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The Influence of Urea, Boric Acid and Zinc Sulphate on Vegetative Traits of Olive

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ABSTRACT

In calcorous soils of Iran, dissolving of nutrient elements especially micronutrients were slow. The objective of this project was to estimate the effect of foliar application of boric acid, zinc sulphate (0, 2000 and 4000 mgL^{-1}) and urea (0, 5000 and 7500 mgL^{-1}) on vegetative traits of olive. Results showed that in first year, the most fresh and dry leaf weight were seen in 2000 boric acid plus urea at 5000 mgL^{-1}. The most leaf area and chlorophyll were observed in boric acid and zinc sulphate at 4000 mgL^{-1} alone and boric acid at 2000 plus urea at 7500 mgL^{-1}, respectively. In second year, the highest shoot length was seen in zinc sulphate at 4000+boric acid at 2000 plus urea at 5000 mgL^{-1}. The highest no of nodes and leaf area was observed in zinc sulphate at 2000 with boric acid at 4000 mgL^{-1}.

Key Words: Boric acid, olive, urea, zinc sulphate.

INTRODUCTION

Because of abundant calcium carbonate, high acidity, use of phosphate fertilizers more than enough, low organic matters in Iran soils, dissolvation of nutritious elements especially micronutrients are low (Malakouti et al. 2005). According to olive (*Olea europaea* L.), Fars province comprised the most planting surface in Iran (Taslimpour and Bonyanpour 2009). Shengeh is the main cultivar, which is cultivated in this province, but it had some problems like low yield, small fruit, low quality of fruit, low depth of field soil and alternate bearing. Low agricultural soil depth of this area induced not to deliver soil nutrients to aerial parts of tree. Foliar application is more effective and economic than soil fertilizer and chelate to supply foliage with nutrient elements directly and quickly. Foliar application of urea is four-fold more efficient than soil application. Application of fertilizers was carried out in 3 ways: Foliar application, soil application with surface distribution or buring the hole and placing fertilizer in it. The objective of this study was to determine the optimum concentration for improving vegetative growth.

MATERIALS AND METHODS

The research was carried out on 14 year-old olive trees (O. *europaea* L. cv. Shengeh) grown with the following characteristics: 93% sand, 5%clay and 2% silt, pH=8.27 and EC=1.04 ds m^{-1}. The trees distances were put 7m×7m apart under a drip irrigation system in Fasa Pishgaman Orchard located in Fars province of Iran. All treated trees were subjected to the same cultural practices. The research was done in 3×3 factorial experiment arranged in complete block design with 3 replicates in two years. Before the onset of experiment, according to soil and water mineral elements analysis, the elements, which were suited to this project were selected. The results of some physicochemical properties of soil and water were recorded in Table 1.Treatments included foliar application with zinc sulphate, boric acid (0, 2000, 4000 mgL^{-1}) and urea (0, 5000 and 7500 mgL^{-1}). Foliar application was done in early morning and in control trees with distillled water. Trees were sprayed before pit hardening (when 90% of flower opening). In order to absorb these solution better, a commercial rica was used as a surfactant. Vegetative characteristics that were assayed in this study were shoot length, no of nodes in current shoot, leaf area and chlorophyll content olive fruit. Leaf area was measured with Delta-T-devices (made in England). Chlorophyll was measured with chlorophyll meter model SPAD-502 (made in Japan). The received datas were analyzed by SAS software ver 9.1 (Soltani 2007). Comparison of means were carried out with LSD and Duncan test at 5% possibility (Assad 1997).

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Table 1. Results of some physicochemical properties of soil and water.

Sand%	Silt%	Clay%	Saturation(%)	pH of soil paste	Electrical Conductivity (EC) (dSm^{-1})
92	2	5	19	8.28	1.04

Sodium Absorbtion Ratio (SAR)	Solouble Sodium Percent (SSP)	pH	TDS (mgl^{-1})	EC (dSm^{-1})
1.29	29.82	8.25	230	365

K^+ ($meqL^{-1}$)	Na^+ ($meqL^{-1}$)	Mg^{2+} ($meqL^{-1}$)	Ca^{2+} ($meqL^{-1}$)	SO_4^{2-} ($meqL^{-1}$)	Cl^{1-} ($meqL^{-1}$)	CO_3H^{1-} ($meqL^{-1}$)	CO_3^{2-} ($meqL^{-1}$)
1	1.7	3	3	low	2	5	0.2

RESULTS

According to combined ANOVA variance, the effect of year in Zn×Br×N was significant on vegetative traits, so results of two years showed in Table 2.
In first year, the most fresh (15.933 g) and dry leaf (9.507 g) weight were seen in 2000 boric acid plus urea at 5000 mgL^{-1} (Table 3). The most leaf area (20.17 cm) and chlorophylle (80.7) were observed in zinc sulphate at 4000 mgL^{-1} alone and boric acid at 2000 plus urea at 7500 mgL^{-1}, respectively. The lowest fresh (12.035 g) and dry (6.76 g) leaf weight were demonstrated in 4000 zinc sulphate alone. The least chlorophylle content (70.5) and leaf area (6.681 cm) were seen in 5000 urea alone and zinc sulphate at 2000 alone, respectively.
In second year, the highest shoot length (8.625 cm) was seen in zinc sulphate at 4000 with 2000 along with urea at 5000 mgL^{-1}, but it did not have any significant difference between boric acid at 4000plus urea at 7500 with or without zinc sulphate at 2000mgL^{-1} (Table 4). The lowest one (4.236 cm) was observed in zinc sulphate with boric acid at 4000 plus urea at 7500 mgL^{-1} and after that in urea at 5000 mgL^{-1} alone. The highest (12.17) and lowest (4.875) number of nodes on current shoots in zinc sulphate at 2000 with boric acid at 4000 and urea at 5000 mgL^{-1} alone, respectively. Zinc sulphate at 2000 plus 4000 boric acid with urea at 5000 mgL^{-1} (in fresh leaf weight) (16.645 g) and 7500 (in dry leaf weight) (9.085 g) were the most effective. The highest (80.67) and lowest (63.22) chlorophyll content was in urea at 5000 mgL^{-1} alone and 2000 zinc sulphate+boric acid at the same rate+urea at 7500 mgL^{-1}, respectively. The highest leaf area (6.191 cm) was showed in 2000 zinc sulphate+4000 mgL^{-1}boric acid The least fresh weight (10.86 g) and dry one (4.345 g) in 2000 zinc sulphate+boric acid at the same concentration+7500 urea and 4000 zinc sulphate+4000 boric acid+5000 urea, respectively.

Table 2. Combined ANOVA mean square on vegetative traits in two years from 2009-2010.

		leaf area	chlorophylle	fresh weight leaf	dry weight leaf
Source	DF				
Year	1	2063.8317 *	380.63471*	0.9621928*	75.337813*
block(year)	4	21.138403*	101.08108*	3.6221298*	2.9510866*
Zn	2	2.26778 ns	24.121471*	5.0971117*	2.2536796*
Br	2	34.353709*	27.877286*	12.781025*	3.8541514*
N	2	5.267108 ns	16.165225*	0.4600196 ns	1.7200032*
Zn*N	4	35.662399*	7.6595543 ns	2.9748076*	1.5675843*
Zn*Br	4	27.52383*	25.644635*	5.7098006*	4.3473956*
Br*N	4	13.893158*	81.327508*	2.3090092 ns	1.2332699*
Zn*Br**N	8	13.991492*	28.904274*	1.3086083 ns	0.4070148 ns
Zn*year	2	0.221369 ns	4.297471 ns	9.465871*	9.8522019*
Br*year	2	33.195478*	63.317804*	10.901265*	5.2434366*
N*year	2	4.831578 ns	132.93885*	2.5612233*	5.1162255*
Zn*Br*year	4	17.151414*	29.128894*	13.935252*	5.918003*
Zn*N*year	4	33.797239*	30.941703*	7.6997279*	3.0711009*
Br*N*year	4	9.462291*	68.631064*	2.9833837*	1.1018245*
Zn*Br*N*year	8	20.701963*	44.25357*	3.3766342*	1.7367*
Error	104	11.15	27.558	3.89	1.27
CV		39.49	6.993	14.38	15.24

Table 3. The Effects of Urea,Boric acid and Zinc sulphate on vegetative growth of Olive in first year.

	Fresh Leaf Weight (g)	**Dry leaf weight (g)**	**Chlorophyll (SPAD UNIT)**	**Leafarea (cm^2)**
$Zn_0Br_0N_0$	14.693 b	8.65 b	75 ef	12.31 m
$Zn_0Br_0N_1$	14.22 b	9 a	70.5 g	13.33 i
$Zn_0Br_0N_2$	14.095 b	8.533 b	78.8 b	9 q
$Zn_0Br_1N_0$	12.32 e	7.033 e	75.85 e	15.45 e
$Zn_0Br_1N_1$	15.933 a	9.507 a	76.4 de	12.513 k
$Zn_0Br_1N_2$	14.107 b	8.583 b	80.7 a	8.011 u
$Zn_0Br_2N_0$	13.26 c	7.8 c	74.2 ef	14.16 h
$Zn_0Br_2N_1$	14.037 b	8.417 b	74 f	8.247 t
$Zn_0Br_2N_2$	14.113 b	8.357 c	77.2 cd	14.579 g
$Zn_1Br_0N_0$	13.295 c	7.837 e	73.9 f	6.681 w
$Zn_1Br_0N_1$	12.453 e	7.13 e	77.1 cd	14.899 f
$Zn_1Br_0N_2$	13.29 c	7.49 cd	76 e	12.382 l
$Zn_1Br_1N_0$	12.51 e	7.23 e	76.4 de	7.773 v
$Zn_1Br_1N_1$	13.71 bc	7.983 c	73.6 f	8.673 r
$Zn_1Br_1N_2$	13.673 bc	8.217 bc	77.733 c	10.663 o
$Zn_1Br_2N_0$	14.546667	8.73 ab	79.15 ab	12.31 m
$Zn_1Br_2N_1$	12.97 cd	7.3 d	76.33 de	17 d
$Zn_1Br_2N_2$	13.38 c	8.183 c	80.2 a	19.431 c
$Zn_2Br_0N_0$	12.035 e	6.76 e	79.2de	20.17 b
$Zn_2Br_0N_1$	13.25 c	7.74 cd	75.8 e	8.58 s
$Zn_2Br_0N_2$	12.61 d	7.263 d	80.27 a	12.52 k
$Zn_2Br_1N_0$	12.843 d	8.087 c	75 ef	8.663 rs
$Zn_2Br_1N_1$	12.79 d	7.633 cd	79.1 ab	8.939 qr
$Zn_2Br_1N_2$	12.957 cd	7.633 cd	78.4 bc	12.643 j
$Zn_2Br_2N_0$	15.75 a	9.466 a	75 ef	10.986 n
$Zn_2Br_2N_1$	15.393 a	9.47 a	75.3 ef	10.482 p
$Zn_2Br_2N_2$	14.07 b	8.19 c	76.9d	14.2375 a

Columns with the same letter(s) were not significantly different according to LSD test at $p \leq 0.05$, $Zn_{0,\ 1\ 2}$=zinc sulphate at 0, 2000 and 4000 mgL^{-1}, respectively, $Br_{0,\ 1\ and\ 2}$=boric acid at 0,2000 and 4000 mgL^{-1}, respectively, $N_{0,\ 1\ and\ 2}$ ureat 0, 5000 and 7500 mgL^{-1}, respectively

Table 4. The Effects of Urea,Boric acid and Zinc sulphate on Vegetative traits of Olive in second year.

	Shootlength (cm)	**No of Nodes per Shoot**	**Fresh Leaf Weight (g)**	**Dry Leaf Weight (g)**	**Leafarea (cm^2)**	**chlorophyll**
$Zn_0Br_0N_0$	7.208 ab	6.75 c	14.87 ab	7.053 d	4.815 cd	74.53 d
$Zn_0Br_0N_1$	4.31 e	4.875 g	13.7 c	6.61 d	4.174 d	80.67 a
$Zn_0Br_0N_2$	7.16 ab	5.66b ef	15.57 ab	8.465 a	4.447 d	66.573 i
$Zn_0Br_1N_0$	5.208 d	5.58 ef	12.36 d	5.56 ef	4.545 d	74.067 e
$Zn_0Br_1N_1$	5.58 cd	5.33 ef	12.23 d	5.017 f	5.657 d	76.13 c
$Zn_0Br_1N_2$	5.41 d	6.083 c	14.223 bc	6.563 d	5.515 b	66.7 i
$Zn_0Br_2N_0$	6.33 c	6.25 c	14.737 b	6.87 c	4.657 ab	78.97 a
$Zn_0Br_2N_1$	6.66 bc	7 b	11.737 b	4.697 fg	5.105 bc	66.533 i
$Zn_0Br_2N_2$	8.16 a	6.25 c	14.28 b	6.93 c	5.031 c	74.5 de
$Zn_1Br_0N_0$	6.375 c	6.083 ef	15.1 ab	7.113 c	4.457 d	80.47 a
$Zn_1Br_0N_1$	4.75 e	5.58 ef	14.975 ab	7.395 c	5.493 b	73.33 ef
$Zn_1Br_0N_2$	7.125 b	6.25 c	13.703 c	6.51 d	5.118 bc	73.2 f
$Zn_1Br_1N_0$	4.54 e	5.33 ef	14.023 bc	6.98 c	4.54 d	70.433 g
$Zn_1Br_1N_1$	5.41 d	6.25 c	12.803 d	6.47 d	5.519 b	74.27 de
$Zn_1Br_1N_2$	7.16 ab	6.75 c	10.86 f	6.525 d	4.49 d	63.22 j
$Zn_1Br_2N_0$	5.66 cd	12.16 a	15.56 ab	8.09 b	6.191 a	74 ef
$Zn_1Br_2N_1$	6.25 c	6.16 c	16.645a	8.38 a	5.239 bc	68.43 h
$Zn_1Br_2N_2$	8.29 a	7.083 b	16.24 a	9.085 a	5.274 bc	79.67 a
$Zn_2Br_0N_0$	7.625 ab	6.66 c	13.91 c	8.12 b	4.151 de	75.433 h
$Zn_2Br_0N_1$	5.16 d	5.91 e	13.643 c	6.2 de	4.897 cd	70.133 gh
$Zn_2Br_0N_2$	5.16 d	5.5 ef	15.03 ab	7.11 c	4.482 d	76.067 c
$Zn_2Br_1N_0$	7.208 ab	6.25 c	12.803 d	6.66 d	4.797 cd	70.2 g
$Zn_2Br_1N_1$	8.625 a	6.5 c	14.157 bc	6.4 de	4.947 cd	77.3 b
$Zn_2Br_1N_2$	5.55 cd	5.75 e	12.65 d	5.687 e	4.63 cd	70.77 g
$Zn_2Br_2N_0$	5.29 d	6 d	10.957 f	5.92 e	4.629 cd	78.33 b
$Zn_2Br_2N_1$	5.625 cd	6 d	11.77 e	4.345 g	3.362 e	75.67 cd
$Zn_2Br_2N_2$	4.236 e	5 f	13.93 c	6.657 d	5.742 a	75.67 cd

Columns with the same letter(s) were not significantly different according to LSD test at $p \leq 0.05$, $Zn_{0,\ 1\ 2}$=zinc sulphate at 0, 2000 and 4000 mgL^{-1}, respectively, $Br_{0,\ 1\ \text{and}\ 2}$=boric acid at 0,2000 and 4000 mgL^{-1}, respectively, $N_{0,\ 1\ \text{and}\ 2}$ ureat 0, 5000 and 7500 mgL^{-1}, respectively.

DISCUSSION

Zinc sulphate increases chlorophyll content. High nitrogen concentration in flower buds increases ovule longevity, pollination and fertilization period, leaf area by foliar application in citrus (Albrigo and Syvertsen 2001), apple (Cheng and Ranwala 2004) and Avocado (Lovatt 1999). Increase in leaf cholorophyll was related to raising N, Mg, and Fe in leaves. These elements have key roles in chlorophyll structure and synthesis (Malakouti et al. 2005). Leaf chlorophyll was in relation with leaf nitrogen, because photosynthetic proteins comprised more than half of leaf nitrogen (Rubio-Covarrubias, et al. 2009).

Nitrogen affects on shoot growth, no of leaves on currant shoot, leaf area (Desouky et al. 2009). The highest Shoot length was seen in urea at 5000 mgL^{-1} plus Fe at 3000 mgL^{-1} (Saki et al. 2009). Foliar boron application does not cause to any significant difference in chlorophyll content and no of nodes on shoot in cotton (*Gossypium hirsutum* L.) (Dordas 2006). The most chlorophyll concentration was observed in zinc sulphate at 5000 mgL^{1-} (Ramezani 2009). Foliar spray with boric acid, zinc chelate and urea in 'Manzanillo' olive were effective in shoot length, no of nodes per shoot and leaf area. Macronutrients sprays contains 0.5% urea, orthophosphoric acid, potassium and magnesium sulphate were more effective for raising growth traits (shoot length, number of nodes per shoot, leaf area) in olive than girdling or micronutrient foliar applicartion alone. Also, micro or macroelements foliar spray with girdling were the mose effective in increasing vegetative

characteristics (El-Khawaga 2007). Foliar application of supplemental nitrogen increased shoot length, leaf area, no of nodes per shoot in persimmon (*Diospyros kaki* cv. Fuyo) (Park et al. 2009). The movement of nitrogen out of treated spurs was determined by the demand for nitrogen in that spur, with less nitrogen leaving spurs containing more nitrogen sinks like developing fruit. In the absence of these local sinks, nitrogen was translocated out of the treated spur to distant, more competitive sinks (Youssefi et al. 2000). It was reported increase in leaf area was due to high concentration of nitrogen, boron and zinc which have important effect on development of leaf cells (Malakouti et al. 2005).
The results was in agreement with above researches, but in some cases that the use of above treatments was not effective was in agreement with Dordas (2006) and Fernandez et al. (2009) Rostami et al. (2005) in olive seedlings.

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