



Productivity and Fruit Qualities of Zaghloul Date Palm in Response to Fruits Spray with Some Nutritive and Regulative Substances

Fatma, M. Fayek¹, M.M. Sharaf², Kh. A. Bakry², Gadalla, E.G.¹ and Amira, S.A. Abd El-Rahman²

¹ Central Laboratory for Date Palm Researches and Development, Agriculture, Research, Center, Giza, Egypt.

² Horticulture Department, Faculty of Agriculture, Benha University, Moshtohor, Toukh 13736, Egypt.

Corresponding author: fatmamokhtar068@gmail.com

Abstract

This study was conducted during two successive 2022 and 2023 seasons on twenty years old Zaghloul date palm trees grown in experimental the Central Laboratory for Date Palm Research and Development, Agriculture Research Center, Giza Governorate, Egypt. It was hoped to increase yield and improve fruit qualities of such desirable cultivar through investigating fruits spray 3 times yearly with (seaweed extract, glutathione and chitosan) either solely or together at their lowest concentration, besides water spray as control. So, impact was evaluated through determining the changes exhibited in various fruiting parameters during two seasons which could be summarized as follows:

- 1- It was quite evident that spraying Zaghloul fruits with various seaweed extract, glutathione and chitosan solutions affected significantly all evaluated fruiting measurements than control except fruit firmness were too slight to be significant.
- 2- Two trends of response were detected, herein 1st declared obviously that, most desirable fruiting parameters particularly yield, bunch weight, weight of (whole fruit & flesh), flesh %, (fruit volume & its dimensions), fruit TSS % and sugars (total, reducing & non-reducing) were significantly increased over control. Effectiveness of sprayed solution varied from one substance to another and also their concentration. Anyhow combinations of 3 substances were statistically the superior, descendingly followed by glutathione at 1000 and 500 ppm. Meanwhile, algae extract solution was the least effective while chitosan was in between.
- 3- trend took the other way around with fruit shape index, total acidity and nearly tannins or phenolic compounds.

Keywords: Zaghloul date, Seaweed, Glutathione, Chitosan, Yield, Fruit quality.

Introduction

Date palm "*Phoenix dactylifera* L." is a monocotyledonous and dioecious belonging to family "Palmaceae". It is one of the oldest fruit trees grown in the world and known as tree of life due to its resilience, limited need of water, long-term productivity and multiple purpose characteristics.

Date palm is a common fruit tree around Arabian countries, Middle East, North Africa and in hot arid area of the world (Chao and Krueger, 2007). The Arab Muslim World are the main production area, eleven countries in these regions carry out 94.0 % of the world production. Egypt ranked 1st followed successively by Iran and Saudi Arabia (Abdel-Kader, 2016).

Dates considered nutritious and high energy food (1180 KJ per 100 g) because they are rich in sugars providing quick energy intake, mineral, vitamins, phenol, flavonoids,

anthocyanins and carotenoids with functional properties (Al-Turki *et al.*, 2010).

All edible cultivars date palm pass through five distinct stages of development and ripening. These stages are: 1- Hababouk, 2- Kimri, 3- Bisir or Khalal, 4- Rutab and 5- Tamer. Whole dates are harvested and marketed at three stages i.e., Bisir or Khalal, Rutab and Tamer depending on cultivar characteristics climatological condition and market demand (Awad, 2007).

Zaghloul date palm is the most important soft cultivar its fruits are very high quality and very demanded in both local Egyptian markets and export (Khayyat *et al.*, 2007). It could be consumed at the Khalal stage due to the conversion of soluble tannins to insoluble form which reduces their astringency.

According to the Egyptian Ministry of Agriculture statistics 2022 year the total number of fruitful female palms reached 15710250 with total production 1847629 tons. However, number of fruitful Zaghloul palms reached 1342115 and

produced 166781 tons/year according to the latest statistics the **Ministry of Agriculture, Egypt (2022)**.

Using bio-fertilizers or their extracts nowadays for fruit crops has collect the attention of several research workers as an alternative to synthetic auxins and mineral N fertilization they are very safe human, animal and environment. In this respect various investigators pointed out the beneficial effect of using seaweeds, glutathione and chitosan as biofertilizers for increasing yield quantitatively and qualitatively in different fruit crops (**Soliman *et al.*, 2008 and Spinelli *et al.*, 2010**). The beneficial effects of seaweed extract are attributed to their own contents from natural hormones which promote growth and delaying leaf aging. They also contain glutathione and other amino acids, enzymes and coenzymes, vitamins B1 & B6. They also are very essential for synthesis of protoporphyrin, the precursor of plant pigments and photosynthesis through enhancing CO₂ release (**Shazly, 2015**) on Saedy palms and earlier investigators cleared the desirable effect of using seaweed extracts on yield and quality of date palm, (**Gobara, 2004**) on Zaghloul cv., (**El-Mahdy *et al.*, 2017**) on Sewy date palm under new reclaimed soil.

As for the glutathione its nature and vital role on promoting, growth, productivity and quality of different fruit crops. Glutathione is a tripeptide, cysteine, glutamic acid and glycine, it is essential in metabolism, defence against biotic & abiotic stresses and cell division (**Noktor and Foyer, 1998**).

Recently most studies gave good evidence for the importance of using glutathione for preventing cell damage caused by ROS "reactive oxygen species" and protecting tree from aging. In addition, reducing environment pollution, subjecting most fruit crops with glutathione had positive effects on yield and fruit quality, (**Ahmed *et al.*, 2013**).

Concerning using of chitosan, previous studies showed its effects in improving fruit quality of different fruit crops, maintained post-harvest quality and beneficially influenced firmness & TSS. Chitosan is a natural antimicrobial compound it can be obtained from crustacean shells (crabs, shrimp and crabs) either by chemical or microbiological processes, as well as it can be produced by some fungi (**Deviliehere *et al.*, 2004**).

Any attempt for enhancing and improving fruit qualities of such popular date palm cultivar will be reflected positively on growers and finally on the international income.

So, the present study was designed for evaluating the fruits spray of Zaghloul palms with seaweed extract, glutathione and chitosan.

Materials and Methods

This study was carried out on twenty years-old-Zaghloul date palm trees grown at the Central Laboratory for Date Palm Research and Development, Agriculture, Research, Center, Giza Governorate, Egypt. It was aimed to improve productivity and fruits quantitatively and qualitatively through spraying fruits with three nutritious and regulative substances namely: seaweeds extract, glutathione and chitosan. These substances were applied either solely each at 3 concentrations (0.1, 0.2 and 0.4 %); (250, 500 and 1000 ppm) and (100, 200 and 400 ppm) for 1st, 2nd and 3rd substances, respectively or combined together at their lowest concentration, besides water spray as control.

The complete randomized block design with three replications was used for arranging these eleven spray treatments, each replicate was represented by a single tree. So, 33 similar and healthy (diseases & insects free) fruitful Zaghloul palm trees were carefully selected and divided according to their vigour into three groups (blocks). Eleven additional trees were also included, so a reserve would be available.

All selected trees were pruned at eight leaves per bunch and received regularly the same horticultural practices adopted in the farm, particularly irrigation (surface/basin), pest control and N, P, K fertilization (ammonium sulphate, Mono calcium super phosphate, potassium sulphate at 3.0, 1.0, 0.5 kg/tree respect.). Moreover, ten bunches ± 1 were maintained/tree and pollination of choiced tree was uniformly performed regarding source, date and method of application to avoid Metaxinia effect.

The investigated eleven spray treatments were randomly distributed among 11 trees devoted for every block (group). Spraying fruits was applied three times during every season at 3 weeks intervals started from May 30th, successively on June 20th and July 11th. Taking into consideration that triton B at 0.05 % as surfactant agent was added to all spray solutions even control (water spray), whereas 3.5 liters solution were sufficient to spray single palm till run off.

Harvesting of mature fruits had been taken place through Bisir "Khalal" stage depending mainly upon the occurrence of the deep redish colour rate on fruit rind (using colour chart). Since, AC 128 (dark cherry tart) was prevailing among fruit skin of most investigated treatments except T5 and T9 i.e., spraying with lower concentration of both glutathione and chitosan, whereas AC 124 (red alert) and AC 129 (Bright Burgundy) were evident, respectively.

The response to investigated spray treatments was evaluated through determining changes exhibited in the following parameters:

III-1. Yield and average bunch weight:-

Total harvested fruits from every palm tree were separately weighed in kg, then yield/tree and average bunch weight were estimated.

III-2. Fruit quality:-

Fifty fruits were randomly sampled from each tree for this purpose then divided into two equal halves.

A. Fruit physical properties:-

Twenty five fruits were weighed in g and divided by 25 to determine the average fruit weight, then the average fruit volume (cm³) was determined using water displacement. Moreover, fruit dimensions (length & diameter) were determined using vernier caliper and fruit flesh firmness expressed as kg/cm² was determined using fruit penetrometer model GY-2 with 3.5 mm plunger diameter. Meanwhile, flesh of these 25 fruits was weighed, then average flesh weight and flesh % were calculated.

B- Fruit chemical properties:

Other halves of sampled fruits from each tree were used for determining chemical characteristics.

B-1. Fruit juice total soluble solids (TSS %): was determined using hand refractometer.

B-2. Total acidity (%): was determined as malic acid per 100 g flesh by titration against 0.10 N sodium hydroxide in the presence of phenol phthalene indicator after method described according to **A.O.A.C. (1995)**.

B-3. Sugar content:-

The water extract of the studied sample firstly was clarified by adding lead acetate to precipitate non sugars, and then excess lead acetate was precipitated by adding potassium oxalate and filtrated to remove non sugars. Reducing sugars and total sugars were estimated by Smogy method according to (**A.O.A.C., 2010**). Non reducing sugars calculated as;

Non-reducing sugars = Total sugars – Reducing sugar

B-4. Total tannins (%):

It was determined according to method described by **A.O.A.C., (2010)**.

B-5. Phenolic compounds (%):

Twenty five fruits were pitted, chopped and 50 g of flesh were put immediately into 150 ml. boiling 80 % ethyl alcohol for 15 min., then the ethanol mixture was blended for 10 min., and filtered. The produce was repeated 3 times using fresh 80 % alcohol solution each time and extracts were collected and filtered. The ethanol extract

was heated and alcohol was replaced with water and volume made up to 100 ml. Then total phenol was determined in the extracts according to **Swain and Hillis (1959)** method.

Statistical analysis

All data obtained during both 2022 and 2023 experimental seasons were subjected to analysis of variance according to **Snedecor and Cochran (1990)**. Moreover, differences among means were significantly distinguished by using letters according to **Duncan, (1955)**.

Results and Discussions

Table (1) displays obviously that all spray solutions of the three investigated substances (seaweed extract, glutathione and chitosan) increased significantly both fruiting parameters i.e., yield per tree and bunch weight of Zaghloul date palm cv. as compared to the analogous ones of control (water spray) during two 2022 and 2023 experimental seasons. However, effectiveness of such spray treatments was not equal. Herein, T11 i.e., spraying with the three substances (seaweed extract, glutathione and chitosan) combined together each at its lowest concentration was statistically the superior, descendingly followed by T7 and T6 spray treatments i.e., spraying with glutathione solution solely at 1000 and 500 ppm which ranked 2nd and 3rd from the statistical point of view, respectively. On the contrary, yield and average bunch weight of sprayed Zaghloul palm trees with any of three sea algae extract solutions particularly those subjected to two lower concentrations (0.1 and 0.2 %) solely were the least effective in spite of they were still effective and exceeded significantly control (water spray) for two fruiting measurements during both 2022 & 2023 experimental seasons.

In addition, spraying chitosan solutions alone regardless of concentration used came in between the aforesaid two extremes, however its highest concentration (400 ppm) tended significantly to be more effective than other members of such intermediate category.

The superiority of spraying with the three substances together may be attributed to the synergistic effect could be resulted as an interaction of their combination.

Moreover, present result regarding the beneficial are agreement with those mentioned by **Khayyat et al., (2007)**, **Abd El-Mawgood et al., (2010)**; **Spinelli et al., (2010)**; **Ahmed et al., (2013)**, **Ahmed et al., (2014)**; **Shazly (2015)**, **El-Mahdy et al., (2017)** and **Al-Wasfy et al., (2022)**.

Table 1. Yield and average bunch weight of Zaghloul date palm cv. in response to fruits spray with algae extract, glutathione and chitosan during 2022 & 2023 experimental seasons.

Fruits spray treatments	Yield (kg/tree)		Bunch weight (kg)	
	2022	2023	2022	2023
T1 water spray (control)	113.1 j	115.3 i	11.31 j	11.43 h
T2 algae extract at 0.1 %	133.8 i	144.1 h	13.36 i	14.41 g
T3 algae extract at 0.2 %	141.7 h	148.2 g	14.17 h	14.82 fg
T4 algae extract at 0.4 %	146.2 g	151.8 f	14.62 g	15.18 f
T5 Glutathione at 250 ppm	164.4 e.	176.1 d	16.44 e	17.61 d
T6 Glutathione at 500 ppm	179.3 c	184.4 c	17.93 c	18.44 c
T7 Glutathione at 1000 ppm	186.3 b	193.4 b	18.63 b	19.34 b
T8 Chitosan at 100 ppm	155.2 f	164.7 e	15.52 f	16.47 e
T9 Chitosan at 200 ppm	157.1 f	167.3 e	15.71 f	16.73 e
T10 Chitosan at 400 ppm	168.9 d	177.9 d	16.89 d	17.79 d
T11 algae extract + Glutathione + Chitosan at 0.1 % + 250 + 100 ppm	206.9 a	219.1 a	20.70 a	21.91 a

Means followed by the same letter/s within each column didn't significantly differ at 5 % level.

III.II. Fruit quality:

III.II. A. Fruit physical properties:

In this regard eight fruit physical characteristics dealing with fruit weight, flesh weight, flesh %, fruit firmness, fruit volume, fruit dimensions (length & width) and fruit shape index in response to spray with various solutions seaweeds extract, glutathione and chitosan were investigated. Data obtained during 2022 & 2023 seasons are presented in Tables (2) and (3).

It is quite evident that five of these investigated fruit physical characteristics indeed average weight of (whole fruit & fruit flesh), fruit volume, fruit dimensions (length & width) followed typically the same trend previously detected with both yield/tree and average bunch weight. Since, spraying fruits with the three seaweed extract, glutathione and chitosan substances combined together i.e., T11 surpassed significantly all investigated spray treatments as the increase over control (water spray) was concerned during both 2022 & 2023 experimental seasons. Meanwhile, in a descending order spraying Zaghloul fruits with glutathione solely either 1000 or 500 ppm ranked statistically 2nd and 3rd during two seasons. On the other hand, spraying with any sea algae extract solutions solely especially at two lower (0.1 & 0.2 %) were the least effective. However effectiveness of three chitosan spray solutions were in between the aforesaid two detected extremes during both 2022 & 2023 seasons.

Nevertheless, the response of fruit flesh % followed to great extent the same trend previously detected with the aforesaid discussed five fruit physical characteristics. Herein, all nutrients solutions significantly surpassed control (water spray) from one hand, while differences in effectiveness between most spray solutions were relatively slight and did not reach level of significance on the other during both experimental seasons.

As for the fruit shape index (fruit length : fruit width) the trend of response to various spray solution treatment took the other way around to that previously detected with above discussed six physical characteristics. Herein, the fruit shape index of control (water sprayed trees) showed statistically the highest value i.e., its fruits tended to be more an oblonged as compared to the analogous values of all investigated nutrients solutions during both experimental seasons. Such result could be logically explained by that fact of the unparalleled rates of response (increase) exhibited in both fruit dimensions by a given spray solution over control. Since, the rate of increase in fruit length over control was relatively lower than that in fruit width as the response of two fruit

dimensions to each treatment was separately concerned. Referring the effect of different spray solution treatments on fruit firmness, data displayed clearly that, differences between investigated treatments were in most cases to slight and didn't reach of significantly except in the first 2022 experimental season, where the tap water spray treatment (control) resulted significantly in the least fruit fresh firmness, However T6 showed generally the firmness fresh.

Table 2. Average weight of whole fruit, flesh, fruit flesh (%) and fruit firmness (kg/m²) of Zaghloul date palm cv. in response to fruits spray with algae extract, glutathione and chitosan during 2022 & 2023 experimental seasons.

Fruits spray treatments	Average fresh weight (g)				Fruit flesh (%)		Fruit firmness (kg/m ²)	
	Whole fruit		Flesh		2022	2023	2022	2023
	2022	2023	2022	2023				
T1 water spray (control)	18.82 h	19.03 i	16.80 g	17.00 h	89.30 e	89.87 e	1.353 e	1.403 b-d
T2 algae extract at 0.1 %	20.42 g	20.51 h	18.56 f	18.63 g	90.90 d	90.80 d	1.373 d	1.417 ab
T3 algae extract at 0.2 %	20.79 g	20.94 h	18.92 f	19.01 g	90.99 d	90.77 d	1.380 cd	1.393 d
T4 algae extract at 0.4 %	21.33 f	21.96 g	19.44 e	20.02 f	91.12 d	91.17 d	1.387 b-d	1.403 b-d
T5 Glutathione at 250 ppm	30.82 c	30.90 c	28.99 b	29.04 b	94.08 a	93.98 b	1.400 ab	1.417 ab
T6 Glutathione at 500 ppm	30.85 c	30.96 bc	28.99 b	29.06 b	93.96 a	93.87 b	1.407 a	1.423 a
T7 Glutathione at 1000 ppm	31.32 b	31.38 b	29.44 b	29.51 b	93.98 a	94.06 b	1.393 a-c	1.413 a-c
T8 Chitosan at 100 ppm	26.37 e	26.74 f	24.52 d	24.81 e	92.96 c	92.76 c	1.380 cd	1.400 b-d
T9 Chitosan at 200 ppm	27.45 d	27.57 e	25.58 c	25.61 d	93.19 bc	92.89 c	1.373 d	1.397 cd
T10 Chitosan at 400 ppm	27.79 d	28.11 d	25.95 c	27.19 c	93.38 b	96.77 a	1.387 b-d	1.403 b-d
T11 algae extract + Glutathione + Chitosan at 0.1 % + 250 + 100 ppm	32.22 a	32.26 a	30.39 a	30.40 a	94.30 a	94.24 b	1.393 a-c	1.410 a-d

Means followed by the same letter/s within each column didn't significantly differ at 5 % level.

Table 3. Average fruit volume and dimensions (length & width) of Zaghloul date palm cv. in response to fruits spray with algae extract, glutathione and chitosan during 2022 & 2023 experimental season.

Fruits spray treatments	Fruit volume (cm ³)		Fruit dimensions				Fruit shape index (F.L./F.W.)	
	2022	2023	Length (mm)		Width (mm)		2022	2023
			2022	2023	2022	2023		
T1 water spray (control)	14.17 i	14.29 h	44.40 g	45.20 h	15.50 f	16.30 e	2.86 a	2.77 a
T2 algae extract at 0.1 %	17.23 h	17.30 g	54.60 f	54.80 g	23.30 e	23.70 d	2.34 b	2.31 b
T3 algae extract at 0.2 %	17.59 g	17.71 f	54.80 f	55.50 fg	23.20 e	23.90 d	2.36 b	2.32 b
T4 algae extract at 0.4 %	18.49 f	18.62 e	55.00 f	56.00 fg	23.90 de	24.10 d	2.30 bc	2.32 b
T5 Glutathione at 250 ppm	26.91 c	27.64 b	59.20 d	60.00 d	29.30 b	30.40 b	2.02 d	1.97 d
T6 Glutathione at 500 ppm	27.53 b	27.63 b	61.60 c	62.30 c	29.50 b	30.60 b	2.09 cd	2.04 cd
T7 Glutathione at 1000 ppm	27.55 b	27.84 b	64.10 b	64.80 b	26.20 c	31.10 b	2.45 b	2.08 cd
T8 Chitosan at 100 ppm	24.23 e	24.47 d	56.40 ef	57.00 ef	24.20 de	24.50 d	2.33 b	2.33 b
T9 Chitosan at 200 ppm	24.39 e	24.57 d	57.40 de	58.00 e	24.50 c-e	24.90 d	2.34 b	2.33 b
T10 Chitosan at 400 ppm	25.28 d	25.44 c	57.90 de	58.80 de	25.30 cd	26.50 c	2.29 bc	2.22 bc
T11 algae extract + Glutathione + Chitosan at 0.1 % + 250 + 100 ppm	28.20 a	29.37 a	66.90 a	67.80 a	32.40 a	33.00 a	2.06 d	2.05 cd

Means followed by the same letter/s within each column didn't significantly differ at 5 % level.

III.II. B. Fruit chemical characteristics:

Percentages of fruit flesh total soluble solids, total sugars (reducing, non-reducing sugars), total acidity, total tannins and phenolic compounds were the seven investigated fruit chemical characteristics of Zaghloul date palm in response to various sea algae extract, glutathione and chitosan spray solutions. Data obtained during both 2022 and 2023 experimental seasons are presented in Tables (4) and (5).

It was so worthy to be noticed that two conflicted trends were detected. Anyhow, TSS %, total sugars %, reducing and non-reducing sugars content as shown from tabulated data in Table (4) displayed clearly that such four chemical constituents followed to great extent the same trend regarding their response to the eleven evaluated spray treatments. Herein, all nutritive and regulative solutions increased significantly such four chemical properties as each was compared to the corresponding one of water spray (control) during both seasons. On the other hand, T11 spray with combination of three nutritious substances was statistically the most effective, while spraying glutathione alone at either 1000 ppm (T7) or 500 ppm (T6) descendingly came 2nd and 3rd respectively from the statistical point of view. On the opposite three solutions of sea algae extract, especially two lower concentrations were the least effective. In additions, spray with chitosan solutions solely, irrespective of concentration used were in between the aforesaid extremes.

Pertaining the three other fruit chemical properties of Zaghloul date palm i.e., percentage of total acidity, total tannins and phenolic compounds, tabulated data in Table (5) declared

obviously that these parameters followed similarly a firm trend which completely conflicted with that previously detected with TSS and sugars %. Meanwhile, all spray solutions of seaweeds extract, glutathione and chitosan (solely or combined together) decreased significantly such three chemical measurements with comparison to those of control during two seasons. Hence, T11 (combinations of 3 nutritious substances) and spraying with glutathione at either 1000 ppm (T7) or 500 ppm (T6) resulted significantly in the greatest reduction in these three chemical constituents bellow control. Meanwhile, other spray treatments were in between the abovementioned two extremes.

The reduction in total acidity, total tannins and phenolic compounds in fruits of sprayed trees with any of nutritious solutions bellow control may be attributed to the dilution effect resulted by the excessive accumulation of dry matter especially TSS and sugars, fruit flesh of nutritive treated trees.

Conclusively, it could be safely advice Zaghloul date palm growers to spray fruits with (sea weed extract + glutathione and chitosan) combined together at 0.1, 250 ppm and 100 ppm; respectively or glutathione solely at 1000 ppm. Taking into consideration that the unexpected lower efficiency of sea algae extract may be due to the undesirable concentration used and or the source itself, as well as method of extraction, so further studies are needed in this respect.

Data obtained in this study regarding the effect of tested treatments on fruit chemical properties are generally supported by findings of **Swain and Hillis (1959)**; **Al-Turki *et al.*, (2010)**; **Alaa El-Din *et al.*, (2017)** and **Esraa (2017)**.

Table 4. Fruit juice total soluble (TSS %), fruit juice total, reducing and non-reducing sugars of Zaghloul date palm cv. in response to fruits spray with algae extract, glutathione and chitosan during 2022 & 2023 experimental seasons.

Fruits spray treatments	TSS (%)		Total sugars (%)		Reducing sugars (%)		Non-reducing sugars (%)	
	2022	2023	2022	2023	2022	2023	2022	2023
T1 water spray (control)	27.83 i	29.80 i	24.70 h	26.10 j	14.21 i	15.18 g	5.51 f	5.93 g
T2 algae extract at 0.1 %	34.74 h	34.84 h	30.41 g	31.38 i	16.66 h	17.22 f	13.75 e	14.06 e
T3 algae extract at 0.2 %	35.01 h	35.42 g	31.51 f	32.28 h	17.54 g	18.62 d	13.97 e	13.66 f
T4 algae extract at 0.4 %	35.98 g	36.15 f	31.63 f	33.19 g	17.61 fg	18.12 e	14.02 e	15.07 d
T5 Glutathione at 250 ppm	38.92 c	39.49 b	36.43 c	36.67 c	18.25 e	19.38 c	18.18 a	17.29 a
T6 Glutathione at 500 ppm	39.64 b	39.69 b	36.56 c	36.77 c	19.33 c	20.08 b	17.23 c	16.69 b
T7 Glutathione at 1000 ppm	39.79 ab	39.90 b	37.55 b	37.72 b	19.91 b	20.21 b	17.64 b	17.51 a
T8 Chitosan at 100 ppm	36.49 f	36.94 e	34.50 e	34.66 f	17.85 f	18.23 e	16.65 d	16.43 bc
T9 Chitosan at 200 ppm	37.45 e	37.85 d	35.46 d	35.59 e	18.55 d	19.37 c	16.91 cd	16.22 c
T10 Chitosan at 400 ppm	38.20 d	38.36 c	35.66 d	36.11 d	18.22 d	19.55 c	17.44 c	16.56 bc
T11 algae extract + Glutathione + Chitosan at 0.1 % + 250 + 100 ppm	40.03 a	40.80 a	38.06 a	38.24 a	20.23 a	20.69 a	17.83 ab	17.55 a

Means followed by the same letter/s within each column didn't significantly differ at 5 % level.

Table 5. Total acidity (%); total tannins and phenolic compounds of Zaghloul date palm cv. in response to fruits spray with algae extract, glutathione and chitosan during 2022 & 2023 experimental seasons.

Fruits spray treatments	Total acidity (%)		Total tannins (%)		Phenolic compounds (%)	
	2022	2023	2022	2023	2022	2023
T1 water spray (control)	0.383 a	0.366 a	0.502 a	0.499 a	0.447 a	0.444 a
T2 algae extract at 0.1 %	0.322 b	0.313 b	0.493 ab	0.484 ab	0.389 b	0.368 b
T3 algae extract at 0.2 %	0.317 b	0.306 b	0.484 a-c	0.477 b	0.375 bc	0.357 bc
T4 algae extract at 0.4 %	0.266 c	0.256 c	0.477 bc	0.468 bc	0.438 a	0.431 a
T5 Glutathione at 250 ppm	0.192 e	0.180 e	0.390 e	0.380 e	0.279 e	0.266 e
T6 Glutathione at 500 ppm	0.181 e	0.177 e	0.383 e	0.372 e	0.273 e	0.260 e
T7 Glutathione at 1000 ppm	0.178 e	0.168 e	0.380 e	0.371 e	0.272 e	0.258 e
T8 Chitosan at 100 ppm	0.250 cd	0.239 cd	0.471 cd	0.467 bc	0.357 cd	0.316 d
T9 Chitosan at 200 ppm	0.242 cd	0.235 cd	0.468 cd	0.457 cd	0.352 cd	0.346 c
T10 Chitosan at 400 ppm	0.231 d	0.222 d	0.454 d	0.444 d	0.342 d	0.338 c
T11 algae extract + Glutathione + Chitosan at 0.1 % + 250 + 100 ppm	0.182 e	0.169 e	0.340 f	0.338 f	0.232 f	0.226 f

Means followed by the same letter/s within each column didn't significantly differ at 5 % level.

Conclusion

Generally it could safely concluded that fruits spray of Zaghloul date palms with either the combination of (sea weed extract + glutathione + chitosan) each at 0.1 %, 250 and 100 ppm, respectively or glutathione solely at 1000 ppm three times started from late May and successively at 3 weeks interval are very efficiency for increasing yield and improving fruit qualities while certainly will be reflected positively on the Zaghloul date palm growers income.

A remarkable point must be taking into consideration is that dealing with the unexpected lower efficiency of sea weed/algae extract which may be attributed to the undesirable concentration used, time of application and/or the source of algae/sea weed extract itself. So further studies are needed.

References

- A.O.A.C. (1995).** Association of Official Agricultural Chemists, Official methods of analysis, 16th Ed., Washington, DC, USA.
- A.O.A.C. (2010).** Official Methods of Analysis of Association of Official Analytical Chemists, 18th Edition, Washington, DC, USA.
- Abdullah Alebidi, Khalid Almutairi, Mohamed Merwad, Essam Mostafa, Mohamed Saleh, Nagah Ashour, Rashid Al-Obeed and Ahmed Elsabagh (2021)** . Effect of Spraying Algae Extract and Potassium Nitrate on the Yield and Fruit Quality of Barhee Date palms. *Agronomy*11,922.
- Abd El-Kader, Noufersaoui (2016).** The date in all, its forms 2nd International Conference for Date Palm (ICDP2016) in Qassim, Kingdom of Saudi Arabia, from 10-12 October.
- Abd El-Mawgood, A.M.R.; Tantawy, A.S.; El-Nemr, M.A. and Sassine, Y.N. (2010).** Growth and yield responses of strawberry plants to chitosan application. *European J. of Sci. rese*, 39 (1): 170-177.
- Ahmed, F.F.; Gad El-Kareem, M.R. and Oroby-Mona, M.M. (2013).** Response of Zaghloul date palm to spraying boron, Silicon and Glutathione. *Stem Cell* 4 (2): 29-34.
- Ahmed, F.F.; Maawad A. Mohamed; Ahmed Y. Mohamed and Mostafa S. Abd Elaaty (2014).** Response of Sakkoti and Bartamuda Date palms to spraying seaweed extract. *World Rural Observ.*; 6 (3): 72-78.
- Alaa El-Din K. Omar, Mahmoud, A. Ahmed, Abdel M. Al-Saif (2017).** Influences of seaweed extract and potassium nitrate foliar application on yield and fruit quality of date palms (*Phoenix dactylifera* L.) cv. Sukary. *Advances in Agricultural Science*, Vol. 5 (3): 16-22.
- Ali H. Ali and Ahmed M.M. Ahmed (2023).** Improving of Yield and Fruit Quality of Ferehy Date Palms by Spraying Royal Jelly and Glutathione Under Siwa Oasis Conditions. *Future J. Agric.*, 3 : 1-8.
- Al-Turki, S.; Mohamed, A. Shahba and Cecil Stushnoff (2010).** Diversity of antioxidant properties and phenolic content of date palm (*Phoenix dactylifera* L.) fruits as affected by cultivar and location. *J. of Food, Agric. & Environ. Vol.*, 8 (1): 253-260.
- Al-Wasfy, M.M.; Gaddalla, E.G.; Hussien, H.M.S. and Samar, S.H. (2022).** Effect of chitosan spraying on growth and fruiting “Sakkoti” date palms grown under Aswan climatic conditions. *Egyptian International J. of Palms vol.*, 2 (2):43-52.
- Awad, M.A. (2007).** Increasing the rate of ripening of date palm fruit (*Phoenix dactylifera* L.) cv. Helali by pre-harvest and postharvest treatments. *J. Post. Bio. & Tech.* Vol. 43 (1): 121-127.
- Chao Chih Cheng, T. and Krueger Robert, R. (2007).** The Date palm (*Phoenix dactylifera* L.) overview of Biology, uses and cultivation. *J. Hort. Sci.*, Vol. 42 (5): 1077-1082.
- Devlieghere, F.; Vermeulen, A. and Debevere, J. (2004).** Chitosan antimicrobial activity, interactions with food components and applicability as a coating on fruit and vegetables. *Food Microbial.*, 21 : 703-714.
- Duncan, D.B. (1955).** Multiple ranges and multiple F. test. *Biometrics*, 11: 1- 42.
- El-Mahdy, T.K. F. Badran; Ibrahim R.A. and Ahmed, A.A. (2017).** Impact of spraying Algae extract, boron and Silicin nutrients on growth and fruiting of sewy date palm under new Reclamid soils. *Assiut J. Agric. Sci.*, (48); No. (5) 187-199.
- Esraa, M. E. Hussein (2017).** Response of Keitte mango trees to spraying Glutathione and Boric acid. *Fayoum J. Agric. Res. & Dev.*, Vol. 31, No. 2, July, 2017.
- Gobara, A.A. (2004).** Effect of Algae extract and yeast on fruiting of Zaghloul date palms. *J. of Agric. Sci. Mansoura Univ.*, 29 (9): 5209-5220.
- Khayyat, M.; Tafazoli, E.; Shghi, S.E. and Rajae, S. (2007).** Effect of nitrogen, boron, potassium and zinc sprays on yield and fruit quality of date palm. *J. Agric. & Environ. Sci.*, 2 (3): 289-296.
- Ministry of Agriculture, Egypt (2022).** Ministry of Agriculture and Land Reclamation Economic Affairs Sector, Bulletin of the Agricultural Statistics Part (2); 2021/2022.

- Mohamed Ahmed Badran (2016).** Effect of Spraying Seaweed Extracts and Silicon on Yield and Fruit Quality of Zaghloul Date Palms Grown under Sandy Soil Conditions. Assiut J. Agric. Sci., (47) No. (5) 2016 (165-174).
- Noktor, G. and C. H. Foyer (1998).** Ascorbate and glutathione, keeping active oxygen under control. Annal Rev. Plant. Physiol. And Plant, Mol. Biol., 49: 249-479.
- Shazly, E.M.E. (2015).** Relation of fruiting in Saedy date palm with spraying salicylic acid and seaweed extract. Ph.D. Thesis, Minia Univ.
- Snedecor, G. W. and Cochran, W. G. (1990).** Statistical Methods. Oxford and J.B.H. publishing com. 7th edition, 593 p.
- Soliman, A.R.L.; Hussein. M.H.; Dcssoui, S.S.A. and Torky, Y. (2008).** Production of Phytohormones by some blue green algae used as soil inoculant for rice fields in Egypt. J. Union Arab Biol, Cairo, vol. (88): 88-109, Physiology and Algae.
- Spinelli, F.; Fiori, G.; Noferini, M.; Sprocatti, M. and Cost, G. (2010).** Perspectives on the use of seaweed extract to moderate the negative effects of alternate bearing in apple trees. Journal of Hort. Sci. & Biot. (2009). P. 131-137.
- Swain, T.; and Hillis, W.E. (1959).** The phenolic constituents of prunus domestic 1- The quantitative analysis of phenolic constituents. J. Sci. Food Agric. 10: 63-68.

استجابة إنتاجية وجودة ثمار نخيل البلح الزغلول لرش الثمار ببعض مواد ذات خصائص غذائية وتنظيمية

فاطمة مختار فائق*؛ محمد محمد شرف**؛ خالد علي بكري**؛ عز الدين جاد الله العباسي*؛ أميرة سلطان عبد الحميد عبد الرحمن**

* المعمل المركزي لبحوث وتطوير نخيل البلح - مركز البحوث الزراعية - جيزة - مصر.

** قسم البساتين - كلية الزراعة - جامعة بنها.

أجريت هذه الدراسة خلال موسمين تجريبيين (2022 و 2023) على نخيل بلح الزغلول عمر 20 سنة نامية بمحطة تجارب مركز البحوث الزراعية بالجيزة، مصر بهدف زيادة إنتاجية وتحسين جودة ثمار هذا الصنف المفضل للمستهلك، برش ثماره بثلاثة مواد لها خصائصها المغذية وقدرتها التنظيمية هي: مستخلصات الأعشاب - الطحالب البحرية والجلوتاثيون والشيتوزان كل مادة بثلاث تركيزات (0.1، 0.2، 0.4 %)؛ (250، 500، 1000 جزء في المليون) و (100، 200، 400 جزء في المليون) للمواد الثلاثة على التوالي سواء تم رش كل مادة منفردة أو مختلطة معاً عند التركيز الأدنى لكل منها بالإضافة إلى الرش بالماء كمقارنة، وعليه فقد استخدم نظام القطاعات التامة العشوائية لتوزيع تلك الأحد عشر معاملة المختبرية في تجربة بسيطة وكررت كل معاملة 3 مرات ومثلت كل مكررة بنخلة واحدة. وفي كل موسم تم الرش ثلاثة مرات مرحلياً بعد كل ثلاثة أسابيع من الرش السابقة 30 مايو و20 يونيو و11 يوليو مع استخدام Triton B بتركيز 0.05 % كمادة ناشرة وقد قيم تأثير هذه المعاملات بتقدير التغيرات التي حدثت في مختلف القياسات الثمرية قيد الدراسة والتي يمكن تلخيصها في النقاط التالية:

- 1- ثبت جلياً أن الرش بأي من المواد الثلاثة أدى إلى تباين معنوي في كل الصفات المختبرية مقارنة بالكنترول ما عدا صلابة الثمار فكانت الفروق قليلة ولم تصل غالباً لمستوى المعنوية.
- 2- أظهرت النتائج اتجاهين متضادين للأستجابة تمثل الأول في زيادة معنوية بمعظم الصفات المرغوبة خاصة المحصول، وزن السوباطة، وزن الثمرة (كاملة واللحم) ونسبة اللحم، حجم الثمرة وأبعادها (طول وعرض) والنسبة المئوية للمواد الصلبة الكلية والسكريات (كلية، مختزلة وغير مختزلة) مقارنة بنظيرتها للكنترول. هذا وقد تفاوتت فعالية مواد الرش ليس من مادة إلى أخرى فقط بل أن التركيز المستعمل لعب دوره الخاص في هذا الصدد. وعلى كل كان الرش بخليط المواد الثلاثة عند التركيز الأقل لكل منها هو الأكثر فعالية يليه معنوياً وفي ترتيب تنازلي الجلوتاثيون منفرداً بتركيز 1000، 500 جزء في المليون. بينما الرش بمستخلص الطحالب البحرية كان الأقل فعالية أما الشيتوزان فكان وسطاً بينهما.
- 3- بعض الصفات كشكل الثمرة ومحتواها من الحموضة والمواد التانينية والفينولات أظهرت اتجاهها مضاداً للسابق ذكره مع باقي القياسات.

وعليه يمكن أن نوصي برش ثمار البلح الزغلول بخليط من أعشاب البحر (0.1 %) والجلوتاثيون (250 جزء في المليون) والشيتوزان (100 جزء في المليون) أو الجلوتاثيون منفرداً بتركيز 1000 جزء في المليون. كما أن إنخفاض فعالية مستخلص أعشاب وطحالب البحر الغير متوقع ربما يعزي إلى عدم ملائمة التركيز المستخدم أو طريقة وموعد المعاملة أو حتى المصدر المستخدم وطريقة الاستخلاص المتبعة وعليه يتطلب ذلك مزيد من الدراسة.