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Effect of different nitrogen fertilizer sources on growth and fruiting of Barhee date palms under sandy soil conditions

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Abstract

This study was carried out during 2021 and 2022 seasons at private orchard of Barhee date palms, west Samalout, Minia Governorate, Egypt. Mineral, organic and bio-fertilizers were applied at various proportions of recommended-N doses, 1000g/palm/year. Results indicated that supplying Barhee date palms is advisable to supply the palm with suitable-N via 40% mineral, 40% organic and 20% biofertilizer that very effective in improving all growth characters, yield/ palm and dates quality compared with using mineral-N completely or 70% mineral plus 30% organic and biofertilization. A gradual increase nutritional status palm and dates quality due to reduce the percentages of mineral nitrogen from 100 to 40 % and at the same time increasing the percentages of organic and bio-fertilizers from 30 to 60%. Such effects improve the fruits quality in terms of increasing fruit weight, TSS%, sugars contents and decreasing percentage of tannins %, total fibre crude and total acidity. The used of organic fertilization source of plant compost was better than the farmyard manure. Hence, to improve Barhee date palms yield quantitively and qualitatively as well as reduce production cost and environmental pollution. It is advisable to supply the palm with eth suitable nitrogen 1000 g/palm/year via 40% mineral + 20% organic + 20% bio-fertilization.

Keywords: Barhee date palm, mineral nitrogen, farmyard manure, plant compost, Nitrobein, yield.

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1. Introduction

The date palm is one of the most important fruit crops that have been a source of nutrition and shelter against harsh condition. In many desert areas, dates have been used as a staple food for hundreds of years. Dates are a rich source of sugars and numerous minerals that are necessary for life and essentially required for good health (Mertz, 1981; Wrigley, 1995). Egypt is considered to be one of the major date producing countries in the worlds (FAO, 2014). Nitrogen fertilization is one of the important tools to increase the fruiting of yield in fruit trees. The efficiency of nitrogen fertilizer under field conditions and surface irrigated soils rarely exceeds 50% and is usually ranged between 30 and 40% (Sahrawat, 1979). Low efficiency may be due to losses of N from soils as nitrate and nitrite by leaching or going up as nitrogen gases through nitrate reduction by volatilization. These huge amounts of chemicals caused many problems, such as nitrate pollution of ground water and environment, as well as depress the activities of both nitrogen fixation bacteria and phosphorus bacteria which work, actively, at low concentration of these substances (Kannaiyan, 2002). In addition, alter the composition of fruits, vegetables and root crops and decrease their contents of vitamins, minerals and other useful compounds. There is a very great danger that harmful residues may remain in food (Bogatyre, 2000; El-Salhy, 2004). Many attempts were established to promote the production yield and fruit quality of the date palm by using unconventional methods. The excessive uses of nitrogen via mineral nitrogen fertilizers lead to the promotion of some vegetative growth characteristics at the expense of yield and fruit quality. Therefore, controlling and adjusting the amount of nitrogen given to the palms was conducted by using plant compost, farmyard manure and the bio-fertilizer have a pronounced stimulation on soils fertility, nitrogen fixation, biosynthesis of natural hormones, organic matter, vitamins and antibiotic root development the availability of most nutrients, water retention, microbial activity and enzymes and have an obvious reduction on soil pH, salinity pathogens and erosion (Bonanzinga *et al.*, 2001; El-Salhy, 2004; Marschner, 1995; Wang *et al.*, 2000). Organic manure and bio-fertilizers are the alternate sources to meet the nutrient requirement of trees, organic manure is derived from animal or plant sources. It is an excellent source of organic matter, some nutrients (macro and micro), in addition to providing nutrients for crop growth, manure has several beneficial effects on soil properties. In addition, it improved chemical, moisture retention, water infiltration rate and the hydraulic conductivity of soil (Kannaiyan, 2002; Kenny and Hassan, 2006; Young, 1997). Many investigators emphasized the importance of the organic and bio-fertilization to increase the growth and fruiting of date palm trees (Abdel-Kafy, 2018; Ahmed *et al*., 2011; Al-wasfy and

Badawy *et al*., 2021; El-Assar, 2005; El-Khawaga, 2008; El-Salhy *et al.*, 2008; El-Sayed *et al*., 2016; Omar, 2015; Osman, 2009; Saad *et al*., 2011; Sayed-Maryam, 2018). So, this study aims to elucidate the effect of using organic and bio- fertilizers as a partial replacement of mineral nitrogen fertilizers on growth, nutritional status, yield and fruit quality of Barhee date palm grown in sandy soil.

2. Materials and methods

2.1 Experimental site and treatments description

The present study was conducted during 2021 and 2022 seasons on twenty-one 12-years old Barhee date palms grown in a private orchard, situated at west Samalout, Minia Governorate, Egypt. The palms are planted at 6.0 × 6.0 meter a part. The selected palms were at the same age and uniform in vigor, pruning was performed to maintain leaf bunch ratio at 10:1. The number of female spathes per palm was adjusted to ten spathes. Pollination was uniformly performed to avoid residues of metaxenia and to prevent contamination of pollens every bunch was bagged after inserting the male strands by paper bags, which were tied at the ends using a piece of cotton for aeration. The bags were shaken lightly to ensure pollen distribution and were removed after four weeks. Soil is classified as sandy in texture with water table depth not less than two meters deep. The results of orchard soil analysis according to Wilde *et al.* (1985) are given in Table (1).

Table (1): Mechanical, physical and chemical analysis of the tested orchard soil.

Characters	Values	Characters	Values
Sand (%)	83.0	O.M. (%)	0.48
Silt (%)	12.5	Total N (%)	0.03
Clay (%)	4.5	K (meq/100 g soil)	0.58
Texture	Sandy	P (ppm)	8.1
PH (1:2.5 extract)	7.98	Zn (ppm)	0.45
E.C. (1:2.5 extract, mmhos/cm)	1.72	Fe (ppm)	5.22
$CaCO_3$ (%)	7.3	Mn (ppm)	0.79

Each selected twenty- one date palm received the common horticultural practices that are already applied in the orchard such as pruning, Irrigation and pest control management, except for those that have been treated by organic, inorganic and bio-fertilization treatments. The experiment included the following seven treatments from mineral, Organic and bio-fertilization as (Nitrobein), which is a commercial product contains a special clone of N fixing non-symbiotic bacteria (*Azotobacter chroococcum*), where the stock fresh liquid culture contained 10^8 cells/ml. Each treatment was under the same recommended N level of 1000 g N/palm/year, as shown in Table (2).

Table (2): The amount of nitrogen in mineral, organic and bio-form applied in the studied treatments.

Treatment		The amount of fertilization						Total N/palm/yield (g)
		Mineral		Organic			Bio	
		Amount/ palm (kg)	Net N/palm (g)	Amount/palm (kg)	Net N/ palm (g)		Net N/palm (g)	
T_1	100% m + 0.0 org + 0.0 bio (control)	2.985	1000	0.0	0.0		0.0	1000
T_2	70% m + 15% org + 15% bio	2.090	700	10.3 compost	150		150 ml nitrobein	1000
T_3	70% m + 15% org + 15% bio	2.090	700	35.7 farmyard	150		150 ml nitrobein	1000
T_4	70% m + 20% org + 10% bio	2.09	700	6.9 compost 23.8 farmyard	200		100 ml nitrobein	1000
T_5	40% m + 30% org + 30% bio	1.195	400	20.7 compost	300		300 ml nitrobein	1000
T_6	40% m + 30% org + 30% bio	1.195	400	71.4 farmyard	300		300 ml nitrobein	1000
T_7	40% m + 40% org + 20% bio	1.195	400	13.8 compost 47.6 farmyard	200 + 200	400	200 ml nitrobein	1000

Ammonium nitrate (33.5%N) was added in three equal doses in the first week of March, first week of May and first week of July for the two consecutive seasons. Plant compost (1.45% N) and farmyard manure (0.42% N), as shown in Table (3) were added once at the last week of Jan. each season. (Nitrobein) was applied once on the middle of Feb. each season. Experiment consists of seven treatments arranged as a Randomized complete block design (RCBD), each treatment included three replicates, and each represented by one palm.

Table (3): Some chemical constituents of the used organic fertilizers.

Constituents	Plant compost	Farmyard manure	Constituents	Plant compost	Farmyard manure
PH (1:2.5 extract)	8.44	-	Total Fe (ppm)	302.0	22.16
O.M.%	31.0	8.96	Total Mn (ppm)	48.0	19.8
Total N%	1.45	0.42	Total Zn (ppm)	36.0	16.2
Total P%	0.53	0.44	Total Cu (ppm)	41.0	9.1
Total K%	1.16	1.47			

During both seasons, the following parameters were determined to evaluate the effects of different fertilization treatments on growth, nutrient status and fruiting, as follow: area of pinnae and leaf (Ahmed and Morsy, 1999). Total chlorophylls were calculated by using chlorophyll meter (Minolta SPAD 502 plus), N.P.K and Mg percent in leaves (on dry weight basis) (Wilde *et al.*, 1985). Percentage of fruit retention and bunch weight (g) as well as yield (kg/palm) were estimated and recorded, average fruit weight (g), length and diameter (cm), flesh percentage, as well as TSS percentage, total and reducing sugars, tannins, titratable acidity percentage and total fiber crude percentage (AOAC, 2000). Statistical analysis was done according to (Snedecor and Cochran, 1980). New L.S.D. test at 5% was used for made all comparisons among different treatment means.

3. Results

3.1 Impact of different treatments on growth characters

Data in Table (4) cleared that supplying Barhee date palms with nitrogen at 70% mineral nitrogen and 30% organic fertilizer (plant compost or F.Y.M.) and (Nitrobein), as bio-fertilization significantly increased pinnae area and leaf area and total chlorophyll content comparing with the using of nitrogen completely via mineral nitrogen or when nitrogen was used as 40% mineral nitrogen and 60% organic and bio-fertilization. The best organic manure in this respect was plant compost followed by F.Y.M. The using of nitrogen at 70% mineral N plus 30% organic and biofertilization were superior to the using of mineral fertilization alone in enhancing these growth characteristics. No significant differences on leaf pinnae, leaf area and chlorophyll content were observed when nitrogen was added via 40% mineral nitrogen plus 60% organic and bio-fertilization. The minimum values in leaf area and total chlorophyll contents were recorded on the palms that received nitrogen as 40% mineral + 30% organic + 30% bio-fertilization. Whereas, supplying the palm with nitrogen as 70% mineral nitrogen + 10% plant compost + 10% F.Y.M. + 10% Nitrobein gave the maximum values. Thus, the increment in leaf area (7.89 and 7.75%) and total chlorophyll (2.06 and 2.03%) due to use 70% mineral plus 20% organic and 10% bio form compared to fertilize by 100% mineral-N during the two studied seasons, respectively. No significant differences were recorded on leaf area due to the using of 70% mineral-N plus 20% organic and 10% bio-form and due to the using of 40% mineral-N plus 40% organic and 20% bio-form. It is obvious from previously data that the results took similar trend during the two studied seasons.

Table (4): Effect of different nitrogen fertilization sources on pinnae area, leaf area and chlorophyll of Barhee date palm during 2021 and 2022 seasons.

Different mineral, organic and bio- fertilization treatments	Pinnae area (cm^2)		Leaf area (m^2)		Total chlorophylls (SPAD value)	
	2021	2022	2021	2022	2021	2022
T_1: 100% AN	55.2	55.4	1.14	1.16	80.11	82.45
T_2: 70% AN + 15% PC + 15% N	61.8	62.2	1.22	1.24	93.82	97.18
T_3: 70% AN + 15% FYM + 15% N	59.2	59.9	1.18	1.21	90.63	93.68
T_4: 70% AN + 10% PC + 10% FYM + 10% N	64.4	64.9	1.23	1.25	96.59	99.17
T_5: 40% AN + 30% PC + 30% N	53.5	54.1	1.08	1.12	88.75	91.53
T_6: 40% AN + 30% FYM + 30% N	53.2	54.1	1.07	1.10	86.61	88.52
T_7: 40% AN + 20% PC + 20% FYM + 20% N	54.8	55.5	1.15	1.18	91.48	94.16
New LSD at 5%	2.6	2.8	0.09	0.08	3.39	3.74

AN= Ammonium nitrate, PC= Plant compost, FYM= Farmyard manure, N= Nitrobein.

On other hand, data in Table (5), clear that N, P, K and Mg% in the leaves significantly increased response to the application of the suitable nitrogen via 70% mineral + 30% organic and bio fertilization as well as 40% mineral, 40% organic and 20% bio comparing with using nitrogen completely via mineral N.

The promotion was gradually associated with reducing percentages of mineral nitrogen from 100% to 40% and increasing organic manures from 0.0% to 60%. The using of plant compost better than (F.Y.M.). The maximum values of N, P, K and Mg in the leaves were recorded on the palms that received nitrogen as 40% mineral + 20% plant compost + 20% (F.Y.M.) + 20% Nitrobein, while the lowest values were recorded on the palms that fertilized with N as 100% mineral. Hence, the increasement in leaf nitrogen (32.41 and 27.33) due to fertilize via 40% mineral plus 40% organic and 20% bio form compared to the fertilizing of 100% mineral-N during the two studied seasons, respectively. In general view, the results showed that using the triple from via 40% mineral plus 40 organic and 20% bio-form was the best treatment for Barhee date palm, where very effective in improving the growth and nutritional status as well as reduce environmental pollution which could be occurred by excess of mineral fertilizers.

Table (5): Effect of different nitrogen fertilization sources on N, P, K and Mg (as %) in the leaves of Barhee date palm during 2021 and 2022 seasons.

Different mineral, organic and bio- fertilization treatments	Leaf N (%)		Leaf P (%)		Leaf K (%)		Leaf Mg (%)	
	2021	2022	2021	2022	2021	2022	2021	2022
T_1: 100% AN	1.45	1.61	0.163	0.176	1.31	1.42	0.51	0.55
T_2: 70% AN + 15% PC + 15% N	1.59	1.76	0.205	0.221	1.41	1.52	0.59	0.63
T_3: 70% AN + 15% FYM + 15% N	1.52	1.69	0.198	0.213	1.36	1.50	0.55	0.60
T_4: 70% AN + 10% PC + 10% FYM + 10% N	1.66	1.82	0.255	0.272	1.46	1.58	0.62	0.66
T_5: 40% AN + 30% PC + 30% N	1.81	1.98	0.318	0.341	1.53	1.67	0.71	0.76
T_6: 40% AN + 30% FYM + 30% N	1.73	1.90	0.283	0.304	1.49	1.62	0.66	0.72
T_7: 40% AN + 20% PC + 20% FYM + 20 % N	1.92	2.05	0.342	0.364	1.56	1.68	0.77	0.81
New LSD at 5%	0.06	0.07	0.028	0.031	0.05	0.06	0.03	0.03

AN= Ammonium nitrate, PC= Plant compost, FYM= Farmyard manure, N= Nitrobein.

3.2 Yield components

It is obvious from the data in Table (6) that fertilizing the palm with nitrogen as 70% mineral + 30% any organic manures and biofertilization significantly increased the percentages of fruit retention, bunch weight and yield/palm compared to the using of nitrogen as 100% mineral N. The best organic manures in this respect were plant compost and (F.Y.M.), in descending order. The maximum yield was observed when the palm received nitrogen as 70% + 10% plant compost + 10% (F.Y.M.) + 10% Nitrobein followed by those fertilized with 40% mineral-N plus 20% PC, 20% F.Y.M. and 20% bio-form (nitrobein). No significant difference was seen due to used 70% or 40% plus organic and bio-form during the two studied seasons. Hence, the obtained yield/palm was (178.6 and 193.5 kg/palm) due to 40% mineral-N plus 40% organic and 20% bio-form during the two studied seasons. Whereas the

yield of the palm that fertilized with nitrogen as 100% mineral nitrogen was (152.3, 162.5 kg/palm) during 2020 and 2021 seasons, respectively. The percentage of increase on the yield due to application of the previous promised treatment over the check treatment reached 17.26 and 18.34% during 2021 and 2022 seasons, respectively. These results were true during the two studies seasons.

Table (6): Effect of different nitrogen fertilization source on yield components of Barhee date palms during 2021 and 2022 seasons.

Different mineral, organic and bio- fertilization treatments	Fruit retention (%)		Bunch weight (kg)		Yield (kg/palm)	
	2021	2022	2021	2022	2021	2022
T_1: 100% AN	44.2	45.8	15.23	16.35	152.3	163.5
T_2: 70% AN + 15% PC + 15% N	49.5	53.6	17.86	18.92	178.6	189.2
T_3: 70% AN + 15% FYM + 15% N	49.0	53.4	17.61	18.75	176.1	187.5
T_4: 70% AN + 10% PC + 10% FYM + 10% N	49.9	54.2	18.22	19.85	182.2	198.5
T_5: 40% AN + 30% PC + 30% N	47.2	51.3	17.48	18.86	174.8	188.6
T_6: 40% AN + 30% FYM + 30% N	46.8	50.9	17.11	18.41	171.1	184.1
T_7: 40% AN + 20% PC + 20% FYM + 20 % N	48.1	52.1	17.86	19.35	178.6	193.5
New LSD at 5%	1.9	2.1	1.26	1.38	7.9	9.2

AN= Ammonium nitrate, PC= Plant compost, FYM= Farmyard manure, N= Nitrobein.

3.4 Physical and chemical fruit characters

It was clear from the data in Tables (7, 8 and 9) that amending the palms with suitable nitrogen as 40% to 70% mineral nitrogen + 60% to 30% any organic manure (plant compost and F.Y.M.) and bio-fertilization (Nitrobein) significantly improved fruit quality in terms of increasing fruit weight and dimensions, flesh %, TSS% and total and reducing sugars and decreasing tannins %, titratable acidity % and total crude fibre % comparing to using nitrogen as 100% mineral. The best organic manure in this connection was plant compost than F.Y.M. in these aspects. Then, Treating Barhee date palms with nitrogen as 40% mineral nitrogen + 20% organic (plant compost) + 20% organic (F.Y.M.) + 20% bio-fertilizer (Nitrobein) gave the best results with regard to fruit quality similar trend was notice during 2021 and 2022 seasons. The highest fruit weight (15.1 and 16.2 g), flesh % and (92.72 and 93.15%) as well as total soluble solids (42.0 and 42.5) and total sugar (37.9 and 38.4) were recorded maximum value due to fertilize via 40% mineral-N plus 40% organic and 20% bio-form during the two studied seasons, respectively. On other hand, the lowest values were (13.8 and 14.6 g), (89.32 and 89.86%), (36.4 and 36.6%) and (32.2 and 32.4%) due to the using of 100% mineral doses during the two studied seasons, respectively. Hence, the corresponding increment percentage were attained fruit weight (9.42 and 10.95%), flesh % (3.81 and 3.66), TSS (15.38 and 16.12%), total sugar (17.70 and 18.52%), respectively.

Table (7): Effect of different nitrogen fertilization sources on weight and dimension of Barhee dates during 2021 and 2022 seasons.

Different mineral, organic and bio- fertilization treatments	Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)	
	2021	2022	2021	2022	2021	2022
T_1: 100% AN	13.8	14.6	3.12	3.27	2.45	2.53
T_2: 70% AN + 15% PC + 15% N	14.6	15.6	3.25	3.44	2.60	2.72
T_3: 70% AN + 15% FYM + 15% N	14.4	15.5	3.18	3.41	2.55	2.67
T_4: 70% AN + 10% PC + 10% FYM + 10% N	14.8	15.8	3.27	3.52	2.71	2.83
T_5: 40% AN + 30% PC + 30% N	14.9	15.8	3.33	3.54	2.77	2.86
T_6: 40% AN + 30% FYM + 30% N	14.5	15.4	3.30	3.49	2.72	2.80
T_7: 40% AN + 20% PC + 20% FYM + 20 % N	15.1	16.2	3.41	3.57	2.81	2.92
New LSD at 5%	0.58	0.61	0.11	0.12	0.07	0.08

AN= Ammonium nitrate, PC= Plant compost, FYM= Farmyard manure, N= Nitrobein.

Table (8): Effect of different nitrogen fertilization sources on flesh %, total soluble solids and sugar contents of Barhee dates during 2021 and 2022 seasons.

Different mineral, organic and bio- fertilization treatments	Flesh (%)		TSS (%)		Total sugars (%)		Reducing sugars (%)	
	2021	2022	2021	2022	2021	2022	2021	2022
T_1: 100% AN	89.32	89.86	36.4	36.6	32.2	32.4	22.0	22.2
T_2: 70% AN + 15% PC + 15% N	91.91	92.46	39.0	39.6	35.1	35.5	25.0	25.3
T_3: 70% AN + 15% FYM + 15% N	91.83	92.32	37.8	38.2	33.6	34.0	23.5	24.0
T_4: 70% AN + 10% PC + 10% FYM + 10% N	92.03	92.55	40.2	40.9	36.1	36.8	26.0	26.6
T_5: 40% AN + 30% PC + 30% N	92.38	92.93	41.2	41.9	37.0	37.2	27.0	27.2
T_6: 40% AN + 30% FYM + 30% N	92.24	92.70	40.8	41.0	36.5	36.9	26.4	26.7
T_7: 40% AN + 20% PC + 20% FYM + 20 % N	92.72	93.15	42.0	42.5	37.9	38.4	27.5	28.2
New LSD at 5%	1.93	2.03	1.12	1.25	0.72	0.91	0.53	0.48

AN= Ammonium nitrate, PC= Plant compost, FYM= Farmyard manure, N= Nitrobein.

Table (9): Effect of different nitrogen fertilization sources on total fiber crude %, contents of acidity and tannins of Barhee dates during 2021 and 2022 seasons.

Different mineral, organic and bio- fertilization treatments	Total fiber crude (%)		Titratable acidity (%)		Tannin (%)	
	2021	2022	2021	2022	2021	2022
T_1: 100% AN	1.35	1.30	0.289	0.288	0.218	0.203
T_2: 70% AN + 15% PC + 15% N	1.05	1.00	0.266	0.258	0.197	0.165
T_3: 70% AN + 15% FYM + 15% N	1.10	1.05	0.271	0.265	0.199	0.163
T_4: 70% AN + 10% PC + 10% FYM + 10% N	0.95	0.90	0.260	0.250	0.195	0.148
T_5: 40% AN + 30% PC + 30% N	0.80	0.75	0.225	0.220	0.169	0.141
T_6: 40% AN + 30% FYM + 30% N	0.90	0.85	0.240	0.230	0.180	0.140
T_7: 40% AN + 20% PC + 20% FYM + 20 % N	0.65	0.60	0.200	0.190	0.169	0.132
New LSD at 5%	0.11	0.10	0.031	0.029	0.026	0.024

AN= Ammonium nitrate, PC= Plant compost, FYM= Farmyard manure, N= Nitrobein.

4. Discussion

Nitrogen fertilization is one of the important tools to increase fruit trees yield. It plays a key role in nutrition of fruit trees that is a necessary element for chlorophyll, protoplasm and nucleic acids (Nijjar, 1985). The beneficial effects of organic manure on growth and fruiting of Barhee date palms might be attributed to its essential roles on enhancing soil physical and chemical characteristics, organic matter, N fixation, biosynthesis of natural hormones such as IAA, GA_3, some vitamins, cytokines and antibiotics, availability of most macro and micro-nutrients, water retention and soil

exchange capacity. Its action in reducing pH soils, salinity and different soil pathogens did not neglect in this respect (Marschner, 1995; Wang *et al.,* 2000; Venzon *et al*., 2001). Also, the positive effects of the bio-fertilizer on growth, yield and fruit quality might be attributed to its are microbial inoculants that have an important role on biological, physical and chemical soil properties. There are a number of inoculants that can serve as useful component of integrated plant nutrient supply system such inoculants may help in increasing crop productivity by increasing biological nitrogen fixation, availability or uptake of some nutrient through solubilization or increasing absorption and stimulation of the plant growth through hormonal action antibiosis and by decomposition of organic residues (Subba-Rao *et al.*, 1993; Wu *et al.,* 2005). These results regarding the promoting effect of organic and bio fertilizers on fruiting date palms are agreement with those obtained by Al-Wasfy and El-Khawaga (2008), El-Salhy *et al*. (2008), Ibrahiem-Zeinab (2010), Ahmed *et al.* (2011), Al-Kahtani and Soliman (2012), Saied (2015), El-Sayed *et al.* (2016), Abd-El-Wahab (2017), Boghdady (2018) and Badawy *et al*. (2021). Current study declared that fertilization with organic and bio-form significantly increased the leaf area for about 6.4% leaf nitrogen 29.8%. Moreover, these fertilization treatments significantly increased yield/palm about 17.8% and fruit weight about 10.10%. In addition, these applications significantly increased total soluble solids about 15.7% and total sugar 18.1%. Thus, these amending lead to increase the yield with good fruit quality which leads to increase the packable yield.

5. Conclusion

On the account of the present results, it could be concluded that fertilization the palms with triple form via 40% mineral-N and 40% organic plus 20% bio-form. These amending were very effective in improving the growth and nutritional status, as well as yield and fruit quality of Barhee date palm under sandy soil. In addition, it improves soil properties and reduces environmental pollution that could be occurred by excess of mineral fertilizers.

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