**Response of Succary Mango Trees to Foliar Application of Silicon and Boron**

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**Abstract:** This study was carried out during 2013 and 2014 seasons to examine the effect of single and combined applications of potassium silicate at 0.1 to 0.2% and boric acid at 0.025 to 0.05% on growth, nutritional status of the trees, yield and fruit quality of Succary mango trees grown under Upper Egypt region conditions. Single and combined applications of potassium silicate at 0.1 to 0.2% and boric acid at 0.025 to 0.05 % were very effective in stimulating all growth characters in the Spring, Summer and Autumn growth cycles, chlorophylls a, b, total chlorophylls, N, P, K and Mg in the leaves, yield and fruit quality relative to the control treatment. Using potassium silicate was superior than using boric acid in this respect. Carrying out three sprays of a mixture of potassium silicate at 0.1 % and boric acid at 0.025 % was responsible for improving yield and fruit quality of Succary mango trees grown under Upper Egypt conditions.

[Moawad A Mohamed; Mohamed A. El- Sayed and Hamdy A. M. Abd El- Wahab. **Response of Succary Mango Trees to Foliar Applciaiton of Silicon and Boron.** *World Rural Observ* 2015;7(2):93-98]. ISSN: 1944-6543 (Print); ISSN: 1944-6551 (Online). <http://www.sciencepub.net/rural>. 14

**Key words:** Succary mango trees, boron, silicon, yield and fruit quality

**1. Introduction**

Nowadays, many attempts are established for improving yield and fruit quality of mango trees by using non- traditional methods. Silicon is beneficial on enhancing the tolerance of mango trees to biotic and abiotic stresses, water and nutrients uptake, photosynthesis and water transport. It is very important for reducing the severity of the trees to most disorders through forming a silicon cuticle double layers on the leaf epidermal tissues which is responsible for preventing the penetration of fungal hypha. Also, it is essential for ameliorating the adverse effects of heavy metal toxicity (**Mengel *et al.,* 2001; Aziz *et al.,* 2002; Lux *et al.,* 2002 and 2003; Sauvas *et al.,* 2002; Iwaskai *et al.,* 2002 : Gang *et al.,* 2003; Melo *et al.,* 2003 and Tahr *et al.,* 2006**).

Boron has an announced impact on fruiting of fruit crops through its important roles in enhancing cell division, biosynthesis and translocation of sugars and hormones, root development, pollens germination, water and nutrients uptake and flower but formation and decreasing dropping of flowers and fruit and the incidence of disorders (**Fraguas and Silva, 1998**).

Previous studies showed that silicon (**Gad El- Kareem, 2012; Ahmed *et al.,* 2013a and 2013b; Abdelaal and Oraby- Mona, 2013, Ibrahiem and Al- Wasfy, 2014; El Khawaga and Mansour, 2014; Gad El- Kareem *et al.,* 2014 and Al- Wasfy, 2014**) and boron (**Ebeid- Sanaa, 2007; El- Sayed- Esraa, 2007; Ibrahiem *et al.,* 2007; Abdelaal, 2008; Refaai, 2014 and Hassan- Huda, 2014**) had an announced promotive effects on growth, yield and fruit quality of different fruit corps.

The target of this study was examining the effect of single and combined applications of silicon and boron at various concentrations on yield and fruit quality of Succary mango trees grown under Upper Egypt region conditions.

**2. Material and Methods**

This study was carried out during 2013 and 2014 seasons on twenty- one uniform in vigour 11- years old Succary mango trees onto seedling mango rootstock. The selected trees are grown in a private orchard located at Keman El- Mataana village, Esna district, Luxor Governorate. The trees are planted at 7x7 meters apart. The texture of the tested soil is clay (**Wilde, 1985**). The selected trees were kept under the normal horticultural practices that already applied in the orchard except those dealing with the application of potassium silicate and boric acid.

This study included seven treatments arranged as follows:

1- Control( treated with water trees).

2- Spraying potassium silicate at 0.1%

3- Spraying potassium silicate at 0.2%.

4- Spraying boric acid at 0.025%.

5- Spraying boric acid at 0.05.

6- Spraying both at the first concentration.

7- Spraying both at the second concentration.

Each treatment was replicated three times, one tree per each. Potassium silicate ( 20% Si + 10% K2O) and boric acid (17% B) were sprayed three times at growth start, just after fruit setting and at one month later Triton b as a wetting agent was added to all sprayed solutions at 0.05% and spraying was done till runoff (50 L water / tree). Randomized completed block design (RCBD) was followed.

**Table (1): Analysis of the tested soil:**

|  |  |
| --- | --- |
| Constituents  | Values |
| **Particle size distribution :** |  |
| Sand %  | 4.1 |
| Silt % | 13.0 |
| Clay % | 82.9 |
| Texture  | Clay |
| pH ( 1 : 2.5 extract) | 7.11 |
| E.C ( ha 2.5 extract) mmhos/ 1 cm/ 25oC) | 0.71 |
| O.M. % | 2.50 |
| CaCO3 % | 1.13 |
| Total N % | 0.12 |
| Available P ( ppm, olsen) | 4.1 |
| Available K (ppm, ammonium acetate) | 450 |

During both seasons the following parameters were recorded, vegetative growth characters namely shoot length (cm.); length and width of leaves (cm.), number of leaves per shoot, shoot thickness (cm.) and leaf area (cm)2 (**Ahmed and Morsy, 1999**) in the three growth cycles (Spring, Summer and Autumn), chlorophylls a & b, total chlorophylls (**Von- Wettstein, 1957 and Hiscox and Isralstam, 1979**) as mg/100 g F.W., N, P, K and Mg in the leaves (**Summer, 1985 and Wilde *et al.,* 1985**), percentages of initial fruit setting and fruit retention, yield / tree (kg.), number of fruits / tree, fruit weight (g.) and dimensions (length & width& thickness) (in cm), percentages of pulp, peel and seed weights, edible / non- edible portions, T.S.S. %, total and reducing sugars **(A.O.A.C., 2000)**, total acidity % as g citric acid / 100 g pulp and vitamin C content ( as mg/ 100 g pulp **(A.O.A.C., 2000)**.

Statistical analysis was done and treatment means were compared using new L.S.D. at 5% according to **Mead *et al.* (1993)**.

**3. Results**

**1- Growth characters in the three growth flushes:**

Table (2): Effect of single and combined applications of potassium silicate and boric acid on some vegetative growth characters in Spring growth cycle of Succary mango trees during 2012 and 2014 seasons.

|  |  |
| --- | --- |
| **Treatment** | **Spring growth cycle**  |
| **Shoot length (cm)** | **No. of leaves / shoot** | **leaf length (cm.)** | **leaf width (cm.)** | **leaf area (cm2)** | **Shoot thickness (cm.)** |
| **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** |
| Control  | **10.1** | **11.0** | **7.0** | **8.0** | **14.0** | **15.0** | **4.0** | **4.7** | **38.14** | **48.29** | **0.48** | **0.50** |
| Spraying K silicate at 0.1 % | **13.9** | **14.8** | **10.0** | **11.0** | **16.9** | **18.0** | **5.1** | **5.8** | **59.27** | **72.02** | **0.57** | **0.59** |
| Spraying K silicate at 0.2 % | **14.0** | **15.0** | **10.0** | **11.0** | **17.1** | **18.** | **5.2** | **5.9** | **61.18** | **74.11** | **0.61** | **0.60** |
| Spraying boric acid at 0.025 % | **11.9** | **13.0** | **8.0** | **9.0** | **15.1** | **16.1** | **4.5** | **5.2** | **46.51** | **57.54** | **0.51** | **0.54** |
| Spraying boric acid at 0.05 % | **1.0** | **13.1** | **8.0** | **9.0** | **15.2** | **16.3** | **4.6** | **5.3** | **47.88** | **89.41** | **0.52** | **0.55** |
| Spraying both at 1st conc.  | **16.3** | **17.5** | **12.0** | **14.0** | **19.0** | **20.0** | **6.9** | **7.6** | **90.71** | **105.34** | **0.67** | **0.68** |
| Spraying both at 2nd conc.  | **16.4** | **17.7** | **12.0** | **14.0** | **19.3** | **20.6** | **7.1** | **7.7** | **94.88** | **109.9** | **0.69** | **0.69** |
| New L.S.D. at 5% | **1.1** | **0.9** | **1.0** | **1.0** | **0.9** | **0.9** | **0.4** | **0.4** | **4.99** | **5.11** | **0.03** | **0.03** |

Table (3): Effect of single and combined applications of potassium silicate and boric acid on some vegetative growth characters in Summer growth cycle of Succary mango trees during 2012 and 2014 seasons.

|  |  |
| --- | --- |
| **Treatment** | **Summer growth cycle**  |
| **Shoot length (cm)** | **No. of leaves / shoot** | **leaf length (cm.)** | **leaf width (cm.)** | **leaf area (cm2)** | **Shoot thickness (cm.)** |
| **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** |
| Control  | **5.1** | **6.0** | **6.0** | **5.9** | **13.0** | **13.1** | **3.8** | **4.5** | **33.52** | **40.21** | **0.42** | **0.44** |
| Spraying K silicate at 0.1 % | **8.9** | **9.8** | **9.0** | **9.0** | **15.1** | **15.2** | **4.9** | **5.6** | **50.73** | **58.52** | **0.55** | **0.57** |
| Spraying K silicate at 0.2 % | **9.0** | **10.0** | **9.0** | **9.0** | **15.2** | **15.3** | **5.0** | **5.7** | **52.14** | **59.99** | **0.56** | **0.58** |
| Spraying boric acid at 0.025 % | **6.3** | **7.4** | **7.3** | **7.2** | **14.0** | **14.1** | **4.2** | **5.0** | **40.1** | **48.29** | **0.47** | **0.49** |
| Spraying boric acid at 0.05 % | **6.4** | **7.5** | **7.5** | **7.3** | **14.1** | **14.2** | **4.3** | **5.1** | **41.38** | **49.63** | **0.48** | **0.50** |
| Spraying both at 1st conc.  | **11.9** | **12.9** | **4.0** | **11.2** | **16.9** | **17.0** | **6.5** | **7.2** | **75.84** | **84.62** | **0.64** | **0.66** |
| Spraying both at 2nd conc.  | **12.0** | **13.0** | **4.3** | **11.5** | **17.0** | **17.1** | **6.6** | **7.3** | **77.48** | **86.32** | **0.65** | **0.67** |
| New L.S.D. at 5% | **1.0** | **1.0** | **1.0** | **1.0** | **0.9** | **0.9** | **0.4** | **0.4** | **3.92** | **3.98** | **0.03** | **0.04** |

Table (4): Effect of single and combined applications of potassium silicate and boric acid on some vegetative growth characters in Autumn growth cycle of Succary mango trees during 2012 and 2014 seasons.

|  |  |
| --- | --- |
| **Treatment** | **Autumn growth cycle**  |
| **Shoot length (cm)** | **No. of leaves / shoot** | **leaf length (cm.)** | **leaf width (cm.)** | **leaf area (cm2)** | **Shoot thickness (cm.)** |
| **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** |
| Control  | **4.7** | **5.5** | **5.0** | **4.9** | **12.5** | **12.6** | **3.5** | **4.1** | **59.57** | **53.10** | **0.40** | **0.44** |
| Spraying K silicate at 0.1 % | **8.5** | **9.3** | **8.0** | **8.0** | **14.5** | **14.5** | **4.6** | **5.2** | **45.63** | **51.72** | **0.53** | **0.55** |
| Spraying K silicate at 0.2 % | **8.6** | **9.5** | **8.0** | **8.0** | **14.6** | **14.7** | **4.7** | **5.3** | **46.97** | **53.48** | **0.54** | **0.56** |
| Spraying boric acid at 0.025 % | **5.9** | **6.9** | **6.8** | **6.9** | **13.6** | **13.7** | **3.9** | **4.6** | **36.07** | **43.05** | **0.45** | **0.48** |
| Spraying boric acid at 0.05 % | **6.0** | **7.0** | **7.0** | **7.0** | **13.8** | **13.8** | **4.0** | **4.6** | **37.58** | **44.34** | **0.46** | **0.49** |
| Spraying both at 1st conc.  | **11.5** | **12.3** | **7.0** | **7.3** | **15.6** | **15.7** | **6.0** | **6.8** | **63.92** | **73.67** | **0.61** | **0.63** |
| Spraying both at 2nd conc.  | **11.6** | **12.4** | **7.1** | **7.4** | **15.6** | **16.0** | **6.1** | **6.9** | **65.55** | **76.22** | **0.62** | **0.64** |
| New L.S.D. at 5% | **0.9** | **0.9** | **1.0** | **1.0** | **0.8** | **0.7** | **0.3** | **0.3** | **3.55** | **3.79** | **0.03** | **0.04** |

It is clear from the data ion Tables ( 2, 3 & 4) that single and combined application of potassium silicate at 0.1 to 0.2% and boric acid at 0.025 to 0.05% significantly was accompanied with stimulating shoot length, length and width of the leaves, number of leaves/ shoot, leaf area and shoot thickness in the three growth cycles comparing with the check treatment Using potassium silicate was superior than using boric acid in this respect. Combined application of such two materials surpassed the application of each material alone in enhancing these growth traits. Increasing concentrations of potassium silicate from 0.1 to 0.2% and boric acid from 0.02 % to 0.05% failed significantly to show any stimulation on these growth traits. The highest values were recorded on the trees that received three sprays of a mixture of potassium silicate at 0.2% and boric acid at 0.05 %. The control trees produced the minimum values. Similar results were announced during both seasons.

**2- Leaf chemical composition**

Data in Table (5) clearly show that chlorophylls a & b, total chlorophylls, N, P, K and Mg in the leaves of Succary mango trees were significantly enhanced in response to single and combined applications of potassium silicate and boric acid rather than non- application. Application of potassium silicate was significantly superior than using boric acid in this connection. Insignificant promotion on these parameters was detected with increasing concentrations of potassium silicate from 0.1 to m0.2% as well as boric acid form 0.0.25 to 0.05%. Using potassium silicate plus boric acid was significantly preferable than using each alone in enhancing these nutrients. A significant promotion was observed owing to using potassium silicate relative to using boric acid. Carrying out three sprays of a mixture of potassium silicate at 0.2 % plus boric acid at 0.05 % gave the maximum values These results were true during both seasons.

Table (5): Effect of single and combined applications of potassium silicate and boric acid on chlorophylls a & b, total chlorophylls and percentages of N, P, K and Mg in the leaves of Succary mango trees during 2012 and 2014 seasons.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Chlorophyll a (mg/ 100 g F.W.)** | **Chlorophyll b (mg/ 100 g F.W.)** | **Total chlorophylls (mg/ 100 g F.W.)** | **Leaf N %** | **Leaf P %** | **Leaf K %** | **Leaf Mg %** |
| **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** |
| Control  | **4.1** | **4.3** | **3.1** | **3.3** | **7.2** | **7.6** | **1.64** | **1.70** | **0.15** | **0.16** | **1.31** | **1.29** | **0.51** | **0.52** |
| Spraying K silicate at 0.1 % | **6.1** | **6.5** | **4.9** | **5.3** | **11.0** | **11.8** | **1.84** | **1.89** | **0.23** | **0.24** | **0.49** | **1.39** | **0.60** | **0.63** |
| Spraying K silicate at 0.2 % | **6.2** | **6.6** | **5.0** | **5.4** | **11.2** | **12.0** | **1.86** | **1.90** | **0.24** | **0.25** | **0.50** | **1.40** | **0.61** | **0.64** |
| Spraying boric acid at 0.025 % | **5.0** | **5.5** | **3.5** | **4.0** | **8.5** | **9.5** | **1.72** | **1.80** | **0.19** | **0.20** | **0.41** | **1.37** | **0.55** | **0.58** |
| Spraying boric acid at 0.05 % | **5.1** | **5.6** | **3.7** | **4.1** | **8.8** | **9.7** | **1.73** | **1.81** | **0.19** | **0.21** | **0.42** | **1.38** | **0.56** | **0.59** |
| Spraying both at 1st conc.  | **8.3** | **9.0** | **6.0** | **6.3** | **14.3** | **15.3** | **1.95** | **1.97** | **0.27** | **0.28** | **0.59** | **1.47** | **0.79** | **0.82** |
| Spraying both at 2nd conc.  | **8.4** | **9.1** | **6.1** | **6.4** | **14.5** | **15.5** | **1.96** | **1.98** | **0.28** | **0.29** | **0.60** | **1.48** | **0.80** | **0.83** |
| New L.S.D. at 5% | **0.3** | **0.3** | **0.3** | **0.3** | **0.4** | **0.4** | **0.05** | **0.06** | **0.03** | **0.03** | **0.05** | **0.04** | **0.03** | **0.03** |

**3- Percentages of initial fruit setting and fruit retention and yield / tree:**

Data in Table (6) obviously reveal that spraying potassium silicate at 0.1 to 0.2%^ and/ or boric acid at 0.025 to 0.05 % significantly improved percentages of initial fruit setting and fruit retention, yield and number of fruits / tree comparing with the check treatment. A significant promotion on these parameters was observed due to using potassium silicate rather than using boric acid in improving fruit setting and yield/ tree. Combined application of potassium silicate and boric acid was significantly preferable than using each alone in improving fruit setting and yield / tree. No significant promotion was attributed to increasing concentrations of potassium silicate from 0.1 to 0.2%, therefore, the recommended concentration of both potassium silicate and boric acid was 0.1 % and 0.025%, respectively. From economical point of view, the best results were obtained owing to spraying potassium silicate at 0.1% plus boric acid at 0.025 % three times. Under such promised treatment yield/ tree reached 57.6 and 58.7 kg/ tree during both seasons, respectively. Untreated trees produced 31.0 and 31.3 kg during 2013 and 2014 seasons, respectively. The percentage of increase on the yield due to using such promised treatment over the control treatment reached 85.8 and 87.5% during both seasons, respectively.

**4- Fruit quality:**

It is evident form the data in Tables ( 6 to 8) that supplying Succary mango trees with potassium silicate at 0.1 to 0.2 % as well as boric acid at 0.025 to 0.05 % either singly or in combinations was significantly very effective in improving fruit quality in terms of increasing fruit weight and dimensions (length & width & thickness), pulp %, edible / non – edible portions, T.S.S. %, total and reducing sugars % and vitamin C and decreasing fruit peel weight % and total acidity % rather than non- application. The investigated treatments had no significant effect on the percentage of seeds. Using potassium silicate was significantly favourable than using boric acid in this connection. Application of potassium silicate plus boric acid was significantly superior than using each alone. A slight and unsignificant promotion on fruit quality was attributed to increasing concentrations of potassium silicate from 0.1 to 0.2% and boric acid from 0.025 to 0.05%. The best results with regard to fruit quality were observed due to treating the trees three times with potassium silicate at 0.1 % plus boric acid at 0.0.25%. Unfavourable effects on fruit quality were observed on untreated trees. These results were true during both seasons.

Table (6): Effect of single and combined applications of potassium silicate and boric acid on the percentages of initial fruit setting and fruit retention, number of fruits/ tree, yield / tree and weight and length of fruit of Succary mango trees during 2012 and 2014 seasons.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Initial fruit setting %** | **Fruit retention %** | **No. of fruits / tree**  | **Yield/ tree (kg.)** | **Fruit weight (g.)** | **Fruit length (cm.)** |
| **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** |
| Control  | **2.9** | **3.0** | **1.0** | **0.9** | **181.0** | **181.0** | **31.0** | **31.3** | **171.0** | **173.0** | **7.8** | **8.0** |
| Spraying K silicate at 0.1 % | **4.5** | **4.7** | **1.7** | **1.6** | **211.0** | **214.0** | **41.1** | **41.5** | **195.0** | **194.0** | **9.0** | **8.8** |
| Spraying K silicate at 0.2 % | **4.6** | **4.8** | **1.7** | **1.7** | **212.0** | **215.0** | **41.7** | **41.9** | **196.7** | **195.0** | **9.1** | **8.9** |
| Spraying boric acid at 0.025 % | **3.5** | **3.6** | **1.3** | **1.3** | **191.0** | **194.0** | **34.6** | **34.9** | **181.7** | **180.0** | **8.2** | **8.4** |
| Spraying boric acid at 0.05 % | **3.6** | **3.7** | **1.4** | **1.4** | **193.0** | **196.0** | **35.3** | **35.6** | **183.0** | **181.5** | **8.3** | **8.5** |
| Spraying both at 1st conc.  | **6.9** | **7.0** | **2.1** | **2.2** | **249.0** | **255.0** | **57.6** | **38.7** | **231.3** | **230.0** | **10.0** | **9.9** |
| Spraying both at 2nd conc.  | **7.0** | **7.1** | **2.2** | **2.3** | **251.0** | **256.0** | **58.6** | **59.5** | **233.3** | **232.5** | **10.1** | **10.0** |
| New L.S.D. at 5% | **0.2** | **0.2** | **0.2** | **7.0** | **7.0** | **6.7** | **1.5** | **1.7** | **4.1** | **3.9** | **0.2** | **0.2** |

Table (7): Effect of single and combined applications of potassium silicate and boric acid on some physical characters of the fruits of Succary mango trees during 2012 and 2014 seasons.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Fruit width (cm.)** | **Fruit thickness(cm.)** | **Pulp %** | **Fruit peel %** | **Seeds %** | **Edible / non edible portions**  |
| **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** |
| **Control**  | **5.7** | **6.0** | **4.5** | **4.8** | **49.0** | **48.8** | **25.0** | **25.9** | **26.0** | **25.3** | **0.96** | **0.95** |
| **Spraying K silicate at 0.1 %** | **6.5** | **6.9** | **6.3** | **6.7** | **51.9** | **52.6** | **22.0** | **23.0** | **26.1** | **24.4** | **1.08** | **1.11** |
| **Spraying K silicate at 0.2 %** | **6.6** | **7.0** | **5.4** | **5.8** | **52.0** | **52.8** | **21.8** | **22.8** | **26.2** | **24.4** | **1.08** | **1.12** |
| **Spraying K silicate at 0.025 %** | **6.0** | **6.4** | **4.8** | **5.2** | **50.5** | **51.0** | **23.9** | **25.0** | **25.6** | **24.0** | **1.02** | **1.04** |
| **Spraying K silicate at 0.05 %** | **6.1** | **6.5** | **4.9** | **5.3** | **50.7** | **51.3** | **23.8** | **24.9** | **25.5** | **23.5** | **1.03** | **1.05** |
| **Spraying at 1st conc.**  | **7.3** | **7.6** | **6.6** | **6.9** | **53.9** | **54.0** | **20.0** | **21.0** | **26.1** | **25.0** | **1.17** | **1.17** |
| **Spraying at 2nd conc.**  | **7.4** | **7.7** | **6.9** | **7.0** | **54.0** | **54.0** | **19.7** | **20.9** | **26.3** | **25.1** | **1.17** | **1.17** |
| **New L.S.D. at 5%** | **0.2** | **0.2** | **0.2** | **0.2** | **0.6** | **0.7** | **1.0** | **1.0** | **NS** | **NS** | **0.05** | **0.06** |

Table (8): Effect of single and combined applications of potassium silicate and boric acid on some chemical characteristics of the fruits of Succary mango trees during 2012 and 2014 seasons.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **T.S.S. %** | **Total sugars %** | **Reducing sugars %** | **Total acidity %** | **Vitamin C content (mg. 100 g. pulp )** |
| **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** | **2013** | **2014** |
| Control  | **14.0** | **13.9** | **10.5** | **10.6** | **3.0** | **3.1** | **0.371** | **0.381** | **38.3** | **39.0** |
| Spraying K silicate at 0.1 % | **14.9** | **15.2** | **11.6** | **12.0** | **3.8** | **4.0** | **0.301** | **0.299** | **41.9** | **42.6** |
| Spraying K silicate at 0.2 % | **15.0** | **15.3** | **11.7** | **12.1** | **3.9** | **4.1** | **0.299** | **0.298** | **42.0** | **42.7** |
| Spraying boric acid at 0.025 % | **14.3** | **14.6** | **10.8** | **11.2** | **3.3** | **3.5** | **0.341** | **0.339** | **40.3** | **41.0** |
| Spraying boric acid at 0.05 % | **14.4** | **14.7** | **10.9** | **11.3** | **3.4** | **3.6** | **0.339** | **0.338** | **40.5** | **41.1** |
| Spraying both at 1st conc.  | **16.5** | **16.9** | **12.9** | **13.5** | **4.5** | **4.6** | **0.260** | **0.258** | **44.1** | **45.0** |
| Spraying both at 2nd conc.  | **16.6** | **17.0** | **13.0** | **13.6** | **4.6** | **4.7** | **0.259** | **0.257** | **44.3** | **45.2** |
| New L.S.D. at 5% | **0.3** | **0.3** | **0.2** | **0.2** | **0.2** | **0.2** | **0.021** | **0.022** | **1.1** | **1.2** |

**4. Discussion:**

The present positive active of silicon on enhancing growth, nutritional status of the trees, yield and fruit quality was ascribed to the beneficial effects of silicon on enhancing the tolerance of plants to biotic and abiotic stresses as well as drought, water and nutrient uptake, photosynthesis process, water transport and root development. The beneficial effect of silicon on reducing the severity of most diseases through forming a silicon cuicle double layers on leaf epidermal tissues which is responsible for preventing water evaporation and the penetration of fungal hypha into host tissues and ameliorating the adverse effects of heavy metal toxicity could explain the present results (**Mengel, 1984; Mengel *et al.,* 2001; Aziz *et al.,* 2002; Lux *et al.,* 2002 and 2003, Sauvas *et al.,* 2002; Iwaskai *et al.*, 2002; Gang *et al.,* 2003; Melo, *et al.,* 2003 and Tahr *et al.,* 2006**).

These results regarding the promoting effect of silicon on growth and fruiting of Succary mango trees are in harmony with those obtained by (**Gad El- Kareem, 2012; Ahmed *et al.,* 2013a and 2013b; Abdelaal and Oraby- Mona, 2013, Ibrahiem and Al- Wasfy, 2014; El Khawaga and Mansour, 2014; Gad El- Kareem *et al.,* 2014 and Al- Wasfy, 2014**) and boron (**Ebeid- Sanaa, 2007; El- Sayed- Esraa, 2007; Ibrahiem *et al.,* 2007; Abdelaal, 2008; Refaai, 2014 and Hassan- Huda, 2014**).

The outstanding effect of boron on growth, tree nutritional status, yield and fruit quality might be attributed to its essential role in enhancing cell division, biosynthesis and translocation of sugars and hormones, root development, germination of pollens, water and nutrients uptake flower bud formation and reducing the incidence of disorders as well as flowers and fruit dropping (**Fraguas and Silva, 1993 and Mengel *et al.,* 2001**).

The results with regard to the promoting effect of boron on growth and fruiting of Succary mango trees are in agreement with those obtained by **Ebeid- Sanaa, (2007); El- Sayed- Esraa, (2007); Ibrahiem *et al.,* (2007); Abdelaal, (2008); Refaai, (2014) and Hassan- Huda, (2014**).

**Conclusion:**

Under Upper Egypt region and the resembling condition, it is advised to foliar application of a mixture of potassium silicate at 0.1% plus boric acid at 0.025 % three times to improve yield and fruit quality of Succary mango trees.

**References**

1. Abdalla, A.A. (2008): Behaviour of Zaghloul date palms to some pollen carriers and boron. M. Sc. Thesis Fac. of Agric. Minia Univ. Egypt.
2. Abdelaal, A.M.K. and Oraby- Mona, M.M. (2013): Using silicon for increasing the mango cv Ewaise transplants to drought. World Rural Observations 5(2): 36-40.
3. Ahmed, F. F. and Morsy, M. H. (1999): A new method for measuring leaf area in different fruit species. Minia J. of Agric. Res. & Develop, Vol. (19) pp 97—105.
4. Ahmed, F.F.; Gad El- Kareem, M. R. and Oraby- Mona, M.M. (2013a): Response of Zaghloul date palms to spraying boron, silicon and glutathione. Stem Cell 4(2): 29-34.
5. Ahmed, F.F.; Mansour, A.E.M.; Mohamed, A.Y.; Mostafa, E.A.M. and Ashour, N.E. (2013b): Using silicon and salicylic acid for promoting production of Hindy Bisinnara mango trees grown under sandy soil. Middle East J. of Agric. Res. 2(2): 51-55.
6. Al-Wasfy, M.M.M. (2014): The synergistic effects of using silicon with some vitamins on growth and fruiting of Flame seedless grapevines Stem Cell 5(1):8-13.
7. Association of Official Agricultural Chemists (2000): Official Methods of Analysis A. O. A. C. 17th Ed Published by A. O. A. C. Washington, D. C. (U.S.A.). pp. 490-510.
8. Ebeid – Sanaa, A. (2007): The promotive effect of seaweed extract and boron on growth and fruiting of Hindy Bisinnara mango trees. Minia J. ofAgric. Rev & Develop. Vol. (27) No. 3 pp 579-594.
9. El- Khawaga, A.S. and Mansour, A.E.A. (2014): Promoting productivity of Washington Navel orange trees by using some crop seed sprout extracts. Silicon and glutathione. Middle East J. of Applied Sci., 4 (3): 779- & 785.
10. El- Sayed- Esraa, M. H. (2007): Response of Ewaise mango trees to foliar application of boron. M. Sc. Thesis Fac. of Agric. Minia Univ. Egypt.
11. Aziz, T.; Gill, M.A. and Rahmatullah, A. (2002): Silicon nutrition and crop production. Pak. J. Agric. Sci. 39(3): 181-187.
12. Fraguas, J.C. and Silva, U.J. (1998): Nutrition of grapevines in tropical regions. Informature Agropeculario 19 (194): 70-75.
13. Gad EJ- Kareem, M.R. (2012): Improving productivity of Taimour mango trees by using glutathione, silicon and vitamin B. Minia J. of Agric. Res. & Develop 32 (7): 1105-1121.
14. Gad El- Kareem, M.R.; Abdelaal, A M.K. and Mohamed A.Y. (2014): The synergistic effects of using silicon and selenium on fruiting of Zaghloul date palm *(Phoenic dectylifera* L.) World Academy of Engineering and Technology, Inter. J. of Agric. Biosystems Sci. and Engineering 8(3): 959-964.
15. Gang, H.J.K.; Chen, K.M., Chen, G. C.; Wan, S.M. and Zhang, C.L. (2003): Effect of silicon on growth of wheat under drought. J. Plant. Mutr. 26 (5): 1055-1063.
16. Hassan-Huda, M.I. (2014): Impact of effective microorganisms and amino acids enriched with some nutrients on growth and fruiting of Valencia orange trees. Ph. D. Thesis Fac. of Agric. Minia Univ. Egypt.
17. Hiscox, A. and Isralstam, B. (1979): A method for the extraction of chlorophyll from leaf tissue without maceration. Can. J. Bot.57: 1332-1334.
18. Ibrahiem, H.I.M. and Al- Wasfy, M.M. (2014): The promotive impact of using silicon and selenium with potassium and boron on fruiting of Valencia orange trees grown under Minia region conditions. World Rural Observations 6(2): 28-36.
19. Ibrahiem, H.I.M.; Ahmed, Y.M. and Ahmed, F.F. (2007): Relation of fruiting in Hindy Bisinnara mangoes to foliar nutrition with Mg, B and Zn and some antioxidants. African crop Sci. Conf. Proc.8:411-415.
20. Iwaskai, K.; Meier, P.; Fecht, M. and Hart, W.I. (2002): Effect of silicon supply oil apoplastic, manganese concentrations in leave sand their relation to manganese tolerance in copea *(Vignci imgnciulata)* plant Soil. 238:288.
21. Lux, A.; Luxova, M, Abe, J. Tanmoto, E, Hattori, T. and Inanaga, S. (2003): The dynamics of silicon deposition in the sorghum root endodermis. New Physiol. 158: 437-441.
22. Lux, A. and Lyxova, M. Hattori, T. Inanaga, S. and Sgimoto, Y. (2002): Silification in sorghum *(Sorghum bidor)* cultivars with different drough tolerance. Physiol. Plantammll5: 87-92.
23. Mead, R.; Currnow, R.N. and Harted, A.M. (1993): Statistical Methods in Agricultural and Experimental Biology. Second Ed. Chapman^: Hall. London, pp. 10- 44.
24. Melo, S.P.; Kordnarfer, G.H., Korndarfer, C.M.; lana, R.M.G. and Santaon, D.G. (2003): Silicon accumulation and water deficient tolerance in grasses. Scientia Agricola. 60 :755-759,
25. Mengel, K.E.; Kirkby E.A.; Kosegarten, H. and Appel, T. (2001): Principles of Plant Nutrition. 5th ed. Kluwer Academic Publishers Dordrecht p. 1-311.
26. Refaai, M.M. (2014): Response of Zaghloul date palms grown under Minia region conditions to spraying wheat seed sprout extract and non- boron Stem Cell 5 (4): 22-28.
27. Sauvas, D.; Manos, G.; Kotsiras, A. and Souvaliotis, S. (2002): Effects of silicon and nutrient induce salicylic on yield flower quality and nutrient uptake of gerbera grown in a closed hydroponic system. J. Appl. Bat. 76: 153-158.
28. Summer, M.E. (1985): Diagnosis and Recommendation Integrated system (DRIS) as a guide to orchard fertilization. Hort. Abst. 55 (8); 7502.
29. Tahr, M.A.; Rahmatullah, A.; Aziz, T, Ashraf, M.; Kanwal, S. and Magsood, A. (2006): Beneficial effects of silicon in wheat *(Triticum aestivim* L.) under salinity stress. Pak.J.Bot. 38(5): 17I5-1727.
30. Von- Wettstein, D. V. C. (1957): Letal und der Sumbmikro Skopisne Pormwechsel de Plastids. Experimental Cell Research, 12:427.
31. Wilde S. A.; Corey, R. B.; Lyer, I. G. and Voigt, G. K. (1985): Soil and Plant Analysis/for Tree Culture. 3rd Oxford & 113H publishing Co., New Delhi, pp. 1 - 218.

5/12/2015