Using Some Organic Manures and Effective Microorganisms as a Partial Replacement of Mineral N Fertilizer in Sukkary Mango Orchards

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Abstract: This study was carried out during 2013 and 2014 seasons to examine the effect of using three organic manures namely plant compost (2%N), filter mud (2%N) and chicken manure (2.5%) applied at 50 to 75% of the suitable N (1000 g N/tree/year) with or without Effective microorganisms at 50 to 100 ml/tree/year as an attempt for reducing inorganic N partially in Sukkary mango orchards under Aswan conditions. Supplying the trees with N via 50% inorganic plus 50% any organic manures with or without biofertilization with EM had a striking effect on all growth characters leaf pigments, nutrients, yield and fruit quality comparing with using N as 100% inorganic N or when inorganic N was applied at 25% of N even with the application of organic and biofertilization. The best organic manures in this connection was chicken manure followed by filter mud and compost. Organic fertilization enriched with EM was materially superior than using organic fertilization alone. A great decline on the yield was observed with N was applied as 25% inorganic N + 75% plant compost. The best results with regard to yield and fruit quality of Sukkary mango trees grown under Aswan conditions were obtained due to supplying the trees with N (1000g N/tree) through 50% inorganic N + 50% chicken manure enriched with Effective microorganisms at 50 ml/tree/year.

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1. Introduction

Sukkarymango as a prime mango cvs till need a lot of studies concerning optimizing N fertilization. As a result of excessive use of N via inorganic N form growth was highly stimulated at the expense of fruiting. This leads to poor yield and environmental pollution. Adjusting N fertilization is accomplished by using organic manures and Effective microorganisms. Effective microorganisms (EM_1) is a biofertilizer containing more than 60 microorganisms such as lactic acid bacteria, photosynthetic bacteria **(Higa, 1989 and 1991)** and is responsible for enhancing soil fertility and nutritional status of the plants through lowering soil pH and enhancing N fixation, microbial activity, organic matter and natural hormones, vitamins B and antibiotics (**Kannaiyan, 2002 and Cabrera *et al.*, 2003).** The same previous benefits were achieved by using organic manures (**Wang *et al.*, 2000 and Venzon*et al.*, 2001**).

The results of **Mahmoud (2012**); **Mohamed *et al* (2012)**; **El-Khawaga and Meklad (2013)**, **Ahmed *et al.* (2013)** and **Omar (2015)** emphasized the essential role of using organic manures as a partial substitute of inorganic N fertilizers. They are involved in enhancing growth and fruiting of different fruit crops.

Application of EM was found by many authors to improve yield and fruit quality in various fruit crops **(Roshdy *et al.* (2011); Mahmoud (2012); Refaai *et al.*(2012); Ibrahiem (2012); Abdelaal*et al.* (2013); El- Khawaga (2013); Faraag (2013); Ahmed *et al.* (2014a)** and **(2014b) and Saied (2015).**

This study was conducted to examine the possibility of using some organic manures and EM as a partial replacement of inorganic N fertilizer in Sukkary mango trees growth under Aswan region.

2. Material and Methods

This investigation was conducted during the two consecutive seasons of 2013 and 2014 on thirty nine years old Sukkary mango trees onto polyembryonic mango seedling rootstock. The trees are grown in a private mango orchard located at KomOmbo district, Aswan Governorate. The uniform in vigour trees of Sukkary mango (39 trees) were planted at 7X7 meters apart. The soil texture of the tested orchard is silty clay (**Table 1)** with a water table depth not less than two meters. Surface irrigation system was followed using Nile water (160 ppm salinity).

The selected trees received all horticultural practices that applied in the orchard except those dealing with N fertilization.

This experiment included the following thirteen treatments from inorganic, organic and biofertilization with EM treatments:

1- Application of the suitable N (1000 g./ tree/ year) completely via inorganic N form only (2985.1 g. ammonium nitrate (33.5% N/ tree/ year).
2- Application of the suitable N through 50% inorganic N form (1492.6 g. ammonium nitrate) + 50% compost (2%N) (25 kg/tree/year).
3- Application of the suitable N through 50% inorganic N form + 50% Filter mud (2%N) (25kg/tree/year).
4- Application of the suitable N through 50% inorganic N form + 50% Chicken manure(2.5%N) (20 kg/tree/year).
5- Application of the suitable N through 50% inorganic N form + 50% compost (25 kg/tree/year) enriched with 50 ml EM/ tree/ year.
6- Application of the suitable N through 50% inorganic N form + 50% Filter mud (25 kg/tree/year) enriched with 50 ml EM/ tree/ year.
7- Application of the suitable N through 50% inorganic N form + 50% Chicken manure (20 kg/tree/year) enriched with 50 ml EM/ tree/ year.
8- Application of the suitable N through 25% inorganic N form (496.3 kg. ammonium nitrate/ tree/ year + 75% compost (37.5 kg/tree/year).
9- Application of the suitable N through 25% inorganic N form + 75% Filter mud (37.5 kg/vine/year).
10- Application of the suitable N through 25% inorganic N form + 75% Chicken manure (30 kg/tree/year).
11- Application of the suitable N through 25% inorganic N form + 75% compost (37.5 kg/tree/year) enriched with 100 ml EM/ tree/ year.
12- Application of the suitable N through 25% inorganic N form + 75% Filter mud (37.5 kg/tree/year) enriched with 100 ml EM/ tree/ year.
13- Application of the suitable N through 25% inorganic N form + 75% Chicken manure (30 kg/tree/year) enriched with 100 ml EM/ tree/ year.
14- Each treatment was replicated three times, one tree per each. Nitrogen source was ammonium nitrate (33.5 % N) and it was applied at three equal batches at the first week of March and at one month intervals. The three organic manures namely compost (2.0%N) **(Table 2)**, Filter mud (2.0% N) (**Table 3)**, and poultry manure (2.5%N) **(Table 4**) at 50 to 75% of the suitable N were applied either alone or each enriched with 50 to 100 ml EM/ tree/year. They were added once after winter pruning in four holes 25×25×25 cm depth, length and width dimension and 25 cm apart from the trunk of each tree. The fresh effective microorganisms (EM) (each ml contains $0.6X10^7$ microorganism cells) was added once at growth start in shallow holes followed by covering with moist soil around canopy of each tree.

Table (1): Mechanical, physical and chemical analysis of the tested orchard soil.

Constituents	values
Particle size distribution:	
Sand %	: 11.1
Silt %	: 52.7
Clay %	: 36.2
Texture	: Siltyclay
pH (1:2.5 extract)	: 7.44
E.C (1: 2.5 extract) (mmhos/ ICM/ 25^0 C)	: 0.66
O.M. %	: 2.22
$CaCO_3$ %	: 1.69
Total N %	: 0.14
Available P (ppm/ Olsen)	: 26
Available K (ppm, ammonium acetate)	: 4.95
Available Mg (ppm)	: 146.00
Available S (ppm)	: 6.96
B (ppm) (hot water extractable)	: 0.27
Available EDTA extractable micronutrients (ppm)	
Zn	: 1.31
Fe	: 11.21
Mn	: 10.25
Cu	: 1.88

Randomized complete block design (RCBD) was adopted. Each treatment was replicated three times one tree per each.

Table (2): Analysis of the Solid mature compost

Parameter	Values
Cubic meter weight (kg.)	600.00
Moisture%	29.0
Organic matter %	30.7
Organic Carbon%	15.63
pH (1: 10)	8.5
EC (ds/m)	6.5
C/N ratio	18.82
Total N %	2.0
Total P %	0.52
Total K %	1.12
Total Ca %	1.25
Total Mg %	1.21
Total Fe (ppm)	320.0
Total Mn (ppm)	45.0
Total Zn (ppm)	34.0
Total Cu (ppm)	42.0

Table (3): Analysis of the tested Filter mud

Parameter	Values
Organic matter %	**22.1**
Organic Carbon%	**29.1**
pH (1: 10)	**9.0**
EC (ds/m)	**5.5**
C/N ratio	**14.5**
Total N %	**2.0**
Total P %	**0.02**
Total K %	**0.1**
Total Ca %	**1.41**
Total Mg %	**1.50**
Total Fe (ppm)	**400**
Total Mn (ppm)	**70**
Total Zn (ppm)	**80**
Total Cu (ppm)	**39.0**

Table (4): Analysis of the tested Chicken manure

Parameter	Values
Organic matter %	58.20
Organic Carbon%	27.9
pH (1: 10)	10.25
EC (ds/m)	15.5
C/N ratio	11.16
Total N %	2.5
Total P %	0.09
Total K %	0.7
Total Ca %	1.55
Total Mg %	1.81
Total Fe (ppm)	429
Total Mn (ppm)	100
Total Zn (ppm)	90
Total Cu (ppm)	42

3- During both seasons the following parameters were measured:

1- Length and thickness of shoots (cm), number of leaves/shoot as well as length and width of leaf (cm) and leaf area (cm^2) (**Ahmed and Morsy, 1999**)in the Spring, Summer and Autumn growth cycles.

2- Chlorophylls a and b, total chlorophylls, total carotenoids (as mg/100g F.W) (**Von-Wettstein, 1957 and Hiscox and Isralstam, 1979**), N, P, K, Mg (as %), Zn, Fe, Mn and Cu (as ppm) in the leaves. (**Cottenie *et al*., 1982 and Summer, 1985**).

3- Percentages of initial fruit setting and fruit retention, yield and number of fruits/tree.

4- Weight (g), length (cm), width (cm) and thickness (cm) of fruit, percentages of pulp, peels and seeds and edible to non-edible portions (pulp/seeds + peels), T.S.S% total acidity% (as g citric acid/ 100ml pulp), total, reducing and non-reducing sugars (**A.O.AC, 2000**), vitamin C (mg/100g pulp) as well as nitrite and nitrate in the pulp. (**Ridnour-Lisa *et al*., 2006**).

Statistical analysis was done according to (**Mead *et al*., 1993)** using new L.S.D test at 5% for differentiate among treatment means.

3. Results

Growth Characters:

Data in **Tables (5 to 7)** clearly show that supplying Sukkary mango trees with N as 50% inorganic N and 50% any one of the three organic manures (filter mud, chicken manure or plant compost) with or without EM_1 at 50 ml/ tree significantly was very effective in stimulating the six growth characters namely length and thickness of shoot, number of leaves per shoot as well as length, width and area of the leaf in the three growth cycles comparing with using N completely via inorganic N or when N was used as 25% inorganic N and 75% any organic manures with or without using EM_1 at 100 ml/tree/year. The best organic manure in this respect was chicken manure followed by filter mud and plant compost occupied the last position in this respect. Using N as 25 to 50% inorganic N plus 50 to 75% plant compost with EM at 50 to 100ml/tree significantly was superior thanusing inorganic and organic fertilization alone in enhancing these growth characters. A significant reduction on these growth characters was observed when N was added via 25% inorganic N plus 75% any organic manures under unbiofertilization with EM. The minimum values were recorded on the trees that received N as 25% inorganic N + 75% compost without using EM. Supplying the tree with N as 50% inorganic N plus 50% chicken manure + EM at 50 ml/tree gave the maximum values. These results were true during both seasons.

1- Pigments as well as N, P, K, Mn, Zn, Fe, and Cu in the leaves:

It is clear from the data in **Tables (8 to 10)** that chlorophylls a & b, total chlorophylls and total carotenoids in the leaves were significantly enhanced in response to application of the suitable N via 50% inorganic + 50% any organic manures with or without EM at 50 ml/tree comparing with using N completely via inorganic N or when N was added via 25% inorganic + 75% organic manures with or

without EM at 100 ml/tree. Leaf content of P, K, Mg, Zn, Fe, Mn and Cu significantly tended to enhance with using N as 25 to 50% plus 50 to 75% organic manures with or without EM at 50 to 100ml/tree comparing with using N completely via inorganic form. The promotion was gradually associated with reducing percentages of inorganic N from 100 to 25%, and increasing organic manures from 0.0 to 75% and EM from 50 to 100 ml/tree. Using chicken manure, filter mud and plant compost, in descending under was significantly responsible for enhancing these nutrients. The maximum values of leaf pigments and N were recorded on the trees that received N as 50% inorganic N + 50% chicken manure + EM at 50 ml/tree. While the lowest values were recorded on the trees that fertilized with N as 25% inorganic + 75% plant compost alone. The maximum values of P, K, Mg, Zn, Fe, Mn and Cu in the leaves were recorded on the trees that received N as 25% inorganic + 75% chicken manure + EM at 100ml/tree. The trees treated with N completely via inorganic N had the lowest values. These results were true during both seasons.

2- Fruit setting and yield / tree:

It is obvious from the data in **Table (11)** that fertilizing the trees with N as 50% inorganic + 50% any organic manures with or without EM significantly improved the percentages of initial fruit setting and fruit retention, number of fruits/tree and yield /tree rather than using N as 100% inorganic N as well as when N was added via inorganic N at 25% regardless organic and biofertilization. The best organic manures in this respect was chicken manure, filter mud and plant compost, in descending order. A significant reduction on fruit setting and yield was observed when N was added in inorganic N form at 25% without biofertilization. Application of EM at 50 to 100ml/tree besides inorganic and organic fertilization significantly was superior than using inorganic and organic fertilization alone in promoting fruit setting and yield. The maximum yield (44.7 & 44.2 kg) during both seasons respectively was observed when the trees received N as 50% inorganic N + 50% chicken manure + EM at 50 ml/tree. The yield of the trees that fertilized with N as 100% inorganic N was 32.5 and 33.3 kg during both seasons respectively. The percentage of increase on the yield due to application of the previous promised treatment over the check treatment reached 37.5 and 32.7% during both seasons, respectively. These results were true during both seasons.

3- Fruit quality:

It was clear from the data in **Tables (12 to 15)** that amending the trees with the suitable N as 25 to 50% inorganic N + 50 to 75% any organic manures (chicken manure, filter mud and plant compost) with or without EM_1 at 50 to 100 ml/tree/year significantly was very effective in improving fruit quality in terms of increasing weight, length, width and thickness of fruit, pulp%, edible non edible portions. T.S.S%, total, reducing and non –reducing sugars and vitamin C content and decreasing percentages of seeds and peel weight and total acidity comparing to using N as 100% inorganic. Both nitrate and nitrite in the pulp were significantly declined with using the present treatments. The best organic manure in this connection was chicken manure followed by filter mud and plant compost occupied the last position in this respect. Treating Sukkary mango trees with N as 25% inorganic N plus 75% chicken manure + EM_1 at 100 gave the best results with regard to fruit quality. Unfavorable effects on fruit quality were attributed to application of N completely via inorganic N. Similar results were announced during both seasons.

Table (5): Effect of inorganic and organic fertilization of N as well as biofertilization with EM on some vegetative growth characters in the Spring growth cycle of Sukkary mango trees during 2013 and 2014 seasons

Inorganic, organic and biofertilization with EM treatments	Spring growth cycle											
	Shoot length (cm)		Shoot thickness (cm)		No. of leaves/shoot		Leaf length (cm)		Leaf width (cm)		Leaf area (cm^2)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1. N as 100% inorg. N	16.0	16.3	0.70	0.71	13.0	13.1	19.5	19.4	5.5	5.5	74.0	73.6
2. N as 50% inorg. N+ 50% compost	17.3	17.6	0.74	0.75	14.0	14.0	20.6	20.5	5.8	5.9	82.6	83.6
3. N as 50% inorg. N+ 50% filter mud	18.3	18.5	0.78	0.79	15.0	15.0	22.0	21.9	6.2	6.1	94.4	92.5
4. N as 50% inorg. N+ 50% Chicken manure	19.4	19.7	0.82	0.83	15.0	15.1	23.0	22.9	6.7	6.3	106.8	99.9
5. N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year	20.3	20.6	0.86	0.86	16.0	16.0	24.0	24.0	7.2	6.5	119.9	108.1
6. N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year	21.0	21.4	0.90	0.91	17.0	16.9	25.1	25.0	7.7	6.7	194.2	116.2
7. N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year	21.8	22.1	0.94	0.95	18.0	17.9	26.2	26.0	8.1	7.1	147.5	128.2
8. N as 25% inorg. N+ 75% Compost	9.1	9.4	0.41	0.42	7.0	6.9	14.0	13.9	3.9	4.0	37.2	37.9
9. N as 25% inorg. N+ 75% filter mud	9.9	10.2	0.46	0.47	8.0	8.1	15.1	15.0	4.2	4.2	43.3	43.0
10. N as 25% inorg. N+ 75% Chicken manure	11.0	11.3	0.51	0.52	9.0	8.9	16.1	15.9	4.5	4.5	49.7	49.0
11. N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year	11.8	12.1	0. 56	0.57	10.0	9.9	16.2	16.1	4.6	4.5	51.1	49.7
12. N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year	12.9	13.3	0.61	0.62	11.0	10.9	17.3	17.2	4.9	5.1	58.3	60.3
13. N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year	14.0	14.0	0.66	0.67	12.0	11.9	18.4	18.3	5.1	5.3	64.6	66.8

Table (6): Effect of inorganic and organic fertilization of N as well as biofertilization with EM on some vegetative growth characters in the Summer growth cycle of Sukkary mango trees during 2013 and 2014 seasons

Summer growth cycle												
Leaf area (cm^2)		Leaf width (cm)		Leaf length (cm)		No. of leaves/shoot		Shoot thickness (cm)		Shoot length (cm)		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	
51.3	50.4	4.4	4.3	17.0	17.1	11.1	11.0		0.50	12.0	12.1	1. N as 100% inorg. N
58.2	56.6	4.7	4.6	18.0	17.9	11.9	12.0	0.54	0.53	12.8	12.8	2. N as 50% inorg. N+ 50% compost
64.7	64.7	5.0	5.0	18.8	18.8	12.9	13.0	0.56	0.56	13.4	13.5	3. N as 50% inorg. N+ 50% filter mud
69.9	69.9	5.2	5.2	19.5	19.5	14.0	14.0	0.60	0.60	14.2	14.2	4. N as 50% inorg. N+ 50% Chicken manure
75.3	73.1	5.4	5.3	20.2	20.0	13.9	14.0	0.64	0.63	14.9	15.0	5. N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
82.7	81.9	5.7	5.7	21.0	20.8	14.9	15.0	0.66	0.66	15.8	15.8	6. N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
90.1	91.2	6.0	6.1	21.7	21.6	16.0	16.0	0.71	0.70	16.5	16.6	7. N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
21.9	21.7	2.5	2.5	13.1	13.0	6.0	6.0	0.31	0.31	8.0	8.1	8. N as 25% inorg. N+ 75% Compost
26.0	26.0	2.8	2.8	13.8	13.8	7.0	7.0	0.34	0.35	8.8	8.8	9. N as 25% inorg. N+ 75% filter mud
30.4	32.7	3.1	3.3	14.5	14.6	8.0	8.0	0.38	0.38	9.5	9.5	10. N as 25% inorg. N+ 75% Chicken manure
35.1	33.7	3.4	3.4	15.2	14.6	8.0	8.0	0.40	0.41	10.0	10.1	11. N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
39.9	39.1	3.7	3.7	15.8	15.5	9.0	9.0	0.45	0.44	10.9	10.8	12. N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
45.1	44.6	4.0	4.0	16.5	16.3	10.0	10.0	0.47	0.47	11.6	11.5	13. N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year
1.0	1.1	0.3	0.2	0.7	0.8	1.0	1.0	0.03	0.03	0.6	0.6	New L.S.D at 5%

Table (7): Effect of inorganic and organic fertilization of N as well as biofertilization with EM on some vegetative growth characters in the Autumn growth cycle of Sukkary mango trees during 2013 and 2014 seasons

Autumn growth cycle												
Leaf area (cm^2)		Leaf width (cm)		Leaf length (cm)		No. of leaves/shoot		Shoot thickness (cm)		Shoot length (cm)		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	
37.7	39.1	3.4	3.5	16.3	16.4	10.0	10.0	0.48	0.47	10.2	10.3	1. N as 100% inorg. N
43.0	43.2	3.7	3.7	17.0	17.1	11.0	11.0	0.50	0.50	10.7	10.8	2. N as 50% inorg. N+ 50% compost
48.8	47.5	4.0	3.9	17.8	17.8	11.9	12.0	0.53	0.53	11.4	11.4	3. N as 50% inorg. N+ 50% filter mud
53.3	50.7	4.2	4.0	18.5	18.5	12.9	13.0	0.55	0.56	12.0	11.9	4. N as 50% inorg. N+ 50% Chicken manure
56.2	53.3	4.4	4.2	18.6	18.5	12.9	13.0	0.56	0.57	12.5	12.6	5. N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
60.8	58.1	4.6	4.4	19.2	19.2	14.0	14.0	0.59	0.60	13.0	13.1	6. N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
66.1	63.3	4.8	4.6	20.0	20.0	15.0	15.0	0.63	0.63	13.7	13.7	7. N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
18.3	18.4	2.3	2.3	12.0	12.1	4.9	5.0	0.28	0.28	7.4	7.5	8. N as 25% inorg. N+ 75% Compost
22.1	21.3	2.6	2.5	12.7	12.8	5.9	6.0	0.33	0.32	8.0	8.1	9. N as 25% inorg. N+ 75% filter mud
26.8	25.0	2.9	2.7	13.7	13.8	7.0	7.0	0.36	0.36	8.5	8.6	10. N as 25% inorg. N+ 75% Chicken manure
28.9	27.2	3.1	2.9	13.8	13.9	7.0	7.0	0.37	0.37	8.7	8.7	11. N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
33.6	31.5	3.3	3.1	15.0	15.0	7.9	8.0	0.40	0.40	9.2	9.2	12. N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
37.7	35.2	3.5	3.3	15.8	15.7	9.0	9.0	0.44	0.44	9.7	9.7	13. N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year
1.1	1.0	0.2	0.2	0.7	0.7	1.0	1.0	0.03	0.03	0.5	0.5	New L.S.D at 5%

Table (8): Effect of inorganic, organic and biofertilization with EM on chlorophylls a & b, total chlorophylls and total carotenoids in the leaves of Sukkary mango trees during 2013 and 2014 seasons

Total Carotenoids (mg/100g Fw)		Total chlorophylls (mg/100g Fw)		Chlorophyll b (mg/100g Fw)		Chlorophyll a (mg/100g Fw)		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	
3.6	3.6	17.0	16.9	4.5	4.6	12.5	12.3	1.N as 100% inorg. N
4.0	4.0	18.3	18.0	5.1	5.0	13.2	13.0	2.N as 50% inorg. N+ 50% compost
4.5	4.3	19.5	19.9	5.6	5.5	13.9	13.7	3-N as 50% inorg. N+ 50% filter mud
4.8	4.6	20.5	20.2	5.9	5.8	14.6	14.4	4-N as 50% inorg. N+ 50% Chicken manure
5.2	4.9	21.5	21.2	6.3	6.2	15.2	15.0	5-N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
5.5	5.2	22.5	22.2	6.7	6.6	15.8	15.6	6-N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
5.9	5.5	23.6	23.3	7.1	7.0	16.5	16.3	7-N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
1.9	1.8	9.7	9.4	2.4	2.3	7.3	7.1	8-N as 25% inorg. N+ 75% Compost
2.2	2.1	11	10.7	2.8	2.7	8.2	8.0	9-N as 25% inorg. N+ 75% filter mud
2.6	2.4	11.9	11.8	3.0	3.1	8.9	8.7	10.N as 25% inorg. N+ 75% Chicken manure
2.9	2.7	13	12.8	3.4	3.5	9.6	9.3	11.N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
3.1	3.0	14.1	13.9	3.8	3.9	10.3	10.0	12.N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
3.2	3.3	15.3	14.9	4.3	4.2	11.0	10.7	13-N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year
0.3	0.3	0.3	0.2	0.3	0.3	0.6	0.6	New L.S.D at 5 %

Table (9): Effect of inorganic and organic of N and biofertilization with EM on the percentages of N, P, K and Mg in the leaves of Sukkary mango trees during 2013 and 2014 seasons

Leaf Mg%		Leaf K%		Leaf P%		Leaf N%		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	
0.49	0.53	1.13	1.11	0.17	0.16	2.12	2.06	1.N as 100% inorg. N
0.53	0.57	1.19	1.17	0.19	0.19	2.20	2.16	2.N as 50% inorg. N+ 50% compost
0.57	0.61	1.25	1.24	0.21	0.21	2.29	2.25	3-N as 50% inorg. N+ 50% filter mud
0.60	0.64	1.30	1.30	0.25	0.24	2.37	2.35	4-N as 50% inorg. N+ 50% Chicken manure
0.64	0.67	1.36	1.36	0.28	0.27	2.45	2.45	5-N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
0.67	0.71	1.41	1.42	0.30	0.30	2.53	2.52	6-N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
0.71	0.76	1.46	1.50	0.33	0.32	2.61	2.59	7-N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
0.74	0.80	1.53	1.55	0.36	0.35	1.64	1.61	8-N as 25% inorg. N+ 75% Compost
0.77	0.84	1.58	1.60	0.40	0.38	1.71	1.70	9-N as 25% inorg. N+ 75% filter mud
0.82	0.87	1.63	1.65	0.43	0.41	1.78	1.77	10.N as 25% inorg. N+ 75% Chicken manure
0.86	0.90	1.69	1.71	0.46	0.43	1.85	1.85	11.N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
0.89	0.93	1.74	1.77	0.49	0.46	1.96	1.91	12.N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
0.92	0.96	1.82	1.83	0.53	0.48	2.04	1.98	13-N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year
0.03	0.03	0.05	0.05	0.02	0.02	0.07	0.06	New L.S.D at 5 %

Table (10): Effect of inorganic and organic of N and biofertilization with EM on the leaf content of Zn, Fe, Mn and Cu in the leaves of Sukkary mango trees during 2013 and 2014 seasons

Leaf Cu (ppm)		Leaf Mn (ppm)		Leaf Fe (ppm)		Leaf Zn (ppm)		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	
2.9	3.1	49.1	50.2	53.1	52.3	56.0	55.9	1.N as 100% inorg. N
3.3	3.5	50.1	51.2	54.2	53.4	57.0	57.0	2.N as 50% inorg. N+ 50% compost
3.6	3.9	51.1	52.2	55.3	54.6	58.1	58.5	3-N as 50% inorg. N+ 50% filter mud
4.0	4.4	52.2	53.3	56.5	55.8	59.2	60.1	4-N as 50% inorg. N+ 50% Chicken manure
4.3	4.7	53.3	54.5	58.0	57.0	60.3	61.5	5-N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
3.6	5.1	54.4	55.7	59.3	57.3	61.5	63.0	6-N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
5.0	5.4	55.5	56.9	60.6	58.7	63.0	64.5	7-N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
5.3	5.8	56.7	58.0	62.0	60.0	64.5	66.0	8-N as 25% inorg. N+ 75% Compost
5.6	6.2	57.9	59.1	63.1	61.1	66.0	67.9	9-N as 25% inorg. N+ 75% filter mud
5.9	6.8	58.9	60.3	64.2	62.3	67.1	70.0	10.N as 25% inorg. N+ 75% Chicken manure
6.2	7.2	60.0	61.5	65.4	63.4	68.1	71.1	11.N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
6.5	7.5	61.2	63.0	66.5	65.0	69.3	72.3	12.N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
6.8	7.9	62.5	64.0	67.8	66.0	70.	73.5	13-N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year
0.3	0.3	0.9	0.9	1.0	0.9	0.9	1.1	New L.S.D at 5 %

Table (11): Effect of inorganic and organic of N and biofertilization with EM on the percentages of initial fruit setting and fruit retention, number of fruits / tree and yield/tree of Sukkary mango trees during 2013 and 2014 seasons

Yield/tree (kg)		No. of fruits /tree		Fruit retention %		Initial fruit setting %		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	
33.3	32.5	200.0	197.0	1.81	1.91	3.03	3.19	1.N as 100% inorg. N
35.6	34.5	205.0	202.0	1.91	2.00	3.40	3.69	2.N as 50% inorg. N+ 50% compost
37.3	36.6	209.0	207.0	2.01	2.16	3.80	4.20	3-N as 50% inorg. N+ 50% filter mud
39.7	39.0	215.0	213.0	2.20	2.32	4.20	4.70	4-N as 50% inorg. N+ 50% Chicken manure
42.2	41.8	220.0	220.0	2.52	2.41	5.11	5.90	5-N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
44.2	44.7	224.0	227.0	2.64	2.51	5.60	6.90	6-N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
46.7	47.2	230.0	235.0	2.85	2.61	5.99	8.00	7-N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
35.5	35.0	171.0	170.0	0.81	0.88	1.00	1.00	8-N as 25% inorg. N+ 75% Compost
37.3	36.8	175.0	174.0	0.92	0.99	1.37	1.41	9-N as 25% inorg. N+ 75% filter mud
39.2	38.8	180.0	179.0	1.04	1.11	1.74	1.82	10.N as 25% inorg. N+ 75% Chicken manure
42.75	40.8	190.0	183.0	1.16	1.21	2.11	2.26	11.N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
45.0	42.8	194.0	187.0	1.27	1.22	2.50	2.67	12.N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
47.0	44.9	198.0	191.0	1.40	1.41	2.64	2.71	13-N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year
	1.8	3.9	4.0	0.07	0.09	0.36	0.41	New L.S.D at 5 %

Table (12): Effect of inorganic and organic of N and biofertilization with EM on some physical characters of the fruits of Sukkary mango trees during 2013 and 2014 seasons

Fruit thickness (cm)		Fruit width (cm)		Fruit length (cm)		Fruit weight (g)		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	
4.3	4.4	5.8	5.7	7.9	7.8	166.5	165.0	1.N as 100% inorg. N
4.5	4.6	6.0	5.9	8.1	8.0	173.6	171.0	2.N as 50% inorg. N+ 50% compost
4.7	4.7	6.2	6.1	8.3	8.3	178.5	177.0	3-N as 50% inorg. N+ 50% filter mud
4.9	4.9	6.4	6.3	8.5	8.6	184.6	183.0	4-N as 50% inorg. N+ 50% Chicken manure
5.1	5.1	6.6	6.5	8.7	8.9	191.7	190.0	5-N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
5.3	5.3	6.8	6.7	9.0	9.2	197.3	197.0	6-N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
5.5	5.5	7.1	6.9	9.2	9.5	202.9	201.0	7-N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
5.7	5.7	7.4	7.1	9.5	9.9	207.8	206.0	8-N as 25% inorg. N+ 75% Compost
5.9	5.9	7.7	7.3	9.8	10.1	213.0	211.5	9-N as 25% inorg. N+ 75% filter mud
6.1	6.1	8.0	7.6	10.0	10.3	218.0	217.0	10.N as 25% inorg. N+ 75% Chicken manure
6.3	6.3	8.1	7.8	10.2	10.5	225.0	223.0	11.N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
6.6	6.5	8.3	8.0	10.5	10.7	231.9	229.0	12.N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
6.8	6.7	8.5	8.2	10.8	11.0	237.3	235.0	13-N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year
0.2	0.2	0.2	0.2	0.2	0.2	5.2	5.0	New L.S.D at 5 %

Table (13): Effect of inorganic, organic and biofertilization with EM on some physical characters of the fruits of Sukkary mango trees during 2013 and 2014 seasons

Edible / non edible portions		Pulp (%)		Peel weight (%)		Seed weight (%)		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	
1.10	1.36	52.4	57.6	23.6	21.0	24.0	21.4	1.N as 100% inorg. N
1.15	1.40	53.4	58.4	23.1	20.6	23.5	21.0	2.N as 50% inorg. N+ 50% compost
1.19	1.44	54.4	59.0	22.6	20.3	23.0	20.7	3-N as 50% inorg. N+ 50% filter mud
1.27	1.48	56.0	59.6	21.8	20.0	22.2	20.4	4-N as 50% inorg. N+ 50% Chicken manure
1.34	1.51	57.2	60.2	21.2	19.7	21.6	20.1	5-N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
1.40	1.58	58.4	61.2	20.6	19.2	21.0	19.6	6-N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
1.46	1.62	59.4	61.8	20.1	18.9	20.5	19.3	7-N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
1.49	1.60	59.9	61.5	20.1	19.2	20.0	19.3	8-N as 25% inorg. N+ 75% Compost
1.53	1.66	60.4	62.4	19.7	18.6	19.6	19.0	9-N as 25% inorg. N+ 75% filter mud
1.59	1.71	61.4	63.1	19.3	18.3	19.3	18.6	10.N as 25% inorg. N+ 75% Chicken manure
1.59	1.66	61.4	62.4	19.3	18.6	19.3	19.0	11.N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
1.63	1.81	62.0	64.4	19.0	18.0	19.0	17.6	12.N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
1.67	1.89	62.6	56.4	18.7	17.6	18.7	17.0	13-N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year
0.04	0.03	0.5	0.5	0.3	0.3	0.3	0.7	New L.S.D at 5 %

Table (14): Effect of inorganic and organic of N and biofertilization with EM on some chemical characteristics of the fruits of Sukkary mango trees during 2013 and 2014 seasons

Reducing sugars %		Total sugars (%)		Total acidity %		T.S.S %		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	
2.7	2.9	9.5	10.0	0.387	0.380	14.3	15.3	1.N as 100% inorg. N
2.9	3.2	9.8	10.3	0.357	0.350	14.7	15.6	2.N as 50% inorg. N+ 50% compost
3.1	3.5	10.3	10.6	0.327	0.320	15.1	16.0	3-N as 50% inorg. N+ 50% filter mud
3.3	3.8	10.7	11.0	0.303	0.290	15.6	16.3	4-N as 50% inorg. N+ 50% Chicken manure
3.5	4.1	11.1	11.4	0.280	0.259	16.0	16.6	5-N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
3.8	4.4	11.5	11.8	0.250	0.229	16.4	16.9	6-N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
4.0	4.7	11.9	12.2	0.230	0.200	16.8	17.3	7-N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
4.2	5.0	12.5	12.7	0.210	0.175	17.2	17.7	8-N as 25% inorg. N+ 75% Compost
4.5	5.2	13.3	13.3	0.192	0.150	17.7	18.1	9-N as 25% inorg. N+ 75% filter mud
4.8	5.3	14.0	13.8	0.180	0.142	18.4	18.4	10.N as 25% inorg. N+ 75% Chicken manure
5.1	5.5	14.3	14.2	0.171	0.140	18.9	18.7	11.N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
5.3	5.7	14.6	14.7	0.161	0.137	19.0	19.1	12.N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
5.6	5.9	14.9	15.3	0.157	0.129	19.3	19.5	13-N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year
0.2	0.2	0.3	0.3	0.023	0.025	0.3	0.3	New L.S.D at 5 %

Table (15): Effect of inorganic, organic and biofertilization with EM on some chemical characteristics of the fruits of Sukkary mango trees during 2013 and 2014 seasons

Nitrite in the pulp (ppm)		Nitrite in the pulp (ppm)		Vitamin C (mg/100pulp)		Non-Reducing Sugars %		Inorganic, organic and biofertilization with EM treatments
2014	2013	2014	2013	2014	2013	2014	2013	
3.4	4.1	10.1	9.1	40.5	41.0	6.8	7.1	1.N as 100% inorg. N
3.2	3.9	8.0	8.5	41.5	42.0	6.9	7.1	2.N as 50% inorg. N+ 50% compost
3.0	3.6	7.5	8.0	42.6	43.1	7.2	7.1	3-N as 50% inorg. N+ 50% filter mud
2.8	3.4	6.9	7.0	43.7	44.0	7.4	7.2	4-N as 50% inorg. N+ 50% Chicken manure
2.6	3.2	6.0	6.1	44.8	45.0	7.6	7.3	5-N as 50% inorg. N+ 50% compost + 50 ml EM/tree/year
2.4	3.0	4.9	5.0	45.9	45.9	7.7	7.4	6-N as 50% inorg. N+ 50% Filter mud + 50 ml EM/tree/year
2.2	2.7	4.1	4.2	47.0	47.0	7.9	7.5	7-N as 50% inorg. N+ 50% Chicken+ 50 ml EM/tree/year
1.9	2.4	3.6	3.7	47.8	47.8	8.3	7.7	8-N as 25% inorg. N+ 75% Compost
1.6	2.1	3.0	3.2	48.9	48.5	8.8	8.1	9-N as 25% inorg. N+ 75% filter mud
1.4	1.7	2.5	2.7	49.9	49.5	9.2	8.5	10.N as 25% inorg. N+ 75% Chicken manure
1.2	1.3	2.1	2.1	50.9	50.5	9.2	8.7	11.N as 25% inorg. N+ 75% compost + 100 ml EM/tree/year
1.0	1.0	1.7	1.8	52.0	51.6	9.3	9.0	12.N as 25% inorg. N+ 75% Filter mud + 100 ml EM/tree/year
0.5	0.7	1.3	1.5	52.6	52.7	9.3	9.4	13-N as 25% inorg. N+ 75% Chicken+ 100 ml EM/tree/year

4. Discussion

The promoting effect of different organic manures namely compost, filter mud and chicken manure (when applied at the optimum rate of the suitable N) on growth, leaf mineral content, yield and fruit quality of Sukkary mango trees might be attributed to the positive action of these organic manures in enhancing soil organic matter, N fixation, microbial activity, soil aggregation and aeration, water holding capacity, nutrient transport, vitamin B, natural hormones and antibiotics as well as reducing soil pH, pathogens, salinity, leaching process and soil erosion consequently enhancing soil fertility and the availability of most elements and tree nutritional status (**Goramnagar *et al.*, 2000; Obreza and Ozores, 2000; Wang *et al.*, 2000 and Venzon *et al.*, 2001**).

The results of **Mahmoud (2012); Mohamed *et al.* (2012); El-Khawaga and Meklad (2013) and Omar (2015)** emphasized the essential roles of organic manure as a partial substitute of inorganic N fertilizers on fruiting of fruit crops. They are involved in enhancing growth and fruiting of different fruit crops.

Application of EM was found by many authors to improve yield and fruit quality in various fruit crops (**Roshdy *et al.* (2011); Mahmoud (2012); Refaai *et al.*(2012); Ibrahiem (2012); Abdelaal *et al.* (2013); El- Khawaga (2013); Faraage (2013); Ahmed *et al.* (2014a) and (2014b) and Saied (2015).**

CONCLUSION

The best results with regard to yield and fruit quality of Sukkary mango trees were obtained due to supplying the trees with N (1000g N/tree) through 50% inorganic N + 50% chicken manure enriched with Effective microorganisms at 50 ml/tree/year.

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