

YIELD AND FRUIT QUALITY OF HINDI BANANA FRUIT AS AFFECTED BY USING SITOFEX AND GIBBERILLIC ACID APPLICATIONS

Hosam El-Din, A. S.; E. G. Ibrahim and A.S. Abdallah

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

ABSTRACT

A field experiment was conducted on Hindi banana cultivar growing in loamy soil in private orchard at Badaway, Mansoura, to study the effect of Sitofex (CPPU) alone or in combination with GA₃ (Gibberellic acid) on yield and fruit quality of banana. Treatments were applied twice, just after emergence of the last hand of the bunch and 1 month later, and consisted of 2.5, 5.0 or 10.0 ppm Sitofex alone and in combination with 300 ppm GA₃, and a control. The highest finger length, diameter, pedicel diameter, and weight were recorded with 10 ppm Sitofex and 300 ppm GA₃. Highest bunch weight, angulation percent, chlorophyll content, peel and pulp weight were recorded with 300 ppm GA₃ + 10 ppm Sitofex also. As well as, total sugars percent were reduced by using 10 ppm Sitofex + 300 ppm GA₃.

INTRODUCTION

Banana are one of the most profitable fruit in Egypt. Hindi (*Musa cavendishii* L.) is one of the important cultivars grown under the local conditions. Yet this cultivar have small and uneven finger size, which can caused major losses in production.

In an attempt to eliminate those problems the efficiency of other growth regulators (which can be used without a health or environmental hazard) were investigated. Sitofex (CPPU), [N- (2-chloro-4-pyridinyl) -N- phenylurea] is a new plant growth regulator, which has promising results by increasing fruit size. The mode of action of it is similar to that of cytokinin (Nickell, 1985). Cytokinines are growth regulators that enhance plant cell division and growth and also delay senescences.

Application of gibberellic acid is currently used to increase fruit size of banana (Hosam El-Dim, 1990).

The objective goal of this study was to examine the effect and the interaction between Sitofex (CPPU) and gibberillic acid (GA₃) on yield and fruit quality of Hindi banana.

MATERIALS AND METHODS

This investigation was undertaken during the seasons of 1998 and 1999 on Hindi banana (*Musa cavendishii*, L.) grown under conditions of loamy soil and flood irrigation in a private orchard at Badaway (approximately 15 km northeast El-Mansoura city, Dakahlia Governorate).

This study started in March 1998, where sufficient numbers of uniform Hindi banana suckers were planted as one sucker per hole. The plants spaced at 2.5 x 2.5 meters apart.

The experiment was designed according to the randomized block system with three replicates per treatment, three plants each. The treatments evaluated in the trial are presented in Table 1.

Table 1. Experimental treatments.

No.	Treatments
1	Control
2	Sitofex (CPPU) at 2.5 ppm
3	Sitofex (CPPU) at 5.0 ppm
4	Sitofex (CPPU) at 10.0 ppm
5	Sitofex (CPPU) at 2.5 ppm + GA ₃ at 300 ppm
6	Sitofex (CPPU) at 5.0 ppm + GA ₃ at 300 ppm
7	Sitofex (CPPU) at 10.0 ppm + GA ₃ at 300 ppm

The bunches were sprayed with Sitofex (CPPU) and GA₃ twice, just after emergence of the last hand of the bunch and one month later.

Harvest date was estimated when the top hands have turned slightly yellow and when the angulation percent reached above 9% according to Abou-Aziz (1970).

The following measurements were undertaken.

1. Average bunch weight (kg).
2. Average finger weight (gm).
3. Finger length (cm).
4. Finger diameter (cm).
5. Angulation percentage.
6. Pulp weight (gm).
7. Peel weight (gm).
8. Pulp / peel ratio.
9. Diameter of finger pedicle.
10. Total chlorophyll was estimated in peel according to Gjerstad (1962).
11. Total sugars was estimated in pulp as percentage according to Ranganna (1979).

The obtained data were statistically analyzed according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1. Finger and bunch weight:

Data presented in Table (2) show clearly that all treatments used significantly increased the average finger weight per plant than the control. Moreover, spraying the bunch with Sitofex at 10 ppm in combination with GA₃ at 300 ppm produced a higher significant finger weight than the other treatments used in the two seasons of this study. It was also cleared that applications of GA₃ and Sitofex together surpassed other treatments.

Concerning the effect on average bunch weight, similar trend to those reported in finger weight was found. That is not strange, since the weight of bunch was affected by finger weight. Our data go in line with those reported by El-Banna (1981), who found that GA₃ application gave a marked effect on yield of banana plants. Yet, plants treated with GA₃ at 100 or 200 ppm increased the yield per plant by about 112.0 and 113.5% during the two seasons of study.

Table 2. Effect of Sitofex and GA₃ on finger and bunch weight of Hindi banana during 1997 and 1998 seasons.

Variables	Finger weight (gm)		Bunch weight (kg)	
	1998	1999	1998	1999
Treatments				
Control	71.67	69.33	14.13	13.27
Sitofex at 2.5 ppm	82.67	83.00	16.73	16.77
Sitofex at 5.0 ppm	94.00	89.33	19.13	19.00
Sitofex at 10.0 ppm	98.00	91.67	19.83	19.10
Sitofex at 2.5 ppm + GA ₃ at 300 ppm	86.33	85.00	17.43	18.00
Sitofex at 5.0 ppm + GA ₃ at 300 ppm	99.33	91.33	19.77	19.40
Sitofex at 10.0 ppm + GA ₃ at 300 ppm	124.67	117.67	22.50	21.67
LSD at 5%	3.51	6.24	1.28	1.39
LSD at 1%	4.92	8.82	1.79	1.95

Furthermore, Tadros *et al.* (1984) mentioned that GA₃ treatments at 10 to 50 ppm significantly increased the bunch weight of banana plant. The increase in bunch weight was paralleled with the increase of GA₃ concentration. Likewise, Hosam El-Din (1990) found that spraying the bunch with GA₃ at 250 and 500 ppm significantly increased bunch weight than the untreated banana plants. Also, our data are in harmony with those reported by Rizk (1998), who found that combined treatments with Sitofex (CPPU) and GA₃ were significantly increased the yield per vine than the untreated one. Moreover, he mentioned that the combined effects of Sitofex and GA₃ were better than the separate effects of each treatment. Similar results were found by Nickell (1986), Diaz and Maldonado (1992) and Dokoozlian *et al.* (1994). Also, Retamales *et al.* (1995), since they found that Sitofex alone or in combination with GA₃ applied at 4 mm fruit diameter improved the yield of Thompson seedless grapes. Kumar and Reddy (1998) found that treatments were applied twice, just after emergence of the last hand of the bunch and one month later, and consisted of 100 or 200 ppm GA₃. The highest bunch weight was recorded with 200 ppm GA₃ of banana.

2. Finger length and diameter:

From Table (3), the data reveal that all treatments used significantly increased finger length of banana fruits compared with the control during the two seasons of the study. Furthermore, the combination applications with Sitofex and GA₃ gave a higher significant effect in this respect than using Sitofex alone.

Considering the effect on finger diameter, a similar trend to that of finger length was found during the first season. While, all applications used gave no significant effect in the second one. Our data are in harmony with those reported by Tadros *et al.* (1984), they reported that GA₃ treatments had a significant effect of banana fruit length. This increment may be attributed to the effect of GA₃ on cell enlargement (Coombe, 1960). Similar results were found by Shaaban (1978) and Hosam El-Din (1990). Moreover, Dokoozlian *et*

5. Pulp, peel and pulp/peel ratio:

Data in Table 4 show that all treatments used significantly increased both of peel and pulp weight than the untreated plants. Furthermore, the highest values in this respect were obtained from the combined treatment with Sitofex at 10 ppm and GA₃. Also, the high concentrations of Sitofex either alone or combined with GA₃ showed a higher significant effect in peel and pulp weight compared with the other treatments used. Our data go in line with those mentioned by Hosam El-Din (1990), who found that spraying the bunch with GA₃ at 250 or 500 ppm significantly increased pulp and peel weight than the other treatments used.

Table 4. Effect of Sitofex and GA₃ on pulp, peel weight, and pulp / peel ratio of Hindi banana during 1997 and 1998 seasons.

Treat	Pulp weight		Peel weight		Pulp/peel ratio		
	1998	1999	1998	1999	1998	1999	
Control	37.567	36.233	35.762	33.767	1.051	1.073	
Sitofex at 2.5 ppm	42.800	41.633	39.933	37.867	1.073	1.106	
Sitofex at 5.0 ppm	48.100	46.600	46.667	42.400	1.033	1.099	
Sitofex at 10.0 ppm	51.133	47.233	47.200	44.433	1.083	1.063	
Sitofex at 2.5 ppm + GA ₃ at 300 ppm	44.033	45.167	42.300	42.333	1.041	1.067	
Sitofex at 5.0 ppm + GA ₃ at 300 ppm	50.767	46.833	48.233	44.500	1.053	1.053	
Sitofex at 10.0 ppm + GA ₃ at 300 ppm	62.933	58.367	61.733	56.633	1.019	1.031	
LSD	5%	3.89	3.85	3.79	4.36	NS	NS
	1%	5.45	5.02	5.32	4.11	NS	NS

Concerning the effect of different applications on pulp / peel ratio, data in Table 4 indicated that all treatments used gave no major differences in this respect, except the combined applications with Sitofex and GA₃, which gave the lowest values than the other treatments used. The obtained data are in harmony with those reported by Tadrose *et al.* (1984), Kumar and Reddy (1999) and Patil and Hulamani (1998), they mentioned that treatment with GA₃ at 150 ppm resulted in significant lower pulp to peel ratio.

6. Chlorophyll content:

From Table 5, data show clearly that all the applications used increased chlorophyll A and B in fruits peel compared with the untreated fruits during the two seasons of study. Moreover, the values of chlorophyll A and B were higher when the fruits sprayed with Sitofex at 10 ppm alone or with GA₃ than the other treatments used. That is not strange, since Hosam El-Din (1990) found that the values of chlorophyll A and B were higher when fruits sprayed with GA₃ either at 250 or 500 ppm than other treatments used or the control as mean of two seasons under the study.

Table 5. Effect of Sitofex and GA₃ on chlorophyll A, B, and Total sugars of Hindi banana fruit during 1997 and 1998 seasons.

Treat	Chlorophyll A		Chlorophyll B		Total sugars		
	1998	1999	1998	1999	1998	1999	
Control	0.150	0.170	0.163	0.170	16.467	15.377	
Sitofex at 2.5 ppm	0.170	0.203	0.190	0.187	16.500	15.537	
Sitofex at 5.0 ppm	0.203	0.230	0.210	0.203	16.577	15.570	
Sitofex at 10.0 ppm	0.237	0.250	0.230	0.230	16.597	15.740	
Sitofex at 2.5 ppm + GA ₃ at 300 ppm	0.207	0.207	0.223	0.187	15.420	15.400	
Sitofex at 5.0 ppm + GA ₃ at 300 ppm	0.200	0.267	0.240	0.220	15.977	15.363	
Sitofex at 10.0 ppm + GA ₃ at 300 ppm	0.280	0.287	0.260	0.260	15.777	14.817	
LSD	5%	0.023	0.016	0.015	0.015	0.096	0.34
	1%	0.032	0.022	0.022	0.021	0.134	0.48

7. Total sugars:

Data in Table 5 indicated that fruits sprayed with Sitofex only gave a slight increase in the total sugars percent in the pulp of fruits. Furthermore, Sitofex at 10 ppm gave the highest values in this respect than the other applications with Sitofex and the untreated ones. Whereas, the combined applications with Sitofex and GA₃ reduced the total sugars percent compared with the other treatments and the control. Moreover, the combined application with Sitofex at 10 ppm and GA₃ showed the highest significant reduction in total sugars content than the other treatments and the untreated fruits. Similar results were reported by Hosam El-Din (1990), who found that GA₃ application of 250 ppm reduced the starch percent. This reduction of total sugars may be due to the loss of neutral sugars (predominantly arabinose and galactose) by using GA₃ (Ben-Arle *et al.*, 1996).

From the previous results one can conclude that spraying Hindi banana fruits with Sitofex (CPPU) at 10 ppm alone or combined with GA₃ at 300 ppm after fruit set presented a higher bunch weight with the higher finger length, diameter and finger pedicle diameter, as well as, these applications increased angulation percent, peel and pulp weight and total sugars percent in the pulp of banana fruits.

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تأثير السيتوفكس وحمض الجبريللين على المحصول وصفات الثمار فى الموز

الهندي

أحمد سعد حسام الدين - السيد جمعة إبراهيم - عباس سعد عبد الله
معهد بحوث البساتين - مركز البحوث الزراعية - مصر

أجريت هذه التجربة على الموز الهندي فى تربة طميية بناحية بداوى - مركز المنصورة ، لدراسة تأثير الرش بالسيتوفكس سواء منفرداً أو مع الجبريللين على المحصول وصفات الثمار فى الموز .

وقد استخدم السيتوفكس بتركيزات ٢,٥ ، ٥,٥ ، ١٠,٥ جزء فى المليون منفرداً أو مع الجبريللين بتركيز ٣٠٠ جزء فى المليون وذلك بعد خروج آخر كف فى السوباته وبعد شهر من هذه المعاملة .

وقد تم الحصول على أصابع موز أطول وأسمك وكذلك زاد سمك عنق الأصابع ووزنه عندما استخدم السيتوفكس بتركيز ١٠ جزء فى المليون مع الجبريللين بتركيز ٣٠٠ جزء فى المليون .

أيضا تم الحصول على أعلى وزن للسوباته وأعلى نسبة منوية من التصلب ومحتوى الكلورفيل ووزن القشرة واللبن باستخدام نفس المعاملة السابقة . إنخفضت النسبة المنوية للسكريات الكلية فى لحم الثمار باستخدام السيتوفكس بتركيز ١٠ جزء فى المليون + جبريللين بتركيز ٣٠٠ جزء فى المليون مقارنة بباقي المعاملات والكنترول (ثمار غير معاملة) .

من هذا يتضح أن استخدام منظم النمو السيتوفكس مع حمض الجبريللين يعطى نتائج أفضل من استخدام كل منظم على حدة بالنسبة للمحصول وصفات الثمار .