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Response of Barhy date palm growth and fruiting to use organic and bio-fertilizers

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Abstract

The beneficial effects of organic manure or combined with some bio-fertilizers on growth, nutritional status, yield and fruit quality of Barhy date palm grown in Research farm of Agricultural research station at Mataana, Luxor Governorate, Egypt, were studied during the three successive seasons 2021, 2022 and 2023. The experimental palms were arranged in complete randomized design with five treatments and three replications one palm per each.

It is evident from the obtained results that applying organic-N either combined with mineral-N (double form), as well as mineral-N and bio-fertilization (triple form) was very effective in improving growth and nutritional status as well as yield and dates quality compared to fertilization with mineral nitrogen only. Fertilizing with triple form (min., organic and bio.) gave the highest values of the studied traits compared to other fertilization treatments.

So, the study suggested that using triple form 50% mineral-N, 25% organic and 25% bio-fertilization (EM, netrobin or yeast) improved the vegetative growth, yield and dates quality. In addition, it reduced environmental pollution problems.

Key words: Organic, Bio-fertilizers, growth, fruit quality, date palm.

Introduction

The date palm is one of the most important fruit crops that has 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 **[1,2]**. Egypt is considered to be one of the major date

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producing countries in the worlds **[3]**. Date palm is grown in both Nile Valley and desert districts in Egypt. Aswan ranked the fourth position among the Egyptian Governorates. Dry date palm cultivars covered all the acreage of total cultivated in Aswan governorate.

Poor yield of Barhy date palm grown under Aswan region is considered a problem. This is attributed to unbalancing nitrogen nutrition. The main cause of the problem may be due to the use of over mineral-N application that is considered as air, soil and water polluting agents [**4,5]**. Adjusting inorganic N fertilization partially by using organic manures enriched with bio-fertilization is necessary to overcome this problem **[6,4,7]**.

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% **[8]**. 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. So, many problems were caused, such as nitrate pollution of ground water and environment. On the other side, these huge amounts of chemicals depress the activities of both nitrogen fixation bacteria and phosphorus bacteria which only work, actively, at low concentration of these substances **[9,10]**. In addition, they can 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 **[11,12]**.

So, organic fertilization for fruit crops became in the last few decades a good alternative to chemical fertilization to depress pollution in the environment and to produce a safe and nutritive food that is good for health **[13,14,15]**. In addition, the growers apply organic and bio-fertilizer to improve soil physical, chemical and biological properties as well as to increase nutrient availability **[16,4,12]**. The use of organic materials as N source has been considered as a best management because organic N is released to the trees more gradually than water soluble inorganic N fertilizers **[17,18]**. Similarly, soil fertility can be managed using organic fertilizers, crop rotation and association along with composting and recycling of the organic matter **[19,14,20]**.

An obvious promotion was observed on growth and fruiting traits due to use compost, EM and nitrobin along mineral – N. The promotion was associated with decreasing percentage of mineral – N and increasing percentage of other forms **[21,22, 23,24,25].**

Many investigators emphasized the importance of the organic and bio-fertilization to increase the growth and fruiting of date palm trees **[21,22,23,24,25,26,27,28,29, 30,31,33,34,35]**.

So, the objective of this investigation was to study the possibility of using organic or bio-

fertilization partially instead of completed mineral fertilization on growth and fruiting of Barhy date palm.

Materials and Methods

This study was conducted at El- Mataana Experimental Res. Station Hort. Res. Instit., Agric. Res. Center Esna district Luxor governorate during three consecutive seasons of 2021, 2022 and 2023 in which 15 tissue culture derived off shoot of Barhy date palms were selected for achieving this study. The palms were planted at 6 x 7 meters apart (100 palms/fed.). The texture of soil is silty clay. This study was conducted to assess the different effects of using plant compost manure as well as effective microorganisms (EM), yeast and nitrobin as a biofertilizer as a partial replacement of inorganic N fertilizers on vegetative growth characteristics, yield and fruit quality in the Barhy date palm. The selected palms were at the same age and uniform in vigour. These palms were 28 years old at the start of study, good physical conditions and free from insects, damages and diseases. The selected palms were irrigated through surface irrigation system. Pruning was performed to maintain leaf bunch ratio at 8:1. The number of female spathes per palm was adjusted to 12 spathes by removing excess earliest, latest and small bunches. Pollination of the experimental palms was uniformly performed to avoid residues of metaxenia.

Experimental work:

This experiment included the following five treatments from inorganic N (ammonium nitrate, 33.5 % N), plant compost manure (2.5 % N) and bio-form i.e. effective microorganisms (EM), nitrobin and yeast arranged as follows:

1- Application of the suitable N as 50% inorganic N (1500 g ammonium nitrate / palm) + 25% plant compost manure (10 kg / palm) plus 25% (200 ml EM).
2- Application of the suitable N as 50% inorganic N (1500g ammonium nitrate / palm) + 25 % plant compost manure (10 kg / palm) plus 25% (250 g nitrobin / palm).
3- Application of the suitable N as 50% inorganic N (1500 g ammonium nitrate / palm) + 25% plant compost manure (10 kg / palm) plus 25% (50 ml yeast).
4- Application of the suitable N as 25 % inorganic N (750 g ammonium nitrate + 75% plant compost manure (30 kg / palm).
5- Application of the suitable N (1000 g N / palm/ year) as 100% inorganic N (3000 g ammonium nitrate / palm).

Each treatment was replicated three times, one Barhy date palm per each. Inorganic N source

was applied in the source of ammonium nitrate (33.5 % N) . It was splitted into three equal batches and applied at the first week of March, May and July for the two consecutive seasons. Organic N fertilizer namely plant compost manure (2.5% N) was added once at the first week of Jan. Biofertilizer as either EM at 200 ml, nitrobin at 250g or yeast at 50 ml/ palm was also added once at the first week of March. Ammonium nitrate was distributed around the canopy of each palm while organic and biofertilizer were applied in holes 10 cm depth and 50 cm apart around the canopy of each palm.

Analysis of orchard soil and plant compost are shown in Table (1).

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

Characters	Values	Characters	Values
Particle size distribution		Cubic meter weight (kg)	600
Sand %	10.60	Moisture %	29.0
Silt %	58.00	Organic matter %	30.7
Clay %	31.40	Organic carbon %	15.63
Texture grade	Silty clay	PH (1:10)	8.5
pH (1:2.5 extract)	8.00	EC(ds/m)	6.5
E.c (1:2.5 extract) mmhos/1cm/25°C	0.91	C/n ratio	18.82
Organic matter %	2.09	Total N%	2.5
$CaCO_3$ %	1.22	Total P%	0.52
Macronutrients values		Total k%	1.21
Total N%	0.11	Total Ca %	1.25
P (ppm Olsen method)	20	Total Mg %	1.21
K (ppm ammonium acetate)	419	Total Fe (ppm)	320
Mg (ppm)	79	Total Mn (ppm)	45
S (ppm)	6.90	Total Zu (ppm)	34
B (ppm hot water extractable)	0.27	Total Cu (ppm)	42
EDTA extractable micronutrients (ppm)			
Zn	1.31		
Fe	11		
Mn	10.18		
Cu	1.60		

Fifteen healthy palms nearly similar in growth vigour were selected.

Regular agricultural practices except nitrogen fertilization were carried out as usual.

The leaf/bunch ratio was adjusted at the end of the blooming season to meet their value of 8:1. Artificial pollination was uniformly performed in respect of source, date and method. The experiment involved five treatments representing various levels of nitrogen fertilization (inorganic and bio-organic). Each treatment except the checked treatment was under the same recommended N level of 1000 g N/palm/year.

The design of the experiment was completely randomized with three replicates, one palm

per each.

The following parameters were determined to evaluate the effects of different fertilization treatments on growth, nutrient status and fruiting.

1- Vegetative growth:

Average number of newly grown leaves was counted at the end of growing season. In addition, four mature leaves (fronds) around fruiting zone (each embracing a bunch) were chosen on each palm to determine, leaf length (m). Four pinnae were taken from the middle part of each leaf to determine pinnae area (cm^2) as follows:

leaflet area = (length x maximum width x 0.84) according to **[36]**. Then, the whole leaf area (m^2) was determined from multiplying the leaflet area by the number of leaflets/leaf.

Total chlorophyll): Samples of five mature pinnae from the six-month-old leaf (1st week of August) were taken during the two seasons to estimate total chlorophyll. Total chlorophyll was calculated using a chlorophyll Meter (Model: 2900, P2900 PDKL Type: Electrical Equipment measurement)

2- Percentage of leaf nutrients:

Samples of pinnae from each replicate were collected at mid of November. The pinnae were washed with tap water, distilled water, air-dried, even-dried at 70°C to constant weight. The dry material was ground in a stainless well and 0.2 g of each sample was digested using concentrated sulphoric acid and 30% hydrogen peroxide for overnight, percentage of N, P and K (on dry weight basis) were determined in the digested solution according to **[37].**

3- Yield and its components:

Fruit set, fruit retention and bunch weight:

Fruit set and fruit retention percentage were calculated after month of pollination and at harvest from number of fruits harvested divided by total number of fruits set and multiplied by hundred using the following equations:

$$\text{Fruit set (\%)} = \frac{\text{Number of seted fruits on the strand}}{\text{Number of seted fruit + Number of flowers scars}} \text{x } 100$$

$$\text{Fruit retention (\%)} = \frac{\text{Number of retained fruits on the strand}}{\text{Number of retained fruit + Number of flowers scars}} \text{x } 100$$

C- Bunch weight and yield/palm:

At the harvest time, bunches of each palm were picked and weighted, then the yield/palm (kg) was recorded.

4- Fruit characteristics:

Sample of 50 fruits were taken randomly from each replicate to determine some physical and chemical properties.

A- Physical characteristics:

These characteristics included the determination of fruit weight, fruit dimension, flesh percentage, flesh thickness and fruit moisture percentage.

B – Chemical characteristics:

These characteristics included, total soluble solids (TSS), sugar contents and total acidity of fruit juice as outlined **[38].**

All the obtained data were tabulated and analyzed to the proper statistical analysis according **to [39,40]**. The differences between treatment means were compared by Duncan's multiple range test at 5% level of probability to **[41]**.

Results

1 - Vegetative growth:

It is evident from the data in Tables (2, 3, 4 and 5) that organic-N form either alone or combined with mineral-N and bio-forms (EM, yeast and nitrobin) significantly increased the growth traits, i.e. leaf length and area of leaflet and leaf, then significantly increased the total leaf surface area per palm. Moreover, all combined forms as well as organic fertilization significantly increased the number and length of leaves, total chlorophyll, leaf N, P and K percentage as well as leaf, Fe, Zn and Mn ppm compared to fertilization with 100 of nitrogen doses as mineral-N only.

The highest values of leaf area, total chlorophyll and leaf mineral contents were recorded on the palms that were fertilized with triple form (50 mineral, 25% organic and 25% bio- form at EM, T1). On other hand, the least values of these studied traits were recorded on palm that fertilized with 100% mineral-N (control treatment, T_5). The highest values were (28.67 leaf, 5.67 m, 2.41 m^2 as an. av. the three studied seasons) for new leaf /palm, leaf length and leaf area, respectively. The corresponding highest values for total chlorophyll and leaf-nutrients contents were (72.16 SPAD, 1.36, 0.203, 1.0% as well as 179.43, 58.31 and 46.97 ppm), respectively. Contrarily, the least values for these traits were recorded on the palms treated with 100% mineral-N (T_5), respectively. Hence the increment percentage of number of leaves (40.26 & 31.26), leaf area (39.31 & 28.90), total chlorophyll (11.91 & 10.07)% and leaf N % were 13.33 as an. av. the three studied seasons due to fertilization with triple form (50% m, 25% org. plus 25 bio-form as EM, T1 or nitrobin T2) compared to fertilization with 100% mineral-N, respectively. No significant differences were found

due to fertilization with either, triple (50% m and 25% organic plus 25% yeast, T3) or double forms (25% mineral-N and 75% organic, T4). The best results with regard to growth and nutritional leaf of Barhy date palm were obtained due to its fertilization with the triple form either 50 m + 25 org plus 25% bio as 200ml, EM (T1) followed use triple form that containing nitrobin (T2) or yeast (T3). While fertilization by binary form mineral plus organic (T4) occupies third plus after the triple ternary form containing nitrobin (T2) or yeast (T3) that occupies second place.

Table (2): Effect of different nitrogen fertilization sources on leaf traits of Barhy date palm during 2021, 2022 and 2023 seasons.

Treatment	No. of fronds				Leaf length (cm)				Leaf area (m^2)			
	2021	2022	2023	m	2021	2022	2023	m	2021	2022	2023	m
T1	29.43	30.38	32.20	30.67	5.10	5.20	5.67	5.32	2.11	2.31	2.81	2.410
T2	25.46	26.38	28.65	26.83	4.93	5.03	5.63	5.20	1.91	2.13	2.63	6.670
T3	23.67	24.67	26.50	24.95	4.82	4.92	5.50	5.08	1.83	2.09	2.51	6.430
T4	22.67	23.67	25.33	23.89	4.75	4.85	5.30	4.97	1.65	1.84	2.33	5.820
Control (T5)	19.33	20.33	21.67	20.44	4.51	4.60	5.13	4.75	1.42	1.65	2.11	5.180
LSD at 0.05	2.28	2.36	2.36		0.26	0.27	0.31		0.11	0.12	0.14	

Table (3): Effect of different nitrogen fertilization sources on pinnae traits and tota chlorophylls of Barhy date palm during 2021 , 2022 and 2023 seasons.

Treatment	No. of pinnae per leaf				Pinnae area (cm^2)				Total chlorophylls			
	2021	2022	2023	m	2021	2022	2023	m	2021	2022	2023	m
T1	224.33	227.00	248.33	233.22	91.51	101.34	113.36	102.07	68.87	71.60	76.00	72.16
T2	222.00	223.33	245.00	230.11	85.67	95.08	107.43	96.06	67.57	70.00	75.33	70.79
T3	220.00	222.67	243.00	228.56	83.16	93.75	104.33	93.75	66.00	68.57	73.67	69.41
T4	218.00	220.33	240.67	226.33	75.56	83.67	93.23	84.15	66.43	68.83	73.33	69.53
Control (T5)	207.33	209.70	228.67	215.23	72.38	79.12	91.15	80.88	62.40	63.87	76.18	64.48
LSD at 0.05	10.38	10.53	11.39	6.29	3.11	3.46	2.98	1.96	2.98	3.34	3.50	1.95

Table (4): Effect of different nitrogen fertilization sources on leaf N, P and K% of Barhy date palm during 2021 and 2022 and 2023 seasons.

Treatment	Leaf N%				Leaf P%				Leaf K%			
	2021	2022	2023	m	2021	2022	2023	m	2021	2022	2023	m
T1	1.27	1.38	1.42	1.36	0.189	0.211	0.208	0.203	0.96	0.98	1.06	1.00
T2	1.24	1.35	1.41	1.33	0.166	0.178	0.185	0.176	0.96	0.97	1.06	1.00
T3	1.22	1.30	1.38	1.30	0.161	0.175	0.186	0.174	0.94	0.97	1.05	0.99
T4	1.23	1.28	1.39	1.30	0.163	0.178	0.189	0.177	0.92	0.96	1.04	0.97
Control (T5)	1.15	1.19	1.26	1.20	0.131	0.140	0.147	0.139	0.86	0.90	0.98	0.91
LSD at 0.05	0.04	0.05	0.05	0.03	0.011	0.016	0.013	0.009	0.03	0.03	0.04	0.02

Table (5): Effect of different nitrogen fertilization sources on leaf Mg, Fe and Zn contents of Barhy date palm during 2021 and 2022 and 2023 seasons.

Treatment	Leaf Mg%	Fe (ppm)	Zn (ppm)

	2021	2022	2023	M	2021	2022	2023	m	2021	2022	2023	m
T1	0.32	0.33	0.36	0.34	172.33	174.67	191.02	179.34	56.00	57.00	61.93	58.31
T2	0.31	0.33	0.34	0.33	172.00	174.67	189.74	178.80	55.75	56.25	61.11	57.70
T3	0.31	0.32	0.33	0.32	171.00	174.67	189.37	178.35	55.50	55.25	61.11	57.29
T4	0.30	0.29	0.33	0.31	170.00	173.00	189.37	177.46	54.00	55.00	60.14	56.38
Control (T5)	0.22	0.24	0.27	0.24	158.33	160.20	175.37	164.63	49.67	48.33	53.33	50.44
LSD at 0.05	0.03	0.04	0.04	0.02	5.54	6.24	7.11	3.68	2.47	2.69	2.29	1.49

2- Yield and its components:

As shown in Tables (6 & 7) fertilizing Barhy date palm with organic N form either alone or combined with bio and mineral-N form significantly increased, fruit set, fruit retention and the heavy bunch weight. The significantly higher values of fruit retention and bunch weight were obtained from the palms that received all amounts of N in triple form (organic plus bio and mineral sources that containing EM as bio form). Whereas, the minimum values of bunch weight and yield/palm were related to the palms that were supplied by 100% mineral (checked treatment, T_5).

Also, data in the prementioned table indicated that the fertilization with triple form significantly increased the bunch weight and yield/palm compared to the use double form (organic and mineral-N). Fertilization with double form 25% mineral-N and 75% organic significantly increased the fruit retention and bunch weight compared to using 100% mineral-N (checked treatment, T5).

The recorded fruit retention 44.50, 43.98% and heaviest bunch weight were 16.79 & 16.46 kg and yield /palm 201.48 & 197.52 kg/palm, as. an. av. the three studied seasons due to fertilization by any triple form (T_1 or T_2), respectively. Contrarily these values on palm that fertilized with 100% mineral were 38.98%, 13.90 kg and 166.80 kg/palm as. an. av. the three studied seasons. Then, the corresponding increment percentage due to the use of triple form over 100% mineral-N were (10.81 & 9.51), (20.78 & 18.42%) and (20.76 & 18.39 %) due to use (T1 or T2) compared (T5), respectively.

In general terms, it seems that the fertilization in either double or triple forms leads to an increase in the yield and its regularity.

Table (6): Effect of different nitrogen fertilization sources on yield components of Barhy date palm during 2021, 2022 and 2023 seasons.

Treatment	Fruit set (%)				Fruit retention (%)				Bunch weight (Kg)			
	2021	2022	2023	M	2021	2022	2023	m	2021	2022	2023	m
T1	65.14	67.10	66.31	66.18	44.52	45.38	43.60	44.50	16.18	17.00	17.18	16.79
T2	64.31	66.18	65.33	65.27	43.78	44.88	43.28	43.98	15.75	16.73	16.89	16.46
T3	63.88	66.54	65.51	65.31	3.93	45.22	43.55	44.23	15.56	16.55	16.58	16.23
T4	62.54	64.36	63.40	63.43	42.68	44.66	41.19	42.84	15.21	16.38	16.40	16.00
Control (T5)	57.86	59.68	58.31	58.62	40.15	41.36	38.98	40.16	13.34	14.25	14.11	13.90

LSD at 0.05	**3.82**	**3.39**	**3.35**		**2.18**	**2.54**	**3.25**		**0.85**	**0.91**	**0.96**	

Table (7): Effect of different nitrogen fertilization sources on fruit weight and fruit length of Barhy dates during 2021, 2022 and 2023 seasons.

Treatment	Yield / palm (Kg)				Fruit Weight (g)				Fruit length (cm)			
	2021	2022	2023	m	2021	2022	2023	m	2021	2022	2023	m
T1	**194.16**	**204.00**	**206.16**	**201.44**	**15.83**	**16.72**	**16.10**	**16.22**	**2.85**	**3.11**	**2.99**	**2.98**
T2	**189.00**	**200.76**	**202.68**	**197.48**	**15.61**	**16.39**	**16.21**	**16.07**	**2.82**	**3.08**	**2.97**	**2.96**
T3	**186.72**	**198.60**	**198.96**	**194.76**	**15.43**	**16.11**	**15.88**	**15.81**	**2.80**	**3.06**	**2.93**	**2.93**
T4	**182.52**	**196.56**	**196.80**	**191.96**	**15.54**	**16.00**	**16.05**	**15.86**	**2.83**	**3.05**	**2.92**	**2.93**
Control (T5)	**160.10**	**171.00**	**169.32**	**166.81**	**13.93**	**14.95**	**14.60**	**14.49**	**2.68**	**2.90**	**2.81**	**2.80**
LSD at 0.05	**10.98**	**11.29**	**10.96**		**0.79**	**0.91**	**0.85**		**0.11**	**0.13**	**0.10**	

3 - Fruit quality:

Data presented in Tables (7, 8, 9 and 10) declared that using all amounts of nitrogen dose in either organic source or combined with bio and mineral source was accompanied with improving fruit weight, dimension and flesh percentage. Their effects produce the heaviest fruit weight with no effect on seed weight and consequently increasing flesh percentage. The heaviest fruit weights (16.22 & 16.07 g), flesh percentage (93.43 & 93.10 %) were recorded on palms that received the fertilization via triple form, T_1 or T_2 whereas, the lightest fruit weights (14.60) and least flesh % (90.52% as. an. av. the three studied seasons) were found on palms that received the fertilization via 100% mineral (T_5), respectively. Hence, the increment percentage of fruit weight attained (11.93 & 10.90%) and flesh % (3.21 & 2.85% as. an. av. the three studied seasons) due to the use of triple form (T1 or T2) compared with 100% mineral, respectively. There are no significant differences in such traits due to any triple form or double form.

Moreover, fertilization with either, double or triple forms was accompanied with improving the quality of dates in terms of raising total soluble solids and sugars contents and in reducing the moisture, tannins contents and total acidity percentage. The highest improvement of these traits of fruit quality was associated with using the triple form. The highest total soluble solids (41.82 & 41.46%) and total sugars (35.38 & 35.02%) were recorded in dates of the palm that received the fertilization via triple form (50% min, 25% organic plus 25% bio-form EM, T1 or nitrobin T2, against the least ones (39.50 & 33.22% as. an. av. the three studied seasons) on 100% mineral (checked treatment, T5), respectively. Then, the increment percentage of TSS were (5.87 & 4.96%) and total sugars were (6.50 & 5.42% as. an. av. the three studied seasons) due to using triple form (T1 or T2) compared to the checked ones (T5), respectively.

On other hand, fertilization with double or triple forms significantly decreased the fruit moisture and tannins and total acidity compared mineral-N alone (checked treatment). The least

fruit moisture % (51.17 & 51.44%), total acidity (0.299 & 0.310%) and tannins contents (0.144 & 0.150 % as. an. av. the three studied seasons) were recorded in dates of the palm that fertilized via triple form (T1 or T2), respectively. Whereas, the highest value of fruit moisture (54.47%), total acidity (0.360%) and tannins contents (0.177% as. an. av. the three studied seasons) due to use 100% mineral-N (T5). Then the corresponding decrement percentage attained (6.06 & 5.56%), (17.22 & 13.60%) and (18.65 & 15.25% as. an. av. the three studied seasons) due to use (T1 or T2) compared to (T5), respectively.

The best results with regard to yield and fruit quality were obtained as a result of supplying the palms with 50% mineral 25% organic and 25% bio-form nitrogen dose/palm.

Table (8): Effect of different nitrogen fertilization sources on some physical properties of Barhy dates during 2021, 2022 and 2023 seasons.

Treatment	Fruit diameter (cm)				Fruit flesh (%)				Fruit moisture (%)			
	2021	2022	2023	m	2021	2022	2023	m	2021	2022	2023	m
T1	2.48	2.61	2.64	2.58	93.28	93.75	93.25	93.43	50.46	51.60	50.96	51.01
T2	2.48	2.70	2.61	2.60	92.96	93.48	92.87	93.10	50.88	52.11	51.33	51.44
T3	2.46	2.71	2.62	2.60	92.78	93.39	92.77	92.98	51.49	52.63	51.95	52.02
T4	2.49	2.70	2.61	2.60	92.69	93.18	92.73	92.87	51.80	52.87	52.23	52.30
Control (T5)	2.33	2.53	2.48	2.45	0.38	90.66	90.53	90.52	53.97	55.03	54.41	54.47
LSD at 0.05	0.12	0.14	0.11		2.10	2.15	1.98		1.89	2.05	2.11	

Table (9): Effect of different nitrogen fertilization sources on flesh %, fruit moisture and TSS of Barhy dates during 2021, 2022 and 2023 seasons.

Treatment	TSS%				Total Sugar%				Reducing Sugar%			
	2021	2022	2023	M	2021	2022	2023	m	2021	2022	2023	m
T1	41.76	41.18	42.51	41.82	35.28	34.69	36.18	35.38	26.88	25.37	25.92	26.06
T2	41.49	40.71	42.18	41.46	34.85	34.28	35.93	35.02	26.49	25.10	25.75	25.78
T3	41.18	40.56	41.89	41.21	34.98	34.60	35.56	35.05	26.65	25.31	25.58	25.85
T4	41.29	40.61	42.11	41.34	34.39	34.25	35.87	34.84	26.18	24.88	25.60	25.55
Control (T5)	38.32	37.53	38.90	38.25	32.68	31.53	32.98	32.40	24.91	23.10	24.31	24.11
LSD at 0.05	1.33	1.46	1.68		1.45	1.61	1.82		1.18	1.25	1.13	

Table (10): Effect of nitrogen fertilization source on sugar contents, acidity and tannins of Barhy dates during 2021, 2022 and 2023 seasons.

Treatment	Non-reducing				Acidity				Tannins			
	2021	2022	2023	m	2021	2022	2023	m	2021	2022	2023	m
T1	8.42	9.32	10.25	9.33	0.291	0.305	0.299	0.298	0.139	0.148	0.146	0.144
T2	8.33	9.19	10.18	9.23	0.306	0.318	0.310	0.311	0.147	0.153	0.150	0.150
T3	8.36	9.29	10.0	9.22	0.308	0.322	0.314	0.315	0.149	0.155	0.152	0.152
T4	8.23	9.38	10.28	9.30	0.310	0.325	0.316	0.317	0.149	0.158	0.152	0.153
Control (T5)	7.78	8.43	8.67	8.29	0.351	0.368	0.360	0.360	0.170	0.183	0.178	0.177
LSD at 0.05	0.28	0.31	0.31		0.031	0.033	0.033		0.012	0.015	0.016	

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 **[17]**. The promotion on growth and nutritional status in response to application of organic-N and bio-fertilizers mainly may be attributed to their positive action on increasing the activity of micro flora, water holding capacity, soil structure, soil aggregation, organic matter, soil humus content and the availability of most nutrients. Also, such findings might be attributed to the effect of organic manure and bio-fertilizers on increasing the soil acidity, reducing the loss of nutrients with drainage water and enhancing the availability of nutrients in the soil. As well as, it can provide most nutrients to palm along the whole growth season. Such stimulation on the uptake of nutrients leads to enhancing the biosynthesis of organic foods and cell division [**9,18,42]**.

n agriculture, the capacity of microorganisms is not only based on the formation of aggregates and improvement of the physical part of the soil, but also on the biological and molecular part.

The main effects of the presence of microorganisms in the soil are:

- **Improved plant nutrition.**
- **Enzymes and phytohormones output.**
  - The microorganisms capacity to produce hormones, such as gibberellins, indole-acetic acid and butyric acid, make them good candidates to promote cell division and, therefore, elongation of the plan aerial and root parts.
  - Microorganisms produce enzymes, such as ACC deaminase, involved in inhibiting the synthesis of ethylene produced by stress.

The promoting effect of yeast and humic acid on growth and nutritional status of palms possesses a positive relationship with improving the fruit quality. These fruit improvement might be attributed to its higher own content from natural hormones, protein and vitamins that are responsible for enhancing the biosynthesis of most foods **[43]**. Foliar spray of yeast, humic acid or their combinations on Sewy date palms significantly increases N, P and K contents of the fruits. These results may be related to the high contents of macro and micro nutrient of both dry yeast and humic acid. Some investigators reported that using yeast and humic acid either alone or in combination as a foliar application improved the nutritional status of different fruit crops

It could be concluded that organic-N either alone or accompanied with inorganic and bio-N forms is beneficial to improve the growth and nutritional status of palms.

So, one can say that amending either by organic N only treatment or organic combined with bio plus mineral increased the yield components and regulated the annual yield. These results

emphasized the vital importance of using organic manure as well as bio-fertilization in order to improve the bunch born, fruit set percentage and bunch weight. Increasing the yield might be due improving the flower bud formation and fruit retention as well as decreasing the fruit drop as a response of organic manure and bio-form application.

There more, improvement of dates in terms of increasing total soluble solids and decreasing the moisture contents and total acidity due to organic nitrogen application either alone or combined with bio plus mineral nitrogen sources could be ascribed to a good balance between growth and fruiting and could be a result of accumulating more carbohydrates that makes them very available for enhancing ripening of dates.

These effects are very important in dates production since the improvement on dates quality is the most important target that induce an increase in packable yield and price.

Current study showed that fertilization with organic and bio-fertilizers significantly increased the leaf area for about 30% of leaf nitrogen for 37%. Moreover, these fertilization applications significantly increased yield/palm for about 50% and fruit weight for 26% as well as significantly improved total soluble solids for about 26% and total sugars about for 23%. Thus these treatments lead to increase the yield with good fruit quality which lead to the increase in packable yield.

These results are in agreement with those obtained **[22,24,25,29,30,31,32,33,34,35,43,44,45].** They reported that using organic and bio-fertilizers could improve the growth aspects followed by a gradual increase of the yield and improving the fruit quality of different palm date cultivars.

Conclusion

On the account of the present results, it could be concluded that fertilization the palms with triple form via 50% mineral-N and 25% organic along with 25% bio-form, specially use EM as bio form, was very effective in improving the growth and nutritional status, as well as yield and fruit quality of Barhy date palm under the circumstance of this study. Additionally, it improves soil properties and reduces environmental pollution which could be occurred by excess of chemical fertilizers.

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استجابه نمو واثمار نخيل البلح البرحي للأسمده العضويه والحيويه

أجريت هذه الدراسة خلال ثلاثه مواسم متتاليه هي 2021 ، 2022 و 2023 علي نخيل البلح البرحي المنزرعة بالمرزعة البحثية لمركز البحوث الزراعية – المطاعنه – الاقصر، مصر.حيث التربة الطينية الطمييية. ويهدف البحث إلي إلقاء المزيد من الضوء علي تأثير التسميد العضوي والحيوي علي النمو الخضري والحالة الغذائية وكذلك المحصول وخصائص الثمار حيث تم إحلال السماد العضوي بنسبة 75-25% بالإضافة للأسمدة الحيوية بنسبة 25% من الجرعة السمادية المضافة للأشجار المقدرة 1000 جم نيتروجين/نخلة (معاملة المقارنة).

وقد أوضحت النتائج:

- تسبب استخدام التسميد العضوي خلطياً مع السماد المعدني فقط أو مع السماد المعدني والأسمدة الحيوية زيادة معنوية في عدد الاوراق الجديده ومساحتها ومحتواها من الكلوروفيل الكلي وعناصر النيتروجين والفوسفور والبوتاسيوم والحديد والزنك والمنجنيز مقارنة باستخدام الأسمدة المعدنية فقط.
- أدي التسميد في الصورة الثنائية (عضوي + معدني) أو الثلاثية (عضوي + معدني + حيوي) إلي زيادة معنوية في نسبه العقد الاولي والنهائي ووزن السباطات والمحصول/نخلة مع تحسين خصائص الثمار من حيث وزن الثمرة – نسبة اللحم – وكذلك الصفات الكيميائية من حيث المواد الصلبة الكلية ومحتواها من السكريات مقارنة بالتسميد المعدني فقط.
- أوضحت النتائج أن استخدام الصورة الثلاثية (معدني + عضوي + حيوي) لتسميد نخيل البلح البرحي سببت تحسين النمو الخضري وزيادة المحصول وخصائص الثمار مع تقليل التلوث البيئي الناشئ عن استخدام الأسمدة الكيميائية.
- وعليه يمكن التوصيه بالتسميد سنويا بمعدل 1000 جرام نيتروجين لكل نخله في الصوره الثلاثيه المكونه من 50 معدني + 25 عضوي + 25 حيوي (200 ml EM).