



Article

Effect of Spraying Royal Jelly and Glutathione on Growth and Nutritional Status of Ferehy Date Palms Grown Under Siwa Oasis Conditions

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Abstract: This study was carried out during 2020 and 2021 seasons to examine the effect of spraying Royal Jelly at 100 to 400 ppm and / or glutathione at 250 to 1000 ppm on growth and tree nutritional status of Ferehy date palms grown under Siwa Oasis conditions. Treating the tree Ferehy date palms three times with royal Jelly at 100 to 400 ppm and /or glutathione at 250 to 1000 ppm was very effective in stimulating length, width and area of leaflet, length and area of leaf, chlorophyll a, chlorophyll b, total chlorophylls, total carotenoids, total carbohydrates%, N, P, K (as %) Fe, Zn, and Mn (as ppm) in the leaves of Ferehy date palms over the control treatment. Carrying out three sprays during seasons study after hand pollination (middle of April), Just after fruit setting (middle of May) and two months later (middle of July) of a mixture of royal Jelly at 400 ppm and glutathione at 1000 ppm gave the best results with regard to growth and tree nutritional status of Ferehy date palms.

Key words: Royal Jelly, Glutathione, Ferehy date palms, Growth, Nutritional status.

INTRODUCTION

Date palms CVs have higher nutritional value and contain more than fifteen kinds of amino acids, antioxidants, vitamins, sugars and minerals. Also, seeds contain carbohydrates proteins, fats, fibres and Ash. The major Fatty acids in the seeds oil are oleic and Linoleic (**Wriley, 1995 and Zaid and Arias-Jimenez, 2002**).

They contain higher amounts of carotenoids, anthocyanins and the four free phenolic acids namely (vanillic acid, syringic acid, ferulic acid and protocatechuic acid) and nine bound phenolic acids namely (p-hydroxybenzoic acid, Vanillic acid, caffeic acid, garlic acid, protactachuic acid syringic acid, p-coumaric acid, Ferulic acid and O-coumaric acid, **Waller and Nowaki (1978) and Gross et al. (1983)**).

Ferehy date palm (*Phoenix dactylifera* L.) is one of the most important cultivar of dry dates successfully grown in Siwa Oasis, there is a great hope that Ferehy date palm fruits can take the lead in the Egyptian exportation little literatures are available about of royal Jelly on fruit corps. Royal Jelly is secreted from glands on heads of worker Bees. It is synthesized from pollen, honey and water mixed with Saliva Vitamins and hormones. Royal Jelly contains 34.7% dry residue and 65.3% water.

The latter is composed from 37.8% carbohydrates, 48.2% proteins, 10.4% lipids and about 2.0% ash. Royal Jelly also contains vitamin B complex and vit. C and richest natural products in some amino acids. It contains at least 16 Amino acids including 8 essential ones. Some amino acids are very important for enhancing the growth, yield and fruit quality. Royal Jelly is also rich in some minerals, especially K, Mg, Ca, Fe, S, Mn, P and Si (**Nation and Robinson, 1991**) and (**Townsend and Lucas, 1966; Heyly, 1951**).

Glutathione (C₁₀H₁₇ N₃O₆S) is a tripeptide comprised of three amino acids namely (glycine, cysteine and glutamic acid). It is an important antioxidant in plants. It is capable of preventing damage to important cellular components caused by reactive oxygen species. Glutathione is the most important non-protein thiol present in the plants. It is essential in sulfur metabolism and defense against stresses. Glutathione is an 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 and reacting directly or indirectly with reactive oxygen of cell structure and the proper functions of various metabolic pathways. In addition to its effect on expression of defense genes glutathione may also be involved in redox control of cell division and enhanced growth, yield and fruit quality of crops (**Levitt, 1980; Rennenberg, 1982; Meister and Anderson, 1983; Dekok and Stulen, 1993; Jorge et al., 1993; Foyer et al., 1997; Noctor and Foyer, 1998; Tausez and Grill, 2000; Kocsy et al., 2001 and Mullineaux and Rausch, 2005**).

The target of this study was elucidating effect of combined and single applications of Royal Jelly and glutathione on growth and three nutritional of Ferehy date palms grown under Siwa Oasis conditions.

MATERIALS AND METHODS

This study was conducted during 2020 and 2021 seasons in a private orchard situated at Siwa oasis, Marsa Matrouh Governorate, Egypt. On 30 palms 24 – years old Ferehy date palms. These palms were produced through conventional propagation by offshoots and characterized by regular bearing. Also, they are uniform and vigorous, free from insects, healthy, good physical conditions, disease and damages. The palms are planted at 7.0x 7.0 meters apart (86 palms/ fed.) and irrigated with well water through surface irrigation system. The texture of the tested soils is sandy clay. Soil analysis was done according to (**Wilde et al., 1985**) and the obtained data are illustrated in Table (1).

Pruning was carried out to maintain the leaf bunch ratio at 8:1 according to (**Sayed, 2002**), Number of the female spathes per bunch was adjusted to 10 spathes and artificial pollination was achieved by inserting five male strands into the female bunch using known high activating pollen sugars throughout three days after female spathe creaking followed by (**Omar, 2007**). All the selected palms (30 palms) received the common horticultural practices that are already applied in the orchard except those dealing with using glutathione and Royal Jelly.

Table (1). Physical and chemical analysis of the tested soil

Content	Value	Content	Value
Sand %	48.5	Total N %	0.06
Silt %	27.5	Available P % (ppm)	9.5
Clay %	24.0	Available K (ppm)	111.0
Texture	Sandy loam	Available Zn (ppm)	1.09
pH (1:2.5 extract)	7.96	Available Fe (ppm)	0.9
E.C. (1: 2.5 extract) mmhous	0.95	Available Mn (ppm)	1.1
M.O. %	3.0	Available Cu (ppm)	0.2
CaCO ₃ %	2.3		

This study included the following ten treatments:

- T₁- Control (sprayed with water).
- T₂- Spraying the palms with Royal Jelly at 100 ppm.
- T₃- Spraying the palms with Glutathione at 250 ppm.
- T₄- Spraying the palms with Royal Jelly at 100 ppm and Glutathione at 250 ppm.
- T₅- Spraying the palms with Royal Jelly at 200 ppm.
- T₆- Spraying the palms with Glutathione at 500 ppm.
- T₇- Spraying the palms with Royal Jelly at 200 ppm and Glutathione at 500 ppm.
- T₈- Spraying the palms with Royal Jelly at 400 ppm.
- T₉- Spraying the palms with Glutathione at 1000 ppm.
- T₁₀- Spraying the palms with Royal Jelly at 400 ppm and Glutathione at 1000 ppm.

Each treatment was replicated three times one palm per each, therefore thirty similar.

Each treatment was replicated three times one palm per each, therefore thirty similar in vigour palms were selected for achieving of this study. Ferehy date palms received three sprays from both glutathione and Royal Jelly after hand pollination (middle of April), just after fruit setting (middle of May) and two months later (2nd week of July). Both glutathione and Royal Jelly solutions were subjected to Triton B as a wetting agent at 0.05% before spraying. The palms were sprayed till runoff (25.0 L solutions / palm) the control treatment as sprayed with water containing Triton b at 0.05%.

During both season, the following parameters were carried out:

- 1- Length, width (cm.) and area (cm)² of leaflet, length (m) and area (m)² of leaf by (**Ahmed and Morsy, 1999**) and Spines length (cm).
- 2- Some pigments of the leaves namely chlorophylls a, b and total chlorophylls, total carotenoids (mg/ g F.W.) (according to **Von- Wettstein, 1957 and Fadle and Seri- El- Deen, 1978**).
- 3- Total carbohydrates percentages in the dried leaflets were determined by using anthron method (**A.O.A.C., 2000**).
- 4- Percentages of N, P and K (as %) and Fe, Zn, and Mn (as ppm) in the dried leaves according to (**Chapman and Pratt, 1965**).

All the obtained data during course of this study were tabulated and subjected to the proper statistical analysis using the new L.S.D. at 5% according to (**Mead et al., 1993**).

RESULTS

Vegetative the growth characteristics

It is clear from the obtained data in Table (2) that combined and single application of Royal Jelly at 100 to 400 ppm and glutathione at 250 to 1000 ppm significantly were accompanied with namely length, width and area of leaflet and length and area of leaf and spine length relative to the check treatments. The stimulation on these growth traits was associated with increasing concentrations of Royal Jelly from 100 to 400 ppm and glutathione from 250 to 1000 ppm combined applications of Royal Jelly and glutathione significantly was superior than using each alone in enhancing these the six growth aspects, also insignificant promotion on these growth aspects was observed among the higher two concentrations of royal Jelly namely 200 and 400 ppm and glutathione namely 500 and 1000 ppm. And using glutathione at 250 to 1000 ppm was superior to using Royal Jelly at 100 to 400 ppm in this connection. The maximum values of leaflet length (46.5, 47 cm), leaflet width (3.30, 3.35 cm), leaflet area (56.0, 57.5 cm²), leaf length (3.45, 3.50 m.), leaf area (1.28, 1.29 m²) and spine length (9.80, 10.00 cm.) during 2020 and 2021 seasons, respectively were observed on the Ferehy date palms that received three sprays of Royal Jelly at 400 ppm and glutathione at 1000 ppm.

The lowest values were recorded on untreated trees. These results were true during both seasons.

Table (2). Impact of single and combined applications of Glutathione and Royal Jelly on some vegetative growth characteristics of Ferehy date palms during 2020 and 2021 seasons

Treatments	Leaflet length (cm)		Leaflet width (cm)		Leaflet area (cm ²)		Leaf area (m ²)		Leaf length (m)		Spine length (cm)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T ₁ - Control	38.5	39.2	2.45	2.50	45.5	46.0	0.92	0.95	2.70	2.75	8.50	8.60
T ₂ – Royal Jelly at 100 ppm	39.4	39.8	2.60	2.62	46.2	46.8	0.99	1.05	2.85	2.90	8.75	8.80
T ₃ –Glutathione at 250 ppm	42.0	42.4	2.85	2.89	49.2	50.0	1.14	1.16	3.10	3.20	9.00	9.08
T ₄ –Royal Jelly at 100 ppm + Glutathione at 250 ppm	44.0	44.5	3.10	3.14	53.0	53.6	1.20	1.23	3.28	3.30	9.30	9.40
T ₅ – Royal Jelly at 200 ppm	41.0	41.6	2.81	2.86	47.8	48.0	1.11	1.14	2.92	3.00	8.84	8.90
T ₆ –Glutathione at 500 ppm	42.8	43.2	2.96	3.00	51.0	51.5	1.18	1.19	3.20	3.25	9.15	9.25
T ₇ –Royal Jelly at 200 ppm + Glutathione at 500 ppm	45.2	46.0	3.20	3.25	54.5	55.0	1.24	1.26	3.39	3.42	9.50	9.60
T ₈ – Royal Jelly at 400 ppm	42.2	43.0	2.91	2.99	49.0	49.5	1.15	1.17	3.05	3.11	8.95	9.00
T ₉ –Glutathione at 1000 ppm	43.2	44.0	3.11	3.15	52.6	53.2	1.21	1.23	3.25	3.28	9.30	9.35
T ₁₀ –Royal Jelly at 400 ppm + Glutathione at 1000 ppm	46.5	47.0	3.30	3.35	56.0	57.5	1.28	1.29	3.45	3.50	9.80	10.00
New L.S.D. at 5%	0.9	1.1	0.05	0.07	1.0	1.1	0.06	0.07	0.11	0.13	0.07	0.09

Leaf chemical composition

It is evident from the obtained data in Tables (3 and 4) that eleven leaf chemical components namely chlorophyll a, chlorophyll b, total chlorophylls, total carotenoids, total carbohydrates % , N, P and K (as %) and Zn, Fe and Mn (as ppm) were significantly varied among the ten Royal Jelly and glutathione treatments .They were significantly enhanced with using Royal Jelly at 100 to 400 ppm and / or glutathione at 250 to 1000 ppm relative to the control treatment .There was a gradual promotion on these the leaves chemical components with increasing concentrations of Royal Jelly and glutathione . Increasing concentrations of glutathione from 500 to 1000 ppm and Royal Jelly from 200 to 400 ppm failed to show significant promotion on these leaf chemical composition using glutathione was significantly superior to using Royal Jelly in enhancing these leaf chemical components. Combined applications of Royal Jelly and glutathione were significantly favorable for enhancing these leaf chemical components relative to using each alone.

The maximum values of chlorophyll a (5.5, 5.7 mg/g F.W.), chlorophyll b (2.9, 2.9 mg/g F.W.), total chlorophylls (8.4, 8.6 mg/ g F.W.), total carotenoids (3.1, 3.3 mg/ g F.W), total carbohydrates (19.2, 19.4%), N (2.11, 2.14 %), P (0.35, 0.38%), K (1.52, 1.55), Zn (74.0, 75.0 ppm), Fe (63.8, 64.0 ppm) and Mn (64.0, 64.2 ppm) during both seasons, respectively were observed on the palms that a mixture of Royal Jelly at 400 ppm and glutathione at 1000 ppm. The untreated palms produced the minimum values. These results were true during 2020 and 2021.

Table (3). Impact of single and combined applications of Glutathione and Royal Jelly on some plants pigments (mg/g F.w.) and leaf total carbohydrates% of Ferehy date palms during 2020 and 2021 seasons

Treatments	Chlorophyll a (mg/g F.W.)		Chlorophyll b (mg/ g F.W.)		Total chlorophylls (mg/g F.W.)		Total carotenoids (mg/g F.W.)		Total carbohydrates %	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
	T ₁ - Control	3.2	3.3	1.2	1.3	4.4	4.6	1.4	1.5	14.2
T ₂ – Royal Jelly at 100 ppm	3.4	3.5	1.4	1.5	4.8	5.0	1.7	1.8	14.6	14.9
T ₃ –Glutathione at 250 ppm	4.1	4.3	1.8	1.9	5.9	6.2	2.0	2.2	17.2	17.4
T ₄ –Royal Jelly at 100 ppm + Glutathione at 250 ppm	4.9	5.1	2.4	2.6	7.3	7.7	2.6	2.8	18.0	18.2
T ₅ – Royal Jelly at 200 ppm	3.6	3.8	1.7	1.8	5.3	5.6	1.9	2.1	15.2	15.6
T ₆ –Glutathione at 500 ppm	4.4	4.7	2.1	2.3	6.5	7.0	2.4	2.5	17.5	17.8
T ₇ –Royal Jelly at 200 ppm + Glutathione at 500 ppm	5.2	5.5	2.7	2.8	7.9	8.3	2.9	3.0	18.8	19.0
T ₈ – Royal Jelly at 400 ppm	3.9	4.1	1.9	2.0	5.8	6.1	2.1	2.3	16.1	16.4
T ₉ –Glutathione at 1000 ppm	4.7	4.9	2.3	2.4	7.0	7.3	2.5	2.8	17.9	18.2
T ₁₀ –Royal Jelly at 400 ppm + Glutathione at 1000 ppm	5.5	5.7	2.9	2.9	8.4	8.6	3.1	3.3	19.2	19.4
New L.S.D. at 5%	0.5	0.6	0.2	0.3	0.7	0.8	0.2	0.2	0.7	0.8

Table (4). Impact of single and combined applications of Glutathione and Royal Jelly on the percentage of N, P, and K (as %) and Zn, Fe and Mn (as ppm) in the leaflet of Ferehy date palms during 2020 and 2021 seasons

Treatments	Leaf N %		Leaf P %		Leaf k %		Leaf Zn ppm		Leaf Fe ppm		Leaf Mn ppm	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T ₁ - Control	1.68	1.71	0.18	0.19	1.15	1.18	62.5	63.0	52.5	53.0	52.7	53.1
T ₂ – Royal Jelly at 100 ppm	1.72	1.75	0.21	0.22	1.19	1.21	64.2	64.5	54.0	54.2	54.5	54.7
T ₃ –Glutathione at 250 ppm	1.81	1.85	0.26	0.28	1.25	1.27	69.5	70.0	59.0	60.1	60.2	60.5
T ₄ –Royal Jelly at 100 ppm + Glutathione at 250 ppm	1.95	1.98	0.30	0.33	1.41	1.43	71.0	71.6	61.0	61.7	61.3	62.0
T ₅ – Royal Jelly at 200 ppm	1.75	1.79	0.24	0.27	1.21	1.24	66.5	67.2	57.0	58.0	57.6	58.2
T ₆ –Glutathione at 500 ppm	1.86	1.90	0.29	0.31	1.29	1.31	71.0	71.5	60.0	60.8	60.4	61.1
T ₇ –Royal Jelly at 200 ppm + Glutathione at 500 ppm	2.02	2.08	0.33	0.35	1.49	1.51	72.5	72.9	62.4	62.9	62.8	63.2
T ₈ – Royal Jelly at 400 ppm	1.79	1.82	0.26	0.28	1.24	1.28	68.0	69.5	59.0	60.5	60.2	60.7
T ₉ –Glutathione at 1000 ppm	1.91	1.96	0.31	0.33	1.36	1.39	71.4	71.8	61.5	62.0	62.1	62.6
T ₁₀ –Royal Jelly at 400 ppm + Glutathione at 1000 ppm	2.11	2.14	0.35	0.38	1.52	1.55	74.0	75.0	63.8	64.0	64.0	64.2
New L.S.D. at 5%	0.07	0.08	0.02	0.03	0.05	0.06	1.3	1.1	1.1	0.9	1.3	1.1

DISCUSSION

The effect of glutathione is the most important non – protein thiol presents in the plant, glutathione is essential in sulfur defense against most stresses and metabolism the plants, glutathione is important pool of reduced sulfur and it regulates sulfur uptake at the roots level. Reduced glutathione the major water soluble the antioxidant in photosynthetic and non- photosynthetic tissues reacting directly and indirectly with reactive oxygen species contribute to maintain the integrity of cells structure and the proper. Functions of various metabolic pathways. Also, in addition to its effects one expression of defense genes glutathione may also be involved in redox in redox control of cells division and enhanced growth of plants (Mulleineaux and Rausch, 2005).

These results concerning the positive action of glutathione in harmony with (Ahmed *et al.*, 2012; Ahmed *et al.*, 2013; El- Khawaga and Mansour, 2014; Madany, 2017, Metwally, 2017 and Khafagy, 2019).

The great promotion effect of Royal jelly on growth aspects , palms nutritional status, yield and fruit quality of Ferehy date palms might be attributed to the own content of Royal jelly from various organic, vitamins and mineral nutrients namely glucose, fructose, sucrose, lipids , proteins Si, K, P, Ca, S, Mg, Fe, Mn, some vitamins B complex (B₁, B₂, B₅ B₆ B₉, B₁₂), C, A, D, K and E as well as some amino acids and hormones (Heyl, 1951, Townsend and Lucas 1966 and Nation and Robinson , 1991).

These results are in agreement with those obtained by (Al-Wasfy, 2013, Moustafa, 2013; Gad El-kareem and Abada, 2014; Ahmed and Habay-Randa, 2014, Abada and Ahmed-Basma 2015, Abdel-Aziz *et al.*, 2015 and Abd El-Aziz- Fatma –El-Zahraa, 2018).

Conclusion

Under Siwa Oasis and the resembling conditions. It sui recommended to spray Ferehy date palms three times after hand pollination (middle of April), just after fruit setting (middle of May) and two months later (middle of July). With a mixture of Royal Jelly at 200 ppm and glutathione at 500 ppm in order to improve the yield and quality of the fruits.

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