Impact of Spraying Some Antitranspirants on Fruiting of Williams Bananas Grown Under Aswan Region Conditions

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Abstract: During 2011/ 2012 and 2012/ 2013 seasons, Williams bananas plants grown under Aswan region conditions were sprayed with eight antitranspirants namely green miracle, salicylic acid, vapor guard, pureshade, sunscreen, calcium carbohydrate, kaoline and chitosane each at 2% (except salicylic acidthat used at 0.05%) in addition to the control treatment. The plants received four sprays at the first week of April and at one month intervals. The goal was examining the positive action of these antitranspirants on growth and fruiting of the plants. Treating the plants with all anti-transpirants was very essential in enhancing growth, nutritional status of the plants yield and fruit quality and reducing total phenols, proline and leaf osmotic pressure comparing with the control treatment. The best antitranspirants in this respect was chitosane followed by kaoline. Spraying Williams banana plants grown under Aswan region conditions four times (April, May, June and July) with the antitranspirants chistosan or kaoline at 2% was very effective for promoting yield and fruit quality.
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1. Introduction

The lack of water is the major restricting factor to cultivation of bananas in arid and semi arid regions. Water deficit occurs whenever the loss of water in transpiration exceeds the rate of absorption. It is characterized by the reduction in water content accompanied with the loss of turgor, closure of stomata andinhibit growth and photosynthesis process **(Boyer, 1995 and Hassan, 1998).**

There is critical need to balance water availability, water requirements and water consumption thus water conserving is becoming a decisive consideration for agriculture, particularly in arid and semi-arid regions where water is the main limiting factor for plant growth. Moreover, plants are prodigal in thewater use because only roughly 5% of water uptake is used forits growth and development while the remaining 95% is lost fortranspiration (**Prakash and Ramachandran, 2000**).

Certain chemical with some biological activities could be used to reduce the transpiration rate and mitigate plant water stress by increasing the leaf resistance to the diffusion of water vapor. Based on their mechanism of action, such antitranspirants were grouped into three categories namely film-forming types(which coat leaf surface with films that are impervious to water vapor), reflecting materials (which reflect back a portion of theradiation falling on the upper surface of the leaves) and stomatal closing types (which affect the metabolic processes in leaf tissues). Film forming and reflecting antitranspirants were found to be non- toxic and have longer period of effectiveness than metabolic types. Moreover, in contrast to most film-forming antitranspirants which are impermeable to CO_2exchange and thus may reduce the rate of photosynthesis, the pinolene-base Vapor gard has not been reported to reduce the photosynthetic rate. It dries on plants to form a clear, glossy film which retards normal moisture dose without interfering with plant growth or normal respiration. It is also safe for human use as well as it has been used on various fruit crops. In addition, a reflective Kaolin spray was found to decrease leaf temperature by increasing leaf reflectance and to reduce transpiration rate more than photosynthesis in many plant species grown at highsolar radiation levels. (**Bergovis *et al.*,2001;Cheng *et al.*, 2008 and Peter, 2008**)

Using antitranspirants will lower the surface tension of water, which increases the efficiency of water penetration but reduces the build-up of water droplets on the plant. This can lead to a reduction in the incidence of scorch during bright weather conditions and the time available for any fungal sporesto try and germinate on the leaf surface. Some products coat the leaf surface with a thin plastic film which prevents water loss. When it is applied to plant tissue it forms a very thin, transparent layer over the leaves and stems. Application is recommended early in the morning or late afternoon. Once dry, the coating allows gases to permeate but not liquids, which allows normal plant respiration but reduces transpiration by upto 80% (**Bose *et al.*,2001; Gindaba and Wand, 2005and Lolicato, 2011**)

Previous studies showed that water deficit has negative effect on growth and fruiting of fruit crops (**Abd El- Moteleb, 1991; Hassan, 1998;Gupta *et***

***al.*,1999; Gowda, 2002 and Khattb- Magda *et al.*, 2012**).

Application of antitranspirants has beneficial effects ongrowth and fruiting of fruit crops (**Kerns and Wright,2000; Wunsche *et al.*,2002; Yazici *et al.*, 2005; Al- Abbasy *et al.*, 2006; Morsy *et al.*, 2008; Glenn, 2009 and El- Khawaga and Mansour, 2014)**.

Chitosan is the most common natural polymers thatcan be obtained from species especially from the exoskeletons of crustance. It is also found in cuiticles of insects and used as a coating materials (**Photochanachai *et al.*, 2006**).

Using salicylic acid to all plants via leaves forms a very thin transparent layers cover the leaves that reduces leaf temperature and increases the reflectance of sun rays **(Joseph *et al.*, 2010**). In different grapevine cvs, using salicylic acid at 50 to 200 ppm via leaves was followed by enhancing growth, yield and fruiting when compared with the check treatment (**Abd El-Kareem, 2008; Ebrahiem – Asmaa (2012); Abdel aal (2012) and Akl *et al.* (2014)**.

The target of this study was examining the effect of some antitranspirants on growth, total chlorophylls, total indoles, total phenols, proline, leaf osmotic pressure, leaf mineral content, yield and fruit quality of Williams banana plants grown under Aswan region conditions.

2. Material and Methods

This study was carried out during 2011/ 2012 & 2012/ 2013 seasons (i.e. on third and fourth ratons, respectively) on Williams banana plants. The selected plants are grown in a private orchard situated at Kom Ombo district, Aswan Governorate. The plants are grown in silty clay soil under flood irrigation system and irrigated by Nile water.Twenty- seven stools planted at 3.5 x 3.5 on apart, each containing three plants were selected as experimental plants. Regular orchard management was carried out as usual.

The experiment included the following nine treatments from eight antitranspirant:

1- Control (using water without any antitranspirants).
2- Spraying Green miracle at 2%.
3- Spraying salicylic acid at 0.05 %.
4- Spraying vapor guard at 2%,
5- Spraying pureshade at 2%
6- Spraying Sunscreen at 2%
7- Spraying calcium carbonate at 2%
8- Spraying kaoline at 2%
9- Spraying chitosane at 2%

Each treatment was replicated three times, one stool per each. The eight antitranspirants were sprayed four times started at the first week of April and at one month intervals. Triton B as a wetting agent was added as 0.05% to all the sprayed antitranspirants.Spraying was done till all plants were completely covered with the antitranspirants. Randomized complete block design (RCBD) was adopted.

During both seasons, the following parameters were measured:

1- Pseudostem height (cm.) (from the soil surface up to the petiole of the last emerged leaf), pseudostem girth (cm.) in the base, middle and top of the pseudostem, then the average was calculated) and number of green leaves/ plant were recorded after the emergence of the inflorosscne (1st week of Sept).

2- Leaf samples were taken from the third upper leaf in the descending leaves from the top of the plant after bunch shooting (mid of Sept.) A sample of 10x 10 cm area from the middle part of the leaf blades (**Martin- Prevel, 1977**) was calculated was taken for determining chlorophylls a & b, then total chlorophylls (as mg / 100 g F.W.) (**Von-Wettstein, 1957)**, total indoles (mg/100 g F.W.), (**Larson *et al.*, 1962)**, total phenols (mg/ 100 g F.W.) (**A.O.A.C., 2000)**; proline content (mg / 100 g F.W.) (**Draz, 1986**) and leaf osmotic pressure (bar) (**Gusov, 1960**) and percentages of N, P and K (**Wilde *et al.*, 1985**).

3- The bunches were picked at the last week of Oct., during both seasons, then bunch weight (kg.) was recorded. Six hands from the base, middle and distal end of the bunch were taken for measuring hand weight (kg.). After artificial ripening weight (g.), T.S.S.%, total and reducing sugars % (**A.O.A.C., 2000**) and total acidity % (as a malic acid / 100 g pulp) (**A.O.A.C., 2000**).

The obtained data were tabulated and subjected to the proper statistical analysis and the differences between different treatment means were compared using new L.S.D. at 5% **(Mead *et al.*, 1993**).

3. Results and Discussion

1- Effect of spraying some antitranspirant on growth characters:

It is clear from the data in Table(1) that treating Williams banana plants four times (April, May, June, and July) with the investigated eight antitranspirants (Chitosane, Kaolien, Calcium carbonate, sunscreen, pureshade, vapor guard, salicylic acid and green miracle) significantly was responsible for stimulating height and girth of pseudostem and number of green leaves / plant rather than the check treatment. The promotion was significantly associated with using green miracle, salicylic acid, vapor guard, pureshade, sunscreen, calcium carbonate, kaoline and chitosane, in ascending order. Significant differences on all growth characters were observed among all antitranspirant. The maximum values of height (251.9 &266 cm) and girth of pseudostem (90 and 92 cm) were recorded on the plants that sprayed four times with chitosane at

2%.The lowest values were recorded on untreated plants. These results were true during both seasons.

2-Effect of some antitranspirants on the leaf chemical composition:

It is clear form the data in Tables (1 &2) that treating the plants with the eight antitranspirants significantly was responsible for promoting total chlorophylls, total indoles and percentages of N, P and K and reducing total phenols, proline and leaf osmotic pressure in the leaves when compared with the check treatment. The best antitranspirants in this respect were chitosane, kaoline calcium carbonate, sunscreen, purshades, vapor guard, salicylic acid and green miracle, in descending order.Varying antitranspirants had significant differences on these chemical traits. The maximum total chlorophylls (2.26 & 2.34 mg / 100 g F.W.), total indoles (9.89 & 10.15 mg / 100 g F.W.), N (2.89 & 2.95 %),. P (0.44 & 0.46 %) and K (2.09 & 2.03 %) were recorded in the plants that received chitosane at 2% four times.Under the previous treatment the lowest values of proline, total phenols and leaf osmotic pressure were recorded. Untreated plants produced the minimum values of total chlorophylls, total indoles, N, P and K in the leaves. These results were true during both seasons.

Table (1): Effect of spraying some antitranspirants on some growth and physiological characters of Williams banana plants during 2011/ 2012 and 2012/ 2013 seasons.

Treatment	Pseudostem height (cm.)		Pseudostem girth (cm.)		No. of green leaves / plant		Total chlorophylls (mg/100 g F.W.)		Total indoles (mg/100 g F.W.)		Total phenols (mg/100 g F.W.)	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Control	220.0	225.5	71.0	72.7	24.0	24.0	1.11	1.15	7.00	7.11	6.00	6.15
Green miracle at 2%	222.0	228.0	72.0	73.8	25.0	26.0	1.31	1.38	7.25	7.36	5.81	5.96
Salicylic acid at 0.05%	224.0	230.0	73.1	74.9	26.0	27.0	1.45	1.52	7.52	7.59	5.61	5.76
Vapor guard at 2%	225.9	233.9	75.2	76.9	27.2	28.3	1.60	1.67	7.92	8.25	5.40	5.65
Pureshade at 2%	229.9	241.0	78.3	80.0	29.0	30.0	1.75	1.82	8.35	9.00	5.20	5.45
Sunscreen at 2%	233.9	247.0	80.0	81.8	30.0	30.0	1.87	1.94	8.86	9.15	4.11	4.36
Calcium carbonate at 2%	241.0	252.0	82.3	84.0	31.0	31.0	2.00	1.08	9.40	9.49	3.71	3.88
Kaoline at 2%	249.0	259.0	86.3	88.3	32.0	32.0	2.22	2.30	9.70	9.90	3.21	3.45
Chitosane at 2%	251.9	266.0	90.0	92.0	33.3	35.0	2.26	2.34	9.89	10.15	2.71	2.80
New L.S.D. at 5%	1.1	1.2	0.8	0.9	1.0	1.0	0.11	0.09	0.14	0.14	0.17	0.18

3- Effect of some antitranspirants on bunch and hand weights:

It is evident form the data in Tables (2 &3) that weights of bunch and hand were significantly promoted with treating the plants four times with any one of the eight antitranspirants comparing with the check treatment. The promotion on the yield and hand weight was significantly related to using chitosane, kaoline, calcium carbonate, sunscreen, pureshade, vapor guard, salicylic acid and green miracle, in descending order. Significant differences on the yield and hand weight were observed between the eight antitranspirants. Bunch weight was maximized (25.0 and 25.3 kg) during both seasons, respectively when the plants received four sprays of chitosane at 2%. The minimum values of bunch weight (18.0 &19.0 kg) were recorded on the untreated plants. The percentage of increase on the yield due to using chitosane at 2% over the check treatment reached 38.9 and 33.2 during both seasons, respectively.

4- Effect of antitranspirants on both physical and chemical characteristics of the fruits

Data in Table (3) clearly show that spraying any one of the eight antitranspirants significantly was very effective in improving fruit quality of the fruits in terms of increasing finger weight, T.S.S. % and total and reducing sugars and decreasing total acidity % comparing with the control treatment. The promotion on fruit quality was significantly associated with using chitosane, kaoline, calcium carbonate sunscreen, pureshade, vapor guard, salicylic acid and green miracle, in descending order. Differing antitranspirants significantly varied all physical and chemical attributes of the fruits. The best results with regard to fruit quality were observed with spraying the plants four times with chitosane at 2% followed by kaoline at 2%, Unfavourable effects on fruit quality were observed on untreated plants.

4. Discussion:

The beneficial effects of antitranspirants on growth and fruiting are mainly ascribed to the important role of these materials on blocking stomata without causing any inferiors effects on photosynthesis. Antitranspirants coat leaf surface with films that are impervious to water vapour, reflect back a portion of the incident radiation falling on the upper surface of the leaves. Some antitranspirants dried on plants to form a clear glossy film which retards normal moisture loss without interfering with plant growth or normal respiration (**Peter, 2008 and Cheng *et al.*, 2009**).

Salicylic acid and chitosane are considered coating materials prevents water loss and they allow gases to permeate but not liquids which allows normal plant respiration but reduce transpiration by up to 80 %. Also, they responsible to reduce leaf temperature and increases leaf reflectance (**Photochanachai *et al.*, 2006 and Joseph *et al.*, 2010**).

The beneficial effects of antitranspirants on growth of Williams bananas are in agreement with those obtained by **Al- Abbasey *et al.*, 2006; Morsy *et al.*, (2008); Glenn (2009) and El- Khawaga and Mansour (2014)** supported the beneficial effects of chitosane as antitranspirants on fruiting due to its effect in preventing the loss of water.

The results of **Abd El- Kareem (2008); Ebrahiem- Asmaa (2012); Abdelaal (2012) and Akl *et al.* (2014)** confirmed the beneficial effects of salicylic acid on growth and fruiting of different grapevine cvs.

Table (2): Effect of spraying some antitranspirants on proline (mg/ 100 g F.W.), leaf osmotic, pressure, weight percentages of N, P and K in the leaves and bunch weight of Williams banana plants during 2011/ 2012 and 2012/ 2013 seasons.

Treatment	Proline content (mg/100 g F.W.)		Leaf osmotic pressure (bars)		Leaf N %		Leaf P %		Leaf K %		Bunch weight (kg.)	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Control	0.77	0.75	15.0	15.5	2.26	2.33	0.16	0.18	1.55	1.59	17.0	17.9
Green miracle at 2%	0.70	0.67	14.0	14.6	2.33	2.40	0.20	0.21	1.61	1.64	18.0	19.0
Salicylic acid at 0.05%	0.63	0.60	13.2	13.0	2.41	2.47	0.23	0.25	1.71	1.69	18.8	19.9
Vapor guard at 2%	0.57	0.54	12.0	11.8	2.50	2.55	0.26	0.28	1.80	1.74	19.8	20.9
Pureshade at 2%	0.51	0.48	11.2	11.0	2.58	2.65	0.30	0.31	1.85	1.80	20.9	22.0
Sunscreen at 2%	0.42	0.39	10.7	10.5	2.68	2.75	0.34	0.35	1.91	1.86	22.0	22.8
Calcium carbonate at 2%	0.37	0.34	10.0	9.7	2.75	2.82	0.38	0.39	1.97	1.92	22.7	23.6
Kaoline at 2%	0.31	0.28	8.0	7.7	2.81	2.90	0.41	0.42	2.03	1.96	23.5	24.5
Chitosane at 2%	0.24	0.21	7.0	6.5	2.89	2.95	0.44	0.46	2.09	2.03	25.0	25.3
New L.S.D. at 5%	0.05	0.04	0.4	0.4	0.05	0.04	0.03	0.03	0.05	0.04	0.7	0.8

Table (3): Effect of spraying some antitranspirants on average hand and finger weights and some chemical characteristics of the fruits of Williams banana plants during 2011/ 2012 and 2012/ 2013 seasons.

Treatment	Av. Hand weight (kg.)		Av. Finger weight (g.)		T.S.S. %		Total sugars %		Reducing sugars %		Total acidity %	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Control	1.80	1.75	81.0	82.5	18.0	17.9	15.0	14.9	7.1	7.2	0.355	0.360
Green miracle at 2%	2.00	1.91	83.0	84.6	18.3	18.1	15.3	15.2	7.3	7.5	0.330	0.330
Salicylic acid at 0.05%	2.15	2.09	86.0	87.6	18.6	18.4	15.6	15.5	7.6	7.8	0.300	0.305
Vapor guard at 2%	2.31	2.25	90.0	91.5	18.9	18.7	16.0	15.8	7.9	8.0	0.285	0.280
Puresha de at 2%	2.50	2.50	95.5	94.0	19.2	14.0	16.2	16.1	8.2	8.3	0.270	0.265
Sunscre en at 2%	2.69	2.66	95.0	96.5	19.5	19.2	16.5	16.5	8.4	8.6	0.2 50	0.245
Calcium carbona te at 2%	2.83	2.82	97.3	99.0	19.8	19.5	16.8	16.8	8.7	9.0	0.230	0.230
Kaoline at 2%	3.00	2.98	100.0	102.0	20.0	19.7	17.1	17.1	9.0	9.3	0.225	0.215
Chitosa ne at 2%	3.15	3.15	105.0	108.0	20.3	20.1	17.3	17.4	9.3	9.5	0.210	0.201
New L.S.D. at 5%	0.14	0.15	1.9	2.0	0.2	0.2	0.2	0.3	0.2	0.2	0.015	0.014

5. Conclusion:

For preventing the adverse effects of water stress as well as promoting yield and fruit quality of Williams bananas grown under Aswan region conditions, it is advised to spraying the plants with any one of chitosane at 2% g kaoline at 2% and calcium carbonate at 2%, in descending order four times started at the first week of April and at one month intervals.

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