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IMPACT OF MINERAL, ORGANIC AND BIO-FERTILIZERS ON LEAF MINERAL CONTENTS, BUNCH CHARACTERS AND YIELD OF ZAGHLOUL DATE PALM

Zagzog, O.A.I.[1, *] and Selim, M.A.F.[2]

[1]Plant Production Dept., Fac. Technology & Development, Zagazig Univ., **Egypt.**
[2]Citrus Research Dept, Horticulture Research Institute, Agricultural Research Center, **Egypt.**

[*]**Corresponding author:** zagzog_1000@yahoo.com **Received:** 10 Dec. 2020 **; Accepted:** 15 Jan. 2021

ABSTRACT: The experiment carried out in El Adlia, Blbas, Sharkia Governorate, Egypt during two successive seasons (2017 and 2018). This study was conducted to investigate the responses of date palm (*Phoenix dactylifera*, L.) cv Zaghloul, to nine different fertilizers treatments i.e. control (0.0 N), and full nitrogen dose (as recommended) shared between three sources of nitrogen i.e. mineral (N), organic (Org) and bio (M) forms and its various possible combinations. The results showed that fertilization treatments significantly affected leaf N, P and K percentages and led to increase bunch weight (kg) and yield/tree (kg) compared with control treatment. Bio-fertilization treatment registered the highest values of bunch weight and yield/tree and the least were recorded by the control treatment. Full N dose as mineral fertilizer gave the highest values of N percentage. The highest values P percentage obtained from the palms fertilized by half-N dose of both organic and mineral+ bio-fertilizers (EM). Meanwhile, the highest values of K recorded with the palms received quarter organic + 3/4 mineral forms. The lowermost values of N, P, and K percentages were recorded by unfertilized palms (control). Bio-fertilizer form improved number of strands/bunch and number of fruits/strands followed by full N dose as organic fertilizer+ bio-fertilizers (EM) in the first season and with bio-fertilization the second season. The least values of number strands/bunch, number of fruits/strands, strands length and length of place of fruit on strand recorded by the control treatment. Bio-fertilization treatment registered the highest values of bunch weight and yield/tree. Adversely the least values recorded by the control treatment, meanwhile other various combinations between N sources treatments were in between in this respect.

Key words: Date palm, fertilizer, organic, bio-fertilizer, bunch characters, yield**.**

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) was an important crop in arid and semi-arid regions of the world. Zaghloul cv.is one of the very important local date in Egypt. Date palm needs additional mineral nutrients as well as application of organic matter to enhance water soil retention. and their fruits play an important role in the nutrition pattern of many people and economic turn and social life. Owing to date palm can grow and produce under a wide range of soil and climatic conditions, growers have mistakenly believed that it does not require much attention. The successful orchard management practices directed toward obtaining a suitable yield with good fruit quality. It has well known that the nutrient requirements of the date palms could fulfilled through the fertilizers application for inter planted crops. Various sources of fertilizers i.e. mineral, organic and bio increase the leaf mineral contents **(Marzouk, 2011 and Amro *et al.* 2014)**. As well as, on other trees fruits with those reported by **Ennab (2016)**, **El-Shamma *et al.* (2017); Mohamed and Massoud (2017) and Fikry *et al.* (2020).**

In addition, fertilization with inorganic and or organic sources were very effective for improving the yield, bunch weight and number of fruits/strand **Osman (2003)**; **Marzouk and Kassem (2011)**; **Kahtani and Soliman (2012)**; **Amro *et al*. (2014)**; **Al-Wasfy *et al.* (2014)** and **Elsadig *et al.* (2017)**.

The present research aimed to determine the best-combination of fertilizers sources and rates that could use to gradually replace regular mineral fertilization programs and the improve leaf mineral contents and yield quantity of Zaghloul date palm cultivar by bio-organic nitrogen fertilization technique.

MATERIALS AND METHODS

This investigation carried out on the Zaghloul date palm cultivar in two successive seasons 2017 and 2018 grown in loamy sandy soil under drip irrigation system, at a private orchard in El Adlia Blbas, Sharkia Governorate, Egypt. Twenty- seven palms (age), as uniform as possible, randomly selected for the study, planted at 10 x 10 meters apart for this experiment. Soil samples were collected at (30 - 60 cm) depth from the experimental orchard and soil analysis results shown in Table 1.

Table 1. Soil and compost analyses

Analyses	O.M. %	pH	EC ds/m	Soluble cations (meq/L)				Soluble anions (meq/L)			Elements (mg/kg)			
				Ca^{+2}	Mg^{+2}	Na^{+1}	k^{+1}	co^{-}_{3}	HCO_3^{-2}	SO_4^{-2}	N	P	K	Zn
Soil	1.83	8.95	2.75	12.00	10.17	45.89	38.60	0.04	3.22	35.83	20.14	8.56	22.11	0.12
Compost	44.68	7.51	1.36	30.11	11.20	40.65	40.32	0.8	2.1	30.41	1500 ppm	50 ppm	8000 ppm	8.20 ppm

Table 2. Determination of mineral content in soil samples at the end of experiment (30 - 60 cm) depth

Soil analyses / Treatments	O.M %	pH	EC ds/m	Elements (mg/kg)			
				N	P	K	Zn
Control Without Fertilization	1.81	8.97	2.76	20.15	8.54	22.10	0.11
Full Nitrogen (Min.)	1.67	8.43	2.36	25.75	9.03	23.91	0.18
1/4 Ora. + 3/4 Min.	1.71	8.25	2.41	26.18	8.79	23.11	0.18
1/2 Ora. + 1/2 Min.	1.69	8.71	2.69	29.76	9.11	23.32	0.19
Full Organic (Ora.)	1.68	8.06	2.18	27.54	8.63	22.75	0.19
1/4 Ora. + 3/4 Min. + EM	1.58	7.87	2.45	25.18	8.73	22.98	0.21
1/2 Ora. + 1/2 Min. + EM	1.83	8.86	2.25	30.18	9.2	24.13	0.23
Full Ora. + EM	1.62	7.54	2.28	26.75	8.54	22.16	0.20
Full Bio-fertilizer (EM)	1.56	8.73	2.45	21.83	8.96	22.73	0.15

Used fertilizers sources

Sulphate Ammonium (20.5 % N) representing mineral nitrogen, Ora. for organic fertilizer (1.5 %N) and EM as a bio-fertilizers. Total nitrogen dose/ palm was 1000 g shared between several possible combinations representing nine treatments as follows: (1) Control. (0.0 N), (2) Full N dose (100%) as mineral fertilizer (at recommended dose 1000 g), (3) Quarter organic fertilizers (17 kg compost) + 3/4 mineral recommended dose), (4) Half-N dose as organic fertilizers (34 kg compost) + half as mineral, (5) Full N dose as organic fertilizer (68 kg compost), (6) Quarter organic fertilizers + 3/4 mineral + bio-fertilizers (EM), (7) Half-N

dose as organic fertilizers + half as mineral + bio-fertilizers (EM), (8) Full N dose as organic fertilizer + bio-fertilizers (EM) and (9) Bio-fertilizers (EM).

Soil application treatments

EM bio-fertilizer (150 ml/palm), mineral fertilizer (Ammonium Sulphate (NH_4) SO_4 20.5 % N are divide into three doses in February, May and July for each season. Compost (mixed with rice straw and animal manure) was added before irrigation by scattering around the palm trunk during the first week of March. Eight spathes per palm were pollinated and the other bunches were removed during April. The same pollen source was used to pollinate all palms subjected to study.

Determination of Leaf mineral contents

The Pinnae samples were washed, dried ground and digested using sulphoric acid and hydrogen peroxide according to **Chapman and Pratt (1961)**. Tested minerals were determined according the following methods N (using the micro-Kjeldahl **Pregl, 1945)**, P by colorimetric with stannous chloride **Truog and Meyer (1929)**, K by Flame photometer (**Jackson, 1958)** and Ca by titration against versenate solution (Na-EDTA) as reported by **Chapman and Pratt (1961)**.

Bunch characters and yield

All bunches (8 bunch/palm) were harvested when reached the commercially derived color. The fruit yield/palm (kg), average bunch weight (kg), average number of strands/ bunch, average strand length (cm) and average number of fruits were determined.

Statistical analysis

Randomized complete block design (RCBD)was followed. The experimental palms divide to nine treatments with three replicates (one palm/replicate) for each Data was subject to the analysis of variance **(Steel and Torrie, 1980)**. Duncan's multiple range test (**Duncan, 1958)** was used to resolve differences among treatment means at 5% significant level.

RESULTS AND DISCUSSION

Leaf mineral contents

Data presented in Table (3) revealed that all treatments significantly increased leaf mineral contents as regards to control and recorded the lowermost values of N % (1.25 and 1.32%), P % (0.207 and 0.208 %) and K % (1.28 and 1.25 %) in the first and second seasons, respectively. Tested treatments significantly affected leaf N, P and K percentages in both seasons. The highest values of N % (2.01 a4. ND 2.32 %) resulted from the palms fertilized by full N dose (100%) as mineral fertilizer. The highest values of P % (0.273 and 0.284 %) obtained from the palms fertilized by half dose of both organic and N fertilizers + bio-fertilizer (EM). The highest values K % (1.94 and 1.98 %) recorded with the palms received quarter organic dose + 3/4 mineral dose in the first and second seasons, respectively. These results agreed with those reported by **Marzouk (2011)** on Zaghloul' date palm and **Amro *et al.* (2014)** on 'Hayany' date palm.

Table 3. Impact of mineral, organic and bio-fertilizers on leaf mineral contents of Zaghloul date palm during 2017 and 2018 seasons

Characters / Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	2017	2018	2017	2018	2017	2018
Control Without Fertilization	1.25^{i}	1.32^{h}	0.207^{f}	0.208^{g}	1.28^{i}	1.25^{i}
Full Nitrogen (Min.)	2.01^{a}	2.32^{a}	0.253^{c}	0.218^{f}	1.76^{g}	1.77^{g}
1/4 Ora. + 3/4 Min.	1.87^{e}	1.91^{d}	0.265^{b}	0.275^{b}	1.94^{a}	1.98^{b}
1/2 Ora. + 1/2 Min.	1.93^{d}	1.96^{c}	0.255^{c}	0.269^{bc}	1.86^{d}	1.92^{d}
Full Organic (Ora.)	1.98^{b}	2.01^{b}	0.240^{e}	0.245^{e}	1.68^{h}	1.75^{h}
1/4 Ora. + 3/4 Min. + EM	1.68^{g}	1.74^{f}	0.265^{b}	0.272^{b}	1.79^{f}	1.81^{f}
1/2 Ora. + 1/2 Min. + EM	1.58^{h}	1.63^{g}	0.273^{a}	0.284^{a}	1.85^{e}	1.94^{c}
Full Ora. + EM	1.71^{f}	1.82^{e}	0.239^{e}	0.241^{e}	1.88^{c}	1.91^{e}
Full Bio-fertilizer (EM)	1.92^{c}	1.96^{c}	0.249^{cd}	0.252^{d}	1.93^{b}	2.01^{a}

Min. = mineral fertilizer (Sulphate Amonum 20.5 % N), Ora. = organic fertilizer 1.5 %N, EM = bio-fertilizers

Bunch characters and yield

Data in Table (4) appeared a significant effect of treatments on bunch morphological characteristic's in both seasons. Thus, the highest values of number strands/bunch recoded with treatment bio-fertilization and full N dose + bio-fertilizer. The highest number of fruits/strands came from bio-fertilization (25.0 and 26.3 in the two seasons, respectively). Meanwhile, the longest strands and length of fruit place on strand came from full N dose as organic fertilizer + bio-fertilizers (EM) in the first season (70.0 & 38.7 cm) and from bio-fertilization (72.3 & 43.0 cm the second season). Contrary, the least values of these characters recorded by the control treatment in both seasons.

Table 4. Impact of mineral, organic and bio-fertilizers on some physical characteristics of Zaghloul date palm during 2017 and 2018 seasons

Characters / Treatments	No. of strands/bunch		No of fruits/strand		Strand length (cm)		Length of fruit place on strand (cm)	
	2017	2018	2017	2018	2017	2018	2017	2018
Control Without Fertilization	54.7^{d}	52.3^{e}	18.3^{c}	18.7^{e}	53.0^{e}	57.7^{e}	24.7^{d}	30.3^{c}
Full Nitrogen (Min.)	62.7^{b}	65.0^{c}	19.3^{b}	20.0^{d}	62.3^{cd}	65.3^{d}	31.7^{c}	34.7^{b}
1/4 Ora. + 3/4 Min.	62.0^{b}	61.0^{d}	20.3^{b}	21.3^{c}	61.0^{d}	64.3^{d}	34.0^{b}	34.3^{b}
1/2 Ora. + 1/2 Min.	65.3^{ab}	65.0^{c}	21.3^{b}	21.7^{c}	64.0^{c}	66.7^{c}	32.0^{c}	34.3
Full Organic (Ora.)	64.0^{b}	65.0^{c}	21.3^{b}	21.0^{c}	60.3^{d}	67.7^{b}	34.0^{b}	34.7^{b}
1/4 Ora. + 3/4 Min. + EM	64.3^{b}	65.0^{c}	21.3^{b}	22.0^{c}	67.0^{b}	66.3^{c}	34.7^{b}	34.7^{b}
1/2 Ora. + 1/2 Min. + EM	61.3^{c}	62.0^{d}	20.0^{b}	21.3^{c}	62.3^{cd}	67.3^{bc}	35.0^{b}	33.3^{b}
Full Ora. + EM	69.7^{a}	69.0^{b}	23.0^{a}	23.7^{b}	70.0^{a}	69.3^{b}	38.7^{a}	33.7^{b}
Full Bio-fertilizer (EM)	68.7^{a}	72.7^{a}	25.0^{a}	26.3^{a}	61.3^{d}	72.3^{a}	36.0^{b}	43.0^{a}

Min. = mineral fertilizer (Sulphate Amonum 20.5 % N), Ora. = organic fertilizer 1.5 %N, EM = bio-fertilizers

Data presented in Table 5 showed the effect of fertilization treatments on bunch weight (kg) and yield/tree (kg) on Zaghloul date palm in two studded seasons. Generally, all fertilization treatments led to increase bunch weight (kg) and yield/tree (kg) compared with control treatment. Bio-fertilization treatment registered the highest values of bunch weight and yield/tree (50.15 & 55.83 and 401.21 & 446.64 kg in the two seasons, respectively). While, the least values of bunch weight and yield/ palm recorded by the control treatment (17.02 & 16.82 and 136.14 & 134.57 kg in the two seasons, respectively). Other various combinations between N sources treatments were in between in this respect. The results are in line on date palm with **Osman (2003); Marzouk and Kassem (2011); Osman *et al.* (2011); Kahtani and Soliman (2012); Amro *et al.* (2014); Al-Wasfy *et al.* (2014) and Elsadig *et al*. (2017).**

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Table 5. Impact of mineral, organic and bio-fertilizers on bunch weight (kg) and yield/ date (kg) of Zaghloul date palm during 2017 and 2018 seasons

Characters / Treatments	Bunch weight (kg)		Yield/ date (kg)	
	2017	2018	2017	2018
Control Without Fertilization	17.02^{e}	16.82^{c}	136.14^{e}	134.57^{e}
Full Nitrogen (Min.)	22.02^{de}	23.92^{e}	176.19^{d}	191.36^{d}
1/4 Ora. + 3/4 Min.	23.03^{d}	24.56^{e}	184.26^{d}	196.45^{d}
1/2 Ora. + 1/2 Min.	27.12^{cd}	27.22^{de}	216.98^{e}	217.78^{d}
Full Organic (Ora.)	30.81^{c}	31.80^{d}	246.47^{b}	254.44^{cd}
1/4 Ora. + 3/4 Min. + EM	33.01^{c}	38.32^{c}	264.80^{b}	306.59^{c}
1/2 Ora. + 1/2 Min. + EM	29.91^{c}	34.60^{c}	239.31^{b}	276.80^{c}
Full Ora. + EM	42.00^{b}	49.10^{b}	336.01^{bc}	392.47^{b}
Full Bio-fertilizer (EM)	50.15^{a}	55.83^{a}	401.21^{a}	446.64^{a}

Min. = mineral fertilizer (Sulphate Amonum 20.5 % N), Ora. = organic fertilizer 1.5 %N, EM = bio-fertilizers

Generally, supplying sufficient nutrition and using sound irrigation scheduling techniques should be high-priority management practices for every grower for expected yield and fruit quality. The most important management practices include irrigation and major elements nutrition and some micronutrients can also affect fruit quality, but only if they are deficient in the soil. In general, when any nutrient element is severely deficient, fruit yield and quality will be negatively affected (**Zekri *et al.*, 2003)**.

Organic matter improves soil physical, chemical, and biological characteristics. Compost provide a stabilized form of organic matter that improves nutrient content, water holding capacity, cation exchange capacity, soil pore space, and aggregate stability (**Shiralipour *et al.*, 1992).** In addition, the application of organic manure might provide supplemental exchangeable cations such as potassium, calcium, magnesium and ammonium, mainly due to organic manure mineralization and release of these basic cations into the soils (**Aseri *et al.*, 2008).** Moreover, the increase of soil P availability is mainly due to the increase of organic acids and the decrease of soil pH **(Amitava and Debashish, 2008)**. Bio-fertilizers significantly improved yield and fruit quality, enhanced the concentration of various nutrients, and soil microbial activity and considered a positive alternative to chemical fertilization to enhance yield and fruit quality because it is safe for human, animal, and environment by reduction it. As well as increases N fixation, enhancement nutrients uptake, and stimulation of natural hormones biosynthesis and production of antibiotics.

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