

Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www.jpp.journals.ekb.eg

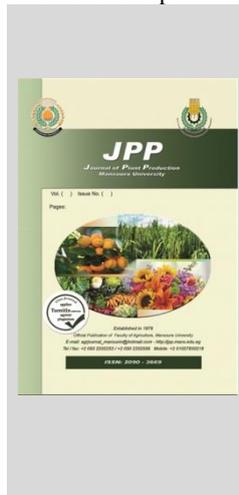
Effect of some Treatments on Vegetative Growth, Yield and Fruit Quality of Gold Nugget Mandarin Trees

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ABSTRACT

This investigation was conducted during two successive seasons (2019/2020; 2020/2021) on almost 12-year old identical Gold Nugget mandarin trees *Citrus reticulata* Blanco (Wilking mandarin x Kincy mandarin), grafted on Volkamer Lemon (*Citrus volkameriana*) (VOL) rootstock cultivated in a private orchard located in Al Qalyubia Governorate, Egypt. The trees were grown at a distance of 2 × 6 m in silt soil under the Immersion irrigation system. To study the effect of hand thinning, chemical thinning using NAA at 400ppm, Potassium nitrate (5gm/L), *Spirulina platensis* (algae extract) (2cm/L) and Potassium sulfate (1.25g/L) +Zinc sulfate (2.5g/L) +Salicylic acid (0.11g/L) on vegetative growth, fruit quality and yield of Gold Nugget mandarin trees. The experiment was designed as a randomized complete block design with five replications. Results illustrate that most of the experimental treatments significantly increased tree canopy volume both hand or chemical thinning was the highest value and Chemical thinning treatment significantly increased leaf area. Potassium nitrate foliar spray significantly increased shoot thickness, number of leaves/ shoot. *Spirulina platensis* treatment enhancing of the spring growth cycle, number of flowers, fruit-set, number of fruits/tree, tree yield efficiency as the number of fruit / M³ canopy and vitamin C. as for Potassium sulfate + zinc sulfate+ Salicylic acid treatment was superior with statistic differences for tree yield as kg/tree and kg/ M³, fruit physical properties (fruit weight, fruit size, Juice volume, Juice weight and fruit Pulp Weight).

Keywords: Gold Nugget, chemical thinning, *Spirulina platensis*, Potassium sulfate

INTRODUCTION

Citrus fruits are considered one of the most important types of fruits in Egypt because of their great economic importance compared to other types of fruits, as it is the first crop in terms of area cultivated and quantity of production, as it is the first export crop and a source of foreign currency, and the cultivated area reached 479656 acres. Citrus fruits occupy 432838 acres. It produced 432303 tons (according to the annual report of the Ministry of Agriculture and Land Reclamation 2018). Citrus fruits are the most famous fruit in the world and have a high nutritional value (rich content of Vitamin A, C, B1, B2 ... etc.) as well as organic acids (citric acid) and dyes (carotenoids, flavonoids, anthocyanins, thiamin, riboflavin, niacin), etc. In additives, fibers, sugars, essential and volatile oils. It also contains mineral elements like calcium, phosphorous, potassium, iron, and sodium. Cheap prices. With the length of the marketing period. In addition to its global reputation in foreign markets, the excellent qualities of fruits give it preference over other fruits. Gold Nugget *Citrus reticulata* Blanco (Wilking mandarin x Kincy mandarin) is a recently-released mandarin variety developed within the University of California Riverside citrus breeding program. The cross was made at Riverside in the 1950s (the exact date is not known). This hybrid was first selected in 1975 by D.K. Soost and J.W. Cameron and repropagated for additional evaluation. A virus-free bud wood source was established at Lindcove Research and Extension center, Exeter, California in 1986 the tree grows vigorously and is upright in form. It can grow

to a moderately-large size at maturity. Gold Nugget fruits are usually medium in size and oblate in the form of a somewhat bumpy orange rind. The aromatic rind is moderately easy to peel. The flesh is bright orange, finely-textured, and seedless (0-6 seed). The flavor is rich and sweet. The fruit usually matures by early March, but holds exceptionally well on the tree, with summer-harvested fruit still being of good quality. Citrus rootstocks are of vital importance in the quality and quantity of production and survival of citrus plants. As well as, Volkamer Lemon (*C. volkameriana*) is a Rangpur type. Fruit quality is slightly better and the rind is of better texture, but fruits commonly do not match the quality standards of those produced onto trifoliolate rootstocks or Sour Orange. Volkameriana seems to be the most vigorous rootstock of all, so requires much more pruning schedules than other stocks (Ibrahim, 2007). Fruit thinning is defined as the removal of certain flowers or clusters of flowers or individual fruitlets after fruit set and natural dropping have occurred. It improves fruit yield and quality and returns bloom for the following year. There are three types of thinning namely: hand, mechanical and chemical. Hand thinning is the manual removal of fruits and is done to reduce crop load and increase fruit size. It is considered the most practiced and least risky method of thinning, but very labor-intensive, higher-value varieties, (Ouma, 2012) chemical thinning is the most common type of thinning. Various chemicals are used for thinning. Naphthalene acetic acid (NAA) is registered as a chemical thinning The efficiency of NAA for fruit thinning depends on many

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DOI: 10.21608/jpp.2021.153073

factors as cultivar, time of application, concentration, as well as tree conditions (Wheaton,1981). It was concluded that the application of NAA at (250 to 500 ppm) during June drop, was the most reliable approach for thinning and increasing fruit size and improve quality in cultivars (Guardiola, and Garcia-Luis, 2000). Salicylic acid is involved in minimizing the stresses through enhancing the antioxidant system. It is responsible for enhancing natural hormones that play a key part in regulating plant growth and development (Ahmed et al., 2010). The enhancement effect of potassium nitrate may be attributed to the important role of potassium in nutrient and sugar translocation in plants and the turgor pressure of plant cells. Also, potassium active numerous enzyme systems involved in the formation of organic substances and the buildup of compounds such as starch or protein. Potassium is involved in cell enlargement and in triggering the young tissues or is due to that potassium is involved in plant meristematic growth and improves fruit quality by enhancing fruit size, juice contents, color, size and juice Flavor (G.S. Sekhon 1999 and Ashraf et al., 2010). Zinc (Zn) is one of the micronutrients required for normal plant growth. It's an important element essential of the plant due to its participation in the synthesis of tryptophan which is a precursor of IAA synthesis. It is well known that zinc acts as a cofactor of many enzymes and affects many biological processes such as photosynthesis reactions, nucleic acid metabolism, protein and carbohydrate biosynthesis (Marschner, 1996 and Swietlik, 1999). *Spirulina platensis* algae are photosynthetic blue-green microalga. It considers a basic bio-fertilizer and has been generally considered due to its commercial significance as a source of proteins, vitamin B-12, basic amino acids and antioxidants (Henrikson, 2010). It can progress plant development and crop yield due to their

release of different growth regulator substances such as gibberellin, auxin and cytokinins (Hashtroudi et al., 2013).

Besides, the main purpose of the present study was aimed to investigate the effect of some treatments on Gold Nugget mandarin behavior and improve productivity and quality under delta conditions.

MATERIALS AND METHODS

This study was conducted during two successive seasons (2019/2020 & 2020/2021) on almost 12-year old identical Gold Nugget trees *Citrus reticulata* Blanco (Wiling mandarin x Kincy mandarin), cultivated in a private orchard located in Al Qalyubia Governorate, Egypt. The trees were grown at a distance of 2 × 6 m in silt soil under the Immersion irrigation system. The main objective of this experiment was to improve the productivity and fruit quality of Gold Nugget trees when budded on Volkamer Lemon (*Citrus volkameriana*).

This experiment included the following treatments:

- 1- Control (tap water).
- 2- Hand thinning was carried out by removing about 25% of the fruits in the 1st week of July.
- 3- Chemical thinning by Naphthalene acetic acid (NAA) at 400 ppm at the 1st week of July.
- 4- Spraying Potassium nitrate (5gm/L) at mid of July, August and September.
- 5- Spraying *Spirulina platensis* algae 2cm/L at the 1st week of March, May and July. Table (1) (according to Koru et al., 2008).
- 6- Spraying Potassium sulfate (1.25gm/L) + zinc sulfate at (2.5gm/L) + Salicylic acid at (0.11gm/L) at the 1st week of March, May and July.

Table 1. Chemical analysis of *Spirulina platensis* algae (according to Koru et al., 2008). General Composition (per 100 g).

Vitamins	Values (mg.)	Parameters	Values (g.)	Minerals	Values	Colorants	Values
Provitamin A (V.B1)	213	Moisture	3.5	P	916 mg.	Phycocyanin	15.6 g.
(V. B2)	1.92	Protein	63.5	Fe	53.6mg.	Carotenoids	456mg
Vitamin B6	3.44	(Lipids)	9.5	Ca	168 mg.	Chlorophyll- a	1.30 g.
Vitamin B12	0.49	Fiber	3.00	K	1.83 g.		
Vitamin E	0.12	Ash	6.70	Na	1.09 g.		
Niacin	10.40	N- free	15	Mg	250 mg		
Folic acid	11.30						
Pantothenic acid	40						
Inositol	0.94						
	76						

Experimental design:

Thirty homogenous trees were selected during the previous season and before the harvest stage and the treatments were arranged in 5 replicates with one tree per replicate using complete randomized block design (RCBD). Experimental aspects under this study: the following parameters were undertaken:

Vegetative growth:

Ten spring shoots/tree were selected and tagged in April and after 6 months (at mid- September) the following parameters were measured:

- 1.Shoot: length & diameter (cm.).
- 2.The number of leaves/shoot.
- 3.Leaf area (cm²) Chou (1966)
- 4.The number of the growth cycle.
- 5.Dry matter (g.).
- 6.Canopy volume (M³): was measured twice / season: at the 1st week of March " x1" and at the end of September " x2".

The increase of tree growth percentage was calculated as follow:

Increasing of tree growth percentage = (X2 – X1) / X1 x100

Floral parameters:

At the first growth season (the 1st week of March) and before the blooming stage, 4 branches (about 1 inch in diameter) were selected and tagged around the tree canopy and at 2 M height from the soil surface. The following blooming aspects were recorded:

- 1.The number of flowers (x1).
- 2.The number of fruitlets. (x2).

Whereas, fruit – set percentage was calculated as =X2/ X1x 100

Tree yield efficiency:

(as Number or kg of fruits / M³ tree canopy).

Fruit Physical and Chemical Properties:

At the harvest stage representative sample of 10 fruits was picked from each replicate and translate to the

citrus lab in Hort. Res. Inst. for fruit Physical and Chemical determination as to the following:

1. Average fruit weight (g).
2. Average fruit size (ml)
3. Dimensions of the fruit (cm), then fruit shape index was calculated as :
Fruit shape index = Fruit height / Fruit width= 1 this mean (Round fruit)
Whereas, F. S. I > 1 this means (oval fruit), < 1 this mean (flat fruit)
4. Peel thickness(mm)
5. The number of seeds/fruit.
6. The number of lobes/fruit
7. Juice weight (g).
8. Juice volume (cm³).
9. Juice percentage was calculated as: = Juice weight (g) / Fruit weight (g) x 100 (W/ W)
10. Total soluble solids (TSS %)
11. Total acidity percentage (A.O.A.C.1995)
12. TSS/Acid ratio was calculated: TSS/Acid ratio =TSS / Total acidity x 100
13. Vitamin C content (as mg ascorbic acid /100 ml juice).

Statistical analysis:

The statistical analysis of the present data was carried out as indicated by **Snedecor and Cochran (1980)**. Significant differences among the means of various treatments were compared by the least significant difference

(LSD) at a 5% level of significance. Data were analyzed by MSTAT-C.

RESULTS AND DISCUSSION

Vegetative growth:

Concern the effect of the experimental treatments on Gold Nugget mandarin Vegetative growth performance (Shoot: length & thickness, number of leaves/shoot, Leaf area and tree Canopy). Data presented in Table (2 a) cleared that all treatments under this study had an insignificant effect on shoot length during the two seasons. While Potassium nitrate foliar spray significantly increased shoot thickness (2.63 & 2.67 mm.) and *Spirulina platensis* was the lowest (2.29 & 2.40 mm.) in both seasons. Concerning the number of leaves/shoots, data also showed that both *Spirulina platensis* or Potassium nitrate increased with significant differences with the other treatments in the first season. On contrary, all treatments showed an insignificant effect on the number of leaves/shoots in the second season. As for leaf area, data in Table (2a) revealed that Chemical thinning treatment significantly increased leaf area (15.2 & 15.3 cm²), and Potassium sulfate + zinc sulfate +Salicylic acid treatment was the lowest for both seasons.

Finally, most experimental treatments significantly increased tree canopy volume, whereas, both hand or chemical thinning was the highest value. On contrary, Potassium nitrate reduced this one during the two seasons.

Table 2 a. Effect of treatments on Gold Nugget mandarin trees vegetative growth performance during the two seasons (2019/020 &2020/021).

Aspects Treatment	Season I						
	Shoot length (cm)	Shoot thickness (mm)	Number of leaves/ Shoot	Leaf area (cm2.)	Tree canopy(M ³)		
Control	20.43 NS *	2.51 BC	15.5 AB	15.1 AB	7.21 B		
Hand thinning	20.35 NS	2.45 CD	15.0 B	14.6 B	7.65 A		
Chemical thinning	20.43 NS	2.55 AB	15.0 B	15.2 A	7.69 A		
Potassium nitrate	20.64 NS	2.63 A	15.7 A	14.6 B	7.11 B		
<i>Spirulina platensis</i>	20.89 NS	2.29 E	15.8 A	14.7 AB	7.33 AB		
Potassium sulfate +zinc sulfate +Salicylic acid	20.33 NS	2.39 D	15.0 B	12.3 C	7.47 AB		
Season II							
Control	20.33 NS	2.51 BC	15.5 NS	14.7 B	7.29 BC		
Hand thinning	19.85 NS	2.53 BC	15.2 NS	13.7 C	8.10 A		
Chemical thinning	20.36 NS	2.57 B	15.2 NS	15.3 A	7.73 AB		
Potassium nitrate	20.40 NS	2.67 A	15.7 NS	13.9 C	6.94 C		
<i>Spirulina platensis</i>	20.42 NS	2.40 D	15.7 NS	13.9 C	7.70 AB		
Potassium sulfate + zinc sulfate +Salicylic acid	19.81 NS	2.48 C	15.2 NS	11.2 D	7.20 C		

Values followed by the same letter (s) are not significantly different at the 5% level

* NS no significantly different

Regarding the effect of experimental treatments on Gold Nugget mandarin vegetative growth (spring and Summer growth cycles). Data presented in Table (2b) cleared that all treatments significantly increased Vegetative growth (spring growth cycle and summer growth cycle) for both seasons. For, spring growth cycle all treatments under study had significantly increased. As that, *Spirulina platensis* treatment gave the highest values (29.33 & 35.88). While, control treatment gave the lowest values (19.36 & 29.18) respectively, for both seasons. On the opposite summer growth cycle, Control treatment gave the highest values (7.89 & 4.89). While, *Spirulina platensis* treatment gave the lowest values (3.72& 3.83) respectively, for both seasons.

As for the number of flowers and fruit set percentage, data presented in Table (2 b) cleared that *Spirulina platensis* algae extract treatment significantly gave the highest number of flowers (835.2 & 652) and fruit-set (1.59 & 1.73) percentage respectively While, hand thinning

treatment gave the lowest number of flowers (687& 448) and fruit-set (1.16 & 1.15%) respectively, for both seasons.

It's well known that regulating fruit load for trees with hand or chemical fruit thinning or spraying foliar nutrients will be positively reflected on tree growth performance as flushing shoots: length, diameter, number of leaves/shoot and leaf area. Thus, the previous results are in agreement with those obtained by, Abd El-Moneim-Eman and Abd-Allah (2008); Faissal *et al.*,(2014); Abd-El-Rhman and Attia(2016) and EL -Sayed *et al.*,(2017) who mentioned that foliar application of alga extract, Potassium nitrate, combined applications of these extracts (Onion, Garlic, Green tea and Turmeric) at 0.1% + salicylic acid (SA) at 100 ppm significantly stimulated tree growth characters as shoot length, number of leaves/ shoot and leaf area rather than untreated trees. On the other hand, the number of leaves/shoot and leaf area were insignificant differences between treatments Hegazi *et al.*,(2011).

Table 2 b. Effect of treatments on Gold Nugget mandarin tree growth cycles and blooming performance during the two seasons (2019/020 &2020/021).

Aspects Treatments	Season I						
	spring cycle		Summer cycle		Number Flowers		Fruit-set (%)
Control	19.36	B	7.89	A	720.0	B	1.27 BC
Hand thinning	25.26	AB	6.22	ABC	687.0	C	1.16 C
Chemical thinning	25.78	AB	7.67	AB	727.8	B	1.30 ABC
Potassium nitrate	27.51	A	4.22	C	745.2	B	1.32 ABC
<i>Spirulina platensis</i>	29.33	A	3.72	C	835.2	A	1.59 A
Potassium sulfate + zinc sulfate+ Salicylic acid	25.63	AB	5.11	BC	752.2	B	1.51 AB
Season II							
Control	29.18	B	4.89	A	492.8	BC	1.17 ab
Hand thinning	31.78	AB	4.33	AB	448.0	C	1.15 b
Chemical thinning	34.93	A	4.55	AB	518.8	B	1.24 b
Potassium nitrate	35.41	A	4.22	AB	524.8	B	1.35 ab
<i>Spirulina platensis</i>	35.88	A	3.83	B	652.0	A	1.73 a
Potassium sulfate + zinc sulfate + Salicylic acid	33.22	AB	4.31	AB	537.2	B	1.35 ab

Values followed by the same letter (s) are not significantly different at 5% level

Tree yield and fruit quality:

Tree yield

Concern the effect of experimental treatments on the yield of Gold Nugget mandarin as the number of fruit or kg/tree, and tree yield efficiency. Data presented in Table (3)

indicated that *Spirulina platensis* treatment significantly gave the highest number of fruits (345 & 344) fruit/tree and tree yield efficiency (47.43 &46.93) as the number of fruit / M³ canopy, while hand thinning was the lowest for the two seasons.

Table 3. Effect of treatments on Gold during mandarin tree yield during the two seasons (2019/2020 & 2020/2021).

Aspects Treatments	Season I						
	Number Fruit / tree		Fruits weight. (kg/ tree)	Tree yield efficiency (Number/ M ³)	Tree yield efficiency (kg/M ³)		
Control	324.0	D	41.60	E	45.17	B	5.83 D
Hand thinning	307.2	F	46.00	D	40.33	C	6.07 D
Chemical thinning	309.2	E	51.20	C	40.30	C	6.70 C
Potassium nitrate	327.0	C	57.60	B	46.13	AB	8.10 B
<i>Spirulina platensis</i>	345.2	A	57.20	B	47.43	A	7.87 B
Potassium sulfate + zinc sulfate+ Salicylic acid	332.8	B	64.20	A	44.70	B	8.67 A
Season II							
Control	322.2	D	47.60	F	44.27	B	6.50 D
Hand thinning	306.0	F	48.60	E	38.30	C	6.07 E
Chemical thinning	309.0	E	51.20	D	40.20	C	6.73 D
Potassium nitrate	325.8	C	56.60	C	46.93	A	8.13 B
<i>Spirulina platensis</i>	344.8	A	57.20	B	45.03	AB	7.50 C
Potassium sulfate + zinc sulfate + Salicylic acid	331.8	B	63.20	A	46.20	AB	8.83 A

Values followed by the same letter (s) are not significantly different at 5% level

In addition, Potassium sulfate + zinc sulfate+ Salicylic acid treatment was superior with statistic differences for tree yield(64.20 & 63.20) as kg/tree and (8.67 & 8.83) kg/ M³ and the control was the lowest. These results are similar to previous studies Abd El-Monein-Eman and Abd-Allah (2008); Abd El-Moneim-Eman *et al.*, (2008); El- Khawaga (2011); Hegazi *et al.*,(2011) and Sarrwy *et al.*, (2012) El-Sharony *et al.*, (2015) they obtained that, using algae extract significantly improved the yield expressed as a weight (kg) and the number of clusters per vine compared to unsprayed ones. Whereas, application of the suitable N plus 40 to 80 ml humic acid and 5 to 25 ml *Spirulina platensis* Algae significantly improved the yield per tree comparing with N via inorganic. Moreover, the highest yield was observed in both seasons when trees were sprayed by 4 % after the final fruit set, while the control treatment gave the lowest average of yield and increased both the number of fruits and yield per tree compared with the control treatment.

Fruit Physical and Chemical Properties:

Fruit Physical Properties:

Concern the effect of experimental treatments on Gold Nugget mandarin fruit physical properties (fruit Weight, fruit size, and fruit shape index). Data presented in Table (4a) confirmed that all treatments significantly increased fruit physical properties (fruit weight & size) for

both seasons. As that, Potassium sulfate + zinc sulfate + Salicylic acid (as a mixture tank component) treatment gave the highest fruit weight (193.7 &190.6 g) and (193.9 &196.6 ml) respectively in both seasons. While the control treatment was the lowest values (128.4 &146.8 g) (160.4& 160.5 ml) respectively, On the other hand, the fruit shape index had an insignificant effect during the two seasons.

As for Peel thickness, all treatments under study had an insignificant effect in the first season. While Potassium sulfate + zinc sulfate + salicylic acid (as a mixture tank component) treatment gave the lowest value (2.39 mm) in the second season. Additionally, the number of lobes/fruit had insignificant differences during the two seasons. Concern the fruit Pulp Weight, data illustrated that all treatments significantly increased fruit pulp weight for both seasons. Whereas, Potassium sulfate + zinc sulfate + Salicylic acid (as a mixture tank component) treatment gave the highest values (121.9 and 120.4 g) respectively, While Control treatment was the lowest values (86.75 & 96.72 g) respectively, for both seasons. On the other side, data in Table (4 b) showed that Potassium sulfate + zinc sulfate + Salicylic acid (as a mixture tank component) treatment significantly reduced the number of seeds for each fruit (11.85 & 10.70), while the Control treatment was the highest (14.02 & 15.80) respectively, for both seasons.

Table 4a. Effect of treatments on Gold Nugget mandarin fruit physical properties during the two seasons (2019/2020 &2020/2021).

Season I						
Aspects Treatments	Fruit Weight (g)		Fruit size (cm ³)		Fruit shape Index	
Control	128.4	E	160.4	F	0.7	NS*
Hand thinning	150.6	D	171.4	E	0.7	NS
Chemical thinning	166.6	C	180.8	D	0.7	NS
Potassium nitrate	175.5	B	190.9	B	0.7	NS
<i>Spirulina platensis</i>	166.7	C	185.4	C	0.7	NS
Potassium sulfate +zinc sulfate +Salicylic acid	193.7	A	193.9	A	0.7	NS
Season II						
Control	146.8	E	160.5	E	0.7	NS
Hand thinning	158.6	D	174.0	D	0.7	NS
Chemical thinning	166.9	C	180.5	C	0.7	NS
Potassium nitrate	173.6	B	196.6	A	0.7	NS
<i>Spirulina platensis</i>	166.6	C	181.8	B	0.7	NS
Potassium sulfate + zinc sulfate +Salicylic acid	190.6	A	196.6	A	0.7	NS

Values followed by the same letter (s) are not significantly different at the 5% level * NS no significantly different

Table 4b. Effect of treatments on Gold Nugget mandarin fruit physical properties during the two seasons (2019/020 &2020/021).

Season I								
Aspects Treatments	Peel Thickness (mm)		Pulp Weight (g)	Number of seeds/fruit	Number of lobes/fruit			
Control	3.03	NS *	86.75	D	14.02	A	9.33	NS
Hand thinning	3.01	NS	108.5	C	13.68	A	10.00	NS
Chemical thinning	2.75	NS	108.6	C	12.50	BC	9.67	NS
Potassium nitrate	2.94	NS	121.8	A	12.70	BC	10.33	NS
<i>Spirulina platensis</i>	2.78	NS	116.9	B	11.85	C	10.00	NS
Potassium sulfate + zinc sulfate+ Salicylic acid	2.69	NS	121.9	A	13.38	AB	10.00	NS
Season II								
Control	3.18	A	96.72	F	15.80	A	9.67	NS
Hand thinning	3.01	B	100.6	E	14.77	B	10.33	NS
Chemical thinning	2.49	C	103.8	D	10.72	D	9.67	NS
Potassium nitrate	2.54	C	111.8	B	10.77	D	10.33	NS
<i>Spirulina platensis</i>	2.51	C	107.9	C	10.70	D	10.33	NS
Potassium sulfate + zinc sulfate + Salicylic acid	2.39	D	120.4	A	12.43	C	10.00	NS

Values followed by the same letter (s) are not significantly different at the 5% level * NS no significantly different

Concern the Gold Nugget mandarin fruit Juice: volume & weight), fruit Juice % (w:w), data presented in Table (4 c) cleared that all treatments significantly increased fruit Juice: volume & weight) for both seasons. So, Potassium sulfate + zinc sulfate + salicylic acid (as a mixture tank component) treatment gave the highest values Followed by *Spirulina platensis* in the first season and Potassium nitrate in the second season. While Control treatment was the lowest. As for fruit Juice percentage (w:w) data illustrated that both the control or fruit hand thinning treatments statistically gave the highest values (43.33 and 43.33%) percentage respectively, in the first season. While *Spirulina platensis* treatment gave the highest value (42.33%) percentage in the second season. Whereas, Potassium sulfate + zinc sulfate + salicylic acid (as a mixture tank component) treatment statistically gave the lowest values (37.67 &38.00%) percentage respectively, for both seasons.

Fruit Chemical Properties:

Regarding the effect of experimental treatments on Gold Nugget mandarin fruit chemical Properties (Vitamin C, TSS %, Acidity % and TSS /Acid). Data presented in Table (5) cleared that all treatments significantly increased Vitamin C content for both seasons. And, *Spirulina platensis* treatment gave the highest values (24.6 & 24.8 mg/100 ml Juice). While chemical thinning treatment was the lowest values (23.4 &23.5 mg/100 ml Juice) respectively for both seasons. On the other hand, all treatments under study had an insignificant effect on TSS and Acidity during the two seasons. Additionally, TSS/acid ratio had an insignificant effect in the first season. While hand thinning treatment gave the highest with significant difference value (14.32) is

compared to the other treatments which had an insignificant effect in the second season.

Table 4c. Effect of treatments on Gold Nugget mandarin fruit physical properties during the two seasons (2019/020 &2020/021).

Season I						
Aspects Treatments	Juice volume (ml)	Juice weight (g)	Fruit juice % (W: W)			
Control	50.43	E	55.92	E	43.33	A
Hand thinning	53.00	D	65.53	D	43.33	A
Chemical thinning	63.62	C	66.73	C	40.00	C
Potassium nitrate	66.75	B	71.77	B	41.00	B
<i>Spirulina platensis</i>	70.38	A	71.62	B	43.00	A
Potassium sulfate + zinc sulfate+ Salicylic acid	70.50	A	73.25	A	37.67	D
Season II						
Control	56.75	E	60.73	F	41.00	B
Hand thinning	61.68	D	61.72	E	39.00	C
Chemical thinning	63.65	C	62.75	D	37.67	D
Potassium nitrate	69.92	A	71.50	B	41.00	B
<i>Spirulina platensis</i>	65.53	B	70.47	C	42.33	A
Potassium sulfate + zinc sulfate + Salicylic acid	70.17	A	72.33	A	38.00	D

Values followed by the same letter (s) are not significantly different at 5% level

Practically, hand or chemical thinning will be necessary to find a balanced relationship between tree crop load and fruit quality. Also, Supplying trees with their nutritional requirements, reducing the eco-stresses and applied the best horticulture management as irrigation, pest control, pruning and weed control. It is one of the main factors that increase the quality of fruits. Generally, these results are in line with those obtained by Sharaf *et al.*, (2011); Abdur Rab *et al.*, (2012); Sarrwy *et al.*, (2012); Aly. *et al.*, (2015); Baiea *et al.*, (2015);

Abd-El-Rhman and Attia(2016); EL-Gioushy, (2016), Shaimaa and El-Tanany (2016); Faysel *et al.*, (2017) and Shireen *et al.*, (2018), who demonstrated that, the increase of fruit size due to thinning up to 25%.Also, sprayed potassium nitrate (KNO₃), mono-potassium phosphate (MKP) and potassium thiosulfate (KTS) at different concentrations supported with chelated zinc at 0.5% increased both the number of fruits and yield per tree. In additions, spraying Calcium chloride and zinc sulfate at 0.5, 1 and 1.5% and potassium sulfate at 1, 2 and 3% on Yield and Fruit Quality of Washington navel orange trees significantly increased average fruit weight,

the average number of fruits per tree, the weight of fruits per tree (kg) and yield weight/fed. (kg).Also, the highest rate of SA and KNO₃ caused an increasing (for both seasons) fruit set %, fruit weight (g) and fruit yield (kg/tree), Combination of 1000 mg KNL⁻¹ with 30g SAL⁻¹ gave an increase in fruit set%, fruit weight (g) and fruit yield (kg/tree),. Moreover, yield as fruit number or weight (kg) per tree was influenced with K treatment alone which differs significantly from all the other treatments or in association with SA which also differs statistically from the other ones as for fruits number, showed higher yield as fruits number or weight per tree in comparison with control.

Table 5. Effect of treatments on Gold Nugget mandarin fruit chemical properties during the two seasons (2019/020 &2020/021).

Season I							
Aspects	Vitamin C (mg/100 ml Juice)		TSS (%)		Acidity (%)		TSS/ Acidity
Treatments							
Control	23.8	AB	10.67	NS	0.81	NS	13.11 NS
Hand thinning	23.8	AB	11.00	NS	0.79	NS	13.92 NS
Chemical thinning	23.4	B	10.83	NS	0.80	NS	13.56 NS
Potassium nitrate	24.4	A	10.67	NS	0.80	NS	13.33 NS
<i>Spirulina platensis</i>	24.6	A	10.83	NS	0.79	NS	13.66 NS
Potassium sulfate + zinc sulfate+ Salicylic acid	23.8	AB	10.83	NS	0.79	NS	13.73 NS
Season II							
Control	23.6	AB	10.67	NS	0.81	NS	13.12 B
Hand thinning	24.2	AB	11.17	NS	0.78	NS	14.32 A
Chemical thinning	23.5	B	11.00	NS	0.80	NS	13.76 AB
Potassium nitrate	24.5	AB	10.67	NS	0.80	NS	13.39 B
<i>Spirulina platensis</i>	24.8	A	10.83	NS	0.80	NS	13.48 B
Potassium sulfate + zinc sulfate + Salicylic acid	23.6	AB	10.83	NS	0.80	NS	13.59 B

Values followed by the same letter (s) are not significantly different at 5% level

* NS no significantly different

Generally, thinning treatments alone or combined with urea spraying significantly reduced fruit number per tree and fruit yield (kg/tree) as compared with control for both heavily-loaded seasons. The highest reduction percentage was recorded for NAA at 400ppm preceded by urea spray in winter. While for (light crop season) thinning treatments increase fruit yield significantly as compared with control. foliar application of NAA was done on experimental plants after the June drop. NAA at 500 mg.l⁻¹ caused heavy fruit thinning by reducing the crop load up to 55% whereas, 200 mg.l⁻¹ NAA reduced the crop load up to 13%.

CONCLUSION

This investigation was conducted to study the effect of hand thinning, chemical thinning using NAA at 400 ppm, Potassium nitrate (5gm/L), *Spirulina platensis* (algae extract) (2cm/L) and Potassium sulfate (1.25g/L) +zinc sulfate (2.5g/L) +Salicylic acid (0.11g/L) on growth and productivity of gold nugget mandarin trees. Potassium nitrate treatment gives a significant improvement in vegetative growth. While *Spirulina platensis* treatment improved flowering, fruit set, the number of fruits, yield efficiency, and vitamin C. as for the treatment of Potassium sulfate + zinc sulfate + salicylic acid was superior in improving the physiological properties of fruits.

ACKNOWLEDGMENT

The authors would like to thank all members of the citrus department for their help and great support in conducting the study experiment.

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تأثير بعض المعاملات على النمو الخضري والمحصول وجودة الثمار لأشجار اليوسفي جولد ناجت

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تم إجراء هذه الدراسة خلال موسمين متتاليين (2020/2019 ؛ 2021/2020) على أشجار اليوسفي جولد ناجت متجانسة تقريباً يبلغ عمرها 12 عاماً، مطعمة على اصل الفولكامارينا زرع بمزرعة خاصة في محافظة القليوبية، مصر. تمت زراعة الأشجار على مسافة 2 × 6 م في تربة طمييه تحت نظام الري بالغمر. لدراسة تأثير الخف اليدوي والخف الكيميائي باستخدام NAA بمعدل 400 جزء في المليون ونترات البوتاسيوم (5 جم / لتر) والاسبيرولينا (2 سم / لتر) وكبريتات البوتاسيوم (1.25 جم / لتر) + كبريتات الزنك (2.5 جم / لتر) + حمض الساليسيليك (0.11 جم / لتر) على النمو الخضري وجودة الثمار ومحصول أشجار اليوسفي جولد ناجت. صممت التجربة بتصميم القطاعات الكاملة العشوائية بخمسة مكررات. أوضحت النتائج أن معظم المعاملات التجريبية أدت إلى زيادة كبيرة في حجم ظل الشجرة وكانت أعلى القيم قد سجلت سواء مع الخف اليدوي أو الخف الكيميائي، كما أدت معاملة الخف الكيميائي إلى زيادة كبيرة في مساحة الورقة. أدى الرش الورقي من نترات البوتاسيوم إلى زيادة معنوية في سمك الفرع وعدد الأوراق / الفرع. معاملة سبيرولينا أدت إلى تحسين لدورة النمو الربيعي، عدد الأزهار، نسبة العقد، عدد الثمار / شجرة، كفاءة إنتاجية الأشجار بعدد الثمار³ و فيتامين سي. أما معاملة كبريتات البوتاسيوم + كبريتات الزنك + حمض الساليسيليك كانت متفوقة إحصائياً في محصول الشجرة ككيلو جرام / شجرة و كجم / م³، الخواص الفيزيائية للثمار (وزن الثمرة، حجم الثمرة، حجم العصير، وزن العصير ووزن اللب).