**Productive Performance of Golek Mango Trees as Influenced by Spraying Amino Acids and Vitamin B12**

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**Abstract:** During 2016 and 2017 seasons mango cv. Golek grown under Aswan conditions was subjected to spraying amino acids (tryptophan, methionine and cysteine) at 0.05 to 0.2% and/or vitamin B12 at 25 to 100 ppm three times. The goal was examining the effect of amino acids and vitamin B12 on growth, tree nutritional status, flowering and fruit setting aspects, yield and fruit quality. Single and combined applications of amino acids at 0.05 to 0.2% and/or vitamin B12 at 25 to 100 ppm was very effective in enhancing all growth aspects, pigments, N, P, K, Mg and Ca in the leaves, panicle length, number of panicle/tree and perfect flowers %, fruit setting %, yield as well as fruit quality relative to the control treatment. Percentage of male flowers tended to reduce with the present treatments. Amino acids application was superior to using vitamin B12 in enhancing the most investigated characteristics. Combined applications were preferable than using each material alone in this respect. Supplying Golek mango trees grown under Aswan climatic conditions three times with amino acids at 0.1% plus vitamin B12 at 50 ppm succeeded in maximizing the yield and improving fruit quality.

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**Keywords**: Golek mango cv, amino acids, vitamin B12, growth, yield, fruit quality.

**Introduction**

Recently, many attempts were accompanied for improving yield and fruit quality of Mango trees by using non- traditional methods. Out of these methods were the application of amino acids and vitamins.

Amino acids with their antioxidative properties play an important role in plant defense against oxidative stress induced by unfavourable conditions. Application of amino acids was accompanied with enhancing proteins biosynthesis as well as protecting plant cells from senescence and death, preventing the free radicals from oxidation of lipids the components of plasma membrane which is accompanied with the loss of permeability and controlling the incidence of disorders (**Orth *et al,* 1993**). They are responsible for stimulating the biosynthesis of natural hormones like, IAA, ethylene, cytokinins and GA3 cell division, organic foods, enzymes as well as DNA and RNA. These positive effects surely reflected on producing healthy trees (**Vianello and Marci, 1991 and Elade, 1992**).

Vitamins are considered antioxidants they play a definite role in protecting the plant cells from senescence and death through preventing the producing free radicals during plant metabolism from oxidation of lipids, the components of plasma membrane which is accompanied with the loss of permeability of cells (**Raskin, 1992; Bertschinger and Stadler, 1997 and Buchala and Schmid, 1997**).

Vitamins B have definite roles in decaerboxylation formation of meristem via supplying metabolites to the apex, coenzymes, flavin mononucleotide coenzymes, flavin adenine, dinucleotide and photosynthesis **(Mer, 1957; Robinson, 1973 and Karabanov, 1977**).

Previous studies showed that using amino acids (**El- Badawy and Abd El- aal, 2013; Fathalla,** **2013;** **Ibrahiem** ***et al.,* 2013, Hassan-Huda 2014, Sayed- Ola, 2014 and Ahmed, 2016**) and vitamins (**Hamad** **2008, Badran and Ahmed** **2009, Zagzog, 2009,** **Ahmed *et al,* 2013, Farag, 2013, Ibrahim *et al*., 2013, Rizk**, **2013 and Omar, 2015**) were found to improve growth, tree nutritional status, yield and quality of the fruits.

The main target of this study was elucidating the effect of spraying some amino acids and vitamin B12 on growth characteristics, tree nutritional status, yield and fruit quality of Golek Mango trees.

**2. Materials and Methods**

This investigation was conducted during two successive experimental seasons 2016 and 2017 on thirty uniform in vigour 15-years old Golek mango trees onto polyembyonic seedling rootstock. The trees are grown in a private orchard situated at El- Besalia Village, Edfu district, Aswan Governorate. The selected trees are planted at 5 x 5 meter a part (5 between rows and 5 between trees). The selected trees were irrigated through surface irrigation system using Nile water. The soil texture of the tested orchard is clay with a water table depth not less than two meters.

The target of this study was elucidating the effect of spraying some amino acids and vitamin B12 on growth characteristics, tree nutritional status, yield and fruit quality of Golek Mango trees.

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 % | 10.8 |
| Silt % | 12.2 |
| Clay % | 77.00 |
| Texture grade | clay |
| pH ( 1: 2.5 extract) | 7.4 |
| E.C. ( 1: 2.5 extract ( ( mmhos/ 1 cm/ 25oC) | 245 |
| Organic matter % | 1.95 |
| CaCO3 % | 2.05 |
| **Macronutrients values** | |
| Total N % | 0.10 |
| P (ppm, Olsen method) | 5.00 |
| K (ppm, ammonium acetate) | 510.0 |
| Mg (ppm) | 6.2 |
| **EDTA extractable (ppm)** | |
| Zn | 3.5 |
| Fe | 4.0 |
| Mn | 5.5 |

The selected trees (30 trees) received 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.

This study included the following ten treatments from amino acids and vitamin B12.

1. Control treatment
2. Spraying amino acids at 0.05%
3. Spraying amino acids at 0.1%
4. Spraying amino acids at 0.2%
5. Spraying vitamin B12 at 25 ppm
6. Spraying vitamin B12 at 50 ppm
7. Spraying vitamin B12 at 100 ppm
8. Spraying both at low concentration.
9. Spraying both at medium concentration
10. Spraying both at high concentration

Therefore, the experiment evolved ten treatments. Each treatment was replicated three times, one tree per each. The three amino acids used were tryptophan, methionine and cysteine. Vitamin B12 (Cyanocobalamin) was dissolved in water. All amino acids and vitamin B12 were sprayed three times at growth start (1st week of Mar.), after fruit setting (Middle of April) and at three weeks later (1st week of May). Triton B as a wetting agent at 0.05% was added to all spraying solutions (each tree needs about 25 L solutions). Spraying was done till runoff. The untreated trees sprayed with water containing triton B.

Randomized complete block design (RCBD) was followed where this experiment included ten treatments and each treatment was replicated three times, one tree per each.

**1- Measurements of vegetative growth characters:**

In spring growth cycle, ten shoots per tree were selected (1st week of June) for measuring average shoot length (cm.), shoot thickness (cm.) and number of leaves per shoot.

Twenty leaves below panicles in the spring growth cycle / tree (according to **Summer, 1985**) were taken in the first week of June for measuring the leaf area (cm2) using the following equation as reported by **Ahmed and Morsy (1999**).

LA= 0.70 (L x W) – 1.06 where LA = Leaf area (cm2)

L = Maximum length of leaf (cm.) and W = Maximum width of leaf (cm.)

**2- Measurements of plant pigments:**

Samples of five mature fresh leaves from Spring growth cycle (1st week of June) per each replicate were taken. The leaves were cut at small pieces, homogenated and extracted by 25 % acetone in the presence of a little amount of Na2C03 and silica quartz then filtered through central glass funnel G4.

The optical density of the filtrate was determined using Carl­Zeis spectrophotometer at the wave length of 662, 644 and 440 nm to determine chlorophylls (a & b) and total carotenoids, respectively, Content of each pigments was calculated by using the following equations (according to **Von-Wettstein, 1957).**

Chl. A = (9.784 x E 662) - (0.99 x E 644) = mg/ L

Chl. B = (21.426 x E 644) - (4.65 x E 662) = mg/ L

**Total Carotenoids** = (4.965 x E 440 - 0.268 (chlorophyll a + chlorophyll b)

where E = Optical density at a given wave length.

The chlorophylls a and b as well as total carotenoids were calculated as mg/ 1 g fresh weight of leaves.

**3- Measurements of leaf content of N, P, K, Mg and Ca (as %)**

In both seasons and in early September, twenty leaves (3rd leaf from the base of non – fruiting spring growth cycle) (according to **Summer, 1985)** were collected carefully at random at the end of September in both (2013 and 2014) seasons. As soon as the leaf samples were picked, they were cleaned with cloth damp to remove any residues that might affect the results. The leaves were oven dried at 70 °C for 48 hours, ground and stored in small pockets prior analysis. Plant material (0.2 g) was taken for determination of total carbohydrates by using phenol- sulfuric method (**Smith *et al.,* 1956**). Plant material (0.2 g) was digested using hydrogen peroxide plus sulfuric acid as recommended by (**Wilde *et al.,* 1985**).

The digested materials were transferred quantitatively to 50 ml volumetric flask and raised up to the uniformity volume for determination of the following nutrients:

1. Nitrogen % was determined by the modified micro kjeldahl methods as described by **Peach and Tracey (1968).**
2. Phosphorus % was determined by using spekol spectrophotometer **(Cottenie *et al,* 1982).**
3. Potassium % was determined by using Flame photometer according to the procedure reported by **Chapman and Pratt (1965).**
4. Percentages of magnesium % and calcium were determined by using versene method **(Chapman and Pratt, 1965)**.

**4 -Measurements of behaviour of flowering and fruit setting:**

Number of flowers on the twelve labeled shoots (three shoots for each directions) was counted periodically at five days intervals starting at the second week of March in both seasons till completed of fruit setting stage (1st week of April). Then, the number of fruitlets was counted and the percentage of initial fruit setting was calculated by dividing the number of fruitlets by total number of flowers and multiplying the product x 100. Percentage of fruits retention was calculated by counting the number of fruits just before harvesting and dividing the number of fruits by number of setted fruits and multiplying the product x 100.

**5 -Measurements of yield as well as physical and chemical properties of the fruits:**

**5.1 Yield:**

Harvesting was achieved during the regular commercial harvesting time under Aswan Governorate conditions (first week of July) in both seasons when the flesh becomes yellowish **(Hulme, 1971)**. The yield expressed in weight and number of fruits per tree was recorded.

**5.2 Physical and chemical properties of the fruits:**

Twenty fruits were taken randomly from the yield of each tree then transferred to the laboratory for determining the following physical and chemical properties of the fruits.

**5.2.1 Physical properties of the fruits:**

1- Average fruit weight (g.).

2-Averages fruit dimensions (in cm) (height, diameter and thickness by vernier caliper).

3- Percentages of fruit pulp and stone.

**5.2.2 Chemical properties of the fruits:**

The studied chemical characteristics of fruits included the following parameters.

**5.2.2.1 Total soluble solids (TSS %):**

The flesh of fruit was well minced with an electric blender and the paste was squeezed and the total soluble solids were determined by using hand refractometer.

**5.2.2.2 Sugars content:**

The percentages of the total and reducing sugars were determined according to **Lane and Eynon (1965)** volumetric method that outlined in (**A.O.A.C., 2000**).

**5.2.2.3 Total acidity (%):**

Twenty five grams of flesh were blended with 100 ml distilled water by an electric blender, the extract was filtrated and twenty ml. of it were titrated against 0.1 N sodium hydroxide using phenolphthalein as an indicator according to the (**A.O.A.C., 2000**). Acidity was determined as g citric acid/ 100 g pulp.

**5.2.2.4 Total fibre %:**

Determination of crude content was achieved using acetic acid glacial and nitric acid mixture at ratio 10: 1 on 1 g sample according to the official methods described in (**A.O.A.C., 2000**).

**5.2.2.5 Total soluble tannins %:**

Total soluble tannins % was determined according to **A.O.A.C. (2000)**.

All the obtained data during the course of this study in the two successive seasons, 2016 and 2017 were tabulated and subjected to the proper statistical analysis. The differences between various treatment means were compared using new L.S.D. test at 5% according to **Mead *et al*., (1993).**

**3. Results**

**1-Vegetative growth characteristics:**

It is noticed from the obtained data in Table (2) that treating Golek mango trees three times with amino acids at 0.05 to 0.2% and vitamin B12 at 25 to 100 ppm either alone or in combinations significantly stimulated the four growth traits namely main length and thickness of shoot, number of leaves/shoot and leaf area over to the control treatment. The stimulation on these growth aspects was significantly correlated to the increase in concentrations of amino acids from 0.05 to 0.2% and vitamin B12 from 25 to 100 ppm. Increasing concentrations of amino acids from 0.1 to 0.2% and vitamin B12 from 50 to 100 ppm failed to significant promotion on these growth traits. Using amino acids was significantly superior than application of vitamin B12 in stimulating these growth aspects. Combined applications significantly were preferable than using each material alone in enhancing these parameters. Using amino acids at 0.2% plus vitamin B12 at 100 ppm gave the highest values of main shoot length **(22.3 & 23.1 cm)**, number of leaves/shoot **(15.0 & 15.0 leaf)**, leaf area **(131.5 & 132.0 cm2)** and shoot thickness **(0.89 & 0.88 cm)** during both seasons, respectively. The untreated trees produced the lowest values. These results were true during 2016 & 2017 seasons.

**2- Leaf chemical composition:**

Chlorophylls a & b, total carotenoids, N, P, K, Mg and Ca in the leaves of Golek mango trees were significantly improved in response to subjecting the trees three times with amino acids at 0.05 to 0.2% and vitamin B12 at 25 to 100 ppm compared to the control treatment as shown in Tables (3 & 4). There was a progressive stimulation on these pigments and nutrients with increasing concentrations of amino acids and vitamin B12. Negligible stimulation on these chemical traits was observed among the higher two concentrations of amino acids (0.1 & 0.2%) and vitamin B12 (50 & 100 ppm). A significant promotion on these leaf chemical components was recorded due to using amino acids relative to the application of vitamin B12. Using amino acids at 0.05 to 0.2% plus vitamin B12 at 25 to 100 ppm together significantly were preferable than using each material alone in enhancing these parameters. The maximum values of chlorophyll a **(4.83 & 4.86 mg/1.0 g FW)**, chlorophyll b **(1.68 & 1.71 mg/1.0 g FW)**, total carotenoids **(1.80 & 1.81 mg/1.0 g FW)**, N **(1.96 & 1.99%)**, P **(0.171 & 0.178%)**, K **(1.57 & 1.60 %),** Mg **(0.85 & 0.95 %)** and Ca **(2.61 & 2.71%)** were observed due to treating the trees three times with a mixture of amino acids at 0.2% and vitamin B12 at 100 ppm during both seasons, respectively. The minimum values of these plant pigments and nutrients were recorded on the untreated trees. Similar results were announced during both seasons.

**3- Behaviour of flowering:**

It is reveal from the obtained data in Table (5) that exposing Golek mango to amino acids at 0.05 to 0.2% and/or vitamin B12 at 25 to 100 ppm significantly enhanced panicle length, number of panicles/ tree and percentage of perfect flowers relative to the untreated trees. Percentage of male flowers was significantly reduced with using amino acids and/or vitamin B12 over the control. The promotion and the reduction was in proportional to the increase in concentrations of amino acids and vitamin B12 without significant promotion among the higher two concentrations of amino acids (0.1 & 0.2%) and vitamin B12 (50 & 100 ppm). Using both materials together significantly was preferable than using each material alone in enhancing these flowering aspects namely panicle length, number of panicles/ tree and percentage of perfect flowers. The maximum values of panicle length **(31.3 & 32.2 cm)**, number of panicles/ tree **(262.0 & 275.0 panicle)**, percentage of perfect flowers **(19.1 & 17.0%)** and the lowest values of mal flowers percentage **(80.9 & 83.0%)** were observed on the trees that received both materials at the higher concentration during both seasons, respectively. The untreated trees produced the lowest values of panicle length **(27.0 & 28.0 cm)**, number of panicles/ tree **(194.9 & 200.0 panicle)**, percentage of perfect flowers **(10.0 & 10.5%)** and the highest percentage of mal flowers percentage **(90.0 & 89.5%)** during both seasons, respectively. The results were true during both seasons.

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

It is clear from the obtained data in Table (6) that supplying Golek mango trees with amino acids at 0.05 to 0.2% and vitamin B12 at 25 to 100 ppm were significantly improved the percentages of initial fruit setting and fruit retention and yield expressed in weight (kg) and number of fruits/tree relative to the control treatment. There was a gradual promotion on these parameters with increasing concentrations of amino acids and vitamin B12. Significant differences on these parameters were observed among the ten treatments. Using amino acids at 0.05 to 0.2% significantly was favourable than using vitamin B12 in enhancing these measurements. Combined applications were significantly preferable than using each material alone in improving the percentages of initial fruit setting and fruit retention and yield /tree. Increasing concentrations of amino acids at 0.1 to 0.2% and vitamin B12 at 50 to 100 ppm had significant promotion on these parameters. From economical point of view, the beat results with regard to fruit setting and yield/tree were obtained due to treating the trees with amino acids at 0.1% plus vitamin B12 at 50 ppm three times. Under such promised treatment yield/tree reached **175.5 & 156.1 kg** compared to the yield in the untreated trees that reached **108.0 & 103.0 kg** during both seasons, respectively. The percentage of increment of yield owing to using the previous promised treatment over the control treatment reached **62.5 & 51.6%** during both seasons, respectively. Similar results were announced during both seasons.

**5- Physical and chemical characteristics of the fruits**

It is evident from the obtained data in Tables (7 to 9) that single and combined applications of amino acids at 0.05 to 0.2% and vitamin B12 at 25 to 100 ppm significantly was very effective in improving quality of the fruits in terms of increasing fruit weight and dimensions (height, diameter and thickness) and percentages of fruit pulp, T.S.S, total and reducing sugars and vitamin C and decreasing percentages of fruit stone, total acidity and total crude fibre relative to the control treatment. The promotion on quality of the fruits was clearly associated with increasing concentrations of amino acids and vitamin B12. No Significant promotion was observed on fruit quality among the two higher concentrations of amino acids (0.1 & 0.2%) and vitamin B12 (50 & 100 ppm). Treating the trees with amino acids significantly was favourable in enhancing fruit quality than using vitamin B12. Combined applications significantly were preferable in enhancing fruit quality than using each material alone. The best results were recorded on the trees treated with amino acids at 0.1% plus vitamin B12 at 50 ppm three times (since the differences between the higher two concentrations of each material were disappeared). The untreated trees produced unacceptable fruits. Similar results were announced during both seasons.

**Table (2): Effect of single and combined applications of amino acids and vitamin B12 on some vegetative growth characteristics of Golek mango trees during 2016 and 2017 seasons.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Shoot length (cm.)** | | **Shoot thickness (cm.)** | | **Number of leaves / shoot** | | **Leaf area**  **(cm)2** | |
| **2016** | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** | **2017** |
| Control treatment | 18.8 | 19.1 | 0.55 | 0.53 | 8.0 | 7.4 | 118.8 | 119.0 |
| Spraying amino acids at 0.05%. | 20.4 | 21.0 | 0.72 | 0.69 | 11.0 | 10.0 | 124.0 | 124.5 |
| Spraying amino acids at 0.1% | 21.0 | 21.5 | 0.78 | 0.75 | 12.0 | 11.0 | 126.5 | 127.9 |
| Spraying amino acids at 0.2% | 21.0 | 21.6 | 0.79 | 0.76 | 12.0 | 11.0 | 127.0 | 128.0 |
| Spraying vitamin B12 at 25 ppm | 19.2 | 19.8 | 0.61 | 0.57 | 9.0 | 8.0 | 119.9 | 120.0 |
| Spraying vitamin B12 at 50 ppm | 19.7 | 20.3 | 0.66 | 0.61 | 10.0 | 9.0 | 121.3 | 121.4 |
| Spraying vitamin B12 at 100 ppm | 19.8 | 20.4 | 0.67 | 0.62 | 10.0 | 9.0 | 121.4 | 121.5 |
| Spraying both at low concentration. | 21.5 | 22.2 | 0.84 | 0.82 | 13.0 | 13.0 | 129.0 | 129.9 |
| Spraying both at medium concentration | 22.2 | 23.0 | 0.88 | 0.87 | 15.0 | 15.0 | 131.3 | 131.9 |
| Spraying both at high concentration | 22.3 | 23.1 | 0.89 | 0.88 | 15.0 | 15.0 | 131.5 | 132.0 |
| **New L.S.D. at 5%** | **0.4** | **0.3** | **0.05** | **0.04** | **1.0** | **1.0** | **0.9** | **1.1** |

**Table (3): Effect of single and combined applications of amino acids and vitamin B12 on some leaf pigments and percentage of N in the leaves of Golek mango trees during 2016 and 2017 seasons.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Chlorophyll a**  **(mg/ 1 g F.W.)** | | **Chlorophyll b**  **(mg/ 1 g F.W.)** | | **Total carotenoids (mg/ 1 g F.W.)** | | **Leaf N**  **%** | |
| **2016** | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** | **2017** |
| Control treatment | 4.11 | 4.15 | 1.29 | 1.30 | 1.40 | 1.41 | 1.49 | 1.55 |
| Spraying amino acids at 0.05%. | 4.44 | 4.46 | 1.50 | 1.51 | 1.61 | 1.62 | 1.74 | 1.81 |
| Spraying amino acids at 0.1% | 4.55 | 4.57 | 1.55 | 1.57 | 1.66 | 1.68 | 1.80 | 1.87 |
| Spraying amino acids at 0.2% | 4.57 | 4.58 | 1.56 | 1.58 | 1.67 | 1.69 | 1.81 | 1.88 |
| Spraying vitamin B12 at 25 ppm | 4.20 | 4.26 | 1.35 | 1.37 | 1.46 | 1.48 | 1.59 | 1.66 |
| Spraying vitamin B12 at 50 ppm | 4.31 | 4.35 | 1.41 | 1.44 | 1.53 | 1.55 | 1.66 | 1.73 |
| Spraying vitamin B12 at 100 ppm | 4.32 | 4.36 | 1.42 | 1.45 | 1.55 | 1.56 | 1.67 | 1.74 |
| Spraying both at low concentration. | 4.71 | 4.79 | 1.62 | 1.64 | 1.74 | 1.75 | 1.88 | 1.94 |
| Spraying both at medium concentration | 4.81 | 4.84 | 1.67 | 1.70 | 1.79 | 1.80 | 1.95 | 1.99 |
| Spraying both at high concentration | 4.83 | 4.86 | 1.68 | 1.71 | 1.80 | 1.81 | 1.96 | 1.99 |
| **New L.S.D. at 5%** | **0.7** | **0.04** | **0.03** | **0.05** | **0.04** | **0.05** | **0.06** | **0.05** |

**Table (4): Effect of single and combined applications of amino acids and vitamin B12 on percentages of P, K, Mg and Ca in the leaves of Golek mango trees during 2016 and 2017 seasons.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Leaf P**  **%** | | **Leaf K**  **%** | | **Leaf Mg**  **%** | | **Leaf Ca**  **%** | |
| **2016** | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** | **2017** |
| Control treatment | 0.112 | 0.109 | 1.11 | 1.08 | 0.51 | 0.47 | 1.99 | 2.01 |
| Spraying amino acids at 0.05%. | 0.142 | 0.145 | 1.36 | 1.40 | 0.69 | 0.71 | 2.30 | 2.36 |
| Spraying amino acids at 0.1% | 0.152 | 0.155 | 1.42 | 1.46 | 0.74 | 0.76 | 2.41 | 2.47 |
| Spraying amino acids at 0.2% | 0.153 | 0.155 | 1.43 | 1.47 | 0.75 | 0.77 | 2.42 | 2.48 |
| Spraying vitamin B12 at 25 ppm | 0.120 | 0.124 | 1.20 | 1.23 | 0.57 | 0.60 | 2.11 | 2.17 |
| Spraying vitamin B12 at 50 ppm | 0.131 | 0.133 | 1.27 | 1.30 | 0.63 | 0.66 | 2.20 | 2.27 |
| Spraying vitamin B12 at 100 ppm | 0.132 | 0.134 | 1.28 | 1.31 | 0.64 | 0.67 | 2.21 | 2.28 |
| Spraying both at low concentration. | 0.163 | 0.170 | 1.50 | 1.53 | 0.80 | 0.87 | 2.53 | 2.61 |
| Spraying both at medium concentration | 0.170 | 0.177 | 1.56 | 1.60 | 0.84 | 0.94 | 2.60 | 2.71 |
| Spraying both at high concentration | 0.171 | 0.178 | 1.57 | 1.60 | 0.85 | 0.95 | 2.61 | 2.72 |
| **New L.S.D. at 5%** | **0.004** | **0.006** | **0.04** | **0.06** | **0.03** | **0.05** | **0.06** | **0.08** |

**Table (5): Effect of single and combined applications of amino acids and vitamin B12 on some flowering aspects of Golek mango trees during 2016 and 2017 seasons.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Panicle length (cm.)** | | **Number of panicles/ tree** | | **Male flowers**  **%** | | **Perfect flowers %** | |
| **2016** | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** | **2017** |
| Control treatment | 27.1 | 28.0 | 194.9 | 200.0 | 90.0 | 89.5 | 10.0 | 10.5 |
| Spraying amino acids at 0.05%. | 29.1 | 30.0 | 221.0 | 231.0 | 84.0 | 86.4 | 16.0 | 15.6 |
| Spraying amino acids at 0.1% | 30.0 | 30.9 | 231.0 | 241.0 | 83.0 | 85.4 | 17.0 | 14.6 |
| Spraying amino acids at 0.2% | 30.1 | 31.0 | 232.2 | 242.0 | 82.9 | 85.0 | 17.1 | 15.0 |
| Spraying vitamin B12 at 25 ppm | 27.6 | 28.5 | 201.0 | 210.0 | 86.0 | 88.7 | 14.0 | 11.3 |
| Spraying vitamin B12 at 50 ppm | 28.5 | 29.4 | 211.0 | 221.0 | 85.0 | 87.9 | 15.0 | 12.1 |
| Spraying vitamin B12 at 100 ppm | 28.6 | 29.5 | 213.0 | 222.0 | 84.0 | 87.4 | 15.1 | 12.6 |
| Spraying both at low concentration. | 30.6 | 31.5 | 250.0 | 261.0 | 82.0 | 84.4 | 18.0 | 15.6 |
| Spraying both at medium concentration | 31.2 | 32.1 | 261.0 | 274.0 | 81.0 | 83.3 | 19.0 | 16.7 |
| Spraying both at high concentration | 31.3 | 32.2 | 262.0 | 275.0 | 80.9 | 83.0 | 19.1 | 17.0 |
| **New L.S.D. at 5%** | **0.4** | **0.5** | **5.1** | **4.8** | **0.9** | **0.8** | **0.6** | **0.8** |

**Table (6): Effect of single and combined applications of amino acids and vitamin B12 on the percentage of initial fruit setting and fruit retention, number of fruits/ tree and yield per tree of Golek mango trees during 2016 and 2017 seasons.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Initial fruit setting %** | | **Fruit retention %** | | **Number of fruits / tree** | | **Yield/ tree**  **(kg.)** | |
| **2016** | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** | **2017** |
| Control treatment | 1.11 | 1.08 | 0.21 | 0.14 | 200.0 | 190.0 | 108.0 | 103.0 |
| Spraying amino acids at 0.05%. | 1.30 | 1.29 | 0.41 | 0.39 | 240.0 | 220.0 | 139.0 | 128.2 |
| Spraying amino acids at 0.1% | 1.36 | 1.35 | 0.49 | 0.50 | 252.0 | 230.0 | 149.4 | 136.9 |
| Spraying amino acids at 0.2% | 1.37 | 1.36 | 0.50 | 0.51 | 253.0 | 231.0 | 153.0 | 137.7 |
| Spraying vitamin B12 at 25 ppm | 1.16 | 1.15 | 0.27 | 0.27 | 211.0 | 201.0 | 116.5 | 111.6 |
| Spraying vitamin B12 at 50 ppm | 1.21 | 1.21 | 0.35 | 0.34 | 223.0 | 210.0 | 126.0 | 119.3 |
| Spraying vitamin B12 at 100 ppm | 1.22 | 1.23 | 0.36 | 0.35 | 225.0 | 211.0 | 127.4 | 120.2 |
| Spraying both at low concentration. | 1.50 | 1.55 | 0.57 | 0.56 | 271.0 | 241.0 | 164.2 | 147.0 |
| Spraying both at medium concentration | 1.61 | 1.69 | 0.64 | 0.63 | 284.0 | 251.0 | 175.5 | 156.1 |
| Spraying both at high concentration | 1.62 | 1.70 | 0.66 | 0.65 | 285.0 | 252.0 | 176.4 | 157.0 |
| **New L.S.D. at 5%** | **0.4** | **0.3** | **0.04** | **0.06** | **10.0** | **9.0** | **4.1** | **5.2** |

**Table (7): Effect of single and combined applications of amino acids and vitamin B12 on some physical characteristics of the fruits of Golek mango trees during 2016 and 2017 seasons.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Average fruit weight (g.)** | | **Fruit height**  **(cm.)** | | **Fruit diameter**  **(cm.)** | | **Fruit thickness**  **(cm.)** | |
| **2016** | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** | **2017** |
| Control treatment | 540.0 | 541.0 | 16.9 | 17.1 | 6.9 | 7.1 | 5.6 | 5.7 |
| Spraying amino acids at 0.05%. | 580.0 | 582.5 | 18.5 | 18.6 | 8.4 | 8.5 | 6.6 | 6.8 |
| Spraying amino acids at 0.1% | 592.0 | 595.0 | 19.1 | 19.3 | 8.8 | 8.9 | 6.8 | 7.0 |
| Spraying amino acids at 0.2% | 593.0 | 596.0 | 19.2 | 19.4 | 8.9 | 9.0 | 6.9 | 7.1 |
| Spraying vitamin B12 at 25 ppm | 552.0 | 555.0 | 17.4 | 17.6 | 7.3 | 7.5 | 5.9 | 7.2 |
| Spraying vitamin B12 at 50 ppm | 565.0 | 568.0 | 18.0 | 18.3 | 7.7 | 7.8 | 6.2 | 6.4 |
| Spraying vitamin B12 at 100 ppm | 566.0 | 569.5 | 18.1 | 18.4 | 8.0 | 8.1 | 6.3 | 6.5 |
| Spraying both at low concentration. | 606.0 | 610.0 | 20.0 | 20.2 | 9.4 | 9.4 | 7.3 | 7.5 |
| Spraying both at medium concentration | 618.0 | 622.0 | 20.6 | 20.8 | 9.8 | 9.8 | 7.5 | 7.8 |
| Spraying both at high concentration | 619.0 | 623.0 | 20.7 | 20.9 | 9.9 | 9.9 | 7.6 | 7.9 |
| **New L.S.D. at 5%** | **10.9** | **11.3** | **0.4** | **0.5** | **0.4** | **0.3** | **0.2** | **0.3** |

**Table (8): Effect of single and combined applications of amino acids and vitamin B12 on some physical and chemical characteristics of the fruits of Golek mango trees during 2016 and 2017 seasons.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Fruit pulp**  **(%)** | | **Fruit stone**  **(%)** | | **T.S.S**  **(%)** | | **Total sugars**  **(%)** | |
| **2016** | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** | **2017** |
| Control treatment | 77.1 | 78.0 | 11.1 | 11.0 | 18.1 | 18.4 | 15.1 | 15.2 |
| Spraying amino acids at 0.05%. | 81.1 | 82.0 | 9.8 | 9.7 | 19.5 | 19.8 | 16.5 | 16.7 |
| Spraying amino acids at 0.1% | 82.4 | 83.3 | 9.5 | 9.4 | 20.0 | 20.3 | 17.0 | 17.2 |
| Spraying amino acids at 0.2% | 82.5 | 83.4 | 9.4 | 9.3 | 20.1 | 20.4 | 17.1 | 17.3 |
| Spraying vitamin B12 at 25 ppm | 78.5 | 79.4 | 10.8 | 10.7 | 18.5 | 18.8 | 15.5 | 15.7 |
| Spraying vitamin B12 at 50 ppm | 79.9 | 80.8 | 10.5 | 10.4 | 19.0 | 19.3 | 16.0 | 16.2 |
| Spraying vitamin B12 at 100 ppm | 80.0 | 80.9 | 10.1 | 10.0 | 19.1 | 19.4 | 16.1 | 16.3 |
| Spraying both at low concentration. | 84.0 | 85.0 | 9.0 | 8.9 | 20.7 | 21.0 | 17.5 | 17.7 |
| Spraying both at medium concentration | 86.3 | 88.0 | 8.7 | 8.6 | 21.5 | 21.7 | 18.0 | 18.2 |
| Spraying both at high concentration | 87.0 | 88.3 | 8.6 | 8.5 | 21.6 | 21.8 | 18.1 | 18.3 |
| **New L.S.D. at 5%** | **1.1** | **0.9** | **0.2** | **0.3** | **0.3** | **0.4** | **0.3** | **0.3** |

**Table (9): Effect of single and combined applications of amino acids and vitamin B12 on some chemical characteristics of the fruits of Golek mango trees during 2016 and 2017 seasons.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Reducing sugars**  **%** | | **Total acidity**  **%** | | **Crude fibre**  **%** | | **Total soluble tannins**  **(%)** | |
| **2016** | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** | **2017** |
| Control treatment | 6.6 | 6.8 | 0.339 | 0.340 | 1.00 | 0.99 | 31.3 | 33.3 |
| Spraying amino acids at 0.05%. | 7.7 | 8.0 | 0.295 | 0.290 | 0.87 | 0.85 | 38.0 | 40.9 |
| Spraying amino acids at 0.1% | 8.0 | 8.3 | 0.280 | 0.275 | 0.84 | 0.82 | 40.0 | 44.0 |
| Spraying amino acids at 0.2% | 8.1 | 8.4 | 0.279 | 0.274 | 0.83 | 0.81 | 40.3 | 44.3 |
| Spraying vitamin B12 at 25 ppm | 6.9 | 7.2 | 0.327 | 0.323 | 0.97 | 0.95 | 33.4 | 36.0 |
| Spraying vitamin B12 at 50 ppm | 7.3 | 7.6 | 0.315 | 0.310 | 0.93 | 0.91 | 36.0 | 38.0 |
| Spraying vitamin B12 at 100 ppm | 7.4 | 7.7 | 0.310 | 0.307 | 0.92 | 0.90 | 36.3 | 38.3 |
| Spraying both at low concentration. | 8.5 | 8.8 | 0.267 | 0.264 | 0.80 | 0.78 | 42.0 | 46.3 |
| Spraying both at medium concentration | 8.8 | 9.3 | 0.255 | 0.252 | 0.71 | 0.64 | 44.0 | 48.9 |
| Spraying both at high concentration | 8.9 | 9.4 | 0.254 | 0.250 | 0.70 | 0.63 | 44.0 | 49.0 |
| **New L.S.D. at 5%** | **0.2** | **0.3** | **0.010** | **0.010** | **0.02** | **0.03** | **0.02** | **0.03** |

**4. Discussion:**

Amino acids with their antioxidative properties play an important role in plant defense against oxidative stress induced by unfavourable conditions. Application of amino acids was accompanied with enhancing proteins biosynthesis as well as protecting plant cells from senescence and death, preventing the free radicals from oxidation of lipids the components of plasma membrane which is accompanied with the loss of permeability and controlling the incidence of disorders (**Orth *et al,* 1993**). They are responsible for stimulating the biosynthesis of natural hormones like, IAA, ethylene, cytokinins and GA3 cell division, organic foods, enzymes as well as DNA and RNA. These positive effects surely reflected on producing healthy trees (**Vianello and Marci, 1991 and Elade, 1992**).

Vitamins are considered antioxidants they play a definite role in protecting the plant cells from senescence and death through preventing the producing free radicals during plant metabolism from oxidation of lipids, the components of plasma membrane which is accompanied with the loss of permeability of cells (**Raskin, 1992; Bertschinger and Stadler, 1997 and Buchala and Schmid, 1997**).

Vitamins B have definite roles in decaerboxylation formation of meristem via supplying metabolites to the apex, coenzymes, flavin mononucleotide coenzymes, flavin adenine, dinucleotide and photosynthesis **(Mer, 1957; Robinson, 1973 and Karabanov, 1977**).

This results regarding the effect of amino acids in improving growth, yield and fruit quality of Golek mango trees are in agreement with those obtained by showed that using amino acids **El- Badawy and Abd El- aal,** (**2013); Fathalla,** **(2013);** **Ibrahiem** ***et al.,* (2013), Hassan-Huda (2014), Sayed- Ola, (2014) and Ahmed, (2016**).

The results of **Hamad** (**2008), Badran and Ahmed** (**2009), Zagzog, (2009),** **Ahmed *et al,* (2013), Farag, (2013), Ibrahim *et al*., (2013), Rizk**, **(2013) and Omar, (2015**) supported the presents results concerning the effect of vitamin B on improving growth, tree nutritional status, yield and quality of the fruits of Golek mangoes.

**5. Conclusion:**

Supplying Golek mango trees grown under Aswan climatic conditions three times with amino acids at 0.1% plus vitamin B12 at 50 ppm succeeded in maximizing the yield and improving fruit quality.

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