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Effect of Fruit Thinning Practices on Fruit Quality of Date Palm (*Phoenix dactylifera* L.) CV. Local

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

A field experiment was conducted during 2024 at the Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, to evaluate the influence of fruit thinning practices on fruit quality of date palm (*Phoenix dactylifera* L.) cv. Local. The experiment was laid out in a completely randomized design with three replications. Eleven treatments were assessed, including different levels of strand thinning, strand shortening, fruit thinning within strands, and an unthinned control. Fruit thinning was carried out 28–35 days after pollination at the hababouak stage. Fruits were harvested at maturity, and quality attributes such as total soluble solids, reducing sugar, non-reducing sugar, total sugar, and acidity were recorded. The results showed that thinning treatments influenced the quality

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parameters of date palm fruits. Among the treatments, thinning 50% strands per bunch recorded the highest total soluble solids (36.17 °Brix), reducing sugar (34.21%), non-reducing sugar (4.54%), and total sugar (38.75%), along with the lowest acidity (0.167%). The control treatment recorded the lowest total soluble solids (30.53 °Brix), reducing sugar (23.98%), non-reducing sugar (3.11%), and total sugar (27.09%), and the highest acidity (0.190%). The findings indicate that fruit thinning, particularly 50% strand thinning per bunch, improved fruit quality attributes under the conditions of the present study. This practice may help enhance the compositional quality of date palm fruits when applied at the pea stage of fruit development.

Keywords: Date palm; fruit thinning; strand thinning; fruit quality.

1. Introduction

Date palm (*Phoenix dactylifera* L.) is a significant fruit crop grown in arid and semi-arid climates, primarily in the Middle East, North Africa and parts of India (Hussain *et al*., 2020). It belongs to the Arecaceae family, and its name "*dactylifera*" means "finger-bearing" describing the shape of its fruit clusters (Jain *et al*., 2021). Cultivated since as early as 3000 BCE, its exact origin is believed to be in ancient Mesopotamia (Wrigley, 1995). The crop requires hot, dry summers and underground water sources to thrive and is tolerant to saline and alkaline soils (Zaid & De Wet, 2002).

The major date palm growing areas in India are Kutch (Gujarat), Rajasthan and certain parts of the Punjab as well as Tamil Nadu state to some extent (Shah, 2014). In Gujarat date palm is cultivated in 20,591 hectares area with a production of 1,917,19 tons per annum and it is cultivated in 19,356 hectares area in Kutch district of Gujarat with a production of 1,838,82 tons per annum (Directorate of Horticulture, Government of Gujarat., 2024).

In India, date fruits are harvested at the *khalal* stage due to climatic limitations, with artificial ripening used thereafter (Shah, 2014). The plant is propagated via suckers, seedlings, or tissue culture, though suckers are preferred to maintain varietal purity (Zaid & De Wet, 2002). Major cultivation issues include rainfall during fruit maturity, insect damage and fruit defects due to high humidity such as cracking and blacknose (Kassem *et al*., 2010; Guedri *et al*., 2016).

Despite high nutritional value with abundant energy, B-vitamins, and minerals like potassium and magnesium (Maqsood *et al*., 2020; Alharbi *et al*., 2021). India's domestic date production often lacks global market quality due to a focus on yield over quality. It is an excellent practice which should be used for overcoming this problem. Fruit thinning in date palm will definitely be a boon to the farmers. It will help in increasing the overall grade and quality of date palm fruits. Moreover, the farmer community will be benefited with high economic returns. Various thinning techniques like bunch thinning (Ali-Dinar *et al*., 2002), strand thinning (Moustafa *et al*., 2019), strand tip cutting (Ahmed *et al*., 2019) and individual fruit removal (Shaaban *et al*., 2019) have shown to reduce competition among fruits and improve quality traits such as TSS and sugar content. Improving quality through thinning practices is vital to meet international standards and enhance farmer incomes through better market returns and export opportunities.

In fruit thinning several methods were used to thin date palm trees, namely: bunch thinning (Ali-Dinar *et al.,* 2002), bunch strands thinning (Moustafa *et al*., 2019; Soliman & Harhash, 2012), Strand shortening from tip (Dawoud & El-Rauof, 2021) and individual fruit removal and Combination of removal of strands had substantially improved fruit quality in date palm (Osman & Abdulrida, 1989; Radwan, 2017). Keeping all these in mind, the present study evaluates the influence of fruit thinning practices on fruit quality of date palm (*Phoenix dactylifera* L.) cv. Local.

2. Material and Method

The experiment was conducted on eight-year-old trees of date palm planted at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, during 2024. Experiment was carried out using a completely randomised design with eleven treatments *viz.,* T_1 : Thinning 10 % strands per bunch, T_2 : Thinning 20 % strands per bunch, T_3 : Thinning 30 % strands per bunch, T_4 : Thinning 50 % strands per bunch, T_5 **:** 1/3 shortening of total strands from terminal tips, T_6 : 1/4 shortening of total

strands from terminal tips, T_7 : Thinning 10 % fruits per strands, T_8 : Thinning 20 % fruits per strands, T_9 **:** Thinning 30 % fruits per strands, T_{10} **:** Thinning 50 % fruits per strands and T_{11} : Control during February to June in the year 2024. Flowering started in the month of February in the year 2024, and hand pollination was carried out. Pollination began on 5th February 2024 and was repeated thrice during the morning hours between 8 and 11 am. Fruit thinning is done at 28 – 35 days after pollination at *hababouak* fruit stage (Pea stage).

Fruits were harvested when their skins developed a deep crimson colour, indicating that they were fully mature. Fruits were picked frequently because they did not all mature and ripen at the same time. In 2024, a total of 15 pickings were conducted during the experiment, which began on 1 June and ended on June 21.

2.1 Procedure of Thinning

In strand thinning (also known as bunch strand thinning) involves the removal of entire fruiting strands from the bunch, typically by (10, 20, 30 and 50 %). This reduces fruit density per bunch, enhances light penetration and ensures better development of the remaining fruits. Studies by Soliman *et al.* (2010), Soliman and Harhash (2012), Bashir *et al*. (2014) and Moustafa *et al*. (2019) have shown that this method improves fruit size, weight and quality.

Strand tip cutting (or strand shortening) refers to the removal of the terminal ends of each fruit-bearing strand by specific length (1/3 and 1/4). This method targets the distal fruits, which often receive fewer nutrients, thereby allowing better nutrient distribution to proximal fruits and resulting in improved uniformity and quality. Marashi and Mousavi (2007), Ben-Salah *et al*. (2016) and Ahmed *et al.* (2019) reported its positive effects on fruit development like fruit size, fruit weight, fruit yield, TSS, sugar and other quality parameter.

Individual fruit thinning involves selectively removing individual fruits from within each strand at varying levels (10, 20, 30 and 50 %). This reduces fruit competition, allowing the remaining fruits to grow larger, ripen more uniformly and achieve higher market quality. Al-Wasfy and Mostafa (2008), Samouni *et al*. (2016) and Shaaban *et al*. (2019) found this method is effective in enhancing fruit quality and quantity characteristics.

3. Result and Discussion

3.1 Effect of Fruit Thinning Practices on Quality Parameter of Date Palm

The data presented on the **quality parameter** as influenced by fruit thinning practices are presented in Table 1. There significant difference found on quality parameters due to application of fruit thinning treatment.

3.2 Total Soluble Solids (°Brix)

In the present study, total soluble solids (TSS) were significantly affected by fruit thinning with the highest value (36.17 °Brix) recorded in T_4 (50% strand thinning per bunch), followed by T_{10}, T_3, and T_9, while the lowest (30.53 °Brix) was in the control (T_{11}). It may be due to received more photosynthates (sugars, nutrients and water) due to reduced competition. This improved the accumulation of sugars in each fruit, resulting in higher TSS. Similar result was obtained by Al-Wasfy and Mostafa (2008), Soliman *et al.* (2010), Soliman and Harhash (2012), Bashir *et al*. (2014), Mukhtar and Ali (2019), Ahmad *et al*. (2023), Sallam (2023) in date palm, Mishra *et al.* (2020) in guava.

3.3 Reducing Sugar (%)

The reducing sugar content was significantly influenced by fruit thinning treatments, with the highest value (34.21%) observed in T_4 (50% strand thinning practices), followed by T_{10} and T_3, while the lowest (23.98%) was recorded in the control (T_{11}). Fruit thinning has led to an increase in reducing sugar content. This effect is attributed to the enhanced availability of photosynthates per fruit due to reduced fruit load, which improves carbohydrate metabolism and sugar translocation into the fruit. The improved light penetration and hormonal balance in thinned fruits also promote enzymatic activity related to sugar conversion, resulting in higher levels of reducing sugars. These results confirmed with the findings of Mostafa and Moamen (2006), Al-Saikhan (2008), Soliman *et al.* (2010), Bashir *et al*. (2014), Omar and Alam-Elden (2014), Moustafa *et al*. (2019), Mukhtar and Ali (2019) in date palm and Mishra *et al.* (2020) in guava.

Table 1. Effect of fruit thinning practices on quality parameters of date palm

Sr. No.	Treatments	TSS (ºBrix)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Acidity (%)
T_1	Thinning 10 % strands per bunch	31.67	25.26	3.47	28.73	0.184
T_2	Thinning 20 % strands per bunch	33.14	28.55	3.75	32.30	0.180
T_3	Thinning 30 % strands per bunch	35.14	32.78	4.32	37.11	0.174
T_4	Thinning 50 % strands per bunch	36.17	34.21	4.54	38.75	0.167
T_5	1/3 shortening of total strands from terminal tips	33.90	29.15	3.84	32.99	0.177
T_6	1/4 shortening of total strands from terminal tips	32.27	26.52	3.62	30.13	0.181
T_7	Thinning 10 % fruits per strands	31.43	25.23	3.36	28.59	0.185
T_8	Thinning 20 % fruits per strands	32.92	27.73	3.69	31.43	0.178
T_9	Thinning 30 % fruits per strands	34.89	32.37	4.22	36.59	0.176
T_{10}	Thinning 50 % fruits per strands	35.97	33.95	4.44	38.39	0.170
T_{11}	Control	30.53	23.98	3.11	27.09	0.190
	S.Em ±	**0.63**	**0.57**	**0.10**	**0.62**	**0.003**
	CD (P=0.05)	**1.84**	**1.66**	**0.29**	**1.83**	**0.009**
	CV%	**3.26**	**3.38**	**4.46**	**3.28**	**3.086**

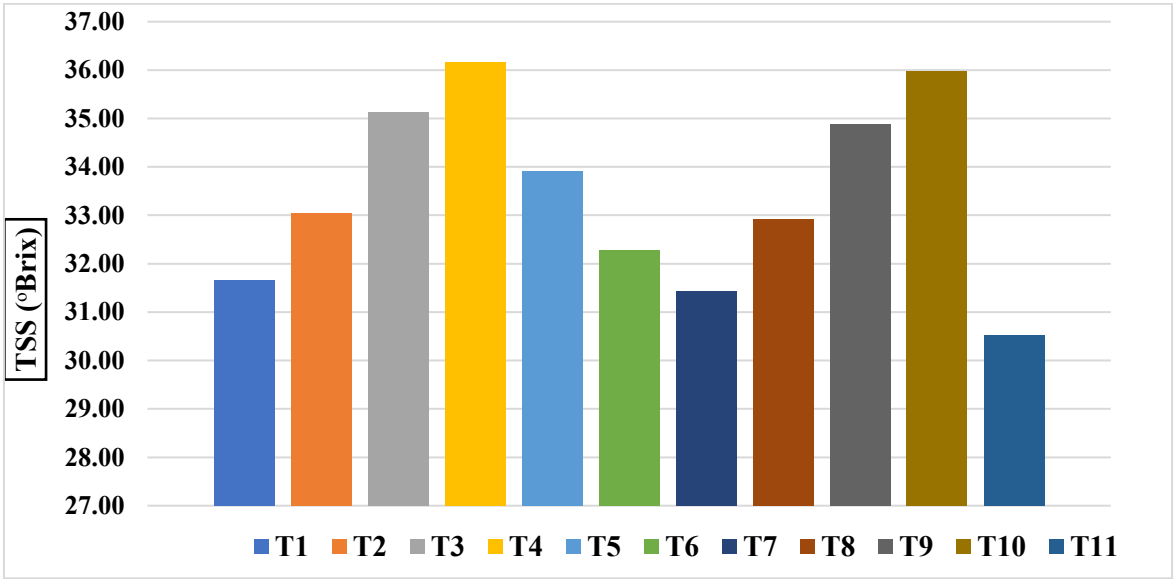

Fig. 1. Effect of fruit thinning practices on TSS of date palm

3.4 Non-reducing Sugar (%)

Fruit thinning significantly increased non-reducing sugar content, with the highest value (4.54%) observed in T_4 (50% strand thinning practices), followed by T_{10} and T_3 and the lowest (3.11%) in the control (T_{11}). The practice of fruit thinning has led to an increase in non-reducing sugar content. This effect is attributed to the enhanced allocation of photosynthates per fruit, which promotes the biosynthesis and accumulation of complex sugars such as sucrose. Thinning reduces the competition among fruits, improves light interception, and stimulates enzymatic activity responsible for the conversion of simple sugars and organic acids into non-reducing forms. These physiological improvements support the buildup of storage sugars essential for fruit sweetness and quality. These results conformed with the findings of Al-Wasfy and Mostafa (2008), Al-Saikhan (2008), Soliman *et al.* (2010), Soliman and Harhash (2012), Omar and Alam-Elden (2014), El-Badawy *et al.* (2018) and Moustafa *et al*. (2019) in date palm.

3.5 Total Sugar (%)

Total sugar content was also significantly affected by thinning, with T_4 recording the highest (38.75%), followed by T_{10}, T_3. While, recorded value T_{11} the lowest (27.09%). The increase in total sugar is attributed to the enhanced availability of photosynthates per fruit due to reduced fruit load, which improves carbohydrate metabolism and sugar translocation into the fruit. The improved light penetration and hormonal balance in thinned trees also promote enzymatic activity related to sugar conversion, resulting in higher levels of total sugars. These results conformed with the findings of Mostafa and Moamen (2006), Al-Saikhan (2008), Soliman *et al.* (2010), Bashir *et al*. (2014), Omar and Alam-Elden (2014), Moustafa *et al*. (2019), Mukhtar and Ali (2019) in date palm and Mishra *et al.* (2020) in guava.

3.6 Acidity (%)

Among the various fruit thinning treatments, thinning 50% strands per bunch (T_4) recorded the lowest acidity (0.167%), closely followed by T_{10}, T_3, and T_9. The highest acidity (0.190%) was observed in the control (T_{11}). The reduction in acidity may be due to the practice of fruit thinning, which likely improved availability of assimilates (mainly carbohydrates) per fruit. When the fruit load is reduced, each remaining fruit receives a greater share of photosynthates, promoting faster and more complete ripening. During the ripening process, organic acids, which contribute to fruit acidity, are either diluted due to increased sugar accumulation or metabolized into sugars and other compounds, thereby reducing overall acidity. Similar results were observed by Al-Wasfy and Mostafa (2008), Soliman *et al.* (2010), Soliman and Harhash (2012), Radwan *et al*. (2022) and Atawia *et al*. (2020) in date palm.

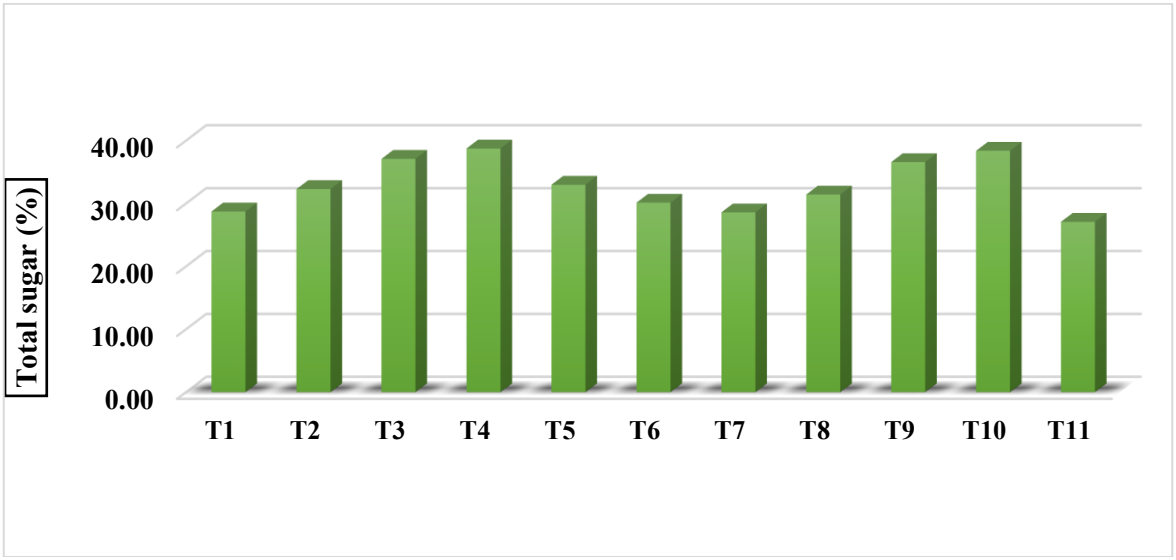

Fig. 2. Effect of fruit thinning practices on Total sugar of date palm

4. Conclusion

The present study indicated that fruit thinning practices influenced the quality attributes of date palm (*Phoenix dactylifera* L.) cv. Local under the experimental conditions of Anand, Gujarat. Among the evaluated treatments, thinning 50% strands per bunch at the pea stage of fruit development, 28–35 days after pollination, recorded the highest values for total soluble solids, reducing sugar, non-reducing sugar, and total sugar, and the lowest acidity. The unthinned control recorded comparatively lower sugar-related quality parameters and higher acidity. These results suggest that reducing fruit load through strand thinning can improve the distribution of assimilates among the remaining fruits, thereby supporting better sugar accumulation and reduced acidity. Based on the observed data, 50% strand thinning per bunch may be considered a useful practice for improving fruit quality of date palm cv. Local. However, the recommendation should be interpreted within the limits of the present experiment, as the study was conducted during a single season and at one location. Further validation under different growing conditions would strengthen the practical applicability of the findings.

5. Limitations

The findings of this study are based on a single-season field experiment conducted during 2024 at one location. Therefore, seasonal variation, environmental differences, and location-specific responses could not be fully assessed. The study focused mainly on selected fruit quality parameters, including total soluble solids, reducing sugar, non-reducing sugar, total sugar, and acidity. Other important attributes such as fruit size, fruit weight, yield per palm, marketable yield, shelf life, consumer acceptability, and economic returns were not presented. The cultivar was described as “Local,” but detailed characterization of the genotype was not provided. The methodology also requires more detail regarding sampling procedure, number of experimental palms, laboratory estimation methods, and statistical analysis. Because of these limitations, the results should be considered preliminary and should be validated through multi-season and multi-location studies before making broader recommendations for commercial date palm cultivation.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

Competing Interests

Authors have declared that no competing interests exist.

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