J. Agric. Sci. Mansoura Univ., 32 (9): 7653 - 7664, 2007

IMPROVING GROWTH AND YIELD OF "COSTATA" PERSIMMON TREES GROWN IN CALCAREOUS SOIL USING MAGNESIUM FERTILIZATION

Mikhael, G.B. and A.S. Wally

Deciduous Fruit Trees Research Department, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt

ABSTRACT

This investigation was carried out during the seasons of 2003, 2004 and 2005 to study the effect of magnesium fertilization on vegetative growth, leaf mineral and chlorophyll contents, yield and fruit quality of "Costata" persimmon trees grown on calcareous soil at El-Beheira Governorate. Results were only taken in 2004 and 2005 seasons. In this respect, four rates (75, 100, 125 and 150 g/tree/year) of both sulphate and chelated magnesium fertilizer forms were used in comparison with control. Each Mg fertilizer rate was applied in two equal doses at mid March and April, respectively. The data revealed that shoot length and diameter as well as area per leaf, were increased by raising Mg (sulphate or chelated) rate up to 125 or 150 g/tree/year. Also, N,P,K and Mg as well as total chlorophyll contents in leaves were significantly increased with increasing Mg fertilizer as compared to the control whereas, leaf Ca content was decreased. On the other hand, Fe, Mn and Zn were not affected in both seasons.

Using 150 g/tree/year of Mg-sulphate and 125 or 150 g/tree/year of Mg-chelated significantly increased fruit set % and yield as number and weight of fruits per tree than the control. In addition, raising either Mg sulphate or chelated rate gradually increased average fruit weight, size, firmness and SSC value. However, acidity percentage and total tannin content in fruit juice were not significantly affected.

Generally, adding 150 g/tree/year of Mg-sulphate or 125 g/tree/year Mg-chelated to the fertilization program of “Costata” persimmon trees. produced a higher yield with good fruit quality.

INTRODUCTION

Japanese persimmon (*Diospyros kaki* L.) is a deciduous fruit trees which belonged to family Ebenaceae. It has bean introduced to Egypt in 1911 (Baghdady and Mineasy, 1964) and successfully grown under the Egyptian environmental conditions due to its low chilling requirements (less than 250 effective chilling units). Persimmon trees grow well in a wide range of soil and produced best on deep fertile, medium textured and will drained soil (Larue *et al.,* 1982). The cultivated area increased specially in the last few years since it reached about 1465 feddans in 2005 produced 8846 tons of fruit according to the last statistics of Ministry of Agriculture and Land Reclamation (2005).

Magnesium plays several important roles in plant. It appears to be involved in the stabilization of ribosomal particles by binding together the subunits that make up the ribosome and serves as an activator of many plant enzyme systems required in growth processes. In addition, it is a component part of chlorophyll molecule and thus essential for photosynthesis process (Mengel and Kirkby 1978 and Bidwell, 1979).

Several reporters i.e., Abu Sayed-Ahmed (1997), Attala *et al.* (1997), Abd El-Wahab *et al.* (1999), El-Gazzar (2000) and Ahmed and Abd El-Hameed (2003) confirmed the beneficial effects of using magnesium on growth, nutritional status and productivity in various deciduous fruit trees.

In Egypt, the traditional fertilization program for almost all fruit crops raised on the soil, did not include magnesium as an essential nutritive element. However, many symptoms of deficiency have bean recently noticed on trees grown in calcareous soil especially under heavy application of K fertilizer which reduced the ability of trees to Mg uptake (Clark and Kajiura, 1986).

This work aimed to study the effect of magnesium fertilization on growth, leaf mineral content, yield and fruit quality of "Costata" persimmon trees grown in calcareous soil.

MATERIALS AND METHODS

This investigation was carried out during three successive seasons of 2003, 2004 and 2005 on 6-years old "Costata" persimmon trees budded on *D. lotus* rootstock, planted at 4 x 4 meters and grown in private orchard located at Abo El-Matamer district, Beheira Governorate, Egypt. The orchard soil was calcareous and the depth of water table was about 140-160 cm. Some analytical properties of the experimental soil are presented in Table (1).

Table (1): Some physical and chemical properties of the experimental soil.

Soil depth (cm)	Soil pH	EC mmhos/cm	O.M %	$CaCO_3$ %	Soluble cations meq/L				Soluble anions meq/L			
					Na^+	K^+	Ca^+	Mg^{++}	CO^{--}_3	HCO^-_3	Cl^-	SO^{--}_4
0-30	8.1	0.45	1.12	15.6	2.94	0.56	3.12	2.27	0.00	1.05	4.28	3.56
30-60	8.3	0.32	0.86	16.2	2.31	0.48	2.80	1.63	0.00	0.79	3.96	2.47

The trees were subjected to cultural practices usually done in this area and NPK fertilization program applied was 1.2 kg ammonium nitrate (33.5% N), 1.0 kg calcium super phosphate (16.0% P_2O_5) and 0.750 kg potassium sulphate (48% K_2O) per tree. Beside, 10 m^3/fed. farmyard manure as organic fertilizer.

Magnesium sulphate (9.8% Mg) or chelated magnesium (14% Mg) was applied in four rates, 75, 100, 125 and 150 g/tree, spread and mixed with the soil under each tree beside, control (which left without magnesium fertilizer). Each level of Mg was divided into two equal doses added at mid-March and April in each season. Twenty seven uniform trees were selected and arranged under nine treatments including the control in a complete randomized block design, each treatment replicated three times with one tree plot and each tree plot surrounded with four untreated trees.

Four main branches, in different direction on each tree were labeled. All new shoots developed on these branches in spring were used for measuring vegetative growth parameters i.e., shoot length and diameter (cm) and leaf area (cm^2) by Li-core 3100 Area meter.

Leaf samples were taken from the middle part of current shoots of each tree in mid-August, then washed, dried, ground and digested with H_2O_2 and H_2SO_4 to determined leaf N by micro-kjeldahl methods (A.O.A.C., 1990), P colourimetrically according to Foster and Cornelia (1967) and K by flame photometer E.E.L., Model (Jackson, 1967).

Ca, Mg, Fe, Mn and Zn were determined using the Atomic absorption spectrophotometer Perkin-Elmer 23800 AL, according to Jackson and Ulish (1959) and Yoshida *et al.* (1972).

Fresh leaf samples were also taken in mid August from each replicate for extracting chlorophyll in 5 ml N.N. dimethyl formamide to determined chlorophyll a and b which estimated according to the method of Moran (1982), then total chlorophyll was calculated.

Percentage of fruit set was calculated by dividing the number of fruit on May, 31st by the total number of flowers which were developed on the selected main branches (four year old). The number of preharvest dropped fruit was recorded after June drop, then the percentage of preharvest fruit drop was calculated in relation to the total number of fruits harvested per trees.

Yield as number and weight (kg) of fruits per tree were recorded at harvest time (first week of October). Ten mature fruits were taken at random to determined fruit weight (g), volume (cm^3) and firmness (lb/in^2). Juice samples were prepared for determined soluble solids content (SSC) by using Gallilis hand refractometer, total acidity % was calculated as malic acid and total tannin contents according to A.O.A.C (1990).

The present data was statistically analyzed according to Snedecor and Cochran (1990) and the treatment means were compared by using Duncan's multiple range test at 5% level of probability.

RESULTS AND DISCUSSION

Effect of magnesium treatments on:

1.Vegetative growth:

Data presented in Table (2) indicated a gradual increase in shoot length and diameter (cm) as well as leaf area (cm^2) of "Costata" persimmon trees by increasing the levels of magnesium which added in sulphate or chelated forms. The highest significant increment were obtained by adding 100, 125 or 150 chelated and 150 g/tree sulphate form without significant differences among them. The effects of magnesium fertilization on shoot and leaf growth parameters were significant in both seasons. The improvement in vegetative growth parameters could be attributed to the enhancement of Mg element sto biosynthesis of carbohydrates as well as their positive action on stimulating both cell division and cell enlargement (Nijjar, 1985). These findings were confirmed by the results of Attala *et al.* (1997) on pear trees and Abo-Sayed Ahmed (1997) and Ahmed and Abd El-Hameed (2003) on grapevines.

Table (2): Effect of magnesium application on vegetative growth of "Costata" persimmon trees.

Magnesium fertilizer		Shoot length (cm)		Shoot diameter (cm)		Leaf area (cm^2)	
Form	**Level g/tree**	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**
Control*		16.4 d	17.1 c	0.47 d	0.50 d	52.2 c	53.9 e
Sulphate	75	17.4 d	18.1 c	0.49 cd	0.51 d	56.3 c	54.6 e
	100	17.8 cd	18.5 c	0.51 c	0.53 cd	58.6 c	59.3 de
	125	19.6 bc	20.6 b	0.54 b	0.56 b	63.9 b	62.8 cd
	150	23.2 a	23.7 a	0.58 a	0.59 a	69.2 a	69.5 ab
Chelated 75	75	21.5 ab	22.9 a	0.54 b	0.55 bc	66.3 ab	65.8 bc
	100	22.3 a	24.0 a	0.57 a	0.59 a	67.9 ab	70.5 ab
	125	23.3 a	24.4 a	0.59a	0.60 a	69.2 a	73.1 a
	150	23.6 a	24.4 a	0.59 a	0.61 a	71.4 a	73.6 a

Mean separation with columns at P = 0.05 by Duncan's multiple range test.
Magnesium sulphate ($MgSO_4$. 7 H_2O) and chelated form contain 9.8 and 14% Mg, respectively.
*** Control treatment: adding no magnesium fertilizer.**

2. Leaf mineral contents:

Data concerning the effect of magnesium fertilization on N, P and K, in leaves of "Costata" persimmon trees (Tables 3) presented that soil application with the higher rates of either sulphate or chelated magnesium fertilizer form (125 or 150 g/tree) significantly increased leaf N and P content in both seasons as well as leaf K-content only in the first season than that the control.

Table (3): Effect of magnesium application on leaf nitrogen, phosphorus and potassium contents of "Costata" persimmon trees.

Magnesium fertilizer		N%		P%		K%	
Form	**Level g/tree**	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**
Control*		1.87 c	1.93 d	0.148 e	0.151 d	2.15 c	2.12 a
Sulphate	75	2.00 bc	2.07 cd	0.157 de	0.154 d	2.23 abc	2.24 a
	100	2.13 abc	2.13 bcd	0.163 cd	0.167 c	2.32 abc	2.31 a
	125	2.27 ab	2.20 a-d	0.173 abc	0.176 abc	2.40 ab	2.35 a
	150	2.33 a	2.27 abc	0.176 ab	0.179 ab	2.44 a	2.36 a
Chelated	75	2.13 abc	2.20 a-d	0.170 bc	1.73 bc	2.19 bc	2.16 a
	100	2.20 ab	2.33 abc	0.173 abc	0.176 abc	2.23 abc	2.23 a
	125	2.40 a	2.40 ab	0.179 ab	0.182 ab	2.27 abc	2.27 a
	150	2.33 a	2.47 a	0.182 a	0.186 a	2.31 abc	2.32 a

Mean separation with columns at P = 0.05 by Duncan's multiple range test.
Magnesium sulphate ($MgSO_4$. 7 H_2O) and chelated form contain 9.8 and 14% Mg, respectively.
*** Control treatment: adding no magnesium fertilizer**

With respect to the influence of magnesium treatments on leaf Ca and Mg contents, the obtained data in Table (4) clear that leaf Mg content was significantly increased while, leaf ca content was significantly reduced by increasing magnesium fertilizer (sulphate or chelated) rate up to 125 or 150 g/tree as compared to the control in 2004 and 2005 seasons.

Table (4): Effect of magnesium application on leaf calcium, and magnesium contents of "Costata" persimmon trees.

Magnesium fertilizer		Ca%		Mg%	
Form	**Level g/tree**	**2004**	**2005**	**2004**	**2005**
Control*		2.52 a	2.49 a	0.28 f	0.30 f
Sulphate	75	2.45 ab	2.44 ab	0.32 ef	0.33 ef
	100	2.41 ab	2.43 ab	0.38 cd	0.378 de
	125	2.43 ab	2.39 bc	0.40 bcd	0.41 cd
	150	2.38 b	2.36 c	0.43 abc	0.42 bc
Chelated	75	2.44 ab	2.42 bc	0.35 de	0.36 e
	100	2.40 ab	2.41 bc	0.39 bcd	0.43 abc
	125	2.39 b	2.37 bc	0.44 ab	0.47 a
	150	2.37 b	2.35 c	0.45 a	0.46 ab

Mean separation with columns at P = 0.05 by Duncan's multiple range test.
Magnesium sulphate ($MgSO_4$. 7 H_2O) and chelated form contain 9.8 and 14% Mg, respectively.
*** Control treatment: adding no magnesium fertilizer**

The present results of leaf micronutrients in Table (5) revealed that leaf Fe, Mn and Zn contents were not significantly affected by all magnesium fertilization treatments in both seasons.

Table (5): Effect of magnesium application on leaf micronutrients contents of "Costata" persimmon trees.

Magnesium fertilizer		Micronutrients (ppm) on D.wt.					
		Fe		Mn		Zn	
Form	**Level g/tree**	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**
Control*		120.2a	118.5a	126.1a	127.4a	16.8a	18.9a
Sulphate	75	121.5a	119.9a	134.2a	128.2a	17.2a	17.4a
	100	118.4a	120.8a	132.5a	133.7a	16.4a	18.1a
	125	122.2a	121.7a	136.9a	138.3a	18.0a	18.9a
	150	123.3a	122.6a	138.2a	139.0a	18.6a	19.2a
Chelated	75	119.8a	118.3a	129.7a	130.2a	17.7a	18.8a
	100	120.6a	120.1a	135.8a	134.6a	19.2a	20.2a
	125	122.6a	123.0a	140.2a	139.3a	21.1a	20.6a
	150	124.1a	123.8a	139.6a	139.9a	20.7a	20.5a

Mean separation with columns at P = 0.05 by Duncan's multiple range test.
Magnesium sulphate ($MgSO_4$. 7 H_2O) and chelated form contain 9.8 and 14% Mg, respectively.
*** Control treatment: adding no magnesium fertilizer.**

The increment or reduction attributed in the studied nutrients in response to the present magnesium fertilization treatments might be due to either synergism or antagonism between nutrients.

These results are in harmony with those obtained by Attala *et al.* (1997) who found that, application with high level of magnesium from sulphate or chelated sources recorded the highest values of K and Mg in leaves of "LeCont" per tree. Also, Ahmed and Abd El-Hameed (2003) indicated that, the application of magnesium sulphate increased significantly the percentage of N, P and Mg in leaves of Red Roomy vines. However, Maksoud *et al.* (1994) reported that, soil application of $MgSO_4$ caused a slight reduction in leaf Ca-content of "Washington Navel" orange trees. In addition, El-Gazzar (2000) mentioned that, iron manganese and zinc were not significantly affected with different rates of magnesium fertilization.

3. Leaf chlorophyll contents:

As regard to the effect of magnesium fertilization on leaf chlorophyll contents, data from Table (6) indicated that all levels of the two magnesium fertilizer forms (sulphate and chelated) significantly increased both chlorophyll a and total chlorophyll in leaves of "Costata" persimmon trees as compared to the control in both seasons of 2004 and 2005. However, chlorophyll b was only significantly increased in the second season especially under high rate of magnesium fertilizer 150 g/tree (sulphate or chelated form).

Table (6): Effect of magnesium application on leaf chlorophyll contents of "Costata" persimmon trees.

Magnesium fertilizer		Leaf chlorophyll contents µg/cm^2					
		Chl. a		Chl. b		Total chl.	
Form	Level g/tree	2004	2005	2004	2005	2004	2005
Control*		59.53f	60.18e	27.09a	27.03d	86.62e	87.20g
Sulphate	75	63.00e	65.01d	27.24a	26.92d	90.23de	91.94f
	100	64.90d	68.07c	28.43a	28.33bcd	93.33cd	96.40de
	125	68.26c	70.32b	27.52a	28.06cd	95.78bc	98.38d
	150	70.50b	72.39ab	29.15a	29.19bc	99.65ab	101.58bc
Chelated	75	65.06d	66.94cd	27.19a	27.96cd	92.25cd	94.90e
	100	69.52bc	70.54b	28.13a	28.84bcd	97.65b	99.38cd
	125	72.88a	72.25ab	29.70a	30.26ab	102.58a	102.51b
	150	73.78a	74.24a	29.78a	31.42a	103.56a	105.67a

Mean separation with columns at P = 0.05 by Duncan's multiple range test.
Magnesium sulphate ($MgSO_4$. 7 H_2O) and chelated form contain 9.8 and 14% Mg, respectively.
*** Control treatment: adding no magnesium fertilizer.**

Our results could be attributed to the role of magnesium as a metallic constituent of chlorophyll. These results are in conformity with the findings of Attala *et al.* (1997) who indicated that, total chlorophyll content in leaves of "LeCont" pear trees was increased by soil application with sulphate or chelated magnesium fertilizer. Moreover, Lavon *et al*. (1999) noticed that, chlorophyll levels in citrus leaves were significantly reduced under Mg deficiency.

4. Fruit set percentage:

The effect of Mg fertilization on fruit set percentage, of "Costata" persimmon trees grown in calcareous soil is presented in Table (7). From the data, it is clear that adding 125 or 150 g/tree of Mg-sulphate and 150 g/tree Mg-chelated significantly increased fruit set percentage without significant differences among them and the difference between each of them and the control was significant in both seasons.

Such results of Mg treatments on fruit set are going in agreement with those of Attala *et al.* (1997) on pear and Abd El-Wahab *et al.* (1999) on apple who found that, fruit set was improved due to application of magnesium fertilizer. However, Yogaratinam and Greenham (1982) who reported that, final fruit set of "Discovery" apple trees was no significantly influenced by foliar application with $MgSO_4$.

Table (7): Effect of magnesium application on fruit set and preharvest fruit drop percentages of "Costata" persimmon trees.

Magnesium fertilizer		Fruit set **(%)		Preharvest fruit drop (%)	
Form	Level g/tree	2004	2005	2004	2005
Control*		60.2 c	61.5 e	1.68 a	1.82 a
Sulphate	75	65.2 bc	66.1 de	1.74 a	1.69 a
	100	67.1 bc	68.4 bcd	1.65 a	1.59 a
	125	72.4 ab	73.9 b	1.59 a	1.54 a
	150	79.3 a	79.9 a	1.63 a	1.53 a
Chelated	75	63.6 bc	65.2 de	1.67 a	1.70 a
	100	66.0 bc	67.8 cd	1.70 a	1.61 a
	125	69.1 abc	70.2 bcd	1.53 a	1.56 a
	150	72.8 ab	72.8 bc	1.47 a	1.52 a

Mean separation with columns at $P = 0.05$ by Duncan's multiple range test.
Magnesium sulphate ($MgSO_4$. 7 H_2O) and chelated form contain 9.8 and 14% Mg, respectively.
*** Control treatment: adding no magnesium fertilizer**
**** Fruit set % in May, 31st**

5. Preharvest fruit drop:

Data of Table (7) showed that, various magnesium fertilization treatments had no effect on preharvest fruit drop during the both seasons of 2004 and 2005 and differences were not significant. These findings are in line with those reported by Wally (1987) who indicated that, there were no post bloom or preharvest drop in "Costata" persimmon cultivar.

6. Yield:

From Table (8), it is clear that, yield as number of fruits per tree was significantly influenced by soil application with both magnesium fertilizers. The highest number of fruits were produced by adding 125 or 150 g/tree of Mg-sulphate or chelated form. Differences among of them were not significant while, difference between each of them and the control was significant in both seasons of study. These findings might be due to the increasing in fruit set percentage as a result of magnesium fertilization.

From the mentioned data in Table (8) it was cleared that yield (kg/tree) was significantly increased by all tested Mg treatments in comparison to the control in both seasons. The best results were obtained by using 150 g/tree of $MgSO_4$, 125 and 150 g/tree of Mg-chelated which produced maximum yield with (31. 8 & 33.6), (34.6 & 35.0) and (34.9 & 35.1) kg/tree in 2004 and 2005 seasons, respectively. Meanwhile, the control treatment (untreated trees) produced the minimum fruit yield with (19.0 & 20.1) kg/tree in both seasons, respectively. However, other Mg treatments came inbetween. The positive action of magnesium application in increasing cell division and biosynthesis of organic substances and improving nutrients uptake which reflected in enhancing tree growth, could explain the increase in fruit set and number of fruit per trees. Furthermore, the increase in number of fruits and average fruit weight could be explain the yield increases. Similar results were obtained by Maksoud *et al.* (1994) and Ram and Bose (2000) on citrus trees and Forshey (1963), Abd El-Wahab *et al*. (1999) and El-Gazzar (2000) on apple trees. Pointed out that, tree yield as number and weights (kg) was significantly increased by increasing magnesium fertilization rate.

Table (8): Effect of magnesium application on yield of "Costata" persimmon trees.

Magnesium fertilizer		No. of fruits/tree		Yield (Kg/tree)	
Form	Level g/tree	2004	2005	2004	2005
Control*		179 e	181 d	19.0 g	20.1 e
Sulphate	75	191 de	196 c	21.8 f	22.9 d
	100	203 bcd	210 b	24.2 e	25.3 c
	125	211 a-d	216 ab	26.0 d	28.3 b
	150	224 ab	228 a	31.8 ab	33.6 a
Chelated	75	199 cde	195 c	25.3 de	25.67 c
	100	215 abc	208 bc	29.2 c	28.9 b
	125	218 abc	214 ab	34.6 a	35.0 a
	150	227 a	219 ab	34.9 a	35.1 a

Mean separation with columns at P = 0.05 by Duncan's multiple range test.
Magnesium sulphate ($MgSO_4$. 7 H_2O) and chelated form contain 9.8 and 14% Mg, respectively.
*** Control treatment: adding no magnesium fertilizer**

7. Physical and chemical fruit properties:

a. Average fruit weight and size:

Data in Table (9) revealed that, average fruit weight (g) and volume (cm^3) were increased by raising either sulphate or chelated Mg fertilizer rate. The application of 125 or 150 g/tree of Mg-chelated form recorded the highest average fruit weight and size without significant differences between them in 2004 season while, the least values obtained with the control and all other Mg treatments come inbetween. The data of the second season revealed the similar trend. The present results are in parallel with those of Attala *et al.* (1997) who indicated that, fruit weight of "LeCont" pear trees was significantly increased by magnesium treatments. On contrary, Forshey (1963) mentioned that, there was no apparent effect of Mg treatment on apple fruit size.

Table (9): Effect of magnesium application on some physical properties of "Costata" persimmon fruits.

Magnesium fertilizer		Av. fruit weight (g)		Av. fruit volume (cm^3)		Fruit firmness lb/in^2	
Form	Level g/tree	2004	2005	2004	2005	2004	2005
Control*		106.5e	111.0f	108.6d	113.9f	15.8d	16.1e
Sulphate	75	114.1de	116.6ef	115.9cd	119.5ef	17.2bc	17.4cd
	100	119.4cde	120.5ef	118.2cd	122.2def	18.3ab	18.5ab
	125	123.2cde	131.2de	122.0cd	129.5cde	19.1a	19.3a
	150	141.8b	147.3bc	145.5ab	151.9ab	18.3ab	18.6ab
Chelated	75	127.3cd	130.7de	130.6bc	134.7cd	16.7cd	17.3d
	100	135.8bc	138.9cd	140.4ab	142.8bc	17.8bc	18.2bcd
	125	158.8a	163.5a	155.7a	161.0a	18.4ab	18.9ab
	150	153.5a	160.4ab	155.8a	161.4a	18.0ab	18.3abc

Mean separation with columns at P = 0.05 by Duncan's multiple range test.
Magnesium sulphate ($MgSO_4$. 7 H_2O) and chelated form contain 9.8 and 14% Mg, respectively.
*** Control treatment: adding no magnesium fertilizer**

b. Fruit firmness:

The effect of magnesium fertilization treatments on fruit firmness (Ib/in^2), data from Table (9) revealed that, increasing Mg sulphate or chelated fertilizer rate up to 125 g/tree significantly increased fruit firmness, yet it decreased with the highest rate (150 g/tree). This increment could be as a result of increasing magnesium pectate in middle lamella of fruit cells while, the reduction in fruit firmness under the application of high Mg fertilizer rate might be due to the great increment in fruit size. This hold was true in both seasons. These results are supported by the conclusion of Noe *et al.* (1995) who found that Mg fertilization increased firmness of "Golden Delicious" apple fruits. On the other hand, El-Gazzar (2000) indicted that, application of 25 g/tree $MgSO_4$ significantly decreased fruit firmness of "Anna" applies.

c. Soluble solids contents (SSC):

Data of Table (10) showed that, SSC value was significantly increased by using all magnesium fertilization treatments as compared to the control in both 2004 and 2005 seasons. The highest values always come from 125 and 150 g/tree of Mg-sulphate or chelated form while, the control treatment recorded the least values. This result could be attributed to higher magnesium level which enhanced the net photosynthesis (Pn) and accumulated more carbohydrate substances. These results are in conformity with the findings of Kabeel *et al.* (1998).

Table (10): Effect of magnesium application on some chemical properties of "Costata" persimmon fruits.

Magnesium fertilizer		SSC (%)		Total acidity (%)		Total tannins (%)	
Form	**Level g/tree**	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**
Control*		20.4e	21.1d	0.456a	0.451a	2.38a	2.45a
Sulphate	75	21.6d	22.2c	0.447a	0.438a	2.24a	2.52a
	100	21.8cd	22.5bc	0.429a	0.442a	2.31a	2.31a
	125	22.5a-d	22.9ab	0.442a	0.425a	2.10a	2.24a
	150	22.8ab	23.2a	0.420a	0.429a	2.03a	2.17a
Chelated	75	21.9bcd	22.4bc	0.438a	0.433a	2.24a	2.38a
	100	22.6abc	22.8abc	0.424a	0.442a	2.03a	2.24a
	125	22.9a	23.1ab	0.433a	0.416a	2.17a	2.10a
	150	23.2a	23.3a	0.415a	0.411a	2.17a	2.17a

Mean separation with columns at P = 0.05 by Duncan's multiple range test.
Magnesium sulphate ($MgSO_4$. 7 H_2O) and chelated form contain 9.8 and 14% Mg, respectively.
*** Control treatment: adding no magnesium fertilizer**

d. Total acidity and tannin content:

Data from the same table also indicated that, total acidity and tannin content were not significantly affected by all magnesium fertilization treatments used in this study as shown in (Table 10). Similar observation were also achieved by El-Gazzar (2000).

Conclusion:

Adding 150 g/tree of magnesium sulphate or 125 g/tree of chelated magnesium are essential application for fertilization program of "Costata" persimmon trees grown in calcareous soil at El-Beheira Governorate which are considered the best treatments in this study. These two treatments not only improved vegetative growth and nutritional status but also produced maximum yield which presented as number and weight (kg) of fruits per tree with good quality particularly average fruit weight, size, firmness and SSC values.

REFERENCES

Abd El-Wahab, W.A.; Samira, M. Mohamed and Gihan, A. Mahmoud (1999). Effect of foliar application of some mineral elements on fruit set, yield, leaf mineral contents and storage ability of Anna apple fruits. J. Agric. Sci. Mansoura Univ., 24(12): 7547-7557.

Abo-Sayed Ahmed, T.A. (1997). Response of Thompson seedless grapevines to magnesium sulphate foliar application. Zagazig J. Agric. Res., 24(1): 117-130.

Ahmed, A.M. and H.M. Abd El-Hameed (2003). Growth, uptake of some nutrients and productivity of Red Roomy vines as affected by spraying of some amino acids, magnesium and boron. Minia J. of Agric. Res. & Develop., 23(4): 649-666.

Association of Official Agriculture Chemists (1990). Official Methods of analysis. 15th Ed., Washington, D.C., USA.

Attala, Eman, S.; M.M. Ali and A.S. Wally (1997). Magnesium effects on "LeCont" pear trees grown in sandy soil. J. Agric. Sci. Mansoura Univ., 22(11): 3871-3885.

Baghdady, H.A. and Mineasy (1964). The fruit production. Textbook, Printed (In Arabic), Egypt. p. 363.

Bidwell, R.G.S. (1979). Plant physiology. Macmillan Publishing Co., Inc. New York 2nd, pp. 726.

Clark, C.J. and I. Kajiura (1986). Nutritional disorders in persimmon. Growing Today, April, 47-50.

El-Gazzar, A.A.M. (2000). Effect of fertilization with nitrogen, potassium and magnesium on Anna apples. 3- Effect of magnesium fertilization. 8th Conf. Agric. Dev. Res., Fac. Agric., Ain Shams Univ., Cairo, Egypt, pp. 1161-1168.

Forshey, C.G. (1963). Potassium-magnesium deficiency of McIntosh apple trees. J. Amer. Soc. Hort. Sci. 83(1): 13-20.

Foster, D.S. and T.S. Cornelia (1967). Colorimetric methods of analysis D. Van Nestrant Company Inc. pp. 551-552.

Jackson, N.L. (1967). Soil chemical analysis. Printice-Hall Inc. Englewood Cliffs-N.S.

Jackson, N.L. and A. Ulish (1959). Analytical method for use in plant analysis Coll. of Agric., Exp. State. Bull. 766: 25 pp.

Kabeel, H.; H. Mokhtar and M.M. Aly (1998). Effect of foliar application of different macro and micro-nutrients on yield, fruit quality and leaf mineral composition of "Le-Cont" pear trees J. Agric. Sci. Mansoura Univ., 23(7): 3317-3326.

Larue, J.H.; K.W. Opitz and J.A. Beutel (1982). Growing persimmon. Division of Agric. Sci. Univ. California Leaflet 21277, Page, 8.

Lavon, R.; R. Salomon and E.E. Goldschmidt (1999). Effect of potassium magnesium and calcium deficiencies on nitrogen constituents and chloroplast components in citrus leaves. J. Amer. Soc. Hort. Sci. 124(2): 158-162.

Maksoud, M.A.; Laila, F. Haggag and K.W. Khalil (1994). The nutritional status and yield of Washington Navel orange trees grown in sandy soil as affected by magnesium sulphate fertilizer.

Mengel, K. and E.A. Kirkby (1978). Principles of plant nutrition. Int. Potash Inst., Berne. Kalyani Publishers New Delhi-Ludhianu Chap. 7: p. 140-159.

Ministry of Agriculture and Land Reclamation (2005). Agricultural Economics Annual Report, Cairo, Egypt.

Moran, R. (1982). Formulae for determination of chlorohyllous pigments extracted with N, N-Dimethyl formamide, Plant Physiol. 69: 1376-1381.

Nijjar, G.S. (1985). Nutrition of fruit trees. Mrs. Usha Raj Kumar for Kalyani Publishers, New Delhi, India, pp. 206-224.

Noe, N.: J. Eccher; R. Stainer and D. Porro (1995). Influence of nitrogen, phosphorus and magnesium fertilization on fruit quality and storability of Golden Delicious apples. Acta Horticulture No. 383: 439-447.

Ram, R.A. and T.K. Bose (2000). Effect of foliar application of magnesium and micronutrients on growth, yield and fruit quality of mandarin orange (*Citrus reticulata* Blanco). Indian J. Hort., 57(3): 215-220.

Snedecor, G.W. and W.G. Cochran (1990). Statistical Methods. 7th Ed. Iowa Sate Univ., U.S.A. p. 593.

Wally, A.S. (1987). Hormonal control of fruit drop and ripening of kaki (*Diospyros kaki* L.). Ph.D. Thesis, Fac. of Agric., Cairo Univ.

Yogaratnam, N. and D.W.P. Greenham (1982). The application of foliar sprays containing nitrogen, magnesium, zinc and boron to apple trees I. The effects on fruit set and cropping J. of Hort. Sci., 57(2): 151-158.

Yoshida, S.; D.A. Forno; J.H. Cock and K.A. Gomez (1972). Laboratory manual for physiological studied of rice. The International Rice Research Institute Los Banos. Philippines.

تحسين نمو ومحصول أشجار الكاكى صنف "كوستاتا" النامية فى التربة الجيرية باستخدام التسميد الماغنسيومى.

جهاد بشرى يوسف ميخائيل و عبد الفتاح سليمان والى
قسم بحوث الفاكهة المتساقطة الاوراق - معهد بحوث البساتين - مركز البحوث الزراعية - الجيزه - مصر

اجرى هذا البحث بهدف دراسة تأثير التسميد الماغنسيومى على النمو الخضرى والمحتوى المعدنى والكلوروفيلى للاوراق والمحصول وصفات جودة ثمار اشجار الكاكى صنف **"كوستاتا"** النامية فى التربة الجيرية بمحافظة البحيرة خلال ثلاث مواسم متتالية: ٢٠٠٣ ، ٢٠٠٤ ، ٢٠٠٥ ، وتم اخذ النتائج فى موسمى ٢٠٠٤ ، ٢٠٠٥ فقط. تم استخدام اربع معدلات من كل من الصورة السلفاتية والمخلبية للماغنسيوم وهى ٧٥ ، ١٠٠ ، ١٢٥ ، ١٥٠ جم/شجرة/سنة مقارنة بالكنترول. حيث اضيف كل مستوى من السماد على جرعتين متساويتين فى منتصف شهرى مارس وابريل على التوالى.

- اظهرت النتائج أن طول وقطر النموات والمساحة الورقية قد زادت بزيادة مستوى سماد الماغنسيوم سواء فى الصورة السلفاتية او الصورة المخلبية حتى ١٢٥ أو ١٥٠ جم/شجرة سنة.
- اوضحت النتائج ان محتوى الاوراق من النتروجين والفوسفور والبوتاسيوم والماغنسيوم والكلوروفيل الكلى ازدادت معنويا بزيادة مستوى السماد الماغنسيومى مقارنة بالكنترول بينما انخفض محتوى الاوراق من الكالسيوم ومن جهه اخرى فان محتوى الاوراق من العناصر الصغرى (الحديد والمنجنيز والزنك) لم يتأثر معنويا فى كلا الموسمين.
- بينت النتائج ان استخدام ١٥٠ جم/شجرة/سنة من سماد سلفات الماغنسيوم ، ١٢٥ جم أو ١٥٠ جم من سماد الماغنسيوم المخلبى أدت الى زيادة معنوية فى النسبة المئوية لعقد الثمار والمحصول كعدد ثمار وكوزن كجم/شجرة مقارنة بالكنترول.
- أدى زيادة اى من سماد المغنسيوم السلفاتى او المخلبى الى زيادة وزن وحجم وصلابة الثمار ومحتواها من المواد الصلبة الذائبة (SSC) بينما لم يتأثر معنويا كل من النسبة المئوية للحموضة والتانينات الكلية.

بصفة عامة فإن إضافة ١٥٠ جم/شجرة/سنه من سماد سلفات المغنسيوم أو ١٢٥ جم/شجرة/سنة من سماد المغنسيوم المخلبى الى البرنامج السمادى لأشجار الكاكى صنف "كوستاتا" قد أعطت أعلى محصول بأفضل صفات جودة للثمار ، لذلك يمكن التوصية بإحدى هاتين المعاملتين.