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Effect of Magnesium Fertilization and Leaf/Bunch Ratio on Growth and Fruiting of Sewy Date Palm

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Abstract

This study was conducted during the two successive seasons of 2013 and 2014 in a private orchard, at El-Kharga Oasis, New Valley Governorate, Egypt to investigate the effect of magnesium fertilization and leaf/bunch ratio on growth and fruiting of Sewy date palm.

The experiment was set up in a randomized complete block design in split plot arranged. The pruning treatments were imposed in main plots while the magnesium fertilization rates were put in the sub-plots. Both pruning and fertilization treatments include three levels per each.

The number of new leaf/palm, leaf area and leaf nutrient composition substantially increased with increasing leaf/bunch ratio from 6 to 10:1 leaf/bunch. Also, such growth traits materially increased with increasing magnesium levels from 500 to 1000 g/palm. All combinations of ($MgSO_4$) at 750 to 1000 g with 8 or 10 leaf/bunch induce a considerable increase in growth traits and nutrient content in the leaves of palms compared to using 500 g N/palm and leaving 6 leaf/bunch. Fertilizing by 750 & 1000 g/palm along with pruning to leave 8 or 10 leaf/bunch was followed by yield and fruit quality of Sewy date palm compared to using 500 g $MgSO_4$/palm and accompanied with leaving 6 leaf/bunch. Fertilizing the palm with 750 or 1000 g $MgSO_4$ improving combined with 8 or 10 leaf/bunch ratio had no major effects.

It could be concluded that leaving 8 active leaves per each retentive bunch combined with fertilizing with 750 g $MgSO_4$/palm gave the best results with regard to yield and fruit quality of Sewy date palm.

Keywords: *Magnesium, Fertilization, Leaf/bunch ratio, Fruit quality, Sewy, Date palm.*

Introduction

Date palm (*Phoenix dactylifera* L.) is the most important crop. It plays an important role in the economical and social life of the people and considered a symbol of life in desert in Egypt. Date palm can grow and produce under different types of soil from light sandy to heavy clay soil. Also, it has high adaptability to stress conditions as it tolerates high levels of salinity, drought and harsh weather (Lunde, 1978, FAO, 1982 and Diallo, 2005).

The dates yield and quality can vary depending on cultivar, soil conditions and cultural practices. Fertilization is an important and limiting factor for growth, nutritional status and fruiting of fruit crop. Fertilization program for most fruit trees does not included magnesium as a major element. In addition, there are very little attentions have been paid towards magnesium nutrient element for date palm nutrition and recommendations which lead to enhance vegetative growth and productivity, especially

for those grown in sandy loam soil. Magnesium is an essential element for chlorophyll molecule structure that regulates photosynthesis processes and acts an activator of many enzyme systems involved in carbohydrate metabolism and synthesis of nucleic acids. Furthermore, it plays an essential role in the biological activity of ATP (Westwood, 1978 and Jones *et al*., 1991).

In addition, new reclaimed soils are poor in their nutrient content including magnesium element. Many investigators have been started to study magnesium nutrition and determination of magnesium needs of economically important crops in Egypt (FAO, 2000; Salem, 2007 and El-Fouly *et al*., 2012). Using 20, 30 or 50 g Mg/palm whatever magnesium chelate (mg EDTA 12.5% Mg) or magnesium sulphate (9.9% Mg) enhanced leaf total chlorophyll contents, yield component and fruit quality of Hayany dates (Salama *et al*., 2014). Magnesium fertilization improved yield and fruit quality of the Washington Navel orange and banana plants (El-Safty and Rabii, 1998; Abou Aziz *et al*., 2000, Mostafa *et al*., 2007 and Hanafy *et al*., 2012).

Bearing capacity and quality of fruit on the date palm seems to be rather closely in proportion to green leaf surface. Too much fruit for the leaf area of the tree reduces size and quality of the fruit and leads to alternate bearing (El-Salhy, 2001 and Hegazi *et al*., 2008). Leaf/bunch ratio for date palms has been studied by many workers in different districts of Egypt and abroad. Proper balance between the number of leaves and bunches is important for regular productivity of higher quality fruits. Ratio of 8-10 leaves per bunch were reported as the most suitable for Zaghloul, Hayani and Samani cultivars (Abdalla *et al*., 1983, Khalifa *et al*., 1987; El-Makhtoon *et al*., 1990; Harhash *et al*., 1998; Abdel-Hamid, 2000 and Shaaban *et al*., 2006).

Meanwhile, El-Salhy (2001) concluded that 6 to 8 active leaves per bunch would achieve a beneficial balance to improve yield and fruit quality. The importance of leaving a sufficient number of fully expanded green leaves per bunch to obtained high yield with good fruit quality has been emphasized by Al-Salman *et al*. (2012) who reported that total production of dates gradually increased significantly with increasing leaf/bunch ratio from 8 to 12 leaves/bunch of Khalass date palm.

The aim of this study was evaluating the effect of magnesium application and leaf/bunch ratio on growth and fruiting of Sewy date palm.

Materials and Methods

This study was carried out during two successive seasons of 2013 and 2014 in a private orchard, at El-Kharga Oasis, New Valley Governorate, Egypt. Sewy date palm trees of 12 years old grown in sandy loam soil, and spaced 6x6 m apart. Physical and chemical analyses of the experimental soil shown in Table 1.

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

Properties	Value		Properties	Value	
	Soil depth (cm) 0-30	Soil depth (cm) 30-60		Soil depth (cm) 0-30	Soil depth (cm) 30-60
Mechanical analysis (fraction %)			Total N (ppm)	40-60	20-40
Clay	17.2	17.2	**Soluble cations and anions (meq/100 g soil)**		
Sil	5.0	0.0	Ca^{+2}	0.3	0.4
Sand	77.8	82.8	Mg^{+2}	0.1	0.2
Texture grade	Sandy loam	Sandy loam	Na^{+}	0.09	0.12
Chemical analysis			K^{+}	0.15	0.32
Total $CaCO_3$ %	4.42	6.50	$CO^{-}_3 + HCO^{-}_3$	0.1	0.1
Ec $dS.m^{-1}$ (1:5)	0.15	0.19	Cl^{-}	0.3	0.3
pH(1:2.5 suspension)	7.62	7.54	SO^{-}_4	0.1	0.36

Twenty seven female palms trees of healthy with no visual nutrient deficiency symptoms, nearly uniform in shape, size and productivity were chosen and devoted to achieving this experiment.

The experiment involved two studied factors (A and B). The first factor (A) included the effect of leaf/bunch ratio.

Both leaves and bunches were pruned to attain a definite leaf/bunch ratio. The treatments were as follows:

10:1 leaf/bunch ratio, 8:1 leaf/bunch ratio, 6:1 leaf/bunch ratio.

The number of bunches left on each palm was 9 bunches by removing excess earliest, latest and small clusters. The retained bunches were thinned to constant number of strands.

The second factor (B) involved three treatments of magnesium fertilization, as follow:

1- 500 g magnesium sulphate ($MgSO_4$ Mg 9.9%) (B_1).

2- 750 g magnesium sulphate ($MgSO_4$ Mg 9.9%) (B_2).

3- 1000 g magnesium sulphate ($MgSO_4$ Mg 9.9%) (B_3).

Soil application of magnesium fertilizer ($MgSO_4$, Mg 9.9%) was divided into equal three doses applied three times a year i.e. April, June and July in each season.

The experiment was designed as split plot design with three replicates for each treatment and each replicate was represented by one palm.

In general, the following measurements were determined during the two studied seasons.

1- Number of newly growing leaves was determined at the end of growth season. In addition, four mature leaves were chosen on each palm to determine number of pinnae/leaf and pinnae area (cm^2) as pinnae area = length x max. width x 0.84, according to Shabana and Antoun (1980). The whole leaf area (m^2) was obtained from multiplying the pinnae area by the number of pinnae/leaf.

2- Leaf mineral content. To determine leaf mineral content NPK and Mg, leaf samples were taken during November and washed with tap water then with distilled water to remove the dust. After washing, they were dried in an electric oven at 70°C for 72 hours. The dried leaves were

ground, digested and prepared for analysis using the methods described by Wilde *et al*. (1985).

3- Yield: All bunches were harvested at tamer stage, bunches of each palm were picked and weighed and then the yield/palm (kg) was recorded.

4- Fruit physical and chemical properties: Fifty fruits were taken at harvest from each palm to determine of some physical and chemical fruit properties were determined according to A.O.A.C. (1985). In addition, the percentage of N, P, K and Mg in dried fruit were determined according to procedures by Wild *et al*. (1985). As well as, percentage of tannin in the fruits was determined using the Indigo Carmen indicator according to Balbaa (1981).

Data were statistically analyzed and differences between treatments means were compared using L.S.D. test at 5% level according to Gomez and Gomez (1984) and Mead *et al*. (1993).

Results and Discussion

1 – Vegetative growth and nutritional status:

In general view data in Tables (2, 3 and 4) showed the effect of different leaf/bunch ratio and magnesium fertilization and interaction between them on leaf traits and its concentration of N, P, K and Mg of Sewy date palm during 2013 and 2014 seasons. It is obvious from data that the results took similar trend during the two studied seasons.

Concerning the effect of leaf/bunch ratio, the results indicated that new leaf/palm and leaf area as well as leaf N, P, K and Mg concentration significantly increased with leaf/bunch ratio increased. Highest values of new leaf number and leaf area as well as leaf N, P, K & Mg percentage were recorded for high leaf/bunch ratio (10:1). No significantly difference in these traits due to raise leaf/bunch ratio from 8:1 to 10:1 ratio.

As regard to effect of different magnesium fertilization, data indicated that leaf traits and its N, P, K and Mg concentration significantly increased with magnesium level increased from 500 to 1000 g ($MgSO_4$)/palm. Raising the magnesium level from 750 to 1000 g ($MgSO_4$)/palms failed to show any significant increase in such leaf traits, where using 500 g ($MgSO_4$)/palm significantly decreased leaf traits compared to other magnesium fertilization levels used.

Table 2. Effect of different leaf/bunch ratio and magnesium application on leaf number and its area of Sewy date palm during 2013 and 2014 seasons.

	No. of new leaves								Total leaf area (m^2)							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1 (A_1)	22.16	22.45	23.48	23.85	24.07	24.47	23.24	23.59	2.87	2.87	2.93	2.92	2.95	2.95	2.92	2.92
Pruning 8:1 (A_2)	21.59	21.92	22.83	23.68	23.43	23.77	22.62	23.12	2.82	2.82	2.90	2.87	2.93	2.92	2.88	2.87
Pruning 6:1 (A_3)	20.41	21.78	21.71	22.01	22.26	22.57	21.46	21.77	2.64	2.64	2.71	2.69	2.73	2.72	2.69	2.69
Mean	21.39	22.05	22.67	23.18	23.26	23.60			2.78	2.78	2.85	2.83	2.85	2.87		
LSD 0.05	**A**: 0.74 **A**: 0.85 **B**: 0.74 **B**: 0.85 **AB**: 1.28 **AB**: 1.48								**A**: 0.04 **A**: 0.05 **B**: 0.04 **B**: 0.05 **AB**: 0.07 **AB**: 0.09							

Table 3. Effect of different leaf/bunch ratio and magnesium application on leaf N and P contents of Sewy date palm during 2013 and 2014 seasons.

	N% leaf								P% leaf							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1(A_1)	1.82	1.83	1.90	1.91	1.91	1.92	1.86	1.87	0.21	0.22	0.20	0.23	0.23	0.23	0.21	0.22
Pruning 8:1 (A_2)	1.80	1.81	1.85	1.86	1.87	1.89	1.85	1.86	0.18	0.20	0.19	0.21	0.20	0.23	0.19	0.22
Pruning 6:1 (A_3)	1.78	1.80	1.81	1.82	1.83	1.85	1.80	1.82	0.15	0.16	0.16	0.18	0.17	0.19	0.16	0.18
Mean	1.80	1.81	1.85	1.87	1.87	1.89			0.17	0.19	0.20	0.22	0.20	0.22		
LSD 0.05	**A**: 0.01 **A**: 0.02 **B**: 0.01 **B**: 0.02 **AB**: 0.02 **AB**: 0.03								**A**: 0.01 **A**:0.01 **B**: 0.01 **B**: 0.01 **AB**: 0.01 **AB**: 0.01							

Table 4. Effect of different leaf/bunch ratio and magnesium application on leaf K and Mg contents of Sewy date palm during 2013 and 2014 seasons.

	K% leaf								Mg% leaf							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1 (A_1)	1.29	1.32	1.36	1.39	1.37	1.40	1.34	1.38	0.36	0.36	0.45	0.46	0.46	0.47	0.42	0.43
Pruning 8:1 (A_2)	1.29	1.32	1.34	1.37	1.35	1.38	1.33	1.36	0.34	0.35	0.43	0.45	0.44	0.46	0.40	0.42
Pruning 6:1 (A_3)	1.18	1.20	1.21	1.24	1.23	1.26	1.22	1.25	0.33	0.34	0.40	0.42	0.41	0.43	0.38	0.39
Mean	1.26	1.29	1.31	1.34	1.32	1.35			0.34	0.35	0.43	0.44	0.44	0.45		
LSD 0.05	**A**: 0.03 **A**: 0.02 **B**: 0.03 **B**: 0.02 **AB**: 0.05 **AB**: 0.04								**A**: 0.02 **A**: 0.02 **B**:0.02 **B**:0.02 **AB**: 0.04 **AB**: 0.03							

In addition data in Tables (2, 3 and 4) indicated that leaf traits i.e. new leaf/palm, total leaf area as well as leaf N, P, K and Mg concentration significantly responded to interaction between the two studied factors. The highest values were obtained in palms that fertilized with 1000 g ($MgSO_4$) /palm and pruned to 10 leaf/bunch. The highest recorded total leaf area was (2.95 & 2.95 m^2) and leaf Mg concentration (0.46 & 0.47%) due to 1000 g/palm with 10 leaf/bunch during the two studied seasons, respectively. In other hand, the recorded total leaf area was (2.78 & 2.78 m^2) and Mg (0.33 & 0.34%) due to 500 g ($MgSO_4$)/palm and pruned to 6 leaf/bunch during the two studied seasons, respectively. Then, the increment percentage of total leaf area was (6.12 & 6.12%) and Mg was (35.29 & 34.29%) due to fertilize with 1000 g ($MgSO_4$)/palm combined prune to 10 leaf/bunch compared to 500 g ($MgSO_4$)/palm combined prune 6 leaf/bunch during the two studied seasons, respectively. No significant difference due to fertilize with 750 or 1000 g ($MgSO_4$) combined with 10 or 8 leaf/bunch ratio.

Therefore, from economical point of view it is suggested to prune Sewy date palm to 8 leaf/bunch combined with fertilized by 750 g ($MgSO_4$)/palm to improve the growth and vigor of palm trees.

2- Bunch weight and yield/palm

Data in Table (5) showed the effect of different leaf/bunch ratio and magnesium fertilization and interaction between them on bunch weight

and yield/palm of Sewy date palm during 2013 and 2014 seasons. it is obvious from data that the results took similar trend during the two studied seasons.

Concerning the effect of leaf/bunch ratio, the results showed that bunch weight and yield/palm took similar tendency and significantly increased as the level of leaf/bunch ratio increased during the two studied seasons. High level of leaf bunch ratio (10%) gave heaviest bunch weight and yield/palm. Highest bunch weight (10.26 & 9.68 kg) and yield/palm (82.06 & 87.15 kg/palm) were recorded on palm that pruned to 10 leaves per bunch, during the two studied season, respectively. No significantly difference in these traits due to reduced leaf/bunch ratio from 10:1 to 8:1 ratio. Hence the increment percentage of yield/palm attained (18.98 & 24.20%) due to prune to 10:1 compared to 6:1 during the two studied seasons, respectively.

As regard to effect of different magnesium fertilization, data indicated that bunch weight and yield/palm significantly increased with magnesium level from 500 to 1000 g ($MgSO_4$)/palm. Raising the magnesium level from 750 to 1000 g ($MgSO_4$)/palms failed to show any significant increase in yield components, where using 500 g ($MgSO_4$)/palm significantly decreased the weight of bunch and yield compared to other magnesium fertilization levels used. The heaviest yield/palm was (81.0 & 84.21 kg/palm) detected on palm that fertilized with 1000 g ($MgSO_4$), against (65.28 & 67.50 kg/palm) on palm that received 500 g ($MgSO_4$).

Table 5. Effect of different leaf/bunch ratio and magnesium application on bunch weight and yield/palm of Sewy date palm during 2013 and 2014 seasons.

	Bunch weight (kg)								Yield (kg/palm)							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1 (A_1)	8.54	9.02	9.12	9.77	9.69	10.26	9.12	9.68	76.89	81.18	82.18	87.96	87.15	92.34	82.06	87.15
Pruning 8:1 (A_2)	8.24	8.88	8.79	9.44	9.31	9.69	8.78	9.34	74.19	79.92	79.08	84.93	83.73	87.18	79.00	84.00
Pruning 6:1 (A_3)	7.25	7.50	7.71	7.76	8.02	8.13	7.66	7.80	65.28	67.50	69.42	69.87	72.15	73.17	68.97	70.17
Mean	8.01	8.47	8.54	8.99	9.01	9.36			72.12	76.20	77.91	80.94	81.00	84.21		
LSD0.05	**A**: 0.50 **A**: 0.48 **B**: 0.50 **B**: 0.48 **AB**: 0.83 **AB**: 0.83								**A**: 4.35 **A**: 3.84 **B**: 4.35 **B**: 3.84 **AB**: 7.52 **AB**: 6.64							

Then the increment percentage of yield/palm attained to (24.08 & 24.76%) due to fertilize with 1000 g ($MgSO_4$) compared to 500 g ($MgSO_4$)/palm during the two studied seasons, respectively.

In addition data in Table (5) indicated that bunch weight and yield/palm significantly responded to interaction between the two studied factors. The highest values were recorded obtained on palms that fertilized with 1000 g ($MgSO_4$)/palm and pruned to 10 leaf/bunch. The highest recorded yield/palm was (87.15 & 92.34 kg/palm) due to 1000 g ($MgSO_4$)/palm with 10 leaf/bunch during the two studied seasons, re-

spectively. In other hand, the recorded yield/palm was (65.28 & 67.50 kg/palm) due to 500 g ($MgSO_4$)/palm and pruned to 6 leaf/bunch during the two studied seasons, respectively. Then, the increment percentage of yield/palm was (33.50 & 36.80) due to fertilize with 1000 g ($MgSO_4$)/palm combined prune to 10 leaf/bunch compared to 500 g ($MgSO_4$)/palm combined prune 6 leaf/bunch during the two studied seasons, respectively. No significant difference due to fertilize with 750 or 1000 g ($MgSO_4$) combined with 10 or 8 leaf/bunch ratio.

As an overview, the results declared that the combination effects significantly increased the yield than increment due to individual effects of either pruning or Mg treatments.

Therefore, from economical point of view it is suggested to pruned to 8 leaf/bunch combined with fertilized by 750 g ($MgSO_4$)/palm to improve the growth and gave the high bunch weight and consequently high yield/palm.

3- Fruit properties:

In general view data in Tables (6 to 12) showed the effect of different leaf/bunch ratio and magnesium fertilization and interaction between them on physiochemical properties of Sewy dates during 2013 and 2014 seasons. It is obvious from data that the results took similar trend during the two studied seasons.

Concerning the effect of leaf/bunch ratio, the results indicated that fruit physical properties i.e., fruit weight, pulp % and fruit dimension as well as chemical properties i.e. total soluble solids, sugar contents and N, P, K & Mg, significantly increased, whereas, tannins contents significantly decreased with level leaf/bunch ratio increased. Highest and lowest negative properties were recorded for high leaf/bunch ratio (10:1). No significantly difference in these traits due to raise leaf/bunch ratio from 8:1 to 10:1 ratio.

The heaviest fruit (11.21 & 11.62 g) and highest TSS % (79.71 & 81.51%) were recorded due to high level of leaf bunch ratio (10:1), against lowest ones (9.81 & 9.88 g) and (77.12 & 78.75%) due to low level of leaf bunch ratio (6:1), during the two studied seasons, respectively. Hence, the increment percentage of fruit weight was (14.27 & 17.61%) due to high level compared to low ones during the two studied seasons, respectively. The corresponding increment percentage of TSS % attained (3.36 & 3.50%), respectively. On other hand, least tannins (0.58 & 0.56%) due to high level of leaf bunch, against the highest ones (0.71 & 0.79%) due to low ones, hence, the decrement percentage of tannins was (25.35 & 29.11%) during the two studied seasons, respectively.

As regard to effect of different magnesium fertilization, data in Table (6 to 12) indicated that using Mg at 750 or 1000 g ($MgSO_4$)/palm significantly improved the fruit quality in terms of increasing fruit weight, pulp % and its dimension as well as total soluble solids, sugar contents and mineral contents of fruits and decreasing the tannins contents and total acidity. Raising the magnesium level from 750 to 1000 g ($MgSO_4$)/palms failed to show any significant increase or decrease in such fruit traits, where using 500 g/palm significantly

decreased or increased fruit traits compared to other magnesium fertilization levels used.

The recorded heaviest fruit was (11.05 & 11.29 g) and highest TSS % (80.95 & 82.53%) due fertilizer with 1000 g ($MgSO_4$)/palm, against lowest ones (10.14 & 10.43 g) and (75.79 & 77.36%) due to fertilize with 500 g ($MgSO_4$)/palm during the two studied seasons, respectively. Thus, the increment percentage of fruit weight was (8.97 & 8.25%) due to apply 1000 g ($MgSO_4$) compared to 500 g ($MgSO_4$), respectively. Contrarily, least tannins (0.58 or 0.61%) record on palm that fertilized with 1000 g ($MgSO_4$)/palm, against (0.70 & 0.72%) on palm that applied by 500 g ($MgSO_4$). Then, the decrement percentage of tannins attained (17.14 & 15.28%) during the two studied seasons, respectively.

Table 6. Effect of different leaf/bunch ratio and magnesium application on fruit weight and pulp % of Sewy dates during 2013 and 2014 seasons.

	Fruit weight (g)								Fruit pulp %							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1 (A_1)	10.74	11.14	11.32	11.74	11.57	11.99	11.21	11.62	86.46	87.33	87.62	88.50	87.86	88.74	87.31	88.18
Pruning 8:1 (A_2)	10.30	10.71	11.19	11.38	11.44	11.67	10.97	11.29	86.22	87.09	87.22	87.95	87.62	88.50	87.02	87.06
Pruning 6:1 (A_3)	9.38	9.44	9.90	9.97	10.15	10.21	9.81	9.88	85.31	86.22	86.27	87.12	86.62	87.48	86.06	86.94
Mean	10.14	10.43	10.80	11.06	11.05	11.29			85.99	86.88	87.03	87.86	87.36	88.24		
LSD 0.05	**A**: 0.38 **A**: 0.42 **B**: 0.38 **B**: 0.42 **AB**: 0.67 **AB**: 0.72								**A**: 0.59 **A**: 0.98 **B**: 0.59 **B**: 0.98 **AB**: 1.03 **AB**: 1.69							

Table 7. Effect of different leaf/bunch ratio and magnesium application on fruit length and fruit diameter of Sewy dates during 2013 and 2014 seasons.

	Fruit length (cm)								Fruit diameter (cm)							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1 (A_1)	3.47	3.54	3.61	3.69	3.69	3.77	3.59	3.66	2.06	2.14	2.14	2.23	2.16	2.25	2.12	2.21
Pruning 8:1 (A_2)	3.45	3.52	3.58	3.66	3.65	3.73	3.56	3.63	2.05	2.13	2.14	2.23	2.15	2.24	2.11	2.20
Pruning 6:1 (A_3)	3.34	3.41	3.47	3.54	3.54	3.61	3.46	3.52	2.01	2.04	2.08	2.16	2.09	2.17	2.06	2.12
Mean	3.42	3.49	3.55	3.63	3.62	3.69			2.04	2.10	2.12	2.20	2.13	2.22		
LSD 0.05	**A**: 0.08 **A**: 0.07 **B**: 0.08 **B**: 0.07 **AB**: 0.14 **AB**: 0.12								**A**: 0.03 **A**: 0.04 **B**: 0.03 **B**: 0.04 **AB**: 0.05 **AB**: 0.07							

Table 8. Effect of different leaf/bunch ratio and magnesium application on TSS/and total sugar of Sewy dates during 2013 and 2014 seasons.

	TSS								Total sugar %							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1(A_1)	77.00	78.54	80.54	82.15	82.20	83.85	79.71	81.51	72.23	73.67	75.53	77.04	77.11	78.65	74.95	76.45
Pruning 8:1 (A_2)	76.30	77.92	80.70	82.32	81.49	83.02	79.63	81.08	71.65	73.08	75.98	77.50	76.62	78.15	74.75	76.24
Pruning 6:1 (A_3)	74.06	75.63	78.16	79.87	78.81	80.73	77.12	78.75	69.45	70.84	73.40	74.87	74.21	75.13	72.35	73.61
Mean	75.79	77.36	79.80	81.45	80.95	82.53			71.11	72.53	74.97	76.47	75.98	77.31		
LSD 0.05	**A**: 0.99 **A**: 1.88 **B**: 0.99 **B**: 1.88 **AB**: 1.71 **AB**: 3.25								**A**: 1.76 **A**: 1.86 **B**: 1.76 **B**: 1.86 **AB**: 3.04 **AB**: 2.05							

Table 9. Effect of different leaf/bunch ratio and magnesium application on reducing and non-reducing sugars of Sewy dates during 2013 and 2014 seasons.

	Reducing sugar								Non-reducing sugar							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1(A_1)	61.18	62.40	64.30	65.58	65.27	66.28	63.58	64.75	8.27	11.27	9.10	11.46	8.94	12.36	8.77	11.70
Pruning 8:1 (A_2)	62.72	63.97	66.87	68.20	67.38	68.43	65.65	66.87	8.93	9.11	9.08	9.70	9.24	9.91	9.10	9.37
Pruning 6:1 (A_3)	63.44	64.81	66.47	67.79	67.83	68.28	65.91	66.96	8.79	6.03	9.06	7.08	9.28	6.85	9.04	6.65
Mean	62.39	63.73	65.88	67.19	66.60	67.66			8.72	8.80	9.09	9.28	9.16	9.65		
LSD 0.05	**A**: 0.88 **A**: 0.65 **B**: 0.88 **B**: 0.65 **AB**: 1.53 **AB**: 1.13								**A**: 0.29 **A**: 0.27 **B**: 0.29 **B**: 0.27 **AB**: 0.50 **AB**: 0.47							

Table 10. Effect of different leaf/bunch ratio and magnesium application on tannins % and acidity of Sewy dates during 2013 and 2014 seasons.

	Tannins %								Acidity %							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1 (A_1)	0.64	0.60	0.57	0.54	0.53	0.53	0.58	0.56	0.10	0.20	0.10	0.20	0.10	0.20	0.10	0.20
Pruning 8:1 (A_2)	0.67	0.64	0.58	0.58	0.54	0.56	0.59	0.59	0.09	0.21	0.09	0.20	0.09	0.21	0.09	0.21
Pruning 6:1 (A_3)	0.80	0.84	0.68	0.77	0.65	0.75	0.71	0.79	0.08	0.21	0.09	0.20	0.08	0.21	0.08	0.21
Mean	0.70	0.72	0.60	0.63	0.58	0.61			0.10	0.20	0.09	0.20	0.09	0.21		
LSD 0.05	**A**: 0.03 **A**: 0.05 **B**: 0.03 **B**: 0.05 **AB**: 0.05 **AB**: 0.09								**A**: N.S. **A**: N.S. **B**: N.S. **B**: N.S. **AB**:N.S. **AB**:N.S.							

Table 11. Effect of different leaf/bunch ratio and magnesium application on fruit N % and P% of Sewy dates during 2013 and 2014 seasons.

	N% fruit								P% fruit							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1(A_1)	0.521	0.523	0.540	0.534	0.545	0.543	0.525	0.533	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Pruning 8:1 (A_2)	0.517	0.519	0.537	0.539	0.540	0.542	0.530	0.534	0.11	0.11	0.11	0.11	0.11	0.12	0.11	0.11
Pruning 6:1 (A_3)	0.504	0.509	0.525	0.532	0.529	0.538	0.520	0.526	0.11	0.11	0.12	0.11	0.11	0.11	0.11	0.11
Mean	0.508	0.519	0.533	0.536	0.538	0.541			0.11	0.11	0.11	0.11	0.11	0.11		
LSD 0.05	**A**: 0.010 **A**:0.006 **B**:0.010 **B**:0.006 **AB**:0.017 **AB**:0.011								**A**: N.S. **A**: N.S. **B**: N.S. **B**: N.S. **AB**:N.S. **AB**:N.S.							

Table 12. Effect of different leaf/bunch ratio and magnesium application on fruit K% and Mg % of Sewy dates during 2013 and 2014 seasons.

	K% fruit								Mg % fruit							
	500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean		500 g $MgSO_4$ (B_1)		750 g $MgSO_4$ (B_2)		1000 g $MgSO_4$ (B_3)		Mean	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Pruning 10:1 (A_1)	0.95	0.97	0.99	1.01	1.00	1.02	0.98	1.00	0.27	0.30	0.29	0.32	0.29	0.32	0.28	0.31
Pruning 8:1 (A_2)	0.94	0.96	0.98	1.00	0.99	1.01	0.97	0.99	0.26	0.29	0.28	0.31	0.29	0.32	0.28	0.30
Pruning 6:1 (A_3)	0.90	0.92	0.94	0.94	0.95	0.97	0.93	0.94	0.24	0.26	0.26	0.29	0.26	0.29	0.25	0.28
Mean	0.93	0.95	0.97	0.98	0.98	1.00			0.26	0.28	0.28	0.30	0.28	0.31		
LSD 0.05	**A**: 0.02 **A**: 0.02 **B**: 0.02 **B**: 0.02 **AB**: 0.03 **AB**: 0.03								**A**: 0.01 **A**:0.01 **B**:0.01 **B**:0.01 **AB**: 0.02 **AB**: 0.02							

In addition data in Tables (6 to 12) indicated that fruit traits i.e. fruit weight, dimension, pulp %, TSS, sugar contents, tannins and fruit N, P, K and Mg concentration significantly responded to interaction between the two studied factors. The highest values of fruit weight and TSS and lowest-values of tannins were obtained in palms that fertilized with 1000 g ($MgSO_4$)/palm and pruned to 10 leaf/bunch. The highest recorded fruit weight was (11.57 & 11.99 g) and TSS% (82.20 & 83.85%) and lowest tannins % (0.53 & 0.53%) due to 1000 g ($MgSO_4$)/palm with 10 leaf/bunch during the two studied seasons, respectively. In other hand, the recorded fruit weight was (9.38 & 9.49 g) and TSS % (74.06 & 75.63%) and tannins (0.80 & 0.84%) due to 500 g ($MgSO_4$)/palm and pruned to 6 leaf/bunch during the two studied seasons, respectively. Then, the increment percentage of fruit weight was (23.35 & 27.01%) and TSS (10.99 & 10.87%) and decrement percentage of tannins (33.75 & 36.96%) due to fertilize with 1000 g ($MgSO_4$)/palm combined prune to 10 leaf/bunch compared to 500 g ($MgSO_4$)/palm combined prune 6 leaf/bunch during the two studied seasons, respectively. No significant difference due to fertilize with 750 or 1000 g ($MgSO_4$) combined with 10 or 8 leaf/bunch ratio in these fruit traits.

As an overview, the results showed that the combining effect was more improvement on the fruit traits than improved due to individual effects of either pruning or magnesium fertilization.

Therefore, from economical point of view it is recommended that pruned to 8 leaf/bunch combined with fertilized by 750 g ($MgSO_4$)/palm to improve nutritional status and fruiting of palm trees.

Discussion

The previous positive action of high leaf/bunch ratio on growth, nutritional status of palms and fruiting of Sewy date palm might be attributed to increase the green leaf surface. Proper balance between the number of leaves and bunches is important for regular productivity of higher fruit quality. Such finding might be due to better supply of food material carbohydrates that are manufactured in the leaves (El-Salhy, 2001). These results agree with those obtained by El-Makhtoon *et al*. (1990), Harhash *et al*. (1998), Abdel-Hamid (2000), El-Salhy (2001), Shaaban *et al.* (2006), Hegazi *et al*. (2008) and Al-Salman *et al*. (2012). They found that 6 to 8 active leaves for each retentive bunch was suitable to get high yield with good fruit quality. Using a lower leaf/bunch ratio caused an adverse affect on fruit quality.

Magnesium is an essential element for chlorophyll molecule structure that regulates photosynthesis process. It plays an essential role in carbohydrate metabolism and synthesis of nucleic acids (Jones *et al*., 1991). Thus, the beneficial effects of Mg on growth, nutritional status of palms and fruiting might be ascribed to its essential role in carbohydrate metabolism and synthesis of nucleic acid which had a positive action on enhancing cell division and maturation.

These results regarding the effect of magnesium on growth, nutri-

tional status and fruiting are in harmony with those obtained by El-Safty and Rabii (1998), Abou Aziz *et al*. (2000), Mostafa *et al*. (2007) on orange trees and banana plants and Salama *et al*. (2014) on Hayany date palm.

Conclusion

It could be concluded that 8 active leaves per each retentive bunch combined with fertilized by 750 g ($MgSO_4$)/palm to improve the growth and fruiting the Sewy date palm.

References

A.O.A.C. (Association of Official Agriculture Chemists) 1985. "Official and Tentative Methods of Analysis". The Association, Washington, D.C.

Abdalla, K.M.; M.A. Melegi and S.Y. Risk. 1983. Influence of crop load and leaf/bunch ratio on yield and fruit properties of "Hayany" dates. 1st Symposium on the Date Palm in Saudi Arabia, Al-Hassa, pp. 222-231.

Abdel-Hamid, N. 2000. Effect of time, rate and patterns of thinning, leaf/bunch ratio and male type on "Zaghloul" date yield and quality. Arab Univ. J. of Agric. Sci., 8 (1): 305-317.

Abou Aziz, A.B.; M.F. Mostafa; N.R. Samara and A.M. El-Tanahy. 2000. Nutritional studies on banana plants. J. Agric. Sci. Mansoura Univ., 25 (1): 433-439.

Al-Salman, H.; N. Al-Wusaibai; M. Al-Husseini; H.I. Al-hajj; I.A. Al-Abdulhadi and A. Ben Abdalla. 2012. The effect of different leaf/bunch ratio on yield and fruit physical characteristics of Khlass date palm cultivar. Indian J. of Sci. and Technology, 5 (3): 2287-2288.

Balbaa, S.L. 1981. Chemistry of drugs. Laboratory manual. Cairo Univ., Chapter 6: 127-132.

Daillo, H. 2005. The role of date palm in combat desertification. In: The Date Palm: From Traditional Resource to green wealth. Pp. 13-19 UAE Center of Studies and Strategy Researches, Abu Dhabi, UAE.

El-Fouly, M.M.; A.I. Rezk; O.A. Nofal and E.A.A. Abou El-Nour, 2012. Depletion of magnesium in Egyptian soils, its content in crops and estimated needs. J. Agric. Res., 1 (1): 1-8.

El-Makhtoon, F.M.; A.M. Abdel-Kader and M.B. Bastawaros. 1990. Effect of leaf/bunch ratio on yield and fruit quality of Khadrawi and Samani dates (*Phoenix dactylifera* L.). J. Agric. Sci., Mansoura Univ., 15 (5): 696-702.

El-Safty, M.A. and R.S. Rabii. 1998. Effect of foliar and soil application of magnesium sulfate on mineral composition, yield and fruit quality of Washington Navel orange trees. J. Agric. Sci., Mansoura Univ., 23 (6): 2635-2641.

El-Salhy, A.M. 2001. The relation between leaf/bunch ratio and Zaghloul date productivity. Egyptian Journal of Horticulture, 28 (2): 149-158.

FAO. 1982. Plant Production and Protection Paper. Date Production and Protection, Food and Agriculture Organization of the United Nation, Rome, Italy, FAO.

FAO. 2000. Fertilizers and their use, Food and Agriculture Organization of the United Nation. Rome, Italy, FAO. pp. 21-23.

Gomez, K.A. and A.A Gomez (1984). Statistical Procedures for Agricultural Research, 2nd Ed. Wily, New York.

Hanafy, A.H.; M.K. Khalil; A.M. Ad El-Rahman and A.M. Nadia Hamed. 2012. Effect of magnesium, copper and growth regulators on growth, yield and chemical composition of

Washington Navel orange trees. J. Applied Sci. Res., 8 (2): 1271-1288.

Harhash, M.M.; M.A. Hussein and Sh. El-Kassas. 1998. Effect of bunch/leaf ratio on the yield and quality of Zaghloul date palm. Proceeding of the First International Conference on date palms in United States. Al-Ain, United States, 365-378.

Hegazi, A.M.; E.F. El-Dengawy and Marwa H. Hamama. 2008. Leaf/bunch ratio for Oreabi date palm cultivar grown at the north Delta of Egypt. J. Agric. Sci. Mansoura Univ., 33 (1): 419-424.

Jones, I.B.; B. Wolf and H.A. Milles. 1991. Plant analysis handbook. Micro-Macro Publishing Inc., pp. 213.

Khalifa, A.S.; A.I. El-Kady; K.M. Abdalla and A.M. El-Hammady. 1987. Influence of thinning patterns and leaf/bunch ratio on "Zaghloul" dates. Annals Agric. Sci., Fac. Agric., Ain Shams Univ., 32, 637.

Lunde, P. 1978. A History of Dates. Saudi Aramco World, 29 (2): 176-179.

Mead, R.; Currow, R.N. and A.M. Harted (1993): Statistical Methods in Agriculture and Experimental Biology. Second Ed. Chapman and Hall, London, pp. 10-20.

Mostafa, E.A.M.; M.M.S. Saleh and M.M.M. El-Migeed. 2007. Response of banana plants to soil and foliar application of magnesium. American Eurasian J. Agric. & Environ. Sci., 2 (2): 141-146.

Salama, A.S.M.; Omima, M. El-Sayed and A.A. Abdel-Hameed. 2014. Effect of magnesium fertilizer sources and rates on yield and fruit quality of Date palm cv. Hayany under Ras-Sudr conditions. Res. J. of Agric. and Biological Sci., 10 (2): 118-125.

Salem, S.E. 2007. Study the interaction effect of potassium and magnesium on yield and quality of grape vine in calcareous soils. M.Sc. Thesis, Fac. Agric., Alex. Univ., Egypt, pp. 172.

Shaaban, S.H.A.; S.S. Soliman and H.A. Hamouda. 2006. Nutrient removal and physical, chemical properties in Samany date palm as influenced by different pruning treatments. J. of Applied Sci. Res., 2 (12): 1142-1150.

Shabana, H.R. and N.S. Antoun. 1980. The determination of leaf area in date palm "Beitroya Zur Tropischen Land Wirtschaft and Veterinar Medizin, 18 (4): 345-349. (C.F. Hort. Abst. 51: 9102).

Westwood, M.N. 1978. Temperate zone pomology. W.H. Freeman Company, San Francisco, USA pp. 428.

Wilde, S.A., B.B. Gorey, J.G. Layer and J.K. Voigt (1985): Soils and Plant Analysis for Tree Culture. Oxford and IBH Publishing Co., New Delhi, India, 529-546.

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تأثير التسميد بالماغنسيوم ونسبة الأوراق للسوباطة علي نمو وإثمار نخيل البلح السيوي

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الملخص

أجريت هذه الدراسة في مزرعة خاصة بواحة الخارجة – الوادي الجديد – مصر علي نخيل البلح السيوي بغرض دراسة تأثير التسميد بالماغنسيوم ونسبة الأوراق للسباطات علي النمو الخضري والإثمار. حيث تم التسميد بمعدل ٥٠٠ ، ٧٥٠ أو ١٠٠٠ جرام سلفات ماغنسيوم وكذلك استخدم ثلاثة نسب من نسبة الأوراق للسوباطات وهي ٦ ، ٨ أو ١٠ أوراق/سباطة.

وقد أوضحت النتائج:

- حدثت زيادة معنوية في عدد الأوراق ومساحتها ومحتواها من العناصر نتيجة زيادة عدد الأوراق/سوباطة من ٦ إلي ١٠ ورقة/سوباطة وكذلك أدي التسميد بمعدل ٧٥٠ أو ١٠٠٠ جرام من سلفات الماغنسيوم/نخلة إلي زيادة معنوية في صفات النمو ومحتوي الأوراق من العناصر مقارنة بالتسميد بمعدل ٥٠٠ جرام سلفات ماغنسيوم/نخلة.
- سبب التسميد بمعدل ٧٥٠ أو ١٠٠٠ جم من سلفات الماغنسيوم وكذلك التقليم بنسبة ٨ أو ١٠ أوراق/سوباطة إلي زيادة معنوية في وزن المحصول/نخلة وكذلك تحسين خصائص الثمار الطبيعية والكيميائية مقارنة بالتسميد بمعدل ٥٠٠ جم سلفات ماغنسيوم أو ترك ٦ أوراق/سوباطة.
- أظهرت نتائج التفاعل بين التسميد والتقليم وجود زيادة معنوية للنمو الخضري والحالة الغذائية للأشجار وكذلك المحصول وخصائص الثمار حيث سجلت أعلي القراءات للنخيل المسمد بمعدل ١٠٠٠ جرام سلفات ماغنسيوم ومقلمة بمعدل ١٠ ورقات/سوباطة مقارنة بالمعاملات الأخري.
- لم تسجل فروق جوهرية بين التسميد بمعدل ٧٥٠–١٠٠٠ جم/نخلة والتقليم بمعدل ١٠ أو ٨ ورقات/للسوباطة.

من نتائج هذه الدراسة يمكن التوصية بالتقليم عن طريق ترك ٨ ورقات/سوباطة مع التسميد بمعدل ٧٥٠ جم من سلفات الماغنسيوم حيث يؤدي ذلك إلي تحسين النمو الخضري والحالة الغذائية لأشجار النخيل مع إنتاج محصول عال ذو خصائص ثمرية جيدة.