*Plant Archives* Vol. 26, No. 1, 2026 pp. 1877-1882 e-ISSN:2581-6063 (online), ISSN:0972-5210

# Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.1.282

# POPULATION FLUCTUATIONS OF MAJOR PESTS OF POMEGRANATE IN RELATION WITH WEATHER PARAMETERS

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(Date of Receiving-12-02-2026; Date of Revision-28-03-2026; Date of Acceptance-17-04-2026)

**ABSTRACT**

The present study was undertaken to explain the population dynamics of major insect pests infesting pomegranate under field conditions during *Hast bahar* season of 2022–23 at the Research Farm, Department of Horticulture, Vasantrao Naik Marathwada Krushi Vidyapeeth (VNMKV), Parbhani, Maharashtra. Systematic observations were recorded at weekly intervals to assess the seasonal incidence and peak activity of key insect pests affecting pomegranate productivity. The major pests monitored included aphids (*Aphis* spp.), thrips (*Scirtothrips dorsalis*) and fruit borer (*Deudorix isocrates*). The results revealed distinct temporal variations in pest populations during the cropping season. Aphid infestation reached its maximum level during the 6th Standard Meteorological Week (SMW), with an average population of 4.98 aphids per 10 cm twig. Thrips population exhibited a pronounced peak during the 52nd SMW, recording a maximum mean density of 20.52 thrips per 10 cm twig. Among the fruit-damaging pests, fruit borer infestation was most severe during the 8$^{th}$ SMW, with the highest fruit damage of 17.35 per cent observed. The study highlights that pest incidence in pomegranate is strongly influenced by seasonal fluctuations, emphasizing the importance of timely monitoring. Identification of peak infestation periods provides a scientific basis for developing need-based and eco-friendly pest management strategies. These findings can assist in optimizing integrated pest management (IPM) practices for sustainable pomegranate cultivation in the Marathwada region.

***Key words :*** Population dynamics, *Helicoverpa armigera*, Gram pod borer, Abiotic factors or Weather parameters.

## Introduction

Pomegranate (*Punica granatum* L.) is a commercially significant fruit crop cultivated predominantly in arid and semi-arid regions due to its tolerance to drought, high nutritional value, medicinal properties, and growing export demand. India ranks among the leading producers of pomegranate, with extensive cultivation in states such as Maharashtra, Karnataka, Gujarat, Andhra Pradesh and Tamil Nadu. The practice of bahar regulation, namely ambe, mrig and hasta bahar, ensures staggered crop phenology which in turn creates year-round host availability and strongly influences the temporal distribution and buildup of insect pest populations (Sharma and Singh, 2011; Patil *et al*., 2016).

Although, pomegranate is considered a hardy crop, it is vulnerable to attack by a diverse complex of insect pests at different growth stages, from nursery to harvest. More than ninety insect species have been documented infesting pomegranate in India, among which sucking pests and fruit borers are of major economic concern. The severity and seasonal occurrence of these pests are governed by crop growth stages, prevailing climatic conditions and orchard management practices highlighting the importance of population dynamics studies for devising effective pest management strategies (Butani, 1979; Balikai *et al*., 2011).

Pomegranate (*Punica granatum* L.) is an economically important fruit crop, whose productivity and fruit quality are severely constrained by the incidence of insect pests. Among the sucking pests, the pomegranate aphid, *Aphis punicae* Passerini, is highly destructive during periods of active vegetative growth, causing leaf curling, chlorosis and reduced plant vigor in addition to promoting sooty mould through honeydew secretion. Aphid populations exhibit distinct seasonal fluctuations often coinciding with new flushes under favorable temperature and humidity regimes. Thrips, particularly *Scirtothrips dorsalis* Hood, constitute another major pest complex, inflicting damage to leaves, flowers and fruits, resulting in flower drop and fruit scarring. Their population dynamics are strongly influenced by temperature, relative humidity and rainfall. Fruit borers including *Virachola isocrates* and *Ectomyelois ceratoniae* cause direct damage to developing fruits leading to internal feeding, fruit rot and significant yield losses. The seasonal incidence of these pests is closely synchronized with crop phenology and prevailing weather conditions emphasizing the importance of weather-based pest monitoring for effective management.

Numerous studies on seasonal incidence and population fluctuations have established that abiotic factors such as temperature, relative humidity, rainfall and sunshine hours play a decisive role in regulating insect pest populations in pomegranate ecosystems. Correlation and regression analyses from field investigations suggest that temperature and humidity are the most influential variables affecting the abundance of aphids, thrips and fruit borers. A clear understanding of these relationships is crucial for developing pest forecasting models and implementing timely integrated pest management strategies (Dhawan *et al*., 2014; Patel *et al*., 2020).

Consequently, detailed knowledge of the seasonal incidence and population dynamics of major insect pests of pomegranate is essential for the formulation of efficient environmentally sound pest management approaches. Such information facilitates precise timing of monitoring and control interventions and minimizes indiscriminate pesticide use and promotes the adoption of integrated pest management practices tailored to specific agro-climatic regions and bahar seasons (Balikai and Prasanna, 2017).

## Materials and Methods

The present investigation was undertaken to study the seasonal incidence and population dynamics of major insect pests of pomegranate at the Research Farm of the Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, during the hasta bahar season of 2022–23. The study focused on assessing the seasonal abundance of major insect pests of pomegranate in relation to prevailing weather parameters. The population dynamics of aphids, thrips, fruit borer were recorded throughout the hasta bahar season of 2022–23.

### Method of observation

For recording pest populations, four pomegranate plants were randomly selected from two rows in the experimental field. From each selected plant, four twigs of 10 cm length were chosen, each representing one of the four cardinal directions (East, West, North and South). Observations on the incidence of major insect pests and their natural enemies were recorded twice weekly under field conditions.

### Relationship between weather parameters and insect pests

The data generated on the population dynamics of major insect pests were statistically analyzed to determine their relationship with different weather parameters. Correlation analysis was employed to evaluate the influence of meteorological factors on the incidence and fluctuation of major insect pest populations in pomegranate.

## Results and Discussion

The findings revealed from the present investigation as well as relevant discussion have been summarized under the following matter.

Studies were conducted to evaluate the seasonal abundance of major insect pests of pomegranate in relation to weather parameters at the Experimental Farm of the Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Observations on the incidence of major sucking pests, namely aphids, thrips along with fruit borer infestation were recorded on pomegranate during the hasta bahar season of 2022–2023. The findings generated from these observations reveals distinct seasonal trends and pest–weather relationships which are presented below to facilitate further interpretation and to formulate appropriate pest management strategies.

### Seasonal abundance of Sucking Pests and their Relationship with Weather parameters

Weekly observations on sucking pests of pomegranate were recorded from pruning to fruit maturity and harvest during the hasta bahar season of 2022–23 at Parbhani, Maharashtra. Population dynamics studies revealed that aphids and thrips were the predominant sucking pests, with their incidence initiating in September 2022 and persisting up to March 2023, affecting different phenological stages of the crop.

### Aphids

Aphid population initiated after pruning during the

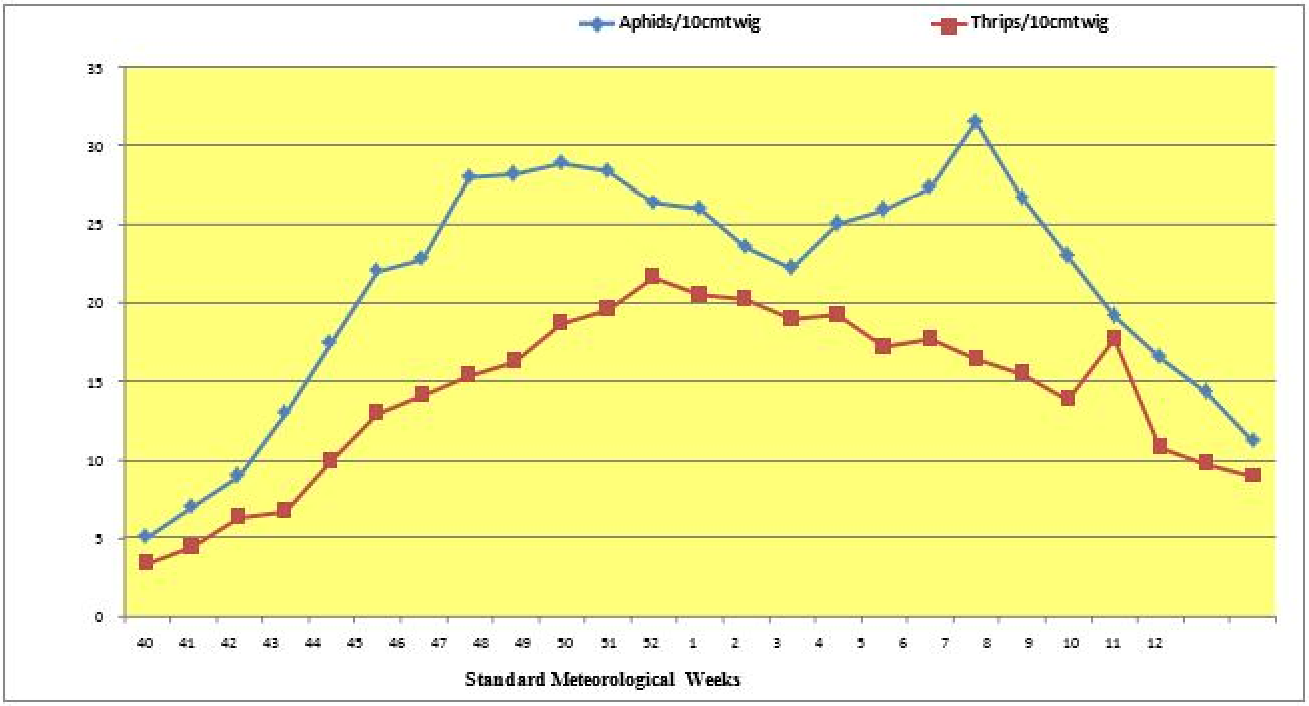


**Fig. 1 :** Seasonal incidence of sucking pest during meteorological weeks.

40th Standard Meteorological Week (SMW) with a mean density of 4.98 aphids per 10 cm twig. The population gradually increased and reached its peak during the 6th SMW of 2023, recording 31.53 aphids per 10 cm twig. The peak infestation coincided with prevailing weather conditions of 33°C maximum temperature, 10°C minimum temperature, 77% morning relative humidity, 16% evening relative humidity, no rainfall, 5.8 mm evaporation, 9.7 hours of bright sunshine and wind speed of 2.4 km $h^{-1}$. Thereafter aphid populations declined steadily until the end of the hasta bahar season.

Correlation analysis revealed that aphid population exhibited a significant negative correlation with rainfall (r = –0.560), minimum temperature (r = –0.760) and evening relative humidity (r = –0.497), while a significant positive correlation was observed with wind speed (r = 0.405).

The present findings are in close agreement with earlier reports which documented peak aphid activity during similar SMWs and highlighted the influence of temperature, humidity, rainfall, evaporation and sunshine hours on aphid incidence. Thus, the results confirm that weather parameters play a crucial role in regulating aphid population dynamics in pomegranate providing a scientific basis for forecasting pest incidence and developing timely management. The present findings are similar to this results that previously reported. This specific pest of pomegranate was also recorded by Butani (1976) in India and Balikai (2000) from Northern Karnataka. The maximum incidence of aphids on pomegranate was observed during third week of Feb and March in Tamil Nadu (Karuppunchamy *et al.*, 1998). Sreedevi and Verghese (2007) found that, aphid population started building up in December on pomegranate at Bangalore which slowly increased and recorded 43.01 and 100.76 aphids per shoot during January and February, respectively. The population declined by second fortnight of March. Moreover, Ananda (2009) suggested that the aphid population on pomegranate initiated at 48 MW and raised slowly upto 52 MW and steadily upto 6 MW and maximum at about 8 MW.

## Thrips

Thrips infestation initiated after pruning during the 40th Standard Meteorological Week (SMW) with a mean population of 3.38 thrips per 10 cm twig and persisted until the end of the season. Following initial appearance, the thrips population gradually increased and attained its peak during the 52nd SMW, recording 20.52 thrips per 10 cm twig. The peak incidence coincided with prevailing weather conditions of 31.6°C maximum temperature, 14.2°C minimum temperature, 88% morning relative humidity, 36.3% evening relative humidity, zero rainfall, 3.2 mm evaporation, 8.2 hours of bright sunshine and wind speed of 1.8 km $h^{-1}$. Thereafter, the population declined over the subsequent weeks and continued to decrease until the end of the hasta bahar season.

**Table 1 :** Seasonal incidence of sucking pests and borer pests of pomegranate and its correlation with weather parameters during *hast bahar* 2022-2023.

| Date and Month | SMW | Abiotic factors | | | | | | | | Sucking pest | | Borer pest |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Rainfall (mm) | Max Temp. ($^0$C) | Min. Temp. ($^0$C) | Morning Relative Humidity (%) | Evening Relative Humidity (%) | EVP | BSS | WS | Aphids/ 10 cm twig | Thrips/ 10 cm twig | Fruit borer (% fruit infested) |
| 01-07OCT | 40 | 11 | 31.8 | 21.4 | 88 | 56 | 4.5 | 6.7 | 4.3 | 4.98 | 3.38 | 0 |
| 08-14OCT | 41 | 57.1 | 31 | 22.1 | 91 | 64 | 3.4 | 6.3 | 2.7 | 6.93 | 4.4 | 0 |
| 15-21OCT | 42 | 87.8 | 30.3 | 21.6 | 91 | 62 | 2.5 | 6.3 | 3.5 | 8.88 | 6.23 | 0 |
| 22-28OCT | 43 | 0 | 30.7 | 14.2 | 86 | 26 | 4.3 | 8.2 | 3.1 | 12.93 | 6.65 | 0 |
| 29-04NOV | 44 | 0 | 30.7 | 12.9 | 86 | 28 | 4.3 | 8.9 | 3 | 17.4 | 9.88 | 0 |
| 05-11NOV | 45 | 0 | 31.5 | 12.6 | 83 | 25 | 4.6 | 8.9 | 2.7 | 21.98 | 12.9 | 0 |
| 12-18NOV | 46 | 0 | 30.4 | 12.2 | 86 | 28 | 4.4 | 8.3 | 2.8 | 22.75 | 14.05 | 0 |
| 19-25NOV | 47 | 0 | 29.3 | 11.4 | 80 | 26 | 4.3 | 8.4 | 2.8 | 27.98 | 15.34 | 0 |
| 26-02NOV | 48 | 0 | 30.1 | 11.4 | 86 | 32 | 3.8 | 8.1 | 2.1 | 28.15 | 16.23 | 0.46 |
| 03-09DEC | 49 | 0 | 29.7 | 13.8 | 87.7 | 34.7 | 3.5 | 5.5 | 2.5 | 28.88 | 18.63 | 0.91 |
| 10-16DEC | 50 | 1.2 | 29.9 | 17.4 | 84.9 | 46.6 | 3.5 | 5.2 | 3.9 | 28.38 | 19.5 | 1.46 |
| 17-23DEC | 51 | 0 | 30.6 | 12.1 | 88.7 | 26.7 | 3.6 | 8.6 | 1.9 | 26.38 | 21.6 | 1.73 |
| 42-31DEC | 52 | 0 | 31.6 | 14.2 | 88.8 | 36.3 | 3.2 | 8.2 | 1.8 | 25.98 | **20.52** | 2.25 |
| 01-07JAN | 1 | 0 | 28.8 | 14.5 | 91 | 44 | 3 | 4.1 | 3.4 | 23.5 | 20.25 | 3.49 |
| 08-14JAN | 2 | 0 | 28.7 | 8 | 88 | 26 | 4.1 | 8.5 | 2.1 | 22.2 | 18.9 | 5.63 |
| 15-21JAN | 3 | 0 | 31.2 | 12.2 | 86 | 28 | 3.7 | 8.3 | 2.3 | 24.95 | 19.18 | 8.56 |
| 22-28JAN | 4 | 0 | 30.7 | 13.1 | 84 | 31 | 4.4 | 8.4 | 3.2 | 25.88 | 17.15 | 10.87 |
| 29-04FEB | 5 | 0 | 30.4 | 12.3 | 79 | 22 | 5.7 | 8.1 | 4.2 | 27.32 | 17.65 | 11.12 |
| 05-11FEB | 6 | 0 | 33.3 | 10 | 77 | 16 | 5.8 | 9.7 | 2.4 | **31.53** | 16.4 | 13.81 |
| 12-18FEB | 7 | 0 | 33.2 | 10.3 | 64 | 13 | 7 | 10 | 3.7 | 26.63 | 15.38 | 15.68 |
| 19-25FEB | 8 | 0 | 35 | 11.3 | 68 | 13 | 13.7 | 9.7 | 2.2 | 22.95 | 13.78 | **17.35** |
| 26-04MAR | 9 | 0 | 30.9 | 12.6 | 56 | 14 | 5.5 | 7.6 | 2.4 | 19.13 | 17.63 | 13.58 |
| 05-11MAR | 10 | 0 | 33.4 | 15.9 | 65 | 21 | 6.4 | 7.2 | 3.4 | 16.53 | 10.75 | 12.65 |
| 12-18MAR | 11 | 2.2 | 33.4 | 17.1 | 65 | 28 | 6.3 | 6.5 | 4.2 | 14.28 | 9.65 | 10.12 |
| 19-25MAR | 12 | 0 | 33.2 | 16.3 | 67 | 24 | 6.3 | 9.4 | 3.7 | 11.17 | 8.86 | 8.43 |
| Coefficient of correlation for population and Rainfall | | | | | | | | | | **-0.560*** | **-0.526*** | -0.290 |
| Coefficient of correlation for population and max temperature | | | | | | | | | | -0.189 | -0.322 | **0.651*** |
| Coefficient of correlation for population and min temperature | | | | | | | | | | **-0.760*** | **-0.671*** | -0.355 |
| Coefficient of correlation for population and morning relative humidity | | | | | | | | | | 0.014 | 0.048 | **-0.781*** |
| Coefficient of correlation for population and evening relative humidity | | | | | | | | | | **-0.497*** | -0.388 | **-0.649*** |
| Coefficient of correlation for population and EVP | | | | | | | | | | 0.034 | -0.097 | **0.721*** |
| Coefficient of correlation for population and BSS | | | | | | | | | | 0.214 | 0.031 | 0.395 |
| Coefficient of correlation for population and WS | | | | | | | | | | **0.405*** | **-0.456*** | 0.086 |

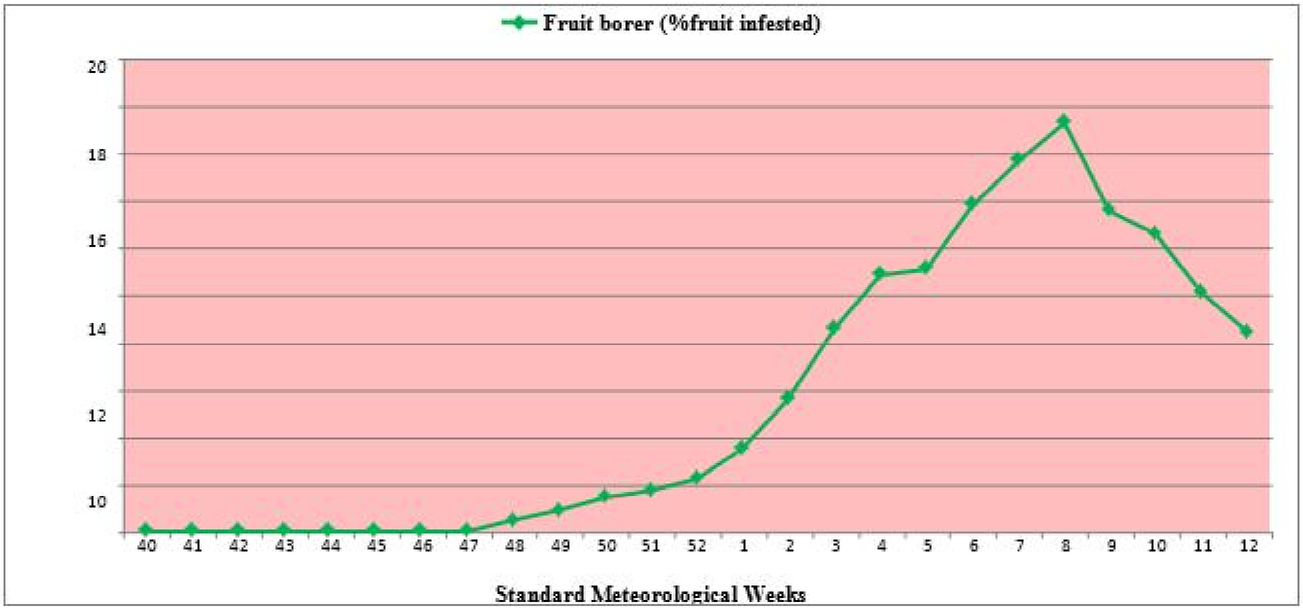


**Fig. 2 :** Seasonal incidence borer pest during meteorological weeks.

Correlation analysis between thrips population and weather parameters revealed a significant negative correlation with rainfall (r = –0.526) and minimum temperature (r = –0.671). Wind speed exhibited a non-significant negative correlation (r = –0.456). Maximum temperature (r = –0.322), evening relative humidity (r = –0.388) and evaporation (r = –0.097) also showed non-significant negative associations. In contrast, morning relative humidity (r = –0.048) and bright sunshine hours (r = 0.031) exhibited non-significant positive correlations with thrips incidence.

The present findings corroborate earlier studies reporting peak thrips incidence during similar SMWs and highlighting the regulatory influence of temperature, humidity, rainfall, evaporation, wind velocity, and sunshine hours on thrips population dynamics. These results emphasize the critical role of abiotic factors in determining thrips abundance on pomegranate and provide a basis for forecasting pest outbreaks and implementing timely management strategies. The similar results were also reported by Balikai (2000) from Northern Karnataka, which corroborate with the present findings. The incidence of thrips on grapes was observed during June to Sept (Shibao, 1990) on mango during Mar to April and Sept to Oct (Kumar *et al.*, 1995). Whereas Bagale (1993) observed that maximum population of pomegranate thrips during June to August.

**Fruit Borer**

Fruit borer infestation initiated during the 48th Standard Meteorological Week (SMW), coinciding with flowering and early fruiting stages, with a mean infestation of 0.46% fruits infested and persisted until harvest. Following initiation, infestation levels gradually increased and reached a peak during the 8th SMW of 2023, recording 17.35% fruit infestation. Peak incidence coincided with weather conditions of 35°C maximum temperature, 11.3°C minimum temperature, 68% morning relative humidity, 13% evening relative humidity, no rainfall, 13.7 mm evaporation, 9.7 hours of bright sunshine, and wind speed of 2.2 km $h^{-1}$. Thereafter, fruit borer infestation declined steadily toward the end of the season.

Correlation analysis revealed that fruit borer infestation exhibited a significant positive correlation with maximum temperature (r = 0.651) and evaporation (r = 0.721), while a significant negative correlation was observed with morning relative humidity (r = –0.781) and evening relative humidity (r = –0.649). The present findings are broadly consistent with earlier studies, which reported significant associations between fruit borer incidence and temperature, humidity, rainfall, evaporation and sunshine hours, confirming the strong influence of abiotic factors on seasonal fruit borer population dynamics in pomegranate.

## Conclusion

The present study on the seasonal abundance of major insect pests and their natural enemies on pomegranate during the hasta bahar season of 2022–23 revealed distinct population trends in relation to prevailing weather parameters. Among the major pests, aphids, thrips and fruit borer exhibited well-defined peak periods influenced by specific abiotic factors. Aphid population reached its first peak during the 6th SMW of 2023 and showed a significant negative association with minimum temperature, evening relative humidity and rainfall, while a significant positive correlation with wind speed was observed. Thrips population attained its maximum during the 52nd SMW, exhibiting a significant negative correlation with minimum temperature and rainfall, along with a significant positive association with wind speed. Fruit borer infestation peaked during the 8th SMW of 2023 and was negatively correlated with morning and evening relative humidity, whereas maximum temperature and evaporation showed significant positive correlations. Overall, the findings clearly indicate that weather parameters play a crucial role in regulating the seasonal incidence of major insect pests of pomegranate. The synchronization of pest peaks with specific climatic conditions highlights the potential for weather-based pest forecasting.

**Suggestion for further study**

Further studies on the population fluctuation of major insect pests of pomegranate, particularly aphids, thrips, and fruit borer, should be undertaken to determine their stage-wise incidence, including nymphal and larval instars. Such detailed investigations would help in identifying the most vulnerable developmental stages of pests, thereby facilitating early and precise management interventions before crossing the Economic Threshold Level (ETL). Further research should also focus on the role of pomegranate varietal characteristics such as fruit rind thickness, calyx structure, leaf toughness and biochemical constituents in conferring resistance or tolerance to insect pests. Understanding these varietal traits would aid in identifying or developing pest-resistant in crops, thereby reducing use of chemical pesticides.

## Acknowledgement

We extend our heartfelt gratitude to guide as well as dean and all individuals who generously contributed to this research endeavor and provided invaluable guidance throughout the process. Their support and expertise were instrumental in shaping the trajectory of this study. Their dedication to sharing knowledge and insights has been pivotal in making this work possible. We are deeply indebted to their assistance and mentorship.

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