International Journal of Minor Fruits, Medicinal and Aromatic Plants. Vol. 11 (1) : 190-195, June 2025

Study of fruit drop pattern in date palm (*Phoenix dactylifera* L.)

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Receipt: 15.03.25 *Revised: 05.04.25* *Acceptance: 06.04.25*
DOI: 10.53552/ijmfmap.11.1.2025.190-195

ABSTRACT

Fruit drop is a common phenomenon in date palm which may significantly affect yield and commercial viability. To understand the pattern of fruit-drop the study was done in three date palm genotypes: Barhee, MDP-20, and MDP-21, under the Gujarat North West Agro-Climatic Zone (Zone-V) at the Date Palm Research Station, Mundra-Kachchh. The research was conducted over three years, with periodic observations of fruit drop at different growth stages. The results reveal that the highest fruit drop occurs between 30-45 days after pollination, followed by the initial 0–30day period. Understanding fruit drop dynamics is crucial for development of effective management strategies, including optimized irrigation, nutrient application, and climatic interventions. This will also serve as a base information to improve fruit retention and ultimately enhancing date palm productivity and economic returns for farmers.

Keywords: Date palm, fruit drop, fruit retention, *Phoenix dactylifera*

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is one of the most important fruit crops cultivated in arid and semi-arid regions worldwide. It plays a crucial role in the economy and food security of many countries, particularly in the Middle East, North Africa, and parts of South Asia (Khan *et al.*, 2022). The fruit is highly valued for its nutritional content, being rich in carbohydrates, fibre, and essential minerals. Due to its high adaptability to harsh climatic conditions and saline soils, date palm cultivation has been expanding to new regions. In India, particularly in Gujarat, date palm cultivation has gained prominence, with Kachchh being a major production hub (Muralidharan *et al.*, 2022; Baidiyavadra *et al.*, 2019). Unlike other parts of the world, In India the focus is one the cultivation of fresh dates (Khalal stage) rather than ripened stage (tamar stage) due to climatic compulsions (Sharma *et al.*, 2019, 2022).

Fruit drop in date palm occurs at different growth stages and is influenced by a combination of genetic, environmental, and physiological factors. It can be categorized into post-pollination drop, pre-maturity drop, and maturity drop, each linked to specific physiological mechanisms such as fertilization failure, environmental stress, nutrient deficiency, and hormonal imbalances (Khan *et al.*, 2022). Studies have shown that fruit drop rates vary among cultivars and environmental conditions, necessitating region-specific studies to develop mitigation strategies (Abbas *et al.*, 2000). While natural fruit drop is a physiological process, excessive loss of fruits can adversely impact economic returns for growers. Various factors, including genetic characteristics, environmental conditions, and cultural practices, influence fruit drop. The timing and intensity of fruit drop vary among cultivars, making it essential to study their specific patterns. By understanding the fruit drop dynamics in different cultivars, farmers can optimize their management practices and enhance productivity. The maturity of the fruits are also genotype specific and may need different heat units (Sharma *et al.*, 2022), and similarly the fruit drop pattern may vary from genotype to genotype. Moreover, the fruit drop may be influenced by the environment, a local study of the fruit drop is needful. Understanding the patterns of fruit drop in this agroclimatic zone will aid in developing region-specific management strategies to enhance fruit retention and improve overall yield.

MATERIAL AND METHODS

The experiment was conducted at the Date Palm Research Station, Mundra-Kachchh, which falls under the Gujarat North West Agro-Climatic Zone (Zone-V). The study involved three date palm cultivars, namely Barhee, MDP-20, and MDP-21, planted under similar agronomic conditions in the year 2012. This region is characterized by extreme climatic conditions, including high temperatures, low rainfall, and arid soils. The location is ideal for date palm research as it closely resembles the natural habitat of the species. Furthermore, Kachchh is a leading producer of date palm in India, making it a critical area for studying factors affecting productivity (Muralidharan *et al.*, 2022). The experiment was done using Randomized Block Design (RBD) with each genotype serving as a separate treatment during 2020-2022. Each treatment had eight replications, with one bunch per replication selected from different plants to ensure variability in the data. Random five strands were tagged per bunch at the time of pollination which were used for observations on number of fruits.

Observations for the number of flowers per strand were recorded at the time of pollination (0 days). From the 30th day onwards, the number of retained fruits per bunch was recorded at intervals of every 15 days. The fruit count data collection continued until 105 days after pollination. Fruit drop percentage was calculated based on the initial flower count and subsequent fruit counts at each recorded interval using the following formula.

$$\text{Fruit drop percentage} = \frac{(\text{Number of fruits at T1 day} - \text{Number of fruits at T2 days}) \times 100}{\text{Number of fruits at 0 days}}$$

Standard agronomic practices, including pruning of dry leaves, dethorning, pollination, inflorescence covering, and tying of bunches, were followed uniformly for all plants under study. Drip irrigation was installed, with an average of 300 litres of water applied per palm per day to maintain optimal moisture levels.

The collected data were subjected to statistical analysis using ANOVA, and the means were compared using the critical difference (CD) at a 5% significance level to determine the statistical significance of fruit drop variations among cultivars. The visualization is made using R programming with ggplot package.

RESULTS AND DISCUSSION

The study revealed distinct fruit drop patterns in the three date palm genotypes (Barhee, MDP-20 and MDP-21) over a period of 105 days after pollination (Figure

1). The data, collected over three consecutive years, showed a progressive decline in the number of fruits per strand, with the most decline in the initial 45 days after pollination followed by a partial stability. This early phase of fruit drop was the most critical period, aligning with previous finding due to fertilization failure, resource competition and environmental stress (Shalom *et al.*, 2024; Khan *et al.*, 2022).The stabilization of fruit count after 75 DAP suggests that the remaining fruits have a higher likelihood of reaching maturity.

Among the genotypes, Barhee exhibited the highest initial fruit count per strand but experienced a steep decline between 0–45 DAP, followed by a slower fruit drop rate in the later stages. The pooled data for Barhee closely followed individual year-wise trends, indicating a consistently high fruit drop rate in the early phase. This is consistent with studies suggesting that genotypic factors contribute significantly to fruit retention (Khan *et al.*, 2022). In contrast, MDP-20 had a lower initial fruit count and a gradual fruit drop over time, with a notable decline around 30–60 DAP. The greater variation in fruit drop across years for this genotype suggests a strong influence of environmental conditions, such as temperature fluctuations, irrigation levels, and nutrient availability (Abbas *et al.*, 2000; Saengpook *et al.*, 2007).

The percentage fruit drop among the different genotypes is presented in Table 1, while the comparative analysis of fruit drop in different duration is presented in Table 2. The highest fruit drop was observed in the early growth stages, particularly between 0–30 days after pollination (DAP) and 30–45 DAP, confirming that the initial fruit development phase is the most vulnerable to fruit shedding. Among the genotypes, MDP-20 exhibited the highest fruit drop in the first 30 days (21.33%), while MDP-21 had the highest drop between 30–45 DAP (25.60%), suggesting that these two genotypes experience greater fruit loss in the critical early stage. Barhee, in contrast, showed a more gradual decline, indicating relatively better early-stage fruit retention.

As fruit development progressed, the mid-stage fruit drop (45–75 DAP) showed a declining trend, with MDP-20 still exhibiting a relatively high drop rate (20.65% between 45–60 DAP), whereas Barhee and MDP-21 showed moderate declines (15.59% and 18.57%, respectively). The gradual stabilization of fruit retention after 45 DAP aligns with findings in previous studies, which indicate that nutrient availability, environmental conditions, and irrigation management significantly influence mid-stage fruit abscission (Khan *et al.*, 2022). The lower fruit drop observed during this period suggests that improved carbohydrate allocation and stronger pedicel attachment might contribute to fruit retention.

In the late-stage fruit drop (75–105 DAP), the rate of fruit drop decreased further across all genotypes, with Barhee and MDP-21 exhibiting the lowest fruit drop percentages (≤5%), while MDP-20 still experienced slightly higher losses (9.99% between 90–105 DAP). This suggests that MDP-20 may have a weaker fruit retention capacity in the later growth stages, potentially due to physiological limitations or environmental factors such as temperature fluctuations and water stress (Saengpook *et al.*, 2007; Hagemann *et al.*, 2014). The stabilization of fruit count after 75 DAP supports the hypothesis that retained fruits have a higher likelihood of reaching full maturity.

The similarity in pooled and yearly data suggests that fruit drop in this genotype follows a relatively predictable trend, reinforcing previous observations that fruit drop patterns are genotype-dependent (Lordan *et al.*, 2021).The total fruit drop percentage across all stages was highest in MDP-20 (55.58%), followed by MDP-21 (48.69%) and Barhee (47.92%), with a pooled mean fruit drop of 50.74%. These values confirm that approximately half of the total fruit set is lost due to natural abscission, reinforcing the need for strategic interventions to enhance fruit retention.

The findings suggest that targeted management strategies should focus on minimizing fruit drop during the first 45 days after pollination, as this is the most critical period for fruit retention. Nutrient management, particularly potassium (K) and urea applications, has been shown to significantly reduce fruit drop in date palms (Khan *et al.*, 2022). Additionally, optimized irrigation management during the early fruit development stage may help reduce fruit abscission, as water stress is a known trigger for increased ethylene production, which accelerates fruit shedding (Shalom *et al.*, 2024). Furthermore, the application of auxins such as 2,4-D has been reported to delay fruit drop by inhibiting abscission zone formation, making it a potential strategy for improving fruit retention in date palms (Shalom *et al.*, 2024).

Based on the results the fruit drop in date palm follows three distinct phases: early fruit drop (0–45 DAP), mid-stage fruit drop (45–75 DAP), and late-stage fruit drop (75–105 DAP).The early phase is the most critical, with the highest fruit loss which might be due to fertilization failure, resource competition, and hormonal imbalances. In the mid-stage, fruit drop declines and it might be influenced by nutrient uptake, irrigation efficiency, and hormonal balance. The late-stage drop stabilizes and the retained fruits are likely to reach maturity.

Understanding these patterns allows for targeted interventions such as optimizing irrigation, foliar nutrient application, and shading techniques to minimize fruit drop losses. Future studies should focus on identifying physiological markers for early detection of fruit drop-prone bunches, allowing for timely interventions and improved yield stability.

CONCLUSION

This study confirms that fruit drop in date palm is a significant challenge, with around 50% fruit loss occurring during the fruiting period. The highest fruit drop was recorded between 30-45 days after pollination, followed by 0-30 days and 45-60 days. The findings highlight genotypic variations in fruit drop trends, with MDP-20 experiencing higher losses, particularly in the early and mid-stages. These variations indicate the importance of customized agronomic practices based on genotype-specific responses. Future research should focus on climatic correlations with fruit drop patterns, allowing for the development of predictive models and adaptive management strategies to improve date palm productivity.

CONFLICT OF INTEREST STATEMENT

The author declare that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES:

Abbas, M. F., Abbas, M. J., and Abdel-Basit, O. I. 2000. Indole-3-acetic acid concentration during fruit development in date palm (*Phoenix dactylifera* L. cv. Hillawi). *Fruits*, **55**: 115–118.

Baidiyavadra, D. A, Muralidharan, C. M. and Sharma, K. M. 2019. Fresh date production in Kachchh (India): Challenges and future prospects. *Medicinal plants*, **11**(3): 218-227.

Hagemann, M. H., Roemer, M. G., Kofler, J., Hegele, M., and Wünsche, J. N. 2014. A new approach for analyzing and interpreting data on fruit drop in mango. *HortScience*, **49**(12): 1498-1505. https://doi.org/10.21273/HORTSCI.49.12.1498

Khan, S. U., Alizai, A. A., Ahmed, N., Sayed, S., Junaid, M., Kanwal, M., Ahmed, S., Alqubaie, A. I., Alamer, K.

H. and Ali, E. F. 2022. Investigating the role of potassium and urea to control fruit drop and to improve fruit quality of Dhakki date palm. *Saudi Journal of Biological Sciences*, **29** (12): 3806–3814. https://doi.org/10.1016/j.sjbs.2022.02.060

Lordan, J., Zazurca, L., Rovira, M., Torguet, L., Batlle, I., DeJong, T., and Miarnau, X. 2021. Almond fruit drop patterns under Mediterranean conditions. *Agriculture*, **11**: 544. https://doi.org/10.3390/agriculture11060544

Muralidharan, C. M., Sharma, K. M. and Baidiyavadra, D. A. 2022. Date palm cultivation in India: research achievements, gaps and future strategies. In: Technical Bulletin 02/2022, Date Palm Research Station, Sardarkrushinagar Dantiwada Agricultural University, Mundra-Kachchh, Gujarat, India. pp. 1-31. https://doi.org/10.13140/RG.2.2.26248.49920

Saengpook, C., Ketsa, S. and van Doorn, W. G. 2007. Effects of relative humidity on banana fruit drop. *Postharvest Biology and Technology*, **45**(1): 151–154. https://doi.org/10.1016/j.postharvbio.2007.02.004

Shalom, M.I., Sadowsky, A., Tikochinsky, T., Ostrovsky, Y., Adler-Agmon, M. and Cohen Y. 2024. Effects of ethrel and auxin applications on date palm fruit abscission during development. *Scientia Horticulturae*, **326**: 112755. https://doi.org/10.1016/j.scienta.2023.112755

Sharma, K. M., Muralidharan, C. M. and Baidiyavadra, D. A. 2022. A comparative study of maturity indices (heat unit) for indigenous and exotic date palm germplasm at Kachchh-India. *International Journal of Minor Fruits, Medicinal and Aromatic Plants*, **8**(1): 27-29.

Sharma, K. M., Muralidharan, C. M., Baidiyavadra, D. A., Panchal, C. N. and Verma, P. 2019. Varietal evaluation of date palm (*Phoenix dactylifera* L.) in Kachchh, India. *Journal of Plantation Crops*, **47**(3): 152-157.

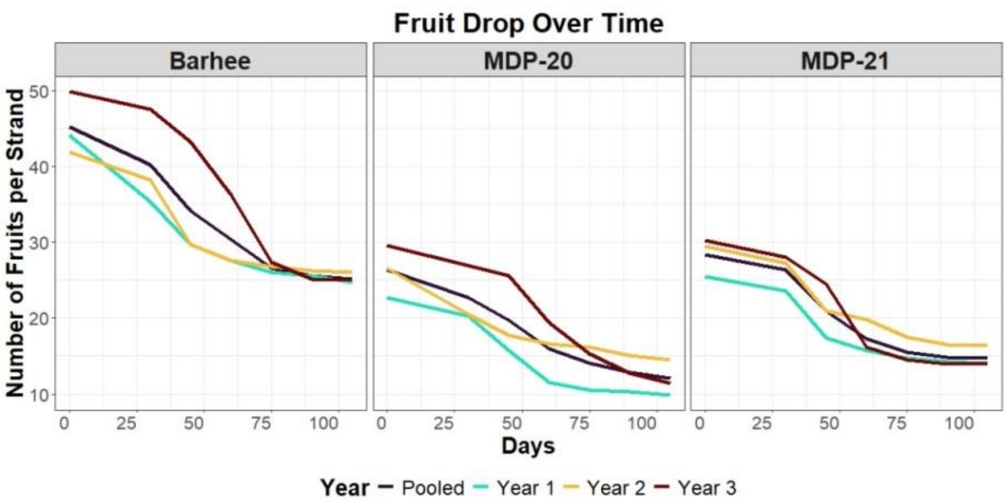

Figure 1: Fruit drop in date palm over time

Table 1: Fruit drop percentage in date palm (pooled for three years)

Genotype	Fruit drop percentage between the days (pooled for three years)*					
	0th to 30th day	30th to 45th day	45th to 60th day	60th to 75th day	75th to 90th day	90th to 105th day
Barhee	18.57 (11.14)	21.21 (13.86)	15.59 (7.98)	13.44 (7.81)	12.35 (6.05)	4.88 (1.08)
MDP-20	21.33 (14.16)	18.90 (11.67)	20.65 (14.51)	12.82 (6.41)	11.42 (5.27)	9.99 (3.56)
MDP-21	14.72 (7.21)	25.60 (19.27)	18.57 (12.22)	12.71 (5.94)	8.01 (2.94)	4.82 (1.12)
Mean	18.21 (10.84)	21.91 (14.94)	18.27 (11.57)	12.99 (6.72)	10.59 (4.75)	6.56 (1.92)
SEm ±	0.89	0.81	1.20	1.53	1.03	0.67
C.D. @ 5 %	2.52	2.29	3.41	NS	2.92	1.91
C.V. %	23.81	17.97	32.03	57.38	47.32	50.04

* Value are arc-sin transformed, value in parenthesis are original value

Table 2: Fruit drop percentage distribution in different date palm genotypes (pooled for three years)

Days	Fruit drop percentage (pooled for three years)*			
	Barhee	MDP-20	MDP-21	Mean
0th to 30th day	18.57 (11.14)	21.33 (14.16)	14.72 (7.21)	18.96 (10.84)
30th to 45th day	21.21 (13.86)	18.90 (11.67)	25.60 (19.27)	22.31 (14.94)
45th to 60th day	15.59 (7.98)	20.65 (14.51)	18.57 (12.22)	18.95 (11.57)
60th to 75th day	13.44 (7.81)	12.65 (6.42)	12.70 (5.94)	14.08 (6.72)
75th to 90th day	12.35 (6.05)	12.81 (5.26)	8.01 (2.93)	11.93 (4.75)
90th to 105th day	4.88 (1.08)	11.41 (3.56)	4.82 (1.12)	7.46 (1.92)
Mean	14.34 (7.99)	15.85 (9.26)	14.07 (8.12)	15.62 (8.46)
Total fruit drop (%)	(47.92)	(55.58)	(48.69)	(50.74)
SEm ±	1.04	1.15	1.08	0.58
C.D. @ 5 %	2.95	3.25	3.06	1.65
C.V. %	35.99	35.83	38.06	18.52

* Value are arc-sin transformed, value in parenthesis are original value