EFFECT OF POTASSIUM AND ASCORBIC ACID ON GROWTH, YIELD AND QUALITY OF OLIVE CV. KHADRAWI

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ABSTRACT

This study was carried out in a private olive orchard located near kasara village, Duhok governorate, Kurdistan region, Iraq, during growing season 2014 in order to study the effect of spraying olive tree 8 years old with three concentration of potassium fertilizer as potassium sulfate (0, 5 and 10 g.l^{-1}) and three concentration of ascorbic acid (0, 200 and 400 mg.l^{-1}). The spraying of both potassium and ascorbic acid carried out twice per season, first two week after growth began, second month later. Results indicate that spraying potassium at 10g.l^{-1} significantly increased leaf area, leaf dry weight, chlorophyll content, fruit weight, fruit flesh weight and fruits quality include fruit length, fruit width and TSS %. Ascorbic acid at 400mg.l^{-1} significantly increased all vegetative growth, physical and chemical fruits properties except seed weight and TSS %. Maximum values (38.77cm^2, 0.184g, 60.32g, 8.533g, 1.903g, 3.40mm, 3.03mm and 16.25%) of leaf area, leaf dry weight, fruit weight, fruit flesh weight, fruit length, fruit width and TSS respectively were resulted from the interaction of 10 g.l^{-1} potassium + 400mg.l^{-1} Ascorbic acid compared to minimum values with untreated trees .

Key word: olive, Khadrawi, potassium, Ascorbic acid.

تاثير البوتاسيوم وحامض الاسكوربك على نمو وحاصل ونوعية الزيتون صنف خضراوي

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المستخلص

اجريت هذه الدراسة في بستان زيتون اهلي يقع في قرية قسارا، محافظة دهوك، اقليم كردستان العراق، خلال موسم النمو 2014 بهدف دراسة تاثير رش اشجار الزيتون بعمر 8سنوات بثلاث تراكيز من سماد البوتاسيوم كسلفات البوتاسيوم (صفرو 5 و10 غم.لتر$^{-1}$) وثلاث تراكيز من حامض الاسكوربك (صفر و200 و400 ملغ.لتر$^{-1}$). رش كلا من البوتاسيوم وحامض الاسكوربك اجري مرتين خلال الموسم الاولى بعد اسبوعين من بدء النمو والثانية بعد شهر. اكدت النتائج بان رش لبوتاسوم بتركيز 10 غم.لتر$^{-1}$ معنويا زاد من مساحة الورقة والوزن الجاف للورقة ومحتوى الكلوروفيل ووزن الثمرة ووزن لحم الثمرة ونوعية الثمار وتتضمن طول وعرض الثمرة والنسبة المئوية للمواد الصلبة الذائبة الكلية. حامض الاسكوربك بتركيز 400 ملغ.لتر$^{-1}$ معنويا زاد جميع صفات النمو الخضري والصفات الفيزيائية والكيميائية للثمار ماعدا وزن البذرة ونسبة المواد الصلبة الذائبة الكلية. اعلى القيم (38,77 سم^2، 0،184غم، 60،32غم، 8،533غم، 1،903 غم، 3،40 ملم، 3،03ملم و25،16٪) لصفات مساحة الورقة والوزن الجاف للورقة ووزن الثمرة ووزن لحم الثمرة طول وعرض الثمرة والنسبة المئوية للمواد الصلبة الذائبة الكلية على التوالي نتجت من التداخل بين 10 غـم.لتر$^{-1}$ بوتاسيوم و 400 ملغ.لتر$^{-1}$ حامض الاسكوربك مقارنة بادنى القيم في الاشجار الغير معاملة.

الكلمات المفتاحية: الزيتون،خضراوي،بوتاسيوم،حامض الاسكوربك

INTRODUCTION

Olive belongs to the family Oleaceae; olives are grown between two latitudes of 30° and 45° N from the equator. About 90% of olives in the world are produced for oil production and 10% are produced as table olives (21, 27). Olive trees are grown in some areas of central and northern of Iraq, Nineveh province, the forefront of other Iraqi provinces in olive production, its cultivation in Nineveh spreading in an area including village of Baashiqa, Bahzany, Fadiliya, Sheikh Uday, Dhecan, Sinjar and Aqrah, followed by Babylon, Diyala, Kirkuk, Baghdad, Arbil and Duhok (10). The Mediterranean region is native habitat (25). However, current olive practices in Iraq largely ignored the mineral nutrition especially in arid and semi arid zones. Potassium is a major element with an important effect on fruit yield and quality (26). This element could be applied with different methods, the foliar application is helpful to satisfy plant requirement and has a high efficiency (14). Potassium is easily adsorbed and distributed trough leaf tissues (8). (7) Studied the effects of foliar application of potassium on vegetative growth, fruit production and leaf mineral content of olive tree (*Olea europaea* L.) under rain-fed condition. The foliar fertilizer rates were 0, 50 and 100% of the tree requirement. The results showed that foliar treatment increases significantly leaf area. Foliar fertilization at 100% accelerates fruit maturation, increases fruit weight, pit ratio and polyphenol, respectively to 0.81g, 3.65 and 59.37ppm. Leaf mineral analysis revealed that K fertilization increased significantly K foliar content with no differences for the others mineral elements (N, P and Mg). (13) Studied the effect of concentration and application time of potassium nitrate (KNO3) on vegetative growth, nutritional status and yield and fruit quality of Picual olive trees under sandy soil conditions. The obtained results showed that, foliar application of potassium nitrate at 4 % after final fruit set or pit hardening improve the vegetative growth, nutritional status especially in the second season and the productivity in both seasons. While sprays potassium nitrate at 4 % after pit hardening gave the best values of fruit quality and flesh oil content of Picual olive fruit in both seasons of the study. Nowadays, there is a prevalent use of the antioxidants especially ascorbic acid for enhancing growth and productivity of fruit trees as well as controlling the prevalence of most fruit disorders (2). Ascorbic acid as an antioxidant has Auxinic action and has synergistic effect on growth, flowering and production of plants (2, 11 and 12). (1) showed that using ascorbic acid alone or combined application with some micronutrient was positively affected on vegetative growth, yield and fruit quality of 'Anna' apple trees. (19) Studied the effect spraying of Ascorbic acid and Humic acid on vegetative growth of two olive (*Olea europaea*) cultivars (Khithairy and Sorany). The transplants were sprayed with four levels (0, 500, 1000 and 2000 $mg.l^{-1}$) Ascorbic acid and four levels of Humic acid (0, 20, 40 and 60 $mg.l^{-1}$). Results indicated when transplant treated with 500 $mg.l^{-1}$ Ascorbic acid significantly increased plant height, leaf fresh weight and leaf dry weight. The objective of this study was to evaluate the response of olive to foliar application of potassium and Ascorbic acid and their effect on growth, yield and quality of olive cv. Khadrawi grown under drip irrigation condition.

MATERIAL AND METHOD

This study was carried out during growing season 2014 in a private olive orchard located near kasara village, Dohuk governorate, Kurdistan region, Iraq, in order to investigate the effect of spraying olive tree 8 years old with three concentration of potassium fertilizer as potassium sulfate (0, 5 and 10 $g.l^{-1}$) and three concentration of ascorbic acid (0, 200 and 400 $mg.l^{-1}$). The spraying of both potassium and ascorbic acid carried out twice per season, first two week after growth began, second month later. The experiment was factorial including two factors and their combination using RBCD design for arranged the treatment and each treatment replicated three times using one tree per experiment unit. The olive trees irrigated with drip irrigation and planted at 5*5 m within the row and 5 m between the rows. The trees under taken in this study received all agricultural and horticultural practices that done in orchards. A detergent powder as wetting agent at (1-2 $g.L^{-1}$) was

added to all the spraying solution, the olive trees were sprayed with decided solutions till run off (2 L/tree). potential effects of potassium and ascorbic acid were evaluated in terms of the change in growth, leaf area was calculated by (17), leaf dry weight, chlorophyll content as (SPAD), fruit weight, fruit flesh weight, seed weight, and fruits quality include fruit length, fruit width and TSS %. All results were analyzed statistically by using SAS programs. Duncan's multiple tests at 5% level of portability was to compare the treatment according to (5).

RESULTS AND DISCUSSION

Vegetative growth properties*:* It's clear from data in table (1) that foliar application of both potassium and ascorbic acid significantly increased vegetative growth properties represented in single leaf area, leaf dry weight and chlorophyll content, since spraying olive trees with 10 $g.L^{-1}$ and 400 $g.L^{-1}$ resulted in highest value (35.74, 0.161 and 81.79) (35.06, 0.161 and 79.40) of single leaf area, leaf dry weight and chlorophyll content respectively. Concerning the interaction, same table shows that the interaction between potassium and ascorbic acid had significant effect of all vegetative growth properties undertaken in this study, maximum values (38.77 and 0.184) of single leaf area and leaf dry weight were obtained with the interaction between 10 $g.L^{-1}$ potassium and 400 $mg.L^{-1}$ Ascorbic acid respectively, whereas the maximum value of total chlorophyll content was 84.13 in interaction between 10 $g.L^{-1}$ potassium and 200 $mg.L^{-1}$ Ascorbic acid compared to the minimum values resulted from control treatment. The significant effect of spraying potassium may be due to the main role of potassium in the synthesis of proteins and activates a number of enzymes and the promotion of normal cell division and growth, which are important components in the synthesis of chlorophyll (3, 7). Auxinic action of ascorbic acid on enhancing cell division and cell enlargement which reflected positively on leaf area was concluded by (2, 4 and 22). On other side, accumulation of dry matter production in canopy and fruits can be assumed proportional to solar radiation intercepted by foliage resulting in more efficiency of photosynthesis process (18).

Table1. Effect of potassium and Ascorbic acid on vegetative growth properties of olive cv. Khadrawi

Treatment		Parameters		
		Leaf area (g)	Leaf dry weight (g)	Total chlorophyll (SPAD)
Potassium ($g.l^{-1}$)	0	27.16 b	0.123 b	70.96 b
	5	32.83 ab	0.142 ab	78.99 a
	10	35.74 a	0.161 a	81.79 a
Ascorbic	0	28.16 b	0.117 b	73.72 b
	200	32.52 ab	0.148 ab	78.61 a
	400	35.06 a	0.161 a	79.40 a
($mg.L^{-1}$)		Potassium x Ascorbic acid		
0	0	24.66 d	0.090 b	65.10 d
	200	25.87 cd	0.136 ab	72.37 cd
	400	30.96 a-d	0.143 ab	75.40 abc
5	0	28.00 bcd	0.126 ab	74.30 bc
	200	35.05abc	0.144 ab	79.33 abc
	400	35.44 ab	0.156 a	83.33 ab
10	0	31.81 a-d	0.134 ab	81.77 ab
	200	36.63 ab	0.165 a	84.13 a
	400	38.77 a	0.184 a	79.47 abc

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

Fruit properties: Data presents in table (2) shows that fruit weight, fruit flesh weight and seed weight for olive trees sprayed with potassium at both concentration are superior significantly on that untreated trees. The highest fruit weight, fruit flesh weight and

seed weight (50.49, 7.29, and1.90) respectively, were given by spraying trees with potassium at 10g.L^{-1} compared with lowest values (34.54, 5.21 and 1.19) respectively at untreated trees. Various levels of potassium were also differed significantly among each other's. Data in the same table also shows that fruit weight and fruit flesh weight for trees sprayed with Ascorbic acid are superior significantly on that untreated. Highest values (47.05 and 7.03) respectively, were obtained in trees sprayed with Ascorbic acid at 400 mg.L^{-1} compared with lowest values (37.75 and 5.25) respectively at untreated trees, whereas Ascorbic acid had no effect on seed weight of olive fruit at both concentration. For the interaction between potassium and Ascorbic acid, data in table (2) indicate that the interaction between 10g.L^{-1} potassium and 400 mg.L^{-1} Ascorbic acid significantly overtopped most of other interaction and had highest value (60.32, 8.53 and 1.90) for the previous properties respectively. fruit weight, fruit flesh weight and seed weight of fruit were increased with increasing the concentration of application of potassium these increasing may be due to the role of potassium in activating meristematic growth, photosynthesis and activates a number of enzymes, including those involved in the synthesis of carbohydrates, and is also involved in the neutralization of organic acids and the promotion of normal cell division and growth (6, 16 and 24). Ascorbic acid act as antioxidants, therefore expected increments of carbohydrates supply to fruits can explain improvements of yield fruit weight and flesh oil content obtained in this experiment (15, 18).

Table 2. Effect of potassium and Ascorbic acid on fruit properties of olive cv. Khadrawi

Treatment		Parameters		
		fruit weight (g)	Fruit flesh weight (g)	seed weight (g)
Potassium (g.l^{-1})	0	34.54 c	5.206 c	1.19 c
	5	41.02 b	6.444 b	1.64 b
	10	50.49 a	7.299 a	1.90 a
Ascorbic (mg.L^{-1})	0	37.75 b	5.252 b	1.486 a
	200	41.25 b	6.662 a	1.603 a
	400	47.05 a	7.034 a	1.640 a
Potassium x Ascorbic acid				
0	0	28.08 c	3.490 c	0.907 c
	200	36.82 bc	6.213 b	1.337 b
	400	38.72 b	5.913 b	1.327 b
5	0	39.85 b	5.767 b	1.633 ab
	200	41.10 b	6.910 b	1.600 ab
	400	42.11 b	6.657 b	1.690 ab
10	0	45.31 b	6.500 b	1.917 a
	200	45.84 b	6.863 b	1.873 a
	400	60.32 a	8.533 a	1.903 a

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level.

Fruit quality properties: Data in Table (3) clearly shows that foliar application of potassium at 10g.L^{-1} was accompanied with improving quality of the olive fruits in terms of increasing fruit length, fruit width and total soluble solids percentage. The best significant results were obtained by the addition of potassium via leaves at 10g.L^{-1}. Ascorbic acid sprays also was of measurable influence on fruits quality in terms of increasing fruit width and total soluble solids percentage, while both concentration of Ascorbic acid had on significant effect on fruit length, the highest values of fruit width and total soluble solids percentage resulted in fruits of trees received Ascorbic acid at 400 mg.L^{-1} compared to the lowest values obtained with control. For the interaction, the best results were regarded when potassium was sprayed at 10 g.L^{-1} and Ascorbic acid at 400 mg.L^{-1}, the highest values of fruit length, fruit width and total soluble solids percentage (3.40, 3.03, and 16.25) respectively, were detected on olive trees received potassium at 10 g.L^{-1} and Ascorbic acid at 400 mg.L^{-1}, compared with the lowest values (2.13, 1.75 and 9.23) respectively from control treatment. The increases in fruit quality traits may be due to the role of potassium influencing meristematic growth, photosynthesis and activates a number of enzymes, including those involved in the synthesis of carbohydrates, and then increased food materials available to the fruits (21, 23).

Table 3. Effect of potassium and Ascorbic acid on fruit quality properties of olive cv. Khadrawi

Treatment		Parameters		
		Fruit length (mm)	Fruit Width (mm)	TSS (%)
Potassium ($g.l^{-1}$)	0	2.52 b	1.88 b	12.72 b
	5	3.09 a	2.11 a	13.94 b
	10	3.12 a	2.54 a	15.58 a
Ascorbic ($mg.L^{-1}$)	0	2.81 a	2.06 b	12.28 c
	200	2.91 a	2.11 ab	14.28 b
	400	3.01 a	2.36 a	15.69 a
Potassium x Ascorbic acid				
0	0	2.13 c	1.75 c	9.33 b
	200	2.80 bc	1.91 bc	12.83 b
	400	2.65 ab	1.98 bc	16.00 a
		3.05 ab	2.17 bc	12.92 b
5	0	3.23 ab	2.09 bc	14.08 ab
	200	2.99 ab	2.07 bc	14.83 ab
	400	3.27 ab	2.27 b	14.58 ab
		2.70 bc	2.32 b	15.92 a
10	0	3.40 a	3.03 a	16.25a
	200			
	400			

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level

The effects of Ascorbic acid on chemical quality of fruit may be due to the influence of Ascorbic acid on stimulating carbohydrate biosynthesis as a result of their effect on improving the vegetative of the plant, (1, and 9), also Ascorbic acid serves as a co-factor for many enzymes and it contributes to the detoxification of reactive oxygen species (23). Also vitamins with their anti oxidative properties play an important role in plant defense against oxidative stress induced by surfactants and selected pesticide (20).

CONCLUSION

According to the experimental results of this study, the most important conclusions can be expressed as follows:

1.Potassium markedly increased Leaf area, Leaf dry weight, total chlorophyll, fruit weight, flesh weight and seed weight as well as fruit length, fruit width and total soluble solid.

2.Potassium at $10g.L^{-1}$ allowed maintenance of fruit physical properties without important loss in fruit quality. 3.Ascorbic acid noticeably increased Leaf area, Leaf dry weight, total chlorophyll, fruit weight and flesh weight as well as fruit length, fruit width. 4.Potassium was effective on fruit quality more than done Ascorbic acid.

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