Growth and nu1`tritional status of Ewaise mango trees grown under Upper Egypt conditions as affected by application of nutrients, plant extracts, selenium and silicon

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Abstract: During 2014, 2015 and 2016 seasons, Ewaise mango trees grown under Upper Egypt conditions were subjected to three sprays with N, P, K, Mg, Zn, Fe, Mn, Cu and B, plant extracts namely extracts of turmeric and green tea and oils of garlic, onion, moringa and nigella, selenium and silicon. Length and thickness of shoot, number of leaves/shoot and leaf area in the spring growth cycle as well as chlorophylls a & b, total chlorophylls, total carotenoids, N, P, K and Mg in the leaves as affected with the present treatments were investigated. Treating the trees with different nutrients alone or in combined with any plant extracts, selenium or silicon had an announced promotion on all growth aspects, pigments and nutrients in the leaves relative to the control. Using selenium and/or silicon was favourable than using any plant extracts with nutrients in enhancing growth and leaf chemical components. The best plant extracts applied with nutrients, in descending order, were turmeric extract, oils of garlic, onion, moringa, nigella and green tea extract. For stimulating growth and tree nutritional status of Ewaise mango trees grown under Upper Egypt conditions, it is recommended to spray the trees three times with a mixture of N, P, K, Mg, Zn, Fe, Mn, Cu and B plus selenium and silicon.
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1. Introduction

Poor cropping and higher fruit dropping are considered to be the serious and major problems faces mango growers in Upper Egypt conditions. Malnutrition and unbalancing nutrition with various macro and micro nutrients are considered the main reasons for such problems.

Nowadays, many efforts had been established for finding out the best horticultural practices that are responsible for enhancing yield and fruit quality of the prime mango cv Ewaise. Among these efforts, are the use of macro and micronutrients, plant extracts, silicon and selenium.

Nutrients are essential in many plant metabolic processes. They play many important regulatory roles in plant development. Functions of nutrients are activating various enzymes involved in plant growth and enhancing the biosynthesis of carbohydrates, fats, proteins and natural hormone, and movement of carbohydrates. They are also responsible for stimulating cell division, cell enlargement, water and nutrient transport and building of amino acids **(Devlin and Withdam, 1983 and Nijjar, 1985).**

Plant extracts are used for improving production of mango fruits instead of using chemicals. The change for using plant extract against chemicals was performed because pathogens resistance to the fungicides has developed as well as for protecting our environment from pollution. It has long been recognized that naturally occurring substances in higher plants have antioxidant activity. Plant kingdom is a good source of natural preparations containing effective bioactive compounds which can be used for different application particular as food additives and health promoting ingredients in the formulations of functional foods and nutraceuticals. Nowadays, the interest has considerably increased for the use in storage studies (**Govinderajan, 1980**).

Silicon, (Si) the second most abundant element in the earth crust, has not yet received the title of essential nutrient for higher plants, as its role in plant biology is poorly understood (**Epstein, 1999**). However, various studies have demonstrated that Si application increased and enhanced plant growth considerably (**Alvarez and Datnoff, 2001**). Beneficial effects of Si are more prominent when plants were subjected to multiple stresses including biotic and abiotic stresses (**Aziz *et al.*, 2002; Rodrigues *et al.*, 2003; Ma, 2004 and Tahir, *et al.*, 2006**). Silicon is also known to increase drought tolerance in plants by maintaining plant water balance, photosynthetic activity, erectness of leaves, and structure of xylem vessels under high transpiration rates (**Melo *et al.*, 2003 and Hattori *et al.*, 2005**). Silicon is responsible

for improving water economy (**Gang *et al.*, 2003**) and leaf water potential under water stress conditions (**Matoh *et al.*, 1991**).

Selenium was found by many authors to enhance the activities of enzymes such as glutathione peroxidase, the tolerance of trees to abiotic and biotic stresses and the biosynthesis of carbohydrates and proteins. It also reduces reactive oxygen species (ROS) and protects plant cells from aging and death (**Gupta *et al.*, 2000; Whanger, 2002; Rayman *et al.*, 2002; Hanson *et al.*, 2003 and 2004; Seppanen *et al.*, 2003; Turakainen *et al.*, 2004 and 2006; Kirn *et al.*, 2005; Nowak-Barbara, 2008 and Jakovljevic *et al.*, 2011**).

Previous studies showed that using nutrients (**Banik *et al*, 1997; Mohamed 1998; Ahmed *et al.*, 2001; Abd –Allah, 2006; Ebeid- Sanaa, 2007; El-Sayed– Esraa, 2007; Ibrahiem *et al.*, 2007; El-Sayed–Esraa, 2010; Mohamed and El- Sehrawy, 2013; Abd El-Rady, 2015 and Abdelaziz *et al.*, 2015)**; plant extracts (**Abdelaal and Aly, 2013**; **Al Wasfy *et al.*, 2013**; **Mohamed and Mohamed, 2013; Ahmed, 2014**; **Refaai, 2014a; El- Khawaga and Mansour, 2014; Refaai, 2014b; Uwakiem, 2014 and Hegazy, 2015)**, silicon (**Gad El- Kareem, 2012; Abdelaal and Oraby- Mona, 2013; Ahmed *et al.*, 2013a and c; El-Khawaga and Mansour, 2014; Gad El- Kareem *et al.*, 2014; Ibrahim and Al-Wasfy, 2014; Abd El-Wahab, 2015 and Mohamed *et al.*, 2015)** and selenium **(Ibrahiem and Al-Wasfy, 2014; Gad El-Kareem *et al.*, 2014; Abo El-Fadle, 2017 and Masoud, 2017)** were very effective in improving vegetative growth traits and tree nutritional status of fruit crops.

The goal of this study was elucidating the effect of some nutrients, plant extracts, selenium and silicon on vegetative growth aspects and tree nutritional status of Ewaise mango trees grown under Upper Egypt conditions.

2. Materials and Methods

This investigation was conducted during three successive experimental seasons 2014, 2015 and 2016 on uniform in vigour thirty-three 10- years old Ewaise mango trees onto seedling rootstock. The trees are grown in a private orchard situated at Waborate El-Mataana village, Esna district, Luxor Governorate. The selected trees are planted at 6 × 6 meters apart (6 between rows and 6 between trees). The selected trees were irrigated through furrow (surface) irrigation system. The soil texture of the tested orchard is silty clay with a water table depth not less than two meters.

The selected trees received (33 trees) a basal recommended fertilizer including the application of 20 m3 farmyard manure (0.35 % N, 0.45 % P2O5, and 1.2 % K2O) added in early December, 200 kg/ fed/ mono calcium superphosphate (15.5 % P2O5) added in mid-January, 450 kg/ fed ammonium sulphate (20.6% N) added in three equal dressings in February, April and July and 200 kg/ fed potassium sulphate (48 % K2O) added in two equal dressings applied in mid-February and April, in addition to the regular agricultural and horticultural practices which were followed in the orchard including micronutrient application, pruning, hoeing, irrigation with Nile water as well as pathogens, insects and weed control.

Soil samples were taken (four samples) from a depth of 0.0 to 90 cm from soil surface and were physically and chemically analyzed before study start according to the procedure outlined by **Black *et al.* (1965)** and the obtained data are shown in Table (1).

Table (1): Analysis of the tested soil:

Characters	values
Particle size distribution:	
Sand %	: 10.1
Silt %	: 50.7
Clay %	: 39.2
Texture	: Silty clay
pH (1:2.5 extract)	: 7.49
E.C (1:2.5 extract) (mmhos/ cm/ 25°C)	: 0.69
O.M. %	: 2.92
$CaCO_3$ %	: 1.74
Total N %	: 0.15
Available P (Olsen method, ppm)	: 4.2
Available K (ammonium acetate, ppm)	: 411.0

This study included the following eleven treatments from macro and micronutrients, plant extracts, silicon and selenium.

1- Control treatment (spraying with water).
2- Spraying Stimufol compound at 0.25%.
3- Spraying Stimufol compound at 0.25%+ green tea extract at 0.05%.
4- Spraying Stimufol compound at 0.25%+ nigella oil at 1%.
5- Spraying Stimufol compound at 0.25%+ moringa leaves extract at 0.05%.
6- Spraying Stimufol compound at 0.25%+ onion oil at 1%.
7- Spraying Stimufol compound at 0.25%+ garlic oil at 1%.
8- Spraying Stimufol compound at 0.25%+ turmeric extract at 0.05%.
9- Spraying Stimufol compound at 0.25%+ selenium at 5 ppm.
10- Spraying Stimufol compound at 0.25%+ silicon at 50 ppm.
11- Spraying Stimufol compound at 0.25%+ selenium at 5 ppm +silicon at 50 ppm.

Each treatment was replicated three times, one tree per each (33 trees for all treatments). Spraying of Stimufol compound, plant extracts, silicon and selenium was done three times at growth start (mid. of Feb.), just after fruit setting (mid. of April) and at three weeks later (1st week of May). Triton B as a wetting agent was added at 0.3 ml/ I water to all solutions. Foliar application was carried out till runoff (20 L/ tree).

Table (2): Analysis of Stimufol amino compound.

character	values
N %	**25% N**
P %	**16 % (P_2O_5)**
K %	**12 % (K_2O)**
MgO	**0.02%**
Fe %	**0.17%**
Zn %	**0.03%**
Mn %	**0.085%**
Cu %	**0.085%**
B %	**0.044%**

Table (3): Chemical analysis of green tea

Constituent	Values
Total carbohydrate	**11 g**
Total fats	**0.4 g**
Favonoides	**0.3 g**
Tannins	**2.9 g**
Flour	**20 mg**
N	**1.19 g**
P	**0.24 g**
K	**1.0 g**
Mg	**0.5 g**
Zn	**41.0**
Fe	**51.0**
Mn	**60.0**
Coneshin	**0.7 g**
Thiamine	**110 mg**
Vitamin A	**90.0 g**
Vitamin B	**74.1 mg**
Vitamin C	**120.0 mg**
Coffeic acid	**315.0 mg**

Table (4): Chemical composition of Black cumin seed (according to Bourgou *et al*., 2010)

Compounds	Values %
Myristic acid %	**1.0**
Palmitic acid%	**13.1**
Palmatolic acid %	**0.2**
Stearic acid%	**2.3**
Oleic acid %	**23.8**
Linoleic acid%	**58.5**
Linolenic %	**0.4**
Archaic acid%	**0.5**
Saturated fatty acid %	**16.8**
Unsaturated fatty acid %	**82.9**
Moisture %	**8.1**
Proteins %	**23.3**
ASH%	**9.9**

Table (5): Chemical composition of moringa extract (*Moringa oleifera*)

Constituents	Values
a) Vitamins (mg/100 g D.W)	
Betacarotine	**149.2**
E	**50**
A	**90**
B_1	**88.9**
B_2	**1.1**
C	**19.0**
K	**25.6**
b) Minerals (mg/100 g D.W)	
Cu	**88.7**
K	**49.9**
N	**89.9**
P	**12.9**
Mg	**20.2**
c) Amino acids (mg/100 g D.W)	
Lysine	**8.3**
Leucine	**9.3**
Threonine	**6.6**
Isoleucine	**6.3**
Cysteine	**2.4**
Methionine	**3.6**
Tryptophan	**3.3**

Table (6): Chemical composition of onion oil (Mnayer *et al*., 2014)

Compounds	Values (mg/100g D.W)
1-Propenyl propyl disulfide [a]	**7.26**
Methyl propyl trisulfide	**5.2**
Menthone	**0.34**
Methyl propyl trisulfide	**0.47**
Dimethyl tetrasulfide	**0.15**
Dipropyl trisulfide	**17.10**
Eugenol	**3.07**
2-Methyl-3,4-dithiaheptane	**6.48**
Dipropyl tetrasulfide	**0.55**
Dipropyl disulfide	**30.92**
Allyl propyl sulfide	**0.42**
Dimethy trisulfide	**0.30**

Table (7): Chemical composition of Turmeric (according to Shiyou *et al*., (2011)

Compounds	Values
β- Bisabolene %	1.3
1.8-Cineol %	2.4
p-Cymene %	3.0
p-Cymen-8-ol %	0.3
Tr-Curcumin%	6.3
Curlone %	10.6
Dehydrocurcumin %	2.2
Myrcene	0.1
α-Phellandrene %	0.1
α- Pinene %	0.1
Terpinolene %	0.3
Tr-Turmerone %	31.1
Turmerone %	10.0
Ascorbic acid (mg)	50.0
ASH (g)	6.8
Calcium (g)	0.2
Carbohydrate (g)	69.9
Fat (g)	8.9

Compounds	Values
Food energy (k Cal)	390.0
Iron (g)	47.5
Niacin (mg)	4.8
Potassium (mg)	200.0
Phosphorus (mg)	260.0
Protein (g)	8.5
Riboflavin (mg)	0.19
Sodium (mg)	30.0
Thiamine (mg)	0.09
Water (g)	6.0

Table (8): Chemical composition of garlic oils (according to Mnayer *et al*., 2014)

Compounds	Values (mg/100g D.W)
Dipropyl disulfide	**0.25**
Diallyl disulfide	**37.90**
Dimethyl trisulfide	**0.33**
Dimethyl thiophene [a]	**0.08**
Allyl methyl disulfide	**3.69**
Methyl propyl disulfide	**0.25**
Methyl 1-propenyl disulfide [a]	**0.46**
Allyl propyl sulfide	**0.09**
Bis-(1-propenyl)-sulfide [a]	**0.08**
Diallyl sulfide	**6.59**
Dimethyl disulfide	**0.15**
Allyl methyl teterosulfide	**1.07**
Allyl propyl trisulfide	**0.23**
Dially trisulfide	**28.06**
Eugenal	**0.23**

Statistical analysis was done using randomized complete block design (RCBD) with three replicates, each with one Ewaise mango trees. Each block contained eleven treatments.

During the three seasons the following measurements were recorded:

1- Vegetative growth characteristics namely length and thickness of spring growth cycle shoot, number of leaves / shoot and leaf area (cm)2 (**Ahmed and Morsy, 1999**).

2- Leaf pigments namely chlorophyll a & b, total chlorophylls and total carotenoids (mg/ 1 g F.W.) (**Hiscox and Isralstam, 1979**).

3- Percentages of N, P, K and Mg in the leaves (on dry weight basis) (**Chapman and Pratt, 1965 and Wilde *et al.*, 1985**).

All the obtained data during the course of this study in the three successive seasons, 2014, 2015 and 2016 were tabulated and subjected to the proper statistical analysis. The differences between various treatment means were compared using new L.S.D. parameter at 5 % (according to **Snedecor and Cochran, 1967 and Mead *et al*. 1993).**

3. Results and Discussion

1- Vegetative growth aspects:

It is clear from the obtained data in Table (9) that the four growth traits namely length and thickness of shoot, number of leaves/shoot and leaf area were significantly varied among the eleven nutrients, plant extracts, selenium and silicon treatments. Single and combined applications of nutrients (N, P, K, Mg, Zn, Fe, Mn, Cu and B), plant extracts (oils of nigella, moringa, onion and garlic each at 1% and extracts of green tea and turmeric each at 0.05%), selenium at 5ppm and silicon at 50 ppm significantly enhanced the four growth aspects rather than non-applications. Using plant extracts (oils of nigella, moringa, onion and garlic each at 1% and extracts of green tea and turmeric each at 0.05%), selenium at 5ppm and silicon at 50 ppm plus nutrients (N, P, K, Mg, Zn, Fe, Mn, Cu and B) was significantly favourable than using nutrients alone in stimulating these growth aspects. Using selenium at 5 ppm and/or silicon at 50ppm was significantly superior than using plant extracts (oils of nigella, moringa, onion and garlic each at 1% and extracts of green tea and turmeric each at 0.05%) in enhancing these plant growth traits. Using silicon at 50 ppm was significantly favourable than using selenium in this respect. Combined application of selenium at 5 ppm and silicon at 50 ppm was significantly superior than using each element alone in this respect. Using green tea extract at 0.05%, oils of nigella, moringa, onion and garlic each at 1% and turmeric extract at 0.05%, in ascending order had an announced promotion on these growth aspects. The best plant extracts in enhancing these growth attributes, in descending order were turmeric extract at 0.05%, oils of garlic, onion, moringa and nigella each at 1% and green tea extract at 0.05%. The maximum values of shoot length **(24.9 & 26.1 & 25 cm)**, shoot thickness **(0.94 & 0.95 & 0.92 cm)**, number of leaves/shoot **(21.0 & 23.0 & 22.0 leaf)** and leaf **area (91.4 & 91.2 & 91.1 cm^2)** were observed on the trees that received three sprays of a mixture of nutrients (N, P, K, Mg, Zn, Fe, Mn, Cu and B), selenium and silicon, during the three seasons, respectively. The lowest values were recorded during the three seasons on the untreated trees. These results were true during the three seasons.

2- Leaf chemical composition:

It is clear from the obtained data in Tables (10 & 11) that treating the trees with nutrients (N, P, K, Mg, Zn, Fe, Mn, Cu and B) and/or any one of the six plant extracts (oils of nigella, moringa, onion and garlic each at 1% and extracts of green tea and turmeric each at 0.05%), selenium at 5ppm and silicon at 50 ppm significantly was responsible for enhancing chlorophylls a & b, total chlorophylls, total carotenoids, N, P, K and Mg in the leaves relative to the check treatment. The promotion on these chemical components was significantly associated with using plant extracts (oils of nigella, moringa, onion and garlic each at 1% and extracts of green tea and turmeric each at 0.05%), selenium at 5ppm and silicon

at 50 ppm with nutrients. Using selenium at 5 ppm and/or silicon at 50 ppm was significantly favourable than using any plant extracts in enhancing these chemical constituents. The highest values were recorded due to using nutrients besides turmeric extract, oils of garlic, onion, moringa and nigella each at 1% and green tea extract at 0.05%, in descending order. Using selenium and silicon was significantly superior than using each alone in enhancing pigments and nutrients in the leaves. The maximum values of chlorophylls a **(8.2 & 7.3 & 7.4 mg/ 1 g F.W.)**, chlorophyll b **(4.0 & 4.0 & 4.0 mg / 1 g F.W.)**, total chlorophylls **(12.2 & 11.3 & 11.4 mg/ 1 g F.W.)** and total carotenoids **(3.3 & 3.5 & 3.6 mg/ 1 g F.W.)**, N **(2.20 & 2.13 & 2.17%)**, P **(0.41 & 0.43 & 0.40%)**, K **(1.50 & 1.47 & 1.52%)** and Mg **(0.93 & 0.86 & 0.90%)** were recorded on the trees that received all materials together (nutrients, selenium and silicon) during 2014, 2015 and 2016 seasons, respectively. The untreated trees produced the minimum values. Similar results were obtained during the three seasons.

4. Discussion

Nutrients are essential in many plant metabolic processes. They play many important regulatory roles in plant development. Functions of nutrients are activate various enzymes involved in plant growth, enhance the biosynthesis of carbohydrates, fats, proteins and natural hormone, and movement of carbohydrates. They are also responsible for stimulating cell division, cell enlargement, water and nutrient transport and building of amino acids (**Devlin and Withdam, 1983 and Nijjar, 1985**).

Table (9): Effect of single and combined applications of some nutrients, plant extracts, selenium and silicon on some vegetative growth aspects of Ewaise mango trees during 2014, 2015 and 2016 seasons.

Treatments	Shoot length (cm)			Shoot thickness (cm)			No. of leaves/shoot			Leaf area (cm^2)		
	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016
1- Control	15.1	15.4	15.9	0.59	0.57	0.60	11.0	11.0	10.0	78.2	78.3	79.0
2- Spraying nutrients	16.0	16.5	16.9	0.62	0.60	0.64	12.0	12.0	11.0	80.0	79.7	80.0
3- Spraying nutrients+ green tea at 0.05%	16.9	17.5	17.9	0.66	0.63	0.68	13.0	13.0	12.0	81.2	81.0	81.3
4- Spraying nutrients+ nigella oil at 1 %	17.8	18.6	18.9	0.70	0.67	0.71	14.0	14.0	14.0	82.5	82.1	83.0
5- Spraying nutrients+ moringa extract at 1%	18.9	19.7	20.0	0.73	0.71	0.75	15.0	16.0	15.0	83.6	83.2	84.4
6- Spraying nutrients+ onion oil at 1%	19.9	20.8	21.0	0.77	0.75	0.77	16.0	17.0	16.0	85.0	84.5	86.0
7- Spraying nutrients+ garlic oil at 1%	20.9	22.0	21.9	0.80	0.80	0.79	17.0	18.0	17.0	86.1	85.8	86.9
8- Spraying nutrients+ turmeric extract at 0.05%	22.0	23.1	23.0	0.84	0.84	0.81	18.0	19.0	18.0	87.3	87.0	87.9
9- Spraying nutrients+ selenium at 5 ppm	22.8	24.1	23.0	0.87	0.87	0.83	19.0	21.0	19.0	89.0	88.4	88.8
10- Spraying nutrients+ silicon at 50 ppm	24.0	25.1	24.0	0.90	0.90	0.86	20.0	22.0	20.0	90.2	90.0	90.0
11- Spraying nutrients+ selenium+ silicon	24.9	26.1	25.0	0.94	0.95	0.92	21.0	23.0	22.0	91.4	91.2	91.1
New L.S.D. at 5%	0.8	1.0	0.9	0.03	0.03	0.02	1.0	1.0	1.0	1.1	1.0	0.9

Table (10): Effect of single and combined applications of some nutrients, plant extracts, selenium and silicon on some leaf pigments of Ewaise mango trees during 2014, 2015 and 2016 seasons.

Treatments	Chlorophyll a (mg/ 1.0 g FW.)			Chlorophyll b (mg/ 1.0 g FW.)			Total chlorophyll (mg/ 1.0 g FW.)			Total carotenoids (mg/ 1.0 g F.W.)		
	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016
1- Control	4.0	4.0	4.0	1.3	1.2	1.4	5.3	5.2	5.4	1.1	1.0	1.0
2- Spraying nutrients	4.4	4.3	4.4	1.6	1.6	1.6	6.0	5.9	6.0	1.3	1.2	1.2
3- Spraying nutrients+ green tea at 0.05%	4.8	4.7	4.8	1.9	1.8	1.8	6.7	6.5	6.6	1.5	1.5	1.5
4- Spraying nutrients+ nigella oil at 1 %	5.2	5.0	5.1	2.2	2.0	2.0	7.4	7.0	7.1	1.8	1.7	1.8
5- Spraying nutrients+ moringa extract at 1%	5.6	5.3	5.4	2.5	2.2	2.2	8.1	7.8	7.6	2.0	1.9	2.0
6- Spraying nutrients+ onion oil at 1%	6.1	5.6	5.7	2.8	2.5	2.6	8.9	8.4	8.3	2.2	2.1	2.2
7- Spraying nutrients+ garlic oil at 1%	6.6	6.0	6.0	3.0	2.7	2.8	9.6	8.7	8.8	2.3	2.3	2.5
8- Spraying nutrients+ turmeric extract at 0.05%	7.0	6.3	6.4	3.3	3.0	3.0	10.3	9.3	9.4	2.5	2.6	2.8
9- Spraying nutrients+ selenium at 5 ppm	7.4	6.6	6.7	3.5	3.3	3.3	10.9	9.9	10.0	2.8	3.0	3.1
10- Spraying nutrients+ silicon at 50 ppm	7.8	7.0	7.0	3.8	3.6	3.6	11.6	10.8	10.6	3.0	3.3	3.3
11- Spraying nutrients+ selenium+ silicon	8.2	7.3	7.4	4.0	4.0	4.0	12.2	11.3	11.4	3.3	3.5	3.6
New L.S.D. at 5%	0.3	0.3	0.4	0.2	0.2	0.2	0.5	0.6	0.6	0.2	0.2	0.2

Table (11): Effect of single and combined applications of some nutrients, plant extracts, selenium and silicon on the percentages of N, P, K and Mg in the leaves of Ewaise mango trees during 2014, 2015 and 2016 seasons.

Treatments	Leaf N %			Leaf P %			Leaf K %			Leaf Mg %		
	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016
1- Control	1.56	1.59	1.57	0.12	0.10	0.10	1.07	1.08	1.10	0.49	0.50	0.48
2- Spraying nutrients	1.62	1.64	1.61	0.15	0.13	0.12	1.11	1.12	1.15	0.54	0.55	0.52
3- Spraying nutrients+ green tea at 0.05%	1.68	1.70	1.67	0.18	0.15	0.14	1.15	1.16	1.20	0.57	0.60	0.56
4- Spraying nutrients+ nigella oil at 1 %	1.74	1.75	1.72	0.21	0.17	0.16	1.19	1.20	1.24	0.61	0.66	0.60
5- Spraying nutrients+ moringa extract at 1%	1.80	1.81	1.79	0.24	0.20	0.18	1.23	1.24	1.28	0.66	0.68	0.64
6- Spraying nutrients+ onion oil at 1%	1.86	1.87	1.88	0.27	0.23	0.21	1.27	1.28	1.32	0.71	0.70	0.69
7- Spraying nutrients+ garlic oil at 1%	1.92	1.94	1.95	0.30	0.27	0.25	1.31	1.32	1.36	0.75	0.73	0.74
8- Spraying nutrients+ turmeric extract at 0.05%	1.99	2.00	2.01	0.33	0.30	0.27	1.36	1.35	1.40	0.80	0.76	0.78
9- Spraying nutrients+ selenium at 5 ppm	2.06	2.04	2.07	0.35	0.34	0.31	1.41	1.38	1.44	0.85	0.80	0.82
10- Spraying nutrients+ silicon at 50 ppm	2.12	2.09	2.12	0.38	0.39	0.35	1.45	1.41	1.48	0.90	0.83	0.86
11- Spraying nutrients+ selenium+ silicon	2.20	2.13	2.17	0.41	0.43	0.40	1.50	1.47	1.52	0.93	0.86	0.90
New L.S.D. at 5%	0.05	0.04	0.03	0.02	0.02	0.02	0.04	0.03	0.04	0.03	0.02	0.03

These results are in concordance with those obtained by **Banik *et al,* (1997); Mohamed (1998); Ahmed *et al.,* (2001); Abd –Allah (2006); Ebeid-Sanaa (2007); El- Sayed - Esraa (2007); Ibrahiem *et al.,* (2007); El- Sayed– Esraa (2010);; Mohamed and El- Sehrawy (2013); Abd El-Rady (2015) and Abdelaziz *et al.,* (2015)**.

Plant extracts are used for improving production of mango fruits instead of using chemicals. The change for using plant extract against chemicals was performed because pathogens resistance to the fungicides has developed as well as for protecting our environment from pollution. It has long been recognized that naturally occurring substances in higher plants have antioxidant activity. Plant kingdom is a good source of natural preparations containing effective bioactive compounds which can be used for different application particular as food additives and health promoting ingredients in the formulations of functional foods and nutraceuticals. Nowadays, the interest has considerably increased for the use in storage studies (**Govindarajan, 1980**).

This results regarding the effect of plant extract in improving growth and nutritional status of Ewaise mango trees are in agreement with those obtained by **Abdelaal and Aly, (2013); Al Wasfy *et al*., (2013); Mohamed and Mohamed (2013); Ahmed, (2014); Refaai (2014a); El- Khawaga and Mansour (2014); Refaai (2014b); Uwakiem (2014) and Hegazy (2015)**.

Silicon, (Si) the second most abundant element in the earth crust, has not yet received the title of essential nutrient for higher plants, as its role in plant biology is poorly understood (**Epstein, 1999**). However, various studies have demonstrated that Si application increased and enhanced plant growth considerably (**Alvarez and Datnoff, 2001**). Beneficial effects of Si are more prominent when plants were subjected to multiple stresses including biotic and abiotic stresses (**Aziz *et al*., 2002; Rodrigues *et al.,* 2003; Ma, 2004 and Tahir, *et al.,* 2006**). Silicon is also known to increase drought tolerance in plants by maintaining plant water balance, photosynthetic activity, erectness of leaves, and structure of xylem vessels under high transpiration rates (**Melo *et al*., 2003 and Hattori *et al*., 2005**). Silicon is responsible for improving water economy (**Gang *et al.,* 2003**) and leaf water potential under water stress conditions (**Matoh *et al.,* 1991**). The previous authors suggested that a silicon cuticle double layer formed on leaf epidermal tissue is responsible for this higher water potential. Results of **Lux *et al.,* (2003) and Hattori *et al.,* (2005)** suggested that Si plays an important role in water transport and root growth under drought conditions. **Bowen *et al.,* (1992)** stated that Si inhibit powders mildew in grapes. **Savuas *et al*., (2002) and Iwaski *et al.,* (2002)** stated that the favorable effects of silicon on crops seem to originate from reinforcement of the cell walls due to deposition of Si in the form of silica morphous ($SiO_2.H_2O$) and opal phytoliths consequently increases the improving light reception. The mechanical strength provided by Si to the plant tissues increases their resistance to several bacterial, fungi insect and diseases and decreased the occurrence of the physiological disorders. Si was implicated to ameliorate the adverse effects of aluminum, manganese and salinity toxicity.

The results of **Gad El- Kareem (2012); Abdelaal and Oraby- Mona (2013); Ahmed *et al.,* (2013a and b); El-Khawaga and Mansour (2014); Gad El- Kareem *et al*., (2014); Ibrahim and Al-Wasfy (2014); Abd El-Wahab (2015) and Mohamed *et al*., (2015)** supported the presents results concerning the effect of silicon on improving growth and tree nutritional status of Ewaise mango trees.

Selenium was found by many authors to enhance the activities of enzymes such as glutathione peroxidase, the tolerance of trees to abiotic and biotic stresses and the biosynthesis of carbohydrates and proteins. It also reduces reactive oxygen species (ROS) and protects plant cells from aging and death (**Gupta *et al*., 2000; Whanger, 2002; Rayman *et al*., 2002; Hanson *et al*., 2003 and 2004; Seppanen *et al*., 2003; Turakainen *et al*., 2004 and 2006; Kirn *et al.,* 2005; Nowak-Barbara, 2008 and Jakovljevic *et al*., 2011**).

The results with regard to the promoting effect of selenium on growth and nutritional status of Ewaise mango trees are in harmony with those obtained by **Ibrahiem and Al-Wasfy (2014); Gad El-Kareem *et al.*, (2014); Abo El-Fadle (2017) and Masoud, (2017)**.

Conclusion

For stimulating growth and tree nutritional status of Ewaise mango trees grown under Upper Egypt conditions, it is recommended to spray the trees three times with a mixture of N, P, K, Mg, Zn, Fe, Mn, Cu and B plus selenium and silicon.

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