

## Effect of Spraying Methylene Urea on Growth and Fruiting of Superior Grapevines

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**Abstract:** During 2016 and 2017 seasons, Superior grapevines grown under Upper Egypt conditions were subjected to spray with the slow release N fertilizer namely methylene urea twice, thrice or four times at 0.25 to 1.0 %. The merit was detecting the effect of these concentrations and frequencies of applications on growth and fruiting of the vines. Two, three or four sprays of methylene urea at 0.25 to 1.0 % succeeded in enhancing growth aspects, photosynthetic pigments N, Mg, Ca, Zn, Fe, Mn, yield and berries characteristics over the control. Percentage of shot berries and total acidity were negatively effected by the present treatments leaf content of P K and Cu was unaffected. The effect either in increase or decrease was depended on increasing concentrations and frequencies of applications. Negligible promotion was noticed among the use of methylene urea thrice or four times. An outstanding effect on yield and berries characteristics was observed due to treating the Superior grapevines three times with methylene urea at 1.0 % (growth start, before blooming and just after berry setting).

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**Keywords:** Methylene urea, concentrations, frequencies of Application, growth, yield, berries characteristics.

### 1. Introduction

Nitrogen is the most important mineral element in fertilization programs of grapevines because plants usually need N in greater amounts than other nutrients. However, less than 20% of the N applied to orchard fruits seems to be recovered by fruit trees. Nitrogen losses are caused by leaching, erosion, volatilization, denitrification and fixation in soil organic matter. Low N recovery by trees increases N losses from the orchards causing in negative impact on the environment (Nijjar, 1985).

Availability of nutrients during the entire growing season; reduced capital and labor quality in horticultural crop production, nutrient loss via leaching and run-off, chemical and biological immobilization reactions in soil which cause plant unavailable forms, rapid nitrification and nitrogen loss through ammonia volatilization and denitrification, seed or seedling damage from high local concentrations of salts, leaf burn from heavy rates of surface applied fertilizers and better seasonal distribution of growth and better acclimatization in home or display environment.

Previous studies showed that using slow release N fertilizers was preferable than using fast ones in enhancing growth, yield and fruit quality in different grapevines cvs ( Ali- Mervet, 2000; Ibrahim-Asmaa, 2001; Tomasi *et al.*, 2001; Kamel, 2002, Uwakiem, 2011; Ahmed and Abada, 2012, Rabie and Negm, 2012; Alam, 2014 and Ahmed *et al.*, 2014).

The main target of this study was examining the effect of different concentrations and frequencies of application of methylene urea on some growth traits, nutritional status of the vines, yield and quality of Superior grapevines.

### 2. Materials and Methods

This study was carried out during two consecutive seasons 2016 and 2017 on 60 uniform in vigour of 10- years old Superior grapevines grown in a private vineyard located at El- Makhadma village, Qena district; Qena Governorate where the texture of the soil is clay and well drained water since water table depth is not less than two meters (Table 2). The chosen vines are planted at 2x 3 meters apart. Cane pruning system was followed at the first week of Jan. leaving 84 eyes per vine ( on the basis of six fruiting canes x 12 eyes plus six renewal spurs x two eyes) with the assistance of Gabel shape supporting system. The vines were irrigated through drip irrigation system using Nile water.

Mechanical, physical and chemical analysis of the tested soil were carried out at the start of the experiment according to the procedures of Piper (1950) and the data are shown in Table (1).

Except those dealing with the present treatments (application of N compounds via foliage), all the selected vines (60 vines) received the usual horticultural practices which are commonly used in the vineyard including the application of 15 m<sup>3</sup> F.Y.M. (0.25% N), 250 kg ammonium nitrate (33.5 % N) and 150 kg calcium superphosphate (15.5 %

P<sub>2</sub>O<sub>5</sub>) and 200 kg potassium sulphate (48% K<sub>2</sub>O) per one feddan annually. Farmyard manure was added one in the middle of January. Phosphate fertilizer was added once at the same time of adding farmyard manure potassium fertilizer was added twice at growth start and again just after berry setting. Ammonium nitrate fertilizer was splitted into three unequal batches applied as 37.5 % at growth start (first week of Mar.) 37.5 % just after berry setting (week of may) and 25% at 30 days after harvesting. Another horticultural practices such as hoeing (twice a year after winter pruning and again after berry setting), irrigation, pinching and pest management were carried out as usual. All fertilizers except farmyard manure and phosphate fertilizers were added via fertigation.

**Table (1): Analysis of the tested soil**

Constituents	Values
<b>Particle size distribution:</b>	
Sand %	11.0
Silt %	22.5
Clay %	68.5
Texture %	Clay
pH (1: 2.5 extract)	8.05
E.C. (1: 2.5 extract) (dsm <sup>-1</sup> ) 1cm / 25°C	1.03
O.M. %	1.88
CaCO <sub>3</sub> %	2.55
Total N %	0.10
Available P ( Olsen method, ppm)	2.22
Available K ( ammonium acetate, ppm)	400

This experiment included the following ten treatments from different concentrations and frequencies of application of methylene urea in addition to the control treatment:

- 1- Control ( spraying with water vines).
- 2- Spraying methylene urea at 0.25 % twice.
- 3- Spraying methylene urea at 0.25 % thrice.
- 4- Spraying methylene urea at 0.25 % four times.
- 5- Spraying methylene urea at 0.50 % twice.
- 6- Spraying methylene urea at 0.50 % thrice.
- 7- Spraying methylene urea at 0.50 % four times.
- 8- Spraying methylene urea at 1.0 % twice.
- 9- Spraying methylene urea at 1.0 % thrice.
- 10- Spraying methylene urea at 1.0 % four times.

Each treatment was replicated three times, two vines per each. (60 vines). Methylene urea produced from American Limited Products Growth Company and brought from Cairo for Trading & Distribution, Cairo, Giza.

Two sprays of methylene urea were conducted at growth start (1<sup>st</sup> week of Mar.) and before blooming (Last week of March). Three sprays were carried out as growth start, before blooming and just after berry setting (2<sup>nd</sup> week of Apr.). The four sprays were performed as previously mentioned in addition to 30 days after berry setting (2<sup>nd</sup> week of May)

Triton B as a wetting agent was used with methylene urea treatments at 0.05 % (0.5 ml/ L), Spraying was done till run off (2 liters/ vine). Control treatment was carried out by spraying water and triton B (0.05%).

Randomized complete block design was followed where this experiment consisted of ten treatments, each treatment was replicated three times, two vines per each.

#### **Different measurements:**

The following measurements were recorded during the two experimental seasons.

#### **1. Measurement of vegetative growth characteristics:**

At the middle of June, the following growth aspects were recorded:

1- Average main shoot length (cm.) as a result of measuring the length of the ten labeled main shoots per vine and then the average was estimated.

2- Average leaf area (cm<sup>2</sup>) as a result of measuring the diameter of twenty mature leaves from those opposite to the basal clusters on the main shoots.

Leaf area (cm<sup>2</sup>) was measured using the following equation that outlined by **Ahmed and Morsy (1999)**.

$$\text{Leaf area (cm}^2\text{)} = 0.45 ( 0.79 \times d^2 ) + 17.77$$

Where d is the maximum diameter of the leaf, then average leaf area was registered.

3- Number of leaves / shoot.

4- Wood ripening coefficient was measured by dividing the length of brownish part of the cane by the total length of cane just before pruning date (1<sup>st</sup> week of January) (**Bourad, 1966**).

5- Just after carrying out winter pruning, the weight removal of 1- year old pruning wood per each vine was recorded ( kg/ vine)

For each vine five canes were selected just before Winter pruning (1<sup>st</sup> week of January) for measuring the cane thickness (mm) by using vernier caliper.

6- Cane thickness cm

#### **2 Measurements of plant pigments:**

Samples of five mature and fresh leaves from those leaves opposite to the basal clusters on each shoot were taken at the middle of June during the three seasons and cut into small pieces and 0.05 g weight from each sample was taken, homogenized

and extracted by 25% acetone in the presence of little amounts of  $\text{Na}_2\text{CO}_3$  then filtered. The residue was washed several times with acetone until the filtrate became colorless. The extract was completed to a known volume (20 ml) with acetone 85%. A portion of this extract was taken for the determination of chlorophylls A & B as well as total carotenoids colorimetrically and acetone (85 % V/V) was used as a blank (as mg/ 100 g F.W). The optical density of the filtrate was determined at the wave length of 662, 664 and 440 nm to determine chlorophylls A & B and total carotenoids, respectively. Concentration of each pigment was calculated by using the following equations according to **Von-Wettstein (1957)**.

Cl. A =  $(9.784 \times E_{662}) - (0.99 \times E_{644}) = \text{mg} / \text{g} / \text{FW}$

Cl. B =  $(21.426 \times E_{644}) - (4.65 \times E_{622}) = \text{mg} / \text{g} / \text{FW}$

Total carotenoids =  $(4.965 \times E_{440} - 0.268 (\text{chlorophylls a} + \text{b}))$

Where E = optical density at a given wave length. Total chlorophylls was estimated by summation of chlorophyll a plus chlorophyll b ( mg/ 100 g. / F.W)

### 3 Measurements of leaf chemical composition:

Twenty leaves picked from the main shoots opposite to the basal clusters (according to **Summer, 1985**) for each vine were taken at the middle of June during the three seasons. Blades of the leaves were discarded and petioles were saved for determining different nutrients. Petioles were oven dried at 70°C and grind then 0.5 g weight of each sample was digested using  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{O}_2$  until clear solution was obtained (according to **Wilde et al. 1985**). The digested solutions were quantitatively transfer to 100 ml volumetric flask and completed to 100 ml by distilled water. Thereafter, leaf contents of N, P, K, Mg, Ca, Zn, Fe, Mn and Cu were determined as follows:

1-N % by the modified microkjeldahl method as described by **Peach and Tracey (1968)**.

2- P % by using Olsen method as reported by **Wilde et al., (1985)**.

3- K % by using flame photometer as outlined by **(Peach and Tracey (1968))**.

4- Mg and Ca by titration against EDTA (Versene method) (**Piper, et al., 1950**)

5- Micronutrients namely Fe, Zn and Mn ( as ppm) by using atomic absorption spectrophotometer according to (**Wilde et al., 1985**).

### 4- Measurements of yield and both physical- and chemical characteristics of the berries:

#### 1- Yield:

Harvesting took place when T.S.S./ acid in the berries of the check treatment reached at least 25:1

(at the last week of June in the three seasons) (according to **Winkler et al., 1974 and Weaver, 1976**). The yield per vine expressed in weight (kg.) and number of clusters per vine was recorded.

#### 2- Berries quality:

Five clusters from each vine were taken at random for determination of the following physical and chemical characteristics.

1- Cluster dimensions (length and shoulder, cm.)

2- Shot berries % by dividing number of shot berries cluster by the total number of berries cluster and multiplying the product x 100.

3- Average berry weight (g.)

4- Average berry dimensions (longitudinal and equatorial, in cm).

5- Percentage of total soluble solids in the juice by using handy refractometer.

6- Percentage of reducing sugars in the juice by **Lane and Eynon (1965)** volumetric method as described in **A.O.A.C. (2000)**.

7- Percentage of total acidity (as g tartaric acid/ 100 ml juice) by titration against 0.1N NaOH using phenolphthalein as an indicator **A.O.A.C. (2000)**.

#### 6- Statistical analysis:

The obtained data were tabulated and significantly analyzed according to **Snedecor and Cochran (1967) and Mead et al., (1993)**. Differences between treatment means were compared during new L.S.D. test at 5% level of probability.

### 3. Results

#### 1-Some vegetative growth aspects:

It is clear from the obtained data in Table (2) that subjecting Superior grapevines twice, thrice or four times with methylene urea at 0.25 to 1.0% significantly stimulated the six growth aspects namely main shoot length, number of leaves/ shoot, leaf area, wood ripening coefficient, cane thickness and pruning wood weight relative to the control. There was a gradual and significant promotion on these growth aspects with increasing concentrations of methylene urea from 0.25 to 1.0 % Significant differences on these growth traits were detected among all frequencies of applications except among the three or four applications of such slow release N fertilizer. The maximum values were recorded on the vines that supplied with methylene urea four times at 1.0%. The untreated vines produced the lowest values. These results were true during both seasons.

#### 2-The leaf chemical components

It is evident from the obtained data in Tables (3 & 4) that supplying Superior grapevines twice, thrice or four times with methylene urea at 0.25 to 1.0%

caused a significant promotion on chlorophylls a & b, total chlorophylls, total carotenoids, N, Mg, Ca, Zn, Fe and Mn relative to the check treatment. Leaf content of these pigments and nutrients was gradually promoted with increasing concentrations and frequencies of applications. Significant differences on these leaf chemical components were observed among all concentrations and frequencies

of application except among the use of such fertilizer thrice or four times. Spraying the vines four times with methylene at 1.0% gave the maximum values. The lowest values were recorded on untreated vines. Leaf content of P, K and Cu was significantly unaffected by the present treatments. Similar trend was noticed during 2016 and 2017 seasons.

Table (2): Effect of different concentration and frequencies of application of methylene urea on some vegetative growth aspects of Superior grapevines during 2016 and 2017 seasons,.

Methylene urea Treatments	Main shoot length (cm)		No. of leaves / shoot		Leaf area (cm) <sup>2</sup>		Wood ripening coefficient		Cane thickness (cm)		Pruning wood weight (kg.)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	110.2	111.0	16.0	17.0	106.4	106.5	0.63	0.62	1.14	1.23	1.61	1.62
0.25 % twice	112.0	113.0	18.0	19.0	108.0	107.8	0.68	0.67	1.19	1.28	1.71	1.72
0.25 % thrice	113.3	114.0	20.0	22.0	109.5	109.6	0.72	0.71	1.25	1.34	1.80	1.81
0.25 % four times	113.5	114.2	21.0	23.0	109.7	109.8	0.74	0.73	1.27	1.36	1.82	1.83
0.50 % twice	115.0	115.9	22.0	23.0	111.0	110.9	0.77	0.76	1.31	1.40	1.89	1.90
0.50 % thrice	116.3	117.0	24.0	25.0	112.3	112.2	0.81	0.80	1.36	1.45	2.00	2.01
0.50 % four times	116.5	117.2	25.0	26.0	112.5	112.4	0.83	0.83	1.38	1.47	2.02	2.03
1 % twice	118.0	118.9	26.0	27.0	114.0	113.9	0.86	0.85	1.41	1.50	2.10	2.11
1 % thrice	119.0	120.0	28.0	29.0	115.0	115.9	0.90	0.89	1.46	1.55	2.51	2.52
1 % four times	119.2	120.2	29.0	30.0	115.2	116.1	0.92	0.91	1.48	1.57	2.53	2.54
New L.S.D. at 5%	0.8	1.0	1.6	1.6	0.8	1.0	0.03	0.04	0.04	0.03	0.06	0.07

**Twice**= growth start and before blooming, **thrice** as previous + just after day after setting, **four times**= as previous + one month later

Table (3): Effect of different concentration and frequencies of application of methylene urea on photosynthetic pigments and percentages of N, P, and K in the leaves of Superior grapevines during 2016 and 2017 seasons,.

Methylene urea Treatments	Chlorophyll a (mg/ g. F.W.)		Chlorophyll b (mg/ g. F.W.)		Total chlorophylls (mg/ g. F.W.)		Total carotenoids (mg/ g. F.W.)		Leaf N %		Leaf P %		Leaf K %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	4.1	4.2	1.0	1.2	5.1	5.4	1.1	1.2	1.58	1.59	0.14	0.16	1.19	1.19
0.25 % twice	4.4	4.5	1.2	1.4	5.6	5.9	1.4	1.6	1.63	1.64	0.15	0.16	1.20	1.19
0.25 % thrice	4.7	4.8	1.5	1.6	6.2	6.4	1.7	1.8	1.69	1.71	0.15	0.17	1.21	1.20
0.25 % four times	4.9	5.0	1.6	1.7	6.5	6.7	1.9	2.0	1.71	1.73	0.15	0.17	1.21	1.20
0.50 % twice	4.9	5.0	1.8	2.0	6.7	7.0	2.0	2.2	1.74	1.75	0.15	0.17	1.21	1.20
0.50 % thrice	5.2	5.3	2.0	2.1	7.2	7.4	2.3	2.3	1.80	1.81	0.15	0.17	1.21	1.20
0.50 % four times	5.4	5.5	2.1	2.2	7.5	7.7	2.5	2.6	1.82	1.83	0.15	0.17	1.21	1.20
1 % twice	5.5	5.6	2.2	2.4	7.7	8.0	2.5	2.6	1.88	1.90	0.15	0.17	1.21	1.20
1 % thrice	5.8	5.9	2.4	2.6	8.2	8.5	2.8	2.9	1.95	1.97	0.15	0.17	1.21	1.20
1 % four times	6.0	6.1	2.5	2.7	8.5	8.8	2.8	2.9	1.97	1.99	0.15	0.17	1.21	1.20
New L.S.D. at 5%	0.3	0.3	0.2	0.2	0.4	0.4	0.3	0.3	0.04	0.03	NS	NS	NS	NS

**Twice**= growth start and before blooming, **thrice** as previous + just after day after setting, **four times**= as previous + one month later

### 3- The yield

Yield / vine was significantly improved in response to treating the vines with methylene urea at 0.25 to 1.0 % twice, thrice or four times over the control. There was a gradual and significant promotion on the yield with increasing concentrations of methylene urea. However, increasing frequencies of application from thrice to four times failed to show significant promotion on the yield. Therefore, from economical point of view, it is suggested to use methylene urea thrice at 1.0%. Under such promised treatment yield per vines reached 10.6 to 14.2 kg, while untreated vines produced 8.0 & 9.4 kg during both seasons, respectively. The percentage of increment on the yield due to using the striked treatment over the control reached 32.5 & 51.1 % during 2016 & 2017 seasons, respectively. Number of clusters per vine in the first season of study was significantly unaffected. These results were true during both seasons ( Table 5).

### 4- Cluster aspects

It is clear from the obtained data in Table (5) that spraying the vines twice, thrice or four times with methylene urea at 0.25 to 1.0 % had significant promotion on weight, length and shoulder of cluster above the control. Significant differences on these cluster aspects were observed among all concentrations. There was a gradual and significant promotion on all aspects except among the higher two frequencies of applications namely thrice or four times. The maximum values were recorded on the vines that supplied with methylene urea four times at 1.0 %. The lowest No. of clusters were borne on the

untreated vines. These results were true during both seasons.

### 5- The percentage of shot berries

One can state from the obtained data in Table (5) that subjecting the vines twice, thrice or four sprays to methylene urea at 0.25 to 1.0 % significantly was followed by controlling the percentage of shot berries over the control. The decline on shot berries % was significantly related to the increase in concentrations till 1.0 % and frequencies of applications till thrice. The lowest values of shot berries were recorded on the vines that treated four times with methylene urea at 1%. The untreated vines produced the highest values. Similar trend was noticed during 2016 & 2017 seasons.

### 6- Berries characteristics

It is evident from the obtained data in Table (6) that treating the vines with methylene urea at 0.25 to 1.0 % either twice, thrice or four times was significantly very effective in improving quality of the berries in terms of increasing weight, equatorial and longitudinal of berry, T.S.S. % and reducing sugars % and decreasing total acidity over the control. There was a gradual promotion on berries characteristics with increasing concentrations and frequencies of application. Significant differences on berries parameters were observed among all concentrations and frequencies of application except among the use of three or four sprays. The best results with regard to berries characteristics were obtained by treating the vines three times with methylene urea at 1.0 %. Unfavourable effects on quality of the berries were recorded the untreated vines. These results were true during both seasons.

Table (4): Effect of different concentration and frequencies of application of methylene urea on the leaf content of Mg and ca ( as %) and Mn, Fe, Zn and Cu ( as ppm) of Superior grapevines during 2016 and 2017 seasons,.

Methylene urea Treatments	Leaf Mg %		Leaf Ca %		Leaf Mn (ppm)		Leaf Fe (ppm)		Leaf Zn (ppm)		Leaf Cu (ppm)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	0.49	0.50	2.60	2.64	47.1	48.0	48.0	48.1	48.8	49.1	1.11	1.11
0.25 % twice	0.52	0.53	2.71	2.74	51.0	50.9	50.9	51.0	51.7	52.0	1.12	1.12
0.25 % thrice	0.56	0.57	2.82	2.86	54.0	54.1	54.0	54.1	54.8	55.1	1.12	1.12
0.25 % four times	0.58	0.59	2.84	2.88	54.2	54.3	54.2	54.3	55.0	55.3	1.12	1.12
0.50 % twice	0.61	0.59	2.92	2.95	55.8	56.0	55.8	56.0	56.7	57.0	1.13	1.12
0.50 % thrice	0.66	0.66	3.00	3.05	58.0	58.2	58.0	58.2	59.0	59.3	1.14	1.12
0.50 % four times	0.68	0.68	3.03	3.08	58.2	58.4	58.2	58.4	59.2	59.5	1.14	1.12
1 % twice	0.69	0.71	3.11	3.15	60.0	60.3	60.0	60.3	61.0	61.3	1.14	1.13
1 % thrice	0.79	0.80	3.20	3.25	62.0	62.2	62.0	62.2	62.9	63.2	1.14	1.13
1 % four times	0.81	0.82	3.22	3.27	62.2	62.4	62.2	62.2	63.7	63.4	1.14	1.13
New L.S.D. at 5%	0.03	0.03	0.05	0.05	1.1	1.2	1.0	0.9	0.8	1.0	NS	NS

**Twice**= growth start and before blooming, **thrice** as previous + just after day after setting, **four times**= as previous + one month later

Table (5): Effect of different concentration and frequencies of application of methylene urea on the yield and some cluster aspects of Superior grapevines during 2016 and 2017 seasons.

Methylene urea Treatments	No. of clusters		Yield/vine (kg)		Av. Cluster weight (g.)		Av. Cluster length (cm)		Av. Cluster shoulder (cm)		Shot berries %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	23.0	25.0	8.0	9.4	347.8	376.0	18.0	18.1	12.2	12.4	6.7	6.6
0.25 % twice	23.0	27.0	8.8	10.4	382.6	385.2	18.5	18.6	12.5	12.7	6.3	6.2
0.25 % thrice	23.0	29.0	9.1	11.5	395.7	396.6	19.0	19.1	12.8	13.0	5.9	5.7
0.25 % four times	24.0	30.0	9.3	11.7	387.5	390.0	19.2	19.3	13.0	13.2	5.7	5.5
0.50 % twice	24.0	30.0	9.7	12.3	404.2	410.0	19.4	19.5	13.1	13.3	5.4	5.3
0.50 % thrice	24.0	31.0	10.0	13.1	416.7	422.6	19.8	19.9	13.4	13.6	5.0	4.9
0.50 % four times	25.0	32.0	10.2	13.3	408.0	415.6	20.0	20.1	13.6	13.8	4.8	4.7
1 % twice	24.0	33.0	10.3	13.8	429.2	418.2	20.2	20.1	13.8	14.0	4.6	4.5
1 % thrice	24.0	34.0	10.6	14.2	441.7	417.6	20.6	20.6	14.1	14.3	4.2	4.1
1 % four times	25.0	35.0	10.8	14.4	432.0	411.4	20.8	20.8	14.3	14.5	4.0	3.9
New L.S.D. at 5%	NS	2.0	0.3	0.4	8.1	8.8	0.3	0.3	0.3	0.3	0.3	0.3

**Twice**= growth start and before blooming, **thrice** as previous + just after day after setting, **four times**= as previous + one month later

Table (6): Effect of different concentration and frequencies of application of methylene urea on some physical and chemical characteristics of the berries of Superior grapevines during 2016 and 2017 seasons.

Methylene urea Treatments	Av. Berry weight (g.)		Av. Berries equatorial (cm)		Av. Berry longitudinal (cm)		T.S.S. %		Reducing sugars %		Total acidity %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	3.00	3.08	2.00	2.04	2.22	2.23	17.6	17.7	15.6	15.6	0.700	0.695
0.25 % twice	3.10	3.19	2.05	2.08	2.26	2.28	18.0	18.2	15.9	16.0	0.685	0.680
0.25 % thrice	3.20	3.29	2.10	2.13	2.31	2.33	18.5	18.6	16.4	16.4	0.670	0.666
0.25 % four times	3.22	3.31	2.12	2.15	2.33	2.35	18.7	18.8	16.6	16.6	0.668	0.664
0.50 % twice	3.30	3.38	2.15	2.18	2.33	2.39	19.0	19.2	17.0	16.9	0.655	0.650
0.50 % thrice	3.39	3.46	2.20	2.24	2.36	2.44	19.5	19.6	17.4	17.5	0.640	0.615
0.50 % four times	3.41	3.48	2.22	2.26	2.38	2.46	19.7	19.8	17.6	17.7	0.635	0.610
1 % twice	3.50	3.59	2.25	2.29	2.41	2.48	20.0	20.1	17.7	17.8	0.625	0.605
1 % thrice	3.60	3.69	2.31	2.35	2.46	2.52	20.5	20.6	18.0	17.9	0.610	0.595
1 % four times	3.62	3.71	2.32	2.37	2.48	2.54	20.7	20.8	18.2	18.1	0.605	0.590
New L.S.D. at 5%	0.07	0.06	0.04	0.03	0.03	0.04	0.4	0.4	0.3	0.3	0.011	0.009

**Twice**= growth start and before blooming, **thrice** as previous + just after day after setting, **four times**= as previous + one month later

#### 4. Discussion

Methylene urea contains of long carbon chain from different urea molecules. It breaks down and N is released slowly and become available for trees by heat beneficial microorganisms, ultra violent rays and water. It reduces nutrients losses via runoff and leaf burn from heavy applied fertilizers. It supplies the trees with their requirements from N for longer periods without leaching (30 days for foliage spraying). Also, it improves the tolerant of trees to colds and frost due to the release of heat energy between carbon and N and the production of heat. It comprises from N, urea, sulphur and NH<sub>3</sub>. Due to its

higher viscosity methylene urea is used as a wetting agent material that is responsible for enhancing the uptake of nutrients.

These results are in agreement with those obtained by ( Ali- Mervet, 2000; Ibrahim- Asmaa, 2001; Tomasi *et al.*, 2001; Kamel, 2002, Uwakiem, 2011; Ahmed and Abada, 2012, Rabie and Negm, 2012; Alam, 2014 and Ahmed *et al.*, 2014)

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