African Journal of Biotechnology Vol. 11(65), pp. 12818-12824, 14 August, 2012
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB12.994
ISSN 1684–5315 ©2012 Academic Journals

Full Length Research Paper

Effects of organic manures on yield, fruit quality, nutrients and heavy metals content of Barhy date palm cultivar

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Accepted 22 June, 2012

A field experiment was conducted to investigate the effects of plant residues and/or inorganic manures with or without chemical fertilizers (NPK) on yield, fruit quality and contents of some nutrients and heavy metals of fruit of Barhy date palm cultivar during 2009 to 2010 and 2010 to 2011 in Jouff, Saudi Arabia. The following five treatments were used in this experiment: agricultural waste + mineral fertilizers, agricultural waste + 5% sheep manure, agricultural waste + 10% sheep manure, agricultural waste + 20% sheep manure and agricultural waste + 40% sheep manure. The results indicate that agricultural waste + 40% sheep manure gave the highest initial fruit set and retained fruit, bunch weight, yield fruit weight, flesh weight, flesh thickness, fruit volume, fruit dimensions, total soluble solids, non-reducing sugars and total sugars as compared with the other treatments in the two seasons. Applying agricultural waste + mineral fertilizers showed highest increase in the total acidity and moisture content percentage than the other treatments in both seasons. Moreover, N, P, K and Mn contents in fruit increased significantly with agricultural waste + 40% sheep manure more than those in the other treatments in both seasons. Fe and Zn contents, did not change significantly in both seasons. It could be concluded that the highest yield and better quality of Barhy date palm cultivar were obtained with agricultural waste + 40% sheep manure.

Key words: Date palm, organic manure, nutrients, heavy metals, fruit quality.

INTRODUCTION

According to FAO (2010), Saudi Arabia is considered the third country of the top ten date producers (982546 tons). Date palm (P*hoenix dactylifera* L.) is one of the important fruit crops in the Kingdom of Saudi Arabia. Barhy is one of the best soft type date palm cultivar found acceptable for Saudi consumer. Successful orchard management practices include appropriate fertilizer which gives the remaining fruits a better chance to develop larger size and better quality.

Organic farming depends on the use of organic fertilizers (natural and manufactured) instead of using chemical fertilizers, because this has a good effect on agricultural products in terms of crop production safety from pollution and harmful elements to human health, especially nitrates, which are due to the use of nitrogenous fertilizers.

In a study by Almadini and Gosaibi (2007), to evaluate the effect of the use of organic fertilizer for palm trees on soil properties and fertility, the results indicate that applying organic amendments led to improve physical and chemical characteristics of the soil and soil fertility, indicating the importance of adding organic fertilizers to enhance soil quality and sustain the productive capacity of Palm quantity and quality.

Aisueni et al. (2009) compared the effect of mineral and organic fertilization on the seedlings of date palm in the

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Table 1. Physical and chemical properties of soil before treatments application.

Particle size distribution				pH	EC (dS m^{-1})	Organic matter (%)	Total N (%)	Available macronutrients (ppm)				Available micronutrients (ppm)			
Sand (%)	Silt (%)	Clay (%)	Texture	(1:2.5)	(1:2.5)			P	K	Ca	Mg	Fe	Mn	Zn	Cu
73.8	11.0	15.2	Sandy loam	8.04	0.974	0.440	0.25	6.11	5.69	5.68	0.41	4.86	0.41	0.55	0.12

Table 2. Physical and chemical characteristics of used organic manure.

Sample	Ph (1:2.5)	EC (dS m^{-1}) (1:2.5)	Dry matter (%)	Organic matter (%)	Organic carbon (%)	Density (Kg/m^3)	C/N Ratio	Macronutrients (%)			Micronutrients (ppm)			
								N	P	K	Fe	Zn	Mn	Cu
T-1	7.52	3.48	67.17	24.71	14.37	601	9	1.60	0.518	0.622	643	88	75	25
T-2	7.32	3.59	67.26	22.87	13.30	559	8	1.60	0.532	0.318	716	32	101	24
T-2	7.31	3.61	66.22	22.08	12,84	546	7	1.84	0.525	0.337	794	32	109	28
T-4	7.15	3.86	66.97	24.52	14.26	533	8	1.88	0.602	0.398	813	42	122	30
T-5	7.11	4.20	65.65	28.84	16.77	557	9	1.92	0.639	0.417	899	57	137	35

nursery, where organic manure (dried poultry droppings) at 0, 50 and 100 g/seedling and ammonium sulfate or muraite of potash at zero, 2, 4, and 8 g/seedling were used. The results show that the dry weight of seedlings increased significantly with increasing organic manure rates and the addition of ammonium sulfate or muraite of potash beyond 2 g per seedling reduced the dry matter. They also found that the addition of organic manure with ammonium sulfate increased significantly date palm seedling dry matter.

MATERIALS AND METHODS

In 2009/2010 and 2010/2011 a field experiment with Barhy date palm cultivar started at the experimental farm of Al-Watania, Jouff, Saudi Arabia. The soil of experimental site was sandy loam. The physico-chemical properties of investigated soil are presented in Table 1.

The experimental date palms (10 × 10 m spaced) were healthy, as they were uniform in growth and vigor. Pollination was achieved by using pollen grains from the same parent in both seasons. All cultural practices were carried out according to the traditional schedule for date palms. Only 10 bunches were left on each experimental tree. The experiment involved the following five treatments as follows: agricultural waste + mixture of mineral fertilizers (T-1), agricultural waste + 5% sheep manure (T-2), agricultural waste + 10% sheep manure (T-3), agricultural waste + 20% sheep manure (T-4) and agricultural waste + 40% sheep manure (T-5). The mineral fertilizers mixture used in this experiment was 20 kg ammonium sulfate +7 kg super phosphate + 1.25 kg potassium sulfate, added to a ton of agricultural waste (waste crushed palm + waste crushed olive trees + waste crushed corn crop, rates 1: 1:1).

The physical and chemical analyses of different organic manures (compost) are shown in Table 2 according to the procedures of Cottanie et al. (1982).

In both seasons, the treatments of organic manures were applied by placing them into a trench on the palm far away; 1 m from the date palms trunk at the first week of January.

The five experimental treatments were arranged in a randomized complete block design with five replications (one palm tree for each replication). The total numbers of trees used in the experiment were 25 palms. The fruits were harvested at the first half of October. Samples of 25 date fruits were picked at random for the determination of both fruit physical and chemical properties.

The average fruit harvest and bunch weight was estimated in kilogram.

Fruit retained percentage

The average initial fruit set and fruit retained percentage was calculated at harvest using this equation:

$$\text{Initial fruit set, \%} = \frac{\text{Total number of retained fruits per strand}}{\text{Total nodes number per strand}} \times 100$$

$$\text{Fruit retained \%} = \frac{\text{Total number of retained fruits per bunch}}{\text{Total nodes number per bunch}} \times 100$$

Fruit physical characteristics

25 fruits of each replicate were randomly sampled to determine fruit size, fruit thickness, fruit dimensions (length and diameter, in cm), fruit weight, and fruit flesh weight and seed weight (in grams).

Chemical properties

The chemical properties of fruits were determined as the follows:

Moisture content

Moisture content was determined according to A.O.A.C. (1995).

Total soluble solids

The percentage of total soluble solids (TSS) was determined in the fruit juice using zice refractometer A.O.A.C. (1995).

Fruit acidity

Fruit acidity was determined as described by A.O.A.C. (1995) and the titrable acidity was calculated as citric acid.

Total soluble sugars

Total soluble sugars and reducing soluble sugars percentages were determined in juice according to the method of Lane and Eynon A.O.A.C. (1995).

Non-reducing sugars

Non-reducing sugars was determined by the difference between total and reducing sugars.

Mineral content of leaves and fruits

For leaf mineral analysis, the newly emerged leaf was collected from each palm during November. Leaf and fruit samples (flesh) were washed with tap water and then with distilled water to remove the dust and any chemical spray residues. After that, they were dried in an electric oven at 70°C for 72 h. The dried samples were ground in an electric mill and stored in paper bags for further analysis.

Wet washing of plant tissues was carried out using hydrogen peroxide and sulfuric acid (Parkinson and Allen, 1975).

Total nitrogen was determined in ground material by semi-micro Kjeldahl methods (Bremner, 1965).

Phosphorus was calorimetrically determined using the molybdenum blow method according to Chapman and Pratt (1961).

Potassium content of plant samples was determined by using flamephotometer as outlined in Jackson (1958). Fe, Mn, Zn were determined using the Elmer atomic absorption spectrophotometer (AAS).

Statistical analysis

All collected data were subjected to statistical analysis according to the procedures reported by Snedecor and Cochran (1980). Means were compared by the least significant difference test (L.S.D.) at the 5% level of probability in the two seasons of the experiment.

RESULTS AND DISCUSSION

In Table 3, the results of the initial fruit set and retained fruit, bunch weight, yield, fruit physical and chemical properties of the fruits in the two seasons are presented.

Initial fruit set and retained fruit

For the initial fruit set and retained fruit percentage, the results obtained indicate that, there were significant differences between different organic manures (compost) treatments in both seasons. The application of agricultural waste + 40% sheep manure gave the highest initial fruit set and retained fruit percentage followed by agricultural waste + 20% sheep manure compared with the other treatments in the two seasons.

These results are in agreement with those of Almadini and Gosaibi (2007) on several date cultivars.

Yield per palm and bunch weight (kg)

Initial fruit set, ultimate fruit retention and bunch weight are considered as indices for date palm yield and bunch weight were significantly affected by organic manures treatments (compost), where agricultural waste + 40% sheep manure treatment gave the highest yield and bunch weight followed by agricultural waste + 20% sheep manure compared with the other treatments in both seasons.

The results indicate that the increase in soil organic matter could contribute to improve soil properties, which might be responsible for increasing yield per palm and bunch weight according with the results of Almadini and Gosaibi (2007) who reported the importance of adding organic fertilizers to sustain the soil productivity and then reflect on increasing the quantity and quality of palm dates. Also, Al-Kharusi et al. (2007) found that the addition of micronutrients fertilizers with organic materials gave the highest number of fruits and yield of date palm. Several authors reported that applying organic material with mineral fertilizers increased yield of date palm (Al-Bakr, 1982; Bacha and Abo-Hassan, 1983; Attala et al., 2003). Marzouk and Kassem (2011) also found that the organic manures led to increase Zaghloul dates yield. Several other authors: Geetha and Nair (2000) on banana cv. Nendran; Kamel (2002) on Wiliams banana; Soliman et al. (2006) on Maghraby banana; Mottaghian et al. (2008), reported that the different organic manures increased yield and bunch weight.

Fruit weight (g)

In both season, the application of agriculture waste + 40% sheep manure or agricultural waste + 20% sheep manure significantly increased the fruit weight. Among these two treatments, the highest values of fruit weight were gained for agriculture waste + 40% sheep manure. Organic manures increases micro-nutrients such as iron,

Table 3. Initial fruit set, retained fruit, bunch weight, yield, fruit physical and chemical characteristics of Barhy date palm cultivar.

Parameter	Beser stage					
	T-1	T-2	T-3	T4	T5	L.S.D (P=0.05)
			2009			
Initial fruit set (%)	48.79	57.60	54.77	65.78	75.27	6.54
Retained fruit (%)	40.80	51.70	52.64	61.96	72.84	5.10
Bunch weight (kg)	15.68	17.83	17.07	18.37	19.01	1.32
Yield (kg)	156.8	178.3	170.7	183.7	190.1	7.78
Fruit weight (g)	18.57	18.73	17.60	21.58	23.45	2.18
Seed weight (g)	1.13	1.19	1.12	1.10	1.16	ns
Flesh weight (g)	17.44	17.54	16.48	20.48	22.29	2.16
Flesh thickness	8.17	8.29	7.13	8.77	8.52	1.05
Fruit volume (cm)	18.83	18.83	14.44	21.00	23.00	1.97
Fruit Length (cm)	3.83	3.80	3.50	3.83	4.17	0.16
Fruit diameter (cm)	3.13	3.17	2.93	3.33	3.47	0.13
L/D Ratio	1.24	1.20	1.19	1.15	1.20	0.07
Acidity (%)	0.127	0.122	0.115	0.112	0.111	0.06
TSS (%)	31.00	30.40	33.20	34.20	36.40	2.23
Reducing Sugars (%)	12.24	11.21	10.88	11.44	12.81	1.56
Non-R. Sugars (%)	17.87	16.91	21.65	21.56	21.88	4.12
Total Sugars (%)	30.11	28.12	32.53	33.00	34.69	4.50
Moisture (%)	66.10	59.88	56.31	55.81	54.98	4.21
			2010			
Initial fruit set (%)	56.03	63.27	65.67	70.60	77.90	1.10
Retained fruit (%)	48.80	54.12	60.90	67.08	70.11	4.77
Bunch weight (kg)	16.77	18.33	20.13	20.60	21.73	1.0
Yield (kg)	167.70	183.30	201.30	206.00	217.30	9.98
Fruit weight (g)	18.05	19.17	17.03	22.74	24.21	1.0
Seed weight (g)	1.02	1.06	1.13	1.23	1.21	0.09
Flesh weight (g)	17.03	18.11	15.90	21.51	23.00	0.91
Flesh thickness	7.23	7.66	8.00	8.98	8.84	1.23
Fruit volume (cm)	18.33	18.83	17.67	22.00	23.50	1.19
Fruit Length (cm)	3.20	3.47	3.53	3.77	3.90	0.08
Fruit diameter (cm)	2.50	2.77	2.90	2.96	3.10	0.11
L/D Ratio	1.28	1.25	1.21	1.27	1.25	0.09
Acidity (%)	0.141	0.134	0.121	0.120	0.115	0.03
TSS (%)	33.8	39.0	39.4	40.93	42.2	2.61
Reducing Sugars (%)	8.19	7.86	7.94	8.01	8.01	Ns
Non-R. Sugars (%)	19.27	20.57	21.87	21.49	24.09	1.62
Total Sugars (%)	27.46	28.43	29.81	29.50	32.10	1.36
Moisture (%)	61.73	60.70	59.70	55.87	55.70	Ns

(T-1), Agricultural waste + mixture of mineral fertilizers; (T-2), agricultural waste + 5% sheep manure; (T-3), agricultural waste + 10% sheep manure; (T-4), agricultural waste + 20% sheep manure; (T-5), agricultural waste + 40% sheep manure.

zinc, manganese, boron that affect the elongation of the cell division and cell enlargement as well as the biosynthesis of carbohydrates and proteins. This could be responsible for increasing weight of fruits (Siminis et al., 1998). Marzouk and Kassem (2011) found that the fruit weight was increased in both years by applying chicken and cow manure compared to mineral N.

Seed weight (g)

The results indicate that the seed weight was not significantly affected by organic manures treatments for Barhy date palm cultivar in the first season. By contrast, in the second season, such differences were statistically significant and agricultural waste + 20% sheep manure

gave the highest seed weight followed by agricultural waste + 40% sheep manure compared to the other treatments.

Flesh weight (g)

Data showed that there are significant differences in flesh weight of Barhy date palm cultivar in both seasons. Agricultural waste + 40% sheep manure treatment gave higher values of flesh weight as compared with the other organic manures treatments. These results are in agreement with those found by Marzouk and Kassem (2011) who found that the flesh weight was increased in both years by applying chicken and cow manure compared to mineral N.

Flesh thickness (cm)

The Barhy flesh thickness was significantly affected by applying organic manures in both seasons. Agricultural waste + 20% sheep manure treatment gave the highest flesh thickness followed by agricultural waste + 40% sheep manure treatment compared to the other treatments. However, agricultural waste + mixture of mineral fertilizers showed the lowest flesh thickness.

Fruit volume (cm^3)

Concerning the fruit volume, the results obtained indicate that there were significant differences between different organic manures treatments in both seasons. Agricultural waste + 40% sheep manure gave higher values of fruit volume as compared with the other organic treatments.

Fruit dimensions (cm)

Data indicate that fruit length and diameter were significantly affected by different treatments for Barhy cultivar in both seasons of study. Applying agricultural waste + 40% sheep manure significantly increased fruit dimensions compared to other treatments in both seasons. In addition, agricultural waste + 10% sheep manure and agricultural waste + mixture of mineral fertilizers led to significant decrease in fruit dimensions compared to others treatments in the first and second seasons, respectively. Length/diameter ratio (L/D Ratio) increased with agricultural waste + mixture of mineral fertilizers as compared with other treatments in two seasons. Organic manures increases micro-elements such as iron, zinc, manganese, boron and affect the elongation of the cell division and cell enlargement as well as the biosynthesis of carbohydrates and proteins, thus increasing weight and dimensions of fruits. These results coincide with those obtained by Siminis et al. (1998) and Marzouk and Kassem (2011), whose results show that the fruit dimensions were increased by applying chicken and cow manure compared to mineral N in both years.

Chemical properties

Result of total soluble solids, reducing sugars, non-reducing sugars, total sugars, total acidity and moisture contents percentage show that those properties were significantly affected by organic manures in both seasons. The fruit total soluble solids and total sugars percentage were increased by agricultural waste + 40% sheep manure followed by agricultural waste + 20% sheep manure compared with the other treatments in both seasons. Agricultural waste + 40% sheep manure treatment followed by agricultural waste + mixture of mineral fertilizers resulted in a significant increase in reducing and non-reducing sugars content as compared with the other treatments in the first season. Agricultural waste + mixture of mineral fertilizers and agricultural waste + 20% sheep manure showed significant increases in reducing and non-reducing sugars, respectively in the second season. However, total acidity percentage was significantly decreased by applying agricultural waste + 40% sheep manure compared to the other treatments in the two seasons. The moisture content percentage significantly increased by applying agricultural waste + mixture of mineral fertilizers.

Del Amor (2007) reported that the organic fertilization led to the increase in fruit hardness and the percentage of total soluble solids compared to traditional mineral fertilizers. These increases in fruit quality characteristics by applying organic manure or organic manure plus mineral NPK compared to mineral NPK and N might be due to the increase in the availability of N, P and K in the soil, which are essential nutrients having a direct impact on photosynthesis and accumulation of dry matter and total soluble solids. In contrast to the acidity results obtained in the present study, Al-Kharusi et al. (2009) reported an increase in Khalas and Khassab date fruits acidity by mineral fertilizers application with or without organic peat. They also explained that date fruit contain malic acid which is produced during the Krebs cycle and its reduction in the fruit indicates an increase in sugars content. However, the levels of sugars and acidity might be attributed to cultivar characteristics and the fruit growth stage. Several other researchers (Kamel, 2002; Caussiol and Joyce, 2004; Soliman et al., 2006) reported that the organic manures improved the fruit chemical properties.

Fruit mineral content and heavy metals

The effect of the different organic manure treatments on fruit mineral content and heavy metals are presented in

Table 4. Average level of some macro and micronutrients and heavy metals in the fruit of Barhy cultivar.

Parameter	Beser stage					
	T-1	T-2	T-3	T4	T5	L.S.D at: 0.05
2009						
N (%)	0.45	0.40	0.40	0.40	0.47	0.03
P (%)	0.11	0.10	0.10	0.10	0.13	0.01
K (%)	1.53	1.53	1.55	1.40	1.61	1.2
Fe (mg/kg)	285.6	229.1	125.8	245.7	230.5	ns
Zn (mg/kg)	7.83	7.27	6.80	6.20	7.87	ns
Mn (mg/kg)	13.27	12.03	11.33	12.67	13.47	1.3
Cd (mg/kg)	UDL	UDL	UDL	UDL	UDL	-
Co (mg/kg)	UDL	UDL	UDL	UDL	UDL	-
Ni (mg/kg)	UDL	UDL	UDL	UDL	UDL	-
Pb (mg/kg)	UDL	UDL	UDL	UDL	UDL	-
2010						
N (%)	0.37	0.33	0.40	0.33	0.43	0.02
P (%)	0.12	0.10	0.10	0.10	0.15	0.02
K (%)	1.73	1.71	1.67	1.73	1.93	1.4
Fe (mg/kg)	274.2	235.7	134.4	240.1	238.2	ns
Zn (mg/kg)	8.17	6.83	7.17	6.47	6.73	ns
Mn (mg/kg)	12.77	11.67	11.47	12.45	14.27	1.2
Cd (mg/kg)	UDL	UDL	UDL	UDL	UDL	-
Co (mg/kg)	UDL	UDL	UDL	UDL	UDL	-
Ni (mg/kg)	UDL	UDL	UDL	UDL	UDL	-
Pb (mg/kg)	UDL	UDL	UDL	UDL	UDL	-

(T-1), Agricultural waste + mixture of mineral fertilizers; (T-2), agricultural waste + 5% sheep manure; (T-3), agricultural waste + 10% sheep manure; (T-4), agricultural waste + 20% sheep manure; (T-5), agricultural waste + 40% sheep manure.

Table 4.

Macro and micro-minerals

The results of both seasons show that the NPK content was significantly affected by applying organic manure treatments in both seasons. Agricultural waste + mixture of mineral fertilizers significantly increased fruit NPK content followed by agricultural waste + 40% sheep manure as compared to the other treatments.

The results indicate also that Fe and Zn were not significantly affected by applying organic manure treatments. However, Mn content was significantly affected by organic manure treatments in the first season. Agricultural waste + 40% sheep manure gave the higher values of Manganese followed by agricultural waste + mixture of mineral fertilizers than those of the other treatments. However, in the second season, agricultural waste + mixture of mineral fertilizers showed the highest Fe and Mn content compared with the other treatments. Zinc was not significantly influenced by applying organic manure treatments. Similar increases in fruit nutrients content by organic manures or their combination with mineral fertilizer were obtained by Attala et al. (2003) and Marzouk and Kassem (2011) working on Samany and Zaghloul date cultivars. Organic manures could enhance soil fertility, resulting in increasing nutrients availability and their uptake by plants (Matthew and Karikari, 1995; Magdoff, 1999; Ofosu-Anim et al., 2006; Kanal and Kuldkeep, 1993; Kaurch et al., 2005). The application of organic manure might provide supplemental exchangeable cations such as potassium, calcium, magnesium and ammonium, mainly due to organic manure mineralization and release of these basic cations into the soils (Usman and Gameh, 2007). Moreover, the increase of soil P availability is mainly due to the increase of organic acids and the decrease of soil pH (Amitava and Debashish, 2008).

Heavy metals

The results of both seasons showed that the heavy metals content (Cd, Co, Ni and Pb) was not significantly affected by different organic manure treatments. It could be concluded that the application of organic manure on Barhy date palm cultivar has no risks of heavy metals

accumulation in plant tissues.

ACKNOWLEDGEMENT

With sincere respect and gratitude, we would like to express deep thanks to King Abdulaziz City for Science and Technology (KACST), Saudi Arabia for the financial support (Study the expected application effects of organic farming and integrated biological control in agriculture, Saudi Arabia).

REFERENCES

Aisueni NO, Ikuenobe CE, Okolo EC, Ekhator F (2009). Response of date palm (*Phoenix dactylifera*) seedlings to organic manure, N and K fertilizers in polybag nursery. Afr. J. Agric. Res. 4(3):162-165.

Al-Bakr A (1982). The date palm, Its Past and Present Status, 2nd ed.Al-Watan Print Shop, Beirut, Lebanon, p. 1085.

Al-Kharusi LM, Elmardi MO, Al-Julanda FA, Al-Rawahi S, Abdulbassit KM (2007). Effect of mineral fertilizer and organic peat on the physical characteristics of khalas and khassab fruits. ISHS Acta Horticulturae p. 736.

Al-Khasrusi LM, Elmardi MO, Ali A, Al-Julanda FA, Abdelbaset KM, Al-Rawahi S (2009). Effect of mineral and organic fertilizers on the chemical characteristics and quality of date fruit. Int. J. Agric. Biol. pp. 290-296.

Almadini AM, Al-Gosaibi AM (2007). Impacts organic fertilizers for date palm trees on soil properties in Al-Hassa Oasis, Saudi Arabia. Proc. Int. conf. date palm Kingdom of Saudi Arabia. Qaseem Branch; King Saud University, p. 69.

Amitava R, Debashish S (2008). Potential of Different Locally Available Organic Manures on the Performance of *Abelmoschus esculentus* L. Cv Arka Anamika (IIHR Sel 10) Grown in New Alluvail Region of West Bengal, India. Am-Eurasian J. Agric. Environ. Sci. 4(5):603-610.

Association of Official Agricultural Chemists(1995). Official methods of Analysis. A.O.A.C.15th Ed. Published by A.O.A.C. Washington, D.C.(U.S.D).

Attala MA, Shahein AH, Kassem HA, Aly HSH (2003). Effect of applying different organic and inorganic nitrogen sources to Zaghloul and Samany date cultivars on: 1. leaf and fruit mineral content. In: Proc. Int. Conf. on date palm, College Agric. Vet. Med., King Saud University, Qassem Branch, Kingdom of Saudi Arabia 16(19):209-222.

Bacha M, Abo-Hassan AA (1983). Effect of soil fertilization on yield, fruit quality and mineral content of Khudairi date palm varity.In: Proc. 1st Symposium date palm Saudi Arabia, Al-Hassa, Saudi Arabia, pp. 174-179.

Bremner JM (1965). Total nitrogen. In: Methods of soil analysis (Part2). Black,C.A. (Ed) pp. 1149-78. Am. Soc. Agron. Madison, USA. pp.1149-1178.

Caussiol LP, Joyce DC (2004). Characteristics of banana fruit from nearby organic vrsus conventional plantations: A case study. J. Hortic. Sci. Biotechnol. 79(5):678-332.

Chapman HD, Pratt PF (1961). Methods of Analysis for Soils, Plants and Waters. Div. Agric. Sci. Univ. California, U.S.A. pp.160-170.

Cottanie A, Verloo M, Kiekens L, Velghe G, Camerlynch R (1982). Chemical analysis of plant and soils. Lab. Anal. Agroch. State Univ. Ghent. Belgium.

Del Amor FM (2007). Yield and fruit quality response of sweet pepper to organic and mineral fertilization. Renewable Agric. Food Syst. 22(3):233-238.

FAO (2010). Food and Agriculture Organization of the United Nations.

Geetha K, Nair RR (2000). Integrated plant nutrition system (IPNS) for banana. Ann. Agric. Res. (India) 21(4):499-503.

Jackson ML (1958). Constable Ltd .CO., London. Soil Chem. Anal. p. 498.

Kamel AB (2002). Physiological studies on biofertilization of banana plants cv. Williams. Ph.D. Thesis. Faculty of Agriculture Minia University, Egypt.

Kanal A, Kuldkepp P (1993).Direct and residual effect of different oranganic fertilizers on Potato and cereals. J. Agron. Crop Sci. 171:85-195.

Kaurch K, Kapoor K, Gupta A (2005). Impact of organic manures with and without mineral fertilizers on soil chemical and biological properties under tropical conditions. J. Plant Nutr. Soil Sci. 168:117-122.

Magdoff F (1999). Building Soils for Better Crops: Organic Matter Management. Ohio Agron. Guide, Bull. p. 672.

Marzouk HA, Kassem HA (2011). Improving fruit quality, nutritional value and yield of Zaghloul dates by the application of organic and/or mineral fertilizers. Scientia Hortic. 127:249-254.

Matthew IP, Karikari SK (1995). Horticulture Principles and Practices. Macmillan Education Ltd, London and Basingtroke, pp. 80-84.

Mottaghian A, Pidashti H, Bahmanyar MA, Abbasian A (2008). Leaf and seed micronutrients accumulation in soybean cultivars in response to integrated organic and chemical fertilizer application. Pak. J. Biol. Sci. 11:1227-1233.

Ofosu-Anim J, Blay ET, Frempong ME (2006). Effect of organic manure on okra (*Abelmoschus esculentus* (L.) Moench) production. J. Appl. Hortic. 8:155-158.

Parkinson JA, Allen SE (1975). A wet oxidation procedure suitable for the determination of nitrogen and mineral nutrients in biological material. Commun. Soil Sci. Plant Anal. 6(1):1-11.

Siminis C, Loulakis M, Kefakis M, Manios T, Manios V (1998). Humic substances from compost affects nutrient accumulation and fruit yield in tomato. ISHS Acta Horticulturae p. 469.

Snedecor GW, Cochran WG (1980). "Statistical Methods" Oxford and J.B.H. Publishing com. 6th edition.

Soliman SS, El-Sonbaty MR, Ahmed MA (2006). Effect of Organic Manures Source on growth, yield, Fruit quality and Some Minerals Content of Maghrabi Banana. Minufiya J. Agric. Res. 31(5):1179-1197.

Usman ARA, Gameh MA (2007). Effect of sugar cane industry wastes on K status of a newly reclaimed loamy sandy soil. Arch. Agron. Soil Sci. 54:665-679.