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Effect of Using Slow Release N Fertilizers Versus Fast Ones on Fruiting of Zaghloul Date Palms

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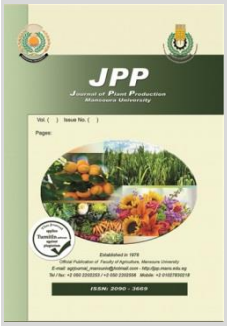

ABSTRACT

During 2016 & 2017 seasons, Zaghloul date palms received three slow release N fertilizers namely Sulphur-coated urea (41 %N), Phosphorus-coated urea (37.11%N) and Urea-formaldehyde (41%N) versus urea (46 %N) as fast release N fertilizer. Both slow and fast release N fertilizers were applied at 250, 500 or 1000g N/palm. The three slow release N fertilizers were added once at growth start while urea was splitted into three equal batches at growth start and two month intervals. The merit was selecting the best source and rate of N for Zaghloul date palms. Fertilizing the palms with N as slow release N fertilizers generally was superior than the application of N via fast source (urea) in improving growth, yield and fruit quality. Using N at 250 g N/palm via sulphur coated urea, phosphorus-coated urea, and urea-formaldehyde, in descending order was very effective in enhancing all the investigated parameters. Increasing N levels from 250 to 1000 g N/palm applied via any slow release N fertilizers failed to show measurable increase on the studied parameters.Carrying out N fertilization via sulphur-coated urea at 250 g N/palm was necessary for promoting yield and fruit quality of Zaghloul date palms growing under Minia region conditions.

Keywords: Urea, Sulphur-coated urea, phosphorus-coated urea, and urea-formaldehyde, Zaghloul date palms, growth, palm nutritional status, yield, fruit quality.

INTRODUCTION

In the past fertilization of fruit crops grown under sandy soil materially depended on using the fast release N fertilizers. The highest loss of N under such conditions encourages the pomologists to find substance that release their N slowly. Using slow release N fertilizers surely supplied the trees with all requirements of N at longer times without loss via leaching at lower costs. Also, the merits of these controlled release are controlling growth of the trees in favour of promoting fruiting as well as protecting our environment from pollution (Nijjar, 1985 and Wang and Alva, 1996).

The outstanding effect of fertilization of fruit crops with slow or controlled release N fertilizers as a complete replacement of soluble ones on controlling N uptake and improving yield and fruit quality was reviewed by Ali-Mervat, (2000); Ibrahim-Asmaa, (2001); Kamel, (2002); Abd El-Hameed and Rabeea, (2005); Liu *et al.*, (2006); shaalan-Nashwh, (2008); Uwakiem, (2011); Ahmed and Abada, (2012); Allam, (2014); Mohamed *et al*., (2018a) and (2018b) and Abd El-Kafy, (2018).

The purpose of this study was evaluating the possibility of using slow release N fertilizers instead of using urea as the fast release one on leaf area, total chlorophylls, N, P and K, yield and fruit characteristics of Zaghloul date palms grown under sandy soil.

MATERIALS AND METHODS

This study was conducted during 2016 and 2017 seasons in a private date palm orchard located at Samalout district, Minia Governorate on 36 -15years Zaghloul date palms (as soft date palm cv.). These palms were produced through conventional propagation by offshoots as well as characterized by regular bearing. Also, they are uniform in vigour, healthy, good physical conditions, free from insects, diseases and damages. They planted at 7x7 meters apart and irrigated with well water through drip irrigation system. The texture of the tested soil is sandy clay. Soil analysis were done according to Wilde *et al*., (1985) and the obtained data are illustrated in Table (1).

Table 1. Analysis of the tested soil.

Parameters	Values
Particle size distribution:	
Sandy %	78.9
Silt %	14.1
Clay %	7.0
Texture	Sandy low
pH (1:5 extract)	8.0
EC (1:5 extract) (ppm)	710.4
$CaCO_3$ %	4.1
Total Available N (ppm)	7
Available P (ppm)	1.25
Available K (ppm)	95.9

All the selected palms (36 palms) received the common and usual horticultural practices that already applied in the orchard except those dealing with N, P and K slow and fast release N fertilization. Bunches /leaf was adjusted to 10.1 (according to Mohamed *et al*., 2017). Hand pollination was carried out inserting five spaces into 1 female spathe after two days from spathe cracking. The study included the following twelve treatments:

1- Soil addition of urea at 250 g N/palm/year.
2- Soil addition of urea at 500 g N/palm/year.
3- Soil addition of urea at 1000 g N/palm/year.

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4- Soil addition of urea –formaldehyde at 250 g N/palm/year.
5- Soil addition of urea –formaldehyde at 500 g N/palm/year.
6- Soil addition of urea –formaldehyde at 1000 g N/palm/year.
7- Soil addition of urea –phosphours coated urea at 250 g N/palm/year.
8- Soil addition of urea –phosphours coated urea at 500 g N/palm/year.
9- Soil addition of urea –phosphours coated urea at 1000 g N/palm/year.
10- Soil addition of urea –sulphur coated urea at 250 g N/palm/year.
11- Soil addition of urea –sulphur coated urea at 500 g N/palm/year.
12- Soil addition of urea –sulphur coated urea at 1000 g N/palm/year.

Each treatment was replicated three times, one palm per each. Hand pollution with five male strands/female spathe was carried out two days after female spathes. The spathes were tied and covered with a marked paper sacks and the papers were removed after one month of hand pollination. It was repeated twice or thrice according to the climatic conditions (El-Khawaga, 1995). The three slow release N fertilizers namely urea-formaldehyde (41% N), sluphur-coated urea (41 % N) and phosphour-coated urea (37.11 %N) were added once at growth start (1st week of March) in holes 10 cm depth canopy of around each palm and then covered with moist sand. The fast release N fertilizer namely urea (46 %N) was added at three equal batches at growth start (1st week of Mar.) and at two weeks intervals. It was added in a circle 10 cm depth around trucking the palm followed by covering with moist sand. All slow and fast release N fertilizers were added at three N levels namely 250, 500 & 1000gN/palm/year (Nijjar, 1985).

Generally, during both seasons the following measurements were taken:

1- Leaf area (m^2) by multiplying the leaflet area (Ahmed and Morsy, 1999) by the total number of leaflets/leaf.
2- Total chlorophylls (a & b) as mg/g F.W in the middle fresh leaflets (Hiscox and Israistam, 1979).
3- Percentages of N, P and K in the middle leaflets on dry weight, basis (Summer, 1985 and Wilde *et al*., 1985).
4- Bunch weight and yield/palm

At ripening, bunch weight was recorded samples of 100 palm fruits and from each bunch were randomly selected to determine fruit weight (g.); flesh %; T.S.S.%; total reducing and non-reducing sugars (Lane and Eynon, 1965 and A.O.A.C., 2000), total acidity % (as g malic acid/100 g pulp), total fibre % (A.O.A.C., 2000) and total soluble tannins % (Balbaa, 1981).

The experiment was set up as a randomized complete block design (RCBD). The analysis of variance (ANOVA) was used according to Mead *et al*., (1993). Treatment means of the twelve treatments were compared using new L.S.D test at 5 % level.

RESULTS AND DISCUSSION

1- Leaf area

It is clear from the data in Table (2) that fertilizing Zaghloul date palms with the three slow release N fertilizers namely urea formaldehyde and P-coated urea (37.11 % N) and S-coated urea (41%N) at 250 to 1000 g N/palm significantly was followed by enhancing the leaf area of the palms relative to fertilization with the fast release fertilizer namely urea at the same levels. Increasing the levels of the fast release N fertilizers namely urea from 250 to 500 g N /palm significantly stimulated the leaf area. However, no significant difference on the leaf area was attributed to increasing levels of urea from 500 to 1000 g N/palm. The maximum values were recorded on the palms that receive urea formaldehyde, P-coated urea and S-coated urea each at 250 to 1000, in ascending order. Using any slow release N fertilizer at levels above 250gN/palm failed to exhibit any significant promotion on the leaf area, therefore, it is enough to use any controlled release N fertilizer at 250 g N/palm. The maximum values of the leaf area (1.29 & 1.33 m^2) were recorded on the palms that fertilized with N via S-coated urea at 250g/palm during both seasons, respectively. The lowest values of leaf area were recorded on the palms fertilized with N via urea at 250 g N/palm. These results were true during both seasons.

Table 2. Effect of different levels of some slow release N fertilizers and urea on the leaf area, total chlorophylls and percentages of N and P in the leaves of Zaghloul date palms during 2016 and 2017 seasons.

Treatments	Leaf area (m^2)		Total chlorophylls (mg/g F.W)		Leaf N %		Leaf P %	
	2016	2017	2016	2017	2016	2017	2016	2017
Urea at 250 g N/palm/year.	0.98	1.01	8.1	8.2	1.59	1.64	0.299	0.300
Urea at 500 g N/palm/year.	1.04	1.07	9.0	9.1	1.66	1.71	0.278	0.279
Urea at 1000 g N/palm/year.	1.05	1.08	9.1	9.1	1.68	1.73	0.277	0.278
Formaldehyde at 250 g N/palm/year.	1.12	1.15	9.9	10.1	1.76	1.81	0.275	0.275
Formaldehyde at 500 g N/palm/year.	1.13	1.16	10.0	10.2	1.77	1.82	0.274	0.275
Formaldehyde at 1000 g N/palm/year.	1.14	1.18	10.2	10.3	1.78	1.83	0.250	0.251
Phosphours coated urea at 250 g N/palm/year.	1.20	1.23	11.0	11.1	1.88	1.94	0.249	0.250
Phosphours coated urea at 500 g N/palm/year.	1.21	1.24	11.2	11.2	1.90	1.95	0.247	0.248
Phosphours coated urea at 1000 g N/palm/year.	1.22	1.25	11.3	11.3	1.91	1.96	0.246	0.246
Sulphur coated urea at 250 g N/palm/year.	1.29	1.33	12.1	12.4	1.99	2.04	0.211	0.212
Sulphur coated urea at 500 g N/palm/year.	1.30	1.33	12.2	12.5	2.00	2.05	0.209	0.211
Sulphur coated urea at 1000 g N/palm/year.	1.31	1.34	12.3	12.6	2.01	2.06	0.207	0.209
New L.S.D. at 5 %	0.05	0.04	0.6	0.8	0.06	0.05	0.021	0.031

2- Leaf chemical components

It is evident from the data in Tables (2 & 3) that supplying Zaghloul date palms with N at 250 to 1000 g N/palm via slow release N fertilizers namely urea-formaldehyde, P-coated urea and S-coated urea was significantly followed by stimulating total chlorophylls and percentages of N, P and K in the leaves relative to the use of the fast release N namely urea at 250 to 100 g n/palm. The

best controlled release N fertilizers were S-coated urea, P-coated urea and urea formaldehyde, in descending order. Increasing urea levels from 250 to 500 g N/palm significantly enhanced these plant pigments and nutrients. However, increasing N levels from 500 to 1000 g N/palm had no significant promotion on the leaf chemical components. Otherwise, when N was applied via slow release N fertilizers, no significant promotion on these pigments and nutrients was observed when N was added at levels above 250 g N/palm. Using N via S-coated urea at 250 g N/palm gave the maximum values. The lowest values were recorded on the palms that fertilized with N via urea at 250 g N/palm. These results were true during both seasons.

3- Bunch weight and yield/palm

Amending Zaghloul date palms with N via controlled N fertilizers (urea formaldehyde, S-coated urea and P-coated urea) each at 250 to 1000 g N/palm as shown in Table (3) had significant promotion on bunch weight and yield relative to the use of N via urea at 250 to 1000 g N/palm. There was a gradual and significant promotion on the bunch weight and yield/palm with increasing the levels of the fast release N fertilizer namely urea. Increasing levels of N from 500 to 1000 g N/palm via urea failed to show significant promotion on this respect. Using the three slow release N fertilizer namely urea formaldehyde, S-coated urea and P-coated urea at levels higher than 250 g N/palm had a slight promotion on the yield/palm. The heaviest clusters were borne on the palms that received N as sulphur coated urea at 250 g N/palm. The untreated palms produced the lowest values. The highest yield /palm (190 & 191 kg/palm) was observed on the palms that received N via sulphur-coated urea at 250 g N/palm during both seasons, respectively. The minimum yield (146 & 141 kg) was recorded when the palm treated with N via urea at 250 g N/palm. Similar trend was noticed during both seasons.

Table 3. Effect of different levels of some slow release N fertilizers and urea on the percentages of K, bunch weight, yield/palm and fruit weight of Zaghloul date palms during 2016 and 2017 seasons.

Treatments	Leaf K %		Bunch weight (kg)		Yield/palm		Fruit weight (g)	
	2016	2017	2016	2017	2016	2017	2016	2017
Urea at 250 g N/palm/year.	2.00	1.99	14.0	14.1	140	141	26.0	26.4
Urea at 500 g N/palm/year.	1.95	1.94	15.1	15.2	151	152	26.6	27.0
Urea at 1000 g N/palm/year.	1.94	1.93	15.2	15.3	152	153	26.7	27.1
Formaldehyde at 250 g N/palm/year.	1.88	1.87	16.3	16.4	163	164	27.4	27.8
Formaldehyde at 500 g N/palm/year.	1.87	1.86	16.4	16.5	164	165	27.6	28.0
Formaldehyde at 1000 g N/palm/year.	1.86	1.85	16.5	16.6	165	166	27.7	28.1
Phosphours coated urea at 250 g N/palm/year.	1.80	1.79	17.6	17.7	176	177	28.6	29.0
Phosphours coated urea at 500 g N/palm/year.	1.79	1.77	17.7	17.8	177	178	28.7	29.2
Phosphours coated urea at 1000 g N/palm/year.	1.78	1.76	17.8	17.9	178	179	28.8	29.3
Sulphur coated urea at 250 g N/palm/year.	1.70	1.67	19.0	19.1	190	191	30.1	30.5
Sulphur coated urea at 500 g N/palm/year.	1.69	1.66	19.1	19.2	191	192	30.2	30.6
Sulphur coated urea at 1000 g N/palm/year.	1.68	1.64	19.2	19.2	192	192	30.3	30.7
New L.S.D. at 5 %	0.04	0.05	1.0	1.1	4.1	3.9	0.4	0.4

4- Fruit characteristics

Data recorded in Tables (4 & 5) exhibit that supplying Zaghloul date palms with N via the three slow release N fertilizers (S-coated urea, P-coated urea and urea formaldehyde) significantly succeeded in improving quality of fruits in terms increasing fruit weight fruit flesh %, T.S.S. % and total, reducing sugars and non-reducing sugars and decreasing total acidity %, total fibre and total soluble tannins % relative to the control. The promotion on fruit quality characteristics was mainly attributed to using formaldehyde, P-coated urea and S-coated urea, in ascending order. The highest characteristics of the fruits were observed on the palms that received N via S-coated urea at 250 g N/palm. These results were true during both seasons.

Table 4. Effect of different levels of some slow release N fertilizers and urea on fruit flesh %, T.S.S.% and total and reducing sugars % in the fruits of Zaghloul date palms during 2016 and 2017 seasons.

Treatments	Fruit flesh %		T.S.S. %		Total sugars %		Reducing sugars %	
	2016	2017	2016	2017	2016	2017	2016	2017
Urea at 250 g N/palm/year.	84.1	83.9	25.0	26.5	21.0	21.8	13.9	14.0
Urea at 500 g N/palm/year.	84.6	84.4	25.6	27.0	21.5	22.3	14.3	14.4
Urea at 1000 g N/palm/year.	84.7	84.5	25.7	27.1	21.6	22.4	14.4	14.6
Formaldehyde at 250 g N/palm/year.	85.3	85.1	26.4	27.6	22.3	23.1	15.0	15.1
Formaldehyde at 500 g N/palm/year.	85.4	85.1	26.5	27.7	22.4	23.2	15.1	15.2
Formaldehyde at 1000 g N/palm/year.	85.5	85.2	26.6	27.8	22.5	23.3	15.2	15.2
Phosphours coated urea at 250 g N/palm/year.	86.1	85.9	27.9	28.5	23.9	24.7	15.9	16.1
Phosphours coated urea at 500 g N/palm/year.	86.2	86.0	28.0	28.6	24.0	24.8	16.0	16.2
Phosphours coated urea at 1000 g N/palm/year.	86.3	86.1	28.1	28.7	24.1	24.9	16.1	16.3
Sulphur coated urea at 250 g N/palm/year.	87.1	86.9	29.9	29.5	25.5	26.4	17.0	17.4
Sulphur coated urea at 500 g N/palm/year.	87.2	87.0	30.0	29.6	25.6	26.5	17.1	17.5
Sulphur coated urea at 1000 g N/palm/year.	87.3	87.1	30.1	30.0	25.7	26.6	17.2	17.6
New L.S.D. at 5 %	0.4	0.4	0.5	0.5	0.3	0.4	0.3	0.3

Table 5. Effect of different levels of some slow release N fertilizers and urea on the percentages of non-reducing sugars, total acidity, total crude fibre and total soluble tannins of Zaghloul date palms during 2016 and 2017 seasons.

Treatments	Non-reducing sugars %		Total acidity %		Total crude fibre %		Total soluble tannins %	
	2016	2017	2016	2017	2016	2017	2016	2017
Urea at 250 g N/palm/year.	7.1	7.8	0.301	0.299	0.99	0.97	0.36	0.35
Urea at 500 g N/palm/year.	7.2	7.9	0.271	0.269	0.94	0.92	0.34	0.33
Urea at 1000 g N/palm/year.	7.2	7.0	0.269	0.267	0.93	0.91	0.33	0.32
Formaldehyde at 250 g N/palm/year.	7.3	8.0	0.230	0.228	0.71	0.68	0.29	0.28
Formaldehyde at 500 g N/palm/year.	7.3	8.0	0.228	0.226	0.69	0.66	0.28	0.27
Formaldehyde at 1000 g N/palm/year.	7.3	8.2	0.227	0.225	0.68	0.65	0.27	0.25
Phosphours coated urea at 250 g N/palm/year.	8.0	8.6	0.191	0.189	0.60	0.57	0.20	0.19
Phosphours coated urea at 500 g N/palm/year.	8.0	8.6	0.180	0.188	0.59	0.55	0.19	0.18
Phosphours coated urea at 1000 g N/palm/year.	8.0	8.6	0.188	0.186	0.58	0.54	0.18	0.17
Sulphur coated urea at 250 g N/palm/year.	8.5	9.0	0.150	0.148	0.40	0.37	0.14	0.13
Sulphur coated urea at 500 g N/palm/year.	8.5	9.0	0.147	0.145	0.39	0.36	0.13	0.12
Sulphur coated urea at 1000 g N/palm/year.	8.5	9.0	0.146	0.144	0.38	0.32	0.12	0.11
New L.S.D. at 5 %	0.4	0.4	0.022	0.020	0.04	0.04	0.02	0.02

Discussion

The previous positive action of the slow release N fertilizers on amending the palms with their requirements from nutrients at longer times as well as their balancing effect on nutrient uptake could explain their beneficial effects on growth, palm nutritional status, yield and fruit characteristics (Nijjar, 1985). The reduction on loss of nutrients via leaching due to applications of the controlled release N fertilizers could add another explanation. Their effects on controlling C/N in favour of improving yield as well as encouraging the fruiting, state can give another reason (Wang and Alva, 1996).

Using fast release N fertilizers encourages the acceleration of growth at the expense of fruiting and this lead to the decline on the yield (Nijjar, 1985).

These results are in accordance with those obtained by Ali-Mervat, (2000); Ibrahim-Asmaa, (2001); Kamel, (2002); abd El-Hameed and Rabeea, (2005); Liu *et al.*, (2006); shaalan-Nashwh, (2008); Uwakiem, (2011); ahmed and Abada, (2012); Allam, (2014); Mohamed *et al*., (2018a) and (2018b) and Abd El-Kafy, (2018).

CONCLUSION

Carrying out N fertilization via sulphur-coated urea at 250 g N/palm was necessary for promoting yield and fruit quality of Zaghloul date palms growing under Minia region conditions.

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تأثير استخدام الأسمدة النيتروجينية بطيئة التحلل فى مواجهة الأسمدة النيتروجينية سريعة التحلل علي الاثمار فى نخيل البلح الزغلول

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[٢]المعمل المركزى لابحاث وتطوير نخيل البلح .مركز البحوث الجيزة - مصر

خلال موسمى ٢٠١٦، ٢٠١٧ تم تسميد نخيل البلح الزغلول بثلاثة اسمدة بطيئة التحلل هى اليوريا المغطاة بالكبريت (٤١% نيتروجين) واليوريا المغطاة بالفوسفور (٣٧,١١% نيتروجين) واليوريا فورمالدهيد (٤١% نيتروجين) ومقارنتها بسماد اليوريا كسماد نيتروجينى سريع التحلل.وقد تم اضافة الأسمدة النيتروجينية سريعة و بطيئة التحلل بثلاثة معدلات من النيتروجين وهى ٢٥٠ و ٥٠٠ و ١٠٠٠ جرام نيتروجين للنخلة. وكان الهدف تحديد أفضل مصدر وجرعة للنيتروجين يحتاجها نخيل البلح الزغلول. وقد تم اضافة الأسمدة بطيئة التحلل مرة واحدة فى بداية النمو أما سماد اليوريا فقد اضيف علي ثلاث جرعات متساوية فى بداية النمو وبفاصل شهرين بعد ذلك. كان تسميد النخيل بالنيتروجين فى صورة الأسمدة بطيئة التحلل عموما متفوقا عن استخدام النيتروجين من خلال السماد سريع التحلل (اليوريا) فى تحسين النمو وكمية المحصول وخصائص الجودة للثمار. كان استخدام النيتروجين بمعدل ٢٥٠ جرام للنخلة علي هيئة اليوريا المغطاة بالكبريت واليوريا المغطاة بالفوسفور واليوريا فورمالدهيد مرتبة ترتيبا تنازليا فعالا جدا فى تحسين جميع المقاييس تحت الدراسة. لم يؤد زيادة الجرعات المستخدمة من النيتروجين من ٢٥٠ الي ١٠٠٠ جرام نيتروجين للنخلة والمستخدمة فى صورة الأسمدة النيتروجينية بطيئة التحلل الى اية زيادات واضحة فى المقاييس المستخدمة. ان تسميد النخيل بالسماد النيتروجينى بطئ التحلل وهو اليوريا المغطاة بالكبريت بمعدل ٢٥٠ جرام نيتروجين للنخلة يكون ضروريا لاجل تحسين كمية المحصول وخصائص الجودة لنخيل البلح الزغلول النامى تحت ظروف منطقة المنيا.

الكلمات الدالة: اليوريا – اليوريا المغطاة بالكبريت -اليوريا المغطاة بالفوسفور -اليوريا فورمالدهيد - نخيل البلح الزغلول – النمو الخضرى - الحالة الغذائية للنخلة – كمية المحصول – خصائص الجودة للثمار .