

Response of Zaghoul Date Palms Grown in New Reclaimed Lands to Application of Organic and Bio Nitrogen Fertilizers

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ABSTRACT

The present study was carried out during three seasons i.e. 2008, 2009 and 2010 on Zaghoul date palms grown in sand silty soil under surface irrigation in new reclaimed land in Mariot sector. The aim of this study was to investigate response of Zaghoul date palms to application of organic and bio nitrogen fertilizers along with mineral N and their combinations (11 treatments). The obtained results indicated that, all studied treatments of mineral, organic and bio nitrogen combinations were effective in improving yield, fruit quality and leaf mineral content compared with those of the control treatment (unfertilized) and 100% mineral nitrogen treatment. It was obvious that, the superior treatment which exerts positive effects on yield/palm, fruit and pulp weight, flesh thickness, TSS%, total and reducing sugars and leaf NPK content was treatment no.10 (25% Min. N + 50% Org. N + Bio. N) followed descendingly with treatment no.3 (50% Min. N + 50% Org. N). In the meantime, both of treatment no.6 (100% Org. N + Bio. N) followed descendingly by treatment no. 10 (above mentioned) were the most effective in enhancing fruit dimensions and leaf Fe, Mn, Zn content.

It could be concluded that, under the conditions of this study, 25% mineral nitrogen + 50% organic nitrogen + Bio nitrogen treatment was very superior one for minimizing the use of mineral nitrogen fertilization to the quarter, reducing environmental pollution and producing an economical yield with best fruit quality of Zaghoul date palms in new reclaimed lands.

Key words: Zaghoul date palms, mineral nitrogen, organic nitrogen -Nitrobin.

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is considered as one of the most commercial and popular crop, so in some religious occasions, this crop occupies a special status in many countries of the world, especially in Egypt as a result of the nutritional value of fruits and due to its uses. In addition, date palms thrive well under drastic environmental conditions of many desert areas. Therefore, growers apply large amounts of chemical fertilizers to improve fertility of these new reclaimed soils and to increase palm yield. However, excessive amount of chemical fertilizers applied during the agricultural practices nowadays lead to many environmental problems such as nitrate pollution of soil and ground water. In addition, such fertilizers can alter the composition of fruits, vegetables and root crops, and

decrease their contents of vitamins, minerals and other compounds. Apparently, harmful residues that remain in food pose threats to health (Bogatyre, 2000; Al-Wasfy and El-Khawaga, 2008).

Additionally, in Egypt the annual production of mineral N fertilizers is not enough to meet the local requirements especially with increasing the area of ready reclaimed land which in turn leads to raise the prices of such fertilizers.

Nowadays, great attention is paid to attract the growers to use organic and biofertilizers as partial substitute for mineral nitrogen fertilizers to avoid these environmental and economical problems.

Organic fertilization for fruit crops became a good alternative to chemical fertilization to avoid pollution of environment (Blake, 1990). Organic manure not only increase of the organic matter in soil but also increased the available phosphorus, exchangeable potassium, calcium and magnesium content (Bhangoo *et al.*, 1988), also organic fertilization improved soil porosity, infiltration rate and soil water retention (Asker *et al.*, 1994 and Nassar, 1998).

Biofertilizers as (Nitrobin) containing nitrogen fixing bacteria could be used as source for fixing nitrogen in the soil. Several processes other than nitrogen fixation could be account for the positive effect of biofertilizer, including production of growth regulators, protection from root pathogens and modification of nutrient uptake by plant (Techan, 1988 and Gogoi *et al.*, 2004). Studies in this respect revealed that inoculation with N biofertilizer could save half the normal field rate of N chemical fertilizers and at the meantime, promote plant production (Ishac, 1989).

Previous studies emphasized the great benefits of using organic and bio nitrogen fertilizers in combination with mineral nitrogen fertilizer in terms of total yield of trees (Umesh *et al.*, 1988; Hussein *et al.*, 1992; Abd El-Naby & Gomma, 2000; Geetha & Nair, 2000; Shaheen *et al.*, 2003; Diab, 2006; Rabie & Saad, 2007 and Abd El-Salam *et al.*, 2009). Also, other related studies were recorded by Tiwary *et al.*, 1988; Mansour, 1998; Tachibana & Yahata, 1998; Joo *et al.*, 1999; Osman, 2003; Abd El-Hameed & Ragab, 2004; Mohamed & Gobara, 2004 and El-Assar, 2005. They pointed to the positive effect of organic and bio nitrogen fertilizers on

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physical and chemical properties of fruits in different fruit crops. As well as, Smith *et al.*, 1994; Soliman, 2001; Magda, 2002; Mansour *et al.*, 2004; El-Shenawi & El-Sayed, 2005; Mai *et al.*, 2005; Basma & Telep, 2008 and Hossam El-Deen & Boshra, 2008 revealed that organic and bio nitrogen applications had considerable effect on leaf mineral contents of some fruit cultivars.

Therefore, the aim of the present study was to investigate the effect of chemical, organic and bio nitrogen fertilizers and their combinations on yield, fruit quality and leaf mineral content of Zaghoul date palms grown in new reclaimed lands. The final target is to produce a safe and healthy food free from chemical pollutants.

MATERIALS AND METHODS

The present study was conducted during 2008, 2009 and 2010 seasons on 10 years old Zaghoul date palms grown in Khoraisish orchard at Mariout sector, Alexandria Governorate. Physical and chemical properties of experimental site were determined at the beginning of the treatments according to Wilde *et al.* (1985) and the obtained data are shown in Table (1).

Forty-four uniform palms planted at 8×8 meters apart were selected for the applications of treatments. Normal cultural practices were followed as usual for date palms and all selected palms were artificially hand pollinated using pollen grains from a certain source during the three experimental seasons. This study included the following eleven treatments for single and combined applications of mineral, organic and bio nitrogen fertilizers as follows:

No.	Treatments	Amounts of fertilizer (Kg/palm/year)*		
		2008	2009	2010
1	100%** Mineral nitrogen (Min.N)	4.9	4.9	4.9
2	100% Organic nitrogen (Org.N)	96.0	93.0	89.0
3	Bio-nitrogen fertilizer (Bio.N)	Bio-N	Bio-N	Bio-N
4	100% Min.N + Bio.N	4.9+Bio.N	4.9+Bio.N	4.9+Bio.N
5	100% Org.N + Bio.N	96.0+Bio.N	93.0+Bio.N	89.0+Bio.N
6	50% Min.N + 50% Org.N	2.5+48.0	2.5+46.5	2.5+44.5
7	50% Min.N + Bio.N	2.5+Bio.N	2.5+Bio.N	2.5+Bio.N
8	50% Org.N + Bio.N	48.0+Bio.N	46.5+Bio.N	44.5+Bio.N
9	25% Min.N + 50% Org.N	1.3+48.0	1.3+46.5	1.3+44.5
10	25% Min.N+50%Org.N+Bio.N	1.3+48.0+Bio.N	1.3+46.5+Bio.N	1.3+44.5+Bio.N
11	Control (Unfertilized palms)***	-	-	-

*According to the chemical analysis of experimental organic fertilizer (FYM) in Table (2).

** 100% = Recommended rate of actual nitrogen = 1000 gms/palm/year.

*** Unfertilized with any nitrogen fertilizers.

Table1. Physical and chemical analysis of experimental soil orchard

Character	Soil depth (Cm)			Mechanical analysis		
	0-30	30-60	60-90	Sand (%)	Silt (%)	Clay (%)
PH (1 : 2.5)	7.96	8.14	8.27	52.9	30.6	16.5
EC (ds/m)	1.14	1.73	1.89	51.8	30.9	17.3
CaCO ₃ (%)	34.82	36.17	36.59	50.7	31.5	17.8
O. M. (%)	0.36	0.24	0.15	Texture class :- Sandy silt		
Total N (%)	0.05	0.03	0.02			
Soluble cations (meq/L)						
Ca ²⁺	4.10	4.23	4.51			
Mg ²⁺	1.08	1.12	1.25			
Na ⁺	8.11	8.31	8.56			
K ⁺	1.83	2.03	2.19			
Soluble anions (meq/L)						
HCO ₃ ⁻	2.11	2.22	2.39			
Cl ⁻	8.53	8.75	9.13			
SO ₄ ²⁻	4.48	4.72	4.99			

Table2. Chemical analysis of organic manure (Farm yard)

Characters	2008	2009	2010
- Moisture content (%)	18.60	19.20	16.24
- Organic matter (%)	22.15	20.35	19.56
- Organic carbon (%)	13.56	16.11	14.78
- Total nitrogen (%)	1.04	1.07	1.11
- C/N ratio	13 : 1	15 : 1	13 : 1
- P (%)	0.43	0.36	0.47
- K (%)	0.98	1.12	1.26
- Fe (ppm)	3190	3250	4103
- Zn (ppm)	715	549	592
- Mn (ppm)	2616	3011	2815

Mineral nitrogen was applied as ammonium sulphate 20.6% N at 3 equal batches in February, April and June every season.

Organic manure was broadcasting as farmyard rate at 20m³/fed. in January every year. Biofertilizer "nitrobin" produced by General Organization of Agricultural Equilibrium Fund (GOAER), Ministry of Agriculture, Egypt. Nitrobin was added once at the first week of March every season in crescentic tranches around each experimental palm in depth of 1 meter near root area at 1.5 meter far from palm trunk, where each palm received 4 liters of nitrobin solution according to the recommended usage method i.e. 1 packet weights 500 gms per 2 liters water. In addition, all selected palms received 1.5 kg/palm and 1 kg/palm of calcium superphosphate (15.5% P₂O₅) and potassium sulphate (50%) in February and July, respectively. After all treatments, palms were directly irrigated.

The treatments were arranged in randomized complete block design with four replications, each replicate was represented by one palm i.e., 11 treatments × 4 replicates = 44 experimental palms.

The number of setted fruits per strand was counted using sixteen tagged attached strands/spathe on four random bunches of each palm after one month from the artificial hand pollination, and then at the commercial harvest date (mid of September), number of retained fruits/selected strand were recorded and fruit retention percentage was calculated. In addition, number and weight of bunches/palm were recorded to estimate the total yield/palm.

For determination of physical and chemical properties, two hundred fruits were collected randomly from every experimental palm, then, weight, length, width, pulp weight and flesh thickness of the fruit were recorded.

Total soluble solids (TSS), total acidity, total and reducing sugars of fruit pulp were determined according to the standard methods which are outlined in

A.O.A.C.(1995). Total soluble tannins in fruit pulp were determined according to Swain and Hillis (1959).

For mineral content determination, pinnae samples were collected in the first of November from the middle pinnae of the full developed leaves located just over the fruiting zone (less than one year old) around the axis as recommended by Embleton and Cook (1947). Twenty pinnae per sample for each replicate were taken, washed several times with tap water and rinsed three times with distilled water then dried at 70°C to a constant weight. Nitrogen and phosphorus were determined colorimetrically according to Evenhuis (1976) and Murphy and Riely (1962), respectively. Potassium was determined by flame photometer. Iron, manganese and zinc were determined by Perkin Elmer Atomic Absorption Spectrophotometer.

The obtained data were statistically analyzed according to Mead *et al.* (1993) using L.S.D. test to recognize the significantly between the various treatments.

RESULTS AND DISCUSSION

I- Effect of mineral, organic and bio nitrogen fertilizers on yield components of Zaghloul date palms:

Data in Table (3) indicated that yield components (fruit retention %, number of bunches/palm, bunch weight and yield/palm) were significantly affected by different levels and combinations of mineral, organic and bio nitrogen fertilizers as compared with that of the control. The results showed that treatment no.10 (25% Min.N + 50% Org.N + Bio-N) produced the highest yield components in the three seasons among all treatments. In the meantime, treatment no.6 (50% Min.N+50% Org.N) came in the second rank in regard to improvement of tested yield components. However, treatment no.11 (control) gave the lowest yield components values, followed by treatment no.3 (Bio-N).

The beneficial effect of organic manure (FYM) to increase both bunch weight and yield per palm may be

attributed to the role of organic manure in increasing nutrient uptake, which plays an important role in producing favorable balance between growth and fruit production. Also the nutritional status of treated palms could be responsible for the increment of yield due to of its important role in photosynthesis process. In addition, the pronounced effect of organic and biofertilizers on yield and its components may be due to increasing cell division and enlargement, and consequently increasing vegetative growth which reflected on increasing the yield and its components as final result from the physiological processes (Abd El-Naby & Gomaa, 2000; Geetha & Nair, 2000 and Shaheen *et al.*, 2009).

These results agreed with those reported by Bhangoo *et al.* (1988); Ishac (1989); Hussein *et al.* (1992); Shaheen *et al.* (2003); Al-Wasfy & El-Khawaga (2008) and Abd El-Salam *et al.* (2009).

2- Effect of mineral, organic and bio nitrogen on physical properties of Zaghoul dates:

Data represented in Table (4) showed that fruit physical properties of Zaghoul date palms i.e. fruit weight, length and width, pulp weight and flesh thickness were significantly improved by different levels and combinations of mineral, organic and bio nitrogen treatments, in comparison with control, in the three experimental seasons. Treatment no.10 (25% Min.N+50% Org.N+Bio.N) gave the highest values of fruit weight, pulp weight and flesh thickness, followed by treatment no.6 (50% Min.N+50% Org.N) in such parameters. At the sametime, treatment no.5 (100% Org.N+Bio.N) produced the highest values of fruit length and width, followed by treatment no.10. However, control treatment produced the lowest values in all fruit physical properties, followed by treatment no.1 (100% Min.N).

It appears from these results that biofertilizer N which combined with the above mentioned treatments had an important role in improvement of fruit physical properties. Gogoi *et al.* (2004); Mai *et al.* (2005) and Shaheen *et al.* (2009) indicated that physical properties of fruits increased with 50% recommended dose of N plus Azospirillum on banana plants.

In addition, organic N alone or combined with mineral source can maintain a good balance between growth and fruit which may result in accumulation more carbohydrates and makes them very available for enhancing ripening of fruits (Al-Wasfy and El-Khawaga, 2008). These results were in agreement with those obtained by Osman (2003); Abd El-Hameed and Ragab (2004); Mohamed and Gobara (2004); El-Assar (2005); Diab (2006) and Rabie & Saad (2007).

3- Effect of mineral, organic and bio nitrogen fertilizers on chemical constituents of Zaghoul dates:

Data in Table (5) clearly showed that all tested mineral, organic and bio nitrogen treatments significantly improved chemical constituents of Zaghoul dates compared with control treatment. Where, treatment no.10 (25% Min.N+50% Org.N+Bio.N) followed by treatment no.6 (50% Min.N+50% Org.N) recorded the highest values with regard to total soluble solids (TSS), TSS/acid ratio, total sugars and reducing sugars. However, both of treatment no.11 (control treatment) followed by treatment no.3 (Bio.N) recorded the lowest values. It is worthy to mention, that both of total acidity and soluble tannins values took the conversal trend. These results were true in the three experimental seasons.

The effect of organic and biofertilizers on increasing the TSS%, reducing and total sugars and decreasing total acidity in fruits could be due to their beneficial effect on the total leaf area of plant which reflected in more carbohydrates production through photosynthesis process that reflect on improvement of chemical properties of fruits (Tiwary *et al.*, 1988; Mansour, 1998; Tachibana & Yahata, 1998; Joo *et al.*, 1999; Magda, 2002; Mansour *et al.*, 2004 and Shaheen *et al.*, 2009).

Additionally, Umesh *et al.* (1988) indicated that Azospirillum inoculated coupled with 50% N resulted in the most pronounced increase in amount of total soluble solids as well as reducing sugars content of banana fruits.

These results were in accordance with those reported by Osman (2003); El-Shenawi & El-Sayed (2005); Basma & Telep (2008); Hossam El-Deen & Boshra (2008).

4- Effect of mineral, organic and bio nitrogen fertilizers on leaf mineral content of Zaghoul date palms:

Data in Table (6) revealed that all of the studied leaf minerals were significantly increased by the combined treatments of mineral, organic and bio nitrogen fertilizers as compared with control treatment. As regard to macronutrients (nitrogen, phosphorus and potassium contents), treatment no.10 (25% Min.N+50% Org.N+Bio.N) gave the highest values, followed by treatment no. 6 (50% Min.N+ 50% Org.N). In the meantime, concerning the micronutrients (iron, manganese and zinc content), treatment no.5 (100% Org.N+Bio.N) recorded the highest values followed by treatment no.10. However, treatment no.11 (control) and treatment no.3 (Bio.N) produced the lowest values of leaf mineral content. The other treatments produced

Table 3. Effect of mineral, organic and bio nitrogen fertilizers on yield components of Zaghloul date palms in 2008, 2009 and 2010 seasons

Treatments	Fruit retention %			No. of bunches/palm			Bunch weight (kg)			Yield/palm (kg)		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
1- 100% Mineral N (Min.N)	50.7 ^f	46.7 ^f	51.7 ^f	6.97 ^f	8.0 ^f	9.36 ^f	12.3 ^f	17.0 ^e	15.2 ^e	86.2 ^f	138.2 ^f	143.0 ^f
2- 100% Organic N (Org.N)	48.2 ^g	44.9 ^g	49.2 ^g	6.86 ^g	7.66 ^g	9.13 ^g	11.9 ^g	16.6 ^f	14.7 ^f	81.9 ^g	122.2 ^g	134.9 ^g
3- Biofertilizer (Bio.N)	42.3 ^j	39.4 ^j	43.2 ^j	6.61 ^j	7.18 ^j	8.13 ^j	10.7 ^j	15.1 ⁱ	13.5 ^{hi}	71.5 ⁱ	114.3 ^h	110.3 ^j
4- 100% Min.N+Bio.N	57.1 ^b	53.7 ^b	58.3 ^b	7.97 ^b	9.00 ^b	10.29 ^b	13.3 ^b	18.3 ^b	16.5 ^b	106.6 ^b	169.0 ^b	170.2 ^b
5- 100% Org.N+Bio.N	46.9 ^h	43.1 ^h	47.3 ^h	6.80 ^h	7.37 ^h	8.76 ^h	11.5 ^h	15.9 ^g	14.2 ^g	78.4 ^h	122.1 ^g	124.9 ^h
6- 50% Min.N+50% Org.N	55.3 ^c	51.9 ^c	56.4 ^c	7.85 ^c	8.77 ^c	10.06 ^c	13.2 ^c	18.2 ^b	16.3 ^d	103.7 ^c	160.7 ^c	164.3 ^c
7- 50% Min.N+Bio.N	52.3 ^e	48.3 ^e	53.5 ^e	7.08 ^e	8.41 ^e	9.59 ^e	12.5 ^e	17.4 ^d	15.5 ^d	89.0 ^e	146.9 ^e	149.4 ^e
8- 50% Org.N+Bio.N	44.4 ⁱ	43.2 ⁱ	45.3 ⁱ	6.69 ⁱ	7.34 ⁱ	8.43 ⁱ	11.1 ⁱ	15.4 ^h	13.7 ^h	73.6 ⁱ	104.8 ⁱ	116.1 ⁱ
9- 25% Min.N+50% Org.N	53.4 ^d	50.1 ^d	54.5 ^d	7.36 ^d	8.53 ^d	9.75 ^d	12.9 ^d	17.7 ^c	15.9 ^c	91.9 ^d	151.6 ^d	155.4 ^d
10- 25% Min.N+50% Org.N+Bio.N	59.8 ^a	55.6 ^a	61.1 ^a	8.59 ^a	9.52 ^a	10.76 ^a	14.4 ^a	18.7 ^a	17.3 ^a	124.0 ^a	173.3 ^a	186.8 ^a
11- Control (Unfertilized palms)	40.3 ^k	37.5 ^k	41.3 ^k	6.45 ^k	7.08 ^k	7.97 ^k	10.5 ^k	14.8 ^j	13.4 ⁱ	67.7 ^j	102.7 ⁱ	107.8 ^k
New I.S.D. at 5%	0.5	0.3	0.3	0.3	0.04	0.03	0.05	0.1	0.2	0.2	2.7	3.0
	0.5	0.3	0.3	0.3	0.04	0.03	0.05	0.1	0.2	0.2	2.7	3.0

The values followed by the same letter do not differ at 5% level of significance.

Table 4. Effect of mineral, organic and bio nitrogen fertilizers on physical properties of Zaghloul dates in 2008, 2009 and 2010 seasons

Treatments	Fruit weight (gm)			Fruit length (cm)			Fruit width (cm)			Pulp weight (gm)			Flesh thickness (cm)		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
1- 100% Mineral N (Min.N)	27.31 ^f	28.69 ^f	27.79 ^f	5.30 ^f	5.73 ^f	5.59 ^f	2.560 ^f	2.863 ^f	2.663 ^f	25.32 ^f	26.20 ^f	25.17 ^f	0.838 ^f	0.945 ^f	0.847 ^f
2- 100% Organic N (Org.N)	27.25 ^e	28.39 ^e	27.70 ^e	5.45 ^e	5.74 ^e	5.55 ^e	2.510 ^e	2.826 ^e	2.613 ^e	24.92 ^e	25.90 ^e	26.36 ^e	0.834 ^e	0.934 ^e	0.842 ^e
3- Biofertilizer (Bio.N)	26.71 ^j	27.82 ^j	26.85 ^j	5.32 ^j	5.59 ^j	5.41 ^j	2.386 ^j	2.676 ^j	2.486 ^j	24.15 ^j	25.33 ^j	24.46 ^j	0.806 ^j	0.914 ^j	0.813 ^j
4- 100% Min.N+Bio.N	28.62 ^b	29.94 ^b	28.77 ^b	5.64 ^c	5.86 ^c	5.68 ^c	2.713 ^c	2.903 ^c	2.810 ^c	26.23 ^b	27.45 ^b	26.37 ^b	0.869 ^b	0.991 ^b	0.877 ^b
5- 100% Org.N+Bio.N	27.05 ^h	28.23 ^c	27.43 ^h	5.40 ^d	5.67 ^h	5.49 ^g	2.506 ^h	2.763 ^h	2.556 ^h	24.70 ^c	25.74 ^c	25.04 ^h	0.825 ^h	0.929 ^h	0.837 ^h
6- 50% Min.N+50% Org.N	28.53 ^c	29.63 ^c	28.65 ^c	5.91 ^a	6.07 ^a	5.78 ^a	2.803 ^a	2.993 ^a	2.916 ^a	26.03 ^c	27.14 ^c	26.16 ^c	0.866 ^c	0.979 ^c	0.874 ^c
7- 50% Min.N+Bio.N	28.23 ^d	29.48 ^d	28.34 ^d	5.59 ^a	5.82 ^d	5.67 ^d	2.670 ^d	2.896 ^d	2.776 ^d	25.82 ^d	26.99 ^d	25.96 ^d	0.855 ^d	0.974 ^d	0.863 ^d
8- 50% Org.N+Bio.N	26.79 ⁱ	28.08 ⁱ	27.18 ⁱ	5.36 ⁱ	5.64 ⁱ	5.45 ⁱ	2.426 ⁱ	2.713 ⁱ	2.543 ⁱ	24.49 ⁱ	25.59 ⁱ	24.79 ⁱ	0.817 ⁱ	0.923 ⁱ	0.825 ⁱ
9- 25% Min.N+50% Org.N	27.98 ^e	29.01 ^e	28.10 ^e	5.35 ^e	5.81 ^e	5.65 ^d	2.630 ^e	2.866 ^e	2.720 ^e	25.59 ^e	26.52 ^e	25.40 ^e	0.847 ^e	0.957 ^e	0.855 ^e
10- 25% Min.N+50% Org.N+Bio.N	28.83 ^a	30.19 ^a	28.99 ^a	5.70 ^b	5.89 ^b	5.73 ^b	2.773 ^b	2.933 ^b	2.856 ^b	26.44 ^a	27.70 ^a	26.57 ^a	0.876 ^a	0.998 ^a	0.884 ^a
11- Control (Unfertilized palms)	26.42 ^k	27.45 ^k	26.54 ^k	5.26 ^k	5.58 ^k	5.41 ^k	2.353 ^k	2.636 ^k	2.446 ^k	24.03 ^k	24.96 ^k	24.15 ^k	0.796 ^k	0.900 ^k	0.803 ^k
New I.S.D. at 5%	0.05	0.03	0.06	0.03	0.02	0.02	0.030	0.020	0.014	0.20	0.15	0.19	0.001	0.001	0.003

The values followed by the same letter do not differ at 5% level of significance.

Table 5. Effect of mineral, organic and bio nitrogen fertilizers on chemical constituents of Zaghoul dates in 2008, 2009 and 2010 seasons

Treatments	Total acidity %										TSS/acid ratio										Total sugars %										Reducing sugars %										Soluble tannins %									
	2008		2009		2010		2008		2009		2010		2008		2009		2010		2008		2009		2010		2008		2009		2010		2008		2009		2010															
1-100% Mineral N (Min.N)	24.37 ^a	25.53 ^b	26.23 ^b	0.139 ^d	0.112 ^d	0.129 ^d	176.7 ^a	205.8 ^b	203.7 ^a	62.4 ^a	68.8 ^b	69.5 ^b	40.6 ^a	44.2 ^b	46.3 ^b	0.363 ^d	0.419 ^e	0.479 ^d	24.37 ^a	25.53 ^b	26.23 ^b	0.139 ^d	0.112 ^d	0.129 ^d	176.7 ^a	205.8 ^b	203.7 ^a	62.4 ^a	68.8 ^b	69.5 ^b	40.6 ^a	44.2 ^b	46.3 ^b	0.363 ^d	0.419 ^e	0.479 ^d														
2-100% Organic N (Org.N)	26.53 ^e	26.51 ^e	28.18 ^e	0.129 ^d	0.112 ^d	0.119 ^d	230.5 ^e	236.8 ^e	236.8 ^e	65.5 ^e	70.3 ^e	71.3 ^e	42.2 ^e	46.7 ^e	49.2 ^e	0.326 ^d	0.371 ^e	0.439 ^e	26.53 ^e	26.51 ^e	28.18 ^e	0.129 ^d	0.112 ^d	0.119 ^d	230.5 ^e	236.8 ^e	236.8 ^e	65.5 ^e	70.3 ^e	71.3 ^e	42.2 ^e	46.7 ^e	49.2 ^e	0.326 ^d	0.371 ^e	0.439 ^e														
3- Biofertilizer (Bio.N)	24.04 ^j	25.07 ^j	25.72 ^j	0.144 ^b	0.128 ^b	0.133 ^b	166.9 ^j	195.8 ^j	193.3 ^j	60.9 ^j	67.3 ^j	68.0 ^j	39.7 ^j	43.3 ^j	45.4 ^j	0.394 ^b	0.455 ^b	0.491 ^b	24.04 ^j	25.07 ^j	25.72 ^j	0.144 ^b	0.128 ^b	0.133 ^b	166.9 ^j	195.8 ^j	193.3 ^j	60.9 ^j	67.3 ^j	68.0 ^j	39.7 ^j	43.3 ^j	45.4 ^j	0.394 ^b	0.455 ^b	0.491 ^b														
4-100% Min.N+Bio.N	26.94 ^b	26.91 ^b	28.82 ^b	0.120 ^j	0.107 ^a	0.111 ^j	224.5 ^b	251.4 ^b	259.6 ^b	67.8 ^b	72.7 ^b	73.8 ^b	43.6 ^b	48.6 ^b	51.2 ^b	0.307 ^d	0.339 ^d	0.384 ^d	26.94 ^b	26.91 ^b	28.82 ^b	0.120 ^j	0.107 ^a	0.111 ^j	224.5 ^b	251.4 ^b	259.6 ^b	67.8 ^b	72.7 ^b	73.8 ^b	43.6 ^b	48.6 ^b	51.2 ^b	0.307 ^d	0.339 ^d	0.384 ^d														
5-100% Org.N+Bio.N	24.37 ^a	25.27 ^a	26.07 ^a	0.142 ^c	0.127 ^c	0.132 ^c	171.6 ^a	198.9 ^a	197.5 ^a	61.8 ^a	68.1 ^a	68.9 ^a	40.1 ^a	43.4 ^a	45.7 ^a	0.385 ^c	0.445 ^c	0.485 ^c	24.37 ^a	25.27 ^a	26.07 ^a	0.142 ^c	0.127 ^c	0.132 ^c	171.6 ^a	198.9 ^a	197.5 ^a	61.8 ^a	68.1 ^a	68.9 ^a	40.1 ^a	43.4 ^a	45.7 ^a	0.385 ^c	0.445 ^c	0.485 ^c														
6-50% Min.N+50% Org.N	26.88 ^c	26.84 ^c	28.72 ^c	0.122 ⁱ	0.109 ^e	0.113 ⁱ	220.3 ^c	246.2 ^c	254.4 ^c	66.7 ^c	71.5 ^c	72.6 ^c	43.0 ^c	48.0 ^c	50.5 ^c	0.279 ^j	0.322 ^j	0.363 ^j	26.88 ^c	26.84 ^c	28.72 ^c	0.122 ⁱ	0.109 ^e	0.113 ⁱ	220.3 ^c	246.2 ^c	254.4 ^c	66.7 ^c	71.5 ^c	72.6 ^c	43.0 ^c	48.0 ^c	50.5 ^c	0.279 ^j	0.322 ^j	0.363 ^j														
7-50% Org.N+Bio.N	25.15 ^f	26.32 ^f	27.20 ^f	0.133 ^f	0.119 ^f	0.124 ^f	199.2 ^f	221.1 ^f	219.5 ^f	63.7 ^f	70.0 ^f	71.1 ^f	41.4 ^f	45.7 ^f	48.2 ^f	0.335 ^f	0.387 ^f	0.454 ^f	25.15 ^f	26.32 ^f	27.20 ^f	0.133 ^f	0.119 ^f	0.124 ^f	199.2 ^f	221.1 ^f	219.5 ^f	63.7 ^f	70.0 ^f	71.1 ^f	41.4 ^f	45.7 ^f	48.2 ^f	0.335 ^f	0.387 ^f	0.454 ^f														
8-50% Org.N+Bio.N	25.10 ^g	25.66 ^g	26.84 ^g	0.136 ^g	0.123 ^g	0.128 ^g	184.5 ^g	208.6 ^g	209.6 ^g	62.9 ^g	69.6 ^g	70.5 ^g	41.0 ^g	44.8 ^g	47.2 ^g	0.349 ^e	0.403 ^e	0.463 ^e	25.10 ^g	25.66 ^g	26.84 ^g	0.136 ^g	0.123 ^g	0.128 ^g	184.5 ^g	208.6 ^g	209.6 ^g	62.9 ^g	69.6 ^g	70.5 ^g	41.0 ^g	44.8 ^g	47.2 ^g	0.349 ^e	0.403 ^e	0.463 ^e														
9-25% Min.N+50% Org.N	26.68 ^d	26.23 ^d	27.50 ^a	0.126 ^h	0.110 ^g	0.114 ^h	211.7 ^d	242.2 ^d	250.3 ^d	66.0 ^d	70.7 ^d	71.7 ^d	42.5 ^d	47.2 ^d	49.8 ^d	0.321 ^h	0.335 ^h	0.397 ^h	26.68 ^d	26.23 ^d	27.50 ^a	0.126 ^h	0.110 ^g	0.114 ^h	211.7 ^d	242.2 ^d	250.3 ^d	66.0 ^d	70.7 ^d	71.7 ^d	42.5 ^d	47.2 ^d	49.8 ^d	0.321 ^h	0.335 ^h	0.397 ^h														
10-25% Min.N+50% Org.N+Bio.N	27.34 ^a	27.50 ^a	29.24 ^a	0.118 ^k	0.106 ^h	0.109 ^h	231.6 ^a	259.4 ^a	268.2 ^a	69.3 ^a	74.3 ^a	75.4 ^a	43.1 ^a	49.4 ^a	52.0 ^a	0.265 ^k	0.306 ^k	0.348 ^k	27.34 ^a	27.50 ^a	29.24 ^a	0.118 ^k	0.106 ^h	0.109 ^h	231.6 ^a	259.4 ^a	268.2 ^a	69.3 ^a	74.3 ^a	75.4 ^a	43.1 ^a	49.4 ^a	52.0 ^a	0.265 ^k	0.306 ^k	0.348 ^k														
11- Control (Unfertilized palm)	23.78 ^k	24.96 ^k	25.43 ^k	0.154 ^a	0.136 ^a	0.143 ^a	154.4 ^k	183.5 ^k	177.8 ^k	59.8 ^k	66.6 ^k	67.3 ^k	39.0 ^k	42.6 ^j	44.3 ^k	0.419 ^a	0.484 ^a	0.524 ^a	23.78 ^k	24.96 ^k	25.43 ^k	0.154 ^a	0.136 ^a	0.143 ^a	154.4 ^k	183.5 ^k	177.8 ^k	59.8 ^k	66.6 ^k	67.3 ^k	39.0 ^k	42.6 ^j	44.3 ^k	0.419 ^a	0.484 ^a	0.524 ^a														
New L.S.D. at 5%	0.01	0.02	0.01	0.002	0.001	0.001	2.1	2.7	4.1	0.4	0.3	0.2	0.3	0.5	0.3	0.004	0.001	0.003	0.01	0.02	0.01	0.002	0.001	0.001	2.1	2.7	4.1	0.4	0.3	0.2	0.3	0.5	0.3	0.004	0.001	0.003														

The values followed by the same letter do not differ at 5% level of significance.

Table 6. Effect of mineral, organic and bio nitrogen fertilizers on leaf mineral content of Zaghoul dates in 2008, 2009 and 2010 seasons

Treatments	Nitrogen (%)			Phosphorus (%)			Potassium (%)			Fe (ppm)			Mn (ppm)			Zn (ppm)		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
1- 100% Mineral N (Min.N)	1.78 ^c	1.70 ^c	1.82 ^c	0.139 ^e	0.167 ^c	0.169 ^c	0.764 ^c	0.717 ^c	0.816 ^c	153.7 ^f	163.4 ^f	172.1 ^f	69.12 ^d	76.70 ^b	86.83 ^d	65.00 ^f	67.05 ^d	68.40 ^f
2- 100% Organic N (Org.N)	1.64 ^f	1.58 ^f	1.70 ^f	0.138 ^f	0.158 ^f	0.160 ^f	0.669 ^f	0.629 ^f	0.718 ^f	163.0 ^e	169.9 ^e	182.4 ^e	71.62 ^e	78.96 ^d	89.91 ^e	70.36 ^e	72.60 ^e	74.03 ^e
3- Biofertilizer (Bio.N)	1.50 ^j	1.39 ^j	1.53 ^j	0.143 ^j	0.147 ^j	0.145 ^j	0.561 ^j	0.510 ^j	0.639 ^j	151.3 ^g	161.8 ^g	169.4 ^g	68.14 ^g	75.20 ^f	85.60 ^f	65.66 ^g	66.98 ^g	66.98 ^g
4-100% Min.N+Bio.N	1.82 ^b	1.75 ^b	1.83 ^b	0.161 ^b	0.170 ^b	0.173 ^b	0.823 ^b	0.753 ^b	0.880 ^b	164.6 ^d	171.1 ^d	184.2 ^d	72.33 ^d	79.76 ^d	90.93 ^d	71.44 ^d	73.07 ^d	75.20 ^d
5-100% Org.N+Bio.N	1.70 ^e	1.62 ^e	1.74 ^e	0.136 ^e	0.161 ^e	0.162 ^e	0.713 ^e	0.656 ^e	0.762 ^e	159.0 ^g	166.7 ^g	177.9 ^g	70.33 ^e	77.80 ^f	88.64 ^e	67.11 ^e	69.28 ^e	70.61 ^e
6-50% Min.N+50% Org.N	1.59 ^h	1.48 ^h	1.62 ^h	0.153 ^h	0.153 ^h	0.152 ^h	0.621 ^h	0.572 ^h	0.664 ^h	173.0 ^a	178.0 ^a	192.3 ^a	74.03 ^a	81.63 ^a	93.03 ^a	75.20 ^a	77.53 ^a	79.13 ^a
7-50% Min.N+Bio.N	1.75 ^d	1.66 ^d	1.79 ^d	0.157 ^d	0.163 ^d	0.164 ^d	0.734 ^d	0.682 ^d	0.787 ^d	161.0 ^f	168.3 ^f	180.2 ^f	70.90 ^f	78.16 ^e	89.03 ^f	68.43 ^f	72.07 ^f	73.13 ^f
8-50% Org.N+Bio.N	1.62 ^e	1.54 ^e	1.65 ^e	0.155 ^e	0.155 ^e	0.156 ^e	0.644 ^e	0.603 ^e	0.689 ^e	156.9 ^h	165.0 ^h	175.7 ^h	69.75 ^h	76.85 ^f	87.70 ^h	66.06 ^h	68.19 ^h	69.50 ^h
9-25% Min.N+50% Org.N	1.54 ⁱ	1.44 ⁱ	1.57 ⁱ	0.145 ⁱ	0.149 ⁱ	0.150 ⁱ	0.592 ⁱ	0.537 ⁱ	0.639 ⁱ	166.7 ^g	172.4 ^g	186.5 ^g	73.16 ^g	80.80 ^g	91.92 ^g	72.30 ^g	73.70 ^g	76.31 ^g
10-25% Min.N+50% Org.N+Bio.N	1.90 ^a	1.84 ^a	1.94 ^a	0.162 ^a	0.173 ^a	0.175 ^a	0.846 ^a	0.792 ^a	0.915 ^a	169.9 ^b	175.0 ^b	189.2 ^b	73.43 ^b	80.86 ^b	92.30 ^b	73.86 ^b	74.83 ^b	77.92 ^b
11- Control (Unfertilized palm)	1.47 ^k	1.33 ^k	1.50 ^k	0.140 ^k	0.144 ^k	0.141 ^k	0.533 ^k	0.483 ^k	0.570 ^k	149.3 ^k	160.2 ^k	167.1 ^k	67.26 ^k	74.23 ^j	84.61 ^k	62.58 ^k	64.53 ^k	65.86 ^k
New L.S.D. at 5%	0.02	0.01	0.01	0.001	0.002	0.002	0.021	0.025	0.023	1.4	1.2	1.1	0.19	0.18	2.2	0.13	0.15	0.16

The values followed by the same letter do not differ at 5% level of significance.

intermediate values of studied leaf mineral content with significant differences between each other in most cases. These results were true for the three experimental seasons.

The positive effect of organic fertilizer on leaf mineral content may be due to its high content of N,P,K beside other nutrients. In addition, the remarkable effect of these organic fertilizers is reducing pH which may be responsible for increasing availability of most nutrients (Asker *et al.*, 1994; Smith *et al.*, 1994; Nassar *et al.*, 1998 and Shaheen *et al.*, 2009).

With respect to biofertilizer (nitrobin), it could be used as source for fixing nitrogen in the soil, beside, its pronounced role in improvement of nutrients uptake and protection from root pathogens (Techan, 1988 and Gogoi *et al.*, 2004).

These results were in line with those found by Umesh *et al.* (1988); Soliman (2001); Magda (2002); Mansour *et al.* (2004); El-Shenawi & El-Sayed (2005); Diab (2006) and Al-Wasfy & El-Khawaga (2008) who indicated that leaf mineral contents was increased by organic and bio nitrogen fertilizers on different fruit trees.

It could be concluded that, fertilizing Zaghoul date palms grown in new reclaimed lands, with 25% mineral N (as ammonium sulphate 20.6% N) + 50% organic nitrogen (as farmyard) + biofertilizer N (nitrobin) gave the best results with regard to yield and fruit quality. In addition, such promising treatment minimizes the application of mineral fertilizers and shares in reducing environmental pollution.

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