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Effect of Compost and Biofertilizer Applications on Growth and Fruit Quality of Williams Banana

Mohamed A. Eissa

Pomology Department, Faculty of Agriculture, Cairo University, Giza, Egypt

Abstract: This study was carried out during two successive seasons (2017 and 2018) on Williams banana plants in private orchard at Alexandria desert road at 84 km in sandy soil under drip irrigation, to study the effect of compost and biofertilizer (EM) application on growth and fruit quality of Williams banana plant. The experiment was set in a (Randomized Complete Block Design) RCBD with five replications per treatment. The experiment included 5 treatments; T1: (Recommended Fertilized Dose) RFD Mineral NPK fertilizers, T2: 50% of the RFD from NPK fertilizer + 50% compost, T3: 100% compost, T4:50% of the RFD from NPK + 50% compost +2 L/Feddan from EM. At November, December and January and T5: 100% compost + 2 L/Feddan from EM. At November, December and January.The results showed that T4 improved growth parameters (number of green leaves/plant, leaf area, bunch length and weight), leaves concentration of NPK and fruit quality of Williams banana.

Key words: Banana · Williams · Compost · EM · Bio fertilizer · Vegetative characters · Fruit quality

INTRODUCTION

Banana is a very important fruit cropin Egypt. The total area of banana reached 27520 Hectare in 2015 which produced 1314177 ton according to FAO [1]. It is very important to replace mineral requirements with organic fertilizations such as compost which improve the soil physical, chemical and microbial characters, reduce cost of fertilizations, important to human health and also, reduce the environment pollution which keep sustainability. Microbial fertilization is one of the application in organic farmers and it is important to increase yield and quality of fruit crops with low cost [2].

Biofertilizer EM is Effective microorganism created in Japan from 30 years ago in Ryukyusin Okinawa University and marketed by EMRO (EM Research organization). EM contains Lactobacillus plantarum, Lactobacilluscasei, Lactobacillus fermentum Lactobacillusadelbrueckii, Saccharomycesacerevisiaeaandaphodopseudomon aspalustris [3]. El Gioushy *et al*. [4] found that partial replacement of mineral fertilization with organic fertilization with compost and biofertilization with EM improve vegetative characters, flowering, fruiting characters, fruit quality and leaves content of NPK of Fagri Kalan mango trees.

The aim of this investigation is to study the effect of organic fertilization with compost and EM on vegetative growth, nutritional status and fruit quality of Williams banana.

MATERIALS AND METHODS

This investigation was carried out during two successive seasons (2017 and 2018) on williams banana cv. plants grown in a private orchard at Alexandria desert road at 84 km, in sandy soil at 3x3.5 m under drip irrigation condition. Twenty five plants of williams banana cv. where chosen to study the effect of compost and biofertilzer (EM) on growth and fruit quality of banana. EM is effective microorganisms which is known as (EM) is a culture containing more than 60 microorganisms include lactic acid bacterial (*Lactobacillus plantarum*, *Lactobacillus casei* and Streptococus lactis, *Phytosyntlesis bacteria*) algae and yeast. EM produce lactic acids [5]. EM source is biofertilizer unit in ministry of agriculture and reclaimed lands. Treatments were practices on two successive seasons, first season F1 plants of (first generation) and the second season is the F2 plants of (second generation). Ammonium nitrate (33.5% N), super phosphate (15.5 % P_2O_5) and potassium

Correspoding Author: Mohamed A. Eissa, Pomology Department, Faculty of Agriculture, Cairo University, Giza, Egypt.

Table 1: Some physical and chemical properties of the soil at start of the experiment.

Soil properties	Soil physical properties
Particle size distribution (%)	
C. Sand	84.50
F. Sand	7.55
Silt	2.67
Clay	5.31
Soil texture	Sandy
	Soil chemical properties
OM (%)	0.85
pH	7.74
EC (dS m^{-1})	1.78
	Available NPK (mg/kg)
N	11.50
P	6.60
K	152.20

Table 2: Chemical analysis of used compost.

Parameters											
EC (dS/m)	pH (1:2.5)	C (%)	N (%)	C/N ratio	OM (%)	P (%)	K (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
0.59	8.42	24.10	1.24	19.43	41.50	0.45	1.34	1650	39	115	15.5

sulfate (48% K_2O) were used as mineral fertilizers. Recommended Fertilizer Dose (RFD) from mineral NPK fertilizers (600 kg ammonium nitrate, 600 kg potassium sulfate, 200 kg super phosphate) form NPK fertilizer per year/feddan. Compost was used as the source of organic fertilizers and added at 10 ton/feddan/year rate. The analysis of the soil and compost were determined according to the standard method as described by Dewis and Fertias [6]; Jackson [7]; Olsen *et al*. [8]; Hesse [9] and Lindsay and Norvell [10] the results of analysis listed in Tables (1 and 2).

The investigation was done in a Randomized Complete Block Design (RCBD) with five replications per treatment. The experiment included the following five treatments as follows:

T1: 100% Recommended Fertilizer Dose (RFD) from mineral NPK fertilizers; T2: 50% of RFD from NPK fertilizer + 50% compost; T3: 100% compost; T4: 50% of the RFD from mineral NPK + 50% compost + (2 l/feddan from E.M. added at November, December, January and February) and T5: 100% compost + (2 l/feddan from E.M. added at November, December, January and February).

The following measurements were determined for each treatment:

Vegetative Growth: After emergency of inflorescence (the end of August in studied seasons) average number of green leaves/ plant were counted also, the third leaf from the top of the plant (m^2) were collected for determining leaf area using the following equation according to Obiefuna and Ndubizu [11]. Leaf area = length x width x 0.86.

Leaf Mineral Content: At September in both studied seasons leaf samples were taken from the third upper portion from the top of plant. Nitrogen was calorimetrically determined according to Pregl [12]; Phosphorus was calorimetrically determined according to Jackson [13] and Potassium was determined flame photometrically according to Piper [14].

Fruit Quality: At bunch maturation, average bunch length (cm); average bunch weight (g); average finger length (cm) and average finger weight were determined. Total soluble solids in the pulb (T.S.S %) was determined by a hand refractometer. Acidity %: as titratable acidity as malic acidity (g/100g); reducing sugars% and total sugars% were determined according to A.O.A.C. [15].

Statistical Analysis: Data were subjected to analysis of variance for each season, according to the procedure described by Snedecor and Cochron [16]. Significance of differences among means was done according to Least Significant Differences test (LSD) at 5% level of probability. Finally, all statistical analysis was carried out using "MSTAT-C" computer software package [17].

RESULTS AND DISCUSSION

Effect of Compost and EM on Average Number of Green Leaves/Plant and Leaf Area of Williams Banana: It is observed of the first season that there was no significant difference between treatment in average number of green leaves/plant Table (3), while in the second season, treatments T3, T4 and T5 recorded the highest values (13.00, 13.00 and 13.33 leaves/ plant) but T1 (control) and T2 (50%mineral nutrition + 50% compost) recorded the lowest values 12.33 and 12.33 leaves/plant. Concerning to leaf area, it was obvious that leaf area was the highest (1.93 m^2) with T4, while it was the lowest (1.72 m^2) with control Table (3). Similar trend was observed in the second season. These results are in line with Barakat *et al*. [18] who found that compost and EM increased vegetative characters in Williams banana cv. Also, this comes in harmony with Shaheen *et al*. [19] who found that organic fertilization and biofertilizers improve vegetative growth of Williams banana. Also, these results are in line with Elgioushy *et al.* [4] who found that replacement of mineral fertilization with organic fertilization with compost and EM biofertilizer improve vegetative characters of Fagri Kalan mango trees.

Effect of Compost and EM on N, P and K in Leaves of Williams Banana: It was shown in the first season, that N content was significantly higher in T4 and T5 (2.24 and 2.25%) while it was the lowest in control treatment T1 and T3 (Table 4). Similar trend was observed in the second season. Concerning to P content, it was noticed that T4 was the highest (0.273%) while it was the lowest in control (0.23%). Similar trend was in the second season. Potassium content was significantly higher in T4 and T5 (2.59 and 2.61%) while it was the lowest in T1 control treatment which recorded (2.31%). These findings are in compliance with Shaheen [19] and Barakat [18]. They found that N, P and K nutrients contents improved by fertilization with organic fertilization and bio fertilization. Also, these results are in harmony with findings of Elgioushy *et al.* [4] who found that replacement of mineral fertilization with organic fertilization with compost and EM biofertilizer increase leaf content with NPK in Fagri Kalan mango trees.

Effect of Compost and EM on Fruit Quality of Williams Banana: It was observed that bunch length and weight was the highest (106.76 cm and 35.87 kg) with treatment T4, while it was the lowest (89.67 cm and 23.97 kg) with control treatment T1 (Table 5). Similar trend was the same in the second season.

Finger length and weight was the highest (19.5 cm and 99.67 g) with treatment T4 while, it was the lowest (17.83 cm and 88.67 g) with control treatment T1. These results are in line with Shaheen *et al.* [19] who found that organic and biofertilization increase bunch length , weight and finger characters. Also, Abd el-naby [20] found the same results on Maghrabi banana cv. when fertilized with compost and this result may due to the increase of growth parameters related the increase of nutrients availability.

Table 3: Effect of compost and EM treatments on average number of green leaves and leaf area m^2 of Williams banana during 2017 and 2018 seasons.

	Average number of green leaves/ plant		Average leaf area m^2	
Treatment	2017	2018	2017	2018
T1: 100% of RFD (control)	12.33a	12.33b	1.72c	1.75d
T2: 50% of RFD + 50% compost	12.67a	12.33b	1.76c	1.80cd
T3: 100% compost	12.67a	13.00ab	18.83b	1.83bc
T4: 50% of RFD + 50% compost + EM	13.00a	13.00ab	1.93a	1.95a
T5: 100% compost + EM	12.67a	13.33a	1.85b	1.87b

RFD: Recommended Fertilizer Dose

Means with the same letter within the same column are not significantly differ at 0.05 level of probability

Table 4: Effect of compost and EM treatments on NPK% in leaves of Williams banana during 2017 and 2018 seasons

	N%		P%		K%	
Treatment	2017	2018	2017	2018	2017	2018
T1: 100% of RFD (control)	2.087c	2.170b	0.230e	0.233e	2.307d	2.367b
T2: 50% of RFD + 50% compost	2.170b	2.243a	0.247d	0.257d	2.487c	2.530a
T3: 100% compost	2.087c	2.147b	0.253c	0.263c	2.547b	2.543a
T4: 50% of RFD + 50% compost + EM	2.240a	2.290a	0.273a	0.280a	2.597ab	2.620a
T5: 100% compost + EM	2.253a	2.267a	0.267b	0.273b	2.610a	2.623a

RFD: Recommended Fertilizer Dose

Means with the same letter within the same column are not significantly differ at 0.05 level of probability.

Table 5: Effect of compost and EM treatments on fruit quality of Williams banana during 2017 and 2018 seasons

	Average Bunch Length (cm)		Average Bunch Weight (kg)		Average Finger Length (cm)		Average Finger Weight (g)	
Treatment	2017	2018	2017	2018	2017	2018	2017	2018
T1: 100% of RFD (control)	89.67c	90.33d	23.97d	25.17d	17.83c	17.83c	88.67c	88.83d
T2: 50% of RFD + 50% compost	94.67bc	96.33c	31.67bc	32.33b	18.83b	19.10b	92.67b	93.00c
T3: 100% compost	95.00bc	95.67c	30.33c	31.00c	19.33ab	19.00b	94.67b	97.50b
T4: 50% of RFD + 50% compost + EM	106.67a	110.33a	35.87a	36.33a	19.50a	19.67ab	99.67a	102.67a
T5: 100% compost + EM	98.33b	100.00b	32.33b	33.00b	19.33ab	20.60a	101.00a	103.67a

RFD: Recommended Fertilizer Dose

Means with the same letter within the same column are not significantly differ at 0.05 level of probability.

Table 6: Effect of compost and EM on T.S.S, acidity reducing and total sugars% of Williams banana during 2017 and 2018 seasons.

	T.S.S%		Acidity%		Reducing Sugars%		Total Sugars%	
Treatment	2017	2018	2017	2018	2017	2018	2017	2018
T1: 100% of RFD (control)	18.33c	18.67c	0.293b	0.295b	7.40c	7.53b	16.50b	16.70b
T2: 50% of RFD + 50% compost	19.33ab	19.33ab	0.299a	0.302a	7.57bc	7.43b	17.10a	17.33ab
T3: 100% compost	19.17ab	19.50a	0.295ab	0.301a	7.83a	7.87a	17.03a	17.00ab
T4: 50% of RFD + 50% compost + EM	19.50a	19.33ab	0.298ab	0.299ab	7.77ab	7.87a	17.17a	17.53a
T5: 100% compost + EM	19.00b	19.00bc	0.300a	0.299ab	7.80ab	7087a	17.37a	17.17ab

RFD: Recommended Fertilizer Dose

Means with the same letter within the same column are not significantly differ at 0.05 level of probability.

Effect of Compost and EM on T.S.S, Acidity Reducing and Total Sugars% of Williams Banana: It was noticed that TSS was the highest (19.5%) with T4 treatment while, it was the lowest (18.33%) with control T1 treatment. About acidity, there was no significantly difference between treatments in acidity values but control treatment recorded the lowest (0.293%) Table (6). Similar trend was observed in the second season in TSS and acidity. Reducing sugars recorded the highest values (7.83, 7.80 and 7.77%) in treatment T3, T5 and T4, while the lowest was T1 and T2 (7.40 and 7.57%) Table (6). Total sugars had the same trend of reduced sugar, (Table 6). Similar trend was observed in the second season. These results agreed with Umeshetal, (1988) who indicated that Azospirillum biofertilizer inoculation coupled with 50% N well as reducing sugars content of cuvendish banana. Also, these findings are in parallel with Barakat *et al.* [18] who found that organic fertilization and bioferlilizers increase reduced, total sugars and TSS compared with chemical fertilization. These results are in parallel with finding of El Gioushy *et al.* [4] who found that organic fertilization with compost and EM biofertilizer improve fruit characteristics and quality of Fagri Kalan mango fruits. From this investigation it could be concluded that: Organic fertilization with compost and bio fertilization with EM improve vegetative characters, fruiting characters and fruit quality. Also increase leaves NPK content.

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