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EFFECT OF FOLIAR APPLICATION OF POTASSIUM AND ZINC ON BEHVIOUR OF MONTAKHAB EL-KANATER GUAVA TREES

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ABSTRACT

This work was carried out for two successive seasons in 1997 and 1998 on budded Montakhab El-Kanater guava trees grown at the Horticulture Research Institute , Giza orchard. Potassium sulfate at 1%, 2% and 3% and zinc sulfate at 0.5%, 1% and 2% were sprayed at full bloom in both seasons. Shoot length, fruit set, fruit retention and yield as weight or number of fruits per tree were significantly increased with 1% 2% potassium sulfate as well as 0.5%, and 1% zinc sulfate sprays. Also, fruit quality was improved with all potassium and zinc treatments .

Key words: *guava, montakhab el-kanater, potassium, zinc.*

1. INTRODUCTION

Potassum is essential for the synthesis of amino acids, thus, plants do not grow in the abscence of potassium (Edmond, *et al.*, 1975).A number of researchers reported that potassium sulphate increased the number of fruits, reduced preharvest drop and improved fruit quality of citrus (Embleton and Jones 1964, Moss 1972; Embleton *et al.*, 1974, Bar-Aktiva and Hamou 1974).

Spraying potassium sulfate at 1% or 2% at mid March and mid May resulted in increased terminal shoot length, fruit set, fruit

retention, fruit yield, fruit weight, T.S.S. and Vitamin "C" content of guava fruits (Lotfy, *et al.*, 1990, Sharama, *et al.*, 1992).

Zinc is necessary in forming IAA, an auxin known to influence RNA and portein synthesis and increase the activity of pectinase and cellulase enzymes which caused increment of growth (Masuda, 1969). Some reports have indicated that zinc sulphate increased fruit set, yield and improved fruit quality (Samoladas, 1964 on mandarins, Embleton and Jones, 1964 on lemon, Champan 1968 on oranges and Sharama, *et al.*, 1974 on sweet orange).

Arora and Singh (1970) mentioned that spraying guava trees with 0.2 or 0.4% zinc sulphate solution during July, had great effect on enhancing chlorophyll content, yield, fruit content of Vitamin "C" and T.S.S., whereas acidity was reduced. Also, fruit set and yield were signficantly increased and T.S.S. were higher in treated fruits than in the control when guava trees were sprayed with zinc sulphate at 0.6 or 1% at mid May (Akahaya, 1971 and Sharama *et al.*, 1992).

The aim of this investigation was to study the effect of potassium and zinc sulphates on fruit set, fruit retention, yield per tree as well as the fruit quality of guava.

2. MATERIALS AND METHODS

This study was conducted during 1997 and 1998 seasons on budded Montakhab El-Kanater guava trees of six-year old and grown at the Horticulture Research Institute, Giza Experimental Orchard.

The selected trees were vigorous, uniform, productive and receiving normal horticultural procedures. Three concentrations of potassium sulphate, *i.e.*, 1%, 2% and 3% and zinc sulphate at 0.5%, 1% and 2% were applied in addition to a wetting agent at full bloom. Three uniform replicate trees were chosen for each treatment and each plot included one tree.

Hundred flowers of each tree were tagged to study the effect of potassium and zinc sulphate sprays on fruit set and fruit retention for each treatment at 2 and 14 week after full bloom. Fruit growth (diameter) was recorded at 2 week intervals. The yield of each replicate was recorded by weight and fruit number per tree at

commercial harvesting time. A sample of ten fruits was taken from each tree to determine fruit characteristics including: Fruit diameter, length, volume, weight, total soluble solids (%) acidity (%) and ascrobic acid content as mg/100 gm fresh weight.

Twenty new shoots on each tree were tagged and the vegetative growth was determined by measuring their length at the end of the growing season (at harvesing time).

3. RESULTS AND DISCUSSION

3.1.Effect of potassium and zinc on shoot length

Data presented in Table (1) show that there are signficant differences between different treatments in both seasons. Treated trees with potassium and zinc sulphates increased length of new shoots in comparison with untreated ones. The highest increase in average shoot length was obtained on trees treated with 0.5% zinc sulphate followed by treated trees with potassium sulphate at 2% in both seasons.

Also, $ZnSO_4$ at 1% and K_2SO_4 at 1 or 3% sprays gave a significant higher increase in shoot length than the control. The lowest value in shoot length was obtained in untreated trees or treated trees with $ZnSO_4$ at 2% in both seasons. There was no signficant difference in shoot length between $ZnSO_4$ at 2% and control. These results confirmed the findings of Masuda (1969) who mentioned that zinc is essential in forming IAA to influence RNA and protein synthesis and increase the activity of enzymes that change cell wall rigidity causing increment of growth. Moreover, Sharama *et al.*, (1992) reported that the number of leaves per shoot and terminal shoot length were increased when potassium sulfate at 1% was applied as a foliar spray on guava trees.

3.2. Effect of potassium and zinc sulfate on fruit set

Results obtained in Table (1) indicated that fruit set percentage was increased in treated trees than untreated ones in the both seasons. The highest signficant increase in fuirt set percentage was obtained when zinc sulfate was sprayed at 0.5 % followed by 1% in both

seasons. While zinc sulfate at 2% gave slight increase in fruit set percentage than the control but not signficant in the two seasons. Also, fruit set percentage was signficantly increased in treated trees with K_2SO_4 at 1 or 2%. The value of fruit set percentage reached about (61.9, 72.5%) by spraying K_2SO_4 at 1%, while 2% K_2SO_4 gave about (63.1, 76.1%) fruit set percentage in both seasons respectively. The lowest fruit set percentage was obtained in the control in both seasons.

These results confirmed previous findings that spraying $ZnSO_4$ at 1 or 2% increased fruit set percentage in guava trees. Lotfy *et al.*, (1990) and Sharama, *et al.*, (1992) mentioned that spraying potassium sulfate at 1% resulted in higher fruit set percentage of guava trees.

3.3. Effect of potassium and zinc sulfate on fruit retention

Statistical analysis showed significant differences in fruit retention between different treatments especially at 1 or 2% K_2SO_4 and 0.5 or 1% $ZnSO_4$ in comparison with other treatments as evident in Table (1) for the two seasons.

In 1997 and 1998 seasons, potassium sulfate significantly increased fruit retention. This was more pronounced at 1% and 2% concentrations as well as 0.5% and 1% zinc sulfate in comparison with the control and 3% K_2SO_4 or 2% $ZnSO_4$ which gave lower fruit retention percentage

Results of Table (1) revealed also a positive correlation between the fruit set percentage (2 weeks after full bloom) and fruit retention percentage (14 weeks after full bloom). This result coincided with findings of Sharama *et al.*, (1992) on guava trees who mentioned that spraying $ZnSO_4$ at (0.2, 0.4 or 0.6%) or K_2So_4 at (1, 1.5 or 2%) reduced preharvest abscission and increased fruit retention percentage compared with the control.

3.4. Effect of potassim and zinc sulfate on yield

Data concerning yield either by weight or by number of fruits per tree in the 1997 and 1998 seasons are shown in Table (1). It is obvious that treatments generally increased yield as weight or number

Table (1): Effect of potassium and zinc sulfate spraying on shoot length, fruit set, fruit retention and yield of guava trees during 1997 and 1998 Seasons.

Treatments	Average shoot length (Cm)	*Fruit set (%)	**Fruit retention (%)	Yield per tree	
				Weight of fruits (Kg)	Number of fruits
1997 Season					
Control (tap water)	20.90 c	45.50 b	22.80 b	28.40 b	281 b
K_2SO_4 (1%)	30.50 b	61.90 a	33.10 a	34.80 a	360 a
K_2SO_4 (2%)	38.60 a	63.10 a	35.40 a	36.00 a	350 a
K_2SO_4 (3%)	32.20 b	48.00 b	25.60 b	29.90 b	289 b
$ZNSO_4$ (0.5%)	40.80 a	70.20 a	40.00 a	39.40 a	385 a
$ZNSO_4$ (1%)	29.90 b	65.80 a	36.80 a	38.60 a	371 a
$ZNSO_4$ (2%)	22.00 c	50.60 b	27.10 b	30.80 b	292 b
1998 Season					
Control (tap water)	34.20 c	57.60 b	30.4 b	37.40 b	352 b
K_2SO_4 (1%)	43.80 b	72.50 a	38.9 a	45.90 a	444 a
K_2SO_4 (2%)	55.10 a	76.10 a	40.10 a	46.80 a	458 a
K_2So_4 (3%)	46.40 b	61.90 b	32.20 b	39.40 b	361 b
$ZNSo_4$ (0.5%)	57.10 a	80.00 a	44.80 a	50.10 a	482 a
$ZNSO_4$ (1%)	48.50 b	78.40 a	41.60 a	47.40 a	466 a
$ZNSO_4$ (2%)	35.80 c	62.80 b	29.50 b	40.00 b	371 b

* 2 Weeks after full bloom.

** 14 Weeks after full bloom.

Mean separation in columns was carried out using Duncan's multiple range test at 5% level.

of fruits per tree in the two seasons.

Regarding yield weight, data showed that there is a significant increase in trees treated with potassium sulfate at 1% or 2% and zinc sulfate at 0.5% or 1%. During 1997 season, the increment in yield as weight was about 22.5, 26.8, 38.7 and 35.9% more than the control when trees treated with K_2SO_4 at 1 or 2% and $ZnSO_4$ at 0.5 or 1% , respectively. While, 3% K_2So_4 and 2% $ZnSO_4$ gave slight increase; about 5.3 and 8.5% than the control, respectively. In 1998 season, the increament in tree yield weight was about 22.7, 25.1, 33.9 and 26.7% more than the control as a result of using 1 or 2% K_2SO_4 and 0.5 or 1% $ZnSo_4$ respectively. The other treatments 3% K_2So_4 and 2% $ZnSo_4$ gave a slight increase in tree yield weight; about 5.3 and 7% more than the control, respectively. There were no signficant differences in tree yield weight between these two treatments and the control.

Concerning yield as number of fruits per tree, data indicated that fruit number took the same trend as tree yield weight.

The increment in yield as number of fruits was about 28.1, 24.6, 37 and 32% than the control when trees were treated with 1 or 2% K_2SO_4 or 0.5 or 1% $ZnSO_4$ in the 1997 season respectively. While a slightly increment in yield as number of fruits was obtained(2.8 and 3.9% than the control) when trees were treated with K_2SO_4 at 3% and 2% $ZnSO_4$ respectively. In 1998 season, great increase in the number of fruits per tree was obtained (26.1, 30.1, 36.9 and 32.4%) than the control with spraying K_2SO_4 at 1 or 2% and $ZnSO_4$ at 0.5 or 1%, respectively. The two other treatments K_2SO_4 at 3% and $ZnSO_4$ at 2% gave a slight increment in yield as the number of fruits per tree when compared with the control. There was no signficant difference between them.

From these results it can be concluded that zinc sulfate at 0.5 or 1% followed by potassium sulfate at 1 or 2% are the promising treatments which gave the highest yield as weight or number of fruits per tree and the increase in tree yield was due to the effect of $ZnSO_4$ and K_2SO_4 treatments on increasing fruit set and fruit retention. The effect of $ZnSO_4$ and K_2SO_4 on yield was previously reported (Lotfy *et al.*, 1990 and Sharama *et al.*, 1992).

3.5. Effect of potassium and zinc sulfate on fruit quality

Data in Table (2) indicate that during the two seasons, fruit weight and volume were increased in all potassium treatments when compared with the control, this increase was evident in 3% potassium sulfate treatment.

Also, zinc increased fruit weight and volume especially when trees were sprayed with 2% followed by 1% zinc in comparison with the control in both seasons.

There were no differences in fruit diameter of different potassium and zinc sulfate treatments except a slight increase noticed by using 3% K_2SO_4 and 2% $ZnSO_4$ in both seasons. Also, fruit length was increased at 3% K_2SO_4 and 2% $ZnSO_4$ treatments in the first season and 3% K_2SO_4 and 1% or 2% $ZnSO_4$ in the second season in comparison with the control or other treatments.

Data in Table (2) showed that high signficant increases in values of total soluble solids in guava fruits were obtained by using 1 or 2% K_2SO_4 and 2% $ZnSO_4$ treatments when compared with the control or other treatments in the two seaons (1997 and 1998).

Concerning titratable acidity (%), potassium and zinc sulfate treatments reduced acidity in guava fruits, that was more pronounced at 0.5 and 1% $ZnSO_4$ followed by 1% K_2SO_4 than the control in the two seasons. However, no signficant differences existed in fruit acidity between the control and other treatments during the two seasons.

These results are in agreement with Lotfy *et al.*, (1990) and Sharama *et al.*, (1992). They mentioned that spraying K_2SO_4 (1, 1.5 or 2%) and $ZnSO_4$ (0.2, 0.4 or 0.6%) increased T.S.S. and reduced acidity of guava fruits.

Also, ascorbic acid content of fruits was signficantly increased by spraying potassium and zinc sulfate treatments, that was more pronounced at 2% K_2SO_4 which gave the highest increase in ascorbic acid content of fruits followed by 2% $ZnSO_4$ concentration when compared with the control in the both seasons. These results agree with the finding of Brosh *et al.*, (1976) on mandarin and Lotfy *et al.*, (1990) on guava.

Table (2): Effect of potassium and zinc sulfate spraying on fruit quality of guava trees in 1997 and 1998 seasons.

Treatments	Fruit weight (gm)	Fruit volum (cm)	Fruit dimensions		T.S.S. %	Acidity %	Ascorbic acid mg/100 gm F.W.
			Diameter (cm)	Length (cm)			
1997 Season							
Control (tap water)	105.2 a	103.2 a	5.20 a	5.50 a	8.10 b	0.46 a	66.90 b
K_2SO_4 (1%)	110.4 a	107.4 a	5.30 a	5.70 a	10.00 a	0.40 a	78.10 a
K_2SO_4 (2%)	114.0 a	112.6 a	5.35 a	5.60 a	9.80 a	0.43 a	82.80 a
K_2SO_4 (3%)	118.5 a	115.8 a	5.45 a	6.00 a	8.20 b	0.45 a	79.10 a
$ZnSO_4$ (0.5%)	100.8 a	99.10 a	5.20 a	5.50 a	7.80 b	0.38 a	77.00 a
$ZnSO_4$ (1%)	108.4 a	106.20 a	5.25 a	5.60 a	8.00 b	0.39 a	75.10 a
$ZnSO_4$ (2%)	111.6 a	110.00 a	5.40 a	5.90 a	9.50 a	0.44 a	80.00 a
1998 Season							
Control (tap water)	103.8 a	98.00 a	5.35 a	5.80 a	9.20 b	0.72 a	74.80 b
K_2SO_4 (1%)	106.2 a	100.10 a	5.40 a	5.90 a	11.10 a	0.66 a	82.90 a
K_2SO_4 (2%)	110.0 a	105.00 a	5.40 a	6.00 a	10.50 a	0.69 a	87.10 a
K_2SO_4 (3%)	116.1 a	121.80 a	5.55 a	6.10 a	9.40 b	0.70 a	83.40 a
$ZnSO_4$ (0.5%)	99.8 a	96.00 a	5.35 a	5.75 a	9.00 b	0.62 a	80.10 a
$ZnSO_4$ (1%)	106.4 a	101.00 a	5.40 a	5.85 a	9.50 b	0.65 a	81.50 a
$ZnSO_4$ (2%)	114.5 a	118.10 a	5.45 a	6.10 a	10.60 a	0.68 a	85.20 a

Mean separation in columns was carried out using Duncan's multiple range test at 5% level.

Table (3): Effect of potassium and zinc sulfate spraying on fruit growth (as diameter cm) of guava trees in 1997 and 1998 seasons.

Treatments	Weeks after full bloom							
	2	4	6	8	10	12	14	Mean
1997 Season								
Control	0.90	1.40	2.20	2.50	3.20	4.20	5.20	2.80a
K_2SO_4 (1%)	1.05	1.55	2.25	2.60	3.35	4.35	5.30	2.92a
K_2SO_4 (2%)	1.10	1.60	2.30	2.70	3.40	4.40	5.35	2.98a
K_2SO_4 (3%)	1.10	1.70	2.35	2.70	3.50	4.40	5.45	3.02a
$ZNSO_4$ (0.5%)	0.95	1.40	2.30	2.55	3.25	4.15	5.20	2.82a
ZNS O_4 (1%)	0.90	1.50	2.30	2.60	3.35	4.25	5.25	2.88a
$ZNSO_4$ (2%)	1.05	1.60	2.25	2.60	3.40	4.40	5.40	2.95a
1998 Season								
Control	1.00	1.50	2.30	2.60	3.20	4.30	5.35	2.89 a
K_2SO_4 (1%)	1.10	1.60	2.30	2.55	3.30	4.35	5.40	2.94 a
K_2SO_4 (2%)	1.10	1.60	2.35	2.70	3.40	4.45	5.40	3.00 a
K_2SO_4 (3%)	1.10	1.65	2.40	2.70	3.50	4.50	5.55	3.05 a
$ZNSO_4$ (0.5%)	1.05	1.55	2.20	2.50	3.25	4.25	5.35	2.88 a
$ZNSO_4$ (1%)	1.00	1.60	2.25	2.65	3.30	4.35	5.40	2.93 a
$ZNSO_4$ (2%)	1.10	1.65	2.35	2.70	3.40	4.40	5.45	2.87 a

Mean separation in columns was carried out using Duncan's multiple rangs test at 5% level.

3.6. Effect of potassium and zinc sulfate on fruit diameter

No signficant differences could be shown in diameter of guava fruits between different treatments during the two seasons as shown in Table (3). At 1, 2 or 3% potassium sulfate and 1 or 2% zinc sulfate, slight increase in fruit diameter was noticed, while 0.5% $ZnSO_4$ treatment was nearly equal to the control in fruit diameter during the two seasons. These results are in parallel with that of Sharama, *et al.*, (1992) who found that K at 1% applied as foliar spray alone, increased fruit growth of guava compared with the control.

Results from Tables (1, 2 and 3) showed that increment in number of fruits per tree did not greatly affect fruit diameter which might be due to the stimulating effect of potassium and zinc on fruit growth.

It can be concluded that K_2SO_4 at 1 or 2% and 0.5 or 1% $ZnSO_4$ concentrations attained the best results through increasing fruit set, fruit retention, increasing yield and improving fruit quality.

4. REFERENCES

Akahaya Kumar Saha (1971). Effect of foliar feeding of nutrients on fruit set of guava *(Psidium guajava)*. The Alla habad Farmer. *XTV* (5).

Arora J.S. and Singh J.R., (1970). Some effects of iron spray on growth, yield and quality of guava trees *(Psidium guajava)*. J. Jap. Soc. Hort. Sci., 39: 139-143.

Bar-Aktiva A. and Hamou M. (1974). Soil factors influencing fruit quality and mineral composition of leaves of Valencia orange trees. Comm. Soil Sci. and Plant Analysis (3): 203-212.

Brosh P. A. Kaluski and Bryn Z. (1976). Increase fruit size of Michal mandarin by fruit thinning and nutritional spray. Alon Hanotea: PP. 653-660 (in Hebrew).

Champan H.D., (1968). The mineral nutrition of citrus. The citrus Industry. 11. Chapter 3, Calif. Univ.

Edmond J.B., Senn T.L ., ndrews F.S. and Halfacre R.G. (1975). The essential elements. Fundamentals of Horticulture. Mcgraw-Hill Book Company. 4th. ed., 131 PP.

Embleton T.W. and Jones W.W. (1964). Leaf analysis: a tool for determining the nutrient status of citrus. Proc. Soc. Soil and Plant Diagnosticiants, 1: 160-169.

Embleton T.W., Jones W.W, Platt. R.G. and Burns R.M. (1974). Potassium nutrition and deficiency in citrus. Calif. Agric., 28(8): 1-20.

Lotfy H.O., Ikram S. and M. El-Said. 1990. Effect of potassium sulfate foliar application on guava trees. Agric. Res. Rev. 68(5): 949-955.

Masuda Y. (1969). Auxin induced cell expansion in relation to cell wall extensibility. Plant and Cell Physiol., 10: 1-9.

Moss G.E. (1972). The role of potassium in determining fruit quality of sweet orange. Australian J. Exp. Agric. Anim. Husbandry, 12 : 195-202.

Samoladas T.H. (1964). The effect of micro elements on tree yield and metabolism of the Unshiu mandarin. Bot. Zurnel, 49: 428-432. (Hort. Abst., 35: 1841).

Sharama R.B., Singh. R. and Sharma H.C., (1974). Response of sweet orange plants to zinc, urea and DBCP. Indian Journal of Hort. 31(1) : 38-44.

Sharama R.K., Ram Kumar and Thakur. S. (1992). Effect of foliar feeding of potassium, calcium and zinc on yield and quality of guava. Indian Journal of Hort. 48(4): 312-314 (Hort. Abst., 62 : 10531).

تأثير الرش بالبوتاسيوم والزنك على سلوك اشجار الجوافة صنف منتخب القناطر

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ملخص

أجريت هذه الدراسة خلال موسمي 1997 ، 1998 على أشجار الجوافة صنف منتخب القناطر بمزرعة معهد بحوث البساتين - بالجيزة. وذلك بغرض دراسة تاثير الرش بكبريتات البوتاسيوم والزنك على عقد الثمار والمحصول وكذلك مواصفات الجودة لثمار الجوافة. وقد اشتملت الدراسة على المعاملات الآتية:-

كبريتات البوتاسيم بتركيز 1% ، 2%،3%.

كبريتات الزنك بتركيز 0.5 % ، 1%، 2%.

تم الرش في مرحلة الإزهار الكامل في كلا الموسمين وقد أوضحت النتائج أن الرش بكبريتات البوتاسيوم بتركيز 1% ، 2%. وكذلك كبريتات الزنك بتركيز 0.5 %،1% أدت إلى زيادة معنوية في طول الفرع، وعقد الثمار والمحصول وكذلك أدت جميع المعاملات إلى تحسين صفات جودة الثمار.

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