

## Effect of Antioxidants, Growth Regulators and Yeast Spraying on Fruiting of Seewy Date Palms

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### Abstract

This study was conducted to evaluate the effect of spraying some growth regulators (CPPU at 15 ppm and GA<sub>3</sub> at 100 ppm), some antioxidants (Amino acids at 0.50 g/L, citric acid at 500 ppm and ascorbic acid at 500 ppm) and active dry yeast at 10 g/L on yield and fruit quality of Seewy date palm during 2015 and 2016 seasons. The experiment was set up in a complete randomized block design with seven treatments and ten replicates, one bunch per each. Date palm were sprayed three times, at the 1<sup>st</sup> week of May, June and July.

Foliar application had a positive effect on yield and fruit quality of Seewy date palm. The best results were obtained with spraying GA<sub>3</sub> at 100 ppm and CPPU at 15 ppm for increasing bunch weight, yield/palm, fruit weight, fruit length and diameter. On the other hand, spraying amino acids at 0.50 g/L and yeast at 10 g/L significantly increased TSS%, total sugars contents, and significantly decreased tannins %, total acidity % and fruit moisture content.

So, it can be concluded that spraying GA<sub>3</sub> or CPPU combined with any amino acid, yeast, citric acid or ascorbic acid three time (1, 2 & 3 month of pollination time) increased the palm yield and improved the fruit quality of Seewy date palm.

**Keywords:** Date palm, Antioxidant, GA<sub>3</sub>, CPPU, Yield, Fruit quality.

### Introduction

Date palm is one of the oldest cultivated fruit trees in the world. Known as tree of life because of its need for limited water inputs, its long term productivity and its multiple purpose qualities. Egypt is considered one of the top ten date producers and total production of date fruits is about 1.3 million tons (FAO, 2012). In Egypt, many cultivars are grown in different regions according to the diversity of their climatic necessity. Seewy date is one of the most economically important semi dry dates and is used demand in local and foreign markets. One of the best tools for date palm reproductivity is the fertilization (Khayat *et al.*, 2007 and

Mostafa, 2015). Spray fertilization has the important role to reduce application rates, uniform distribution of fertilizer materials and quick responses to applied nutrients. Moreover, hidden hungers can easily be managed (Umar *et al.*, 1999 and Mengel, 2002).

Bio-fertilizers are considered as a safe fertilization method to increase productivity and quality of many fruit species. Yeast as a bio-fertilizer is characterized by its own different nutrients, vitamins and cytokinin as a natural plant hormone and photosynthesis stimulator (Subba Rao, 1984; Mostafa, 2015). Synthetic auxins are effective on enhancing fruit growth. These auxins are known by their abil-

ity to increase the cell size and enhance fruit growth (El-Kassas, 1983; Nickell, 1985; Davis, 2004; Al-Juburi and Al-Masry, 2003; Kassem *et al.*, 2011; Awad and Al-Qurashi, 2012; Ahmed-Dorria *et al.*, 2012; Merwad *et al.*, 2015 and El-Salhy *et al.*, 2016).

The physiological effects of ascorbic acid included stimulation the activity of lipase, catalase and peroxidase. Moreover, Ascorbic acid has an effect on the metabolism of gibberellic acid (Kamiya *et al.*, 1984). Amino acids contain both acid and basic groups and act as buffers, which help to maintain favorable pH value within the plant cell (Davies, 1982). Amino acids are considered as precursors and constituents of proteins, which are important for stimulation of cell growth (Rao, 2002).

Antioxidants such as amino acids, citric acid, ascorbic acid and vitamins may play a definite role on solving the problem of poor yield. Through enhancing growth nutritional status, yield and fruit quality in different evergreen fruit crops, especially date palm (Ahmed *et al.*, 2007; Ahmed-Dorria *et al.*, 2012 and Merwad *et al.*, 2015).

The objective of this present study is to evaluate the effect of spraying bunches with amino acid, ascorbic acid, citric acid, yeast, GA<sub>3</sub> and CPPU on yield and fruit quality of Seewy date palm.

### Materials and Methods

The experiment was carried out during two successive seasons of 2015 and 2016 on Seewy date palms (*Phoenix dactylifera* L.). The date palms were grown in a private orchard located at El-Dakhla Oasis,

New Valley, Egypt, where the soil is sandy loam. Ten healthy palms selected randomly and at similar age (20 years-old), uniform in vigour, healthy, good physical conditions, free from insects and diseases and regularly bearing. All palms subjected to the same management and cultural practices except those subjected to spray treatment. The leaf/bunch ratio was adjusted at the end of the blooming season to meet their value of 7:1. Bunches were thinned to nine per palm by removing excess earliest, latest and smallest ones. Artificial pollination was uniformly performed in respect of source, date and method

This experiment included the following seven spray treatments:

- 1- Amino acid at 0.50 g/L.
- 2- Active dry yeast at 10 g/L.
- 3- Ascorbic acid at 500 ppm.
- 4- Citric acid at 500 ppm.
- 5- GA<sub>3</sub> at 100 ppm.
- 6- CPPU at 15 ppm.
- 7- Control (distilled water).

All treatments were applied on the same palm. Bunches were sprayed three times, on the first week of May, June and July, using a small hand sprayer until run-off. Bunches were separated from each side with plastic sheets to avoid any contamination between other treatments. The experiment was arranged in a complete randomized block design (RCBD) with ten replications, one bunch each.

The following measurements were determined during the two investigated seasons.

### Yield components

At the harvest time (late rutab stage) bunches of each palms were

picked and weighed. Then the yield/palm (kg) was recorded. Twenty five fruits from each bunch were selected to estimate the physical characteristics, i.e. fruit weight (g), flesh percentage (%), fruit length (cm), fruit diameter (cm) and fruit moisture. The chemical properties i.e. T.S.S.% was determined using the hand refractometer, total acidity % (as ascorbic acid/100 g/pulp), total soluble tannins %, total sugars %, reducing sugars %, and non-reducing sugars % were determined according to A.O.A.C. (1985).

Statistical analysis was done according to Mead *et al.* (1993). Using L.S.D. at 5% to compare the different treatments means.

## Results

### Yield:

Data presented in Table (1) show the effect of antioxidant, growth regulators and yeast spraying on yield of Seewy date palm during 2015 and 2016 seasons. It is obvious that the results took the similar trend during the two studied seasons. It could be observed that all foliar applications of amino acid at 0.50 g/L,

ascorbic acid at 500 ppm, citric acid at 500 ppm, yeast at 10 g/L, GA<sub>3</sub> at 100 ppm and CPPU at 15 ppm significantly increased bunch weight and yield/palm compared with the untreated ones (control). The heaviest bunch weight and yield/palm were detected on the palms that sprayed with GA<sub>3</sub> or CPPU followed by the antioxidant or yeast treatments. However, no significant differences were observed in bunch weight and yield due to spray GA<sub>3</sub> or CPPU, as well as amino acid, yeast, ascorbic acid or citric acid. The maximum values of bunch weight (14.64 & 14.29 kg) and yield/palm (131.76 & 128.57 as an av. of the two studied seasons) were recorded when spray the bunch with GA<sub>3</sub> at 100 ppm or CPPU at 15 ppm, respectively. On the other hand, the least values of bunch weight was 12.07 kg and yield/palm was 108.59 kg as an av. of the two studied seasons due to unsprayed one (control). Hence the increment percentage of yield/palm was 21.29 & 18.39% as an av. the two studied seasons due to GA<sub>3</sub> or CPPU spray compared with the control, respectively.

**Table 1. Effect of antioxidants, growth regulators yeast spraying on bunch weight and yield of Seewy dates during 2015 and 2016 seasons.**

Property Treat.	Bunch weight (kg)			Yield (kg/date palm)		
	2015	2016	Mean	2015	2016	Mean
1- Amino acids	12.84	13.98	13.41	115.56	125.82	120.69
2- Yeast	13.27	14.56	13.92	119.43	131.04	125.24
3- Ascorbic acid	12.71	14.20	13.46	114.39	127.80	121.10
4- Citric acid	12.65	13.75	13.20	113.65	123.65	118.70
5- GA <sub>3</sub>	14.10	15.18	14.64	126.90	136.62	131.76
6- CPPU	13.84	14.73	14.29	124.56	132.57	128.57
7- Control	11.68	12.45	12.07	105.12	112.05	108.59
LS.D.	0.82	0.88		6.65	5.96	

**Fruit quality:****Physical properties:**

Data in Tables (2 & 3) show that all the treatments significantly increased fruit weight, flesh %, fruit length (cm) and fruit diameter (cm) and significantly decreased fruit moisture content compared with the control. Spraying GA<sub>3</sub> at 100 ppm gave the highest fruit weight (g), flesh percentage and dimensions compared with an other treatments.

The heaviest fruit weight and size were recorded on bunches that sprayed with GA<sub>3</sub> or CPPU. No significant differences were detected due spray with either GA<sub>3</sub> or CPPU, as well as amino acids, yeast citric acid or ascorbic acid.

The maximum fruit weight (17.50 & 17.16 g as an av. the two studied seasons) was recorded on bunches that sprayed by GA<sub>3</sub> at 100

ppm and CPPU at 15 ppm, respectively. On the other hand, fruit picked from untreated palms recorded the minimum fruit weight (13.94 g as an av. the two studied seasons).

The increment percentages attained 25.54 & 23.31 as an av. of the two studied seasons were obtained due to spray with GA<sub>3</sub> or CPPU compared to unsprayed ones, respectively. These results were true during both seasons.

Generally, the abovementioned results disclosed that GA<sub>3</sub>, CPPU, amino acid, yeast, citric acid and ascorbic acid sprayed greatly improved all fruit physical properties. No significant differences were detected due spray with either GA<sub>3</sub> or CPPU, as well as amino acids, yeast citric acid or ascorbic acid.

**Table 2. Effect of antioxidants, growth regulators and yeast spraying on fruit weight and pulp percentage of Seewy dates during 2015 and 2016 seasons.**

Property Treat.	Fruit weight (gm)			Flesh %		
	2015	2016	Mean	2015	2016	Mean
1- Amino acids	15.25	16.10	15.68	87.32	87.93	87.63
2- Yeast	15.68	16.60	16.14	87.76	88.30	88.03
3- Ascorbic acid	15.50	16.38	15.94	87.54	88.10	87.82
4- Citric acid	15.27	15.93	15.60	88.41	87.96	87.69
5- GA <sub>3</sub>	17.19	17.81	17.50	88.32	88.85	88.59
6- CPPU	16.78	17.53	17.16	87.96	88.56	88.26
7- Control	13.75	14.13	13.94	85.18	85.73	85.46
LS.D.	0.71	0.67		2.19	1.98	

**Table 3. Effect of antioxidants, growth regulators yeast spraying on fruit dimensions and moisture % of Seewy dates during 2015 and 2016 seasons.**

Property Treat.	Moisture %			Fruit length (cm)			Fruit diameter (cm)		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
1- Amino acids	17.12	16.42	16.77	4.13	4.30	4.22	2.34	2.35	2.35
2- Yeast	16.96	16.37	16.67	4.17	4.32	4.25	2.35	2.36	2.36
3- Ascorbic acid	18.66	18.03	18.35	4.10	4.25	4.18	2.32	2.32	2.32
4- Citric acid	18.18	17.58	17.88	4.06	4.20	4.13	2.31	2.33	2.32
5- GA <sub>3</sub>	18.00	17.32	17.66	4.32	4.46	4.39	2.47	2.49	2.48
6- CPPU	17.62	16.93	17.28	4.16	4.28	4.22	2.52	2.56	2.54
7- Control	22.06	21.33	21.70	3.95	4.10	4.03	2.27	2.28	2.28
LS.D.	2.12	1.66		0.10	0.12		0.04	0.05	

### Chemical characteristics:

Results in Tables (4&5) showed that all parameters of fruit chemical characteristics significantly increased when used amino acid spray at 0.50 g/L, ascorbic acid at 500 ppm, citric acid at 500 ppm, yeast at 10 g/L, GA<sub>3</sub> at 100 ppm and CPPU spray at 15 ppm. The highest T.S.S.%, total sugars % and reducing sugars were recorded when spraying amino acid (83.09, 75.31 and 61.06 as an av. the two studied seasons), respectively.

In the opposite, the lowest values of the total acidity % and tannins % recorded when spraying amino acid at 0.50 g/L (0.312 and 0.61% as an av. of the two studied seasons, re-

spectively) compared with other treatments and control. No significant differences in chemical fruit quality due to were found the palms sprayed with GA<sub>3</sub>, CPPU antioxidants and active dry yeast.

Therefore, the respective corresponding increment percentage of total soluble solids attained 6.21% and total sugar 10.93 as an av. the two studied seasons due to amino acids sprayed compared to control, respectively. On the other hand, the corresponding decrement percentage of acidity was 9.03% and tannins 24.69% as an av. of the two studied seasons, respectively.

**Table 4. Effect of antioxidants, growth regulators yeast spraying on TSS, acidity and tannins percentage of Seewy dates during 2015 and 2016 seasons.**

Property Treat.	TSS %			Acidity %			Tannin %		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
1- Amino acids	82.69	83.48	83.09	0.308	0.316	0.312	0.60	0.62	0.61
2- Yeast	82.88	83.52	83.20	0.316	0.325	0.321	0.71	0.71	0.71
3- Ascorbic acid	81.14	81.85	81.49	0.325	0.332	0.329	0.73	0.75	0.74
4- Citric acid	81.62	82.31	81.97	0.329	0.334	0.332	0.75	0.74	0.75
5- GA <sub>3</sub>	81.96	82.56	82.26	0.318	0.326	0.322	0.69	0.73	0.71
6- CPPU	82.28	82.98	82.63	0.312	0.322	0.317	0.75	0.76	0.76
7- Control	77.91	78.54	78.23	0.336	0.349	0.343	0.81	0.80	0.81
LS.D.	2.43	2.69		0.011	0.015		0.03	0.02	

**Table 5. Effect of antioxidants, growth regulators yeast spraying on sugars contents of Seewy dates during 2015 and 2016 seasons.**

Property Treat.	Total sugar %			Reducing sugars %			Non-reducing sugars %		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
1- Amino acids	75.28	75.34	75.31	61.32	60.80	61.06	13.96	14.54	14.25
2- Yeast	75.39	74.70	75.05	60.84	60.44	60.64	14.55	14.26	14.41
3- Ascorbic acid	73.28	72.68	72.98	58.92	58.11	58.52	14.36	14.57	14.47
4- Citric acid	72.50	72.63	72.57	58.61	58.36	58.49	14.09	14.07	14.08
5- GA <sub>3</sub>	73.36	72.98	73.17	59.50	59.10	59.30	13.36	13.88	13.62
6- CPPU	74.58	73.80	74.19	60.24	59.59	59.92	14.34	14.21	14.28
7- Control	68.33	67.45	67.89	55.40	53.93	54.67	12.99	13.52	13.26
LS.D.	3.56	2.83		2.35	2.94		0.62	0.55	

### Discussion

Bio-fertilizers are considered a promising alternative for chemical

fertilizers. It is very safe for human, animals and environment (Verna, 1990). Active dry yeast contains dif-

ferent nutrients, higher percentage of proteins, vitamin B and natural plant growth hormones (Moor, 1979). The results of the present study regarding the effect of active dry yeast agreed with those obtained by (Osman *et al.*, 2011; El-Khayat & El-Noam, 2013 and Mostafa, 2015). Salicylic and citric acids as antioxidant compounds have an auxinic action. They provided disease control and improving growth, yield and fruit quality of fruit crops (Ahmed *et al.*, 2003). In addition, antioxidants had essential metabolic functions in the life of plant. This antioxidant gave resistance to oxidative stress and longevity in plant life. Also, the endogenous level of them has recently been suggested to be important in the regulation of developmental senescence and plant defense against oxidative stress (Arrigoni and Tullo, 2000). Regarding the effect of antioxidants on yield and fruit quality of Seewy dates are in harmony with the findings of Hafez *et al.* (2010), Hafez *et al.* (2011), Ahmed-Dorria *et al.* (2012), Abd El-Razek *et al.* (2013) and Esam *et al.* (2016).

Plant growth regulators play an important role in regulating fruit growth and development. Some of these substances were used in controlling ripening date (delayed ripening) as well as improving the fruit quality (Kassem *et al.*, 2011). CPPU is a new plant growth regulator which has strong cytokinin activity. Using sitofex at 1 to 20 ppm causes great effects on fruit size. The effectiveness of growth regulators was associated with methods of applications, the type of desired response, the developmental stage of the plant at time of

application and other variables (Nickell, 1985 and Ogata *et al.*, 1988).

The promotion effect of GA<sub>3</sub> and CPPU on yield of some palm cultivars was emphasized by Soliman (2007), El-Kosary (2009) and Al-Qurashi *et al.* (2012). They concluded from their studies on different palm cultivars that spraying bunches with GA<sub>3</sub> and CPPU were increased the bunch weight and yield/palm. The improvement of the fruit quality in response to use GA<sub>3</sub> and CPPU were reported by Soliman (2007), Al-Obeed (2010), Kassem *et al.* (2011), Ghazzawy (2013), Merwad *et al.* (2015) and El-Salhy *et al.* (2016).

### Conclusion

From the results of this study it could be concluded that foliar application with amino acid at 0.50 g/L, ascorbic acid at 500 ppm, citric acid at 500 pm, yeast at 10 g/L, GA<sub>3</sub> at 100 ppm and CPPU at 15 ppm was recommended to increase bunch weight, yield/palm and get highest fruit quality when spraying at three times beginning from the first week of May and then Jun and July. However, GA<sub>3</sub> spray at 100 ppm gave the maximum value of bunch weight, yield/ palm and physical properties compared with all treatments. On the other hand, spraying amino acid at 0.50 g/L gave the highest values in the tested chemical fruit properties compared with other treatments of Seewy date palm under this experiment conditions.

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تأثير رش مضادات الأكسدة ومنظمات النمو والخميرة علي إثمار نخيل البلح السيوي  
عبدالفتاح مصطفى الصالحي<sup>١</sup>، إيمان عبد الحكيم عبد الله أبوزيد<sup>١</sup>، يوسف مصطفى سيد دياب<sup>٢</sup>،  
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### الملخص

أجريت هذه الدراسة علي نخيل البلح السيوي المزروعة بمزرعة خاصة بالداخلية - الوادي الجديد - مصر خلال موسمي ٢٠١٥ و ٢٠١٦ بهدف دراسة تأثير رش الأحماض الأمينية وحمض الأسكوربيك وحمض السيتريك والخميرة الجافة وحمض الجبريليك والسيتوفكس علي المحصول وخصائص الثمار. وقد تم الرش ثلاث مرات في الأسبوع الأول من شهر مايو و يونيو و يونيو. وتوضح النتائج الآتي:

- أدت جميع المعاملات إلي زيادة جوهريّة في وزن السباطة ووزن المحصول مقارنة بأشجار الغير مرشوشة (الكنترول)
- تم الحصول علي أعلى وزن للسباطة وبالتالي أعلى وزن للمحصول عند الرش بـ حمض الجبريليك GA<sub>3</sub> بتركيز ١٠٠ ppm ويليه الرش بالسيتوفكس بتركيز ١٥ ppm.
- أدت جميع المعاملات زيادة معنوية في وزن الثمرة والنسبة المئوية للحم وطول وعرض الثمرة وسجلت أعلى القيم عند الرش بـ GA<sub>3</sub> أو CPPU.
- أدت جميع المعاملات تحسناً ملحوظاً في الصفات الكيميائية للثمار حيث تزداد نسبة المواد الصلبة الذائبة الكلية والسكريات في الثمار وتقل النسبة المئوية للحموضة الكلية والتانينات بالثمار وكانت أفضل المعاملات هي الرش بالحمض الأميني بتركيز ٥,٥ جم/لتر.

من نتائج هذه الدراسة يمكن التوصية برش أغاريض نخيل البلح السيوي ثلاث مرات خلال مايو و يونيو و يوليو بإحدى مضادات الأكسدة أو الخميرة بالإضافة إلي حمض الجبريليك أو السيتوفكس وذلك للحصول علي محصول عال ذو خصائص ثمرية جيدة.