

## Effect of NAA, GA<sub>3</sub> and Cytophex Spraying on Samany and Zaghloul Date Palm Yield, Fruit Retained and Characteristics

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**Abstract:** This investigation was conducted during two successive seasons (2005 and 2006) at the Experimental Research Station, Fac. Agric. Giza, Egypt. Samany and Zaghloul fruiting date palms were conducted in this study. The study is aimed to improve fruit quality through spraying NAA at 0, 50, 100, 150 ppm, GA<sub>3</sub> at 0, 50, 100, 150 ppm and Cytophex (CPPU, 2-Chloro-4-ridyl phenyl urea) at 0, 25, 50, 75 ppm on strands after carples fall (4 weeks after pollination). Results indicated that spraying 150 ppm of GA<sub>3</sub> produced the lowest retained fruits and bunch weight of Samany and Zaghloul cultivars. Also, spraying 75 ppm of cytophex increased significantly fruit and flesh weight of Samany and Zaghloul fruits. Fruit length, fruit diameter and fruit size of Samany and Zaghloul date palm had increased by spraying cytophex at 75 ppm. Fruit chemical properties appeared that fruit moisture content was reduced by spraying GA<sub>3</sub> at 150 ppm or cytophex at 75 ppm in both cultivars during the two seasons. In addition, spraying 75 ppm of cytophex increased Samany and Zaghloul fruits content of TSS, Total soluble sugars and reducing sugars in the two seasons. From these results, spraying 75 ppm of cytophex is the best treatment to increase Samany and Zaghloul fruits quality under Giza conditions.

**Key words:** Cultivar • Cytophex • Date palm • Fruits • GA<sub>3</sub> quality samany • Spraying • Zaghloul

### INTRODUCTION

In Egypt, distribution of date palm (*Phoenix dactylifera* L.) trees, covers a large area extends from Aswan to north Delta, beside the oasis of Siwa, Bahriya, Farafra, Kharga and Dakhla. The recent plantation of date palm cultivars under desert or new reclaimed area are aiming to enhance their fruit quality through different treatments to raise the superiority of developed fruits for native markets and exportation. However, there is a positive relationship between different stages of date palm fruit growth and growth promoters content, as increase of growth promoters content in Kimeri stage, will be increased the fruit size [1]. Moreover, Al-Kalifah *et al.* [2] reported that abnormality fruits can be corrected by exogenous application of kinetin or other cytokinins which may indicate that the abnormality is due to physiological effects rather than being genetically. Ethephon treatments after 2 weeks of spathe cracking affected bunch weight, average yield and fruit quality of different date palm cultivars [2-10]. The cytokinins are plant growth regulators that enhance plant cell division and cell expansion. Also, spraying NAA and GA<sub>3</sub> affected

fruit retained percentage, bunch weight and fruit quality as well as fruit contents of TSS total sugars and reducing sugars of date palm cultivars [1, 2, 7-16].

The present investigation is planned to study the effect of spraying NAA, GA<sub>3</sub> and cytophex just after carples fall (4 weeks after pollination) on Samany and Zaghloul date palm fruits aiming to improve fruit physical and chemical characteristics.

### MATERIALS AND METHODS

The presents study was carried out during two successive seasons (2005 and 2006) at the Experimental Research Station, Faculty of Agriculture, Cairo University, Giza, Egypt. Five uniform female palms of each Samany and Zaghloul date palm cultivars, (20 years old) were selected; and leaf bunch ratio 8:1 was imposed [17]. All palms received normal agricultural practices. They were pollinated by the same source of pollen grains at 4 days after spathe cracking during the fourth week of March in both seasons. Twelve bunches were left on each female palm. The individual bunches were covered before and after treatments by tissue paper. Each palm was sprayed

with NAA (naphthalene acetic acid) at 0, 50, 100 and 150 ppm, GA<sub>3</sub> (gibberellins) at 0, 50, 100 and 150 ppm and cytophex (CPPU, 2-Chloro-4-pyridyl phenyl urea) at 0, 25, 50 and 75 ppm. Each of the individual concentration of the studied growth regulators was sprayed on one bunch of the five palms (five replicates). All treatments started just after carps fall (4 weeks after pollination done).

**Statistical Analysis:** The obtained data were subjected to analysis of variance. The mean values were compared using LSD method at 5 % level. The data were tabulated and statistically analyzed according to the randomized complete blocks design method [18]. The percentages were transformed to the arcsine to find the binomial percentages [19].

The fruits of this experiment were harvested at maturity stage (the second week of September) in the two seasons [20]; and the following characteristics were studied:

- Fruit retained percentage: It was calculated using this equation:

$$\text{Fruit retained} = \frac{\text{Total number of retained fruits per bunch}}{\text{Total scores number per bunch}} \times 100$$

- Bunch weight (Kg).

**Fruit Physical Properties:** Samples were taken from each treatment, 10 fruits of each replicates (bunch) were taken randomly to determine fruit weight, flesh weight, seed weight, seed/fruit weight percentage, fruit length (L), diameter (D) and L/D ratio, fruit size and fruit firmness (kg/cm<sup>2</sup>).

- Fruit moisture content [21].
- Fruit acidity percentage [21] and the titratable acidity was calculated as citric acid [22].
- Total soluble solids content (TSS) percentage was determined in fruit juice [21].
- Total soluble sugars [23] in the methanol extract using the phenol sulfuric acid method and the concentration was calculated as g /100 g fresh weight.
- Reducing soluble sugars were determined in the methanol extract [21, 24] and the percentage was calculated as g /100 g fresh weight.
- Non-reducing sugars were determined by differences between total and reducing sugars.

## RESULTS

**Fruit Retained Percentage:** Data presented in Table 1 cleared that fruit retained percentage of Samany and Zaghoul date palm cultivars did not affected significantly by spraying the three substances (NAA, GA<sub>3</sub> and Cytophex) in both seasons. On the other hand, concentration effects appeared significant differences in fruit retained percentages of Samany and Zaghoul date palm cultivars in the two seasons. It was obviously that spraying with water (control) produced the highest Samany and Zaghoul fruit retained which take a descending order as concentrations increased in both seasons.

Samany and Zaghoul fruits retained were significantly affected by the interaction between substances and their concentrations in both seasons. The lowest Samany and Zaghoul retained fruits percentages were recorded with the highest concentrations of each substance in both seasons. Moreover, 150 ppm GA<sub>3</sub> produced the lowest Samany fruit retained percentage (20.70 % in the 1<sup>st</sup> and 20.73 % in the 2<sup>nd</sup> seasons). While the lowest fruit retained percentage of Zaghoul fruit retained was recorded with spraying 150 pp NAA (20.39 %) in the first and 150 ppm GA<sub>3</sub> (19.08 %) in the second seasons.

**Bunch Weight (Kg):** Samany and Zaghoul bunch weights were significantly affected by spraying NAA, GA<sub>3</sub>, Cytophex and their concentrations in both seasons except substances effect on Samany bunch weight in the second season only (Table 1). However, spraying Cytophex had significantly increased bunch weight of either Samany (21.962 and 19.765 kg) or Zaghoul (17.617 and 16.056 kg) followed by bunches sprayed by GA<sub>3</sub> and NAA in the first and second seasons, respectively.

In respect to concentration effect, it was obviously detected that Samany and Zaghoul bunch weights significantly decreased by increasing substance concentrations in both seasons. The interaction between substance and concentration exhibited that bunch weight of Samany and Zaghoul date palm cultivars during the two seasons were significantly affected. Spraying 150 ppm GA<sub>3</sub> produced the lowest Samany bunch weight (16.850 and 15.804 kg) in the first and second seasons comparing with other interactions used. Whereas, the lowest Zaghoul bunch weight was obtained by spraying 150 ppm GA<sub>3</sub> (11.729 kg) in the first season and 75 ppm Cytophex (10567 kg) in the second season comparing with other interactions used.

Table 1: Effect of spraying NAA, GA<sub>3</sub> and Cytophex on retained fruits (%) and bunch weight (kg) of Samany and Zaghloul date palm cultivars during 2005 and 2006 seasons

Factor	Fruit retained (%)				Bunch weight (kg)			
	Samany		Zaghloul		Samany		Zaghloul	
	2005 season	2006 season	2005 season	2006 season	2005 season	2006 season	2005 season	2006 season
Substance								
NAA	28.18	25.14	23.77	22.31	21.067	19.348	16.742	15.339
GA <sub>3</sub>	28.38	25.13	24.22	22.13	21.098	19.394	16.813	15.475
Cytophex	28.38	25.23	24.39	22.68	21.962	19.765	17.617	16.056
LSD at 5%	N.S.	N.S.	N.S.	N.S.	0.606	N.S.	0.447	0.614
Concentration (conc.)								
First conc. Cont.	33.64	28.71	26.50	24.59	24.550	22.629	22.553	21.061
Second conc.	30.91	27.96	25.25	23.87	22.895	20.654	19.515	18.105
Third conc.	26.39	22.41	23.41	21.23	20.371	18.510	14.082	12.690
Fourth conc.	22.31	21.09	21.36	19.80	17.688	16.216	12.078	10.637
LSD at 5%	0.88	0.71	0.82	0.62	0.700	0.504	0.516	0.709
Interaction between substance and concentration								
NAA	0 ppm	33.64	28.71	26.50	24.59	24.550	22.629	22.553
	50 ppm	31.52	28.50	25.71	24.53	22.584	19.580	18.167
	100 ppm	24.80	22.50	22.49	20.77	19.760	18.254	13.732
	150 ppm	22.75	20.84	20.39	19.34	17.375	16.929	12.514
GA <sub>3</sub>	0 ppm	33.64	28.71	26.50	24.59	24.550	22.629	22.553
	50 ppm	30.70	28.68	25.65	23.85	22.400	20.367	19.433
	100 ppm	28.49	22.39	23.79	20.98	20.592	18.775	13.534
	150 ppm	20.70	20.73	20.96	19.08	16.850	15.804	11.729
Cytophex	0 ppm	33.64	28.71	26.50	24.59	24.550	22.629	22.553
	25 ppm	30.52	26.70	24.40	23.22	23.700	22.014	20.945
	50 ppm	25.88	23.83	23.94	21.93	20.762	18.500	14.980
	75 ppm	23.48	21.69	22.73	20.98	18.838	15.915	11.990
LSD at 5%	1.53	1.22	1.34	1.08	1.213	0.873	0.894	1.228

Table 2: Effect of spraying NAA, GA<sub>3</sub> and Cytophex on fruit, flesh and seed weights (g) and seed/fruit weight (%) of Samany date palm cultivar during 2005 and 2006 seasons

Factor	Fruit weight (g)		Flesh weight (g)		Seed weight (g)		Seed/fruit weight %	
	2005 season	2006 season	2005 season	2006 season	2005 season	2006 season	2005 season	2006 season
Substance								
NAA	29.41	31.21	26.69	28.44	2.72	2.77	9.34	8.96
GA <sub>3</sub>	27.83	30.31	25.11	27.50	2.72	2.81	9.83	9.28
Cytophex	30.31	32.01	27.57	29.23	2.74	2.78	9.15	8.73
LSD at 5%	0.68	0.75	0.81	0.84	N.S.	N.S.	N.S.	N.S.
Concentration (conc.)								
First conc. (control)	26.31	28.52	23.56	25.78	2.75	2.74	10.45	9.61
Second conc.	27.40	29.28	24.65	26.53	2.75	2.75	10.03	9.40
Third conc.	30.27	32.55	27.48	29.75	2.79	2.80	9.27	8.62
Fourth conc.	32.75	34.36	30.12	31.50	2.63	2.86	8.02	8.34
LSD at 5%	0.79	0.87	0.94	0.97	N.S.	N.S.	1.56	N.S.
Interaction between substance and concentration								
NAA	0 ppm	26.31	28.52	23.56	25.78	2.75	2.74	10.45
	50 ppm	27.34	28.58	24.62	25.88	2.72	2.70	9.95
	100 ppm	30.48	32.48	27.79	29.59	2.69	2.89	8.82
	150 ppm	33.52	35.25	30.79	32.48	2.73	2.77	8.14
GA <sub>3</sub>	0 ppm	26.31	28.52	23.56	25.78	2.75	2.74	10.45
	50 ppm	26.40	28.52	23.64	25.76	2.76	2.76	10.45
	100 ppm	28.04	31.45	25.15	28.63	2.89	2.82	10.31
	150 ppm	30.57	32.76	28.09	29.85	2.48	2.91	8.11
Cytophex	0 ppm	26.31	28.52	23.56	25.78	2.75	2.74	10.45
	25 ppm	28.47	30.74	25.71	27.96	2.76	2.78	9.69
	50 ppm	32.30	33.72	29.50	31.03	2.80	2.69	8.67
	75 ppm	34.17	35.08	31.50	32.17	2.67	2.91	7.81
LSD at 5%	1.37	1.51	1.63	1.69	N.S.	N.S.	2.70	N.S.

Table 3: Effect of spraying NAA, GA<sub>3</sub> and Cytophex on fruit, flesh and seed weights (g) and seed/fruit weight (%) of Zaghoul date palm cultivar during 2005 and 2006 seasons

		Fruit weight (g)		Flesh weight (g)		Seed weight (g)		Seed/fruit weight (%)	
		2005 season	2006 season	2005 season	2006 season	2005 season	2006 season	2005 season	2006 season
Factor									
Substance									
NAA		29.60	31.48	27.18	29.17	2.42	2.31	8.27	7.46
GA <sub>3</sub>		29.87	31.34	27.45	28.93	2.42	2.41	8.25	7.80
Cytophex		30.81	32.20	28.53	29.93	2.28	2.27	7.58	7.19
LSD at 5%		0.50	0.54	0.57	0.54	N.S.	N.S.	N.S.	N.S.
Concentration (conc.)									
First conc. (control)		24.98	26.00	22.47	23.63	2.51	2.37	10.05	9.11
Second conc.		29.47	30.80	27.13	28.45	2.34	2.35	7.94	7.63
Third conc.		31.49	34.44	29.14	32.12	2.36	2.32	7.50	6.74
Fourth conc.		34.44	35.47	32.15	33.18	2.29	2.29	6.66	6.45
LSD at 5%		0.57	0.62	0.66	0.63	N.S.	N.S.	1.16	0.78
Interaction between substance and concentration									
NAA	0 ppm	24.98	26.00	22.47	23.63	2.51	2.37	10.05	9.11
	50 ppm	28.57	30.30	26.30	28.04	2.27	2.26	7.94	7.46
	100 ppm	31.36	34.48	28.88	32.18	2.48	2.30	7.91	6.67
	150 ppm	33.50	35.16	31.09	32.84	2.41	2.32	7.19	6.60
GA <sub>3</sub>	0 ppm	24.98	26.00	22.47	23.63	2.51	2.37	10.05	9.11
	50 ppm	29.54	30.64	27.05	28.16	2.49	2.48	8.43	8.09
	100 ppm	30.43	33.73	28.00	31.24	2.43	2.49	7.98	7.38
	150 ppm	34.54	35.01	32.27	32.69	2.27	2.32	6.57	6.63
Cytophex	0 ppm	24.98	26.00	22.47	23.63	2.51	2.37	10.05	9.11
	25 ppm	30.30	31.46	28.04	29.15	2.26	2.31	7.46	7.34
	50 ppm	32.69	35.10	30.53	32.93	2.16	2.17	6.61	6.18
	75 ppm	35.27	36.24	33.08	34.02	2.19	2.22	6.21	6.12
LSD at 5%	1.00	1.08	1.14	1.09	N.S.	N.S.	2.01	1.35	

#### Weights of Fruit, Flesh, Seed and Seed/fruit Percentage:

Samany fruit and flesh weights had significantly increased by spraying Cytophex followed by NAA and GA<sub>3</sub> in the first and second seasons, respectively (Table 2). Meanwhile, Samany seed weight and weight of seed per fruit percentage did not affect significantly by different substances sprayed in both seasons (Table 2). Whatever, spraying GA<sub>3</sub> had increased Samany seed weight in the second season and the percentage of seed/fruit weight in both seasons comparing with either NAA or Cytophex. Regarding concentrations effect, Samany fruit and flesh weights showed significant correlation, in ascending order, with increasing the concentration of substance in both seasons. The highest fruit or flesh weights were obtained by using the highest concentration followed by lowers concentrations, in ascending order, to the control in both seasons.

In respect to Samany seed weight, there was no significant effects had detected as affecting by different concentrations used in both seasons. Referring to Samany seed/fruit weight percentage, it decreased, in both seasons, affecting by increasing spraying concentrations without significant differences in the second season only.

The interaction between substances and their concentrations showed significant effect on Samany fruit

and flesh weights. On the opposite, seed weight was not significantly affected by these interactions in both seasons. Whereas, Samany seed/fruit weight percentage had significantly affected by these interactions in the first seasons only. Whatever, the highest Samany fruit weight was obtained by spraying 75 ppm Cytophex (34.17 g) in the first season. Also, in the second season, Samany fruit weight was 35.25 and 35.08 g when 150 ppm NAA and 75 ppm Cytophex were sprayed, respectively.

In respect to data presented in Table 3, spraying Cytophex produced significantly increasing in weights of Zaghoul fruit (30.81, 32.20 g) and flesh (28.53, 29.93 g) in the first and second seasons, respectively. In addition, spraying Cytophex produced the lowest Zaghoul seed weight (2.27 and 2.28 g) and percentage of seed/fruit weight (7.58 and 7.19 %) comparing with other sprayed substances in the first and second seasons, respectively.

Zaghoul fruit and flesh weights were increased significantly by increasing concentration used in both seasons. On the other hand, percentage of seed/fruit weight was significantly decreased by increasing the studied concentrations in both seasons.

The interaction between substances concentrations shows significantly effect on Zaghoul fruit and flesh weights as well as percentage of seed/fruit weight in the two seasons. Moreover, spraying Cytophex at 75 ppm

Table 4: Effect of spraying NAA, GA<sub>3</sub> and Cytophex on fruit dimensions (cm), size (cm<sup>3</sup>) and fruit length/diameter ratio of Samany date palm cultivar during 2005 and 2006 seasons

		Fruit length (L) (cm)		Fruit diameter (D) (cm)		Fruit size (cm <sup>3</sup> )		Fruit L/D ratio	
		2005 season	2006 season	2005 season	2006 season	2005 season	2006 season	2005 season	2006 season
Factor									
Substance									
NAA		5.07	5.36	2.78	2.85	25.56	27.20	1.82	1.88
GA <sub>3</sub>		5.14	5.42	2.83	2.92	26.29	28.41	1.82	1.85
Cytophex		5.32	5.54	2.87	3.05	28.79	31.53	1.85	1.81
LSD at 5%		0.21	0.16	N.S.	0.12	0.46	0.38	N.S.	N.S.
Concentration (conc.)									
First conc. (control)		4.42	4.70	2.40	2.59	20.86	22.78	1.84	1.81
Second conc.		4.93	5.11	2.81	2.95	26.40	28.06	1.76	1.73
Third conc.		5.47	5.84	2.99	3.07	28.85	31.54	1.83	1.90
Fourth conc.		5.89	6.11	3.11	3.15	31.42	33.80	1.89	1.94
LSD at 5%		0.24	0.18	0.17	0.14	0.54	0.44	N.S.	N.S.
Interaction between substance and concentration									
NAA	0 ppm	4.42	4.70	2.40	2.59	20.86	22.78	1.84	1.81
	50 ppm	4.79	5.04	2.77	2.83	24.08	26.17	1.73	1.78
	100 ppm	5.23	5.66	2.88	2.95	27.14	28.26	1.82	1.92
	150 ppm	5.84	6.05	3.08	3.03	30.17	31.58	1.90	2.00
GA <sub>3</sub>	0 ppm	4.42	4.70	2.40	2.59	20.86	22.78	1.84	1.81
	50 ppm	4.95	5.05	2.88	3.01	25.07	27.22	1.72	1.68
	100 ppm	5.45	5.82	2.98	3.02	28.65	31.17	1.83	1.93
	150 ppm	5.75	6.10	3.05	3.07	30.58	32.48	1.88	1.99
Cytophex	0 ppm	4.42	4.70	2.40	2.59	20.86	22.78	1.84	1.81
	25 ppm	5.05	5.24	2.77	3.02	30.05	30.80	1.82	1.73
	50 ppm	5.73	6.04	3.10	3.25	30.77	35.20	1.85	1.86
	75 ppm	6.09	6.18	3.21	3.35	33.50	37.34	1.90	1.84
LSD at 5%	0.42	0.32	0.30	0.93	0.77	N.S.	N.S.		

Table 5: Effect of spraying NAA, GA<sub>3</sub> and Cytophex on fruit dimensions (cm), size (cm<sup>3</sup>) and fruit length/diameter ratio of Zaghloul date palm cultivar during 2005 and 2006 seasons

		Fruit length (cm)		Fruit diameter (cm)		Fruit size (cm <sup>3</sup> )		Ratio of fruit length/diameter	
		2005 season	2006 season	2005 season	2006 season	2005 season	2006 season	2005 season	2006 season
Factor									
Substance									
NAA		5.22	5.54	2.74	2.88	28.54	30.23	1.90	1.92
GA <sub>3</sub>		5.27	5.54	2.82	2.86	29.28	30.87	1.86	1.93
Cytophex		5.56	5.74	2.86	2.94	29.49	31.06	1.93	1.94
LSD at 5%		0.14	0.12	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Concentration (conc.)									
First conc. (control)		4.23	4.53	2.42	2.50	23.32	24.59	1.75	1.81
Second conc.		5.47	5.68	2.84	2.95	28.49	30.33	1.93	1.92
Third conc.		5.67	6.09	2.97	3.03	31.22	33.07	1.91	2.01
Fourth conc.		6.03	6.13	3.00	3.09	33.39	34.89	2.01	1.98
LSD at 5%		0.16	0.14	0.17	0.16	1.18	1.07	N.S.	N.S.
Interaction between substance and concentration									
NAA	0 ppm	4.23	4.53	2.42	2.50	23.32	24.59	1.75	1.81
	50 ppm	5.15	5.42	2.66	2.94	27.54	29.85	1.94	1.84
	100 ppm	5.50	6.09	2.93	3.00	30.86	32.40	1.88	2.03
	150 ppm	5.99	6.12	2.95	3.07	32.44	34.07	2.03	1.99
GA <sub>3</sub>	0 ppm	4.23	4.53	2.42	2.50	23.32	24.59	1.75	1.81
	50 ppm	5.36	5.56	2.88	2.94	28.91	30.55	1.86	1.89
	100 ppm	5.47	6.01	2.95	2.98	31.81	33.31	1.85	2.02
	150 ppm	6.02	6.06	3.02	3.02	33.08	35.05	1.99	2.01
Cytophex	0 ppm	4.23	4.53	2.42	2.50	23.32	24.59	1.75	1.81
	25 ppm	5.90	6.07	2.97	2.97	29.03	30.59	1.99	2.04
	50 ppm	6.03	6.16	3.03	3.12	30.99	33.51	1.99	1.97
	75 ppm	6.08	6.22	3.04	3.18	34.64	35.55	2.00	1.95
LSD at 5%	0.29	0.25	0.30	0.29	2.05	1.86	N.S.	N.S.	

gave the highest Zaghoul fruit weight (35.27 and 36.24 g) and flesh weight (33.08 and 34.02 g) comparing with other interactions in the first and second seasons, respectively. The same interaction (75 ppm with Cytophex) produced the lowest percentage of seed/fruit weight (6.21 and 6.12%) comparing with other interactions in the first and second seasons, respectively. Zaghoul seed weight did not affected significantly by these interactions in both seasons. Whatever, spraying 50 ppm Cytophex produced the lowest Zaghoul seed weight comparing with other interactions used in both seasons.

**Fruit Dimensions and Size:** Table 4 demonstrate that Samany fruit length (L), Diameter (D) and size had significantly affected by substances, concentrations and the interactions between them in both seasons, except, fruit diameter in the first season which was not significantly affected by substances only. On the other hand, fruit length/diameter (L/D) ratio was similar statistically by the above factors or their combinations in both seasons. The highest fruit dimensions (5.32 and 5.54 cm L and 2.87 and 3.05 cm D) and size (28.79 and 31.53 cm<sup>3</sup>) were recorded by spraying Cytophex comparing with other substances used in the first and second seasons, respectively. Moreover, using the high concentration of spraying had increased Samany fruit dimensions, size and L/D ratio comparing with other of lower concentrations in both seasons.

Regarding to the interaction between substances and their concentrations, spraying 75 ppm of Cytophex produced the highest fruit length (6.09 and 6.18 cm), diameter (3.21 and 3.35 cm) and size (33.50 and 37.34 cm<sup>3</sup>) comparing with other interactions used in the first and second seasons, respectively. Whereas, the highest fruit L/D ratio had resulted by 75 ppm of Cytophex in the first season and 150 ppm of NAA in the second season comparing with other interactions.

The results of Zaghoul fruit dimensions and size are tabulated in Table 5. It was clearly noticed that sprayed substances had increased insignificantly the studied characteristics Zaghoul fruits during both seasons, except, fruit length that differed significantly affecting by substances used in both seasons. Whatever, spraying Cytophex had increased fruit length (5.56 and 5.74 cm), diameter (2.86 and 2.94 cm), size (29.49 and 31.06 cm<sup>3</sup>) and L/D ratio (1.93 and 1.94) of Zaghoul fruits comparing with other substances in the first and second seasons, respectively. On the other way, increasing spraying concentration had significantly increased, in ascending

order, Zaghoul dimensions and size in the two seasons, except, L/D ratio that was not significantly affected during study.

The interaction between substances and their concentrations showed significantly effect on Zaghoul fruit length, diameter and size in both seasons. It was obviously found a clear trend regarding Zaghoul fruit length, diameter and size that was correlated in ascending order by increasing spraying concentrations of each of Cytophex, GA<sub>3</sub> and NAA during both seasons. Whatever, spraying 75 ppm of Cytophex produced the highest Zaghoul fruit length (6.08 and 6.22 cm), diameter (3.04 and 3.18 cm) and size (34.64 and 35.55 cm<sup>3</sup>) in the first and second seasons, respectively. Meanwhile, Zaghoul fruit L/D ratio was not significantly affected by the interaction between substances and their concentrations in the two seasons.

#### **Fruit Firmness and Fruit Moisture, Acidity and TSS**

**Contents:** Samany fruit firmness and acidity were not significantly affected by substance, concentration and the interaction between them in both seasons (Table 6). Whereas, Samany fruit content of moisture and TSS had differed significantly affecting by the mentioned factors during the two seasons. Whatever, Samany fruit firmness was ranged within 6.48 to 7.07 kg/cm<sup>2</sup> as affected by NAA, GA<sub>3</sub>, Cytophex and the interactions between them during study. Also, Samany fruit acidity content was ranged within 0.019 to 0.029 % affecting by different factors mentioned before during study.

Spraying NAA on Samany fruits increased fruit moisture content (71.22 and 70.40 %) comparing with Cytophex that decreased it to 69.03 and 67.74 % in the first and second seasons, respectively. Whereas, spraying GA<sub>3</sub> had intermediate effect in this respect during study. Regarding substance concentration effect, the highest concentration reduced fruit moisture content to 66.47 and 66.00 % comparing with control that increased it to 76.60 and 74.59% in the first and second seasons, respectively.

The interaction between substances and their concentrations referred that highest concentrations of NAA, GA<sub>3</sub> or Cytophex produced the lowest percentage of Samany fruit moisture content in both seasons. In addition, the lowest moisture percentage was obtained by GA<sub>3</sub> at 150 ppm (65.49 in the 1<sup>st</sup> and 64.69% in the 2<sup>nd</sup> seasons) comparing with other interactions used.

In regard to TSS content, the highest Samany fruit TSS content (29.11 and 30.45 %) was obtained by spraying Cytophex followed by GA<sub>3</sub> and NAA

Table 6: Effect of spraying NAA, GA<sub>3</sub> and Cytophex on firmness (kg/cm<sup>2</sup>), moisture (%), Acidity (%) and TSS (%) of Samany fruits during 2005 and 2006 seasons

		Fruit firmness (kg/cm <sup>2</sup> )		Fruit moisture (%)		Fruit acidity (%)		Fruit TSS (%)	
Factor		2005 season	2006 season	2005 season	2006 season	2005 season	2006 season	2005 season	2006 season
Substance									
NAA		6.77	6.75	71.22	70.40	0.025	0.025	27.13	29.07
GA <sub>3</sub>		6.86	6.83	69.57	68.68	0.026	0.025	27.73	29.26
Cytophex		6.64	6.70	69.03	67.74	0.024	0.022	29.11	30.45
LSD at 5%		N.S.	N.S.	0.44	0.64	N.S.	N.S.	0.69	0.58
Concentration (conc.)									
First conc. (control)		6.51	6.48	76.60	74.59	0.029	0.027	23.29	25.35
Second conc. 7.02		6.95	69.19	68.45	0.025	0.023	28.28	29.71	
Third conc.		6.83	7.00	67.48	66.72	0.023	0.024	29.47	31.12
Fourth conc.		6.67	6.61	66.47	66.00	0.023	0.022	30.94	32.20
LSD at 5%		N.S.	N.S.	0.51	0.74	N.S.	N.S.	0.80	0.67
Interaction between substance and concentration									
NAA	0 ppm	6.51	6.48	76.60	74.59	0.029	0.027	23.29	25.35
	50 ppm	7.05	6.94	71.55	70.69	0.026	0.026	27.18	28.70
	100 ppm	6.94	6.98	68.68	68.37	0.025	0.024	28.70	30.77
	150 ppm	6.58	6.58	68.05	67.95	0.022	0.022	29.37	31.48
GA <sub>3</sub>	0 ppm	6.51	6.48	76.60	74.59	0.029	0.027	23.29	25.35
	50 ppm	7.02	7.02	68.66	68.92	0.026	0.025	27.37	28.73
	100 ppm	6.96	7.07	67.51	66.51	0.024	0.026	28.78	30.59
	150 ppm	6.95	6.73	65.49	64.69	0.024	0.023	31.49	32.37
Cytophex	0 ppm	6.51	6.48	76.60	74.59	0.029	0.027	23.29	25.35
	25 ppm	6.99	6.88	67.37	65.74	0.023	0.019	30.28	31.70
	50 ppm	6.59	6.94	66.25	65.29	0.021	0.022	30.94	32.00
	75 ppm	6.49	6.51	65.88	65.35	0.022	0.021	31.95	32.77
LSD at 5%	N.S.	N.S.	0.89	1.28	N.S.	N.S.	1.39	1.17	

Table 7: Effect of spraying NAA, GA<sub>3</sub> and Cytophex on firmness (kg/cm<sup>2</sup>), moisture (%), Acidity (%) and TSS (%) of Zaghloul fruits during 2005 and 2006 seasons

		Fruit firmness (kg/cm <sup>2</sup> )		Fruit moisture (%)		Fruit acidity (%)		Fruit TSS (%)	
		2005 season	2006 season	2005 season	2006 season	2005 season	2006 season	2005 season	2006 season
Factor									
Substance									
NAA		6.39	6.47	70.67	69.22	0.026	0.025	30.56	31.67
GA <sub>3</sub>		6.52	6.53	70.35	68.57	0.026	0.025	30.84	32.02
Cytophex		6.50	6.20	69.47	68.60	0.024	0.023	32.25	33.55
LSD at 5%		N.S.	N.S.	0.48	0.61	N.S.	N.S.	0.62	0.53
Concentration (conc.)									
First conc. (control)		6.44	6.61	74.26	72.44	0.027	0.025	28.61	29.55
Second conc.		6.66	6.57	70.21	69.55	0.025	0.025	29.87	30.94
Third conc.		6.65	6.35	68.72	67.53	0.025	0.024	32.60	33.65
Fourth conc.		6.14	6.08	67.46	65.67	0.024	0.023	33.80	35.53
LSD at 5%		N.S.	N.S.	0.55	0.70	N.S.	N.S.	0.71	0.61
Interaction between substance and concentration									
NAA	0 ppm	6.44	6.61	74.26	72.44	0.027	0.025	28.61	29.55
	50 ppm	6.48	6.74	70.51	69.29	0.027	0.026	29.59	30.04
	100 ppm	6.59	6.44	69.48	68.44	0.025	0.024	31.81	33.14
	150 ppm	6.07	6.10	68.44	66.70	0.025	0.024	32.26	33.95
GA <sub>3</sub>	0 ppm	6.44	6.61	74.26	72.44	0.027	0.025	28.61	29.55
	50 ppm	6.70	6.84	70.80	70.03	0.026	0.025	29.62	30.51
	100 ppm	6.70	6.59	68.48	66.48	0.026	0.025	31.40	32.48
	150 ppm	6.25	6.07	67.87	65.33	0.024	0.024	33.73	35.55
Cytophex	0 ppm	6.44	6.61	74.26	72.44	0.027	0.025	28.61	29.55
	25 ppm	6.81	6.12	69.33	69.33	0.023	0.023	30.40	32.26
	50 ppm	6.66	6.03	68.20	67.66	0.023	0.022	34.59	35.33
	75 ppm	6.11	6.06	66.08	64.99	0.022	0.021	35.40	37.08
LSD at 5%	N.S.	N.S.	0.96	1.33	N.S.	N.S.	1.24	1.06	

Table 8: Effect of spraying NAA, GA<sub>3</sub> and Cytophex on total, reducing and non-reducing sugars (%) of Samany fruits during 2005 and 2006 seasons

		Sugars (g/100 g fresh weight)					
		Total		Reducing		Non-reducing	
Factor		2005 season	2006 season	2005 season	2006 season	2005 season	2006 season
Substance							
NAA		23.06	24.80	19.18	20.87	3.88	3.93
GA <sub>3</sub>		23.70	24.86	19.84	21.08	3.85	3.78
Cytophex		24.50	26.28	20.91	22.55	3.59	3.73
LSD at 5%		0.49	0.41	0.41	0.53	N.S.	N.S.
Concentration (conc.)							
First conc. (control)		20.48	21.44	15.94	16.26	4.54	5.18
Second conc.		22.33	24.63	18.59	20.93	3.74	3.71
Third conc.		25.38	27.13	21.96	23.79	3.41	3.34
Fourth conc.		26.82	28.06	23.43	25.02	3.39	3.03
LSD at 5%		0.56	0.47	0.48	0.61	0.52	0.62
Interaction between substance and concentration							
NAA	0 ppm	20.48	21.44	15.94	16.26	4.54	5.18
	50 ppm	22.55	24.29	18.65	20.53	3.90	3.77
	100 ppm	23.92	26.55	20.30	23.00	3.62	3.55
	150 ppm	25.29	26.92	21.84	23.71	3.45	3.21
GA <sub>3</sub>	0 ppm	20.48	21.44	15.94	16.26	4.54	5.18
	50 ppm	20.70	23.95	16.93	20.18	3.77	3.77
	100 ppm	25.77	26.44	22.25	23.41	3.52	3.03
	150 ppm	27.84	27.62	24.25	24.46	3.59	3.16
Cytophex	0 ppm	20.48	21.44	15.94	16.26	4.54	5.18
	25 ppm	23.73	25.66	20.18	22.09	3.55	3.58
	50 ppm	26.44	28.40	23.33	24.97	3.11	3.43
	75 ppm	27.33	29.62	24.19	26.88	3.14	2.72
LSD at 5%	0.98	0.82	0.83	1.06	0.90	1.09	

(27.73, 29.26 % and 27.13, 29.07 %) in the first and second seasons, respectively. In addition, using the highest concentration had increased Samany fruit content of TSS comparing with other concentrations used during study. Whereas control (0.0 ppm) gave the lowest TSS percentage in both seasons. From the interactions between substances and their concentrations, clearly showed that highest TSS percentage (31.95 % in the 1<sup>st</sup> and 32.77 % in the 2<sup>nd</sup> seasons) was recorded when Samany fruits were sprayed by 75 ppm of Cytophex comparing with other interactions.

Results about Zaghoul fruit firmness and content of moisture, acidity and TSS percentage are tabulated in Table 7. Firmness and acidity content of Zaghoul fruits did not differ significantly as affected by substances, concentration and interactions between them in both seasons. Whereas, Zaghoul fruit content of moisture and TSS percentages had significantly affected by substance, concentration and the combination between them during both seasons. It was clearly recorded that spraying Cytophex in the first season or GA<sub>3</sub> in the second season produced the lowest moisture content. Moreover, spraying the highest concentration had increased Zaghoul fruit moisture content comparing with other

concentrations during the study. In addition, the lowest Zaghoul fruit moisture content was obtained with Cytophex at 75 ppm comparing with other interactions during the two seasons of study.

Zaghoul fruit TSS content showed that spraying Cytophex had increased fruit TSS (32.25% in the 1<sup>st</sup> and 33.55% in the 2<sup>nd</sup> seasons) followed by GA<sub>3</sub> and NAA, respectively. Also, TSS content was increased gradually from 28.61% to 33.80 % in the 1<sup>st</sup> and 29.55% to 35.53% in the 2<sup>nd</sup> seasons by increasing the concentration of substances. Also, the highest TSS content was obtained when Cytophex at 75 ppm was used during both seasons.

#### **Total, Reducing and Non-reducing Sugars Contents:**

Spraying NAA, GA<sub>3</sub> or Cytophex at different concentrations and interactions between them was significantly affected Samany fruit content of total, reducing and non-reducing sugars, regardless the effect of studied substances on reducing sugars, in both seasons (Table 8).

Spraying Cytophex had increased fruit total and non-reducing sugars content comparing with spraying GA<sub>3</sub> and NAA in the first and second seasons, respectively. Concerning growth regulators

Table 9: Effect of spraying NAA, GA<sub>3</sub> and Cytophex on total, reducing and non-reducing sugars (%) of Zaghloul fruits during 2005 and 2006 seasons

		Sugars (g/100 g fresh weight)					
		Total		Reducing		Non-reducing	
Factor		2005 season	2006 season	2005 season	2006 season	2005 season	2006 season
Substance							
NAA		27.16	27.26	23.80	24.12	3.36	3.13
GA <sub>3</sub>		26.84	28.90	23.58	25.74	3.27	3.16
Cytophex		27.99	28.89	24.80	25.81	3.19	3.08
LSD at 5%		0.54	0.49	0.85	0.84	N.S.	N.S.
Concentration (conc.)							
First conc. (control)		23.57	24.78	19.34	20.65	4.23	4.12
Second conc.		25.68	27.25	22.54	24.34	3.13	2.91
Third conc.		28.89	29.67	25.90	26.84	2.99	2.83
Fourth conc.		31.19	31.70	28.46	29.06	2.73	2.64
LSD at 5%		0.62	0.56	0.98	0.97	0.36	0.40
Interaction between substance and concentration							
NAA	0 ppm	23.57	24.78	19.34	20.65	4.23	4.12
	50 ppm	26.11	26.84	22.65	23.86	3.46	2.98
	100 ppm	28.44	27.61	25.39	24.65	3.05	2.96
	150 ppm	30.51	29.81	27.82	27.33	2.69	2.48
GA <sub>3</sub>	0 ppm	23.57	24.78	19.34	20.65	4.23	4.12
	50 ppm	25.51	27.48	22.50	24.56	3.01	2.92
	100 ppm	27.74	30.81	24.68	27.99	3.06	2.82
	150 ppm	30.55	32.52	27.78	29.73	2.77	2.79
Cytophex	0 ppm	23.57	24.78	19.34	20.65	4.23	4.12
	25 ppm	25.40	27.43	22.47	24.61	2.93	2.82
	50 ppm	30.48	30.59	27.62	27.87	2.85	2.71
	75 ppm	32.51	32.78	29.78	30.11	2.73	2.67
LSD at 5%	1.08	0.98	1.70	1.69	0.63	0.70	

concentrations effects, the highest concentration had increased total and non-reducing sugars fruit content comparing with other concentrations used during study. Meanwhile, the lowest one (control) gave the highest Samany fruit content of reducing sugars in both seasons.

The interaction between substance and its concentration revealed that highest total sugars was obtained from spraying GA<sub>3</sub> at 150 ppm (27.84%) in the first season and Cytophex at 75 ppm (29.62%) in the second season comparing with other interactions during study. Also, the highest non-reducing sugars content of Samany fruits was 24.19 and 26.88% that resulted from spraying Cytophex at 75 ppm in the first and second seasons, respectively.

Regarding to Zaghloul fruit sugars content, total, reducing and non-reducing fruit sugars content is tabulated in Table 9. It was clearly noticed that total and non-reducing sugars were significantly affected by substances, concentration and the interactions between them in both seasons. Spraying Cytophex raised total sugars content (27.99%) followed by NAA (27.16%) and GA<sub>3</sub> (26.84%) in the first season. While, in the second season, GA<sub>3</sub> produced the highest values in this respect followed by Cytophex and NAA, respectively. Also,

spraying NAA in the first season or GA<sub>3</sub> in the second season recorded the highest Zaghloul reducing sugars content comparing with other substances used. Whereas, spraying Cytophex produced the highest non-reducing sugars content of Zaghloul fruits during the two seasons comparing with other substances sprayed.

Total and non-reducing sugars content had increased as concentration of substances increased in both seasons. Meanwhile, reducing sugars content tended to take the opposite trend in this respect during study. Concerning the interaction between substance and concentration, the highest total and non-reducing sugars content were produced by spraying Cytophex at 75ppm (32.51, 32.78% and 29.78%, 30.11%) comparing with other interactions in the first and second seasons, respectively.

## DISCUSSION

From the above fruit physical characteristics, it can be concluded that using cytophex sparing on Samany and Zaghloul date palm cultivars raised the bunch, fruit and flesh weights, as well as fruit length, fruit diameter and fruit size comparing with NAA or GA<sub>3</sub> treatments in the two seasons. Regarding substance concentrations,

the highest concentrations of either NAA or GA<sub>3</sub> or cytophex had produced the highest fruit weight, flesh weight, fruit length, fruit diameter and fruit size. Finally, spraying Samany and Zaghloul date palm cultivars by cytophex at 75 ppm produced the highest fruit and flesh weights; as well as fruit dimensions and size in the two seasons comparing with other interactions. The obtained results are in compatible with [2, 9, 10, 12, 13, 16]. It may be due to the efficacy of these substances in reducing the number of fruits per bunch consequently enhancement of the fruit weight and quality. These effects might be due to more accumulation of carbohydrates and other substances in bunches that affected by thinning [11], or it might be due to correct of endogenous growth regulators by adding exogenous ones [2]. Also, it seems that the studied substances tend to increase cell expansion [3].

Concerning the fruit chemical contents, it can be concluded that using cytophex spraying on Samany and Zaghloul date palm cultivars produced the highest fruit TSS, Total soluble sugars and reducing sugars contents comparing with other substances used. Regarding to substances concentrations, the highest concentration of each substances produced the lowest fruit firmness and the highest fruit contents of TSS, total soluble sugars and reducing sugars comparing with the lowest concentrations in the two seasons. Finally, spraying Samany and Zaghloul fruits with cytophex by 75 ppm produced the highest fruit TSS, total soluble sugars and reducing sugars contents. The obtained results are in line with [1, 2, 7-9, 13-16]. They reported that spraying growth substances on date palm cultivars increased their fruits contents of TSS, total and reducing sugars.

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