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Response of Mango Transplants to Bio- Fertilizer Treatments 1- Vegetative growth measurements

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ABSTRACT

The present study was conducted on mango transplants during 2016 & 2017 seasons to investigate the influence of some bio substances as addition nutritive fertilizers i.e. VAM, EM, Blue green algae and Diatom algae extracts. The influence was evaluated through the response of some vegetative growth of "mango transplants.

The specific effect of mango cultivars on some vegetative growth, data revealed that, Kent mango cultivar was better than the other investigated cultivar (Keitt) in this respect. Also, fertilizer with soil application of VAM fungi at 4 cm^3/ transplant + control or soil application of blue green algea extract at 1g/ transplant + control was superior in this respect where it was able to increase significantly vegetative growth as compared with the other different investigated fertilization especially NPK only (control) during both seasons of study. Concerning the interaction effect of the two investigated factors i.e., mango cultivars and different fertilization on some vegetative growth measurements of mango transplants, data show the highest vegetative growth were obtained with the combination between Kent mango cultivar and fertilized with soil application of VAM fungi at 4 cm^3/ transplant + control or soil application of blue green algea extract at 1g/ transplant + control.

***Keywords*:** Mango-bio fertilizer, Mineral fertilizer, Kent, Keitt

Introduction

Mangoes *(Mangifera indica* L.) belong to family Anacardiaceae native to South Eastern 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 considered to be the queen of fruits. The Mangoes is one of the oldest widely cultivated fruits in the subtropical and semitropical regions. It is also one of the popular tropical cultivated in both the world and Arab Republic of Egypt.

Mango is regard in Egypt as one of the major local fruit crops and approximately could be considered the second fruit crop after citrus. The total cultured area in Egypt reached about 240804 feddans that produced about 4.29 tons/feddan with total fruit production 786533 tons from produced area 183341 feddans (FAO, 2014).

Fertilization is one of the important management tools in increasing growth and crop yield, especially with nitrogen. Nitrogen (N) is known to be one of the most major elements for plant nutrition and development. It plays an important role as a constituent of all proteins, nucleic acids and enzymes (Nijjar, 1985).

Nitrogen fertilization effects depend upon the nutrient status of cultivated soil, as well as applied amount, sources and methods of N applications. In addition, ammonia fertilizers are rapidly nitrified and the nitrate nitrogen is leached downward during watering from the root zone or upward after watering to the surface (Yagodin, 1990).

Phosphorus is an essential nutrient as a part of several key plant structure compounds and as a catalysis in the conversion of numerous key biochemical reactions in plants. Phosphorus is noted especially for its role in capturing and converting the sun's energy into useful plant compounds (Bill, 2001).

Potassium, like phosphorus and nitrogen, constitutes is important macronutrient in the nutrition of trees for regular, large-scale production of high quality fruits. Fruit crops, in general are heavy

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feeders of potash and the quantities of potash removed are comparable to nitrogen and in some cases even much higher (Miller *et al*, 1990). Potassium is essential element in many plant metabolic processes. In spite, K does not become a part of plant compounds; it plays many important regulatory roles in development of different tissues. In addition, K may also increase disease resistance by increasing the thickness of outer walls in epidermal cells (Mengel *et al*., 2001).

High costs of mineral fertilizers needed to fruit trees are one of these problems. Additionally, the uses of mineral fertilizers have an increased role in the health problems of mankind. However, they are considered as air, soil and water polluting agent results from leached chemical fertilization into the soil led to disturbance in the natural biological balance in the soil and accumulates in food chain causing hazardous effects for human health. The use of bio-fertilizers in enhancing plant growth and yield has gained momentum in recent years because of higher cost and hazardous effect of chemical fertilizers. Nitrogen-fixing bacteria and arbuscular mycorrhizal fungi were found to enhance the growth and production of various fruit trees significantly (Khanizadeh *et al*., 1995 and Aseri *et al*., 2008).

Bio-fertilizers are the most importance for plant production and soil as they play an important role in increasing vegetative growth, yield and fruit quality (El-Khawaga (2012) and Hasan *et al*. (2013b)) on mango.

The main objective of this study, is to carry out a comparison between using mineral (NPK) fertilizer and bio - fertilizer or the combination between them as a source of (NPK) soil fertilization to know which NPK fertilizer source and the actual nutritional demand to be more beneficial for growth mango transplants as well as adjusting the best NPK management that responsible for obtaining an economical income as another desirable target.

Materials and Methods

This study was carried out during the two successive seasons of 2016 and 2017 on two mango cultivars transplants. This experiment aimed to know more knowledge about the effect of bio-fertilizer on growth of mango transplants at the experimental research green house of National Research Centre, Dokki, Giza, Egypt.

Healthy uniform seedlings of Keitt and Kent mango *Cvs*. grafted on Zebda rootstock were used. The seedlings were planted in black polyethylene bags with 40 cm^3 diameter fooled with 20 kg washed sand mixed with Compost at rate 2:1, respectively.

Uniform and healthy one-year- old seedlings of Keitt and Kent mango cultivars were the plant material used in this study.

This experiment involved nine treatments:

1-Control: Soil application of Crystalon at 90g / transplants as a source of NPK (20% N: 20% P: 20% K).
2-Soil application of blue green algea extract at 100 cm^3/ transplant + Control.
3-Soil application of blue green algea extract at 200 cm^3/ transplant + Control.
4-Soil application of marine diaton extract at 100 cm^3/ transplant + Control.
5-Soil application of marine diaton extract at 200cm^3/ transplant + Control.
6-Soil application of Effective microorganisms (EM) at 50 cm^3/ transplant + Control.
7-Soil application of Effective microorganisms (EM) at 100 cm^3/ transplant + Control.
8-Soil application of VAM fungi at 20g/ transplant + Control.
9-Soil application of VAM fungi at 40g/ transplant + Control.

Crystalon: As a source of NPK equal to 90g Crystalon (20% N: 20% P: 20% K)/ seedling. It was divided into 10 equal doses and soil applied during growing season to different tested treatments including control from April to August at two weeks intervals (dissolved in the irrigation water).

Mycorrhizal VAM was prepared by wet-sieving and decanting procedure in Microbiology Dept., NRC. Completely mixed with sterilized compost at rate 1+1 Kg, moistening for 2 hour and soil inoculated.

VAM and EM were inoculated by adding one time in April.

Both blue green algae *Spirulina sp*. and Diatom algae *Amphora sp*. extracts were produced by the Algae Biotechnology Unit, Fertilization Technology Dept., National Research Centre (NRC),

Dokki, Egypt. Bags concerned blue green algae *Spirulina sp*. Extract, were divided as two groups: [100 or 200cm^3/seedling] expressed by Sp^1 and Sp^2. Each was applied into 10 doses as soil application from April to August at two weeks intervals.

Experimental layout:

The complete randomized block design with four replications was used for arranging the differential investigated treatments. Every replicate was represented in each of the aforesaid three plants. The response of mango transplants to differential treatments of the experiment was investigated throw determining of the following measurements:

Vegetative growth measurements:

On last week of September during both seasons the experiment was ended, the effect of different treatments on some vegetative growth measurements were evaluated by the following growth parameters during both seasons as follows:

Increment percentage of stem length "plant height":

Net increase in plant height = plant height in the end of September- initial plant height on the first of April.

Increment percentage in stem height was estimated as follows:

$$\frac{\text{Final stem length - Initial stem length}}{\text{Initial stem length}} \text{ X } 100$$

Increment percentage of stem diameter:

Net increase in stem diameter = Stem diameter in the end of September - Initial stem diameter in the first of April.

Increment percentage in stem diameter was estimated as follows:

$$\frac{\text{Final stem diameter- Initial stem diameter}}{\text{Initial stem diameter}} \text{ X } 100$$

Average number of shoots /transplant:
Average number of leaves / plant:
Leaf area:

Five mature leaves were collected from each transplant for determining length (L) and width (W). Leaf shape index was calculated = L/W. In addition, leaf area (LA) was stimulating by using formula Leaf area (LA) = 0.70 (L x W) -1.06 according to Ahmed and Morsy (1999).

Total foliage area per transplant:

As assimilation area / transplant (cm^2) was calculated on the base of number of leaves / transplant × average leaf area (dec^2). The method was described by Motskobili, (1984) and followed by Mohsen *et al*. (1987).

Top/ root ratio: Top/root ratio of mango transplants was estimated in stem dry weight / root dry weight.

Statistical analysis:

All data of the present investigation were subjected to analysis of variance and significant differences among means were determined according to Snedecor and Cochran, (1980). In addition, significant differences among means were differentiated according to the Duncan·s, multiple test range (Duncan, 1955), where capital and small letters were used for differentiating the values of specific and interaction effects of the investigated factors, respectively.

Results and Discussion

This investigation was carried out to cover the influence of the two investigated factors namely: 1- mango cultivars (Keitt and Kent), 2- Some fertilization and their possible combinations on mango transplants were studied during both 2016 and 2017 seasons. Such influence was evaluated through the response of some vegetative growth of the treated mango transplants.
Therefore, obtained results presented in Tables (1-7) in this study dealing with any of the abovementioned three aspects are separately during both seasons of study discussed as follows:

Vegetative growth:

In this regard in stem height; stem diameter; number of lateral shoots, number of leaves; leaf area; total leaves assimilation area and top/root ratio were the seven growth measurements of mango transplants investigated pertaining their response to the specific effect of investigated variables of each studied factor i.e., mango cultivars and mineral or bio-fertilizer soil applications as well as interactions effect of the combinations between the variables of both investigated factors.

Increment percentage of stem height:

A. Specific effect:

As for the response to specific effect of mango cultivars, data in Table (1) displays that, Kent mango cultivar surpassed statistically Keitt mango cultivar during two seasons of study in this respect. Meanwhile, the specific effect of fertilizer treatments, Table (1) displays that the stem was higher in transplants fertilized with soil application of VAM fungi at 20 g / transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control rather than in other treatments especially NPK (control).

Table 1: Effect of mineral and bio-fertilizers on increment percentage of stem height of mango transplants during both 2016 and 2017 seasons.

Treatments	Increment percentage of stem height					
	Keitt	Kent	Mean	Keitt	Kent	Mean
	First season			Second season		
1	21.40 k	24.40 ij	22.90 G	20.70 m	23.90 jkl	22.30 H
2	34.10 cd	37.20 ab	35.65 A	3.40 cde	36.50 ab	34.95 B
3	23.80 ijk	26.60 hi	25.20 EF	23.30 klm	26.10 ij	24.70 FG
4	31.30 def	34.80 bc	33.05 B	30.70 efg	34.23 bcd	32.47 C
5	24.50 ij	27.80 gh	26.15 E	23.80 jkl	27.30 hi	25.55 F
6	28.73 fgh	32.30 cde	30.52 C	28.10 ghi	31.70 def	29.90 D
7	21.60 jk	24.80 i	23.20 FG	21.20 lm	24.30 jk	22.75 GH
8	33.27 cd	40.10 a	36.68 A	35.93 bc	39.20 a	37.57 A
9	26.70 hi	30.10 efg	28.40 D	26.20 ij	29.50fgh	27.85 E
Mean	27.27 B	30.90 A		27.04 B	30.30 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.
1-Control: Soil application of Crystalon at 90g / transplants as a source of NPK (20% N: 20% P: 20% K).
2-Soil application of blue green algea extract at 100 cm^3/ transplant + Control.
3-Soil application of blue green algea extract at 200 cm^3/ transplant + Control.
4-Soil application of marine diaton extract at 100 cm^3/ transplant + Control.
5-Soil application of marine diaton extract at 200cm^3/ transplant + Control.
6-Soil application of Effective microorganisms (EM) at 50 cm^3/ transplant + Control.
7-Soil application of Effective microorganisms (EM) at 100 cm^3/ transplant + Control.
8-Soil application of VAM fungi at 20g/ transplant + Control.
9-Soil application of VAM fungi at 40g/ transplant + Control.

B. Interaction effect:

Regarding the interaction effect of various (mango cultivars x fertilizer treatments) combinations Table (1) reveals that, Kent mango cultivar and fertilized with soil application of VAM fungi at 20 g / transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control had significantly the tallest stem. Meanwhile, the reverse was true with Keitt mango cultivar and fertilized with NPK. In addition other combinations were in between during two seasons.
The obtained results are in confirmed with Akanbi *et al*., (2002) and Gautam *et al.* (2012).

Increment percentage of stem diameter:

A. Specific effect:

As for the response to specific effect of mango cultivars, data in Table (2) displays that, Kent mango cultivar surpassed statistically Keitt mango cultivar during two seasons of study. Meanwhile, the specific effect of fertilizer treatments, Table (2) displays that, the stem was thickness in transplants fertilized with soil application of VAM fungi at 20 g / transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control rather than in other treatments especially NPK (control).

B. Interaction effect:

Regarding the interaction effect of various (mango cultivars x fertilizer treatments) combinations Table (2) reveals that, Kent mango cultivar and fertilized with soil application of VAM fungi at 20 g/ transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control had significantly the thickened stem. Meanwhile, the reverse was true with Keitt mango cultivar and fertilized with NPK. In addition other combinations were in between during two seasons. This result is agreement with that reported by Wassel *et al*., (2015).

Table 2: Effect of mineral and bio-fertilizers on increment percentage of stem diameter of mango transplants during both 2016 and 2017 seasons.

Treatments	Increment percentage of stem diameter					
	Keitt	Kent	Mean	Keitt	Kent	Mean
	First season			Second season		
1	14.43 j	17.60hi	16.02 G	14.30 k	17.80 i	16.05 G
2	23.70 d	27.40c	25.55 C	23.70 e	27.70 d	25.70 C
3	16.40 i	19.67fg	18.03 F	15.90 j	20.00 gh	17.95 F
4	29.90 b	32.97a	31.43 A	29.10 c	33.30 a	31.20 A
5	16.60 i	20.60f	18.60 F	16.13 j	20.80 g	18.47 F
6	20.10 f	24.57d	22.33 D	19.50 h	24.80 e	22.15 D
7	14.70 j	18.10h	16.40 G	14.30 k	18.30 i	16.30 G
8	26.80 c	30.37b	28.58 B	26.80 d	30.50 b	28.65 B
9	18.30 gh	22.30 e	20.30 E	17.87 i	22.50 f	20.18 E
Mean	20.10B	23.73A		19.73B	23.97 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.
1-Control: Soil application of Crystalon at 90g / transplants as a source of NPK (20% N: 20% P: 20% K).
2-Soil application of blue green algea extract at 100 cm^3/ transplant + Control.
3-Soil application of blue green algea extract at 200 cm^3/ transplant + Control.
4-Soil application of marine diaton extract at 100 cm^3/ transplant + Control.
5-Soil application of marine diaton extract at 200cm^3/ transplant + Control.
6-Soil application of Effective microorganisms (EM) at 50 cm^3/ transplant + Control.
7-Soil application of Effective microorganisms (EM) at 100 cm^3/ transplant + Control.
8-Soil application of VAM fungi at 20g/ transplant + Control.
9-Soil application of VAM fungi at 40g/ transplant + Control.

Number of lateral shoots per transplant:

A. Specific effect:

As for the response to specific effect of mango cultivars, data in Table (3) displays that, Kent mango cultivar surpassed statistically Keitt mango cultivar during two seasons of study in this respect. Meanwhile, the specific effect of fertilizer treatments, Table (3) displays that the transplants fertilized with soil application of VAM fungi at 20 g/ transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control gave highest number of lateral shoots compared with other treatments especially NPK (control).

*C. Interaction effect***:**

Regarding the interaction effect of various (mango cultivars x fertilizer treatments) combinations Table (3) reveals that, Kent mango cultivar and fertilized with soil application of VAM fungi at 20 g / transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control had significantly the highest number of lateral shoots. Meanwhile, the reverse was true with Keitt mango cultivar and fertilized with NPK. In addition other combinations were in between during two seasons. The present result is in harmony with those found by Das *et al.* (2009) and Hasan *et al.,* (2009).

Table 3: Effect of mineral and bio-fertilizers on number of lateral shoots per mango transplant during both 2016 and 2017 seasons.

Treatments	No. of shoots / transplant					
	Keitt	Kent	Mean	Keitt	Kent	Mean
	First season			Second season		
1	2.140 n	2.457 l	2.298 H	1.440 no	1.793 mn	1.617 H
2	4.107 ef	4.340 de	4.223 C	3.497 def	3.807 cde	3.652 C
3	2.870 k	2.840 k	2.855 G	1.890 lm	2.160 klm	2.025 G
4	4.887 ab	5.127 a	5.007 A	4.357 ab	4.680 a	4.518 A
5	2.927 k	3.220 j	3.073 F	3.090 fgh	3.397 efg	3.243 D
6	3.317 ij	3.590 hi	3.453 E	2.677 hij	2.990 ghi	2.833 E
7	2.150 mn	2.440 lm	2.295 H	1.153 o	1.747 mn	1.450 H
8	4.487 cd	4.727 bc	4.607 B	3.920 cd	4.227 bc	4.073 B
9	3.710 gh	3.960 fh	2.298 H	2.270 jkl	2.567 ijk	1.617 H
Mean	3.399 B	3.633 A		2.699 B	23.041 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different
1-Control: Soil application of Crystalon at 90g / transplants as a source of NPK (20% N: 20% P: 20% K).
2-Soil application of blue green algea extract at 100 cm^3/ transplant + Control.
3-Soil application of blue green algea extract at 200 cm^3/ transplant + Control.
4-Soil application of marine diaton extract at 100 cm^3/ transplant + Control.
5-Soil application of marine diaton extract at 200cm^3/ transplant + Control.
6-Soil application of Effective microorganisms (EM) at 50 cm^3/ transplant + Control.
7-Soil application of Effective microorganisms (EM) at 100 cm^3/ transplant + Control.
8-Soil application of VAM fungi at 20g/ transplant + Control.
9-Soil application of VAM fungi at 40g/ transplant + Control.

Number of leaves / transplant:

A. Specific effect:

Table (4) shows that, no significantly differences between mango cultivars in the number of leaves per transplants during both seasons of study. As for the specific effect of fertilizer treatments, it is quite evident that, transplants fertilized with soil application of VAM fungi at 20 g / transplant +

control gave highest value of number of leaves rather than in other treatments especially NPK (control).

Table 4: Effect of mineral and bio-fertilizers on number of leaves per mango transplant during both 2016 and 2017 seasons.

Treatments	No. of leaves/ transplant					
	Keitt	Kent	Mean	Keitt	Kent	Mean
	First season			Second season		
1	25.40 j	28.83 i	27.12 H	24.10 k	26.20 ijk	25.15 F
2	43.30 d	43.73 d	43.52 C	41.90 cd	36.10 ef	39.00 C
3	34.50 g	34.03 g	34.27 F	29.10 hij	29.80 hi	29.45 E
4	46.17 c	48.10 b	47.13 B	45.60 bc	47.47 b	46.53 B
5	40.37 e	40.50 e	40.43 D	38.10 def	38.60 de	38.35 C
6	31.57 h	30.47 h	31.02 G	30.47 gh	29.20 hij	29.83 E
7	25.67 j	24.57 j	5.12 I	25.87 ijk	25.40 jk	25.63 F
8	48.40 b	50.30 a	9.35 A	49.40 ab	51.80 a	50.60 A
9	37.47 f	37.10 f	7.28 E	34.27 fg	34.17 fg	34.22 D
Mean	37.36 A	37.13 A		35.42 A	35.41 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different

1-Control: Soil application of Crystalon at 90g / transplants as a source of NPK (20% N: 20% P: 20% K).
2-Soil application of blue green algea extract at 100 cm^3/ transplant + Control.
3-Soil application of blue green algea extract at 200 cm^3/ transplant + Control.
4-Soil application of marine diaton extract at 100 cm^3/ transplant + Control.
5-Soil application of marine diaton extract at 200cm^3/ transplant + Control.
6-Soil application of Effective microorganisms (EM) at 50 cm^3/ transplant + Control.
7-Soil application of Effective microorganisms (EM) at 100 cm^3/ transplant + Control.
8-Soil application of VAM fungi at 20g/ transplant + Control.
9-Soil application of VAM fungi at 40g/ transplant + Control.

B. Interaction effect:

Regarding the response of number of leaves per transplants to interaction effect of various combinations between mango cultivars and fertilizer treatments, it was so clear to notice that, the Kent mango cultivar fertilized with soil application of VAM fungi at 20 g / transplant + control gave the highest number of leaves transplant during two seasons of study. On the other hand, the reverse was found with the Keitt mango cultivar and fertilized with NPK. In addition other combinations were in between during two seasons.

The present result is in harmony with those found by Kundu *et al.,* (2011) and Wassel *et al.* (2015).

Average leaf area (cm^2):

A. Specific effect:

Data presented in Table (5) displayed that, no significantly differences between mango cultivars in leaf area during two seasons of study. Meanwhile, the specific effect of fertilizer treatments, Table (5) displays that, the average leaf area was largest in transplants fertilized with soil application of VAM fungi at 20 g / transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control rather than in other treatments especially NPK (control).

B. Interaction effect:

Referring the interaction effect of mango cultivars and fertilizer treatments, it was quite evident that, the Kent mango cultivar fertilized with soil application of VAM fungi at 20 g / transplant + control gave the highest value of leaf area during two seasons of study. On the other hand, the reverse

was found with the Keitt mango cultivar and fertilized with NPK. In addition other combinations were in between during two seasons.

Table 5: Effect of mineral and bio-fertilizers on average leaf area (cm^2) of mango transplants during both 2016 and 2017 seasons.

Treatments	Leaf area (cm2)					
	Keitt	Kent	Mean	Keitt	Kent	Mean
	First season			Second season		
1	48.57 jk	50.97 ijk	9.77 GH	49.20 h	51.40 h	50.30 E
2	67.67 cde	69.97 cd	68.82 BC	75.50 bc	74.50 bcd	75.00 B
3	55.77 ghi	58.70 fgh	57.23 EF	57.90 fgh	53.37 gh	55.63 DE
4	71.37 bcd	73.50 bc	72.43 B	78.10 abc	82.17 ab	83.58 A
5	63.30 ef	66.63 de	64.97 CD	80.10 ab	70.70 cde	75.40 B
6	52.17 h-k	54.90 g-j	53.53 FG	66.20 def	65.70 def	65.95 C
7	45.70 k	47.60 k	46.65 H	55.77 gh	53.27 gh	54.52 E
8	77.37 ab	83.87 a	80.62 A	76.53 abc	85.00 a	77.32 AB
9	59.47 fg	62.70 ef	61.08 DE	61.20 fg	61.60 efg	61.40 CD
Mean	60.87 A	62.48 A		65.40 A	67.73 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different
1-Control: Soil application of Crystalon at 90g / transplants as a source of NPK (20% N: 20% P: 20% K).
2-Soil application of blue green algea extract at 100 cm^3/ transplant + Control.
3-Soil application of blue green algea extract at 200 cm^3/ transplant + Control.
4-Soil application of marine diaton extract at 100 cm^3/ transplant + Control.
5-Soil application of marine diaton extract at 200cm^3/ transplant + Control.
6-Soil application of Effective microorganisms (EM) at 50 cm^3/ transplant + Control.
7-Soil application of Effective microorganisms (EM) at 100 cm^3/ transplant + Control.
8-Soil application of VAM fungi at 20g/ transplant + Control.
9-Soil application of VAM fungi at 40g/ transplant + Control.

Total leaves assimilation area (cm^2):

A. Specific effect:

Data presented in Table (6) displayed that, Kent mango cultivar surpassed statistically Keitt mango cultivar during two seasons of study. Meanwhile, the specific effect of fertilizer treatments, Table (6) displays that, the average leave assimilation area was largest in transplants fertilized with soil application of VAM fungi at 20 g / transplant + control rather than in other treatments especially NPK (control).

B. Interaction effect:

Referring the interaction effect of mango cultivars and fertilizer treatments, it was quite evident that, the Kent mango cultivar fertilized with soil application of VAM fungi at 20 g / transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control gave the highest value of leaves assimilation area during two seasons of study. On the other hand, the reverse was found with the Kent mango cultivar and fertilized with NPK. In addition other combinations were in between during two seasons.

The obtained result is confirmed by those previously mentioned by Abd EL-Latif (2007); El-Khawaga (2012); Abd EL-hamed (2014) and Wassel *et al.* (2015).

Top /root ratio:

A. Specific effect:

With regard to the specific effect of mango cultivars, Table (7) shows that top /root ratio of Kent mango cultivar was relatively higher than that of Keitt mango cultivar. As for the specific effect of fertilizer treatments, it was quite evident that the response was more pronounced than that previously discussed with mango cultivars. Whereas, the top /root ratio in the transplants fertilized

with soil application of VAM fungi at 20 g / transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control rather than in other treatments especially NPK (control) during both seasons of study.

Table 6: Effect of mineral and bio-fertilizers on total assimilation area per transplant (cm^2)of mango transplants during both 2016 and 2017 seasons.

Treatments	Total assimilation area per transplant (cm2)					
	Keitt	Kent	Mean	Keitt	Kent	Mean
	First season			Second season		
1	1167.11 o	1177.15 o	1172.16 H	1240.22 i	1292.11 hi	1266.16 F
2	2925.33ef	3065.44 de	2995.34 C	3176.20 b	3144.40 b	3160.30 B
3	1903.00kl	2000.00 jk	1952.00 F	1685.60 efg	1593.20 fgh	1639.40 E
4	3292.11cd	3541.13bc	3416.12 B	3849.22 a	3907.24 a	3878.23 A
5	2562.02gh	2703.00 fg	2632.01 D	2710.22 c	2730.02 c	2720.14 C
6	1647.00mn	1674.00lm	1660.00 G	2021.11 de	1917.43 def	1969.12 D
7	1397.01no	1297.22 o	1347.12 H	1446.44 ghi	1352.00 ghi	1399. 22 F
8	3634.11b	3892.24 a	3763.17 A	3786.22 a	4049.10 a	3917.16 A
9	2233.00ij	2324.00 hi	2278.00 E	2100.66 d	2045.22 d	2072.44 D
Mean	2308.30 B	2407.42 A		2446.14 A	2448.55 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different
1-Control: Soil application of Crystalon at 90g / transplants as a source of NPK (20% N: 20% P: 20% K).
2-Soil application of blue green algea extract at 100 cm^3/ transplant + Control.
3-Soil application of blue green algea extract at 200 cm^3/ transplant + Control.
4-Soil application of marine diaton extract at 100 cm^3/ transplant + Control.
5-Soil application of marine diaton extract at 200cm^3/ transplant + Control.
6-Soil application of Effective microorganisms (EM) at 50 cm^3/ transplant + Control.
7-Soil application of Effective microorganisms (EM) at 100 cm^3/ transplant + Control.
8-Soil application of VAM fungi at 20g/ transplant + Control.
9-Soil application of VAM fungi at 40g/ transplant + Control.

Table 7: Effect of mineral and bio-fertilizers on top/root ratio of mango transplants during both 2016 and 2017 seasons.

Treatments	Top/root ratio					
	Keitt	Kent	Mean	Keitt	Kent	Mean
	First season			Second season		
1	1.823 de	1.953 b-e	1.888 CD	2.130 abc	2.110 abc	2.120 A
2	2.060 b-e	2.120 bcd	2.090BCD	2.167abc	2.310 abc	2.238 A
3	1.837 cde	1.963 b-e	1.900 CD	2.040 c	2.230 abc	2.135 A
4	2.217b	2.620 a	2.232 AB	2.250abc	2.373 a	2.312 A
5	2.053 b-e	2.183 bcd	2.118 BC	2.240 abc	2.347 ab	2.293 A
6	1.993b-e	2.153 bcd	2.073BCD	2.320 abc	2.323 abc	2.322 A
7	1.740 e	1.933 b-e	1.837D	2.067 bc	2.213 abc	2.140 A
8	2.200 bc	2.263 ab	2.418 A	2.183 abc	2.350 ab	2.267 A
9	2.00 b-e	2.130 bcd	2.068 BCD	2.183 abc	2.323 abc	2.253 A
Mean	2.037 A	2.102 A		2.176 B	2.287 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different
1-Control: Soil application of Crystalon at 90g / transplants as a source of NPK (20% N: 20% P: 20% K).
2-Soil application of blue green algea extract at 100 cm^3/ transplant + Control.
3-Soil application of blue green algea extract at 200 cm^3/ transplant + Control.
4-Soil application of marine diaton extract at 100 cm^3/ transplant + Control.
5-Soil application of marine diaton extract at 200cm^3/ transplant + Control.
6-Soil application of Effective microorganisms (EM) at 50 cm^3/ transplant + Control.
7-Soil application of Effective microorganisms (EM) at 100 cm^3/ transplant + Control.
8-Soil application of VAM fungi at 20g/ transplant + Control.
9-Soil application of VAM fungi at 40g/ transplant + Control.

Top /root ratio:

A. Specific effect:

With regard to the specific effect of mango cultivars, Table (7) shows that top /root ratio of Kent mango cultivar was relatively higher than that of Keitt mango cultivar. As for the specific effect of fertilizer treatments, it was quite evident that the response was more pronounced than that previously discussed with mango cultivars. Whereas, the top /root ratio in the transplants fertilized with soil application of VAM fungi at 20 g / transplant + control or soil application of blue green algea extract at 100cm^2 / transplant + control rather than in other treatments especially NPK (control) during both seasons of study.

B. Interaction effect:

Referring the response of top/root ratio to the interaction effect of various combinations between mango cultivars and fertilizer treatments, Table (7) clears that, the highest top /root ratio was usually coupled with those Kent mango cultivar transplants and fertilized with soil application of VAM fungi at 20 g/ transplant + control or soil application of blue green algea extract at 100cm^2/ transplant + control. The reverse was true with Keitt mango cultivar and fertilized with NPK, whereas the lowest values in top /root ratio was statistically exhibited by such combination during both seasons of study.

Such trend of response goes generally in line with finding of Kerni and Gupta (1986); Silva and Siqueira (1991); Sivakumar (2001); Akanbi *et al*., (2002) and Gautam *et al.* (2012).

References

Abd El Hamied, S.A., 2014. Improving Growth and Productivity of "Sukkary" Mango Trees Grown in North Sinai Using Extracts of Some Brown Marine Algae, Yeast and Effective Microorganisms. 1- Mineral content of leaves and fruit growth aspects. Middle East Journal of Agriculture Research, 3(2): 318-329.

Abd El-Latif, F.M., 2007. Response of Hindy Bisinara Mango trees to Inorganic, Organic and Bio fertilization. Fayoum J. Agric. Res. & Dev., 21 (2): 161-174.

Ahmed, F.F. and M.H. Morsy, 1999. A new methods for measuring leaf area in different fruit species. Minia J. Argic. Res. & Dev. 19:97 – 105.

Akanbi, W.B., A.O. Togun and R.A. Baiyewu, 2002. Suitability of plant residue compost as nursery growing medium for some tropical fruit tree seedlings. Moor Journal of Agricultural Research, 3: 1, 24.29; 12 ref.

Aseri, G.K., N. Jain, J. Panwar, A. V. Rao and P. R. Meghwal, 2008. Bio-fertilizers improve plant growth, fruit yield, nutrition, metabolism and rhizosphere enzyme activities of pomegranate (*Punica granatum* L.) in Indian Thar Desert. Scientia Horticulture, 117: 130-135.

Bill, G., 2001. Efficient Fertilizer Use-Phosphorus, pp.85-91. IMC Global 4th Ed. Illinois, USA.

Das, A., K.K. Mandal, M.A. Hasan, B.Bhattacharya, D. Majumder and B. Bandopadhyay, 2009. Effect of organic and inorganic nutrients on improving flowering. Acta Horticulturae, (820): 371-380. 12 ref.

Duncan, D. B., 1955. Multiple ranges and multiple F. test. Biometrics, 11: 1-42.

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.

FAO statistics, 2014, Food and Agriculture Organization WWW. FAO. Org.

Gautam, U.S., S. Rajesh, T. Neelam, P.S. Gurjar and A. Kumar, 2012. Effect of integrated nutrient management in mango cv. Sunderja. Indian Journal of Horticulture, 69 (2): 151-155. 13 ref.

Hasan, M.A., M. Manna, P. Dutta, K. Bhattacharya, S. Mandal, H. Banerjee, S.K. Ray and S. Jha, 2013b. 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 ref.

Hasan, M.A., R.R. Chowdhury, K.K. Mandal, D. Majumdar and A. Das, 2009. Effect of organic and inorganic nutrients in improving flowering of mango. Crop Research, 37(1/3): 95-100.

Kerni, P.N. and A. Gupta, 1986. Growth parameters affected by azotobacterization of mango seedlings in comparison to different nitrogen doses. Research and Development Reporter, 3: 2, 77-79; 5 ref.

Khanizadeh, S., C. Hamell H. Kianmehr, D. Buszard and D.L. Smith, 1995. Effect of three arbuscular mycorrhizal fungus species and phosphorus on productivity and vegetative growth of three strawberry cultivars. J. Plant Nutr., 18: 1073-1079.

Kundu, S., P. Datta, J. Mishra, K. Rashmi, and B. Ghosh, 2011. Influence of bio-fertilizer and inorganic fertilizer in pruned mango orchard cv. Amrapali. Journal of Crop and Weed, 7(2):100-103. 13 ref.

Mengel, K.E.; A. Kirkby; H. Kosegarten and T. Appel, 2001. Principles of plant nutrition. 5th edition. Kluwer Academic Publishers, Dordrecht.

Miller, E.W., R.L. Donahue and J.U. Miller, 1990. Soil an introduction to Soils and Plant Growth Brentice Hall International Inc. Engle Word Cliffs, New Jersey, pp. 210-220.

Mohsen, A.M., H.M. El- Mosallamy and S. M. El-Hefnawy, 1987. Some anatomical features of guava seedlings in response to soil moisture and soil salinity. 1. Leaf subculture . Zagazig J. Agric. Res. No. 14 (1) : 1-22.

Motskobili, N.A., 1984. Assimilation area of Satsuma in relation to mineral nutrition and it's effect on productivity. Subtropicheskie Kultry, No. 5, 83-90 VNILL chayaisk, Makharadze, Georgian SSR. (C.F. Hort., Abst. 55:2979).

Nijjar, G.S., 1985. Nutrition of Fruit Trees. Mrs. Usha Raji Kumar, Kilyani, New Delhi, India, 206-234.

Sivakumar, U., 2001. Effect of bacterial inoculants on mango (*Mangifera indica* L.) rootstock. Madras. Agricultural Journal, 88: 79, 486-487; 5 ref.

Silva, L.F. and J.O. Siqueira, 1991. Growth and nutrient contents of avocado, mango and papaya seedlings under the influence of different vesicular arbuscular mycorrhiza fungal species. Revista Brasileira de Ciencia do Solo, 15:3, 283-288; 26 ref.

Snedecor, G.W. and W.G. Cochran, 1980. Statistical Methods. Oxford and J.B.H. publishing com. 7th edition, 593 p.

Wassel, A.H.M., M.A. Sayed, A.Y. Mohamed, A.M. Ebrahim and E.A.M. Hassan, 2015. Effect of Using Plant Compost Enriched With Spirulina Platensis Algae as aPartial Replacement of Inorganic N Fertilization on Fruiting of Ewaise Mangoes. World Rural Observations, 7 (3): 102-109.

Yagoden, B.A., 1990. Agriculture Chemistry. Mir publishers Moscow pp. 278-281.