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RESPONSE OF ZAGHLOUL DATE PALM GROWN ON CALCAREOUS SOIL TO SOURCES OF ORGANIC FERTILIZATION

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ABSTRACT

Organic manure is playing a profound role in plant nutrition and soil improvement, particularly under conditions of dry climatic regions. Field experiments on twenty- years- old Zaghloul date palm trees, grown on calcareous soil at Maryout Research Station, Desert Research Center, were conducted to study the trees response to different organic manures for two consecutive seasons 2012 and 2013, under rainfed circumstances. Three local sources of organic manures were used as: camel, sheep and compost manure. The application rate were 0, 25, 50 kg organic manure/palm tree. Two treatments of potassium humate; without and with (one kg/palm tree) were combined with the organic manures. The results indicated that, fruit yield, fruit physical characteristics and total sugar content were significantly increased by organic manures applications with or without K-humate compared to control treatment, during the two seasons. Also, application of organic manures led to raise the P and K content than the minimum of sufficient level in soil and plant. However, these treatments were not able to increase N up to sufficient level in soil and plant. The results of this study showed that the optimum fertilizer treatment was sheep manure (50 kg/tree) along with K-humate, which achieved suitable quality and quantity fruit yield of Zaghloul date palm. Moreover, this treatment increased the mineral content of soil and leaves of palm compared to compost and camel manures. Also, the organic manure resulted from sheep is considered the cheapest manure and more available in desert soils compared to other manures. Therefore, this manure is recommended for Zaghloul date palm cultivated on calcareous soil under conditions of arid and semi-arid regions that are limited in water resources.

Keywords: Zaghloul date, Organic manures, Sheep, Camel, Compost, Humic acids, Yield, Calcareous soil

INTRODUCION

Soil organic matter is one of the most important constituents of soil due to its capacity in affecting plant growth indirectly and directly. Organic matter acts as a reservoir of plant nutrients especially N, P, K, S & micronutrients, prevents leaching of nutrients and also improves cation exchange capacity of soil (Bongiovanni and Lobartini, 2006). Organic fertilizers are obtained from decomposed plant and animal materials which are relatively stable and their application can cause better plant nutrition and soil fertility improvement as well as reducing in water requirement of plants, particularly under conditions of water limitation. It is not only necessary for plant nutrition as slow release fertilizers but also essential for efficient plant production system (Steve, 2009). Application of organic manure had a promoted soil aggregation, reduces surface crusting, reduces soil pH,

increases soil organic matter, and is beneficial to crop and soil on the long term (Tirol *et al.,* 2007).

Drought will continue being a problem to be solved for crop production, since water limitation causes stress in plants and restrictions the production of important cultivations world wide (Boyer, 1982). Practices that increase soil moisture content can be categorized in three groups: (i) those that increase water infiltration; (ii) those that manage soil evaporation; and (iii) those that increase soil moisture storage capacities. All three are related to soil organic matter (Bot and Benites, 2005).

Humic acid is one of bio-stimulants which known as the organic materials that promote plant growth and help plants to withstand harsh environments when applied in small quantities (Chen *et al.,* 1994). It is also highly beneficial for both plant and soil; it maintains proper plant growth as well as it increases nutrient uptake, tolerance to drought and availability of soil nutrients particularly in calcareous soil and low organic matter of soil (Ismail *et al.,* 2007). Therefore, using of humic acid improves nutrient availability in calcareous soils since it promotes nutrient uptake as chelating agent. Furthermore, humic materials may increase root growth (Khattab *et al.,* 2012). In this direct, potassium humate is considered as an organic fertilizer. It contains 5% nitrogen, 2.8% phosphorus, 10% potassium and some micronutrients including molybdenum, copper, zinc, cobalt and magnesium. Potassium humate increases production and quality of a crop, plant tolerance to drought stress, salinity, heat, cold, disease and pests (Jalil. *et. al*, 2013).

Date palm (Phoenix dactylifera L.) is one of the oldest fruit trees in the world. It is known as “tree of life” because of its resilience, its need for limited water inputs, its long term productivity and its multiple purpose qualities (Marzouk and Kassem, 2011). Zaghloul dates, which are the most economically important soft cultivars grown in Egypt. Generally, they are grown and are highly productive under stringent environmental conditions that may be not suitable for many other species of fruit trees.

In Egypt, newly reclaimed soils are alkaline and mostly calcareous in nature. High pH of calcareous soils has a negative effect on nutrient availability and calcium carbonate particles often form strong sorption sites for phosphorus rendering them unavailable to plants (Khattari and Tell, 1988). Also, very few researches have been done regarding organic agriculture, in spite of good sources of organic matter especially animal manure and plant residues, which are available at very low costs. Hence, sheep, camel and compost manures were more efficient in improving soil physical and chemical characteristics and enhancing growth of fruit trees. So, these media are recommended for fruit trees cultivation under the arid and semi-arid regions, which are limited in water resources, especially calcareous soil. Therefore, the target of this investigation was to study the response of Zaghloul date palm to three local organic sources i.e camel, sheep and compost manures under calcareous soil conditions.

MATERIALS AND METHODS

The present study was carried out during the two successive seasons 2012 and 2013 on Zaghloul date palm (*Phoenix dactylifera L*) at the Maryout Research Station-Desert Research Center (DRC), between longitude 29°47′ and 15°27′ E and latitudes 31°00′ and 18°37′ N. The work aimed to study the response of Zaghloul date palm grown on calcareous soil to different sources of organic fertilization. The Twenty-year-old Zaghloul date palms were similar in growth vigor and were on 8 × 8 m spacing and the irrigation depends on rainfall only. The soil is calcareous and sand loamy in texture. Some physical, chemical properties and fertility status of the studied soil are shown in (Table 1). The level of soil organic matter content is low in the soil surface and subsurface layers.

The experiment was conducted by using three local organic manures, camel, sheep and compost manures at three rates of each (0, 25, 50 Kg /tree) with and without of one kg/tree K-humate combined with the organic manures in a randomized complete block design, with 12 treatments, plus control (without fertilizer) using three replicates. Analyses of some chemical characteristics of organic manures are presented in Table 2. At the last week of November, organic manures were applied in holes at depth of 30 cm around trees at a distance of 50 cm from the palm trunk. Also, K- humate treatments were applied to the wetted soil surface surrounding each tree as a single application in the second week of December in both seasons.

In both study years, the bunch numbers of dates per palm were counted at harvest. Also, the palms were harvested in early-October when fruits reached to Khalal stage (fully mature, crunchy and red in color). The average of bunch weight and fruit yield was recorded in Kg. Thirty-date samples were randomly picked out of the palm fruit yield for the assessment of fruit physical properties, i.e., fruit weight, fruit length, fruit diameter, and fruit volume according to A.O.A.C. methods (1985). Fruit total sugar was determined as percentage of the dry weight according to Challin and Kennedy (1994).

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

Soil depth (cm)	pH	O.M %	E.C dS/m	$CaCO_3$ %	Sand %	Silt %	Clay %	Texture	Available nutrients ($mg.Kg^{-1}$ soil)		
									N	P	K
0 - 30	8.40	0.76	2.92	26.63	75.52	12.75	11.63	SL	19.30	5.16	43.52
30- 60	8.62	0.52	1.39	29.95	74.64	14.52	10.84	SL	15.42	2.15	42.58

Table (2): Some chemical characteristics of the used organic manures.

Parameters	Organic manures		
	Camel	Sheep	Compost
Organic matter (%)	36.6	47.5	40.1
Organic carbon (%)	21.2	27.6	23.3
pH	8.12	7.93	8.05
EC (dS/m)	6.54	4.98	5.28
C/N ratio	20.1	17.8	16.2
Total N (%)	1.05	1.55	1.44
Total P (%)	0.42	0.76	0.84
Total K (%)	0.98	1.26	1.18

Leaf mineral contents, N, P, and K were determined after harvest immediately of each season. Leaf samples were chosen from among fruiting leaves from each replicate, (Shawky *et al.* (1999). Plant samples were cleaned, dried at 70°C for 72 hr., ground and digested in a mixture of sulfuric (H_2SO_4) and perchloric (HCl_4) and total of N, P and K were determined according to AOAC, (1985).

Four random soil samples from main directions of each replicate were taken at depth of 0-30 and 30-60 cm after the harvest in two seasons. Soil were mixed, air-dried and ground to pass a 2-mm sieve. Available of N, P and K were determined according to Black *et al.,* (1982).

The data were subjected to the analysis of variance (ANOVA) using MSTAT computer software, and least significant difference test (LSD) was used to differentiate means at 5% level of probability (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of organic manures on Zaghloul yield parameters

The results presented in Table 3, show that, number of bunches per palm was insignificantly affected by the application of organic manures in the first season, whereas, number of bunches per palm was significantly increased by organic manure applications when compared with the control treatment in the second season. On the other hand, the average number of bunches produced by the trees at different rates of organic manures, showed non significant differences among the treatments. This may be referred that the physiological system of the trees was trying to adapt to the nutritional treatments (Abou-Amer, 2007). These results are similar to those obtained by Bacha and Abo-Hassan, (1983) who found that the fertilization (NPK and organic manure) did not affect the average number of bunches per tree of Khudari date palm at harvest.

With regard to bunches weight per palm, the data presented in Table 3, indicate that the bunches weight could successfully exhibit significant responses due to the application of different organic manures. All applied manures fertilizers could significantly increase bunch weight over that of the

control. Sheep manure (50 kg/tree) with K-humate gave the most prominent enhancing bunches weight in the two seasons compared to compost and camel manures. Similar results were obtained by Osman (2009) on Sakkoty date palm.

Concerning the fruit yield, the application of organic manures (camel, sheep and compost) and their interaction had a significant role in enhancing fruit yield of Zaghloul date palm in both seasons, when compared with the control treatment. Fruit yield per palm was increased with increasing the level of organic manures added to the trees. The application of K-humate with organic fertilizer could significantly enhance date palm fruit yield, when compared with the influence of organic manures alone. The greatest fruit yield per palm was recorded from trees that received the sheep manure (50kg/tree), which was followed by compost (50kg/tree) with and without K-humate. Furthermore, combination of K-humate with organic manures whether at the smallest rate (25kg/tree) led to increased fruit yield per palm in two seasons of study. On the other hand, the control treatment gave less yields in the 2nd season than the first year due to the absence of nutrient replenishment and continued depletion of nutrients from the soil by plant uptake. Moreover, fruit yield per palm in the second season was the best compared with the first season of study. This may be attributed to accumulating residual effects of organic manures. So, it can be concluded that increasing organic manures application rate with K-humate combination is recommended to enhance the efficiency of soil application and to raise the soil total content of major elements (NPK) and hence increasing the availability of these elements. Consequently, applying organic manures at the highest level is the most effective practice for feeding date palm trees and producing the highest fruit yield. These results are in agreement with those of Bacha and Abo-Hassan (1983) for Khudari date, Shahein *et al*., (2003) for Zaghloul date and Osman (2009) for Sakkoty date palm.

It was found from the results in Table (3) that the fruit total sugar (%) in the two seasons increased with first and second levels of organic fertilizers as compared with the control treatment. Also, total sugars increased by applied organic fertilizers with K-humate when compared with organic fertilizers alone. The content of total sugar in the fruits was greater with highest rate of sheep manure than with highest rates of compost and camel manures with and without K-humate in the first and second season. The favorable effect of organic manures or organic with K-humate on total sugars content may be due to response of palm trees to organic fertilization and improve fruit quality. Similar trends were obtained by Abou-Amer (2007) and Kassem (2012).

Table (3). Effect of organic fertilizer on Zaghloul yield parameters and total sugar content during two sequence seasons

Organic manure treatments	No. of bunches/palm		Bunch weight (Kg/ bunch)		Fruit yield (Kg/ palm)		Fruit total sugar (%)	
	-H*	+H	-H	+H	-H	+H	-H	+H
Season 2012								
Control	10.33		13.43		106.76		25.12	
25 kg Camel	10.33	10.33	13.82	14.12	107.59	109.86	26.01	26.13
50 kg Camel	10.00	10.33	13.99	14.48	109.15	111.22	26.25	26.60
25 kg Sheep	10.33	10.67	14.21	14.33	113.46	113.53	26.86	26.94
50 kg Sheep	10.67	11.33	14.43	14.64	114.36	115.73	27.13	27.36
25 kg Compost	10.67	10.67	13.86	14.26	109.78	112.00	26.38	26.79
50 kg Compost	11.00	11.33	14.23	14.51	112.13	114.92	26.50	27.14
Mean	10.48	10.67	14.00	14.25	110.46	112.00	26.32	26.58
LSD (0.05)								
Humic	n.s.		0.054		0.383		0.091	
Organic manures	n.s.		0.101		0.716		0.169	
Interaction	n.s.		0.142		1.012		0.240	
Season 2013								
Control	10.33		13.39		106.23		25.05	
25 kg Camel	10.67	11.00	14.40	15.35	109.25	111.45	26.15	26.32
50 kg Camel	11.00	11.00	14.86	15.83	111.09	114.38	26.43	26.84
25 kg Sheep	11.00	11.33	14.70	15.65	111.12	114.02	26.70	27.08
50 kg Sheep	11.33	11.33	15.64	16.74	115.68	118.36	26.93	27.53
25 kg Compost	10.67	11.00	14.64	15.53	113.14	113.20	26.38	26.95
50 kg Compost	11.33	11.67	15.18	16.20	115.34	117.53	26.66	27.66
Mean	10.90	11.10	14.69	15.53	111.69	113.60	26.33	26.78
LSD (0.05)								
Humic	n.s.		0.061		0.402		0.102	
Organic manures	0.582		0.114		0.751		0.193	
Interaction	n.s.		0.161		1.062		0.274	

***: Humic acid treatment as potassium humate**

On the economic side, it was clear that the treatment of sheep manure on Zaghloul fruit yield at a rate of 50 kg/tree as ton per hectare combined with K-humate achieved the highest fruit yield as compared to other treatments. The increment recorded 11.6 % as compared to control, as shown in Fig. (1). This could be due to application of sheep manure that had high water retention effect in the soil during rainfall, and applied at optimal rate, saves much of irrigation water required, (Steve, 2009). Moreover, the cost of sheep manure application is reduced under drought conditions, especially, when the absence of mineral fertilizers of the region.

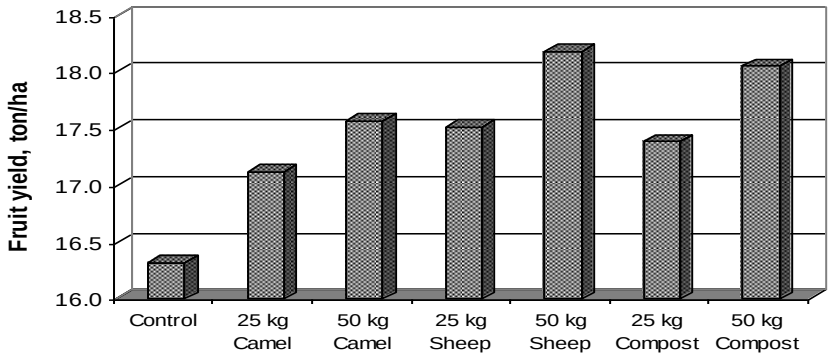

Figure (1): Fruit yield of date palm trees, ton/ha as affected by organic manure treatments combined with humic acid under rainfed conditions.

Effect of organic manures on Zaghloul fruit parameters

The results presented in Table 4, show that fruit parameters (i.e. weight, length, diameter and volume) were good indication of fruit differentiation in response to the applied fertilizer treatments in the two years of study.

Table (4). Effect of organic fertilizer on Zaghloul fruit parameters during two sequence seasons

Season 2012								
Organic manure treatments	**Fruit weight (gm)**		**Fruit length (cm)**		**Fruit diameter (cm)**		**Fruit volume (cm^3)**	
	-H*	+H	-H	+H	-H	+H	-H	+H
Control	25.94		5.68		2.52		25.43	
25 kg Camel	26.22	26.36	5.80	5.91	2.56	2.59	25.75	26.21
50 kg Camel	26.48	26.65	5.89	5.98	2.58	2.68	26.02	26.34
25 kg Sheep	26.93	27.22	6.23	6.32	2.73	2.86	26.92	27.10
50 kg Sheep	26.95	27.29	6.31	6.45	2.80	2.95	27.09	27.28
25 kg Compost	26.42	26.63	6.18	6.21	2.64	2.72	26.21	26.56
50 kg Compost	26.72	26.94	6.25	6.32	2.68	2.80	26.52	26.84
Mean	26.52	26.72	6.05	6.12	2.64	2.73	26.28	26.54
LSD $_{(0.05)}$								
Humic	0.045		0.021		0.026		0.072	
Organic manures	0.085		0.040		0.048		0.134	
Interaction	0.120		n.s.		n.s.		n.s.	
Season 2013								
Control	25.91		5.65		2.50		25.35	
25 kg Camel	26.28	26.59	5.95	6.02	2.60	2.68	25.98	27.12
50 kg Camel	26.61	26.76	6.04	6.15	2.66	2.74	26.16	26.29
25 kg Sheep	27.03	27.30	6.36	6.56	2.78	2.90	26.94	27.25
50 kg Sheep	27.28	27.42	6.49	6.63	2.89	3.00	27.19	27.45
25 kg Compost	26.46	26.68	6.21	6.26	2.66	2.76	26.42	26.63
50 kg Compost	26.82	26.96	6.33	6.38	2.76	2.85	26.68	27.02
Mean	26.63	26.80	6.15	6.23	2.69	2.78	26.39	26.73
LSD $_{(0.05)}$								
Humic	0.042		0.028		0.015		0.080	
Organic manures	0.079		0.052		0.028		0.150	
Interaction	0.112		0.073		0.040		0.212	

***: Humic acid treatment as potassium humate**

Application of organic manures (camel, sheep and compost) treatments, K-humate and their interaction had significant increased fruit parameters of Zaghloul fruits as compared to organic manures without humate. At the same time, application of the organic manures alone at the lower rates resulted in the positive effect on parameters of dates than the control. The data indicate that the highest fruit weight was found in sheep manure followed by compost and camel manure with humate at the highest rate (50 kg/tree) of applications. These results agree with those of El-Morshedy (1997), who found that chicken manure was more effective in increasing fruit weight of Zaghloul as compared with some other fertilization treatments

Data in the same Table (4) clearly indicate the response of Zaghloul date palm to different rates and sources of organic fertilization on fruit dimensions (length and diameter in the two seasons. Fruit length and diameter were more influenced by organic manures treatments combination with K-humate compared to organic manures without humate and control. In addition, the highest of fruit dimensions were recorded with the combination of sheep manure at the second rate with K-humate in the first and second seasons. These results agree with those of Osman (2009).

With regard to Zaghloul fruit size, the data presented in Table 4, indicate that the impact of organic manure treatments with or without K-humate and their interactions on fruit size were significant than the control treatment. Also, the trend of fruit size for both organic manure levels was exactly similar as was recorded for weight and dimensions of fruit in the first and second seasons. These results are in trends with those of Bacha and Abo-Hassan, (1983) and El-Morshedy (1997).

Effect of organic manures on leaf mineral content

Leaf nutrient analysis is the best method for diagnosing the tree nutritional status and considered an important guide for fertilization requirements, (Benton, 1985). In this respect, the data in Table 5 indicate that organic manure fertilizers and their interactions had significantly affected leaf N, P and K contents compared to the control treatment in both seasons. The highest N (1.16- 1.21%) and K (0.96 - 0.98%) percentages in leaves were recorded by trees fertilized with sheep manure with K-humate in the first and second seasons, respectively. This may be due to the higher application of organic manures to trees and the higher content N and K of sheep manure compared to compost and camel manures. These results are in accordance with those obtained by Fayed (2010) who found that sheep manure application increased leaf mineral content of K. However, trees treated by compost manure had the highest values of P percentage (0.120-0.124%) with K-humate during the first and second seasons, respectively. This may be due to the manure had a higher P content compared to sheep and camel manures, as shown in Table 2. On the other hand, trees treated by camel manure gave the lowest values of N, P and K in both seasons.

Maximum content of macronutrients were obtained by application of highest rates (50kg/tree) of all organic manures treatments. Also, leaf mineral contents were increased in the second season than in the first season. This

may be due to the higher application of organic manures to trees and residual effect of organic manures application. In this respect, Kotez and Joubert (1992) indicated that the improvement of the nutritional status may be attributed to increasing exchanges and water holding capacity of the soil. Improving tree performance was probably due to improving utilization of applied manures to trees. These results agree with those obtained by Hegazi *et al.,* (2007) on Picual olive trees.

Table (5). Effect of organic fertilizer on Zaghloul leaf mineral content during two sequence seasons.

Season 2012						
Organic manure	**Leaf N (%)**		**Leaf P (%)**		**Leaf K (%)**	
treatments	-H*	+H	-H	+H	-H	+H
Control	1.08		0.110		0.84	
25 kg Camel	1.10	1.11	0.112	0.115	0.86	0.89
50 kg Camel	1.12	1.13	0.114	0.118	0.87	0.93
25 kg Sheep	1.12	1.12	0.115	0.118	0.89	0.91
50 kg Sheep	1.14	1.16	0.116	0.120	0.92	0.96
25 kg Compost	1.10	1.13	0.113	0.115	0.88	0.91
50 kg Compost	1.13	1.15	0.116	0.120	0.91	0.95
Mean	1.11	1.13	0.114	0.116	0.88	0.91
LSD $_{(0.05)}$						
Humic	0.005		0.001		0.006	
Organic manures	0.009		0.001		0.012	
Interaction	0.012		0.002		0.017	
Season 2013						
Control	1.06		0.109		0.82	
25 kg Camel	1.11	1.13	0.114	0.117	0.88	0.91
50 kg Camel	1.13	1.16	0.118	0.122	0.91	0.95
25 kg Sheep	1.14	1.15	0.115	0.118	0.91	0.93
50 kg Sheep	1.16	1.21	0.118	0.123	0.94	0.98
25 kg Compost	1.14	1.15	0.116	0.120	0.90	0.93
50 kg Compost	1.15	1.17	0.119	0.124	0.93	0.97
Mean	1.13	1.15	0.116	0.119	0.90	0.93
LSD $_{(0.05)}$						
Humic	0.006		0.001		0.005	
Organic manures	0.011		0.001		0.010	
Interaction	0.015		0.002		0.014	

***: Humic acid treatment as potassium humate**

Sufficient range of macronutrients were (1.50- 3.5% N), P (0.11-0.80%) and K (0.70- 4.0%) for date palm trees, (Silva and Uchida, 2000). In this respect, application of organic manures led to raise the level of P and K than the minimum of sufficient level. On the other hand, application of organic manures did not increase the N% to reach the sufficient level, although the high N content was recorded in the second season. This difference can be attributed to the slow release of nutrients from the organic matter, (Abu-Zahra

and Tahboub, 2008). Also, it is possible to increase the N% to reach the sufficient level as a result of successive application annually.

Effect of organic manures on soil mineral content

Soil availability indexes of macronutrients (mg/kg^{-1}) were (0-28 low N), P (0-8 low P) and (0-60 low K), (Abou-Amer, 2007). In this respect, application of organic manners did not improve the status of soil P and K. On the other side, application of organic manners did not raise the low content of soil N. But it may be with application of annual successive were cause an increase in soil N, P and K nutrients, (Table 6). In this respect, application of organic manure and their interactions had significantly affected soil N, P and K contents compared to the control treatment in two seasons (Table, 6). However, similar trends were observed with leaf mineral contents of trees. In this direction, the highest contents of soil N (23.16-25.93 mg/kg^{-1}) and K (57.53 – 59.08 mg/kg^{-1}) in surface layer were recorded by trees treated with sheep manure and K-humate in the first and second seasons, respectively. This could be due to the higher content N and K of sheep manure than the compost and camel manures, as shown in Table, 2.

Table (6). Effect of organic fertilizer on soil mineral content through two sequence seasons

Organic manure treatments	Available N (mg/kg^{-1})				Available P (mg/kg^{-1})				Available K (mg/kg^{-1})			
	Surface		Sub-surface		Surface		Sub-surface		Surface		Sub-surface	
	-H	+H	-H	+H	-H	+H	-H	+H	-H	+H	-H	+H
Season 2012												
Control	20.51		7.64		4.85		1.18		45.96		19.56	
25 kg Camel	21.12	21.64	8.72	8.83	6.56	6.73	1.86	1.28	50.12	52.15	20.10	20.30
50 kg Camel	22.54	23.56	8.96	9.14	8.31	8.38	2.14	2.65	53.93	55.94	21.21	21.40
25 kg Sheep	21.96	23.16	8.79	8.91	6.52	6.64	1.60	1.55	51.92	53.74	21.32	21.64
50 kg Sheep	23.61	24.82	9.14	9.52	7.92	8.28	2.63	3.12	57.38	58.65	21.95	22.25
25 kg Compost	21.39	22.94	8.65	8.86	6.54	6.78	1.34	1.64	51.22	52.90	20.21	20.83
50 kg Compost	22.50	23.86	8.90	9.18	8.01	8.46	2.93	3.16	54.61	57.53	21.10	21.75
Mean	21.95	22.93	8.68	8.87	6.96	7.16	1.95	2.08	52.16	53.84	20.78	21.10
LSD $_{(0.05)}$												
Humic	0.208		n.s.		0.054		n.s.		0.218		n.s.	
Organic manures	0.390		n.s.		0.100		n.s.		0.407		n.s.	
Interaction	0.551		n.s.		0.142		n.s.		0.576		n.s.	
Season 2013												
Control	20.29		7.82		4.79		1.15		45.12		19.15	
25 kg Camel	22.12	22.81	9.23	9.58	6.64	6.80	1.38	1.82	51.96	54.21	20.83	21.28
50 kg Camel	23.63	24.48	9.81	10.63	8.34	8.50	2.23	2.81	55.13	57.19	21.46	22.28
25 kg Sheep	22.54	24.59	9.96	10.35	6.58	6.72	1.93	1.78	53.34	55.12	21.98	22.45
50 kg Sheep	24.38	25.93	10.15	11.21	8.03	8.43	2.38	3.18	58.80	61.15	22.52	23.15
25 kg Compost	22.46	23.82	9.46	9.92	6.60	6.86	1.85	1.61	52.98	54.91	21.12	21.79
50 kg Compost	23.83	24.56	9.75	10.10	8.06	8.60	2.81	3.25	56.53	59.08	21.91	22.95
Mean	22.75	23.78	9.46	9.94	7.00	7.24	1.96	2.23	53.41	55.25	21.28	21.86
LSD $_{(0.05)}$												
Humic	0.201		n.s.		0.060		n.s.		0.271		n.s.	
Organic manures	0.376		0.766		0.112		n.s.		0.508		n.s.	
Interaction	0.532		n.s.		0.158		n.s.		0.718		n.s.	

***: Humic acid treatment as potassium humate**

Moreover, trees fertilized by compost manure with K-humate gave the highest content of soil P (8.46-8.60 mg/kg^{-1}) in surface layer during the first and second seasons, respectively. This may be due to compost manure had high P content compared to sheep and camel manures. In this direction, Russo and Berlyn (1990) indicated that, humic acid increase the activity of

beneficial availability of soil nutrients particularly in alkaline soils and low organic matter (calcareous soil conditions.) On the other hand, trees fertilized by camel manure had the lowest values of these elements in both seasons. This may be due to camel manure had the lowest content of N, P and K compared with sheep and compost manures.

Soil mineral contents were increased by increasing organic manures application (50kg/tree) with K-humate, and also, increased in the second season compared to the first season. In this respect, humate has many effects due to their increase of cation exchange capacity which affects the retention and availability of nutrients, (Chunhua *et al.,* 1998). These results are harmony with those obtained by Safar *et al.,* (2012) on Picual olive trees.

On the other side, soil N in subsurface layer was less than the surface layer in the two seasons, this may be resulted from increasing root growth of trees and subsequently increasing uptake of N. Also, soil mineral content of N, P and K were lowest in soil subsurface layer compared to surface layer, this due to slow mobility of P and K from surface to subsurface soil. Also, there are insignificantly effects of organic manures with and without K-humate applications on N, P and K contents in the soil subsurface layer.

CONCLUSION

The results of this study indicate that sheep manure was more efficient and economical in improving soil and plant minerals and enhancing fruit yield with suitable quality of Zaghloul dates compared to compost and camel manures. Therefore, this manure is recommended for Zaghloul date palm trees cultivation under arid and semi-arid regions that are limited in water resources, especially calcareous soil. However, the sheep manure was not able to supply the soil and plant by sufficient level of N - nutrient, so should be added with supplementary dose of mineral nitrogen as an integrated value, whenever possible.

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إستجابة نخيل البلح الزغلول النامى فى الأراضى الجيرية لمصادر التسميد العضوى

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أجريت تجربة حقلية في محطة بحوث مريوط التابعة لمركز بحوث الصحراء لموسمين متتالين خلال عامى ٢٠١٢، ٢٠١٣ وذلك لدراسة إستجابة نخيل البلح الزغلول النامى فى الأراضى الجيرية لمصادر التسميد العضوى. إستخدمت ثلاثة أنواع من الأسمدة العضوية المحلية وهى أسمدة الجمال والأغنام وسماد الكمبوست عند ثلاث مستويات من كل نوع وهى صفر ، ٢٥ كجم/سماد و ٥٠ كجم/سماد لشجرة نخيل البلح الزغلول وهى عند عمر ٢٠ سنة والتى تعتمد فى ريها على مياه الأمطار. كما استخدمت هيومات البوتاسيوم والتى أضيفت بمعدل واحد كجم / شجرة بجانب معاملة الكنترول (بدون تسميد وبدون هيومات).

تضمنت المعاملات إضافة الأسمدة العضوية بدون هيومات البوتاسيوم ثم إضافة الأسمد العضوية مع هيومات البوتاسيوم. وقد أضيفت الأسمدة على دفعة واحدة فى الأسبوع الأخير من شهر نوفمبر كما أضيفت هيومات البوتاسيوم على دفعة واحدة أيضا فى الأسبوع الثانى من ديسمبر وذلك من كل عام.

وقد أظهرت النتائج إستجابة أشجار نخيل البلح الزغلول معنويا لجميع معاملات التسميد العضوى سواء باضافة أو بدون إضافة هيومات البوتاسيوم فى زيادة محصول وصفات جودة الثمار وكذلك محتواها من السكر الكلى وذلك مقارنة بمعاملة الكنترول.

كما أدت إضافة الأسمدة العضوية الى الوصول الحد الأدنى لمستوى الكفاية من الفوسفور والبوتاسيوم لكن لم تصل الى الحد الأدنى من النتروجين فى الأوراق. كذلك وصلت الى الحد الأدنى من الفوسفور والبوتاسيوم الميسر فى التربة لكن أيضا لم تصل الى الحد الأدنى من النتروجين الميسر. وقد يمكن تحقيق ذلك من خلال الاضافات المتتالية للأشجار من الأسمدة العضوية سنويا مع جرعة من السماد المعدنى اذا أمكن ذلك. وكانت أفضل النتائج لسماد الأغنام يليه سماد الكمبوست ثم سماد الجمال عند المعدلات الأعلى (٥٠ كجم/شجرة) مع هيومات البوتاسيوم.

نتائج هذة الدراسة توصى باستخدام المعاملة السمادية من سماد الأغنام باضافة ٥٠ كجم / شجرة /سنويا تحت ظروف الأراضى الجيرية وكذلك الأراضى المشابهة لها بالمناطق ذات الموارد المائية المحدودة فى حدود المعاملات المستخدمة فى هذه الدراسة خاصة عند عدم توافر الأسمدة المعدنية فى هذه المناطق.