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EFFECT OF FOLIAR APPLICATION OF POTASSIUM AND SOIL BIOFERTILIZER APPLICATION ON THE GROWTH AND YIELD OF LOZI APRICOT CULTIVAR (*Prunus armeniaca* L.)

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ABSTRACT

This study was conducted in a private apricot orchard in Sab al Boor city in Baghdad during 2013 and 2014 growing seasons to investigate the influence of potassium spray and soil biofertilizer application on seven-years-old trees of "Lozi" apricot cultivar. This study included two factors; *i.e.*, potassium (K) and (N) biofertilizer (nitrobeine). The first factor was at three levels of potassium, 0, (K_1), 5 (K_2), 10 (K_3) g/L. and the second factor was four levels of biofertilizer (nitrobeine), 0(N_1), 10 (N_2), 20 (N_3) and 30 (N_4) g/tree. Each treatment was replicated three times with a factorial experiment using RCBD. The number of used trees was 36 trees. The experimental results showed that potassium at 10 g/L and nitrobeine at 30 g/tree (K_3N_4) gave significantly the highest leaf area of 27.13 and 28.28 cm^2, the highest chlorophyll content of 30.87 and 31.14 SPAD unit and the highest nitrogen leaf content of 1.26 and 1.30%, potassium leaf content of 1.56 and 1.61%, the highest fruit weight of 19.43 and 20.17g and yield of 14.05 and 14.27 kg for both seasons, respectively. Whereas, the lowest values of these parameters were found in the control (K_1N_1) treatment. It could be concluded that the potassium at level K_3 and nitrobeine at N_4 improved vegetative and fruits characteristics in apricot trees cv. Lozi and finally it could be recommend to use these treatments annually to study the effect of potassium and biofertilizer in other concentrations on the apricot cultivars.

Key words: Potassium foliar application, biofertilizer, Zaini apricot, fruit set, fruit quality, leaf chemical compostion.

INTRODUCTION

Apricot (*Prunus armeniaca* L.) classified under the prunus species, sub-family prunoidae, family Rosaceae and order Rosales. It is an important fruit crop believed to be originated in China (Janick, 2005), (Choudhary and Mehta, 2010). The world annual production of apricot exceeded 3,728,083 ton. Turkey ranked the first in the world production of apricot, while Iran ranked the second and Italy was the third (FAO, 2009). The total number of apricot trees planted in Iraq was estimated to be 655,975 trees and the average yield of tree was 25.4 kg (STAT, 2009).

Apricot plays an important role in human nutrition due to its good source of carbohydrate , protein and vitamins especially A and C, and can be used as a fresh, dried or processed fruit such as frozen apricot, jam, jelly, marmalade, pulp, juice, nectar, extrusion products, *etc.* Moreover, apricot kernels are used in the production of oils, cosmetics, active carbon and aroma perfume. Most apricot cultivars (local and introduced) ripe during May and June. Potassium is the most important cation in plant tissue where it is involved in meristemic growth (synergism with IAA, GA, and Cytokinins), photosynthesis, and translocation of photosynthesis.

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The physiological effect of potassium was declared to play an important role in balancing membrane potential and turgor, activating enzymes, regulating osmotic pressure, stomata movement and tropisms (Cherel, 2004).

Bio-fertilization for fruit crops has become in the last few years a positive alternative to chemical fertilizers. Application of biofertilizers as supplementary amendments to fruit crops reduced pollution happened concerning both soil and underground water. Biofertilizers are microbial preparation containing primarily of sufficient numbers of potent strains of microorganisms and furnishing a beneficial rhizosphere for plant growth. Moreover, biofertilizers have a significant effect of deferent strain groups such as nitrogen fixers (Abou El-Khashab, 2002 ; Abou-Taleb *et al.*, 2004) and nutrient mobilizing microorganisms which help in the availability of metals and their forms in the composted materials and level of extractable nutrient elements (El-Karamany *et al.*, 2000). Bio-application improves plant growth, fruit yield and chemical composition through the exertion of plant promoting substances mainly IAA, gibberellic acid and cytokinin like substances, vitamins and amino acid content (Abd El-Mouty *et al.*, 2001).

Many previous studies revealed that potassium foliar sprays and biofertilizers enhanced nutritional status and improved the yield and quality of different fruit crops. Al-Obaidi (2008) found that Zaini apricot trees were sprayed with 100 g/L K led to improve leaf mineral N , P and K content as well as chlorophyll content and leaf area. Fawzi *et al.* (2010) mentioned that the treatment of Le Conte pear trees with biofertilizers (phosphorene and nitrobeine) showed higher concentration of leaf N, Zn and Fe and vegetative growth (shoot length and leaf area).

The aim of this study was to test the effect of potassium foliar and soil biofertilizers application on fruit set, fruit quality, growth and leaf chemical composition of Zaini apricot trees.

MATERIALS AND METHODS

This study was conducted in a private apricot orchard in Sab al Boor city in Baghdad during 2013 and 2014 growing seasons to investigate the influence of potassium foliar spray and soil biofertilizer application on seven-years-old trees of "Lozi" apricot cultivar. Trees were cultivated at 4 × 4 m apart under basin irrigation system. Trees were healthy, similar in vigor and subjected to the same horticultural practices adapted in the region.

Trees have been sprayed with three levels of potassium (0 (k_1), 5 (k_2) and 10 (k_3) g/l potassium sulphate), as well as soil application of four levels of biofertilizer (nitrobeine) (0 (N_1), 10 (N_2), 20(N_3) and 30 (N_4) g/tree) and their interactions, the source of biofertilizers was the General Organization for Agriculture Equalization Found (GOAEF) Ministry of Agriculture, Egypt. Treatments were replicated three times as factorial experiment in a completely randomized block design. Each replicate consisted of one tree. The following parameters were determined in the two successive seasons:

1. Leaf area (cm^2): Ten leaves from the middle position of the shoot were randomly taken for measuring leaf area (cm^2) by leaf area meter (Model Cl-202 USA made).
2. Chlorophyll pigments were estimated in the leaves in June by a SPAD meter (Felix Loh and Nina, 2000).
3. Leaf dry weight percentage: In both seasons, leaf samples were collected in the first week of June. The fresh weight was determined, then the leaf samples were dried at 70°C until constant dry weight. Leaf dry weight percentage was calculated by dividing dry weight on fresh weight × 100.
4. Leaf chemical composition: Leaf samples were collected for chemical analysis at the first week of June in both seasons. Each sample consisted of 20 leaves / tree. Leaves were washed several times with tap water, rinsed with distilled water, and then dried at 70°C until a constant weight, ground and digested according to (Chapman and Pratt, 1978). Nitrogen was estimated by semi-micro kieldahl method of (Plummer, 1974). Phosphorus was determined by the method outlined by (Jackson, 1973) potassium was determined by using atomic absorption

spectrophotometer "Perkin Elmer 1100B" after samples digested according to (Chapman and Pratt, 1978).

5. Fruit set (%): Two main branches from two direction (east and west) of each tree were chosen and tagged on March of the two experimental seasons, the number of flowers was recorded and then set fruits on the selected branches were counted for calculation the percentage of fruit set (divided number of fruits per branch/ total number of flowers per branch x100).
6. Fruit weight (g): Samples of 10 randomly mature fruits from each experimental unit were used for measuring fruit weight.
7. Yield per tree: Fruits were harvested at maturity stage (the first week of May) from each tree of various replicates and yield was recorded as a number of fruits/ tree and weighted in Kilograms.

The obtained results were subjected to analysis of variance according to (Elsahookie and Wuhaib, 1990) and LSD was used for comparing differences between various treatment means.

RESULTS AND DISCUSSION

Effect of Potassium Foliar Spray and Soil Biofertilizer on Leaf Area, Chlorophyll Percentage and Leaf Dry Weight

It is evident from the obtained data in Table 1 that single or combined application of potassium spray and biofertilizer improved significantly the leaf area and chlorophyll percentage compared to control treatment. Results indicated that the combination between potassium spray and biofertilizer displayed that 10 g/L (k_3) and 30 g/tree biofertilizer gave the highest leaf area (27.13 and 28.28 cm^2) and the highest leaf chlorophyll content (30.87 and 31.14 SPAD unit) in both seasons, respectively. Values in Table 1 showed that leaf dry weight was not significantly affected by foliar application of potassium and biofertilizer application. These results may be due to the fact that potassium catalyst in the formation of chlorophyll, proteins and do a lot of biological processes such as photosynthesis, leading to increase vegetative growth and, thus, increasing leaf area (Cherel, 2004; Veberic *et al.*, 2005). Moreover, these results may be due to the role of biofertilizer in improving soil physical, biological and chemical properties resulting in more release of available nutrient elements to be absorbed by plant roots in addition to the capability of microorganisms in biofertilizers to produce growth regulators such as auxins, cytokinins and gibberellins which affect growth and nutrient uptake (Soliman, 2001).

These results are in agreement with those obtained by Ibrahim (2010) on peach trees, Obaid (2012) on apricot trees. Moreover, the results are in harmony with those obtained by El-Sabagh *et al.* (2011) who worked on nitrobeine in grapevines.

Effect of Potassium Spray and Soil Biofertilizer on Leaf N, P, K Content

Data concerning the effect of treatments on leaf N, P, K content during the two experimental seasons are listed in Table 2. The data cleared that, potassium spray and soil biofertilizer increased significantly leaf N, P, K content compared with the control in both seasons. Moreover, spraying potassium at 10 g/L combined with biofertilizer at 30 g/tree was more effective than the other treatments, which gave the highest leaf nitrogen content of 1.26 and 1.30%, phosphor content of 0.33 and 0.36% and potassium content of 1.56 and 1.61% in both seasons, respectively. The increase of nitrogen and phosphorous content in leaves may be due to the role of potassium in many biological processes such as photosynthesis and the representation of carbohydrates, leading to increase in activity of vegetative growth and the efficiency of the absorption of nitrogen and phosphorous from the soil (Cherel, 2004; Veberic *et al.*, 2005).

These effects could be due to the ability of soil microorganism to process and mobilize the unavailable forms of nutrient elements to be available for absorption by roots. These results are in line with those reported by Magda (2002) and Fawzi *et al.* (2010) worked on the biofertilizer and Al-Obaidi (2008), Ibrahim (2010) and Stino *et al.* (2010) worked on potassium.

Table 1. Effect of potassium foliar spray and soil biofertilizer on leaf area, chlorophyll percentage and leaf dry weight of "Lozi" apricot trees during 2013 and 2014 seasons

Potassium g/l	Biofertilizer g/tree	Leaf area (cm^2)		Chlorophyll percentage		Leaf dry weight (%)	
		2013	2014	2013	2014	2013	2014
0	0	22.22	23.45	28.11	28.27	38.34	38.23
	10	23.23	23.89	28.33	28.78	38.54	38.66
	20	23.78	24.05	28.95	29.23	38.78	38.89
	30	24.08	24.77	29.34	29.89	38.97	39.04
5	0	22.34	24.11	28.56	28.66	38.86	39.00
	10	23.55	24.67	28.99	29.13	39.11	39.16
	20	24.04	25.43	29.56	30.00	39.23	39.26
	30	25.44	27.15	30.22	30.45	39.38	39.44
10	0	24.19	26.35	29.19	29.45	39.32	39.33
	10	25.78	27.31	29.80	30.11	39.56	39.77
	20	26.24	28.00	30.36	30.96	39.96	40.03
	30	27.13	28.28	30.87	31.14	40.19	40.25
LSD 5%	Potassium	0.86	0.89	1.36	1.48	NS	NS
	Biofertilizer	0.99	1.04	1.57	1.71	NS	NS
	Interaction	1.72	1.81	2.72	2.96	NS	NS

Table 2. Effect of potassium foliar spray and soil biofertilizer on leaf N, P, K content of "Lozi" apricot trees (2011 and 2012 seasons)

Potassium g/l	Biofertilizer g/tree	N (%)		P (%)		K (%)	
		2013	2014	2013	2014	2013	2014
0	0	0.79	0.86	0.13	0.16	1.11	1.16
	10	0.84	0.99	0.18	0.19	1.18	1.25
	20	0.97	1.02	0.20	0.22	1.24	1.33
	30	1.04	1.07	0.23	0.25	1.30	1.35
5	0	0.85	0.93	0.15	0.18	1.19	1.22
	10	0.97	0.99	0.19	0.22	1.29	1.34
	20	1.03	1.05	0.23	0.28	1.36	1.40
	30	1.08	1.11	0.29	0.32	1.47	1.51
10	0	1.00	1.06	0.19	0.23	1.24	1.29
	10	1.12	1.15	0.23	0.27	1.36	1.42
	20	1.19	1.23	0.30	0.34	1.45	1.53
	30	1.26	1.30	0.33	0.36	1.56	1.61
LSD 5%	Potassium	0.12	0.09	0.05	0.07	0.15	0.15
	Biofertilizer	0.14	0.11	0.06	0.09	0.18	0.17
	Interaction	0.23	0.15	0.11	0.14	0.29	0.30

Effect of Potassium Foliar Spray and Soil Biofertilizer on Fruit Set, Fruit Weight and Yield Per Tree

Values in Table 3 show that fruit set was not affected by potassium spray and biofertilizer in both seasons. Data in Table 3 generally showed that spraying potassium combined with biofertilizer enhanced fruit weight compared with potassium or biofertilizer application alone, untreated trees that gave the lowest fruit weight in the two studied seasons 14.78, 14.83, respectively. Application of potassium or biofertilizer alone or in combination improved significantly the yield per tree compared to control treatment. The increase in yield per tree may be due to the efficiency of photosynthesis by increasing the leaf area and the leaf chlorophyll content as shown in the Table 1 due to potassium spray and biofertilizer, which increased carbohydrates manufacturing, which positively reflected on the fruit weight and therefore increasing the yield.

These results are in agreement with Abdel-Hady (2003) on grapevines, Fawzi *et al.* (2010) on pear trees; as the fruit weight and yield were positively correlated with biofertilizer in these trees. These results are in harmony with Abd El-Fatah *et al.* (2008) worked on potassium spray in persimmon trees and Obaid (2012) worked on potassium spray in apricot trees.

Table 3. Effect of potassium foliar spray and soil biofertilizer on fruit set, fruit weight and yield per tree of "Lozi" apricot trees (2011 and 2012 seasons)

Potassium g/l	Biofertilizer g/tree	Fruit set (%)		Fruit weight (g)		Yield (kg/tree)	
		2013	2014	2013	2014	2013	2014
0	0	8.16	8.28	14.78	14.83	11.13	11.35
	10	8.25	8.36	15.99	16.04	11.29	11.41
	20	8.54	8.57	16.16	16.23	11.38	11.46
	30	8.66	8.67	16.37	16.44	11.49	11.56
5	0	8.22	8.28	16.20	16.35	11.45	11.50
	10	8.36	8.39	17.41	17.57	11.92	12.00
	20	8.48	8.51	17.60	17.79	12.03	12.11
	30	8.60	8.61	17.81	17.90	12.19	12.26
10	0	8.28	8.31	17.99	18.19	12.77	12.81
	10	8.38	8.41	18.45	18.73	13.40	13.55
	20	8.50	8.52	18.91	19.11	13.60	13.73
	30	8.62	8.64	19.43	20.17	14.05	14.27
LSD 5%	Potassium	N.S	N.S	1.01	1.11	0.44	0.48
	Biofertilizer	N.S	N.S	1.18	1.29	0.63	0.67
	Interaction	N.S	N.S	2.02	2.22	0.88	0.96

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تأثير رش البوتاسيوم والسماد الحيوي في النمو والمحصول للمشمش صنف لوزي (*Prunus armeniaca* L.)

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أجريت هذه التجربة في بستان مشمش خاص في مدينة سبع البور في بغداد للموسمين ٢٠١٣ و٢٠١٤ وعلى صنف المشمش لوزي بعمر سبع سنوات لمعرفة تأثير الرش بالبوتاسيوم والتسميد الحيوي على بعض الصفات الخضرية والثمرية، واشتملت هذه الدراسة على عاملين هما رش البوتاسيوم (K) والتسميد الحيوي (N)، واستخدم في هذه الدراسة ثلاث مستويات من البوتاسيوم هي صفر (K_1) و٥ (K_2) و ١٠ (K_3) جم/لتر وأربعة مستويات من السماد الحيوي هي صفر (N_1) و١٠ (N_2) و٢٠ (N_3) و ٣٠ (N_4) جم/شجرة، اشتملت كل معاملة على ثلاث مكررات في التجربة العامليه بتصميم القطاعات كاملة العشوائية، كان عدد الأشجار المستخدمة في التجربة ٣٦ شجرة، وأظهرت النتائج أن المعاملة K_3N_4 قد تفوقت على باقي المعاملات في مساحة الورقة؛ حيث أعطت أعلى القيم وهي ٢٧,١٣ و٢٨,٢٨سم^2، وأعلى معدل للكلوروفيل ٣٠,٨٧ و٣١,١٤ وحدات SPAD، وأعلى محتوى للأفرع من النتروجين بلغ ١,٢٦ و ١,٣٠%، وأعلى محتوى للأفرع من البوتاسيوم بلغ ١,٥٦ و ١,٦١%، وأعلى معدل لوزن الثمرة بلغ ١٩,٤٣ و ٢٠,١٧ جم، وأعلى حاصل بلغ ١٤,٠٥ و١٤,٢٧ كجم لموسمي الدراسة، على التوالي، بينما سجلت أقل القيم لهذه القياسات في معاملة المقارنة K_1N_1، نستنتج من هذا البحث أن معاملات رش البوتاسيوم عند المستوى k_3 وإضافة النتروبين عند المستوى N_4 أدت إلى تحسين الصفات الخضرية والثمرية في أشجار المشمش صنف لوزي ونوصي بإجراء هذه المعاملات سنوياً على أشجار المشمش ودراسة تأثير السماد البوتاسي والحيوي بتركيزات أخرى على أصناف المشمش.

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