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Effect of boron and gibberellins spray on the chemical content in the leaves of olive tree

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ABSTRACT:

This examination was done in the olive orchard of, Civil Engineering Department, College of Engineering – University of Baghdad-Al-Jadriya during 2015/2016 growing seasons to research the impact of gibberellins (GA3) and boron spray on 15 year's old trees of "Ashrasi" olive cultivar. This examination included two treatments, *viz*: three levels of spraying of GA_3, 0 (GA_0), 100mg.L^{-1} (GA_{100}) and 200 mg.L^{-1} (GA_{200}) and three concentration of boric acid (17% Boron) such as spray 0 (B_0), 25 mg.L^{-1} (B_{25}) and 50 mg.L^{-1} (B_{50}) with their replications. Medicines were imitated multiple times at factorial trial in a Randomized Complete Black Design (RCBD) using 27 trees. The exploratory outcomes demonstrated that gibberellin at 200 mg.L^{-1} and boric acid at 50 mg.L^{-1} ($GA_{200}B_{50}$) altogether gave the most elevated leaf chlorophyll content of 64.34 and 68.10 (SPAD unit), leaf carbohydrate content 0.52 and 0.68 %, the most elevated leaf nitrogen content of 1.204 and 1.446 %, leaf potassium content of 1.582 and 1.710 %, leaf boron content of 26.19 and 32.98 mg.kg^{-1} and leaf zinc substance of 13.10 and 17.12 mg.kg^{-1} for the two seasons, separately. The least estimation of these parameters was found in the control (GA_0B_0) treatment.

Keywords:

Gibberellin, Boron, Foliar spray, Leaves mineral, Olive trees.

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INTRODUCTION

Olive is the fruit tree, which is economically important in the Oleaceae family and which follows the Olea species, it was and still with economic importance especially in the lives of peoples. Most scientists agree that the olive tree originated in the eastern mediterranean. Its fruits are used as food and its leaves are extracted from medical preparations and its oil are used in cooking, making soap and cosmetics. Olive oil is one of the best vegetable oils because it protects against atherosclerosis, heart disease and yellow gland activity. It contains high levels of oleic acid, linoleic acid and vitamin K (Kailis and Harris, 2007; Preedy and Watson, 2010). In 2016, the acreage of olive in the world reached about 10650068 ha, with the production of 19267493 tons. The main olive producing countries are Spain then Greece, Italy, Turkey and Morocco (Al-Rawi, 2013). In 2016, the estimated number of olive fruit trees in Iraq, including nearly 4,72,767 tree produces up to 9,332 tons and the average production per tree is about 19.74 kg (PCBS, 2016).

Boron is the micronutrients that have an important role in the natural growth of the plant, and not less important than the macronutrients. Many studies and research pointed to the importance of micro elements in the growth of the plants (Ali, 2012). It is the most important vital function of boron because it makes the transition of sugars in the plant easy and it stimulates the formation of phenolic and lignin, it has a role in the formation of cells and composition the nuclear acids DNA and RNA. They also contribute in water absorption and transpiration (Al-Mousily, 2015). In spite of its importance in physiological operations and the vital interaction in the plant particularly the enzymology which works in the regulate the enzymatic activity and auxin movement inside plants (Havlin *et al*., 2005).

Several studies have been conducted to determine the role of boron in leaf mineral and chlorophyll content. Ismael (2011) mentioned that the foliar spray with 200, 400, 600 and 800 mg H_3BO_3 L^{-1} caused significant increase in leaves phosphorous, potassium and Bo content, especially at 800 $mg.L^{-1}$, while the dry matter and leaves nitrogen content did not affected in his study on (Sourani) olive trees. Khudair and Al-Musawi (2014) have studied the effect of spray three levels of boron (0, 30 and 60) $mg.L^{-1}$, and found the concentration of boron at 60 $mg.L^{-1}$ caused significant increase in total chlorophyll in leaves and boron concentration in leaves in olive seedling.

Jasrotia *et al*. (2014) recorded that, highest content of leaves potassium, calcium and magnesium and leaf chlorophyll in the Frantoio olive trees treated with boric acid as foliar spray. Hussein (2015) found that the spray of two olive cultivars with boric acid at 5 $mg.L^{-1}$ gave the highest leaf nitrogen, phosphorus, potassium and chlorophyll content.

Gibberellins are naturally occurring phytohormones in the tissues of endogenous. Gibberellins are found in embryos, seeds, fruits, tubers, and shoot tips, and the gibberellin moves from its source to where its effect occurs. Gibberellic acid is one of the most important plant growth regulators in commercial production. It has important effects on the development and germination of seeds and control of dormancy. It also encourages elongation of plant branches by increasing elongation and expansion of cells by increasing the softness of the cellular wall and activating cellular division in apical meristems and activation of certain genes in the cell chromosomes, which lead to the activation of DNA and the formation of RNA, especially mRNA, producing some enzymes such as protease and α - amylase and ribonuclease, the elongation of the plant cells by stimulating the production of auxins or by somehow interfering with the auxins and produces an increase in the rate of auxins and decrease in the rate of demolition because the gibberellin somehow reduces the effectiveness of the

Table 1. Effects of boron and GA spray on chlorophyll content, dry weight and carbohydrates content in leaves of Ashrasi olive trees during 2015 and 2016 seasons

Season	2015				2016			
GA ($mg.L^{-1}$)	Boron (B)				Boron (B)			
	0	25	50	mean	0	25	50	mean
Leaf chlorophyll content (SPAD unit)								
0	61.12	61.89	62.78	61.93	62.28	63.20	63.90	63.13
100	61.32	62.18	63.68	62.39	63.19	64.22	66.13	64.51
200	61.97	63.00	64.34	63.10	64.28	66.17	68.10	66.18
mean	61.47	62.36	63.60		63.25	64.53	66.04	
L.S.D5%	GA	B	Inter		GA	B	Inter	
	0.43	0.43	0.75		1.14	1.14	1.97	
Leaf dry weight (%)								
0	26.13	26.30	27.11	26.51	26.47	29.22	28.12	27.94
100	26.27	27.15	27.00	26.81	27.19	28.10	30.14	28.48
200	26.47	26.88	28.22	27.19	27.34	28.88	30.33	28.85
mean	26.29	26.78	27.44		27.00	28.73	29.53	
L.S.D5%	GA	B	Inter		GA	B	Inter	
	0.18	0.18	0.31		0.37	0.37	0.64	
Leaf carbohydrates content (%)								
0	0.34	0.36	0.41	0.37	0.39	0.42	0.50	0.44
100	0.37	0.41	0.46	0.41	0.44	0.48	0.63	0.52
200	0.38	0.45	0.52	0.45	0.52	0.55	0.68	0.58
mean	0.36	0.41	0.46		0.45	0.48	0.60	
L.S.D5%	GA	B	Inter		GA	B	Inter	
	0.05	0.05	0.09		0.07	0.07	0.12	

enzyme IAA oxidase and peroxidase and work to delay the aging of leaves and increase the construction of chlorophyll (Al-Khafaji, 2014; Hartmann *et al*., 2002). AL-Taey (2009) mentioned that the foliar spray with 250 mg $GA_3.L^{-1}$ caused significant increase in vegetative growth and dry weight compared with the control treatment in the study on olive seedlings cv Sorani. Al-Shamri *et al*. (2011) found that foliar spray with gibberellic acid at 200 $mg.L^{-1}$ caused significant increase in leaves dry weight, leaves chlorophyll content, leaves carbohydrates content and leaves boron and GA_3 content in k18 olive seedling. Al-Timeme *et al*. (2015) recorded that, highest content of leaves dry weight and chlorophyll it was in the olive trees treated with gibberellic acid (GA_3) as foliar spray. The target of this study was to evaluate "Ashrasi" olive cultivar parameters under using GA_3 and boron.

MATERIALS AND METHODS

This study was conducted in the olive orchard, civil engineering department, college of engineering – University of Baghdad- Al-Jadriya during 2015 / 2016 growing seasons to investigate the influence of gibberellins (GA_3) and boron spray on 15 year's old trees of "Ashrasi" olive cultivar. This study included two treatments: three levels of sprayingof GA_3, 0 (GA_0), 100 $mg.L^{-1}$ (GA_{100}) and 200 $mg.L^{-1}$ (GA_{200}) and three levels of spraying of boric acid (17% boron), 0 (B_0), 25 $mg.L^{-1}$(B_{25}) and 50 $mg.L^{-1}$ (B_{50}) and their interaction. Treatments were replicated three times at factorial experiment in a RCBD. The number of trees used was

Table 2. Effects of boron and GA spray on leaf nitrogen, phosphorous and potassium content

Season	2015				2016			
GA (mg.L^{-1})	Boron (B)				Boron (B)			
	0	25	50	Mean	0	25	50	Mean
				N (%)				
0	1.112	1.119	1.133	1.121	1.226	1.286	1.308	1.273
100	1.120	1.128	1.154	1.134	1.244	1.367	1.380	1.330
200	1.127	1.147	1.204	1.159	1.248	1.414	1.446	1.369
Mean	1.120	1.131	1.164		1.239	1.356	1.378	
L.S.D5%	GA	B	Inter		GA	B	Inter	
	0.007	0.007	0.012		0.013	0.013	0.023	
				P (%)				
0	0.139	0.145	0.155	0.146	0.142	0.157	0.166	0.155
100	0.141	0.146	0.158	0.148	0.147	0.150	0.172	0.156
200	0.145	0.149	0.161	0.152	0.145	0.161	0.177	9.161
Mean	0.142	0.147	0.158		0.145	0.156	0.172	
L.S.D5%	GA	B	Inter		GA	B	Inter	
	N.S	0.011	0.019		N.S	0.010	0.017	
				K (%)				
0	1.367	1.388	1.418	1.391	1.402	1.438	1.526	1.455
100	1.398	1.413	1.566	1.459	1.421	1.510	1.618	1.516
200	1.424	1.441	1.582	1.482	1.478	1.528	1.710	1.572
Mean	1.396	1.414	1.522		1.434	1.492	1.618	
L.S.D5%	GA	B	Inter		GA	B	Inter	
	0.016	0.016	0.028		0.044	0.044	0.076	

27 trees. The following parameters were determined in the two successive seasons:

1. Leaf chlorophyll contents (SPAD unit).
2. Leaf dry weight (%): Various leaves were taken from the trees was weighing then drained and calculated the percentage of dry matter by dividing weight after drying on weight before drying× 100.
3. Leaf carbohydrates content (%) was determined according to Dubois *et al*. (1956).
4. Leaf mineral content: Leaf samples were gathered for chemical examination at the second week of June of the two seasons. Each sample comprised of 10 leaves per Tree. Leaves were washed with tap water, washed with refined water, and afterward dried at 70□C until a steady weight, ground and processed according to Chapman and Pratt (1978). Nitrogen was evaluated by micro Kjeldahl technique of AOAC (1980). Phosphorus was determined chromatically by utilizing spectrophotometer as per Estefan *et al*. (2013). Potassium was estimated utilizing flame photometer as indicated by Estefan *et al*. (2013) Iron, boron and zinc were estimated utilizing atomic absorption as per for boron as Black (1965) for zinc and iron.

The results were analyzed using analysis of variance as indicated by (Elsahookie and Wuhaib, 1990) utilizing L.S.D 0.05 for comparing differences between different treatment means.

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Table 3. Effects of boron and GA spray on leaf boron, iron and zinc content of Ashrasi olive trees during 2015 and 2016 seasons

Season	2015				2016			
GA ($mg.L^{-1}$)	Boron (B)				Boron (B)			
	0	25	50	Mean	0	25	50	Mean
				Boron ($mg.kg^{-1}$)				
0	11.37	19.29	21.88	17.51	15.19	19.78	25.45	20.14
100	11.52	20.22	24.90	18.88	16.00	21.90	30.13	22.68
200	11.98	21.00	26.19	19.72	16.12	22.14	32.98	23.75
Mean	11.62	20.17	24.32		15.77	21.27	29.52	
L.S.D5%	GA	B	Inter		GA	B	Inter	
	N.S	4.03	6.98		N.S	4.88	8.45	
				Iron ($mg.kg^{-1}$)				
0	22.12	22.98	24.17	23.09	25.11	25.90	28.88	26.63
100	22.91	24.08	25.90	24.30	26.00	28.92	31.70	28.87
200	23.16	25.38	27.09	25.21	26.24	28.81	34.18	29.74
Mean	22.73	24.15	25.72		25.78	27.88	31.59	
L.S.D5%	GA	B	Inter		GA	B	Inter	
	1.11	1.11	1.92		1.42	1.42	2.46	
				Zinc ($mg.kg^{-1}$)				
0	10.22	10.67	11.13	10.67	11.60	12.34	14.00	12.65
100	10.71	11.00	12.15	11.29	12.28	13.15	15.97	13.80
200	10.93	11.12	13.10	11.72	12.59	14.44	17.12	14.72
Mean	10.62	10.93	12.13		12.16	13.31	15.70	
L.S.D5%	GA	B	Inter		GA	B	Inter	
	0.47	0.47	0.81		0.93	0.93	1.61	

RESULTS AND DISCUSSION

Effects of boron and GA spray on chlorophyll content, dry weight and carbohydrates content in leaves

Data concerning the effect of treatments on leaves chlorophyll content leaves dry weight and leaves carbohydrates content during the two experimental seasons are recorded in Table 1. The information cleared that, GA_3 spray at 200 $mg.L^{-1}$ altogether enhanced the leaf chlorophyll content (63.10 and 66.18 SPAD units), leaf dry weight (27.19 and 28.85 %) and the most high leaf carbohydrates content(0.45 and 0.58 %) for the two seasons, respectively. Table 1 additionally demonstrates that the boric corrosive at 50 $mg.L^{-1}$was better than the control treatment and gave the most astounding leaf chlorophyll content (63.60 and 66.04 SPAD units), leaf dry weight (27.44 and 29.53 %) and leaf carbohydrate (0.46 and 0.60 %)for the two seasons, respectively. GA_3 and boron in combination altogether influenced in every single examined traits.

This may be due to the increased leaves nitrogen content Table 2, which is involved in the construction of the chlorophyll dye, for its involvement in the installation of porphyrins in the composition of this pigment (Havlin *et al.*, 2005). The increase in leaves dry weight and leaves carbohydrate content may be attributed to the role of the GA_3 in increasing the leaf area of the trees. This may increase the process of photosynthesis and the resulting substances, carbohydrates and dry weight (Chen and Chen, 2004). The results are in accordance with (Al-Shamri *et al.*

(2011) and Al-Tamimi *et al*. (2015) an olive trees and peach trees (Al-Rawi *et al*., 2016).

The increase in chlorophyll content may be due to the role of boron in the representation of carbohydrates, proteins and chlorophyll. The reason for the increase in leaf dry weight and carbohydrates is due to the role of boron in increasing the leaf area and chlorophyll and then increase the amount of carbohydrates stored in them, which leads to increase the rate of leaves dry weight and may also be attributed to the role of boron in stimulating the process of photosynthesis, leading to the transmission of their products to the vegetative parts and their role in facilitating the transfer of sugars and permeability of cellular membranes as well as its role in the chemistry of carbohydrates (Wojcik and Wojcik, 2006). These results are in agreement with those obtained by Al-Rawi (2013) and Hussein (2015) on olive transplants. They found that the leaves chlorophyll content and leaves dry weight and leaves carbohydrates content positively correlated with boron spray in those transplants.

Effects of boron and GA spray on leaf nitrogen, phosphorous and potassium content

Information concerning the impact of treatments on nitrogen, phosphorous, potassium during the two study seasons are recorded in Table 2. GA spray at 200mg.L^{-1} significantly resulted in most elevated leaf nitrogen content of 1.159 and 1.369 %, leaf potassium content of 1.482 and 1.472 % for the two seasons, respectively, while GA did not influence on leaf phosphorous content. Table 2 likewise demonstrates that boric acid at levels of 50 mg.L^{-1} significantly better than control and gave the most elevated leaf nitrogen content of 1.164 and 1.378 %, leaf phosphor content of 0.158 and 0.178 % and leaf potassium content of 1.522 and 1.618 % for the two seasons, respectively. The association among GA and boric acid significantly influenced all the parameter.

Effects of boron and GA spray on leaf boron, iron and zinc content

Seen from the outcomes as shown in the Table 3 the interaction between gibberellic acid and boric acid are influenced significantly. On account of spray as gibberellic acid, it had no significant effect on the leaf boron content; any how, the impact was noteworthy in leaf iron and zinc content. Boric acid at 50 mg.L^{-1} significantly resulted in better result as compared to the control and had highest leaf boron content of 24.32 and 29.52 mg.kg^{-1}, leaf iron content of 25.72 and 31.59 mg.kg^{-1}and leaf zinc content of 12.13 and 15.70 mg.kg^{-1} for the two seasons, separately. The purpose behind these outcomes might be because of enhanced growth foliar spray of gibberellic acid which plays a role in the division and cell prolongation Gindia (2003), which prompts enhanced take-up of soil components, in this way enhancing their content in the leaves. Our results are in concordance with apricot trees (Al-Abbassy and Luma, 2009).

Also, Al-Rawi *et al*. (2016) decided the same results on peach trees. As for the effect of the boric acid had a significant effect on nitrogen, phosphorous and potassium as well as micronutrients. These results are in agreement with those obtained by Al-Rawi (2013) and Hussein (2015) on olive transplants; they found that the leaves mineral content positively correlated with boric acid spray in those trees.

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