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IMPROVING PRODUCTIVITY OF TAIMOUR MANGO TREES BY USING GLUTATHIONE, SILICON AND VITAMINS B

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ABSTRACT

The present study was carried out during ٢٠١١ and ٢٠١٢ seasons to examine the effect of treating Taimour mango trees thrice with glutathione at ٠.١ %, potassium silicate at ٠.١ %, pyridoxine (vitamin $B_{٦}$) at ٥٠ ppm and cyanocobalamin (vitamin $B_{١٢}$) at ٥٠ ppm either singly or in all possible combinations on fruiting of the trees.

Results showed that single and combined applications of glutathione at ٠.١ %, potassium silicate at ٠.١, pyridoxine at ٥٠ ppm and cyanocobalamin at ٥٠ ppm stimulated the leaf area, chlorophylls a & b, total chlorophylls, and total carotenoids. Also, leaf content of N, P, K, Mg, Zn, Mn and Cu, fruit retention %, yield/ tree, fruit weight, T.S.S % and total sugars % and reducing total acidity % was improved in compar to the check treatment. The promotion was associated with using cyanocobalamin, pyridoxine, potassium silicate and glutathione, in ascending order. Application of the tested compounds gave the best findings.

Spraying Taimour mango trees three times (at growth start, just after fruit setting and at one month later) with a mixture contains glutathione at ٠.١ %, potassium silicate at ٠.١ %, pyridoxine (vitamin $B_{٦}$) at ٥٠ ppm and cyanocobalamin (vitamin $B_{١٦}$) at ٥٠ ppm gave the best results with regard to yield and fruit quality.

INTRODUCTION

The decline of yield in Taimour mango trees grown under Souhag conditions is considered as a major problem that faces mango growers. Unbalanced or malnutrion as well as unsuitable environmental conditions are considered the main causes for poor cropping. Most studies carried out recently emphasized the great benefits of using glutathione, silicon and vitamins B as important antioxidants on fruiting of different mango cvs.

Glutathione is the most important non- protein thiol present in plants. It is essential in sulfur metabolism and defense against most stresses. It is important pool of reduced sulfur and it regulates sulfur uptake at root level. Reduced glutathione, the major water soluble antioxidant in photosynthetic and non- photosynthetic tissues, reacting directly or indirectly with reactive oxygen species, contribute to maintain the integrity of cell structure and the proper functions of various metabolic pathways. In addition to its effects on expression of defense genes glutathione may also be involved in redox control of cell division and enhanced growth of plants (Levitt, ١٩٨٠; Rennenbery, ١٩٨٢; Meister and Anderson, ١٩٨٣; Dekok and Stulen, ١٩٩٣; Jorge *et al*., ١٩٩٣; Foyer *et al*., ١٩٩٧; Noctor and Foyer, ١٩٩٨; Tausz and Grill, ٢٠٠٠; Kocsy *et al*., ٢٠٠١ and Mullineaux and Rausch, ٢٠٠٥).

Abdelaal *et al*., (٢٠١٢) found that foliar application of glutathione at ٠.٠٥ to ٠.٢ % three times resulted in great promotion on yield as well as physical and chemical characteristics of Taimour mango fruits.

Although silicon (Si) is the second most abundant element both on the surface of the earth crust and in the soils, it has not yet been listed among the essential elements for higher plants. Evidence is still lacking that Si is part of the molecule of an essential plant constituent or metabolite have proposed a new definition of essentiality Epstein (١٩٩٩) and Epstein and Bloom (٢٠٠٣). Based on this new definition, the essentiality of Si for higher plants will be finally established.

Over last two or three decades, the striking and unique role of Si in conferring plants against various abiotic and biotic stresses has received increasing interest. Silicon is known to effectively mitigate various abiotic (environmental) stresses including manganese, aluminum, and heavy metal toxicity, and salinity, drought, chilling or freezing stresses etc. However, mechanisms for such Si-mediated alleviation of various abiotic stresses remain poorly understood. The key mechanisms of Si-mediated alleviation of abiotic stresses in higher plants include: ١) stimulation of antioxidant systems in plants, ٢) complexation or co-precipitation of toxic metal ions with Si, ٣) immobilization of toxic metal ions in growth media, ٤) uptake processes, and ٥) compartmentation of metal ions within plants.

Silicon deficiency in crops has been relatively unknown and the element has been regarded as non- essential for plant growth. However, recent research show that Si is a functional plant nutrient and that Si application can considerably enhance insect pest resistance in plants with consequent yield increases. Most reports show that responses to Si application in reducing pest populations and plant damage was more obvious in susceptible than in resistant varieties. Recent evidence suggests that Si deposition in the plant may reinforce plant insect resistance by providing a mechanical barrier against insect pests. This passive role of Si is contested in the relation Si- treated plants and resistance to diseases. Silicon is widely considered as activator by stimulating the expression of natural defense reaction through production of other chemicals phenolic compounds. The application of Si in crops provides a viable component of integrated management of insect pests and diseases . It leaves no insecticide residues in foods or the environment and it can be easily integrated with other pest management practice, (Epstein, ١٩٩٩).

All silicon compounds had beneficial effects on growth and fruiting of fruit crops (Matichenkov *et al*., ٢٠٠٠; Neumann and Zur-Nieden, ٢٠٠١; Ma *et al*., ٢٠٠١; Ma and Takahashi, ٢٠٠٢; Kanto, ٢٠٠٢ and Qin and Tian, ٢٠٠٤).

Recently, it was suggested that vitamins B participate in plant growth and development indirectly by enhancing the endogenous levels of various growth factors such as cytokinins and gibberellins. They are synthesized in the leaves and translocated in the phloem. For more than two decades, study of the role of these antioxidants in plants attracted sporadic attention. These studies indicated that various physiological processes such as nutrient uptake, respiration, photosynthesis as well as chlorophyll and protein synthesis depend more or less on the availability of these antioxidants (Samiullah *et al*., ١٩٨٨ and Tzeng and Devay, ١٩٨٩).

Previous studies showed that exogenous application of vitamins was responsible for enhancing growth and fruiting of fruit crops (Oretli, ١٩٨٧; Ahmed and Seleem- Basma, ٢٠٠٨; Abada and Abd El-Hameed, ٢٠٠٩; Madian and Refaai, ٢٠١١; Mohamed- Ebtesam, ٢٠١٢; Ahmed *et al*., ٢٠١٢a and Ahmed *et al*., ٢٠١٢b).

The goal of this study was testing the effect of glutathione, silicon and vitamins B on fruiting of Taimour mango trees.

MATERIALS AND METHODS

The present study was conducted during ٢٠١١ and ٢٠١٢ seasons on forty- eight ٢٠- years old Taimour mango trees onto mango seedling rootstock in a private orchard located at Gerga district, Souhag Governorate, Upper Egypt. The texture of the soil is clay. Planting distance is ٧ × ٧ meters. Surface irrigation system was followed. The selected trees were subjected to the normal horticultural practices that are usually followed in the orchard except those dealing with the application of any antioxidants.

The following sixteen treatments from single and combined applications of glutathione, potassium silicate and the two vitamins B namely pyridoxine ($B_{٦}$) and cyanocobalamin ($B_{١٢}$) were arranged as follows:-

١- Control (where the trees were sprayed with tap water).
٢- Spraying glutathione at ٠.١ %.
٣- Spraying potassium silicate at ٠.١ %.
٤- Spraying pyridoxine (vit. $B_{٦}$) at ٥٠ ppm.
٥- Spraying cyanocobalamin (vit. $B_{١٢}$) at ٥٠ ppm.
٦- Spraying glutathione at ٠.١ % + potassium silicate at ٠.١ %.
٧- Spraying glutathione at ٠.١ % + pyridoxine at ٥٠ ppm.
٨- Spraying glutathione at ٠.١ % + cyanocobalamin at ٥٠ ppm.

٩- Spraying potassium silicate at ٠.١ % + pyridoxine at ٥٠ ppm.
١٠- Spraying potassium silicate at ٠.١ % + cyanocobalamin at ٥٠ ppm.
١١- Spraying pyridoxine at ٥٠ ppm + cyanocobalamin at ٥٠ ppm.
١٢- Spraying glutathione at ٠.١ % + potassium silicate at ٠.١ % + pyridoxine at ٥٠ ppm.
١٣- Spraying glutathione at ٠.١ % + potassium silicate at ٠.١ % + cyanocobalamin at ٥٠ ppm.
١٤- Spraying potassium silicate at ٠.١ % + pyridoxine at ٥٠ ppm + cyanocobalamin at ٥٠ ppm.
١٥- Spraying glutathione at ٠.١ % + pyridoxine at ٥٠ ppm + cyanocobalamin at ٥٠ ppm.
١٦- Spraying all substances at the named concentrations.

Each treatment was replicated three times, one tree per each. The three antioxidants were sprayed three times annually at growth start (last week of Feb.), just after fruit setting (last week of April) and at one month later (last week of May). Triton B as a wetting agent at ٠.٠٥ % was added to all antioxidant solutions. Spraying was applied till runoff (٣٠ L/ tree). The control trees were sprayed with tap water containing Triton B.

The experiment was set up in a complete randomized block design.

Twenty leaves from Spring growth cycle were chosen on four labeled branches (four shoots for each direction) for measuring the leaf area according to Ahmed and Morsy (١٩٩٩).

Samples of five mature and fresh leaves/ tree were taken (last week of June) for determination of chlorophylls a & b and total carotenoids (mg/ ١٠٠ g fresh weight (F.W) according to Fadl and Seri El- Deen (١٩٧٨). Total chlorophylls (a & b) was then calculated (as mg/ ١٠٠ g. F.W).

Twenty mature leaves from non- fruiting shoots in the Spring growth cycle (Summer, ١٩٨٥) were taken (last week of June) for determination of N, P, K and Mg (as percentages) as well as Zn, Fe, Mn and Cu (as ppm) according to the procedures that outlined by Chapman and Pratt (١٩٦٥).

Ten panicles/ tree were chosen and labeled four counting number of perfect flowers just before harvesting. Number of retained fruits on the ten selected panicles/ tree was counted. Percentage of fruit retention was estimated by dividing the number of retained fruits/ ten panicles by total number of flowers on these panicles and multiplying the product by ١٠٠.

Harvesting was made at the middle of July during both seasons. Yield/ tree expressed in number of fruits/ tree and weight (kg.)/ tree was recorded. Ten fruits from each tree were taken for determination of fruit weight (g.), T.S.S %, total sugars % and total acidity % (as g citric acid/ ١٠٠ ml juice) according to A.O.A.C., (١٩٩٥).

Statistical analysis was done according to Mead *et al*., (١٩٩٣). Treatment means were compared using New L.S.D. at ٥ %.

RESULTS AND DISCUSSION

١- Leaf area:

It is quite clear from the data in Table (١) that single and combined applications of glutathione at ٠.١ %, potassium silicate at ٠.١ %, pyridoxine (vit. $B_{٦}$) at ٥٠ ppm and cyanocobalamin (vit. $B_{١٢}$) at ٥٠ ppm significantly stimulated the leaf area of Taimour mango trees in relative to the Check treatment. Spraying cyanocobalamin, pyridoxine, potassium silicate and glutathione, in ascending order was significantly promoted such growth trait. Combined applications of the tested substances was favourable than using each compound alone in this respect. Application of all antioxidants gave the maximum values. The minimum values were recorded on the untreated trees. Similar results were obtained during both seasons.

The beneficial of glutathione on increasing cell division, tolerance of plant to stress and the biosynthesis of organic foods could result in enhancing growth characters (Meister and Anderson, ١٩٨٣).

The effect of silicon on alleviating the abiotic stresses and stimulating of antioxidant systems in plants could explain the present results (Epstein and Bloom, ٢٠٠٣).

The promotive effects of vitamins B on the biosynthesis of natural hormones (cytokinins and GA٣) nutrient uptake, photosynthesis and plant pigments surely reflected on stimulating growth characters (Samiullah *et al*., ١٩٨٨).

The results of Kocsy *et al*., (٢٠٠١) and Abdelaal *et al*., (٢٠١٢) who worked on glutathione, Kanto (٢٠٠٢) and Qin and Tian (٢٠٠٤) who worked on silicon and Ahmed *et al*., (٢٠١٢a) and (٢٠١٢b) who worked on vitamin B confirmed the present results.

٢- Leaf chemical composition:

It is evident from the data in Tables (١ & ٢) that plant pigments namely chlorophylls a & b and total carotenoids as well as total chlorophylls besides leaf content of N, P, K, Mg, Zn, Fe, Mn and Cu were significantly promoted with using glutathione at ٠.١ %, potassium silicate at ٠.١ %, pyridoxine at ٥٠ ppm and cyanocobalamin at ٥٠ ppm either singly or in all combinations rather than the control treatment. The stimulation on these chemical components was significantly related to using glutathione, potassium silicate, pyridoxine and cyanocobalamin, in descending order. Combined application of these antioxidants was superior than application of each antioxidant alone in enhancing these organic and mineral nutrients. The best double combination was represented in using glutathione and potassium silicate. Application of glutathione, potassium silicate and pyridoxine was the best triple combination. The maximum values were recorded on the trees that treated with all antioxidants. The untreated trees produced the minimum values. Similar trend was noticed during both seasons.

The beneficial effects of glutathione, silicon and vitamins B on enhancing root development and uptake of nutrients could explain the present results (Meister and Anderson, ١٩٨٣; Samiullah *et al*., ١٩٨٨ and Epstein and Bloom, ٢٠٠٣).

The results of Kocsy *et al*., (٢٠٠١) and Abdelaal *et al*., (٢٠١٢) who worked on glutathione, Kanto (٢٠٠٢) and Qin and Tian (٢٠٠٤) who worked on silicon and Ahmed *et al*., (٢٠١٢a) and (٢٠١٢b) who worked on vitamin B confirmed the present results.

Table ١: Effect of spraying glutathione, potassium silicate, pyridoxine and cyanocobalamin on the leaf area (cm٢) and some plant pigments (as mg/ ١٠٠ g F.W) of Taimour mango trees during ٢٠١٠ and ٢٠١١ seasons.

Treatment	Leaf area (cm٢)		Chlorophyll a (mg/١٠٠g F.W)		Chlorophyll b (mg/١٠٠g F.W)		Total Chlorophylls (mg/١٠٠g F.W)		Total Carotenoids (mg/١٠٠g F.W)	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Control	٦٤.٣	٦٥.٠	١٨.١	١٨.٥	٦.١	٦.٣	٢٤.٢	٢٤.٨	٤.٠	٤.٣
Glutathione at ٠.١ %.	٧١.٢	٧٢.٢	٢٠.٨	٢١.٢	٩.٤	٩.٦	٣٠.٢	٣٠.٨	٦.٠	٦.٢
Potassium silicate at ٠.١ %.	٧١.٠	٧١.٧	٢٠.٠	٢٠.٤	٨.٩	٩.١	٢٨.٩	٢٩.٥	٥.٤	٥.٧
Pyridoxine (v. B٦) at ٥٠ ppm.	٦٩.٠	٦٩.٧	١٩.٣	١٩.٧	٧.٩	٨.١	٢٧.٢	٢٧.٨	٤.٩	٥.٣
Cyanocobalamin (v B١٢) at ٥٠ ppm.	٦٧.٣	٦٨.٠	١٨.٧	١٩.١	٦.٨	٧.٠	٢٥.٥	٢٦.١	٤.٤	٤.٧
Glutathione + Silicon.	٧٨.٢	٧٩.٠	٢٤.٨	٢٥.٢	١٣.٠	١٣.٢	٣٧.٨	٣٨.٤	٨.٠	٨.٣
Glutathione + Pyridoxine.	٧٧.٠	٧٧.٧	٢٤.٠	٢٤.٤	١٢.٣	١٢.٥	٣٦.٣	٣٦.٩	٧.٦	٨.٠
Glutathione + Cyanocobalamin.	٧٥.٧	٧٦.٢	٢٣.٠	٢٣.٤	١١.٧	١١.٩	٣٤.٧	٣٥.٣	٧.٣	٧.٦
Silicon + Pyridoxine.	٧٤.٤	٧٥.١	٢٢.٣	٢٢.٧	١١.١	١١.٣	٣٤.٠	٣٤.٠	٧.٠	٧.٣
Silicon + Cyanocobalamin.	٧٣.١	٧٣.٨	٢١.٥	٢١.٩	١٠.٥	١٠.٧	٣٢.٠	٣٢.٦	٦.٦	٦.٩
Pyridoxine + Cyanocobalamin	٧٢.٠	٧٢.٧	٢٠.٧	٢١.١	١٠.٠	١٠.٢	٣٠.٧	٣١.٣	٦.٣	٦.٦
Glutathione + Silicon + Pyridoxine.	٨٣.٣	٨٤.٠	٢٧.٠	٢٧.٥	١٥.٠	١٥.٢	٤٢.٠	٤٢.٧	٩.٣	٩.٦
Glutathione + Silicon + Cyanocobalamin.	٨١.٩	٨٢.٦	٢٦.٢	٢٦.٦	١٤.٣	١٤.٥	٤٠.٥	٤١.١	٩.٠	٩.٣
Silicon + Pyridoxine + Cyanocobalamin.	٧٩.٥	٨٠.٣	٢٥.٦	٢٦.٠	١٣.٦	١٣.٨	٣٩.٢	٣٩.٨	٨.٣	٨.٦
Glutathione + Pyridoxine + Pyridoxine.	٨٠.٧	٨١.٥	٢٦.٩	٢٧.٥	١٤.٠	١٤.٢	٤٠.٩	٤١.٧	٨.٦	٨.٩
All substances.	٨٥.٥	٨٧.٠	٢٧.٩	٢٩.٠	١٥.٥	١٥.٨	٤٣.٤	٤٤.٨	٩.٨	١٠.٢
New L.S.D at ٥ %	١.٠	١.١	٠.٥	٠.٦	٠.٥	٠.٦	٠.٥	٠.٥	٠.٣	٠.٣

Table ٢: Effect of spraying glutathione, potassium silicate, pyridoxine and cyanocobalamin on the leaf content of N, P, K, Mg as percentage and Zn (as ppm) of Taimour mango trees during ٢٠١٠ and ٢٠١١ seasons.

Treatment	Leaf N %		Leaf P %		Leaf K %		Leaf Mg %		Leaf Zn (ppm)	
	٢٠١٠	٢٠١١	٢٠١٠	٢٠١١	٢٠١٠	٢٠١١	٢٠١٠	٢٠١١	٢٠١٠	٢٠١١
Control	١.٦١	١.٦٥	٠.١١	٠.١٤	١.٢٢	١.٣٠	٠.٢١	٠.٢٥	٤١.٠	٥١.٠
Glutathione at ٠.١ %.	١.٨٥	١.٨٩	٠.٢١	٠.٢٤	١.٣٨	١.٤٦	٠.٣٨	٠.٤٢	٤٩.٠	٥٩.٠
Potassium silicate at ٠.١ %.	١.٨٠	١.٨٥	٠.١٩	٠.٢٢	١.٣٤	١.٤٢	٠.٣٤	٠.٣٨	٤٧.٠	٥٧.٠
Pyridoxine (v. B٦) at ٥٠ ppm.	١.٧٢	١.٧٦	٠.١٦	٠.٢٠	١.٣٠	١.٣٨	٠.٣٠	٠.٣٤	٤٥.٠	٥٥.٠
Cyanocobalamin (v B١٢) at ٥٠ ppm.	١.٦٦	١.٧٠	٠.١٤	٠.١٧	١.٢٦	١.٣٤	٠.٢٥	٠.٢٩	٤٣.٠	٥٤.٠
Glutathione + Silicon.	٢.٢٥	٢.٢٩	٠.٣٧	٠.٤٠	١.٥٨	١.٦٦	٠.٦٥	٠.٦٩	٦٣.٥	٧٤.٠
Glutathione + Pyridoxine.	٢.٢٠	٢.٢٥	٠.٣٥	٠.٣٨	١.٥٥	١.٦٢	٠.٦٠	٠.٦٤	٦١.٠	٧١.٠
Glutathione + Cyanocobalamin.	٢.١٤	٢.١٨	٠.٣٢	٠.٣٦	١.٥٢	١.٦٠	٠.٥٥	٠.٥٩	٥٨.٩	٦٩.٠
Silicon + Pyridoxine.	٢.٠٧	٢.١١	٠.٣٠	٠.٣٤	١.٤٩	١.٥٧	٠.٥٠	٠.٥٤	٥٥.٩	٦٦.٠
Silicon + Cyanocobalamin.	٢.٠٠	٢.٠٤	٠.٢٧	٠.٣١	١.٤٥	١.٥٣	٠.٤٦	٠.٥٠	٥٤.٠	٥٥.٠
Pyridoxine + Cyanocobalamin	١.٩٢	١.٩٦	٠.٢٤	٠.٢٨	١.٤١	١.٥٠	٠.٤١	٠.٤٥	٥١.٦	٦٢.٠
Glutathione + Silicon + Pyridoxine.	٢.٥١	٢.٥٥	٠.٤٦	٠.٥٠	١.٥٠	١.٥٨	٠.٨١	٠.٨٥	٧٢.٠	٨٢.٠
Glutathione + Silicon + Cyanocobalamin.	٢.٤٤	٢.٤٨	٠.٤٤	٠.٤٨	١.٤٧	١.٥٥	٠.٧٥	٠.٧٩	٦٩.٥	٨٠.٠
Silicon + Pyridoxine + Cyanocobalamin.	٢.٣١	٢.٣٥	٠.٤٠	٠.٤٤	١.٤١	١.٥٠	٠.٦٥	٠.٦٩	٦٥.٠	٧٥.٠
Glutathione + Pyridoxine + Pyridoxine.	٢.٣٧	٢.٤١	٠.٤٢	٠.٤٦	١.٤٤	١.٥٢	٠.٧٠	٠.٧٤	٦٧.٥	٧٨.٠
All substances.	٢.٦١	٢.٦٦	٠.٤٨	٠.٥٢	١.٥٤	١.٦٣	٠.٨٦	٠.٩٠	٧٤.٢	٨٤.٠
New L.S.D at ٥ %	٠.٠٤	٠.٠٤	٠.٠٢	٠.٠٢	٠.٠٣	٠.٠٣	٠.٠٤	٠.٠٤	١.٩	٢.٠

٣- Fruit retention % and yield per tree:

Data in Tables (٣ & ٤) clearly show that percentage of fruit retention and yield expressed in weight (kg.) and number of fruits per tree were significantly varied among the four antioxidant treatments. Single and combined applications of cyanocobalamin, pyridoxine, potassium silicate and glutathione significantly was responsible for promoting fruit retention % and yield in comparison to the check treatment. The promotion on these parameters was associated with using cyanocobulamin, pyridoxine, potassium silicate and glutathione, in ascending order. Combined applications of these antioxidants were preferable than using each antioxidant alone on this respect. The maximum fruit retention (٠.٩٣ and ٠.٩٣ %), number of fruits per tree (٢٢٩ and ٢٣٣ fruits) and yield as weight (kg.) (٦٤.١ and ٦٥.٥ kg.) were recorded on the trees that received the four antioxidant together during both seasons (٢٠١١, ٢٠١٢), respectively. Untreated trees produced ٠.٤١ and ٠.٤٥ % fruit retention, ١٠٥ and ١٠٦ fruits per tree and ٢٢.٢ and ٢٢.٧ kg. weight of yield during both seasons, respectively. The percentage of yield increase on the best treatment (application of all antioxidants) over the check treatment reached ١٨٨.٩ and ١٨٨.٥ % during both seasons, respectively.

The beneficial effect of these antioxidants on fruit retention and yield was mainly attributed to their positive action on enhancing growth and nutritional status of the trees in favour of increasing carbohydrates at the expense of N consequently caused a great promotion on fruit retention and yield.

These results are in harmony with those obtained by Abdelaal *et al.*, (٢٠١٢) who worked on glutathione; Qin and Tian (٢٠٠٤) who worked on silicon and Mohamed- Ebtesam (٢٠١٢) who worked on vitamins B.

٤- Some physical and chemical characteristics of the fruits:

Treating Taimour mango trees thrice with cyanocobulamin, pyridoxine, potassium silicate and glutathione either alone or in all combinations was significantly responsible for promoting fruit quality in terms of increasing fruit weight, total soluble solids % and total sugars % and reducing total acidity % in comparison to the check treatment.

Table ٣: Effect of spraying glutathione, potassium silicate, pyridoxine and cyanocobalamin on the leaf content of Fe, Mn and Cu (ppm), fruit retention % and number of fruits per tree of Taimour mango trees during ٢٠١٠ and ٢٠١١ seasons.

Treatment	Leaf Fe (ppm)		Leaf Mn (ppm)		Leaf Cu (ppm)		Fruit retention %		No. of fruits/ tree	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Control	٤٦.٠	٤٧.١	٤١.٥	٤٢.٢	٥.١	٥.٣	٠.٤١	٠.٤٥	١٠٥.٠	١٠٦.٠
Glutathione at ٠.١ %.	٥٥.٦	٥٧.٨	٥٢.٥	٥٣.٢	٦.٦	٧.٠	٠.٨١	٠.٦٥	١٤٥.٠	١٥٠.٠
Potassium silicate at ٠.١ %.	٥٣.٥	٥٥.٠	٥٠.٠	٥٠.٧	٦.٣	٦.٧	٠.٦٩	٠.٦٠	١٣٥.٠	١٤٠.٠
Pyridoxine (v. B٦) at ٥٠ ppm.	٥١.٠	٥٢.٣	٤٧.٠	٤٧.٨	٦.٠	٦.٥	٠.٥٩	٠.٥٥	١٢٥.٠	١٣٠.٠
Cyanocobalamin (v B١٢) at ٥٠ ppm.	٤٨.٠	٥٠.٠	٤٤.٥	٤٥.٣	٥.٥	٥.٩	٠.٥١	٠.٥٠	١١٥.٠	١١٧.٠
Glutathione + Silicon.	٧١.٩	٧٣.٩	٦٨.٠	٦٨.٨	٨.٨	٩.٢	٠.٩١	٠.٩٠	١٨٠.٠	١٩٠.٠
Glutathione + Pyridoxine.	٧٠.٠	٧١.٥	٦٤.٩	٦٥.٨	٨.٤	٨.٨	٠.٩٠	٠.٨٩	١٧٥.٠	١٨٧.٠
Glutathione + Cyanocobalamin.	٦٦.٩	٦٩.٠	٦١.٩	٦٢.٧	٨.٠	٨.٤	٠.٨٧	٠.٨٤	١٧١.٠	١٨٠.٠
Silicon + Pyridoxine.	٦٤.٣	٦٥.٩	٥٨.٥	٥٩.٣	٧.٦	٨.٠	٠.٨٥	٠.٧٩	١٦٣.٠	١٧٩.٠
Silicon + Cyanocobalamin.	٦١.٠	٦٣.٣	٥٦.٠	٥٦.٧	٧.٣	٧.٧	٠.٨٤	٠.٧٥	١٦٠.٠	١٦٩.٠
Pyridoxine + Cyanocobalamin	٥٨.٠	٦١.٠	٥٤.٠	٥٤.٨	٦.٩	٧.٣	٠.٨٢	٠.٧٠	١٥٥.٠	١٦٠.٠
Glutathione + Silicon + Pyridoxine.	٨١.٠	٨٦.٠	٧٩.٥	٨٠.٣	١٠.٤	١٠.٨	٠.٩٣	٠.٩٥	٢١١.٠	٢٢٠.٠
Glutathione + Silicon + Cyanocobalamin.	٧٨.٥	٨٣.٠	٧٦.٠	٧٦.٨	٩.٩	١٠.٣	٠.٩٣	٠.٩٤	٢٠١.٠	٢١١.٠
Silicon + Pyridoxine + Cyanocobalamin.	٧٤.٠	٧٧.١	٧١.٠	٧١.٨	٩.٢	٩.٦	٠.٩٢	٠.٩٢	١٨٠.٠	١٩٥.٠
Glutathione + Pyridoxine + Pyridoxine.	٧٦.٠	٨٠.٠	٧٤.٠	٧٤.٨	٩.٦	١٠.٠	٠.٩٣	٠.٩٤	١٨٩.٠	٢٠٠.٠
All substances.	٨٨.٥	٩١.٠	٨٢.٨	٨٣.٥	١٠.٨	١١.٢	٠.٩٣	٠.٩٦	٢٢٩.٠	٢٣٣.٠
New L.S.D at ٥ %	٢.٠	٢.١	٢.٠	٢.٠	٠.٣	٠.٣	٠.٤	٠.٥	٨.٠	٨.٣

Table ٤: Effect of spraying glutathione, potassium silicate, pyridoxine and cyanocobalamin on the yield and some physical and chemical characteristics of the fruits of Taimour mango trees during ٢٠١٠ and ٢٠١١ seasons.

Treatment	Yield/ tree (kg.)		Fruit weight (g.)		T.S.S %		Total sugars %		Total acidity %	
	٢٠١٠	٢٠١١	٢٠١٠	٢٠١١	٢٠١٠	٢٠١١	٢٠١٠	٢٠١١	٢٠١٠	٢٠١١
Control	٢٢.٢	٢٢.٧	٢١١	٢١٤	١٤.٤	١٤.٦	١٣.٠	١٣.٣	٠.٤٢٤	٠.٤٣٤
Glutathione at ٠.١ %.	٣٤.٩	٣٦.٥	٢٤١	٢٤٣	١٥.٣	١٥.٥	١٣.٦	١٣.٩	٠.٣٤١	٠.٣٥١
Potassium silicate at ٠.١ %.	٣١.٧	٣٣.٠	٢٣٥	٢٣٦	١٥.٢	١٥.٤	١٣.٥	١٣.٨	٠.٣٥٠	٠.٣٦٠
Pyridoxine (v. B٦) at ٥٠ ppm.	٢٨.٣	٢٩.٨	٢٢٦	٢٢٩	١٥.٠	١٥.٢	١٣.٤	١٣.٧	٠.٣٥٢	٠.٣٦٢
Cyanocobalamin (v B١٢) at ٥٠ ppm.	٢٥.٢	٢٥.٩	٢١٩	٢٢١	١٤.٧	١٥.٠	١٣.٣	١٣.٦	٠.٣٩٠	٠.٤٠٠
Glutathione + Silicon.	٤٧.٣	٥٠.٤	٢٦٣	٢٦٥	١٦.٤	١٦.٦	١٤.٦	١٤.٩	٠.٣٠٣	٠.٣١٣
Glutathione + Pyridoxine.	٤٥.٥	٤٩.٠	٢٦٠	٢٦٢	١٦.٢	١٦.٥	١٤.٥	١٤.٨	٠.٣٠٤	٠.٣١٤
Glutathione + Cyanocobalamin.	٤٤.١	٤٧.٠	٢٥٨	٢٦١	١٦.٠	١٦.٢	١٤.٤	١٤.٧	٠.٣٠٥	٠.٣١٦
Silicon + Pyridoxine.	٤١.٦	٤٦.٥	٢٥٥	٢٦٠	١٥.٩	١٦.١	١٤.٢	١٤.٥	٠.٣٠٦	٠.٣١٦
Silicon + Cyanocobalamin.	٤٠.٥	٤٣.٤	٢٥٣	٢٥٧	١٥.٧	١٦.٠	١٤.١	١٤.٤	٠.٣١٠	٠.٣٢٠
Pyridoxine + Cyanocobalamin	٣٨.٨	٤١.٠	٢٥٠	٢٥٦	١٥.٦	١٦.٠	١٣.٩	١٤.٢	٠.٣١١	٠.٣٢١
Glutathione + Silicon + Pyridoxine.	٥٨.٠	٥٩.٨	٢٧٥	٢٧٢	١٦.٩	١٧.٢	١٥.١	١٥.٤	٠.٢٩٢	٠.٣٠٢
Glutathione + Silicon + Cyanocobalamin.	٥٥.٣	٥٧.٢	٢٧٥	٢٧١	١٦.٨	١٧.٠	١٥.٠	١٥.٤	٠.٢٩٥	٠.٣٠٥
Silicon + Pyridoxine + Cyanocobalamin.	٤٧.٩	٥٢.٥	٢٦٦	٢٦٩	١٦.٦	١٦.٩	١٤.٧	١٥.٠	٠.٣٠٠	٠.٣١٠
Glutathione + Pyridoxine + Pyridoxine.	٥١.٠	٥٤.٠	٢٧٠	٢٧٠	١٦.٧	١٧.٠	١٤.٨	١٥.٣	٠.٢٩٩	٠.٣٠٩
All substances.	٦٤.١	٦٥.٥	٢٨٠	٢٨١	١٦.٩	١٧.٥	١٥.٢	١٥.٧	٠.٢٨٢	٠.٢٩١
New L.S.D at ٥ %	٢.١	٢.٠	٦.١	٦.٦	٠.٣	٠.٣	٠.٣	٠.٣	٠.٣١	٠.٣٣

The best antioxidant was glutathione, followed by potassium silicate, however both vitamins B ($B_{٦}$ or $B_{١٢}$) occupied the last position in this respect. Application of the four antioxidants together resulted in the highest promotion on quality of the fruits. Unfavourable effects on fruit quality may attributed to using the control treatment. These results were similar during both seasons.

The great benefits of these antioxidants on the biosynthesis and translocation of carbohydrates surely reflected in advancing maturity and improving fruit quality.

These results are in harmony with those obtained by Abdelaal *et al*., (٢٠١٢) who worked on glutathione; Qin and Tian (٢٠٠٤) who worked on silicon and Mohamed- Ebtesam (٢٠١٢) who worked on vitamins B.

For improving yield quantitively and qualitatively of Taimour mango trees, it is suggested to use a mixture of antioxidants containing glutathione at ٠.١ %, potassium silicate at ٠.١ %, pyridoxine (vitamin $B_{٦}$) at ٥٠ ppm and cyanocobalamin (vitamin $B_{١٢}$) at ٥٠ ppm three times during each season.

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تحسين إنتاجية أشجار المانجو التيمور عن طريق استخدام الجلوتاثيون والسليكون وفيتامينات ب

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أجريت هذه التجربة خلال موسمي ٢٠١١ ، ٢٠١٢ لاختبار تأثير معاملة أشجار المانجو التيمور ثلاثة مرات بالجلوتاثيون بتركيز ٠,١ % ، سليكات البوتاسيوم بتركيز ٠,١ % ، البيرودوكسين فيتامين (ب٦) بتركيز ٥٠ جزء فى المليون والسيانوكوبلامين (فيتامين ب ١٢) بتركيز ٥٠ جزء فى المليون إما فى الصورة الفردية أو بجميع التوليفات المختلفة على الإثمار.

أشارت نتائج الدراسة إلى أن الإستخدام الفردى والمشترك للجلوتاثيون بتركيز ٠,١ % ، سليكات البوتاسيوم بتركيز ٠,١ % والبيرودوكسين بتركيز ٥٠ جزء فى المليون ، السيانوكوبلامين بتركيز ٥٠ جزء فى المليون كان مصحوبا بتحسين مساحة الورقة ، كلورفيل أ ، ب ، الكلوروفيل الكلى والكاروتينات الكلية ومحتوى الورقة من عناصر النيتروجين والفوسفور والبوتاسيوم والماغنيسيوم والزنك والمنجنيز والحديد والنحاس والنسبة المئوية للثمار المتبقية علي الشجرة وكمية المحصول للشجرة ووزن الثمرة والنسبة المئوية للمواد الصلبة الذائبة الكلية والسكريات الكلية وتقليل النسبة المئوية للحموضة الكلية وذلك بالمقارنة بمعاملة الكونترول. وكان التحسن مرتبطا باستخدام السيانوكوبلامين والبيرودوكسين وسليكات البوتاسيوم والجلوتاثيون مرتبة ترتيباً تصاعدياً.

أعطى رش أشجار المانجو التيمور ثلاثة مرات (فى بداية النمو ، بعد عقد الثمار مباشرة وبعدها بشهر) بمخلوط يحتوى على بالجلوتاثيون بتركيز ٠,١ % ، سليكات البوتاسيوم بتركيز ٠,١ % ، البيرودوكسين (فيتامين ب٦) بتركيز ٥٠ جزء فى المليون والسيانوكوبلامين (فيتامين ب ١٢) بتركيز ٥٠ جزء فى المليون أفضل النتائج بخصوص كمية المحصول وخصائص الجودة.