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INSIGHT ON THE EFFECTS OF SALICYLIC ACID ON FRUITING OF WILLIAMS BANANA

H. H. M. Saied.
South Valley Univ. Aswan, Egypt.

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ABSTRACT

This study focused on the effects of salicylic acid on growth, yield as well as physical and chemical characteristics of bananas fruits during ٢٠٠٩ and ٢٠١٠ seasons. Williams bananas received two, three or four sprays of salicylic acid at ٥٠ to ٢٠٠ ppm

Applying two, three or four sprays of salicylic acid at ٥٠ to ٢٠٠ ppm caused improving of plant height and girth, total surface area per plant, nutrients namely N and P in the leaves, weights of bunch, hand and finger, total soluble solids as well as total and reducing sugars and decreasing total acidity compared with the control treatment. The promotion effect was associated with increasing salicylic acid concentrations from ٥٠ to ٢٠٠ ppm and frequencies from twice to four times. Negligible effect was observed at the higher two concentrations and frequencies of salicylic acid on the studied parameters.

Treating Williams bananas thrice with salicylic acid at ١٠٠ ppm was accompanied with improving yield quantitively and qualitatively.

INTRODUCTION

Plant growth and development are hampered by various biotic and abiotic stress factors. Detection of compounds capable of reducing these stresses are of great importance from both theoretical and practical points of view. Salicylic acid compounds play an important

role in developmental prosses and some of them have key roles in 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, ١٩٩٢ and Shah, ٢٠٠٣). Recent studies suggested that it participates in signaling during abiotic stresses (Harvath *et al*., ٢٠٠٧). 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 has been found to mitigate the damaging effects of various stress factors in plants (Harvath *et al*., ٢٠٠٧) such as heavy metals, high temperature, chilling or salinity (Szepesi *et al*., ٢٠٠٩) 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, ١٩٩٢).

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*., ٢٠٠٣; Gobara, ٢٠٠٤; Gamal, ٢٠٠٦; Ahmed *et al*., ٢٠٠٧ and Badran and Ahmed, ٢٠٠٩).

This study was conducted to examine the beneficial effects of using salicylic acid at various concentrations and frequencies on growth and fruiting of Williams bananas.

MATERIALS AND METHODS

This study was conducted during ٢٠٠٩ and ٢٠١٠ seasons on the second and third ratoons of Williams bananas in a private orchard located at Kom Ombo district, Aswan Governorate where the soil is silty clay. The stools which are cultivated at a spacing of ٣.٥ meters were thinned to leave three suckers for fruiting in the following season in addition to the three suckers that would give the crop of the current season. All horticultural practices except the application of salicylic acid were done as usual. The experiment included ten treatments:

١- Control.
٢- Spraying salicylic acid twice at ٥٠ ppm.
٣- Spraying salicylic acid thrice at ٥٠ ppm.

٤- Spraying salicylic acid four times at ٥٠ ppm.
٥- Spraying salicylic acid twice at ١٠٠ ppm.
٦- Spraying salicylic acid thrice at ١٠٠ ppm.
٧- Spraying salicylic acid four times at ١٠٠ ppm.
٨- Spraying salicylic acid twice at ٢٠٠ ppm.
٩- Spraying salicylic acid thrice at ٢٠٠ ppm.
١٠- Spraying salicylic acid four times at ٢٠٠ ppm.

Each treatment was replicated three times, one stool per each. Salicylic acid (soluble in Ethyl alcohol) was applied twice (growth start and before inflorescence emergence), thrice (the two previous dates and at one month later) or four times (the three previous dates and at one month later). Triton B as a wetting agent at ٠.٠٥ % was added to all salicylic acid solutions.

The experiment was set up in complete randomized block design with three replicates each was represented with one Williams banana stool.

Plant height (cm.) and girth (cm.) as well as total surface area per plant (m^2) were recorded after the end of salicylic acid application (according to Ahmed and Morsy, ١٩٩٩). Percentages of N and P in the leaves were determined according to Chapman and Pratt (١٩٦٥). The bunches were picked at the middle of Dec. during both seasons when the fingers reached the full mature stage and the weight was recorded. After artificial ripening, weights of hand and finger, total soluble solids total and reducing sugars (A.O.A.C, ١٩٩٥) and total acidity (as g citric acid/ ١٠٠ g pulp) were determined.

Statistical analysis was carried out using new L.S.D at ٥ % according to Gomez and Gomez (١٩٨٤).

RESULTS AND DISCUSSION

Growth characters and percentages of N and P in the leaves:

Data in Tables ١ and ٢ clearly show that foliar application of salicylic acid either twice, thrice or four times at ٥٠ to ٢٠٠ ppm significantly promoted the three growth characters namely height and girth of pseudostem and total surface area per plant as well as

percentages of N and P in the leaves rather than non- application. The promotion was associated with increasing concentrations from ٥٠ to ٢٠٠ ppm and frequencies from twice to four times. Increasing concentrations from ١٠٠ to ٢٠٠ ppm and frequencies from three to four times had no significant promotion on these parameters. The maximum values were recorded on the plants that received four sprays of salicylic acid at ٢٠٠ ppm. Untreated plants gave the minimum values. Similar trend was observed during the two experimental seasons.

These results could be attributed to the positive action of salicylic acid on enhancing all division, the biosynthesis of organic foods and uptake of nutrients (Raskin, ١٩٩٢).

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).

Weights of Bunch and hand:

It is clear from the data in Table ٢ that weights of bunch and hand were significantly improved with using salicylic acid twice, thrice or four times at ٥٠ to ٢٠٠ compared to the control treatment. A gradual promotion on weights of bunch and hand was observed with increasing concentrations from ٥٠ to ٢٠٠ ppm and frequencies of salicylic acid from twice to four times. Meaningless promotion on weights of bunch and hand was observed with the higher two concentrations and frequencies. Therefore, the recommended concentration and frequency of salicylic acid were ١٠٠ and thrice, respectively. At this treatment, bunch weight reached ٢٣ and ٢٣.٥ kg during both seasons, respectively. Untreated plants gave bunch had weights of ١٦ and ١٧ kg during ٢٠٠٩ and ٢٠١٠ season, respectively. Similar trend was attained during both seasons.

The essential role of salicylic acid on stimulating growth and nutritional status in favour of producing greater fruit number and weight surely reflected in improving the yield.

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).

Physical and chemical characteristics of the fruits:

Data in Tables ٢ and ٣ clearly show that using salicylic acid twice, thrice or four times at ٥٠ to ٢٠٠ ppm significantly improved fruit quality in terms of increasing finger weight, total soluble solids as well as total and reducing sugars and decreasing total acidity compared with the control treatment. The promotion was associated with increasing concentrations and frequencies of salicylic acid. No significant differences on quality parameters were observed among the higher two concentrations and frequencies of salicylic acid. Thus the best results with regard to quality of the fruits from economical point of view were obtained with using three sprays of salicylic acid at ١٠٠ ppm. Unfavorable effects on quality of the fruits were observed on untreated plants. Similar trend was revealed during both seasons.

The promoting effect of salicylic acid on improving the biosynthesis and translocation of plant pigments and sugars (Raskin, ١٩٩٢) could result in enhancing fruit quality.

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 Williams banana plants three times with salicylic acid at ١٠٠ ppm gave the best results with regard to yield and fruit quality.

Table ١: Effect of different concentrations and frequencies of salicylic acid on some growth characters and percentage of N in the leaves of Williams banana plants during ٢٠٠٩ and ٢٠١٠ seasons.

Character	Plant height (cm.)		Plant girth (cm.)	
Salicylic acid treatments	٢٠٠٩	٢٠١٠	٢٠٠٩	٢٠١٠
١- Control	١٩٠.٠	١٩٤.٠	٥٧.٩	٥٨.٢
٢- Salicylic acid at ٥٠ ppm twice	١٩٣.٣	١٩٨.٠	٦٠.٠	٦١.٥
٣- Salicylic acid at ٥٠ ppm thrice	١٩٧.٩	٢٠٥.٠	٦٢.٠	٦٣.٥
٤- Salicylic acid at ٥٠ ppm four times	١٩٨.٠	٢٠٦.٠	٦٢.٥	٦٤.٠
٥- Salicylic acid at ١٠٠ ppm twice	٢٠٨.٠	٢١٢.٠	٦٩.٠	٧١.٠
٦- Salicylic acid at ١٠٠ ppm thrice	٢١٢.٠	٢١٨.٠	٧٢.٠	٧٤.٠
٧- Salicylic acid at ١٠٠ ppm four times	٢١٣.٠	٢١٩.٠	٧٢.٥	٧٤.٥
٨- Salicylic acid at ٢٠٠ ppm twice	٢٠٩.٠	٢١٣.٠	٧٠.٠	٧١.٥
٩- Salicylic acid at ٢٠٠ ppm thrice	٢١٣.٠	٢١٩.٠	٧٢.٥	٧٤.٥
١٠- Salicylic acid at ٢٠٠ ppm four times	٢١٤.٠	٢٢٠.٠	٧٣.٠	٧٥.٠
New L.S.D at ٥ %	**٢.٩**	**٣.٠**	**١.٥**	**١.٦**
Character	**Total leaf area/ plant (m^2)**		**Leaf N %**	
١- Control	٩.٠	٩.٦	١.٩٩	٢.٠١
٢- Salicylic acid at ٥٠ ppm twice	١٠.٠	١٠.٧	٢.٠٧	٢.١٢
٣- Salicylic acid at ٥٠ ppm thrice	١١.٠	١١.٨	٢.١٥	٢.٢٢
٤- Salicylic acid at ٥٠ ppm four times	١١.٢	١٢.٠	٢.١٦	٢.٢٣
٥- Salicylic acid at ١٠٠ ppm twice	١٢.٢	١٣.٠	٢.٣١	٢.٥٠
٦- Salicylic acid at ١٠٠ ppm thrice	١٤.٠	١٥.٥	٢.٤٩	٢.٦١
٧- Salicylic acid at ١٠٠ ppm four times	١٤.٣	١٥.٨	٢.٥٠	٢.٦٢
٨- Salicylic acid at ٢٠٠ ppm twice	١٢.٥	١٣.٢	٢.٣٣	٢.٥١
٩- Salicylic acid at ٢٠٠ ppm thrice	١٤.٢	١٥.٧	٢.٥٠	٢.٦٢
١٠- Salicylic acid at ٢٠٠ ppm four times	١٤.٥	١٦.٠	٢.٥٢	٢.٦٤
New L.S.D at ٥ %	**٠.٦**	**٠.٧**	**٠.٠٥**	**٠.٠٦**

Effect of salicylic acid on Williams banana

Table ٢: Effect of different concentrations and frequencies of salicylic acid on the percentage of P as well as weights of bunch, hand and finger of Williams banana plants during ٢٠٠٩ and ٢٠١٠ seasons.

Character	Leaf P %		Bunch weight (kg.)	
Salicylic acid treatments	٢٠٠٩	٢٠١٠	٢٠٠٩	٢٠١٠
١- Control	٠.١١	٠.١٢	١٦.٠	١٧.٠
٢- Salicylic acid at ٥٠ ppm twice	٠.١٤	٠.١٦	١٧.٥	١٩.٠
٣- Salicylic acid at ٥٠ ppm thrice	٠.١٧	٠.١٩	١٩.٠	٢٠.٥
٤- Salicylic acid at ٥٠ ppm four times	٠.١٨	٠.٢٠	١٩.٥	٢١.٠
٥- Salicylic acid at ١٠٠ ppm twice	٠.٢٠	٠.٢٢	٢١.٥	٢٢.٠
٦- Salicylic acid at ١٠٠ ppm thrice	٠.٢٤	٠.٢٤	٢٣.٠	٢٣.٥
٧- Salicylic acid at ١٠٠ ppm four times	٠.٢٥	٠.٢٥	٢٣.٥	٢٣.٦
٨- Salicylic acid at ٢٠٠ ppm twice	٠.٢١	٠.٢٢	٢٢.٠	٢٢.٠
٩- Salicylic acid at ٢٠٠ ppm thrice	٠.٢٥	٠.٢٤	٢٣.٠	٢٤.٠
١٠- Salicylic acid at ٢٠٠ ppm four times	٠.٢٦	٠.٢٦	٢٣.٦	٢٤.٠
New L.S.D at ٥ %	٠.٠٢	٠.٠٢	١.١	١.٠
Character	**Hand weight (kg.)**		**Finger weight (g.)**	
١- Control	١.٦٢	١.٦٤	٨٥.٥	٨٦.٠
٢- Salicylic acid at ٥٠ ppm twice	١.٧٢	١.٧٥	٨٨.٩	٩٠.٠
٣- Salicylic acid at ٥٠ ppm thrice	١.٩٠	١.٩٢	٩١.٩	٩٣.٠
٤- Salicylic acid at ٥٠ ppm four times	١.٩٢	١.٩٤	٩٢.٠	٩٣.٠
٥- Salicylic acid at ١٠٠ ppm twice	٢.١٢	٢.١٥	٩٥.٠	٩٦.٥
٦- Salicylic acid at ١٠٠ ppm thrice	٢.٢٩	٢.٣٢	٩٧.٥	٩٩.٩
٧- Salicylic acid at ١٠٠ ppm four times	٢.٣٠	٢.٣٣	٩٨.٠	١٠٠.٠
٨- Salicylic acid at ٢٠٠ ppm twice	٢.١٣	٢.١٦	٩٥.٥	٩٧.٠
٩- Salicylic acid at ٢٠٠ ppm thrice	٢.٣٠	٢.٣٣	٩٨.٠	١٠٠.٠
١٠- Salicylic acid at ٢٠٠ ppm four times	٢.٣٢	٢.٣٤	٩٨.٥	١٠١.٠
New L.S.D at ٥ %	٠.٠٦	٠.٠٧	١.٩	٢.٠

Table ٣: Effect of different concentrations and frequencies of salicylic acid on some chemical characteristics of the fruits of Williams banana plants during ٢٠٠٩ and ٢٠١٠ seasons.

Character	T.S.S %		Total sugars %	
Salicylic acid treatments	**٢٠٠٩**	**٢٠١٠**	**٢٠٠٩**	**٢٠١٠**
١- Control	١٩.٠	١٩.٠	١٦.٠	١٦.١
٢- Salicylic acid at ٥٠ ppm twice	١٩.٤	١٩.٥	١٦.٤	١٦.٦
٣- Salicylic acid at ٥٠ ppm thrice	١٩.٧	٢٠.٠	١٦.٨	١٧.٠
٤- Salicylic acid at ٥٠ ppm four times	١٩.٨	٢٠.١	١٦.٩	١٧.١
٥- Salicylic acid at ١٠٠ ppm twice	٢٠.٦	٢٠.٩	١٧.٤	١٧.٨
٦- Salicylic acid at ١٠٠ ppm thrice	٢١.٠	٢٢.٩	١٨.٥	١٨.٩
٧- Salicylic acid at ١٠٠ ppm four times	٢١.٢	٢٣.٠	١٨.٦	١٩.٠
٨- Salicylic acid at ٢٠٠ ppm twice	٢٠.٧	٢١.٠	١٧.٥	١٧.٩
٩- Salicylic acid at ٢٠٠ ppm thrice	٢١.٠	٢٣.٠	١٨.٦	١٩.٠
١٠- Salicylic acid at ٢٠٠ ppm four times	٢١.٣	٢٣.١	١٨.٧	١٩.١
New L.S.D at ٥ %	**٠.٢**	**٠.٢**	**٠.٣**	**٠.٢**
Character	**Reducing sugars %**		**Total acidity %**	
١- Control	٦.٦	٦.٧	٠.٣٨٠	٠.٣٨٥
٢- Salicylic acid at ٥٠ ppm twice	٦.٩	٧.٠	٠.٣٥٥	٠.٣٦٤
٣- Salicylic acid at ٥٠ ppm thrice	٧.٢	٧.٣	٠.٣٢٥	٠.٣٤٠
٤- Salicylic acid at ٥٠ ppm four times	٧.٣	٧.٤	٠.٣٢٠	٠.٣٣٧
٥- Salicylic acid at ١٠٠ ppm twice	٧.٦	٨.٠	٠.٣٠٠	٠.٢٩٩
٦- Salicylic acid at ١٠٠ ppm thrice	٧.٩	٨.٣	٠.٢٧٠	٠.٢٦٠
٧- Salicylic acid at ١٠٠ ppm four times	٨.٠	٨.٣	٠.٢٦٥	٠.٢٥٥
٨- Salicylic acid at ٢٠٠ ppm twice	٧.٦	٨.١	٠.٢٩٧	٠.٢٩٤
٩- Salicylic acid at ٢٠٠ ppm thrice	٨.٠	٨.٤	٠.٢٦٨	٠.٢٥٥
١٠- Salicylic acid at ٢٠٠ ppm four times	٨.١	٨.٥	٠.٢٦٤	٠.٢٥٢
New L.S.D at ٥ %	**٠.٢**	**٠.٢**	**٠.٠١٧**	**٠.٠٢٠**

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نظرة الي تأثيرات حامض السلسليك علي الاثـمـار في الموز الوليامز

حسين حمدان محمد سعيد

جامعة جنوب الوادي – أسوان – مصر.

خلال موسمي ٢٠٠٩، ٢٠١٠ تم رش نباتات الموز الوليامز مرتان، ثلاثة أو أربعة مرات بحامض السلسليك بتركيز ما بين ٥٠ إلي ٢٠٠ جزء في المليون ولقد تركزت الدراسة علي التأثيرات المختلفة لحامض السلسليك علي النمو وكمية المحصول وكذلك الخصائص الطبيعية والكيميائية للثمار.

وجد أن رش حامض السلسليك مرتان، ثلاثة أو أربعة مرات بتركيز ما بين ٥٠ إلي ٢٠٠ جزء في المليون يكون فعالا في تحسين ارتفاع ومحيط الساق الكاذب ومساحة الاوراق الكلية للنبات الواحد وعنصر النيتروجين والفوسفور في الأوراق وأوزان السوباطة والكف والصباع والنسبة المئوية للمواد الصلبة الذائبة الكلية والسكريات الكلية والمختزلة وفي نقص النسبة المئوية للحموضة الكلية وذلك بالمقارنة بمعاملة الكونترول وكان التحسن مرتبطا بزيادة التركيزات من ٥٠ الي ٢٠٠ جزء في المليون وعدد مرات الاستخدام من مرتان الي اربعة مرات وكان التأثير طفيف ما بين التركيزين وعدد مرات الاستخدام الاعلي علي الصفات تحت الدراسة.

إن معاملة نباتات الموز الوليامز ثلاثة مرات بحامض السلسليك بتركيز ١٠٠ جزء في المليون يكون مصحوبا بتحسين المحصول كما ونوعا.