

EFFECT OF SULPHUR SOIL APPLICATION ON GROWTH, YIELD AND FRUIT QUALITY OF HINDI BANANA CULTIVAR.

Hosam El-Deen, A. S. H.

Hort. Res. Inst., Agric. Res. Center, Egypt.

ABSTRACT

The present study was carried out during 1996 and 1997 seasons in a private orchard at Badaway near El-Mansoura. The aim of this study was to investigate the effects of sulphur application on growth, yield, fruit quality and nutrient status of Hindi cultivar (*Musa cavendishii* L.) growing in loamy soil.

Addition of sulphur to normal fertilizers (NPK) significantly increased the length and girth of pseudostem and the height of the sucker. In the same time, sulphur treatments greatly improved yield and fruit quality. The best effective treatment was soil application of sulphur at a rate of 150 g/plant. Such practice increased bunch weight, number of hands and fingers. While, it decreased finger angulation. Sulphur also increased finger size, length & diameter and pulp weight. The leaf N and P content were significantly increased with increasing the rate of applied sulphur during the two seasons. But, K leaf content tended to decrease.

The obtained results proved that soil application of sulphur to Hindi banana plants was very useful for improving the soil physical characteristics and increased the nutrient availability. Also, sulphur application at 150 g/plant increased banana bunch weight by about 90.8% over the untreated plants as a means of the two seasons.

INTRODUCTION

Sulphur is a major element needed in relatively large amounts for optimal plant growth and important metabolic functions. It was used for many years in reclamation and improvement of sodic soils (Stomberg and Tisdale, 1979). Moreover, sulphur after oxidized by soil micro-organisms to sulphuric acid, which in turn lowers soil pH and improves the availability of most soil nutrients (Hassan and Olsen, 1966).

Many investigators reported the importance of sulphur in improving the productivity of plants (Cummings *et al.*, 1981; Peterson *et al.*, 1987; Abo-Rady *et al.*, 1988, Hening *et al.*, 1991 and Kassem *et al.*, 1995).

The present study was carried out to clarify the effects of sulphur on growth, yield, fruit quality and nutrient status of Hindi bananas.

MATERIALS AND METHODS

This work was performed on Hindi cultivar (*Musa cavendishii* L.) growing in loamy soil in private orchard at Badaway near El-Mansoura, Dakahlia Governorate. The plants spaced at 2.5 x 2.5 meters apart, and received the normal cultivar practices recommended by the Hort. Res. Inst. for banana plantation in Egypt.

For this study, 36 plants free from diseases, uniform in growth and in good physiological conditions as possible were selected at random. Each treatment was represented by 9 plants distributed in three blocks in complete

randomized design, three plants of each block received one of the following treatments:-

1. Control (untreated plants).
2. 50 g sulphur / plant / year.
3. 100 g sulphur / plant / year.
4. 150 g sulphur / plant / year.

Sulphur was added to the soil in May at the three levels mentioned.

At harvest time, length and circumferences of pseudostem at 20 cm was measured. The height of suckers was also recorded for each treatment. Bunch weight, number of hands and fingers / hand, finger weight, length, diameter, volume, angulation and pulp & peel weight were examined.

Chemical leaf analysis:

Leaf samples were taken from the third upper leaf in the descending leaves from the top of the plant after bunch shooting as recommended by Hewit (1955), and adapted by Abou-Aziz *et al.* (1987a).

Hundred grams of fresh weight were oven dried at 70°C until constant weight, it was ground for estimation of macro-nutrients (NPK) according to A.O.A.C. (1960). Elements were calculated as a percentage of dry matter.

Chemical soil analysis was carried out before the application of fertilizers as shown in Table (1).

Data were statistically analyzed according to Snedecor and Cochran (1967).

Table 1. Soil chemical analysis.

Anions (mg/1 kg soil)			Cations (mg/1 kg soil)						EC mmhos/ cm/ 25 °C	pH
HCO ₃	Cl	SO ₄	Ca	Mg	Na	N	P	K		
0.60	0.80	0.60	0.80	0.60	0.50	0.40	0.50	0.30	0.47	7.9

* Estimated in 1 : 5 soil extract.

RESULTS AND DISCUSSION

1. Vegetative growth:

Data in Table (2) indicated that all soil applications of sulphur significantly increased the height and girth of pseudostem and the height of the sucker than the control during the two seasons. Moreover, application of sulphur at 150 g/plant had the highest values in this respect followed with 100 and 50 g sulphur / plant. While, the untreated plants gave the lowest values in vegetative growth. The highest concentration of sulphur gave the best results in this respect.

The obtained results are in line with those obtained by Turner and Barkus, 1983; Abd El-Kader (1990), Abou-Aziz *et al.* (1993) and Pertin and Das (1998).

Table 2. Effect of sulphur on length, and girth of plant and sucker of Hindi cultivar.

Sulpher (g / plant)	Pseudostem length (cm)			Pseudostem girth (cm)			Sucker length (cm)		
	1996	1997	Mean	1996	1997	Mean	1996	1997	Mean
O	170.0	118.3	144.2	69.6	73.3	71.2	85.0	86.7	85.9
50	195.0	198.3	196.7	73.3	76.7	75.0	95.8	93.5	94.8
100	203.6	208.3	205.8	79.6	80.0	79.5	135.0	135.0	135.0
150	208.0	213.3	213.5	83.3	90.0	86.7	145.0	148.3	146.7
LSD at 5%	9.2	7.5	--	5.0	8.2	--	8.3	13.8	--

2. Yield and fruit quality:

a. Yield:

The results in Table (3) revealed that the sulphur soil applications had significant increasing effect on bunch weight and fruit quality in the two seasons as compared with the control. Moreover, sulphur application at 150 g/plant gave the highest yield compared with the other treatments and the control. This is not strange, because this treatment increased bunch weight, number of hands and number of fingers per hand. Furthermore, the application of sulphur at 150 g/plant increased the bunch weight by 90.8% over the control as the mean of the two seasons of study.

These results are in harmony with those obtained by Turner (1980), Abd El-Kader *et al.* (1990) and Abou Aziz *et al.* (1993).

b. Fruit quality:

From Table (4), it is clear that soil applications of sulphur decreased the angulation ratio during the two seasons of the study. The decrease was matching with the applied rate / plant. The highest rate of sulphur gave the lowest angulation ratio.

Table (4) also indicated that soil application of sulphur had significant increasing effect on finger size, length and diameter in the two seasons. Moreover, the highest concentration of sulphur applied gave the highest increase in this respect.

The obtained results are in line with those obtained by Twyford (1967) and Abou Aziz *et al.* (1993).

Comparing the effect of sulphur application on pulp and peel weight, results in Table (5) show significant increase compared with the untreated plants. The increase was matching with the concentration of sulphur fertilizer, i.e. the highest concentration gave the highest values of pulp and peel weight. In addition, all sulphur treatments gave no clear effect on pulp / peel ratio during the two seasons of study.

Table 5. Effect of sulphur on pulp, peel weight and pulp / peel ratio

Sulpher (g / plant)	Pulp weight (g)			Peel weight (g)			Pulp / peel ratio		
	1996	1997	Mean	1996	1997	Mean	1996	1997	Mean
O	36.7	37.3	37.0	36.3	38.3	37.3	1.1	1.0	1.05
50	42.0	41.0	41.5	43.0	39.7	41.4	1.1	1.0	1.05
100	43.7	45.7	44.7	40.7	40.3	40.5	1.1	1.1	1.1
150	48.0	45.1	46.6	43.0	46.3	44.7	1.1	1.1	1.1

Hosam El-Deen, A. S. H.

LSD at 5%	3.6	4.4	--	5.1	3.8	--	NS	NS	--
-----------	-----	-----	----	-----	-----	----	----	----	----

3,4

The obtained data are in line with those reported by Abd El-Kader (1990) and Abou Aziz *et al.* (1993).

3. Leaf mineral content:

From Table (6), data indicated that N and P content in the leaves were significantly increased by the sulphur soil application as compared with control. While, it could be observed that leaf K content decreased with sulphur treatments compared with control as a mean of two seasons.

These data are in agreement with those found by Hasan *et al.* (2000). They reported that K tended to decline after shooting stage.

The observed higher N and P contents by the application of such fertilizer may be due to its effect on decreasing the soil pH value and then increased the nutrient availability in the soil. These data are in line with the findings of Moreau and Robin (1972), Turner (1980), Abd El-Kader *et al.* (1990) as well as Abou Aziz *et al.* (1993).

Table 6. Effect of sulphur on NPK content of Hindi cultivar leaves.

Sulphur (g/ plant)	Nitrogen (%)			Phosphorus (%)			Potassium (%)		
	1996	1997	Mean	1996	1997	Mean	1996	1997	Mean
0	1.8	1.8	1.80	0.21	0.20	0.21	2.83	2.65	2.75
50	2.1	2.0	2.05	0.24	0.23	0.24	3.13	3.25	3.19
100	2.1	2.2	2.10	0.32	0.32	0.32	3.66	2.83	3.25
150	2.3	2.4	2.40	0.36	0.37	0.37	4.03	4.00	4.02
LSD at 5%	0.2	0.1	--	0.03	0.02	--	0.20	0.10	--

In conclusion, it is evident from the obtained results that soil application of sulphur to Hindi banana plants greatly improved vegetative growth, yield and fruit quality. These effects might be due to the effect of sulphur on decreasing the soil pH value and the resultant increase in nutrient availability. So, it could be recommended to use sulphur in Egyptian banana cultivation.

REFERENCES

- Abd El-Kader, A.M.; M.B. Bastawros and A.A. Abd El-Aal (1990). Effect of magnesium sulphate application on growth and yield of Maghrabi banana. *J. Agric. Sci. Mansoura Univ.*, 15(4):577-581.
- Abo-Rady, M.D.K.; O. Duheash; M. Khalil and M.A. Turjoman (1988). Effect of elemental sulphur on some properties of calcareous soil and growth of date palm seedlings. *Arid Soil Res. and Rehabilitation*, 2(2):121-130.
- Abou Aziz, A.B.; A.N.M. Abd El-Kader; M.R. El-Sonbaty and Soad M.M.M. (1993). Effect of different levels of (K - Mg) compound fertilizer on vegetative growth, yield, fruit quality and some leaf-nutrient contents of Maghrabi banana cultivar. *Assuit J. Agric. Sci.*, 24(1).
- Abou-Aziz, A.B.; I.S. Shawky; M.M. El-Tanahy and M.R. Tadros (1987a). Effect of potassium fertilization on growth and yield of Williams banana. *Proc. 1st Conf. Agric. Develop. Res., Fac. Agric., Ain Shams Univ.*, 1:62-70.

- A.O.A.C. (1960). Association of Official Agricultural Chemists. Official and Tentative Methods of Analysis. The A.O.A.C., Washington, D.C., USA.
- Cummings, C.M.; I.P. Mainland and J.P. Lilly (1981). Influence of soil pH, sulphur and sawdusts on blueberry survival, growth and yield. *J. Amer. Soc. Hort. Sci.*, 106(6):783-785.
- Hasan, M.A.; C.P. Suresh; S. Bhattacharya and P.K. Chattopadhyay (2000). Uptake pattern of nutrients in cavendish banana (Musa AAA). *Environ. and Ecol.*, 17(3):560-562. India. (C.F. Hort. Abst., 70(2):1185).
- Hassan, N. and R.A. Olsen (1966). Influence of applied sulfur on availability of soil nutrients for corn (*Zea mays* L.) nutrition. *Soil Sci. Soc. Amer. Proc.*, 30:284-286.
- Hening, H.; D. Sparks and J.J. Evans (1991). Sulphur deficiency influence vegetative growth, chlorophyll and element concentrations and amino acids of pecan. *J. Amer. Soc. Hort. Sci.*, 116(6):974-980.
- Hewitt, C.W. (1955). Leaf analysis as a guide to the nutrition of bananas. *F. Mp. J. Exp. Agric.*, 23. (C.F. Hort. Abst., 25:4346).
- Kassem, A.A.; H.A. Kassem and H.M. Kamal (1995). The influence of source, levels of nitrogen fertilizers and sulphur application on guava trees grown in alkaline sandy soil. *Menofiya J. Agric. Res.*, 20(3):1223-1235.
- Moreau, B. and J. Robin (1972). A potassium and magnesium fertilizer trial on banana at the station d'Ivoliana, Tamatare, Madagascar. *Fruits*, 27(9):595-602.
- Pertin, N. and R.P. Das (1998). Effect of micronutrients on vegetative growth of banana cv. Barijahaji (Musa AAA group, cavendish sub group. *J. Agric. Sci. Soc. North East India*, 9(2):166-168.
- Peterson, P.V.; C.A. Mullins; D.A. Lietzke and D.E. Deyton (1987). Effect of soil applied elemental sulphur, aluminum sulfate and sawdust on growth of rabbitage blueberries. *J. Amer. Soc. Hort. Sci.*, 112:612-616.
- Snedecor, C.W. and W.G. Cochran (1967). *Statistical Methods*. 6th ed. The Iowa State Univ. Press. Amer, Iowa, USA. PP. 395.
- Stromberg, L.K. and S.L. Tisdale (1979). Treating irrigated arid-land soils with acid-forming sulphur compounds. *The Sulphur Institute Technical Bulletin*, 24, P. 2.
- Turner, D.W. (1980). Plant growth and dry matter production of the Williams banana in relation to supply of potassium, Mg and Mn in sand culture. *Scientia Hort.*, 12(1):27-45. (C.F. Hort. Abst., 50:7442).
- Turner, D.W. and B. Barkus (1983). Long term nutrient absorption ions and competition between ions in banana in relation to supply of K, Mg and Mn (Abstract). *Aust. Hort. Res. Newsletter*, 55:137-138.
- Twyford, I.T. (1967). Banana nutrition. A review of principles and practices. *J. Sci. Food and Agric.*, 18:177-183.

تأثير التسميد الأرضي بالكبريت على النمو الخضري والمحصول وصفات الثمار
للموز الهندي

أحمد سعد حسام الدين

قسم الفاكهة الإستوائية - معهد بحوث البساتين

أجريت هذه الدراسة عامي ١٩٩٦ ، ١٩٩٧ بمزرعة خاصة بناحية بدواي مركز المنصورة ، وذلك بهدف معرفة تأثير الإضافة الأرضية لعنصر الكبريت على النمو الخضري والمحصول وجودة الثمار ومحتوى الأوراق من العناصر الغذائية (ن ، فو ، بو) للموز الهندي تحت ظروف التربة الطميية .
وقد نتج عن الدراسة مايلي:-

- ١- أدت الإضافة الأرضية للكبريت بنسبة ٥٠ ، ١٠٠ ، ١٥٠ جم/نبات إلى حدوث زيادة معنوية في طول وسمك الساق وكذلك إرتفاع الخلفات .
 - ٢- جميع معدلات الكبريت المضافة نتج عنها تحسن كبير في المحصول متمثلاً في وزن السوباطه ووزن وعدد الأصابع بالكف وكذلك صفات الثمار وخاصة إضافة الكبريت بمعدل ١٥٠ جم/نبات حيث أدت إلى زيادة وزن وعدد الكفوف وكذلك الأصابع ، بينما أدت هذه المعاملة إلى نقص التضليح للأصبع . كما أن هذه المعاملة أيضاً أدت إلى زيادة كل من حجم وطول وسمك الأصابع وكذلك زيادة وزن اللب والقشرة .
 - ٣- لوحظ وجود زيادة معنوية في محتوى الأوراق من النيتروجين والفوسفور بزيادة نسبة الكبريت المستخدم خلال موسمي الدراسة مقارنة بالكنترول . بينما كان المحتوى من البوتاسيوم يميل إلى النقص .
- مما سبق يتضح أن الإضافة الأرضية لعنصر الكبريت إلى نباتات الموز الهندي تكون مغيدة جداً في تحسين الخواص الطبيعية للتربة وصلاحية العناصر الغذائية للإمتصاص . هذا بالإضافة إلى زيادة وزن السوباطه بحوالى ٩٠,٨% عن النباتات الغير معاملة كمتوسط لموسمي الدراسة .

Table 3. Effect of sulphur on yield, number of hands, and number and weight of finger of banana Hindi cultivar.

Sulphur (g/plant)	No. of hands / bunch			No. of fingers / hand			Finger weight (gm)			Bunch weight (kg)		
	1996	1997	Mean	1996	1997	Mean	1996	1997	Mean	1996	1997	Mean
O (Control)	8.7	5.7	7.2	19.0	20.0	19.5	71.4	72.3	72.0	11.9	12.1	12.0
50	9.3	8.7	9.0	20.3	21.0	20.7	85.0	83.3	84.2	16.1	15.2	15.7
100	9.3	9.3	9.3	21.7	21.0	21.4	98.3	95.0	96.7	19.8	19.0	19.4
150	9.7	9.7	9.7	23.3	23.0	23.2	101.7	103.3	102.5	22.9	22.9	22.9
LSD at 5%	1.0	1.0	--	2.2	2.1	--	4.2	4.1	--	2.4	2.3	--

Table 4. Effect of sulphur on angulation, size, length and diameter of fingers of banana Hindi cultivar.

Sulphur (g/plant)	Angulation			Size (ml)			Length (cm)			Diameter (cm)		
	1996	1997	Mean	1996	1997	Mean	1996	1997	Mean	1996	1997	Mean
O (Control)	14.7	16.0	15.4	75.7	76.7	76.2	17.0	18.0	17.5	2.8	2.7	2.8
50	12.7	14.0	13.4	86.7	86.7	86.7	19.3	19.3	19.3	2.9	2.8	2.9
100	12.0	13.0	12.5	98.3	95.0	96.7	20.3	20.0	20.2	2.8	3.1	3.0
150	11.0	12.7	11.9	101.3	103.3	102.3	21.0	21.3	21.3	3.3	3.2	3.3
LSD at 5%	2.1	1.8	--	2.5	5.9	--	1.9	2.29		0.4	0.2	--