FSA

Available online free at www.futurejournals.org

The Future Journal of Horticulture

Print ISSN: 2692-5826 Online ISSN: 2692-5834

Future Science Association

Future J. Hort., 3 (2021) **19-31** **OPEN ACCES**

DOI: 10.37229/fsa.fjh.2021.09.25

PREHARVEST APPLIED TREATMENTS ON ENHANCEMENT VEGETATIVE GROWTH AND FRUIT QUALITY OF TWO MANDARIN CULTIVARS

B- LEAF MINERAL CONTENT AND SOME CHEMICAL COMPONENTS OF MANDARIN AS AFFECTED BY SEVERAL PREHARVEST APPLIED TREATMENTS

Ahmed, R.E. Atawia[1]; Neven M.N. Nagy[2,*]; Said M. Attia[2] and Mohamed G. Elmasry[2]

[1]Faculty of Agriculture at Moshtohor, Benha University, Qalyubeia Governorate, **Egypt.**
[2]Hort. Dept. of (Pomology), Fac. Agric., Damanhour University, P.O.Box 22516, Damanhour, **Egypt.**

[*]**Corresponding author:** neven.nagy@agr.dmu.edu.eg **Received:** 24 Aug. 2021 **; Accepted:** 25 Sept. 2021

ABSTRACT: The target of growers is constantly enhancement leaf mineral content, shoot composition and fruit quality to achieve a high economic return. Thus, this investigation was conducted during 2018 and 2019 seasons on the two important cultivars of mandarin (genetically convergent), namely Santra and Satsuma. Trees were sprayed with water (control), CPPU at 30 & 60 ppm, yeast extract at 100 & 200 ppm, promalin at 75 & 100 ppm and CPPU 30 ppm + yeast extract at 100 ppm + promalin at 75 ppm. The data proved that shoot total carbohydrates to total nitrogen ratio, leaf chlorophyll, leaf mineral and pigment contents, in addition to fruit chemical quality in the two genetically convergent mandarin cultivars, namely Satsuma and Santra were enhanced by the combination of CPPU (30 ppm), yeast extract (100 ppm) plus promalin (75 ppm) and yeast extract at 200 ppm treatments.

Key words: Mandarin, cytokinins, yeast extract, promalin, leaf minerals, C/ N ratio, chemical fruit quality.

INTRODUCTION

Citrus are the most important fruits in Egypt due to the great economic importance compared to other fruits. It took the first rank in terms of cultivated area as well as the first export crop and a source of foreign currency. Furthermore, it is considered the first popular fruit in Egypt and has a high nutritional value.

Citrus growers always aim to improve chemical composition of tree to enhance fruit quality to achieve a high economic return.

Plant growth promoters play an important role in enhancement leaf mineral and pigment contents, in addition to some chemical components of fruits.

Improvement of fruit quality in response to GA_3 and CPPU application was reported by **Al-Obeed (2010)**, **Kassem *et al.* (2012)**, **Ghazzawy (2013)**, **Merwad *et al*. (2015)** and **El-Salhy *et al.* (2016)**. CPPU (as cytokinins) casused a significant increase in leaf orange seedlings content of N, P, K elements (**Janabi, 2014)**. **Abd-Alwahab and Al-Mashari (2017)** indicated that CPPU increased chlorophyll content of “Navel" orange. **Lijun *et al*. (2017)** proved that spraying CPPU effectively improved fruit vitamin C content of mango fruits compared to the control.

Moreover, yeast extract (as a foliar application) enhanced leaf chlorophylls as well as leaf mineral contents in "Washington navel " orange (El-**Shazly and Mustafa, 2015).** Furthermore, yeast extract improved fruit quality and leaf mineral content of "Valencia" orange trees (**El-Tanany and Mohamed, 2016)**. **Mustafa *et al.* (2019)** indicated that citrus lemon leaves treated with yeast had higher chlorophyll and minerals (P, K, and Mg) contents than the control. On the other hand, yeast extract had no effect on N and Ca contents**.**

El-Boray *et al.* (2015) proved that foliar applications of yeast extract increased fruit SSC and reduced acidity contents in fruit juice of in

"Washington navel" orange. **El-Shazly and Mustafa (2015)** reported that active dry yeast (as bio stimulant) markedly increased total soluble solids (TSS), total sugars and vitamin C content in "Washington navel " orange fruit juice. **El-Tanany and Mohamed (2016)** showed that spraying "Valencia" orange trees with active dry yeast extract significantly increased total soluble solids, acidity and V.C contents in fruit juice.

Promalin was able to increase chlorophylls and minerals content, TSS, TSS to acidity ratio and V.C in juice of "Jaffa" orange and decrease juice acidity **(Bakry, 2007).**

In recent years, the world focused his interest to reduce the environmental pollution by minimizing the use of synthetic fertilizers and chemicals in crops production. Thus, several researchers tend to use environmentally safe and costless organic substances to encourage the productivity and quality of plant **(Dawood *et al.*, 2013).**

Therefore, the target of this work is to study the influence of CPPU (as cytokinins), yeast extract and promalin and their combination (as natural bio-stimulants foliar application) at different times and concentrations on enhancement leaf mineral content, shoot composition and fruit quality of two genetically- convergent mandarin cultivars namely, Santra and Satsuma.

MATERIALS AND METHODS

The present study was performed during the two successive seasons of 2018 and 2019 at the citrus orchard at Moshtohor, Benha, Qalyubia Governorate on the two important cultivars of mandarin (genetically convergent), namely: Santra mandarin (*Citrus reticulata*, Blanco) and Satsuma mandarin (*Citrus unshiu* L.).

The trees were sixteen years old, budded on sour orange rootstock (*Citrus aurantium* L Osbeck), planted in clay loam soil, spaced 5 × 5 meters in mixed blocks of different citrus varieties. The trees have been receiving standard agricultural practices as well as free from physiological disorders and visible pathological diseases as possible. Twenty-four healthy and nearly uniform in vigor and size trees of each cultivar were randomly selected and exposed to the following treatments: - Water (control), CPPU at 30 & 60 ppm, yeast extract at 100 & 200 ppm, promalin at 75 & 100 ppm and CPPU 30 ppm + yeast extract at 100 ppm + promalin at 75 ppm. The non- ionic surfactant Top film at 0.05% was added to all treatments.

The trees were sprayed three times on the following dates:

1) At the beginning of flowering (28 February).
2) After setting (28 March).
3) Before June drop (28 June).

Each treatment was represented by three replicates and each replicate included one tree. The response of the two tested cultivars to yeast extract and growth regulator treatments was handled as follows:

Chemical characteristics

- Total soluble solids (TSS) content in fruit juice as Brix was measured using a Carlzeiss hand refractometer, titratable acidity content as g citric acid (the dominant acid in citrus) per 100 ml juice was determined according to **A.O.A.C. (2006)** and then TSS to acidity ratio was calculated.

- Vitamin C was also estimated by the titration of 2,6 - dichlorophenolindophenol dye in the presence of oxalic and glacial acetic acid and expressed as mg L- ascorbic acid per 100 ml juice (**A.O.A.C., 2006)**.

- Juice total sugars were extracted and the percentage was calculated according to the method of **Egan *et al*. (1987).**

- Leaf total chlorophyll (mg/ g. F. w.), shoot total carbohydrate (%) and shoot total nitrogen (%) were determined using the procedure of **A.O.A.C. (2006)**, consequently C/ N ratio of shoot was calculated.

- Leaf mineral content: The third leaf from the base of previously tagged non-fruiting spring flush shoots were picked for chemical analysis. The leaves were washed with tap water and then with water to remove the dust and any spray residues after washing they were dried in an electric oven at 70˚C for 48 hours. The dried material was ready for analysis: Wet washing of plant material was carried out using hydrogen peroxide and sulfuric acid as recommend by **Perkinson and Allen (1975).**

-Total nitrogen (%) was determined by semi-micro kjeldahl method as recommended by **Black *et al*. (1965)**.

-Phosphorus (%) was measured according to **Chapman and Pratt (1961)**.

- Potassium (%) was estimated as outlined in **Jackson (1970).**

- Fe, Mn and Zn were determined as ppm using Elmer atomic absorption spectrophotometer **(Egan *et al*., 1987).**

Statistical analysis

The data of this study was designed out as a factorial experiment consisted of two mandarin cultivars and eight treatments arranged in a complete randomized blocks design. All data obtained during both seasons of study were subjected to statistical analysis according to **Snedecor and Cochran, (1972)** using Costat program version 6.4 **(Costat 2008).** Means values representing the various investigated treatments were compared using the Duncan's multiple range test (**Duncan, 1955**) at 5% level of significance. Letters were used for distinguishing various values, representing means of differential investigated treatments, whereas values followed by the same letter/s were not significantly different.

RESULTS

Total soluble solids to acidity ratio in the juice

The effect of some preharvest applied treatments, mandarin cultivars and their interaction on total soluble solids to acidity ratio during 2018 and 2019 seasons is displayed in Table 1. Data showed that the highest ratio between total soluble solids (TSS) and acidity was recorded by spraying the combination of CPPU (30 ppm), yeast extract (100 ppm) and promalin (75 ppm), but the lowest ratio was found by spraying water (control). The treatment of CPPU at 30 ppm gave higher TSS to acidity ratio than the treatment of promalin at 100 ppm. This trend of results was consistent in the two seasons of study.

The effect of mandarin cultivars on TSS to acidity ratio was indicated in Table 1. It was evident that Santra mandarin cultivar had significantly higher TSS to acidity ratio as compared with Satsuma cultivar.

When the interaction between the used treatments and the mandarin cultivars was followed, there was many obvious trends such as the highest TSS to acidity ratio was in Santra mandarin cultivar sprayed with the combination of CPPU, yeast extract and promalin. The rating between the total soluble solids and acidity of "Satsuma" mandarin sprayed with yeast extract at 200 ppm was higher than the remaining treatments and identical to that of "Santra" mandarin sprayed with the same treatment and to that of "Satsuma" treated with the combination of CPPU, yeast extract and promalin. Control treatments achieved the lowest ratio of TSS to acidity and "Santra" mandarin sprayed with water had higher TSS to acidity ratio than "Satsuma" mandarin receiving the same treatment during both seasons.

Table 1. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on total soluble solids to acidity ratio during 2018 and 2019 seasons

Parameter	TSS/acidity (ratio)					
Treatments / Cultivars	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season (2018)			Second season (2019)		
T1- Control (Water)	8.07h***	9.81g	**8.94E***	8.01h	9.43g	**8.72F**
T2- CPPU at 30 ppm.	10.23fg	10.89e	**11.56C**	10.20f	10.78e	**10.49D**
T3- CPPU at 60 ppm.	10.10fg	9.98g	**10.04D**	10.11f	10.64e	**10.38D**
T4- Yeast extract at 100 ppm.	12.83d	13.24c	**13.03B**	12.19d	12.64c	**12.41C**
T5- Yeast extract at 200 ppm.	13.92b	13.67b	**13.80A**	13.88b	13.66b	**13.77B**
T6- Promalin at 75 ppm.	10.07fg	10.68e	**10.37C**	9.93fg	10.06f	**10.00E**
T7- Promalin at 100 ppm.	9.80g	10.13fg	**9.96D**	9.75fg	10.06f	**9.90E**
T8- The combination of T2+T4+T6 treatments.	13.67b	14.31a	**13.99A**	13.92b	14.67a	**14.29A**
Mean	**11.09B****	**11.59A**	**-**	**11.00B**	**11.49A**	**-**

*, **, *** Values, within the column or the row or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.

Ascorbic acid content (V.C) in the juice

The effect of some preharvest applied treatments, mandarin cultivars and their interaction on ascorbic acid content (V.C) during 2018 and 2019 seasons is shown in Table 2. The data revealed that the combination of CPPU, yeast extract and promalin led to the highest content of vitamin C, while the lowest content was observed by the treatment of control. All used treatments resulted in increasing vitamin C content relative to the control. Meanwhile, spraying yeast extract either at 200 or 100 ppm caused higher content of vitamin C comparing with spraying promalin at 100 or 75 ppm and then CPPU at 60 or 30 ppm. The high concentrations of each applied component were more effective as compared with the low concentrations in increasing ascorbic acid content.

Furthermore, the results in Table 2 also showed that Satsuma mandarin cultivar had higher vitamin C content than "Santra" mandarin.

Concerning the response of vitamin C content to the interaction between the applied treatments and mandarin cultivars, the data in Table 2 indicated that spraying the combination of CPPU, yeast extract plus promalin succeeded in raising vitamin C either in Satsuma or Santra cultivars, without any significant difference between them. Yeast extract at 200 and 100 ppm caused high vitamin C content of "Satsuma" and "Santra" as compared with the remaining treatments. Vitamin C content of "Satsuma" mandarin sprayed with yeast extract at 200 ppm was similar to that of Santra cultivar. Moreover, promalin treatments were more effective in increasing vitamin C than CPPU treatments. Meanwhile, the content of vitamin C was markedly decreased by control treatments either in Satsuma or Santra cultivars. This trend was consistent in the two seasons of study.

Table 2. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on ascorbic acid content (V.C) during 2018 and 2019 seasons

Parameter	Ascorbic acid content (mg/ 100ml juice)					
Treatments \ Cultivars	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season (2018)			Second season (2019)		
T1- Control (Water)	42.35k***	42.10l	42.23H*	43.05m	42.40n	**42.73H**
T2- CPPU at 30 ppm.	45.30i	44.90j	45.10G	45.65k	45.33l	**45.49G**
T3- CPPU at 60 ppm.	46.70g	45.99h	46.35F	46.45i	46.10j	**46.28F**
T4- Yeast extract at 100 ppm.	51.30c	50.95d	51.13C	51.02c	50.55d	**50.79C**
T5- Yeast extract at 200 ppm.	54.20b	54.10b	54.15B	54.30b	54.20b	**54.25B**
T6- Promalin at 75 ppm.	48.20f	48.10f	48.15E	48.52g	47.97h	**48.25E**
T7- Promalin at 100 ppm.	49.10e	48.90e	49.00D	49.30e	48.88f	**49.09D**
T8- The combination of T2+T4+T6 treatments.	55.30a	55.15a	55.23A	55.41a	55.24a	**55.33A**
Mean	**49.06A****	**48.77B**	**-**	**49.21A**	**48.83B**	**-**

*, **, *** Values, within the column or the row or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels

.

Total sugars percentage in the juice

The effect of some preharvest applied treatments, mandarin cultivars and their interaction on percentage of total sugars in the juice during 2018 and 2019 seasons is presented in Table 3. The results reported that the greatest percentage of total sugars was achieved with yeast extract treatment at 200 ppm comparing with all applied treatments. In addition, the treatment of CPPU, yeast extract plus promalin as a combination followed by the treatment of yeast extract at 100 ppm increased the percentage of total sugars relative to promalin treatments. The high concentration of CPPU (60 ppm) was more effective in increasing the percentage of total sugars than the low concentration (30 ppm). Control treatment led to the lowest percentage of total sugars in both seasons.

The data in Table 3 also showed that there was no difference between Satsuma and Santra mandarin cultivars in the percentage of total sugars, in the first season. In the second season, Santra mandarin cultivar had higher percentage of total sugars than Satsuma cultivar.

Table 3 discussed the interaction effect between used treatments and mandarin cultivars. It was evident that the highest percentages of total sugars were recorded by yeast extract at 200 ppm in Satsuma and Santra mandarin cultivars in consistent manner during both seasons. Furthermore, the combination of CPPU, yeast extract plus promalin and yeast extract (100 ppm) treatment also caused increasing in total soluble solids percentages of Satsuma and Santra mandarin cultivars comparing the individual application of promalin. Moreover, both used concentrations of CPPU gave better total sugars contents than the control which recorded the lowest content of total sugars in the two seasons of study, but the high concentration of CPPU was more effective relative to the low one. In general, the effect of each used treatment on total sugars content in Satsuma was similar to that of Santra cultivar. For example, Satsuma and Santra mandarin cultivars spayed with the triple combination of CPPU, yeast extract plus promalin had significantly the same percentages of total sugars. On the other hand, CPPU at 30 ppm treatment gave different trend where "Santra" mandarin treated with this treatment had higher contents of total sugars relative to "Satsuma" mandarin sprayed with the same treatment in a consistent manner in both seasons.

Table 3. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on percentage of total sugars during 2018 and 2019 seasons

Parameter	Total sugars (%)					
Treatments \ Cultivars	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season (2018)			Second season (2019)		
T1- Control (Water)	7.51h***	7.37h	**7.44H***	7.60k	7.91j	**7.76H**
T2- CPPU at 30 ppm.	8.30g	8.55f	**8.43G**	8.40i	8.74h	**8.57G**
T3- CPPU at 60 ppm.	8.70f	8.68f	**8.69F**	9.11g	9.07g	**9.09F**
T4- Yeast extract at 100 ppm.	10.11c	10.21c	**10.16C**	10.37d	10.41d	**10.39C**
T5- Yeast extract at 200 ppm.	10.70a	10.68a	**10.69A**	10.90a	10.88ab	**10.89A**
T6- Promalin at 75 ppm.	9.20e	9.15e	**9.18E**	9.33f	9.42f	**9.38E**
T7- Promalin at 100 ppm.	9.50d	9.64d	**9.57D**	9.61e	9.73e	**9.67D**
T8- The combination of T2+T4+T6 treatments.	10.40b	10.27bc	**10.34B**	10.74bc	10.69c	**10.72B**
Mean	**9.30^{NS}**	**9.32**	**-**	**9.51B****	**9.61A**	**-**

*, **, *** Values, within the column or the row or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.
NS: Non significant.

leaf total chlorophyll

The effect of some preharvest applied treatments, mandarin cultivars and their interaction on leaf total chlorophyll during 2018 and 2019 seasons is reported in Table 4. The data showed that there were significant differences in total leaf chlorophyll among all treatments. Meanwhile, the greatest content of total chlorophyll was achieved by the treatment of yeast extract at 200 ppm followed by the treatments of CPPU, yeast extract plus promalin in a combination relative to other used treatments. Promalin treatments were better than CPPU treatments in increasing total chlorophyll content. On the contrary, the lowest total chlorophyll content was recorded by the control.

Results in Table 4 also showed that Santra mandarin cultivar had higher total chlorophyll content comparing with "Satsuma" mandarin. This trend was consistent in both seasons of study.

As for the interaction effect between the used treatments and mandarin cultivars on total chlorophyll content, the data in Table 4 revealed that the biggest increase in total chlorophyll was recorded by "Santra" mandarin sprayed with 200 ppm yeast extract. Moreover, "Santra" mandarin treated with the combination of CPPU, yeast extract and promalin gave a high content of total chlorophyll as compared with the remaining treatments. Spraying water lead to the lowest content of total chlorophyll either in Satsuma or in Santra mandarin cultivars.

Shoot C/N ratio

The effect of some preharvest applied treatments, mandarin cultivars and their interaction on shoot C/N ratio during 2018 and 2019 seasons is presented in Table 5. From the obtained results, it could be noticed that yeast extract at 100 and 200 ppm treatments were more effective on increasing C/N ratio in shoot relative to other applied ones. Moreover, using promalin alone at 100 ppm or at 75 ppm mixed with CPPU at 30 ppm and yeast extract at 100 ppm resulted in higher shoot C/N ratio comparing with promalin treatment at 75 ppm and CPPU treatments at both used concentrations. On the contrary, shoot sprayed with water (control) had the lowest C/N ratio. This trend was consistent during both seasons.

From the presented data in Table 5, it could be observed that mandarin cultivars had no effect on shoot C/N ratio. In other words, Satsuma and Santra mandarin cultivars had significantly similar shoot C/N ratio in a consistent way.

Regarding the influence of various used treatments on shoot C/ N ratio in Satsuma and Santra mandarin cultivars during the two studied seasons (Table 5), the data revealed that the highest shoot C/N ratio was noticed in "Satsuma" and "Santra" mandarins sprayed with yeast extract at either 100 or 200 ppm, without any significant differences among them. Furthermore, "Satsuma" and "Santra" shoots sprayed either with promalin at 100 ppm or with the combination of CPPU, yeast extract and promalin at 75 ppm had higher C/N ratio relative to the remaining treatments. The effect of both treatments was significantly similar on shoot C/N ratio in Satsuma and Santra cultivars. Untreated shoots of Satsuma and Santra cultivars had significantly the least C/N ratio during both seasons of study.

Table 4. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on leaf total chlorophyll during 2018 and 2019 seasons

Parameter	Leaf total chlorophyll (mg/g.F.W)					
Treatments \ Cultivars	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season (2018)			Second season (2019)		
T1- Control (Water)	36.25n***	37.19m	36.72H*	37.51m	39.24l	**38.38G**
T2- CPPU at 30 ppm.	41.77l	43.17k	42.47G	42.59k	43.90j	**43.25F**
T3- CPPU at 60 ppm.	43.51k	43.20k	43.35F	45.14i	45.86h	**45.50E**
T4- Yeast extract at 100 ppm.	54.15e	55.29d	54.72C	56.74c	57.15c	**56.95B**
T5- Yeast extract at 200 ppm.	56.38c	60.90a	58.64A	58.34b	61.13a	**59.74A**
T6- Promalin at 75 ppm.	44.17j	46.57h	45.37E	46.74g	48.28f	**47.51D**
T7- Promalin at 100 ppm.	45.94i	48.71g	47.33D	47.82f	49.77e	**48.80C**
T8- The combination of T2+T4+T6 treatments.	53.61f	57.82b	55.72B	55.62d	58.22b	**56.92B**
Mean	**46.97B****	**49.11A**	**-**	**48.81B**	**50.44A**	**-**

*, **, *** Values, within the column or the row or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.

Table 5. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on shoot C/N ratio during 2018 and 2019 seasons

Parameter	Shoot C/N ratio					
Treatments \ Cultivars	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season (2018)			Second season (2019)		
T1- Control (Water)	7.81f**	7.99f	**7.90E***	7.83e	7.81e	**7.82F**
T2- CPPU at 30 ppm.	8.48e	8.49e	**8.49D**	8.44d	8.45d	**8.45E**
T3- CPPU at 60 ppm.	8.86de	8.99d	**8.93C**	8.89c	8.86c	**8.88D**
T4- Yeast extract at 100 ppm.	10.25ab	10.25ab	**10.25A**	10.54a	10.62a	**10.58A**
T5- Yeast extract at 200 ppm.	10.37a	10.29ab	**10.33A**	10.30a	10.27a	**10.28B**
T6- Promalin at 75 ppm.	9.10d	9.08d	**9.09C**	8.28d	8.27d	**8.28E**
T7- Promalin at 100 ppm.	9.57c	9.70c	**9.63B**	9.79b	9.71b	**9.75C**
T8- The combination of T2+T4+T6 treatments.	9.94a-c	9.83bc	**9.89B**	9.84b	9.76b	**9.80C**
Mean	**9.30^{NS}**	**9.32**	**-**	**9.23**	**9.21**	**-**

*, ** Values, within the column or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.
NS: Non significant.

Leaf nitrogen content

The effect of some preharvest applied treatments, mandarin cultivars and their interaction on leaf nitrogen content during 2018 and 2019 seasons is shown in Table 6. The results indicated that the highest leaf nitrogen content was found by spraying the combination of CPPU, yeast extract and promalin at used concentrations comparing with other treatments. Moreover, promalin treatments caused higher content of leaf nitrogen content than yeast extract and CPPU treatments. Both used concentrations of promalin were similar in their effects on leaf nitrogen content. In addition, CPPU treatments at 60 ppm had significantly the same effect on leaf nitrogen content to that of yeast extract treatment at 100 ppm. The treatments of CPPU at 30 ppm gave higher leaf nitrogen content than control treatment. Control treatment had the least leaf nitrogen content relative to other applied treatments in the two seasons of study.

The effect of mandarin cultivars on leaf nitrogen content, regardless the treatments, was indicated in Table 6. The results revealed that "Satsuma" leaves had higher nitrogen content than "Santra" leaves in both seasons.

With regard to leaf nitrogen content as influenced by the interaction between various applied and mandarin cultivars, the data in Table 6 showed that the highest leaf nitrogen content was achieved in "Satsuma" mandarin treated with the combination of CPPU, yeast extract and promalin comparing with other used treatments. Furthermore, "Satsuma" mandarin sprayed with promalin at either 75 or 100 ppm and" Santra" mandarin treated with the combination of CPPU, yeast extract and promalin had higher leaf nitrogen content than the remaining treatments. On the other side, the lowest nitrogen content was found in leaves of "Santra" mandarin sprayed with water and CPPU (30 ppm) treatments. Untreated "Satsuma" mandarin had similar content of leaf nitrogen to that "Santra" mandarin treated with CPPU at 30 ppm. The results were consistent during both seasons.

Table 6. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on leaf nitrogen content during 2018 and 2019 seasons

Parameter	Leaf nitrogen content (%)					
Treatments \ Cultivars	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season 2018			Second season 2019		
T1- Control (water)	2.15jk***	1.95k	**2.05F***	2.17g	1.96h	**2.07E**
T2- CPPU at 30 ppm.	2.44f-i	2.05kl	**2.25E**	2.51cd	2.08gh	**2.30D**
T3- CPPU at 60 ppm.	2.59d-f	2.27ij	**2.43D**	2.42d-f	2.31ef	**2.37CD**
T4- Yeast extract at 100 ppm.	2.63c-e	2.34hi	**2.49CD**	2.30f	2.36ef	**2.33CD**
T5- Yeast extract at 200 ppm.	2.71cd	2.41g-i	**2.56C**	2.45c-e	2.39d-f	**2.42C**
T6- Promalin at 75 ppm.	2.88b	2.49e-h	**2.69B**	2.81b	2.51cd	**2.66B**
T7- Promalin at 100 ppm.	2.91ab	2.55d-g	**2.73B**	2.93b	2.57c	**2.75B**
T8- The combination of T2+T4+T6 treatments.	3.05a	2.78bc	**2.92A**	3.07a	2.81b	**2.94A**
Mean	**2.67A****	**2.36B**	**-**	**2.58A**	**2.37B**	**-**

*, **, *** Values, within the column or the row or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.

Leaf phosphorus content

The response of leaf phosphorus content as affected by some preharvest treatments is presented in Table 7. The data provided evidences that the combination of CPPU, yeast extract and promalin caused a significant increase in leaf phosphorus content in both seasons relative to the remaining treatments. Both used concentrations of promalin recorded higher content of phosphorus than yeast extract treatments in the two seasons. Yeast extract treatments were more effective on increasing leaf phosphorus content than CPPU treatments. Control treatment resulted in the lowest leaf phosphorus content.

Regarding the influence of mandarin cultivars on leaf phosphorus content during the two studied seasons (Table 7), the data revealed that Satsuma and

Santra mandarin cultivars had similar content of leaf phosphorus in both seasons of study.

In terms of leaf phosphorus content as influenced by the interaction between applied treatments and mandarin cultivars, the results in Table 7 indicated that Satsuma and Santra mandarin cultivars sprayed with the combination of CPPU (30 ppm), yeast extract (100 ppm) and promalin (75 ppm) had the greatest content of phosphorus in their leaves relative to other used treatments. Moreover, there was another increase of leaf phosphorus content of "Satsuma" and "Santra" mandarin treated with promalin either at 75 or 100 ppm, in a consistent manner during the two seasons. "Satsuma" and "Santra" mandarins sprayed with water had significantly the least leaf phosphorus content.

Table 7. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on leaf phosphorus content during 2018 and 2019 seasons

Parameter	**Leaf phosphorus content (%)**					
Treatments / **Cultivars**	**Satsuma**	**Santra**	**Mean**	**Satsuma**	**Santra**	**Mean**
	First season 2018			**Second season 2019**		
T1- Control (Water)	0.290i**	0.270j	**0.280G***	0.280f	0.294f	**0.287G**
T2- CPPU at 30 ppm.	0.380h	0.370h	**0.375F**	0.391e	0.391e	**0.391F**
T3- CPPU at 60 ppm.	0.410g	0.400g	**0.405E**	0.421d	0.411de	**0.416E**
T4- Yeast extract at 100 ppm.	0.440f	0.452ef	**0.446D**	0.456c	0.457c	**0.457D**
T5- Yeast extract at 200 ppm.	0.460de	0.471cd	**0.466C**	0.472bc	0.477bc	**0.475C**
T6- Promalin at 75 ppm.	0.480bc	0.492b	**0.486B**	0.492b	0.497b	**0.495B**
T7- Promalin at 100 ppm.	0.475b-d	0.481bc	**0.478B**	0.481bc	0.475b	**0.483BC**
T8- The combination of T2+T4+T6 treatments.	0.532a	0.545a	**0.539A**	0.545a	0.561a	0.553A
Mean	**0.433 NS**	**0.435**	**-**	**0.442**	**0.447**	**-**

*,, ** Values, within the column or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.
Ns: Non significant.

Leaf potassium content

Potassium content of leaf as influenced by various used treatments was recorded in Table 8. The data showed that the greatest content of potassium in leaf was found by CPPU, yeast extract and promalin combination and yeast extract at 200 ppm in the first season. Promalin treatment at 100 ppm was more effective in increasing leaf potassium content than promalin one at 75 ppm. The content of leaf potassium content in promalin treatments at 100 ppm was similar to that in CPPU treatment at 60 ppm. A higher concentration of CPPU (60 ppm) was better than a low (30 ppm) in raising leaf potassium content. Control treatment caused a major reduction of leaf potassium content.

Data of leaf potassium content as affected by mandarin cultivars was reported in Table 8. The data showed that there was no effect on mandarin cultivars on leaf potassium content, where "Satsuma" mandarin leaves had significantly the same content of potassium to those of Santra mandarin cultivar.

With regard to the interaction effect between applied treatments and mandarin cultivars on leaf potassium content, the results recorded in Table 8 illustrated that spraying Satsuma and Santra mandarin cultivars with the combination of CPPU, yeast extract and promalin led to the highest content of potassium comparing with other treatments. Moreover, treating "Satsuma" and "Santra" mandarin with yeast extract 100 or 200 ppm was useful in increasing leaf potassium content relative to treating both cultivars with promalin treatments. In general, using high concentrations of CPPU, yeast extract and promalin was better in increasing leaf potassium content of "Satsuma" and "Santra" mandarin than low ones. The lowest content of potassium was found in "Satsuma" and "Santra" mandarin leaves treated with water (control).

Table 8. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on leaf potassium content during 2018 and 2019 seasons

Parameter	Leaf potassium content (%)					
Cultivars / Treatments	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season 2018			Second season 2019		
T1- Control (Water)	1.27g**	1.25g	**1.26F***	1.29k	1.31k	**1.30G**
T2- CPPU at 30 ppm.	1.61f	1.60f	**1.61E**	1.57j	1.59j	**1.58F**
T3- CPPU at 60 ppm.	1.81d	1.79d	**1.80C**	1.84gh	1.89fg	**1.87D**
T4- Yeast extract at 100 ppm.	1.92c	1.95bc	**1.94B**	1.95ef	1.97de	**1.96C**
T5- Yeast extract at 200 ppm.	2.01ab	2.00ab	**2.01A**	2.02cd	2.05bc	**2.04B**
T6- Promalin at 75 ppm.	1.67e	1.69e	**1.68D**	1.77i	1.79hi	**1.78E**
T7- Promalin at 100 ppm.	1.77d	1.79d	**1.78C**	1.85gh	1.87g	**1.86D**
T8- The combination of T2+T4+T6 treatments.	2.02a	2.06a	**2.04A**	2.09ab	2.13a	**2.11A**
Mean	**1.76^{NS}**	**1.77**	**-**	**1.80**	**1.83**	**-**

*, ** Values, within the column or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.
Ns: Non significant.

Leaf iron content

The response of leaf iron content as influenced by various used treatments was reported in Table 9. It was obvious that the highest leaf iron content was achieved by the combination treatment of CPPU, yeast extract and promalin, while the least content was found by the control. Meanwhile, promalin treatments were better in increasing leaf iron content than the remaining treatments in a consistent way. Yeast extract treatments were able to increase leaf iron content relative to CPPU treatments. In general, high concentrations of CPPU, yeast extract and promalin were better than low ones in raising leaf iron content. This trend was consistent in both seasons.

With regard to leaf iron content as affected by mandarin cultivar, the data was reported in Table 9 revealed that the effect of cultivars on leaf iron content was inconsistent during the two consecutive seasons. In the first seasons, "Satsuma" mandarin had higher leaf iron content than Santra cultivar. The opposite trend was found in the second season, where" Santra" mandarin gave a high leaf iron content as compared with "Satsuma" one.

Data of leaf iron content as influenced by the interaction between used treatments and mandarin cultivars was tabulated in Table 9. The results showed that treating Satsuma and Santra mandarin cultivars with the combination of CPPU, yeast extract and promalin gave higher leaf iron content than other treatments. On the contrary, the lowest contents of leaf iron were achieved by spraying Satsuma and Santra mandarin cultivars with water (control).

Leaf manganese content

Leaf manganese content was measured as affected by preharvest used treatments, regardless the mandarin cultivar factor and the results were recorded in Table 10. The obtained data indicated that using CPPU (30 ppm), yeast extract (100 ppm) and promalin (100 ppm) as a combination caused the greatest content of leaf manganese. In a similar manner, promalin treatments were better in increasing leaf manganese content than yeast extract treatments. Moreover, CPPU treatments either at 30 or 60 ppm were more effective in raising leaf manganese content relative to the control which recorded the lowest content of leaf manganese in a consistent way during the two successive seasons.

The influence of mandarin cultivar factor on leaf manganese content was shown in Table 10. From the obtained data, it could be noticed that Santra mandarin cultivar had higher leaf manganese content than "Satsuma" in a consistent way.

The interaction effect between applied treatments and mandarin cultivars on leaf manganese content was shown in Table 10. During the two studied seasons, "Satsuma" mandarin followed by Santra cultivar sprayed with the combination of CPPU, yeast extract and promalin had higher leaf manganese content relative to other treatments. On the other side, control treatment caused the lowest content of "Satsuma" and "Santra" leaves in both seasons of study.

Table 9. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on leaf iron content during 2018 and 2019 seasons.

Parameter	Leaf iron content (ppm)					
Treatments / Cultivars	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season 2018			Second season 2019		
T1- Control (Water)	110.3o***	112.4n	**111.3H***	113.3p	114.6o	**113.0H**
T2- CPPU at 30 ppm.	132.2l	129.8m	**131.0G**	137.5m	135.4n	**136.4G**
T3- CPPU at 60 ppm.	135.5k	137.3j	**136.4F**	141.2l	143.5k	**142.4F**
T4- Yeast extract at 100 ppm.	147.3h	143.2i	**145.2E**	153.2i	151.4j	**152.3E**
T5- Yeast extract at 200 ppm.	151.2g	150.9g	**151.0D**	157.6h	160.7g	**159.2D**
T6- Promalin at 75 ppm.	161.7f	163.7e	**162.7C**	168.8f	172.2e	**170.5C**
T7- Promalin at 100 ppm.	174.2c	172.4d	**173.3B**	177.2d	179.4c	**178.3B**
T8- The combination of T2+T4+T6 treatments.	181.2a	180.6b	**180.9A**	191.3b	193.1a	**192.2A**
Mean	**149.2A****	**148.8B**	**-**	**154.8B**	**156.3A**	**-**

*, **, *** Values, within the column or the row or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.

Table 10. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on leaf manganese content during 2018 and 2019 seasons

Parameter	Leaf manganese content (ppm)					
Treatments / Cultivars	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season 2018			Second season 2019		
T1- Control (Water)	16.20p***	16.90o	**16.55H***	17.12p	17.55o	**17.34H**
T2- CPPU at 30 ppm.	25.50n	26.10m	**25.80G**	24.55n	25.10m	**24.83G**
T3- CPPU at 60 ppm.	26.45l	27.20k	**26.83F**	26.54l	27.15k	**26.85F**
T4- Yeast extract at 100 ppm.	29.20j	30.05i	**29.63E**	29.75j	31.11i	**30.43E**
T5- Yeast extract at 200 ppm.	3121h	33.05i	**32.13D**	33.61h	34.10g	**33.86D**
T6- Promalin at 75 ppm.	34.75f	36.25d	**35.50C**	35.25f	39.64c	**37.45B**
T7- Promalin at 100 ppm.	35.66e	36.71c	**36.19B**	36.51e	37.95d	**37.23C**
T8- The combination of T2+T4+T6 treatments.	41.28a	40.10b	**40.69A**	42.19a	40.15b	**41.17A**
Mean	**30.30B**	**30.81A****	**-**	**30.69B**	**31.59A**	**-**

*, **, *** Values, within the column or the row or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.

Leaf zinc content

Concerning the effect of preharvest applied treatments on leaf zinc content, the data in Table 11 indicated that the greatest increase of leaf zinc content was recorded by the combination treatment of CPPU, yeast extract and promalin relative to other used treatments. Furthermore, promalin treatments were able to increase leaf zinc content than yeast extract treatments. Moreover, the individual application of CPPU either at 30 or 60 ppm resulted in higher leaf zinc content as compared with control treatments which caused the lowest concentration of leaf zinc content in a consistent manner during the two studied seasons. In general, using high concentrations of CPPU, yeast extract and promalin was better than low ones of each component.

Mandarin cultivars effect on leaf zinc content was indicated in Table 11. The results showed that Satsuma mandarin cultivar had higher leaf zinc content than Santra one in the two seasons.

Table 11 referred to the influence of the interaction between applied treatments and mandarin cultivar on leaf zinc content. The data illustrated that "Satsuma" mandarin treated with the individual application of promalin at 100 ppm had the highest leaf zinc content only in the first seasons, but "Satsuma" sprayed with the combination of CPPU, yeast extract and promalin had the greatest leaf zinc content only in the second seasons. The lowest leaf zinc content was achieved by treating "Satsuma" and "Santra" mandarin with water in a consistent way during the two seasons.

Table 11. Effect of some preharvest applied treatments, mandarin cultivars and their interaction on leaf zinc content during 2018 and 2019 seasons.

Parameter	Leaf zinc content (ppm)					
Treatments \ Cultivars	Satsuma	Santra	Mean	Satsuma	Santra	Mean
	First season 2018			Second season 2019		
T1- Control (Water)	21.18m***	17.25n	**19.22H***	22.10m	18.10n	**20.10H**
T2- CPPU at 30 ppm.	33.15j	31.10l	**32.13G**	34.50i	31.50l	**33.00G**
T3- CPPU at 60 ppm.	35.19h	32.25k	**33.72F**	36.70g	33.10k	**34.90F**
T4- Yeast extract at 100 ppm.	36.74g	33.15j	**34.95E**	37.41f	33.70j	**35.56E**
T5- Yeast extract at 200 ppm.	38.19e	34.95i	**36.57D**	38.95e	35.20h	**37.08D**
T6- Promalin at 75 ppm.	40.15d	37.10f	**38.63C**	40.88d	37.40f	**39.14C**
T7- Promalin at 100 ppm.	44.54a	40.20d	**42.37B**	45.37b	40.90d	**43.14B**
T8- The combination of T2+T4+T6 treatments.	41.19c	44.15b	**42.67A**	52.22a	44.75c	**48.49A**
Mean	**36.29A**	**33.77B****	**-**	**38.52A**	**34.33B**	**-**

*, **, *** Values, within the column or the row or the table, of similar letter are not significantly different according to Duncan's Multiple Rang at 0.05 levels.

Discussion

1- Effect of preharvest treatments on fruit quality

The data in Tables 1-3 showed that CPPU, promalin and yeast extract treatments enhanced fruit TSS to acidity ratio, vitamin C and total sugars as compared with control treatment. The positive effects of such treatments might be attributed to enhancing transport of assimilates from the leaves to the fruits (**Mostafa and El-Berry, 2020**).

To explain the role of different treatments on chemical properties of two mandarin cultivars, **Ali *et al.* (2019)** indicated that the dry yeast suspension at 10g.L-1 with amino acid 2ml.L-1 led to increase fruit total carbohydrate content in both seasons in olive fruits. Moreover, **Bakry (2007)** showed that promalin treatments (25 and 50 ppm) were able to increase TSS, TSS to acidity ratio and V.C in juice of "Jaffa" orange. On the other side, the obtained data revealed that these treatments decreased juice acidity.

The increase in fruit TSS, vitamin C, total sugars and the reduced acidity found in this study agree with the findings of others such as **Mataa *et al.* (1997)** on "Ponkan" fruits, **Atawia and El-Desouky (1997)** on "Washington navel" orange trees, **Abd El-Motty *et al.* (2010)** on Keitte" mango trees, **Kassem *et al*. (2012)** on palm fruit trees, **El-Shazly and Mustafa (2015)** on "Washington navel" orange trees and **Lijun *et al*. (2017)** on mango fruit trees.

2- Effect of preharvest treatments on leaf total chlorophyll, shoot carbohydrate to nitrogen ratio and leaf nutrient contents

The data in Tables 4- 11 illustrated that all preharvest treatments enhanced leaf chlorophyll, shoot carbohydrate to nitrogen ratio and leaf nutrient contents. The positive effects of CPPU, promalin and yeast extract treatments might be attributed to improvement synthesis of chlorophyll (**Hasan and Jumaa, 2013**), delaying chlorophyll breakdown (**Yuan *et al*. 2004**), great amounts of vitamin B1, B2, and B6 and cytokinins as a natural plant hormone (**Thanaa *et al*., 2015**) and availability of minerals and their forms in the composted material and increases levels of extractable N, P, K, Fe, Zn and Mn. Producing growth regulating like auxins, cytokinins, gibberellins or vitamin B which can be transferred to the host plant (**Soliman, 2001**; **Abd- Rabou, 2006; Fayed, 2010**). To explain the role of different treatments on chemical properties of two mandarin cultivars, **Janabi (2014)** found that a significant increase in leaf content of elements (N, P, K) when CPPU was sprayed on orange seedlings. Moreover, **Hasan *et al.* (2020)** showed that the highest content of nitrogen in shoot of orange tree (1.356) was achieved using CPPU at 30 ppm. Moreover, **Bakry (2007)** found that yeast extract either at 100 or 200 ml/L was able to increase chlorophylls and minerals (N. P, K, Ca, Fe, Mn, Zn) in "Jaffa" orange leaves. Furthermore, **Mustafa *et al.* (2019)** indicated that citrus lemon leaves treated with yeast at 3% had higher chlorophyll and minerals (P, K, and Mg) contents comparing to the control. **Bakry (2007)** proved that promalin either at 25 or 50 ppm resulted in increases of chlorophylls and minerals (N. P, K, Ca, Fe, Mn, Zn) content in "Jaffa" orange leaves. The results of the present study are in harmony with the findings of **El-Tanany and Mohamed (2016)** on "Valencia" orange trees and **Bakry (2007)** on "Jaffa" orange leaves.

Conclusion

In conclusion, this investigation recommended that the combination of CPPU (30 ppm), yeast extract (100 ppm) plus promalin (75 ppm) and yeast extract at 200 ppm treatments were the most effective treatments in enhancing shoot total carbohydrates to total nitrogen ratio, leaf chlorophyll, leaf mineral content and fruit chemical quality in the two genetically convergent mandarin cultivars, namely Satsuma and Santra.

REFERENCES

A.O.A.C. (2006). Official Method of Analysis of the Association of agricultural chemists, Twelfth edition, Washington D.C., U.S.A.

Abd El-Motty, E.; Shahin, M.M.; El-Shiekh, M. and Abd-El-Migeed, M. (2010). Effect of algae extract and yeast application on growth, nutritional status, yield and fruit quality of "Keitte" mango trees. Agric. Bio. J. N. Am., 1 (3): 421- 429.

Abd-Alwahab, N. E. and Al-Mashari, B. Y. G. (2017). Effect of humic acid and cytokinin CPPU sprays on some growth standards of navel orange and local lemon. Diyala Agricultural Sciences Journal, 9(1): 201-212.

Abd-Rabou, F.A. (2006). Effect of microbein, phosphorene and effective micro-organisms (EM) as biostimulants on growth of avocado and mango seedlings. Egypt. J. Appl. Sci., 21(6B): 673-693

Ali, A. H.; Aboohanah, M. A. and Abdulhussein, M. A. (2019). Impact of foliar application with dry yeast suspension and amino acid on vegetative growth, yield and quality characteristics of olive (*Olea europaea* L.) trees. Kufa J. Agric. Sci, 11: 33-42.

Al-Obeed, R.S. (2010). Improving fruit quality, marketability and storage ability of "Barhee" date palm. World Applied Sciences Journal, 9 (6): 630-637.

Atawia, A. A. R. and El-Desouky, S. A. (1997). Trials for improving fruit set, yield and fruit quality of Washington Navel Orange by application of some growth regulators and yeast extract as a natural source of phytohormones. Annals of Agricultural Science, Moshtohor, 35(3):1613-1632.

Bakry, Kh. A. (2007). Response of Jafa orange trees to spray with yeast extract and promalin. Egypt. J. Appl. Sci., 22 (10A): 195-210.

Black, C. A.; D. D. Evans; J. L. White; L. E. Ensmingher; F. E. Clarke and R. C. Dinauer (1965). Methods of soil analysis. Part 2-chemical and microbiological properties, 9 series agronomy. American Society of Agronomy. Inc, Madison, Wisconsin, USA.

Chapman, H. D. and Pratt, P. F. (1961). Methods of Analysis for Soil, Plant and Waters. Univ. of Calif. Division of Agric. Sc. 6th Ed. P: 56-64.

Costat (2008). Costat version 6.400, CoHort Software 798 Ligthouse Ave. PMB 320 Monterey, CA, 93940, USA.

Dawood, M. G.; S. R. El-Lethy and M. Sh. Sadak (2013). Role of methanol and yeast in improving growth, yield, nutritive value and antioxidants of soybean. World Applied Sciences journal, 26 (1): 6- 14.

Duncan, **D. B**. (**1955**): Multiple range and multiple "F" test. Biometrics, 11:1-42.

Egan, H.; Kird, R. S. and Sawyer, R. (1987). Pearson's Chemical Analysis of Foods. Eight Edition-Longman Scientific and Technical. Essex CM_{20}.2TE, England.

El-Boray, M. S.; Pratt, M. F. M.; Salem, S. E. and El-Sawwah, O. A. O. (2015). Improving yield and fruit quality of Washington navel orange using foliar applications of some natural biostimulants. Journal of Plant Production, 6(8): 1317-1332.

El-Salhy, A.M.; Mostafa, R. A. A.; Al-Badawi, A. A. and Abd-Allah, M. G. (2016). Response of "Seewy" date palm to GA_3 and CPPU spraying. Assiut J. Agric. Sci., (47) No. (5).

El-Shazly, S.M. and Mustafa, N.S. (2015). Enhancement yield, fruit quality and nutritional status of "Washington navel" orange trees by application of some bio stimulants. ActaHortic., 1065: 1303- 1309.

El-Tanany, M. M. and Mohamed, A. S. (2016). Effect of foliar application of cytokinin, active dry yeast and potassium on fruit size, yield, fruit quality and leaf mineral composition of "Valencia" orange trees. Egypt. J. Hort., 43(2): 389-414.

Fayed, T.A. (2010). Optimizing yield, fruit quality and nutrition status of "Roghiani" olives grown in Libya using some organic extracts. J. Hort. Sci. and Ornam Plants, 2(2): 63-78.

Ghazzawy, H.S. (2013). Effects of some applications with growth regulators to improve fruit physical chemical characteristics and storage ability of Barhee date palm cultivar. International Research Journal of Plant Science, 4 (7): 208-213.

Hasan, A. M.; Mohamed Ali, T. J. and Al-Taey, D. K. (2020). Effects of winter foliar fertilizing and plant growth promoters on element and carbohydrate contents on the shoot of navel orange sapling. International Journal of Fruit Science, 20(4): 682-691.

Hasan, A.M. and Jumaa, F.F. (2013). Effect of pruning and some growth promoters on vegetative growth of mandarin transplants, cv. Clementine. Euphrates J. Agric. Sci. 5 (4):244–255.

Jackson, M.L. (1970). Soil Chemical Analysis Prentice Hall. Englewood Gliffs, N.J.

Janabi, A.M.I. (2014). Effect of Origin Type and Treatment with Cytokinin CPPU and CO2 Enrichment on the Success Rate of Local Orange Grafts and Some Characteristics of its Vegetative Growth. Ph.D. Dissertation, University of Baghdad, College of Agriculture, Iraq.

Kassem, H.A.; Al-Obeed, R.S. and Ahmed, M. A. (2012). Effect of bioregulators preharvest application on date palm fruit productivity, ripening and quality. African J. Agric. Res., 7 (49): 6565-6572.

Lijun, G.; Hongyan, F.; Huidong, D.; Zhiwen, L.; Shu, H.; Hu Fuchu, H.; Xianghe, W.; Fan, H. and Min, H. (2017). Effect of forchlorfenuron (CPPU) and ethychlozate on fruit development and quality of mango cultivar Tainong. Plant Diseases and Pests, 8 (1): 39-42.

Mataa, M.; Tominaga, S. and Kozaki, I. (1997). Effects of exogenous growth regulator applications on source-leaf carbohydrate accumulation patterns in ponkan (*Citrus reticulata* Blanco). Journal of the Japanese Society for horticultural Science, 66(2), 245-251.

Merwad, M.A.; Eisa, R. A. and Mostafa, E. A. M. (2015). Effect of some growth regulators and antioxidants sprays on productivity and some fruit quality of "Zaghloul" date palm. International Journal of Chem. Tech. Research, 8 (4): 1430-1437.

Mostafa, Y. S. and El-Berry, I. M. (2020). Effect of NAA and CPPU on fruit drop, yield and quality of avocado trees. Egyptian Journal of Horticulture, 47(2): 137-147.

Mustafa, N. S.; Matter, I. A.; Abdalla, H. R.; El-Dahshouri, M. F.; Moustafa, Y. A. T. and Zaid, N. S. (2019). The promotive effects of some natural extracts (algal, yeast and vermiwash) on vegetative characteristics and nutrients status of citrus lemon (*Citrus aurantifolia*) seedlings. Net Journal of Agricultural Science, 7(2): 43-49.

Perkinson, J. And S. Allen (1975). A wet oxidation procedure suitable for the determination on nitrogen and mineral nutrients in biological material. Commun. Soil Sci. Plant Anal. 6, 1–11. https://doi.org/10.1080/00103627509366539.

Snedecor, G. W. and Cochran, G. W. (1990). Statistical Methods. 8th Ed, the Iowa State Univ., Press Amer., Iowa. U.S.A., pp. 503-507.

Soliman, M. G. A. (2001). Response of Banana and Guava Plants to some Biological and Mineral Fertilizers (Doctoral dissertation, M. Sc. Thesis, Fac. Agric., Alex. Univ., Egypt).

Thanaa, S.M.; Nabila, E. K. and AbouRayya, M. S. (2015). Effect of foliar application with dry yeast extract and benzyl adenine on growth and yield of "Manzanillo" olive trees. Res. J. pharmaceutical Biol. and Chem. Sci., 6 (2): 1573-1583.

Yuan, J.; Xiong, B.; Yu, D. and Zeng, M. (2004). Advances of the Application of CPPU to Fruit Trees. Northern Fruits. p. 02.