# EFFECT OF UREA, SOME MICRONUTRIENTS AND TWO GROWTH REGULATORS FOLIAR SPRAYS ON VEGETATIVE GROWTH, YIELD AND FRUIT QUALITY OF WASHINGTON NAVEL ORANGE TREES

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## ABSTRACT

This investigation was carried out during the two successive seasons 2008 and 2009 on 25- years old Washington Navel orange trees grown in an orchard at El- Nobaria sector, El- Behera governorate to study the effect of foliar spraying with urea (0.5%), a mixture of Zn (0.4%), Mn (0.3%), Fe(o.5%) and Cu (0.3%) in sulphate salts form (23% Zn, 28% Mn, 19% Fe and 30%Cu), respectively and two growth regulators, $GA_3$ at 25 ppm and NAA at 10ppm. The trees spraying were two ones, the first before flowering (the third week of Feb.), and the second spraying applied four weeks after fruit set to study the effect of these treatments on some vegetative growth characters and leaf mineral contents, Fruiting aspects (set, drop and Pre-harvest drop) percentage, yield per tree by number and weight, as well as the average weight of fruits and some fruit physical and chemical properties. The obtained results showed that the treatments included spraying Urea& micronutrients (Zn, Mn, Fe and Cu), Urea and NAA achieved the highest values for average leaf area and shoot diameter. Regarding shoot length, Urea& micronutrients followed by $GA_3$ had the highest values. Leaf analysis showed that the highest values of leaf N content obtained by using Urea, Urea& micronutrients, $GA_3$ and NAA, respectively. The lowered values of leaf N content recorded when using micronutrients treatment followed by control. All treatments were significantly effective in increasing fruit set and reducing fruit drop as compared with control. Application of NAA, Urea & micronutrients and $GA_3$ significantly increased fruit set percentage and reduced June and pre-harvest fruit drop, however NAA was more effective in reducing fruit drop than $GA_3$. Spraying Washington Navel orange trees with Urea & micronutrients and NAA significantly increased the number of fruit per tree, yield per tree. However, the treatment included both of Urea & micronutrients Followed by $GA_3$ were the most effective in increasing fruit weight and pulp weight. Spraying of Urea and micronutrients slightly reduced juice acidity and increased T.S.S., total sugars and ascorbic acid contents as well as T.S.S./ acid ratio. In the contrary, either of $GA_3$ or NAA caused the same increase in ascorbic acid content in the juice.

**Key words:** Washington Navl organge - Urea-Micrandrients, Growth regulators, Foliar sprays

## INTRODUCTION

Citrus is considered to be of the world's most common popular fruits. **Firgany *et. al,* (1983)** on Balady orange trees found that, the trees produced a large vegetative growth, leaf minerals, fruit set and fruiting percentage by using main nutrients fertilizer (NPK**). Omran *et. al,* (1998),** added that fruit setting is directly

related to nutritional factor either organic and inorganic where reports indicated an increase in fruit set as a result of fertilizer application. Nutrition of trees imbalance and deficiency of micronutrients, particularly Fe, Mn,Zn and Cu form as one of major limiting factors of yield and production. **El-Fouly and Fawzi, (1982).** It is apparent from the review that (N, P, K, Fe, Zn, Mn) elements is very closely related to yield. **Maksoud and Haggag, (1994).** Foliar application of elements may be effective for correcting the nutritional status of the trees. **Vinay, (1982).** For evaluating the nutritional status of citrus trees and effect on yield and fruit quality, there was a significant role of nutrient elements such as N, Zn, Fe, Mn and Cu on yield. **Baker *et. al*. (1981)** and **Maksoud and Haggag, (1996).** The effect of foliar spraying with Urea on leaf area, shoot length and diameter were studied by **Darwish *et. al.* (1992)** found that spraying 1%Urea on the foliage of Balady orange trees during a period began just before flower initiation and after fruit set effectively increased vegetative growth. **El-Hagah *et. al.;* (1987)** and **Soliman *et. al.* (1985)** studying the foliar spraying with some micronutrients on vegetative growth, proved on enhancing effect of the sprayed nutrients on the vegetative characters. Some investigators revealed that spraying $GA_3$ at a concentration ranging 25 to 100ppm, considerably increased leaf area, leaf mineral contents, fruit set and yield, **Wang (1982),** on Washington Navel orange trees and **Soliman *et al;* (1985)** on Valencia orange trees. Naphthalene acetic acid (NAA) is suggested to be of announced effect on different vegetative growth aspects and yield. **Tominaga *et. el.* (1982), Wallace (1966)** and **Sweidan *et. al.* (1982**) found that spraying Washington Navel orange trees with chelated Fe, Zn, Mn or Cu On Navel orange and Balady mandarin trees in March, June or September increased the leaf mineral contents of the sprayed nutrient. **Nawar, (1978)** and **Selim *et. al.*, (1976).** The suggestion dealing with the role of balancing the nutritional status of the trees in overcoming the problem of poor yielding in different citrus species through its effect on flowering and fruit dropping was recorded. Yield per tree was confirmed by the results obtained by many investigators such as **Samoladas, (1964), Chapman, (1968), Higa *et. al.* (1980), Singh** and **Singh (1982**) and **Baldry *el. al.* (1982).** They fund a considerable increase in total soluble solids reducing and total sugars and Vitamin C content in fruit juice, but a reduction in juice acidity as a result of using Urea and micronutrients.

Thus, the aim of this research was to study the effect of application of spraying with Urea at o.5%, mixture of four micronutrients (Zn 0.4%, Mn 0.3%, Fe 0.5% and Cu0.3%), two growth regulators ($GA_3$ at 25 ppm and NAA at 10ppm) on shoot length and diameter, leaf area, leaf (N, Zn, Mn, Fe and Cu) contents, fruit set%, June drop%, Pre-harvest drop %, number of fruits per tree, yield per tree in kgs and yield per feddan in Tons and some fruit physical and chemical properties

## MATERIAL AND METHODS

This investigation was carried out during two consecutive seasons (2008 &2009) on 25 years old Washington Navel orange trees, budded on sour orange rootstock, grown in a private orchard located at El- Nobaria sector, El- Behera governorate planted in sandy soil at 5x5 meter apart. The objective of the investigation was to study the effect of foliar spraying with urea (0.5%), a mixture of four micronutrients (Zn 0.4%, Mn 0.3%, Fe 0.5% and Cu0.3%) in sulphate salts form (23%,Zn, 28%Mn,119% Fe and 30% Cu) respectively, and two growth

regulators, Gibberellic acid ($GA_3$) at 25ppm and Naphthalene acetic acid (NAA) at 10ppm on some vegetative growth characters and leaf mineral contents, percentage of fruit (set, drop and Pre-harvest drop), yield per tree by number and weight, as well as some fruit physical and chemical properties.

The trees spraying two ones, the first before flowering (the third week of Feb.), and the second spraying applied four weeks after fruit set.

The experiment was arranged in a completely randomized block design with three replicates of one tree per each replicate. All the experimental trees were selected at random as uniform as possible in their growth. They treated alike as far as cultural practices were concerned except for the purpose of this study .

**Studied treatments included the following:**

1- Water spraying (control)
2- Urea at a concentration of (0.5%)
3- Micronutrients {Zn at 0.4%, Mn at 0.3%, Fe at 0.5% and Cu at 0.3%} together as sulphate salts (23% Zn, 28% Mn, 19%Fe and 30%Cu)
4- Urea and micronutrients
5- Gibberellic acid growth regulators ($GA_3$) at 25 ppm
6- Naphthalene acetic acid Growth regulator (NAA) at 10ppm.

**Studied parameters:**

**1- Measurement of vegetative characters**: Length and diameter of spring shoots were measured at the last week of May (2008 and 2009) and average leaf area $cm^2$ was estimated on mature leaves (7 months old) from those of spring growth cycle according to **Watson (1958).**

2- **Determination of leaf elements contents:** Leaf N content using the method described by **Pregl (1945**), Zn, Mn, Fe and Cu were determined according to **Wilde *et. al*. (1979).**

3- **Determination of fruiting aspects**:

**A- Fruit set percentage:** The number of fruitletes was counted and the fruit set percentage was calculated according to the following equation:

$$\text{Fruit set \%} = \frac{\text{Number of fruitletes}}{\text{Total number of flowers}} \times 100$$

**B- June drop %:**

June drop percentage was calculated by recording the number of dropping fruit during the period from the last week of April till the last week of June, then the percentage was calculated according to the following equation given by **Vyvyan (1946).**

$$\text{June drop \%} = \frac{\text{Number of dropping fruits}}{\text{number of fruits at the first week of April}} \times 100$$

**C- Pre-harvest drop percentage:** Was calculated by recording the dropping of fruits during the period from mid of November till the first week of January (harvesting time) in the two experimental seasons, the percentage was calculated according to the following equation

$$\text{Pre harvest drop \%} = \frac{\text{Number of dropping fruits}}{\text{Number of number of fruits at mid November}} \times 100$$

4- **Determination of yield:** In regard to yield, as fruit reached to ripening stage (early December) in every season of study, fruits of each tree were individually harvested then the number of fruit per tree were counted and fruits weighed in Kgs/tree, as well as the yield per feddan was calculated as yield per tree x 168 tree in Tons.

**Fruit quality:**

A sample of 10 fruits were randomly taken from the yield of each tree for determination of some physical and chemical propertied as follow:

**5- Fruit physical and chemical properties:**

**A-** Fruit physical properties: They involved, fruit weight (gm), rind weight (gm) and pulp weight (gm).

**B-** Fruit chemical properties: Included juice total soluble solids (T.S.S.)%, Total acidity%, total sugar % and ascorbic acid (mg/100ml juice) according to the methods described by **A.O.A.C.(1985).** In addition, T.S.S./ acid ratio was calculated and recording in this study.

6- **Statistical analysis**:

All the obtained data were tabulated and statistically analyzed according to the procedure of **Snedecor and Cochran (1967)** outlined by **Little and Hills (1978)**. The L.S.D. test at 5% was used to distinguish the significance of the differences between means.

## RESULTS AND DISCUSSION

**Vegetative growth**:

1- Shoot length: Data in Table (1) cleared that the treatment of Urea foliar spraying together with the used micronutrients resulted the highest shoot length followed by $GA_3$ foliar spraying. On the other hand, spraying Urea, Micronutrients and NAA gave the same values. All treated trees had higher shoot length than control.

2- Shoot diameter: Data presented in Table (1) indicated that, no differences between treatments in shoot diameter and the data were insignificant. Urea and micronutrients together resulted the highest values compared with the other nutrition treatments, whereas, the $GA_3$ treatment recorded the lowest shoot diameter.

3- Leaf area: Data in Table (1) showed that Urea & micronutrients followed by NAA then Urea at 0.5% treatments respectively increased average leaf area. Micronutrients treatments had higher leaf area than $GA_3$. All treatments had larger leaf area than control.

The obtained results are in agreement with those of **Darwish *et al.* (1992), El-Hagga *et al.* (1987), Soliman *et al*. (1985), Wang (1982**) and **Higa *et al.* (1980).**

**Table (1): Effect of spraying Urea, some micronutrients and two growth regulators on shoot shoot diameter(cm) and leaf area ($cm^2$) of Washington Navel orange trees.**

| vegetative growth characters | Shoot Length(cm) | | | Shoot diameter(cm) | | | Leaf area ($cm^2$) | | |
|---|---|---|---|---|---|---|---|---|---|
| **Treatments** | **2008** | **2009** | **Mean** | **2008** | **2009** | **Mean** | **2008** | **2009** | **Mean** |
| **Control (water spraying)** | 11.94 | 12.96 | 12.45 | o.61 | 0.58 | 0.59 | 17.39 | 17.23 | 17.31 |
| **Urea (0.5%)** | 14.29 | 14.99 | 14.64 | 0.72 | 0.73 | 0.73 | 20.39 | 20.83 | 20.61 |
| **micronutrients (Fe,Zn,Mn,Cu)** | 14.33 | 14.97 | 14.65 | 0.71 | 0.69 | 0.70 | 19.33 | 19.67 | 19.50 |
| **Urea& micronutrients** | 16.08 | 16.42 | 16.25 | 0.75 | 0.76 | 0.76 | 22.72 | 23.17 | 22.95 |
| **GA3** | 15.62 | 16.03 | 15.83 | 0.66 | 0.63 | 0.64 | 18.96 | 18.13 | 18.54 |
| **NAA** | 13.78 | 14.76 | 14.27 | 0.72 | 0.73 | 0.72 | 21.25 | 22.38 | 21.82 |
| **L.S.D. at 5%** | 0.406 | 0.556 | | N.S. | N.S. | | 0.420 | 0.567 | |

**Leaf mineral contents:**

1- **Leaf nitrogen content:** It is quite evident from Table (2) that leaf N content was increased in all treatments comparing with those of the untreated one. There are significant differences between treatments. The Urea treatment recorded the highest values of leaf N content followed with Urea& micronutrients then $GA_3$ and NAA, respectively. The treatment included micronutrients gave the lowest values and recorded the same values of the control.

2- **Leaf Zn, Mn, Fe and Cu contents:** Considering leaf Zn, Mn, Fe and Cu contents, it is quite clear from Table (2) that, by adding micronutrients & Urea, the leaves had more Zn, Mn, Fe and Cu contents. The main observation is that Urea& micronutrients, micronutrients, $GA_3$ and NAA respectively, had the largest content. Urea treatment recorded the lowest values of Zn, Mn, Fe and Cu. All treatments increased the leaves minerals content than the control. These results are in agreement with those obtained by **(Selim *et. al.*, 1976), (Nawar, 1978),** and (**Soliman and Saad-Allah, 1988a&b).**

**3- Fruiting aspects:**

1- Fruit set%: Data presented in Table (3) indicated that fruit set percentage was increased by using treatments and the obtained results cleared that NAA recorded the highest fruit set percentage followed with Urea& micronutrients then $GA_3$, micronutrients and Urea on descending order. All treatments increased fruit set% than control.

2- June drop%: Furthermore, Table (3) indicated that the trees treated with NAA followed by Urea& micronutrients recorded the lowest fruit drop percentage. Control treatment caused the highest June drop% whereas, spraying micronutrients and $GA_3$ gave the same results. However, NAA was effective in reducing fruit drop than $GA_3$.

3- Pre- harvest drop%: The lowest percentage of pre- harvest drop% was obtained when the sprayed materials was NAA, followed by Urea & micronutrients. All treatments reduced pre-harvest drop than control.

Generally, any of nutrients treatments was significantly effective in increasing fruit set and reducing fruit and pre-harvest drop compared with control.

**Table 2**

**Table (3) Effect of spraying urea, some micronutrients and two growth regulators on fruit set(%),June drop (%) and pre- harvest (%) of Washington Navel orange trees.**

| Fruiting character | Fruit set (%) | | | June drop (%) | | | Pre- harvest (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | 2008 | 2009 | Mean | 2008 | 2009 | Mean | 2008 | 2009 | Mean |
| Control(water spraying) | 1.99 | 1.83 | 1.41 | 49.21 | 50.31 | 49.76 | 13.88 | 12.11 | 12.99 |
| Urea (0.5%) | 2.08 | 1.53 | 1.81 | 36.04 | 38.57 | 37.30 | 8.53 | 7.77 | 8.15 |
| micronutrients (Fe,Zn,Mn,Cu) | 2.44 | 1.93 | 2.19 | 29.26 | 34.66 | 31.96 | 8.59 | 5.54 | 7.06 |
| Urea& micronutrients | 3.25 | 2.94 | 3.09 | 19.21 | 24.43 | 21.82 | 6.15 | 3.45 | 4.80 |
| GA3 | 2.68 | 2.27 | 2.47 | 32.82 | 34.71 | 33.77 | 8.43 | 6.86 | 7.25 |
| NAA | 4.06 | 3.43 | 3.75 | 18.98 | 22.62 | 20.80 | 1.09 | o.69 | 0.89 |
| L.S.D. at 5% | 0.148 | 0.203 | | 4.513 | 6.191 | | 14.56 | 10.92 | |

## Yield:

1- Number of fruit per tree: Results concerning fruit number per tree of Washington Navel orange at harvesting time, data in Table (4) cleared that spraying trees with Urea& micronutrients and NAA significantly increased the number of fruits born on the trees, however, the treatment included both of Urea& micronutrients was most effective in this respect.

2- Yield per tree and per feddan (by weight): The influence of Urea 0.5%, micronutrients(Zn, Mn, Fe and Cu), Urea & micronutrients, and two growth regulators ($GA_3$ and NAA) on the yield per tree in kilograms or Tons per feddan of Washington navel orange is shown in Table (4), The treatment included Urea plus micronutrients together followed by NAA were responsible for the highest yield per tree in kilograms or per feddan, Then $GA_3$ followed by micronutrients. The trees sprayed with Urea 0.5% gave the lowest yield per tree in all treated trees. Generally, trees treated gave the higher yield than control. The obtained results are confirmed with those obtained by **Soliman *et. al.* (1985), Darwish *et. al.* (1992). El-Fouly and Fawzi, (1982)** and **Maksoud and Haggag (1994).**

**Table (4): Effect of spraying urea, some micronutrients and two growth regulators on number of fruit per tree, yield (kgs) /tree and yield per Feddan (Tons) of Washington Navel orange trees.**

| Yield | No. of fruit /tree | | | Yield/tree (Kg) | | | Yield /Feddan(Tons) | | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | 2008 | 2009 | Mean | 2008 | 2009 | Mean | 2008 | 2009 | Mean |
| Control(water spraying) | 212.3 | 215.3 | 213.80 | 56.15 | 62.4 | 59.28 | 9.43 | 10.48 | 9.96 |
| Urea (0.5%) | 228.3 | 235.0 | 231.65 | 67.66 | 76.5 | 72.08 | 11.37 | 12.85 | 12.11 |
| micronutrients(Fe,Zn,Mn,Cu) | 241.4 | 255.4 | 248.41 | 73.91 | 86.1 | 80.01 | 12.42 | 14.46 | 13.44 |
| Urea& micronutrients | 278.1 | 295.3 | 286.71 | 90.84 | 98.3 | 94.57 | 15.26 | 16.51 | 15.89 |
| GA3 | 243.7 | 258.2 | 250.95 | 78.02 | 89.7 | 83.86 | 13.11 | 15.07 | 14.09 |
| NAA | 273.7 | 286.0 | 279.85 | 82.32 | 95.0 | 88.66 | 13.83 | 15.96 | 14.89 |
| L.S.D. at 5% | 7.230 | 9.913 | | 2.501 | 3.429 | | 6.185 | 8.437 | |

## Fruit physical properties:

Data of Table (5) showed that Navel orange trees responded to different treatments concerning fruit weight and pulp weight. It is cleared that there were significant differences between the various fertilizers treatments on fruit properties.

The highest values were obtained with application of Urea & micronutrients followed in descending order by GA3, micronutrients treatment, NAA, Urea 0.5% and control. No significant differences between treatments on rind weight. Nevertheless, there was a beneficial effect of Urea & micronutrients on both weight fruit and pulp due to the role of nutrients in improving nutritional status of the trees. These results go in the same line of those obtained by **Selim *et. al.* (1976), Nawar, (1978), Soliman and Saad Alla, (1982)** and **Sweidan *et. al.* (1982).** They reported that the increment in fruit weight or improving of fruit physical properties due to spraying with Urea and micronutrients may be attributed to the activation in the metabolic process and by the abundant mineral in trees tissues which led to improve the fruits quality. The main observation that the role of sprayed nutrients led to increase of new tissues, as well as their effect on leaf area, which subsequently increased carbohydrates production through increasing photosynthesis activity can explain their observed effect in increasing the weight of fruit.

**Table (5): Effect of spraying urea, some micronutrients and two growth regulators on some fruit physical properties of Washington Navel orange trees.**

| some fruit physical properties | Fruit weight(gm) | | | Rind weight (gm) | | | Pulp weight (gm) | | |
|---|---|---|---|---|---|---|---|---|---|
| **Treatments** | **2008** | **2009** | **Mean** | **2008** | **2009** | **Mean** | **2008** | **2009** | **Mean** |
| **Control (water spraying)** | 261.9 | 288.4 | 275.15 | 27.4 | 28.3 | 27.85 | 234.5 | 260.1 | 247.3 |
| **Urea (0.5%)** | 294.9 | 324.1 | 309.50 | 25.9 | 26.3 | 26.10 | 269.0 | 297.8 | 283.4 |
| **Micronutrients (Fe,Zn,Mn,Cu)** | 306.1 | 327.2 | 316.65 | 26.1 | 26.8 | 26.45 | 280.0 | 300.4 | 290.2 |
| **Urea& micronutrients** | 325.4 | 365.7 | 345.55 | 26.7 | 26.1 | 26.40 | 198.7 | 339.6 | 319.2 |
| **GA3** | 318.7 | 344.7 | 331.7 | 27.1 | 16.4 | 26.75 | 291.6 | 318.3 | 304.9 |
| **NAA** | 298.2 | 328.8 | 313.50 | 25.4 | 25.5 | 25.45 | 272.8 | 303.3 | 288.05 |
| **L.S.D. at 5%** | 6.537 | 8.966 | | N.S. | N.S. | | 8.006 | 11.06 | |

**Fruit chemical properties:**

Data presented in Table (6) show no significant differences between treatments concerning fruit chemical properties, Juice T.S.S.%, total acidity% and T.S.S./ acid ratio except in total sugar and ascorbic acid in the two studied seasons.

1- T.S.S. %: The results cleared that the highest juice T.S.S.% content was obtained by spraying micronutrients or Urea plus micronutrients which recorded the same value of T.S.S.% in the two seasons, whereas Urea 0.5%, NAA and $GA_3$ produced the same values in juice T.S.S.%. The lowest values in juice T.S.S.% was obtained by control treatment.
2- Total acidity %: The main observation was that, control had the highest total acidity% followed by Urea 0.5%, $GA_3$ and NAA which produced the same values. while, the lowest values was obtained by using Urea plus micronutrients or by adding micronutrients.
3- T.S.S./acid ratio: The results cleared that micronutrients followed with Urea plus micronutrients gave the highest ratio than other treatments. Urea 0.5% and NAA recorded the same ratio whereas, the juice of the fruit produced from trees sprayed with $GA_3$ recorded the lowest values. Generally, the treated trees had larger values than control treatment.

**Table 6**

4- Total sugar %: The juice from the fruit of the trees treated with (micronutrients, Urea &micronutrients, Urea 0.5% and NAA) had the same values of total sugar% followed by GA3 and control, respectively.

**3- Ascorbic acid (mg/100ml juice):** Significant differences between treatments were obvious in regard to juice ascorbic acid, Urea plus micronutrients treatment had the highest content of ascorbic acid than others treatments. Finally $GA_3$, micronutrients and NAA recorded the same values and had the second position after Urea plus micronutrients followed by Urea 0.5% The lowest value was produced by using control treatment. Anyhow, these results are in accordance with results of **(El-Fouly and Fawzi, 1982). (Soliman *et. al.,* 1985) ,(Darwish *et. al.,* 1992**) and **(Maksoud and Haggag,1994).**

## CONCLUSION

Results revealed that spraying of Urea plus micronutrients led to increase shoot length, shoot diameter, leaf area and minerals content, number of fruit per tree, fruit weight, yield, juice T.S.S.%, T.S.S./acid ratio, total sugar% and Ascorbic acid, whereas, it recorded the lowest June drop % and pre- harvest drop%. The same treatment had the second position in fruit set after NAA which recorded the highest fruit set and total acidity.

Consequently, it could be concluded that using Urea plus micronutrients had the best effects on trees growth, fruit set and yield and reduced June drop and improving fruit quality. So, that, it could be recommended using this treatment to obtain satisfactory results under Nobaria, El- Behera governorate conditions.

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**تأثير الرش باليوريا وبعض العناصر الصغرى وأثنين من منظمات النمو على النمو الخضرى والمحصول وجودة الثمار فى أشجار البرتقال ابو سرة**

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أجريت هذه الدراسة فى موسمين ٢٠٠٨ و ٢٠٠٩على أشجار البرتقال أبو سرة عمرها خمسة وعشرون سنة ومطعومة على أصل النارنج و النامية فى تربة رملية فى مزرعة خاصة بالنوبارية بمحافظة البحيرة. لدراسة تأثير الرش باليوريا ٠.٥ %، مخلوط من عناصر الزنك ٠.٤، منجنيز ٠.٣، الحديد ٠.٥، والنحاس ٠.٣ وهذة العناصر تم استخدامها على صورة سلفات مثل سلفات (الزنك٢٣%، المنجنيز٢٨%، الحديد١٩% والنحاس٣٠%)، وأثنين من منظمات النمو هما حمض الجبريليك ٢٥ جزء فى المليون ونفثالين حمض الخليك ١٠ جزء فى المليون الأشجار تم رشها مرتين الأولى قبل التزهير (فى الأسبوع الثالث من فبراير) والثانية بعد العقد بأربعة أسابيع لدراسة تأثيرهده المعاملات على النمو ومحتوى الأوراق من عناصر النتروجين، والزنك، المنجنيز، الحديد والنحاس وعلى العقد وتساقط يونيو والتساقط قبل الجمع والمحصول وجودة الثمار.

وكانت أهم النتائج المتحصل عليها كالاتى:

١- المعاملات التى تشتمل على اليوريامع العناصر، ونفثالين حمض الخليك أعطت أعلى القيم فى مساحة الورقة، قطر الفرع وكان حمض الجبريلبك الافضل من نفثالين حمض الخليك فى زيادة طول الفرع.

٢- من تحليل الورقة تبين أن أعلى قيم نتروجين كان عند استخدام اليوريا ثم اليوريا مع العناصر، حامض الجبريليك ونفثالين حمض الخليك على الترتيب وكان أقل محتوى من النتروجين عند استخدام معاملة العناصر فقط يلية معاملة الكنترول وقد وجد أن محتوى الأوراق من العناصر قيد الدراسة كان الأعلى عند المعاملة باليوريا مع العناصر.

٣- كل المعاملات أدت لزيادة العقد وتقليل التساقط مقارنة بالكنترول وكانت المعاملة بنفثالين حمض الخليك، يوريا مع العناصر ثم حامض الجبريلبك أعطت أعلى القيم.

٤- الرش باليوريا مع العناصر أدى لزيادة عدد الثمار/شجرة وكذلك زيادة وزن الثمارمما أدى لزيادة المحصول. ومن الملاحظ أن الرش بنفثالين حمض الخليك أدى لزيادة عدد الثمار/شجرة فى حين أن الرش باليوريا مع العناصر أعطى أعلى القيم فى حمض الأسكوربيك

٥- الرش باليوريا أدى لنقص الحموضة الكلية للعصيروزيادة المواد الصلبة الدائبةو السكريات الكلية و المواد الصلبة الدائبة/ الحموضة وحمض الأسكوربيك.

٦- أفضل المعاملات كانت عند أستخدام اليوريا مع العناصر حيث أعطت أعلى القيم فى جميع صفات النمو الخضرى قيد الدراسة ومحتوى الأوراق من العناصر وانتجت الأشجار اكبر عدد من الثمار وأعلى محصول وكذلك افضل صفات طبيعية للثمار وأحتوى عصير الثمار على أعلى محتوى من المواد الصلبة الدائبة والسكريات الكلية وحمض الأسكوربيك.

٧- من النتائج المتحصل عليها ينصح باستخدام اليوريا مع عناصر الحديد والزنك والمنجنيز والنحاس بالتركيزات المستخدمة للحصول على أفضل النتائج من حيث تحسين النمو الخضرى والمحصول وصفات الجودة للثمار.