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The Beneficial Effects of Minimizing Mineral Nitrogen Fertilizers on Fruiting of Seewy Date Palms by Using Organic and Bio-fertilizers

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Abstract:

The effects of replacing mineral-N fertilization partially by organic or bio-fertilization on growth and fruiting of Seewy date palms were studied during 2012, 2013 and 2014 seasons. The palms are grown in a private orchard at El-Dakhla oasis, New Valley, Egypt, where the texture of soil is sandy loam.

Ammonium nitrate, farmyard manure and nitrobien were added as mineral, organic and bio-forms of N, respectively. The experiment was set up in a complete randomized block design with nine treatments and three replicates, one palm per each.

The obtained results indicated that:

- Fertilizing the palms with either two forms (mineral plus organic) or (organic plus bio-form), as well as, three forms (mineral, organic plus bio-form) considerably increased the leaf area and N, P & K contents of leaves compared to using mineral-N source only. Using three forms gave the highest values of these traits.

- Using either two form or three forms of nitrogen fertilization increased the residually of N, P and K compared to use mineral-N source only.

- The heaviest bunch weight was detected on the palms that fertilized with the three forms, contained the third of them. Moreover, using either two or three forms was accompanied with improving fruit quality in terms of increasing fruit weight, total soluble solids and sugar contents and decreasing the moisture percentage.

So, it is concluded that Seewy date palm production can rely on organic and bio-fertilization as alternatives to mineral-N fertilization or at least rationalize its use in the production of organic palm dates as well as increasing soil fertility, the nutritional status and yield besides reducing environmental pollution that may occurr by excess of chemical fertilizers used.

Keywords: Date palm, fertilization, organic bio-form, yield –fruit quality, nutritional status, pollution, environmental.

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Introduction:

Date palm is one of the oldest cultivated fruit trees in the world, known as tree of life because of its resilience, its need for limited water inputs, its long term productivity and its multiple purpose qualities. Date palm is the most important fruit species in Egypt and its plays an important role in the economic and social aspects of the people in Egypt.

Seewy date is the most important cultivar of semi-dry and is very demandable in the local and foreign markets. The efficiency of fertilizers to increase crop yield is an important goal in all agricultural systems as well as the influence of the different types of fertilizers on human health (El-Khayat and El-Noam, 2013).

Date palm growth, yield and fruit quality are mostly dependant on cultivar, pollination, fertilization and water relations. Most of the date palms produced in Egypt are in sandy and sandy loam soils. So, fertilization is necessary to improve the growth and production of the palm tree. The main causes for poor cropping are unbalancing or malnutrition of nutrients particularly N (Mengel, 1984). Nitrogen is known to be one of the most major elements for plant nutrition and development. The demand of trees for N is required to form lecithins (plant fat make up), chlorophyll and to assimilate into amino acids and proteins (cell protoplasm make up) as well as to support shoot and leaf area development (Mengel and Kirkby, 1987). The efficiency of N fertilization under field conditions and surface irrigated soil rarely exceed 50% and is usually ranging from 30 to 40% (Sahrawat, 1979). Such low efficiency may be due to its great leaching or through nitrate reduction by volatilization. On the other side, the huge amounts of chemicals depress the activities of both nitrogen fixation bacteria and phosphorus bacteria which only works, actively at low concentration of these substances (Waksman, 1952). Partial replacement of mineral-N fertilizers by using organic and bio-fertilization is a good means for controlling the release of N from soil to plants (Wani and Lee, 1995 and Kannaiyan, 2002).

Organic farming depends on the use of organic and bio-fertilizers instead of using chemical fertilizers, because this has a good effect on agricultural products in terms of crop production free from pollution and harmful elements to human health, especially nitrates that occur due to the use of nitrogenous fertilizers (Ahmed, 2008 and Al-Kahtani and Soliman, 2012).

In addition, the growers apply organic and bio-fertilizers for perceived or real improvement, in soil physical, chemical and biological properties but the main benefit appear to be the increase in nutrient availability, especially P and exchangeable K, Ca and Mg content (Yagodin, 1984; Darwish *et al*., 1995 and El-Salhy *et al*., 2008). Previous studies emphasized the beneficial effect of organic and bio-fertilization as a partial replacement for mineral-N in date palm orchards for avoiding pollution and promoting yield and fruit quality (Osman, 2003; Gobara, 2004; Mansour *et al*., 2004; El-Assar, 2005; Kenney and Hassan, 2006; Almadini and Gosaibi, 2007; Ahmed, 2008; Alwasfy and El-Khawaga, 2008; El-Salhy *et al*., 2008; Osman *et al*., 2011; Al-Kahtani and Soliman, 2012; El-Khawaga, 2013; El-Khayat and El-Noam, 2013; Abdel-Galil *et al*.,

2014; Al-Wasfy & Abdel-Rahman, 2014 and Salama *et al*., 2014).

So, the present investigation is conducted in order to study the effects of replacing mineral-N fertilizer partially by using organic or bio-fertilizers on growth and fruiting of Seewy date palms.

Materials and Methods:

The experiment was carried out during three successive growing seasons i.e. 2012, 2013 and 2014 on 25 years old Seewy date palms. The selected palms were grown in a private orchard located at El-Dakhla Oasis, New Valley, Egypt. The texture of the soil is sandy loam. Analysis of the soil was done according to Wilde *et al*., 1985 and the obtained data are given in Table (1).

Table (1): Some physical and chemical characteristics of the experimental soil used before and after treatments.

Soil property	Before treatment	After treatment			
		Inorganic form (control)	50% at each (org. + bio, T_3)	50% at each (org. + bio, T_5)	Three forms (33% of them, T_9)
Clay %	15.68	15.90	16.35	18.90	18.20
Silt %	6.00	4.48	7.50	8.50	8.16
Sand %	78.32	79.62	75.85	72.60	73.64
Texture grade	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
pH (1:2.5)	7.89	8.15	7.56	7.46	7.56
EC (1:1)	0.41	0.38	0.48	0.65	0.61
$CaCO_3$ %	2.25	2.20	1.73	1.67	1.68
Total (N) %	0.182	188	0.253	0.248	0.270
O.M. (%)	1.86	1.92	2.56	3.04	2.78
W.H.C. (%)	54.5	55.30	46.69	41.0	43.17
F.C.	25.0	25.80	20.25	19.0	19.55
Available P (mg kg^{-1})	3.50	3.52	5.19	5.38	5.36
Available K (mg kg^{-1})	103	105	147	165	157

Forty five healthy palms nearly similar in growth vigour were selected. Regular horticultural 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 7:1. Artificial pollination was uniformly performed in respect of source, date and method.

The experiment involved nine treatments representing various levels of nitrogen (inorganic, organic and bio-form). 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 organic and inorganic form applied in the studied treatments.

Treament (F)		The amount of fertilization						Total N/ palm
		Inorganic		Organic		Bio-fertilizer		
		Kg	Net/N (g)	Kg	Net/N (g)	Kg	Net/N (g)	
100% inorganic	T_1	3.000	1000	0.0	0.0	0.0	0.0	1000
75% inorg. + 25% org.	T_2	2.250	750	30	250	0.0	0.0	1000
50% inorg. + 50% org.	T_3	1.500	500	60	500	0.0	0.0	1000
25% inorg. + 75% org.	T_4	0.750	250	90	750	0.0	0.0	1000
50% org. + 50% bio.	T_5	0.0	0.0	60	500	0.500	500	1000
75% org. + 25% bio.	T_6	0.0	0.0	90	750	0.250	250	1000
50% inorg. + 25% org. + 25 bio.	T_7	1.500	500	30	250	0.250	250	1000
25% inorg. + 25% org. + 50 bio.	T_8	0.750	250	30	250	0.500	500	1000
33% inorg. + 33% org. + 33 bio.	T_9	1.000	333	40	333	334	334	1000

Nitrogen in inorganic source was added as ammonium nitrate form (33.5% N), while, farmyard manure (0.85% N) and nitrobien (N-fixing bacteria) were added as organic and bio-form, respectively. Farmyard manure was added in one dose in two exchangeable holes, 1 m apart from palm trunk in December. Nitrobien was added in two equal doses around the palm in March and May and then was directly irrigated after covering with soil. Ammonium nitrate was applied at three equal batches in March, May and July of each season.

The design of the experiment was completely randomized with five replicates, one palm per each.

Average number of newly grown leaves was determined 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) and number of pinnae. Four pinnae were taken from the middle part of each leaf to determine pinnae area (cm2) as follows:

Leaflet area = (length x maximum width x 0.84) according to Shabana and Antoun (1980), and the leaf area was estimated.

The number spathes of date palm were counted at the end of blooming season.

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

Consequently, sample of 50 fruits were taken randomly from each palm for determination of some physical and chemical fruit properties as outlined in A.O.A.C. (1985).

All the obtained data were tabulated and analyzed by the proper statistical analysis according to Snedecor and Cochran (1990) and Mead *et al*. (1993) using L.S.D. test for distinguishing the significance differences among various treatments means.

Results:

1- Vegetative growth and leaf N, P and K contents as well as residuals of soil NPK in the soil:

Data presented in Tables (3, 4 & 5) show the effect of different sources

of nitrogen fertilization on some vegetative growth aspect, leaf N, P and K contents and residuals of NPK in the soil during 2012, 2013 and 2014 seasons. It is obvious from the data that the results took similar trend during the three studied seasons. It could be observed that all nitrogen fertilization treatments had insignificant effects on number of annual new leaves per palm and leaf length. However, using the two nitrogen sources either organic plus mineral (T_2, T_3, T_4) or organic plus bio-form (T_5, T_6) as well as using the mixture of three sources (organic, bio and mineral-N (T_7, T_8 and T_9) significantly increased the pinna and leaf area as well as N, P and K contents of leaves compared to the mineral N fertilization source (T_1).

The maximum values of total leaf area and N, P & K contents of leaves were recorded in the palms that fertilized with treatment which contained the three forms (T_8 or T_9), followed in a descending order by that contained the two forms, organic and mineral-N (T_3 or T_4). The improving effects on leaf area and their N, P and K contents were associated with increasing the level of organic-N applied, whatever of two or three forms. The highest recorded leaf area (4.13 m^2) and N, P & K contents values (2.08%, 0.236% and 1.69%) over the three studied seasons are due to the use of the three forms (T_9).

Moreover, no significant differences were found in such traits with on either two forms (T_3 & T_4) or three forms (T_8) compared to the use of three form (T_9).

Moreover, data in Table (4) show that fertilization with either two forms or three forms of nitrogen fertilizers caused a significant increase in the remaining soil N compared to fertilization with the mineral source. Using the three forms, containing the third of them (T_9) gave the highest values (0.27%) of remaining soil-N in comparison with other fertilization treatments. Whereas, the remaining soil phosphorus and potassium were higher (5.66 ppm and 165 ppm) due to two form (75% organic plus 25% bio-form, T_6) and (50% organic and 50% bio-form, T_5), respectively, compared to other fertilization treatments.

These findings emphasized the important role of organic manure and bio-fertilization for the sustainability of the soil fertility and agricultural production.

2- Yield and fruit quality:

Data presented in Tables (6, 7 and 8) show the effect of different sources of nitrogen fertilization on fruiting of Seewy date palm during 2012, 2013 and 2014 seasons. In a general view, results took approximately a similar trend as all treatments during the three studied seasons.

As shown in Table (6) that all treatments of nitrogen fertilization resulted in significant increases in bunch weight over the mineral-N fertilization used (T_1). The heaviest bunch weight was detected on the palm that received the treatment of the three forms (T_9). No significant differences were found in bunch weight due to use of either the two forms (T_3 or T_4) or three forms (T_8) compared to using the three forms (T_9). The average recorded bunch weight over the three studied seasons

were 12.98, 13.37, 13.18 and 13.42 kg due to the use of T_3, T_4, T_8 and T_9, respectively compared to 11.12 kg for check treatment (T_1). Hence, the respective corresponding increment percentage due to these treatments were 16.73, 20.02, 18.58 and 20.68% of the check one (T_1).

Moreover, data presented in the perementioned tables declared that using amount of nitrogen fertilization dose in either the two forms or three forms was accompanied with improving fruit weight, dimension and flesh percentage compared to the use of mineral-N only. Increasing the level of organic-N of the two forms (T_3 & T_4) or three forms (T_8 & T_9) was accompanied with improving the chemical constituents of dates in terms of raising total soluble solids and sugar contents and in decreasing the moisture percentage. The highest values of fruit weight, total soluble solids and total sugars as well as lowest moisture content were detected on the palms that fertilized with nitrogen fertilization that contained the three forms, T_9 (third of mineral plus organic and bio-form) compared to other treatments. No significant differences was found in fruit quality due to the use of either T_3, T_4 and T_8 compared to using T_9. The average recorded fruit weight, total soluble solids (TSS) over the three studied seasons were 15.48, 15.73, 15.58 & 16.13g, 75.02, 75.36, 75.33 & 76.45% due to the use of T_3, T_4, T_8 and T_9, respectively, compared to 13.78 g and 71.78% for check treatment (T_1). Therefore, the respective corresponding increment percentage due to these treatments were 12.34, 14.15, 13.06 and 17.05% for fruit weight, as well as, 4.51, 4.99, 4.49 and 6.51% for TSS of the check treatment (mineral-N only). On other hand, the least values of fruit moisture percentage were recorded on the palms that fertilized with the three forms of nitrogen fertilization (T_9) compared to other studied fertilization treatments. The average recorded fruit moisture percentage over the three studied seasons were 19.01, 18.62, 18.64 and 18.29%, respectively, compared to 21.56% for check treatment (T_1). Hence the respective corresponding decrement percentage due to these fertilization treatments were 11.83, 13.64, 13.54 and 15.17% of the check treatment. Recorded fruit moisture percentage over the three studied seasons were 19.01, 18.62, 18.64 and 18.29%, respectively, compared to 21.56% for check treatment (T_1). Hence the respective corresponding decrement percentage due to these fertilization treatments were 11.83, 13.64, 13.54 and 15.17% of the check treatment.

Table (3): Effect of organic, bio and mineral-N fertilization treatments on the number and length of Seewy date palm leaf during 2012, 2013 and 2014 seasons.

No.		Leaf no/palm				Leaf length (cm)			
		2012	2013	2014	Mean	2012	2013	2014	Mean
100% inorganic	T_1	20.10	21.60	21.20	20.97	483.30	464.40	475.30	474.33
75% inorg. + 25% org.	T_2	19.68	21.20	20.80	20.56	480.60	462.50	472.10	471.73
50% inorg. + 50% org.	T_3	19.30	20.80	20.50	20.40	473.40	461.80	470.30	468.50
25% inorg. + 75% org.	T_4	19.60	20.80	20.35	20.25	484.30	472.90	481.40	479.70
50% org. + 50% bio.	T_5	19.20	20.50	20.45	20.05	468.20	458.00	470.50	465.60
75% org. + 25% bio.	T_6	19.45	20.70	20.60	20.25	469.00	458.70	467.50	465.10
50% inorg. + 25% org. + 25 bio.	T_7	19.80	21.15	20.90	20.62	473.00	463.20	473.50	469.90
25% inorg. + 25% org. + 50 bio.	T_8	19.50	20.95	20.70	20.38	489.50	468.10	478.40	478.70
33% inorg. + 33% org. + 33 bio.	T_9	21.15	21.40	21.50	21.02	491.40	480.10	492.00	487.80
LSD 5%		N.S.	N.S.	N.S.	-	N.S.	N.S.	N.S.	-

Table (4): Effect of organic, bio and mineral-N fertilization treatments on the area of pinna and leaf of Seewy date palm during 2012, 2013 and 2014 seasons and remaining soil (RS), N, P and K at the end of experiment.

No.	Pinna area (cm^2)				Leaf area (cm^2)				RS-NPK		
	2012	2013	2014	Mean	2012	2013	2014	Mean	N%	P (ppm	K (ppm)
T_1	179.6	185.3	182.5	182.5	3.63	3.50	3.45	3.53	0.188	3.52	105
T_2	193.0	197.6	191.6	194.1	3.96	3.94	3.85	3.92	0.245	4.82	142
T_3	197.3	200.0	196.3	197.9	4.02	3.97	3.99	3.99	0.253	5.19	147
T_4	202.1	200.5	197.6	200.1	4.17	4.01	4.01	4.06	0.274	5.61	156
T_5	188.6	192.2	191.0	190.6	3.77	3.78	3.76	3.77	0.248	5.38	165
T_6	186.0	190.8	188.6	188.5	3.76	3.78	3.79	3.78	0.239	5.66	161
T_7	186.3	190.4	188.3	188.3	3.80	3.79	3.79	3.79	0.256	4.89	145
T_8	204.3	203.0	199.6	202.3	4.20	4.06	4.02	4.09	0.265	4.90	155
T_9	201.1	206.0	202.3	203.1	4.15	4.14	4.09	4.13	0.270	5.36	157
LSD 5%	4.07	3.42	3.76		0.11	0.16	0.18				

Table (5): Effect of organic, bio and mineral-N fertilization treatments on the leaf N, P and K% of Seewy date palm during 2012, 2013 and 2014 seasons.

No.	Leaf N %				Leaf P %				Leaf K %			
	2012	2013	2014	Mean	2012	2013	2014	Mean	2012	2013	2014	Mean
T_1	1.53	1.66	1.68	1.62	0.143	0.162	0.158	0.154	1.14	1.19	1.31	1.18
T_2	1.87	2.01	2.02	1.97	0.187	0.205	0.208	0.201	1.44	1.49	1.51	1.48
T_3	1.93	2.06	2.10	2.03	0.198	0.218	0.222	0.213	1.48	1.54	1.57	1.53
T_4	2.03	2.17	2.15	2.09	0.211	0.234	0.240	0.228	1.55	1.63	1.65	1.61
T_5	1.89	2.04	2.04	1.99	0.218	0.239	0.241	0.233	1.65	1.72	1.76	1.71
T_6	1.85	1.99	2.01	1.95	0.203	0.217	0.224	0.215	1.63	1.70	1.74	1.69
T_7	1.92	2.06	2.09	2.02	0.191	0.212	0.218	0.207	1.45	1.50	1.55	1.50
T_8	1.97	2.11	2.13	2.07	0.189	0.210	0.216	0.205	1.53	1.61	1.63	1.59
T_9	1.98	2.11	2.15	2.08	0.221	0.240	0.246	0.236	1.59	1.65	1.71	1.65
LSD 5%	0.08	0.10	0.11		0.018	0.021	0.026	0.022	0.08	0.10	0.11	

Table (6): Effect of organic, bio and mineral-N fertilization treatments on bunch weight, fruit weight and flesh percentage of Seewy date palm during 2012, 2013 and 2014 seasons.

No.	Fruit weight				Bunch weight				Flesh percentage %			
	2012	2013	2014	Mean	2012	2013	2014	Mean	2012	2013	2014	Mean
T_1	13.75	14.10	13.50	13.78	11.30	10.45	11.60	11.12	86.30	86.40	86.30	86.23
T_2	14.60	15.10	14.80	14.83	11.95	11.30	12.40	11.88	87.10	87.20	87.40	87.10
T_3	15.30	15.75	15.40	15.48	13.10	12.30	13.55	12.98	87.48	87.40	87.30	87.39
T_4	15.70	15.90	15.60	15.73	13.20	13.30	13.60	13.37	87.55	87.45	87.60	87.53
T_5	14.55	15.30	15.16	15.00	11.86	11.18	12.28	11.77	86.95	87.10	86.80	86.95
T_6	14.75	15.10	15.25	15.03	11.90	11.46	12.60	11.99	86.90	87.00	86.80	86.90
T_7	14.80	15.33	15.15	15.09	12.00	11.45	12.33	11.93	86.90	87.20	87.18	87.08
T_8	15.50	15.85	15.40	15.58	13.25	12.65	13.65	13.18	87.50	87.40	87.60	87.50
T_9	16.10	16.30	16.00	16.13	13.60	12.80	13.85	13.42	87.95	87.80	88.00	87.92
LSD 5%	0.70	0.83	0.66		0.48	0.61	0.55		0.52	0.59	0.70	

Table (7): Effect of organic, bio and mineral-N fertilization treatments on fruit dimension and moisture percentage of Seewy dates during 2012, 2013 and 2014 seasons.

No.	Fruit length (cm)				Fruit diameter (cm)				Fruit moisture			
	2012	2013	2014	Mean	2012	2013	2014	Mean	2012	2013	2014	Mean
T_1	3.68	3.71	3.57	3.65	2.13	2.18	2.09	2.13	21.88	21.70	21.11	21.56
T_2	3.85	3.90	3.89	3.88	2.23	2.25	2.21	2.23	20.36	19.98	19.52	19.95
T_3	3.90	3.95	3.93	3.93	2.27	2.26	2.24	2.26	19.50	19.10	18.43	19.01
T_4	3.90	4.05	3.98	3.98	2.26	2.30	2.26	2.27	19.28	18.50	18.08	18.62
T_5	3.77	3.87	3.73	3.79	2.20	2.25	2.24	2.23	20.63	19.58	19.51	19.91
T_6	3.83	3.85	3.70	3.79	2.22	2.24	2.19	2.22	19.88	19.30	19.35	19.51
T_7	3.82	3.85	3.76	3.81	2.23	2.25	2.22	2.23	19.86	20.10	20.88	20.28
T_8	3.95	4.00	3.95	3.97	2.26	2.29	2.26	2.27	19.36	18.60	17.95	18.64
T_9	3.98	4.04	4.01	4.01	2.28	2.31	2.28	2.29	18.90	18.30	17.68	18.29
LSD 5%	0.06	0.09	0.11		0.04	0.05	0.06		0.68	0.73	0.65	

Table (8): Effect of organic, bio and mineral-N fertilization treatments on TSS, reducing and total sugars of Seewy dates during 2012, 2013 and 2014 seasons.

No.	TSS				Reducing sugars %				Total sugars %			
	2012	2013	2014	Mean	2012	2013	2014	Mean	2012	2013	2014	Mean
T_1	71.30	71.80	72.23	71.78	55.48	55.80	55.40	55.56	65.38	66.20	65.75	65.78
T_2	73.78	74.14	74.35	74.09	57.88	58.38	58.15	58.14	67.80	68.23	68.21	68.08
T_3	74.20	75.30	75.56	75.02	58.06	58.51	58.30	58.29	68.00	68.65	69.18	68.61
T_4	74.38	75.80	75.90	75.36	58.15	58.78	58.21	58.38	68.38	69.41	69.50	69.10
T_5	72.60	73.65	73.50	73.25	57.70	58.00	57.83	57.84	67.81	68.48	68.33	68.21
T_6	73.18	74.63	74.30	74.04	57.96	58.20	58.50	58.22	66.92	67.88	68.20	67.67
T_7	73.03	73.48	73.86	73.46	57.78	58.10	58.10	57.99	68.11	68.56	68.53	68.40
T_8	74.25	75.73	76.00	75.33	57.90	58.38	58.90	58.39	68.15	69.30	64.61	69.02
T_9	75.60	76.58	77.16	76.45	58.18	58.60	58.83	58.54	69.40	69.85	70.30	69.85
LSD 5%	1.36	1.61	1.71		1.08	1.10	1.24		1.18	1.43	1.62	

Hence, it could be mentioned that using the three forms of nitrogen fertilization caused the best effect in improving fruits weight and their constituents as compared to other treatments or mineral-N only. Such treatment is very important in date production since the increase fruit weight and decrease in fruit moisture percentage are the most important target for total yield and packable yield.

Discussion:

Fertilization is one of the important management tools in increasing crop productivity. Nitrogen is a necessary element for chlorophyll, protoplasm, protein and nucleic acid synthesis (Nijjar, 1985), so that its application induce an increase in the growth traits due to the increase of the cell number and its size. Major compensation to overcome the low fertility of soil is to use chemical fertilizers that become an expensive item for orchard management and environmental pollution. Using organic and bio-fertilizers are considered a promising alternative for chemical fertilizers, as well as, their safety for soil, human, animals and environment (Verna, 1990 and El-Salhy *et al*., 2010). Moreover, the organic fertilization has a positive action in increasing the activity of microflora, water holding capacity, soil structure aggregation, soil organic matter, soil humus content and the availability of most nutrients. This can induce an increasing nutrient supply and improving the efficiency of macroelements as well as its ability to meet some micronutrient requirements (El-Nagar, 1996). Such stimulation on the uptake of nutrients leads to enhance the biosynthesis of organic foods and cell division (Miller *et al*., 1990).

Bio-fertilizers are microbial inoculants that have an important role on biological, physical and chemical soil properties. There are a number of inoculants which can serve as useful components of integrated plant nutrient supply systems. Such inoculants may help in increasing crop productivity by increasing biological N fixation, availability or uptake of nutrient through solubilization or increasing absorption, stimulation of plant growth through hormonal action, antibiosis and by decomposition of organic residues (Subba-Rao *et al*., 1993 and Wu *et al*., 2005).

Hence, the fertilization using either organic or bio sources singly or in combination, as well as the use of the three fertilization sources are effective in improving the palm vigour expressed as an increase in leaf surface expansion and its nutrient status, Tables (4&5).

These findings emphasize the vital importance of these fertilization sources in order to overcome the losses of nutrients by leaching, volatilization and mobility of movement elements. These sources also, improve the soil fertility due to the highest values of the residual nutrients Table (4), enhance the solubility of nutrients and increase the activity of microorganisms.

The beneficial effects of the organic fertilizers on the growth and yield of date palm were emphasized by Osman (2003), Gobara (2004), Kenney and Hassan (2006), Ahmed (2008), Al-Wasfy and El-Khawaga (2008), Osman *et al*. (2011) and Saad *et al*. (2011).

Moreover, organic and bio-fertilizers improved the nutrient status and the total leaf surface area of the palms which led to enhance

photosynthesis and increase synthesis of carbohydrates and proteins and consequently enhance cell division and enlargement leading to increase the fruit weight and dimensions. Also, the more available carbohydrates translocated to the fruit could advance the fruit maturity and improve the fruit chemical attributes. In addition to, the importance of these fertilization treatments for the organic farming production.

Similar results were detected by El-Assar (2005), Almadini and Gossaibi (2007), Ahmed (2008), Al-Kahtani and Soliman (2012), El-Khayat and El-Noam (2013), Al-Wasfy & Abdel-Rahman (2014), Salama *et al*. (2014) and Abdel-Galil *et al*. (2014).

Conclusion:

According to the overall results, it is concluded that Seewy date palm production can rely on organic and bio-fertilization as alternative to mineral-N fertilization or at least rationalize its use in the production of organic date palm as well as increasing soil fertility, the nutritional status and yield besides reducing environmental pollution that may be occurred by excess chemical fertilizers used. Moreover, they help to maintain and preserve soil and water resources for sustainability of agricultural production and future generation.

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التأثيرات المفيدة لتقليل الأسمدة النيتروجينية المعدنية بإستخدام الأسمدة العضوية والحيوية علي إثمار نخيل البلح السيوي

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الملخص:

أجري هذا البحث علي نخيل البلح السيوي المنزرع بمزرعة خاصة ذات تربة Sandy loam بالداخلة بالوادي الجديد – مصر خلال مواسم ٢٠١٢ ، ٢٠١٣ و ٢٠١٤ بهدف دراسة التأثيرات المفيدة للإستبدال الجزئي للأسمدة النيتروجينية المعدنية بالأسمدة العضوية والحيوية علي النمو والحالة الغذائية والمحصول وخصائص الثمار. وقد صممت التجربة بنظام القطاعات كاملة العشوائية والتي تحتوي علي تسعة معاملات وثلاثة مكررات.

ويمكن تلخيص النتائج كالتالي:

- سبب التسميد بالصورة الثنائية (معدني + عضوي أو عضوي + حيوي) أو الثلاثية (معدني + عضوي + حيوي) زيادة جوهرية في مساحة الورقة ومحتوي الأوراق من عناصر NPK مقارنة بإستخدام التسميد بالأسمدة النيتروجينية المعدنية فقط. وكذلك نسبة العناصر المتبقية بالتربة.
- سجلت أعلي القياسات علي الأشجار المسمدة بالصورة الثلاثية – خصوصاً عند إستخدام ثلث الجرعة لكل من الأسمدة المعدنية والعضوية والحيوية.
- أعطي التسميد بالصورة الثنائية أو الثلاثية زيادة جوهرية لكل من وزن السباطة وخصائص الثمار الطبيعية والكيميائية وكانت أفضل القياسات لثمار الأشجار المسمدة بالصورة الثلاثية.

من نتائج هذه الدراسة يمكن التوصية بإستبدال ٥٠-٧٥% من الأسمدة المعدنية النيتروجينية بالأسمدة العضوية أو الحيوية ، حيث يؤدي ذلك إلي زيادة خصوبة التربة والمحافظة عليها بالإضافة إلي تحسين النمو الخضري والحالة الغذائية وإثمار نخيل البلح السيوي تحت ظروف التربة الطميية الرملية – فضلاً عن تقليل تكاليف التسميد ومشاكل التلوث البيئي والإنتاج العضوي لثمار نخيل البلح السيوي.