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NUTRITIONAL STUDIES ON BANANA PLANTS

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ABSTRACT

This investigation was undertaken during two seasons of 1996 and 1997 on Williams banana (*Musa sp*) grown in loamy soil under drip irrigation in private orchard at Belkas near Mansoura, Dakahlia Governorate to study the effect of magnesium as soil or foliar fertilization on yield, fruit quality and leaf-nutrient contents.

This study indicated that magnesium fertilizer at 60 or 120 gm $MgSO_4$ /plant each alone as soil or foliar application at 2 % $MgSO_4$ significant by increased the bunch weight throughout increasing both hand and finger weight than untreated plants. Also, these treatments increased the content of total carbohydrates and starch, but reduced total phenols content in pulp of bananas fruits. Magnesium treatments increased the content of nitrogen and magnesium but reduced the content of potassium and calcium in the leaves of banana plants compared with the control.

INTRODUCTION

Banana is one of the most popular and favorite fruits grown in Egypt. It is considered the green gold of many African countries (Abou Aziz *et al*., 1969). Africa represents 50% of the total world production followed by Asia and America 25 % each (Simmonds, 1960). Total banana planted area in Egypt is about 40340 feddan, which produced 635115 tons with an average yield of 15.75 ton/fed, according to the Last Statistic of Ministry of Agriculture, A.R.E., (1997).

Magnesium is a major essential element that is a component of the chlorophyll molecule. This element serves as a co-factor in most enzymes that activate phosphorylation process, serves as a bridge between pyrophosphate structures of ATP or ADP and the enzyme molecule, and stabilizes the ribosome particles in the configuration for protein synthesis (Jones *et al*., 1991)

Guillier (1965) reported that 100 kg of $MgSO_4$ /ha annual production of Poyo and Grand Naine banana. Abd El-Kader *et al*., (1990) mentioned that soil application with $MgSO_4$ at 25 - 50 gm /plant in mid-May to Magharabi banana increased yield as bunch weight, number of hands and fingers per bunch were increased and improved fruit characters.

Irizarry *et al*. (1990) reported that annual application with Mg (dolomit) at 275 kg /ha gave an optimum yield (8.9 ton /ha /year), whereas, higher application with $MgSO_4$ at 448 /ha /year increased bunch weight.

Wardlow (1961) mentioned that the higher rate of $MgSO_4$ may be antigonize the other necessary elemnets. Abd El-Kader *et al*. (1990) presented that $MgSO_4$ applications decreased the percentage of phosphorus in banana leaves and no significant in N content. While, the percentage of Mg

in the leaves was increased by increasing $MgSO_4$ application. Furthermore, significant decrease in K and Ca percentage was detected by increasing the level of $MgSO_4$ to banana plants.

Irizarry *et al*. (1990) found that mangnesium concentration in the third youngest banana leaf averaged 0.3 % in the plants received 224 and 448 kg /ha of Mg (dolomit).

MATERIALS AND METHODS

This study was performance on Williams banana growing in loamy soil under drip irrigation in private orchard at Belkas near Mansoura, Dakahlia Governorate.

96 plants, healthy, uniform in growth, cultivated on spaced 2.5 x 3 m apart. Each treatment was represented by 12 plants, distributed in three blocks in a complete randomized design. All plants received all other agriculture practices that are common in commercial banana orchard in that district.

The following treatments were used:-

1- Control (untreated with Mg).
2- Soil application, at 30 gm $MgSO_4$/plant.
3- Soil application, at 60 gm $MgSO_4$/plant.
4- Soil application, at 120 gm $MgSO_4$/plant.
5- Foliar application at 2 % $MgSO_4$.
6- Soil and foliar application at 30 gm / plant + 2% $MgSO_4$.
7- Soil and foliar application at 60 gm / plant + 2% $MgSO_4$.
8- Soil and foliar application at 120 gm / plant + 2% $MgSO_4$.

The source of $MgSO_4$ was Epsom salt, 49 % $MgSO_4$ = 16 % MgO and soil application were divided into six equal doses yearly from mid May till mid October. Yet, foliar application was applied twice at 15 June and 15 August. Fruit harvest date was estimated when the top hands have turned slightly yellow according to Van Loescke (1950), and when the angulation percent reached about 9 - 10 % according to Abou Aziz *et al.* (1993).

At harvest, samples of each replicate were collected to determine the following properties:

I- Physical properties

1- Average weight of bunch and hand in kg.
2- Number of hands per bunch.
3- Average finger weight: 20 fingers were weighed and the average weight was calculated in gm.
4- Average finger size (ml^3).
5- Average finger length and diameter.
6- Angulation percentage: The equatorial diameter of two different sides were measured by using the Virnier Caliper and the angulation percent was estimated by using the following equation according to Abou Aziz *et al*. (1993):

$$\text{Angulation \%} = \frac{\text{Mean of total highest reading - Mean of total lowest reading}}{\text{Mean of total highest reading}}$$

Mean of total highest reading

II- Chemical properties:

Samples from the dried pulp were taken to determine the following measurements:

1- Total carbohydrates: It was determined in fruits pulp as gm/100 gm dry weight by using the calorimetric method as described by Dubois *et al.,* (1956).
2- Starch percentage: It was determined in dry weight pulp using Schaffer and Hartman Method, (1921).
3- Phenols percentage: It was determined in the dry weight pulp by using the calorimetric method of folin - Denis as recommended by A.O.A.C (1970).

Leaf mineral content:

Leaf samples from each individual plants were taken as 15 cm strip from each side of the midrib in the middle of blade of the third leaf from the top of the plant at shooting stage as recommended by Hewitt, (1955) and Bhargava and Reddy, (1992).

The following elements were determined:

1- Total nitrogen according to Yeun and Follard (1952).
2- Potassium according to Troug and Meyer (1939).
3- Calcium and Magnesium were determined accoding to the methods of Ranganna (1979).

Statistical analysis:

The obtained data during both seasons were statistically analyzed using ANOVA method according to Snedecor and Cochran (1981). Treatment means were compared using LSD method.

RESULTS AND DISCUSSION

I- Effect of magnesium application on yield and fruit quality:

1. Bunch, hand, finger weight and angulation:

Data from Table (1) show clearly that all treatments used significantly increased average of each bunch, hand, finger weights and angulaton compared with control. Moreover, spraying banana plants with magnesium at 2 % combined with 120 gm or 60 gm /plant as soil applications increased the same characters than the other treatments or the control. Also, data presented in Table (1) show that all magnesium treatments as soil or foliar applied alone or in combination gave no clear effect on finger angulation. But most of treatments used tended to decrease the angulation percent compared with the control in the second season only. Our data are in harmony with those mentioned by Turner and Barkus (1982) which found that bunch weight was increased at all levels of Mg supply. Similar results were also reported by Abd El-Kader *et al*., (1990) on Mghrabi banana.

2. Fruit quality:

It is obvious from Table (2) that all magnesium application significantly increased the content of total carbohydrates, starch percentage and reduced the total phenols in the pulp of banana fruits. In addition, combined treatment ($MgSO_4$ at 120 gm /plant soil and 2 % foliar application) gave best results for increasing total carbohydrates, starch percentage and reduced the

Table (1): Effect of magnesium application on bunch, hand and finger weights as well as angulation of Williams banan during 1996 and 1997 seasons.

Characters	Bunch weight (kg)		Hand weight (kg)		Finger weight (g)		Angulation percentage	
Treatments	1996	1997	1996	1997	1996	1997	1996	1997
Control	17.53	17.10	1.81	1.71	76.0	69.3	10.42	10.38
30 g Mg/plant	18.77	18.33	2.00	1.89	79.0	72.0	10.40	10.43
60 g Mg/plant	19.94	19.79	2.13	2.04	82.0	75.0	10.37	10.37
120 g Mg/plant	21.53	21.20	2.38	2.29	84.0	77.0	10.41	9.70
Mg at 2%	20.91	20.30	2.13	2.03	77.0	71.0	10.42	9.67
Mg at 2% + 30 g	21.93	21.63	2.18	2.10	79.7	72.6	10.44	9.70
Mg at 2% + 60 g	22.21	21.91	2.29	2.18	84.0	77.0	10.43	10.37
Mg at 2% + 120 g	22.77	22.30	2.26	2.17	92.6	85.7	10.47	10.39
L.SD at 5%	0.77	0.51	0.12	0.11	3.9	4.4	N.S	N.S

Table (2): Effect of magnesium application on yield and fruit quality of Williams banan during 1996 and 1997 seasons.

Characters	Total carbohydrates %		Starch %		Total phenol %	
Treatments	1996	1997	1996	1997	1996	1997
Control	44.62	44.45	21.80	21.20	0.95	0.93
30 g Mg/plant	46.46	47.26	23.00	24.30	0.86	0.83
60 g Mg/plant	47.90	46.87	24.10	23.20	0.90	0.86
120 g Mg/plant	47.29	46.27	23.80	22.90	0.93	0.91
Mg at 2%	45.55	45.29	22.10	22.00	0.96	0.93
Mg at 2% + 30 g	46.89	46.07	23.40	22.30	0.91	0.89
Mg at 2% + 60 g	47.60	46.63	24.60	23.50	0.87	0.86
Mg at 2% + 120 g	47.93	47.64	24.90	24.60	0.81	0.78
L.SD at 5%	0.62	0.85	0.32	0.39	0.02	0.02

total phenols. Data obtained in this work are in line with Makasoud *et al*. (1994), they found that $MgSO_4$ applications significantly increased total chlorophyll and carbohydrates contents compared with the control. Also, Ahmed (1997) found that Mg application. are very effective in improving the yield as well as physical and chemical properties of mango fruits. Also, Mg is as a co-factor in almost all enzymes activating phosphorylation process. Magnesium forms a bridge between the pyrophosphate structure of ATP or ADP and the enzyme molecule (Jones *et al*., 1991). According to Balke and Hodges (1975), the activation of ATP-ase by Mg is brought about this bridging function, the favourable effect of Mg on CO_2 assimilation and related process

such as sugar and starch production which were probably the consequence of this activation of ribulose bisphosphate carboxylase.

II- Leaf mineral content:

Data presented in Table (3) clearly show that $MgSO_4$ either applied to the soil, sprayed or together increased nitrogen and magnesium but reduced potassium and calcium in leaves of banana plants compared with control.

In this respect, Abd El-Kader *et al*. (1990) they mentioned that a significant decreased in K percentage when increasing the level of $MgSO_4$ applied to banana plant. Also, Maksoud *et al*. (1994) reported that leaf Ca content declined as a result of Mg application.

Table (3): Effect of magnesium application on leaf mineral content of Williams banan during 1996 and 1997 seasons.

Characters	Nitrogen %		Magnesium %		Potassium %		Calcium %	
Treatments	1996	1997	1996	1997	1996	1997	1996	1997
Control	2.66	2.13	0.30	0.21	2.90	2.69	0.27	0.19
30 g Mg/plant	2.90	2.32	0.35	0.26	2.55	2.34	0.27	0.19
60 g Mg/plant	2.94	2.34	0.36	0.27	2.50	2.29	0.24	0.17
120 g Mg/plant	2.95	2.36	0.38	0.28	2.25	2.05	0.22	0.16
Mg at 2%	2.71	2.21	0.30	0.21	3.00	2.82	0.29	0.21
Mg at 2% + 30 g	2.82	2.33	0.33	0.23	2.85	2.68	0.25	0.18
Mg at 2% + 60 g	2.87	2.38	0.34	0.25	2.67	2.55	0.23	0.17
Mg at 2% + 120 g	2.91	2.41	0.40	0.31	2.54	2.48	0.23	0.17
L.SD at 5%	0.04	0.02	0.02	0.02	0.04	0.03	0.02	0.02

From the previous results, we can conclude that magnesium application at 120 mg /plant as soil with 2 % as foliar fertilization gave significantly highest finger weight and size values, also, gave the highest total carbohydrates and starch contents in pulp of banana fruits than that of the control.

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دراسات غذائية على نبات الموز

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*** قسم البساتين ـ المركز القومى للبحوث ـ الجيزة**

****قسم الفاكهة ـ كلية الزراعة ـ جامعة المنصورة.**

أجريت دراسة تأثير التسميد بالماغنسيوم سواء تسميد أرضى بمعدل ٣٠ ، ٦٠ ، ١٢٠ جرام / نبات أو رش بتركيز ٢% على محصول وصفات ثمار الموز صنف وليامز وأيضا على محتوى العناصر المعدنية من النتروجين والماغنسيوم والبوتاسيوم والكالسيوم بالأوراق.

أوضحت النتائج ما يلى:ـ

ـ أدى التسميد بالماغنسيوم عامة إلى زيادة ملحوظة فى كل من وزن السباطة والكف مقارنة بتلك غير المسمدة بالماغنسيوم.

ـ أدى التسميد بالماغنسيوم بمعدل ١٢٠ جم / نبات بالإضافة إلى الرش بـ ٢ % إلى زيادة فى وزن السوباطة والكف عن التسميد الأرضى أو الرش منفردا .

ـ التسميد سواء أرضيا أو بالرش بالماغنسيوم لم يعطى تأثيرا واضحا على معامل التضليع فى الثمار .

ـ أعطت جميع معاملات الماغنسيوم سواء أرضيا أو بالرش الورقى إلى زيادة فى محتوى لب الثمار من الكربوهيدرات الكلية والنشا بالمقارنة بتلك غير المعاملة.

ـ أدت معظم المعاملات بالماغنسيوم إلى خفض محتوى لب الثمار من المواد الفينولية.

ـ أظهرت معظم معاملات الماغنسيوم سواء الأرضية أو الورقية إلى زيادة محتوى الأوراق من عنصر النتروجين والماغنسيوم وتقليل البوتاسيوم والكالسيوم.

وبصفة عامة نستطيع القول أنه يمكن التوصية بتسميد نباتات الموز بمعدلات ٦٠ أو ١٢٠ جم سلفات ماغنسيوم للنبات مع الرش بتركيز ٢ % إذ أن تلك المعاملة أدت إلى زيادة المحصول عن طريق زيادة وزن السوباطة من خلال زيادة وزن الكف ووزن الأصابع ، هذا علاوة على زيادة محتوى لب الثمار من الكربوهيدرات والنشا وخفض الفينولات.