Available online free at www.futurejournals.org

The Future Journal of Horticulture

Print ISSN: 2692-5826 Online ISSN: 2692-5834

Future Science Association

Future J. Hort., 2 (2022) **1-9** **OPEN ACCES**

DOI: 10.37229/fsa.fjh.2022.04.15

EFFECT OF PIGEON MANURE TEA AND *Spirulina plantensis* ALGAE ON NUTRITIONAL STATUS AND FRUIT QUALITY OF SUCCKARY MANGO TREES

Hamdy I.M. Ibrahim*; Ali H. Ali and Mahmoud H.G. Madany

Hort. Dept. (Pomology), Fac. of Agric., Minia Univ., El-Minia, **Egypt**.

***Corresponding author:** hamdy_france@yahoo.com **Received: 14** Feb. 2022 **; Accepted:** 15 April 2022

ABSTRACT: Nutritional status and fruit physical and chemical properties of Succkart mango trees grown in clay soil under Aswan Governorate conditions, Egypt in response partial replacement of mineral nitrogen by using pigeon manure tea + *Spirulina plantensis* algae were investigated during 2018 and 2019 seasons. Replacement of mineral N by using pigeon manure tea + Spirulina plantensis were very effective in improving all leaves mineral contents (macro elements; N%, P%, K% and Mg % and micro nutrients; Fe, Zn, and Mn ppm). However, non-significant differences were observed in leaves Cu contents. Furthermore, fruit physical properties (in terms of fruit length, fruit diameter & pulp/fruit ratio) and chemical properties (in terms of increasing TSS%, reducing, total sugars % & vitamin C contents and decreasing total acidity%) were improved. This positive effect continually until replaced 40% of mineral N fertilizer by using 20% pigeon manure tea + 20% *Spirulina plantensis*. However, gradual increasing of mineral N replaced ratio from 40% to 100% caused a gradual and significant decrement in all leaves mineral elements, fruit physical and chemical properties. However, the trees received 60% mineral N + 20% pigeon manure tea + 20% *Spirulina plantensis* present the best results. Contrary, the trees received 0.0% mineral N + 50% 50% pigeon manure tea + 50% *Spirulina plantensis* present the lowest contents of macro and micro elements as well as fruit physical and chemical properties.

Key words: Succkary mango, (*Mangifera indica*), pigeon manure tea, *Spirulina plantensis*

INTRODUCTION

Mango tree (*Mangifera indica*) belongs to family Anacardaceae. It considered as a main fruit crops in many countries such as; India, Pakistan, Philippines and Bangladesh and Egypt. So, mangos are Popular and favorite among All Egyptians people. In Aswan Governorate, mango ranks the fourth position after Ismailia, Noubaria, and Sharkia (**Annual Reports of Statist. and Agric. 2018**). Succkary mango *cv.* is considered a prime and outstanding mango cultivar in all Egyptian Governorates, due to its strong spicy flavor, producing appealing aroma, sweet, low in fiber, popular in the domestic market for fresh consumption and it has a wide acceptance in international markets (**Madany, 2017**).

Using organic and biofertilizer extracts nowadays for fruit crops has attract researchers interest and attention, as an alternative to synthetic auxins and mineral nitrogen fertilization. They are safe for human, animal and environment. Clean cultivation is greatly achieved by using organic and biofertilizers (**Russo and Berlyn, 1990; Kulk 1995; Litterick *et al.*, 2004; Eman *et al.*, 2010; Ibrahim *et al.*, 2015 and Ibrahim *et al.*, 2019**). The pigeon manure tea, it retains all the beneficial soluble bioactive compounds, making it a potent source of plant stimulatory and defensive compounds. The exact nature and extent of these features are, however modified by fermentation process, feedstock quality.

There is a rapidly developing field of research on using bio-fertilization as a safety alternate of mineral fertilization, may be due to the beneficial effects of the biofertilizer, such Spirulina plantensis, which attributed to their own from natural hormones, glutathione, lecithin, adenylic acid, enzymes and co-enzymes, vitamins B1 & B6 and glycine. Also, they are essential for the synthesis of protoporphyrin, precursor of plant pigments and photosynthesis through enhancing the release of CO_2 (**El-Shenawy and Fayed 2005; Abd El-Aal *et al.*, 2007; Chang *et***

***al.*, 2007; Gad-El-Kareem, 2009; Ibrahim *et al.*, 2019 and De-Oliveira *et al.*, 2020**).

The main objective of this investigation was studied the effect of partially replacement of mineral nitrogen by using pigeon manure tea and *Spirulina Plantensis* algae on mineral statues and fruit physic-chemical properties of Succkary mango trees grown under Aswan Governorate conditions, Egypt.

MATERIALS AND METHODS

This investigation was conducted during two successive seasons 2018 and 2019 on 24 uniforms in vigor 15-years old Succkary Mango trees grown in private orchard located at Edfu district, Aswan Governorate. The soil texture is loamy clay and well drained water. The chosen trees are planted at 7 X 7 meters apart. Surface irrigation system was used Nile water was adopted.

Plant material

The selected Succkary mango trees were 15 years old at the start of experiment grown under Edfu district, Aswan Governorate. The trees were cultivated at 7X7 meters apart. Surface irrigation system, using Nile river water, was followed in this orchard.

Soil characters

The orchard where the present experiment carried out (at Edfu district, Aswan Governorate) was loamy clay soil (Table 1). A composite sample was collected and subjected to Physical and chemical analysis using to the procedures outlined by **Wilde *et al.*, (1985**) and **Buurman *et al.*** (**1996**). The data are shown in Table (1).

Table 1. Physical and chemical analysis of experimental orchard soil

Constituents	Values
Sand %	6.1%
Silt %	86.7%
Clay %	7.2%
Texture	loamy clay
EC (1 : 1 extract, dSm^{-1})	0.59
Organic matter %	2.39
pH (1 : 2.5 extract)	7.4
Soluble cations (meq/l)	
Ca^{++}	1.5
Mg^{++}	2.5
Na^{+}	0.69
K+	0.74
Soluble anions (meq/l)	
HCO_3	1.1
Cl^{-}	1.7
SO_4^{--}	1.14
Available P ppm (Olsen)	6.14

Experimental work

In order to study the effect of partial replacement of mineral N fertilization by using pigeon manure tea + *Spirulina plantensis* on nutritional status and fruit quality of Succkary mango trees, the following six doses of mineral N partial replacement were examined:

1- 100% mineral + 0.0% organic + 0.0% bio fertilization
2- 80% mineral N + 10% pigeon manure tea + 10% *Spirulina plantensis.*
3- 60% mineral N + 20% pigeon manure tea + 20% *Spirulina plantensis*.
4- 40% mineral N + 30% pigeon manure tea + 30% *Spirulina plantensis*.
5- 20% mineral N + 40% pigeon manure tea + 40% *Spirulina plantensis*.
7- 0.0% mineral N + 50% pigeon manure tea + 50% *Spirulina plantensis*.

Then, the study included six treatments from the mineral, organic and bio-fertilization, each treatment was replicated four times, one tree per each. Complete Randomized block design (CRBD) arrangement was followed (according to **Snedecor & Cochran 1980**). The obtained data were analyzed and the differences between the means were compared by using new LSD test.

Preparation of pigeon manure tea

Fresh pigeon manure was obtained from three pigeonhole near the farm that were pigeon not being fed hormones or manufactured diets for poultry feed. The manure was placed in burlap bags (2 kg/bag), then the bags was placed in plastic drums filled with water (20 liters/drum), a rock was added to the manure to make sure it did not float. Then the barrels were covered with plastic wrap to complete the fermentation process. The burlap bags were manual moved up and down several times daily. After three weeks of fermentation, the pigeon manure tea was ready for use (**Price and Duddles 1984)**.

Table 2. Chemical composition of pigeon manure tea (1:10 extraction) used in this experiment

Constituents	Values
pH	7.92
EC ($dS.m^{-1}$)	1.46
Total N (ppm)	219
Phosphorus (ppm)	329
Potassium (ppm)	318
Fe (ppm)	7.52
Cu (ppm)	3.1
Zn (ppm)	1.78
Mn (ppm)	0.05

Preparation of *Spirulina plantensis* fungi

Spirulina plantensis algae was grown on Potato dextrose media (according to **EL-Boray *et al.*, 2015**) incubated for 2-3 days at 28 C^o to maintain populations of 3 x 10^8 colony forming unit ml^{-1} (CFU\ml). The fungi strain was kindly provided from Dept. of Microbiology Faculty of Agriculture, Minia University – Egypt.

Leaf mineral contents

During full blooming, sample consists of 32 leaves were collected from the four main geographical sides of tree at the mid-height area of the tree, 8 leaves per each said were taken. According to the protocol outlined by **Martin-Préval *et al.*, (1984)** and illustrated by **Ibrahim *et al.* (2009)**. Leaf contents of N. P, K, Mg, Ca, Fe, Zn and Mn for each sample were determined as follows:

- Nitrogen was determined by the modified microkejldahl method as described by (**Martin-Préval *et al.*, 1984**).

- Phosphorus was determined by using colorimetric method, described by Wild et al., (1985), by measuring the optical density of phosphor-molibdo-vanadate complex by Spectro-photometrically at wave length 430 nm.

- Potassium was flam-photometrically determined, using the method outlined by **Martin-Préval *et al.*, (1984)**.

- Magnesium was determined by using versene method (**Martin-Préval *et al.*, (1984)**.

- Ca, Fe, Zn and Mn were determined by using atomic absorption method (according to **Martin- Préval *et al.*, (1984)**.

Fruit physical and chemical properties

A randomized sample, consists five fruits, was taken from each tree yield washed with tap water and air dried, then the following physical and chemical analysis were made:

- Fruit weight (g), using 0.01 sensitivity balance.

- Fruit dimensions (longitudinal and equatorial, in cm) were measured, using vernier caliper, note that the equatorial was measured at the shoulder.

- Fruit volume, in cm^3, by estimating the volume of liquid displaced by the size of fruit.

- Fruits were peeled, and then the fruit peel and seed were weighted and recorded. Fruit pulp was collected after removing the peel and seed and mixed using an electric blender, then the following chemical parameters were determined:

- Percentage of total soluble solids (TSS %) by using a handy refractometer was determined.

- Percentage of reducing, non-reducing, and total sugars were determined by using methods of Lane and Eynon**,** outlined in **Ranganna (1985)**. Total sugars% was mathematically calculated, as the sum of reducing and non-reducing sugars.

- Percentage of total acidity (as a gram of malic acid per 100 g fresh pulp) was determined by titration with NaOH 0.1N according to **A.O.A.C. (2000)**.

- Vitamin C was determined by volumetric titration method using 2,6-Dichlorophynol Endophynol Pigment, according to **Ranganna (1985)** and **IAL (2008).**

Statistical analysis

The obtained data were analyzed and the differences between the means were compared by using L.S.D. test according to (**Snedecor & Cochran 1980).**

RESULTS AND DISCUSSIONS

Effect on Leaf macro-nutrients content

Data obtained during the two experimental seasons (2018 and 2019) as shown in Table (3) displayed that, replacing mineral N by using pigeon manure tea (as organic fertilizer) + *Spirulina plantensis* (as a bio-fertilizer) significantly enhancing leaves N%, P%, K% and Mg%. This increment continually until replacing 40% of mineral N fertilizers by using 20% pigeon manure tea + 20% *Spirulina plantensis*. While, increasing the replaced ratio of organic fertilizer + bio fertilizers from 40% to 100% significantly decrease the leaves contents of the four macro elements, these results were true during the two experimental seasons. The highest nitrogen (2.04 & 2.00%), phosphorus (0.37 & 0.38%), potassium (1.35 & 1.39%) and Magnesium (0.79 & 0.77%) were obtained from the trees received 60% of mineral N fertilizers + 20% pigeon manure tea + 20% *Spirulina plantensis* algae. However, the lowest percentages of the four macro nutrients were obtained when the trees received 0.0% mineral N + 50% in form of pigeon manure tea + 50% in form of *Spirulina plantensis* algae (1.60 & 1.58% for nitrogen, 0.15 & 0.16% for phosphorus, 1.10 & 1.08% for potassium and 0.50 & 0.74% for magnesium), during the two experimental seasons respectively.

Effect on Leaf micro-nutrients content

Change in leaves micronutrients (Fe, Zn, Mn and Cu) contents of Succkary mango trees during 2018 and 2019 seasons as a response to replacing mineral N by using pigeon manure tea + *Spirulina plantensis* are shown in Table (4). It's clear from this Table that, replacing the mineral N fertilizer by using pigeon manure tea and *Spirulina plantensis* was very effective in enhancing significantly the leaves contents of Fe, Zn and Mn in Succkary mango trees.

However, non-significant differences were observed in leaves Cu contents. This increment was continually until replacing 40% of mineral N fertilizer by pigeon manure tea + *Spirulina plantensis*. While, increasing the ratio of pigeon manure tea + *Spirulina plantensis* over than 40% had a negative effect on leaves micro nutrients. The higher contents of Fe (49.1 & 50.5 ppm), Zn (44.0 & 42.1 ppm) and Mn (53.1 & 54.4 ppm) were obtained from the trees received 60% mineral N nitrogen + 20% pigeon manure tea + 20% *Spirulina plantensis*, during the two experimental seasons respectively. On the opposite side, the lowest micro nutrient contents were observed when the trees received 0.0% mineral N + 50% organic N (pigeon manure tea) + 50% bio-fertilizer (*Spirulina plantensis* algae), these values were 46.0 & 47.4 ppm for Fe, 41.2 & 39.5 ppm for Zn and 50.0 & 51.5 ppm for Mn, during the two experimental seasons respectively.

The present findings on leaf mineral contents following organic manure tea and *Spirulina plantensis* as a bio-fertilizer are in line with the results obtained also by: **Litterick *et al.*, 2004; Mostafa *et al.*, 2009; Abdel Gawad, 2016**; **Mahran, 2005, El-Khafagy, 2013; Hasan, 2015** and **Ibrahim *et al.*, 2019.** The positive effect of pigeon tea on Succkary mango trees which observed in the present study can be explained by the beneficial effects of organic manure tea on fruit trees: it is considered as a very important source of mineral nutrients, organic matter and micro-organisms. It can be used to fertilize for many fruit crops as a soil or foliar applications, inoculated fruit trees residue to facilitate decomposition, improvement of mineral nutrient cycling in soil through increasing the activity of micro-organisms and manage certain plant pathogens, through microbial competition and eventually improve plant nutrition (**Mostafa, 2009; Marzouka and Kassem, 2011; El-Khawaga, 2011; Sau *et al.*, 2017; Abd El-Hamid and El-Shazly2019**.

It's well documented that, in soil, algae "such as *Spirulina plantensis"* have important functions beyond protecting plant surfaces from non-beneficial organism growth, by competing for nutrients, space and occupying infection sites (according to **Weltzein, 1989; Trankner, 1992; El-Khawaga, 2011)** these functions include: Retention of nutrients (N, P, S, Ca, Fe, *etc*.) in algae biomass (the C : N ratio of fungi means that fungi cannot possibly be mineralizing N, they have to be immobilizing N in their biomass). Retention of micronutrients in algae biomass - fungi are the major holders of Ca, at least in soils we have tested, decomposition of plant-toxic materials and plant residues (especially more recalcitrant, less easy to use substrates). It has an important role in building soil aggregate structure. The visible aggregates that are seen in soil are built by algae by binding together the "bricks" made by bacteria, organic matter, root hairs, fecal pellets provided by soil arthropods, etc. furthermore, improvement of soil water-holding capacity, by improving building the structure in soil. The pervious essential functions of *Spirulina plantensis* can clearly explained the its positive effect on enhancing leaves continents of macro and micro nutrients, as well as its contents of main pigments (**Vonshakl *et al.*, 1994 and Marschner *et al,* 1995**).

Table 3. Effect of partially replacement of mineral nitrogen by using pigeon manure tea and *Spirulina plantensis* on leaves N, P, K and Mg contents (% D.W.) of Succkary mango trees, during 2018 and 2019 seasons

Treatments	Nitrogen (% of D.W.)		Phosphorus (% of D.W.)		Potassium (% of D.W.)		Magnesium (% D.W.)	
	2018	2019	2018	2019	2018	2019	2018	2019
100% mineral N	1.81	1.80	0.27	0.30	1.24	1.25	0.68	0.64
80% mineral + 10% pigeon + 10% S. plantensis	1.91	1.89	0.32	0.34	1.30	1.32	0.75	0.70
60% mineral + 20% pigeon + 20% S. plantensis	2.04	2.00	0.37	0.38	1.35	1.39	0.79	0.77
40% mineral + 30% pigeon + 30% S. plantensis	1.74	1.73	0.22	0.23	1.19	1.19	0.60	0.57
20% mineral + 40% pigeon + 40% S. plantensis	1.66	1.66	0.19	0.20	1.15	1.14	0.54	0.52
0% mineral + 50% pigeon + 50% S. plantensis	1.60	1.58	0.15	0.16	1.10	1.08	0.50	0.74
New LSD at 5%	**0.06**	**0.07**	**0.03**	**0.03**	**0.04**	**0.05**	**0.03**	**0.04**

Table 4. Effect of replacing mineral nitrogen partially by using pigeon manure tea and *Spirulina plantensis* on leaves Zn, Fe, Mn and Cu contents (ppm D.W.) of Succkary mango trees, during 2018 and 2019 seasons

Treatments	Zn (ppm of D.W)		Fe (ppm of D.W)		Mn (ppm of D.W)		Cu (ppm of D.W)	
	2018	2019	2018	2019	2018	2019	2018	2019
100% mineral N	45.5	43.6	50.8	52.0	54.8	55.8	1.3	1.4
80% mineral + 10% pigeon + 10% S. plantensis	48.0	45.7	52.5	53.4	56.4	57.47	1.4	1.2
60% mineral + 20% pigeon + 20% S. plantensis	50.3	48.0	54.3	55.3	58.0	58.9	1.2	1.3
40% mineral + 30% pigeon + 30% S. plantensis	44.0	42.1	49.1	50.5	53.1	54.4	1.3	1.3
20% mineral + 40% pigeon + 40% S. plantensis	42.5	40.6	47.5	48.9	51.5	52.9	1.3	1.4
0% mineral + 50% pigeon + 50% S. plantensis	41.2	39.5	46.0	47.4	50.0	51.5	1.2	1.2
New LSD at 5%	**1.0**	**1.1**	**1.5**	**1.4**	**1.4**	**1.3**	**NS**	**NS**

Effect on fruit physico-chemical properties

Fruit physical properties

Data concerning the effect of partial replacement of mineral N by pigeon manure tea + *Spirulina plantensis* on fruit physical properties of Succkary mango trees during 2018 and 2019 seasons are presented in Table (5). It is clearly shown from these data that treating Succkary mango trees three times with pigeon manure tea and *Spirulina plantensis* significantly was accompanied with improving fruit length (cm), fruit width (cm) and the ratio of pulp/fruit, relative to using 100% mineral fertilizers, during the two experimental seasons. This promotion was parallel to increasing the ratio of mineral N replaced by pigeon manure tea and *Spirulina plantensis* until reached at 40% for the fruit length and fruit width (cm). While, this increment continually for the pulp/fruit ratio until replacing 80% of mineral N. On opposite side, increasing the ratio of pigeon manure tea + *Spirulina plantensis* over than 40% significantly decreased fruit length and fruit width during the two experimental seasons. It's clear that, this decrement was sharp and gradually from replacing 40% to replacing 100% of mineral N by using pigeon manure tea + *Spirulina plantensis*, this data was true during the two experimental seasons.

Data illustrated in Table (5) clearly shown that, the trees received 40% of nitrogen fertilizer (20% pigeon manure tea + 20% *Spirulina plantensis*) present the highest fruit length (9.9 & 9.8 cm) and fruit width (7.4 & 7.8 cm). While, those received 80% of N fertilizer (40% pigeon manure tea + 40% *Spirulina plantensis*) present the highest pulp/fruit ratio (3.4 & 3.4), during the two experimental seasons respectively. On the opposite side, Succkary mango trees received 50% pigeon manure tea + 50% *Spirulina plantensis* fungi and 0.0 mineral N present the lowest fruit height (7.5 & 7.7 cm), fruit width (5.5 & 5.7 cm) and pulp/fruit ratio (2.1 & 2.0), during the two experimental seasons respectively.

The obtained results regarding all physical properties of Succkary mango trees were supported by the findings of many authors such as: **Ibrahim *et al.*, 2015** on Kiette mango trees; **Abd EL-Moniem and Radwan, (2003); EL-kholy (2004)**; **Barakat *et al.*, (2011); Vazquez and Lopez (2012)** and **Baiea** and **El-Gioushy (2015)** on banana plants; **Roussos (2011)** on Salustiana orange trees and **Abou El-khashab (2003)** on olive trees.

Fruit chemical properties

The effect of gradual partial replacement of mineral N fertilizer by using pigeon manure tea + *Spirulina plantensis* on chemical properties of Succkary mango fruits during 2018 and 2019 seasons are shown in Tables (6 & 7). The TSS% as well as reducing and total sugars percentages were significantly and gradually improved in response to partial replacement of mineral N fertilizers. However, treated Succkary mango with 20 % form of pigeon manure tea + 20% *Spirulina plantensis* + 60% mineral N present the highest TSS% (17.2 & 17.3%), reducing sugars% (4.6 & 4.8%) and total sugars% (12.3 & 12.5%), during the two experimental seasons respectively. on the opposite side, increasing the N replaced ratio over than 40% was combined with remarkable decrement in TSS%. Reducing sugars% and total sugars%. However, the trees received 50% pigeon manure tea + 50% *Spirulina plantensis*, without using any mineral N fertilizers present the lowest TSS% (15.1 & 14.7%), reducing sugars% (2.8 & 3.0%) and total sugars % (10.0 & 10.0%), during the two experimental seasons respectively. the same Table showed that increasing the replaced ratio of mineral N by using pigeon manure tea + *Spirulina plantensis* were failed to varied significantly the non-reducing sugars on fruit, neither in the first season nor in the second season.

Table 5. Effect of replacing mineral N partially by using pigeon manure tea and *Spirulina plantensis* on fruit length and fruit width as well as pulp/fruit ratio of Succkary mango trees, during 2018 and 2019 seasons

Treatments	Fruit height (cm)		Fruit width (cm)		Pulp/fruit Ratio	
	2018	2019	2018	2019	2018	2019
100% mineral N	9.0	8.9	6.5	7.1	2.2	2,3
80% mineral + 10% pigeon + 10% S. plantensis	9.3	9.4	7.0	7.4	2.4	2.6
60% mineral + 20% pigeon + 20% S. plantensis	9.9	9.8	7.4	7.8	2.8	2.9
40% mineral + 30% pigeon + 30% S. plantensis	8.2	8.4	6.1	6.5	3.1	3.2
20% mineral + 40% pigeon + 40% S. plantensis	7.7	8.0	5.8	6.1	3.4	3.4
0% mineral + 50% pigeon + 50% S. plantensis	7.5	7.7	5.5	5.7	2.1	2.0
New LSD at 5%	**0.2**	**0.3**	**0.2**	**0.3**	**0.2**	**0.2**

Furthermore, data illustrated in Table (6) shows that, TSS/acid ratio and vitamin C (mg/100g F.W.) were significantly improved as a results of increasing the ratio of mineral N replaced by using pigeon manure tea + 50% *Spirulina plantensis* from 0.0% to 40%. Then, increasing the ratio replaced over than 40% was combined with gradual and significant decrease in TSS/acid ratio and vitamin C (mg/100g F.W.). Succkary mango trees received 20% pigeon manure tea + 20% *Spirulina plantensis* + 60% mineral N present the heights TSS/acid ratio (61.2 & 59.5) and vitamin C (50.1 & 50.4 mg/100g F.W.). On the opposite side, the trees received 50% pigeon manure tea + 50% *Spirulina plantensis* + 0.0% mineral N present the lowest TSS/acid ratio (38.7 & 37.2) and vitamin C (41.5 & 41.0 mg/100g F.W.), these data were true during the two experimental seasons respectively.

Conversely, data illustrated in Table (6) clearly shows that increasing the replaced ratio of mineral N pigeon manure tea + *Spirulina plantensis algae* was a combined with a gradual and significant decrement in fruit total acidity%, drying the two experimental seasons. This decrement was continually until replaced 40% of mineral N. Then, increasing the replaced ratio than 40% until 100% were combined with significantly increase, these data were true during the two experimental seasons.

However, treating Succkary mango trees with 20% pigeon manure tea + 20% *Spirulina plantensis* algae succeeded in produced the minimum values of total acidity% (0.281 & 0.291%), during the two experimental seasons respectively. Similar trend was noticed during 2018 and 2019 seasons. Contrary, succkary mango trees received 50% pigeon manure tea + 50% *Spirulina plantensis algae* + 0.0% mineral N present the highest total acidity (0.390 & 0.395%), in both experimental seasons respectively.

The obtained results regarding the fruit chemical properties of Succkary mango trees were supported by the findings of many authors such as **Abd EL-Moniem and Radwan, (2003), EL-kholy (2004)**, **Barakat *et al.*, (2011)**, **Vazquez and Lopez (2012)** and **Baiea and El-Gioushy (2015)** on banana plants; **Ibrahime *et al.*, (2015)** on Kiette mango trees; and **Abou El-khashab (2003)** on olive trees.

It's well-known that, organic manure tea, such as pigeon manure tea, consist many beneficial microorganisms, (may be spontaneously found in the manure or associated fermentation process). These microorganisms may work to increase essential mineral elements availability for trees and inhibiting pathogen growth. The organic manure teas apparently contain large numbers of beneficial microbes that positively effect on leaves and fruits. Benefits described to the use of Spirulina plantensis fungi as bio fertilizers related enhance the nutrient availability and uptake, improving fruit growth and fruit quality properties (**Hasan, 2015 and Abdel Gawad, 2016**). So, the previews beneficial effects of pigeon manure tea and *Spirulina plantensis* could explained its positive effects on the physical properties of Succkary mango fruit, which observed in the present investigation. In addition to organic manure tea, the positive effect of *Spirulina plantensis* which investigated in the present study may be due to its multiple benefits to fruit quality and human health. *Spirulina platensis* is a microalga with suitable composition for use as a food supplement, as it was classified as safety microorganisms by the Food and Drug Administration. Its composition on a dry basis has high protein (64 to 74%), deferent fatty acid, vitamins and antioxidant compounds (**Colla *et al.*, 2007**). Also, various studies have been developed on using *Spirulina plantensis* as a biofertilizer capable to improve fruit trees physical and chemical properties such as **Hasan (2015)** on grapevines; **Onias *et al.***

(2016) on Tommy Atkins mango fruits; **Guedes *et al.* (2018):** on papaya fruit; **Abd El-Hamid and El-Shazly (2019)** on Succkary mango fruits and **De-Oliveira *et al.* (2020)** on pomegranate fruits However, using organic manure tea as an organic fertilizer was also investigated by certain authors such as **Ibrahim *et al.*, (2015)** on Keitte mango fruits; **Hagag *et al.* (2018)** on the effect of Pigeon manure tea on olive trees and **Marzouka and Kassem (2011)** on fruit quality of Zaghloul date palm.

Table 6. Effect of replacing mineral N partially by using pigeon manure tea and *Spirulina plantensis* on reducing, non-reducing and total sugars % of Succkary mango trees, during 2018 and 2019 seasons

Treatments	Reducing sugars %		Non reducing sugars %		Total sugars %	
	2018	2019	2018	2019	2018	2019
100% mineral N	3.9	4.1	7.5	7.4	11.4	11.5
80% mineral + 10% pigeon + 10% S. plantensis	4.3	4.5	7.6	7.6	11.9	12.1
60% mineral + 20% pigeon + 20% S. plantensis	4.6	4.8	7.7	7.7	12.3	12.5
40% mineral + 30% pigeon + 30% S. plantensis	3.3	3.8	7.3	7.3	10.6	11.1
20% mineral + 40% pigeon + 40% S. plantensis	3.0	3.4	7.3	7.2	10.3	10.6
0% mineral + 50% pigeon + 50% S. plantensis	2.8	3.0	7.2	7.0	10.0	10.0
New LSD at 5%	**0.2**	**0.2**	**NS**	**NS**	**0.3**	**0.4**

Table 7: Effect of replacing mineral N partially by using pigeon manure tea and *Spirulina plantensis* on TSS% and total acidity% of Succkary mango trees, during 2018 and 2019 seasons

Treatments	TSS %		Total acidity %		TSS/acid ratio		V. C mg/100 g F.W.	
	2018	2019	2018	2019	2018	2019	2018	2019
100% mineral N	16.3	16.1	0.323	0.335	50.5	48.1	46.1	46.5
80% mineral + 10% pigeon + 10% S. plantensis	16.8	16.6	0.303	0.313	55.4	53.0	48.1	48.2
60% mineral + 20% pigeon + 20% S. plantensis	17.2	17.3	0.281	0.291	61.2	59.5	50.1	50.4
40% mineral + 30% pigeon + 30% S. plantensis	15.8	15.5	0.342	0.356	46.2	43.5	44.0	44.7
20% mineral + 40% pigeon + 40% S. plantensis	15.4	15.0	0.362	0.376	42.0	39.9	42.6	42.4
0% mineral + 50% pigeon + 50% S. plantensis	15.1	14.7	0.390	0.395	38.7	37.2	41.5	41.0
New LSD at 5%	**0.3**	**0.3**	**0.018**	**0.019**	**3.2**	**2.7**	**1.0**	**1.1**

Conclusion

Under Aswan Governorate conditions similar conditions, it could be recommended to replace 40% of mineral nitrogen fertilizers by using 20% pigeon manure tea + 20% *Spirulina plantensis* algae in order to improve nutritional status and fruit physic-chemical properties of Succkary mango trees.

REFERENCES

A.O.A.C. (2000). Association of Official Agriculture Chemists. Official Methods of Analysis 17th Ed. Gaithersburg, MD, USA. pp 494-510.

Abd El-Aal, A.H.M.; Selim, B.M. and Shaker, S.H. (2007). Response of Superior grapevines to application of filter mud, compost El-Nile and green manure. J. Agric. Sci. Mansoura Univ. 32 (12):10300-10309.

Abd El-Hamid, S.A. and El-Shazly, M.M. (2019). Response of mango trees to organic and biofertilization in North Sinai. Egyptian J. Desert Res., 69 (1): 39-66.

Abd EL-Moniem, E.A.A. and S.M.A. Radwan, (2003). Response of Williams banana plants to biofertilization in relation to growth, productivity and fruit quality. Arab Univ. J. Agric. Sci. 11(2):751- 763.

Abdel Gawad, N.M.A. (2016). Effect of Organic Compost Tea and Humic Acid to Reduce Dose of NPK Fertigation of Banana Plants cv."Grand Nain". Egypt. J. Hort. 43(2): 195-210.

Abou El-Khashab, A.M. (2003). Growth and chemical constituents of some olives cultivars as affected by biofertilizers and different water regimes. Egypt J. Agric. Res., 1 (2):243-265

Annual Reports of Statistical and Agricultural Economics in Arab Republic of Egypt, **(2018)**.

Baiea, M.H.M. and EL-Gioushy, S.F (2015). Effect of some Different Sources of Organic Fertilizers in Presence of Bio-fertilizer on Growth and Yield of Banana cv. Grande Naine plants. Middle East J. Agric. Res. 4(4): 745-753.

Barakat, M.R.; El-Kosary, S. and Abd-ElNafea, M.H. (2011). Enhancing Williams banana cropping by using some organic fertilization treatments. Journal of Horticultural Science & Ornamental Plants 3(1): 29-37.

Buurman, B.; Van-Lagen, B. and VeVelthorst, E.J. (1996). Manual for soil and water analysis. Backhuys Publishers Leiden. Pp 314 pags.

Colla, L.M.; Reinehr, C.O.; Reichert, C.; Costa, J.A.F. (2007). Production of biomass and nutracelutical compounds by Spriulina plantensis under different temperature and nitrogen regions. Bioresource Technology, 98(7): 1489-1493.

Chang, E.H.; Chung, R.S. and Tsai, Y.H. (2007). Effect of different application rates of organic fertilizer on soil enzyme activity and microbial population. Soil Science and Plant Nutrition. 53, 132-140.

De-Oliveira, L.M.; De-Oliveira, A.M.F.; Rocha, R.H.C.; Dias, G.A.; Teodósio, A.M.B.; De-Lima, J.F.; Barbosa, L.D.S. and Guedes, W.A. (2020). Spirulina platensis coating for the conservation of pomegranate. AIMS Agric. & Food 5(1): 76-85.

EL-Boray, M.S.; Mostafa, M.F.; Shaltout, A.D. and Hassan, K.H. (2015). Influence of fulvic acid plus some microelements and microorganisms on yield and quality characteristics of Flame seedless grapevines. J. Plant Production, Mansoura Univ., Vol. 6 (3):287 -305.

El-Khafagy, H.A. (2013). Physiological study on productivity and quality of some grape varieties under bio organic fertilization. Ph.D, Thesis community serving and Environmental studies Institute. Sadat City, Minufiya Univ. Egypt.

El-Khawaga, A.S. (2011). Partial replacement of mineral N fertilizers by using humic acid and Spirulina plantensis algae biofertilizers in Florida prince peach orchards. Middle East J. of Applied Sci., 1(1): 5-10.

EL-Kholy, M.F.A., (2004). A mitigation chemical fertilizers on banana yield by using biofertilizer (EM). PhD. Thesis, Fac. Agric. Ain shams Univ., Cairo, Egypt.

El-Shenawy, F.E. and Fayed, T.A. (2005). Evaluation of the convential to organic and bio-fertilizers on Crimson seedless grapevine in comparison with chemical fertilization. 2-Yield and fruit quality. Egypt. J. Appl. Sci., 20(1): 212-225.

Eman, E.K.; Abd-Ella, E.E.K.; Mervate, S.S. and Wafaa, A.Z. (2010). Effect of Some Organic and Mineral Fertilizer Applications on Growth and Productivity of Pomegranate Trees. Alexandria Sci. Exchange J. 31(3): 296-304.

Gad-El-Kareem, M.R. (2009): Response of Swelling and Floridaprince peach trees to application of some rest-breaking chemicals as well as organic and biofertilization under Sohag conditions. Ph.D. Thesis. Fac. of Agric. Minia Univ. Egypt.

Hagag, L.F.; Abd El-Migeed, M.M.M.; Shahin, M.F.M.; Mahdy, H.A El-Hady, E.S. (2018). Impact of organic fertilizer and bio-stimulating substances in maximizing productivity and fruit quality of cv. "Cyprus" olive trees. Bioscience Research 15(4): 3262-3269.

Hasan, S.S.A. (2015). influence of reducing mineral nitrogen fertilizer partially by using plant compost enriched with Spirulina plantensis algae on fruiting of Flame seedless grapevines. Ms.C. Thesis, Fac. of Agric. Minia Univ., Egypt.

Ibrahim, H.I.M.; Mansour, A.E.M. and Merwad M.A. (2015). Impact of Spraying some Organic Manure Tea, Seaweed Extract and Royal Jelly on Fruiting of Keitte Mango Trees. Intern. J. of ChemTech Res., 8(4): 2131:2141.

Ibrahim, H.I.M.; Mohamed, A.Y. and Hassan E.M. Ibrahim, H.E.M. (2019). Using Carboxylic Enriched with Carboxylic Calcium, Algae Extract, and Glycine to Promote Yield and Fruit Quality of Williams Banana Plants. New York Sci. Journal, 12(1): 17-29.

Ibrahim, H.I.M.; Zaglol, M.M.A. and Hammad, A.M.M. (2009). Response of Balady Guava Trees Cultivated in Sandy Calcareous Soil to Biofertilization with Phosphate Dissolving Bacteria and or VAM Fungi. J. of American Sci. USA. 9 (2): 73-85.

Kulk, M.M., (1995). The potential for using Cyanobacteria (blue-green algae) fungi. European J.Plant Pathol., Vol. 10 pp. 585-599.

Litterick, A.M.; Harrier, L.; Wallace, P.; Waston, C.A. and Wood, M. (2004). The role of uncomposted materials, compost, manures and compost extracts in reducing pests and diseases incidence and severity in sustainable temperate agricultural and horticultural crop production. Plant Science, 23 (6): 453-479.

Madany, M.H.G. (2017). Response of Succary mango trees to foliar application of glutathione and boric acid. Master of Since Fac. of Agric. Minia Univ. Egypt

Mahran, M.K. (2005). Response of White Banaty grapevines to fertilization with organic and

biofertilizers as well as spraying with ascobin. Ph.D. Thesis, Fac. of Agric. Minia Univ., Egypt.

Marschner, H. (1995): Mineral nutrition of higher plants. Second Edition, Paston press Ltd, Londdon, New York. pp 889.

Martin-Préval, P.; Gagnard, J. and Gautier, P. (1984). L'analyse végétale dans le contrôle de l'alimentation des plantes tempères et tropicales. 2nd Ed. pp 810. Technique et Documentation – Lavoisier, Paris, France.

Marzouka, H.A. and Kassem, H.A. (2011). Improving fruit quality, nutritional value and yield of Zaghloul dates by the application of organic and/or mineral fertilizers. Scientia Horticulture. 127: 249–254

Mostafa, M.; El-Boray, M.S.S.; Abd El-Wahab, A.F. and Barakat, R.A. (2009). Effect of enriched compost tea on Washington navel orange trees. J. Agric. Sci. Mansoura Univ., 34 (10): 10085-10094.

Price, M. and Nathan Duddles, N. (1984). Manure tea preparation, Research report. ECHO Technical Notes | TN #7 Manure Tea: Research Report (1984).

Onias, E.A., Rocha, R.H.C., Lima, J.F. (2016). Organic Tommy Atkins mango postharvest quality when treated with biofilms enriched by Sprolina plantensis. Rev. Cientifica, 44: 286-293.

Ranganna, S. (1985). Manual analysis of fruit and vegetable products. Edition Tata Mc Grow-Hill Publishing Company, New Delhi India, 634 P.

Roussos, P.A. (2011). Phytochemicals and antioxidant capacity of orange (*Citrus sinensis* L) Osbeck cv. Salustiana) juice produced under organic and integrated farming system in Greece. Scientia Horticulturae. 129(2): 253-258.

Russo, R.O. and Berlyn, G.P. (1990). The use of organic biostimulants to help low input sustainable agriculture. J. Sustainable Agric., 1(2):19-42.

Sau, S., Mandal, P.; Sarkar, T.; Das, K. and Datta, P. (2017). Influence of biofertilizer and liquid organic manures on growth, fruit quality and leaf mineral content of mango cv. Himsagar Journal of Crop and Weed, 13 (1): 132-136.

Snedecor, G.W. and Cochran, W.G. (1990). Statistical Methods, 7th Ed. The Iowa State Univ. Press Ames. pp 80-100.

Trankner, A. (1992). Use of agricultural and municipal organic wastes to develop supper siveness to plant pathogens. p. 35-42. In: E.C. Tjamos, G.C. Papavizas, and R.J. Cook (ed.) Biological Control of Plant Diseases: Progress and Challenges for the Future. NATO ASI Series No. 230. Plenum Press, New York, NY.

Vazquez, O.J.A. and Lopez, A.D.K. (2012). Sensory and physic-chemical quality of banana fruits (Grande naine) grown with biofertilizer. African J. of Agric., Res. 7 (33): 4620-4626.

Vonshakl A.; Torzillo, G. and Loisa Tomaseli (1994). Use of chlorophyll fluorescence to estimate the effect of photoinhibition in outdoor cultures of *Spirulina platensis*. J. of Applied Phycology 6: 31-34.

Weltzein, H.C. (1989). Some effects of composted organic materials on plant health. Agric., Ecosystems & Environ. Vol. 27: 439 446.

Wilde, S.A; Corey, R.R.; Layer, J.G. and Voigt, G.K. (1985). Soil and plant Analysis for tree culture. Oxford and IBH publishing Co., New Delhi, India pp. 10-120.

RESEARCH ARTICLE

Effect of pigeon manure tea and *Spirulina plantensis* algae on nutritional status and fruit quality of succkary mango trees

Authors' contributions

Author details: Hamdy I.M. Ibrahim; Ali H. Ali and Mahmoud H.G. Madany,
Hort. Dept. (Pomology), Fac. of Agric., Minia Univ., **Egypt**.

Funding: NA

Ethics approval and consent to participate: Not applicable

Consent for publication: Not applicable

Competing interests

The authors declare that they have no competing interests.

Received: 5 Feb. 2022 **; Accepted:** 7 March 2022