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REACTING OF MULTIFARIOUS NITROGEN FERTILIZER RESOURCES ON THE YIELD TRAITS OF "ZAGHLOUL CV." DATE PALM AND THE CALCAREOUS SOIL FERTILITY

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ABSTRACT

This study was conducted during 2006 and 2007 seasons in Nubaria Horticulture Research Station, North Tahreer region, Beheira province, Egypt to assay the impact of some sources of nitrogen (N) fertilizers (experimental factor A), the field addition rates (experimental factor B) and the field application treatments (interaction among the experimental factor levels "ab") on the yield traits and fruit quality characteristics of "Zaghloul" date palm cultivar and the influence on some properties of calcareous soil and its fertility. Factor (A) types were (a1) mineral nitrogen (MN), (a2) animal manure (AM), (a3) poultry manure (PM), (a4) compost (C) and (a5) mixture of MN, AM, PM, and C in 1: 1:1:1 ratio. Factor (B) levels were 0.0, 500, 1000 and 2000 g N/ palm/ year for (b1), (b2), (b3) and (b4), respectively. The interaction among their levels was represented as field experimental treatments. Data were obtained and statistically analyzed in the end of the both seasons for yield & fruits characteristics and in the end second season for soil properties. The results cleared that the studied yield traits; most fruit physical & chemical characteristics except fruit diameter in two study seasons and soluble tannin percentage in the 1st season were statistically affected; likewise, most of soil properties except soil acidity (soil pH) were statistically affected by both experimental factors and the interaction among their levels.

The mineral fertilizer type (a1) level leads to the significant highest palm yield, bunch weight, fruit weight and longest fruit length. On the other side, organic fertilizer types (a2), (a3) and (a4) levels lead to the significant highest values of dry matter percentage , TSS percentage, total sugars percentage and total protein percentage; beside the significant lowest values of fruit juice acidity percentage were obtained in two study seasons. And the lowest significant value of soluble tannins percentage in the 2nd season.

Field addition rate 2000 g N/ palm/ year (b4) level leads to the significant highest palm yield, highest bunch weight, heaviest fruit weight, longest fruit length and the best values of both of dry matter percentage, TSS percentage, total sugars percentage, total protein percentage and fruit juice acidity percentage in both two seasons.

Field application treatment (a1b4) leads to the significant highest palm yield, highest bunch weight and heaviest fruit in two study seasons. On the other hand, the (a4 b4) field application treatment leads to the significant best values of dry matter percentage and fruit juice acidity percentage traits. Also, (a4 b4) treatment leads to significant best values of TSS percentage, total sugars percentage and total protein percentage traits in two seasons. Likewise, this treatment leads to significant best value of soluble tannins percentage (lowest value) in the 2nd season.

Concerning the soil properties, the organic fertilizer type (a4) level leads to the significant highest values of soil total nitrogen (T-N), available phosphorus (Av-P), organic matter (OM), soil cation exchangeable capacity (CEC) and soil bulk density

(Db). Field addition rate 1000 g N/ palm/ year (B3) level leads to the significant highest of T-N, Av-P, OM, CEC, & Db. Field application treatment (a4b3) leads to the significant highest & best value of T- N, Av- P, OM and Db. On the other hand, the (a5b2) leads to the significant best value of soil CEC in the end of second season.

INTRODUCTION

Dates have been used as a staple food for several thousands of years. Their high energy value and good store-ability make dates a wise choice of crop in places where they can be grown. Date palm "*Phoenix dactylifera*, L." starts to be the expend crop all over Egypt. Date palm is considered one of the suitable trees which can be cultivated in the new reclaimed desert regions, specially in a carbonate rich soil. Several investigators have been studied the fruit physical properties and chemical constituents of various date palm cultivars; and the factors that affected their composition (El-Hammady *et al.,* 1987; Verner 1997 and El-Kouny *et al.,* 2004).

MATERIALS AND METHODS

The present investigation was conducted during two experimental seasons (2006 and 2007) on "Zaghloul" date palm cultivar, more than 25 years old trees in Nubaria Horticulture Research Station under the calcareous soil conditions. Trees were submitted to a general fertilization treatment (50 kg animal manure + 2 kg ammonium sulphate + 1 kg mono calcium phosphate + 0.5 kg potassium sulphate + 0.5 kg sulphur in winter, and 2 kg ammonium sulphate + 0.5 kg potassium sulphate at two doses during the growth season) for one season before conducting the field experimental treatments. The leaf/ bunch ratio for trees was 10:1 rate. The soil samples (0 - 75 cm) were analyzed according to technique which described by Page *et al*. (1982), data of physical & chemical properties are present in Table (1-a&b).

Two experimental factors were studied. Nitrogen fertilizer types had used as the 1st experimental factor (A), its levels were: ammonium sulphate $(NH_4)_2SO_4$ (20.5 % N) as mineral source (a1 level), animal manure 0.55 % N (a2 level), poultry manure 2.75 % N (a3 level), biologically activated compost 3.01 % N (a4 level) and mixture of a1, a2, a3 and a4 in 1:1:1:1 rate (a5 level). Biologically activated compost was prepared in Soil Salinity and Alkalinity Research Lab., Bacos, Alexandria (El-Kouny *et al*., 2004). The various used types of organic manures were analyzed according to El-Kouny (1999) and Bertran Kehres and Andrease (1994), data are presented in Table (2). The 2nd experimental factor was the field addition rates of nitrogen amount (B). The field application levels were: 0.0 (control), 500, 1000 and 2000 g N/ palm/ year as b1, b2, b3 and b4, respectively.

The applying fertilization treatments were consisting of all possible combinations among levels of both experimental factors (interaction), as the following:-

Field treat. No. 1	$a\text{-}b_1$	(Control treatment)	in level 0.0 g N/ palm/ year
Field treat. No. 2	a_1b_2	Mineral nitrogen	in level 500 g N/ palm/ year
Field treat. No. 3	a_2b_2	Animal manure	in level 500 g N/ palm/ year
Field treat. No. 4	a_3b_2	Poultry manure	in level 500 g N/ palm/ year
Field treat. No. 5	a_4b_2	Compost	in level 500 g N/ palm/ year
Field treat. No. 6	a_5b_2	Mixture (1:1:1:1)	in level 500 g N/ palm/ year
Field treat. No.7	a_1b_3	Mineral nitrogen	in level 1000 g N/ palm/ year
Field treat. No. 8	a_2b_3	Animal manure	in level 1000 g N/ palm/ year
Field treat. No. 9	a_3b_3	Poultry manure	in level 1000 g N/ palm/ year
Field treat. No. 10	a_4b_3	Compost	in level 1000 g N/ palm/ year
Field treat. No. 11	a_5b_3	Mixture (1:1:1:1)	in level 1000 g N/ palm/ year
Field treat. No. 12	a_1b_4	Mineral nitrogen	in level 2000 g N/ palm/ year
Field treat. No. 13	a_2b_4	Animal manure	in level 2000 g N/ palm/ year
Field treat. No. 14	a_3b_4	Poultry manure	in level 2000 g N/ palm/ year
Field treat. No. 15	a_4b_4	Compost	in level 2000 g N/ palm/ year
Field treat. No. 16	a_5b_4	Mixture (1:1:1:1)	in level 2000 g N/ palm/ year

The organic fertilizers were added as one dose in winter but the mineral nitrogen was added in two doses (the 1^{st} dose was added in winter with organic fertilizer and the 2^{nd} dose was added in the end of May during the fruit growth period). Each palm was treated by 1000 g potassium sulphate in two doses (in the same times of mineral nitrogen); 1000 g rock phosphate and 500 g elemental sulpher were added with organic fertilizers. Amounts of the applied organic and mineral fertilizers were calculated according to the (N) percentage in each one of them.

Fruit samples were collected in the ripening stage (October, 5-10 period). Yield of studied palms was recorded in kg per palm and per each bunch in harvest time. Physical fruit characteristics such as fruit weight (g), fruit length and diameter (cm) were measured. Fruit quality characteristics were determined: total soluble solids (TSS %) in fruit juice was measured using hand refactometer, juice acidity (as malic acid) percentage was titrated (A.O.A.C. 1980), tannins percentage was evaluated by method of Swain and Hillis (1959), total sugars percentage was determined in dried fruit samples in 56 C^o in an oven until constant weight (Malik and Singh1980), total protein as a total nitrogen was determined (ppm) using Kjeldahl method according to Jackson (1967) and dry matter percentage was taken after drying sample in 65 C^o until constant weight.

Regarding soil chemical properties: pH (1: 2.5 soil: water) was measured using glass electrode pH meter, Electrical Conductivity (EC) was determined using the method described by Jackson (1967), Available potassium (Av-K) was determined by flame photometer and Cation

Exchangeable Capacity (CEC) was determined using NH_4 OAC method as Page *et al*. (1982). For macronutrient elements determination, samples had been digested with sulphoric acid and hydrogen peroxide then outlined by a Perkin Elmer_atomic absorption spectrophotometer (AAS). Concerning the mechanical analysis of soil which Bulk Density (Db); Soil Texture and Total Calcium Carbonate (%) were determined as method described by Piper (1950).

Table (1-a): Physical properties of the experimental orchard soil.

Particle Size Distribution (%)				Bulk density ($g\ cm^{-3}$)	Field capacity (%)	Total CaCO3 (%)	Texture class
Corse sand	Fine sand	Silt	Clay				
35.13	42.25	12.37	10.25	1.62	16.60	22.50	Sandy loam

Table (1-b): Chemical properties of the experimental orchard soil.

Parameter	pH (1:2.5)	EC($dS\ m^{-1}$)	Av-P (ppm)	Av- K(ppm)	T- N percentage	T- O.M (%)	Soluble anions (meq/L)			Soluble cations (meq/L)				Zn (ppm)	Fe (percentage)	Mn (ppm)	Cu (ppm)	CEC(meq/100 g)
							$SO4^{2-}$	Cl^-	HCO_3^-	K^+	Na^+	Mg^{2+}	Ca^{2+}					
Values	8.15	2.90	16.25	21.42	0.04	1.02	5.40	11.50	12.30	0.50	10.70	5.20	12.60	75.00	0.05	24.00	18.50	14.15

Table 2: Characteristics of adding organic manure types.

Parameter*	Values		
	Animal manure	Poultry manure	Compost
Moisture content (percentage)	27.75	14.50	15.50
Bulk density ($kg\ m^{-3}$)	390.00	610.00	630.00
EC ($dS\ m^{-1}$) (1:10)	3.20	4.85	5.15
pH (1:10)	7.20	7.95	6.25
T- N (percentage)	0.55	2.75	3.05
T-C (percentage)	19.25	30.75	44.70
T-OM (percentage)	33.19	53.01	77.00
C/N ratio	35.00	11.18	14.66
T-K (K_2O) (percentage)	0.35	2.01	2.75
T-P (percentage)	0.25	1.35	2.50
Fe (percentage)	0.03	0.11	0.18
Mn (ppm)	230.00	350.00	450.00
Zn (ppm)	280.00	490.00	420.00
Cu (ppm)	200.00	120.00	170.00
Na (percentage)	0.17	0.24	0.22
Cl (percentage)	0.16	0.25	0.24
Humic substances (percentage)	7.20	12.25	18.25

Parameter*
T-N = Total Nitrogen, T-C = Total Carbon, T-OM = Total Organic matter,
T- K = Total Potassium, T-P = Total Phosphorus, C/N = Carbon Nitrogen ratio.

All obtained data were tabulated and analyzed using Complete Randomized Design (CRD) with three replicates according to Steel and Torrie (1980). Statistical analysis was done for two seasons concerning the yield and fruit characteristics and in the end of study for the soil properties.

RESULTS AND DISCUSSION

1. Yield traits

1-1. Yield of palm (kg / palm)

Data tabulated in table (3) indicate that the yield of date palms had significantly affected by the fertilizer types (factor A). Where, the mineral fertilizer type (a1) level leads to the significant highest yield amount in two study seasons (118.3 and 117.9 kg / palm for the 1st and 2nd seasons, respectively) followed by the mixed fertilizer type (a5). While, the organic fertilizer types came later without statistical differences among their related yield values in two study seasons.

Table (3): Effect of nitrogen types (A) and field addition rates (B) factors on the yield traits.

Factor A*					Factor B**				
Levels	Yield of palm (kg/ palm)		Bunch weight (kg/ bunch)		Levels	Yield of palm (kg/ palm)		Bunch weight (kg/ bunch)	
	2006	2007	2006	2007		2006	2007	2006	2007
a1	118.3	117.9	12.4	12.5	b1	75.8	74.6	7.4	7.1
a2	100.4	101.9	10.4	10.8	b2	100.7	111.2	9.8	10.1
a3	101.7	102.5	10.6	10.5	b3	121.6	131.6	12.7	13.4
a4	101.5	100.2	10.2	10.6	b4	123.2	132.1	13.9	13.6
a5	103.8	103.6	11.5	11.8	-----	------	------	-----	----
LSD	1.4	1.6	0.8	0.7	LSD	1.7	1.8	1.3	1.2

A: Fertilization type factor.** * B: Field addition rate factor.**
a1: Mineral fertilization. **b1: 0.0 g (N).**
a2: Animal manure fertilization. **b2: 500 g (N).**
a3: Poultry manure fertilization. **b3: 1000 g (N).**
a4: Biologically activated compost fertilization. **b4: 2000 g (N).**
a5: Mixed (1:1:1:1) fertilization.

Also, yield had significantly affected by the field addition rates (factor B). Where, yield of (b4) level was significantly highest (123.2 and 132.1 kg/ palm for the 1st and 2nd study seasons, respectively) in comparison with (b1) and (b2) levels; and without statistical difference with yield of (b3) level, Table (3). It can say that, the field addition rates were the main factor which impact on the palm yield quantity. However, no statistical difference between related yield of (b3) and (b4) levels was found.

Regarding the effect of field application treatments, Table (5) indicate that field fertilization treatments have a significant effect on this trait. Highest yield value was obtained using the (a1b4) field application treatment in two study seasons (130.1 and 130.7 kg/ palm for the 1st and 2nd seasons, respectively). The second highest yield amount was obtained using the (a5 b4) treatment in two seasons (125.2 and 125.8 kg/ palm for the 1st and 2nd seasons, respectively). The previous yield results are in agreement with those of Aly (1993), El-Hammady *et al* (1993), and Mahmoud (2001).

1-2. Bunch weight (kg / bunch)

Bunch weight was significantly affected by types of fertilization (A factor), Table (3). Since the weight bunch response was significantly high with mineral fertilization type (a1 level) in comparison with all other types in both two study seasons (12.4 and 12.5 kg / bunch for 1st and 2nd seasons, respectively). Also, data of table (3) indicate that the mixed fertilization type (a5) was significantly superior in comparison with all organic types in regard bunch weight. However, no significant differences were found among the bunch weight related with organic fertilization types (a2, a3, and a4 levels). This result is considered to be for the yield palm's result and is on line with those of Mahmoud (2001) and Hoda Ali (2003).

Concerning the effect of field addition rates (B factor), data of table (3) show that the significant highest bunch weight was related with high levels of field addition rates (b4 and b3 levels) without statistical differences (13.9 and 12.7 kg/ bunch for 1st season and 13.6 and 13.4 kg/ bunch for 2nd season, respectively). On the other hand, the absolute lowest bunch weight was resulted with (b1) level (zero addition). Mahmoud (2001) and El-Assar (2005) were reported similar results.

Likewise, this criterion significantly affected by the field application treatments. Data of Table (5) indicate that the significant highest bunch weight was recorded with (a1b4) treatment in two study seasons (13.7 and 13.5 kg/ bunch for 1st and 2nd seasons, respectively). But, no statistical difference was appeared in comparison with (a5b4) field application treatment. However, data of Table (5) show that the combining of mineral fertilizer type with any of field addition rate levels was the reason for superiority of this field application treatment when compared it with any of other field application treatments in the same level of mineral fertilizer. Hussein & Hussein (1983), Aly (1993) and Mahmoud (2001) were found similar results for bunch weight trait.

2. Fruit physical characteristics

2-1. Fruit weight (g / fruit)

Data of Table (4) indicate that fruit weight had significantly affected by both experimental factors in two study seasons. Concerning the fertilizer types factor, absolute highest fruit weight values were related with mineral fertilizer type (a1) (25.1 and 25.5 g/ fruit for the 1st and 2nd seasons, respectively), Mixed fertilizer type (a5) comes significantly second for this trait (22.2 and 22.3 g/ fruit for the 1st and 2nd seasons, respectively). The lowest significant fruit weight values were related with the organic nitrogen resource types (a2), (a3) and (a4) levels without statistical differences among them.

Regarding the field addition rates factor, data of Table (4) indicate that significant weighty fruit was related with (b4) level (25.6 and 25.5 g/ fruit for the 1st and 2nd seasons, respectively). Absolute significant lowest fruit weight value was related with (b1) level (16.4 and 18.1 g/ fruit for the 1st and 2nd seasons, respectively). No statistical difference was observed between fruit weight values which related with 500 and 1000 g nitrogen/ palm rates in two study seasons (23.3 and 25.6 g/ fruit for the 1st as well as 22.9 and 25.5 g/ fruit for the 2nd seasons, respectively).

Table (4): Effect of nitrogen type and field addition rate factors (A) & (B) and their levels on fruit physical characteristics.

Factor A							Factor B						
levels	Fruit weight (g)		Fruit length (cm)		Fruit diameter(cm)		levels	Fruit weight (g)		Fruit length (cm)		Fruit diameter(cm)	
	2006	2007	2006	2007	2006	2007		2006	2007	2006	2007	2006	2007
A1	25.1	25.5	4.35	4.46	2.40	2.60	b1	16.4	18.1	2.90	3.05	1.95	1.89
a2	20.2	20.5	3.75	3.85	1.85	1.90	b2	22.7	22.5	3.55	3.65	2.23	2.25
a3	20.2	20.4	3.85	4.00	1.85	1.85	b3	23.3	22.9	4.65	4.80	2.45	2.50
a4	20.1	20.4	3.65	3.85	1.90	1.85	b4	25.6	25.5	4.95	5.25	2.80	2.85
a5	22.2	22.3	4.45	4.50	2.75	2.55	------	------	------	------	------	------	------
LSD	1.10	1.2	0.44	0.46	0.16	0.23	LSD	1.30	1.55	0.59	0.53	NS	NS

Field application treatments were significantly affected the fruit weight trait in two study seasons (Table 5). Absolute significant weighty fruits were related with (a1b4) and (a5b4) field application treatments without statistical difference in two study seasons (23.3 and 22.7 g/ fruit for 1st season as well as 23.7 and 23.1 g/ fruit for 2nd season, respectively). Evermore, the lowest fruit weight value was accompanier with the control field application treatment (10.8 and 10.4 g/ fruit for 1st and 2nd seasons, respectively). Data tabulated in Table (5) indicate that (a1 b2) treatment was significantly superior (a2b2), (a3b2) and (a4b2) treatments, but no statistical difference was observed when compared with (a5b2) treatment. Also, (a1b3) treatment was significantly superior (a2b3), (a3b3) and (a4b3) treatments, but no statistical difference was observed when compared with (a5b3) treatment. Likewise, (a1b4) treatment was significantly superior (a2b4), (a3b4) and (a4b4) treatments, but no statistical difference was observed when compared with (a5b4) treatment. Fruit weight results are logically and on line with those of Mahmoud (2001) and Hoda Ali (2003).

Table (5): Effect of field application treatments on yield traits and fruit physical characteristics.

Field applying treatment	Yield traits				Fruit physical characteristics					
	Kg/ palm		Kg/ bunch		Fruit weight (g)		Fruit length (cm)		Fruit diameter(cm)	
	2006	**2007**	**2006**	**2007**	**2006**	**2007**	**2006**	**2007**	**2006**	**2007**
Control	53.8	54.0	5.6	5.7	10.8	10.4	3.50	3.43	1.75	1.75
a1 b2	110.6	109.9	10.9	10.8	17.1	17.8	4.52	4.54	1.79	1.78
a2 b2	101.1	102.0	9.7	9.9	14.8	15.2	3.98	3.97	1.76	1.75
a3 b2	102.6	102.9	9.8	10.1	14.6	15.1	3.85	3.83	1.88	1.85
a4 b2	103.5	102.7	9.8	10.3	14.1	14.9	3.82	3.87	1.79	1.82
a5 b2	109.7	112.7	11.1	11.2	16.9	17.2	4.18	4.30	1.80	1.82
a1 b3	120.3	120.2	11.9	12.1	19.8	19.7	4.95	4.90	2.50	2.65
a2 b3	108.8	110.3	10.6	10.8	16.4	17.5	4.36	4.32	2.40	2.45
a3 b3	109.3	107.8	10.8	11.1	16.7	17.1	4.28	4.31	2.40	2.45
a4 b3	106.9	108.1	10.5	10.6	16.2	17.6	4.24	4.38	2.50	2.55
a5 b3	120.9	122.8	12.4	12.6	19.4	19.2	4.65	4.68	3.25	3.30
a1 b4	130.1	130.7	13.7	13.5	23.3	23.7	5.30	5.35	3.30	3.30
a2 b4	111.8	113.5	11.3	11.5	18.9	18.1	5.10	5.05	3.30	3.25
a3 b4	110.9	112.8	11.7	11.6	18.2	18.4	5.05	5.00	3.28	3.20
a4 b4	109.3	110.6	11.2	11.2	18.5	19.1	4.98	4.95	3.20	3.23
a5 b4	125.2	125.8	12.8	12.9	22.7	23.1	5.35	5.35	3.10	3.20
L.S.D	4.7	4.8	1.1	1.3	0.85	0.75	0.40	0.45	NS	NS

2-2. Fruit length (cm)

In both seasons of study, results indicate that differences in fruit length trait were statistically affected by both studied factors and interaction among their levels. The significant longest fruits were correlated with mineral and mixed fertilizers in comparison with those of organic fertilizers, without statistical difference (4.35 and 4.45 cm for 1st season as well as 4.46 and 4.50 cm for 2nd season, respectively), Table (4). No statistical differences were observed among fruit length values which related with organic fertilizers. These results are parallel with the previous palm's yield and bunch weight results. Data tabulated in Table (4) show that values of fruit length which related 2000 and 1000 g N/ palm field addition rates (b4 and b3 levels) were significantly superior to those related 500 and 0.0 g N/ palm field addition rates (b2 and b1 levels) in two study seasons, without statistical difference. But, fruits of (b2) level were significantly longest in comparison with those of (b1) level.

Regarding the impact of field application treatments on fruit length criterion, data of Table (5) indicate that (a5b4) treatment results the longest fruits in two seasons (5.35 cm for both seasons), without statistical differences in comparison with (a1b4), (a2b4), (a3b4) and (a4b4) treatments in two seasons. It means that the high amount of nitrogen fertilizer was the main reason for this superiority, regardless the type of fertilizer. However, (a1b3) treatment comes next (4.95 and 4.90 cm for the 1st and 2nd seasons, respectively). The differences were statistical in comparison with values of all other treatments. Mahmoud (2001) and Hoda Ali (2003) were reported similar results for this criterion.

2-3. Fruit diameter (cm)

There was no significant effect for studied factors and the interactions among their levels on fruit diameter trait in two study seasons. Differences appeared among values of this trait were not statistical, Table (5).

It can decided that, the variances among the yield traits (yield of palm & bunch weight) and fruit weight values were due to the variance among values of fruit length trait not fruit diameter trait, which was neither statistically affected by these factors levels nor field treatments.

3. Fruit chemical criterions.

3-1. Dry matter (%)

Dry matter percentage criterion had significantly affected by two studied factors and the interaction among their levels. Concerning the (A) factor, data of Table (6-a) point that the significant highest values dry matter percentage were obtained with (a2), (a3) and (a4) levels in two study seasons (organic fertilizer types), without statistical differences (24.6, 24.7 and 25.1 % for 1st season as well as 24.6, 24.6 and 25.4 % for 2nd season, respectively). However, the mixed fertilizer type (a5) comes significant secondly and has a statistical difference in comparison with mineral fertilizer type (a1) in two study seasons (Mahmoud, 2001).

Regarding the field addition rates factor, data of Table (6-b) indicate that no statistical differences were found among dry matter percentages related with all of (b2), (b3) and (b4) levels.

Table (6-a): Effect of types of fertilizers factor (A) on fruit chemical characteristics

levels	Factor A											
	Dry matter (%)		TSS (%)		Fruit juice acidity (%)		Total sugars (%)		Total protein (%)		Soluble tannins (%)	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
a1	21.8	22.1	20.8	20.3	1.63	1.65	77.5	76.9	0.98	0.96	0.28	0.24
a2	24.6	24.6	22.6	22.9	1.39	1.34	78.9	79.2	1.45	1.48	0.20	0.19
a3	24.7	24.6	23.2	23.2	1.36	1.35	79.0	78.9	1.42	1.43	0.20	0.18
a4	25.1	25.4	23.2	23.5	1.32	1.29	78.8	79.3	1.45	1.45	0.19	0.18
a5	23.4	23.7	22.9	22.7	1.48	1.45	78.2	78.3	1.34	1.33	0.24	0.20
LSD	0.53	0.85	0.65	0.85	0.08	0.10	0.85	0.87	0.07	0.06	N.S	0.02

Table (6-b): Effect of field addition rates factor (B) on fruit chemical characteristics

levels	Factor B											
	Dry matter (%)		TSS (%)		Fruit juice acidity (%)		Total sugars (%)		Total protein (%)		Soluble tannins (%)	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
B1	21.3	21.2	17.5	17.1	1.65	1.68	76.7	76.3	0.95	0.93	0.25	0.24
B2	24.4	24.5	21.8	22.3	1.53	1.53	77.3	77.5	1.35	1.33	0.24	0.20
B3	25.2	25.6	23.9	24.2	1.42	1.43	78.0	78.3	1.48	1.48	0.20	0.17
b4	25.7	26.1	24.5	24.6	1.38	1.39	78.8	78.8	1.50	1.52	0.19	0.16
LSD	0.65	0.49	0.70	0.65	0.09	0.10	0.65	0.70	0.08	0.07	N.S	0.02

However, the significant lowest dry matter percentage value was related with (b1) level in both studying seasons.

Likewise, the significant highest value of dry matter percentages were occurred with (a4b4) field application treatment in two study seasons (27.3 and 27.6 % for 1st and 2nd seasons, respectively), Table (7). But no statistical difference was found in comparison with (a3b4) treatment in two seasons (27.1 and 27.4 % for 1st and 2nd seasons, respectively). This result was compatible with factors effect's results. Contrariwise, the absolute lowest dry matter percentage value was obtained with control treatment without statistical difference with (a1b2) treatment in two seasons (20.8 and 21.4 % for 1st season as well as 20.9 and 21.2 % for 2nd season, respectively). More statistical differences were found among values of this criterion in Table (7). Results of this trait are on line with those obtained by Salem and Musa (1989) and El-Kouny *et al.* (2004).

3-2. Total soluble solids (TSS %)

Both studied factors (N fertilizater types and field addition rates) have significantly affected the TSS percentage criterion in two study seasons. Data of table (6-a) indicate that fertilizer types were significantly affected TSS percentage criterion. Where, the absolute lowest value was related with mineral fertilizer type (a1 level) in two seasons. While the other fertilizer types (organic types) were lead to significant high TSS percentage values without statistical differences in two seasons. Kassem *et al*. (1997) decided that mineral nitrogen fertilization tended to decrease the fruit TSS percentage criterion.

Also, data of Table (6-b) clear that significant highest TSS percentage value was related with (b4) level without statistical difference in comparison with TSS percentage value of (b3) level in two study seasons (26.1 and 25.6 % for 1st season as well as 26.6 and 26.4 % for 2nd season, respectively). Likewise, (b2) level leads to a good TSS percentage value 21.8 and 22.3 % for 1st and 2nd seasons, respectively, with statistical difference in comparison with (b1) level which leads to absolute lowest value in two study seasons (17.5 and 17.1 % for 1st and 2nd seasons, respectively). It must consider, the effect of nitrogen regardless its source.

Results indicate that the field application treatments have a significant effect on this criterion in two study seasons. High TSS percentage value was produced with (a4b4) field application treatment (26.2 and 26.3 % for 1st and 2nd seasons, respectively). Without statistical differences in comparison with all values related with (a4b3), (a3b4), (a2b4) and (a3b3) treatments, consecutively in the 1st season. As well as without statistical differences in comparison with all values related with (a4b3), (a2b4), (a3b4) and (a3b3) treatments, consecutively in 2nd season. Control treatment leads to absolute lowest TSS percentage value (15.4 and 15.1 % for 1st and 2nd seasons, respectively) in comparison with all field application treatments, Table (7). Previous results are going together, and they are in harmony with those of Hussein *et al*. (1992), Mahmoud (2001) and Hoda Ali (2003).

3-3. Acidity of fruit juice (%)

Results indicate that fruit juice acidity percentage values were significantly impacted by levels of both experimental factors in two study seasons (Tables 6– a & b). The significant lowest values of this trait were related with organic fertilizer types (a2), (a3) and (a4) levels in two seasons without statistical differences (1.39, 1.36 and 1.32 % for 1st season as well as 1.34, 1.35 and 1.29 % for 2nd season, respectively). While, the absolute highest value of fruit juice acidity percentage was achieved with mineral type (a1) in two seasons (1.63 and 1.65 % for 1st and 2nd seasons, respectively). The mixed fertilizer type (a5) leads to a medial value of this trait in two seasons (Table 6-a). Bacha and Abo-Hassan (1983) reported opposite results, they reported that palms receiving mineral nitrogen were not inferior to those receiving organic manure only.

Data of Table (6-b) shows that the significant lowest juice acidity percentage values were related with (b4), and (b3) levels without statistical difference in two study seasons (1.38 and 1.42 % for 1st season as well as 1.39 and 1.43 % for 2nd season, respectively). While, the significant highest values were produced by (b1) and (b2) levels with statistical difference (1.65 and 1.53 % for the 1st season as well as 1.68 and 1.53 for 2nd season, respectively). Kassem *et al*. (1997), El-Kouny *et al*. (2004), and El-Assar (2005) reported similar results.

Concerning the field application treatments, data of Table (7) indicate that significant best value of fruit juice acidity percentage (lowest value) was related with (a4b4) treatment (1.08 and 10.5 % for the 1st and 2nd season, respectively) without statistical difference in comparison with value of (a3b4) treatment, followed by (a2b4) treatment with a statistical difference in two seasons (1.10 and 1.15 % for 1st season as well as 1.09 and 1.13 % for 2nd season, respectively). More statistical relations were found in Table (7). Gobara *et al*. (2001) and El-Assar (2005) were found similar results when they studied fruit quality traits.

3-4. Total sugars (%)

Data of Tables (6- a & b) indicate significant effects for both experimental factors on the total sugars percentage in dates flesh. The lowest significant value was related with mineral fertilizer type (a1) in two study seasons (77.5 and 76.9 % for the 1st and 2nd seasons, respectively). On the other side, no statistical differences were found among total sugars percentage values which resulted from all other fertilizer types in two seasons (Table 6-a).

Also, data show that significant lowest total sugar percentage value was observed with (b1) level without statistical difference in comparison with value of (b2) level in two study seasons (76.7 and 77.3 % for the 1st season as well as 76.3 and 77.5 % for the 2nd season, respectively). While, the significant highest total sugar percentage values were related with high addition rates (b4) and (b3) levels without statistical difference in two study seasons (78.0 and 78.8 % for the 1st season as well as 78.3 and 78.8 % for the 2nd season, respectively), Table (6 - b).

Recorded data in Table (7) show a significant effect of field application treatments on the value of this trait in two seasons of study. The highest values of total sugar percentage were related with (a4b4), (a3b4), and (a2b4) treatments in two seasons (80.4, 80.1 and 80.1 %, respectively for 1st season and 80.4, 80.4 and 80.3 %, respectively for 2nd season) without statistical differences in either seasons. The control treatment had the absolute lowest value of total sugar percentage in two seasons. Much statistical relationships were found in Table (7). Results of Hoda Ali (2003) El-Kouny *et al*. (2004) and El-Assar (2005) were supported the previous obtained results.

3-5. Total protein (%)

Data of Table (6 - a) show a significant impact for fertilizer type factor on total protein percentage values in two study seasons. Significant highest values of total protein percentage were related with the organic fertilizer types (a2), (a3) and (a4) levels without statistical differences in two study seasons (1.45, 1.42 and 1.45 % for 1st season, as well as 1.48, 1.43 and 1.45 % for the 2nd season, respectively). The absolute lowest value of total protein percentage was related with the mineral fertilizer type (a1) level in two study seasons. While the mixed fertilizer type (a5) level leads to a significant medium value of total protein percentage in two seasons (1.34 and 1.33 % for the 1st and 2nd seasons, respectively). The obtained results agree with those of El-Kouny *et al*. (2004) and El-Assar (2005).

Regarding the addition rates factor, data of Table (6 - b) indicates that highest value of total protein percentage was attendant the (b4) level in two study seasons without statistical difference in comparison with value of (b3) level (1.50 and 1.48 % for the 1st season as well as 1.52 and 1.48 % for the 2nd season, respectively). While the absolute lowest value of total protein percentage was related with (b1) level in two study seasons (0.95 and 0.93 % for the 1st and 2nd seasons, respectively).

Concerning the effect of field application treatments, data of Table (7) shows that the value of total protein percentage which related with the (a4b4) treatment was significantly superior all other values except those values which related with the (a3b4) and (a2b4) treatments in two experimental seasons (1.65, 1.59 and 1.60 % for the 1st season as well as 1.68, 1.62 and 1.60 % for the 2nd season, respectively). The obtained results are facing those of Shawky *et al*. (1999); they decided that fruit quality of Sewy dates not significantly affected by different rates of N fertilization. But, Mahmoud (2001), Hoda Ali (2003) and El-Assar (2005) found similar results.

3-6. Soluble tannins (%)

Data of Tables (6 – a & b) and (7) indicate that neither the experimental factors nor the interaction among their levels have significant effect on soluble tannin percentage trait in the 1st study season. It means that the differences among tabulated soluble tannin percentage values were not statistically. In the 2nd season, differences among soluble tannin percentage values were statistical. Concerning the effect of (A) factor, the best values (low values) were related with (a4), (a3) and (a2) levels (0.18, 0.18 and 0.19 %, respectively) without statistical differences. The significant medium value was related with (a5) level and the significant bad value (highest value) was related with (a1) level. It means that the organic and mixed fertilizers types caused a decrease in soluble tannin percentage values in comparison with mineral fertilizer type, Table (6- a). Mahmoud (2001), Hoda Ali (2003) El-Kouny *et al*. (2004) and El-Assar (2005), reported homological results.

Regarding the effect of (B) factor, data of Table (6-b) indicate that best soluble tannin percentage values (low values) were related with (b4) and (b3) levels without statistical difference (0.16 and 0.17 %, respectively). However, the highest value (bad value) was related with (b1) level followed by (b2) level (0.20 and 0.24 %, respectively) with a statistical difference. It must ignore the nitrogen type.

Concerning the field application treatments effect, data of Table (7) show that absolute lowest values of soluble tannins percentage (best values) were related with the (a4b4) treatment (0.10 %) followed by (a3b4) and (a2b4) treatments (0.11 % for both). The absolute highest value of soluble tannins percentage (bad value) was related with control treatment (0.29 %) followed by this of (a1b2) treatment (0.28 %). Much statistical differences were found in Table (7). Mahmoud (2001) support these results.

Table (7): Effect of field application treatments on fruit chemical characteristics

Fertilization Treatments	Fruit chemical characteristics											
	Dry matter (%)		TSS (%)		Fruit juice acidity (%)		Total sugars (%)		Total protein (%)		Soluble tannins (%)	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Control	20.8	20.9	15.4	15.1	1.68	1.65	73.8	73.5	0.95	0.99	0.30	0.29
a1 b2	21.4	21.2	18.7	18.8	1.65	1.66	74.8	75.0	1.05	1.08	0.29	0.28
a2 b2	22.8	22.7	22.3	22.3	1.40	1.40	76.5	76.8	1.33	1.32	0.24	0.21
a3 b2	22.7	23.1	22.4	23.0	1.40	1.38	76.7	77.0	1.35	1.28	0.24	0.20
a4 b2	23.2	23.9	23.2	23.8	1.38	1.35	78.1	78.4	1.38	1.36	0.21	0.20
a5 b2	23.7	23.1	20.8	21.0	1.53	1.55	75.8	75.8	1.18	1.20	0.28	0.22
a1 b3	21.8	21.4	20.7	20.6	1.63	1.60	75.1	75.1	1.10	1.12	0.28	0.27
a2 b3	25.4	25.3	23.4	23.7	1.35	1.33	78.3	78.2	1.40	1.45	0.16	0.12
a3 b3	25.3	25.7	24.5	24.7	1.25	1.25	78.9	78.7	1.43	1.46	0.16	0.13
a4 b3	26.1	25.9	25.4	26.0	1.15	1.15	78.8	79.0	1.45	1.45	0.11	0.12
a5 b3	24.3	24.2	23.4	23.6	1.40	1.42	76.8	77.0	1.39	1.40	0.20	0.16
a1 b4	22.0	21.9	22.8	23.4	1.55	1.55	76.6	76.8	1.18	1.16	0.21	0.20
a2 b4	25.4	25.5	25.1	25.3	1.15	1.13	80.1	80.3	1.60	1.60	0.08	0.11
a3 b4	27.1	27.4	25.1	25.2	1.10	1.09	80.1	80.4	1.59	1.62	0.08	0.11
a4 b4	27.3	27.6	26.2	26.3	1.08	1.05	80.4	80.4	1.65	1.68	0.07	0.10
a5 b4	24.2	24.4	23.9	23.2	1.26	1.29	78.2	78.2	1.45	1.48	0.18	0.16
L.S.D	0.40	0.35	1.75	1.65	0.05	0.06	0.65	0.55	0.07	0.09	N.S	0.01

4. Soil characteristics

4-1. Organic matter (%)

Soil organic matter percentage characteristic was significantly affected by N fertilizer types and field addition rates factors, Table (8). The highest value (1.775 %) was resulted with the biologically activated compost type (a4) level, followed by those of mixed fertilizer type (a5) level and poultry manure type (a3) level. It means, the most efficient types of fertilizers for increasing the organic matter under calcareous soil conditions were the organic fertilizers, while the mineral fertilizer type was the least efficient for this characteristic (0.870 %). Concerning the effect of addition rates factor, the significant highest O.M value (1.678 %) was obtained with (b3) level. Results recorded in Table (9) show that the best significant field application treatment was (a3b3), which leads to (2.30 %) O.M value. However, some other field application treatments were significantly superior the control treatment, Table (9). These results are in harmony with those obtained by Khalil *et al*. (2000) and El-Kouny *et al*. (2004).

4-2. Soil pH

Results tabulated in Tables (8 and 9) indicated that soil pH characteristic was not significantly affected by either experimental factors (A & B) or field application treatments. It may be due to high buffering capacity of calcareous soil which resists changes of soil reaction, Tester (1990).

4-3. Soil CEC

Data of Table (8) show that, values of soil CEC were significantly affected by all levels of two studied factors (A & B) and the field application treatments. Highest significant value of soil CEC (20.95 C mol/ kg) was resulted with (a4) level, without statistical difference in comparison with value of (a5) level (20.75 C mol/ kg). Likewise, the best significant value (20.07 C mol/ kg) was related with (b4). Data of Table (9) depict that, soil CEC values significantly affected by field application treatments. The significant high values (25.48, 25.20, 25.15 and 25.10 C mol/ kg) were related with (a4b2), (a4b3), (a5b2) and (a5b3) treatments, respectively. The increasing in soil CEC value with compost type fertilizer may be attributing to its high content of organic matter and organic nutrients. These results are in agreement with those of Gobara *et al*. (2001) and El-Kouny *et al*. (2004).

4-4. Bulk Density (Db)

Soil bulk density (Db) values have significantly affected by field addition rates factor (B) and the field application treatments. Data of Table (8) indicate that there were no statistical differences among (Db) values resulted by (a1), (a2), (a3), (a4) and (a5) levels. However, data show that significant highest value of soil bulk density (1.70 g cm^3) was related with (b1) level. No statistical differences were found among soil bulk density values related with all other addition rate levels, Table (8). The decrease in soil bulk density values which resulted from the increase of aggregate sizes and the stability which due to the increasing in organic matter and soil conditioners. The binding of aggregates may build new bigger size aggregates which have lower values of soil bulk density. Data of Table (9) show that, the significant highest soil bulk density values were related with both (control) and (a1b2) treatments without statistical difference (1.52 and 1.51 g/cm^3, respectively). While the significant lowest (the best) values were related with (a4b4), (a5b4) and (a4b3) treatments (1.30, 1.31 and 1.31 g/ cm^3, respectively) without statistical differences, Tester (1990) and El Kouny *et al*. (2004) have similar results.

4-4. Available phosphorus (Av-P)

Data in Table (8) show that, values of (Av-P) significantly affected by both of experimental factors (A & B) and the interaction among their levels. The highest value (23.43 ppm) was recorded with (a4) level without statistical differences in comparison with values related with (a5), (a3) and (a2) levels (23.15, 22.75 and 22.16 ppm, respectively). Also, data show that the absolute best value was related with (b4) level (24.71 ppm), flowed by this of (b3) level (21.01 ppm). While (b1) and (b2) levels lead to significant lowest Av-P value (15.38 ppm). Data given in Table (9) show that, the significant high values of Av-P content (27.88, 27.20, 27.10 and 27.10 ppm) were related with (a4b3), (a4b4), (a5b3) and (a5b4) field application treatments, respectively. However, these values were not statistically differing. The high increase in Av-P contents in samples of treated organic manure and compost soil in comparison with control treatment may be attribute to the decomposition of used organic materials and producing the organic acids, which decreasing the phosphorus fixation in soil and increased the Av-P, consequently. Similar results were obtained by El-Dawwy and Morsy (2000) and El-Kouny *et al*. (2004)

4-6. Total (N) percentage (T–N %)

Data in Table (8) show that, (T-N) percentage values were significantly affected by both of fertilizer types factor (A) and field addition rates factor (B) as well as the field application treatments. The absolute highest value (0.196 %) was related with (a4) level followed by values correlated with (a5), (a3), (a2) and (a1) levels (0.171, 0.148, 0.114 and 0.051 %, respectively). All differences among the related values were statistical. It may be a result of organic fertilizer decomposition and its analysis into simple N form. Concerning the factor (B), data of Table (8) indicate that (b4) level leads to significant highest value of T-N percentage (0.191 %). Data of Table (9) show that, the significant highest values of T-N percentages were related with (a5b4), (a4b4) and (a4b3) treatments (0.285, 0.285 and 0.280 %, respectively) without statistical differences. On the other hand, the significant lowest values of T-N percentage were recorded with (control) and (a1b2) treatments without statistical difference (0.030 and 0.035 %, respectively). These results indicate the importance of climatic conditions and the compost quality on dynamic of N element in soil and plant availability, Tester and El-Nashar (1990) and Verner (1997). The results of the present study clearly indicate that, composting management and material sources could be important factors for improving of compost fertilizer value (Gagnon *et al*. 1997).

Table (8): Effect of N fertilizer types and field addition rates factors on soil characteristics.

Factors	Levels	T-N (%)	Av-P (ppm)	O.M (%)	Soil pH (1:2.5)	CEC (C mol/ kg)	Bulk Density (g/cm3)	T-$CaCO_3$ (%)
Factor A	a1	0.051	15.98	0.870	7.72	12.52	1.63	25.08
	a2	0.114	22.16	1.180	7.77	15.96	1.40	23.93
	a3	0.148	22.75	1.170	7.69	16.40	1.38	24.40
	a4	0.196	23.43	1.775	7.48	20.95	1.36	22.85
	a5	0.171	23.15	1.640	7.66	20.75	1.37	23.43
LSD (0.05)		0.023	2.14	0.071	N.S.	1.21	N.S	N.S
Factor B	b1	0.003	15.38	0.700	8.33	12.88	1.70	24.25
	b2	0.136	15.38	1.371	7.63	16.59	1.40	28.30
	b3	0.187	21.01	1.610	7.49	19.72	1.30	23.76
	b4	0.191	24.71	1.678	7.45	20.07	1.35	21.65
LSD (0.05)		0.020	1.85	0.063	N.S	1.05	0.30	N.S

4-7. Total calcium carbonate (T-Ca CO_3)

Results indicated that, no significant effect was appeared for either studied factors or field interaction treatments on this criterion. It means that all differences among the obtained values were not statistical, Tables (8 & 9).

Finally, the results of this study give the basic for recommend by applying the previous field treatments under the same conditions to raise the efficiency of date palm crop "Zaghloul Cv." and to improve the calcareous soil fertility.

Table (9): Effect of field application treatments on soil characteristics.

Fertilization Treatments	T-N (%)	Av-P (ppm)	OM (%)	CEC (C mol/ kg)	pH (1:2.5)	Bulk density (g/cm^3)	T-$CaCO_3$ (%)
Control	0.030	15.38	0.700	12.88	8.33	1.52	24.25
a1b2	0.035	14.70	0.825	12.13	8.02	1.51	25.75
a2b2	0.110	22.00	1.200	14.98	7.62	1.40	24.10
a3b2	0.155	22.10	1.220	15.76	7.72	1.38	23.90
a4b2	0.190	23.25	1.800	20.25	7.29	1.33	21.75
a5b2	0.190	23.00	1.710	19.85	7.42	1.42	23.30
a1b3	0.075	17.10	0.900	12.65	7.76	1.36	23.15
a2b3	0.165	25.50	1.300	17.23	7.45	1.35	21.80
a3b3	0.200	26.75	1.200	18.10	7.43	1.36	22.95
a4b3	0.280	27.88	2.200	25.48	7.22	1.31	21.00
a5b3	0.215	27.10	1.900	25.15	7.62	1.38	21.40
a1b4	0.065	16.75	0.920	12.45	7.73	1.37	23.15
a2b4	0.150	25.75	1.440	18.75	7.48	1.35	21.55
a3b4	0.205	26.75	1.420	18.85	7.42	1.35	22.95
a4b4	0.285	27.20	2.300	25.20	7.16	1.30	20.35
a5b4	0.285	27.10	2.100	25.10	7.23	1.31	20.75
LSD (0.05)	0.012	1.07	0.033	00.60	N.S	0.02	N.S

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تاثير المخصبات النيتروجينية من مصادر متنوعة علي صفات وجودة المحصول لنخيل البلح "صنف الزغلول" وخصوبة الأراضي الجيرية

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أجريت هذه الدراسة خلال الموسمين ٢٠٠٦ و٢٠٠٧ في محطة بحوث البساتين بالنوبارية بمنطقة شمال التحرير, محافظة البحيرة, مصر. لإختبار تأثر محصول نخيل البلح صنف الزغلول لأشجار بعمر أكثر من ٢٥ عاماً بعامل نوع المخصب النيتروجيني(A) وعامل معدلات الإضافة (B) والتفاعل بين مستوياتهما (ab). وكذلك تأثير هذين العاملين والتفاعل بين مستوياتهما على بعض صفات التربة وخصوبتها. مستويات عامل نوع المخصب النيتروجيني (A) كانت (a١) نتروجين معدنى،(a2) سماد حيوانى، (a3) سماد دواجن، (a4) كمبوست، (a5) سماد مختلط من النتروجين المعدنى والسماد الحيوانى وسماد الدواجن والكمبوست بنسبة١:١:١:١. مستويات عامل معدلات الإضافة(B) كانت صفر، ٥٠٠، ١٠٠٠، ٢٠٠٠جم نتروجين/ نخلة/ سنة والتى تمثل المستويات(b1, b2, b3, b4 علي التوالي). وتم تحليل النتائج المتحصل عليها إحصائيا فى نهاية كل موسم على حدة بالنسبة لخصائص محصول نخيل البلح وخصائص الثمار وفى نهاية الموسم الثانى فقط بالنسبة لخواص التربة. أوضحت النتائج أن خصائص المحصول وجودة الثمار تأثرت معنوياً بواسطة العاملين التجريبيين(A) و(B) وكذلك التفاعل بين مستوياتهما ما عدا صفة قطر الثمرة فى كلا الموسمين وقيمة النسبة المئوية للتانينات القابلة للذوبانِ فى الموسم الأول فقط.

نوع المخصبِ المعدنيِ (المستوى١a) أدّى إلى أعلي كمية لمحصولِ النخلة وأثقل وزن للسباطة وأثقل وزن للثمرة وأكبر طول للثمرة معنوياً, بجانب القيم العالية للنسبة المئوية لصفة لحموضة عصير الثمار والتانينات القابلة للذوبان. ولكن القِيَم الأعلى معنوياً للنسبة المئوية لكل من المادة الجافة والمواد الصلبة الذائبة والسكريات الكلية والبروتين الكلي بجانب القيم المنخفضة للنسبة المئوية للتانينات القابلة للذوبان تعلقت بأنواع المخصبات العضوية (المستويات a2, a3, a4).

معدل الإضافة ٢٠٠٠جم نيتروجين/ نخلة/ سنة (المستوى٤b) أدى إلي أعلي كمية لمحصول النخلة وأثقل وزن للسباطة وأثقل وزنِ للثمرة وأكبر طول للثمرة وأفضل القيم معنويا للنسبة المئوية لكل من للمادة الجافة و(TSS) و للسكريات الكلية والبروتين الكليِ وحموضة عصير الثمار والتانينِات القابلة للذوبانِ.

معالجة التطبيقِ الحقلِي (a1 b4) أدت إلـي أكبر كميـة من محصـول النخلـة وأفضـل وزن للسباطةِ بجانب وزن الثمرة الأثقل معنوياً في كلا فصلي الدراسة. أكبر طـول للثمـار معنويـاً وجد مـع معالجة التطبيق الحقلـي (a5b4) فـي كـلا الفصـلين. فـي حين أن معالجـة التطبيقِ الحقلِـي (a4 b4) أدت إلي أعلى قِيمة للنسبة المئوية للمادة الجافة وأفضل نسبة مئويـة لحموضـة عصـير الثمـار (القيمـة الأقل), كمـا أدت إلـي أعلـي قيمـة معنويـاً للنسبة المئويـة (TSS). وكـذلك أدت إلـي أعلـي قيمـة نسبة مئوية لكل من السكريات الكلية والبروتينِ الكلى في كلا فصلي الدراسةِ. أيضاً هذه المعاملـة أدت إلـي أفضل قيمة نسبة مئوية للتانينات القابلة للذَوبانِ معنوياً (القِيَمِة الاقل) فى نهاية الموسم الثاني.
كما أوضـحت النتـائج أن نـوع السماد العضـوي (المستوي a4) أدّي إلـي أعلـي قيمـة معنويـاً لكـل من النيتروجين الكلي والفوسفور الصـالح والمـادة العضـوية والسعة التبادليـة الكتيونيـة والكثافـة الظاهريـة للتربـة تحت الدراسة.

معدل الإضـافة ١٠٠٠جم نيتروجين/ نخلة/ سنة (المستوى b3) أدّي إلي أعلـي قيمـة معنويـاً لكل مـن النيتـروجين الكلـي والفوسـفور الصـالح والمـادة العضـوية والسـعة التبادليـة الكتيونيـة والكثافـة الظاهريـة للتربـة تحت الدراسة.

معالجــة التطبيــقِ الحقلِــي (a4b3) أدت إلــي أفضــل القـيم لكــل مــن النيتــروجين الكلــي والفوسفور الصـالح والمادة العضوية والكثافة الظاهرية للتربة. من ناحية أخرى أدت معالجـة التطبيـق الحقلي (a5b2) إلى أعلى قيمة معنوية للسعة التبادلية الكتيونية للتربة(a5 b3) في نهاية الدراسة.

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