

## THE BENEFICIAL EFFECT OF MINIMIZING MINERAL NITROGEN FERTILIZATION ON SEWY DATE PALM TREES BY USING ORGANIC AND BIOFERTILIZERS

Salama, M. I. ; A. F. El-Samak ; A. A. El-Morsy and K. M. M. Aly  
Hort Dept., Fac. Agric., Kafrelsheikh Univ.

### ABSTRACT

Minimizing mineral nitrogen fertilization through using 50% organic N (FYM) + 50% mineral N (urea) with *Azotobacter chroococcum* that fixed nitrogen as biofertilizer source were tested on mature Sewy date palm trees 12- years-old grown on sandy soil in private orchard located at El-Dakhla oasis, El-Wady El-Gedeed governorate. Leaf mineral content, yield and fruit quality especially fruit heavy metals, nitrate and nitrite contents and economic evaluation comparing with the traditional nitrogen fertilization (100% mineral nitrogen) were investigated. The obtained results showed that fertilizing palm with 50% organic N+ 50% mineral N+ biotreatments tended to increase N, P, K, Ca and Mg leaf contents. Moreover, treatments, 100% mineral or 50% organic N+ 50% mineral N+ biofertilizer significantly increased the yield kg/palm without non-significant differences between them in both seasons compared to other treatments. Both treatments of 100% organic or 50% organic N+ 50% mineral N+ biofertilizer improvement physical and chemical characteristics of date fruits. Also, content of heavy metals, nitrate and nitrite significantly reduced by tested treatments especially when added combined with treatment. So, it seems that yield, fruit quality and net income/fed of Sewy date palm trees could be greatly improved through fertilizing palm trees with 50% organic N+ 50% mineral N+ biofertilizer.

**Keywords:** Date palm, organic, biofertilizer, yield, fruit quality, nitrate and heavy metals contents.

### INTRODUCTION

Date palm (*Phoenix dactylifera* L.) has been associated with people's life for many years. It is believed that this tree is blessed since it is mentioned in many verses in the Holy Quraan and in many of saying of the profit. The date palm tree has been a source of nutrition and a shelter against harsh condition. It will not only flourish in the most extreme desert conditions, but will tolerate an excess amount of alkalinity in the soil that will kill any other crop. Moreover, owing to its great height, the palm permits other crops to be planted under its shade.

In Egypt, the number of fruitful female palms is almost eleven million (11,209,539) planted in approximately 8217 feddan. The total crop of yield is estimated to be 1,166,182 metric tons of fresh, semi-dry and dry dates. The El-Wady El-Gedeed governorate is the leading governorate in either new or old land for date cultivations with an area of 43.13 and 7.84% of total number of fruitful female palm in new land and whole Egypt, respectively, whereas the production was about 36.02 and 6.03% of total production in new land and whole Egypt, respectively (according to the annual statistical records of (Ministry of Agriculture in 2009).

There is a general agreement that several factors affect productivity and fruit quality of date palm trees. One of the important factors plays a vital

role in this concern is nitrogen fertilization which considered as agent of accumulative harmful residues like nitrate and nitrite in fruits (Montasser *et al.*, 2003). Thus, a great attention is focused on minimizing the intensive amounts of mineral nitrogen fertilization especially under sandy soil which are naturally poor either in nutrient element or organic matter through using alternative organic N fertilization as well as using biofertilizers which had illustrated greater source of nitrogen as efficiencies of crops and in particular fruit crops when inoculated with organic matter or soil (Sangakkora and Weerakera, 1999). Accordingly, the present investigation was planned and conducted to evaluate the effect of combined application of mineral N (urea) and farmyard manure (FYM) as organic N fertilizer with or without *Azotobacter chroococcum* as source biofertilizer of nitrogen on leaf mineral content, yield and fruit quality as well as heavy metals, nitrate and nitrite and economic evaluation for different treatments of Sewy date palm trees grown under El-Wady El-Gedeed conditions.

## MATERIALS AND METHODS

The present investigation aimed to study the effect of different fertilizers (organic manure fertilizer mineral and biofertilizers) on productivity and date fruits quality of semi dry date palm of Sewy palm cv.

The present investigation was carried out during two successive seasons of 2008 and 2009 on Sewy date palm cultivar (*Phoenix dactylifera* L.) 12 years-old grown in private orchard located at El-Dakhla oasis, El-Wady El-Gedeed governorate, Egypt. The palm trees were planted at 7 x 7 meters apart and received the normal cultural practices commonly adopted for this area except the tested fertilization treatments.

Some chemical and physical properties of the experimental soil are presented in Table (1), 36 healthy palms similar in growth vigour were selected.

**Table (1): Analytical properties of the soil at the trail location.**

Soil properties	Before experiment
Clay %	15.68
Silt %	6.00
Sand %	78.32
Texture grade	Sandy loam
pH	7.89
EC (dS/m)	0.65
CaCO <sub>3</sub>	2.25
Soluble ions (m/L)	
Ca <sup>++</sup>	3.0
Mg <sup>++</sup>	0.80
K <sup>+</sup> + Na <sup>+</sup>	2.30
CO <sub>3</sub> <sup>-2</sup> + HCO <sub>3</sub> <sup>-</sup>	0.80
Cl <sup>-</sup>	2.28
SO <sub>4</sub> <sup>-</sup>	3.00
Total N%	1.823
OM%	1.86

**Table (2): Quantity of organic and mineral fertilizers for different nitrogen source treatments**

Nitrogen source	Quantity of fertilizers		
	Farmyard kg/palm	Urea kg/palm	Biofertilizer (mL/palm)
100% inorganic N fertilizer (control)	-	1.2	-
100% organic manure	22	-	-
100% Biofertilizers ( <i>Azotobacter chroococcum</i> )	-	-	100
50% organic N+ 50% inorganic + biofertilizer	11	0.6	100
25% organic + 75 inorganic + biofertilizer	5.5	0.9	100
75% organic + 25% inorganic + biofertilizer	16.5	0.3	100

The leaf/bunch ratio was adjusted at the end of the blooming season to meet the value of 7:1 for all experimental palms during the two seasons of study. Pollination was achieved by using pollen grains from male palm tree for all tested female under study to avoid the effect of metaxinia. Accordingly, the present investigation was planned and conducted to evaluate the effect of combined application of mineral N (urea) and farmyard manure (FYM) as organic N fertilizer with or without *Azotobacter chroococcum* as source of biofertilizer on leaf mineral content, yield and fruit quality as well as heavy metals, nitrate and nitrite and economic evaluation for different treatments of Sewy date palm trees grown under El-Wady El-Gedeed Conditions.

Nitrogen source (inorganic) was added as urea form (46.5% N) in three equal doses in March, May and July while organic manure was added as farmyard (2.5% N) at the first week of December in holes with 70 cm diameter and 70 cm depth at the distance of 1 meter from the palm trunk on one side in the first season and one the opposite side in the second season. The amount of nitrogen needed from organic manures was determined according to nitrogen percentage input (chemical analysis for total nitrogen) from source of organic manure to provide 552 g N/palm

**Yield:**

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

**Fruit quality:**

**A. Physical properties of fruits:**

Sample of 50 fruits were taken randomly from each palm (Second week of August) to determination of some physical fruit properties included:

- Fruit weight (g)
- Fruit length (L) and diameter (D) measured by vernir caliper (cm), then the fruit shape (L/D) was calculated.
- Fruit firmness was measured by using Pentameter Pressure Tester Lb/inch<sup>2</sup>.

**B. Chemical characters of fruits:**

The same previous of fruits samples were used to determine chemical characters.

- Soluble solid content (SSC).
- Reducing, non-reducing and total sugars percentage as described by Duboiss *et al.* (1956).
- Tannins % according to (Swain and Hillis, 1956).

**Leaf mineral content:**

Five leaflets were taken from the middle part of each leaf to determine:

- Nitrogen according to Chapman and Partt (1978).
- Phosphorus %as described by Murphy and Riely (1962).
- Potassium as described by Jackson, (1967).

**Chemical characters of Date fruits:**

**A. Fruit heavy metals content (ppm):**

Fruit heavy metal content Pb and Cd were determined by Perkin Elmer Atomic Absorption Spectrophotometer Model 2880, according to Jackson and Ulrich (1959) and Yoshido *et al.* (1972)

**B. Fruit nitrate and nitrite content (ppm):**

It was estimated by rapid colorimetric determination in dried date fruits by nitration of salicylic acid according to Cataldo *et al.* (1975)

**Economic evaluation:**

Economic evaluation for different nitrogen fertilization treatments was compared under conditions of this study.

**Statistical analysis:**

Data were statistically analyzed using a randomized complete block design according to procedure out lined by Little and Hills (1972). Duncan's multiple range test (DMRT) was used to compare the treatment means.

## **RESULTS AND DISCUSSION**

**Nutritional status of leaf mineral composition (N, P, K, Ca and Mg):**

In this concern, leaf of N, P, K, Ca and Mg contents of Sewy date palm was investigated pertaining the response to effect of different nitrogen fertilization treatments. Table (3) displayed that leaf in N responded to fertilization treatments. Hence, palms fertilized by 100% inorganic N had statistically the richest leaves in N in the first season only, while the differences in the second one were not significantly affected by treatments. As for P content in leaves was not significantly affected by treatments on both seasons. Data concerning K content in the same table cleared that 50% organic N+ 50% inorganic + biofertilizer treatment gave increase of K followed by 100% organic treatment in both seasons.

Regarding the effect of different nitrogen fertilizations on Ca and Mg leaf contents data in Table (3) cleared that, there were non-significant differences between all treatments in the first season and second season in Ca and Mg content, meanwhile in the second and first season in Ca and Mg, respectively, were significant. The palms fertilized with 50% organic N+ 50% inorganic + biofertilizer treatment gave the highest values during the two seasons of the study in this respect compared with the other treatments. A similar observation El-Morshedy (1997) on Zaghloul date palm trees, Omar (1997) on Hayany and Ereby palm trees, Aly, Hoda (2003) on Zaghloul and Samany palm trees.

**Table (3): Effect of different nitrogen fertilization treatments on leaf mineral content (N, P, K, Ca, Mg) of Sewy date palm trees during 2008 and 2009 seasons**

Characters	Elements (g/100 g dry weight)									
	N		P		K		Ca		Mg	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
100% inorganic (cont)	1.31 a	1.43	0.126	0.148	0.856 b	0.830 cd	1.16	1.22 b	0.53 b	0.54
100% organic	0.88 b	1.19	0.142	0.144	0.842 b	0.855 b	0.98	1.13 c	0.54 ab	0.53
Biofertilizer	0.88 b	1.09	0.121	0.154	0.812 b	0.804 e	0.936	0.81 e	0.54 ab	0.54
50% organic N+ 50% inorganic + biofertilizer	1.12 ab	1.43	0.142	0.156	0.426 a	0.940 a	1.28	1.31 a	0.55 a	0.54
25% organic + 75% inorganic + biofertilizer	1.12 ab	1.33	0.133	0.151	0.828 b	0.818 de	1.10	1.12 c	0.53 ab	0.52
75% organic + 25% inorganic + biofertilizer	0.95 b	1.21	0.141	0.142	0.864 b	0.839 bc	1.01	0.90 d	0.54 ab	0.53

Any values on the same vertical line for the character having the same letters were not statistically different according to DMRT.

**The yield:**

**a. Bunch weight:**

Data presented in Table (4) indicated that, supplying by 100% inorganic nitrogen treatment or 75% organic + 25% inorganic + biofertilizer treatment gave the highest bunch weight (13.13 and 14.29 kg/bunch) and 12.46 and 14.85 kg/bunch) in both seasons. Other treatments gave intermediate values.

**Table (4): Effect of different nitrogen fertilization treatments on number of bunches, weight of bunches and yield of Sewy date palm cultivar during 2008 and 2009 seasons**

Characters	Bunch weight		Yield/palm (kg)	
	2008	2009	2008	2009
Treatments				
100% inorganic (cont)	13.13 a	14.29 a	100.70 a	123.83 a
100% organic	11.32 b	12.28 b	83.00 b	85.98 b
Biofertilizer	11.61 b	13.45 ab	77.33 b	85.19 b
50% organic N+ 50% inorganic + biofertilizer	11.29 b	13.77 ab	105.30 a	124.00 a
25% organic + 75% inorganic + biofertilizer	11.35 b	13.67 ab	87.00 b	105.53 ab
75% organic + 25% inorganic + biofertilizer	12.46 ab	14.85 a	83.00 b	99.07 ab

Any values on the same vertical line for the character having the same letters were not statistically different according to DMRT.

**b. Yield/palm (kg):**

Data concerning yield/palm of Sewy date palm as influenced by organic, inorganic nitrogen plus biofertilizer during 2008 and 2009 seasons are presented in Table (4). Data showed that, the highest yield/palm related with palms that received 100% inorganic N or 50% organic N+ 50% inorganic + biofertilizer without significant differences between them compared to the

lowest values obtained by biofertilizer treatment which recorded (77.33 and 85.19 kg/palm).

The above results are in line with those of Kaloosh (1993), El-Morshedy (1997), Sourour *et al.* (1998), Aly, Hoda (2003) on Zaghloul and Samany date palm trees, Abdel-Hamed and Ragab (2004) on Sewy date palm trees, Marzouk and Kassem (2011) on Zaghloul date and Al-Kahtani and Soliman (2012) on Barhy date palm trees where found that organic manure alone or in combination with mineral NPK increased palm yield as compared to mineral fertilization alone.

**Fruit quality:**

**A. Physical characters:**

**a. Fruit weight:**

Data presented in Table (5) showed the effect of different nitrogen fertilization mean treatments on mean fruit weight of Sewy date during 2008 and 2009 seasons. The results showed that the differences between treatments were statistically significant.

The highest mean of fruit weight obtained from palm trees that fertilized with 50% organic N+ 50% inorganic + biofertilizer (21.21 and 24.01 g) followed by 100% inorganic N, (19.55 and 22.85 g) while the lowest values obtained from palm trees that received biofertilizer treatment (17.95 and 17.80 g) in both seasons of 2008 and 2009, respectively.

**b. Flesh weight of date fruits:**

Data presented in Table (5) cleared that, palm trees supplied by 100% inorganic or 50% organic N+ 50% inorganic + biofertilizer treatments produced high values of flesh weight compared to biofertilizer treatment.

The important role of organic manure is providing the palms with their requirements from various nutrients and the positive action of these elements in biosynthesis of organic foods as cell division (Nijjar, 1985), controlling the uptake of nitrogen by root for a long period could give a good explanation for the present effect in such physical fruit properties.

The beneficial of amending the date palm trees with organic nitrogen sources either alone or combined with mineral nitrogen sources on physical date fruits properties was confirmed by the results of Shahein *et al.* (2003) and Al-Assar (2005) they stated that Zaghloul and Samany fruit flesh weight increased as responded to fertilizing with some organic nitrogen sources either alone or combined with inorganic nitrogen sources. The same finding was emphasized by Abdel-Hamid and Ragab (2004) and Mansour *et al.* (2004) they reported that increasing the organic-N level substantially from 12.5 to 75% of recommended nitrogen dose was followed by a gradual enhancing fruit weight of Sewy date fruits.

**Table (5): Effect of different nitrogen fertilization treatments on fruit weight, flesh weight and fruit firmness of Sewy date fruits during 2008 and 2009 seasons**

Treatments	Characters	Fruit weight (g)		Flesh weight (g)		Fruit firmness (Lb/inch <sup>2</sup> )	
		2008	2009	2008	2009	2008	2009
100% inorganic (cont)		19.55 b	22.85 ab	17.38 a	20.66 a	11.72 b	10.50 cd
100% organic		18.77 bc	20.13 c	16.95 ab	16.90 c	14.2 a	14.20 a
Biofertilizer		17.05 c	17.80 d	15.35 b	15.02 d	11.00 c	9.00 d
50% organic N+ 50% inorganic + biofertilizer		21.21 a	24.01 a	17.43 a	20.93 a	11.70 b	10.98 bc
25% organic + 75% inorganic + biofertilizer		19.77 b	21.55 bc	16.25 ab	19.33 b	11.68 b	10.20 cd
75% organic + 25% inorganic + biofertilizer		18.06 c	19.93 c	15.50 b	18.65 b	11.60 b	11.65 b

**c. Fruit firmness:**

Regarding fruit firmness, data in Table (5) indicated that, the statistical analysis showed significant differences between all treatments where 100% organic N recorded significant increase (14.2 and 14.20 lb/inch<sup>2</sup>) followed by (11.7 and 10.98) recorded by 50% organic N+ 50% inorganic + biotreatment in comparison with biofertilizer treatment which had the lowest values (11.00 and 9.00 lb/inch<sup>2</sup>) in both seasons, respectively.

**d. Fruit dimensions**

Data in Table (6) cleared that, fruit length, diameter and L/D were not affected by all treatments in both seasons.

**Table (6): Effect of different nitrogen fertilization treatments on fruit length, fruit diameter, fruit shape of Sewy date palm fruit during 2008 and 2009 seasons**

Treatments	Characters	Fruit length (cm)		Fruit diameter (cm)		Fruit shape (L/D)	
		2008	2009	2008	2009	2008	2009
100% inorganic (cont)		4.2	4.1	2.66	2.60	1.58	1.66
100% organic		4.4	4.1	2.66	2.50	1.65	1.64
Biofertilizer		4.3	4.1	2.50	2.53	1.72	1.62
50% organic N+ 50% inorganic + biofertilizer		4.5	4.3	2.83	2.70	1.54	1.62
25% organic + 75% inorganic + biofertilizer		4.5	4.3	2.73	2.40	1.64	1.79
75% organic + 25% inorganic + biofertilizer		4.3	4.2	2.66	2.40	1.62	1.75

**B. Chemical characters:**

**a. SSC% and Tannin content in date fruit:**

Table (7) showed the effect of different nitrogen fertilization treatments on some fruit chemical characters SSC and Tannin%. Data in both seasons indicated that there were statistically significant differences between the different treatments and control.

Palm trees that received by 100% organic or 50% organic N+ 50% inorganic + biofertilizer treatment gave significant increase in SSC%. On the other hand, palms trees which supplying with biofertilizer or 100% inorganic treatments significant increased percentage of Tannin compared to 50% organic N+ 50% inorganic + biofertilizer treatment in both seasons.

**Table (7): Effect of different nitrogen nitrogen fertilization treatments on SSC (%) and Tannin content (%)of Sewy date palm cultivar during 2008 and 2009 seasons**

Characters	SSC%		Tannin content (%)	
	2008	2009	2008	2009
<b>Treatments</b>				
100% inorganic (cont)	23.37 b	22.47 d	0.453 a	0.437 ab
100% organic	29.17 a	33.80 a	0.437 ab	0.387 abc
Biofertilizer	24.03 b	28.57 b	0.447 a	0.467 a
50% organic N+ 50% inorganic + biofertilizer	30.07 a	30.27 b	0.363 c	0.337 c
25% organic + 75% inorganic + biofertilizer	25.53 ab	25.30 c	0.367 c	0.367 bc
75% organic + 25% inorganic + biofertilizer	29.87 a	24.87 c	0.383 bc	0.353 bc

These findings was supported by those of Shahein *et al.* (2003), Gobara and Ahmed (2004), Al-Assar (2005) and Kharusi-Latifa *et al.* (2009). They cleared that soluble solids content in Zaghloul and Samany date fruits tended to increase due to fertilizing with organic nitrogen fertilizer sources either alone or combined with artificial nitrogen source compared to artificial nitrogen fertilizers only, also decreased the percentage of tannin compound. Abdell-Hamid and Ragab (2004) and Mansour *et al.* (2004) came to similar conclusion as a result of work on Sewy date palm trees, where they found that application of nitrogen in both organic and inorganic sources was preferable than using inorganic nitrogen for improving dates quality.

**b. Sugar contents:**

The effect of different nitrogen fertilization treatments on sugar content in form reducing, non-reducing and total sugar of Sewy dates fruits during 2008 and 2009 seasons were presented in Table (8). Data cleared that, there were no significant differences between all treatments in the first season and in both seasons regarding to reducing and non-reducing sugar.

As for reducing sugar, there were significant differences in the second season. The palms trees fertilized with 100% organic or 50% organic N+ 50% inorganic + biofertilizer treatments gave significant increase on reducing sugar compared to 100% inorganic or biofertilizer treatments.

Regarding total sugar%, data revealed that, palm trees that fertilized with 50% organic N+ 50% inorganic + biofertilizer or 100% organic only produced significant increase in higher total sugar than the other fertilizer treatment. The previous results are in agreement with those reported by Al-Jubari *et al.* (1991), El-Morshedy (1996), Shahein *et al.* (2003), Al-Assar (2005), and Osman (2003) who found that sugar contents were improving in Zaghloul and Samany date fruits as a response to organic N either application partial or total of the whole N dose/palm.



**Table (8): Effect of different nitrogen fertilization treatments on reducing, non-reducing and total sugars of Sewy date palm fruits during 2008 and 2009 seasons**

Treatments	Characters	Reducing sugars		Non-reducing sugars		Total sugars	
		2008	2009	2008	2009	2008	2009
100% inorganic (cont)		19.87	20.23 c	10.03	10.30	29.90 cd	30.53 ab
100% organic		24.46	27.13 a	10.10	5.63	36.63 a	32.76 ab
Biofertilizer		19.87	18.23 c	7.20	9.88	26.83 d	28.11 b
50% organic N+ 50% inorganic + biofertilizer		26.24	26.50 ab	10.32	10.00	36.56 a	33.50 a
25% organic + 75% inorganic + biofertilizer		22.67	24.01 b	10.20	9.77	32.87 bc	33.78 a
75% organic + 25% inorganic + biofertilizer		23.65	23.66 b	10.15	10.11	33.80 ab	33.78 a

The same results emphasized in Sewy date fruits by Abdel-Hamid and Ragab (2004), Mansour *et al.* (2004) and Marzouk and Kassem (2011) who reported that, application of organic manure or its supplementation with mineral NPK enhancement chemical fruit quality compared to mineral fertilization alone.

**Fruit heavy metals, nitrate and nitrite contents:**

Data in Table (9) indicated that, fruit nitrate and nitrite contents were significantly decreased by different treatments in the two seasons comparing with 100% inorganic N (control), which gave the highest values on nitrate content (47.02 and 56.31 ppm), (8.500 and 8.06 ppm) followed by 25% organic + 75% inorganic + biofertilizer treatment (45.96 and 62.03 ppm), (7.86 and 7.83 ppm). Meanwhile, palms fertilized by 100% organic, biofertilizer treatment and 50% organic N+ 50% inorganic produced fruits with low nitrate and nitrite contents in both seasons. This mean that values of replacing nitrogen fertilization partially through using only 50% organic N+ 50% inorganic + biofertilizer instead of 100% mineral N form had a beneficial effect on reducing nitrate and nitrite in fruit tissue.

**Table (9): Effect of different nitrogen fertilization treatments on nitrate and nitrite contents in fruits of Sewy date palm fruits during 2008 and 2009 seasons**

Treatments	Characters	Nitrate (ppm)		Nitrite (ppm)	
		2008	2009	2008	2009
100% inorganic (cont)		47.02 a	56.31 a	8.50 a	8.06 a
100% organic		36.88 d	49.03 de	6.06 e	6.03 e
Biofertilizer		35.77 d	46.04 e	5.06 f	5.00 f
50% organic N+ 50% inorganic + biofertilizer		44.69 b	52.56 c	6.90 c	6.56 c
25% organic + 75% inorganic + biofertilizer		45.96 ab	62.03 b	7.86 b	7.83 b
75% organic + 25% inorganic + biofertilizer		40.34 c	51.03 cd	6.63 d	6.30 d

As for heavy metals Pb and Cd contents data in Table (10) indicate a slight increase in Pb and Cd by using 100% inorganic N control compared with the other treatments in both seasons.

The palm trees fertilized with biofertilizer or 100% organic N produced fruit with the lowest value of Pb and Cd contents. Similar results were reported by Harhash and Abd El-Nasser (2000) on grapevine, Aly, Hoda (2003) on Zaghloul and Samany date palm trees, and Abd El-Migeed *et al.* (2007) on Navel orange trees.

Generally, high concentration of heavy metals such as leads, cadmium, nickel and cobalt were found in mineral fertilizers as reported by Hassanein and Kandil (2007).

Heavy metals, like Pb and Cd in salt form, are much more available for plant uptake and potentially toxic than those held in organic matrix (Kabata Pendias and Adriano, 1995; Bhattacharyya *et al.*, 2005).

**Table (10): Effect of different nitrogen fertilization treatments on some heavy metals (Pb and Cd) in fruits of Sewy date palm fruits during 2008 and 2009 seasons**

Characters	Pb (ppm)		Cd (ppm)	
	2008	2009	2008	2009
<b>Treatments</b>				
100% inorganic (cont)	1.057 a	1.037 a	0.040 a	0.063 a
100% organic	0.773 d	0.780 f	0.008 b	0.011 b
Biofertilizer	0.747 d	0.803 e	0.008 b	0.011 b
50% organic N+ 50% inorganic + biofertilizer	0.917 bc	0.910 c	0.011 b	0.008 b
25% organic + 75% inorganic + biofertilizer	0.973 b	0.970 b	0.011 b	0.007 b
75% organic + 25% inorganic + biofertilizer	0.867 c	0.860 d	0.009 b	0.008 b

The phenolic and carboxyl functional groups on organic matter form stable complexes with metals through the cation exchange property, or chelating the metals (Kabata-Pendis, 2001). Therefore applying organic fertilizers could result in the fixation of these elements and decrease their available amount for plant uptake (Bell *et al.*, 1991). In addition, the formation of soluble organic forms of heavy metals and their mass transport through canalization may result in their movement from the surface layers (Berti and Jacobs, 1998), where most of the absorbing roots of the date palm trees are present (Oihabi, 1991). The previous discussion might explain the lower values of Pb and Cd content in the fruit by application of organic fertilizers than mineral fertilization only.

Similar increase in nitrate and nitrite contents by the application of organic manures combined with mineral fertilizers was obtained by Shahein *et al.* (2003) who reported that combining organic manure with the mineral fertilizer ammonium nitrate might lead to the increase in ammonium cations and the synthesis of nitrate and nitrite.

**Economic evaluation:**

Economic evaluation of different nitrogen fertilization treatments used in this study is an attempt to put light on the beneficial effects of organic and biofertilizer-fertilizers as alternative to mineral fertilizers. The evaluation depended on estimating the total costs of production, crop value and net income/feddan as shown in Table (11). Total costs for used fertilizers including all chemical fertilizers for treatments were calculated.

**Table (11): Economic evaluation of different nitrogen fertilization treatments (LE/fed.) in 2008 and 2009 seasons**

Characters Treatments	Calculated cost/fed		Crop value/fed.		Net income/fed.	
	2008	2009	2008	2009	2008	2009
100% inorganic (cont)	142.8	142.8	25878.05	29958.25	25735.25	29815.45
100% organic	280.5	280.5	21169.0	24692.5	20888.5	24412.00
Biofertilizer	85	85.0	197919.15	21723.5	147834.15	21638.50
50% organic N+ 50% inorganic + biofertilizer	296.69	296.65	26851.5	36890.0	26554.811	36593.35
25% organic + 75% inorganic + biofertilizer	262.225	262.225	22185.0	31395.0	21422.775	31133.535
75% organic + 25% inorganic + biofertilizer	652.37	652.37	21165.0	20473.3	20512.63	14820.93

The results manifested that, calculated cost/fed for used fertilizers was 142.8 LE for the control treatment, 280.5 for 100% organic treatment, 85 LE for biofertilizer treatment, 296.69 LE for 50% organic N+ 50% inorganic + biofertilizer treatment, 262.22 for 25% organic + 75% inorganic + biofertilizer and 652.3 for 75% organic + 75% inorganic + biofertilizer. Concerning crop value/fed., the highest recorded was obtained from palm trees fertilized with 50% organic N+ 50% inorganic + biofertilizer. This value recorded 26851.5 and 36890.4 L.E., while the lowest recorded (19719.15 and 21723.4) resulted by biofertilizer treatment in both seasons, respectively. Regarding net income/fed. the treatment 50% organic + 50% inorganic + biofertilizer gave the largest return (26554.8 and 36593.35 LE) whereas the lowest value resulted from the biofertilizer treatment.

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**التأثير الإيجابي للحد من استخدام التسميد النتروجيني على أشجار نخيل البلح  
السيوى باستخدام الأسمدة العضوية والحيوية  
محيى الدين ابراهيم سلامة ، عبد الحميد فايد السمك ، عبد الوهلب المرسي  
خضر محمود محمد على  
قسم البساتين - كلية الزراعة - جامعة كفر الشيخ**

أجريت هذه الدراسة خلال موسمى 2008 و 2009م على أشجار نخيل البلح السيوى عمر 12 عام والمزروعة تحت ظروف واحة الداخلة بمزرعة خاصة بمحافظة الوادى الجديد وذلك بهدف دراسة تأثير معاملات التسميد النتروجينى المختلفة (عضوى - معدنى - حيوى) والتداخل بينهم مقارنة بالتسميد المعدنى (الكنترول) على المحصول وجودة ثمار البلح وكذلك محتوى الأوراق من العناصر ومحتوى الثمار من النترات والنترت والعناصر الثقيلة بالإضافة إلى التقييم الإقتصادى للمعاملات. وقد تضمنت الدراسة أربعة معاملات بالإضافة إلى معاملة الكنترول (التسميد المعدنى) وهى كالاتى 100% تسميد معدنى (كنترول) ، 100% عضوى ، 100% حيوى ، 50% عضوى + 50% معدنى + 50% حيوى ، 25% عضوى + 75% معدنى + 75% حيوى و 75% عضوى + 25% معدنى + 25% حيوى. وقد أظهرت النتائج أن تسميد أشجار نخيل البلح السيوى بـ 50% عضوى + 50% معدنى + 50% حيوى أدى إلى زيادة محتوى الأوراق من النتروجين والفوسفور والبوتاسيوم والكالسيوم والمغنسيوم إضافة إلى ذلك فقد سجلت الأشجار التى تم تسميدها بـ 100% معدنى أو 50% عضوى + 50% معدنى + 50% حيوى أعلى محصول فى حين أدت معاملة التسميد 100% عضوى أو 50% عضوى + 50% معدنى + 50% حيوى إلى تحسين خواص الثمار الطبيعية والكيمائية، فى حين خفضت جميع المعاملات تحت الدراسة من محتوى الثمار من النترات والنترت والعناصر الثقيلة خاصة مع معاملة التسميد الحيوى مقارنة بالكنترول. لذا بالاعتماد على النتائج المتحصل عليها يمكن تسميد أشجار نخيل البلح السيوى تحت ظروف هذه الدراسة بـ 50% عضوى + 50% معدنى + 50% السماد الحيوى وذلك للحصول على أعلى محصول وأعلى صافى ربح للفدان وأفضل جودة للثمار.

**قام بتحكيم البحث**

كلية الزراعة – جامعة المنصورة  
كلية الزراعة – جامعة كفر الشيخ

أ.د / محسن فهمى  
أ.د / سمير محمود زعربان