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Partial Replacement of Mineral NPK by Organic and Bio-Fertilizers of Fagri Kalan Mango Trees

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Abstract: This study was carried out during 2016 and 2017 seasons on mango trees cv. Fagri Kalan grown in the Research and Production Station Orchard, El-Nobaria region, Behera Governorate, Egypt. Twenty-one trees of 13 years old, planted at 5×5 m apart in a sandy soil under drip irrigation system were carefully selected as being healthy, disease free and uniform as possible in their vigour and size to investigate the possibility of replacing the expensive mineral NPK fertilizers commonly adopted in the region with other cheaper and environment friendly alternative sources by organic (compost) and bio-organic fertilizers through the response of vegetative growth, leaf mineral contents, some fruiting aspects and fruit quality. Data obtained displayed that the investigated growth measurements and leaf N, P, K contents as well as fruiting aspects and fruit quality responded obviously to the treatments and followed to great range the same trend. Herein, the greatest values of the abovementioned were significantly coupled with the trees subjected to T1- 100% chemical N, P and K. Moreover, T2- 75 % chemical + 25% organic and T5- 75 % chemical + 25% bio-organic treatments both showed significantly the same effectiveness as they resulted and came statistically the second in this regard. On the contrary, the least values of aforesaid parameters were usually in concomitant to T4- 25 % chemical + 75 % organic.

Key words: Mango · Fagri Kalan · Compost · Bio-organic · Fruiting aspects and Quality

INTRODUCTION

Mango (*Mangifera indica* L.) belongs to the family Anacardiceae. It's grown in the hot tropical regions of the world and used as staple food for most of the population in these areas. Mango fruit contains many vitamins such as C and B6, as well as many beneficial minerals to the human body such as potassium and magnesium. In addition, it contains proteins, lipids, malic acid and citric acid.

Fagri Kalan tree is characterized by strong vegetative growth and leaves density. The fruit is sweet, fibers free and the pulp/seed ratio is high. Fruit is weighing around 700 to 1000 gm, tolerant to storage & transportation and late in maturity.

Continuous use of chemical fertilization leads to deterioration of soil characteristics and fertility and accumulation of heavy metals in plant tissues, affecting the fruit nutritional value and edibility [1]. There is a general agreement that nutrition is one of the most effective factors affecting tree growth, yield and fruit quality. However, the high cost of mineral fertilization is a big problem facing fruit tree growers. In addition, the recent research revealed that mineral fertilizers have a role in the health problems and environmental pollution [2, 3].

Organic fertilizer improves physical, chemical and biological properties of nearly all soil types; adjusting soil pH and increasing solubility production of the plants [4]. Youssef *et al*. [5] and Abou-Hussein *et al*. [6] revealed that, the addition of organic fertilizer (compost) to the soil encouraged proliferation of soil microorganisms, increased microbial population and activity of microbial enzymes i.e. dehydrogenaze, urease and nitrogenase.

Bio-fertilizers are with great importance for plant production and soil as they play an important role in increasing vegetative growth, yield and fruit quality [7].

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The hoped objective by mango growers is to increase the net income. Such goal could be achieved through increasing productivity accompanied with higher fruit quality from one side and minimizing cost of the needed orchard practices especially those related to fertilization from the other side. Hence, building a strong tree canopy structure is considered as a real surety for realizing such factors, which related to increasing productivity and fruit quality. Moreover, lowering mango production cost using cheaper alternative sources especially those having an economical and environment friendly bio-fertilizers substances is the second reason by which the expected final goal could be achieved.

Therefore, the present work is mainly aims to investigate the possibility of reducing the use of high cost chemical fertilizers which directly impacts on human health by other cheaper alternatives and environment friendly such as bio-fertilizers and organic fertilizers which may lead to a lack of productivity and quality. However, it is cheaper, environment friendly, slow releasing fertilizers and does not affect human health. Therefore, the current mineral fertilization program relied in the region compared to organic and bio-fertilizers either alone or accompanied by the other alternatives were investigated in this regard.

MATERIALS AND METHODS

This study was carried out during 2016 and 2017 seasons on mango trees cv. Fagri Kalan grown in Research and production Station orchard at El-Nobaria region, Behera Governorate, Egypt. Twenty-one Fagri Kalan mango trees of 13 years old, planted at 5×5 m apart in a sandy soil under drip irrigation system were carefully selected as being healthy, disease free and uniform as possible in their vigour and size, to study the effect of mineral (NPK), organic (compost) and bio-fertilizers on vegetative growth, leaf chemical constituents, fruiting aspects and fruit quality. All devoted trees received regularly the same horticultural practices (irrigation, pest control, pruning etc.,) adopted in the region's mango orchards. Complete randomized block design with three replications (each replicate was represented by a single tree) was used for arranging the following seven spray treatments:

T1: Control; full dose of chemical fertilizer (100 % NPK).
T2: 75% chemical NPK + 25% organic.
T3: 50 % chemical NPK + 50% organic.
T4: 25% chemical NPK + 75% organic.
T5: 75% chemical NPK + 25% bio-organic.
T6: 50 % chemical NPK + 50% bio-organic.
T7: 25% chemical NPK + 75% bio-organic.

Taking into consideration that, 25% organic = 1 ton compost /feddan, 50% organic = 2 ton compost /feddan and 75% organic = 3 ton compost/feddan. Meanwhile, 25% bio-organic = 0.5 ton compost /feddan + bio-NPK, 50% bio-organic = 1.5 ton compost /feddan + bio-NPK and 75% bio-organic = 2.5 ton compost /feddan + bio-NPK,

Table A: Physical and chemical properties of the investigated soil.

Properties	Value	Properties	Value
Clay %	5.00	P %	0.44
Silt %	5.00	K %	0.57
sand %	90	Ca mg/L	2.65
Texture	Sandy	Mg mg/L	2.40
PH	8.2	HCO_3 mg/L	3.85
EC	1.5	Cl mg/L	53
N%	Trace	SO_4 mg/L	55.65

Table B: Analysis of the used composted material.

Analysis	Value	Analysis	Value
M3 weight	792 kg	Total P%	0.7
Moisture %	31	Total K%	1.35
PH (1:10)	8.9	Total Ca%	1.80
EC (ds/m)	3.41	Total Mg%	0.93
Organic matter	35.6	Total Fe (ppm)	1115
C/N ratio	17.6	Total Mn (ppm)	119.7
Organic carbon %	26.4	Total Zn (ppm)	31.5
Total N%	1.7	Total Cu (ppm)	17.90

Rate and Application Method of Chemical Fertilizers (NPK): Four rates of chemical fertilizers NPK were employed in this study. The first rate was 100 % of NPK (210, 50 and 150 g per tree, respectively). The second rate was 75 % of NPK (157.5, 37.5 and 112.5 g per tree, respectively). The third rate was 50 % of NPK (105, 25 and 75 g per tree, respectively). The fourth rate was 25 % of NPK (52.5, 12.5 and 37.5 g per tree, respectively). The chemical fertilizers were added into two equal doses at the first week of February and two weeks later of fruit set through drip irrigation system during 2016 & 2017 experimental seasons. Moreover, Ammonium nitrate (NH_4NO_3, 33.5 % N), phosphoric acid (H_3PO_4, 80 % P_2O_4) and potassium sulfate (K_2SO_4 - high soluble 50 % K_2O) were used as a source of N, P and K.

Rate and Application Method of Organic Manure (Compost): Three rates of compost were employed in this study (75 %, 50 % and 25 %) at 3, 2 and 1 tons per feddan, respectively which equivalent to the same quantities delivered by using (75 %, 50 % and 25 %) mineral NPK fertilizers and added at the beginning of December in the

two seasons. One trench (100×50×50 cm) was excavated on one side of the tree, then, the given amount of compost as a part of the soil surface were mixed together and added to the chuck hole and followed by irrigation.

Rate and Application Method of Bio-Organic Fertilizers: A mixture of three types of bio-fertilizers (equal amounts for each) was investigated throughout this study. These types namely:

Phosphorene: A commercial phosphor bio-fertilizer, which contains some active fungi strains (*Arbuscalar mycorrhiza*).

Nitrobein: A commercial nitrogen bio-fertilizer contains special bacteria (*Azotobacter choroccocum*)

Potassein: A commercial potassium bio-fertilizer contains special bacteria (*Bacillus pasteurii*).

Each of the three abovementioned bio-fertilizers was added in soil (15 cm depth) to the wetted compost in one dose in early December at the rate of 8 Kg per feddan, plus, compost after decreasing its quantities from 3, 2 and 1 ton/feddan to the rates 2.5, 2.0 and 0.5 ton per feddan, respectively.

Measurements and Analyses: The effect of different investigated spray treatments was evaluated through the response of the following measurements:

Vegetative Growth Parameters: On each tree, at 2nd week of July, four main branches (limbs/scaffolds) similar in their vigour and well distributed around its periphery (each towards one geographic direction) were carefully selected and labeled. Then, twelve spring cycle shoots (three per every labeled limb) were selected to determine the following growth measurements:

Number of new shoots, shoot length (cm), shoot diameter (cm), number of leaves\shoot and leaf area (cm^2) according to Ahmed and Morsy [8] using the following equation: Leaf area (cm^2) = 0.70 (leaf length x leaf width) - 1.06.

Leaf N, P and K Contents: Total leaf N, P and K content as percentages in dry matter of leaf samples at the 2nd week of July during both seasons were determined as follows:

Total nitrogen content of dried leaf samples was determined by the modified Micro-Kjeldahl method as described by Pregl [9].

Total leaf phosphorus content was determined using a spectrophotometer at 882-OVV according to the method described by Murphy and Riely [10].

Total leaf potassium content was determined using the atomic absorption (3300) according to Jackson and Ulrich [11] and Chapman and Pratt [12].

Fruiting Aspects: At full bloom forty panicles/ tree distributed at the four directions were randomly chosen and tagged. The following parameters were determined:

Initial fruit set was determined as the number of setting fruits per panicle two weeks after fruit setting or petal drop at 1st week of April for both seasons according to Shaban [13].

Fruit retention percentage was recorded at mature stage (a week before harvest) by the following equation: Fruit retention percentage = (number of mature fruit per panicle / initial number of fruit set per panicle) X 100.

Number of Fruit/Tree: At fruit maturity stage (1st week of September), the total number of fruits that were born on each considered tree was counted and recorded.

Yield (Kg/tree): At harvesting time, fruits of each individual tree (replicate) were counted and weighed in g, then yield was expressed as fresh fruit weight as Kg/tree.

Fruit Quality: Five mature fruits were randomly sampled from those harvested ones per each tree for determining the following fruit physical and chemical properties:

Fruit Physical Characteristics: Such as average fresh weights of the whole fruit, pulp, peel and stone (seed) in grams were determined. Besides, pulp/fruit ratio was also estimated and fruit firmness ($lb/inch^2$) which was determined using penetrometer (pressure tester).

Fruit Chemical Characteristics: Samples of fruit juice were used to determine the total soluble solids percentage (TSS %) using hand refractometer and total sugars as (g/100 g fresh weight) after method described by Smith *et al*. [14]. Moreover, total acidity as a percentage of citric and malic acids was determined according to A.O.A.C [15]. Fruit ascorbic acid (V. C.) content as milligrams ascorbic acid/100 ml juice was determined according to A.O.A.C [15].

Statistical Analysis: The obtained data in both seasons were statistically analyzed using analysis of variance

method according to Snedecor and Cochran [16]. However, means were distinguished by the Duncan's multiple range tested Duncan [17].

RESULTS AND DISCUSSION

Vegetative Growth Measurements: In this regard, number of new shoots of each tagged main branch, average shoot length & diameter, number of leaves per shoot and average leaf area were the investigated growth parameters in response to the differential mineral, organic and bio-organic fertilizer treatments. Data obtained during both 2016 and 2017 experimental seasons are presented in Table (1). Herein, the differential investigated treatments showed obviously a considerable variation in this respect. Anyhow, the greatest values of the abovementioned were significantly coupled with the trees subjected to T1- 100 % chemical N, P and K. Moreover, T2- 75 % chemical + 25 % organic and T5- 75 % chemical + 25 % bio-organic treatments both significantly showed the same effectiveness as they resulted and came statistically second in this concern during both experimental seasons, respectively. On the contrary, the least values of vegetative growth parameters were usually in concomitant to T4- 25 % chemical + 75 % organic, which ranked statistically last during both 2016 and 2017 experimental seasons. On the other hand, four other investigated treatments were in between the aforesaid two extremes in spite of T7- 25 % chemical + 75 % bio-organic was relatively the least effective one as compared to the other members of such intermediate category.

Leaf Mineral Composition: In this regard, leaf N, P and K contents of Fagri Kalan mango trees as an indicator for nutritional states of trees which influenced by the differential investigated treatments were the concerned leaf mineral composition under study. Data obtained during both 2016 & 2017 experimental seasons are presented in Table (2). Herein, T1- 100 % chemical N, P and K was statistically the superior in this concern during both seasons of study. Moreover, T5- 75 % chemical + 25 % bio-organic ranked statistically 2nd after the aforesaid superior treatment. Other investigated treatments could be descendingly arranged pertaining their efficiency as follows: T2- 75 % chemical + 25 % organic, T6- 50 % chemical + 50 % bio-organic and T3- 50 % chemical + 50 %organic. Such trend was true during both 2016 and 2017 experimental seasons.

Some Fruiting Aspects: In this regard, percentages of both fruit set & retention and tree productivity (No. of fruits/tree, fruit weight and yield/tree) were the investigated fruiting parameters for Fagri Kalan mango trees pertaining their response to the differential application treatments. It is quite evident as shown from tabulated data in Table (3) that, T1- 100 % chemical N, P and K surpassed statistically all other treatments during both 2016 & 2017 experimental seasons. However, T2- 75 % chemical + 25 % organic and/or T5- 75 % chemical + 25 % bio-organic particularly in the second season ranked statistically second after the superior one (T1). On the contrary, T4- 25 % chemical + 75 % organic was significantly the inferior, whereas, the least value in this regard was observed during both seasons of study. In addition, the other investigated treatments were in between the aforesaid two extremes with a noticeable degree of efficiency linked with T6- 50 % chemical + 50 % bio-organic for increasing the abovementioned parameters compared to the analogous members of such intermediate treatments during 2016 & 2017 experimental seasons.

Fruit Quality

Fruit Physical Properties: In this regard, fruit firmness, pulp weight, peel weight, seed weight and pulp/fruit ratio were the evaluated fruit physical properties of Fagri Kalan mango cv. in response to the differential investigated mineral, organic and bio-organic fertilizer treatments. Data obtained during both 2016 & 2017 experimental seasons are presented in Table (4). It is quite evident as shown from tabulated data that T1- 100 % chemical N, P and K was statistically the superior and showed the greatest values in this concern during 2016 & 2017 experimental seasons. Whereas, differences between T2- 75 % chemical + 25 % organic and T5- 75 % chemical + 25 % bio-organic were too little to be taken into consideration from the statistic stand point and ranked statistically second in this regard. Anyhow, the least values in fruit physical properties were significantly in concomitant T4- 25 % chemical + 75 % organic and T7- 25 % chemical + 75 % bio-organic during 2016 and 2017 experimental seasons, respectively. In addition, two other investigated nutritive compound treatments i.e., T3- 50 % chemical + 50 % organic and T6- 50 % chemical + 50 % bio-organic were in between the aforesaid two extremes. Such two intermediate nutritive compound treatments significantly didn't differ as compared to each other, in spite of statistically varying as compared to the abovementioned superior and inferior treatments during two experimental seasons.

Table 1: Effect of partial replacement of mineral NPK fertilizers by using organic and bio-organic fertilizers on some vegetative growth parameters of Fagri Kalan mango trees

	No. of new shoots		Shoot length (cm)		Shoot thickness (mm)		No. of leaves/shoot		Leaf area (cm^2)	
Treatments	2016	2017	2016	2017	2016	207	2016	2017	2016	2017
T1- 100% chemical N, P and K	9.33 a	10.00 a	48.67 a	47.67 a	12.33 a	13.67 a	35.33 a	37.00 a	73.00 a	72.33 a
T2- 75 % chemical + 25% organic	7.67 b	8.33 bc	43.67 b	43.67 b	10.67 b	11.00 b	30.00 b	32.67 b	66.33 c	68.33 b
T3- 50 % chemical + 50 % organic	6.33 cd	7.67 cd	41.00 d	42.00 c	10.00 bc	11.67 b	24.67 d	29.33 c	63.67 d	62.33 d
T4- 25 % chemical + 75 % organic	7.33 d	6.67 ef	36.33 e	36.67 f	8.67 de	9.66 c	21.67 e	26.33 d	60.00 f	59.33 e
T5- 75 % chemical + 25% bio-organic	7.33 bc	8.67 b	42.67 bc	43.00 b	10.67 b	11.33 b	27.33 c	31.67 b	69.00 b	68.67 b
T6- 50 % chemical + 50 % bio-organic	6.33 cd	7.33 de	41.67 cd	39.67 d	9.33 cd	9.66 c	24 d	28.67 c	61.67 e	64.66 c
T7- 25 % chemical + 75 % bio-organic	5.67 d	6.33 f	37.67 e	38.33 e	8.00 e	8.33 d	22 e	27 d	57.33 g	58.33 f

Means followed by the same letter/s within each column didn't significantly differ at 5% level

Table 2: Effect of partial replacement of mineral NPK fertilizers by using organic and bio-organic fertilizers on some leaf mineral contents of Fagri Kalan mango trees

	N%		P%		K%	
Treatments	2016	2017	2016	2017	2016	207
T1- 100% chemical N, P and K	1.350 a	1.373 a	0.363 a	0.363 a	1.103 a	1.130 a
T2- 75 % chemical + 25% organic	1.197 b	1.230 b	0.307 c	0.330 b	1.053 c	1.076 b
T3- 50 % chemical + 50 %organic	1.157 cd	1.197 c	0.280 d	0.307 c	1.023 e	1.056 c
T4- 25 % chemical + 75 %organic	1.117 e	1.153 e	0.233 f	0.257 e	0.98 g	0.996 d
T5- 75 % chemical + 25% bio-organic	1.250 b	1.243 b	0.323 b	0.340 b	1.066 b	1.086 b
T6- 50 % chemical + 50 % bio-organic	1.173 c	1.207 d	0.277 d	0.293 d	1.04 d	1.043 c
T7- 25 % chemical + 75 % bio-organic	1.150 d	1.183 e	0.253 e	0.266 e	0.993 f	0.996 d

Means followed by the same letter/s within each column didn't significantly differ at 5% level.

Table 3: Effect of partial replacement of mineral NPK fertilizers by using organic and bio-organic fertilizers on some fruiting aspects parameters of Fagri Kalan mango trees

	Initial fruit set		Fruit retention %		No. of fruits /tree		Fruit weight (g)		Yield/tree (Kg)	
Treatments	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
T1- 100% chemical N, P and K	11.83 a	12.67 a	2.27 a	2.42 a	58.33 a	59.67 a	515.33 a	516.66 a	30.06 a	30.83 a
T2- 75 % chemical + 25% organic	9.67 b	12.00 ab	1.98 b	2.13 b	55.00 b	59.33 b	498.00 b	514.00 b	27.39 b	30.50 a
T3- 50 % chemical + 50 % organic	7.67 cd	10.337 c	1.82 cd	2.04 bcd	49.00 c	55.00 c	484.33 cd	503.33 c	23.73 c	27.69 c
T4- 25 % chemical + 75 % organic	6.33 e	8.33 d	1.73 d	1.95 d	46.33 d	50.00 d	475.00 e	492.33 d	22.01 d	24.62 d
T5- 75 % chemical + 25% bio-organic	9.13 b	11.00 bc	2.01 b	2.11 bc	54.33 b	58.33 b	499.00 b	507.67 bc	27.11 b	29.61 ab
T6- 50 % chemical + 50 % bio-organic	8.67 bc	10.00 c	1.86 c	1.99 cd	49.33 c	55.00 c	490.67 bc	501.67 c	24.21 c	27.59 c
T7- 25 % chemical + 75 % bio-organic	6.83 de	8.33 d	1.77 cd	1.95 d	47.33 d	50.00 d	477.00 de	489.67 d	22.58 d	24.48 d

Means followed by the same letter/s within each column didn't significantly differ at 5% level.

Table 4: Effect of partial replacement of mineral NPK fertilizers by using organic and bio-organic fertilizers on some fruit physical properties of Fagri Kalan mango trees

	Fruit firmness ($Lb/inch^2$)		Pulp weight (g)		Peel weight (g)		Seed weight (g)		Pulp/fruit ratio	
Treatments	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
T1- 100% chemical N, P and K	2.323 a	2.287 a	416.00 a	421.00 a	63.33 a	64.67 a	40.00 c	37.67 c	0.801 a	0.804 a
T2- 75 % chemical + 25% organic	2.223 b	2.223 b	394.67 bc	414.00 ab	62.66 a	59.87 b	40.67 bc	40.13 bc	0.793 b	0.805 a
T3- 50 % chemical + 50 % organic	2.167 c	2.117 d	383.67 de	404.67 c	59.16 bc	58.87 cd	41.50 ab	39.80 bc	0.792 b	0.804 ab
T4- 25 % chemical + 75 % organic	2.067 e	2.033 e	375.33 e	392.67 d	58.33 c	58.17 de	41.33 ab	41.50 ab	0.790 b	0.798 bc
T5- 75 % chemical + 25% bio-organic	2.213 b	2.177 c	398.67 b	407.00 bc	59.33 b	59.67 bc	41.00 ab	41.00 ab	0.799 a	0.802 ab
T6- 50 % chemical + 50 % bio-organic	2.150 d	2.107 d	389.66 cd	403.00 c	59.33 b	57.337 e	41.67 a	41.33 ab	0.794 b	0.803 ab
T7- 25 % chemical + 75 % bio-organic	2.037 f	1.983 f	378.66 e	388.00 d	58.33 c	58.67 d	40.00 c	43.00 a	0.794 b	0.792 c

Means followed by the same letter/s within each column didn't significantly differ at 5% level

Table 5: Effect of partial replacement of mineral NPK fertilizers by using organic and bio-organic fertilizers on some fruit chemical properties of Fagri Kalan mango trees

	T.S.S %		Total sugars %		Total Acidity %		TSS/Acid ratio		Ascorbic acid	
Treatments	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
T1- 100% chemical N, P and K	18.03 a	18.12 a	12.83 a	12.91 a	0.623 a	0.610 a	28.77 d	29.72 f	35.31 d	32.99 e
T2- 75 % chemical + 25% organic	17.30 b	17.37 b	12.27 b	12.08 b	0.536 b	0.563 b	32.25 cd	30.87 e	37.09 c	35.57 d
T3- 50 % chemical + 50 % organic	16.71 d	17.15 c	11.67 c	11.53 c	0.523 b	0.487 d	33.05 c	35.26 c	38.42 b	37.53 c
T4- 25 % chemical + 75 % organic	16.28 e	16.35 e	11.12 d	11.19 d	0.437 c	0.440 f	37.35 ab	37.20 b	37.21 c	37.31 c
T5- 75 % chemical + 25% bio-organic	17.36 b	17.46 b	12.27 b	12.21 b	0.520 b	0.547 c	33.41 bc	31.97 d	39.79 a	38.31 b
T6- 50 % chemical + 50 % bio-organic	16.95 c	17.04 d	11.59 c	11.46 c	0.490 bc	0.473 e	34.63 abc	36.07 c	40.34 a	39.99 a
T7- 25 % chemical + 75 % bio-organic	16.08 f	16.22 f	10.95 d	11.02 e	0.427 c	0.413 g	37.74 a	39.31 a	37.98 bc	38.11 b

Means followed by the same letter/s within each column didn't significantly differ at 5% level

Fruit Chemical Properties: In this regard, fruit juice total soluble solids (TSS %), total sugars %, total acidity %, TSS/acid ratio and ascorbic acid (vitamin C) contents were the five investigated fruit juice chemical properties for Fagri Kalan mango cv. regarding their response to the evaluated bio and organic fertilizer treatments. Data obtained during both experimental seasons as shown in Table (5) displayed that, the highest fruit juice TSS % and total sugars % were markedly coupled with T1- 100% chemical N, P and K during both seasons. Moreover, T2- 75 % chemical + 25 % organic and T5- 75 % chemical + 25 % bio-organic ranked statistically second as the influence on fruit juice TSS % and total sugars %. The reverse was true with T4- 25 % chemical + 75 % organic and T7- 25 % chemical + 75 % bio-organic, which induced significantly the poorest fruits in their TSS % and total sugars content during both experimental seasons.

Moreover, it is quite evident that acidity percentage decreased by all investigated treatments of applied organic and bio-organic fertilizers as compared to T1- 100 % chemical N, P and K during both experimental seasons. However, the highest rate of decrease over T1- 100% chemical N, P and K was significantly detected by T7- 25 % chemical + 75 % bio-organic and T4- 25 % chemical + 75 % organic during both seasons, respectively. On the other side, four other investigated bio and organic nutritive compound treatments were less effective with a variable degrees of response and varied from one season to another either compared to each other or to T1- 100 % chemical N, P and K. Such trend may be attributed to the relative delaying in fruit maturation exhibited by increasing both fruit weight and size induced by 100 % chemical fertilizer treatment, which previously discussed with fruit physical properties.

However, the total soluble solids/total acidity ratio (TSS/Acid ratio) was slightly influenced by the different investigated treatments. Such response was relatively higher and reached level of significance with only T7- 25 % chemical + 75 % bio-organic and T4- 25 % chemical + 75 % organic. On the other hand, no considerable differences were observed with comparing the other five treatments to T1- 100 % chemical N, P and K. Anyhow, such trend of response (relative lower differences in fruit juice TSS/Acid ratio to various investigated treatments) could be logically explained depending upon the paralleled rates of changes exhibited in both fruit juice TSS and total acidity parameters to a given investigated treatment.

In addition, all investigated organic & bio-organic treatments increased fruit juice vitamin C (ascorbic acid) content compared to T1- 100 % chemical N, P and K. The highest fruit vitamin C content was markedly coupled with T6- 50 % chemical + 50 % bio-organic during both seasons. Moreover, T5- 75 % chemical + 25 % bio-organic ranked statistically second in this regard. Meanwhile, the reverse was true with T1- 100 % chemical N, P and K, which induced significantly the poorest fruits in their vitamin C content during experimental seasons.

The present results regarding the great benefit of NPK bio-fertilizers application on stimulating different growth parameters of Fagri Kalan mango trees, went in line with those found by several investigators i.e., Fawzia-Eissa [18], Kabeel *et al*. [3] on Canino apricot cv., Kabeel *et al*. [19] on Anna apple trees, Stino *et al*. [20] on Canino apricot cv., Osman and Abd El- Rahman [21] on Fig trees, Darwesh [22] on costata persimmon trees and El-Sharony [23] on fruitful mango trees cv. Fagri Kalan. All pointed out the suitability of some bio NPK fertilizers.

The present results are in general accordance with those previously found by Fawzia-Eissa [18], Kabeel *et al*. [3] Stino *et al*. [20] on Canino apricot cv., Osman and Abd El-Rahman [21] on Fig trees and Darwesh [22] on costata persimmon trees, EL-Gioushy [24] on Canino Apricot and EL-Gioushy [25] on young Manfalouty pomegranate trees.

These results are in accordance with those found by Jitendra Singh and Maurya [26] Ebeed *et al*. [27] and Ranjit Kumar *et al*. [28] who reported that, foliar application of mineral nutrients on Amrapali mango trees was the most effective treatment in increasing the number of mango fruits per tree. Also, Yadav *et al*. [29] found that, the organic nutrients (compost), inorganic fertilizer (NPK), bio-fertilizers and micronutrients (zinc and iron) enhanced the initial fruit setting of mango Amrapali cv.

These results agreed with Zaen El-Deen *et al*. [30] who reported that, the application of compost and monthly foliar application (from April to August) with anti-transpiration materials such as kaolin (aluminum silicate) and silicon (potassium silicate) on four years old mango trees (*Mangifera indica* var, Keitt), improved and enhanced fruit total sugar content.

CONCLUSION

In conclusion, it can be recommended that, the possibility of reducing high cost of chemical fertilizers (NPK) which directly impacts on human health by cheaper alternative and environment friendly such as organic and bio-organic fertilizers (3ton compost/feddan or 2.5ton compost /feddan + bio-NPK) which provided the best results on Fagri Kalan mango trees.

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