



Article

Improving of Yield and Fruit Quality of Ferehy Date Palms by Spraying Royal Jelly and Glutathione Under Siwa Oasis Conditions

Ali H. Ali and Ahmed M.M. Ahmed*

Horticulture Dept. Fac. of Agric. Minia Univ., Egypt.

*Corresponding author: ahmadsywa_25@yahoo.com



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Abstract: This study was carried out during 2020 and 2021 seasons for elucidating the effect of single and combined during foliar applications the antioxidant glutathione at 250 to 1000 ppm and Royal Jelly at 100 to 400 ppm three times after hand pollination, just after fruit setting and two months later on percentage of Initial fruit setting, the yield and fruit quality of Ferehy date palms grown under Siwa Oasis conditions. Foliar application three times with Royal Jelly at 100 to 400 ppm and /or the antioxidant glutathione at 250 to 1000 ppm had considerable promotion on initial fruit setting % and yield as well as physical and chemical characteristics of fruits over the control treatment. The promotion was associated with increasing the concentrations of Royal Jelly and glutathione. For promoting the yield and fruit quality of Ferehy date palms grown under Siwa Oasis conditions it is necessary for spraying a mixture of the antioxidant glutathione at 1000 ppm and Royal Jelly at 400 ppm three times after hand pollination, just after fruit setting and two months later.

Key words: Royal Jelly, Antioxidant (Glutathione), Ferehy date palms, Yield, Fruit quality.

INTRODUCTION

Date palm 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 (Wrigley, 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, gallic acid, protocatechuic 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 load 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 V.T.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, (1971), Townsend and Lucas, 1940; Hely, 1949**)

Glutathione ($G_{10}H_{17}N_3O_6S$) is a tripeptide comprised of three amino acids namely (glycine, Cysteine and glutamic acid). It is an important antioxidants 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 important pool of reduced sulfur and it regulates sulfur uptake at root level. Reduced glutathione, the major water soluble the 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 grow, yield and fruit quality of fruit corps (**Levitt, 1980; Rennenberg, 1982; Meister and Anderson, 1983; Dekok and Stulen, 1993; Jorge *et al.*, 1993; Foyer *et al.*, 1997, Noctor and Foyer, 1998; Tausz 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 yield and fruit quality of Ferehy date palms grown under Siwa Oasis conditions.

MATERIALS AND METHODS

This study was conducted in a private orchard located at Siwa Oasis, Matruh Governorate, Egypt during 2020 and 2021 seasons on thirty 24 years old Ferehy date palms. These palms were produced through conventional propagation by offshoots and characterized by regular bearing. Also, they are uniform in vigour, free from insects, healthy good physical conditions, damages and diseases. They planted at 7.0 x 7.0 meters (86.0 palms fed.) a part and irrigated with well water through surface irrigation system. Pruning was performed to maintain leaf bunch ratio at 8: 1 (according to **Sayed, 2002**).

The number of spathes female per palm was adjusted to 10 spathes by removing excess earliest, latest and small bunches. Pollination of the study palms was uniformly performed in respect of sources date and method to avoid residues of metaxinia, pollination was achieved by inserting five male strands into the female bunch using known high activity pollen source throughout 3-4 days after female spathe cracking, to prevent contamination of pollen every bunch was bagged after inserting the male strands by paper bags which were tied at the ends using a piece of some cotton for aeration. The bags were shaken lightly to ensure pollen distribution and were removed after four weeks (**Hussein *et al.*, 1993 and Dammas, 1998**).

Table (1). Physical and chemical analysis of the tested soil (Wilde *et al.*, 1985)

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 seasons the following parameters were carried out:

1- Percentage of fruit setting, length spathe (cm), number of stands per spathe, Brunch weight (kg.) and yield / palm (kg.)

2- Some physical and chemical characteristics of the fruits namely weight(g.), diameter and height (cm)of fruit, seed%, flesh%, edible / non-edible, TSS% total, reducing and non-reducing sugars% total, acidity% and total crude fibre% (A.O.A.C.2000 and Lane and Eynon, 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

Percentage of Initial fruit setting, Brunch weight and yield

It is evident from the obtained data in Table (2) that treatment Ferehy date palms three times with Royal Jelly and / or glutathione significantly improved spathe length, number of stands per spathe, Initial fruit setting %, yield/ palm and brunch weight relative to the control treatment. There was a gradual promotion on these parameters with increasing concentrations of Royal Jelly and glutathione. Increasing concentrations of Royal jelly from 200 to 400 ppm and glutathione from 500 to 1000 ppm had no-significant promotion on the spathe length, number of stands spathe, fruit setting %, Brunch weight and the yield per palm, Application of glutathione was significantly preferable in improving these measurements than using royal Jelly. Combined applications royal Jelly and glutathione significantly were accompanied with improving these parameters relative to application each material alone. From economical point of view, the best results with regard to fruit setting, brunch weight and yield were obtained due to treating the palms three times with medium concentration of Royal Jelly (200 ppm) and glutathione (500 ppm), under such promised treatment, yield per Ferehy date palm reached 139.1, 141.1 kg. during 2020 and 2021 seasons, respectively.

The untreated palms produced yield per palm reached 105.0 and 108.1 kg. during both seasons, respectively. The percentage of increment of the yield / palm in the promised treatment over the control treatment reached similar trend was noticed during 2020 and 2021 seasons.

Table (2). Impact of single and combined applications of Glutathione and Royal Jelly on length Spathe, number of stands per spathe, percentage of Initial fruit setting, brunch weight and yield/ palm of Ferehy date palms during 2020 and 2021 seasons

Treatments	Spathe length (cm)		No. of stands/ spathe		Initial fruit setting %		Brunch weight (kg)		Yield per palm (kg)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T ₁ - Control	45.0	46.5	68.0	69.0	45.5	46.0	10.50	10.81	105.0	108.1
T ₂ – Royal Jelly at 100 ppm	47.0	48.0	71.5	72.0	46.6	47.0	11.05	11.18	110.5	111.8
T ₃ –Glutathione at 250 ppm	49.5	50.0	75.0	76.0	50.4	51.0	12.12	12.20	121.2	122.0
T ₄ –Royal Jelly at 100 ppm + Glutathione at 250 ppm	52.0	52.5	81.0	81.8	54.0	54.2	13.22	13.35	132.2	133.5
T ₅ – Royal Jelly at 200 ppm	48.5	49.8	73.0	74.2	48.0	48.5	11.42	11.61	114.2	116.1
T ₆ –Glutathione at 500 ppm	51.5	51.9	77.0	78.0	52.0	52.5	12.45	12.65	124.5	126.5
T ₇ –Royal Jelly at 200 ppm + Glutathione at 500 ppm	53.0	53.5	83.0	83.6	55.2	56.0	13.91	14.11	139.1	141.1
T ₈ – Royal Jelly at 400 ppm	50.0	50.7	74.5	75.0	49.2	50.5	11.95	11.99	119.5	119.9
T ₉ –Glutathione at 1000 ppm	52.0	52.5	79.0	80.2	53.5	54.0	13.01	13.10	130.1	131.0
T ₁₀ –Royal Jelly at 400 ppm + Glutathione at 1000 ppm	54.5	54.8	84.0	84.6	56.0	56.5	14.35	14.68	143.5	146.8
New L.S.D. at 5%	0.5	0.6	0.8	0.9	1.1	1.2	0.66	0.71	6.1	7.2

Physical and chemical characteristics of the fruits

Data in Tables (3 and 4) clearly show that supplying Ferehy date palms with Royal Jelly at 100 to 400 ppm and / or glutathione at 250 to 1000 ppm significantly was responsible for improving some physical and chemical characteristics of fruit namely (weight, diameter and height of fruit, flesh%, edible / non-edible, TSS%, total, reducing and non-reducing sugars and reducing seed%, total acidity% and crude fiber %, relative to the control treatment. The promotion on some fruit quality characteristics was related to the increase in concentrations of Royal Jelly and glutathione Negligible promotion on fruit quality was observed among the higher two concentrations of both Royal Jelly and glutathione. Using glutathione was significantly preferable than using Royal Jelly in this connection.

Combined applications (Royal Jelly and Glutathione) were significantly superior than application each material alone in this respect. From economical point of view, the best results with regard to fruit quality were recorded on the palms that received three sprays of a mixture of Royal Jelly 200 ppm and glutathione at 500 ppm. Low fruit quality indices were observed on untreated palm. There results were true during 2020 and 2021 seasons.

Table (3). Impact of single and combined applications of Glutathione and Royal Jelly on some physical characteristics of the fruits of Ferehy date palms during 2020 and 2021 seasons

Treatments	Fruit weight (g)		Fruit height (cm)		Fruit diameter (cm)		Seed %		Flesh %		Flesh / seed (edible / non-edible)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T ₁ - Control	4.4	4.5	2.5	2.5	1.4	1.5	13.2	13.0	86.8	87.0	6.6	6.7
T ₂ – Royal Jelly at 100 ppm	4.7	4.8	2.7	2.8	1.6	1.7	12.5	12.3	87.5	87.7	7.0	7.1
T ₃ –Glutathione at 250 ppm	5.5	5.7	3.3	3.4	2.0	2.1	11.3	11.0	88.7	89.0	7.8	8.1
T ₄ –Royal Jelly at 100 ppm + Glutathione at 250 ppm	6.0	6.2	3.8	3.9	2.4	2.5	10.3	10.0	89.7	90.0	8.7	9.0
T ₅ – Royal Jelly at 200 ppm	5.1	5.3	2.9	3.0	1.8	1.9	11.8	11.6	88.2	88.4	7.5	7.6
T ₆ –Glutathione at 500 ppm	5.9	6.1	3.5	3.6	2.3	2.4	11.0	10.8	89.0	89.2	8.1	8.3
T ₇ –Royal Jelly at 200 ppm + Glutathione at 500 ppm	6.2	6.4	4.1	4.3	2.6	2.7	10.0	9.6	90.0	90.4	9.0	9.4
T ₈ – Royal Jelly at 400 ppm	5.5	5.8	3.1	3.3	2.0	2.1	11.4	11.0	88.6	89.0	7.8	8.1
T ₉ –Glutathione at 1000 ppm	6.0	6.3	3.6	3.8	2.4	2.5	10.5	10.0	89.5	90.0	8.5	9.0
T ₁₀ –Royal Jelly at 400 ppm + Glutathione at 1000 ppm	6.5	6.8	4.2	4.3	2.7	2.8	9.5	9.2	90.5	90.8	9.5	9.9
New L.S.D. at 5%	0.3	0.4	0.2	0.3	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4

Table (3). Impact of single and combined applications of Glutathione and Royal Jelly on some chemical characteristics of the fruits of Ferehy date palms during 2020 and 2021 seasons

Treatments	TSS %		Total sugars %		Reducing sugars %		Non-reducing sugars %		Total acidity %		Crude fiber %	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T ₁ - Control	68.0	68.5	61.2	61.7	12.5	12.8	48.7	48.9	0.350	0.345	1.25	1.30
T ₂ – Royal Jelly at 100 ppm	69.0	69.8	62.0	62.6	13.0	13.2	49.0	49.4	0.335	0.330	1.20	1.18
T ₃ –Glutathione at 250 ppm	71.0	71.2	64.1	64.4	14.4	14.6	49.7	49.8	0.300	0.295	1.10	1.07
T ₄ –Royal Jelly at 100 ppm + Glutathione at 250 ppm	72.8	73.0	65.7	68.0	15.8	16.0	49.9	52.0	0.275	0.270	0.99	0.97
T ₅ – Royal Jelly at 200 ppm	70.0	70.5	63.4	63.8	13.6	14.0	49.8	49.8	0.320	0.310	1.14	1.11
T ₆ –Glutathione at 500 ppm	71.9	72.2	64.8	65.2	15.1	15.6	49.7	49.6	0.295	0.290	1.07	1.05
T ₇ –Royal Jelly at 200 ppm + Glutathione at 500 ppm	73.4	73.5	65.9	66.4	16.1	16.6	49.8	49.8	0.260	0.255	0.91	0.89
T ₈ – Royal Jelly at 400 ppm	70.8	71.2	63.5	63.8	14.2	14.8	49.3	49.0	0.310	0.300	1.11	1.06
T ₉ –Glutathione at 1000 ppm	72.5	73.0	65.9	66.6	15.8	16.1	50.1	50.5	0.280	0.270	1.00	0.98
T ₁₀ –Royal Jelly at 400 ppm + Glutathione at 1000 ppm	74.2	74.5	67.1	67.7	16.8	17.1	50.3	50.6	0.255	0.250	0.88	0.86
New L.S.D. at 5%	0.8	0.9	0.4	0.5	0.3	0.4	0.1	0.2	0.015	0.018	0.02	0.02

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 (Table 3) 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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