

The Combined Effect of Some Organic Manures, Mineral N Fertilizers and Algal Cells Extract on Yield and Fruit Quality of Williams Banana Plants

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Abstract: This study was conducted during 2005/2006 and 2006/2007 seasons on the third and fourth ratoons of Williams banana plants grown in a private farm located at El-Mansoria, Giza Governorate Egypt. This study aimed to throw some light on the effect of some organic N fertilizers and Algal extract on fruiting of Williams banana. Selecting the best ratio of organic and mineral N source as well the best organic N source and the optimum Algae extract concentration for such banana cv. was also concerned. Nitrogen fertilization through using both organic and mineral sources was greatly favorable in improving yield, hand and finger weight compared to using N via mineral source only. Organic N sources namely Banana compost caused a promising promotion on yield, hand and finger weight compared to the mineral source. The best results were obtained in Williams banana plants received N via banana compost and mineral source at 50% per each. Mineral fertilization did not show positive results. Spraying Algal extract at 25 to 100% considerably improved yield/plant, hand and finger weight compared to control plants. Raising concentration from 50 to 100% caused a slight promotion. Therefore, the recommended concentration was 50% Algae extract. The lowest values were detected on untreated plants. Organic fertilization by using 50% Banana compost + mineral source at 50% out of the recommended rate of N plus spraying Algal extract at 50% gave satisfactory promotion on the yield of Williams banana. Chemical character of Williams banana fruits were greatly improved as a result of using N in both organic and mineral sources rather than using N completely via mineral source only. Organic fertilization by using banana compost or F.Y.M was favorable for improving fruit quality in terms of increasing finger weight, total soluble solids %, total sugars % and in decreasing starch % and total acidity %. The best results with regard to quality of fruits were obtained from plants received N through 50% banana compost plus 50% out of the recommended rate (R.R) of N mineral source. Organic fertilization by using banana compost at 50% along with mineral N source at 50% of the R.R of N and foliar application of Algal extract at 50% gave the best results with regard to quality of the fruits. Unfavorable effects on fruit quality were recorded on plants did not receive organic fertilizers or spray with Algal extract.

Key words: Banana % Organic fertilizers % Mineral fertilizers % Algal extract % Yield % Fruit quality

INTRODUCTION

Bananas have a great economic importance as one of the most popular fruits in Egypt and for its high nutritive value. Banana plays an important role in tropical economics as a cash export and as complementary food in local sets.

It is well known that banana needs large amounts of fertilizers especially nitrogen. So, the major problems facing banana growers are the high costs of excessive manufactured fertilizers needs for banana plants. Besides, these chemical fertilizers are considered as air, soil and water polluting agents during their production and

utilization. Consequently, it has drowned the attention of researchers and banana growers to use the organic fertilizers which are safe for human, animal and environment as a partial substitute for mineral source. Thus, it is preferred to use these natural fertilizers to avoid pollution and to reduce the costs of chemical fertilizers [1, 2].

Fertilization is an important and limiting factor for growth and productivity of banana plants because plants remove large amounts of nutrients from the soil. Among these nutrients, nitrogen is considered the prime nutrient for growth of plants.

Nitrogen has many functions in plant life. Being a part of proteins, N is an important constituent of protoplasm. It is responsible for the biosynthesis of enzymes, nucleoproteins, amino acid, amines, amino sugars, polypeptides, chlorophylls and encourages cell divisions [3].

The use of the waste products is one of the corner stones of organic farming. This means returning back to the soil, all manures and plant residues produced on the farm in the best form possible, with minimum loss and maximum stability of nutrients [4, 5].

The amount of banana waste reached on million tons per year from the total banana cultivated area in Egypt. This tremendous amount is an environmental and economical problem facing the Egyptian banana farm. Therefore, re-applied banana stalks (pseudostem) and leaves to the banana mats after harvest was reported, such banana trash used as mulch to maintain soil moisture and livestock feed [6, 7, 8].

Bekunda [9] and Zaki *et al.* [10] showed that organic manures are the most important fertility amendments that farmer supply and they give priority to bananas.

The various positive effects of applying bio-fertilizers were attributed to its own from different nutrients, higher percentages of proteins, larger amount of vitamins B and natural plant growth regulators such as cytokinins. In addition, they contain active microorganisms hydrolyzing the insoluble nutrients in soluble ones and they have greater amount of symbiotic and nonsymbiotic bacteria. Biological fertilization plays an important role in improving growth and fruiting of banana cvs. [11]. Bio-fertilization techniques using algae extract are recommended for increasing the growth parameters of many plants [12, 13]. This is due to the higher own Algae extract from nitrogenase, nitrate reductase, amino acids and peptides [14, 15, 16].

MATERIALS AND METHODS

This investigation was conducted during two successive seasons of 2005 /2006 (third ratoon) and 2006/2007 (fourth ratoon) on Williams banana plants (*Musa cavendishii* L.). Banana plants are grown in a private plantation situated at El-Mansoriea, Giza Governorate. Soil is classified as silty clay loam in texture with a water table depth not less than two meters deep.

Physical and Chemical Analysis of the Soil: The soil samples were collected from different locations in the plantation at 0.0-90 cm depth and analyzed for physical and chemical characters according to the standard procedures that mentioned by Wilde *et al.* [17].

Experimental Work: This experiment was carried out during 2005/2006 and 2006/2007 seasons on the third and fourth ratoon plants of Williams banana. Planting distance was 3.5x3.5 m apart and only two suckers were leaved per each hole.

Ammonium nitrate 33.5% N was used as mineral N source, while mature farm yard manure (FYM) and banana composed were used as organic N sources. Each plant received 500g N according to Mostaffa [18] as mineral or organic form. The mineral N form (ammonium nitrate) was added at 14 equal doses beginning from the first of April till the mid of October (one dose every two weeks). On the other hand, the organic N form (FYM or banana composed) was divided into 10 equal doses and added monthly from the beginning of January till the beginning of October of each studied seasons. Analysis of the used organic fertilizers was conducted according to Wilde *et al.* [17] and data are shown in Table 2.

Table 1: Physical and chemical analysis of the tested orchard soil

Characters	Value	Characters	Value
Particle size distribution:		Available macronutrients:	
Clay	36.3	N%	0.11
Silt	42.5	P ppm.	19.00
Sand	21.2	K ppm.	385.00
Texture grade	Silt clay loam	Mg ppm	1.02
pH (1:2.5 suspension)	7.90	Available micronutrients:	
EC (1:2.5) mmohs/cm	0.40	Zn ppm	2.50
Organic matter %	1.85	Fe ppm	5.10
Total carbonate %	1.33	Cu ppm	0.85

Table 2: Chemical analysis of organic fertilizers

Character	Values	
	Farmyard manure (F.Y.M)	Banana compost (B.C)
Moisture %	-	35.00
Organic matter %	9.50	65.00
Total N %	0.30	2.00
Total P %	0.62	0.55
Total K %	1.73	1.32

Table 3: The amount of organic and mineral N fertilizer forms

Type	N%	Rate of N/plant (g.)			Amount of fertilizer	
		Organic	Mineral	Total N/plant	Organic (kg/plant)	Mineral (g./plant)
Mineral	33.5	0.0	560 (100%)	560	-	1672
Farmyard manure (F.Y.M)	0.30	140 (25%)	420 (75%)	560	46.6	1254
		280 (50%)	280 (50%)	560	93.3	836
		420 (75%)	140 (25%)	560	140.0	418
		560 (100%)	0.0	560	186.7	-
Banana compost (B.C)	2.0	140 (25%)	420 (75%)	560	7.0	1254
		280 (50%)	280 (50%)	560	14.0	836
		420 (75%)	140 (25%)	560	21.0	418
		560 (100%)	0.0	560	28.0	-

Table 4: Major chemical composition and elemental contents of *chlorella vulgaris* cells extract

Major components of alga cells extract	Elements content of the cell extract.		
Protein	44.6	Macro-elements %	
Fats	7.3	N	7.1
Carbohydrates	12.8	P	0.66
Amino acid composition (g/100g protein)*	K		2.15
Arginine	6.9	Ca	0.18
Histidine	2.0	Mg	0.34
Isoleucine	3.2	Na	0.04
Lucien	9.5	Micro-elements (ppm)	
Lysine	6.4	Fe	245.0
Methionine	1.3	Mn	131.2
Phenylalanine	5.5	Zn	111.5
Threonine	5.3	Cu	28.0
Tryptophan	1.5		
Valine	7.0		

© Source El-Fouly *et al.* [19]

Preparation of Alga Cells Extract: A fresh slurry of the microalgae *Chlorella vulgaris* (contains about 10% water) was washed with distilled water, re-concentrated by centrifugation and freeze-dried and then re-melted at room temperature. Then the melted slurry was centrifuged at 5000 rpm to obtain a clear cell sap. Major components and nutrient contents of the algal extract are shown in Table 4.

Alga extract was sprayed four times during the growing season at 0.0, 25, 50, 75 and 100% concentrations. Sprays were carried out at 30 days intervals starting at the second week of May in 2007 and 2008 seasons. Spraying solution was applied each time to the plants till runoff and Triton B as a wetting agent was applied at 0.5%.

The other agricultural practices (fertilization program, irrigation....etc.) were the same for all plants under investigation.

Measurements of Yield and Fruit Chemical Properties

Yield per Plant: The bunches were harvested when the fingers reached the full mature stage as well as when the top hands and fingers become roundish and turned slightly yellow according to Nolin [20] and Abd-Alla [21]. Bunch weight in kg and the average weight of the finger in gm were recorded.

Fruit Chemical Properties: After the artificial ripening of bunches, sample was taken from the fruit pulp and the following constituents were determined.

- C Total soluble solids percentage by using a hand refractometer.
- C Total titrable acidity (expressed as g of malice acid per 100 g of pulp).
- C Total sugars as well as starch percentages were determined using Lane and Eynon procedure that outlined in A.O.A.C. [22].

Statistical Analysis: All the obtained data were tabulated and statistically analyzed according to Snedecor and Cochran [23] using the L.S.D. test at 5% level to recognize the significance of the differences between various treatment means.

RESULTS AND DISCUSSION

Effect of Some Organic Fertilizers and Algal Extract on Yield, Hand and Finger Weight:

It is clear from the obtained data in Table (5, 6 and 7) that fertilizing Williams Banana plants with the recommended rate of N through mineral plus organic sources significantly enhanced yield, hand and finger weight rather than using N via mineral source only. Significant differences were detected on yield, hand and finger weight with varying organic N fertilizer sources. The maximum values were detected on plants received F.Y.M or banana compost. Raising concentration of each organic N source applied with mineral N source from 25 to 50% caused a significant increment on yield, hand and finger weight. Banana compost considered the best organic N source followed by Farmyard manure. Fertilizing Williams banana plants with banana compost and mineral N source at 50% for each out of recommended rate of N gave the maximum values. The minimum ones were recorded on plants fertilized with completely mineral N source (inorganic fertilization). These results were true in two seasons.

Enhancing weight of bunch as well as hand weight may be due to the beneficial effect of organic N fertilizers on growth characters and nutritional status of the plants in favor of maintaining good balance between growth and fruiting behavior.

Table 5: Effect of combined use of some organic manures, mineral fertilizers and alga cells extract as foliar application on bunch weight/plant (kg) of Williams banana during 2005/2006 and 2006/2007 seasons

Fertilizers	Season 2005/2006					Season 2006/2007				
	Green alga cells extract conc. %									
	0.0	25	50	75	100	0.0	25	50	75	100
0.0 % F.Y.M* + 100% mineral	20.50	21.35	23.70	24.15	24.08	18.35	20.11	21.54	22.30	25.70
25 % F.Y.M + 75 % mineral	21.00	22.14	25.10	26.30	26.60	20.25	22.42	24.35	28.35	28.81
50 % F.Y.M + 50 % mineral	23.60	23.55	27.20	28.22	29.45	24.60	25.09	26.40	26.70	29.90
75 % F.Y.M + 25 % mineral	21.80	23.30	25.13	25.20	28.30	22.55	24.15	25.70	26.33	26.71
100 % F.Y.M + 0.0% mineral	20.55	24.22	24.26	25.10	27.42	19.15	21.65	21.50	23.64	24.25
0.0 % B.C.** + 100% mineral	20.32	21.61	23.00	24.00	24.20	18.54	20.30	21.25	22.26	25.45
25 % B.C. + 75% mineral	21.60	23.43	26.10	26.90	29.16	22.08	27.10	28.33	28.33	30.71
50 % B.C. + 50% mineral	26.30	28.21	30.50	30.50	30.65	25.50	27.15	29.80	31.41	31.40
75 % B.C. + 25% mineral	25.16	28.20	29.45	29.00	31.30	24.60	24.12	27.70	27.62	27.62
100 % B.C. + 0.0% mineral	22.15	23.25	26.30	28.00	28.24	22.39	23.00	24.00	25.40	25.22
L.S.D at 5% level	1.85	1.31	1.49	1.29	1.42	1.40	1.23	1.23	1.37	1.51

* F.Y.M = Farmyard manure. ** B.C. = Banana compost

Table 6: Effect of combined use of some organic manures, mineral fertilizers and alga cells extract as foliar application on hand weight (kg) of Williams banana during 2005/2006 and 2006/2007 seasons

Fertilizers	Season 2005/2006					Season 2006/2007				
	Green alga cells extract conc. %									
	0.0	25	50	75	100	0.0	25	50	75	100
0.0 % F.Y.M* + 100% mineral	2.27	2.41	2.52	2.60	2.65	1.90	2.40	2.40	2.42	2.60
25 % F.Y.M + 75 % mineral	2.35	2.62	2.90	3.11	3.25	2.40	2.42	2.55	2.80	2.95
50 % F.Y.M + 50 % mineral	2.70	2.85	2.92	3.30	3.83	2.45	2.75	2.90	3.00	3.11
75 % F.Y.M + 25 % mineral	2.07	2.90	3.00	3.00	3.10	2.00	2.70	2.75	2.90	3.00
100 % F.Y.M + 0.0% mineral	1.85	2.00	2.15	2.15	2.50	1.75	1.80	2.00	2.30	2.50
0.0 % B.C.** + 100% mineral	2.27	2.41	2.52	2.60	2.65	1.90	2.40	2.40	2.42	2.60
25 % B.C. + 75% mineral	3.22	3.45	3.50	3.72	3.90	2.85	2.90	3.00	3.38	3.55
50 % B.C. + 50% mineral	3.60	3.71	3.82	4.08	4.20	2.90	2.95	3.15	3.50	3.62
75 % B.C. + 25% mineral	2.10	3.00	3.10	3.20	3.25	2.20	2.35	2.75	3.00	3.00
100 % B.C. + 0.0% mineral	1.92	2.11	2.40	2.41	2.92	2.00	2.30	2.50	2.82	2.90
L.S.D at 5% level	0.43	0.20	0.12	0.18	0.15	0.21	0.23	0.41	0.16	0.15

* F.Y.M = Farmyard manure. ** B.C. = Banana compost

Table 7: Effect of combined use of some organic manures, mineral fertilizers and alga cells extract as foliar application on finger weight (gm) of Williams banana during 2005/2006 and 2006/2007 seasons

Fertilizers	Season 2005/2006					Season 2006/2007				
	Green alga cells extract conc. %									
	0.0	25	50	75	100	0.0	25	50	75	100
0.0 % F.Y.M* + 100% mineral	80.9	85.0	88.5	92.0	92.2	82.3	82.3	84.9	87.4	87.0
25 % F.Y.M + 75 % mineral	92.5	93.0	96.2	100.0	105.2	90.1	95.5	98.0	101.6	104.0
50 % F.Y.M + 50 % mineral	99.0	99.0	100.1	103.0	112.5	91.0	91.5	100.0	103.3	105.0
75 % F.Y.M + 25 % mineral	90.3	29.5	93.0	100.0	102.1	90.0	93.0	96.4	96.3	100.0
100 % F.Y.M + 0.0% mineral	83.5	90.3	92.5	95.0	98.2	80.5	80.0	80.6	85.5	95.0
0.0 % B.C.** + 100% mineral	85.0	91.1	94.0	95.0	105.3	88.2	90.5	93.3	100.2	110.0
25 % B.C. + 75% mineral	117.0	125.7	130.1	130.0	136.2	121.0	172.2	133.0	133.5	137.0
50 % B.C. + 50% mineral	121.6	130.8	133.2	139.0	142.4	130.0	132.3	136.0	136.3	139.0
75 % B.C. + 25% mineral	120.9	129.3	130.5	131.0	133.1	120.0	124.0	125.0	130.0	135.0
100 % B.C. + 0.0% mineral	110.0	112.3	117.5	117.0	120.1	108.0	122.0	117.0	120.5	120.0
L.S.D at 5% level	5.60	6.25	3.20	7.45	9.85	6.35	5.95	3.62	6.73	7.32

* F.Y.M = Farmyard manure. ** B.C. = Banana compost

These results are in concordance with those obtained by Dave *et al.* [24] on Basari banana, Smith [25] on Grand nain banana Zake *et al.* [26], Saleh [27] on Williams banana, El-Sayed-Shren [28] and Roshdy [29].

It is obvious from the data in Table 5, 6 and 7 that bio-fertilization with Algal extract at 25 to 100% significantly improved yield, bunch and hand weight in comparison with the non-bio- fertilized one. A gradual promotion was recorded on bunch and hand weight with increasing Algal extract concentration from 25 to 100%. Significant differences were observed on yield and hand weight among all concentrations except between 50 and

100%. The maximum values were detected on plants sprayed with 100% Algal extract; however the recommended and economical concentration was 50%. The untreated plants had the lowest values. These results are the same in both seasons.

These results may explain due to the great benefits of Algal extract on amending the plants with their requirements from organic and mineral nutrients.

These results are in conformity with those obtained by El-Shamaa [30], Hosam El-Deen *et al.* [31] on Williams Banana, Abd El-Aziz [32], Abd El-Moniem- Eman and Radwan [33], Ahmed *et al.* [34] and Hammam [35].

Table 8: Effect of combined use of some organic manures, mineral fertilizers and alga cells extract as foliar application on total soluble solids% of Williams banana during 2005/2006 and 2006/2007 seasons

Fertilizers	Season 2005/2006					Season 2006/2007				
	Green alga cells extract conc. %									
	0.0	25	50	75	100	0.0	25	50	75	100
0.0 % F.Y.M* + 100% mineral	19.00	19.2	19.4	19.4	19.5	18.6	19.3	19.4	19.5	19.7
25 % F.Y.M + 75 % mineral	19.4	19.4	19.6	19.8	19.9	19.0	19.2	19.5	19.8	19.9
50 % F.Y.M + 50 % mineral	19.6	19.6	20.1	20.2	20.4	19.8	20.1	20.1	20.4	20.5
75 % F.Y.M + 25 % mineral	19.0	19.6	19.9	20.0	20.1	18.7	18.9	19.2	19.3	19.5
100 % F.Y.M + 0.0% mineral	18.2	18.5	18.8	19.0	19.1	18.0	18.1	18.3	18.6	18.7
0.0 % B.C.** + 100% mineral	18.5	18.7	19.0	19.1	19.3	18.3	18.6	19.0	19.0	19.5
25 % B.C. + 75% mineral	21.0	21.3	21.5	22.0	22.0	21.8	22.1	22.3	22.5	22.7
50 % B.C. + 50% mineral	21.2	21.2	22.0	22.0	22.3	21.9	22.2	22.4	22.5	22.9
75 % B.C. + 25% mineral	21.1	21.2	21.7	22.1	22.2	20.0	20.3	20.5	20.8	21.0
100 % B.C. + 0.0% mineral	21.0	21.3	21.6	21.9	22.0	21.1	21.5	21.8	22.0	22.2
L.S.D at 5% level	0.15	0.32	0.46	0.38	0.41	0.18	0.21	0.17	0.23	0.13

* F.Y.M = Farmyard manure. ** B.C. = Banana compost

Table 9: Effect of combined use of some organic manures, mineral fertilizers and alga cells extract as foliar application on total acidity (gm/100gm pulp) of Williams banana during 2005/2006 and 2006/2007 seasons

Fertilizers	Season 2005/2006					Season 2006/2007				
	Green alga cells extract conc. %									
	0.0	25	50	75	100	0.0	25	50	75	100
0.0 % F.Y.M* + 100% mineral	0.511	0.502	0.491	0.482	0.480	0.532	0.517	0.500	0.490	0.485
25 % F.Y.M + 75 % mineral	0.480	0.460	0.447	0.445	0.438	0.492	0.481	0.460	0.455	0.420
50 % F.Y.M + 50 % mineral	0.455	0.440	0.430	0.427	0.425	0.482	0.470	0.462	0.458	0.411
75 % F.Y.M + 25 % mineral	0.481	0.470	0.467	0.457	0.436	0.490	0.482	0.470	0.462	0.425
100 % F.Y.M + 0.0% mineral	0.495	0.482	0.475	0.462	0.455	0.493	0.485	0.465	0.446	0.432
0.0 % B.C.** + 100% mineral	0.522	0.510	0.502	0.490	0.481	0.499	0.482	0.463	0.425	0.401
25 % B.C. + 75% mineral	0.410	0.391	0.381	0.380	0.371	0.364	0.355	0.347	0.347	0.340
50 % B.C. + 50% mineral	0.391	0.390	0.380	0.360	0.358	0.360	0.342	0.334	0.332	0.331
75 % B.C. + 25% mineral	0.408	0.400	0.392	0.383	0.375	0.372	0.365	0.351	0.340	0.340
100 % B.C. + 0.0% mineral	0.421	0.415	0.406	0.401	0.392	0.393	0.381	0.366	0.361	0.345
L.S.D at 5% level	0.05	0.070	0.030	0.020	0.040	0.030	0.070	0.060	0.080	0.040

* F.Y.M = Farmyard manure. ** B.C. = Banana compost

The best results with regard to yield were obtained on Williams banana plants fertilized with banana compost and mineral source each at 50% of the R.R of N and sprayed with 50% Algal extract. Under such promising treatment, bunch weight reached 30.50 and 29.80 kg in the first and second seasons, respectively. The lowest yield (20.50 and 18.35 kg) in two seasons, respectively was detected on plants did not receive organic and bio-fertilizers.

The great benefits of the combination between organic and bio-fertilization on yield was emphasized by the results obtained by Ruiz [36] on Gran enano banana,

Smith [25] on Grand nain banana, Chezhiyan *et al.* [37] on Virupekshi banana, Geetha and Nair [38] on Nendran banana, Ayuso [39] on Valery banana and El-Sawy [40].

Effect of Some Organic Fertilizers and Algal Extract on Some Chemical Characters of Fruits: Data in Table 8, 9, 10 and 11 shows that organic fertilization along with mineral source significantly was beneficial in improving chemical properties of Williams banana fruits compared to using N at mineral source only. Application of F.Y.M or banana compost at 25 to 50% out of the recommended rate of N announced promotion on fruit quality in terms of

Table 10: Effect of combined use of some organic manures, mineral fertilizers and alga cells extract as foliar application on total sugars % of Williams banana during 2005/2006 and 2006/2007 seasons

Fertilizers	Season 2005/2006					Season 2006/2007				
	Green alga cells extract conc. %									
	0.0	25	50	75	100	0.0	25	50	75	100
0.0 % F.Y.M* + 100% mineral	16.30	16.50	16.85	17.00	17.05	16.00	16.40	16.62	16.82	17.00
25 % F.Y.M + 75 % mineral	17.00	17.40	17.60	17.70	17.85	16.30	16.35	16.70	16.90	17.20
50 % F.Y.M + 50 % mineral	17.35	17.60	17.72	17.80	17.90	16.50	16.70	16.85	17.00	17.35
75 % F.Y.M + 25 % mineral	16.70	16.82	16.93	17.20	17.30	16.25	16.40	16.45	16.90	17.15
100 % F.Y.M + 0.0% mineral	16.52	16.42	16.73	16.92	17.00	16.25	16.32	16.40	16.65	16.70
0.0 % B.C.** + 100% mineral	16.50	16.90	17.30	17.45	17.63	17.00	17.10	17.25	17.71	18.00
25 % B.C. + 75% mineral	18.60	18.90	19.40	19.70	19.80	17.80	17.92	18.15	18.35	19.00
50 % B.C. + 50% mineral	18.80	19.20	19.70	19.90	20.10	17.92	18.20	18.95	19.20	19.30
75 % B.C. + 25% mineral	18.20	18.90	19.15	19.20	19.50	18.00	18.00	18.20	18.55	18.75
100 % B.C. + 0.0% mineral	18.00	18.20	18.50	18.60	19.00	17.50	17.65	17.93	18.20	18.45
L.S.D at 5% level	0.29	0.34	0.42	0.32	0.40	0.31	0.40	0.49	0.25	0.37

* F.Y.M = Farmyard manure. ** B.C. = Banana compost

Table 11: Effect of combined use of some organic manures, mineral fertilizers and alga cells extract as foliar application on starch in pulp% of Williams banana during 2005/2006 and 2006/2007 seasons

Fertilizers	Season 2005/2006					Season 2006/2007				
	Green alga cells extract conc. %									
	0.0	25	50	75	100	0.0	25	50	75	100
0.0 % F.Y.M* + 100% mineral	2.18	2.16	2.10	2.08	2.07	2.20	2.15	2.08	2.06	2.11
25 % F.Y.M + 75 % mineral	2.00	1.91	1.91	1.90	1.85	2.17	2.13	2.10	2.00	2.00
50 % F.Y.M + 50 % mineral	1.95	1.80	1.80	1.81	1.76	2.08	2.00	1.90	1.90	1.83
75 % F.Y.M + 25 % mineral	1.93	1.90	1.82	1.81	1.80	2.13	2.10	2.05	2.00	1.95
100 % F.Y.M + 0.0% mineral	2.13	2.10	2.08	2.07	1.92	2.15	2.10	2.00	2.00	1.98
0.0 % B.C.** + 100% mineral	2.00	1.90	1.82	1.70	1.55	2.13	2.10	2.00	1.85	1.65
25 % B.C. + 75% mineral	1.83	1.73	1.55	1.51	1.48	1.75	1.62	1.51	1.32	1.20
50 % B.C. + 50% mineral	1.80	1.62	1.40	1.30	1.30	1.67	1.41	1.35	1.20	1.18
75 % B.C. + 25% mineral	1.90	1.83	1.60	1.57	1.40	1.70	1.66	1.43	1.32	1.30
100 % B.C. + 0.0% mineral	2.00	1.91	1.80	1.65	1.50	1.82	1.70	1.65	1.55	1.45
L.S.D at 5% level	0.36	0.05	0.09	0.08	0.03	0.42	0.45	0.29	0.06	0.05

* F.Y.M = Farmyard manure. ** B.C. = Banana compost

increasing total soluble solids % and total sugars and decreasing % of starch and total acidity. The promotion on chemical quality of fruits was associated with increasing concentrations of each organic source from 25 to 50%. Application of N at 560 g/plant through banana compost and mineral source at 50% of the recommended rate of N gave the best results with regard to chemical quality of the fruits. Application of mineral N source only (without organic N fertilizers) did not show a positive effect on chemical quality of the fruits. These results were true in both seasons.

The highest content of organic N fertilizers in the essential nutrients which could results on enhancing the biosynthesis and translocation of carbohydrates could explain the present results.

These results are in agreement with those obtained by Hammam *et al.* [41] on William banana, Shintani *et al.* [42], Abd-El-Naby [43] on Maghrabi banana, Abd El-Naby and Gomaa [44] and El-Sawy [40].

Application of Algal extract at 25 to 100% significantly was accompanied with improving fruit quality in terms of increasing percentages of total

soluble solids as well as total sugars and in decreasing percentages of starch and total acidity compared to the untreated plants. There was a remarkable promotion on chemical quality parameters with increasing Algal extract concentrations from 25 to 100%. Significant differences on these characters were detected among all concentrations except between using the two higher concentrations namely 50 and 100%. The untreated plants gave did not give a promising effects on chemical quality of the fruits. These results were true in both seasons.

The beneficial effect of Algae extract on enhancing the biosynthesis and translocation of carbohydrate could result in improving quality and advancing fruit maturity.

These results are confidence with those obtained by Tiwary *et al.* [45], Hosam el-Deen *et al.* [31] on Williams banana, Suresh and Hasan [46] on Cavendish banana, Abd El-Moniem- Eman and Radwan [33] and Ahmed *et al.* [34].

The interaction between organic and bio-fertilization had positive effect on chemical quality parameters in both the two seasons. Organic fertilization accompanied with Algal extract at 100% gave the best results with regard to chemical properties of fruit. No effects were attributed to inorganic or not bio-fertilized plants.

These results are in harmony with those obtained by Joo *et al.* [47] on Valencia orange fruits, Abd El-Aziz [32], Kamel [48] on Williams banana, Shaarawy [49] on Balady lime fruits and El-Sawy [40].

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