

Yield and Fruit Nitrate and Nitrite Content of Zaghoul Date Palm as Affected by Mineral, Organic and Bio Nitrogen Fertilization Treatments

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ABSTRACT

This investigation was conducted during three seasons 2010, 2011 and 2012 on Zaghoul date palm cultivar grown in calcareous soil at AL- Nahda region near Alexandria governorate, Egypt. The palms received the recommended N dose of each mineral fertilizer only and or from organic N and bio fertilizers to study the effect of such treatments on date palm yield, fruit nitrate and nitrite content. The obtained results clarified that all used treatments of organic and bio fertilizers were effective in improving date palm yield and decreased fruit content of NO_3 and NO_2 in comparison with 100% mineral N. It was also noticed that combined treatment of 50% mineral N+50% organic manure with bio fertilizer is the superior treatment for increasing the values of yield and decreasing its content of NO_3 and NO_2 . Hence, it could be concluded that, minimizing the use of chemical nitrogen fertilizer to half of recommended dose through addition of 50% mineral N+ 50% organic manure with bio fertilizer and also, the utilization of organic and bio fertilizers is considered as a promising alternative for chemical fertilizers to avoid pollution and reduce costs.

Key words: mineral, Organic, biofertilizers, Nitrate, Nitrite, Zaghoul date cultivar.

INTRODUCTION

Date palm (*Phoenix dactylifera L.*) is one of the oldest cultivated trees in the world. According to FAO (2010), Egypt is considered among the top ten date producers (1,130,000 tones). Date palm fruits are one of the most fruit crops in Egypt, where they are harvested and marketed at three stages of their development. Zaghoul date is the best date cultivar suitable for marketing at Khalal stage and most economically important soft cultivars grown in Egypt. Dates fruits contain substantial amounts of sugars, minerals and vitamins and plays a major role in the life of people in Arabic nations.

It is well known that nitrogen fertilizers are lost via nitrate reduction, denitrification and ammonia volatilization. Moreover, some nitrogenous fertilizer can be leached to the underground water causing environmental pollution. Pollutants are transferred through the plants to human & animals and causes serious diseases. Thus, environmental pollution as a result of exaggeration in the application of chemical fertilizers is reported by (NiJJar, 1985, Casale et al., 1995 and

Ram Rao et al., 2007). Recently, great attention has been focused on the possibility of using organic and bio fertilizers for enhancing growth & fruit quality and depressing pollution occurring in the Egyptian environment.

Therefore, the present investigation was conducted to evaluate the effect of combined application of mineral N and farmyard manure (FYM) as organic N fertilizer with or without bio fertilizer on yield and fruit quality as well as fruit nitrate and nitrite content of Zaghoul date palm cv grown under calcareous soil conditions.

MATERIALS AND METHODS

The present investigation was conducted during three successive seasons 2010, 2011 and 2012 on Zaghoul date palm cultivar (*Phoenix dactylifera, L.*) grown in a private orchard located at El- Nahda region (km23, Alex.-Cairo desert road), Alexandria governorate, Egypt.

Forty palms as uniform as possible were randomly selected for this experiment. Palms were subjected to 10 fertilization treatments with 4 replicates (one palm for each). The treatments included three nitrogen sources, mineral, organic and biofertilizers applied either alone or in combinations as follow:

T1: 100% Mineral N (control)

T2: 100% Mineral N + Bio fertilizer.

T3: 75% Mineral N + 25% Organic N

T4: 75% Mineral N + 25% Organic N + Bio fertilizer

T5: 50% Mineral N + 50% Organic N

T6: 50% Mineral N + 50% Organic N+ Bio fertilizer.

T7: 25% Mineral N + 75% Organic N

T8: 25% Mineral N + 75% Organic N+ Bio fertilizer.

T9: 100% Organic N

T10: 100% Organic N + Bio fertilizer.

The mineral nitrogen source as ammonium sulphate (20.6%N) was applied at 3 equal doses in March, May and July of each season. Meanwhile, organic N was applied as farm yard manure (FYM) and added once at the first week of January in the three seasons. The bio fertilizer "Bio humin" produced by General Organization of Agricultural Equilibrium Fund, Ministry of

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Table 1. The added amount of mineral, organic, actual and total N per palm applied in 2010, 2011 and 2012 seasons

Fertilization treatments	The amount of fertilizers & actual N/Palm				Total N/Palm (g)
	(Mineral)		(Organic manure)		
	(Kg)	(g)	(Kg)	(g)	
100% Min. N	6.0	1200	0	0	1200
75% Min. N+25% Org.	4.5	900	30	300	1200
50% Min. N+50% Org.	3	600	60	600	1200
25% Min.+75% Org.	1.5	300	90	900	1200
100% Org.	0	0	120	1200	1200

Agriculture, Egypt was applied once at one Liter/palm/year in the first week of April in the three seasons. Calcium super phosphate (15.5% P₂O₅) and potassium sulphate (48% k₂O) were added at one kg/palm, the experimental palms were irrigated immediately after treatments. The experiment was arranged in a randomized complete block design .The added amount of the mineral and organic fertilizers as well as the amount of actual N per palm applied during the three seasons is presented in Table(1).

Yield (kg /palm)was recorded for each treatment at the commercial harvest date(at khalal stage)

Nitrate and Nitrite content in fruits (ppm), it was determined using phenol disulfonic acid method and sulfanilic acid alphanaphthyl amine method, respectively (Chapman and Pratt, 1961).

The proper statistical analysis was carried out according to the methods out lined by Mead et al. (1993) using L.S.D test to recognize the significantly between the various treatments. Also, combined analysis

for the three seasons was carried out according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Herin, we will discuss the obtained results concerning yield and fruit nitrate & nitrite content of Zaghoulcv as an average of the three successive seasons as follow:

1- Yield/palm (kg):

The data in Table (2) shows the average yield/palm of Zaghoul cultivar as affected by different levels and combination of mineral, organic and bio N fertilizers during 2010, 2011 and 2012 and average of the three seasons. The obtained results indicated that the highest average yield/palm (200.9 kg) was noticed by applying 50% Min. N + 50% Org. N+ Bio(T6) comparing with all other treatments. In the meantime, T5 (50% Min. N + 50% Org. N) the second highest yield value (196.7 kg/palm),on the other hand, both T9(100% Org. N) and T7 (25% Min. N + 75% Org. N) gave the lowest values (162.3 and 162.8 kg/palm, respectively) followed by T1(100% Min.).

Table 2. Fruit yield (kg/palm) of Zaghoul date palm as influenced mineral, organic and bio N fertilization treatments in 2010, 2011 &2012 and the average of the three seasons

Treatments	2010	2011	2012	Average of 3 seasons.*
T1: 100% Min. N (control)	162.2	173.4	164.1	166.6 h
T2: 100% Min. N + Bio	172.9	181.1	171.8	175.3 f
T3: 75% Min. N + 25% Org. N	176.6	195.8	177.6	183.4 d
T4: 75% Min. N + 25% Org. N+ Bio	182.3	194.2	184.8	187.1 c
T5: 50% Min. N + 50% Org. N	193.9	200.1	196.4	196.7 b
T6: 50% Min. N + 50% Org. N + Bio	200.1	202.7	200.0	200.9 a
T7: 25% Min. N + 75% Org. N	154.4	176.1	157.8	162.8 I
T8: 25% Min. N + 75% Org. N + Bio	162.1	183.6	163.0	169.6 g
T9:100% Org. N	154.6	176.4	155.9	162.3 I
T10: 100% Org. N + Bio	180.3	177.9	179.4	179.2 e
L.S.D 0.05	3.7	3.2	2.9	2.1

*Averages followed by the same letter are not significantly different.

The pronounced effect of organic and bio fertilizers on yield may be attributed to increase nutrient uptake, which plays an important role in producing favorable balance between growth and fruit production and increasing cell division & enlargement and consequently increasing vegetative growth which reflected on increasing the yield as finally result from the physiological processes (Geetha and Nair, 2000 and Shaheen et al., 2009). In addition, bio fertilizer increased the soil content of growth regulator such as IAA and Cytokinins (li et al., 1998).

2- Fruit nitrate content (ppm)

It is clear from the obtained data in Table (3) that fertilizing Zaghloul date palm with the recommended rate of N through organic and bio fertilizer sources significantly reduced fruit nitrate content compared with

using N via mineral source only. Application of 100% Org. N + Bio (T10) gave the lowest values (37.3 ppm) of fruit nitrate content followed by both T9 (100% Org N) and T6 (50% Min N+ 50% Org. + Bio) which gave (39.7 and 40.8 ppm, respectively).

At the same time, applies 100% Min. N (T1) resulted the highest values of fruit nitrate content. It is well known that nitrate is easily formed from mineral nitrogen fertilizer, whereas it slowly formed from organic and bio nitrogen (Ibrahim, 1994).

3- Fruit nitrite content (ppm):

It is clear from data in Table (4) that mineral nitrogen fertilizer alone resulted in higher values (8.1 ppm) of residues of nitrite in Zaghloul date fruits compared with the other treatments.

Table 3. Fruit nitrate content (ppm on dry weight basis) of Zaghloul date palm as influenced mineral, organic and bio N fertilization treatments in 2010, 2011 &2012 and the average of the three seasons

Treatments	2010	2011	2012	Average of 3 seasons.*
T1: 100% Min. N (control)	53.9	61.2	57.3	57.5 a
T2: 100% Min. N + Bio.	52.7	56.7	51.6	53.7 c
T3: 75% Min. N + 25% Org. N	52.8	51.8	61.5	55.3 b
T4: 75% Min. N + 25% Org. N + Bio	52.0	47.8	54.7	51.5 d
T5: 50% Min. N + 50% Org. N	48.0	45.4	42.9	45.4 ef
T6: 50% Min. N + 50% Org. N + Bio	41.0	41.7	39.7	40.8 g
T7: 25% Min. N + 75% Org. N	47.8	46.4	45.1	46.4 e
T8: 25% Min. N + 75% Org. N+ Bio	44.3	45.5	44.1	44.6 f
T9: 100% Org. N	40.1	41.4	37.8	39.7 g
T10:100% Org. N+ Bio	39.0	36.7	36.4	37.3 H
L.S.D 0.05	2.5	2.2	1.8	1.3

*Averages followed by the same letter are not significantly different.

Table 4. Fruit nitrite content (ppm on dry weight basis) of Zaghloul date palm as influenced mineral, organic and bio N fertilization treatments in 2010, 2011 &2012 and the average of the three seasons

Treatments	2010	2011	2012	Average of 3 seasons.*
T1: 100% Min. N (control)	8.1	7.9	8.4	8.1 a
T2: 100% Min. N + Bio.	7.2	7.0	7.0	7.0 c
T3: 75% Min. N + 25% Org. N	7.3	8.1	7.3	7.5 b
T4: 75% Min. N + 25% Org. N + Bio	6.3	6.2	6.2	6.2 d
T5: 50% Min. N + 50% Org. N	6.0	5.7	5.9	5.9 de
T6: 50% Min. N + 50% Org. N + Bio	5.6	5.2	5.4	5.4 f
T7: 25% Min. N + 75% Org. N	5.7	5.5	5.7	5.6ef
T8: 25% Min. N + 75% Org. N+ Bio	4.9	4.6	5.0	4.8 g
T9: 100% Org. N	5.1	5.0	4.9	4.9g
T10:100% Org. N+ Bio	4.9	4.6	4.6	4.7 g
L.S.D 0.05	0.5	0.3	0.4	0.5

*Averages followed by the same letter are not significantly different.

On the other hand, all treatments of organic nitrogen combined with bio fertilizer significantly reduced nitrite residues in Zaghloul dates comparing with analogous treatments without them. The application of 100 Org N + Bio(T10), 25% Min. N + 75% Org. N + Bio.(T8) and 100% Org. N(T9) caused the lowest values of nitrite content (4.7, 4.8 and 4.9 ppm, respectively) with no significant differences among them. In the meantime, applying 50% Min. N + 50% Org. N+ Bio(T6) and 25% Min. N + 75% Org. N (T7) came the second rank (5.4 and 5.6 ppm), while the other remaining treatments gave intermediate values.

The beneficial effect of organic and bio fertilizers on reducing nitrite may be due to increase the induction of nitrate reductase enzyme, and this reflect on producing nitrite reductase in the plants (Schroder, 1978). The obtained results are in line with those of (Abd El-Migeed et al., 2007 and Hossam El-Dein and Boshra , 2008).

From the above mentioned results, it is clear that yield and fruit quality of Zaghloul date was improved accompanied with reducing fruit nitrate and nitrite content. It could be recommended to replace the use of Mineral N fertilization (100% Min. N) partially through using 50% Min. N + 50% org.N accompanied with adding bio fertilizer).

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REFERENCES

- Abd El-Migeed, M.M.M.: M.M.S. Saleh and E.A.M. Mostafa. 2007. The Beneficial effect of minimizing mineral nitrogen fertilization on Washington Naval orange trees by using organic and bio fertilizers. *World Journal of Agricultural Sciences* 3(1): 80-85.
- Casale, W.L., V. Minassian, J.A. Menge, C.J. Lovatt, E. Johnason and F.Guillemet.1995: Urban agricultural wastes for use as delivery of microbial biocontrol agents. *J. Hort. Sci.* 10(2): 315-332.
- Chapman, H.D. P.F. Pratt. 1961. *Methods of analysis for soils, plants and water* University of California, Division of Agricultural Sciences.
- FAO (2010). *Food & Agriculture Organization of the United Nations*.
- Geetha, K. and Nair, R.R. .2000. Integrated plant nutrition system (IPNS) for banana. *Ann. of Agric. Res., (India)* 21 (4): 499-503.
- Gomez, K.A. and A.A. Gomez. 1984. *Statistical Procedures for Agriculture Research*. 2nd Ed., Wiley, New York.
- Hosam El-Dein, A.S. and E.S. Boshra. 2008. Effect of different sources of organic fertilizers as a partial substitute for mineral nitrogen fertilizer of Williams banana. *J. Agric. Sci. Mansoura Univ.*, 33(6): 4369-4381.
- Ibrahim, T. 1994. *Water pollution. Part 1. Science and life series*. Egyptian Organization for Books, Cairo, Egypt, pp: 58-61. (In Arabic).
- Li, X.J. Dona, S.F. and liu, Y.S. 1998. Determination of IAA and Cytokinins in the soil with different organic manure for pot cultured apple. *Plant Physiology Communications*, 34(3):183-185.
- Mead R., Currow, R.N. and Harted A.M. 1993. *Statistical Methods in Agriculture and Experimental Biology* 2nd ed. Chapman & Hall, London.
- Nijjar, G.S. 1985: *Nutritional of fruit trees*. Mrs. Usha. RaJ. Kumar for kalyani, publishers, New Delhi. India PP. 10-52.
- Ram Rao, D.M., Kodandaramaiah, J., Reddy, M.P., Katiyar, R.S. and Rahmathulla, V.K. 2007. Effect of AM fungi and bacterial bio fertilizers on mulberry leaf quality and silk worm cocoon characters under semiarid conditions. *Caspian J. Env. Sci.* 5(2): 111-117.
- Schroder, L.E. 1978. Critique-of "Factors influencing nitrate acquisition by plants: Assimilation and fate of reduced nitrogen". *Nitrogen in the environment*. Academic Press Rapid Manuscript Reproduction P. 101:137.
- Shaheen, M.A. Eissa; M.M. Saad and S.M. Mahmoud. 2009. Influence of organic and bio fertilization on growth, yield and fruit quality of Williams banana- *J. Agric. Sci. Mansoura Univ.*, 34(7): 8013-8025.

الملخص العربي

المحصول ومحتوى الثمار من النيتريت والنترات لنخيل البلح صنف الزغلول وعلاقته بمعاملات

التسميد المعدني والعضوي والحيوي في مصر

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من النيتريت والنترات بالمقارنة بالتسميد بـ 100% سماد نيتروجيني معدني فقط. أيضا أوضحت النتائج أن استخدام 50% من السماد النيتروجيني المعدني + 50% من السماد العضوي مع الحيوي قد تفوقت على باقى المعاملات في زيادة المحصول وخفض محتوى الثمار من النيتريت والنترات.

وهذا يوضح أن استخدام 50% سماد نيتروجيني عضوي بالإضافة إلى السماد الحيوي يمكن أن يوفر 50% من كمية السماد المعدني بالإضافة إلى أن استخدام السماد العضوي والحيوي يقلل الإسراف في استخدام السماد المعدني وتقليل التلوث الناتج عنه.

أجرى هذا البحث خلال مواسم 2010، 2011، 2012 على نخيل صنف الزغلول النامي في أرض جيرية بمنطقة النهضة بالقرب من محافظة الإسكندرية بجمهورية مصر العربية- سمدت أشجار النخيل بسماد نيتروجيني معدني منفردا مع توليفات مختلفة من السماد العضوي و/او السماد حيوي لدراسة تأثير هذه المعاملات على المحصول ومحتوى الثمار من النيتريت والنترات والتي لها تأثير سلبي على صحة الإنسان والحيوان والبيئة.

أظهرت النتائج أن كل المعاملات المستخدمة من السماد العضوي أو الحيوي كانت فعالة في تحسين محصول الثمار وتقليل محتوى الثمار