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## **RESPONSE OF SAKKOTI DATE PALMS TO FOLIAR APPLICATION OF SALICYLIC ACID**

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### **ABSTRACT**

This study was carried out during 2010 and 2011 seasons to examine the effect of spraying salicylic acid twice, thrice or four times at 50 to 200 ppm on fruiting of Sakkoti date palms grown under Upper Egypt conditions.

Results revealed that applying two, three or four sprays of salicylic acid at 50 to 200 ppm caused a remarkable promotion on total surface area per palm, total chlorophylls, percentages of N, P, K, Mg and total carbohydrates in the leaves, bunch weight, yield and physical and chemical characteristics of the fruits compared with the control (non- application). The promotion was associated with increasing concentrations and frequencies of salicylic acid. Meaningless effect on these parameters was detected among the higher two concentrations and frequencies.

Three sprays of salicylic acid at 100 ppm resulted in the production of economical yield and improving fruit quality of Sakkoti date palms.

### **INTRODUCTION**

Plant growth and development are affected by various biotic and abiotic stress factors. Detection of compounds capable of reducing these stresses are of great important from both theoretical and practical points of view. Salicylic acid compounds play an important role in the developmental processes and some of them have a key roles in the

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mechanism leading to acclimation for changing environments. Salicylic acid has long been known as a signal molecule in the induction of defense mechanisms in plants (Raskin, 1992 and Shah, 2003). Recent studies suggested that it also participates in signaling during abiotic stresses (Harvath *et al.*, 2007). Previous results suggested that salicylic acid could be a promising compound for the reduction of abiotic stress sensitivity in plants, since under certain conditions it was found to mitigate the damaging effects of various stress factors in plants (Harvath *et al.*, 2007) such as heavy metals, high temperature, chilling or salinity (Szepesi *et al.*, 2009) by inducing a wide range of processes involved in stress tolerance mechanisms. It was also shown to influence a number of physiological processes including flowering, ion uptake and transport, photosynthesis rate and stomatal conductance (Raskin, 1992).

Previous studies showed that application of salicylic acid as an important antioxidant was essential in improving growth and fruiting in different evergreen fruit crops (Ahmed *et al.*, 2003; Gobara, 2004; Gamal, 2006; Ahmed *et al.*, 2007 and Badran and Ahmed, 2009).

The purpose of the present study was to elucidate the impact of salicylic acid on growth and fruiting of Sakkoti date palms.

### **MATERIALS AND METHODS**

This study was carried out during 2010 and 2011 seasons in a private orchard situated at Kom Ombo district, Aswan Governorate on 20 years old Sakkoti date palms. Soil texture is silty clay and the plants were planted at 4 × 4 meters apart and irrigation was by using surface system. Pruning was carried out to maintain leaf bunch ratio at 1: 1 (Sayed, 2002). Number of female spathes per each palm was adjusted to 10 spathes. Artificial pollination was achieved by inserting five male strands into the female bunch using known high activity pollen source throughout 2 – 3 days after female spathe cracking followed by bagging. Each selected palm received the common horticultural practices that are already applied in the orchard except those dealing with using salicylic acid.

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This study included ten treatments from different concentrations and frequencies of salicylic acid:

- ١- Control.
- ٢- Spraying salicylic acid twice (growth start and just after fruit set) at ٥٠ ppm.
- ٣- Spraying salicylic acid thrice (growth start, just after fruit set and at one month later) at ٥٠ ppm.
- ٤- Spraying salicylic acid four times (growth start, just after fruit set and one month intervals) at ٥٠ ppm.
- ٥- Spraying salicylic acid twice (growth start and just after fruit set) at ١٠٠ ppm.
- ٦- Spraying salicylic acid thrice (growth start, just after fruit set and at one month later) at ١٠٠ ppm.
- ٧- Spraying salicylic acid four times (growth start, just after fruit set and at one month intervals) at ١٠٠ ppm.
- ٨- Spraying salicylic acid twice (growth start and just after fruit set) at ٢٠٠ ppm.
- ٩- Spraying salicylic acid thrice (growth start, just after fruit set and one month later) at ٢٠٠ ppm.
- ١٠- Spraying salicylic acid four times (growth start, just after fruit set and at one month intervals) at ٢٠٠ ppm.

Each treatment was replicated three times, one palm per each. It is worth to mention that salicylic acid did dissolve in water but it dissolved easily in ethyl alcohol. Triton B as a wetting agent was added at ٠.٠٥ % to all salicylic acid solutions. Untreated palms were sprayed with water containing Triton B and Ethyl alcohol. Completely randomized block design was followed.

During both seasons the following parameters were carried out.

- ١- Total surface area/ palm (m<sup>٢</sup>) according to Ahmed and Morsy (١٩٩٩).
- ٢- Total chlorophylls (mg/ ١٠٠ g F.W) according to Wettstein (١٩٥٧).

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- ٢- Percentages of N, P, K and Mg in the dried leaves according to Chapman and Pratt (١٩٦٥).
- ٤- Percentage of total carbohydrates in the dried leaves was determined according to the procedures that outlined in A.O.A.C. (١٩٩٥).
- ٥- Bunch weight (kg.).
- ٦- Yield/ palm (kg.) at the last week of August.
- ٧- Some physical and chemical characteristics of the fruits namely fruit weight (g.), total soluble solids %, total and reducing sugars % (A.O.A.C, ١٩٩٥), fibre crude % and total soluble tannins % (A.O.A.C, ١٩٩٥), and total acidity % (as g malic acid/ ١٠٠ g pulp according to A.O.A.C, ١٩٩٥).

All the obtained data were tabulated and subjected to the proper statistical analysis using new L.S.D at ٥ % according to Mead *et al.*, (١٩٩٣).

### **RESULTS AND DISCUSSION**

#### **Total surface area per palm and leaf chemical composition:**

It is clear from the data in Tables ١ and ٢ that foliar application of salicylic acid twice, thrice or four times at ٥٠ to ٢٠٠ ppm improved significantly total surface area per palm and total chlorophylls and percentages of N, P, K, Mg and total carbohydrates comparing with non- application. The promotion was associated with increasing concentrations and frequencies of salicylic acid. Increasing concentrations from ١٠٠ to ٢٠٠ ppm and frequencies from thrice to four times of salicylic acid had no significant stimulation on these parameters. The maximum values were recorded on palms that received four sprays of salicylic acid at ٢٠٠ ppm. Untreated palms produced the minimum values. Similar trend was noticed during ٢٠١٠ and ٢٠١١ seasons.

These results might be attributed to the positive action of salicylic acid on enhancing cell division, the biosynthesis of organic foods and uptake of nutrients and reducing various stresses (Raskin, ١٩٩٢).

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These results are in agreement with those obtained by Ahmed *et al.*, (٢٠٠٣); Gobara (٢٠٠٤); Gamal (٢٠٠٦); Ahmed *et al.*, (٢٠٠٧) and Badran and Ahmed (٢٠٠٩).

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**Table 1: Effect of different concentrations and frequencies of salicylic acid on total surface area per palm, total chlorophylls (mg/ 100 g F.W) and percentages of N and P in the leaves of Sakkoti date palms during 2010 and 2011 seasons.**

Character	Total surface area/ palm (m <sup>2</sup> )		Total chlorophylls (mg/ 100 g F.W)	
	2010	2011	2010	2011
<b>Salicylic acid treatments</b>	20.10	20.11	20.10	20.11
1- Control	15.0	15.0	26.0	27.0
2- Salicylic acid at 50 ppm twice	16.0	17.0	28.0	29.0
3- Salicylic acid at 50 ppm thrice	18.0	19.0	30.0	31.0
4- Salicylic acid at 50 ppm four times	18.2	19.7	31.0	31.0
5- Salicylic acid at 100 ppm twice	19.0	20.0	30.0	36.0
6- Salicylic acid at 100 ppm thrice	22.0	23.0	38.0	39.0
7- Salicylic acid at 100 ppm four times	23.0	23.0	38.0	39.7
8- Salicylic acid at 200 ppm twice	20.0	20.0	30.0	36.0
9- Salicylic acid at 200 ppm thrice	23.0	23.0	38.0	39.0
10- Salicylic acid at 200 ppm four times	23.2	24.0	39.0	40.0
<b>New L.S.D at 5 %</b>	1.0	1.1	1.6	1.7
Character	Leaf N %		Leaf P %	
1- Control	1.79	1.72	0.11	0.13
2- Salicylic acid at 50 ppm twice	1.79	1.84	0.10	0.16
3- Salicylic acid at 50 ppm thrice	1.91	1.96	0.20	0.21
4- Salicylic acid at 50 ppm four times	1.92	1.97	0.21	0.21
5- Salicylic acid at 100 ppm twice	2.06	2.12	0.20	0.26
6- Salicylic acid at 100 ppm thrice	2.18	2.24	0.30	0.32
7- Salicylic acid at 100 ppm four times	2.20	2.20	0.31	0.33
8- Salicylic acid at 200 ppm twice	2.07	2.13	0.26	0.26
9- Salicylic acid at 200 ppm thrice	2.19	2.20	0.31	0.33
10- Salicylic acid at 200 ppm four times	2.21	2.26	0.32	0.34
<b>New L.S.D at 5 %</b>	0.06	0.07	0.03	0.03

**Bunch weight and yield per palm:**

Data in Tables 2 and 3 show that foliar application of salicylic acid at 50 to 200 ppm twice, thrice or four times were significantly very effective in improving bunch weight and yield per palm

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comparing with the control treatment. A gradual promotion was observed on bunch weight and yield per palm with increasing concentrations and frequencies of salicylic acid. Significant differences on such two parameters were observed among all concentrations and frequencies of salicylic acid except among the higher two concentrations namely 100 and 200 ppm and two frequencies namely three or four times. Therefore, from economical point of view, it is advised to use salicylic acid at 100 ppm thrice. Under such promised treatment, yield per palm reached 110 and 116 kg during both seasons, respectively in relative to 81 and 83 kg produced by each untreated palms. Similar trend was observed during both seasons. The essential role of salicylic acid on stimulating growth and nutritional status in favour of producing greater fruit retention surely reflected on improving the yield. These results are in agreement with those obtained by Ahmed *et al.*, (2003); Gobara (2004); Gamal (2006); Ahmed *et al.*, (2007) and Badran and Ahmed (2009).

#### Physical and chemical characteristics of the fruits:

Data in Tables 3 and 4 clearly show that spraying salicylic acid twice, thrice or four times at 50 to 200 ppm significantly was accompanied with improving fruit quality in terms of increasing fruit weight, total soluble solids and total and reducing sugars and decreasing total acidity, crude fibre and total soluble tannins comparing with the control treatment. The promotion on fruit quality was associated with increasing concentrations and frequencies of salicylic acid. No significant differences on these parameters were observed among the higher two concentrations (100 and 200 ppm) and two frequencies (three or four times). The best results from economical point of view on fruit quality were observed with using salicylic acid thrice at 100 ppm. Unfavourable effects on fruit quality were observed on untreated palms. These results were true during 2010 and 2011 seasons.

The promoting effect of salicylic acid on improving the biosynthesis and translocation of plant pigments and sugars (Raskin, 1992) could result in enhancing fruit quality.

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These results are in agreement with those obtained by Ahmed *et al.*, (٢٠٠٣); Gobara (٢٠٠٤); Gamal (٢٠٠٦); Ahmed *et al.*, (٢٠٠٧) and Badran and Ahmed (٢٠٠٩).

As a conclusion, treating Sakkoti date palms thrice with salicylic acid at ١٠٠ ppm gave the best results with regard to yield and fruit quality.

**Table ٢: Effect of different concentrations and frequencies of salicylic acid on the percentages of K, Mg and total carbohydrates in the leaves and bunch weight of Sakkoti date palms during ٢٠١٠ and ٢٠١١ seasons.**

Character	Leaf K %		Leaf Mg %	
<b>Salicylic acid treatments</b>	٢٠١٠	٢٠١١	٢٠١٠	٢٠١١
١- Control	١.٤١	١.٤٢	٠.٢٢	٠.٢٢
٢- Salicylic acid at ٥٠ ppm twice	١.٤٧	١.٤٨	٠.٢٦	٠.٢٦
٣- Salicylic acid at ٥٠ ppm thrice	١.٥٥	١.٥٦	٠.٣٠	٠.٣٠
٤- Salicylic acid at ٥٠ ppm four times	١.٥٦	١.٥٧	٠.٣١	٠.٣١
٥- Salicylic acid at ١٠٠ ppm twice	١.٦٤	١.٦٦	٠.٣١	٠.٣١
٦- Salicylic acid at ١٠٠ ppm thrice	١.٧٤	١.٧٦	٠.٣٦	٠.٣٦
٧- Salicylic acid at ١٠٠ ppm four times	١.٧٥	١.٧٧	٠.٣٧	٠.٣٧
٨- Salicylic acid at ٢٠٠ ppm twice	١.٦٥	١.٦٦	٠.٣١	٠.٣١
٩- Salicylic acid at ٢٠٠ ppm thrice	١.٧٥	١.٧٧	٠.٣٦	٠.٣٧
١٠- Salicylic acid at ٢٠٠ ppm four times	١.٧٦	١.٧٨	٠.٣٨	٠.٣٨
<b>New L.S.D at ٥ %</b>	٠.٠٥	٠.٠٥	٠.٠٢	٠.٠٢
Character	Total Carbohydrates %		Bunch weight (Kg.)	
١- Control	١٦.٠	١٦.٥	٨.١	٨.٣
٢- Salicylic acid at ٥٠ ppm twice	١٧.٠	١٧.٦	٨.٥	٨.٧
٣- Salicylic acid at ٥٠ ppm thrice	١٨.٠	١٨.٦	٩.٠	٩.٤
٤- Salicylic acid at ٥٠ ppm four times	١٨.٢	١٨.٧	٩.١	٩.٥
٥- Salicylic acid at ١٠٠ ppm twice	١٩.٩	٢٠.١	١٠.٠	١٠.٥
٦- Salicylic acid at ١٠٠ ppm thrice	٢١.٠	٢١.٩	١١.٠	١١.٦
٧- Salicylic acid at ١٠٠ ppm four times	٢١.٠	٢٢.٠	١١.٢	١١.٧
٨- Salicylic acid at ٢٠٠ ppm twice	٢٠.٠	٢٠.١	١٠.٠	١٠.٥
٩- Salicylic acid at ٢٠٠ ppm thrice	٢١.٠	٢٢.٠	١١.٠	١١.٦
١٠- Salicylic acid at ٢٠٠ ppm four times	٢١.٢	٢٢.٢	١١.٣	١١.٧
<b>New L.S.D at ٥ %</b>	٠.٥	٠.٥	٠.٣	٠.٣



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**Table 3: Effect of different concentrations and frequencies of salicylic acid on the yield/ palm (kg.) as well as some physical and chemical characteristics of the fruits of Sakkoti date palms during 2010 and 2011 seasons.**

Character	Yield/ palm (kg.)		Fruit weight (g.)	
	2010	2011	2010	2011
<b>Salicylic acid treatments</b>				
1- Control	81.0	83.0	9.0	10.0
2- Salicylic acid at 00 ppm twice	80.0	87.0	9.9	10.0
3- Salicylic acid at 00 ppm thrice	90.0	94.0	10.3	11.1
4- Salicylic acid at 00 ppm four times	91.0	90.0	10.4	11.2
5- Salicylic acid at 100 ppm twice	100.0	100.0	10.9	11.0
6- Salicylic acid at 100 ppm thrice	110.0	116.0	11.4	11.0
7- Salicylic acid at 100 ppm four times	112.0	117.0	11.0	11.6
8- Salicylic acid at 200 ppm twice	100.0	100.0	11.0	11.0
9- Salicylic acid at 200 ppm thrice	110.0	116.0	11.0	11.6
10- Salicylic acid at 200 ppm four times	113.0	117.0	11.6	11.7
<b>New L.S.D at 0 %</b>	<b>3.0</b>	<b>2.9</b>	<b>0.3</b>	<b>0.3</b>
<b>Character</b>	<b>T.S.S %</b>		<b>Total sugars %</b>	
1- Control	78.0	79.0	72.0	73.0
2- Salicylic acid at 00 ppm twice	78.6	79.7	73.0	74.6
3- Salicylic acid at 00 ppm thrice	79.6	70.6	70.0	76.6
4- Salicylic acid at 00 ppm four times	70.0	71.0	76.0	76.8
5- Salicylic acid at 100 ppm twice	71.9	72.9	78.6	79.7
6- Salicylic acid at 100 ppm thrice	74.0	70.0	70.3	71.0
7- Salicylic acid at 100 ppm four times	74.2	70.2	70.0	71.3
8- Salicylic acid at 200 ppm twice	72.0	73.0	78.6	70.0
9- Salicylic acid at 200 ppm thrice	74.0	70.0	70.0	71.0
10- Salicylic acid at 200 ppm four times	74.4	70.0	70.6	71.0
<b>New L.S.D at 0 %</b>	<b>0.0</b>	<b>0.0</b>	<b>0.4</b>	<b>0.4</b>

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**Table 4: Effect of different concentrations and frequencies of salicylic acid on some chemical characteristics of the fruits of Sakkoti date palms during 2010 and 2011 seasons.**

Character	Reducing sugars %		Total acidity %	
	2010	2011	2010	2011
<b>Salicylic acid treatments</b>				
1- Control	13.0	13.0	0.377	0.371
2- Salicylic acid at 00 ppm twice	13.0	13.7	0.350	0.340
3- Salicylic acid at 00 ppm thrice	14.0	14.8	0.310	0.300
4- Salicylic acid at 00 ppm four times	14.6	14.9	0.308	0.303
5- Salicylic acid at 100 ppm twice	15.9	16.0	0.270	0.260
6- Salicylic acid at 100 ppm thrice	16.9	17.1	0.230	0.220
7- Salicylic acid at 100 ppm four times	17.0	17.2	0.228	0.223
8- Salicylic acid at 200 ppm twice	16.0	16.0	0.269	0.264
9- Salicylic acid at 200 ppm thrice	17.0	17.1	0.229	0.224
10- Salicylic acid at 200 ppm four times	17.1	17.3	0.226	0.221
<b>New L.S.D at 0 %</b>	0.3	0.3	0.020	0.022
Character	Fibre crude %		Total soluble tannins %	
1- Control	2.11	2.08	0.66	0.69
2- Salicylic acid at 00 ppm twice	2.06	2.00	0.61	0.60
3- Salicylic acid at 00 ppm thrice	2.00	1.91	0.50	0.54
4- Salicylic acid at 00 ppm four times	1.99	1.91	0.54	0.53
5- Salicylic acid at 100 ppm twice	1.90	1.80	0.33	0.31
6- Salicylic acid at 100 ppm thrice	1.70	1.66	0.27	0.24
7- Salicylic acid at 100 ppm four times	1.68	1.60	0.26	0.23
8- Salicylic acid at 200 ppm twice	1.87	1.79	0.32	0.30
9- Salicylic acid at 200 ppm thrice	1.69	1.60	0.26	0.23
10- Salicylic acid at 200 ppm four times	1.67	1.64	0.20	0.22
<b>New L.S.D at 0 %</b>	0.03	0.03	0.03	0.03

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### استجابة نخيل البلح السكوتي للرش الورقي بحامض السلسليك

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أجريت هذه الدراسة خلال موسمي ٢٠١٠، ٢٠١١ لاختبار تأثير رش حامض السلسليك مرتان، ثلاثة أو أربعة مرات بتركيز ما بين ٥٠ إلى ٢٠٠ جزء في المليون علي الإثمار في نخيل البلح السكوتي النامي تحت ظروف مصر العليا. أشارت نتائج الدراسة أن رش حامض السلسليك مرتان، ثلاثة أو أربعة مرات بتركيز ما بين ٥٠ إلى ٢٠٠ جزء في المليون أدى إلي حدوث تحسين واضح في المسطح الكلي للأوراق للنخلة والكلوروفيل الكلي، والنسب المئوية للنيتروجين والفوسفور والبوتاسيوم والماغنيسيوم والكربوهيدرات الكلية في الأوراق، وزن السويطة وكمية محصول النخلة وكذلك الخصائص الطبيعية والكيميائية للثمار وذلك بالمقارنة بعدم استخدام حامض السلسليك وكان التحسن متوافقا مع زيادة التركيز وعدد مرات الاستخدام لهذا الحامض ولم يكن هناك فرق محسوس علي هذه المقاييس ما بين اعلي تركيزين وعدد مرات رش. أدى رش حامض السلسليك ثلاثة مرات بتركيز ١٠٠ جزء في المليون الي الحصول علي محصول اقتصادي وتحسين خصائص الجودة للثمار في نخيل البلح السكوتي.