

EFFECT OF FOLIAR APPLICATION WITH UREA ON FLOWERING, FRUITING AND LEAF NITROGEN CONTENT OF VALENCIA ORANGE TREES.

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ABSTRACT

Foliar application with urea at 1.5% or 3.0% foliar urea in mid-December and/or mid-January to Valencia orange trees budded on Volkameriana rootstock, increased the number of flowers/branch, fruit set/branch and number of fruits/tree. The data also reveal that average of fruit weight, length and yield of trees which sprayed in mid-January with 1.5% urea solution was higher than the control but fruit diameter was affected, only in the second season, by different urea treatments. Juice volume per fruit also showed an increase for most urea treatments. SSC, total acidity and Vit. C were also affected by urea applications leaf nitrogen and ammonium contents were also increased as a result of sprayed trees with winter urea.

INTRODUCTION

Foliar application, with urea in the winter are an easy, economical, practical and promising method for applying nitrogen to wide types of plants. Direct usage of nitrogen by the leaves can be effective in reducing the dose needed by the trees. This phenomena may be of significant importance as fertilizers prices always increasing. Besides, California growers decreased the amount of nitrogen applied to the soil and increased the use of foliage nitrogen to reduce nitrogen contamination of ground water (Ali & Lovatt 1992). To obtain the best results of this practice, we have to determine the suitable time and the concentration for different varieties growing under different locations. Application of N during the stages of flower bud differentiation, morphological differentiation and flower drop increased fruit yield of Satsuma mandarin (Liu and Liu 1998). The aim of the present study is to investigate the effect of winter foliar application with urea on flowering, fruit set, yield, fruit properties and leaf ammonium content of Valencia orange trees growing in a sandy soil under drip irrigation system.

MATERIALS AND METHODS

The present study was carried out during two successive seasons of 2005/2006 and 2006/2007 on five years old Valencia orange trees (*Citrus sinensis*, Osbeck) budded on Volkameriana lemon rootstock grown in sandy soil in a private orchard located at Tawfeik El-Hakeem village, Boustan area, El-Behera governorate. The main goal of the study was to examine the influence of foliar application with urea on flowering, fruiting, leaf nitrogen and leaf ammonium content and fruit quality. The selected trees were nearly uniform in vigour and size, spaced at 4 x 5 m. apart and receiving the same

cultural practices usually adapted for this area according to the recommendation of Horticulture Research Institute, Ministry of Agriculture, Egypt. The nitrogen fertilizing program adapted in this culture was 1.900 Kg/tree per year ammonium nitrate (33.5% N) added through fertilizer injector pump (fertigation). Besides, the trees were also sprayed with crystalon (19:19:19 N, P,K) only once; at bud sprouting in March at the rate of 4Kg/600 Liter water. In addition, trees were sprayed with (250gm chelated iron 8%, 250 gm chelated manganese 14%, 150gm chelated zinc 13% and 3 Kg urea/600 Liter of water) three times; at bud sprouting; in March, after fruit set; in May, and during fruit growth ; in August. Surface drip irrigation system is used in the orchard. The treatments are presented as follows:

- 1) Control,(sprayed with water).
- 2)Trees sprayed at 1.5% urea solution sprayed on December, 15.
- 3) Trees sprayed at 1.5 urea solution sprayed on January, 15.
- 4)Trees sprayed at 1.5 urea solution sprayed twice, on December, 15 and January,15.
- 5)Trees sprayed at 3% urea solution sprayed on December, 15.
- 6)Trees sprayed at 3% urea solution sprayed on January, 15.
- 7)Trees sprayed at 3% urea solution sprayed twice on December, 15 and January, 15.

Four replicates were selected to represent each treatment i.e. twenty-eight trees were used for the study.

Different treatments were applied using a 20 liters hand sprayer on the foliage until drip point of the solution. Each tree received (4 Liters i.e 60 gm. and 120 gm. Commercial urea with low-biuret 46.5 N%) per tree for 1.5% and 3% treatments, respectively. Guard rows were left around the trees of each spray treatment. Different treatments were repeated on the same trees for the two successive experimental seasons.

A-Tissue analysis:

A leaf sample of 20 – 30 full-expanded mature leaves was taken from non-fruiting shoots of the previous spring growth flushes. The leaves were collected from all over the circumference of each tree. Leaf samples were taken after 20 and 30 days from application date. The leaf samples were washed with tap water, rinsed three times in distilled water, oven dried at 65 – 70°C to a constant weight and grounded to 20 mesh size. The sample were used for ammonium and total nitrogen determination. Ammonium was extracted from 0.5 gm. ground dry material using the procedure suggested by Ali and Lovatt (1995), and colorimetrically determined by Nessler method according to the A.O.A.C. (1960). For total nitrogen determination, 0.3 gm. ground dry material was digested with sulfuric acid and hydrogen peroxide according to Evenhuis and DeWaard (1980). Nitrogen in the digested solution was colorimetrically determined according to Evenhuis (1976).

B- Flowering and fruit setting,

During March and April of 2006 and 2007 seasons, two branches located in two different directions (in north and south) were tagged from each tree. The circumference of chosen branches was 4.5cm. The number of flowers born on each branch on each season was recorded.

During both experimental seasons, number and percentage of setted fruits were recorded in three different counting dates i.e 1st May, 10th and 26th of June.

C- Fruit number and yield

In February of 2006 and 2007 seasons, fruit number of each tree was recorded and on April, 10 average fruit weight; of 10 randomly selected mature fruits was estimated for each tree. Fruit yield of each experimental tree was then calculated as kg per tree.

D- Fruit quality.

At harvest time (on April, 10) of both seasons, fruit length, diameter and weight of three fruits, randomly taken from each experimental tree, were determined. Soluble solids content (SSc) in fruit juice was determined by hand refractometer. Fruit juice volume was also recorded. Acidity, as citric acid percent, was determined using 0.1 N sodium hydroxide. Vitamin C content in the juice was determined by titration with 2,6 dichlorophenol endophenol dye (A.O.A.C 1960). The data were statistically analyzed using a complete randomized block design according to Snedecor and Cochran (1974).

RESULTS AND DISCUSSION

Effect of foliar winter urea sprays on flowering:

From Table (1) it is evident that spraying trees with 1.5% urea in mid-January gave the highest number of flowers /branch in both season. The results also showed that spraying twice. in mid- December and mid-January with both 1.5% urea solution in the second and 3% urea in both seasons resulted in a higher number of flowers/branch when compared with the control treatment and the differences were significant. In general, control treatment produced lower number of flowers/branch in both season when compared with different urea treatments. These results agree with Dai *et al* (1995) in china, using Pongan mandarin, since , they reported that results of 10 years showed that a high leaf N content prior to the physiological differentiation stage was a key factor for flower bud formation. Lovatt *et al* (1992), reported that raising the ammonia content with the application of low-biuret urea raised the number of floral shoots and flowers /shoot but did not influence on the number of vegetative shoots. Kim-Yong *et al* (1997) studied the effect of foliar application of urea (0.5 – 3%) on tree growth of Satsuma mandarin. They concluded that foliar sprays of 1% urea, applied one week before and after harvest, improved the nutritional status of trees, resulting in better reproductive growth. Albrigo (1999), found that sprays of urea or nutriphite applied between 25, December and 11, January increased the number of flowers.

Effect of winter urea on fruit set

The effect of different winter urea on number of fruit set/branch showed that spraying 1.5% urea solution in mid-January, in both seasons, gave the highest number of fruit set (Table 2). It was also clear that control trees, receiving no foliar urea, contained lower fruit set, specially on the first counting date, 1 May, in both season.

The results of fruit set percentage, presented in Table (3) revealed the same trend as that of fruit set number/branch, as spraying 1.5% urea in mid January, in both seasons, gave almost the highest percentage of fruit set when compared with the control. However, fruit set percentage of trees sprayed with 3% urea solution in mid December, in the second season, was as high as that of trees sprayed with 1.5% urea solution in mid January.

These results agree with Lovatt (1999) who reported that a single prebloom foliar application of nitrogen as low-biuret urea to 30- year-old Washington Navel orange (*Citrus sinensis*) trees during flower initiation significantly increased yield and fruit number per tree for each of 3 consecutive years.

Ali and Lovatt (1994) found that winter application of low biuret urea to the foliage of Washington Navel orange in mid – Jan. or mid- Feb. independent of irrigation treatment had significantly greater yield and fruit number / tree each year than the control trees for 3 consecutive years.

In 2- year trials with 10 – year – old (*Citrus aurantifolia*) trees Singh and Prasad (1981), in India, found that fruit set was highest (68.5 – 70%) in trees which received the highest N (as urea) and GA rates via the foliage of the trees.

Effect of winter urea application on fruit number / tree, average fruit weight and yield.

The results concerning the effect of different foliar urea sprays on fruit number per tree, in both seasons, showed that all the trees which received urea sprays produced higher number of fruits per tree than the control. However, the number of fruits of trees receiving 3% urea on 15, January was almost similar with that of the control (Table 4). These results agree with Lovatt 1999, who reported that, a single winter prebloom foliar application of low-biuret urea to Washington Navel orange trees significantly increased fruit number per tree for each of 3 consecutive years. Similar results were also obtained by Ali and Lovatt, 1994. On the other hand, Salem et al, 1995, working on Balady mandarin, in Minia governorate, found that urea on its own had not increased numbers and yields.

These results concerning the effect of different urea sprays on average fruit weight revealed that, trees sprayed with 1.5% urea solution on January, 15, in both seasons, produced heavier fruits than the control but the differences were significant. It was also found that fruits sprayed with 1.5% urea on December, 15, in the second season, have almost similar weight as those of 1.5% urea spray on January, 15,. However, fruit weight of trees of the other treatments were almost the same as those of the control (Table 4).

These results agree with Ali and Lovatt, 1992 who reported that low-biuret urea when sprayed Washington Navel orange in winter produced the greatest number of fruit with diameters from 7.0-8.0 cm. Lovatt, (1999) also reported that a single winter prebloom foliar application of low-biuret urea increased the number of commercially valuable large size fruits of Washington navel orange. Ali and Lovatt, (1994), found that winter application of low-biuret urea to the foliage of Washington Navel orange trees increased the number of fruits with diameters of 6.1 – 8.0 cm.

Moreover, Singh and Prasad, 1981 also reported that applying urea via the foliage of acid lime (*Citrus aurantifolia*) produced heavier fruits than those of the control.

Yield per tree of the different winter foliar urea sprays is shown in Table (4). The results revealed that spraying 1.5% urea solution on January, 15, in both seasons, and 1.5% urea on December, 15, in the second season, produced higher yield per tree than the control and the differences were significant. It was also clear that similar trend was also obtained concerning average fruit weight as shown before, Table (4).

Increasing yield of citrus trees due to a single winter prebloom foliar application of urea was reported by many investigators, Lovatt, 1999; Ali and Lovatt, 1994; Albrigo, 1999; Ahmed and Abo-Shelbaya, 1988; Singh and Prasad, 1981; Rabe et al 1993; Liu and Liu 1998 and Kumar et al 1988.

Effect of foliar application with urea on physical fruit properties.

The results of the first season showed a slight increase in average fruit length of fruits of all trees sprayed with urea solution when compared with that of the control, but the differences were only significant for 1.5% urea treatment sprayed on January, 15, (Table 5).

The results of average fruit length in the second season showed almost similar trend, except that of trees sprayed with 3% urea solution in mid January which produced fruits of about equal length as that of the control.

As for fruit diameter in the first season, the results revealed no differences between fruits of all treatments, while in the second season, all fruits of trees sprayed with urea, except those of trees sprayed with a single 3% urea, has more fruit diameter than that of the control and the differences were significant (Table 5). Furthermore, fruit weight results, in the first season, showed no clear differences between all treatments, while in the second season, trees sprayed with 1.5% urea solution in mid December were heavier fruit when compared with those of other treatments and the differences were significant (Table 5).

The results of average fruit dimensions and weight partially agree with Ali and Lovatt (1994), working on Washington Navel orange trees who found an increase in the number of fruits with diameters of 6.1 – 8.0 cm, due to foliar applied urea in mid-January or mid-February. In this respect, Lovatt (1999) also reported that a single winter urea spray, applied to Washington Navel orange trees, increased the commercially valuable large-size fruits with an increment in yield. Ahmed and Abo-Shelbaya, (1988), reported that fruit dimensions of Balady mandarin were increased by all urea and micronutrients sprays.

The effect of different urea application on Juice volume are shown in Table (5). The results in the first season revealed a slight increase in fruit juice due to different urea spray treatments when compared with that of the control. However, in the second season, this trend was only clear in fruits of trees sprayed with 1.5% urea solution on January, 15, and those of trees sprayed twice with 3.0% urea solution on December, 15, and January, 15, and the differences were significant, Table (5).

Ahmed and Abo-Shelbaya, 1988, found that juice percentage of Balady mandarin was increased by all urea and micronutrients treatments.

Effect of foliar application with urea on chemical fruit properties.

The results of both seasons clearly showed an increase in fruit soluble solids content due to different application with urea when compared with that of the control, but the differences were only significant in the second season (Table 6). Albrigo (1999), working on Valencia orange trees, found that winter urea sprays for 4 consecutive years increased orange juice soluble solids .

The effect of different urea treatments, in the first season, showed a slight increase in juice acidity in all treatments, when compared with that of the control. However, total acidity in fruit juice of trees sprayed twice on December, 15, and January, 15, whether urea solution concentration 1.5% or 3% was not high enough to be significant. Results of the second season indicated that higher acidity percentage was found in fruits of trees sprayed with 1.5% urea solution on January, 15, and those sprayed with 3% urea solution on December, 15, while that of other treatments was almost similar to that of the control trees, Table (6). Seligman and Keren (1997), reported that foliar application of low-buired urea to grapefruit trees did not influence soluble solids / acid ratio of fruits.

The results are shown in Table (6) revealed that, in both seasons, vitamin C in fruits of trees sprayed with urea, in most cases, was higher than that of the control, but the differences were only significant for spraying urea solution at 1.5% on December, 15, and January, 15, and 3% on December, 15.

Effect of foliar application with urea on leaf nitrogen content.

After 20 days from different foliar urea spray treatments, total nitrogen content of the leaves, in both seasons, was increased when compared with the control and this effect was more pronounced in the leaves of trees sprayed in mid-December whether urea solution concentration was 1.5% or 3.0% Table (7).

Leaf samples collected after 30 days from trees sprayed with different urea treatments reflected almost similar trend as those sampled after 20 days. These results agree with Kim *et al.* (1996), working on Satsuma mandarin, Lovatt and Cheng (1990) and Lovatt *et al.* (1992) on Washington Navel orange. On the other hand, Ali and Lovatt (1994), working on Washington Navel trees, reported that annual winter application of low-buired urea to the foliage did not significantly increased leaf total nitrogen at the end of 3 years.

As for leaf ammonium content the results showed that, in both seasons, leaves of trees sprayed twice in mid-December and mid-January, whether with 1.5% or 3.0% urea solution contained the highest ammonium content when compared with the control and the differences were significant, Table (8). However, leaves collected from control trees, in both seasons, contained almost lower amounts of ammonium when compared with those of other urea treatments. These results agree with Lovatt *et al.* (1992) who reported that the application of low-buired urea to Washington Navel orange raised the ammonium content of leaves. These results also agree with Kim *et al.* (1996), working on Satsuma mandarin and Salem *et al.* (1995) on Balady mandarin.

On the other hand, Ali and Lovatt (1994), Rabe *et al.* (1993) and Seligmann and Karen (1997), reported that the application of low-biuret urea did not increase N content of leaves.

Conclusion :-

We concluded that foliar application with urea at 1.5 % or 3.0 % in mid – December and / or mid – January to Valencia orange trees increased flowering fruiting and yield of trees without any reduction in fruit size and also improvement of fruit quality .

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تأثير الرش باليوريا على التزهير و الاثمار و محتوى الاوراق من النتروجين في اشجار البرتقال الصيفي

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وجد أن إضافة اليوريا بتركيز ١,٥% أو ٣% عن طريق الأوراق في منتصف ديسمبر أو منتصف يناير أو في كلا الميعادين على أشجار البرتقال الفالانسيا المطعومة على أصل الفولكامارينا و عمرها ٥ سنوات والنامية في أرض رملية تحت نظام الري بالتنقيط ، نتج عنه زيادة في عدد الأزهار على الفرع ، عدد الثمار العاقدة على الفرع وكذلك عدد الثمار على الشجرة. وكان متوسط وزن الثمرة وطولها وكذلك محصول الأشجار التي تم رشها بتركيز ١,٥% بمحلول يوريا في ميعاد منتصف يناير أعلى من أشجار المقارنة، بينما لم يتأثر قطر الثمار نتيجة للمعاملات المختلفة سوى في الموسم الثاني. كما أظهرت النتائج زيادة في حجم عصير الثمرة نتيجة للمعاملة بمعظم معاملات رش اليوريا المختلفة. كما تأثرت خواص الثمار الكيماوية وتشمل المواد الصلبة الذاتية والحموضة ومحتواها من فيتامين C نتيجة للمعاملات المختلفة لرش اليوريا. وأظهرت النتائج كذلك زيادة واضحة في محتوى الأوراق من النتروجين الكلى وكذلك الامونيا نتيجة للرش الشتوي للأشجار بمحلول اليوريا.

الخلاصة :-

نستخلص بأن الرش باليوريا على الاوراق بتركيز ١,٥% أو ٣,٠% في منتصف ديسمبر و / او منتصف يناير على اشجار البرتقال الصيفي يزيد من الازهار و عقد الثمار و المحصول بدون أي نقص في حجم الثمار (وزن الثمار) ، و ايضا يحسن من صفات جودة الثمار .

Table (1): Effect of urea application on the total number of flowers/branch in Valencia orange trees during 2005/2006 and 2006/2007 seasons.

Winter urea spraying treatments	2005/2006 season.		2006/2007 season.	
	Total number of flowers		Total number of flowers	
Control	96.4	c	60.8	c
1.5% on December, 15	131.6	b	133.13	ab
1.5% on January, 15	172.1	a	168.5	a
1.5% on December, 15 and on January, 15	107.5	bc	140.4	a
3% on December, 15	112.4	bc	88.6	bc
3% on January, 15	125.4	abc	134.3	ab
3% on December, 15 and on January, 15	149.9	ab	139.5	ab
L. S. D _{0.05}	30.9		51.65	

Means within a column with the same letter are not significant.

Table (2): Effect of urea application on the total number of fruit set in Valencia orange trees during 2005/2006 and 2006/2007 experimental seasons.

Winter urea spraying treatments	First experimental season (2005/2006). Fruit set counting dates.						Second experimental season (2006/2007) Fruit set counting dates.					
	May,1		June,10		June,26		May,1	June,10	June,26			
	Control	57.8	d	10.5	c	7.75	c	38.4	e	31.0	d	13.3
1.5% on December, 15	92.6	bc	19.4	ab	15.0	ab	90.6	b	67.8	b	15.9	cd
1.5% on January, 15	139.9	a	25.0	a	17.38	a	145.4	a	101.3	a	50.3	a
1.5% on December, 15 and on January, 15	80.0	c	11.5	bc	9.5	c	78.3	c	55.5	c	16.4	cd
3% on December, 15	82.6	c	14.0	bc	10.25	bc	67.5	d	52.6	c	26.6	b
3% on January, 15	81.3	c	12.6	bc	11.0	bc	79.1	c	54.5	c	20.5	bc
3% on December, 15 and on January, 15	102.1	ab	15.3	bc	13.5	b	74.8	c	50.0	c	15.4	cd
L. S. D _{0.05}	17.67		6.22		3.48		10.42		8.24		6.23	

Means within a column with the same letter are not significant

Table (3): Effect of urea application on fruit set percentages in Valencia orange trees during 2005/2006 and 2006/2007 experimental seasons.

Winter urea spraying treatments	First experimental season (2005/2006). Fruit set counting dates.			Second experimental season (2006/2007) Fruit set counting dates.		
	May,1	June,10	June,26	May,1	June,10	June,26
	Control	60.60 b	10.5 b	7.93 b	62.9 c	51.1 ab
1.5% on December, 15	70.51 ab	14.8 ab	11.42 a	68.4 bc	52.7 a	13.14 cd
1.5% on January, 15	81.74 a	15.9 a	10.60 ab	87.0 a	60.5 a	30.0 a
1.5% on December, 15 and on January, 15	75.63 ab	10.66 b	8.82 ab	59.2 c	43.6 bc	12.8 cd
3% on December, 15	76.42 ab	13.11 ab	9.17 ab	75.1 b	59.6 a	30.3 a
3% on January, 15	70.73 ab	10.67 b	8.97 ab	59.0 c	41.0 c	15.3 c
3% on December, 15 and on January, 15	70.44 ab	10.54 b	9.46 ab	60.3 c	40.5 c	25.7 b
L. S. D _{0.05}	20.72	4.96	2.82	11.46	9.44	3.85

Means within a column with the same letter are not significant

Table (4): Effect of urea application on fruit number per tree, average fruit weight and fruit yield of Valencia orange trees during 2005/2006 and 2006/2007 experimental seasons.

Winter urea spraying treatments	First experimental season (2005/2006).			Second experimental season (2006/2007)		
	Fruit number/ tree	Average Fruit weight (gm)	Fruit yield (Kg/tree)	Fruit number/ tree	Average Fruit weight (gm)	Fruit yield (Kg/tree)
Control	159.00 c	170.90 ab	27.336 c	235.00 b	190.20 de	44.888 c
1.5% on December, 15	218.00 ab	183.75 ab	40.068 ab	295.30 a	234.40 a	68.011 a
1.5% on January, 15	243.70 a	189.60 a	46.130 a	286.50 a	230.60 a	65.971 a
1.5% on December, 15 and on January, 15	205.80 ab	179.20 ab	36.080 bc	276.30 a	217.50 b	59.916 b
3% on December, 15	219.80 ab	185.40 ab	40.486 ab	291.50 a	197.50 cd	57.642 b
3% on January, 15	185.80 bc	177.10 ab	33.012 bc	221.30 b	182.10 e	40.153 d
3% on December, 15 and on January, 15	225.80 ab	164.40 b	37.105 abc	284.30 a	208.60 bc	59.004 b
L. S. D _{0.05}	43.76	22.55	10.05	26.25	12.25	4.54

Means within a column with the same letter are not significant

Table (5): Effect of urea application on physical fruit properties of Valencia orange during 2005/2006 and 2006/2007 experimental seasons.

Winter urea spraying treatments	Fruit season (2005/2006)				Second season (2006/2007)			
	Fruit length (cm.)	Fruit diameter (cm.)	Fruit weight (gm.)	Juice volume (ml.)	Fruit length (cm.)	Fruit diameter (cm.)	Fruit weight (gm.)	Juice volume (ml.)
control	6.74 b	6.58 a	177.60 a	62.40 c	6.98 cd	6.94 b	208.80 c	89.60 c
1.5% on December, 15	6.85 ab	6.64 a	179.10 a	72.50 ab	7.52 a	7.40 a	238.40 a	102.50 ab
1.5% on January, 15	7.23 a	6.61 a	199.02 a	76.51 a	7.40 ab	7.20 a	219.13 bc	109.20 a
1.5% on December, 15 and on January, 15	6.93 ab	6.63 a	175.02 a	75.30 ab	7.61 a	7.30 a	220.60 bc	93.60 bc
3% on December, 15	6.99 ab	6.62 a	183.10 a	78.60 a	7.18 bc	6.80 b	193.60 cd	86.07 c
3% on January, 15	6.90 ab	6.70 a	178.95 a	75.40 ab	6.90 d	6.70 b	183.60 d	88.30 c
3% on December, 15 and on January, 15	6.78 b	6.55 a	172.70 a	68.70 bc	7.50 a	7.30 a	227.80 ab	105.00 a
L. S. D _{0.05}	0.404	0.376	21.91	16.11	0.225	0.244	17.57	9.456

Means within a column with the same letter are not significant.

Table (6): Effect of urea application on chemical fruit properties of Valencia orange during 2005/2006 and 2006/2007 experimental seasons.

Winter urea spraying treatments	Fruit season (2005/2006)			Second season (2006/2007)		
	Total Soluble Solids(%)	Acidity (%)	Vit. C (mg/100ml.Juice)	Total Soluble Solids(%)	Acidity (%)	Vit. C (mg/100ml.Juice)
control	11.10 a	0.13 c	35.90 c	8.23 d	0.17 cd	42.30 b
1.5% on December, 15	11.50 a	0.16 b	39.80 abc	9.91 b	0.19 bc	43.10 b
1.5% on January, 15	13.00 a	0.16 b	38.30 bc	10.10 b	0.20 ab	46.90 ab
1.5% on December, 15 and on January, 15	13.20 a	0.15 bc	42.53 ab	9.93 b	0.17 cd	49.30 a
3% on December, 15	13.20 a	0.20 a	44.70 a	10.75 a	0.22 a	50.10 a
3% on January, 15	12.20 a	0.16 b	39.90 abc	10.45 ab	0.17 cd	46.60 ab
3% on December, 15 and on January, 15	11.40 a	0.14 bc	41.60 abc	8.93 c	0.16 d	44.60 ab
L. S. D _{0.05}	2.33	0.0205	5.91	0.59	0.022	5.59

Means within a column with the same letter are not significant.

Table (7): Effect of urea application on Total leaf nitrogen content in Valencia orange trees after, 20 and 30 days from urea application during 2005/2006 and 2006/2007 experimental seasons.

Treatments	First experimental season (2005/2006).				Second experimental season (2006/2007)			
	After 20 days		After 30 days		After 20 days		After 30 days	
	% Total nitrogen		% Total nitrogen		% Total nitrogen		% Total nitrogen	
Control	1.60	d	1.42	d	2.56	c	2.12	b
1.5% on December, 15	3.52	a	2.53	a	3.52	a	3.12	a
1.5% on January, 15	1.92	bcd	1.78	bcd	2.98	bc	2.82	a
1.5% on December, 15 and on January, 15	2.17	b	2.03	b	3.09	ab	2.67	ab
3% on December, 15	3.32	a	2.87	a	3.53	a	3.08	a
3% on January, 15	1.73	cd	1.88	bc	3.30	ab	3.06	a
3% on December, 15 and on January, 15	1.99	bc	1.61	cd	2.94	bc	2.57	ab
L. S. D _{0.05}	0.36		0.37		0.50		0.59	

Means within a column with the same letter are not significant.

Table (8): Effect of urea application on leaf ammonium content after 20 and 30 days from urea application of Valencia orange trees during 2005/2006 and 2006/2007 experimental seasons.

Urea Spraying Treatments	First experimental season (2005/2006).				Second experimental season (2006/2007)			
	After 20 days (p.pm)		After 30 days (p.pm)		After 20 days (p.pm)		After 30 days (p.pm)	
control	50.90	c	50.17	b	46.65	ac	33.14	c
1.5% on December, 15	52.20	c	52.72	b	80.14	ab	57.94	a
1.5% on January, 15	76.94	b	47.69	b	72.92	abc	40.71	bc
1.5% on December, 15 and on January, 15	147.41	a	120.76	a	96.74	a	57.71	a
3% on December, 15	63.71	b	49.11	b	73.34	abc	54.23	ab
3% on January, 15	132.11	a	61.72	b	47.12	bc	39.47	bc
3% on December, 15 and on January, 15	141.5	a	100.80	a	85.62	a	57.50	a
L. S. D _{0.05}	21.22		36.71		33.41		16.76	

Means within a column with the same letter are not significant.