



Response Keitte Mango Trees Grown Under Aswan Region to Spraying Fish Oil and Glutathione

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Abstract: During 2019 and 2020 seasons Keitte mango trees grown under Aswan climatic conditions were treated with glutathione and / or fish oil each at 0.5 to 2.0 %. The merit was examining the effective of these treatments on growth, nutritional status, yield and quality of the fruits. The trees received three sprays during season on (first week of March, last week of April and last week of May). Treating the trees three times with glutathione and/ or fish oil each at 0.5 to 2.0 % materially was accompanied with stimulating the spring shoot length, number of leaves/ shoot, shoot thickness, leaf area, chlorophylls a, b, total chlorophylls, total carotenoids, N, P, K and Mg in the leaves, percentages of initial fruit setting and fruit retention, yield as well as physical and chemical characteristics of the fruits relative to the control treatment. The promotion was related to the increase in concentrations. Combined applications were superior than using each material alone. Using glutathione was superior than fish oil in this respect. Treating Keitte mango trees three times with a mixture of glutathione and fish oil each at 1.0% was necessary for producing higher yield and better fruit quality.

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1. Introduction

Mango (*Mangifera indica* L.) is a very delicious tropical fruit belongs to family Anacardiaceae, it is also considered as the queen of the fruits as it is very popular worldwide. Mango fruit is an abundant source of minerals, vitamins, total sugars and is famous for its excellent flavor, attractive fragrance and nutritional value. It is as an emerging tropical export crop and is produced in about 95 countries in the world with a production of over 820.877 MT. In Egypt, mango is considered the most popular fruit. The area of mango orchards reached 304118 feddan producing about 1091535 tons of fruits annually. (Raid, *et al.*, 1997, F.A.O., 2015 and Annual Reports of Statistical Institute and Agricultural Economic Research in Egypt, 2019).

Mango cv. Keitte as a prime, outstanding and popular fruit crops is still need more studies for overcoming yield poor by using new techniques for providing the trees with their requirements spraying antioxidants was very favourable for improving growth, nutritional status of the trees, yield and fruit quality.

Fish oil contains two types fatty acids omega 3-fatty acid namely docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA), Tocopherols, Fe, P, Cu, and carotenoids (Hultin and Jafan, 1991) it is considered an important source of antioxidants.

Glutathione (GSH) (molecular formula $C_{10}H_{17}N_3O_6S$) is a tripeptide that contains an usual peptide linkage to a glycine and the carboxyl group of the glutamate side-chain. It is an antioxidant preventing damage to the important cellular components caused by reactive oxygen species such as free radicals and peroxides. Thio groups are reducing agents existing at a concentration of approximately 5 mm in plant cells. It reduces disulfide bonds formed within cytoplasmic proteins to cysteines by serving as an electron donor. In this process, it is converted to its oxidized form glutathione disulfide (GSSG), also called (-) - glutathione. Once oxidized, it can be reduced by glutathione reductase using NADPH as an electron donor. The ratio of reduced and oxidized glutathione within cells is often used as a measure of cellular toxicity. It is not an essential nutrient, since it can be synthesized from the amino acids L- cysteine, L. glutamic acid and glycine (Grill *et al.*, 2001; Pastemak, *et al.*, 2007 and Rouhier *et al.*, 2008).

In this cycle, GSH is used by dehydroascorbate reductase (DHAR) to regenerate ascorbate to scavenge H_2O_2 and is converted to oxidized form (GSSG) which is then regenerated by glutathione reductase (GR) (Asada and Takahashi, 1987 and Noctor and Foyer, 1998).

Recently, most studies gave good evidence for the important role of using fish oil and glutathione for preventing the cell from aging in addition, such two

materials, one responsible for enhancing the idea of organic farming and reducing environment pollution. Using fish oils was responsible for promoting growth tree nutritional status, yield and quality fruit of different crops (Olma *et al.*, 1981; Osnaya and Schlasser, 1998; Mc- Arthey *et al.*, 2006; Yoder *et al.*, 2009; Masoud, Abou Zaid- Eman, 2017 and Saied, 2019).

This study was established to recognize the impact of using glutathione and fish oil applied via foliage on growth characters, tree nutritional status, yield and fruit quality of Keitte mango trees grown under Aswan region conditions.

2. Materials and Methods

This investigation was carried out the experimental farm of a private orchard situated at Wady el- Nokra, Aswan, Aswan governorate, Egypt during two successive seasons 2019 and 2020 on thirty uniform in vigor -12-years Old Keitte mango trees onto seedling rootstock and grown in sandy soil. The selected trees are planted at 4x2 meters apart. Drip irrigation system was followed. The selected trees received the common horticultural practices that already applied in the orchard.

Table (1): Shows the analysis of the tested soil (Wilde *et al.*, 1985).

Characters	Vales
Partical size distribution	
Sand %	71.8
Silt %	18.0
Clay %	10.2
Texture	Sandy
pH (1: 2.5 extract)	8.02
E.C. (1: 2.5 extract) mmh ^o s/ 1cm/ 25°C)	0.98
Organic matter %	0.33
CaCO ₃ %	1.25
Marconutrients values	
Total N %	0.10
P (ppm, olsen method)	6.1
K (ppm, ammonium acetate)	71.9
EDTA extractable micronutrients (ppm)	
Fe	0.33
Zn	0.63
Mn	0.45

This study included the following ten treatments from spraying glutathione and fish oil singly and in combinations:

- 1- Control (untreated trees).
- 2- Spraying glutathione at 0.5 % (5 g / L water).

- 3- Spraying glutathione at 1.0 % (10 g / L water).
- 4- Spraying glutathione at 2.0 % (20 g / L water).
- 5- Spraying fish oil at 0.5 % (5 ml / L water).
- 6- Spraying fish oil at 1.0 % (10 ml / L water).
- 7- Spraying fish oil at 2.0 % (20 ml / L water).
- 8- Spraying glutathione + fish oil at 0.5%
- 9- Spraying glutathione + fish oil at 1.0 %
- 10- Spraying glutathione + fish oil at 2.0 %

Therefore, the experiment evolved ten treatments. Each treatment was replicated three times. One tree per each. Spraying of glutathione and Fish oil was done three times. At the growth start (first week of Mar.), just after fruit setting (last week of Apr.) and at one month later (last week of May).

Triton B as a wetting agent at 0.05 % was added to all spraying solutions (each tree needs about 5 L solution) spraying was done till run off. The untreated trees sprayed with water containing triton B.

This study was statistically analyzed using Randomized complete Block Design (RCBD) in which the experiment included ten treatments and each treatment was replicated three times, one tree per each.

During both seasons, the following measurements were recorded:

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

2- Leaf pigments namely chlorophylls a, b, total chlorophylls and total carotenoids (as mg/ 1.0 g F.W.) Von Wettstein, 1957 and Hiscox and Isralsatm, 1979).

3- Percentages of N, P, K and Mg in the leaves on dry weight basis. (Cottenie *et al.*, 1982; Summer, 1985 and Wilde *et al.*, 1985).

4- Percentages of initial fruit setting and fruit retention on yield expressed in weight (kg.) and number of fruits / tree.

5- Some physical and chemical characteristics of the fruits namely weight, length, width and thickness if fruit, percentages of peels and pulp, edible to non- edible portions of the fruits, T.S.S. %, total and reducing sugars % (Lane and Eynon, 1965), titratable acidity % (as citric acid/ 100 g pulp), vitamin C (mg/ 100 g pulp) and crude fibre % (A.O.A.C., 2000).

Statistical analysis was done using new L.S.D. at 5% (Mead *et al.*, 1993). Treatment means were compared using new L.S.D. at 5%.

3. Results

1-Vegetative growth characteristics:

Data in Table (2) clearly show that single and combined applications of the antioxidant glutathione and fish oil each at 0.5 to 2.0% significantly was

responsible for stimulating the four growth characteristics namely spring shoot length, number of leaves per shoot, shoot thickness and leaf area comparing to the check treatment. The stimulation on such growth aspects was in proportional to the increase in concentrations of both glutathione and fish oil from 0.5 to 2.0%. Significant differences on these growth traits were observed among different concentrations of glutathione and fish oil except among the higher two concentrations namely 1.0 and 2.0 % combined application of glutathione and fish oil was significantly superior than using each material alone in stimulating these growth traits.

The maximum values of these growth characteristics were obtained on the trees received three sprays of a mixture of glutathione and fish oil each at 2.0 %. The untreated trees produced the minimum values. These results were trees during 2019 and 2020 seasons.

2-Leaf chemical composition:

Table (2): Effect of single and combined applications of glutathione and Fish oil on some vegetative growth characters and chlorophylls a and b in the leaves of Keitte mango trees during 2019 and 2020 seasons.

Treatments	Spring shoot length (cm)		No. leaves / shoot		Shoot thickness (cm)		Leaf area (cm) ²		Chlorophyll a (mg /1.0 g F.W.)		Chlorophyll b (mg /1.0 g F.W.)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Control	19.4	19.5	13.5	13.6	0.70	0.71	73.8	74.0	3.5	3.6	1.1	1.1
Spraying glutathione at 0.5%	22.0	22.2	16.0	16.2	0.84	0.86	78.6	78.8	4.5	4.6	1.7	1.8
Spraying glutathione at 1.0 %	23.6	24.0	16.9	17.0	0.90	0.91	80.1	80.3	5.3	5.4	2.1	2.2
Spraying glutathione at 2.0 %	24.4	24.6	17.3	17.7	0.91	0.93	81.0	81.2	5.5	5.6	2.3	2.4
Spraying fish oil at 0.5%	20.5	20.7	14.0	14.3	0.75	0.76	76.0	76.3	3.9	4.0	1.2	1.3
Spraying fish oil at 1.0 %	21.6	21.9	15.0	15.5	0.81	0.82	77.8	78.2	4.2	4.4	1.5	1.6
Spraying fish oil at 2.0 %	21.9	22.2	15.8	16.0	0.82	0.84	78.3	78.8	4.4	4.5	1.6	1.7
Spraying glutathione + fish oil at 0.5%	25.6	25.9	18.0	19.0	0.93	0.94	81.3	81.5	5.7	5.9	2.4	2.5
Spraying glutathione + fish oil at 1.0 %	27.0	27.6	21.0	22.0	0.97	0.98	84.2	84.9	6.6	6.7	2.9	3.0
Spraying glutathione + fish oil at 2.0%	27.4	28.0	21.8	23.0	0.98	0.99	85.6	86.0	6.8	6.9	3.0	3.1
New L.S.D. at 5%	0.8	0.9	1.1	1.2	0.03	0.03	1.2	1.3	0.2	0.3	0.2	0.3

4- Some physical and chemical characteristics of the fruits

It is evident from the data in Tables (5, 6) that treating Keitte mango trees three times with glutathione and / or fish oil each at 0.5 to 2.0 % significantly was very effective in improving fruit quality in terms of increasing weight, length, diameter and thickness of fruit, pulp %, edible to non- edible portions, T.S.S. %, total and reducing sugars % and vitamin C content and decreasing percentages of total acidity and total crude fibre. Over the control treatment, using glutathione was significantly superior than using fish oil in improving fruit quality. combined applications were significantly favourable

than using each material alone in improving fruit quality. The promotion on fruit quality was associated with increasing concentrations of both material from 1.0 to 2.0 %. A slight and insignificant promotion on fruit quality was observed with increasing concentrations of glutathione and fish oil from 1.0 to 2.0 %. Therefore, the best results with regard to fruit quality were obtained due to using both materials together at 1.0 %. The untreated trees produced unfavourable effects on both physical and chemical characteristics of the fruits. These results were true during both seasons.

It is clear from the data in Tables (3, 4) that treating Keitte mango trees three times with glutathione and/Or fish oil each at 0.5 to 2.0% caused a significant promotion on chlorophyll a, b, total chlorophylls, total carotenoids, N, P, K and Mg in the leaves over the check treatment. The promotion was associated with increasing concentrations of both materials. Using glutathione was significantly superior than using fish oil in enhancing these leaves chemical composition.

Meaning promotions on these chemical constituents were observed with increasing concentrations from 0.5 to 2.0 % from glutathione and fish oil. Using both together at the investigated with using each alone. The maximum values were recorded when glutathione and fish oil were applied together at 2.0 %. The lowest values were recorded on untreated trees,. Similar results were announced during both seasons.

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

Data in Table (5) noticeably reveal that percentages of initial fruit setting and fruit retention as well as yield expressed in weight and number of fruit / tree were significantly improved in response to using the antioxidant glutathione and fish oil each at 0.5 to 2.0 % either singly or in combinations over the check treatment. Using glutathione was significantly preferable than using fish oil in this respect. There was a gradual promotion on such parameters with increasing concentrations of such two materials from 0.5 to 2.0 % without significant promotion among the higher two concentration namely 1.0 and 2.0 %. Therefore, from economical point of view, it is suggested to use concentrations of 1.0 % for both materials.

Combined applications were significantly preferable than using each material alone in this respect. The best results from economical point of view were obtained due to the application of both materials together at 1.0% under such promised treatment percentages of fruit retention reached 2.9, 2.9 and yield per tree reached 35.5, 36.8 kg during both seasons respectively.

The untreated trees produced 0.7 and 0.7 % fruit retention and gave yield per tree reached 17.5 and 18.3 kg during 2019 and 2020 seasons respectively. The percentage of increment due to application of the previous promised treatment over the control treatment reached 102.9 and 101.1 % during 2019 and 2020 seasons, respectively. These results were true during both seasons.

Table (3): Effect of single and combined applications of glutathione and Fish oil on total chlorophylls, total carotenoids and the percentages of N, P, K and Mg on dry weight basis) in the leaves of Keitte mango trees during 2019 and 2020 seasons.

Treatments	Total chlorophylls (mg/ 1.0 g F.W.)		Total carotenoids (mg/ 1.0 g F.W.)		Leaf N %		Leaf P %		Leaf K %		Leaf Mg %	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Control	4.6	4.7	1.1	1.1	1.60	1.60	0.15	0.16	1.10	1.09	0.48	0.49
Spraying glutathione at 0.5%	6.2	6.4	1.9	2.1	1.79	1.80	0.24	0.25	1.25	1.27	0.59	0.60
Spraying glutathione at 1.0 %	7.4	7.6	2.2	2.4	1.85	1.86	0.28	0.29	1.33	1.34	0.66	0.67
Spraying glutathione at 2.0 %	7.8	8.0	2.3	2.5	1.87	1.88	0.29	0.30	1.36	1.37	0.67	0.68
Spraying fish oil at 0.5%	5.1	5.3	1.3	1.4	1.68	1.70	0.18	0.19	1.16	1.17	0.53	0.54
Spraying fish oil at 1.0 %	5.7	6.0	1.6	1.7	1.73	1.76	0.22	0.23	1.21	1.22	0.56	0.57
Spraying fish oil at 2.0 %	6.0	6.2	1.7	1.8	1.75	1.77	0.23	0.24	1.22	1.23	0.57	0.58
Spraying glutathione + fish oil at 0.5%	8.1	8.4	2.5	2.7	1.91	1.92	0.31	0.32	1.37	1.38	0.69	0.70
Spraying glutathione + fish oil at 1.0 %	9.5	9.7	2.8	3.0	2.00	2.01	0.36	0.37	1.41	1.42	0.77	0.78
Spraying glutathione + fish oil at 2.0%	9.8	10.0	2.9	3.1	2.02	2.03	0.37	0.39	1.42	1.43	0.78	0.79
New L.S.D. at 5%	0.8	0.9	0.2	0.2	0.05	0.05	0.03	0.04	0.04	0.05	0.03	0.04

Table (4): Effect of single and combined applications of glutathione and Fish oil on the percentage of initial fruit setting and fruit retention, number of fruits/ tree as well as yield per tree and fruit weight of Keitte mango trees during 2019 and 2020 seasons.

Treatments	Initial fruit setting %v		Fruit retention %		Number of fruits / tree		Yield/ tree (kg.)		Fruit weight (g.)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Control	4.5	4.6	0.7	0.7	50.0	52.0	17.5	18.3	350.0	352.0
Spraying glutathione at 0.5%	6.0	6.3	1.8	1.9	63.0	65.0	24.6	25.7	390.0	396.0
Spraying glutathione at 1.0 %	6.9	7.2	2.2	2.3	71.0	72.0	29.3	29.9	412.0	415.0
Spraying glutathione at 2.0 %	7.3	7.6	2.3	2.4	72.0	73.0	30.2	31.0	420.0	424.0
Spraying fish oil at 0.5%	5.0	5.2	0.9	1.0	52.0	55.0	18.2	19.5	350.0	355.0
Spraying fish oil at 1.0 %	5.6	5.9	1.4	1.5	60.0	62.0	22.1	22.9	368.0	370.0
Spraying fish oil at 2.0 %	5.8	6.1	1.6	1.7	62.0	64.0	23.3	24.3	375.0	380.0
Spraying glutathione + fish oil at 0.5%	7.5	7.7	2.4	2.5	73.0	74.0	31.4	32.0	430.0	433.0
Spraying glutathione + fish oil at 1.0 %	8.6	9.0	2.8	2.9	77.0	78.0	34.7	35.3	450.0	452.0
Spraying glutathione + fish oil at 2.0%	9.0	9.3	2.9	2.9	78.0	80.0	34.5	36.8	455.0	460.0
New L.S.D. at 5%	0.6	0.7	0.3	0.3	4.4	4.8	1.9	2.1	13.1	13.9

Table (5): Effect of single and combined applications of glutathione and Fish oil on some physical characteristics of the fruits of Keitte mango trees during 2019 and 2020 seasons.

Treatments	Av. Fruit height (cm)		Av. Diameter (cm.)		Av. Fruit thickness (cm.)		Pulp %		Edible to non- edible portions of fruit	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Control	12.1	12.2	8.0	8.0	6.2	6.3	67.0	67.6	2.2	2.3
Spraying glutathione at 0.5%	13.3	13.3	8.7	8.8	7.0	7.1	71.3	72.0	3.4	3.5
Spraying glutathione at 1.0 %	13.6	13.7	9.1	9.2	7.5	7.6	73.0	73.6	3.9	4.0
Spraying glutathione at 2.0 %	13.7	13.8	9.2	9.3	7.7	7.8	74.0	74.5	4.1	4.2
Spraying fish oil at 0.5%	12.5	12.6	8.2	8.3	6.4	6.5	69.0	69.5	2.6	2.7
Spraying fish oil at 1.0 %	12.9	13.0	8.5	8.6	6.7	6.8	70.5	71.0	2.9	3.0
Spraying fish oil at 2.0 %	13.0	13.1	8.6	8.7	6.8	6.9	70.8	71.3	3.1	3.2
Spraying glutathione + fish oil at 0.5%	13.8	13.9	9.3	9.4	7.7	7.8	74.1	74.7	4.3	4.4
Spraying glutathione + fish oil at 1.0 %	14.1	14.2	9.6	9.7	8.0	8.0	76.6	77.0	4.6	4.7
Spraying glutathione + fish oil at 2.0%	14.2	14.3	9.7	9.8	8.2	8.3	77.5	78.0	4.7	4.8
New L.S.D. at 5%	0.2	0.2	0.2	0.2	0.2	0.3	1.0	1.1	0.3	0.4

Table (6): Effect of single and combined applications of glutathione and Fish oil on some chemical characteristics of the fruits of Keitte mango trees during 2019 and 2020 seasons.

Treatments	T.S.S. %		Total acidity %		Total sugars %		Reducing sugars %		Vitamin C content (mg/ 100 g pulp)		Total fibre %	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Control	9.3	9.4	0.885	0.880	7.2	7.3	3.0	3.1	40.0	40.6	1.13	1.11
Spraying glutathione at 0.5%	10.5	10.6	0.830	0.825	8.1	8.2	3.9	4.0	45.0	45.3	0.96	0.95
Spraying glutathione at 1.0 %	10.9	11.0	0.800	0.795	8.6	8.7	4.2	4.4	47.6	47.9	0.85	0.84
Spraying glutathione at 2.0 %	11.1	11.2	0.790	0.785	8.7	8.8	4.3	4.5	48.8	49.0	0.80	0.79
Spraying fish oil at 0.5%	9.7	9.9	0.870	0.865	7.5	7.6	3.2	3.3	41.1	41.3	1.06	1.05
Spraying fish oil at 1.0 %	9.9	10.1	0.850	0.845	7.8	7.9	3.6	3.7	43.2	43.5	0.99	0.98
Spraying fish oil at 2.0 %	10.0	10.2	0.845	0.840	8.0	8.1	3.8	3.9	44.6	44.8	0.97	0.96
Spraying glutathione + fish oil at 0.5%	11.2	11.3	0.775	0.770	8.8	8.9	4.4	4.6	49.0	49.2	0.78	0.77
Spraying glutathione + fish oil at 1.0 %	11.7	11.8	0.745	0.740	9.1	9.2	4.7	4.8	51.2	51.5	0.75	0.74
Spraying glutathione + fish oil at 2.0%	11.8	11.9	0.735	0.730	9.2	9.3	4.8	4.9	51.5	51.8	0.73	0.72
New L.S.D. at 5%	0.2	0.3	0.015	0.015	0.2	0.3	0.2	0.3	1.1	1.2	0.05	0.06

4. Discussion

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 (Mulleineaux and Rausch, 2005). Thus, the promoting effect of glutathione on growth and nutritional status surely reflected on enhancing fruit retention, yield and fruit quality of Keitte mango trees. The results are in the

same line to the results obtained by (Abdelaal *et al.*, 2012; Gad El- Kareem, 2012) on Taimour mango trees, Ahmed *et al.*, (2013) on Zaghloul date palms. These results are nearly in agreement with those obtained by El- Khawaga and Mansour (2019) on Washington Navel orange trees and Saied, 2019 on Ewaise mango trees.

Fish oil contains two types on Fatty acids (omega 3- Fatty acids namely, Docosahexaenoi acid (DHA), eosapentaenotic acid (EPA), Tocopherols, P, Fe, Cu and carotenoids (Hultin and Jafan, 1991).

It is considered on important source of antioxidants, recently, most studies gave good evidence for the important role of using fish oil and glutathione for preventing the cell damage caused by ROS and protecting the trees from aging.

These results regarding the beneficial effects of fish oil on growth, nutritional stats, yield and fruiting

quality of Keitte mango are in harmony with (Olmo *et al.*, 1981; Osnaya and Schlasser, 1998; Mc- Arthey *et al.*, 2006, Yoder *et al.*, 2009, Masoud and Abou-Zaid- Eman, 2019 and Saied, 2019).

Conclusion

Carrying out three sprays on first week of March, last week of April and last week of May of a mixture containing glutathione and fish oil each at 1.0 % was necessary for improving yield and fruit quality of Keitte mango trees grown under Aswan climatic conditions.

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