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Effectiveness of Compost and Potassium Silicate under Low Rate of Mineral Fertilizers on Production, Quality, Marketability and NPK Contents of Banana Plants

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ABSTRACT

Banana (*Musa spp*) is considered as one of the most important fruit crops in Egypt, where it occupy an area of 27.5 thousand ha. Field experiments on banana cv. Grand Nain for two consecutive seasons (2016 and 2017) were conducted in Horticulture Research Station located in El-Kanter Elkharia, Kaluobia Governorate. The main objective of this study was to investigate the possibility of reducing the mineral fertilizers applied to the banana crop by using compost and potassium silicate treatments. Three rates of compost (15, 20 and 25 kg per mate) were applied with 50% of the recommended rate of mineral fertilizers along with or without potassium silicate at a rate of 60 ml per mate. These treatments were compared with recommended rates of mineral fertilizers mixed with and without potassium silicate. Obtained results showed that application of compost led to enhance all studied parameters and recorded highly significant differences particularly under the treatments combined with potassium silicate and 50% of the recommended rate of mineral fertilizers. The highest level of compost with potassium silicate treatment recorded the uppermost values of growth, yield and quality of banana fruits. Moreover, the same treatment recorded significant increments in total sugar and T.S.S% in fruits as compared with the recommended dose of mineral fertilizers.

Keywords: Grand Nain banana, compost, potassium silicate, fruit quality, mineral fertilizers and NPK contents.

INTRODUCTION

Banana (Musa spp) is the most important crop grown in the tropical and subtropical regions of the world and considered as one of the most important and favorite fruits in the world. The area of plantain has enormously increased through the last decade because it gives the highest economic revenue comparing with other fruit crops. The world's production exceeded 114 million tons (FAO, 2014). The total area of banana plantations in Egypt amounted to 79,857 feddans (feddan = 0.4 hectare), while the fruitful area reached 65,497 feddans produced about 1.3 million tons (Ministry of Agriculture, 2015). Generally, banana plants need large amounts of fertilizers, especially nitrogen and potassium (Ganeshamurthy *et al*., 2011). Moreover, it draws nutrient elements from a very limited soil depth due to its shallow roots. The major problems that face the banana growers are the high cost of inorganic fertilizers needed for banana plants. Beside this, chemical fertilizers are considered as a potent air, soil and water polluting agents during both their production and utilization. Consequently, it has drawn the attention of researchers and banana growers to use organic and natural compounds such as sillicic acid, humic acid, and silicon…etc. that are safe for human, animals and the environment. The utilization of compost is considered as promising alternative for chemical fertilizers, especially for developing countries. Ramesh *et al*. (2010) surveyed that organic farming improves soil quality in terms of various parameters, viz. physical, chemical, biological properties, indicating an enhanced soil health and sustainability of crop production. Continuous use of chemical fertilization leads to the deterioration of soil characteristics and fertility and might lead to the accumulation of heavy metals in plant tissues, affecting the fruit nutritional value and edibility (Shimbo *et al*., 2001). The great availability and release of N, P and K due to the application of compost fertilizers were announced by Abd-Rabou (2006) on av°Cados and mangos and Al-Ashkar *et al*. (2007) on bananas. Compost fertilizers are the most important for plant production and soil as they play an important role in improving fruit quality and yield grapevines (Akl *et al*., 1997). The composting pr°Cess can result in obtaining stable humus, humic and fulvic acids, characterized by a high nutritional value and potential for fertilization of soils with nutriment deficiencies (Tognetti *et al*., 2005). Adding organic composts to apple orchard soils has been shown to improve the blooming and growth of newly planted trees (Autio *et al*.,1991) and fruit yields (Niggli *et al*.,1990). Silicon is the most abundant element in the earth's crust next to oxygen and comprises 28% of its weight, 3-17 % in soil solution (Epstein, 1999). It is most commonly found in soils in the form of solution as silicic acid (H_4SiO_4) and is taken up directly as silicic acid (Ma *et al*., 2006). Many plants can accumulate Si concentrations higher than essential macronutrients (Epstein, 1999). Silicon deposited in the walls of epidermal cells after absorption by plants, contributes considerably to stem strength. Silicon is not that much mobile element in plants (Savant *et al*., 1999). The role of silicon in plant biology is to reduce multiple stresses including biotic and a biotic stresses. It is also known to increase drought tolerance in plants by maintaining plant water balance, photosynthetic activity, erectness of leaves and structure of xylem vessels under high transpiration rates (Melo *et al*., 2003). Gong *et al*. (2006) observed improved water economy and dry matter yield by silicon application and it enhanced leaf water potential under water stress conditions, reduced incidence of micronutrient and metal toxicity (Matoh *et al*., 1991). Silicon application was essential for stimulating growth and fruiting of different fruit crops (Abd El-Hameed, 2012; Lalithya *et al*., 2014; Roshdy, 2014; Kumbargire *et al*., 2016). In reference to this background information and based on the possible benefits of silicon and compost, the present work was carried out to investigate the effectiveness of compost and potassium silicate under low rate of mineral fertilizers on production, quality, marketability and NPK contents of banana plants (cv. Grand Nain).

MATERIALS AND METHODS

This study was conducted on third sucker of 3 & 4 Grand Nain banana rations grown in clay loamy soil of banana plantation belong to Horticulture Research Station at

El-Kantar El-Khairia, Kaluobia Governorate, Egypt, during 2016 and 2017 experimental seasons. Some physical and chemical properties of the used soil were determined according to Jackson (1973) are shown in table 1. The plantation holes (Mats) were 3.5 * 3.5 m with three productive rations (three suckers were selected and kept to grow for consecutive cropping).

Table 1. Some physical and chemical properties of the studied soil

Property	Values
Ca ppm	1.21
Chemical properties	
Clay	28.75
Cu ppm	1.13
EC. $dS.m^{-1}$	0.59
Fe ppm	0.57
K ppm	24.52
O.M. %	1.08
P ppm	4.55
pH	7.8
Physical properties	
Sand	32.98
Silt	37.11
T.N %	0.18
Texture	Clay loamy
Total carbonate %	2.71 %
W.H.C. %	37%
Zn ppm	0.97

Table 2. Some physical and chemical characteristic of used compost

Characteristic	Values
Weight of m^3(kg)	580
Humidity %	26.75
pH	8.2
E.C.$dS.m^{-1}$	4.73
Total nitrogen %	1.41
Organic matter %	36.42
Organic carbon %	21.13
Aches %	73.25
C/N ratio	18.1
Total phosphorus	0.71
Total potassium	0.83
Fe ppm	371.40
Mn ppm	57.30
Cu ppm	29.53
Zinc ppm	47.11
Nematoda (worm)	Nil
Total E. col.	Nil
Weed seed	Nil

Compost used (Plant and animal wastes)

Compost (C) was added and mixed with soil in preparation stage at three rates 15, 20 and 25 kg. $mate^{-1}$ (equal 5, 7 and 9 tons $fed.^{-1}$). Table 2. shows some physical and chemical properties of used compost.

NPK-mineral (M) treatments;

NPK- mineral fertilizers were applied at two rates (50 and 100%) of the recommended rate, the N and K doses were splitted into three equal doses, and the doses were added as following distribution;

- In March, at preparation stage, P doses were added along with compost as well as the first doses of N and K doses were added.
- In April, the second dose of N was added.
- In May, the third doses of N were added along with the second doses of K.
- In August, the third doses of K were added.

Silicon fertilization;

Silicon as potassium silicate (KSi), a commercial liquid fertilizer (10% K_2O and 25% Si) was applied as soil treatment monthly from May to July, at rate of 60 ml per mate.

A complete block design with three replicates containing eight treatments was used as follows:

1. 100% of recommended mineral fertilizers application (600, 100 and 500 kg. $fed.^{-1}$ of N, P_2O_5 and K_2O, respectively) as a control.
2. 100% of recommended mineral fertilizers + Potassium silicate (60 ml per mate).
3. 50% of recommended mineral fertilizers + Potassium silicate (60 ml per mate) + 25 kg compost $mate^{-1}$.
4. 50% of recommended mineral fertilizers + Potassium silicate (60 ml per mate) + 20 kg compost $mate^{-1}$.
5. 50% of recommended mineral fertilizers + Potassium silicate (60 ml per mate) + 15 kg compost $mate^{-1}$.
6. 50% of recommended mineral fertilizers + 25 kg compost $mate^{-1}$.
7. 50% of recommended mineral fertilizers + 20 kg compost $mate^{-1}$.
8. 50% of recommended mineral fertilizers + 15 kg compost $mate^{-1}$.

Response of banana plants to different treatments were investigated based on the following parameters;

- **Vegetative growth**

After inflorescence emergence, some vegetative growth parameters were measured as following:

- Pseudostem height in cm was measured from the soil surface up to the petiole of the last emerged leaf.
- Pseudostem circumference, which measured at 20-cm. height above the soil surface.
- Number of green leaves at bunch shooting stage (number of green leaves presented per plant was recorded).
- Leaf area: The area of the third full sized leaf (from the top) was calculated in square meters according to Murry, (1960) using the following equation:
- Leaf area= length x width x 0.8.

- **Leaves mineral content**

Leaves samples of one leaf was collected from every Pseudostem during each season. They were dried at 70 °C until reached constant weight and then ground by using a manual mill 0.2g. The ground material was digested using a mixture of 1:10 percholoric and sulphoric acid (v/v) for determination the following nutrient elements, total nitrogen (N%), phosphorus (P%) and potassium (K) according to Page *et al*. (1982).

- **Time from bunch shooting to harvesting**

Duration needed from bunch shooting till harvesting (Maturation) in days was calculated.

- **Bunch characteristics and yield**

Bunch weight (kg), number of hands per bunch, number of fingers per bunch, bunch length (cm) and yield (ton fed^{-1}) were estimated.

- **Fruit ripening**

Banana bunches for every treatment were harvested at maturity stage and held 24 hours in the laboratory at room temperature. Bunches were divided into hands, washed with tap water and air dried then packed in plastic boxes and

placed on shelves in ripening room at 20 °C ±2 and 90% ±2 relative humidity. Samples were subjected to acetylene gas generated from calcium carbide (5 gm calcium carbide in boiling water m^{-3} ripening room) for 24 hours then transferred to be held at 15 °C ±2.

At 7 days intervals, Samples of all treatments were examined for the following characters:

- **Physical properties**

- Pulp weight; peel weight; pulp percentage; finger length (cm); finger diameter; finger weight and thickness peel were determined in sample of 10 fruits replicated in the three periods (7days).
- Fruit firmness (g. mm^{-2}) was determined by LFRA texture analyzer using a penetrating needle of 1 mm diameter with 10 mm in distance, speed of 2 mm per second and the peak of resistance was recorded as g. mm^{-2}.
- Peel color of fruit was measured by averaging two measurements taken on two opposite points of each fruit equator with a Minolta Colorimeter (Minolta Co. Ltd; Osaka, Japan) on the basis of the CIELAB color system. In this system values of (a & b) specify the green-red and blue-yellow axis, respectively. Values were determined and Hue angle was calculated according to Mc-Guire, 1992.
- Fruit Weight Loss percentage (FWL %):- The loss in mass fruit weight was recorded and calculated as percentage.

- **Chemical properties**

- Fruit moisture percentage was determined by weight of 100g from fresh banana fruits then oven dried at 70^0C till constant weight reached.
- Freshly prepared juice of banana fruits samples were used for TSS, total acidity and total sugars determination as described by A.O.A.C., 2005.

- **Statistical analysis**

The obtained data were subjected to analysis of variance according to Snedecor and Cochran, 1990 and the significant differences among the various treatments were comparing using L.S.D values at 5% level.

RESULTS AND DISCUSSION

- **Vegetative growth**

Application of deferent compost (C) levels with or without added potassium silicate (KSi) recorded significant differences as compared to application mineral NPK fertilizers as such or in combination with (KSi). Data presented in Table 3 reveal that both treatments which received (50% M + KSi + 25 kg C) and (100% M + KSi) recorded the highest values at all vegetative growth parameters tested and scored significantly effects as compared to other tested treatments. Application of 50% M + 15 kg C has recorded the lowest values at all vegetative growth parameters tested. But no significant differences were observed between different treatments 100% M (control), 50 M + Si + 20 kg C, 50% M + KSi + 15 kg C and 50% M+ 25 kg C at all vegetative growth parameters tested.

The increases in all vegetative growth parameters, mentioned-above, could be attributed to higher uptake of nutrients, particularly nitrogen (Nalina *et al*., 2009). This fact is also supported by the work of Pafli (1965) who indicated that the uptake of nitrogen, the chief constituent of chlorophyll, proteins and amino acids is accelerated through its increased supply at appropriate time to the plants.

Table 3. Effect of mineral, KSi and compost fertilizer applications on some vegetative growth parameters of banana during 2016 & 2017 seasons

Treatments	Leaf No. plant^{-1}		Leaf area (m^2)		Pseudostem height (m)		Pseudostem circumference (cm)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
100% M (control)	11.67 bc	12.83 a	1.76 bc	1.88 ab	270.7 abc	270.7 abc	76.33 abc	80.00 abc
100% M+KSi	12.57 a	13.43 a	1.82 a	1.93 a	274.7 ab	280.0 a	81.67 a	84.33 a
50% M+KSi+25 kg C	12.07 ab	13.40 a	1.78 ab	1.91 ab	278.3 a	285.0 a	80.67 ab	82.00 a
50% M+KSi+20 kg C	11.07 cd	12.90 a	1.72 cd	1.81 bc	271.3 abc	275.0 ab	77.67 abc	78.00 ab
50% M+KSi+15 kg C	10.40 de	12.63 a	1.65 e	1.74 cd	266.7 bcd	268.7 abc	73.00 bcd	76.00 bc
50% M+25 kg C	10.73 de	11.60 b	1.70 d	1.72 cd	263.0 cde	269.0 ab	73.67 bcd	75.00 bc
50% M+20 kg C	9.97 ef	11.33 b	1.62 ef	1.67 de	259.3 de	259.7 bc	72.00 cd	73.00 cd
50% M+15 kg C	9.60 f	9.97 c	1.58 f	1.60 e	252.3 e	254.3 c	67.33 d	69.00 d

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

- **Plant mineral uptake (N, P and K %) and days NO from shooting to harvesting**

Results in Table 4 indicate that the treatments with different levels of compost with potassium silicate induced significant increases of plant N, P and K contents in both two seasons as compared to the treatments received 100% mineral NP and K as such or with KSi. The increase in nitrogen, phosphorus and potassium uptake with 100% M, 100% M + KSi may be attributed to the direct addition of nutrients in the form of chemical fertilizers which provide the nutrient to the soil solution in readily available forms. Plants that received inorganic fertilizers contained optimum leaf nutrient concentrations (Bhargava, 1999). Regarding the uptake of nitrogen, N supply from organic sources depends upon their chemical nature and nitrogen content too. The nitrogen generates banana growth and vegetative matter production. Phosphorous prevents premature ageing of leaves and aids in the growth of young independent plants. On the other hand potassium has a determinant action on bunch weight, number of hands and on Pseudostem size (Alvarez *et al*., 2001). However, among organic treatments 50% M + KSi + 25 kg C registered maximum value of nutrient concentrations of N (5.960), P (0.806) and K (7.012). During the harvesting stage the leaf nitrogen, phosphorous, potassium content was reduced due to the movement of nutrients to shooting and fruit development (Selvamani and Manivannan, 2009). All treatments 50%M with the different levels of compost with or without potassium silicate resulted in reduced duration of days from shooting to harvesting (In case of shooting to bunch

development, 50%M+15 kg C treatment has taken minimum number of days for maturing (116). In control (100%M) recorded 133 days from shooting to harvest. While, organic treatments receded 116 to 128 days from shooting to harvest. Treatment 100% M + KSi receded 130 days from shooting to harvest. The obtained data are in agreement with Athani *et al*., 2009 who reported that application of compost with silicon recorded early shooting in banana plants.

Table 4. Effect of mineral, KSi and compost fertilizer applications on N, P and K contents (%) of banana plants and time from bunch shooting to harvest during 2016 & 2017 seasons

Treatments	% N		% P		% K		Day No. from shooting to harvesting	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
100% M (control)	6.337 a	6.452 a	0.810 a	0.867 a	6.840 a	7.453 a	131 a	133 a
100% M+KSi	6.237 ab	6.450 a	0.776 a	0.840 ab	6.680 a	7.333 a	125 ab	130 a
50% M+KSi+25 kg C	5.947 bc	5.960 ab	0.690 b	0.806 b	6.147 b	7.012 b	129 a	128 ab
50% M+KSi+20 kg C	5.613 c	5.887 ab	0.680 bc	0.733 c	5.820 c	6.707 c	126 ab	128 ab
50% M+KSi+15 kg C	5.223 d	5.410 abc	0.607 cd	0.687 cd	5.627 cd	6.450 cd	116 ab	120 ab
50% M+25 kg C	5.607 c	5.280 abc	0.580 d	0.643 de	5.423 d	6.217 d	121 ab	125 ab
50% M+20 kg C	4.930 de	5.003 bc	0.547 d	0.593 ef	5.053 e	5.223 e	122 ab	125 ab
50% M+15 kg C	4.703 e	4.580 c	0.543 d	0.573 f	4.620 f	4.830 f	110 b	116 b

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

- **Bunch characteristics:-**

The data pertaining to bunch characters are presented in The data reveals that bunch characters showed significant difference among the treatments. The mineral fertilizer with potassium silicate treatment (100% M + KSi) has recorded highest results of bunch length, number of hands bunch-1, finger No/bunch and bunch weight (108.67cm, 12, 198.3, 27kg respectively) and among the compost different levels with potassium silicate and 50% M treatments have recorded highest results, 50% M + KSi + 25 kg C has recorded highest results (102.67cm, 11.83, 193.3, 24.80 kg respectively). The use of compost and potassium silicate exerted a positive influence on bunch weight and yield attributes like number of hands per bunch and number of fingers per bunch (The highest bunch weight (27.00) was observed in treatment 100% M + KSi .However, 50% M + KSi + 25 kg C treatment showed highest bunch weight (24.80) among organic treatments with 50%mineral.This is in confirmation with the findings of Babu Ratan (2006). Found that plants with thicker Pseudostem are desirable as they reflect on bunch size and other related characters.

The banana plantation on application mineral with potassium silicate and compost improves nutrient availability to the plants and results in high yields. This is also in conformity with (Doran *et al*., 2005; Soliman *et al*., 2006 and Athani *et al*., 2009) higher number of fingers, finger weight and yield was recorded in banana plants.

Table 5. Effect of mineral, KSi and compost fertilizer applications on banana bunch characteristics during 2016 & 2017 seasons

Treatments	Bunch length (cm)		Hand No. bunch^{-1}		Finger No. bunch^{-1}		Bunch weigh (kg)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
100%M (control)	91.00 b	91.33 b	10.17 bc	10.33 bc	189.0 a	190.0 ab	21.33 bc	21.90 b
100%M+KSi	102.00 a	108.67 a	11.67 a	12.00 a	197.0 a	198.3 a	26.17 a	27.00 a
50%M+KSi+25 kg C	101.33 a	102.67 a	11.33 ab	11.83 ab	191.7 a	193.3 a	23.33 ab	24.80 a
50%M+KSi+20 kg C	84.33 bc	86.33 bc	9.50 cd	10.00 c	184.3 a	186.0 bc	20.50 b	20.67 cd
50%M+KSi+15 kg C	80.67 cd	82.00 c	8.67 de	8.83 cde	168.7 b	176.3 c	18.17 cd	18.20 def
50%M+25 kg C	83.33 c	91.67 b	9.17 cde	9.67 cd	183.0 a	183.7 bc	19.93 bc	19.95 cde
50%M+20 kg C	80.67 cd	81.00 c	8.33 de	8.50 de	162.7 b	163.3 d	16.83 d	17.33 ef
50%M+15 kg C	76.33 d	77.67 d	8.00 e	8.00 e	160.0 b	162.0 d	16.27 d	16.33 f

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

- **Yield and fruit quality**

Results of yield, finger, peel and pulp parameters were presented in and it is obvious from the obtained data that added potassium silicate and /or compost with 50%mineral had significantly and improving fruit quality of banana plants (Grand Naincv.) in terms of increasing weight, length, diameter, pulp weight, peel weight, peel thickness, pulp % of finger, and yield ton /fed^{-1}. The promotion on fruit quality was ass°Ciated with treatments 100%M+Si and 50%M+Si+25 kg C. Using 100% M + KSi or 50% M + KSi + 25 kg C were significantly effect as compared to100%M (control). Application of potassium silicate with 50% mineral fertilizer as each or in combination with various levels of compost exited a positive effect on yield (ton/fed) as well as finger weight, length and diameter. The highest yield in terms of finger weight (112.07 g) was observed in 100% M + KSi. However, 100% M + KSi showed highest yield (26.90 ton/fed). For peel thickness, weight, pulp weight and percentage data present at Table 7 had the same tread which obtained at the yield and finger parameters. The treatments which received potassium silicate in combination with 100% mineral fertilizers and/or different levels of compost recorded higher values and led to scared significant effects as compared to treatment received 100% mineral fertilizers as such (control). The beneficial effects of silicon on protecting the plants from unfavorable effects of environment

during maturity surely reflected on improving fruit quality (Ma *et al*., 2001). The promoting effect of silicon on fruit quality was emphasized by the results of Ahmed *et al*. (2013) and Al-Wasfy (2013). Moreover Roshdy (2014) reported that the best results with regard to yield as well as physical and chemical characteristics of the fruits of Grand Nain banana plants were obtained owing to using Potassium silicate and seaweed extract.

Table 6. Effect of mineral, KSi and compost fertilizer applications on yield (ton fed^{-1}), finger length (cm), finger diameter (cm) and finger weight (g) of banana fruits during 2016 & 2017 seasons

Treatments	Yield ton fed^{-1}		Finger length (cm)		Finger diameter (cm)		Finger weight (g)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
100%M (control)	21.93 bc	22.50 b	17.93 bc	17.94 bc	3.30 bc	3.43 b	93.00 b	97.70 bc
100%M+KSi	26.90 a	27.73 a	19.83 a	20.33 a	4.33 a	4.38 a	110.60 a	112.07 a
50%M+KSi+25 kg C	24.00 ab	25.50 a	18.63 ab	19.17 ab	4.17 a	4.19 a	105.03 a	105.30 b
50%M+KSi+20 kg C	20.93 cd	21.10 b	16.17cde	17.00 c	3.50 b	3.50 b	89.50 bc	90.03 cd
50%M+KSi+15 kg C	18.70 def	18.67 cd	15.67 de	16.17 c	3.23 bc	3.33 b	80.00 cd	83.43 def
50%M+25 kg C	20.27 cde	20.47 bc	16.33 cd	16.50 c	3.17 bc	3.18 b	84.33 bcd	85.37 de
50%M+20 kg C	17.83 ef	17.90 d	15.33 de	16.13 c	3.00 c	3.10 b	75.33 d	79.07 ef
50%M+15 kg C	16.47 f	16.73 d	14.50 e	15.50 c	3.03 c	3.07 b	75.67 d	77.07 f

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

Table 7. Effect of mineral, KSi and compost fertilizer applications on peel thickness (mm), peel weight (g), pulp weight (g) and pulp percentage of banana fruits during 2016 & 2017 seasons

Treatments	Peel thickness (mm)		Peel weight (g)		Pulp weight (g)		Pulp percentage	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
100%M (control)	2.00 d	2.10 bc	39.00 bc	41.03 abc	54.0 bc	56.67 ab	58.067 ab	58.03 a
100%M+KSi	2.50 a	2.53 a	45.60a	48.17 a	65.00 a	63.90 a	58.73 a	57.00 a
50%M+KSi+25 kg C	2.40 ab	2.40 ab	43.80 ab	44.60 ab	61.23 ab	63.10 a	58.27 ab	60.43 a
50%M+KSi+20 kg C	2.47 a	2.50 a	39.73 bc	37.57 bc	51.77 cd	52.40 bc	57.83 ab	58.20 a
50%M+KSi+15 kg C	2.23 bc	2.37 ab	32.37 d	34.40 bc	45.63 de	49.30 bcd	57.03 ab	59.27 a
50%M+25 kg C	2.00 d	2.10 bc	35.40 cd	34.13 c	48.93 cde	50.63 bcd	58.03 ab	59.33 a
50%M+20 kg C	2.03 cd	2.07 bc	33.00 d	32.07 c	42.33 e	47.00 cd	56.13 ab	59.47 a
50%M+15 kg C	1.97 d	1.93 c	33.87 d	33.50 c	41.80 e	43.57 d	55.27 b	56.57 a

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

Physical and chemical properties

- Peel color and fruit firmness

The obtained results in table 8 table 9 clearly indicated that peel color and fruit firmness (g /mm2) with extend of the ripening period in all treatments to attain the maximum at the end of ripening period (14 days after harvest). Application of potassium silicate with 100% and/or 50% mineral fertilizers in combination with different levels of compost recorded a positive effect at peel color and firmness and recorded significant differences as compared to control plants in both seasons. At the end of ripening period banana fruits the treatment which received 50%M (mineral) + KSi in presence of compost rates were more firmer than control plant and significant difference were found as compared to applied of 100% mineral fertilizer in both seasons. The best result was obtained at treatment, which received 50% M (mineral fertilizer) with potassium silicate in presence of 25 kg mats-1 compost. Peel color and firmness (g⁄mm2) were affected by many physic logical processes that occurred during ripening starch hydrolysis, breakdown of insoluble pectic substances to soluble forms and poly galacturonidase, which compost and potassium silicate fertilizers had a positive effect on these physiological processes. In this respect, these finding are in harmony with these; Prabha, *et al*. 2009; El-Kafrawy *et al*. 2011 and El-Mehrat *et al*. 2012 who reported that the changing of the peel color due to chlorophyll disappearing to reveal the yellow color caused by xanthophylls and carotenes might be regarded as the visible sign of ripening of banana fruits.

Table 8. Effect of mineral, KSi and compost fertilizer applications on Firmness (g. mm^{-2}) in banana fruits during marketing period for 2016 & 2017 seasons

Treatments	Firmness (gmm^{-2})							
	0	7	14	Mean	0	7	14	Mean
	1st season				2nd season			
100%M (control)	343.7 a	243.7 a	145.7 c	244.3 ab	361.7 a	148.3 c	101.3 d	203.8 d
100%M+KSi	358.3 a	200.0 abc	197.7 ab	251.7 a	363.7 a	198.3 b	136.7 cd	232.9 c
50%M+KSi+25 kg C	355.0 a	242.7 a	204.7 a	267.3 a	354.0 ab	281.3 a	228.3 a	287.9 a
50%M+KSi+20 kg C	346.3 a	232.7 ab	197.0 ab	258.7 a	360.0 ab	203.7 b	199.7 ab	254.4 b
50%M+KSi+15 kg C	357.3 a	231.0 ab	197.0 ab	261.7 a	344.0 ab	195.7 b	158.7 bc	232.8 c
50%M+25 kg C	362.3 a	189.7 abc	159.7 bc	237.3 ab	345.0 ab	184.7 bc	162.0 bc	230.6 c
50%M+20 kg C	349.3 a	172.0 bc	134.3 cd	218.7 bc	333.3 bc	179.0 bc	161.3 bc	224.6 c
50%M+15 kg C	343.3 a	152.3 c	104.7 d	200.0 c	313.7 c	162.3 bc	110.7 d	195.6 d

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

Table 9. Effect of mineral, KSi and compost fertilizer applications on Peel color in banana fruits during marketing period for2016 & 2017 seasons

Treatments	Peel color							
	0	7	14	Mean	0	7	14	Mean
	1st season				2nd season			
100%M (control)	115.3 ab	93.3 b	87.4 bc	98.7 b	116.5 abc	91.1 bc	88.3 ab	98.6 c
100%M+KSi	117.3 a	107.7 a	92.0 ab	105.7 b	117.8 ab	107.3 a	94.2 a	106.4 ab
50%M+KSi+25 kg C	116.3 ab	109.0 a	95.4 a	106.9 a	118.6 a	109.2 a	96.9 a	108.2 a
50%M+KSi+20 kg C	117.3 a	110.0 a	89.5 abc	105.6 a	117.9 ab	107.6 a	94.4 a	106.6 ab
50%M+KSi+15 kg C	116.0 ab	93.0 b	89.1 abc	99.3 b	116.3 bc	103.3 a	91.6 a	103.7 b
50%M+25 kg C	115.0 b	99.3 b	85.3 bc	100.0 b	114.5 cd	93.1 b	89.6 a	99.1 c
50%M+20 kg C	115.7 ab	94.0 b	83.6 c	97.5 b	113.6 d	89.9 bc	84.9 ab	96.1 cd
50%M+15 kg C	112.0 c	82.3 c	73.9 d	89.4 c	113.7 d	85.8 c	76.1 b	91.9 d

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

- Moisture percentage (%)

The obtained data in table 10 clearly indicated that continuous loss in moisture percentage (%) with extend of the ripening period in all treatments to attain the maximum at the end of ripening period (14 days after harvest) Application of different rates of compost with potassium silicate plus 50%mineral fertilizers recorded positive effect at moisture percentage (%) and led to scored significant difference as compared to control plants in both seasons. At the end of ripening period the treatment which received 50% M + KSi + 25 kg C recorded the higher values of fimer and led to scored significant differences as compared to other tested treatment. Moisture percentage (%) was affected by many physic logical pr°Cesses that occurred during ripening ie starch hydrolysis, accompanied water loss, breakdown of insoluble pectic substances to soluble forms and poly galacturonidase, which bio-fertilizers had a positive effect on these physiological processes. In this respect, these finding are in harmony with these Abd El-Moneim *et al* 2008; El-Kafrawy *et al* 2011 and El-Mehrat *et al* 2012.

Table 10. Effect of mineral, KSi and compost fertilizer applications on moisture (%) in banana fruits during marketing period for 2016 & 2017 seasons

Treatments	Moisture (%)							
	0	7	14	Mean	0	7	14	Mean
	1st season				2nd season			
100%M (control)	73.87 a	73.97 a	74.88 ab	74.23 a	74.50 a	75.10 a	75.78 a	75.10 a
100%M+KSi	71.23 cd	72.97 b	73.75 c	72.63 c	73.00 b	73.93 b	75.60 a	74.17 b
50%M+KSi+25 kg C	70.00 d	70.53 c	72.78 d	71.10 d	70.77 d	72.00 c	72.57 a	71.77 e
50%M+KSi+20 kg C	72.10 bc	72.83 b	73.97 bc	72.97 bc	71.93 c	72.43 c	73.25 de	72.53 d
50%M+KSi+15 kg C	72.80 ab	73.47 ab	74.39 abc	73.53 ab	72.67 bc	73.33 b	74.37 bc	73.47 bc
50%M+25 kg C	72.97 ab	73.70 ab	74.88 ab	73.80 a	72.27 bc	73.60 b	73.83 cd	73.23 cd
50%M+20 kg C	72.77 ab	74.23 a	74.93 a	73.97 a	73.00 b	73.83 b	75.09 ab	73.97 b
50%M+15 kg C	73.33 ab	74.30 a	75.02 a	74.23 a	72.90 b	73.47 b	75.23 ab	73.87 bc

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

Fruit Weight loss percentage (%)

It was clear from data in table 11 that a continuous loss in weight existed with extend of the ripening period in all treatments to attain the maximum at the end of ripening period(14 days after harvest).the treatment(50% M + KSi + 25 kg C) fertilizer showed the least percentage of fruit weight loss (8.14% and 8.07%), while the mineral fertilizer (100%M (control) or 100% M + KSi) give the highest percentage of fruit weight loss(10.93 & 11.17 and 10.10 & 10.43) in both seasons, respectively. Loss of fruit weight during ripening might be the end result of many physiological processes that occurred during ripening. Starch hydrolysis and the accompanied water loss, anabolism of hemicelluloses, anabolism of tannins…etc. that accompanied the rise of fruit respiration during ripening are some physiological processes that led to loss of dry matter. In addition, loss of water through transpiration and respiration might be responsible to a great extent for loss weight of fruits during ripening process. The above mentioned results are in line with Abd El-Moneim *et al.* (2008) on banana.

Table 11. Effect of mineral, KSi and compost fertilizer applications on Weight loss (%) in banana fruits during marketing period for 2016 & 2017 seasons

Treatments	Weight loss (%)							
	0	7	14	Mean	0	7	14	Mean
	1st season				2nd season			
100%M (control)	0.00 a	8.13 a	24.67 a	10.93 a	0.00 a	9.07 ab	24.47 a	11.17 a
100%M+KSi	0.00 a	7.03 abc	23.27 ab	10.10 abc	0.00 a	8.07 bc	23.20 abc	10.43 bc
50%M+KSi+25 kg C	0.00 a	5.93 c	18.48 c	8.14 d	0.00 a	6.10 d	18.13 e	8.07 e
50%M+KSi+20 kg C	0.00 a	6.53 bc	20.10 bc	8.88 cd	0.00 a	7.70 c	20.27 d	9.33 d
50%M+KSi+15 kg C	0.00 a	6.90 abc	20.40 bc	9.10 bcd	0.00 a	8.23 bc	21.93 c	10.03 cd
50%M+25 kg C	0.00 a	7.13 abc	22.20 ab	9.78 abc	0.00 a	8.43 abc	22.93 bc	10.47 abc
50%M+20 kg C	0.00 a	7.27 ab	23.43 ab	10.23 ab	0.00 a	8.87 ab	23.67 ab	10.83 ab
50%M+15 kg C	0.00 a	7.80 ab	22.07 ab	9.96 abc	0.00 a	9.30 a	24.03 ab	11.10 ab

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

Acidity percentage (%)

The results presented in show the effect of application of different compost fertilizers rates with potassium silicate on total acidity (%). The obtained results suggest that acidity(%) changes may be connected with the changes in the mechanism of respiratory process throughout storage period and applied of compost fertilizers rates with potassium silicate produced decreasing values of total acidity (%). Generally, application of compost different rates with potassium silicate plus 50%mineral fertilizers recorded a positive effect on fruit total acidity (%), in this respect these data are harmony with findings of Abd El-Moniem *et al* 2008; El-Koly 2010 and El-Kafrawy *et al* 2011.

- **Total sugar percentage (%) and Total soluble solids (TSS):-**

As shown in table 13 the total sugar percentage of Grand Nain banana cv was rapidly increased at the beginning of ripening period within 7 days and followed by a gradual and slight increase during the late ripening period to attain the maximum values at the end of the storage period(14 days). Moreover, application of 50% M + KSi + 25 kg C did support the values of total sugar (%) and recorded highest values between the two seasons, rising up to 18.73%.Data TSS% of banana fruits presented at Table 14) indicated that the treatment which received 50% mineral fertilizers with addition of potassium silicate in presences of 20 Kg compost gave the highest values of TSS and recorded significant differences as compared to other tested treatments. The obtained data are in agreement with Vazquez-ovando *et al*. (2012), El-Mehrat *et al*. (2012), Roshdy (2014) and Bakheit & Elsadig (2015) who reported that application of organic fertilizers and /or potassium silicate for banana fruits led to enhance both total sugar percentage and TSS% and scored differences increases as compared to untreated treatments.

Table 12. Effect of mineral, KSi and compost fertilizer applications on Acidity (%) in banana fruits during marketing period for 2016 & 2017 seasons

Treatments	Acidity (%)							
	0	7	14	Mean	0	7	14	Mean
	1st season				2nd season			
100%M (control)	0.690 a	0.383 ab	0.170 b	0.417 ab	0.717 a	0.387 a	0.173 b	0.427 a
100%M+KSi	0.473 b	0.397 ab	0.277 a	0.383 ab	0.667 ab	0.380 a	0.253 a	0.433 a
50%M+KSi+25 kg C	0.683 a	0.413 a	0.217 ab	0.440 a	0.600 abc	0.357 a	0.213 ab	0.390 abc
50%M+KSi+20 kg C	0.627 ab	0.353 ab	0.240 ab	0.410 ab	0.633 abc	0.337 a	0.207 ab	0.393 ab
50%M+KSi+15 kg C	0.600 ab	0.337 b	0.197 b	0.380 ab	0.550 bc	0.317 a	0.207 ab	0.357 bcd
50%M+25 kg C	0.550 ab	0.377 ab	0.193 b	0.373 ab	0.540 bc	0.337 a	0.200 ab	0.357 bcd
50%M+20 kg C	0.537 ab	0.333 b	0.187 b	0.350 b	0.523 bc	0.300 a	0.190 b	0.337 cd
50%M+15 kg C	0.523 ab	0.327 b	0.170 b	0.340 b	0.493 c	0.313 a	0.177 b	0.327 d

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

Table 13. Effect of mineral, KSi and compost fertilizer applications on Total Sugar (%) in banana fruits during marketing period for 2016 & 2017 seasons

Treatments	Total sugar (%)							
	0	7	14	Mean	0	7	14	Mean
	1st season				2nd season			
100%M (control)	2.40 abc	13.33 bc	15.60 bc	10.43 bc	2.57 a	14.87 abc	16.03 bc	11.13 bc
100%M+KSi	2.43 abc	14.13 bc	16.67ab	11.07 abc	2.53 a	15.20 ab	16.47 b	11.40 b
50%M+KSi+25 kg C	2.17 bcd	17.03 a	17.67 a	12.27 a	2.57 a	15.80 a	18.73 a	12.37 a
50%M+KSi+20 kg C	2.63 a	15.27 ab	16.23 abc	11.37 ab	2.47 a	14.70 abc	16.40 b	11.20 bc
50%M+KSi+15 kg C	2.53 ab	14.57 abc	15.60 bc	10.90 bc	2.27 ab	13.43 cde	15.33 cd	10.33 de
50%M+25 kg C	2.10 cd	13.00 bc	15.83 bc	10.33 bc	2.00 bc	14.10 bcd	15.67 bc	10.57 cd
50%M+20 kg C	1.97 d	13.63 bc	15.33 bc	10.33 bc	1.93 bc	12.70 de	14.47 de	9.70 ef
50%M+15 kg C	2.20 bcd	12.47 c	14.73 c	9.80 c	1.83 c	12.40 e	14.43 e	9.53 f

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

Table 14. Effect of mineral, KSi and compost fertilizer applications on TSS (%) in banana fruits during marketing period for 2016 & 2017 seasons

Treatments	TSS (%)							
	0	7	14	Mean	0	7	14	Mean
	1st season				2nd season			
100%M (control)	2.80 abc	15.67 b	18.00 b	12.17 b	2.97 ab	17.47 ab	18.87 b	13.10 abc
100%M+KSi	2.73 bc	17.00 ab	18.67 b	12.80 b	2.87 abc	17.67 ab	19.20 b	13.24 ab
50%M+KSi+25 kg C	2.70 bcd	20.00 a	21.00 a	14.57 a	3.00 ab	17.00 b	20.53 a	13.51 a
50%M+KSi+20 kg C	3.10 a	18.00 ab	18.67 b	13.27 ab	2.87 abc	18.27 a	19.10 b	13.41 a
50%M+KSi+15 kg C	2.37 d	16.00 b	18.00 b	12.13 b	3.10 a	18.10 a	18.93 b	13.38 a
50%M+25 kg C	2.93 ab	15.67 b	17.33 b	12.00 b	2.50 c	15.67 b	18.53 bc	12.23 c
50%M+20 kg C	2.60 bcd	15.67 b	17.33 b	11.87 b	2.73 abc	16.73 ab	18.27 bc	12.58 abc
50%M+15 kg C	2.50 cd	15.73 b	17.07 b	11.80 b	2.67 bc	16.67 ab	17.60 c	12.31 bc

Means in same column followed by similar letters are not statistically different at 0.05 level according to Tukey test.
M = Mineral fertilizer KSi = Potassium silicate C = Compost

CONCLUSION

The application of potassium silicate and /or organic fertilizers (compost) with lower amount of mineral fertilizers enhanced growth, yield and fruit quality of banana. The highest values of yield and yield components were significantly greater in case of use potassium silicate in combination with organic fertilizers as compared to applied mineral fertilizers under Egyptian soil condition. Meanwhile, the use of potassium silicate could be a good solution in reducing the negative impact of mineral fertilizer on the environment.

REFERENCES

A.O.A.C, 2005. Official Methods of Analysis 18th ed. Association Of Official Analytical Chemists. Gaithersburg, Maryland USA. William Hurwitz. Editor.

Abd El-Hameed, H. M., 2012. Using silicon, boron and folic acid to promote yield quantitatively and qualitatively of Early Superior grape vines. Minia J. Agric. Res. & Develop, 32(5): 869-886.

Abd El-moniem, E. A., A. S. E. Abd Allah and M. A. Ahmed, 2008. The combined effect of some organic manures, mineral N fertilizer and algal cells extract on yield and fruit quality of Williams banana plants. American Eurasian J. Agric. & Environ. Sci., 4(4): 417-426.

Abd-Rabou, F. A., 2006. Effect of microbien, phosphorene and effective micro-organisms (EM) as Bio-stimulants on growth of avocado and mango seedlings. Egyptian Journal of Applied Sciences, 21: 673-693.

Ahmed, F. F., M. R. Gad El- Kareem and M. M. Oraby-Mona, 2013. Response of Zaghloul date palms to spraying boron,silicon and glutathione. Stem Cell, 4(2): 29-34.

Akl, A. M., F. F. Ahmed, F. M. El-Morsy and M. A. Ragab, 1997. The effect of soil and foliar application of nitrogen, phosphorus and potassium on some vegetative and fruiting characteristics in white banaty seedless grapevines. II Bud behavior, yield and fruit quality, Minia First Conference for Horticultural Crops, Minia, 19-21 October, 453-476.

Al-Ashkar, R. A., A. E. M. Mansour and M. M. Merwad, 2007. Effect of organic and biofertilization treatments on growth and productivity of grandnian banana plants. Egyptian Journal of Applied Sciences, 22: 276-301.

Alvarez, C. A., A. Ortega, M. Fernandez and A. A. Borges, 2001. Growth, yield and leaf nutrient content of organically grown banana plants in the Canary Islands Fruits. 56: 17-26.

Al-Wasfy, M. M., 2013. Response of Sakkoti date palms to foliar application of royal jelly, Silicon and vitamin B.J of Amer. Sci., 9(5): 315-321.

Athani, S. I., Revanappa and P. R. Dharmatti, 2009. Influence of organic fertilizer doses and vermicompost on growth and yield of banana. Karnataka Journal of Agricultural Sciences, 22 (1): 147-150.

Autio, W. R., D. W. Greene, D. R. Cooley and J. R. Schupp, 1991. Improving the growth of newly planted apple trees. Hort. Science, 26: 840-843.

Babu Ratan, P., 2006. Standardization of banana (Musa spp.) production by organic farming, Ph.D. Thesis submitted to the Acharya N G Ranga Agricultural University.

Bakheit,I. and E. H. Elsadig, 2015. Effects of organic and chemical fertilizers on yield and total soluble solids (TSS) in Banana Cavendish group (AAA). Journal of Horticulture and Forestry, 7(4): 94 – 98.

Bhargava, B.S., 1999. Leaf analysis for diagnosing nutrients need in fruit crops. Indian Horticulture, 43(4): 6-8.

Doran, I., B. Sen and Z. Kaya, 2005. The effects of compost prepared from waste material of banana on the growth, yield and quality properties of banana plants. Journal of Environmental Biology, 26 (1): 7-12.

El-Kafrawy, A. A., S. A. Fawaz and K. A. Roshdy, 2011. Effect of yeast application on yield, fruit quality and storability of banana. Egypt. J. of Appl. Sci., 26(2): 61- 76.

El-Kholy, M. F. A., 2010. Physiological studies on the response of banana plant "Grand Nain" to organic and biofertilization. Ph.D. Thesis, Fac. Agric. Al azhar Univ. Cairo, Egypt.

El-Mehrat H. G., A. A. Ragab, S. A. Faowz and H. H. Abotaleb, 2012. Enhancement of guava fruits quality by using biofertilizers. Ann. of Agric. Sci. Moshtohor, 50(2): 185- 192.

Epstein, E., 1999. Silicon Annul. Rev. plant physiol. PlantMol. Biol., 50: 641-644.

FAO, 2014. Food and Agriculture Organization of United Nations Agriculture data base prod STAT online http:⁄⁄faostat-fao.org⁄site⁄339⁄default.aspx.

Ganeshamurthy, A. N., G. C. Satisha and Prakash Patil, 2011. Potassium nutrition on yield and quality of fruit crops with special emphasis on banana and grapes.Karnataka Journal of Horticulture, 24 (1): 29-38.

Gong, H. J., K. M. Chen, G. C. Chen, S. M. Wang and C. L. Zhang, 2006. Effect of silicon on growth of wheat Emir. J.Food Agric., 19(2): 01-07.

Jackson, M. L., 1973. Soil Chemical Analysis Perentice Hall Inc. Engle woofd Cliffs, N. J. p 331.

Kumbargire, G. A., G. S. K. SWAMY and A. S. Kalatippi, 2016. Inluenceof Diatomaceous earth as a source of silicon on leafnutrient status and yield attributing characters of banana cv. Grand Naine. The Bioscan, 11(1): 435-438.

Lalithya, K. A., H. P. Bhagya, K. Bharathi, and K. Hipparagi, 2014. Response of soil and foliar application of silicon and micronutrients on leaf nutrient status of sapota. The Bioscan, 9(1): 159-162.

Ma, J. F., S. Goto, K. Tamai and M. Ichii, 2006. Role of root hairs and lateral roots in silicon uptake by rice. Plant Physiology, 127: 1773–1780.

Ma,J.F., Y. Miyake and E. Takahashi, 2001. Chapter 2. Silicon as a beneficial element for crop plants. In silicon. Editor (s) (Datnoff, L. E., G. H. Snyder and G.H. Komdorfer). Elsevier Amsterdam 8: 17-40,.

Matoh, T. S., Murata and E. Takahashi, 1991. Effect of silicateapplication on photosynthesis of rice plants (in Japanese).J. Soil Sci. Plant Nutr., 62: 248-251.

Mc-Guire, R. G., 1992. Reporting of objective colour measurements. Hort. Sci., 27: 1254-1255.

Melo, S. P., G. H. Korndorfer, C. M. Korndorfer, R. M. Lana and D. G. Santan, 2003. Silicon accumulation and water deficient tolerance in grasses. Sci. Agricola., 60: 755-759.

Ministry of Agric. A. R. E., 2015. Acreage and total production of Agric. Crop in A.R.E. Bull Agric. Econ. and Statistics.

Murry, D. B., 1960. Deficiency symptoms of the major elements in the banana. Trop. Agric. Trim, 36: 100-107.

Nalina, L., N. Kumar, K. Soorianathasundram and P. Jeya kumar, 2009. Effect of different nutrient levels on growth and development of tissue cultured banana cv. Robusta (AAA). Indian Journal of Horticulture, 66 (2): 169-174.

Niggli, U., F. P. Weibel and W. Gut, 1990. Weed Control with Organic Mulch Materials in Orchards. Results from 8 Year Field Experiments. Acta Horticulturae, 285, 97-102.

Pafli, G., 1965. Relations between abundant N supply and amino acid concentration on leaves of rice plants. Plant Soil, 23: 275-84.

Page, A. L., R. H. Miller and D. R. Keeney 1982. "Methods of Soil Analysis" ll. Chemical and Microbiological Properties 2rdEd. Madison, Wisconsim USA.

Prabha K. P., L. Y. Li and U. R. Kumari, 2009. An experimental study of vermibiowaste composting for agricultural soil improvement. Bio- Resource Technology, 99: 1672-1681.

Ramesh, P., N. R. Parwar, A. B. Singh, S. Ramana, S. K. Y. Rahul Shrivastava and A. Subba Rao, 2010. Status of organic farming in India. Current Science. 98 (9): 1190-1194.

Roshdy, Kh. A., 2014. Effect of spraying silicon and seaweed extract on growth and fruiting of Grandnaine banana. Egypt. J. Agric. Res., 92(3):979-991.

Savant, N. K., G. H. Korndorfer, L. E. Datnoff and Gii, 1999. Silicon nutrition and sugarcane production: A review. J. Plant Nutr., 22 : 1853-1903.

Selvamani, P. and K. Manivannan, 2009. Effect of organic manures, inorganic fertilizers and biofertilizers on the nutrient concentration in leaves at different growth stages of banana cv. Poovan. Journal of Phytology, 1(6): 381-387.

Shimbo, S., Z. W. Zhang, T. Watanabe, H. Nakatsuka, N. Matsuda-Inoguch, K. Higashikawa and M. Ikeda, 2001. Cadmium and Lead Contents in Rice and Other Cereal Products in Japan in 1998-2000. Science of the Total Environment, 281, 165-175.

Snedecor, G. W. and W. G. Cochran, 1990. Statistical Methods 7th Ed. The Iowa State Univ. Press Amer. Iowa USA p. 593.

Soliman, S. S., M. R. El-Sonbaty and M. A. Ahmed, 2006. Effect of organic manures source on growth, yield, fruit quality and some minerals content of Maghrabi banana. Minufiya Journal of Agricultural Research, 31(5): 1179-1197.

Tognetti, C., F.Laos, M. J. Mazzarino and M. T. Hernández, 2005. Composting vs. Vermicomposting: A comparison of end product quality. Compost Science & Utilization, 13: 6-13.

Vazquez-Ovando, J. A., D. K. Andrino-Lopez, M. D. L. Adriano-Anaya, M. Salvador-Figuero and I. Ovando-Medina, 2012. Sensory and physic-chemical quality of banana fruits "Grand Nain" grown with biofertilizer African Journal of Agricultural Research, 7(33): 4620-4626.

فعالية الكمبوست وسليكات البوتاسيوم تحت معدل منخفض من الاسمدة المعدنية فى انتاج وجودة والقدره التسويقيه لثمار الموز

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يعتبر الموز احد اهم محاصيل الفاكهة فى مصر. لذلك اجريت تجربة حقلية على الموز صنف جراند نان بمحطة بحوث البساتين بالقناطر الخيرية بمحافظة القليوبيةخلال موسمى 2016 و 2017. هذه الدراسة تهدف الى دراسة امكانية خفض الاسمدة المعدنية اللازمة لانتاج الموز باستخدام الكمبوست وسليكات البوتاسيوم. تحتوى المعاملات على 50% من المعدل الموصى به من الاسمدة المعدنية مع ثلاث مستويات من الكمبوست (25 و20 و 15كجم / جورة) باضافة او بدون اضافة سليكات البوتاسيوم (60 مل / جورة). هذه المعاملات تم مقارنتها مع التسميد المعدنى الموصى به مع او بدون اضافة سليكات البوتاسيوم. اظهرت النتائج المتحصل عليها الى ان اضافة الكمبوست ادت الى تحسين كل الصفات المختبرة. وسجلت تفوق معنوى خاصة عند خلطها مع سليكات البوتاسيوم. معاملة 50% سماد معدنى مع المستوى العالى من الكمبوست مع اضافة سليكات البوتاسيوم اعطت اعلى القيم فى النمو والمحصول وجودة ثمار الموز. هذا الى جانب ان نفس المعاملة سجلت زيادة معنوية فى نسبة السكريات الكلية والمواد الصلبة الذائبة بالثمار مقارنة بمعاملة السماد المعدنى الموصى به.