International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page: www.iscientific.org/Journal.html

Effect of thinning treatments on yield and fruit quality of 'Seewy' date palm under New Valley conditions

Zakaria B. Ali[1], Ahmed H. Abdelaal[2], Osama A. Khodair[2] and Yousef M. Diab[1]*

1 Cent. Lab for Date Palm Res. and Devel, Agric. Res Center, Giza, Egypt

2 Hort. Dept. Fac. of Agric., Al-Azhar Univ. (Assiut Branch), Egypt

Abstract

The present study was carried out during two successive seasons of 2022 and 2023 on Seewy date palms cultivated at El-Dakhla oasis, New Valley, Egypt to study the effect thinning treatments on yield and fruit quality. Results indicated that all thinning treatments significantly decreased punch weight andyield/ palm compared to control (without Thinning). Comparing the different thinning methods, it was found that fruit thinning by shortening 30% of spikelet tip of bunches + Thinning by removal of 50% from fruits (Srpnaah) was more effective compared to another thinning treatment in increasing fruit weight as well as improving other physical and chemical fruit traits. In general view, all thinning treatments significantly increased the fruit weight and fruit dimensions and decreased moisture percentage compared to non-thinned ones. No significant differences in such fruit traits due to the thinning by shortening 30% of spikelet tip bunches or thinning by removal of the heart bunches10% from bunches number, when thinning done with the same degree. All treatments more effects to improve the fruits quality in terms of increasing TSS%, sugars contents, carotenoid % and decreasing percentage of tannins and total acidity. On the highlight of current results, it could be concluded that fruit thinning by Shortening 30 or 10% from the length of flowering bunches + Thinning by removal of 50% from fruits (Srpnaah) could lead to considerable yield with good fruit quality.

Keywords: Seewy date palm, Thinning treatments, yield, fruit quality.

Full length article **Corresponding Author*, e-mail: prof_osamakhodair@yahoo.com

1. Introduction

The date Palm (*Phoenixv dactylifera L.*), a monocotyledonous and dieocious plant belonging to Arecaceae (Palmaceae) family. It is considered as one of the world's oldest cultivated fruit trees. It has diploid chromosome number 2n=36. Archaeological evidences suggest that the date palm was domesticated some 6000 years ago in the Mesopotamian (Iraq) Region [1]. Date palm is the most common fruit tree grown in semiarid and arid-regions it plays an important role in the protection of interplant cropping systems and the stabilization of the ecological system [2]. Egypt is considered to be one of the major date producing countries in the worlds [3]. Date palm fruit play an important role in the nutrition pattern of many people as well as a strategic crop in food and biochemical industries [4]. Thinning is the first practice which provides more nutrients to a fewer number of fruits. This will increase the fruit size, enhance the quality, prevent delay in ripening, and reduce the weight and compactness of the fruit bunch. Thinning will also decrease fungal infection and mechanical damages. This will benefit both the harvesting and packing operations. There are three different methods of thinning: first method of thinning will reduce the number of strands from the central part of each bunch, the second method reduces the number of bunches per palm and the third method of thinning reduces the number of fruits per strand [5,6]. Fruit thinning is one of the major practices that often helps in overcome the alternate bearing, enhances fruit quality of dates and reduce compactness of fruit bunches, beside increase adequate flowering in the following season [7,8,9,10].

Thinning can be done by bunch thinning, where some strands or portions are removed, by complete bunch removal or both. It is also recommended to prune off persistent leaves and old fruit stalks [11,12]. Such results could be obtained either by reducing the number of bunches per palm or fruits per bunch. The recommended method of thinning was dependent on the date palm cultivar [7,13,14,15,16,17]. Therefore, this study aimed to find out the effect of different fruit thinning methods on yield and fruit quality; such practices are essential and great importance for palm growers.

2. Materials and Methods

The present study was carried out during two successive seasons of 2022 and2023 in Seewy date palms cultivated at El-Dakhla oasis, New Valley, Egypt. It is a semi-dry date variety. The trees of uniform size, vigor and that of bearing stage were chosen. The palms are planted at 7x7 meter apart (85 palms /fed.) the selected palms were irrigated with well water via drip irrigation. 18 healthy Seewy date palms nearly similar in growth vigor were selected. Regular agricultural practices were carried out as usual. The following parameters were determined to evaluate the effects of different thinning methods on fruiting. Experiment consists of six treatments arranged as a Randomized complete block design. (RCBD) each treatment included three replicates and each represented by one palm.

Experiment included the following six treatments:

T_1 -Control without Thinning.

T_2 -Shortening 30% of spikelet tip of bunches (at the time of pollination).

T_3 -Thinning by removal of the heart bunches about 10% of spikelet numbers.

T_4 -Thinning by removal of 50% from fruits (Srpnaah)**.**

T_5 -Shortening 30% of spikelet tip of bunches + Thinning by removal of50% from fruits (Srpnaah)**.**

T_6 -Thinning by removal of the heart bunches about 10% from spikelet numbers + Thinning by removal of 50% from fruits (Srpnaah).

These treatments were carried out and other horticultural practices, which are used in orchards including pruning, fertilization and pollination, were carried out as usual. Uniformed palms of the same age and uniform growth and bearing free of insect damage and diseases were selected. Number of bunches per palm was adjusted to ten bunches and leaf bunch ratio was maintained at 8:1**.** Pollination was uniformed in respect of source and method to avoid residues [10]. Generally, the following measurements were determined during the tow investigated seasons. Average bunch weight (kg) as well as yield (kg/palm) were estimated andrecorded. Average fruit weight (g) and diameter (cm), flesh% and Moisture %, as well as TSS %, total sugars, reducing sugars, and non-reducing sugars, tannins, titratable acidity % and Carotenoid (mg /100Gdw) [18]. Statistical analysis was done according to [19]. New L.S.D. test at 5% was used for made all comparisons among different treatment means.

3. Results and Discussion

3.1. Yield characteristics

Data existed in Table (1) show the effect of thinning treatments on yield characteristics of Seewy date palm during 2022 and 2023 seasons. It is evident from the data that results followed a similar trend over the two studied seasons. In general view, all treatments significantly decreased punch weight and yield/ palm compared to control (without Thinning). The obtained punch weight was (8.16, 8.11, 7.45, 6.36, 6.54 and 9.11 kg) and yield/palm were (81.6, 81.1, 74.5, 63.6, 65.4 and 91.1 kg as an av. of the two studied seasons) due to fruit thinning by cutting 30% of spikelet tip of bunches at the time of pollination(T2), Thinning by removal of the heart bunches10% of spikelet numbers from bunches number(T3), Thinning byremoval of 50% from fruits (Srpnaah) (T4), Shortening 30% of spikelet tip of bunches + Thinning by removal of 50% from fruits (Srpnaah) (T5), Thinning by removal of the heart bunches10% of spikelet numbers + Thinning by removal of 50% from fruits (Srpnaah) (T6) and non-thinning ones (T1), respectively. The decrement percentage of punch weight and yield/palm of fruit thinning under non- thinning ones (T1) were (11.64, 12.33, 22.28, 43.23 and 39.29 % as an av. of the two studied seasons), due to T2 to T5 compared to T1, respectively. Similar responses were reported about thinning practices by removing 15 and 30% of the total number of strands from the center of each bunch in 'Khalas' date palm [6] and 'Succary' date palm [20]. and 'Segae' dates [21]. Furthermore, strand thinning to either 20 or 25 strands bunch-1 significantly decreased the bunch weight and yield tree-1 of 'Zaghloul' as compared to non-thinning. On the other hand, reported by [21] that thinning practices by removal of 1/3 of central strands and shorting the tips of strands by 1/3 in 'Ruzeiz' date palm reduces significantly both bunch weight and fruit yield as compared to control and to either method of strand thinning techniques alone. Decreased the average of bunch weight and yield/palm as reported by [6,20,22,23,24]. These results are in agreement with those obtained by [21,25,26,27,28] on several date cultivars, since removal part of strands led to a less bunch weight.

3.2. Fruit properties

3.2.1. Physical fruit properties

These physical fruit properties include fruit weight, fruit dimension, flesh and moisture percentage. Data in Tables (2,3) demonstrate that the fruit weight and its dimension took similar trend in response to different treatments. Results indicate thatall treatments significantly increased the fruit weight, fruit dimension and flesh percentage and significantly decreased the moisture content compared to un thinned once control (T1) during the two studied seasons. The obtained fruit weights were (11.69, 11.31, 12.84, 14.11, 13.80 and 9.28g as an av. of the two studied seasons) due to fruit thinning from T2 to T6 and non-thinning ones T1, respectively. The increment percentage of fruit weight due to fruit thinning over un thinned once (T1) were (25.69, 21.87, 38.36, 52.04 and 48.70% as an av. of thetwo studied seasons) due to T2 to T6 compared to control (T1), respectively. On the other hand, no significant differences in the flesh % were recording due to using any treatment compared other. Also, all fruit thinning treatments significantly increased flesh % compared to non-thinning once control. The higher value of fruit moisture percentage (13.49% as an av. of the two studied seasons) due to non-thinned bunches and the lowest value of moisture content ranged about (12.97 & 12.84% as an av. of the two studied seasons). All thinning treatments generally improved fruit physical properties such as fruit weight, flesh weight, fruit volume, fruit length and fruit diameter. Those results had appeared due to the reduction of fruit compactness within the bunch which gave more space for the fruit to grow reported by [26,29].

The positive effects of thinning practices on fruits physical properties might be attributed to the reduction in fruit competition for nutrients and photosynthetic products and to the reductions in compactness of fruits within bunches that improves their coloration and make maturity

more uniform reported by [6]. In agreement with our findings, Fruit thinning of per bunch resulted in increased fruit weight dates as compared to the non-thinning treatments reported by [6]. Moreover, fruit thinning per bunch date palm resulted in larger fruit size than those non-thinned reported by [30]. Moreover, fruits and bunch thinning practices are primarily used to manage alternate bearing problems associated with non-thinning and improve both fruit size and quality reported by [31]. On the other hand, no significant differences in the flesh % were recording due to using any treatment compared other. Also, all fruit thinning treatments significantly increased flesh % compared to non-thinning once control. Increased fruit size and decreased moisture content at maturity were also observed in response to strands thinning in date palm reported by [20**,**32]. Furthermore, have indicated [24] increased fruit size of 'Seewy' date palm and decreased moisture content in response to increased percentage of thinning. On the other hand, reported by [15] that 'Barhee' fruit size and quality was not affected by bunch and strand thinning treatments in an experiment conducted in Iran. Moreover, indicated [2**6**] no significant effect among all thinning treatments on fruits moisture content in one growing season, while strand thinning by removing 30% of total number of strands significantly decreased moisture content in the second season.

3.2.2. Chemical fruit constituents

Data represented in tables (4, 5 and 6) stated that all treatments, significantly improved the fruit chemical constituents in terms of increasing the total soluble solids, sugars content and Carotenoid content and reduction, total acidity percentage and the tannin contents compared to control. Shortening 30% of spikelet tip of bunches + Thinning by removal of 50% from fruits (Srpnaah) (T5) and thinning by removal of the heart bunches10% of spikelet numbers of bunches + thinning by removal of 50% from fruits (Srpnaah) (T6), gave the maximum values of soluble solids and sugar contents compared Control. No significant difference in fruit chemical properties were observed due to Thinning different treatments. The obtained total soluble solids (TSS) were (68.05, 71.48, 71.73, 71.62, 72.39 and 72.39 as av. the two studied seasons) due to T1 to T6, respectively. The increment percentage of TSS due to fruit thinning was attained (5.04, 5.40, 5.24, 6.38 and 6.38% as av. the two studied seasons) due to T2 to T6 compared to T1, respectively, this might be because fruit thinning alters source sink relations through lowering the competition between fruits and thus increasing adequate allowable carbohydrates to the remaining [26] and hence increasing the total soluble solids and sugar content of fruits and hasten maturity and improve fruit quality. In agreement with our work, thinning treatments significantly increased the TSS of seewy date palm fruits and that might be due to the higher loading rate of photosynthetic products and other metabolites to the fruits [30]. In this context, similar findings were reported by several investigators who have studied several date cultivars [6,30]. The obtained total sugars were (60.81, 64.01, 64.04, 63.94, 64.65 and 64.52 as av. the two studied seasons) due to T1 to T6, respectively. The increment percentage of total sugars due to fruit thinning over un thinned once (T1) were (5.26, 5.31, 5.14, 6.31 and 6.10% as an av. of the two studied seasons) due to T2 to T6 compared to control (T1), respectively. These results are in agreement with those reported by [8,33,34], they mentioned that fruit thinning increased total sugars of Zaghloul dates. In addition, reported by [35] that fruit sugar contents of Samani dates significantly increased by fruit thinning. Similar results were reported by [28] on Siwi and by [25] on Nabtet Ali dates. They found that removing 30% of entire spikelets from bunches center of fruit dates increased the fruit total sugars content reported by [23] on Succary dates found that the shortening of strands 40 % gave the highest value of total sugars. Also, the obtained reducing sugars were (52.39 ,54.28 ,54.42 ,54.59 ,55.34 and 55.4) as av. the two studied seasons) due to T1 to T6, respectively. The increment percentage of reducing sugars due to fruit thinning over un thinned once (T1) were (3.61, 3.87, 4.2, 5.63 and 5.84%) as an av. of the two studied seasons) due to T2 to T6 compared to control (T1), respectively. These results are in general agreement with those obtained by [8,33,34] on Zaghloul dates, [22] on Nabtet Ali dates, [36] on Sakkoti and Shamia and Balady dates [23] on Succary dates. They reported that fruit thinning treatments increased reducing sugars. Moreover, the obtained non-reducing sugars were (8.42, 9.73, 9.62, 9.36, 9.32 and 9.08) as av. the two studied seasons) due to T1 to T6, respectively. The increment percentage of non-reducing sugars due to fruit thinning over un thinned once (T1) were (15.56, 14.25,11.16, 10.69 and 7.84%) as an av. of the two studied seasons) due to T2 to T6 compared to control (T1), respectively. These results are in agreement with those reported by [23,36]. Also, carotenoids were (0.725, 0.765, 0.775, 0.765, 0.795 and 0.790 mg/100g) due to T1 to T6, respectively. These results are in agreement with those reported by [37].

Contrary, results showed that all thinning treatments decreased total acidity and tannins content compared control un-thinned once. the least values of titratable acidity percentage (0.212 & 0.214 %) and tannins content (0.522 & 0.524% as an av. of the two candied seasons) due to T5 and T6 compared the highest ones (0.232 & 0.557%) on untreated ones, respectively. Hence, the corresponding decrement percentage of titratable acidity (9.43 & 8.41% as an av. of the two studied seasons) due to T5 and T6 compared to control (T1), respectively. These results are in harmony with those obtained by [38] on "Zaghluol", [23] on "Succary", [39] on Khadrawy, [6] on "Khalas" and [20] on Succary & [22] on "Kur" and [40] on "Segae" date palm. These findings might be due to the reduction in the fruit retention percentage remained fruits due to fruit thinning different treatments. Such reduction in fruits was effective on lowering the competition among the fruits and induces adequate carbohydrates and other essentials assimilated for the residual ones, which consequently enhance the fruit maturity and improves its contents of total soluble solids and sugar contents. In addition, fruit thinning, effectively lowered the competition occurred between fruits and consequently raised the total soluble solids and sugar contents for each fruit. So, it could be said that the fruit thinning different treatments has an effect on improving the fruit quality. In general, it could be concluded that there is a positive relationship between fruit thinning and improvement of physical quality and the chemical constituents. On other hand, there is a negative relationship between the fruit retention and improvement of fruit quality.

Table 1: Effect of thinning treatments on yield characteristics of Seewy date palm during 2022 and 2023 seasons

Charact.	Bunch weight (kg)			Yield/palm (kg)		
Treat	Season1	Season2	Mean	Season1	Season2	Mean
T1	8.65 A	9.57 A	9.11 A	86.5 A	95.7 A	91.1 A
T2	7.69 B	8.62 B	8.16 B	76.9 B	86.2 B	81.6 B
T3	7.63 B	8.60 B	8.11 B	76.3 B	86.0 B	81.1 B
T4	7.31 B	7.56 C	7.45 C	73.1 B	75.6 C	74.5 C
T5	6.03 C	6.71 D	6.36 D	60.3 C	67.1 D	63.6 D
T6	6.20 C	6.89 D	6.54 D	62.0 C	68.9 D	65.4 D
LSD	0.54	0.63	0.43	5.4	6.3	4.3

(T1) Control without Thinning. (T2) Shortening 30% from the length of flowering bunches (at the time of pollination). (T3) Thinning by removal of the heart bunches10% from bunches number. (T4) Thinning by removal of 50% from fruits (Srpnaah). (T5) Shortening 30% from the length of flowering bunches + Thinning by removalof 50% from fruits (Srpnaah). (T6) Thinning by removal of the heart bunches10% from bunches number + Thinning by removal of 50% from fruits (Srpnaah).

Means within each column followed with different letters indicate significant differences at $p \leq 0.05$.

Table 2: Effect of fruit thinning treatments on fruit weight and dimension ofSeewy date palm during 2022 and 2023 seasons

Charact.	Fruit weight (g)			Fruit diameter (cm)		
Treat	Season1	Season2	Mean	Season1	Season2	Mean
T1	8.82 C	9.74 C	9.28 D	2.10 B	2.17 B	1.018 B
T2	11.00 B	12.38 B	11.69 C	2.27 A	2.35 A	1.051 A
T3	10.49 B	12.13 B	11.31 C	2.25 A	2.35 A	1.06 A
T4	12.71 A	12.97 B	12.84 B	2.32 A	2.40 A	1.05 A
T5	13.38 A	14.84 A	14.11 A	3.35 A	3.46 A	1.064 A
T6	13.11 A	14.49 A	13.80 A	3.33 A	3.40 A	1.06 A
LSD	0.79	0.35	0.59	0.11	0.12	0.08

Means within each column followed with different letters indicate significant differences at $p \leq 0.05$.

Table 3: Effect of fruit thinning treatments on pulp weight and moisturepercentage of Seewy date palm during 2022 and 2023 seasons

Charact.	Flesh %			Moisture %		
Treat	Season1	Season2	Mean	Season1	Season2	Mean
T1	86.11 C	87.06 C	86.57 C	13.58 A	13.41 A	13.495 A
T2	88.05 B	89.16 A	88.61 B	13.01 B	12.85 B	12.93 B
T3	87.48 B	88.83 B	88.16 B	13.05 B	12.90 B	12.975 B
T4	88. 86 A	89.75 A	89.31 A	12.98 B	12.76 B	12.87 B
T5	89.38 A	90.28 A	89.83 A	12.91 B	12.80 B	12.855 B
T6	89.11 A	90.33 A	89.72 A	12.95 B	12.73 B	12.84 B
LSD	1.25	1.31	0.93	0.41	0.45	0.32

Means within each column followed with different letters indicate significant differences at $p \leq 0.05$.

Table 4: Effect of fruit thinning treatments on total soluble acids and total sugars contents of Seewy date palm during 2022 and 2023 seasons

Charact.	TSS			Total sugars		
Treat	Season1	Season2	Mean	Season1	Season2	Mean
T1	67.37 B	68.64 B	68.05 B	60.28 B	61.34 B	60.81 B
T2	70.78 A	72.19 A	71.48 A	63.49 A	64.53 A	64.01 A
T3	71.19 A	72.28 A	71.73 A	63.50 A	64.58 A	64.04 A
T4	70.95 A	72.30 A	71.62 A	63.41 A	64.47 A	63.94 A
T5	71.70 A	73.08 A	72.39 A	64.12 A	65.19 A	64.65 A
T6	71.63 A	73.15 A	72.39 A	63.93 A	65.11A	64.52 A
LSD	1.83	1.95	1.37	1.98	2.11	1.49

Means within each column followed with different letters indicate significant differences at p≤0.05.

Table 5: Effect of fruit thinning treatments on reducing and non-reducingcontents of Seewy date palm during 2022 and 2023 seasons

Charact.	Reducing			Non-reducing		
Treat	Season1	Season2	Mean	Season1	Season2	Mean
T1	51.93 B	52.85 B	52.39 B	8.35 B	8.49 B	8.42 B
T2	53.80 A	54.76 A	54.28 A	9.69 A	9.77 A	9.73 A
T3	53.94 A	54.90 A	54.42 A	9.56 A	9.68 A	9.62 A
T4	54.11 A	55.06 A	54.59 A	9.30 A	9.41 A	9.35 A
T5	54.86 A	55.82 A	55.34 A	9.26 A	9.37 A	9.31 A
T6	54.98 A	55.91 A	55.45 A	8.95 A	9.20 A	9.08 A
LSD	1.83	1.95	1.38	0.39	0.34	0.26

Means within each column followed with different letters indicate significant differences at p≤0.05.

Table 6: Effect of thinning treatments on total acidity%, tannins %, fiber % of Seewy date palm during 2022 and 2023 seasons

Charact.	Acidity %			Tannins %			Carotenoid(mg /100Gdw)		
Treat	Season1	Season2	Mean	Season1	Season2	Mean	Season1	Season2	Mean
T1	0.235 A	0.228 A	0.232 A	0.550 A	0.564 A	0.557 A	0.71 B	0.74 B	0.725 B
T2	0.219 B	0.212 B	0.215 B	0.551 B	0.529 B	0.54 B	0.75 A	0.78 A	0.765 A
T3	0.222 B	0.213 B	0.217 B	0.518 B	0.532 B	0.525 B	0.76 A	0.79 A	0.775 A
T4	0.220 B	0.211 B	0.215 B	0.520 B	0.530 B	0.525 B	0.75 A	0.78 A	0.765 A
T5	0.216 B	0.208 B	0.212 B	0.515 B	0.529 B	0.522 B	0.78 A	0.81 A	0.795 A
T6	0.218 B	0.211 B	0.214 B	0.518 B	0.530 B	0.524 B	0.78 A	0.80 A	0.790 A
LSD	0.013	0.015	0.0	0.018	0.021	0.014	0.06	0.08	0.05

Means within each column followed with different letters indicate significant differences at p≤0.05.

4. Conclusions

Such thinning is considered the best horticultural treatment in regular bearing which lead to suitable number of inflorescence and reduced compactness within bunch, so, improve the light, air and competition of nutrients among the bunches, so, improve fruit properties (quality). Thinning by Shortening 30% of spikelet tip of bunches along with Srpnaah gave the lowest bunch weight and yield per palm. Whereas, improved physical properties, i.e., fruit weight, flesh %, fruit dimension than control and other treatments during in both seasons. All strand thinning treatments improved chemical properties such as TSS %, total sugars contents, and reducing sugars %. However, thinning treatments significantly decreased, total acidity % and tannins content in the two studied seasons of Seewy date palm cultivar. On the highlight of current results, it could be concluded that fruit thinning by Shortening 30% of spikelet tip or 10% of spikelet number of bunches + thinning by removal of 50% from fruits (Srpnaah) could lead to considerable yield with good fruit quality.

References

[1] D. Zohary & M. Hopf. (2000). Domestication of plants in the old World. 3rd ed. Oxford University Press, U.K.

[2] A.M.A. Hansaoui, M.A. Elhoumaizi, A. Hakkou, B. Wathelet & M. Sindic. (2011). PP. Physio-chemical characterization, classification an quality Evaluation of Date Palm fruits of some Moroccan Cultivars: J. Sci. Res., 3 (1): 139-149.

[3] FAO. (2014). Quarterly Bulletin of Statistics 6 No. 113, 32 years Book. Annual 10 Prod. 46: 155-157.

[4] M. Khayyat, E. Tafazoli, S. Eshghi & S. Rajaee. (2007). Effect of nitrogen, boron, potassium and Ginc on yield and fruit quality of date palm. Amer

Eurasion J. Agric. & Environ. Sci., 12(3): 289 - 296.

[5] J. Pieniążek, S.Z. Pieniążek. (1981). Owoce krain dalekich (Fruits of distant countries). PWRiL, Warszawa, 278−285 (in Polish).

[6] S.S. Soliman, R.S. Al-Obeed & M.M. Harhash. (2011). Effects of bunch thinning on yield and fruit quality of khalas date palm cultivar. World J. of Agric. Sci., 7 (1): 42-46.

[7] R.W. Nixon & J.B. Carpenter. (1978). Growing dates in the United States. U.S. Dep. Agric., Inform. Bull. 207, 56 p.

[8] A.S. Khalifa, A.I. El-Kady, K.M. Abdalla and A.M. El-Hammady. (1987). Influence of thinning patterns and leaf/bunch ratio on "Zaghloul" dates. Annals Agric. Sci., Fac. Agric., Ain Shams Univ., 32, 637.

[9] R.K. Godara, N.R. Godara & N.S. Nehra. (1990). Effect of level of thinning on ripening of date palm fruit (Phoenix dactylifera) cv. Shamran. Res. Dev. Rep., 7(1-2): 21-25.

[10] Y.M. Diab. (2006). Effect of some cultural practices on yield and fruit quality of (*Phoenix dactylifera* L.). cv. Sewy under New Valley conditions. M.Sc. Thesis, Fac. of Agric., Assiut Univ., Egypt.

[11] D. Huntrods. (2011). Date profile. Agricultural Marketing Resource Center Bulletin. USDA, Washington, DC. 3p.

[12] G. Sanderson. (2001). Natural history of the date palm – *Phoenix dactylifera*. Available at http://enhg.4t.com/articles/date.htm (accessed March 23, 2013). Sci., Fac. Agric., Ain Shams Univ., Cairo, Egypt, 32(1): 637-647.

[13] N. Abdel-Hamid. (2000). Effect of time, rate and patterns of thinning, leaf bunch ratio and male type on "Zaghloul" date yield and quality. Arab, J. Agric. Sci. Ain Shams Univ., Cairo, 8 (1): 305-317.

[14] A.E.E. Mahmoud. (2005). Effect of some horticultural practices on yield and fruit quality of certain date palm (*Phoenix dactylifera* L.) cultivars under Asiut conditions. M.Sc. Thesis, Fac. Agric., Assiut Univ., Egypt.

[15] S. Marashi & A. Mousavi. (2007). Effect of different methods and degrees of fruit thinning on yield and fruit characteristics of Barhee date cultivar. Acta Hort. (ISHS), 736: 187-192.

[16] R.A.A. Mostafa & M.M. El Akkad. (2011). Effect of fruit thinning rate on yield and fruit quality of Zaghloul and Haiany date palms. Australian J. of Basic and Applied potassium and zinc sprays on yield and fruit quality of date palm. American Eurasian J. A. Sci., 5, 12: 3233-3239.

[17] M. T. Samouni, A. M. El-Salhy, I. F. Badawy & E. F. Ahmed. (2016). Effect of pollination and thinning methods on yield and fruit quality of Saidy Date palms. Assiut J. Agric. Sci., 47, 92-103.

[18] A.O.A.C. (2000). Association of Official Agricultural Chemists, Official Method of Analysis (A.P.A.C.) 15th Ed., Published by A.O.A.C. Washington, D.C.(U.S.A.) pp. 490-510.

[19] G.W. Snedecor & W.G. Cochran. (1980). Statistical methods. 7th. Iowa State University USA, 80-86.

[20] S.S, Soliman & M.M. Harhash. (2012). Effects of strands thinning on yield and fruit quality of Succary date palm. African J of Biotechnology, 11(11):2672–2676.

[21] M.S. Al Saikhan, (2008). Effect of thinning practises on fruit yield and quality of Ruzeizdate palm cultivar (*Phoenix dactylifera* L.) in Al-Ahsa Saudi Arabia. Asian J. Plant Sci., 7 (1), 105–108 https://doi.org/10.3923/ajps.2008. 105.108.

[22] M.A. Bashir, M. Ahmad, F. Altaf & K. Shabir. (2014). Fruit quality and yield of date palm (Phoenix dactylifera L.) as affected by strand thinning. J. Anim. Plant Sci., 24 (3): 951-954.

[23] R.S. Al-Obeed, M.A. Harhash & N.S. Fayez. (2005). Effect of bunch thinning on yield and fruit quality of Succary date palm cultivar grown in the Riyadh region. J. King Saud Univ. Agric. Sci., 17(2):235–249.

[24] H.E.M. El-Badawy, S.F. El-Gioushy & I.A.M. Ahmed (2018). Effect of some thinning practices on yield and fruit quality of Sewidate palm grown in Farafra Region. Asian Journal of Agricultural and Horticultural Research, 2 (3), 1–20. https://doi.org/10.9734/AJAHR/2018/45474.

[25] S.M. El-Shazly. (1999). Effect of fruit thinning on yield and fruit quality of "Nabtet Ali" Saudi date palm. The International Conference on date palm Nov. 9-11, Assiut Univ., Egypt, pp: 17-33.

[26] A.R. Moustafa, N. Abdel-Hamid, A. Abd El-Hamid, R. El-Sonbaty & S.K.M. Abd El-Naby (2019). Strand thinning of Khadrawi date palm cultivar in relation to yield and fruit quality. Bull. Natl. Res. Cent., 43 (1), 204 https://doi.org/ 10.1186/s42269-019-0234-3.

[27] A.A. Moustafa, A.Z. Bondok & M.A. Salama (1984). Effect of different hand thinning treatments on yield and quality of Hayany date fruits. Bull. Fac. Of Agric. Univ. Cairo, 35(30): 1543-51.

[28] A.A. Moustafa. (1993). Effect of fruit thinning on yield and fruit quality of Seewy date palms under El-Fayoum Governorate conditions. The Third Symposium on the date palm in Saudi Arabia. King Univ, Al-Hassa. Vol. 1, January 17-20.

[29] A.A. Moustafa. (1998). Studies on fruit thinning of date palm. The First International Conference on date palm Al-Ain United Arab Emirates, pp: 354-363.

[30] M.S. Al-Saikhan & A.A. Sallam. (2015). Impact of chemical and non-chemical thinning treatment on yield and fruit quality of date palm. J. of Food and Research, 4 (4): 18-24.

[31] C.C.T. Chao & R.R. Krueger (2007). The date palm (*Phoenix dactylifera* L.): overview of biology, uses and cultivation. HortScience, 42 (5), 1077–1082 https://doi.org/10.21273/HORTSCI.42.5.1077.

[32] C.N. Panchal, C.M. Muralidharan, D.A. Baidiyavadra & K. Mohan Sharma. (2021).

Standardization of leaf: bunch ratio in date palm (*Phoenix dactylifera* L.). Plant Arch., 21 (1), 1757–1759. https://doi.org/10.51470/PLANTARCHIVES.2021.v21.S1.279.

[33] S.E. El-Kassas. (1983). Manual and chemical thinning of Zaghloul dates. Assiut J. Agric. Sci., 14(2): 221-233.

[34] S.G.M. Sayed. (1991). The effect of some fertilization and fruit thinning on the yield and fruit quality of Zaghloul and Samany date palms. Ph.D. Thesis, Fac. Agric. Assiut Univ. Egypt.

[35] M.A. Hussein, S.Z. El-Agamy, M.A. Ahmed & S. Galal. (1992). Physiological studies for prolonging harvest date of Samany date under Assiut governorate conditions. A: Effect of GA and fruit thinning. Assiut J. Agric. Sci., 23(2): 321-334.

[36] S.M. Osman and S.S. Soliman. (2001). Effect of thinning on fruiting and fruit characteristics of some dry date palm cultivars under Aswan conditions. Minufiya J. Agric. Res., 26(3): 845-858.

[37] M. Al-Farsi, C. Alasalvar, A. Morris, M. Baron & F. Shahidi. (2005). Compositional and sensory characteristics of three native sun-dried date (*Phoenix dactylifera* L.) varieties grown in Oman. J. Agri. Food Chem., 53 (19), 7586–7591.

[38] H.M. Mahmoud, T.K. El-Mahdy & M.A. Fouad. (2003). Effect of bagging and fruit thinning treatments on yield and fruit quality of "Zaghloul" dates under Aswan conditions. Proc. of the International Conference on Date Palm. King Saud Univ., Qassem Branch. Qassem, Saudi Arabia, Sep 247-258.

[39] K. Nirmaljit, J.S. Josan & P.K. Monga. (2006). Fruit thinning of dates in relation to fruit size and quality. Abstract of the Third International Date Palm Conf. Feb. 19th-21th, Abu Dhabi, United Arab Emirates.

[40] S.S. Soliman, R.S. Al-Obeed & A.M. Al-Saif. (2015). Multivariate analysis as a tool in the assessment of thinning of Segae date palm cultivar (*Phoenix dactylifera* L.). Pak. J. Bot., 47(5):2023–2029.