluded that Cortiana Olive variety attained the highest values in stem diameter, root fresh weight, root dry weight and stem dry weight growth parameters while Carolea Olive variety attained the best in roots dry weight, leaf fresh weight, leaf dry weight, shoot fresh weight, shoot dry weight and leaf area under the irrigation of different saline water.

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