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Vegetative Growth and Ions Accumulation of Olive (*Olea europaea* Cv. Dezfol) Under Salinity Stress

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ABSTRACT: A study was conducted to determine the salt tolerance of "Dezful" olive and its effects on vegetative growth and ions accumulation (Na, Cl, K). The results indicated that increasing salinity level caused a decrease in shoot length, leaf area, shoot dry weight that were not significantly different at 5% level, DNMRT but at 200 mM salinity, leaf number difference and leaf chlorophyll content influenced significantly. Increasing of salinity level caused an increase in Na and Cl but a decreased in K:Na ratio in leaf, shoot and root. Sodium concentration was higher in the roots whereas Cl accumulation was higher in aerial parts.

Keywords: Olive, Salinity, Ion, Growth, Dezful

INTRODUCTION

Olive is native to the Mediterranean region, tropical and central Asia and various part of Africa. The olive, (*Olea europea*) is one of the oldest cultured trees that belong to the oleracea family. The growth and yield of most crop plants are highly sensitive to changes in the environment. Salinity is an important environmental stress for some plants. Soil salinity is a serious problem in arid and semiarid climates. Such as in the Mediterranean region, where plants are subjected to high temperature regimes and extreme water deficits during the dry season. Salinity is one of the main factors limiting crop productivity (Staples *et al.,* 1984). Olive is a glycophytic species that have intermediate tolerance to salinity. Several studies have shown that olive is more tolerant than other fruit trees (Bartolini, *et al.,* 1991, Tattini *et al.,* 1992). Tattini *et al.,* 1995). Previouse studies explained that Frantoio and Leccino cultivars had a different capacity to exclude Na^+ and Cl^- ions frome the shoot when NaCl was applied to the root zone (Tattini,1992).

MATERIALS AND METHODS

The present study was conducted in one-year old rooted cutting of olive cv "Dezful" that had been carried to glasshouse of horticulture department of Shiraz university -Iran to determine the salt tolerance of this plants and effect of salinity on vegetative growth and ions accumulation (Na, Cl and K). Culture medium has been changed with sterilization soil mix include ratio 1:1:1 of field soil: sand: leaf mold. For sterilization of medium we used high temperature then irrigated by 2% benomyle fungicide and 1% P.C.N.B. Irrigation was selected based on field capacity (F.C) by weight method in each pot.

The experiment was carried out in a completely randomized design (CRD) with factorial arrangements with four replications. Salinity levels applied were 0, 50, 100 and 200 mM NaCl that was added from third week till end of experiment. After 16 weeks of experiment time, different factors such as shoot height difference, leaf number difference, fresh and dry weight of root and shoot, root/shoot dry weight ratio, leaf area, content chlorophyll and concentration of Na, K and Cl in aerial (leaf, shoot) and roots of plants were determined.

At the end of experiment, data were analyzed using MSTATC computer software and mean were compared by statistical test. We considered differences significant at p values 0.05%.

RESULTS AND DISCUSSION

The results indicated that by increasing salinity level, leaf number decreased that was statistically significant ($p<0.05$) at 200mM salinity level (Table 1). Also decreasing of stem length and leaf area was observed that there was not statistically significant at all of the salinity levels at 5% level using DMRT. Several studies suggest that typical symptoms of salt stress in olive plants are reduced growth, leaf tip burn, leaf chlorosis, leaf rolling, witting of flowers, root necrosis, shoot die back and defoliation.

Necrotic areas develop first at the distal end of mature leaves and then expand to the rest of the leaf (Benlloch, *et al.,* 1991, 15). Leaf abscission occurs at high salt concentration, but it is not necessarily related to the appearance of visual symptoms, that is, abscising leaves may appear as green and healthy as those of untreated plants. The results are in agreement with the other studies and according to them, with increasing of salinity level, leaf chlorophyll content decreased. The decrease was statistically significant ($p<0.05$) at 100 and 200 mM salinity level (Table 1).

Tattini *et al* (1992) reported root morphology is also affected since root branching is inhibited under saline conditions. Tattini *et al* (1995) and Bongi and Loreto (1989) explained that shoot growth of olive is completely inhibited at NaCl concentrations higher than 200 mM (Bongi *et al.,* 1989, Tattini *et al.,* 1995). Although there is evidence that concentrations lower than 100mM NaCl seldom produce toxicity symptoms and salt-treated olive plants usually characterized by smaller size, smaller leaves, shorter internodes, decreased number of shoots and leaves and decreased leaf area (Bartolini *et al.*, 1991, Bongi and Loreto 1989, Tattini *et al.,* 1992, Therios *et al.*, 1988). Table 1 shows the effect of salinity on root, shoot and root/shoot dry weight ratio "Dezful" olives. It is well Known that dry weight of shoot and root was decreased with increased salinity level, however they were not significantly different at 5% level of probability, but root/shoot dry weight ratio increased. The result of this supports other studies shoot growth is generally more strongly inhibited that root growth (Klein *et al.,* 1994). The data are in agreement with results of Tattini *et al* (1992, 1995) that explained the root/shoot d.w ratio tends to increase in salt- stressed plants. It is a common.

Table 1: Effect of salinity treatments on vegetative growth indices in olive of Dezful cultivar.

Vegetative growth indices							
Salinity (mM)	**Leaf number difference (number)**	**Stem length difference (cm)**	**Leaf area(mm^2)**	**Leaf chlorophyll content (mg/gr leaf f.w)**	**Shoot dry weight(gr)**	**Root dry weight(gr)**	**Shoot/root d.w ratio**
0	†93.88abc	†15.25ab	†599.4abc	†1.478ab	†4.475abcde	†1.550a	†0.3402bc
50	54.75bcdefgh	14.5abc	48.8abcd	1.216bc	4.537abcde	1.450a	0.3800bc
100	37.75cdefghi	12.81abc	494.1Bcd	1.112cde	3.664cdef	1.587a	0.4472bc
200	27.38efghi	4.44abc	418.1bcd	0.965e	3.819abcdef	1.337a	0.3161bc

†Means in each column with the same letter are not significantly different at 5% level; DNMRT.

Table 2: Effect of salinity treatments on Ions accumulation in olive of Dezful cultivar.

Salinity (mM)	**Ions accumulation**					
	Leaf Na (mg/grdw)	**Shoot Na (mg/grdw)**	**root Na (mg/grdw)**	**Leaf K (mg/grdw)**	**Shoot K (mg/grdw)**	**Root K (mg/grdw)**
0	†1.88h	†3.57h	†7.92a	†0.6685a	†1.99ab	†0.43abcde
50	15.53defgh	22.52efgh	21.31bcde	0.4609abcde	0.973abcdef	0.40abcde
100	23.91cdefg	34.55defg	31.6abcd	0.3455de	0.768ef	0.35abcde
200	29.3bcde	45.93bcde	34.95abc	0.4615abcde	0.881bcdef	0.44abcde

†Means in each column with the same letter are not significantly different at 5% level; DNMRT.

Table 3: Effect of salinity treatments on Ions accumulation in olive of Dezful cultivar.

Salinity (mM)	**Ions accumulation**					
	Leaf Cl (mg/grdw)	**Shoot Cl (mg/grdw)**	**root Cl (mg/grdw)**	**Leaf K/Na (mg/grdw)**	**Shoot K/Na (mg/grdw)**	**Root K/Na (mg/grdw)**
0	†0.485g	†0.84e	†0.754ebcdefgh	†0.3561a	†0.70ab	†0.0694abc
50	1.384efg	2.34de	1.41abcdefgh	0.366b	0.14de	0.0317de
100	2.855bcdefg	4.18cde	1.85abcdef	0.0158b	0.06de	0.0120de
200	5.35a	7.96abc	1.9abcde	0.0158b	0.06de	0.0155de

†Means in each column with the same letter are not significantly different at 5% level; DNMRT.

The results (Table 2, 3) show that increasing salinity level caused an increase in Na and Cl but a decrease in K/Na ratio. Sodium concentration was higher in the roots whereas Cl accumulation was higher in aerial parts. Increasing of accumulation of Na in leaf, shoot and root was significantly different at 5% level at 100 and 200 mM of salinity. Decrease in K/Na in 50, 100 and 200 mM salinity level was significantly different at 5% level this results were in agreement with studies of others. Tattini (1992) explained that there is a decreasing gradient in Na and Cl contents from the root to the apical part of the olive plant.

The Na content in the stem and leaf tissue is higher in the salt-sensitive “Leccino” than in the salt-tolerant “Frantoio” whereas it is similar in the root of salt-treated of both cultivar. The K/Na ratio is consistently higher in “Frantoio” than in “Leccino” and values are higher in the shoot than in the root of both cultivars (Gucci and Tattini 1997). Differential accumulation of Cl into the shoots of olive plants has also been reported, but the uptake and transport of Cl is usually lower than that of Na (Bartolini *et al.,* 1991, Bongi. and Loreto 1989, Tattini *et al.,* 1992). The leaf Cl concentration is about three times greater than the root concentration after five weeks of salt stress. It is a common observation that sensitive and tolerant cultivars often behave in a similar manner at low salt concentrations or during the initial stages of stress. Sensitive cultivars tend to accumulate Na and Cl without apparent toxicity symptoms and they reach toxic concentrations of these ions earlier than tolerant cultivars (Gucci and Tattini. 1997). Benloch *et al* 1991 and Tattini *et al* studies showed that growth is affected when plant are irrigated with water in the range between 40-100 mM NaCl depending on the cultivar.

Many physiological parameters are affected at 100 mM NaCl and more .accumulation of Na and Cl occurs after a few days of salinization with NaCl. Survival, growth and yield are strongly influenced by environmental conditions, especially in field trials (Benlloch *et al.,* 1991, Bernal *et al.*, 1974, Klein *et al.*, 1994). Olive is a glycophytic species avoiding salinity damage essentially by salt exclusion. Exclusion mechanisms of ion exclusion and retention of Na and Cl in the root. According to Heimler *et* al (1995) the salt-sensitive olives accumulated more Na and Cl in the leaves and showed a lower K/Na selectivity ratio than the salt-tolerant olives (Heimler *et al.,* 1995).

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