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RESPONSE OF VALENCIA ORANGE TREES GROWN IN SANDY SOIL TO TREATMENTS WITH BIOZEM, AMCOTONE , CA-EDTA AND ZN-EDTA AND THEIR EFFECT ON FRUIT QUALITY, REGREENING AND YIELD

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ABSTRACT

This investigation was conducted in (2004 - 2005 and 2005-2006) seasons on 14- year- old Valencia orange (*Citrus sinensis* L.) trees grafted on sour orange (*Citrus aurantium* L.) rootstock and spaced at 5 × 5 m in a private orchard near El –Sadat city (sandy soil). It aimed at studying the effect of foliar application with active ingredients, micro elements and fitohormonas biologicamente actives(Biozem)and Naphthyl acetic acid +1- naphtyyl acetamide (Amcotone) and their combination with Ca-EDTA , Zn-EDTA on tree yield productivity , fruit set , fruitting percentage, regreening , leaf area, leaf chlorophyll's and mineral content . Different treatments significantly affected leaf area. Biozem plus Ca-EDTA plus Zn-EDTA and Biozem plus Zn-EDTA were more effective in this respect . It is quite evident that leaf chlorophyll's content was significantly affected by these treatments .Some fluctuations have been noticed , as , Biozem plus Zn-EDTA gave a high effect in both seasons . Tree yield and productivity , fruit set and fruitting percentage were significantly affected by Biozem plus Ca–EDTA and Zn-EDTA or Biozem plus Zn –EDTA compared to the other treatments which gave the lowest value of fruit June drop and fruit preharvest drop . All calcium treatments significantly increased fruit removal pull force and firmness as compared to control . Fruit weight , fruit volume, fruit removal force, fruit shape , peel thickness , juice percentage and juice density were significantly influenced by the different treatments . Fruit weight, fruit volume , peel thickness and juice density were significantly affected by Biozem application alone or as a combined treatment with Zn-EDTA and Ca-EDTA. Amcotone plus Ca-EDTA gave the highest fruit juice percentage if compared to other treatments . Biozem plus Ca-EDTA and Zn-EDTA caused increased juice T.S.S. and juice density. While Amcotone plus Zn-EDTA recorded the highest T.S.S/ Acid ratio . Moreover , Amcotone alone significantly increased total sugar content in juice. Whereas Biozem plus Zn- EDTA increased ascorbic acid content (V.C). Moreover , all calcium treatments increased rind chlorophylls and decreased rind catotenoids . Biozem and Amcotone plus Ca–EDAT or Zn-EDTA increased leaf mineral content of N, P, K, Ca ,Mg ,Zn , Fe and Mn leaf content . This may improve tree yield and leaf chlorophyll's content .

The highest yield / tree and the best fruit quality of Valencia orange trees was obtained when the trees were sprayed with Biozem at 1.5 ml/L +Ca–EDTA 1.4 gm /L +Zn–EDTA 1.5 mg /L (on 20 of March, first of July and mid of August)

***Key words** : Amoctone , biozem , ca- EDTA , , coloring , fruit firmness, , fruit pull force, , fruit quality, , regreening valencia orange, Zn EDTA.*

1. INTRODUCTION

Valencia orange is an important fresh fruit for exports and local markets and for making juice during summer season , however the trees tend to have poor crop under sandy soil conditions .

In citrus , massive abscission of developing ovaries , generally occurs shortly after anthesis . Cultural practices were tied to overcome this problem mostly including application of exogenous growth regulators (GA_3)and some foliar nutrients applications (like Zn) **(**Talon *et al.***,**2000). In addition, Arora and Yamdagni (1986) found that compound fertilizer which contain Zn at 0.5% increased the number of flowers / shoot , the percentage of hermaphrodite flowers , fruit set and final fruit retention. Giffillan *et al.* (1974) and Simit (1990) mentioned that GA_3 significantly affects tree yield and fruit quality. Sharaf (1990) suggested that $ZnSO_4$ resulted in the highest

fruit-set and significantly increased the number of flowers formed on bearing shoots . Desai *et al.*, (1991) increased leaf chlorophyll content, average fruit weight and T.S.S and vitamin C concentration of fruit .Also, Navel orange fruiting was increased by 20-30% after spraying with GA_3 + Zn + Mn (Blanco *et al.,* 1994**)**.

Zinc is one of the most important micro-nutrient required for normal plant nutrition (Follett *et al.*,1981) , Zinc is essential for the synthesis of indol acetic acid (IAA) (Mengel and Kirkby,1978, Follett *et al.,* 1981 and Faust**,** 1989**).** Also, it plays the same important role in the biosyntheses of chlorophyll precursors and photosynthesis (Clarkson and Hanson , 1980 and Yagodin , 1984 , a)

In addition, auxin may either delay or stimulate this process and ethylene acts as a trigger agent responsible for the expression of cell wall degrading enzyme (Zacarias and Stead 2000). Ferguson (1988) considered the association of Ca^{2+}-EDTA spraying with plant growth substance in the following facts , : (a) There is an extra cellular role for Ca^{2+}-EDTA spray in plant tissue , (b) There is an intracellular role for Ca^{2+}-EDTA spray in plant tissues , where Ca^{2+}-EDTA spray may act as a secondary messenger transfusing external stimuli into immediate and long-term metabolic events, which might involve both fundamental growth responses to specialized environmental stimuli ,(c) There is tightly controlled regulation of Ca^{2+}-EDTA spray concentration and fluxes in the cell .This control is essential for normal cell function, and any malfunction of this regulation will lead to disruption of growth and cellular damage or death **.**

Therefore , the aim of this study is to assess the effect of Biozem , Amcotone , Ca-EDTA and Zn-EDTA separately or combined on yield , fruit quality and leaf mineral contents of Valencia orange trees , under sandy soil conditions .

2. MATERIALS AND METHODS

This investigation was carried out through two seasons of (2004 - 2005 and 2005-2006)in a private orchard near El-Sadat City (sandy soil) grafted on 14- year old Valencia orange trees (*Citrus sinensis* L.) on sour orange (*Citrus aurantium* L.) rootstock . The trees were planted at 5 ×5 m and drip irrigation system was used . All trees (one hundred and eight) were selected and grouped to a nine treatments with four replicates including three trees for each treatment in a complete randomized block design

The following treatments were applied on 20 March, first July and mid of August

T_1 : Biozem at 1.5 ml / L .

T_2 : Biozem at 1.5 ml / L+ Ca–EDTA at 1.4 gm / L

T_3 : Biozem at 1.5 ml / L Zn–EDTA at 1.5 mg / L

T_4 : Biozem at 1.5 ml/L +Ca–EDTA at 1.4 gm /L +Zn–EDTA at 1.5 mg /L .

T_5 : Amcotone at 0.75 gm / L .

T_6 : Amcotone at 0.75 gm / L + Ca–EDTA at 1.4 gm / L .

T_7 : Amcotone at 0.75 gm / L + Zn–EDTA at 1.5 mg / L .

T_8 : Amcotone at 0.75 gm /L+ Ca–EDTA at 1.4 gm /L +Zn–EDTA at 1.5 mg /L .

T_9 : Control (water sprayerd).

Table (1) a- Biozyme contents :

(active ingredients (micro elements (eq. a 19.34 gr / lt 1.86)	Fierro 0.49 % , Zinc 0.34 % , Manganeso 0.012 %, Magnesio 0.14 % , Boro 0.30 % , Azufre 0.44 % -
(Fitohormonas biologicamente actives 78.87)	Giberelines 32.2 ppm (eq . a 0.031 gr/it) , Acide indolacetico 32.2 ppm (eq. a 0.031 gr/ lt) , zeatine 83.2 ppm (eq. a 0.083 gr /lt)
Inert ingredients	(Diluyentes y acondicionadores 19.27)

b- Amcotone contents :

Plant growth regulator	
Chemical Name **- Naphthyl acetic acid +1- naphtyyl acetamide**	
Composition	
NAA	045 %
NAAM	1.25 %
ADUVANTS+ INFPTS	98.3 %
TOTAL	100 %

The following aspects were studied

2.1. Flowering , yield and fruit quality

flowering, fruit set %,fruit June drop % ,fruit pre-harvest drop % and removed fruit % (fruit set was estimated by selecting six secondary branches around each tree in February . At the blooming time (Late March) flowering twigs on each selected branch were tagged and the total number of flowers per twig was recorded . The number of setting fruits was counted at weekly intervals till the middle of November and fruiting % was calculated by dividing the number of fruits in mid November by the total number of flowers in late March x 100 .

B- Yield: at mid of April fruit yield was recorded annually as a number and weight per tree (kg.) .

C-Sample of 10 mature fruits per each replicate was selected in the 4^{Th} week of February to determine fruit physical properties The average fruit weight (gm), fruit volume , fruit removal - force L/Cm^3 (F R F) (according to El –Zeftawi and Dinsey 1983) ,fruit firmness (by means of Meangness Taglor pressurs tester) , fruit shape L/D length and diameter in cm (by Vernier caliper length to diameter ratio), peel thickness was measured by Vernier caliper and juice percentage and juice density. Chlorophylls(a&b) and carotenoid pigments in the rind of fruit were extracted in three dates (15 April , 1 May and 15 May) as Wettstein 's formula (1957**),** measured at 662.644 and 440 Mu wave length using spectrophtometer (Backman ,Du 6400) and calculated according to the following equations:

- Chl. a = 9.784 x E, 662 – 0.99 x E 644 = mg/L.
- Chl. b = 21.426 x E, 644 – 4.65 x E 662 = mg/L.
- Carotenoids = 4.695 x E 440 – 0.264 (a +b) = mg/L.
- Where E: optical density at the wave length indicated .

Fruit chemical properties : Total soluble solids (T.S.S) determined by using Carl Zeiss hand referactometer, total acidity as gms of unhydrus citric acid and Vitamin C as mg ascorbic acid were determined and estimated per mg/ 100 ml juice. Fruit juice was measured according to A.O.A.C. (1965) , Moreover ,T.S.S/acid ratio was also estimated and total sugars were determined colorimetrically as gm . glucose per 100 mls of juice according to the methods described by Thomas and Dutcher (1924) .

2.2. Leaf area and leaf mineral contents

On March of both seasons , twenty spring non-fruiting shoots from all over the outer circumference of each treated tree were labeled in leaf samples . From each replicate , a sample of about 60 leaves was taken in the first week of October (each year) for the chemical analysis and calculated leaf area as Bremner and Taha (1966) The collected leaf samples were washed with tap water , rinsed three times with distilled water and then oven dried at 70° C to a constant weight . Leaf dried materials were ground in a stainless steel rotary knife with a mill 20 mesh . The dried ground sample was digested with sulphuric acid and hydrogen peroxide according to Evenhuis and De Waard (1980). Suitable aliquots were taken for the determination of N,P,K, Ca, Mg, Fe , Zn and Mn

a- Total nitrogen percentages in dry leaves are determined by using the microkjeldahal method as described by A.O.A.C. (1965) .

b- Phosphorus was determined by using ammonium venedate method as described by Chapman and Pratt (1961) .

c- Potassium was determined by flame photometer according to Brown and Lilleland (1946) .

d- Calcium and magnesium were determined according to the wet aching method technique as reported by Koch and Meekin (1924) , by using atomic absorption spectorphotometer .

e-Zinc was determined according to Chapman (1961) directly in the original solution by using atomic absorption spectorphotometer .

f-Fe and Mn were determined according to Evenhuis and De Waard 1980 **)**

g- Determination of photosynthetic pigments in leaves : Chlorophyll a and b were exteracted from fresh leaves by grinding them in a mortar with 85 % aqueous acetone . The pigments were filtered through funnel No, G4 , then the filtrate was made up to a known volume with 85% acetone . The optical density of the filtrate was determined using Carl –Zeiss spectrocolorimeter at the wave length of 662, 644 and 440 nm for chlorophyll a and b , respectively .The concentrations of chlorophyll a and b were calculated by means of Wettstein's formula (Wettstein , 1957)**.**

Experimental design was a complete randomized block design according to Snedecor and Cochran (1967) . The averages were compared using L.S.D. parameter .

3. RESULTS AND DISCUSSIONS

Data obtained on the influence of Biozem , Amcotone , Ca- EDTA and Zn-EDTA on Valencia orange trees are as follows.

3.1. Leaf area

Data presented in (Table 1) reveal that , Biozem plus Zn or Biozem plus Zn and Ca or Amcotone plus Zn treatments significantly increased Valencia orange leaf area compared to the other treatments in both seasons . Biozem plus Zn and Ca treatment showed the highest effect (21.89 and 22.94 cm^2) in both seasons respectively. However the control treatment had the lowest values (17.18 and 17.63 cm^2) , respectively in both seasons .

These results are in line with those obtained by Desai *et. al*., (1991); Nawab Ali *et al.,* (1992) and Ouyang (1993) on some citrus species. They reported that Zinc enhanced leaf area. Singh and Sharma (2000) working on Citrus , reported that all the micronutrients play a vital role in several biochemical processes in plant system . Sayed *et al.,* (2004 b) reported that GA3 and micronutrient foliar spray increased leaf area of Valencia orange trees .

3.2. leaf chlorophyllcontent

From the data presented in (Table 1) it is quite obvious that Valencia orange leaf chlorophyll (a &b) content increased when compared to the control in both seasons . It is clear that chlorophyll -a significantly increased in both seasons compared with the control by Biozem plus Zn-EDTA spraying, Biozem plus Ca-EDTA plus Zn–EDTA , Amcotone plus Zn–EDTA and Amcotone plus Ca–EDTA plus Zn-EDTA. Also chlorophyll-b significantly increased in the first season compared with the control by spraying of Biozem plus Zn-EDTA and Biozem plus Ca-EDTA plus Zn–EDTA respectively , while in the second season chlorophyll-b was significantly increased by spraying Biozem , Biozem plus Zn–EDTA , Biozem plus Zn–EDTA , Biozem plus Ca-EDTA plus Zn–EDTA , Amcotone plus Zn–EDTA and Amcotone plus Ca- EDTA plus Zn–EDTA . The best treatment in this regard was obtained by spraying Biozem plus Zn–EDTA in both seasons 8.960 and 8.983 as chlorophyll-a and 5.728 and 5.799 as chlorophyll -b) respectively . The increase in chlorophyll -b may be due to the increase in chlorophyll-a because chlorophyll- a is a precursor for the synthesis of chlorophyll -b (Smith and French , 1963 and Castelfranco and Beale , 1983) .These results are in harmony with those obtained by Nawab Ali *et al.,* (1992); Ouyang (1993) on some citrus species. They reported a positive enhancement of Zinc on all growth parameters and leaf pigments. El Saida (1996) reported the positive enhancement of Zinc on all leaf pigments . Abd El Rahman (2002) found that calcium treatments increased rind chlorophyll as compared with the control . Sayed *et al.*,(2004 b) suggested that GA_3 and micronutrients increased chlorophyll (a and b) content in leaf tissues . Hamed (2005) found that Zinc treatments gradually increase in chlorophyll a, b in leaves of Valencia orange trees .

3.3.Leaf mineral composition (Macronutrients)

3.3.1. Leaf nitrogen content

Table (1) shows that all treatments of Biozem , Amcotone , Zn-EDTA and Ca- EDTA and their combinations caused a high significant increase in leaf N % of Valencia orange trees compared to the control during the two seasons. Biozem plus Zn- EDTA recorded the highest values (2.58 and 2.59 %) in both seasons a respectively . These result are in agreement with the findings of El Saida (1996 **,** 2001), Abd El-Rahman *et al.,* 2001 & Abd El Rahman 2003) who reported that Zinc sulfate alone and its combination(with Ca-EDTA and Biozem increased N in Navel orange leaves . Sayed *et al.,(*2004b)suggested that GA_3 and micronutrients increased leaf mineral content .

3.3.2. Leaf phosphorus content

Concerning leaf P % (Table 1) the obtained data show that all treatments resulted in a slight significant increase in leaf P % as compared to the control during the two seasons. Nevertheless ,Biozem plus Ca- EDTA plus Zn EDTA and Amcotone plus Ca EDTA were more effective (0.205 , 0.272 and 0.269 , 0.266 %) respectively in the two seasons . Similar trend was found by El Saida (1996, 2001), Abd El Rahman *et al.,* 2001& Abd El Rahman 2003 and Sayed *et al.,* (2004 b) who found that Zinc sulfate a lone and its combination (with Ca-EDTA and Biozem and Biostimulant + GA_3 + Zn) treatments increased leaf content of P % compared with the control .

3.3.3. Leaf Potassium content

Referring to the effect of Biozem , Amcotone , Ca-EDTA , Zn–EDTA and their combinations on the Valencia orange trees, data presented in (Table 1) reveal that all treatments increased leaf – K content when compared to the control in both seasons . Biozem plus Zn-EDTA , Amcotone plus Ca- EDTA and Amcotone plus Ca- EDTA and Amcotone plus Zn-EDTA clearly increased leaf – K content (1.60 , 1.56 , 1.48 and 1.28 , 1.36 ,1.77 %) respectively for the two seasons , while Amcotone alone had the lowest effect (1.00 and 1.02 %) ,respectively in the two seasons .

These result are in agreement with that reported by El-Shazly (1981) who reported foliar application of chelated Zinc significantly increased leaf potassium content of Valencia

Table (1): Effect of some treatments on Leaf area C m^2 , Chlorophylls (A,B) and mineral composition of Valencia orange trees during 2004-2005 and 2005-2006 .

First season, 2004-2005											
Treat	**Leaf area C m^2**	**Chlorophyll(A)**	**Chlorophyll(B)**	**N %**	**P %**	**K %**	**Ca %**	**Mg %**	**Zn ppm**	**Fe ppm**	**Mn ppm**
T_1	**18.39**	**7.478**	**5.296**	**2.42**	**0.164**	**1.02**	**4.87**	**0.447**	**46**	**101**	**48**
T_2	**19.22**	**7.628**	**5.349**	**2.45**	**0.170**	**1.03**	**4.81**	**0.423**	**55**	**105**	**69**
T_3	**21.26**	**8.960**	**5.728**	**2.58**	**0.155**	**1.60**	**4.43**	**0.410**	**45**	**112**	**54**
T_4	**21.89**	**8.21**	**5.651**	**2.53**	**0.205**	**1.22**	**5.15**	**0.480**	**50**	**105**	**54**
T_5	**18.22**	**7.211**	**5.200**	**2.17**	**0.146**	**1.00**	**4.44**	**0.409**	**41**	**100**	**39**
T_6	**18.59**	**7.300**	**5.279**	**2.41**	**0.272**	**1.56**	**4.39**	**0.400**	**69**	**101**	**72**
T_7	**19.62**	**7.809**	**5.359**	**2.31**	**0.180**	**1.48**	**4.56**	**0.430**	**44**	**110**	**56**
T_8	**19.80**	**7.984**	**5.364**	**2.39**	**0.159**	**1.15**	**5.12**	**0.470**	**46**	**108**	**65**
T_9	**17.18**	**6.902**	**5.155**	**1.87**	**0.100**	**0.85**	**3.13**	**0.360**	**34**	**97**	**28**
L.S.D 5%	**2.19**	**0.88**	**0.25**	**0.30**	**0.074**	**0.32**	**0.87**	**0.051**	**15.05**	**6.45**	**17.63**
Second season, 2005 -2006											
Treat	**Leaf area C m^2**	**Chlorophyll(A)**	**Chlorophyll(B)**	**N %**	**P %**	**K %**	**Ca %**	**Mg %**	**Zn ppm**	**Fe ppm**	**Mn ppm**
T_1	**19.26**	**7.487**	**5.488**	**2.48**	**0.174**	**1.06**	**4.98**	**0.457**	**47**	**100**	**50**
T_2	**18.80**	**7.710**	**5.481**	**2.58**	**0.180**	**1.09**	**5.76**	**0.480**	**56**	**104**	**70**
T_3	**22.35**	**8.983**	**5.799**	**2.59**	**0.158**	**1.28**	**4.63**	**0.427**	**46**	**111**	**52**
T_4	**22.94**	**8.580**	**5.789**	**2.54**	**0.269**	**1.04**	**5.08**	**0.500**	**55**	**105**	**54**
T_5	**18.49**	**7.260**	**5.222**	**2.24**	**0.150**	**1.02**	**4.53**	**0.414**	**42**	**100**	**41**
T_6	**18.26**	**7.316**	**5.300**	**2.38**	**0.266**	**1.36**	**4.49**	**0.437**	**60**	**105**	**74**
T_7	**21.39**	**7.786**	**5.499**	**2.33**	**0.170**	**1.77**	**4.58**	**0.440**	**45**	**108**	**56**
T_8	**19.44**	**8.168**	**5.596**	**2.53**	**0.161**	**1.19**	**5.42**	**0.453**	**48**	**104**	**68**
T_9	**17.63**	**6.896**	**5.201**	**1.95**	**0.120**	**0.94**	**3.30**	**0.353**	**30**	**95**	**33**
L.S.D 5%	**2.28**	**0.88**	**0.25**	**0.28**	**0.076**	**0.18**	**1.06**	**0.063**	**12.9**	**6.88**	**15.91**

T_1 **Biozem at 1.5 ml / L (on 20 March, first July and mid August)**
T_2 **Biozem at 1.5 ml / L + Ca – EDTA 1.4 gm / L (on 20 March, first July and mid August)**
T_3 **Biozem at 1.5 ml / L + Zn – EDTA 1.5 mg / L (on 20 March, first July and mid August)**
T_4 **Biozem at 1.5 ml/L +Ca – EDTA 1.4 gm /L +Zn– EDTA 1.5 mg /L (on 20 March, first July and mid August)**
T_5 **Amcotone at 0.75 gm / L (on 20 March, first July and mid August)**
T_6 **Amcotone at 0.75 gm / L + Ca – EDTA 1.4 gm / L (on 20 March, first July and mid August)**
T_7 **Amcotone at 0.75 gm / L + Zn – EDTA 1.5 mg / L (on 20 March, first July and mid August)**
T_8 **Amcotone at 0.75 gm /L+Ca – EDTA 1.4 gm /L +Zn– EDTA 1.5 mg /L (on 20 March, first July and mid August)**
T_9 Control

orange trees. El-Saida(2001) found that Zinc sulfate and its combinations with Biozem and GA3 increased leaf content of potassium than the control . Sayed *et al.,(*2004 b) found that GA_3 and micronutrients increased leaf mineral content . Hamed (2005**)** reported that the highest values of K concentration were detected in the leaves of the trees treated with the highest level of Zn .

3.3.4. Leaf calcium

Concerning leaf Ca content , it is clear from the data presented in (Table 1) that Biozem plus Ca-EDTA plus Zn- EDTA and Amcotone plus Ca-EDTA plus Zn- EDTA in the first season and Biozem plus Ca- EDTA , Biozem plus Ca-EDTA plus Zn-EDTA and Amcotone plus Ca- EDTA plus Zn-EDTA in the second season had a highly significant increase leaf Ca content of Valencia orange compared to the other treatment (5.15 and 5.12%) in the first season ,(5.76, 5.08 and 5.42 %) in the second season , respectively . The obtained results are confirmed by the finding of Mohsen *et al.,* (1990) on Balady oranges who reported that Zn foliar application tended to increase leaf- Ca content. El-Saida (1996) , (2001) found that Zn So4 + Biozem increased leaf content of Ca compared with other treatments . Sayed *et al*.,(2004 b) reported that GA_3 and micronutrients increased leaf mineral content .

3.3.5. Leaf magnesium content

Concerning leaf Mg content, the data in (Table 1) show that all treatments increased Mg content in both seasons . The highest value was recorded by Biozem plus Ca- EDTA and Amcotone plus Ca-EDTA plus Zn–EDTA (0.480 and 0.470 %) in the first season, receptively , but in the second season it was by Biozem plus Ca- EDTA and Biozem plus Ca- EDTA plus Zn-EDTA (0.480 and 0.500 %), respectively . These results are in agreement with those mentioned by Meyer *et al.,* (1966), as amino acids and Zinc foliar application enhanced IAA synthesis in the cells of plant which stimulate cations absorbtion . Sayed *et al.,* (2004 b) Reported that the best results were obtained from foliar sprays of Biostumlant + GA3 + K 40 % + Zn 14% treatment .

3.4. Micronutrients

3.4. Leaf Zinc content

From the data obtained in both seasons (Table 1) it could be concluded that Biozem plus Zn-EDTA and Amcotone plus Zn- EDTA gave highly significant increase in leaf Zn content in the first season (69 and 50 ppm) respectively , but Biozem plus Zn-EDTA , Biozem plus Ca- EDTA plus Zn-EDTA and Amcotone plus Zn-EDTA gave highly significant increments (60, 55 and 56 ppm) respectively in second season . However , Biozem plus Ca-EDTA and Amcotone treatments slightly increased it compared to the control (44 and 41 ppm and 45 and 42 ppm) in the first and second seasons, respectively . These results are in line with those obtained by Mohsen *et al.,* (1990) who found that the highest leaf Zn content was obtained by spraying Balady orange with 1 % followed by 0.5 Zn So_4 . Swietlik and Laduke (1991) El- Saida (2001)and Abd El Rhman(2003) reported that Zinc sulfate alone and its combination with Ca- EDTA and Biozem increase Zn in Navel orange leaves .

3.4.2. Leaf iron content

Regarding leaf – Fe content , data in (Table 1) show that Biozem plus Zn- EDTA and Amcotone plus Zn-EDTA gave the highest values (112 and 110 ppm in first season and 111 and 108 ppm in the second season , respectively) . Also, the data indicated that leaf Fe content increased compared with the control in all treatments .

This result is in harmony with those obtained by Mohsen *et al*.,1990 who mentioned that Zn foliar application on Balady orange caused a correction of leaf chlorosis . El- Saida (2001) reported that Zn So_4 + Biozem increased leaf content of Fe as a combined or Biozem alone. Abo El-Komsan *et al* ., (2003) on mandarin reported that foliar application of GA3 ; Zn and micronutrients has a positive effect on leaf mineral content .

3..4.3. Leaf manganese content

Generally , from the data obtained in both seasons (Table 1) , it could be noticed that leaf Mn content was increased by all treatments seasons . The highest values were obtained by foliar sprays of Biozem plus Ca- EDTA , Amcotone plus Ca- EDTA and Amcotone plus Ca- EDTA plus Zn- EDTA (69 , 72 , 65 and 70 , 74 , 68 ppm) , respectively in both seasons. These findings are in agreement with those obtained by El- Saida (2001) who found that Zn So4 + Biozem treatments increased leaf content of Mn combined treatment or alone. Abd El- Rahman (2001) reported that Zinc sulfate alone (at 5 g/ L) and its combination (with Ca-EDTA at 0.5g/ L Biozem at 1.5 m/L and gibberellic acid at 15 ppm) increased N, Ca, Fe , Zn and Mn in Navel orange leaves . El- Baz (2003) found that foliar sprays of both Zinc (Zn sulphate soluation at 250 and 500 ppm zn) increased significantly the concentration of N, K, Mn and Zn in Balady mandarin leaves of spring flush .

3..4.5. Fruit set percentage

Data concerning fruit set percentage recorded in both seasons are presented in (Table 2) . It is clear that fruit set percentage increased

significantly in treated trees compared with the control in both seasons , except foliar sprays of Biozem alone and Amcotone plus Ca-EDTA in the first season and Biozem alone and Amcotone alone in the second season which was insignificantly increased.The best treatments in this regard were foliar sprays of Biozem plus Ca-EDTA plus Zn–EDTA , Biozem plus Zn- EDTA and Amcotone plus Ca-EDTA plus Zn-EDTA in both seasons (37.81 ,37.33 and 37.01 %) in the first season and (38.02 , 37.88 and 37.22 %) in the second season), respectively

3.4.6. Fruit Juice drop percentage

According to the data presented in (Table 2) fruit June drop decreased by all treatments in both seasons and the best result was obtained by Biozem plus Ca- EDTA plus Zn- EDTA in both seasons (90.09 , 90.31 and 90.89 %) in the first season and (90.00 , 90.11 and 90.50 %) in the second season ,.

3.4.7. Preharvest fruit drop percentage

It is clear from the data presented in (Table 2) that foliar sprays of Biozem plus – Ca – EDTA plus Zn- EDTA , Biozem plus Zn- EDTA and Amcotone plus Ca- EDTA plus Zn- EDTA treatments significantly decreased the preharvest fruit drop percentage in both seasons (1.21 , 1.49 , 1.82 and 1.13 , 1.26 ,1.59 %) , respectively . The data also indicated that preharvest fruit drop percentage was the lowest under all treated trees compared to the control .

3.4.8. Fruit remained percentage

Data presented in (Table 2) indicated that fruit remained percentage increased by all treatments in both seasons . Data showed that the highest values were obtained by foliar sprays of Biozem plus Ca-EDTA plus Zn-EDTA , Biozem plus Zn-EDTA and Amcotone plus Ca-EDTA plus Zn-EDTA treatments in first and second seasons (2.66, 2.51 ,2.43 and 2.71 ,2.64 , 2.50 %) respectively .

3.5. Tree yield

Valencia orange tree yield as number or weight per tree significantly increased by the applied treatments (Table 2) .

3.5.1. Yield by kgs per tree

It is evident from the data presented in Table (2) that yield by kgs per tree significantly increased in all treatments in the first season except foliar sprays of Amcotone alone and Amcotone plus Ca- EDTA, the increase was insignificant. The most convenient treatments were foliar sprays of Biozem plus Ca- EDTA plus Zn- EDTA , Amcotone plus Zn- EDTA and Amcotone plus Ca- EDTA plus Zn- EDTA (72.13, 73.70 and 69.41 kg) , respectively . In the second season the average yields as weight per tree was significantly increased by all foliar spray treatments compared with the control . The best values were by Biozem plus Ca- EDTA , Biozem plus – Zn- EDTA and Biozem plus Ca- EDTA plus Zn – EDTA (90.37 , 92.04 and 85.34 kg) , respectively .

3. 5.2.Yield as number per tree

It is clear from the data presented in Table(2) that foliar sprays of Biozem plus Zn- EDTA and Biozem plus Zn- EDTA plus Ca- EDTA gave the highest number of fruit per tree (425and 445) , respectively . Also , the average number of fruits per tree increased significantly by all treatments in the first season except foliar sprays of Biozem alone and Amcotone plus Ca- EDTA . Average yield as number per tree in the second season increased significantly in all treatments except in foliar sprays of Biozem alone , Amcotone alone and Amcotone plus Ca- EDTA which increased insignificantly . The best results in this regard were obtained by foliar sprays of Biozem plus Zn-EDTA and Biozem plus Zn- EDTA plus Ca-EDTA (473 and 783) , respectively .The obtained results are in accordance with those obtained by Stino *et al* (1981) who found that NAA decreased soluble pectin in the abscission zone of the pedicel of Leconte pear. Sharaf (1990) on Balady orange , found that Zn So4 increased fruit set, fruitting , and yield , and decrease fruit June drop, Sourour (2000) , Perveen and Rehman (2000) on sweet orange .El-Azazi (2001) , reported that potassium and calcium application had a great influence on fruit set efficiency and reducing pre- harvest fruit drop .and El- Saida (2001) on Navel orange trees , found that zinc sulphate + Biozem or GA_3 significantly increased fruit set percentage , had superior effect on the reduction of June drop percent , reduction of pre-harvest fruit drop percent subsequently the highest yield was obtained. Abd El- Rahman (2003) , El-Baz (2003**)** on Balady mandarin trees , reported that the highest yield was obtained by spraying Zn (250 ppm), the increase occurred in both fruit number per tree and their fruit weight .Sayed *et al.,* (2004 a) found that calcium nitrate and GA_3 on grapefruit trees increased fruit yield per tree . Hamed (2005) found significant and gradual increase in tree yield (kg) and number of fruits per tree of Valencia orange with increasing Zn rate as foliar spraying .

3.5.3. Fruit removal force L/ Cm^3 (FRF)

It can be stated from the obtained data in (Table 2) that fruit removal force significantly increased in all treatments in both seasons , except the trees treated with Biozem alone or Amcotone alone.

Table (2): Effect of some treatments on yield, fruit set %, fruit drop (June and preharvest), fruit remand percentage and some fruit quality of Valencia orange trees during 2004 -2005and 20052006 .

Treat.	Yield weight / tree	Yield No. / tree	Fruit set %	Fruit June drop %	Preharvest fruit drop %	Fruitting percentage	Fruit weight(gm)	Fruit volume(ml)	Fruit pull force L/cm^3	Firmness L/ 1inch^2	Fruit shape H/D
First season, 2004-2005											
T_1	66.98	331	35.20	92.77	3.20	2.22	201.90	207.03	42.77	15.81	1.09
T_2	61.52	374	36.18	91.68	2.60	2.30	170.05	175.55	44.23	16.34	1.10
T_3	68.65	425	37.33	90.31	1.49	2.51	166.42	170.53	45.81	17.25	1.05
T_4	72.13	445	38.81	90.09	1.21	2.66	167.18	173.19	46.37	17.82	1.08
T_5	50.17	326	35.03	92.91	3.33	2.19	153.89	160.02	41.68	15.69	1.06
T_6	51.64	340	35.46	92.30	2.81	2.29	155.81	161.08	43.90	16.07	1.03
T_7	73.70	380	36.74	91.18	2.07	2.40	196.69	201.50	44.76	16.88	1.13
T_8	69.41	382	37.01	90.89	1.82	2.43	183.57	188.56	45.13	17.01	1.12
T_9	43.4	310	34.10	93.01	3.69	2.03	142.42	147.23	40.48	14.26	1.01
L.S.D 5%	12.35	58.05	1.6	1.26	1.07	0.27	25.78	25.7	2.53	1.16	0.051
Second season, 2005-2006											
T_1	69.98	385	35.81	92.35	3.04	2.26	185.81	190.77	43.01	16.05	1.09
T_2	90.37	416	36.74	91.22	2.40	2.37	220.87	226.18	44.79	16.61	1.12
T_3	92.04	473	37.88	90.11	1.26	2.66	211.03	216.04	46.38	17.50	1.14
T_4	85.34	483	38.02	90.00	1.13	2.71	182.40	188.39	47.15	18.00	1.16
T_5	60.98	351	35.38	92.41	3.24	2.21	173.73	179.88	42.66	15.92	1.06
T_6	65.56	358	36.30	92.04	2.52	2.32	185.42	189.66	44.00	16.35	1.07
T_7	77.12	425	37.13	90.97	1.96	2.46	188.78	193.95	44.91	17.17	1.05
T_8	73.82	425	37.22	90.0	1.59	2.50	177.93	182.79	45.75	17.31	1.13
T_9	45.74	322	34.26	92.82	3.44	2.06	145.50	150.51	40.36	14.32	1.04
L.S.D 5%	13.36	69.23	1.62	1.21	0.99	0.31	32.40	32.53	2.92	1.21	0.051

T_1 Biozem at 1.5 ml / L (at 20 March, first July and mid August)

T_2 Biozem at 1.5 ml / L + Ca – EDTA 1.4 gm / L (on 20 March, first July and mid August)

T_3 Biozem at 1.5 ml / L + Zn – EDTA 1.5 mg / L (on 20 March, first July and mid August)

T_4 Biozem at 1.5 ml/L +Ca – EDTA 1.4 gm /L +Zn– EDTA 1.5 mg /L (on 20 March, first July and mid August)

T_5 Amcotone at 0.75 gm / L (on 20 March, first July and mid August)

T_6 Amcotone at 0.75 gm / L + Ca – EDTA 1.4 gm / L (on 20 March, first July and mid August)

T_7 Amcotone at 0.75 gm / L + Zn – EDTA 1.5 mg / L (on 20 March, first July and mid August)

T_8 Amcotone at 0.75 gm /L+Ca – EDTA 1.4 gm /L +Zn– EDTA 1.5 mg /L (on 20 March, first July and mid August)

T_9 Control

It is clear that fruit removal force significantly increased by all foliar spray treatments with calcium (Biozem plus Ca-EDTA , Biozem plus Ca-EDTA plus Zn-EDTA , Amcotone plus Ca-EDTA , Amcotone plus Ca-EDTA plus Zn-EDTA) compared with the control in both seasons (44.23 , 46.37, 43.90 , 45.13 and 44.79 , 47.15 ,44.00 , 45.75 L/ cm^3), respectively . The highest values were obtained by Biozem plus Ca-EDTA plus Zn-EDTA , Biozem plus Zn-EDTA and Amcotone plus Ca- EDTA plus Zn-EDTA treatment in both seasons and were (46.37,45.81 ,45.13 and 47.15 , 46.38 , 45.75 L/ cm^3), respectively

3.5.4. Fruit firmness L/1 inch ^{2}

From the data in (Table 2) it is noticed that all calcium treatments resulted in a significantly increase in fruit firmness, it is clear that Biozem plus Ca-EDTA , Biozem plus Ca-EDTA plus Zn-EDTA , Amcotone plus Ca-EDTA and Amcotone plus Ca-EDTA plus Zn-EDTA significantly increased fruit in both seasons amounting to (16.34 , 17.82 , 16.07 , 17.01 and 16.61 , 18.00 , 16.35 , 17.31 L/ 1 $inch^2$) respectively . The best treatment in this regard was Biozem plus Ca-EDTA plus Zn-EDTA (17.82 , 18.00 L/ 1 $inch^2$) in both seasons respectively.

Effects of calcium may be attributed to delaying the abscission process by separation layer as divisions in paranchyma cells with simple vesicular conjunction , this increased pull force , Grieson and Tucker (1983), mentioned that Ca- EDTA spray , markedly reduced the cell wall break- down and fruit senescences , therefore it reduced pre- harvest fruit drop chance . El-Shafey *et al.,* (2002) , reported that calcium has an important role in maintaining in cell wall structure and membrane intergrity by the inter action of calcium with pectic acid in cell wall to form calcium pectate . Moreover , they added that calcium causes a reduction or delay in cell wall break down , and this effect causes a delay in fruit softing **.** Sayed *et al.,* (2004 a**)** stated that calcium nitrate showed a remarkable increase in thickness of both union zone and pedicel by 154.6 and 10.6 % , respectively , also showed well brought- up degree of vascular connection and enough amounts of cell adhesion in the union zone comparing with the untreated plants .

To sum up , to obtain the maximum fruitting percentage , presence of Biozem or Amcotone plus Ca- EDTA plus Zn- EDTA or plus Zn- EDTA alone is necessary. This may be attributed to that , Biozem and Zn-EDTA increase levels of IAA , Amcotone and Ca-EDTA delays fruit by delays abscission process and increase fruit removal force . This regime will give the maximum number of fruits on tree at harvesting time . Naturally this will be translated into final yield .

3.5.5.Fruit physical and chemical properties

Fruit weight

Data in (Table 2) show clear that fruit weight increased by all treatment in both seasons , but significant increases were obtained by foliar spray of Biozem , Acotone plus Zn- EDTA , Amcotone plus Ca- EDTA plus Zn- EDTA and Biozem plus Zn- EDTA (201.90 , 196.69 , 183.57 and 170.05 g) in the first season , respectively , and in the second season to foliar spray with Biozem alone (220.87, 211.03 , 188.78 and 185.81gm) , respectively .

Fruit volume

It can be stated from the obtained data in (Table 2) that fruit volume increased by all applications in both seasons. It is clear that the highest values were obtained by foliar sprays of Biozem , Amcotone plus Zn- EDTA and Amcotone plus Ca- EDTA plus Zn- EDTA (207.03 , 201.50 and 188.56 ml) , respectively in the first season , but in the second season by foliar sprays with Biozem plus Ca-EDTA , Biozem plus Zn- EDTA and Amcotone plus Zn- EDTA (226.18 , 216.04 and 193.95 ml.) , respectively .

Fruit shape (H/ D)

Data regarding fruit shape (H/ D ratio) presented in (Table 2) , show that , all treatments have changed fruit shape to be oblong , and also indicated that most treatment was significantly increased H/ D ratio compared control except in foliar sprays with Biozem plus Zn- EDTA , Amcotone and Amcotone plus Ca- EDTA. In second season however , data the showed that fruit shape index increased significantly compared with the control by foliar sprays of Biozem or Amcotone plus Ca- EDTA , Zn- EDTA and Biozem plus Ca-EDTA .

Peel thickness

Table 2 shows that all treatments gave a significant increment in peel thickness compared with the control in both seasons . It is clear from data that the highest peel thickness was obtained by foliar sprays of Biozem plus Ca- EDTA plus Zn- EDTA (0.56 and 0.58 cm) in the first and the second seasons, respectively.

Juice percentage

According to the data in (Table 2) average Juice percentage increased in all treatments compared with the control in both seasons . All treatments significantly increased it compared to the control , except foliar sprays with Amcotone alone whereas the increment were insignificant in the first season , by foliar sprays with Biozem

plus Ca- EDTA , Biozem plus Ca -EDTA plus Zn-EDTA and Amcotone alone in the second season . It could be observed that Amcotone foliar application in combination with of Ca - EDTA gave the highest increment in fruit juice percentage (56.54 and 50.55%), respectively in the first and the second seasons.

Juice density

Data in (Table 2) indicated that juice density increased by all treatments compared with the control . The best results were obtained by foliar sprays of Biozem plus Zn- EDTA, Biozem plus Ca – EDTA plus Zn- EDTA and Amcotone plus Zn- EDTA plus Zn- EDTA (1.08, 1.07, 1.06 and 1.06, 1.09 , 1.08 gm/mL) in first and second seasons , respectively .

Total soluble solid percentage

It could be stated from the obtained data in (Table 3) that all treatments increased significantly the percentage of total soluble solids of fruit juice as compared with the control . Biozem plus Ca – EDTA plus Zn- EDTA gave the best results in the first and the second seasons (12.87 and 12.93 %), respectively .

Acidity percentage

Data in the (Table 3) clearly show that the total acidity percentage increased significantly compared by the control and by foliar sprays of Biozem alone, Biozem plus Ca–EDTA , Biozem plus Zn-EDTA and Biozem plus Ca–EDTA plus Zn-EDTA in first and second seasons (1.19 , 1.13, 1.18 , 1.16 and 1.22, 1.20 , 1.21 , 1.23 %) respectively . The highest values were by foliar sprays of Biozem in both season (1.19 and 1.22), respectively , and by foliar sprays of Amcotone plus Zn-EDTA in first season and Amcotone plus Ca-EDTA plus Zn-EDTA in second season (1.02 and 1.02) respectively .

T.SS / acid ratio

It is clear from the data in Table 3 that Amcotone plus Zn- EDTA showed superiority over all other treatments (11.500) in the first season . In the second season, Amcotone plus Ca – EDTA plus Zn- EDTA was superior over all other treatments (11.4618) including the control. Also, it was observed that the foliar sprays of Amcotone plus Ca – EDTA or plus Zn- EDTA or in combination in creased T.S.S.% acid ratio as compared with all treatment . The increment in this ratio came as a result of reducing acidity and increasing T.S.S which definitely affect T.S.S/ acid ratio.

Total sugar percentage

It is obvious from the data presented in (Table 3) that all treatments increased total sugar % as compared with the control in both seasons. Maximum increment was obtained when Biozem was applied with Ca – EDAT or Zn-ETDA alone and with them both. Statistical analysis of the present data proved that all treatments with Biozem were superior over all the treatments with Amcotone . It is evident that the average total sugars % increment for foliar application of Biozem plus Ca-EDTA , Biozem plus Zn-EDTA , Biozem and Biozem plus Ca-EDTA plus Zn-EDTA (8.72. 8.51. 8.30 and 8.23 %) in first season , respectively compared with the control, whereas in the second season the total sugars % was enhanced by folior spray of Biozem plus Ca-EDTA, Biozem, Biozem plus Ca-EDTA plus Zn-EDTA and Biozem plus Zn- EDAT (8093. 8089 . 8.82 . and 8.81%) compared with the control respectively. The best results were obtained by foliar spray of Biozem plus Ca –EDTA (8.72 and 8.93%), respectively in the both seasons .

Vitamin C

Data regarding Vitamin C content in fruit juice (mg/100 ml juice) presented in (Table 3) show that all treatments significantly increased Vitamin C except Amcotone compared with the control in both seasons. The best result was obtained by foliar sprays of Biozem plus Zn-EDTA Biozem and Biozem plus Ca –EDTA treatments as the increased Vitamin C was significantly higher than other treatments (49.27.48.90.40.30 and 49.93 49.10.48.53 mg/100 ml juice) , respectively in both seasons .

3.6. Rind pigments

3.6.1.First sample (mid April)

a. Chlorophyll-a

Concerning the effect of the all treatments on chlorophyll -a content of fruit rind in (Table 3) the results clearly show that the amount of chlorophyll-a was increased if compared with the control. The highest values of chlorophyll-a content in fruit rind were recorded by Biozem plus Ca–EDTA plus Zn–EDTA , Biozem plus Zn–EDTA, Biozem plus Ca–EDTA , and Biozem (0.0719 , 0.0718, 0.0702 ,0.0628 and 0.0800 , 0.0758, 0.0743 , 0.0734 mgm / 100 gms) of fresh weight , respectively in both seasons . It is clear from the data that chlorophyll-a content was significantly increased by all treatments compared with the control in both seasons except foliar sprays of Amcotone alone which insignificantly increased chlorophyll-a content in both seasons. It is obvious from the previous data that zinc application increased chlorophyll-a content in fruit rind. This increment could be due to its role in the synthesis of chlorophyll precursor protoporpho billingen (PPB), which is the precursor of the chlorophyll **(**Yagodin, 1984,b**) .**

Table (3): Effect of some treatments on some chemical properties and rind pigments(in mid April , first May and half May) of Valencia orange trees during 2004-2005 and 2005- 2006.

Treat.	.S.S %	Acidity %	T.S.S / Acidity ratio	Total sugars %	V.C mg / 100 ml juice	Rind pigments in mid April			Rind pigments in first May			Rind pigments in half May		
						Chl.(A)	Chl.(B)	carotonoids	Chl.(A)	Chl.(B)	carotonoids	Chl.(A)	Chl.(B)	carotonoids
First season , 2004-2005														
T_1	12.60	1.19	10.588	8.30	48.90	0.0628	1.7148	8.0192	0.3803	2.2408	6.8052	0.5553	2.3778	6.3522
T_2	12.30	1.13	10.884	8.72	48.30	0.0702	1.7303	6.9220	0.3822	2.2563	5.7080	0.5572	2.3933	5.255
T_3	12.23	1.18	10.364	8.51	49.27	0.0718	1.7341	8.0657	0.3838	2.2601	6.8517	0.5588	2.3971	6.3987
T_4	12.87	1.16	10.501	8.23	45.03	0.0719	1.8732	7.6680	0.3839	2.3992	6.4540	0.5589	2.5362	6.001
T_5	11.60	1.06	10.943	7.88	38.19	0.0519	1.1687	7.8571	0.3639	1.6947	6.6431	0.5389	1.8317	6.1901
T_6	11.77	1.06	11.103	7.27	46.20	0.0572	1.3655	5.9443	0.3692	1.8915	4.7303	0.5442	2.0285	4.2773
T_7	11.73	1.02	11.500	7.54	44.53	0.0602	1.6826	7.9999	0.3722	2.2086	6.7859	0.5472	2.3456	6.3329
T_8	11.57	1.07	10.812	7.64	44.92	0.0604	1.7124	6.6769	0.3724	2.2384	5.4629	0.5474	2.3754	5.0099
T_9	10.24	1.00	10.24	4.66	33.50	0.0449	0.9175	7.8165	0.3569	1.4435	6.6025	0.5319	1.5805	6.1495
L.S.D 5%	1.13	0.08	0.54	1.75	6.78	0.0113	0.4027	0.9099	0.01269	0.4491	0.9970	0.0126	0.3838	0.9971
Second season, 2005 -2006														
T_1	12.17	1.22	10.467	8.89	49.10	0.0734	1.8491	8.1282	0.4304	2.4651	6.8072	0.4524	2.7001	6.3452
T_2	12.67	1.20	10.558	8.93	48.53	0.0743	1.9213	6.7045	0.4313	2.5373	5.3835	0.4533	2.7723	4.9215
T_3	12.69	1.21	10.487	8.81	49.93	0.0758	1.9228	8.1303	0.4328	2.5388	6.8093	0.4548	2.7738	6.3473
T_4	12.93	1.23	10.500	8.82	47.87	0.0800	1.9749	7.5918	0.4370	2.5909	6.2708	0.4590	2.8259	5.8088
T_5	11.62	1.07	10.859	7.96	39.25	0.0558	1.3049	7.7412	0.4128	1.9209	6.4202	0.4348	2.1559	5.9582
T_6	11.97	1.08	11.083	7.89	46.47	0.0563	1.5005	5.9695	0.4133	2.1165	4.6485	0.4353	2.3515	4.1865
T_7	11.93	1.09	10.945	7.72	44.90	0.0701	1.7249	7.8474	0.4271	2.3409	6.5264	0.4491	2.5759	6.0644
T_8	11.69	1.02	11.461	7.89	45.33	0.0726	1.7956	6.5794	0.4296	2.4116	5.2584	0.4516	2.6466	4.7964
T_9	10.29	1.01	10.188	5.13	34.97	0.0416	0.9811	7.6127	0.3986	1.5971	6.2917	0.4206	1.8321	5.8297
L.S.D 5%	1.14	0.09	0.65	1.63	6.43	0.0159	0.4203	0.9201	0.0180	0.4670	1.0155	0.1804	0.4670	1.0156

T_1 Biozem at 1.5 ml / L (at 20 March, first July and mid August)

T_2 Biozem at 1.5 ml / L + Ca – EDTA 1.4 gm / L (on 20 March, first July and mid August)

T_3 Biozem at 1.5 ml / L + Zn – EDTA 1.5 mg / L (on 20 March, first July and mid August)

T_4 Biozem at 1.5 ml/L +Ca – EDTA 1.4 gm /L +Zn– EDTA 1.5 mg /L (on 20 March, first July and mid August)

T_5 Amcotone at 0.75 gm / L (on 20 March, first July and mid August)

T_6 Amcotone at 0.75 gm / L + Ca – EDTA 1.4 gm / L (on 20 March, first July and mid August)

T_7 Amcotone at 0.75 gm / L + Zn – EDTA 1.5 mg / L (on 20 March, first July and mid August)

T_8 Amcotone at 0.75 gm /L+Ca – EDTA 1.4 gm /L +Zn– EDTA 1.5 mg /L (on 20 March, first July and mid August)

T_9 Control

b. Chlorophyll-b

The present results showed that, there was a considerable similarity between the results of chlorophyll-a and b . It is clear from the data in (Table 3) that chlorophyll-b significantly increased in first and second seasons compared with the control by all treatments except by foliar spray of Amcotone which insignificantly increased it . The best results were obtained from foliar sprays of Biozem plus Ca-EDTA plus Zn-EDTA, Biozem plus Zn- EDTA, Biozem plus Ca-EDTA and Biozem treatments as the increased in chlorophyll-b content was significantly higher (1.8732 , 1.7341, 1.7303 , 1.7148 and 1.97ug , 1.9228 , 1.9213 , 1.8491 mgm/100 gm fresh weight) than the other treatments in both seasons , respectively .

The increase in chlorophyll-b content in fruit rind of fruits treated with Zinc as compared with the control could be due to the influence of Zinc treatment on increasing the fruit rind content of chlorophyll-a , as both chlorophyll-a and chlorophyll-b could be converted to each other, and chlorophyll-a is the immediate precursor of chlorophyll-b (Castelfranco and Beale, 1983) .

c. Carotenoids

Table 3 shows that the average carotenoids insignificantly increased by foliar sprays of Biozem, Biozem plus Zn-EDTA , Amcotone and Amcotone plus Zn- EDTA (8.0192, 8.0657, 7.8571, 7.999 and 8.1282, 8.1303, 7.7412, 7.8474 mgm /100 gm) of fresh weight compared with control in both seasons, respectively . On the other hand, foliar spray of Ca–EDTA plus Biozem or plus Amcotone significantly or insignificantly decreased average carotenoids compared with the control in both seasons .It is evident from the data that average carotenoids insignificantly decreased for foliar sprays of Biozem plus Ca- EDTA and Biozem plus Ca- EDTA plus Zn-EDTA (6.9220 , 7.6680 and 6.7045 , 7.918 mgm /100 mg) of fresh weight compared with control , respectively in both seasons . Data obviously indicate that carotenoids were significantly decreased by foliar sprays of Amcotone plus Ca-EDTA and Amcotone plus Ca-EDTA plus Zn-EDTA (5.9443 , 6.6769 and 5.9695, 6.5794 mgm/ 100 gm) of fresh weight compared with control in both seasons respectively .

3.6.2. Second and third samples (first May and half May)

Concerning rind chlorophyll –a, chlorophyll-b and carotenoids in both samples and in both seasons , it could be noticed that all calcium treatments caused an increased in rind chlorophyll (a &b) and showed a decrease in carotenoids ,this mean that calcium increased regreening of fruit rind in maturity stage .

a. Chlorophyll- a

It is clear from the data in (Table 3) that the highest values of chlorophyll-a content in fruit rind were recorded by Biozem plus Ca-EDTA plus Zn-EDTA (0.3839 and 0.5589 mgm/ 100 gm) of fresh weight in both samples and in first season and (0.4370 and 0.4590 mgm/ 100 gm) in second season respectively compared with the control .

b. Chlorophyll-b

It is obvious from data presented in (Table 3) that all calcium treatments increased chlorophyll-b in both seasons and in both samples. Foliar spray of Biozem plus Ca- EDTA plus Zn-EDTA gave the highest values of chlorophyll-b (2.3992 and 2.5362 mgm/ 100 gm) of fresh weight in both samples and in first season and (2.5909 and 2.8259 mgm/ 100 gm) in second season respectively compared with the control .

c. Carotenoids

Data presented in (Table 3) indicate that the lowest values were obtained by foliar sprays of Amcotone plus Ca-EDTA were 4.7303 and 4.2773 mgm/ 100 gm of fresh weight in both samples and in first season and 4.6485 and 4.1865 mgm/ 100 gm in the second season respectively compared with the control.

These findings are partially in harmony with those obtained by Miller *et al.,* (1940) who stated that during orange maturation there was a loss of chorophylls accompanied with an increase in carotenoids . Khadr *et al.* (1978) decided that Washington Navel orange when sprayed with Zn So_4 causes an increase in fruit weight, fruit peel thickness and juice weight. El- Kassas *et al.,* (1987) , found that Zinc improved both physical and chemical fruit quality of Valencia orange trees .Njaroge *et al.* (1988 a and b) concluded that calcium caused an increase in rind chlorophyll's and a decrease in ring corotenoids. These may be, attributed to the role of calcium in delaying or reducing ripening and senescence. Desai *et al.* (1991), on sweet orange trees and Ouyang (1993), on Shaddock, orange and satsuma mandarin, suggested that zinc application increases fruit weight, ascorbic acid content of fruit juice, total sugars El-Saida (1996) mentioned that, the application of Zn SO_4 or GA_3 significantly increased fruit size, peel thickness . El-Saida (2001) found that both Zn So_4 plus Biozem or GA3 resulted in a high percentage of T.S.S , T.S.S/ Acid ratio and a good rind colour. Also. El–Azaze (2001) obtained that Ca-EDTA Spray application as protective in reducing the plant

senescence and fruit ripening , much calcium would be disadvantageous in that it might inhibit cell enlargement and calcium chelate foliar consider by spraying a good protective agents for reducing fruit crack at harvest time and improved Navel orange fruit weight, Size and firmness Kanonich *et al.* (2000) and El- Saida (2001) found that foliar sprays of naphthalene acetic acid increased Juice % and acidity of kinnow mandarin. Kononich *et al.,* (2000) and Ibraheim *et al.,* (2001) suggested that NAA (400 ppm) treatment increased T.S.S and acidity .Abd-El Rahman (2002) found that calcium treatments increased rind chlorophyll and decrease rind corotenoids . El- Shafey *et al.,* (2002) reported that calcium concentrations (48 and 126 ppm) at all application dates increased fruit pull force . El-Baz (2003) reported that, foliar zinc improved the quality (Fruit weight, Fruit juice, T.S.S% and Vitamin C) of Balady mandarin trees . El-Saida (2001) and Abd El- Rahman (2003) found that, fruit weight , fruit size, fruit dimensions , peel thickness were significantly affected by Zn SO4 and their combination Ca- EDTA, GA3 and Biozem, also significantly increased fruit juice weight , T.S.S%, T.S.S% acid ratio in Navel orange. Sayed *et al*., (2004b) reported that foliar sprays of Zinc 14 % at 2.9 g/ L on Valencia orange increased fruit weight fruit dimensions , peel thickness , Juice percentage , total soluble solids % . Sayed *et al.,* (2004 a) found that calcium nitrate and GA_3 on grape fruit trees improved the physical and chemical fruit properties , *e. g*. fruit weight , size , peel thickness, juice %, T.S.S % acidity %, T.S.S / acidity ratio , total sugar , vitamin C. Hamed (2005**)** indicated that , a significant and gradually increases in total sugars , Vit C , total acidity and total soluble solids were obtained by the fruit of Valencia orange trees with increasing Zn foliar application .

From the aforementioned results in this study , it was observed that foliar spray of Biozem plus Zn-EDTA plus Ca-EDTA increased of leaf area and chlorophylls of leaves. This improved fruit set , fruitting and reduce June drop percentage. Also this treatments gave the highest peel thickness , fruit removal force and firmness , which reflected on raising the yield .

It could be generally concluded that foliar spray with Biozem at 1.5 ml /L + Ca-EDTA 1.4 gm/L +Zn-EDTA 1.5 mg/L (on 20 March , first July and mid August) on Valencia orange trees , obtained the highest yield / tree and the best fruit quality .

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استجابة اشجار برتقال الفالنشيا المنزرعة فى الاراضى الرملية للمعاملة بالبايوزيم والامكوتون وكلا من شيلات الكالسيوم والزنك على صفات الجودة والاخضرار والمحصول

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ملخص

اجريت هذه الدراسة خلال موسمى 2005/2004 ، 2006/2005 على اشجار برتقال فالنشيا عمر 14 سنة مطعومة على اصل النارنج فى احد البساتين الخاصة بمدينة السادات لدراسة تأثير الرش بالبايوزيم والامكوتون وكلا من شيلات الكالسيوم والزنك على صفات الجودة والتلوين والمحصول .

اظهرت المعاملة بكل من البايوزيم والكالسيوم والزنك والمعاملة بالبايوزيم مع الكالسيوم اعلى زيادة معنوية فى مساحة الورقة ، كما اظهرت الدراسة ايضا زيادة محتوى الاوراق من الكلوروفيلات بنفس المعاملة وادت المعاملة بالبايوزيم مع الكالسيوم او البايوزيم مع الزنك الى زيادة معنوية للمحصول ونسبة العقد ونسبة الاثمار بالمقارنة بباقى المعاملات كما اظهرت تلك المعاملات اقل نسبة تساقط (يونيو ، ما قبل الجمع) .

ولوحظ ان بعض المعاملات خاصة التى بها كالسيوم سبب زيادة معنوية فى كل من قوة الفصل وصلابة الثمار وكانت افضل نتيجة تم التوصل اليها بالمعاملة بالبايوزيم مع الكالسيوم ومع الزنك فى كلا الموسمين وقد ادت المعاملة بالبايوزيم بمفرده او مع الزنك والكالسيوم الى تاثير معنوى على كل من وزن الثمار وحجم الثمار وسمك القشرة ونسبة العصير وكثافة العصير .

كما اعطت المعاملة بالامكوتون مع الكالسيوم الى اعلى نسبة عصير بالمقارنة بباقى المعاملات . كما اوضحت النتائج الى زيادة المواد الصلبة الذائبة بالمعاملة بالبايوزيم مع الكالسيوم مع الزنك وكانت اعلى نسبة مواد صلبة الى الحموضة بالمعاملة بالامكوتون مع الزنك .

كما اشارت النتائج الى زيادة معنوية فى محتوى السكريات الكلية بالمعاملة بالامكوتون ، كذلك زيادة نسبة فيتامين ج بالمعاملة بالبايوزيم مع الزنك . ايضا اوضحت النتائج زيادة كل من كلورفيل أ ، ب فى قشرة الثمار بالمعاملة بالبايوزيم و الكالسيوم و الزنك مع بعضهما او بمفردهما وان المعاملة بالبايوزيم اعطت اعلى قيمة فى كلا الموسمين . ومن ناحية اخرى ادت المعاملة بالبايوزيم او الامكوتون منفردين او مع الزنك الى زيادة معنوية فى الكاروتينيدات فى قشرة الثمرة كما اظهرت النتائج ان المعاملات التى اشترك فيها الكالسيوم ادت الى قلة الكاروتينيدات وزيادة الكلوروفيلات خاصة فى العينة الثانية والثالثة .وأدت الى زيادة نسبة الاخضرار فى قشرة الثمار . ولوحظ ايضا ان المعاملة بالامكوتون مع الكالسيوم مع الزنك حسنت المحتوى المعدنى للاوراق (ن، فو ، بو ، كا ، مع ، زنك ، حديد ، منجنيز) وهذا ادى الى زيادة محتوى الاوراق من الكلوروفيلات مما انعكس على زيادة المحصول.

ويوصى من خلال النتائج التى تم التوصل اليها فى هذه الدراسة للحصول على اعلى صفات جودة طبيعية وكيماوية لاطول مدة ممكنة على الاشجار وايضا لتقليل نسبة تساقط وزيادة نسبة الاثمار وزيادة كلا من قوة الفصل (قوة التصاق الثمرة بالعنق) وصلابة الثمار بالمعاملة بالبايوزيم (1.5 مللجم / لتر) مع الكالسيوم (1.4 جم / لتر) مع الزنك (1.5 مللجم / لتر) بالرش فى 20 مارس واول يوليو ونصف اغسطس .

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