EFFECT OF SOME CHEMICAL COMPOUNDS ON SOME CHARACTERISTICS OF SHOOT AND FRUIT OF PEACH (*Prunus persica* L.) CV. EARLY CORONET

[*]Sarfaraz F. A. Al- Bamarny [**]Mohammed A. Salman
[*] Zulaykha R. Ibrahim
[*] Duhok Univ. - college of Agriculture- Horticulture Dept.-Duhok-Iraq
[**]Baghdad Univ.-college of Agriculture-Horticulture Dept.-Baghdad-Iraq

Key words**:** *spray treatment, NAA, KNO_3, Fe, Fruit, leaf and Peach*

ABSTRACT

This study was carried out during 2008 growing season on peach trees (*Prunus persica* L.) cv. Early Coronet selected from orchard in Seiujh - Duhok city - Kurdistan Region, Iraq, to investigate the effect of [Naphthalene acetic acid [NAA, Riedel-de Haen (0 and 5 mg.l^{-1}); KNO_3 (Merck) (0, 0.1 and 0.2 %), and Fe (NaFeEDDHA) Technical Sodium Ferric ethylenediamine di-o-hydroxyphenyle acetate (0, 30 and 60 mg.l^{-1}] on growth and fruit characteristics. One month after fruit set, trees were sprayed at two date (24/April/2008 and 25/May/2008) with NAA, KNO_3 and Fe. Raising the levels of NAA to 5 mg.l^{-1}, KNO_3 to 0.2 % and Fe to 60 mg.l^{-1} led to a significant increase in the value of shoot dry weight, total chlorophyll, fruit number, fruit length, fruit diameter, total carotene as compared with untreated trees. The interaction between Foliar spray of 5 mg.l^{-1} NAA × 0.2% KNO_3 × 60 mg.l^{-1} Fe were the best treatment which gave the highest means of shoot dry weight, total chlorophyll, fruit number, fruit length, fruit diameter and total carotene.

INTRODUCTION

The peach *Prunus persica* is known as a species of prunus that bear an edible juicy fruit. It is belonging to the subfamily *Prunoideae* of the family "Rosaceae" (Grisez *et al.,* 2000). Peach is one of the most important stone fruit, due to its heavy loading and dietetic value, the fruit is a good source of carbohydrate, protein and vitamins especially (A, B and C) and mineral nutrient such as phosphorus, potassium, calcium and iron. Beside the different uses of the fruit, it is often used as table fruits (fresh fruit), juice and jams (Bal, 2005).

Today, peaches are the third largest commercial fruit in Iraqi Kurdistan Region, after grapes and apples. Increasing yield of fruit trees are the result of improved cultivars, cultural practices and pest control as well as the use of fertilizers and growth regulators. Heavy peaches crops year after year tends to decrease nutrients availability in soil due to continuous removal of nutrients from the soil, thus application of fertilizers to improve yield of plant is required (Westwood, 1978).

Auxins such as NAA have been used since a long time to improve fruit quantity and quality in many deciduous fruit tree. It controls fruit developing (Acquaah, 2005). Today the one remaining auxin that is registered for this use is NAA (Edgerton and Williams, 2009).

Part of the MSc. thesis of the 3rd author 2010
Received 28-7- 2010 accepted 4/10/2010

Stern *et al.,* (2007) studied the effect of application of (30mg.l^{-1} NAA) on Japanese plum *(Prunus salicina)* at the beginning of pit-hardening when fruitlet diameter was ca. 13 mm caused appreciable and significant increases in fruit size.

Since most of Iraqi soils are calcareous and their pH is high (Al-Zubaidi, 1989), this tends to decrease some nutrients availability. Potassium deficiencies greatly reduce crop yield. In fact, serious yield reduction may reduce with the appearance of deficiency symptoms and this phenomenon has been termed hiddenhunger (George, 2003). Photosynthesis is decreased with insufficient potassium whereas at the same time respiration may be increased, this seriously reduces the supply of carbohydrates and consequently the growth of the plant (Tisdale and Nelson, 1975). Ruiz (2006) applied a field trial with three sources of K (KNO_3, K_2SO_4 and KCl) of early nectarines cv. Fairlane resulted in a significant increase in yield, fruit weight and diameter of the fruit by all the K sources, while no effects were measured in all evaluated seasons in terms of soluble solids levels in the fruit.

Iron plays an important role in the activation of chlorophyll and in the synthesis of many heme proteins such as different cytochrome, which participate in different functions in the plant metabolism (Bhandari and Randhawa 1985). El-Sheikh *et al.,* (2007) Sprayed "Florida Prince and Desert Red" peach trees once, twice and thrice a year with combinations of chelate at the rate of Fe, Zn and Mn or combinations of Zn, Mn, Fe sulphate, The results indicated that spraying the trees twice or thrice yearly was more effective than spraying once a year or control in improving and increasing yield, fruit weight, fruit size and fruit firmness of both peach fruits. Moreover, they improved most of fruit quality parameters. This study investigates foliar application of nutrients and the interactive effect of NAA, KNO_3 and Fe on nutrient status, shoot and yield characteristics of peach.

MATERIALS and METHODS

This study was conducted at Seiujh, 15km north of Duhok city, Kurdistan Region, Iraq in 2008 season. Table (2) shows the different components of the soil of the experiment location.

Trees used in this study were four years old of peach (*Prunus persica* L) cv. Early Coronet, budded on seedling peach rootstocks, the trees were aproximatly similar in size and bloom density. When the mean of fruit diameter reached 9 ± 1.5mm, 54 peach trees, were grouped into three randomized complete blocks of 18 trees.

Each tree was sprayed to drip point with a solution containing (0 , 5 mg^{-1}NAA , 0, 0.1, 0.2 % KNO_3 and 0, 30, 60 mg^{-1} Fe) alone or in combination at two date son April 24-2008 and May 25-2008, using 16 Liter sprayer. The surfactant agent Tween-80 was added to all the solutions at concentration 0.01%. Regular agricultural practices were applied to all trees throughout the experiment.

The experiment was laid out as factorial in Randomized Complete Blocks Design (R.C.B.D) with three replicates, one tree per experimental unit. Observation on different growth parameter was recorded at the end of the experiment and at the final harvest (1st June) for determination fruit characteristics, twenty fruits were picked up randomly from each replicate as a composite sample. Duncan Multiple

Range Test was used for the comparison of treatment means at 5% level (Al-Rawi and Khalafallah, 1980). All the data were tabulated and statistically analyzed with computer using (SAS system 2002).

Table (1): Some physical and chemical properties of orchard soil

Characteristics	Value
Volumetric distribution of soil separates	
Sand %	49.11
Silt%	28.75
Clay%	21.95
Texture	Sandy clay loam
Available nutrient content	
Total-N%	0.200
Available Phosphorus($mg.l^{-1}$)	7.9
Available Potassium ($Mmol.L^{-1}$)	0.217
Calcium carbonate %	12.6
Available iron ($mg.l^{-1}$)	2.15
Organic mater%	1.63
pH	8.23
Electrical conductivity ($ds.m^{-1}$)	0.522

The analysis was carried out at soil and water science laboratory, Agriculture College, Duhok University.

Measurements

1- Shoot Dry Weight (%): the 1st of June, 20 current season shoots were randomly collected from all sides of trees under treatment, and put in polyethylene bags to be quickly transferred to laboratory. After shoots weight were taken, they were oven – dried at 70ºC until weight fixing, (Gobara, 1998) percentage of shoot dry weight was then calculated by the following equation:

$$\% \text{ percentage of dry matter} = \frac{Dry \quad weight}{fresh \quad weight} \times 100$$

2- Total Chlorophyll Content ($mg.g^{-1}$ fresh weight): For determining average leaf chlorophyll content,(6-10 leaves from the apex of plant) according to (Tattini *et al.,* 1988). Then the total chlorophyll content of leaves ($mg.g^{-1}$ fresh weight) was calculated according to Knudsen method as described in Wintermans and DeMots (1965) and shown in the following equations:

mg chl. a/ml solution = (13.7) (A 665 nm) – (5.76) (A 649 nm)

mg chl. b/ml solution = (25.8) (A 649 nm) – (7.6) (A 665 nm)

Total chlorophyll ($mg.g^{-1}$ fresh weight) = (chl. a + chl. b) * 0.06

3- Number of fruit/tree was counted.

4- Fruit Length, Fruit Diameter: Fruits were randomly picked up, fruit length; fruit diameter was determined by electric vernier.

5- Total Carotene ($mg.cm^2$ solution): The stain was extracted by acetone (80%) from fresh peach fruit by (Goodwin, 1976).

RESULTS AND DISCUSSION

1- Shoots Dry Weight (%): The percentage of dry weight of shoot was increased by sprayed with 5 $mg.l^{-1}$ NAA and KNO_3 up to 0.2%. Significant increase in the percentage of shoot dry weight was noted in the trees received 5 $mg.l^{-1}$ NAA × 0.2% KNO_3 and 5 $mg.l^{-1}$ NAA × 60 $mg.l^{-1}$ Fe. Trees treated with 5 $mg.l^{-1}$ NAA × 0.2% KNO_3 × 60 $mg.l^{-1}$ Fe significantly increase in shoot dry weight than trees in the control (table 2).

2- Leaves total Chlorophyll Content ($mg.g^{-1}$ fresh weight): Significant differences in leaf total chlorophyll content were noticed due to NAA, KNO_3 and Fe application. Leaf total chlorophyll was increased significantly in the trees received 5 $mg.l^{-1}$ $mg.l^{-1}$ NAA up to 15.92$mg.g^{-1}$ fresh weight and in those receiving 0.2% KNO_3 or 60 $mg.l^{-1}$ Fe were 16.32 and 15.50$mg.g^{-1}$ fresh weight respectively. Whereas leaf total chlorophyll content was 12.40, 12.21, 12.85$mg.g^{-1}$ fresh weight respectively in those receiving 0 NAA, 0 %KNO_3 or 0 $mg.l^{-1}$ Fe. The interactions of NAA × KNO_3, NAA × Fe or KNO_3 × Fe, leaf total chlorophyll resulting from the trees receiving 5 $mg.l^{-1}$ NAA × 0.2% KNO_3, 5 $mg.l^{-1}$ NAA × 60 $mg.l^{-1}$ Fe or 0.2% KNO_3 × 60 $mg.l^{-1}$ Fe were 18.22, 17.12, 17.98$mg.g^{-1}$ fresh

Table (2): Shoot dry weight (%) of peach cv. Early Coronet as influenced by spray with NAA, KNO_3 and Fe.

NAA ($mg.l^{-1}$)	KNO_3 (%)	Fe($mg.l^{-1}$)			NAA × KNO_3	NAA Mean
		0	30	60		
0	0	42.87c	43.33c	49.06bc	45.08c	47.91b
	0.1	43.94c	44.74c	50.65bc	46.44c	
	0.2	56.98a-c	50.76bc	48.88bc	52.21bc	
5	0	53.25a-c	52.97a-	51.17bc	52.46bc	57.15a
	0.1	60.98ab	52.58a-	52.76a-	55.44b	
	0.2	61.86ab	61.01ab	67.76a	63.54a	
NAA× Fe	0	47.93cd	46.28d	49.53b-	KNO_3 Mean	
	5	58.70a	55.52a-	57.23ab		
KNO_3 × Fe	0	48.06b	48.15b	50.11ab	48.77b	
	0.1	52.46ab	48.66ab	51.71ab	50.94b	
	0.2	59.42a	55.89ab	58.32ab	57.88a	
Fe Mean		53.31a	50.90a	53.38a		

Means within a column, row and their interactions followed with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

weight respectively. Also results show that the highest total chlorophyll content in leaf (19.68$mg.g^{-1}$ fresh weight) was obtained from leaves of the trees receiving 5 $mg.l^{-1}$ NAA × 0.2% KNO_3 × 60 $mg.l^{-1}$ Fe (table 3).

3- Fruit Number/tree: Table (4) showed that increasing levels of NAA, KNO_3 and Fe significantly increased the fruit number/tree as compared to control. Thus, foliar spray with the higher concentration of NAA or KNO_3 or Fe increased the fruits number/tree significantly (221.15, 218.33 and 222.33), respectively.

Table (3): Total chlorophyll (mg.g^{-1} fresh weight) of peach cv. Early Coronet as influenced by spray with NAA, KNO_3 and Fe.

NAA (mg.l^{-1})	KNO_3 (%)	Fe(mg.l^{-1})			NAA× KNO_3	NAA Mean
		0	30	60		
0	0	9.42l	10.84k	11.65jk	10.64e	12.40b
	0.1	10.51kl	12.24ij	13.71-h	12.15d	
	0.2	13.19g-	13.79f-	16.28cd	14.42c	
5	0	12.47h-	13.84fg	15.04d-	13.78c	15.92a
	0.1	14.71ef	15.97c-	16.63c	15.77b	
	0.2	16.79c	18.20b	19.68a	18.22a	
NAA× Fe	0	11.04f	12.29e	13.88d	KNO_3 Mean	
	5	14.65c	16.00b	17.12a		
KNO_3 × Fe	0	10.94g	12.34f	13.35de	12.21c	
	0.1	12.61ef	14.11d	15.17bc	13.96b	
	0.2	14.99c	15.99b	17.98a	16.32a	
Fe Mean		12.85c	14.15b	15.50a		

Means within a column, row and their interactions followed with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

Table (4): Fruits number/tree of peach cv. Early Coronet as influenced by spray with NAA, KNO_3 and Fe.

NAA (mg.l^{-1})	KNO_3 (%)	Fe(mg.l^{-1})			NAA × KNO_3	NAA Mean
		0	30	60		
0	0	174.67f	190.00ef	210.67b-d	191.78d	203.37b
	0.1	196.67de	208.33b-d	215.00a-d	206.67c	
	0.2	200.00de	215.00a-d	220.00a-c	211.67bc	
5	0	205.00c-e	220.33a-c	225.00ab	216.78ab	221.15a
	0.1	210.00b-d	225.00ab	230.00a	221.67a	
	0.2	215.00a-d	226.67ab	233.33a	225.00a	
NAA× Fe	0	190.44e	204.44d	215.22bc	KNO_3 Mean	
	5	210.00cd	224.00ab	229.44a		
KNO_3 × Fe	0	189.83e	205.17cd	217.83ab	204.28b	
	0.1	203.33d	216.67a-c	222.50a	214.17a	
	0.2	207.50b-d	220.83a	226.67a	218.33a	
Fe Mean		200.22c	214.22b	222.33a		

Means within a column, row and their interactions followed with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

Interactions of 5 mg.l^{-1} NAA × 0.2% KNO_3, 5 mg.l^{-1} NAA×60 mg.l^{-1} Fe and 0.2% KNO_3×60 mg.l^{-1} Fe showed a significant increase in fruit number per tree as compared to the control. Interaction of NAA×KNO_3×Fe indicated that the highest fruit number per tree (233.33) was recorded on trees treated with 5 mg.l^{-1} NAA×0.2% KNO_3×60 mg.l^{-1} Fe whereas the lowest fruit number per tree (174.67) was recorded on the untreated trees(table 4).

4- Fruit Length (mm): The highest significant fruit length was obtained from trees sprayed with 5 mg.l^{-1} NAA, 0.2% KNO_3 and 60 mg.l^{-1} Fe (58.80, 58.43, 58.84 mm), respectively.

The highest length of fruit was obtained when trees were sprayed with 5 mg.l^{-1} NAA×0.2% KNO_3 (60.09mm) and 5 mg.l^{-1} NAA×60 mg.l^{-1} Fe (60.79mm) and 0.2% KNO_3×60 mg.l^{-1} Fe (60.70mm). Also the highest significant fruit length (63.04mm) was obtained from the treatment of 5 mg.l^{-1} NAA×0.2% KNO_3×60 mg.l^{-1} Fe, while the lowest value for fruit length (52.93mm) was noticed in fruit from the untreated trees (table 5).

5- Fruit Diameter (mm): Diameter of fruit increased significantly and gradually by foliar spray with 5 mg.l^{-1} NAA, 0.2% KNO_3 and60 mg.l^{-1}Fe, which showed the highest significant diameter (59.68, 59.33 58.93mm) respectively.

The interactions between 5 mg.l^{-1} NAA×0.2% KNO_3, 5 mg.l^{-1} NAA×60 mg.l^{-1} Fe and 0.2% KNO_3×60 mg.l^{-1} Fe gave the highest significant values (61.99, 61.84

Table (5): Fruit length (mm) of peach cv. Early Coronet as influenced by spray with NAA, KNO_3 and Fe.

NAA (mg.l^{-1})	KNO_3 (%)	Fe(mg.l^{-1})			NAA × KNO_3	NAA Mean
		0	30	60		
0	0	52.93i	53.27hi	55.05f-i	53.75e	55.37b
	0.1	53.18hi	56.27d-	57.26c-g	55.57d	
	0.2	54.43g-i	57.53b-	58.37b-e	56.78cd	
5	0	55.80e-	58.15b-	59.04b-d	57.66bc	58.80a
	0.1	56.84d-	58.78b-	60.31b	58.64ab	
	0.2	57.18c-	60.03bc	63.04a	60.09a	
NAA× Fe	0	53.51d	55.69c	56.89c	KNO_3 Mean	
	5	56.61c	58.99b	60.79a		
KNO_3× Fe	0	54.36d	55.71cd	57.04bc	55.70c	
	0.1	55.01d	57.53bc	58.79b	57.11b	
	0.2	55.81cd	58.78b	60.70a	58.43a	
Fe Mean		55.06c	57.34b	58.84a		

Means within a column, row and their interactions followed with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

and61.44mm) respectively. Whereas the interactions between 5 mg.l^{-1} NAA×0.2% KNO_3 × 60 mg.l^{-1} Fe resulted in significantly highest fruit diameter (65.01

mm) than theand61.44mm) respectively. Whereas the interactions between 5 mg.l^{-1} NAA × 0.2% KNO_3 × 60 mg.l^{-1} Fe resulted in significantly highest fruit diameter (65.01 mm) than the interactions(table 6).

Table (6): Fruit diameter (mm) of peach cv. Early Coronet as influenced by spray with NAA, KNO_3 and Fe.

NAA (mg.l^{-1})	KNO_3 (%)	Fe(mg.l^{-1})			NAA × KNO_3	NAA Mean
		0	30	60		
0	0	49.70k	52.44i j	54.37g-i	52.17d	54.02b
	0.1	50.58jk	53.29h-j	55.81e-h	53.22d	
	0.2	55.07f-i	57.09d-g	57.87c-f	56.68c	
5	0	55.86e-	58.31c-e	59.81b-d	57.99bc	59.68a
	0.1	57.44d-	59.03cd	60.70bc	59.06b	
	0.2	58.66c-	62.32b	65.01a	61.99a	
NAA× Fe	0	51.78e	54.27d	56.01c	KNO_3 Mean	
	5	57.32c	59.89b	61.84a		
KNO_3× Fe	0	52.78f	55.38de	57.09cd	55.08b	
	0.1	54.01ef	56.16d	58.25bc	56.14b	
	0.2	56.86cd	59.70ab	61.44a	59.33a	
Fe Mean		54.55c	57.08b	58.93a		

Means within a column, row and their interactions followed with the same letters are not significantly different from each other according toDuncan's multiple range test at 5% level.

6- Fruit Carotene Content (mg.cm²): Data in table (7) show that carotene contents of fruit were significantly increased by foliar application of NAA, KNO_3 or Fe, whereas no significant differences were detected between 30 and 60ppm Fe.

There were significant increase in fruit carotene contents from the trees received foliar applications of 5 mg.l^{-1} NAA × 0.2% KNO_3, 5 mg.l^{-1} NAA × 60 mg.l^{-1} Fe or 0.2% KNO_3 × 60 mg.l^{-1} Fe. Carotene contents in fruits resulting from these treatments were 0.22, 0.20 and 0.22 mg.cm² respectively. The highest carotene content in fruits was (0.25 mg.cm²) which was recorded in fruits from the trees received 5 mg.l^{-1}NAA × 0.2% KNO_3 × 60 mg.l^{-1} Fe, and was significantly higher than the other interactions and control. Significant increase in shoot dry weight and leaf chlorophyll content, fruit number per tree, fruit length, fruit diameter and carotene content (table 2, 3, 4, 5, 6 and 7) by spray with NAA, KNO_3 and Fe. These results may be attributed to the role of NAA in increasing cell division and elongation and its role in enhancement of metabolite accumulation in leaves, also to increasing photosynthesis which leads to increase chlorophyll content in the leaves. Many studies showed that NAA plays an important physiological role in increasing the division and elongation of the cells. Moreover, it increases permeability of the cell wall which would allow greater amount of water and dissolve material to inter the cell and increases its size (Heyn, 1993). Agusti *et al.,* (2002) indicated that

treatment with synthetic auxins in peach and apricot increased fruit size and also increased the carbohydrate level in the fruit and as a result enlarge the fruit and reduce the extent of fruit drop, due to the retention and increased the size of fruit, and also the increase in fruit weight which might be due to hormone mediation, direct transport and accumulation of photosynthesis in the enhance strength of the sink for carbohydrate. Gupta and Kaur (2007) displayed that foliar sprayed of plum trees with (10-20 $mg.l^{-1}$ NAA) increased fruit yield due to the more fruit fruit, which resulted in better development of the fruit.

Table (7): Fruit carotene content ($mg.cm^2$) of peach cv. Early Coronet as influenced by spray with NAA, KNO_3 and Fe.

NAA ($mg.l^{-1}$)	KNO_3 (%)	Fe($mg.l^{-1}$)			NAA × KNO_3	NAA Mean
		0	30	60		
0	0	0.13f	0.14ef	0.14ef	0.14d	0.15b
	0.1	0.15ef	0.15de	0.16de	0.15c	
	0.2	0.16de	0.18cd	0.18c	0.17b	
5	0	0.14ef	0.16c-e	0.15de	0.15c	0.18a
	0.1	0.15ef	0.18cd	0.18c	0.17b	
	0.2	0.18c	0.23b	0.25a	0.22a	
NAA× Fe	0	0.14c	0.16b	0.16b	KNO_3 Mean	
	5	0.16b	0.19a	0.20a		
KNO_3× Fe	0	0.13f	0.15c-e	0.15ef	0.14c	
	0.1	0.15de	0.16cd	0.17c	0.16b	
	0.2	0.17c	0.20b	0.22a	0.20a	
Fe Mean		0.15b	0.17a	0.18a		

Means within a column, row and their interactions followed with the same letters are not significantly different from each other according to Duncan's multiple range test at 5% level.

The reasons behind this may be due to the physiological role of potassium in stimulation of enzymes responsible for carbohydrate synthesis and energy production, so physiological and nutritional status of plant will improve. Hence, potassium was found to be a regulator in closing and opening of stomata (Ashley *et al.,,,* 2006). Robbins *et al.,,* (1998) recorded that potassium had an important role in increasing photosynthesis which increased the synthesis of nutrients as a result of photosynthesis process and using these nutrients in increasing cell division and growth and development of leaf, potassium also has an important role in activation of vegetative growth.

Which are gained with the foliar application of Fe, were attributed to the actions of iron on metabolism of plant cell. Al-Taai *et al.,,* (1994) found that iron was implicated as a Co-enzyme in the synthesis of the chlorophyll, iron was found to participate as a Co-enzyme in chlorophyll syntheses and as active components of cytochromes. Al- Aareji (2001) showed that the increase in chlorophyll content with the application of iron may increase the photosynthesis rate and efficient utilization of photosynthetic product in vegetative growth.

تاثير بعض المواد الكيميائية في بعض الصفات الخضرية والثمرية للخوخ (*Prunus persica* L.) cv. Early Coronet

سرفراز فتاح علي البامرني[1] محمد عباس سلمان[2] زليخة رمضان ابراهيم[1]
كلية ازراعة – جامعة دهوك[1] كلية الزراعة – جامعة بغداد[2]

الخلاصة

نفذت التجربة خلال موسم النمو ٢٠٠٨ على اشجار الخوخ صنف Early Coronet المزروعة في بستان في قرية سيجي – محافظة دهوك – اقليم كردستان – العراق. لدراسة تأثير NAA (Riedel- de Haen) بتركيز(صفر و ٥ ملغم.لتر$^{-1}$) و نترات البوتاسيوم KNO_3 (Merck) بتركيز(صفر، ٠,١% و ٠,٢%) والحديد باستخدام المادة المخلبية Technical Sodium Ferric (NaFeEDDHA) ethylenediamine dio-hydroxyphenyle acetate بتركيز(صفر، ٣٠ و٦٠ ملغم.لتر$^{-1}$) على صفات النمو الخضري والثمري. رشت الاشجار بـ NAA و KNO_3 و Fe مرتين بعد شهر من العقد في 24 نيسان ٢٠٠٨ و في 25 ايار ٢٠٠٨. اكدت النتائج ان تركيز NAA ٥جزء بالمليون و KNO_3 ٠,٢% و٦٠ Fe ملغم.لتر$^{-1}$ ادى الى زيادة معنوية في الوزن الجاف للافرع والكلوروفيل الكلي للأوراق وعدد الثمار / شجرة و طول وقطر الثمرة و الكاروتين في الثمرة مقارنة بالثمار غير المعاملة. و كانت احسن النتائج في معاملة التداخل بين ٥ ملغم.لتر$^{-1}$NAA و ٠,٢% KNO_3 و٦٠ ملغم.لتر$^{-1}$ Fe والتي ادت الى زيادة معنوية في الوزن الجاف للافرع والكلوروفيل الكلي للأوراق وعدد الثمار/شجرة وطول وقطر الثمرة والكاروتين الكلي للثمار.

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