

Effect of Spraying Some Chelated Nutrients on Yield and Fruit Quality of “Bartamoda” Date Palms in Aswan Governorate

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Abstract

This study was conducted during 2019 & 2020 seasons to elucidate the impact of using potassium at 750 to 3000 ppm, calcium at 375 to 1500 ppm and micronutrients at 200 to 400 ppm in chelates form on yield and fruit quality of “Bartamoda” date palms grown under Aswan conditions. This experiment set up in a randomized complete block design with ten treatments and three replications, one palm per each. Treating the palms with these nutrients via chelated form at the previous concentrations had an announced promotion on all aspects of yield and fruit quality compared to the control treatment (water spraying). Using chelated nutrients at concentrations higher than potassium at 1500 ppm, calcium at 750 ppm and micronutrients at 200 ppm failed to show measurable effects. Then, the best results with regard to yield and fruit quality of “Bartamoda” date palms were obtained due to spraying the palms three times with potassium at 1500 ppm, calcium at 750 ppm and micronutrients at 200 ppm via chelated form.

Keywords: Chelated nutrients, micronutrients, “Bartamoda” date palms, yield, fruit quality.

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Introduction

Date palm (*Phoenix dactylifera* L.) is considered as one of the leading fruit crops. In Egypt, it covers a large area that extended from Aswan to the North Delta; Egypt is considered the leading country in producing dates. The total number of females reached 14865631 palms and their yield reached about 1710603 ton. Among all the Egyptian Governorates, Aswan Governorate is considered to be one of the leading Egyptian Governorates in dry dates production (M.A.L.R., 2020). Date palm cultivars are of three main groups according to its fruit moisture content, i.e. soft, semi-dry and dry cultivars. “Bartamoda” date palm is the most important cultivar of dry dates in Egypt. It can grow well under drastic environmental conditions. The variations in the soil types and orchard management have their influence on the characteristics of both tree growth and fruit quality (Selim *et al.*, 1970). Nutrients play a great regulatory role in many physiological and biochemical processes of plants. Moreover, using micronutrients significantly increased the yield through increasing efficiency of fruiting and improved the fruit quality and nutrients status of fruit (Marchner, 1995 and Abdel-Migeed *et al.*, 2013). Foliar application had advantage of low using rates, uniform distribution of fertilizer materials and quick responses to applied nutrients (Umer *et al.*, 1999). Several investigators had studied the effect of potassium and calcium fertilization on the fruit physical and chemical properties and some nutrient contents of different date palm varieties (Abdalla

et al., 1987; El-Hammady *et al.*, 1994; Ibrahim and Sinbel, 1989; Kassem *et al.*, 1997; Soliman and Osman, 2003; Osman, 2010; Abdel-Migeed *et al.*, 2013; Jahromi and Nasser, 2015; Abdalla, 2016; Al-Hajaj *et al.*, 2020 and El-Salhy *et al.*, 2021). Using micronutrients had announced promotion on growth aspects, tree nutritional status, yield and fruit characteristics in different fruit crops relative to the control (Abd-Allah, 2006; Fernandes *et al.*, 2009; Ahmed *et al.*, 2014 and Hassan-Huda, 2014). In most cases using these nutrients via chelated form was superior to using nutrients via traditional method (Bozary, 2012; Jahromi and Naseri, 2015 and Ahmed *et al.*, 2021). The merit of this study was evaluating the effect of using some nutrients via chelated form nutritional status on yield and fruit quality of “Bartamoda” date palms grown under Aswan environmental conditions.

Materials and methods

This study was conducted during 2019 and 2020 seasons on 18 years “Bartamoda” date palms grown in a private date palm orchard situated in Edfu district of Aswan Governorate. These palms were characterized by regular bearing, uniform in vigour, healthy, good physical conditions, free from insects, diseases and damages. They planted at 7x7 meters apart and irrigated with well water through surface irrigation system. The texture of the tested soil is salty clay. All the selected palms received the common and usual horticultural practices that already applied in the orchard. Pollination was uniformly performed in respect of sources, date and method to avoid residues of *metaxinia*. Hand pollination was carried out by inserting five male strands into the female spathe after two days from spathe cracking. The number of female spathes per palm was adjusted to 10 spathes by removing excess earliest, latest and small ones.

The experiment included the following ten treatments of chelating compounds (potassium, calcium and mixed micronutrients) as follow:

1. Spraying the palms with chelated potassium at 750 ppm.
2. Spraying the palms with chelated potassium at 1500 ppm.
3. Spraying the palms with chelated potassium at 3000 ppm.
4. Spraying the palms with chelated calcium at 375 ppm.
5. Spraying the palms with chelated calcium at 750 ppm.
6. Spraying the palms with chelated calcium at 1500 ppm.
7. Spraying the palms with the mixture of chelated Micronutrients at 100 ppm.
8. Spraying the palms with the mixture of chelated Micronutrients at 200 ppm.
9. Spraying the palms with the mixture of chelated Micronutrients at 400 ppm.
10. Control (sprayed with water).

The nutrients in chelated form were sprayed three times one, two and three months after pollination. All nutrients were supplied with wetting agent substance namely triton B at 0.05 % (0.5 ml/l) and bunches were sprayed till runoff. The experimental treatments were arranged in a randomized complete block design with three replications, one palm for each replication.

The yield of the experimental trees was harvested through the first half of October in each season to determine.

The following measurements and determination:

- 1. Yield components**, i.e. fruit retention, bunch weight and yield/palm.
- 2. Fruit physical properties:** Samples of 50 fruits per palm were taken for the determination of fruit, flesh weight % and fruit moisture percentage.
- 3. Fruit chemical properties:** Ten date fruits from each treatment were divided into pieces and seeds were omitted. 50g of pieces were put in an electric mixer for extraction, and then filtered and the filtrate was used for determinations. Total soluble solids (TSS) as a percentage were recorded by using hand refractometer, acidity percentage as malic acid, total, reducing and non-reducing sugars percentage and total crude fiber % were determined according to A.O.A.C., 2000 and total soluble tannins % (Balbaa, 1981).

Statistical analysis

The results were subjected to statistical analysis according to Snedecor and Cochran (1980) and Mead et al. (1993). Treatment means of the ten treatments were compared using new L.S.D test at 5 % level.

Results

1. Bunch weight and yield/palm

Data presented in Table (1) show the effect of chelated potassium, calcium and micronutrients on yield components of “Bartamoda” date palm during 2019 and 2020 seasons. It is obvious from the data that the results took a similar trend during the two studied seasons. Data exhibits that chelated form applications of potassium, calcium and micronutrients significantly improved fruit retention, bunch weight and yield/palm relative to the control. The promotion was significantly related to the increase in concentrations of nutrients applied via chelated form of potassium from 750 to 1500 ppm, calcium, 375 to 750 ppm and micronutrients, 100 to 200 ppm. However no significant promotion on these studied yield components was observed among the higher two concentrations namely (1500 & 3000, 750 & 1500 and 200 to 400 ppm) applied via chelated form. From economical point of view the best results with regard to bunch weight and yield per palm were obtained due to using the potassium at 1500 ppm, calcium at 750 ppm and micronutrients at 200 ppm via chelated form. Under such promised treatment, bunch weight reached 14.19, 14.12 and 14.83 kg and yield/palm were 141.92, 141.23 and 148.26 kg, respectively. The lowest bunch weight (8.08 kg) and yield/palm (80.80 kg as av. of the two studied seasons) were recorded on untreated palms. Then, the increment percentage of yield/palm over control were attained (75.64, 74.79 & 83.49% as av. of the two studied seasons) due to spray chelating potassium at 1500 ppm, calcium at 700 ppm and micronutrients at 200 ppm, respectively.

Table (1): Effect of some chelating compounds spraying on yield components of “Bartamoda” date palm during 2019 and 2020 seasons.

Treat.	Fruit retention %			Bunch weight (kg)			Yield/palm (kg)		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
1	31.56	32.40	31.98	10.86	12.37	11.62	108.63	123.73	116.18
2	36.00	36.36	36.18	12.95	15.43	14.19	129.52	154.31	141.92
3	37.06	37.43	37.25	13.66	15.48	14.57	136.63	154.80	145.72
4	32.30	32.80	32.55	9.92	10.71	10.32	99.23	107.11	103.17
5	36.40	36.74	36.57	13.78	14.46	14.12	137.80	144.63	141.23
6	35.49	35.66	35.58	13.70	13.69	13.40	131.12	136.93	134.03
7	32.38	32.79	32.59	11.31	12.65	11.98	113.14	126.49	119.82
8	36.28	36.15	36.22	13.65	16.00	14.83	136.52	160.00	148.26
9	37.42	37.50	37.46	13.82	16.15	14.98	138.2	161.51	149.85
10	28.99	29.58	29.29	7.60	8.56	8.08	75.97	85.63	80.80
New L.S.D. at 5%	1.30	1.43		0.86	0.93		8.24	9.36	

1-Spraying chelated potassium at 750 ppm, 2-Spraying chelated potassium at 1500ppm 3-Spraying chelated potassium at 3000 ppm, 4-Spraying chelated calcium at 375ppm, 5-Spraying chelated calcium at 750ppm, 6-Spraying chelated calcium at 1500 PPM, 7-Spraying chelated microelements at 100 PPM, 8-Spraying chelated microelements at 200 ppm, 9-Spraying chelated microelements at 400 Pppm, 10- Control (spraying with water)

2. Fruit characteristics

Data in Tables (2 to 5) measurably indicate that subjecting “Bartamoda” date palms growing under Aswan environmental condition to the potassium, calcium and micronutrients in chelated form was significantly responsible for improving fruit quality in terms of increasing weight, length and width of fruit, fruit flesh %, T.S.S.%, total, reducing and non-reducing sugars % and decreasing, moisture %, total acidity %, total crude fibre % and total soluble tannins relative to the control treatment. The promotion on both physical and chemical characteristics of the fruits was significantly in proportional to the increase in concentrations of these nutrients applied via chelated form, potassium from 750 to 1500 ppm, calcium from 375 to 750 ppm and micronutrients from 100 to 200 pm. Increasing concentrations of these nutrients applied via chelated potassium from 1500 to 3000 ppm, calcium 750 to 1500 ppm and micronutrients from 200 to 400 ppm had no significant promotion effect on fruit characteristics. The highest fruit weight was (15.64, 15.56 & 16.11 g), against (10.94 g as an av. of the two studied seasons) due to spray chelated potassium at 3000 ppm, chelated calcium at 750 ppm and chelated micronutrients at 400 ppm and untreated ones, respectively. The corresponding flesh % was (92.64, 92.55, 92.75 & 90.16%), respectively. Then the corresponding increment percentage of fruit weight attained to (43.33, 42.23 & 47.26%), respectively. Moreover, the highest total soluble solids was (82.69, 80.65 & 79.73, against 69.87% as an av. of the two studied seasons) due to spray potassium, calcium and micronutrients at 300, 750 or 400 ppm via chelated form compared to water spray, respectively. Hence, the increment percentage of TSS due to these nutrients spraying over water spraying attained (18.35, 15.43 and 14.11%), respectively. Therefore the best results with regard to quality parameters were obtained due to treating the palms three times with potassium, calcium micronutrients via chelated form at 3000, 750 or 400 ppm. From

economic via, the best results for yield and fruit quality due to spray potassium, calcium or micronutrients at 1500, 750 or 200 ppm via chelated forms, since, no significantly increased due to increase the spraying concentrations from 1500 to 3000, 750 to 1500 or 200 to 400 ppm.

Table (2): Effect of some chelating compounds spraying on fruit weight and dimension of “Bartamoda” date palm during 2019 and 2020 seasons.

Treat.	Fruit weight (g)			Fruit height (cm)			Fruit diameter (cm)		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
1	11.63	12.23	11.93	4.85	4.93	4.89	1.96	1.98	1.97
2	14.68	15.13	14.91	5.30	5.18	5.24	2.32	2.34	2.33
3	15.37	15.9	15.64	5.33	5.37	5.35	2.38	2.40	2.39
4	11.84	12.17	12.01	4.85	4.88	4.87	1.95	2.06	2.01
5	15.12	16.00	15.56	5.33	5.40	5.37	2.13	2.35	2.24
6	14.47	15.36	14.89	5.18	5.23	5.21	2.08	2.28	2.18
7	11.49	13.5	12.50	4.80	4.87	4.84	1.97	2.05	2.01
8	14.85	15.93	15.39	5.30	5.33	5.32	2.26	2.29	2.28
9	15.48	16.73	16.11	5.47	5.50	5.49	2.31	2.35	2.33
10	10.9	10.97	10.94	4.53	4.70	4.62	1.90	1.93	1.92
New L.S.D. 5%	0.79	0.85		0.19	0.22		0.07	0.08	

Table (3): Effect of some chelating compounds spraying on flesh %, moisture percentage and TSS of “Bartamoda” date palm during 2019 and 2020 seasons.

Treat.	Flesh %			Moisture %			TSS %		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
1	91.4	91.3	91.35	16.50	16.33	16.42	71.17	80.83	76.00
2	91.93	92.64	92.29	15.80	15.62	15.71	80.25	82.83	81.54
3	92.20	93.07	92.64	15.40	15.31	15.36	81.22	84.15	82.69
4	91.53	91.53	91.53	16.70	16.43	16.57	70.50	76.83	73.67
5	92.20	92.90	92.55	16.31	16.20	16.26	79.43	81.87	80.65
6	92.73	92.47	92.60	15.88	15.61	15.75	78.17	80.67	79.42
7	91.2	92.33	91.77	17.10	16.95	17.03	69.93	74.73	72.33
8	92.23	93.4	92.82	16.50	16.02	16.26	77.57	79.33	78.45
9	92.47	93.03	92.75	15.98	15.48	15.73	78.83	80.83	79.73
10	90.10	90.21	90.16	17.82	17.60	17.72	68.57	71.17	69.87
New L.S.D. 5%	0.97	1.03		0.54	0.66		1.68	1.84	

Table (4): Effect of some chelating compounds spraying on sugar contents of “Bartamoda” date palm during 2019 and 2020 seasons.

Treat.	Total sugars %			Reducing sugars %			Non-reducing sugars %		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
1	54.42	54.78	54.60	40.13	41.53	40.83	14.29	13.25	13.77
2	57.87	58.62	58.25	43.19	44.77	43.98	14.68	13.85	14.27
3	58.98	59.45	59.22	43.25	44.72	45.98	15.73	14.73	14.33
4	54.48	54.60	54.54	39.07	40.67	39.87	15.40	13.93	14.67
5	56.16	56.12	56.14	40.75	41.96	41.36	15.40	14.16	14.78
6	55.32	55.98	55.65	40.31	42.10	41.21	15.00	13.88	14.44
7	53.55	54.36	54.06	40.27	40.53	40.40	14.38	13.93	14.16
8	55.60	57.11	56.36	40.45	41.95	41.20	15.15	15.16	15.16
9	57.30	58.76	58.18	42.28	43.96	43.12	15.14	15.02	15.08
10	52.08	52.26	52.17	38.58	49.17	49.88	13.50	13.69	13.30
New L.S.D. 5%	1.72	1.96		0.96	1.38		0.64	0.49	

Table (5): Effect of some chelating compounds spraying on acidity, crude fiber % and tannins % of “Bartamoda” date palm during 2019 and 2020 seasons.

Treat.	Total acidity %			Crude fiber %			Soluble tannins %		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
1	0.170	0.162	0.166	1.42	1.41	1.42	0.662	0.636	0.649
2	0.150	0.128	0.139	1.03	1.06	1.05	0.576	0.536	0.556
3	0.136	0.112	0.124	0.96	0.99	0.92	0.551	0.518	0.535
4	0.179	0.165	0.172	1.52	1.58	1.55	0.654	0.635	0.645
5	0.168	0.156	0.162	1.38	1.36	1.37	0.539	0.504	0.522
6	0.153	0.128	0.141	1.31	1.26	1.29	0.552	0.485	0.519
7	0.176	0.170	0.173	1.46	1.50	1.48	0.673	0.646	0.659
8	0.163	0.156	0.160	1.21	1.23	1.31	0.626	0.558	0.592
9	0.158	0.128	0.143	1.15	1.13	1.14	0.578	0.539	0.559
10	0.213	0.208	0.211	1.63	1.62	1.63	0.736	0.713	0.725
New L.S.D. 5%	0.032	0.036		0.09	0.11		0.026	0.029	

Discussion

The favorable effects of using potassium and calcium as well as micronutrients on bunch weight, yield and fruit characteristics might be attributed to their positive action on enhancing cell division, biosynthesis of chlorophylls and other plant pigments, natural hormones, uptake and movement of water and nutrients, building most of organic foods, enzyme activity, tolerance of plants to all stresses (biotic and abiotic stresses), pollen germination and photosynthesis (Nijjar, 1985). The superiority of using nutrients applied via chelated form on the previous parameters was mainly attributed for their small sizes that responsible for enhancing nutrient use efficiency, facilitating the uptake of nutrients and balancing nutrients absorption at longer periods (Mohammadi *et al.*, 2008 and Jahromi and Naseri, 2015).

Using nutrients via chelated form was more effective in fruit retention and hence significantly increased the bunch weight and yield/palm. Fruit weight is among the most important quantitative indexes for date fruit, which chelated nutrients significantly affected it. Application of potassium, calcium and micro-nutrient chelates had the highest influence on fruit weight. The results demonstrated that correct application of potassium, calcium and other micro-nutrients can be increase fruit weight. Application these materials can be affect and improve the fruit quality. In addition, it decreased many disorders such as wilting, blowing out and sun burning of date fruits. Nowadays, high waste of date fruit and reducing its quality is one of the principle problems in date fruit production. Application of nutrients chelates increase date fruit quality and production of one degree fruits. The highest TSS was observed in potassium and calcium chelate treatment (Jahromi and Nasser, 2015). Generally, can be concluded that nutrients chelates had significant influence on quantitative and qualitative properties of Bartamoda date fruit such as fruit weight, flesh %, fruit dimension and chemical properties such as TSS and sugar contents. Thus, potassium, calcium and micronutrients via chelated form can be used for increasing and improving qualitative and quantitative characteristics of date fruit. The results of Abd-Allah, (2006); Fernandes *et al.*, (2009); Bozary, (2012); Ahmed *et al.*, (2014); Hassan-Huda, (2014); Jahromi and Naseri, (2015); Al-Hajaj *et al.* (2020) and Ahmed *et al.* (2021) confirmed the present results regarding the beneficial effects of chelated potassium, calcium and micronutrients on fruiting on different fruit crops.

Conclusion

On the light of previous results, it could be concluded that spraying the Bartamoda date palms grown under Aswan region conditions three times with chelated potassium at 1500 ppm, calcium at 750 ppm and micronutrients at 200 ppm to obtained high yield with best dates quality.

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تأثير رش بعض العناصر المخليبية علي إنتاجية وجودة ثمار نخيل البلح البرتمودا بمحافظة أسوان

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الملخص العربي

أجريت هذه الدراسة خلال موسمي ٢٠١٩ و ٢٠٢٠ علي نخيل البلح صنف البرتمودا المنزرعة في منطقة أدفو بمحافظة أسوان - وذلك لدراسة تأثير رش البوتاسيوم والكالسيوم وخليط من العناصر الصغرى في الصورة المخليبية علي المحصول وخصائص الثمار. وكان تصميم التجربة بنظام القطاعات كاملة العشوائية تحتوي علي عشرة معاملات وثلاثة مكررات. وقد تم إجراء عملية الرش ثلاثة مرات خلال موسم النمو بعد شهر وشهرين وثلاثة أشهر من التلقيح. ويمكن تلخيص النتائج كالتالي: سببت جميع معاملات الرش سواء بالبوتاسيوم أو الكالسيوم أو مخلوط العناصر الصغرى في الصورة المخليبية زيادة معنوية في نسبة الثمار المتبقية ووزن السوابة ووزن المحصول/نخلة مقارنة بمعاملة الكنترول (رش ماء). أدي الرش بأي من العناصر الغذائية إلي زيادة معنوية في وزن الثمار وأبعادها ونسبة اللحم ونقص نسبة الرطوبة وكذلك تحسین معنوي في خصائص الثمار الكيميائية من حيث زيادة محتوى الثمار من المواد الصلبة الذائبة والسكريات مع نقص الحموضة ونسبة التانينات ونسبة الألياف مقارنة بمعاملة الكنترول. ومن الناحية الاقتصادية كانت أفضل المعاملات نتيجة الرش بالبوتاسيوم بتركيز ١٥٠٠ جزء في المليون والكالسيوم بتركيز ٧٥٠ جزء في المليون ومخلوط العناصر الصغرى بتركيز ٢٠٠ جزء في المليون. وعليه ينصح بالرش بالبوتاسيوم ١٥٠٠ جزء في المليون أو الكالسيوم ٧٥٠ جزء في المليون أو مخلوط العناصر الصغرى ٢٠٠ جزء في المليون في الصورة المخليبية وذلك لإنتاج محصول عال ذو خصائص ثمرية جيدة لنخيل البلح برتمودا.

الكلمات الدالة: العناصر المخليبية، العناصر الصغرى، نخيل البلح صنف برتمودا، المحصول، جودة الثمار