

## Effect of Bio and Mineral Nitrogen Fertilizers on Growth and Productivity of Sultani Fig Trees Under Northern Western Condition

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### ABSTRACT

This investigation was carried out during 2007 and 2008 growing seasons on ten years old Sultani fig trees , grown in a sandy clay loam soil in a private farm located at Alex.- Matrouh road ,in order to study the effect of mineral N fertilizer ( Ammonium Sulphate 20.6 % N) at rates 50 , 75 and 100 % of the recommended dose ( 3 Kgs / tree ) either alone or in combination with Biogein biofertilizer (100 gm / tree ) on vegetative growth , fruit set , yield , fruit quality and leaf mineral content during both seasons of studying . Results showed that vegetative growth, fruit set, yield as weight or number of fruits / tree as well as fruit quality (Average fruit weight, diameter, length, TSS and total sugars) and leaf N content were generally, improved under all treatments as compared with control in both seasons. While, slight effects on acidity and leaf P content were noticed. The studied treatments did not significantly affect fruit V.C. and leaf K content in both seasons. The striking treatments 50 and 70% of the recommended N rate + biofertilizer were most effective in improving all parameters when compared with other treatments. It is worthy to note that using treatments 50 or 75% of the recommended dose of N + bio fertilizers had a similar effect to the treatment 100% of recommended N without biofertilizer. Hence, it could be concluded that, using Biogein as biofertilizer can reduce about 25 to 50% of N- mineral fertilizer and improved growth, productivity and quality of Sultani fig trees.

### INTRODUCTION

The figs, *Ficus carica*, L. is considered one of the most important commercial fruit trees which grow successfully in Egypt and their fruits are from the most popular for local consumption. The total area of fig orchards increased to 80563 feddans and the total annual production was about 262307 tons of fresh fruit in Egypt in 2007 (according to the latest statistics of Ministry of Agriculture and Land Reclamation in 2007). More than 80% of the new established fig orchards were along the North Western Coast of Egypt and it considered the main area of fig production (new cultivated

area) where the "Sultani" variety is the most widely grown and its main crop ripens from early July to November (Rokba *et al.*, 1985)

Fertilization is considered an important practice during the growing season to obtain an economic yield and to improve the fruit quality characters. In Egypt, most growers usually apply mineral fertilizers in large quantities, especially nitrogen fertilization. The consumption per hectare of chemical fertilizers has reached about ten times more than average consumption of the whole world (FAO, 1994).

In recent years and because of the environmental awareness nowadays, the demand for minimizing the use of chemical fertilizers has directed the production techniques to use harmless, low polluted and less expensive fertilizers such as bio fertilizers.

Biofertilizers are biological preparations containing primarily potent strains of microorganisms in sufficient numbers which are safe for human, animal and environment when it be handled with field applications. They have definite beneficial roles in the fertility of soil rhizosphere and the growth of the plants. They are proved to eliminate the use of pesticides sometimes, and rebalance the ratio between plant nutrients in the soil (Tchan, 1988). They also increase crop yields and decrease the cost of some agricultural practices (Ishac, 1989 and Saber, 1993). They are capable of nitrogen fixation (Ruiz - Lozano *et al.*, 1995) as well as enhancing availability of nutrients (Frankenberger and Arshad, 1995).

Biofertilizers application with a half dose of chemical nitrogen fertilizer proved to be an efficient tool in increasing available nutrients in the soil as well as growth performance and yield of different fruit trees are also improved ( Awasthi *et al.*, 1998; Gabr and Nour EL-Dein, 2005 ; Rania , 2005 ; Yousif and Marzouk , 2005 ; Eman , 2006 and Eman *et al.* , 2008 ).

Accounting for the aforementioned aspects, this trial was planned to study the effect of using Biogein as biofertilizer containing (N- Fixing bacteria) and mineral N fertilizer, [ammonium sulphate (20.6% N) at different rates either alone or in combinations on growth, leaf mineral content, yield and fruit quality of Sultani fig trees grown in sandy clay loam soil and the efficiency of bio fertilizers, in reducing the application rate of N fertilization without any risk on fruit yield and quality.

## MATERIALS AND METHODS

The present study was carried out during 2007 and 2008 successive seasons on 10 years old Sultani fig trees , grown in a sandy clay loam soil of a private farm located at Alex .- Matrouh road and spaced at 5x5 meters apart . Physio – chemical properties of soil characters are

listed in Table (1). Trees in this orchard were annually fertilized with 15m<sup>3</sup> /feddan of organic manure in December of each year and 1.5kg of calcium super phosphate (15.5 % P<sub>2</sub>O<sub>5</sub>). Also, 1.0 Kg ammonium sulphate (20.6%N) and 2kg of potassium sulphate (48%K<sub>2</sub>O) per tree were added as soil application in three equal doses at March, April and June (control). Trees were selected as uniform as possible, free from any pathogens and received different mineral and biofertilizer applications. The mineral fertilizer ammonium sulphate (20.6 N) was added as a percent of the recommended rate by Ministry of Agric. i.e. (3Kgs / tree) and divided into three equal doses at April, June and 1st of August. The biofertilizer (Biogein) was produced by the General Organization for Agricultural Equalization Found, Ministry of Agriculture, and Egypt. At the last week of January, a quantity of 100gm Biogein per tree was added to the wetted soil. The experimental trees were subjected to seven treatments representing different applications of mineral N and / or Biogein as follows:

- 1- Control ( adopted fertilization in the farm )
- 2- 100% of the recommended rate of N ( 3.0kgs / tree )
- 3- 75 % of the recommended rate of N ( 2.25kgs /tree )
- 4- 50 % of the recommended rate of N ( 1.5 Kgs /tree )
- 5- Biogein biofertilizer only 100g /tree (BF)
- 6- 75 % of the recommended rate of nitrogen + ( BF )
- 7- 50 % of the recommended rate of nitrogen + ( BF )

Treatments were arranged in a Randomized Complete Block Design with 4 replications for each treatment using three trees as a single replicate (7 treatments X 4 replicates X 3 trees = 84 trees. Nitrogen fertilizer treatments were broadcasted on the soil surface 0.5-1.0m apart from the tree trunk. The Biogein fertilizers was mixed with sand and broadcasted on the soil surface and trees were irrigated after application. The following parameters were recorded and calculated in both seasons:

#### **1- Vegetative growth :**

At the beginning of both growing seasons , on early April , eight new shoots well distributed around periphery of each replicate tree were randomly selected and labeled ( 2 shoots toward each direction), total number of shoots per tree and length of each shoot ( cm ) were measured when the growth was ceased (October, 30) in both seasons. Five leaves were collected randomly from the first fully mature leaves from the tip of the previously tagged shoots and their areas (cm<sup>2</sup>) were measured using a planimeter. Also, total leaf chlorophyll content was determined in the same fresh leaves according to the method described

by Yadava (1986) using Minolta Chlorophyll Meter Spad-502 (Minolta Camera, LTD Japan).

#### **2- Leaf minerals content :**

Sample of five leaves was randomly selected from the middle part of non fruiting shoots of each replicate tree in both seasons. The selected leaves were washed with tap water, rinsed with distilled water and oven dried at 70°C to constant weight and then grounded. The grounded leaf samples were digested with sulfuric acid and hydrogen peroxide according to Evenhuis and Dewaard (1980). Suitable aliquots were taken for the determinations of N, P and K. Nitrogen and Phosphorus were determined calorimetrically according to Evenhuis (1976), and Murphy and Riley (1962), respectively. Potassium content was determined by a Flame photometer.

#### **3- Fruit set percentage :**

The total numbers of buds were recorded and then numbers of syconia on the selected shoots were counted to calculate the percentage of fruit set.

#### **4- Yield and fruit quality :**

The total yield (kg) of each replicate tree was calculated using the average fruit weight (gm) and the total number of fruits per tree. The number of fruits per each experimental tree was counted on 15 July in both seasons. At harvesting time, 1<sup>st</sup> August, of both seasons, eight fruits were taken at random from each replicate tree to determine fruit quality (average fruit weight (gm), diameter (cm) and length (cm). In juice of each fruit sample, total soluble solids (TSS) percentage was determined by a hand refractometer and the percentage of acidity was measured according to A.O.A.C. (1995). Vitamin C was determined by titration with dichlorophenol indophenol blue dye and expressed as mg vitamin C/ 100 ml juice. Total sugars in fruit pulp tissues were determined by phenol sulfuric method according to (Dubois *et al.*, 1956).

Data were statistically analyzed according to Snedecor and Cochran (1990) and L.S.D test at 0.05 levels was used for comparison between treatments.

## **RESULTS AND DISCUSSION**

### **1- Vegetative growth:**

It is quite evident as shown in Table ( 2 ) that all the evaluated growth measurements ( average shoot length ,total number of shoots and leaf area) as well as leaf chlorophyll content of Sultani fig

trees were statistically affected by all mineral and bio N fertilization treatments either applied alone or in combinations as compared with the control treatment . Meanwhile, the combination representing 75% of the recommended rate of N + Biogein bio fertilizer was the most effective treatment as it gave the best results while 50% of the recommended rate of N + Biogein was intermediate. However, the lowest values of the studied vegetative growth parameters were recorded when N- fertilizer was added at the lowest rate of 50% of recommended rate of N alone as compared with the control treatment. No significant differences were noticed for this treatment except in the second season for shoot length and in the first season for total number of shoots and total chlorophyll in both seasons. The data followed to a great extent the same trend of response during both seasons. These results may be due to the role of N fertilizer on promotion of vegetative growth of plants due to its association with many plant growth substances and the role of bio-fertilizers i.e. biogein on increasing the availability of nutrients to plant absorption which in turn on increasing the vegetative growth ( Subbo – Rao , 1988 and Wange , 1997). Also, the enhancement of plant growth due to asymbiotic N – fixers could be attributed to the capability of these organisms to produce growth regulators such as auxins, cytokinines and gibberellins which affect the production of root biomass and nutrients uptake (Jadhav *et al.*, 1998). These results are in line with those reported by Abou Taleb *et al.*, (1999) and Eman (2006) on pomegranate and Rania (2005) and Eman *et al.*, (2008) on grapevine.

## **2- Fruit set and yield:**

As for the effect of bio and mineral N fertilizer applied alone or in combinations , it is clear from Table ( 3 ) that fruit set and yield as number or weight ( Kg / tree ) of fruit were significantly increased with increasing the N rates or with Biogein whether applied alone or in combinations with each other . Thus the treatment (75% of the recommended rate of N + Biogein) gave significantly the highest fruit set %, number and weight of fruits per tree than most of other treatments. In addition, applying 75 % or 50% mineral N fertilizers + biofertilizer gave almost the same effect on yield. The improvement in setting and yield measurements due to biofertilizers application may be attributed to the stimulating effect of the absorbed nutrients on photosynthesis process which certainly affected positively the measurements of both flowering and fruiting aspects (Youssef *et al.*, 2001, Zaghloul, 2002 and Safia *et al.*, 2004). These results are in agreement with those obtained by Akl *et al.*, (1997) and Mansour (1998). They reported that, Phosphorin, active dry yeast and

Nitrobein were very effective in improving the yield. On the other hand. Gomez and Munoz (1998) stated that, biofertilizers did not totally replace mineral fertilization, but they significantly reduced their rates of application.

### **3- Fruit quality:**

The results in Table (4) showed that gradually and significantly increased for fruit physical and chemical properties i.e. fruit weight, diameter, length, TSS and total sugars with increasing the level of N- fertilizer from 50, 75 to 100 % of the recommended rate and / or Biogein as compared with the control. Acidity, however showed an opposite trend, additionally, V.C. was not significantly affected.

Data in Table (4) also cleared that the highest records of the studied fruit quality parameters were recorded with trees received 75 % of nitrogen fertilizers + Biogein followed by 50 % of nitrogen fertilizer + Biogein. However, 50 % of the recommended N rate when applied alone was the lowest. While, applying 50 or 75 % of the recommended N + Biogein significantly decreased acidity especially in the first season. The stimulus effect of biofertilizers application may be attributed to the promotive effect on the parameters of plant growth which are enable to absorb more minerals by its root system and thus reflected on total fruit yield and its properties (Sangakkora and Weerakera, 1999). Finding of many investigators gave a real support to our results Abd El – Hameed (2002), Rania (2005), Yousif and Marzouk (2005), El- Desuki *et al.*, (2006) and Eman (2006).

### **4- Leaf mineral content:**

Data concerning the effect of the investigated treatments on leaf minerals content during the two experimental seasons are shown in Table (5). The tabulated data indicated that, nitrogen content was markedly increased with increasing nitrogen rates whether alone or in combination with Biogein biofertilizer when compared with the control. In the meantime, leaf P content increased by adding 100 % of the recommended N rate alone or in combination with Biogein with 75% or 50% of the recommended N rate treatments. The differences were so few to be significant in the first season only. However, leaf K content was not significantly affected by different treatments in both seasons. Such effect may be attributed to that applying biofertilizers stimulates the living microorganisms in soil to work on the organic matter included and consequently convert the organic forms of some unavailable nutrients to available mineral form that certainly reflected on increasing nutrients uptake (Soliman, 2001, Abou EL-khashab, 2002, and Rania, 2005).

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**Table (1) Physical and chemical analysis of soil.**

Soil depth (cm)	CaCO <sub>3</sub>	pH	EC dS/m	Soluble Cations				meq/L	Soluble anions			Mechanical Analysis %			Soil texture
				Na <sup>+</sup>	K <sup>+</sup>	Ca <sup>+</sup>	Mg <sup>+</sup>		CO <sub>3</sub> <sup>2-</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>-</sup>	Sand	Silt	
0-30	28.0	8.0	0.75	3.84	0.36	2.38	0.92	-	2.60	3.64	1.26	81.73	7.02	11.25	SL
30-60	28.0	9.1	0.61	2.16	0.26	2.04	1.04	-	2.44	3.30	0.36	67.53	14.24	18.23	SL
60-90	35.2	8.7	0.45	2.09	0.21	1.78	0.44	-	1.60	2.66	0.24	52.49	15.18	21.51	SCL

**Table (2) Effect of bio and mineral N-fertilizers on some vegetative growth parameters and total leaf chlorophyll of Sultani fig trees during 2007 and 2008 seasons.**

Treatments	Average shoot length (cm)		Total number of shoots/Tree		Leaf area (cm) <sup>2</sup>		Total Chlorophyll	
	2007	2008	2007	2008	2007	2008	2007	2008
		36.75	40.38	91.22	95.00	180.0	195.0	21.59
Control	39.44	44.68	98.44	100.11	205.0	220.0	26.11	29.35
100% of the recommended rate of N	38.82	43.22	96.50	98.22	200.0	211.0	25.16	29.31
75 % of the recommended rate of N	36.18	42.90	94.00	96.00	187.0	200.0	23.66	27.45
50 % of the recommended rate of N	39.00	43.00	97.35	100.00	200.0	210.0	25.18	28.10
Biogein Biofertilizer (BF)								
75 % of the recommended rate of N+ (BF)	41.19	46.00	99.75	103.64	220.0	231.0	27.28	29.87
50 % of the recommended rate of N+ (BF)	40.50	45.77	97.80	101.50	215.0	225.0	27.00	29.80
L.S.D. 0.05	0.44	0.39	0.61	1.35	13.06	15.49	0.12	0.77

**Table (3): Effect of bio and mineral N fertilizers on fruit set percentage and yield of Sultanl fig trees during 2007 and 2008 seasons.**

Treatments	Fruit set %		No. of fruits / tree		Yield/tree Kg / tree	
	2007	2008	2007	2008	2007	2008
	Control	11.72	13.70	412	435	15.21
100% of the recommended rate of N	17.11	17.28	453	454	18.11	19.83
75 % of the recommended rate of N	16.00	16.25	426	449	16.52	19.55
50 % of the recommended rate of N	14.28	14.55	413	444	16.22	19.00
Biogein Biofertilizer (BF)	16.55	16.74	429	453	16.87	19.75
75 % of the recommended rate of N + (BF)	18.82	19.85	458	464	18.53	20.71
50 % of the recommended rate of N + (BF)	17.00	18.00	450	454	18.13	20.00
L.S.D. 0.05	0.30	0.33	16	11	1.66	1.41

**Table (4) Effect of bio and mineral N fertilizers on some fruit quality parameters of Sultanl fig trees during 2007 and 2008 seasons.**

Treatments	Fruit weight (gm)		Fruit diameter (cm)		Fruit length (cm)		Vitamin C mg / 100ml		Acidity (%)		T.S.S (%)		Total sugars (%)	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
Control														
100% of the recommended N	36.90	39.00	3.35	3.85	3.15	3.60	1.3	1.4	0.25	0.23	12.11	13.21	39.57	40.11
75 % of the recommended N	39.96	43.65	5.15	6.00	4.20	5.17	1.5	1.5	0.22	0.20	15.15	16.17	42.88	44.75
50 % of the recommended N	38.77	43.54	4.75	5.80	4.00	5.11	1.5	1.5	0.22	0.20	14.40	15.41	41.42	42.61
Biogein Biofertilizer BF	39.20	42.79	4.70	5.75	3.54	4.44	1.4	1.4	0.23	0.20	14.30	15.00	40.33	42.00
75 % of the recommended N + BF	39.32	43.59	5.00	5.94	5.15	5.00	1.4	1.6	0.20	0.19	16.22	17.53	42.00	43.55
50 % of the recommended N + BF	40.45	44.63	6.00	6.77	6.30	6.37	1.6	1.7	0.18	0.17	18.55	18.33	44.11	46.33
L.S.D 0.05	40.02	44.05	5.66	6.40	6.00	6.35	1.6	1.7	0.18	0.17	17.50	18.00	43.55	45.10
	1.87	1.30	0.76	1.99	0.55	0.18	N.S	N.S	0.07	N.S	2.18	1.08	1.14	1.77

**Table (5): Effect of bio and mineral N fertilizers on leaf mineral content of SultanI fig trees during 2007 and 2008**

Treatments	N %		P %		K %	
	2007	2008	2007	2008	2007	2008
Control	1.38	1.40	0.20	0.22	1.08	1.11
100% of the recommended rate of N	1.76	1.87	0.28	0.29	1.14	1.17
75 % of the recommended rate of N	1.72	1.83	0.27	0.28	1.12	1.14
50 % of the recommended rate of N	1.70	1.80	0.26	0.26	1.12	1.13
Biogein Biofertilizer (BF)	1.75	1.85	0.26	0.28	1.13	1.13
75 % of the recommended rate of N + BF	1.92	2.05	0.29	0.29	1.17	1.19
50 % of the recommended rate of N + BF	1.86	1.90	0.28	0.28	1.17	1.17
L.S.D 0.05	0.21	0.13	0.08	N.S	N.S	N.S

## الملخص العربي

### تأثير التسميد النيتروجيني الحيوي والمعدني علي نمو وإنتاجية أشجار التين السلطاني تحت ظروف الساحل الشمالي الغربي .

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أجري هذا البحث عامي 2007 - 2008 علي أشجار تين صنف سلطاني عمرها 10 أعوام ومزروعة في أرض رملية طميية بمزرعة خاصة علي طريق إسكندرية - مطروح الساحلي لدراسة تأثير التسميد النيتروجيني المعدني والحيوي مضافين منفرديين أو معا علي النمو وعقد الثمار والمحصول ومحتوي الأوراق من العناصر وصفات جودة الثمار ، وقد أضيف السماد النيتروجيني المعدني في صورة كبريتات امونيوم بمعدلات 100 % ، 75 % ، 50 % من الجرعة الموصي بها وذلك لكل شجرة وأضيف السماد الحيوي بيوجين بمعدل 100 جرام لكل شجرة في كلا موسمي الدراسة . وقد أوضحت النتائج ان كل المعاملات أدت إلي زيادة واضحة في طول الأفرخ وعدد الأفرخ بالشجرة والمساحة الورقية ومحتوي الأوراق من الكلوروفيل والنيتروجين .

كذلك وجد تحسن واضح في نسبة عقد الثمار والمحصول وبعض صفات جودة الثمار ( وزن وطول وعرض الثمار والمواد الصلبة الكلية والسكريات الكلية) بينما قلت الحموضة ، وذلك بالمقارنة بمعاملة الكنترول .

كان هناك زيادة بسيطة في محتوى الأوراق من الفوسفور ونقص في حموضة الثمار في الموسم الأول بينما لا يوجد تأثير واضح علي فيتامين ج ومحتوي الأوراق من البوتاسيوم خلال موسمي الدراسة كانت المعاملتان الأكثر تأثيرا 50 % ، 100 % من الجرعة الموصي بها من التسميد النيتروجيني المعدني + السماد الحيوي علي جميع المعاملات خلال موسمي الدراسة والتي أدت إلي تحسن واضح في معظم النتائج تحت الدراسة .

ومن الجدير بالذكر أن استخدام المعاملتان 50 ، 75 % من الجرعة الموصى بها من النيتروجين مع السماد الحيوي كانت تماثل استخدام المستوي 100 % من التسميد النيتروجيني بدون التسميد الحيوي وهذا يوضح ان التسميد الحيوي بالبيوجين يمكن أن يوفر حوالي 25 الي 50 % من السماد الأزوتي وكذلك يحسن نمو ومحصول و صفات ثمار أشجار التين السلطاني .