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Response of Mango Trees to Mineral, Bio-Organic Fertilizers and Growth Stimulants

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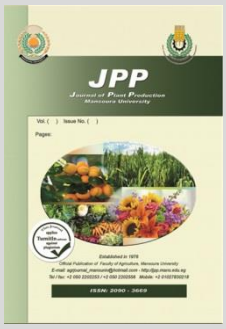

ABSTRACT

This investigation was carried out at privet farm, Ismailia Governorate during 2019 and 2020 seasons. The effect of mineral (NPK) soil application either alone or in combination with organic (compost), some soil bio-stimulants (Phosphorein, Nitrobein and Potasein) and foliar spray with potassium silicate at (5 ml/liter) and bento cide at 10 g/liter as growth stimulants were investigated through studying their effect on fruiting aspects and fruit characteristics of mango "Sedika cv." trees. Results showed that, all investigated NPK soil application in mineral form, organic (compost) fertilizers, bio-fertilizers and some foliar nutrients (Bento cide and potassium silicate) resulted in significant effect, however, the fertilization with NPK in mineral form at 50% level + organic (compost) fertilizer at 50% level coupled with either bento cide at 10 g/liter or potassium silicate at 5 ml/liter were the most effective treatments for increasing fruiting aspects and fruit characteristics of mango trees "Sedika" cv.

Keywords: Organic fertilizer – Compost - Bio-fertilizer - Potassium silicate – Bento cide – Mango.

INTRODUCTION

Mangoes (*Mangifera indica* L.) belong to family Anacardaceae, native to Southeastern Asia and considered one of the most important fruits of the tropical and sub-tropical countries. It is one of the most popular and favorite fruits because of its rich flavor, aroma, pleasant appearance, attractive fragrance, and delicious taste. It is the queen of fruits.

Mango trees were introduced to Egypt around year 1825 and ever since, its' cultivation has gradually expanded throughout the country and become one of the main fruits grown in Egypt. It ranks the third after citrus and grape. The total area harvested in Egypt reached to about 379366.25 feddans that produced about 1473538 tons/feddans (FAO, 2019).

Organic fertilizer improves physical, chemical, and biological properties of nearly all soil types; adjusting soil pH and increasing solubility production of the plants (Zhou *et al*., 2001).

The addition of organic fertilizer (compost) to the soil encouraged proliferation of soil microorganisms, increased microbial population and activity of microbial enzymes i.e., dehydrogenize, urease and nitrogenase (Youssef *et al.*, 2001 and Abou Hussein *et al.*, 2002). Some investigators studied the effect of organic manure application as compared with chemical fertilizer on different fruit crops, Wassel *et al.* (2015) on Ewaise mango trees; Al-Khawaga and Maklad (2013) on citrus and Mohamed *et al.* (2010) on pear, they reported that, under organic system soil biotic life increased as a result of the plant synthesis of more vitamins and amount of total sugars. Moreover, the addition of organic fertilizer is necessary for the best growth, greater yield and fruit quality when compared with mineral fertilizers.

Bio-fertilizers are the most valuable for plant and soil as contribute to increasing vegetative growth, yield and fruit quality (El-Khawaga, 2012 and Hasan *et al*., 2013) on mango. Also, Hassan and Abou-Rayya (2003) showed that, all bio-fertilizers (Nitrobein, Phosphorein, Biogein and Rhizobacterin at 10, 20, 30 g per tree) were effective in improving nutritional status of Anna apple trees.

Silicon, the second most abundant element in the earth's crust, has not yet received the title of essential nutrient for higher plants, as its role in plant biology is poorly understood (Epstein, 1999). Potassium silicate is a wellspring of profoundly solvent potassium and silicon. It is utilized in horticultural creation framework basically as a silica revision and has added the advantage of providing limited quantities of potassium (Tarabih *et al.* 2014) Silicon is likewise known to expand dry season resilience in plants by keeping up with plant water balance, photosynthetic action, erectness of leaves and design of xylem vessels under high happening rates (Melo *et al*., 2003; Hattori *et al*., 2005 and Gong *et al*., 2003).

Gad El-Kareem (2012) reported that, silicon application on Timour mango trees improving vegetative growth parameters.

Foliar spray of micronutrients helps in efficient utilization of nutrients to plants directly through leaves within few days we can realize the effect of micronutrient spray. Ranjit *et al*., (2008); Anees *et al.*, (2011) and Nafees (2011) found that foliar spray of micronutrients on mango trees significantly increase fruit quality, fruit yield and improving leaf mineral contents.

The main objective of this study, is to carry out a comparison between using organic manure (compost) or inorganic (NPK) fertilizer or the combination between them as a source of (NPK) soil fertilization, as well as foliar spray with potassium silicate and microelements

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(bento cide) as effective nutritive stimulants in order to know their effect on productivity of Sedika mango trees as well as adjusting the best NPK management that responsible for obtaining an economical and safety health yield as another desirable target.

MATERIALS AND METHODS

This investigation was carried out at privet farm, Ismailia Governorate during two successive 2019 and 2020 experimental seasons. Four-year-old mango trees of "Sedika cv." were the plant materials used in this investigation, planted at 5x5 meters separated (168 trees/feddan) in sandy soil under dribble water system framework. Thirty sex fruitful mango trees were selected and devoted for this search. Those trees were similar as well as they received the same culture managements adopted in ministry of agriculture. Physical and chemical analysis of orchard soil have been carried out prior to the first season according to the methods after Piper (1947) and Jackson (1967) as shown in Table (1).

Table 1. Physical and chemical analysis of the experimental orchard soil.

Physical characteristics (%)		Chemical characteristics	
Field capacity	11.77	$CaCO_3$ (%)	12.25
Available water	7.57	Organic matter (%)	0.08
Wilting point	4.20	pH	7.5
Coarse sand	67.08	EC (ds/m)	2.14
Fine sand	9.5	Ca (mg/100 g)	0.14
Silt	0.7	Na (mg/100 g)	0.34
Clay	5.2	K (mg/100 g)	0.16
Texture class	Sandy	Cl (mg/100 g)	0.30

This work included five investigated materials:

1- Chemical (mineral) fertilizers (NPK).
2- Organic fertilizer (compost).
3- Bio- fertilizers. 4- Potassium silicate.
5- Bento cide.

Rate and method of soil and spray application of the investigated materials will be summarized as follows:

The Application Method of Chemical fertilizers (NPK):

Two rates of chemical fertilizers NPK were employed in this study. The first rate was 100% of NPK (205.0, 50.0 and 145.0 g per tree, respectively) which regularly used as a chemical (mineral) fertilizer program recommended by the Ministry of Agriculture. The second rate was 50% of NPK (102.5, 25.0 and 72.5 g per tree, respectively).

The fertilizers were added into two equal doses at the 1st week of February and two weeks later of fruit set through drip irrigation system during both seasons of study. Ammonium nitrate (NH_4NO_3, 33.5 % N) at 612 g, mono Calcium phosphate (15.5 % P_2O_5) at 323 g and potassium sulphate (K2SO4- high soluble 50% K_2O) at 290 g were used as a source of N, P and K respectively to 100% level.

Rate and application Method of organic manure:

Two rates of organic (compost) manure fertilizer were used, the first rate was 100% level (17 kg compost per tree), such rate release 205, 103 and 145 g of N, P and K per tree, respectively, from one hand, and equivalent to the same quantities delivered by using the mineral NPK fertilizers that recommended by the Ministry of Agriculture from the other one. The second rate was 50% level (8.5 kg compost per tree) which release 102.5, 51.5 and 72.5 g of N, P and K per tree. Moreover, in early December of both seasons of study, one trench (50x50x50 cm) was excavated on two side of the tree, then the given amount of compost as well as part of surface soil were mixed and added to the chuck hole followed by irrigation. The chemical analysis of organic manure (compost) shown in Table (2).

Table 2. Chemical analysis of organic manure (compost)

Parameter	Mature form compost
Cubic meter weight (kg)	450
Moisture (%)	26
Organic matter (%)	51
pH (1:10)	8.3
EC (ds/m)	3.1
C/N ratio	15.78
Total N (%)	1.22
Total P (%)	0.61
Total K (%)	0.85
Total Ca (%)	1.95
Total Mg (%)	0.96
Total Fe (ppm)	1025
Total Mn (ppm)	115
Total Zn (ppm)	28
Total Cu (ppm)	180
Other mineral constituents (%)	16

Rate and application method of Bio-fertilizers:

Three types of bio-fertilizers were investigated through out this study, those types namely:

a- Phosphorein: is a commercial phosphorus bio-fertilizer which contains some active bacterial strains (***Arbuscular mycrohiza*** and ***silicate bacteria***) that play an important nutritional role in P uptake through changing the unavailable phosphate form (insoluble tri-calcium phosphate) into available soluble one (mono-calcium phosphate).
b- Nitrobein: is a commercial nitrogenous bio-fertilizer which contains special bacteria (***Azotobacter choroccocum***) having the ability for free nitrogen fixation.
c- Potasein: is a commercial potassium bio-fertilizer contains special bacteria (***Bacillus pasteurii***) which releasing the potassium in available form.

Each of the three abovementioned bio-fertilizer was soil added (15cm depth) to the wetted compost in three equal doses in December, March and June) at the rate of 30g/tree/dose.

Rate and application method of potassium silicate and Bento cide:

Bento cide is a natural compound supplied by Al-Ahram mining company it contains some micro-nutrient elements such as Fe, Zn, Cu, Bo, and S which controlled malformation in mango flowers as well as it improves flowering and fruiting rate of many plant species. Potassium silicate contents 15% silicon and 10% potassium, two rates of potassium silicate (5 ml/litter and 10 ml/litter) and bento cide (10 g/litter and 20 g/litter) were employed in this study as a growth stimulant foliar spray. Spraying was repeated on each tree at fifteen days intervals from full bloom to fruit mature stage.

The investigated materials including organic manure (compost), bio-fertilizers (Phosphorein, Nitrobein

and Potasein, NPK mineral fertilizers, potassium silicate and bento cide were arranged of the following investigated treatments:

T2. Organic (compost) fertilizer 100%
T3. Organic (compost) fertilizer 100% + three bio-fertilizers (nitrobein, phosphorein and potasein)
T4. NPK 50% + compost 50%.
T5. NPK 50 % + compost 50% + potassium silicate 5 ml/litter
T6. NPK 50% + compost 50% + bento cide 10 g/litter

The design completed randomize blocks was used in our study as arranged for the spraying fertilizer treatments and the above-mentioned soil, while each two mango trees represented as a treatment and the data was collected from 3 replicant for each treatment

Methodology which has been followed in this study is being determined as follows:

1- Flowering and fruiting measurements

At full bloom forty panicle/tree distributed at the four directions were random chosen and tagged in the 1st week of April for both seasons. The following parameters were determined:

a. Panicles Length and width (cm) were measured at full bloom stage.

b. Number of initial fruit set: Number of flowers/panicle was counted at full bloom, then number of developed fruitlets/panicle was counted 15 days after petal fall stage, initial fruit set % was calculated according to the following equation:

$$\text{Initial fruit set}\ (\%) = \frac{\text{Total number of fruitlets / panicle}}{\text{Total numbers of flowers per panicle}} \times 100$$

c. Fruit retention percentage: Fruit set % was estimated on 20th and 17th of April during 1st and 2nd seasons 'respectively. it was determined at harvesting time by the following equation:

$$\text{Fruit retention percentage} = \frac{\text{Number of mature fruits / panicle}}{\text{Number of fruit set / panicle}} \times 100$$

d. Number of fruits/tree: at fruit maturity stage, the total number of fruits that was born on each considered tree was counted and recorded, meanwhile fruit remaining % was estimated on 10th and 12th of June during the 1st and 2nd seasons respectively.

e. Yield (kg/tree): At harvesting time (which was extended to August 15th during both seasons of study), fruits of each individual tree were counted and weighed in Kg, then an average of two trees per each replicate was estimated for being, representative, of yield as weight of harvested fruits per tree in (Kg) or tons per feddan.

2. Fruit quality:

Samples of twenty mature fruits at harvesting time from each tree were randomly collected and the physical and chemical properties were determined as follows:

a. Fruit physical characteristics: The average of fruit weight (g), fruit volume (cm^3), and fruit firmness ($Ib/inch^2$) using penetrometer (pressure tester) were determined and estimated.

b. Fruit chemical characteristics: The following four fruit juice chemical properties of mature fruits were determined according to Hussein and Youssef (1972) as follows:

Total soluble solids percentage (TSS%): Fruit juice total soluble solids percentage (TSS%) was determined using a Carl Zeiss hand refractometer.

Total titratable acidity percentage: Fruit juice total acidity was estimated as a percentage of anhydrous citric and malic acids according to the method described by A.O.A.C. (1995).

TSS/acid ratio: TSS/acid ratio was estimated by dividing the total soluble solids (TSS) percentage over total acidity percentage.

Ascorbic Acid (vitamin C): Fruit juice vitamin C was estimated as (mg/100 ml fresh juice according to A.O.A.C. (1995).

Total sugars content: total sugar of fruit pulp was determined colorometrically as g/100 g flesh weight according to the method described by Dubaist *et al.* (1956).

Statistical analysis:

The statistical analysis was carried out using one-way ANOVA using SPSS, ver. 25 (IBM Corp. Released 2013). All the obtained data in the two seasons of study were statistically analyzed using the analysis of variance method according to Steel *et al.* (1997). Multiple comparisons were carried out applying Duncun test. The significance level was set at < 0.05.

RESULTS AND DISSCUTION

Panicle length and width (cm):

Regarding, flowering parameters (panicle length and width) data presented in **Table (3)** indicated that, the panicle length and diameter in most cases significantly respond to the investigated treatments. The highest value of panicle length and width were because of those fertilized trees with NPK as mineral fertilizer at 50% level + organic (compost) fertilizer at 50% level (T4) and the combination between NPK mineral plus organic fertilizers each at 50% combined with bento cide at 10 g/L (T6).

On the other hand, the less significant in flowering parameters were found by those treated trees with organic (compost) fertilizer at 100% level as a unique source of NPK (T2) during both seasons of study.

Table 3. Panicle length and width of mango trees Sedika Cv. in response to mineral, bio-organic fertilizers, and growth stimulants during 2019 and 2020 experimental seasons.

Treatments	Panicle length (cm)		Panicle width (cm)	
	2019	2020	2019	2020
NPK 100 %	11.07 b	11.20 b	8.90 ab	8.87 ab
Compost 100%	10.57 c	10.63 b	8.80 b	8.83 b
Compost 100% + bio-fertilizers	11.27 b	11.00 b	9.07 ab	9.27 ab
NPK 50% + compost 50%	12.37 a	12.07 a	9.37 a	9.37 a
NPK 50% + compost 50% + potassium silicate 5 ml/liter	12.03 a	11.77 a	9.47 a	8.85 b
NPK 50 % + compost 50% + bento cide 10 g/liter	12.03 a	11.60 a	9.30 ab	9.13 ab

Fruiting aspects:

In this regard, fruiting parameters (initial fruit set, fruit retention %, number of fruits/ tree and yield) were investigated in response to mineral (NPK), organic (compost) fertilizers as well as bio-fertilizer and foliar spray with potassium silicate and bento cide. It is clear from data in Table (4) there were significant differences

among the tested treatments, the highly remarkable positive difference in this respect was observed when the trees were fertilized with mineral (NPK) fertilizer at 50% + organic fertilizers (compost) at 50 % compared with bento cide as growth stimulant at 10 g/L (T6) maximized the value of the initial fruit set %, fruit retention % and yield (kg/tree and ton/feddan) compared with the other studied treatments.

Meanwhile, the fertilization with NPK in mineral form at 50% level combined with organic (compost) fertilizer at 50% level (T4) coupled with potassium silicate at 5 ml/L (T5), as well as the treated trees with NPK in inorganic form (mineral fertilizer) at 100% level (T1) came after and occupied the second rank for the initial fruit set % and fruit retention % during both seasons of study.

On the other hand, the minimum significant in fruiting parameters were detected by those treated trees with organic (compost) fertilizer at 100% level as a unique source of NPK (T2) during both seasons of study.

Table 4. Some yield indicators of mango trees Sedika cv. in response to mineral, bio-organic fertilizers, and growth stimulants during 2019 and 2020 experimental seasons.

Treatments	Initial fruit set (%)	Fruit retention (%)	No. of fruits/tree	Yield (kg/tree)	Yield (ton/ feddan)
First season					
NPK 100 %	10.33 b	8.59 b	17.00 bc	10.43 b	1.752 b
Compost 100%	8.67 d	6.66 c	15.33 c	8.85 c	1.824 b
Compost 100% + bio-fertilizers	9.67 c	8.92 b	18.67 b	10.86 b	1.431 c
NPK 50% + compost 50%	10.00 c	9.96 b	19.00 b	11.81 b	1.984 b
NPK 50% + compost 50% + potassium silicate 5 cm/liter	10.33 b	8.41 b	18.00 b	11.99 b	2.014 b
NPK 50 % + compost 50% + Bento cide 10 g/liter	14.00 a	13.4 a	22.67 a	14.26 a	2.395 a
Second season					
NPK 100 %	10.67 c	8.19 b	17.33 b	10.76 c	1.703 c
Compost 100%	9.33 d	7.23 c	16.33 c	9.55 c	1.703 c
Compost 100% + bio-fertilizers	9.67 cd	8.92 b	17.67 b	10.28 c	1.728 c
NPK 50% + compost 50%	10.33 c	9.49 b	20.00 b	12.97 b	2.178 b
NPK 50% + compost 50% + potassium silicate 5 cm/liter	11.33 b	8.69 b	17.33 b	11.65 b	1.957 b
NPK 50 % + compost 50% + bento cide 10 g/liter	14.67 a	12.12 a	23.00 a	14.31 a	2.401 a

These results coincided with those found by Santos (2007) and Yadav *et al*., (2011) who found that the organic nutrients (compost) inorganic fertilizer (NPK), bio-fertilizers and micronutrients (zinc and iron) enhancing the flowering and fruit set % of mango cv. Amrapali. Ranjit *et al.*, (2008) reported that, foliar application of mineral nutrients on Amrapali mango trees were the most effective treatments in improving the number of mango fruit per tree.

Fruit characteristics:

a – Fruit physical properties:

In this regard, some fruit physical characteristics i.e., fruit weight, fruit volume and fruit firmness of mango trees "Sedika cv." were investigated in response to different investigated treatments.

Data in Table (5) cleared that, the highly remarkable positive difference in fruit weight and volume were found when the trees were fertilized with NPK in mineral form at 50% + organic (compost) fertilizer at 50% combined with bento cide as growth stimulant at 10 g/L (T6) as compared with the other studied treatments during both seasons of study.

Moreover, the fertilization with NPK in mineral form at 50% + organic (compost) fertilizer at 50% only (T4) or (T4) combined with potassium silicate 5 ml/L (T5) came in the second standing during both seasons of study.

In addition, the organic fertilization with compost at 100% only (T2) were less effective in promoting fruit weight and volume.

On the other hand, fruit firmness was not significantly different by the investigated treatments, as the significant values of the tested parameter were relatively closed to each other, during both seasons of study.

Similar results were reported by Hasan *et al*., (2013) who found that, the organic and inorganic fertilizers and foliar of nutrient elements (nitrogen, phosphorus, potassium, zinc and boron) were effective in enhancing fruits length, width and weight of fruits mango trees.

Table 5. Some fruit physical properties of mango trees Sedika cv. in response to mineral, bio-organic fertilizers, and growth stimulants during 2019 and 202 experimental seasons.

Treatments	Fruit weight(g)		Fruit volume(cm^3)		Fruit firmness ($Lb/inch^2$)	
	2019	2020	2019	2020	2019	2020
NPK 100%	613.67 b	621.00 b	577.00 b	544.33 b	2.17 c	2.30 c
Compost 100%	577.33 b	585.00 b	540.33 b	547.00 b	2.32 b	2.38 b
Compost 100% + bio-fertilizers	581.67 b	582.00 b	546.33 b	554.33 b	2.37 b	2.43 b
NPK 50% + compost 50%	621.33 a	648.67 a	605.00 a	610.67 a	2.35 b	2.38 b
NPK 50% + compost 50%+ potassium silicate 5 cm/liter	666.33 a	672.00 a	626.67 a	632.00 a	2.58 a	2.63 a
NPK 50% + compost 50% + bento cide 10 g/liter	629.00 a	6.22 33 a	583.33 a	583.67 a	2.67 a	2.63 a

b- Fruit chemical properties:

In this regard, data tabulated in Table (6) indicated that, dealing with the response of some fruit pulp juice chemical properties such as total soluble solids (TSS%), total titrable acidity%, total soluble solids/acid ratio, total sugars percentage and ascorbic acid content of mango fruit pulp juice "Sedika cv." to the different investigated treatments.

Regarding, the total soluble solids (TSS%), total soluble solids/ acid ratio, total sugar percentage and

ascorbic acid content the results showed that the highest values of these parameter were recorded with those trees treated with NPK in two forms (mineral and organic) by sharing with 50% of each coupled with bento cide either at 10g/ L (T6) was the best two treatments, as both treatments achieved the highest significant values of the parameter as compared with the other treatments during two seasons of study. Meanwhile, fertilization with NPK in mineral form only at level 100% (T1) come after and place the second rank in this respect, followed by the fertilization with NPK in mineral farm at 50% level + compost (organic fertilizer) at 50% level (T4) and (T4) combined with K-silicate at either 5 m/L (T5).

On the other hand, the least value of the investigated parameter was detected with those treated trees with organic (compost) fertilizer form at 100% level as unique source of NPK (T2) or with the three investigated bio-fertilizers (T3).

Hence, the least value of fruit acidity % was obtained from the trees which fertilized with mineral form at 100% level as the unique soured of NPK (T1) or received their NPK demand as mineral fertilizer and organic (compost) fertilizer at the rate of 50% of each fertilizer coupled with bento cide at 10 g/L (T6), and both treatments (T1 and T6) reflected the minimum value of acidity % as compared with the other treatments, during two seasons of study.

Similar results were reported by Abd El-Rahman (2015) who found that, foliar application of potassium silicate at 0.2% was very effective in increasing fruit TSS, vitamin C. and total sugars content of Kitte mango fruits. Zaen El-Deen *et al.,* (2015) 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) recorded the highest significant effect on improving of total sugars. Ebeed *et al*., (2007) reported that, foliar spraying with some micronutrients and growth substances (Fe, Zn, Mn, Fe + Mn, Fe + Zn, Mn + Zn, Fe + Zn + Mn) significantly increased fruit Ascorbic acid (vitamin C) content.

Table 6. Fruit juice total soluble solids, total titratable acidity %, TSS/ acid ratio, ascorbic acid (vitamin C) and total sugars of mango trees Sedika cv. in response to mineral, bio-organic fertilizers, and growth stimulants during (2019-2020) experimental seasons.

Treatments	TSS (%)	Total Acidity (%)	TSS/Acid ratio	Ascorbic acid content (mg/100 ml juice)	Total sugars (g/100gF.W)
First season					
NPK 100%	18.17 a	0.370 a	49.56 bc	24.57 c	10.17 c
Compost 100%	16.73 b	0.340 c	48.73 bc	25.44 bc	10.38 c
Compost 100% + bio-fertilizers	16.70 b	0.360 ab	46.85 c	25.39 bc	10.45 bc
NPK 50 % + compost 50%	18.50 a	0.360 ab	51.46 ab	26.38 ab	10.30 c
NPK 50% + compost 50%+ potassium silicate 5 cm/liter	19.00 a	0.350 bc	55.45 a	26.88 a	10.85 a
NPK 50% + compost 50% + bento cide 10 g/liter	18.67 a	0.350 bc	52.95 a	26.92 a	10.89 a
Second season					
NPK 100%	18.50 a	0.350 a	52.45 bc	26.61 d	10.14 ab
Compost 100%	16.43 b	0.330 b	49.30 cb	27.40 cd	9.65 bc
Compost 100% + bio-fertilizers	16.47 b	0.340 ab	48.91 d	27.85 cd	9.17 c
NPK 50 % + compost 50%	18.17 a	0.330 b	54.56 ab	28.13 bc	10.05 ab
NPK 50% + compost 50%+ potassium silicate 5 cm/liter	19.00 a	0.330 b	59.81 a	28.81 ab	10.93 a
NPK 50% + compost 50% + bento cide 10 g/liter	18.33 a	0.330 b	56.14 a	29.29 a	10.28 a

REFERENCES

Abd El-Rahman, M.M.A. (2015). Relation of spraying silicon with fruiting of Kitte mango trees growing under Upper Egypt conditions. Stem cell, 6(2): 1-5.

Abou Hussein, S.D.; El-Oksha, I.; El-Shorbagy, T. and Gomaa, A.M. (2002). Effect of cattle manure, bio fertilizers and reducing mineral fertilizer on nutrient content and yield of potato plant. Egypt. J. Hort., 29(1): 99-115.

Al-Khawaga, A.S. and Maklad, M.F. (2013). Effect of mixing between bio and mineral fertilization on vegetative growth, yield and fruit quality of Valencia orange tree. Hortscience J. Suez Canal Univ. 1: 69-79.

Anees, M.; Tahir, F.M.; Shahzad, J. and Mahmood, N. (2011). Effect of foliar application of micronutrients on the quality of mango (*Mangifera indica* L.) cv. Dusehri fruit. Mycopath, 9(1): 25-28.

A.O.A.C (Association of Official Analytical Chemists). (1995). "Official methods of analysis, the A.O.A.C 14th Ed., Benjamin Franklin Station, Washington, D.C.U.A. pp490-510.

Dubaist, M.; Gilles, K.A.; Hamilton, J.K.; Rebres, P.A. and Smith, F. (1956). Colorimetric methods for determination of sugars. Analytical Chemistry, 28(3): 350-356.

Ebeed, S.; El-Gazzar, A. and Bedier, R. (2007). Effect of foliar application of some micronutrients and growth regulators on fruit drop, yield, fruit quality and leaf mineral content of Mesk mango cv. trees. Annals of Agric. Sci., Moshtohor, 39(2): 1279-1296.

El-Khawaga, A.S. (2012). Effect of compost enriched with actinomyces and Bacillus polymyxa algae as a partial substitute for mineral N in Ewaise Mango orchards. Research Journal of Agriculture and Biological Sciences, 8(2): 191-196. 28 ref.

Epstein, E. (1999). Silicon. Annl. Rev. Plant Physiol. Plant Mol. Biol. 50: 641-664.

FAO statistics (2019): Food and Agriculture Organization WWW. FAO. Org.

Gad El-Kareem, M. R. (2012). Improving productivity of Taimour mango trees by using glutathione, silicon and vitamins B. Minia J. Agric. Res. & Develop, 32 (4): 402-430.

Gong, H.J., Chen, K.M., Chen, G.C., Wang, S.M. and Zhang, C.L. (2003). Effect of silicon on growth of wheat under drought. J. Plant Nutr. 26(5): 1055-1063.

Hasan, M.A.; Manna, M.; Dutta, P.; Bhattacharya, K.; Mandal, S.; Banerjee, H.; Ray, S.K. and Jha, S. (2013). Foliar nutrient content in mango as influenced by organic and inorganic nutrients and their correlative relationship with yield and quality. Acta Horticulturae, 992:201-206. 11.

Hassan, H.S. A. and Abou- Rayya, M.S. (2003). Effect of some bio fertilizers on leaf mineral content, yield and fruit quality of Anna apple trees grown under Northern Sinai condition. Egypt. J. Appl. Sci., 18(8B): 559-574.

Hattori, T., Inanaga, S., Araki, H., An, P., Morita, S., Luxova, M. and Lux, A. (2005). Application of Silicon Enhanced Drought Tolerance in Sorghum bicolor. Physiologia Plantarum, 123, 459-466. http://dx.doi.org/10.1111/j.1399-3054.2005.00481.x

Hussein, M.A. and Youssef, K.E. (1972). Phisio-chemical parameters as an index of optimum maturity in Egyptian mango fruit (*Mangifera indica* L.). Assuit J. Agric. Sci. 3 (2): 273-281.

Jackson, M.L., 1967. Soil Chemical Analysis. Prentice-Hall of India Pvt. Ltd., New Delhi, 498p.

Melo, S. P.; Korndorfer, G. H.; Korndorfer, C. M.; Lana R. M. Q. and Santan, D. G. (2003). Silicon accumulation and water deficient tolerance in grasses. Scientia Agricola, 60:755- 759.

Mohamed, S.M.; Fayed, T.A.; Ismail, A.F. and Abdou, N.A. (2010): Growth, nutrient status and yield of le-conte pear trees as influenced by some organic and biofertilizer rates compared with chemical fertilizer.Bull. Fac. Agric. Cairo Univ. 61: 17-32.

Nafees, M. (2011). Bimonthly nutrient application program on calcareous soil improves flowering and fruit set in mango (*Mangifera indica* L.). Pakistan Journal of Botany, 43(2): 983-990.

Piper, C.S. (1947). Soil and plant analysis. Inter. Sci. Publishers. New York, 213-217.

Ranjit, K.; Pawan, K. and Singh, U.P. (2008): Effect of foliar application of nitrogen, zinc and boron on flowering and fruiting of mango (*Mangifera indica* L.) cv Amrapali. Environment and Ecology, 26 (4): 1965-1967..

Santos, B. M. (2007). Effects of adding compost to fertilization programs on 'Keitt' mango. Journal of Agronomy, 6(2): 382-384.

Steel, R.; Torrie, J. and Dickey, D. (1997): Principles and procedures of Statistics: A Biometrical Approach, 3rd ed., McGraw-Hill, New York, NY.

Tarabih, M.E.; El-Eryan, E.E. and El-Metwally, M.A. (2014). Physiological and pathological impacts of potassium silicate on storability of Anna apple fruits. American Journal of Plant Physiology, 9 (2): 52-67.

Wassel, A.H.M.; Sayed, M.A.; Mohamed, A.Y.; Ebrahim, A.M. and Hassan E.A.M. (2015). Effect of using plant compost enriched with *Spirulina platensis* algae as a partial replacement of inorganic N fertilization on fruiting of Ewaise Mangoes. World Rural Observations, 7(3): 102-109.

Yadav, A.K.; Singh, J.K. and Singh, H.K. (2011). Studies on integrated nutrient management in flowering, fruiting, yield and quality of mango cv. Amrapali under high density orcharding. Ind. J. Horti., 68(4): 453-460.

Youssef, A.H.; El-Fouly, A.H.; Youssef, M.S. and Mohamadien, S.A. (2001). Effect of using organic and chemical fertilizers in fertigation system on yield and fruit quality of potato plants. Resent Technologies in Agriculture. Proc. of the 2nd Congress, 9(1): 79-94.

Zaen El-Deen, E.M.; Attia, M.F.; Laila, F.H.; Shahin, M. F.; Genaidy, E.A. and Merward, M. A. (2015). Soil mulching and foliar anti-transpirations effect on soil, growth and nutrients status of young mango trees cultivated in Toshka. Inter. J. Agri. Technol, 11(4): 1013-1032.

Zhou, X.W; Li, Z.Y.; Lu, B.; Chen, X.N and Yi, Y.W. (2001). Study on the improvement of soil of the newly established orchard on the reclaimed purple soil. J. Fruit Sci., 18(1): 15-19.

استجابة اشجار المانجو للاسمدة المعدنية والحيوية والعضوية ومنشطات النمو

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أجريت هذه الدراسة بمزرعة خاصة بمحافظة الإسماعيلية خلال موسمين متتاليين (2019&2020) على أشجار المانجو صنف صديقة عمرها أربعة سنوات والمنزرعة على مسافة 5×5 م بكثافة 168 شجره للفدان في ارض رملية تروي بالتنقيط. تم دراسة تأثير السماد العضوي (الكمبوست) والتسميد الحيوي (الفوسفورين - النيتروبين - البوتاسين - EM) والتسميد المعدني (NPK) وتأثير الرش بسليكات البوتاسيوم والبنتوسيد الذي يحتوي علي عناصر الزنك، الحديد، النحاس، البورون والكبريت على إثمار تلك الأشجار من خلال المعاملات التالية: 1- التسميد المعدني (NPK)عند مستوى 100%. 2- التسميد العضوي (الكمبوست) عند مستوى 100%3.- التسميد العضوي (الكمبوست) عند مستوى 100% + التسميد الحيوي (الفوسفورين، النيتروبين، البوتاسين). 4- التسميد المعدني (NPK) عند مستوى50% + التسميد العضوي (الكمبوست)عند مستوى 50%5.- التسميد المعدني (NPK) عند مستوى50% + التسميد العضوي (الكمبوست) عند مستوى 50% + رش سيليكات البوتاسيوم (5 ملليلتر/لتر). 6-التسميد المعدني (NPK) عند مستوى50% + التسميد العضوي (الكمبوست) عند مستوى 50% + رش بنتوسيد (10جرام/لتر). وأظهرت النتائج المتحصل عليها وجود اختلافات معنوية بين المعاملات، حيث ان استخدام التسميد المعدني (NPK) بنسبة 50 % مع التسميد العضوي بنسبة 50 % إلى جانب الرش بمركب البنتوسيد بمعدل 10جرام/لتر كمصدر للمغذيات الصغرى كانت ذات تأثير فعال وايجابي في زيادة الإنتاجية وتحسين صفات جودة الثمار.

الكلمات الدالة: التسميد العضوي – الكمبوست – التسميد الحيوي – سيليكات البوتاسيوم – بنتوسيد - المانجو