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EFFECT OF DIFFERENT RATES OF BENTONITE COATED UREA AS A SLOW RELEASE N FERTILIZERS ON LEAF MINERAL STATUS, YIELD AND FRUIT QUALITY OF LE-CONTE PEAR TREES

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ABSTRACT

Two slow release N fertilizers namely bentonite coated urea with thin coated material (4% BCU1) and bentonite coated urea with thick coated material (12% BCU 2) each at 150, 225 and 300 gm N/tree/year in addition to urea (fast release N fertilizer) at 300 gm N/tree/year (as a recommended dose) added to le-conte pear trees during 1997 and 1998 seasons.

Results show that application of slow release N fertilizers surpassed the application of urea in improving leaf mineral content especially N and K, increasing yield and improving physical characteristics of fruits.

The best results with regard to yield and fruit quality of le-conte pear trees were obtained in the treatment of bentonite coated urea with thick material (12% BCU 2) at 150 gm N/tree year.

Total soluble solids, total acidity and total soluble solids/acid ratio were not affected significantly by different treatments in both seasons of study.

INTRODUCTION

Pear fruit is one of the most lovely and favorite fruits of temperate zone deciduous fruits. It can be considered the third in importance among deciduous fruits in the world and the fourth among all fruits together (Scheer and Juergenson, 1976).

The main pear cultivar grown in Egypt (Le-conte) is a hybrid between (Pyrus communis, L.) and (Pyrus serotina, Rehd). The total cultivated area of pears in Egypt is about 11618 fed. represented 56630 tons yearly (Ministry of Agriculture A.R.E., 1997).

Yield of Le-conte pear cultivar in Egypt varies from year to another and from orchard to other. This variability has been attributed to many reasons, mainly fertilization as forms, amounts and doses.

There are numerous advantages of using slow-release fertilizers such as reducing the amounts used for supplying the plant requirements of fertilizers through saving the waste, minimizing the number of fertilizer additions and subsequently minimizing the fertilizer cost, increasing element use efficiency, reducing adverse effects on environmental and reducing nitrate leaching.

Urea as a fertilizer is one of the nitrogenous sources that is needed in some cases, like severe deficiency of nitrogen in the neglected orchards and in the case of sandy poor soils. Rafah orchard suffer from these factors. It was hard to find a research work about the effect of slow-release fertilization on pear trees.

The aim of this study was to compare the different rates of slow release N fertilizers with the recommended dose (of urea fast release N fertilizers) on leaf mineral status, yield and fruit quality of le-conte pear trees grown under Rafah condition.

MATERIALS AND METHODS

The present study was conducted during 1997 and 1998 seasons on Le-conte pear trees. The trees were 20 years old grown at 5 x 5 m apart, budded on pyrus communis rootstock in sandy soil located at Rafah, Northern Sinia Governorate.

This soil had the following characteristics pH 8.3, E.C 0.12 DSm-1, $CaCO_3$ 1.65%, sand 80.52%, silt 12.68% and clay 6.8%, O.M 0.35%, total nitrogen 0.015%.

Twenty one trees as uniform as possible were selected for this study.

Table (1) The seven treatments involved in this experiment were arranged as follows:

Source of nitrogen	Treatments
1. Bentonite coated urea (35% N) with thin coating material (4% BCU1) 2. Bentonite coated urea (35% N) with thick coating material (12% BCU2) 3. Urea	1. 150 gm N/tree/year as (BCU1) 2. 225 gm N/tree/year as (BCU1) 3. 300 gm N/tree/year as (BCU1). 4. 150 gm N/tree/year as (BCU2) 5. 225 gm N/tree/year as (BCU2) 6. 300 gm N/tree/year as (BCU2) 7. 300 gm N/tree/year as (control)

The previous fertilizers at the named doses were applied at the end of April during the growing season.

Each treatment was replicated three times, one tree per each. It should be pointed out that bentonite coated urea and urea fertilizer were applied 15 cm under the soil surface.

Complete randomized block design was adapted. The following determinations were carried out:

Leaf mineral content

Samples of 20 mid terminal leaves/tree were collected in early June. and dried at 70°C until constant weight then they were grounded and finally digested.

Nitrogen, phosphorus and potassium were determined on dry weight basis.

- Nitrogen content was determined by the micro Kieldahl-method as described by Pregl (1945).
- Phosphorus was determined by the colourimetric method according to Troug and Meyer (1929).
- Potassium was measured by using flame-photometer due to method described by Brown and Lilliland (1946).

Yield/Tree

When the fruit reached maturity stage (Mid July) yield was recorded as number of fruits and weight as Kgs/tree.

Fruit Characteristics

1. Physical characteristics

Sample of 20 fruits was taken from each tree at the harvest time to study the following characteristics:

- Average fruit weight (gm).
- Average fruit volume (cm³)
- Specific grafity $\frac{fruit\ \ weight\ \ (gm)}{fruit\ \ voluem\ \ (cm^3)}$
- Average fruit length and diameter (cm).
- Fruit shape index $\frac{fruit\ \ length\ \ (cm)}{fruit\ \ diameter\ \ (cm)}$
- Firmness of fruits was determined by using penetrometer (pressure tester).

2. Chemical Characteristics

Total soluble solids of fruit juice (TSS): by using a handle refractometer.

Acidity:

The percentage of total acidity in fruit juice was determined as malic acid (according to A.O.A.C., 1970).

Total soluble solids/acid ratio

The ratio between total soluble solids to total acidity percentage was calculated.

Statistical analysis

All data were subjected to analysis of variance according to the procedures reported by *(Snedecor and Cochran, 1974)*. Treatment means were compared by the least significant difference test (LSD) at 5% level of probability in the two seasons of study.

RESULTS AND DISCUSSION

Leaf mineral content

It is clear from the data in Table (2) that raising rates of both sources of slow release N fertilizers (BCU1 or BCU2) significantly increased nitrogen percentage in the leaves. The values of nitrogen percentage in leaves were greater in trees fertilized with BCU2 at 300 gm N/tree/year since it was 2.6% than those fertilized with BCU1 at the same dose. While the least N percentage in the leaves was obtained by control trees (1.68%).

Generally, there were significant increase in N percentage in the leaves of trees treated with BCU2 than in those of BCU1 at the medium or the high rate (225 or 300 gm N/tree/year) since, they were 2.4% for the medium rate of BCU2 and 2.25% for the medium rate of BCU1. With the low rate (150 gm/N/tree/year), no significant differences were detected between the two forms since it attained the same value (2.0%).

This was true in the first season, whereas in the second season results showed almost the same trend but the differences between some treatments were not significant.

Phosphorus percentage was not affected significantly by different treatments in both seasons. The values ranged between (0.16 – 0.22%) in the two seasons of the study. However, a particular trend was noticed, that P content in the leaves tended to increase with increasing N rate specially in BCU2 source in both seasons.

As for K, results clearly showed that different treatments increased potassium percentage in the leaves significantly comparing with the control treatment. This was true in the two seasons. The values ranged between (1.64 – 1.67% and 2.28 – 2.39%) in the first and second seasons, respectively. Control trees produced the least values, since it was 1.58% and 2% in the first and second season, respectively. There were no significant differences between BCU1 and BCU2 treatments.

Generally, N and K content in the leaves in the second season were higher than those of the first one. It could be clearly noticed that pear trees responded to different rats of both slow-release N fertilizer sources (BCU1 or BCU2) with respect to N and K content in the leaves. This means that nutrional status of pear trees grown under sandy soil could be markedly enhanced by fertilizing with slow-release N fertilizers.

These results are in agreement with those obtained by Scuderi et al. (1983), Balo et al. (1988), Thomas 1997 and Mansour (1998).

Table (2) Effect of different rates of bentonite coated urea as a slow release nitrogen fertilizers on leaf mineral content of Le-conte pear in 1997 and 1998 seasons.

Treatments	Nitrogen %		Phosphorus %		Potassium %	
	1997	1998	1997	1998	1997	1998
BCU1 150 gm (N)	2.00	2.68	0.16	0.17	1.64	2.32
BCU1 225 gm (N)	2.25	2.69	0.17	0.16	1.65	2.28
BCU1 300 gm (N)	2.50	2.72	0.18	0.18	1.65	2.30
BCU2 150 gm (N)	2.00	2.67	0.18	0.19	1.67	2.39
BCU2 250 gm (N)	2.40	2.69	0.19	0.19	1.66	2.35
BCU2 300 gm (N)	2.60	2.70	0.22	0.21	1.66	2.32

Control	1.68	2.31	0.16	0.18	1.58	2.0
L.S.D. 5%	0.04	0.03	NS	NS	0.04	0.13

Yield / Tree

It is clear from the data presented in Table (3) that all treatments caused a significant increase in number of fruits/tree in comparing with the control treatment. Raising the rate of both slow-release N fertilizers significantly increased the number of fruits/tree in the two seasons.

Highest yield as number of fruits/tree was obtained by fertilizing trees with (300 gm N/tree/year) as BCU1 in the first season values were (412 fruits) and by BCU2 in the second season (359 fruits) in the second season.

The least number of fruits per tree was obtained by control trees, since it was 375 and 325 fruits in the first and second seasons, respectively.

Data in Table (3) clearly show that Le conte pear trees responded greatly to different rates and types of the slow release N fertilizers with respect to yield as Kgs/tree in both studied seasons.

It is easy to notice that different treatments significantly increased yield (kgs/tree) than those obtained by the control. The highest yield was produced by BCU2 at 150 gm N/tree/year since it was 31.9 and 40.5 kg in the first and second season, respectively. This result may be due to attaining this treatment the highest fruit weight in comparing with the other treatments.

This trend was also noticed, fertilizing trees with the different doses of slow-release N fertilizer as (BCU2) type produced a slight and insignificant increase in yield than of the analogous ones of the slow release N fertilizer as (BCU1).

The highest yield (average the two seasons) was produced by (BCU2 at 150 gm N/tree/year), since it was 36.2 kg followed by BCU1 at 150 gm N/tree/year since it was 35.7 kg.

Moreover, yield weight tended to decrease with increasing the slow release N fertilizer doses either as BCU1 or BCU2 forms. This result may be due to the increment of number of fruits/tree with increasing the dose of the slow release fertilizers. From the data illustrated in Table (3) it can be concluded that highest yield as (kgs/tree) was obtained by fertilizing tress with the low rate of the slow release N fertilizer (150 gm N/tree/year) especially as BCU2 form. Yield was increased by 32.3% and 29.8% with BCU2 (at 150 gm N tree/year) as compared with control trees in the first and second seasons respectively.

These results are in agreement with those obtained by Sharasbenidze et al. (1986), Ahmed and El-Dawwey (1992), Boman 1993, Maria et al. (1996), Mansour et al. (1999).

Table (3) Effect of different rates of bentonite coated urea as a slow release nitrogen fertilizers on number of fruits/tree and average yield/tree in 1997 and 1998 seasons.

Treatments	Number of fruits/tree		Average of two seasons	Yield/tree kg		Average of two seasons
	1997	1998		1997	1998	
BCU1 150 gm (N)	398	345	372	31.4	39.9	35.7

BCU1 225 gm (N)	400	352	376	29.7	39.5	34.6
BCU1 300 gm (N)	412	349	381	28.9	39.4	34.2
BCU2 150 gm (N)	400	350	375	31.9	40.5	36.2
BCU2 250 gm (N)	406	355	381	30.9	39.6	35.3
BCU2 300 gm (N)	400	359	380	30.2	39.4	34.8
Control	375	325	350	24.1	31.2	27.7
L.S.D. 5%	9.0	8.0	5.0	0.7	1.2	0.8

Fruit Characteristics

1. Physical Characteristics

Results in Table (4) show that supplying Le-conte pear trees with bentonite coated urea (BCU1 and BCU2) as a slow-release N fertilizer significantly increased fruit weight and volume comparing with the control (urea at 300 gm/N/tree/year).

The highest fruit weight and volume were produced from tress fertilized with the low rate (150 gm/N/tree/year) as BCU2 and BCU1, since the values were 79.7 gm, 80.6 cm³ and 117 gm, 118.6 cm³ in the first and second seasons, respectively. While the least values of fruit weight and volume were obtained from trees of the control in both seasons. The values ranged between 61-97.6 gm and 62-98.1 cm³. These results are in agreement with those obtained by Boman 1993 and Mansour (1998).

Specific grafity of Le-conte pear fruits was not affected significantly by different treatments in the two seasons. The values ranged between 0.97 and 0.99 gm/cm³. These results are in agreement with those obtained by Gobara, 1998.

Fruit length was significantly affected by different treatments in both seasons. The highest fruit length was produced from trees received the low rate of slow-release N fertilizer (150 gm/N/tree/year) as BCU2, since it was 6.3 cm and 7.6 in the first and second seasons, respectively. The least values was recorded in control trees, since it was 5.6 cm and 6.7 cm in the first and second seasons of study.

Concerning fruit diameter, Table (4) show that fruits taken from trees fertilized with 150 gm N per tree as BCU1 recorded the highest values since they were 4.9 cm and 5.8 cm in the first and second seasons, respectively. While, the control trees recorded the least fruit diameter, since it was 4.5 cm and 5.5 cm in the first and second seasons, respectively.

Data presented in Table (4) show that shape index was affected significantly by the different treatments. The values ranged between (1-2% - 1.4%) in the two season of study.

The highest shape index was recorded from tree treated with (150 gm/N/tree/year) as BCU2 in both seasons since it was 1.4%. While the least shape index attained by control trees in both seasons, since it was 1.2%.

As for fruit firmness it is clear from the data presented in Table (4) that increasing the level of slow-release N fertilizes (BCU1 or BCU2) significantly decreased fruit firmness. This was true in the two seasons. Fruit firmness values ranged between (14.3 – 15.3) and (13.2 – 14.8) in the first and second seasons, respectively. The least fruit firmness were obtained from control trees since it was 13.9 and 13.0 in the first and second seasons respectively.

This means that highest values of Le conte fruit firmness could be obtained by fertilizing trees with the low rate (150 gm N/tree/year) of slow-release N fertilizer either as BCU1 or BCU2.

Table (4) Effect of different rates of bentonite coated urea as a slow release nitrogen fertilizers on fruit physical characteristics of Le-cont pear in 1997 and 1998 seasons.

Treatments	Fruit weight (g)		Fruit volume (cm³)		Specific grafity (gm/cm³)		Fruit length (cm)		Fruit diameter (cm)		Shape index L/D ratio		Fruit firmness lb/12	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
BCU1 150 gm (N)	79.0	117.0	80.0	118.6	0.99	0.99	6.0	7.5	4.9	5.8	1.2	1.3	15.3	14.8
BCU1 225 gm (N)	74.2	113.0	75.4	114.2	0.98	0.99	6.0	7.2	4.7	5.7	1.3	1.3	14.8	13.7
BCU1 300 gm (N)	70.2	113.6	72.0	114.8	0.98	0.99	5.9	7.2	4.6	5.7	1.3	1.3	14.8	13.6
BCU2 150 gm (N)	79.7	115.6	80.6	116.6	0.99	0.99	6.3	7.6	4.6	5.6	1.4	1.4	15.2	14.8
BCU2 250 gm (N)	76.2	111.5	78.3	113.5	0.97	0.99	6.1	7.2	4.6	5.6	1.4	1.3	14.9	13.4
BCU2 300 gm (N)	75.4	110.0	76.6	110.5	0.98	0.99	6.0	7.0	4.8	5.6	1.3	1.3	14.3	13.2
Control	61.0	97.6	62.0	98.1	0.98	0.99	5.6	6.7	4.5	5.5	1.2	1.2	13.9	13.0
L.S.D. 5%	2.1	3.7	2.2	7.7	NS	NS	0.2	0.2	0.3	0.2	0.05	0.05	0.6	0.5

2. Chemical Characteristics

Data presented in Table (5) show that the application of bentonite coated urea at different rates improved total soluble solids comparing with control treatment in both seasons of study.

The values ranged between (13.9 – 14%) and (14.6 – 15%) in the first and second seasons, respectively.

As for acidity, it is obvious from data in Table (5) that no significant differences were observed between different treatments. The values ranged between (0.49 – 0.51%) and (0.46 – 0.50%) in the two seasons, respectively.

Tss/acid ratio was not affected significantly by different treatments in both seasons. The values ranged between (27.0 – 28.6%) and (29-31%) in the two seasons respectively.

Table (5) Effect of different rates of bentonite coated urea as a slow release nitrogen fertilizer on fruit chemical characteristics of Le-conte pear in 1997 and 1998 seasons.

Treatments	TSS %		Acidity		TSS/acid ratio	
	1997	1998	1997	1998	1997	1998
BCU1 150 gm (N)	14.0	14.6	0.49	0.48	28.6	30.4
BCU1 225 gm (N)	13.9	14.8	0.50	0.48	27.8	30.8
BCU1 300 gm (N)	13.9	15.0	0.50	0.49	27.8	30.0
BCU2 150 gm (N)	14.0	15.0	0.49	0.46	28.6	30.6
BCU2 250 gm (N)	14.0	14.9	0.50	0.48	28.0	31.0
BCU2 300 gm (N)	14.0	15.0	0.50	0.48	28.0	30.0
Control	13.8	14.5	0.51	0.50	27.0	29.0
L.S.D. 5%	NS	NS	NS	NS	NS	NS

From this study it may be recommended that the use of bentonite coated urea with thick coated (12%) at 150 gm N/tree/year added at the end of April is promising for Le-conte pear trees grown in circumstances of Rafah orchard or similar to it since it increased leaf mineral content, yield and improved fruit quality.

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تأثير المعدلات المختلفة من التسميد بالأسمدة الأزوتية البطيئة التحلل على المحتوى المعدني للورقة والمحصول وجودة ثمار الكمثرى الليكونت

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استخدم صورتين من الأسمدة النتروجينية البطيئة التحلل وهما اليوريا المغلفة بالبنتونيت غلاف رقيق (4%) واليوريا المغلفة بالبنتونيت غلاف سميك (12%) بمعدلات 150 ، 225 و 300 جم نيتروجين/الشجرة في السنة بالإضافة إلى اليوريا العادية (سماد نتروجيني سريع التحلل) بالمعدل الموضح به 300 جم ن/الشجرة في السنة على أشجار الكمثرى الليكونت خلال موسمي 1997 و 1998.
أظهرت النتائج أن المعاملة بالأسمدة النتروجينية البطيئة التحلل تفوقت على المعاملة باليوريا العادية (سماد نتروجيني سريع التحلل) في تحسين محتوى الورقة من العناصر خاصة النتروجين والبوتاسيوم والمحصول والصفات الطبيعية للثمار.
أمكن الحصول على أفضل النتائج للمحصول وجودة الثمار الكمثرى الليكونت المعاملة باليوريا المغلفة بالبنتونيت غلاف سميك (12%) بمعدل 150 جم نتروجين/ الشجرة في السنة.
أما المواد الصلبة الذائبة الكلية والحموضة ونسبة المواد الصلبة / الحموضة لم تتأثر معنويًا بالمعاملات المختلفة خلال موسمي الدراسة.