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Effect Of Irrigation With Saline Water On Fibrous Root Growth Of Manzanillo And Picual Olive Cultivars.

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Abstract: The present investigation was conducted during the period 1994 - 1995. The objective of this experiment is to determine the annual pattern of root growth of young plants of Manzanillo and Picual cultivars. Uniform 5. month - old plants (orginally propagated by stem cutting) of two cultivars were grown in nursery of Faculty of Agriculture, Cairo University at Giza. Olive plants were planted in above-ground rhiziotrons. Plastic barrels rhizotrons were 50 cm in diameter and 90 cm depth were filled with sand and clay (8:1 by volume). Strogonov chloride mixture (1962) was used as the source of salinity. Linear extension of roots in each rhizotron was measured every 15 days. Samples were taken at the end of the experiment and the following properties were studied: Length of the fibrous root and wooden root per plant and dry weight of roots per plant. According to the obtained data it could be noticed that the presence of salts in root media depressed directly root growth. This result was true for both types of the studied roots, i.e fibrous roots (> 2mm) and non fibrous roots (< 2mm). Moreover, the degree of depression seems to be strongly dependant on the salt concentration. In this respect, control plants which received tap water recorded the longest roots, then a gradual significant decrease was detected by raising salt concentration, whereas 7000 ppm. disclosed the highest reduction compared to the other two salt treatments. Consequently, salinity had a restrictive effect on rate of root elongation. The dry weight of roots as affected by salinity stress on olive cultivars had similar trend to that of growth rate weight, whereas yield of plant dry weight progressively decreased by increasing salinity concentration in the irrigation water. Discussing the differences among the two studied cultivars, the obtained data generally showed that Manzanillo cv. produced the longest roots with the highest growth rate than Picual cv. Moreover, the effect of interaction between cultivar x salt concentration appeared, as a general trend, that Manzanillo cultivar at any salt concentration seemed to have longer fibrous roots than Picual cv.

Key words: saline water - fibrous root – growth and dry weight of roots

INTRODUCTION

Plant roots generally take up moisture by a type of osmosis through membranes in root cells. Osmosis is a natural process where water, passing through a semi-permeable membrane, moves from a solution of low levels of dissolved salts to one with a higher salt level. This process allows water to move from a solution of relatively low concentration (the irrigation water) into a solution of relatively high concentration (in the plant root cells) in an attempt to establish equilibrium in the two solutions.This continues until the plant cells become full, or turgid. If highly saline irrigation water is used, the process of osmosis can become reversed. Where the solution outside the plant roots is higher in salt concentration than that of the root cells, water will move from the roots into the surrounding solution.The plant loses moisture, and so suffers stress.This is why symptoms of high salt damage are similar to those from high moisture stress (ANCID/Sinclair Knight Merz, Armadale 2001)

El-Saidi *et al* (1988) worked on one year old olive seedlings cultivar Picual. The used salt concentrations in irrigations water, were 2000, 4000, 6000 and 8000 ppm. in addition to tap water as control, showed that total number, diameter, fresh and dry weight of roots were reduced by increasing salt concentration. This reduction in lower concentrations was insignificant, but at 8000 ppm. concentration reduction reached more than 30% in comparison with control.

Moreover, Hassan and Galal (1989) noticed that growth of shoot was less affected by salinity than roots of some citrus rootstocks. Alva and Syvertsen (1991) reported that root densities of citrus rootstocks were increased by high salinity. Root densities were higher in soil sampled under drippers than that sampled outward from drippers. High salinity irrigation water of citrus rootstocks increased total fibrous root dry weight (Duke *et al* 1986 and Syvertsen *et al* 1993).

Tursunov (1970) showed that salinity affected root system distribution of grapevine, so that the salt-affected vines seemed to have roots nearer to soil surface, fewer shorter shoots and roots as well as worse leaves.

El-Hawary (1987) reported that root density of grapevine was decreased under saline conditions (NaCl and CaCo3). Al-Saidi and Alawi, (1984), Abou Rayya *et al*., (1988) showed that root system of grapevine was

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affected by irrigation with saline water. The difference among differnt treatments were obvious in comparsion with the control. The most clear difference was that of the treatmet in which 3000 ppm. was given where the reduction in root weight (fresh and dry), total number of roots and percentage of roots more and less than 2mm in diameter was very clear.

The number and length of roots of differnce apple stocks were greatly affected by salinity. The decrease in density of the absorbent roots (roots less than 1mm in diameter) was more evident than that in the transferable (1-3 and 3-5 mm) and main (75 mm) roots. Moreover, increasing the level of salt in the root medium reflected on root growth and root branching. Therefore, the weakness in the growth and development of shoot system by increasing salinity level is mainly due to the potential collapse in root system induced by salinity bad-affect (Sweidan *et al*, 1992).

Shahin, (1989) on plum rootstocks, found that salt treatments decreased roots number and lengths of feeding and growing roots especially at the highest levels of NaCl (3000 and 4000 ppm.) Moreover, Marianna rootstock recorded the highest decrease. Kassimet *et al* (1992) studied the effect of saline irrigation on root system growth of pomegranate seedlings. Root system and its characteristics were not affected significantly by irrigation with saline water up to 2000 ppm. but the highest salt concentrations 3000 and 4000 ppm. significantly reduced the total number, diameter, fresh and dry weight of roots.

The influence of salinity on root system growth of guava hybrids was investigated by Salem *et al*. (1991), who reported that salinity condition caused a marked depression in the number of roots formed per plant. The fresh and dry weights of root system of different guava genotype decreased significantly by increasing the level, of sodium chloride Moreover, the degree of depression seems to be strongly depends on salt concentration

MATERIALS AND METHODS

The present investigation was conducted during the period 1994 - 1995.

The objective of this experiment is to determine the annual pattern of root growth of young plants of Manzanillo and Picual cultivars.

Uniform 5. month - old plants (orginally propagated by stem cutting) of the two cultivars were grown in nursery of Faculty of Agriculture, Cairo University at Giza. Olive plants were planted in above-ground rhiziotrons. Plastic barrels rhizotrons were 50 cm in diameter and 90 cm depth were filled with sand and clay (8:1 by volume). Three rhizotrons replicates were included in each treatment. Strogonov chloride mixture (1962) was used as the source of salinity. The mixture of salt was expressed as percentage of the total salt content.

Table 1: Contents of Strogonor chloride mixture.

$MgCl_2$	$CaCo_3$	$MgSo_4$	NaCI
2gm	10 gm	10 gm	78 gm

Salt concentrations in irrigation water were 3000, 5000, 7000 ppm. in addition to tap water as control. The irrigation was carried out three times/

week during the summer and twice in the winter. The quantity of water in each irrigation time was 4 liters. The nutrition occurred by spraying plants with Greenzed at concentration of 1mm / Litre.

Linear extension of roots in each rhizotron was measured every 15 days.

Root growth was recorded by tracing root with an indelible marking pen on clear plastic sheets that were placed over the viewing face.

Growth rate for roots of a given plant was computed with the following formula:

Mean linear growth for roots (mm/day) = $\frac{\text{total growth}}{no.days}$

where total growth = the total growth of all measured roots in mm. since the last measurement, and no. days = the number of days since the last measurements were taken. Standard horticultural management (Fertilization, irrigation) were applied.

Samples were taken at the end of the experiment and the following properties were studied:

1- Length of the fibrous root and wooden root per plant.

2- Dry weight of roots per plant.

Statistical Analysis Procedure:

All data were subjected to statistical analysis according to procedures reported by Snedecor and Cochran (1972). Treatments means were compared by the least Significant Difference test (L.S.D.) at the 5% level of probability of experimentation.

RESULTS AND DISCUSSION

According to data presented in Table (2) it could be noticed that the presence of salts in root media depressed directly root growth. This result was true for both types of the studied roots, i.e fibrous roots (> 2mm) and non fibrous roots (< 2mm).

Moreover, the degree of depression seems to be strongly dependant on the salt concentration. In this respect, control plants which received tap water recorded the longest roots, then a gradual significant decrease was detected by raising salt concentration, whereas 7000 ppm. disclosed the highest reduction compared to the other two salt treatments. Consequently, salinity had a restrictive effect on rate of root elongation.

This conclusion was also recorded by El - Saidi *et al*. (1988) on olive; Abou Rayya *et al*. (1988) on grapevine ; Shahin (1989) on plum,and Sweidan *et al*. (1992) on apple.

Discussing the differences among the two studied cultivars, the obtained data generally showed that Manzanillo cv produced the longest roots with the highest growth rate than Picual cv. Moreover, the effect of interaction between cultivar x salt concentration appeared, as a general trend, that Manzanillo cultivar at any salt concentration seemed to have longer fibrous roots than Picual cv.

Dealing with the effect of date of observation, it was found that rate of root growth gradually decreased by extending the period of irrigation with saline solution from Sep. 1994 up to Jan. 1995 and from Feb, 1995 to May 1995. The effect of different interactions showed a significant differences,

Table 2: Root length (m) of two olive cultivars as affected by salinity treatment

Cultivars (A)	Salt Concentrations ppm (B)	Root System	
		Fibrous root (> 2 mm)	Non Fibrous root (< 2 mm)
Manzanillo	0 (control)	55.80	2.80
	3000	26.60	1.50
	5000	19.60	1.40
	7000	10.60	110
Ave. (A)		28.20	1.70
Picual	0 (control)	31.20	2.50
	3000	18.70	2.00
	5000	9.70	1.10
	7000	5.60	1.40
Ave. (A)		16.30	1.80
Ave (B)	0 (control)	43.50	2.70
	3000	22.70	1.80
	5000	14.70	1.80
	7000	8.10	1.80

L.S.D. at 5% for : Cultivars (A) 3.38 N. S
Concentration (B) 4.8 0.52
Interaction (A × B) 6.8 N. S

Table 3: Growth rate (cm/month) of fibrous roots of two olive cultivars as Affected by salinity treatments.

Cultivars (A)	Salt Concentrations ppm (B)	Dates (C)										Ave. (A × B)
		Sep. 1994	Oct. 1994	Nov. 1994	Dec. 1994	Jan. 1995	Feb. 1995	Mar. 1995	Apr. 1995	May. 1995		
Manzanillo	0 (control)	21.00	19.90	14.80	1.50	1.70	32.20	17.10	15.90	7.00		14.57
	3000	5.00	0.80	9.10	2.30	2.00	17.00	15.60	5.80	1.40		6.56
	5000	6.00	0.70	0.70	0.00	0.70	2.77	1.50	0.30	2.20		1.65
	7000	3.40	0.00	1.00	0.00	1.00	0.50	2.00	0.33	1.20		1.05
Ave. (A × C)		8.85	5.35	6.40	0.95	1.35	13.12	9.05	5.58	2.95	Ave.(A)	5.96
Picual	0 (control)	15.60	13.40	8.70	5.00	1.20	9.90	2.80	4.10	3.20		7.10
	3000	14.10	15.80	4.50	4.90	2.20	8.30	2.40	2.80	1.20		6.24
	5000	3.30	2.40	3.40	1.90	1.80	2.10	1.94	1.80	1.20		2.20
	7000	3.00	0.90	0.00	0.22	0.30	0.70	1.30	1.20	0.70		0.92
Ave. (A × C)		9.00	8.12	4.15	3.01	1.38	5.25	2.11	2.22	1.57	Ave.(A)	4.09
Ave. (B × C)	0 (control)	18.30	16.65	7.90	3.25	1.45	21.05	9.95	10.00	5.10		10.40
	3000	9.55	8.30	6.80	3.60	2.10	12.65	9.00	4.30	1.30	Ave. (B)	6.40
	5000	4.65	1.55	2.05	0.95	1.25	2.43	1.72	1.05	1.70		6.35
	7000	3.70	0.45	0.50	0.11	0.65	0.60	1.65	0.76	0.95		1.04
Ave. (C)		8.92	6.73	5.27	1.98	1.37	9.18	5.58	3.90	2.26		

L. S. D. at 5% for : Cultivars (A) 1.54 Interaction (A × B) 3.31
Salt concentration (B) 2.34 Interaction (A × C) 2.95
Date (C) 2.08 Interaction (B × C) 4.17
Interaction (A × B× C) 5.90

Table 4: Dry weight (gm) of Manzanillo and Picual olive cultivars Root as affected by salinity treatment.

Cultivars (A)	Salt Concentrations ppm (B)	Root System	
		Fibrous root (> 2 mm)	Non Fibrous root (< 2 mm)
Manzanillo	0 (control)	42.60	78.70
	3000	18.10	98.10
	5000	14.10	72.80
	7000	11.70	35.10
Ave. (A)		21.60	71.20
Picual	0 (control)	23.60	113.90
	3000	20.70	38.00
	5000	17.40	31.80
	7000	12.90	22.30
Ave. (A)		18.70	51.50
Ave (B)	0 (control)	33.10	96.30
	3000	15.80	52.30
	5000	12.30	28.70
	7000	8.10	1.80

L.S.D. at 5% for :	Cultivars (A)	N. S	8.90
	Concentration (B)	4.80	12.90
	Interaction (A × B)	6.90	17.8

The root length and growth rate of the two cultivars were evidently reduced than the control (Table 3).

The weight of roots as affected by salinity stress and olive cultivars is presented in Table (4). In general, similar trend to that of growth rate was followed by plant dry weight, whereas yield of plant dry weight progressively decreased by increasing salinity concentration in the irrigation water.

Data in (Table 4) show that all salt treatments yielded less root dry weight than the control. Moreover, the degree of depression seemed to be dependant on salt concentration, since at the maximum concentration of salt, 7000 ppm, the yield of root dry matter reached about 30 to 37 % of the control.

Therefor, it could be conclude that salinity condition decrease the dry matter of roots. The magnitude of depression was more obvious in higher salt concentration. The same pattern of response to salt application was also referred to by El-Saidi. *et al*. (1988) and Bartolini et a. (1992) on olive; Al - Saidi and Alawi, (1984) and Abou Rayya *et al* (1988) on grapevine ; Salem *et al*. (1993) on guava and Kassim (1992) on pomegranate, since they mentioned that increasing salinity reduced shoot and root growth parameters.

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