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PHYSIOLOGICAL STUDIES ON SALT TOLERANCE OF TWO BANANA CULTIVARS
3- EFFECT OF SALT STRESS AND FOLIAR SPRAY WITH SOME NUTRIENT ELEMENTS ON LEAF ANATOMICAL STRUCTURE

BY

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ABSTRACT

The present investigation was carried out during 2006 experimental season in the greenhouse of the Horticulture Research Station at El-Kanater Qalyoubia Governorate on 3 months old banana plants of Williams and Grand Nain cvs. In this experiment, it was aimed to investigate the possibility of decreasing the depressive effect of using saline solution for irrigation of two banana cultivars under study through foliar spray with the three nutrient elements i.e., P, K and Zn. Taking into consideration that salt stressed banana plants were irrigated with 3000 ppm saline solution of SAR 6 and/or lower/higher $Cl:SO_4$ ratio.

Leaf structures of saline stressed Williams and Grand Nain banana plants (irrigated with 3000 ppm saline solution of 6 SAR) were investigated regarding their response to P, K and Zn foliar sprays under lower or higher $Cl:SO_4$. Thickness of cuticle and epidermis layers of both lower and upper leaf surfaces; mesophyll (palisade & spongy tissues), fiber (upper and lower the vascular bundle), phloem & xylem tissues and diameter of widest xylem vessel in the vascular bundle were the investigated leaf anatomical characteristics.

The obtained results showed that:

1- Salinity increased thickness of both cuticle and epidermis layers of two leaf surfaces as well as palisade tissue thickness. However, spongy tissue thickness and two elements of vascular bundle i.e. phloem and xylem rows, as well as fiber tissue especially of lower bundles and diameter of xylem vessels in vascular bundle were decreased in salt stressed banana plants of two banana cvs. as compared to the analogous ones of tap water irrigated plants (control).

2- Any of P, K or Zn sprayed solution succeeded at variable degrees to alleviate the harmful effect of salinity stress occurred in leaf anatomical character. Herein, thickness of (cuticle & epidermis layer) of two leaf surfaces and palisade tissue were obviously decreased as compared to the corresponding ones of unsprayed salt stressed plants for two banana cultivars. However, spongy tissue and xylem rows in vascular bundle were decreased. Such trends were true with variable degrees of differences exhibited in rate of response that depended mainly on concerned anatomical character, sprayed element and banana cultivar itself.

From obtained results of the present three papers (1- effect of salt concentration, sodium adsorption ratio and chloride level in irrigation water on growth and chemical constituents, 2- effect of sodium adsorption ratio (SAR), chloride level in irrigation water and foliar spray with some minerals on growth and chemical constituents and 3- effect of salt stress and foliar spray with some nutrient elements on leaf anatomical structure of two banana cultivars) it could be recommended for nursery men that under shortage of available fresh water that saline solution of relatively lower level of salt concentration (2000 ppm), SAR 3 and $Cl:SO_4$ could be safely used for

irrigation purposes. Moreover, foliar sprays of salt stressed banana plants with P, K and Zn solutions minimize to great extent the harmful influences of salinity stress and consequently improve growth, nutritional status and anatomical characteristics.

INTRODUCTION

Banana (*Musa spp.*) is a tropical plant and considered as one of the most popular fruit in Egypt for its high nutritive value and palatability for the egyptian consumer. Also, from the economical point of view, banana growers get relatively very high and fast net return from their orchard due to the rapid growth cycle of banana plant. The over all acreage of banana reached about 28750 fed. in 1986 and about 53607 fed. in 1999 produced about 28799 tons of edible fruits (Ministry of Agriculture, 1999). This acreage mainly concentrated in the delta and the Nile valley 32841 fed. As there is an ample water supply, which needed to have good production. Nowadays, there is a great plantation of banana in new reclaimed lands especially Noubaria as the acreage reached 20752 fed. in 1999.

Water encomization may be of great urge in the following decade due to the ecological changes in the area of the Nile resources in the past years. One of the possible solutions is the use of low quality water such as the drainage water.

The main goal of this investigation was to explore the possible effect of different levels of salinized irrigation water applied to banana plants on their growth and chemical contents.

Recently, mutualistic association of plant and spray elements such as (P, K and Zn) have attracted the attention of agricultural researches due to better understanding of the importance of spray elements (P, K and Zn).

On banana revealed that salinity at 3000 ppm increase leaf blade thickness, upper and lower epidermis and palisade thickness, meanwhile thickness of lacuna and xylem area were decreased as compared with control leaves, root diameter thickness of epidermis and cortex were increased at high level of salinity 3000 ppm meanwhile, diameter of vascular cylinder number of xylem vessels and xylem area in cross sections were decreased as compared with control roots (Mohamed, 2001).

Salinity increased thickness of both cuticle and epidermis layers of two leaf surfaces as well as palaside tissue thickness. However, spongy tissue thickness and xylem rows in vascular bundle were decreased in salt stressed apple transplants of three apple rootstocks as compared to the analogous ones of tap water irrigated transplants (control). Moreover, any of P, K and Zn sprayed solution succeeded at variable degree to alleviate the harmful effect of salinity stress occurred in leaf anatomical characteristics. Herein, thickness of (cuticle & epidermis layers) of two leaf surfaces and palisade tissue were obviously decreased as compared to the corresponding ones of unsprayed salt stressed transplants for 3 apple rootstocks. However, spongy tissue and xylem rows in vascular bundle were decreased. He added also that such trends were true with variable degree of differences exhibited in rate of response that depended mainly on concerned anatomical character, sprayed element and apple rootstock itself (Ali, 2005).

Leaf anatomical structure of two rootstocks transplants (M.M. 106 and Pyrus communis) as influenced by salt stress irrigated with 2000 and 6000 ppm) saline solution were investigated. Obtained results revealed that salinity increased thickness of both cuticle and epidermis layers of two leaf surfaces as well as palisade tissue thickness. However, spongy tissue thickness and xylem rows in vascular bundle were decreased in salt stressed of two rootstocks as compared to the analogous ones of tap water irrigated transplants (control) (Ragab, 2006).

In this experiment, it was aimed to investigate the possibility of decreasing the depressive effect of using saline solution of

irrigation of two banana cultivars under study through foliar spray with the three nutrient elements i.e., P, K and Zn. Taking into consideration that salt stressed banana plants were irrigated with 3000 ppm saline solution of SAR 6 and/or lower/higher $Cl:SO_4$ ratio. Moreover, different P, K and Zn spray solutions even water spray.

MATERIALS AND METHODS

The present investigation was carried out during 2006 experimental season in the greenhouse of the Horticulture Research Station at El-Kanater, Qalyoubia Governorate on 3 months old banana plants of Williams and Grand Nain cvs. It was amid to throw some lights on the possible changes could be occurred in some leaf anatomical features of banana plants due to either salinity stress (irrigation with saline solution) from one hand or resulted by foliar spray of salt stressed plants with P, K and Zn from the other with comparison to the normal state (irrigation with fresh water).

Experimental layout:

On march 15th during 2006 season uniform and healthy banana plants (suckers) of two cultivars were transplanted individually in 35 cm diameter pots (plastic bags) filled with specific weight (10 kg/each) of clay + sand mixture at 2.1 ratio (V.V.). Irrigation with fresh (tap) water was carried out twice weekly at the rate of one liter/plant tile the investigated treatments (saline solutions and P, K, Zn foliar sprays) were started two weeks later (April 1st). Moreover, all plants were supplied with the same N, P fertilization program adopted in 1st and 2nd papers.

In this experiment the effect of irrigation with two saline solutions (3000 ppm concentration and SAR 6 at either lower or high $Cl:SO_4$ ratio), besides irrigation with tap water as control as well as foliar spray of salt stressed plants with P, K and Zn at 250, 250 and 100 ppm, respectively were investigated. Taking into consideration that tween twenty at the rate of 0.1% as surfactant agent was used for different P, K and Zn spray solutions even with water spray. So, the investigated salinity and spray treatments were as follows:

1. Irrigation with tap water (control).
2. Irrigation with 3000 ppm, SAR 6 and low $Cl:SO_4$ ratio + water spray.
3. Irrigation with 3000 ppm, SAR 6 and low $Cl:SO_4$ ratio + P spray.
4. Irrigation with 3000 ppm, SAR 6 and low $Cl:SO_4$ ratio + K spray.
5. Irrigation with 3000 ppm, SAR 6 and low $Cl:SO_4$ ratio + Zn spray.
6. Irrigation with 3000 ppm, SAR 6 and high $Cl:SO_4$ ratio + water spray.
7. Irrigation with 3000 ppm, SAR 6 and high $Cl:SO_4$ ratio + P spray.
8. Irrigation with 3000 ppm, SAR 6 and high $Cl:SO_4$ ratio + K spray.
9. Irrigation with 3000 ppm, SAR 6 and high $Cl:SO_4$ ratio + Zn spray.

The complete randomized block design with five replications was employed for arranging the aforementioned nine treatments and every replicate was represented by two plants. Saline solutions used were prepared as shown in Table (1) for being applied every 3 other days from April 1st until October 1st, while foliar spray treatments (P, K, Zn and water) were applied monthly from April 15th till September 15th. To prevent salt accumulation, rewatering with tap water was done fortnightly till experiment was ceased early October.

Anatomical examination:

To study the effect of salt stress and foliar sprays of salt stressed plants of two cultivars with P, K and Zn, samples were collected from the middle position of new unrolled leaves (3rd one from plant top) on October 1st at 9.0 am. Sampled leaves were immediately killed and fixed in FAA (50 ml formalin, 5 ml glacial acetic acid and 90 ml ethyl alcohol 70%) washed in 50% ethyl alcohol, dehydrated in series of ethyl alcohols 70, 90, 95 and 100%. In filtrated in xylene embedded in paraffin wax with a melting point of 60-63C° sectioned to 20 microns in thickness (Guss, 1951) stained with the double stain method (fast green and safranin), cleared

and mounted in Canada balsam (Johansom, 1940) Sections were examined to detect histological manifestation of noticeable responses resulted from other treatments.

The prepared section were microscopically examined, counts and measurements (M) were taken using a micrometer eye piece. Average of readings from 3 slides/treatment were calculated, where prepared slides had been oven dried at 40°C before they were examined and microscopically photographed.

Cuticle and epidermal thickness of both upper and lower leaf blade surface, palisade, spongy tissues thickness and number of xylem row in vascular bundle were measured after (Ibrahim, 2001).

RESULTS AND DISCUSSION

In this regard some anatomical features of banana leaf blade (Williams and Grand Nain cvs.) were microscopically examined to study their response to saline stress (irrigation with 2 saline solution of 3000 ppm, SAR 6 and lower/higher $Cl:SO_4$ ratio) from one hand and spraying these salt stressed plants with P, K and Zn solutions from the other. Thickness of cuticle and epidermis layers (upper and lower leaf surfaces), mesophyll tissues (palisade and spongy); fiber tissues (upper and lower vascular bundle); phloem and xylem tissues in vascular bundle) and the diameter of widest xylem vessel in the vascular bundle were the investigated anatomical characteristics in this regard. Data obtained regarding the response to saline stress and foliar sprays with P, K and Zn solution with combing to fresh/tap water irrigation were tabulated in Tables (2 & 3) and microscopically photographed in Photos (1 & 2).

1-Leaf anatomical structure:

In this regard some anatomical features of banana leaf blade (Williams and Grand Nain cvs.) were microscopically examined during 1st experimental season (2006) to study the following:

1- The influence of saline stress, where plants were irrigated with the saline solution of 3000 ppm concentration, SAR 6 and lower or higher $Cl:SO_4$ ratio in comparison with the fresh/tap water irrigated plants as control.
2- The effect of P, K and Zn foliar sprays on leaf anatomical structure of saline stressed banana plants (irrigated with 3000 ppm saline solution of SAR6 and low or high $Cl:SO_4$ ratio).

The investigated leaf anatomical characteristics in this concern were the thickness of [cuticle and epidermis layers of (both lower and upper leaf surfaces), mesophyll (palisade & spongy tissues), number of palisade and spongy tissues, fiber tissues (upper and lower the vascular bundle), phloem and xylem tissues in vascular bundle and diameter of widest xylem vessel in the vascular bundle]. Data obtained regarding the response to saline stress and foliar sprays with the three P, K and Zn nutrient elements were tabulated in Tables (2 and 3) and illustrated by Photos (1 and 2).

1-Effect of salinity stress:

Regarding the effect of irrigation with the (3000 ppm -SAR 6 and $Cl:SO_4$ at low & high ratios) saline solution, it was quite evident that a noticeable increase in cuticle thickness of both lower and upper leaf surfaces was obviously exhibited in leaves of such saline stressed plants as compared to the analogous ones of fresh/tap water irrigated plants. However, such trend was true with two cultivars of banana regardless of $Cl:SO_4$ ratio from one hand, but the increase tended relatively to be more pronounced with the higher $Cl:SO_4$ saline solution from the other side.

Nevertheless, with leaf epidermis thickness, the same trend previously discussed with cuticle layers was also detected. Herein, salinity stress resulted clearly in increasing epidermis thickness of both lower and upper leaf surfaces, but differences in rate of variances due to $Cl:SO_4$ ratio of saline irrigation water were more pronounced as compared to those previously mentioned with cuticle layers. It was so worthy to be observed

also that both cuticle and epidermis layers of the upper leaf surface were obviously thicker than the analogous ones of the lower leaf surface.

As for the response of mesophyll (palisade & spongy tissues to saline stress, it was so clear to be noticed that palisade tissue thickness slightly increased by 3000 ppm of SAR 6 and lower chloride saline solution. However, with the higher $Cl:SO_4$ ratio the trend took the other way around. As for spongy tissue, the thickness decreased with increasing saline solution. Such trend of response for spongy tissues were true in two banana (Williams & Grand Nain cvs.), regardless of the $Cl:SO_4$ ratio in saline solution.

Table (3) shows that thickness of fibers layers influenced by saline solution. Herein, the fibers upper the vascular bundle increased in salt stressed plants of two banana cultivars. The increase exhibited by irrigation with saline solutions was more pronounced under higher $Cl:SO_4$ ratio. The trend took the other way around for the thickness of fibers layers lower of vascular bundle. The decrease was relatively slight under two $Cl:SO_4$ ratios of 3000 ppm and SAR 6 saline solution.

Thickness of xylem, phloem tissues and diameter of the widest xylem vessel in vascular bundle decreased with increasing saline solution for two banana cvs. (Wiliams and Grand Nain).

Similar result were obtained by Walter *et al.* (1958), Boluse *et al.* (1972) and Owais (1976) on the leaves of Nicotina fabaccum, Ricinus and gerbera, respectively.

Also mesophyll thickness increased with salinity treatments due to the increase in length of palisade and spongy cell layers in different species i.e., beans (Meri and Poljakoff, 1967); Cotton (Strogonov, 164), Jojoba (Yermanos *et al.*, 1967).

These results also, were in line with those of Gaser (1992) on Thompson seedless grape transplants, Sourial *et al.* (1978) on mango and guava seedlings, Salem *et al.* (1989) on apple; Abd El-Karim (1997) on grapevine seedlings and Ali (2005) on apple rootstocks.

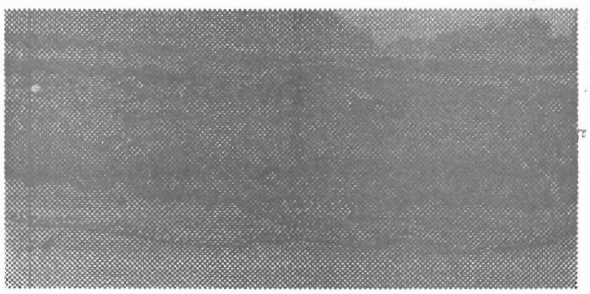
2- Effect of P, K and Zn foliar spray on leaf anatomical structure of salt stressed banana plants:

With regard to the effect of P, K and Zn foliar spray on leaf cuticle and epidermis layers of salt stressed banana plants, it were quit that each sprayed element generally decreased thickness of both layers for two leaf surfaces for two banana cvs., except lower surface of Grand Nain K sprayed leaves. However, the superiority of each used nutrient element over two other ones varied not only from one anatomical parameter to other, but also banana cv. itself plays also its own role in this concern.

Anyhow Zn and K spray were more effective than P foliar spray except with upper cuticle layer where P exhibited greater reduction especially with grand Nain cv.

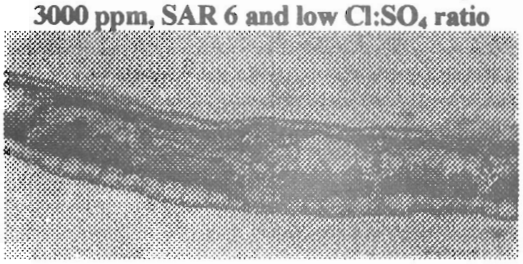
Taking into consideration that an obvious reduction was exhibited in both upper and lower epidermis thickness of salt stressed plants by any of three sprayed elements, whereas in most cases it resulted in decreasing such parameter even below those of control (tap water irrigated plants). Herein, the reduction in both upper and lower epidermis in salt stressed banana cvs. resulted by P, K and Zn foliar spray induced leaves with thinner epidermis than the analogous ones of control plants (tap water irrigated plants).

As for the palisade thickness, it was quite evident that the increase exhibited by the saline solution especially of the 3000 ppm, SAR 6 and lower $Cl:SO_4$ ratio was partially repaired by any of the three nutrients elements sprayed (P, K and Zn). However, the beneficial effect exhibited by Zn application in palisade tissue thickness of the salt stressed transplants was relatively less pronounced rather than that induced by two other elements. on the other hand, P foliar spray was the most effective in this regard.



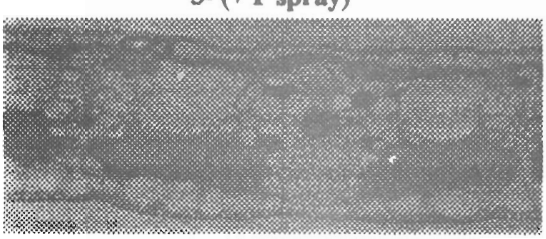
1- Tap water irrigation

3000 ppm, SAR 6 and low $Cl:SO_4$ ratio

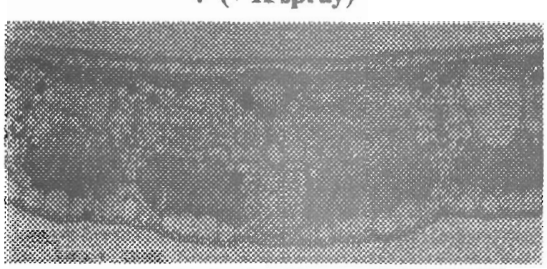


2- (+ Water spray)

3- (+ P spray)

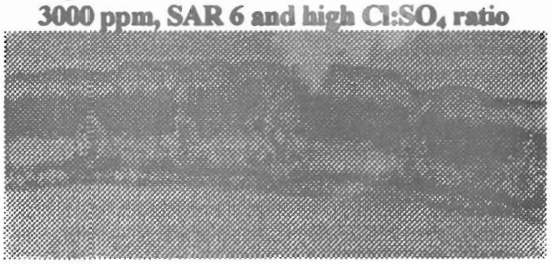


4- (+ K spray)

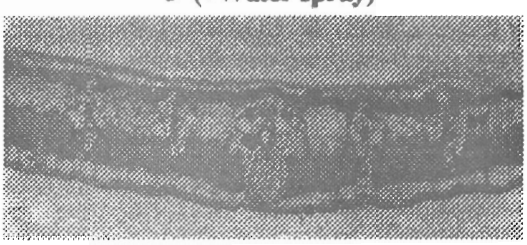


5- (+ Zn. Spray)

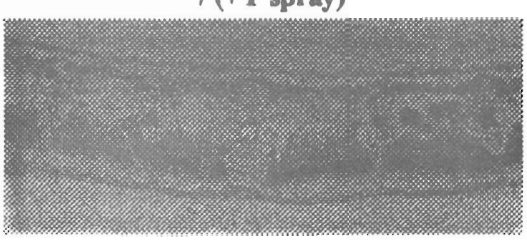
3000 ppm, SAR 6 and high $Cl:SO_4$ ratio



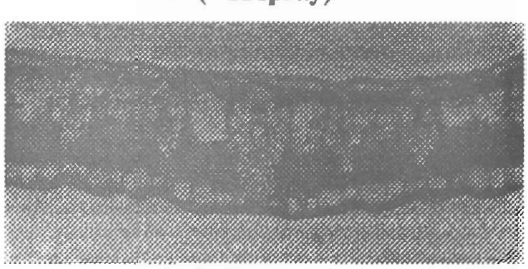
6- (+Water spray)



7 (+ P spray)

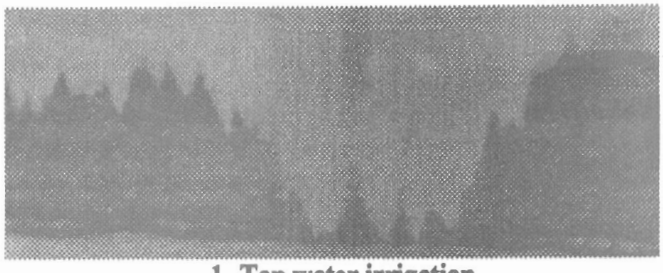


8- (+ K spray)



9- (+ Zn spray)

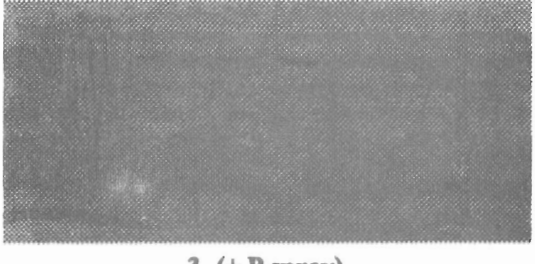
Photo. (1): Leaf anatomical structure of salinity stress Williams banana plants as influenced by P, K and Zn foliar sprays (X =100)



1- Tap water irrigation

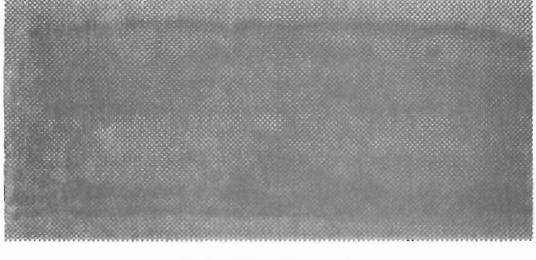
3000 ppm, SAR 6 and low $Cl:SO_4$ ratio

2- (+ Water spray)



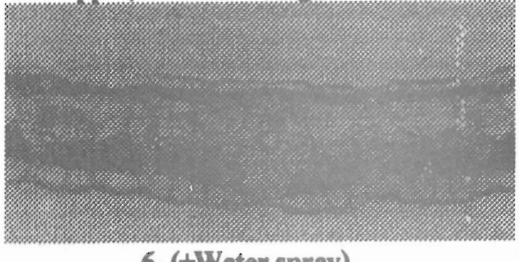
3- (+ P spray)

4- (+ K spray)

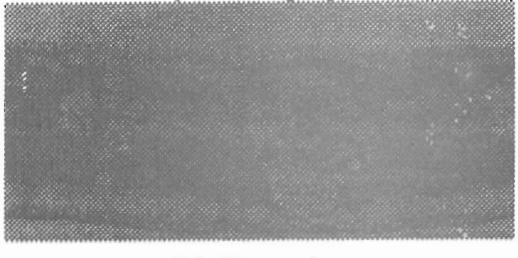


5- (+ Zn. Spray)

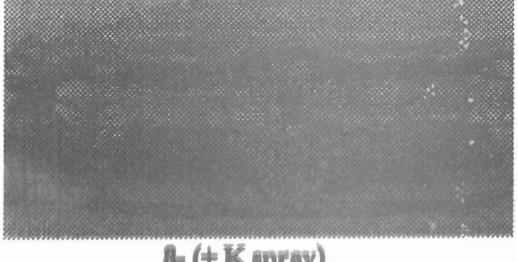
3000 ppm, SAR 6 and high $Cl:SO_4$ ratio



6- (+Water spray)



7 (+ P spray)



8- (+ K spray)

9- (+ Zn spray)

Photo. (2): Leaf anatomical structure of salinity stress Grand Nain banana plants as influenced by P, K and Zn foliar sprays.(X=100).

Table (1): Preparation of the differential investigated eight saline solutions.

Saline solution	Salt* added per litter												SAR**	Cl meq/l	SO_4 meq/l	Cl/SO_4 ratio
	$CaCl_2$		$MgSO_4$		KCl		K_2SO_4		Na_2SO_4		NaCl					
	g	meq	g	meq	g	meq	g	meq	g	meq	g	meq				
3000 ppm SAR 6 low Cl	0.42	7.50	0.75	12.50	0.14	0.68	0.45	5.17	0.70	9.86	0.54	9.23	6	17.41	27.53	0.63
3000 ppm SAR 6 high Cl	0..95	17.12	0.50	8.33	0.05	0.68	0.14	3.45	0.57	8.04	0.79	13.43	6	31.48	18.82	1.67

* Refers that salts used were estimated as unhydrous from.

** Refers that SAR values were estimated as: $SAR = \sqrt{meq \frac{Na}{(Ca + Mg)/2}}$

Table (2): Leaf anatomical structure (thickness of cuticle layers, epidermis, palisade and spongy tissues) of Williams and Grand Nain banana plants grown in sandy clay soil mixture as influenced by saline solutions (3000 ppm; SAR 6 and low or high $Cl:SO_4$ ratio) and foliar spray with P, K or Zn solutions.

Treatments			Leaf anatomical characteristics											
Irrigation solution		Foliar spray	Cuticle thickness				Epidermis thickness				Palisade tissue thickness		Spongy tissue thickness	
			Upper		Lower		Upper		Lower					
			W.cv.	G.N.cv.	W.cv.	G.N.cv.	W.cv.	G.N.cv.	W.cv.	G.N.cv.	W.cv.	G.N.cv.	W.cv.	G.N.cv.
Tap water	1	No spray (control)	8.10	9.20	6.30	6.75	85.40	83.60	49.05	42.30	104.85	94.50	152.55	159.75
3000 ppm, SAR 6 and higher $Cl:SO_4$ ratio	2	Water spray	10.55	10.35	7.45	8.20	90.45	86.85	54.65	42.53	112.95	99.55	151.88	148.55
	3	P spray	9.00	9.90	5.85	7.65	74.70	72.45	41.85	39.33	77.85	76.50	71.10	113.85
	4	K spray	8.55	11.15	4.95	9.00	79.88	87.98	38.35	42.08	97.65	85.40	108.00	144.23
	5	Zn spray	9.45	11.80	4.95	7.20	97.20	72.90	42.45	46.76	94.15	103.00	99.00	89.78
3000 ppm, SAR 6 and higher $Cl:SO_4$ ratio	6	Water spray	12.37	12.83	8.85	8.65	96.95	95.53	58.60	44.10	99.90	89.73	136.80	128.73
	7	P spray	9.90	10.35	6.30	9.23	72.45	81.90	38.25	35.60	84.83	84.30	12038.00	87.30
	8	K spray	10.13	12.05	7.65	9.90	65.48	80.64	37.48	40.95	99.78	84.60	91.35	107.55
	9	Zn spray	9.75	12.35	6.33	8.55	79.20	72.90	39.98	43.80	103.05	110.05	141.98	139.95

Table (3): Leaf anatomical structure (thickness of fiber, phloem, xylem tissues and diameter of widest vessel in vascular bundle) of Williams and Grand Nain banana plants grown in sandy clay soil mixture as influenced by saline solutions (3000 ppm; SAR 6 and low or high $Cl:SO_4$ ratio) and foliar spray with P, K and Zn solutions.

Treatments			Leaf anatomical characteristics									
Irrigation solution	Foliar spray		Fiber tissue thickness				Phloem tissue thickness		Xylem tissue thickness		Diameter of widest xylem vessel in vascular bundle	
			Upper of vascular bundle		Lower of vascular bundle							
			W.cv.	G.N.cv.	W.cv.	G.N.cv.	W.cv.	G.N.cv.	W.cv.	G.N.cv.	W.cv.	G.N.cv.
Tap water	1	No spray (control)	52.65	68.85	33.30	33.30	47.70	41.85	144.45	130.05	54.90	54.00
3000 ppm, SAR 6 and higher $Cl:SO_4$ ratio	2	Water spray	58.95	69.08	31.50	25.65	45.90	32.85	146.70	124.65	52.65	43.43
	3	P spray	40.95	67.50	20.70	31.05	42.75	31.50	92.70	114.75	34.65	52.65
	4	K spray	58.95	99.45	24.75	30.83	40.50	56.03	112.05	162.90	50.85	62.78
	5	Zn spray	56.29	70.20	26.10	31.05	32.85	32.40	143.20	104.40	40.95	40.73
3000 ppm, SAR 6 and higher $Cl:SO_4$ ratio	6	Water spray	63.05	82.35	31.95	28.80	42.75	39.60	132.75	119.70	48.15	37.58
	7	P spray	53.33	55.80	26.78	24.53	43.20	31.58	110.70	82.58	38.25	42.75
	8	K spray	74.93	53.10	21.50	31.95	27.90	47.70	97.20	127.58	37.80	59.85
	9	Zn spray	74.25	72.90	31.95	32.85	38.03	40.50	142.05	109.35	46.13	45.45

Nevertheless, the trend of response representing the P, K and Zn foliar spray effect on spongy tissues thickness of salt stressed banana cvs. followed approximately the same trend previously discussed with palisade tissue. Herein, an obvious decrease in spongy tissues thickness was induced by any of the three nutrients elements sprayed. Such trend was not only true with two banana cvs. but, also it pointed out an obvious reduction in spongy tissue of P, K or Zn sprayed banana plants which become thinner than those of control (tap water irrigated plants).

With regard to e effect of P, K and Zn spray on thickness of fiber tissue (upper/lower vascular bundle); phloem and xylem tissues, as well as the diameter of the widest xylem vessel in vascular bundle Table (3) and Photos (1 and 2) show that however the response was not so pronounced and didn't follow a firm trend from one hand, but in most cases a noticeable tendency of decrease could be observed for all/most measurements. In other words, the trend of response to great extent was prevailing for all measurements of Williams cv., however, with Grand Nain banana plants especially those sprayed with K solution the trend took the other way around for most anatomical parameters. The variance in trend of response between two cvs. may be considered as a specific characteristic of each cv. regarding its own ability to tolerated salinity.

Such results go partially with the finding of Janes (1966); Tal (1971); Ali (2005) on apple rootstocks and Hassan (2005) on some olive cvs.

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دراسات فسيولوجية على تحمل نباتات صنفين من الموز للملوحة
٣- تأثير الإجهاد والرش الورقى ببعض العناصر المغذية على التركيب التشريحى

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أجريت هذه الدراسة على نباتات الموز عمر ثلاثة شهور لصنفى الموز الويليامز والجراندنين خلال موسم النمو ٢٠٠٦ بصوبة محطة بحوث البساتين بالقناطر الخيرية. وقد استهدفت الدراسة اختبار مقاومة وتحمل هذه الأصناف لملوحة ماء الرى ومدى إمكانية التغلب على أضرار الإجهاد الملحى.

تم دراسة التركيب التشريحى لورقة شتلات الموز تحت الدراسة لمعرفة تأثير الإجهاد الملحى (مقارنة بالرى بالماء العادى ومحلول ملحى تركيز ٣٠٠٠ جزء فى المليون ونسبة الصوديوم المدمص به ٦ ومستويين من نسبة الكلوريدات إلى الكبريتات منخفض وعالى)

كما تم دراسة تأثير الرش بمحاليل الفوسفور، البوتاسيوم والزنك على التركيب التشريحى (سمك طبقتى الكيوتيكل، البشرة لسطحى الورقة، النسيج العمادى والأسفنجى، وسمك نسيج وعدد صفوف أنابيب الخشب بالحزمة الوعائية) لورقة شتلات الموز صنفى الويليامز والجراندنين النامية تحت ظروف الإجهاد الملحى. أوضحت النتائج المتحصل عليها ما يلى:

١- تأثر سمك طبقتى الكيوتيكل، البشرة لسطحى الورقة العلوى والسفلى فى الشتلات نتيجة لريها بمحلول ملحى حيث تزايدت وكان هذا الأثر أكثر وضوحا مع زيادة نسبة الكلوريد. كما سلك النسيج العمادى والأسفنجى اتجاهين متضادين فقد ازداد سمك الأول نتيجة الرى بالماء الملحى فى حين تناقص الثانى فى الشتلات تحت الأجهاد الملحى وأن كان أثر نسبة الكلوريد غير فعال فى محلول الرى وتناقص عدد صفوف (سمك) أنابيب الخشب بالحزمة الوعائية نتيجة الرى بماء مالح. كما تناقص سمك كل من الأنسجة الليفية (أعلى وأسفل الحزمة) وكذلك أنابيب اللحاء بالحزمة نتيجة الرى بالمحلول الملحى.

٢- قلل الرش بأى من العناصر الثلاثة تأثير الملوحة على التركيب التشريحى للورقة حيث قلل من سمك طبقتى الكيوتيكل والأدمة وسمك النسيج العمادى بينما ازداد سمك النسيج الأسفنجى وعدد صفوف أنابيب الخشب (سمكها) بالحزمة الوعائية (تغير طفيف).

وبناء على النتائج المستخلصة من هذه الدراسة فإنه يمكن التوصية لأصحاب مشاتل الموز أنه فى حالة عدم توفر مياه الرى العذبة الكافية يمكن تحت الظروف القهرية استخدام الماء المالح حتى تركيز ٣٠٠٠ جزء فى المليون مع استخدام الرش بأى من العناصر المغذية (البوتاسيوم والفوسفور كلا بتركيز ٢٥٠ جزء فى المليون أو الزنك بتركيز ١٠٠ جزء فى المليون) خاصة الصنف جراندنان بغض النظر عن نسبة الكلوريد إلى الكبريتات.