Journal of Applied Horticulture, 12(2): 145-150, July-December, 2010

Improving yield and fruit quality of date palm by organic fertilizer sources

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Abstract

A field study was carried out during 2007 and 2008 seasons on twenty-six years old Zaghloul cultivar of date palm growing in clay silt soil. One level of nitrogen alone or plus P and K from mineral (ammonium nitrate alone or ammonium nitrate + calcium superphosphate + potassium sulphate, NPK) and organic sources [poultry /chicken manure (CM), cow dung (CD) and town refuse compost (TR)] were applied either alone or in combinations to study their influence on the yield and fruit physico-chemical quality. The results revealed that applying organic manure either alone or combined with mineral fertilizers increased palm yield and enhanced fruit colour as compared with mineral fertilization alone. CM and CD resulted in the best fruit weight, fruit flesh weight and length. Fruit TSS, anthocyanin and sugars content increased while, tannins content was decreased by CM and CD as compared with combining organic manure with NPK or mineral alone. However, fruit acidity was not affected by any of the treatments when compared among each others. In general, micronutrients contents were significantly higher in fruits by applying organic manure alone than organic manure combined with NPK or mineral fertilization alone. Organic manure fertilization alone (especially CM and CD) resulted in decreasing lead, cadmium, nitrate and nitrite content than mineral fertilization.

Key words: Organic, inorganic, fertilization, quality, Zaghloul dates, yield, poultry manure, cow dung, town refuse compost

Introduction

Date palm (*Phoenix dactylifera* L.) is one of the oldest fruit trees in the world, known as tree of life because of its resilience, its need for limited water inputs, its long term productivity and its multiple purpose qualities. In Egypt, dates are an important traditional crop. According to FAO (2009), Egypt is considered as leading country among the top ten date producers (11,30000 tones). Zaghloul date is the most important soft cultivars grown in Egypt. It is usually harvested and consumed at the Khalal (Bisr) stage. Most of the date palms in Egypt are growing in loam and sandy loam soils. With time, these types of soils may become deficient in N, P, K, Mg and B (Tisdale and Nelson, 1978).

Date palm yield and fruit quality are mostly dependant on cultivar, nutrition and water relations. Fertilization programs play an effective role in increasing palm yield and improving dates quality. The use of chemical fertilizer is necessary for supplying the nutrient requirements. However, the continual use of chemical fertilization leads to deterioration of soil characteristics and fertility (Shimbo *et al*., 2001). Also, it is reported that chemical fertilizers such as super phosphate contain Cd and Pb and they may be the major source of cadmium uptake in plant (Shimbo *et al*., 2001). Thus, continuous use of chemical fertilizer might lead to the accumulation of heavy metals in plant tissues which contributes to fruit nutrition value and edible quality. The second source of nutrients is organic manure which is derived from animal or plant sources. It is an excellent source of organic matter and macro and micro-nutrients. Animal manure is an important source of N, P and K and its addition to the soil increases the available phosphorus and exchangeable K, Ca and Mg contents (Magdoff, 1998). In addition to providing nutrients for crop growth, manure has several beneficial effects on soil properties. Application of organic fertilizers improved structural stability and lowered bulk density of the soil, improved moisture retention, water infiltration rate and the hydraulic conductivity of soil (Tisdale *et al*., 1990; Young, 1997). Also, manures were found to enhance soil biological properties (Chai *et al*., 1988) and soil fertility leading to increase in crop yield (Lal and Mathur, 1989). Organic manure may be beneficial to crop and soil on the long term (Tirol-Padre *et al*., 2007), and their efficiency in enhancing crop growth and yield in the short term by combining them with mineral fertilizers has been reported (Kanal and Kuldkepp, 1993; Mottaghian *et al*., 2008).

In view of the above facts, the present study was undertaken to investigate the effect of different nutrient supply regimes namely, cow dung, chicken manure, town refuse compost and mineral fertilizer on the yield and fruit quality and nutritional value of Zaghloul date palm growing in clay silt soils and irrigated with drainage water.

Materials and methods

Plant material and experimental design: Field experiment was conducted during 2007 and 2008 seasons in a private orchard at El- Nubaria region, EL- Behera Governorate, Egypt on date palms (*P. dactylifera* L.) cultivar, Zaghloul planted at 10x10 m apart. The trees were growing in clay silt soil and irrigated with drainage water. Soil was well drained with water table 110 cm and pH 8. The physical and chemical characters of the soil are presented in Table 1. The palms were fertilized with inorganic and/or organic fertilizers either alone or in combinations. The inorganic fertilizer was ammonium nitrate (33.5 %N) + triple super phosphate, (46%P_2O_5) + potassium sulphate (48% K_2O). Organic fertilizer were poultry manure (chicken manure, CM), cattle manure (cow

Table 1. Physical and chemical characteristics of experimental orchard soil (average of 2007 and 2008)

Characters	Soil depth (cm)		
	0-30	30 -60	60 – 90
$CaCO_3$ (%)	13.65	11.78	13.45
EC (ppm)	507	702	1523
Texture	Clay	Clay	Clay
N (%)	0.26	0.16	0.08
P (ppm)	54	37	46
K (ppm)	0.24	0.51	1.7
Ca^{++} (meq L^{-1})	5.7	6.0	12.3
Mg^{++} (meq L^{-1})	2.9	2.4	4.2
Na^{+} (meq L^{-1})	2.6	2.7	7.1
Fe (ppm)	25	21	22
Zn (ppm)	13	8	14
Mn (ppm)	54	34	50
Cu (ppm)	14	10	11
HCO_3^- (meq L^{-1})	6	5.4	5.1
Cl^- (meq L^{-1})	1.9	2.8	9.7
SO_4^- (meq L^{-1})	3.4	3.7	11.6

Table2. Chemical analysis of organic fertilizers used (average of both seasons 2007 and 2008)

Organic fertilizers	Parameters (%)				
	Moisture	Organic matter	Total N	P_2O_5	K_2O
Chicken Manure (CM)	9.32	33.54	3.38	1.68	1.72
Cow Dung (CD)	22.98	47.69	2.25	1.11	1.21
Town Refuse (TR)	33.36	58.43	1.35	0.64	0.72

dung, CD), and compost (town refuse, TR). Chemical analysis (average of both years) of organic fertilizers used is presented in Table 2. Each treatment included 1000 g nitrogen (applied from inorganic or organic source alone, or in combinations) + 535 g K_2O + 500 g P_2O_5 (estimated from the average amount of K_2O and P_2O_5 determined in the three organic manures). In both years mineral fertilizer was added at three intervals; half amount in March, a quarter in May and the last quarter in August of both years, and organic fertilizers were applied once at the second week of December. Each mineral fertilized Palm only received 3 kg ammonium nitrate + 1.1 kg triple super phosphate +1.1 kg potassium sulphate. Female palms were selected similar in growth, vigour, height, pollen source and age (30 years old) and were subjected to the normal cultural practices carried out as usual used for date palms. Eight soil application treatments were arranged in a complete randomized design with five replicates (1 replicate = 2 palms) per treatment (*i.e.,* 5 x 8 = 40 palm). The treatments were as follows: (1) 3 kg ammonium nitrate + 1 kg triple super phosphate + 1 kg potassium sulphate (NPK mineral only); (2) 3 kg ammonium nitrate (N only); (3) 30 kg Chicken manure (CM); (4) 45 kg Cow dung (CD); (5) 75 kg town refuse (TR); (6) ½ NPK mineral + ½ CM (½ treat.1 + ½ treat. 3); (7) ½ NPK mineral + ½ CD (½ treat.1 + ½ treat. 4); (8) ½ NPK mineral + ½ TR (½ treat.1 + ½ treat. 5).

Yield estimation: The fruits were harvested at the end of September in both years and the average yield and bunch weight was recorded in kilograms. Samples of 50 fruits per each palm were randomly taken (as a sample for each replicate) to determine fruit quality characters and mineral content.

Fruit physical characters: A 15 fruit sample from each replicate was taken to determine fruit weight (g), length (mm), diameter (mm) and flesh weight (g). Also fruit colour was recorded for each fruit sample using a degree of colour intensity as follow: (1) = 100 % green, (2) = 25% red, (3) = 50% red, (4) = 75% red and (5) =100% red.

Fruit chemical characters: In a 15 fruit sample, the percentage of total soluble solids (TSS) was determined in the juice using hand refractometer. Acidity was determined according to A.O.A.C. (1995). Soluble tannins content per 100 g fresh weight was determined as mentioned by Abou Sayed-Ahmed *et al.* (1997). Anthocyanin content in the fruit peel was measured using spectrophotometer by the method of Fuleki and Francis (1968). Total and reducing sugars as percentage of fresh weight were determined according to A.O.A.C. (1995). Non reducing sugars were calculated by the difference between total and reducing sugars.

Fruit mineral content: A sample of 20 fruits for each replicate was washed with tap water, rinsed twice in distilled water, dried to a constant weight in air drying oven at 70 °C, ground and digested with H_2O_2 and H_2SO_4 according to Evanhuis and De Waard (1980). Total nitrogen was determined colorimetrically according to Evanhuis (1976). Phosphorus was determined colorimetrically by ascorbic acid method according to Murphy and Riley (1962). Potassium content was determined by flame photometer. Pb, Cd, Ca, Mg, Fe, Zn, Mn and Cu contents were measured using an atomic absorption spectrophotometer 305B. The concentrations of N, P, K, Ca and Mg were expressed as percent, while Pd, Cd, Fe, Mn, Zn, and Cu were expressed as parts per million (ppm) on dry weight basis. Fruit nitrate and nitrite contents were measured according to Chapman and Pratt (1961) and expressed as ppm on dry weight basis.

Statistical analysis: All data were tested for treatments effects by analysis of variance (ANOVA) using Statistical Analysis System (SAS Institute, 1989).

Results and discussion

Yield: The data of both years presented in Table 3 showed that palm yield was significantly higher by applying CM, CD, ½ NPK mineral + ½ CM, ½ NPK mineral + ½ CD and ½NPK mineral + ½ TR than NPK or N mineral alone and TR. Chicken manure resulted in the highest yield as compared with the other treatments in the first year only. Our results support earlier findings which indicated the importance of supplementing the organic matter with mineral fertilizers to increase yield of date palms (Al-Bakr, 1982; Bacha and Abo-Hassan, 1983).

Fruit physical and chemical characters: The data for fruit physical and chemical characters in both years are presented in Table 3 and 4. As for the physical quality, a significant enhancement in fruit colour was obtained in both years by applying CM, CD, TR and ½NPK mineral + ½ CM when compared with NPK mineral or N fertilization with no significant differences obtained among them. In addition, ½NPK mineral + ½ CD and ½NPK mineral + ½TR resulted in higher increase in fruit colour than N mineral alone. Average fruit weight of both years did not significantly differ among all treatments (except N mineral in both years). Applying CM, CD, TR and ½NPK mineral + ½ CD gave significantly higher fruit weight than N mineral alone in both years. Also, NPK mineral (in the second year), ½NPK mineral + ½ CM and ½NPK mineral + ½ TR (in

the first year) resulted in higher fruit weight than N mineral alone. Similarly flesh weight did not significantly differ among all treatments (except N mineral alone) in both the years. Moreover, in both years NPK mineral, CM, CD, TR and ½NPK mineral + ½ CD had higher effect on average flesh weight than N mineral alone without significant differences among them. In both years fruit length was significantly higher than N mineral alone by all treatments (except town refuse in the first year). In addition, application of chicken manure (CM) resulted in higher fruit length than N mineral alone (in both years) and NPK mineral, TR, ½NPK mineral + ½ TR (first season). Also, application of cow dung (CD) alone resulted in higher fruit length than ½NPK mineral + ½ TR in both years. Fruit diameter did not significantly differ between all treatments (except N mineral and TR) and NPK mineral in both years. However, NPK mineral gave fruit diameter than N mineral and TR treatments in both years.

In addition, the data of different chemical characters determined in both years showed that application of CM, CD, TR, ½NPK mineral + ½ CM, ½NPK mineral + ½ CD and ½NPK mineral + ½ TR did not significantly differ from each other and they (except ½NPK mineral + ½ CM and ½NPK mineral + ½ CD in the first year) resulted in higher total soluble solids content than NPK or N mineral treatments. All treatments showed no significant difference among each other in affecting fruit juice acidity content in both years. In addition, the application of organic fertilizers either alone or in combinations with the NPK mineral fertilizer resulted in higher fruit non-reducing and total sugars contents than mineral fertilization alone (NPK or N mineral alone) in both years. However, only the application of chicken manure or cow dung gave higher non-reducing sugars content than NPK mineral in the first year only, whereas, in the second year no significant differences among all treatments were obtained except that ½NPK mineral + ½ CD gave higher non-reducing sugars content than ½NPK mineral + ½ CM and N mineral treatments. Fruit peel anthocyanin content increased significantly by the application of organic fertilizers alone (CM, CD or TR) when compared with the mineral fertilizer treatments (NPK or N mineral alone) in the first year only. The cow dung fertilizer (CD) resulted in higher anthocyanin content than all organic manure fertilizers combined with NPK mineral in both years. In addition, the data obtained of both years showed no significant difference in fruit pulp tannins content among all fertilizer applications except for nitrogen alone mineral fertilizer (N mineral). The application of nitrogen mineral fertilizer alone (N mineral) resulted in significantly higher content than town refuse (TR), ½NPK mineral + ½ CD and ½NPK mineral + ½ TR (in the first year), and than all treatments (second year).

Table 3. The effect of organic and inorganic fertilization on the yield and fruit physical characters of Zaghloul dates in 2007and 2008

Treatments/ year	Parameters					
	Yield kg/ palm	Fruit colour	Fruit weight (g)	Flesh weight (g)	Fruit length (mm)	Fruit diameter (mm)
2007						
NPK mineral	182	4.6	33.03	31.68	6.3	2.92
N mineral	178	4.5	30.34	28.76	5.8	2.12
Chicken manure (CM)	208	5.0	34.87	32.94	6.8	2.74
Cow Dung (CD)	198	4.9	34.76	32.95	6.6	2.84
Town refuse (TR)	179	4.9	32.62	30.73	5.9	2.24
½ NPKmineral + ½ CM	193	5.0	32.74	30.67	6.4	2.84
½ NPKmineral + ½ CD	200	4.8	33.97	31.85	6.7	2.86
½ NPKmineral + ½ TR	197	4.8	32.44	30.40	6.1	2.55
LSD (*P*=0.05)	8.0	0.3	2.85	2.14	0.43	0.61
2008						
NPK mineral	170	4.7	35.68	33.83	6.9	2.83
N mineral	159	4.5	31.69	28.89	5.4	2.03
Chicken manure (CM)	189	5.0	35.64	33.97	7.2	2.98
Cow dung (CD)	184	5.0	36.27	34.69	7.4	3.02
Town refuse (TR)	166	4.9	34.94	32.56	6.7	1.84
½ NPKmineral + ½ CM	184	4.9	34.11	31.98	6.8	2.84
½ NPKmineral + ½ CD	186	4.8	36.03	33.86	6.8	2.90
½ NPKmineral + ½ TR	185	4.8	34.01	31.86	6.4	2.35
LSD (*P*=0.05)	13	0.2	2.68	1.97	0.84	0.60

Table 4. The effect of organic and inorganic fertilization on the fruit chemical characters of Zaghloul dates in 2007and 2008

Treatment/ year	Parameters						
	TSS (%)	Acidity (%)	Reducing sugars (%)	Non-Redu. sugars (%)	Total sugars (%)	Anthocyanin (mg /100 g f.wt.)	Tannins (%)
2007							
NPK mineral	24.95	0.40	17.01	5.06	22.07	16.26	0.15
N mineral	25.60	0.45	15.83	6.04	21.87	14.36	0.17
Chicken manure (CM)	28.95	0.42	19.14	6.98	26.12	20.25	0.13
Cow dung (CD)	29.10	0.46	19.63	8.35	27.98	22.72	0.11
Town refuse (TR)	28.94	0.56	21.06	5.06	26.12	19.78	0.09
½ NPKmineral + ½ CM	27.70	0.46	20.28	5.06	25.34	17.83	0.12
½ NPKmineral + ½ CD	27.40	0.48	20.09	4.78	24.87	18.90	0.10
½ NPKmineral + ½ TR	29.05	0.45	19.83	7.25	27.08	18.22	0.10
LSD (*P*=0.05)	2.16	N.S	1.86	1.74	1.68	2.87	0.07
2008							
NPK mineral	26.47	0.39	16.08	6.46	18.45	18.45	0.1 9
N mineral	23.66	0.44	15.18	5.11	16.34	16.34	0.23
Chicken manure (CM)	30.93	0.45	20.83	6.64	18.35	18.35	0.16
Cow dung (CD)	30.98	0.51	20.01	6.96	19.12	19.12	0.18
Town refuse (TR)	31.92	0.48	20.96	6.80	17.85	17.85	0.18
½ NPKmineral + ½ CM	32.27	0.46	22.71	5.16	14.02	14.02	0.16
½ NPKmineral + ½ CD	30.89	0.49	19.36	7.51	15.28	15.28	0.19
½ NPKmineral + ½ TR	31.25	0.44	22.18	6.35	14.25	14.25	0.06
LSD (*P*=0.05)	3.18	N.S	2.43	2.13	1.96	1.96	0.04

Table 5. The effect of organic and inorganic fertilization on fruit macro and micro-nutrients content of Zaghloul dates in 2007 and 2008

Treatments/ year	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
2007									
NPK mineral	1.02	0.09	0.69	0.61	0.39	55	35	37	5
N mineral	0.96	0.19	0.98	0.78	0.34	52	30	38	6
Chicken manure (CM)	1.23	0.11	0.78	0.63	0.47	66	41	40	7
Cow dung (CD)	1.01	0.12	0.80	0.59	0.42	68	45	43	7
Town refuse (TR)	1.12	0.15	0.97	0.59	0.45	57	44	39	9
½ NPKmineral + ½ CM	1.05	0.13	0.90	0.61	0.39	54	34	43	8
½ NPKmineral + ½ CD	1.08	0.10	0.81	0.58	0.46	52	41	40	8
½ NPKmineral + ½ TR	1.14	0.10	0.90	0.62	0.40	57	42	36	7
LSD (*P*=0.05)	0.11	0.04	0.21	0.16	0.08	6.0	6.0	6.0	2
2008									
NPK mineral	1.19	0.09	0.71	0.57	0.35	58	28	31	5
N mineral	1.03	0.13	0.91	0.68	0.35	50	29	33	4
Chicken manure (CM)	1.13	0.14	0.82	0.64	0.44	63	33	40	6
Cow dung (CD)	1.09	0.11	0.99	0.67	0.40	69	30	41	7
Town refuse (TR)	1.17	0.14	0.99	0.63	0.41	62	39	40	8
½ NPKmineral + ½ CM	1.19	0.17	0.80	0.77	0.40	65	40	38	7
½ NPKmineral + ½ CD	1.26	0.19	0.90	0.69	0.42	64	44	34	6
½ NPKmineral + ½ TR	1.07	0.13	0.81	0.68	0.44	60	38	36	8
LSD (*P*=0.05)	0.08	0.02	0.15	0.19	0.05	7.0	4.0	3.0	4

The above results indicated enhancement in fruit quality characters by the application of organic manures either alone or when supplemented with mineral fertilizers. These results are in line with those reported by Bacha and Abo-Hassan (1983) and Shahein *et al.* (2003). In addition, Al-Kharusil *et al.* (2009) reported the highest dry matter content of date fruits by combining NPK mineral fertilizer with organic peat. In our study the application of nitrogen by combination of mineral and organic sources gave better fruit characters than using mineral source alone. Similarly, Sharawy (2005) reported that the combined application of N through mineral and compost was effective in improving fruit quality of lime trees compared to using each source alone.

Fruit mineral content

The effect of the different fertilization treatments on fruit mineral content is presented in Tables 5 and 6.

Table 6. The effect of organic and inorganic fertilization on fruit Pb, Cd, nitrate and nitrite contents of Zaghloul dates in 2007 and 2008

Treatments/ year	Parameters (ppm)			
	Lead	Cadmium	Nitrate	Nitrite
2007				
NPK mineral	1.08	0.010	50	7.9
N mineral	1.17	0.018	51	8.6
Chicken manure (CM)	0.89	0.010	39	5.5
Cow dung (CD)	0.94	0.009	37	6.7
Town refuse (TR)	0.78	0.008	48	6.2
½ NPKmineral + ½ CM	1.09	0.013	58	7.5
½ NPKmineral + ½ CD	1.06	0.011	56	7.7
½ NPKmineral + ½ TR	1.12	0.010	57	6.9
LSD (*P*=0.05)	0.10	0.008	3.0	0.7
2008				
NPK mineral	1.01	0.009	54	6.5
N mineral	1.22	0.020	58	7.8
Chicken manure (CM)	1.00	0.012	40	5.9
Cow dung (CD)	0.98	0.010	38	6.3
Town refuse (TR)	0.89	0.010	36	6.0
½ NPKmineral + ½ CM	1.08	0.015	45	6.7
½ NPKmineral + ½ CD	1.11	0.013	48	7.9
½ NPKmineral + ½ TR	1.09	0.016	50	6.9
LSD (*P*=0.05)	0.13	0.005	2.0	1.3

Macro and micronutrients: The data presented in Table 5 showed that in the first year only chicken manure and ½NPK mineral + ½ TR increased fruit nitrogen content than NPK mineral, whereas, in the second year fruit nitrogen contents was significantly lower by adding N mineral, CD and ½NPK mineral + ½ TR than NPK mineral. Moreover, no significant difference was obtained between NPK mineral and, TR, ½NPK mineral + ½ CM and ½NPK mineral + ½ CD in both years. Phosphorus content was higher by N alone fertilization than NPK in both years. Moreover, in the first year only TR, ½NPK mineral + ½ CM resulted in significantly higher phosphorus than NPK mineral, whereas, in the second year all fertilization increased phosphorus content in comparison with NPK mineral alone. Potassium content increased by the application of nitrogen mineral alone (N mineral) and town refuse (TR) in both years, ½NPK mineral + ½ CM and ½NPK mineral + ½ TR (in the first year) and cow dung (CD) and ½NPK mineral + ½ CD (in the second year) as compared with applying NPK mineral alone. In addition, the data of both years showed no significant difference when chicken manure and cow dung fertilizers were applied either alone or combined with NPK mineral. Moreover, only mineral nitrogen alone (N mineral) in the first year and ½NPK mineral + ½ CM in the second year gave higher fruit calcium content than NPK mineral. In the first year, only cow dung (CD) increased magnesium content as compared with NPK mineral, whereas, in the second year all treatments (except N alone) increased magnesium content as compared with NPK mineral fertilization. In addition, cow dung application gave significantly higher iron content than NPK mineral in both years. Also, chicken manure (in the first year) and ½NPK mineral + ½ CM (in the second year) had significant higher iron content than NPK mineral. Fruit zinc content was significantly higher by application of CM, TR, ½NPK mineral + ½ CD and ½NPK mineral + ½ TR than NPK or N mineral in both years. Manganese content increased by cow dung (CD) and ½NPK mineral + ½ CM as compared with NPK mineral in the first year, whereas, in the second year all treatments (except ½NPK mineral + ½ CD) increased manganese concentration as compared with NPK mineral and N alone treatments. Fruit copper was increased by all treatments (except N alone) as compared with NPK mineral

in the first year only. The application of organic fertilizers either alone or in combination with NPK mineral did not significantly differ from each other with respect to fruit Ca, Mg, Fe, Zn, Mn and Cu contents in both years.

The general, increase in fruit mineral contents as a result of organic manures application in combinations with mineral fertilizers might be due to the enhancement of soil properties and soil fertility by organic soil amendments (Mathew and Karikari, 1995; Kaur *et al.*, 2005) which might lead to the increase of available nutrients and their uptake (Kanal and Kuldkepp, 1993). Moreover, similar increase in fruit mineral contents by organic manures alone or in combination with mineral source were obtained by Attala *et al*. (2003) working on Samany and Zaghloul date cultivars.

Heavy metals, nitrate and nitrite: The data (Table 6) indicated that lead content significantly decreased in fruits fertilized with the three organic manures (CM, CD and TR) alone as compared with NPK mineral (in the first year) and N alone (in both the years). In addition, the application of organic fertilizers alone resulted in lower lead fruit content than combining them with the mineral NPK fertilizer in both years. Moreover, data of both years showed that fruit cadmium content did not differ significantly when organic fertilizers were applied either alone or in combinations (except ½NPK mineral + ½ CM and ½NPK mineral + ½ TR in the second year) as compared with NPK mineral. No significant differences were obtained between organic fertilization alone and organic fertilization combined with mineral fertilizer (except that combining TR manure with mineral NPK resulted in higher cadmium than town refuse alone in the second year only). In general, using mineral nitrogen fertilizer alone gave the highest lead and cadmium contents in comparison with all other fertilizing treatments in both years.

Nitrate content decreased significantly when chicken manure and cow dung (in both years) and town refuse (in the second year) were applied than NPK mineral and N alone fertilization. Moreover, in both years, nitrate content was significantly higher when organic manures were combined with mineral NPK than organic manures alone. In addition, in the first year, all treatments gave significantly lower nitrite content than nitrogen alone treatment with no differences obtained among them, except that CM gave the lowest nitrite content when compared with all other treatments. In the second year, nitrite content was significantly decreased by organic fertilization alone when compared with mineral nitrogen alone (N mineral) and ½NPK mineral + ½ CD. Our results are in line with those of Attala *et al.* (2003). In our study, the application of organic fertilizers alone resulted in lower fruit contents of Cd, Pb, nitrate and nitrite than applying them in combinations with mineral fertilizer or mineral fertilizer alone. Shimbo *et al.* (2001) stated that chemical fertilizers such as super phosphate contained cadmium and lead and it can be the major source of their uptake in plant.

From the findings of present investigation, we conclude that applying organic fertilization to Zaghloul date palms improved fruit quality and also resulted in better nutritional quality of the fruit than the mineral fertilization as it lowered the amount of heavy metals, nitrate and nitrite contents as compared with mineral fertilizing only.

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Received: November, 2009; Revised: August, 2010; Accepted: September, 2010