Impact of potassium fertilization and bunch thinning on Zaghloul date palm

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ABSTRACT

The present study was carried out during 2000, 2001 and 2002 growing seasons of Zaghloul date palm ***(Phoenix dactylifera L***) growing on sandy soil in private orchard at Rosetta region, Egypt. The aim of the present study is to evaluate the effect of potassium fertilization and bunch thinning on growth, yield, fruit quality and leaf elemental contents. Potassium fertilization added in 4 rates namely; 0, 1, 2, and 3 kg/palm as potassium sulfate (48% K_2O) at two doses. While the thinning done by two methods, the first without thinning and the second with removal of 25% of the strands number from bunch center, three weeks after pollination. The results showed that potassium fertilization lead to increase the number of new growing leaves and number bunches/palm. The thinning has a same trend. Increasing the potassium fertilization increased the fruit yield, while the thinning showed a decrease effect in fruit yield. Increasing potassium fertilization increased the percent of grade A and B fruits, while decreased the grade C fruits. The thinning increased the percent of grad A fruits and decreased the grade C, while the grade B did not affected. Potassium fertilization and thinning treatment lead to improve the fruit physical and chemical characteristics, especially with high levels of potassium fertilization (weight and volume of fruit, length and diameter of fruit, TSS, acidity and reducing, non-reducing and total sugars). Increasing potassium fertilization increased the pinnae contents of N, P, K, Fe, Mn, Cu and Zn while the Ca and Mg contents were significantly decreased. The thinning showed significant increase in N, P, K, Ca and Fe, but other elements were showed variable effects. Thus, it is recommended to apply 2 Kg K_2SO_4 /palm/year with 25% bunch thinning to improve the growth and to obtain best yield with good fruit quality of Zaghloul date palm grown under the present conditions.

Keywords: Date palm- K fertilization- bunch thinning– fruit quality- TSS- total sugars- acidity- pinnae elemental contents.

INTRODUCTION

Date palm is a most important fruit crops. In Egypt, date palm ranked the third crop after orange and grape (Agric. Econ. Bull., 2005). Because of date palm can grow and produce under a wide rang of soil and climatic conditions, growers have mistakenly believed that it does not require much attention. The successful orchard management practices are directed toward obtaining a suitable yield with good fruit quality. Two of the most important cultural practices in date palm orchards are fruit thinning and fertilization. Recommendations of the scientific meetings for data palm research stressed the importance of fertilization to improve the productivity and fruit quality of date palm ***(Phoenix dactylifera L***). Fruit thinning of dates is necessary for the following reasons: a) to insure adequate flowering and to releave the alternate bearing for the successive year; b) to obtain larger size and improve quality of fruits and c) to lighten the bunch and to make it less compact and easier to handle. (Hussein, 1970; Hussein *et al*., 1976 and 1979; EI-Kassas, 1983; Moustafa, 1993 and El-Shazly, 1999).

It has been well known that the nutrient requirements of the date palms could be fulfilled through the fertilizers application for the interplanted crops. However, this pattern of application depends on soil texture and the interplanted crops. In addition, the nutrient requirements of the date palms differ greatly within each stage of tree life. Applying the potassium element generally improves growth, yield and fruit quality of some date palm cultivars. EI-Hammady *et al*. (1991) found that the highest yield and fruit quality of Seewy dates were obtained by adding 2 kg potassium sulphate/palm yearly. Kassem *et al*.(1997) reported an increase in N and K contents of pinnae in Zaghloul date palm due to increasing of potassium fertilizer rate, while Ca and Mg contents tended to decrease. However, Shawky et al. (1999) recommended 1.5 kg potassium sulphate/date palm each year. Also, Bamiftah(2000) recommend 2 or 3 Kg of potassium Sulphate/palm/year for high yield and fruit quality, while, Harhash (2000) recommended 750 g K_2O(1.5 Kg potassium Sulphate) /palm/year.

Fruit thinning is necessary to reduce the weight and compactness of the fruit bunches and to insure adequate flowering for the next year. Hussein (1970) and Hussein *et al*.(1976) reported an increase in yield of Seewy date palm due to 30% thinning of stands. While, El-Makhtoun *et al.*(1995) found a reduction in bunch weight due to 25% reduction in stands of Zaghloul date palm. In the same time, El-Shazly (1999) found

a decrease in yield of "Nabtet Ali" date palm grown in Saudi Arabia due to removing of 30 or 50% of entire spikelets tips. In contrast, Badran(1999) reported an increase in bunch weight after removal of 20% of stands length after pollination. Many investigators found an increase in physical and chemical characteristics of date palm fruits due to bunch thinning (Badran, 1999 , El-Shazly , 1999 Harhash, 2000 and Bamiftah, 2000).

The objective of this study is to investigate the effect of fruit thinning combined with different rates of potassium fertilizer on vegetative growth, number of bunches per palm, yield, fruit quality and leaf elemental content of Zaghloul date palm grown under Rosetta condition, Egypt.

MATERIALS AND METHODS:

The present study was conducted during 2000(base year, all treatment were carried out without taking a measurements), 2001 and 2002 growing seasons on twenty years old "Zaghloul" date palm trees grown in a private orchard at Rosetta, Egypt. The palm trees were planted at seven meters apart on sandy loam soil. Some physical and chemical properties of the soil are presented in (Table 1).

Forty palm trees were chosen as uniform as possible in growth and vigor and subjected to the same cultural practices commonly adopted in the orchard. In addition, chemical fertilizers were not applied to the experimental trees several years before the initiation of the present experiment.

The selected palms were pruned at a level maintaining all palms possessing the same number of function leaves (81 leaves /palm). The number of bunches per palm was adjusted to 9 of nearly equal size by removing the excess ones from the latest and earliest small ones. The leaf/bunch ratio was adjusted by the end of blooming to be 9:1 in both seasons. Pollination was achieved by using pollen grains from the same parents in both seasons. As there were originally 80 to 120 strands on each bunch of "Zaghloul" palms, the number of strands on every bunch was reduced to 75, so as each bunch contained the same number of strands. The ordinary fertilization program was 20 Kg of chicken manure per palm added during winter, 1Kg/palm of triple calcium super phosphate (45% P_2O_5) broadcast on the soil surface through the whole area during December and 5 Kg ammonium Sulphate/palm (20% N) broadcast on the soil surface through the whole area during March,

April, May, June and July at equal doses.

Table (1). Some physical and chemical analysis of orchard soil at start of experiment

Parameters	Soil depth(cm)		
	0 - 30	30 - 60	60 - 90
Particle size distribution, %			
Sand	62.43	67.72	73.60
Silt	11.12	15.22	13.14
Clay	26.45	17.06	13.26
Textural Class	Sandy clay loam	Sandy loam	Sandy loam
Organic matter content (%)	1.25	1.05	0.75
$CaCO_3$ content (%)	12.11	15.37	16.78
pH	7.82	7.73	7.92
EC_e (dS/m)	2.56	3.12	3.72
Soluble cations(me/L)			
Ca^{2+}	12.32	15.42	18.58
Mg^{2+}	7.11	8.75	10.41
Na^{+}	5.24	6.17	7.55
K^{+}	0.45	0.38	0.49
Soluble anions(me/L)			
$CO_3^{-}+HCO_3^{2-}$	4.34	4.78	4.93
Cl^{-}	8.53	11.17	14.53
SO_4^{2-}	12.26	14.82	17.48

The study comprised the effect of potassium fertilizer and fruit thinning. Four levels of potassium sulphate (48-52% K_2O) were achieved as following: Zero (control), 1, 2 and 3 Kg K_2SO_4/palm yearly at two equal doses in February and July for all treatments. The potash fertilizer was broadcasted on soil surface 1.5 m apart from the palm trunk. Two thinning treatments were carried out three weeks after pollination in all seasons as following: 1) control (no thinning) and 2) removal of 25% of the number of strands from center.

The experiment was arranged in split plot technique in randomized complete block design. The potassium fertilization treatments were assigned to the main plot and thinning treatments were assigned to the subplots. Five palm trees were assigned to each treatment

as replicates.

Measurements:

1) The number of new growing leaves/palm and number of bunches/palm during growing season were recorded in March, 2001 and 2002.

2) At harvest time, as the peak of fruit color development during the second half of October in both seasons, yield per palm was recorded and samples of 100 fruits were randomly collected at ripening from each palm for determining the fruit weight, length, and diameter. Also, fruit moisture content was determined. Total soluble solids (TSS), total acidity, reducing, non-reducing and total sugars were determined in pulp juice as outlined by A.O.A.C (1990). Fruits were graded according to the uniformity of size, color and absence of defects as reported by Rugg(1975).

3) At mid of October of each season, samples of 100 pinnae (one year old) from the middle portion of the leaf above fruiting zone as recommended by Embleton and Cook(1947). Each sample was collected randomly at a constant height and at all directions of the trees. Leaf samples were washed with tap water, distilled water, air-dried and oven dried at 65°C for 72 hr. The dried samples were ground and then digested with concentrated Sulphuric acid + 30% hydrogen peroxide according to the method of Wolf (1982). Total N was determined by micro-Kjeldahl method (Jackson, 1973). Phosphorus was determined according the method of Murphy and Riely (1962). Potassium was determined by Flame Photometry (Jackson, 1973). Calcium, Magnesium and micronutrients (Fe, Mn, Cu and Zn) leaf contents were determined by atomic absorption Spectrophotometer (Carter, 1993).

The all collected data were subjected to statistical analysis of variance according to SAS Software (SAS Institute Inc., 1996).

RESULTS AND DISCUSSION

1. Vegetative growth

Results shown in Table(2) illustrate that K- fertilization significantly affected the vegetative growth of date palm i.e. number of new growing leaves and number of bunches per palm for both growing seasons. Increasing the K-fertilization rate from zero (control) to 3 Kg K_2SO_4/palm/year increased the No. of new growing leaves from 17.70 to 22.86 and from 19.78 to 23.61 for both seasons, respectively. The same

Table (2). Vegetative growth and yield of "Zaghloul" date palm for 2001 and 2002 growing seasons

K_2SO_4 rate Kg /palm	Thinning	No. of new leaves	No. of bunch/palm	Fruit yield (Kg/palm)
2001 growing season				
0	**0**	17.50	12.25	117.5
	25%	17.89	12.75	111.6
1	**0**	19.85	13.75	122.82
	25%	20.95	14.50	115.43
2	**0**	21.75	15.75	125.91
	25%	22.75	16.25	120.23
3	**0**	22.45	16.00	130.34
	25%	23.27	16.25	123.34
Interaction LSD(0.05)		1.44*	1.12*	3.62*
Mean effect of potassium fertilization				
K0		17.70	12.50	114.57
K1		20.40	14.13	119.13
K2		22.25	16.00	123.07
K3		22.86	16.13	126.84
LSD(0.05)		1.02**	0.79**	2.98**
Mean effect of bunch thinning				
T0		20.39	14.44	124.15
T1		21.22	14.94	120.16
LSD(0.05)		0.72*	0.46*	3.52*
2002 growing season				
0	**0**	19.43	11.50	124.50
	25%	20.12	12.40	121.75
1	**0**	21.64	12.75	130.75
	25%	23.19	13.75	126.60
2	**0**	22.56	13.25	136.50
	25%	23.95	14.75	131.40
3	**0**	22.97	14.00	138.75
	25%	24.25	15.50	133.85
Interaction LSD(0.05)		2.44*	0.60*	2.88*
Mean effect of potassium fertilization				
K0		19.78	11.95	123.13
K1		22.27	13.25	128.68
K2		23.26	14.13	133.95
K3		23.61	14.75	136.30
LSD(0.05)		1.72**	0.43**	2.44**
Mean effect of bunch thinning				
T0		21.65	12.94	132.63
T1		22.81	14.10	128.40
LSD(0.05)		1.08*	0.31**	1.44**

trend was noticed with No. of bunches per palm in which it increased from 12.50 to 16.13 and from 11.95 to 14.75 for both seasons, respectively. The increases were account as 29.15 and 19.36% for both seasons, respectively. The results also, indicated that the difference between the two highest K-fertilization levels (2 and 3 Kg K_2SO_4/palm/year) was not significant, but it differed from the two other rates (zero and 1 Kg K_2SO_4/palm/year).

In general, application of K-fertilization at rates of 2 or 3 Kg K_2SO_4/palm/year tends to increase the vegetative growth of palm trees. The present results are in agreement with those obtained previously by many investigators. Montasser *et al*.(1991) recommended 2 or 3 Kg of potassium sulphate to increase the vegetative growth of Seewy date palm. Also, Shawky(1999), Harhash(2000), Bamiftah(2000), Abdel-Nasser et al.(2000) and Abdel-Nasser and El-Shazly(2001)supported this result.

Bunch thinning significantly increased both No. of new growing leaves and No. of bunches/palm for both seasons. Bunch thinning increased the No. of new leaves from 20.39 to 21.22 and from 21.65 to 22.81 for both seasons, respectively. The same trend was also noticed with No. of bunches/palm in which it increased from 14.44 to 14.94 and from 12.94 to 14.10 for both seasons, respectively. Montasser *et al*.(1991), Shawky(1999), Bamiftah(2000) and Harhash(2000) supported the present results.

The beneficial effect of K-fertilization may be attributed to the physiological role of potassium in carbohydrate formation, translocation and accumulation within plant organs (Evans and Sorger, 1966 and Mayer and Anderson, 1970). Also, K is involved in plant meristematic growth (Mengel and Kirkby, 1987). In addition to synergistic effect between K and indole acetic acid and the enhancement of K on gibberelic acid and cytokinins effects on plant growth (Coccuci and Dalla Rosa, 1980 and Green, 1983).

2. Yield

Table (2) shows the yield results for Zaghloul date palm as affected by K-fertilization and bunch thinning. The present results indicated that increasing K-fertilization significantly increased the fruit yield. The fruit yield was increased from 114.57 to 126.84 Kg/palm in the first season as K-fertilization increased from zero to 3 Kg K_2SO_4/palm/year. The corresponding values for the second season were

from 123.13 to 136.30 Kg/palm. The increases were account as 15.07 and 10.70% for both seasons, respectively. The increment in yield may be attributed to the increase in number, and length of growing leaves. Consequently, an increase will be expected in the photosynthesis rate. In addition, the present results may be attributed to the physiological role of potassium in enhancing many metabolic processes such as carbohydrate formation, translocation and accumulation (Evans and Sorger, 1966 and Marchner, 1986). Archer (1985) reported that translocation of photosynthates depended on cell potassium concentration. The obtained results are in close agreement with those found by Abdalla *et al*. (1987), EI-Hammady *et al*. (1991), Shawky et al. (1999), Bamiftah(2000) and Harhash(2000), Abdel-Nasser et al.(2000) and El-Shazly and Abdel-Nasser(2001).

Thinning treatment significantly decreased the fruit yield for both seasons (Table, 2). The fruit yield was decreased from 124.15 to 120.16 Kg/palm in the first season and from 132.63 to 128.40 Kg/palm in the second season as a result of bunch thinning treatment. The reduction was account as 3.21 and 3.19% for the two growing season, respectively. The present results are in accordance with the previous obtained results by Hussein (1970) on Sakkoti dates, Hussein *et al.* (1976) on Barhi dates, Moustafa (1993) on Seewy dates, El-Shazly (1999) on Nabtet Ali dates, Bamiftah(2000) on Zaghloul dates and Harhash(2000) on Seewy dates. They stated that fruit thinning reduced the yield of the studied date varieties.

3. Fruit physical characteristics

Effect of potassium on the physical characteristics is shown in Table (3). The results demonstrated significant increments in fruit length, diameter, weight, and volume as a result of increasing K-fertilizer rate up to 3 Kg K_2SO_4/palm/year. Increasing potassium fertilization increased the percent of grade A and B fruits, while decreased the grade C fruits. The two K levels of 2 and 3 Kg K_2SO_4/palm/year gave no differences in physical characteristics for the present study. The increment in fruit physical characteristics may be due to the potassium application, where it plays an important role in, pH stabilization, osmoregulation, enzyme activation, protein synthesis, stomatal movement, photosynthesis, and cell extension (Läuchli and Pfluger, 1978). Moreover, potassium is an important solute in expanding cells (Marchner, 1986). These results are in agreement with those obtained by EI-Hammady *et al.* (1991), Shawky

et al. (1999), Harhash (2000) and Bamiftah(2000).

Table (3). Fruit physical characteristics of "Zaghloul" date palm for 2001 and 2002 growing seasons

K_2SO_4 rate Kg/palm	Thinning	fruit length (cm)	fruit diameter (cm)	fruit weight (g)	fruit volume (cm^3)	Fruit grad A (%)	Fruit grad B (%)	Fruit grad C (%)
2001 growing season								
0	**0**	5.97	2.72	30.61	29.60	19.21	65.65	15.14
	25%	6.61	2.95	33.89	33.05	22.83	67.34	9.83
1	**0**	6.12	2.79	31.43	30.81	21.21	68.50	10.29
	25%	6.75	3.06	34.87	34.05	23.76	68.89	7.35
2	**0**	6.42	2.88	32.43	31.52	23.28	68.75	7.97
	25%	6.92	3.05	35.53	35.12	27.06	67.12	5.82
3	**0**	6.62	2.94	33.29	32.42	23.38	69.75	6.87
	25%	6.94	3.15	36.54	35.95	28.21	68.23	3.56
Interaction		0.07*	0.006*	0.62*	0.18*	2.76*	2.15*	0.75*
Mean effect of potassium fertilization								
K0		6.29	2.84	31.75	31.33	21.02	66.50	12.49
K1		6.44	2.93	33.32	32.43	22.49	68.70	8.82
K2		6.67	2.97	33.98	33.32	25.17	67.94	6.90
K3		6.78	3.05	34.91	34.42	25.80	68.99	5.22
LSD(0.05)		0.32*	0.10**	1.31*	0.89*	0.67*	1.08*	1.67*
Mean effect of bunch thinning								
T0		6.28	2.83	32.02	31.21	21.77	68.16	10.07
T1		6.81	3.05	34.96	34.54	25.47	67.89	6.64
LSD(0.05)		0.23*	0.07**	0.92*	0.63*	0.48*	ns	1.18*
2002 growing season								
0	**0**	5.68	2.65	28.95	29.12	18.14	63.19	18.67
	25%	6.42	2.82	29.53	31.25	20.73	65.12	14.15
1	**0**	6.35	2.75	29.96	30.43	19.25	67.28	13.47
	25%	6.85	2.95	31.45	31.98	22.63	68.15	9.22
2	**0**	6.75	2.90	30.85	31.32	24.72	67.28	8.00
	25%	6,97	3.13	33.75	32.87	28.62	68.18	3.20
3	**0**	6.98	2.85	31.25	31.98	25.12	68.52	6.36
	25%	7.12	3.06	34.10	33.45	29.12	67.12	3.76
Interaction		0.24*	0.013*	4.53*	0.30*	1.32*	2.28*	3.10*
Mean effect of potassium fertilization								
K0		6.05	2.74	29.24	30.19	19.44	64.16	16.41
K1		6.60	2.85	30.71	31.21	20.94	67.72	11.35
K2		6.86	3.02	32.19	32.10	26.67	67.73	5.60
K3		7.05	3.08	32.68	32.72	27.12	67.82	5.06
LSD(0.05)		0.611	0.19**	0.61*	0.55*	0.59*	0.30*	0.78*
Mean effect of bunch thinning								
T0		6.44	2.84	30.20	30.71	21.81	66.57	11.63
T1		6.84	3.01	32.21	32.39	25.28	67.14	7.58
LSD(0.05)		0.43*	0.13**	0.43*	0.39*	0.42*	ns	0.55*

The effect of fruit thinning (Table, 3)demonstrated significant increase in fruit length, diameter, weight, and volume. The thinning increased the percent of grad A fruits and decreased the grad C, while the grad B did not affected. These results may be due to the decrease of fruit number per palm (yield) due to thinning which permits the fruits to take sufficient amount of carbohydrates, water and nutrients. The un-thinning fruit palm had the highest yield and lowest fruit characteristics. These results are in harmony with those obtained by Hussein (1970), Hussein *et al*. (1976), Khalifa *et al.* (1987), El-Shazly (1999), Harhash (2000) and Bamiftah(2000).

4. Fruit chemical characteristics

Regarding the influence of K fertilizer levels on the tested chemical characteristics, the results presented in Table(4) clearly showed that the increasing K application rate up to 3 Kg K_2SO_4/palm/year was associated with significant increase in T.S.S., total acidity, sugar (reducing, non-reducing and total) and decrease the fruit moisture content in both growing seasons. The last two levels of potassium (2 and 3 Kg K_2SO_4/palm/year) were not significantly different in their effects on the studied chemical properties. These results are due to the fact that potassium activates the enzymes involving in sugar biosynthesis and helps in translocation of sugars (Evans and Sorger, 1966 and Archer, 1985). In addition, Suelter (1970) mentioned that there are more than 50 enzymes which are stimulated by potassium. The obtained results appeared to be in close agreement with the findings reported by Abdalla *et al.* (1987), EI-Hammady *et al*. (1991), Attalla *et al*. (1999), Harhash (2000) and Bamiftah(2000).

Bunch thinning significantly increased the T.S.S., sugars contents (total, reducing and non-reducing sugar) and fruit moisture content and decreased the total acidity in both seasons. These results may be due to the highly providing rate of adequate carbohydrates and other metabolites to the fruits. The previous results are in accordance with those found by Hussein (1970), and El-Shazly (1999), Harhash (2000) and Bamiftah(2000).

Table (4). Fruit chemical characteristics of "Zaghloul" date palm for 2001 and 2002 growing seasons

K_2SO_4 rate Kg/palm	Thinning	Fruit moisture content (%)	Total soluble solids (TSS) (%)	Total acidity (%)	Reducing sugars (%)	Non-Reducing sugars (%)	Total sugars (%)
2001 growing season							
0	**0**	71.65	27.65	0.221	16.71	4.72	21.43
	25%	71.87	28.81	0.213	17.76	6.05	23.81
1	**0**	70.65	28.78	0.242	18.32	5.32	23.64
	25%	71.12	31.65	0.24	20.08	6.51	26.59
2	**0**	69.43	29.87	0.261	18.26	5.91	24.17
	25%	70.54	32.76	0.251	21.45	5.95	27.40
3	**0**	68.23	30.64	0.276	19.13	5.85	24.98
	25%	69.76	33.56	0.258	22.23	6.03	28.26
Interaction LSD(0.05)		1.13*	2.39**	0.001*	3.48*	0.78**	0.54**
Mean effect of potassium fertilization							
K0		71.76	28.23	0.217	17.24	5.39	22.62
K1		70.89	30.22	0.241	19.20	5.92	25.12
K2		69.99	31.32	0.256	19.86	5.93	25.79
K3		68.99	32.10	0.267	20.68	5.94	26.62
LSD(0.05)		0.51**	0.53**	0.014*	0.74**	0.22**	0.67**
Mean effect of bunch thinning							
T0		69.99	29.24	0.250	18.11	5.45	23.56
T1		70.82	31.70	0.241	20.38	6.14	26.52
LSD(0.05)		0.36**	0.37**	0.010*	0.53**	0.15**	0.48**
2002 growing season							
0	**0**	71.87	26.25	0.214	15.96	4.59	20.55
	25%	71.96	28.12	0.206	17.65	5.14	22.79
1	**0**	69.76	27.15	0.226	18.25	5.99	24.24
	25%	70.54	29.55	0.219	21.45	6.42	27.87
2	**0**	69.06	29.84	0.238	20.33	6.14	26.47
	25%	70.76	33.65	0.222	22.15	6.85	29.00
3	**0**	68.54	30.14	0.254	19.85	6.32	26.17
	25%	69.65	32.95	0.247	22.05	7.09	29.14
Interaction LSD(0.05)		1.43*	2.14**	0.001*	1.48*	0.08*	1.16*
Mean effect of potassium fertilization							
K0		71.92	27.19	0.211	16.81	4.87	21.67
K1		70.15	28.35	0.223	19.85	6.21	26.06
K2		69.91	31.75	0.230	21.24	6.50	27.74
K3		69.10	31.55	0.251	20.95	6.71	27.66
LSD(0.05)		0.88**	0.52**	0.013*	0.57**	0.29**	0.58**
Mean effect of bunch thinning							
T0		69.81	28.35	0.233	18.59	5.76	24.36
T1		70.73	31.07	0.225	20.83	6.38	27.20
LSD(0.05)		0.63**	0.36**	0.009*	0.40**	0.21**	0.41**

5. Leaf elemental contents

Data presented in Table(5) show a significant effect of potassium fertilization levels on pinnae elemental contents(i.e. N, P, K, Mg, Fe, Mn, Cu and Zn), but Ca content was significantly decreased. Increasing pinnae elemental contents due to K-fertilization may be attributed to the fact that increasing K-fertilization can improve plant ability to uptake soil nutrients. Improving plant uptake reflects on increasing vegetative growth and consequently improves efficiency for absorption and utilization of nutrients (Mangle and Kirkby, 1987and Abdel-Nasser and El-Shazly, 2001). These results are in harmony with those obtained by Perica et al.(1994) and Loupassaki et al.(1997).Decreasing pinnae Ca content with increasing K application levels may be due to the fact that more absorption of K ion may lead to antagonistic effect of such element with Ca(Epestein, 1972).

`Also, bunch thinning had a different effect on pinnae elemental contents. It was found that N, P, K, Mg, Fe were significantly affected by bunch thinning treatment. Other elements have different effects. The nutrient uptake may be accumulated in plant tissue by thinning which improved the growth of plant. These findings were in agreement with those found by Montasser *et al*. (1991) and Shawky *et al.* (1999).

Regarding the interaction effect of K fertilization and bunch thinning treatments, the data of both seasons indicated that both of K fertilization and thinning had significant effects. The highest values were attained at high level of K with thinning.

According the present results, it is recommended to apply 2 Kg K_2SO_4 /palm/year with 25% bunch thinning to improve the growth and to obtain best yield with good fruit quality of Zaghloul date palm grown under the present conditions.

Table (5). Pinnae elemental content of "Zaghloul" date palm for 2001 and 2002 growing seasons

K_2SO_4 rate Kg/palm	Thinning	Macronutrients (%)					Micronutrients(mg/Kg)			
		N	P	K	Ca	Mg	Fe	Mn	Cu	Zn
2001 growing season										
0	**0**	1.213	0.225	0.802	1.177	0.370	121	49	14	51
	25%	1.223	0.229	0.812	1.187	0.386	123	48	13	52
1	**0**	1.243	0.232	0.870	1.157	0.348	127	52	16	53
	25%	1.249	0.242	0.882	1.167	0.354	129	53	17	54
2	**0**	1.265	0.253	0.988	1.137	0.320	131	56	19	57
	25%	1.276	0.259	0.995	1.142	0.338	132	57	20	56
3	**0**	1.284	0.268	0.996	1.127	0.305	135	59	22	60
	25%	1.297	0.286	1.012	1.132	0.317	138	59	21	61
Interaction LSD(0.05)		0.010*	0.009*	0.008*	0.004*	0.010*	2.3*	3.3*	1.7*	4.1*
Mean effect of potassium fertilization										
K0		1.218	0.227	0.811	1.182	0.378	122.3	48.8	13.8	51.9
K1		1.246	0.237	0.882	1.162	0.351	128.4	52.8	16.7	53.8
K2		1.271	0.256	1.028	1.139	0.329	131.7	57.0	19.8	57.2
K3		1.291	0.277	1.264	1.129	0.311	137.1	59.5	22.0	60.9
LSD(0.05)		0.007*	0.011**	0.181**	0.009*	0.018*	2.5**	3.0**	2.2**	2.8**
Mean effect of bunch thinning										
T0		1.251	0.245	0.984	1.149	0.336	128.5	54.0	17.7	55.3
T1		1.261	0.254	1.038	1.157	0.349	130.5	54.3	17.8	55.8
LSD(0.05)		0.005*	0.008*	0.128*	ns	0.013*	1.8*	ns	ns	ns
2002 growing season										
0	**0**	1.232	0.231	0.895	1.187	0.383	123	52	16	53
	25%	1.247	0.241	0.914	1.197	0.396	124	53	17	54
1	**0**	1.243	0.241	0.921	1.153	0.375	126	53	17	55
	25%	1.258	0.253	0.942	1.165	0.387	128	55	19	56
2	**0**	1.249	0.249	0.942	1.142	0.363	130	55	19	58
	25%	1.261	0.259	0.958	1.153	0.379	132	58	20	60
3	**0**	1.254	0.258	0.974	1.128	0.342	134	57	21	61
	25%	1.269	0.267	0.993	1.137	0.357	135	61	23	63
Interaction LSD(0.05)		0.012*	0.007*	0.012*	0.006*	0.011*	1.9*	2.8*	2.1*	3.8*
Mean effect of potassium fertilization										
K0		1.239	0.236	0.905	1.192	0.389	123.9	52.9	16.7	53.8
K1		1.251	0.247	0.931	1.159	0.381	127.2	54.3	18.6	56.2
K2		1.255	0.254	1.091	1.148	0.371	131.4	57.0	20.1	59.4
K3		1.262	0.265	1.277	1.132	0.349	135.1	59.7	22.3	62.7
LSD(0.05)		0.005*	0.014**	0.166**	0.010*	0.023*	3.8**	2.7**	2.0**	3.4**
Mean effect of bunch thinning										
T0		1.245	0.245	1.025	1.153	0.366	128.6	54.8	18.8	57.2
T1		1.259	0.255	1.074	1.163	0.379	130.2	57.3	20.3	58.7
LSD(0.05)		0.009*	0.010*	0.118*	ns	0.016*	2.7*	1.9*	1.4*	ns

REFERENCES

Abdalla, K.M., S.I. Gaafer, A.S. Khalifa and A.M. EI-Hammady (1987). Influence of fertilization with potash on Hayany dates grown on sandy soil. Anna. Agric. Sci., Fac. Agric., Ain Shams Univ., Cairo, Egypt, 32 (1): 649-656.

Abdel-Nasser, G. , M. M. Harhash and S. M. EL-Shazly(2000).Response of some olive cultivars grown in Siwa Oasis to well water quality. J. Agric. Sci. Mansoura Univ., 25(5):2877-2896.

Abdel-Nasser, G. and S. M. El-Shazly(2001). Response of Picual Olive Trees to Potassium and Boron Fertigation. 1. Vegetative Growth and Leaf Constituents. J. Adv. Agric. Res., 6(3): 631-649.

Agricultural Economic Bulletin (2005). Ministry of Agriculture and Land Reclamation, A.R.E., Acreage and total production of fruits, pp.177(in Arabic).

Arsher, J. (1985). Crop nutrition and fertilizer use. Farming Press Ltd. 258 pp. Attalla, A.M.; M.M. Attia and Hoda S. Aly (1999). Effect of some NPK fertilizer on Zaghloul date palm cultivar yield and fruit characteristics. Proc. The International Conference on Date Palm. Assiut, Egypt, 223-235.

Association of Official Analysis Chemists , A.O.A.C. (1990). Official Methods of Analysis. 13th ed. Association of Official Analysis Chemists. Washington, D.C., USA.

Attalla, A. M., M.M. Attia and H.S. Aly(1999). Effects of some NPK fertilizer on Zaghloul date palm cultivar yield and fruit quality characteristics. Proceedings of the International Conference on Date Palm, Assuit University, Egypt, November 9-1, pp.223-235.

Badran, M.A.F.M.(1999). Effect of bagging and fruit thinning treatments on yield and fruit quality of Zaghloul dates under Aswan conditions. M. Sc. Thesis, Fac. Of Agric., Assuit University, Egypt.

Bamiftah, M.A.O. (2000). Effect of potassium fertilization and bunch thinning on yield and fruit quality of Zaghloul date palm. M. Sc. Thesis, Fac. Agric. Sci., Saba Basha, Alex. Univ.

Carter, M.R. (1993). Soil Sampling and Methods of Analysis. Canada Society of Soil Science, Lewis Publishers.

Cocucci, M. C. and S. Dalla Rosa(1980). Effects of canavanine on IAA- and fusicoccin-stimulated cell enlargement, proton extrusion and potassium uptake in maize coleoptiles. Physiol. Plant., 48: 239-

242.
El-Hammady, A.M.; A.S. Khalifa and A.S. Montasser (1991). Effect of potash fertilization on Seewy date palms. II. Effect on yield and fruit quality. Egypt. J. Hort. 18, No. 2, pp. 199-210.
El-Kassas, S.E. (1983). Manual and chemical thinning of Zaghloul dates. Assiut J. Agric. Sci., 14 (2): 221-233.
El-Makgtoum, F. M., A. M. Abd El-Kader and A. A. Abd El-Al(1995). Effect of different fruit thinning methods on yield and fruit characteristics of Zaghloul dates. Zagazig J. Agric. Res., 22(1):143-149.
El-Shazly, S.M. (1999). Effect of fruit thinning on yield and fruit quality of Naptet Ali Saudi date palm. Proc. The International Conference on Date Palm. Assiut, Egypt, 17-33.
El-Shazly, S.M. and Abdel-Nasser(2001). Response of Picual Olive Trees to Potassium and Boron Fertigation 2. Fruit set, Yield, Oil Content, Water Use-Efficiency and Fruit Quality. J. Adv. Agric. Res., 6(3): 651-669.
Embleton, T.W. and J.A. Cook (1947). The fertilizer value of date leaf and fruit stalk pruning. Date Grower15 Inst. rept. 24, 18.
Epestein, E.(1972). Mineral nutrition of plants. Principles and Perspectives. Pp.212-216. John Wiley& Sons, Inc., New York
Evans, H.J. and G.J. Sorger (1966). Role of mineral-elements with emphasis on the univalent cations. Ann. Rev., Plant Physio!., 17: 47-76.
Green, J.(1983). The effect of potassium and calcium on cotyledon expansion and ethylene evolution induced by ctyokinins. Physiol. Plant., 57: 57-61.
Harhash, M. M. (2000).Effect of Fruit Thinning and Potassium Fertilization on "Seewy" Date Palms Grown at Siwa Oasis. J. Adv. Agric. Res., 5(3):1519-1531.
Hussein, F. (1970). Effect of fruit thinning on size, quality and ripening of Sakkoti date grown at Asswan. Trap. Agric. 47 (2): 163-166.
Hussein, F.; M.S. El-Kahtany and Y.A. Wally (1979). Palm culture and dates production in Islamic and Arabic worlds. Ain Shams Univ., Press (In Arabic) p. 196.
Hussein, F.; S. Moustafa and F. El-Samaer (1976). Size, quality and ripening of Barhi dates as affected by fruit thinning. J. Agric. Res., Zagazig Univ., 3 (2): 125-142.
Jackson, M.L. (1973). Soil Chemical Analysis. Prentice-Hall, Inc. India.

Kassem, H.A., M. B. El-Sabrout and M. M. Attia(1997). Effect of nitrogen and potassium fertilization on yield, fruit quality and leaf mineral content in some Egyptian soft varieties.Alex. J. Agric. Res., 42(1):137-157.

Khalifa, A.S.; A.I. EI-Kady; K.M. Abdalla and A.M. EI-Hammady (1987). Influence of thinning patterns and leaf/bunch ratio on Zaghloul dates. Annals Agric. Sci., Fac. Agric., Ain Shams Univ., Cairo, Egypt, 32 (1): 637- 647.

Läuchli, A. and R. Pfluger (1978). Potassium transport through plant cell membranes and metabolic role of potassium in plants. Proc. 11th Congr. Int. Potash Inst. Bern, pp 111-163. (C.F. Marschner, 1986, pp 254-288).

Loupassaki, M. H., I.I. Androulakis, S. M. Lionakis, E. Sfakiotakis and J. Porlingis(1997). Effect of P and K fertilizers and of the date of sampling on the concentration of macro- and micro-elements in the leaves of four kiwi cultivars. Acta Hort., 444: 249-254.

Mangel, K. and E.A. Kirkby (1987). Princeple of plant Nutrition 4th Ed., International Potash Institute, Bern, Switherland.

Marschner, H. (1986). Mineral nutrition of higher plants. Academic Press: Harcourt Brace Jovannovich, Publishers. London, San Diego, New York and Tokyo, p. 673.

Mayer, B.S. and D.B. Anderson (1970). Plant Physiology, 2nd Ed., 4th East-West Reprint, Chap xxv 473, Affiliated East West Press PVT. LTD. New Delhi.

Montasser, A.S.; A.M. El-Hammady and A.S. Khalifa (1991). Effect of potash fertilization on Seewy date palms. I. Effect on growth and mineral content of leaves. Egypt. J. Hort. 18, No. 2, pp. 211-220.

Moustafa, A.A. (1993). Effect of fruit thinning on yield and fruit quality of Seewy date palms under EI-Fayoum Governorate conditions. Proceeding of the third symposium of the Date Palm in Saudi Arabia, King Faisal Univ, January 17-20, 239-249.

Murphy, J. and J.P. Riely (1962). A modified single solution method for the determination of phosphorus in natural water. Anal. Chem. Acta. 27: 31-36.

Perica, A., I.I. Androulakis, M.H. Loupassaki, S. Lavee and I. Klein(1994). Effect of summer application of nitrogen and potassium on mineral composition of olive leaves. Acta Hort., 336:221-224.

Rugg, G.L.(1975). Date development, handling and picking in the

United States , USDA Handbook, Washington, D.C., No. 482, 1-7 pp

SAS Institute Inc. (1996). The SAS System for Windiows. Release 6.12, SAS Institute Inc., Cary , NC, USA.

Shawky, L; M. Yousif and A. EI-Gazzar (1999). Effect of potassium fertilization on Seewy" date palm. Annals Agric. Sci., Ain Shams Univ., Cairo, 44 (2): 727-735.

Suelter, C.H. (1970). Enzymes activated by movement cations. Science. 168: 789-795.

Wolf, B.(1982). A comprehensive system of leaf analysis and its use for diagnosing crop nutrient status. Commu. Soil Sci., Plant Anal. 13: 1035-1059.

تأثير التسميد البوتاسي وخف السوباطة على نخيل البلح الزغلول

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الملخص العربي

أجريت هذه الدراسة خلال مواسم النمو2000, 2001 و 2002 على نخيل البلح (*Phoenix dactylifera, L*) صنف الزغلول نامية في تربة رملية بمزرعة خاصة بمنطقة رشيد – جمهورية مصر العربية . الغرض من الدراسة الحالية هو معرفة تأثير التسميد البوتاسي وخف السوباطة على النمو – المحصول – جودة الثمار ومحتوى الأوراق من العناصر الغذائية. أضيف السماد البوتاسي في ٤ معدلات هي صفر ، ١، ٢ و٣ كجم /شجرة في صورة سلفات بوتاسيوم (٤٨% بوأ٢) على دفعتين .أما الخف فقد تم بطريقتين الأولى بدون خف للسوباطة والثانية خف ٢٥% من عدد الشماريخ من وسط السباطة بعد ٣ أسابيع من التلقيح. أظهرت النتائج أن زيادة التسميد البوتاسي أدى إلى زيادة في عدد الأوراق الجديدة وزيادة عدد الشماريخ/ نخلة .كما أن الخف أعطى نفس الاتجاه. زادت محصول النخلة مع زيادة التسميد البوتاسى أما الخف فقد اظهر نقص في محصول النخلة. حدوث زيادة في نسبة الثمار من الدرجة(أ و ب) ونقص في نسبة الثمار من الدرجة (ج) خاصة مع المعدلات العالية من التسميد البوتاسي. أما عملية الخف فقد أدت إلى زيادة نسبة الثمار من الدرجة أ ونقص في نسبة الثمار من الدرجة ج بينما الدرجة ب لم تتأثر. التسميد البوتاسي وعملية الخف أدت إلى تحسين خواص الجودة الفيزيائية والكيمائية للثمار خاصة مع المستويات العالية من التسميد البوتاسي (وزن وحجم الثمرة- طول وقطر الثمرة- المواد الصلبة الذائبة – الحموضة – السكريات المختزلة وغير المختزلة والكلية). زيادة التسميد البوتاسي أدت إلى زيادة محتوى الأوراق من البوتاسيوم والفسفور والنيتروجين والحديد والمنجنيز والنحاس و الزنك بينما حدث نقص في الكالسيوم . أما الخف فقد أدى إلى زيادة معنوية في محتوى الأوراق من النيتروجين ,الفسفور , البوتاسيوم, الماغنيسيوم و الحديد وباقي العناصر أظهرت تأثيراً متبايناً. لهذا فإننا نوصى بالتسميد البوتاسي بمعدل ٢ كجم سلفات بوتاسيوم/نخلة مع خف ٢٥% من عدد الشماريخ لتحسين النمو الخضري والحصول على أعلى محصول بصفات جودة جيدة لنخيل البلح صنف الزغلول تحت ظروف الدراسة الحالية.

الكلمات الدالة: نخيل التمر – التسميد البوتاسي – خف الأغاريض-جودة الثمار – المواد الصلبة الذائبة-السكريات الكلية – الحموضة- محتوى العناصر