

# Bioecology of Blossom Midge of Jasmine, *Contarinia maculipennis* Felt (Cecidomyiidae: Diptera) in Different *Jasminum* Cultivars

I. Merlin Kamala

## Abstract

Jasmine is a well-renowned flower around the world especially in the tropics because of its unique fragrance. *Jasminum sambac*, *Jasminum auriculatum*, *Jasminum grandiflorum*, and *Jasminum nitidum* are the four cultivable species of *Jasminum*. Blossom midge, *Contarinia maculipennis* Felt (Cecidomyiidae, Diptera), a dipteran pest, has attained the status of a major pest causing severe economic loss by reducing the marketable quality of the flowers. To compare the lifecycle of the notorious midge in all the cultivable *Jasminum* species, a detailed laboratory study was conducted at the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore, India. The observations on life cycle parameters of blossom midge, *C. maculipennis*, revealed that the life cycle consists of egg, maggot, pupa, and adult. The life cycle and duration of each stage are found to be the shortest on *J. nitidum* and the longest on *J. sambac*.

**Keywords:** *Jasminum sambac*, *Jasminum auriculatum*, *Jasminum grandiflorum*, *Jasminum nitidum*, blossom midge

## 1. Introduction

The genus *Jasminum*, belonging to Oleaceae or Olive family, contains over 200 species of vines or shrubs with opposite leaves and fragrant flowers [1]. The name “jasmine” or “jessamine” is derived from the Arabic and Persian “yasmin” or “yasaman” and originally referred to the species of Arabian jasmine (*Jasminum sambac* (L.) Ait) [2]. This plant, with its extremely fragrant flowers, is native to southern Asia, but it has been cultivated in the Middle East for centuries [3]. *Jasminum* is the generic name of shrubs and vines in the olive family (Oleaceae). Although more than 200 species are known, 40 species have been identified in India, and 20 species are cultivated in South India [4–6], of which only three species are used for commercial cultivation namely, *J. sambac* (Gundumalli/Madurai Malli), *Jasminum auriculatum* (Mullai), and *Jasminum grandiflorum* (Jathimalli/Pitchi). The angel jasmine, *Jasminum nitidum*, with sweetly fragrant, snow-white, pinwheel-shaped flowers is recently introduced for commercial cultivation in Tamil Nadu, India.

## 2. *Jasminum sambac*

*J. sambac* is an evergreen vine or shrub reaching up to 0.5–3 m (1.6–9.8 ft) tall. The plant produces flowers all throughout the year in clusters of 3–12 together at the ends of branches. They are strongly scented flowers with a white corolla. The flowers open at night (usually around 6–8 in the evening). The sweet, heady fragrance of *J. sambac* is its distinct feature (**Figure 1**). It is widely grown throughout the tropics from the Arabian Peninsula to Southeast Asia and the Pacific Islands as an ornamental plant and for its strongly scented flowers [7].



*J. sambac* plant



*J. sambac* flower



*J. sambac* flower bud

**Figure 1.**  
*Jasminum sambac*.

## 3. *Jasminum auriculatum*

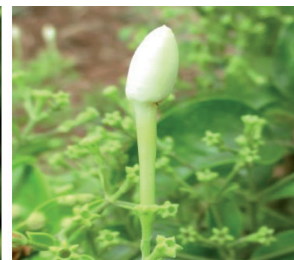
*J. auriculatum* is a species of jasmine, in the family Oleaceae. It is found in India and other Asian countries. It is cultivated commercially in India and Thailand for its commercial oil. It is used for decorative purposes in occasions and festivals in India. It is a small climbing bushy plant with simple ovate dark green small leaves and small white flowers. Leaves are opposite, sometimes hairless, simple, or trifoliate. Lateral leaflets are much smaller, rarely exceeding 4 mm in diameter, the central one up to 3.5 cm long and 1.5 cm broad, ovate, shortly pointed. Flowers are fragrant in many-flowered cymes. Flower stalks are up to 5 mm long. Flowers are white, tube 1.5 cm long, lobes elliptic, up to 8 mm long. Berry is 5 mm in diameter, globose, black (**Figure 2**) [8].



*J. auriculatum* plant



*J. auriculatum* flower



Flower bud

**Figure 2.**  
*Jasminum auriculatum*.

## 4. *Jasminum grandiflorum*

*J. grandiflorum* is also known variously as the Spanish jasmine, Royal jasmine, and Catalan jasmine. It is a stunning deciduous shrub growing to 2–4 m tall.



**Figure 3.**  
*Jasminum grandiflorum*.

The leaves are opposite, 5–12 cm long, with 5–11 leaflets in pinnate form. The flowers are produced in open cymes, and the individual flowers are white having corolla with a basal tube 13–25 mm long and five lobes 13–22 mm long. The flower's fragrance is unique and sweet. It is widely cultivated as an ornamental plant in warm temperate and subtropical regions. The Jasmine Concrete and Jasmine Oleoresin (sold as Jasmine Absolute) were extracted by solvent extraction method. Both products have a huge demand in the fragrance industry (**Figure 3**). Methyl jasmonate isolated from the jasmine oil of *J. grandiflorum* has led to the discovery of the molecular structure of the jasmonate plant hormones [9].

### 5. *Jasminum nitidum*

This twinning climber has slender stems and forms a dense habit. The dark glossy green leaves are lance shaped, and the fragrant white star-shaped flowers appear throughout summer in clusters (**Figure 4**). The angle-winged jasmine is grown for its flowers and glossy foliage. It is planted in small or large gardens for its fragrance or to grow over lattice or a pergola. It is suitable for coastal sub-tropical regions and establishes in 1–2 years. It is also used in containers and grown under glass in cold climates. Once established, it has a high-water requirement and responds to an occasional deep watering particularly during dry periods [10].

The production of jasmine is affected by various factors, among which insect pests are the most devastating factor. The major pests affecting jasmine are jasmine bud worm (*Hendecasis duplifascialis* Hampson), leaf webworm (*Nausinoe geometralis* Guenee), gallery worm (*Elasmopalpus jasminophagus* Hampson), leaf roller (*Glyphodes unionalis* Hübner), and the two spotted mite (*Tetranychus urticae* Koch). Of these, bud worm and blossom midge gain major economic importance, as they cause excessive damage to the buds, which is the economic part of the plant [11]. The midge maggots enter into the buds at the base of the corollas resulting in swelling and shrivelling at the base of the buds. The maggots feed inside unopened flower buds, causing deformed, pink discolored buds and blossoms. In case of severe infestations, buds dry prematurely leading to bud drop or blossom drop, thereby the marketable quantity of the flowers is greatly reduced [12] (**Figure 5**).

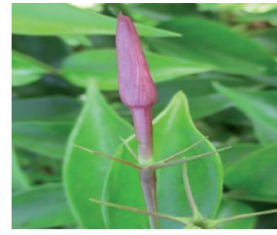
Management of this pest has become a menace for the jasmine growers. The knowledge on life history of the pest as well as the life table on different varieties is essential for developing IPM in better management of any pests. The knowledge of the sequence of developmental stages, their duration, and number of generations and method of overwintering is essential to know the 'weakest link' in the life cycle. This would help to aim control measures effectively at the most vulnerable stage of the pest. The biology of jasmine midge is attempted in the four cultivable jasmine



***J. nitidum* plant**



***J. nitidum* flower**



**Flower bud**

**Figure 4.**  
Jasminum nitidum.



**Pink discoloured buds**



**Pre-mature drying of buds**



**Adult midge**



**Shrivelled bud stalk**



**Maggot inside the shrivelled  
bud stalk**

**Figure 5.**  
Symptoms of damage of blossom midge, *Contarinia maculipennis*.

species, that is, *J. sambac*, *J. auriculatum*, *J. grandiflorum*, and *J. nitidum*. The objective of the study is to compare the different life stages of blossom midge in different *Jasminum* species.

## 6. Materials and methods

In the laboratory, 10 pairs of adult midges were introduced into the rearing cage (50 × 45 × 45 cm). A 250 ml conical flask filled with water plugged with adsorbent cotton and inserted with fresh *J. sambac* branches with flowers and buds was kept inside the cages to facilitate oviposition. The buds were checked for eggs, and the life history was studied. The lower surface of the rearing cage was filled with moist sand and planted with three-fourth mature flower buds to facilitate pupation of the maggots. The egg, maggot, pupal, and adult longevity periods were recorded. Jasmine branches with flowers were replaced daily with fresh branches.

The biology was also studied by rearing them in *J. auriculatum*, *J. grandiflorum*, and *J. nitidum* buds by placing the respective branches in the conical flask with flowers and buds (**Figure 6**).

To study the biology in different *Jasminum* species, the midges were cultured in *J. sambac*, *J. auriculatum*, *J. grandiflorum*, and *J. nitidum* placed inside Petri dishes, and the following parameters were recorded.



**Figure 6.**  
*Mass culturing of blossom midge.*

## 7. Results and discussion

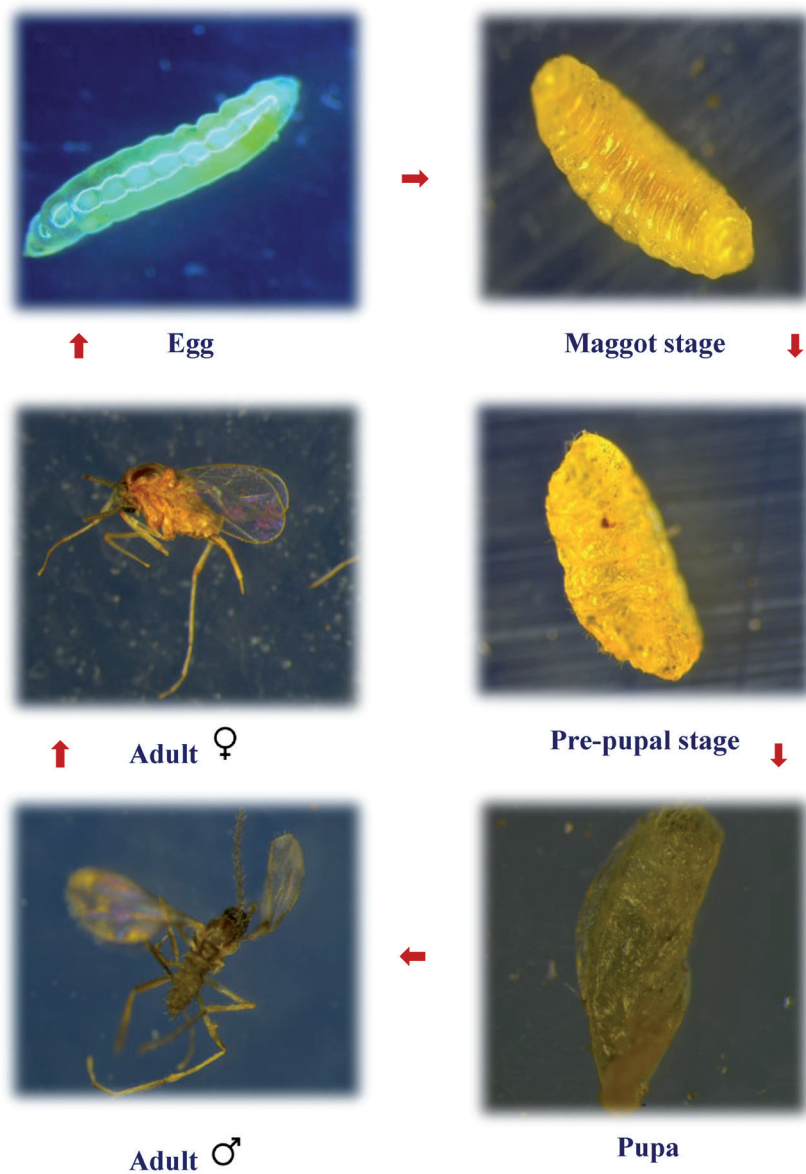
The life span of blossom midge, *C. maculipennis*, was studied on four cultivable *Jasminum* species namely, *J. sambac*, *J. auriculatum*, *J. grandiflorum*, and *J. nitidum* in the laboratory. The life cycle of blossom midge consisted of egg, larval, pupal, and adult stages (**Figure 7**). The extensive details of life stages were studied in all the four *Jasminum* sp. and furnished in **Table 1**. The different life stages were detailed in the following paragraphs.

### 7.1 Eggs

The eggs were elongated and cylindrically laid on the inner whorls of the petals in groups of 10–13 during night times. The eggs hatched in 1–2 days. The average egg period was 1.3, 1.2, 1.1, and 1.1 days in *J. sambac*, *J. auriculatum*, *J. grandiflorum*, and *J. nitidum*, respectively.

### 7.2 Maggot

The larval stages of midges are called maggots. There were totally four larval instars. The maggots were narrow with pointed anterior and posterior ends.



**Figure 7.**  
*Biology of blossom midge, Contarinia maculipennis.*

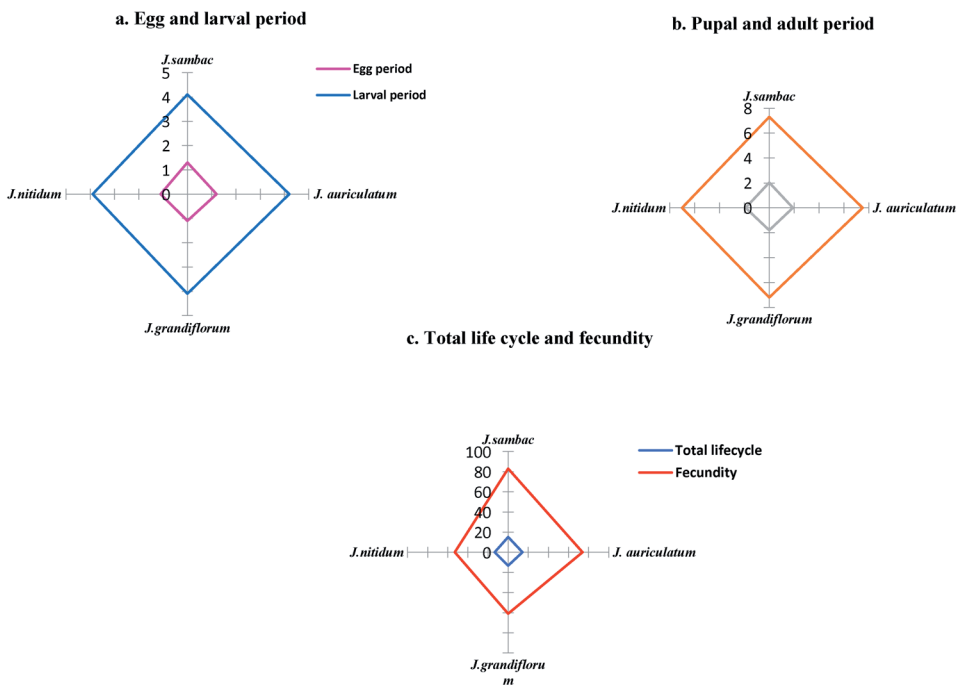
The maggots on eclosion were dull white in color and turned yellow as the development progressed. The maggots scraped the petals, stamen, and stigma and suck sap from the flower buds. The larval period lasted for 4–5 days. The average larval period observed in *J. sambac*, *J. auriculatum*, *J. grandiflorum*, and *J. nitidum* was 4.4, 4.2, 4.1, and 3.9 days, respectively.

### 7.3 Pupa

The maggots turned orangish yellow before pupation. Pupation occurred in the top superficial layer of soil in a thin white case. The pupal period lasted for 7–8 days. The average pupal period was 7.5, 7.3, 7.2, and 7.0 days in *J. sambac*, *J. auriculatum*, *J. grandiflorum*, and *J. nitidum*, respectively.

| Life stages of midge | Duration of different life stages of <i>C. maculipennis</i> in four <i>Jasminum</i> species, mean $\pm$ SD (in days) |                       |                        |                   |
|----------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-------------------|
|                      | <i>J. sambac</i>                                                                                                     | <i>J. auriculatum</i> | <i>J. grandiflorum</i> | <i>J. nitidum</i> |
| Egg period           | 1.30 $\pm$ 0.483                                                                                                     | 1.20 $\pm$ 0.421      | 1.10 $\pm$ 0.31        | 1.10 $\pm$ 0.31   |
| Larval period        | 4.40 $\pm$ 0.737                                                                                                     | 4.10 $\pm$ 0.42       | 4.10 $\pm$ 0.32        | 3.90 $\pm$ 0.32   |
| Pupal period         | 7.50 $\pm$ 0.674                                                                                                     | 7.30 $\pm$ 0.52       | 7.20 $\pm$ 0.42        | 7.00 $\pm$ 0.00   |
| Adult period         | 2.03 $\pm$ 0.874                                                                                                     | 1.90 $\pm$ 0.88       | 1.80 $\pm$ 0.79        | 1.90 $\pm$ 0.57   |
| Total life cycle     | 15.20 $\pm$ 14.24                                                                                                    | 14.3 $\pm$ 1.004      | 13.3 $\pm$ 1.441       | 13.40 $\pm$ 1.07  |

**Table 1.**  
*Life stages of blossom midge, Contarinia maculipennis, on four Jasminum species.*



**Figure 8.**  
*Radar representation of biology of blossom midge, Contarinia maculipennis Felt in different Jasminum species.*

7.4 Adult

The adults were minute and delicate flies. The females had a black head and yellowish brown body and were characterized by a distinct long ovipositor. The males were brownish and shorter than females. The moniliform antennal segments adorned with hairs in whorls were short and cylindrical in males and long and spherical in females. The adults usually lived for 1–2 days and for 3 days in rare cases. In an average, the adult period was observed to be 2.0, 1.9, 1.8, and 1.9 days in *J. sambac*, *J. auriculatum*, *J. grandiflorum*, and *J. nitidum*, respectively.

7.5 Total life span

The total duration taken to complete egg to adult stage was 15.4, 14.3, 13.3, and 13.4 days in *J. sambac*, *J. auriculatum*, *J. grandiflorum*, and *J. nitidum*, respectively (Figure 8).

## 8. Discussion

The average egg, maggot, pupal, and adult period were 1.3, 4.4, 7.3, and 2.0 days in *J. sambac*. The findings were in agreement with previous reports that cecidomyiid eggs hatched in 1.4 days, and the larval stage lasted 4–5 days, and adults emerged in 7–8 days [13]. Previous research works studied on the life stages of *C. maculipennis* and evolved the same results [14]. While comparing the biology in different *Jasminum* species, the egg period was highest (1.3 days) in *J. sambac* and least (1.1 days) in *J. grandiflorum* and *J. nitidum*. The trend was similar to other stages also. The total life cycle was highest (15.4 days) in *J. sambac* and least (13.4 days) in *J. nitidum* [15]. The longest duration of midges on *J. sambac* revealed the presence of physical factors like bud shape and size or chemical factors like high phenols, lower protein, and sugars that impair the faster growth and development. Host plants adversely affect the biology of the phytophagous insect, reducing the size, longevity, fecundity, and increasing mortality or alternatively may indicate that midges do not prefer to feed on *J. auriculatum*, *J. grandiflorum*, and *J. nitidum*.

## 9. Conclusion

The life cycle studies of blossom midge on four cultivable *Jasminum* sp., *J. sambac*, *J. auriculatum*, *J. grandiflorum*, and *J. nitidum* revealed that the life cycle consists of egg, maggot, pupal, and adult stages. The life cycle and duration of each stage are found to be the shortest on *J. nitidum* and the longest on *J. sambac*.

The use of moderately resistant varieties as a part of IPM strategy can enhance the biological and chemical tools of insect pest management. One of the techniques to decrease the pest damage is the use of the cultivars or species, which shows higher resistance to insect pests such as *J. nitidum* and *J. grandiflorum* in areas where incidence of jasmine mites was high. *J. grandiflorum* is a commercially cultivated species of Jasmine, well known for its mesmerizing fragrance as well as usage for concrete recovery. But, *J. nitidum* is a new *Jasminum* species with star-shaped fragrant flowers newly introduced for commercial flower cultivation. Hence, utilizing this least preferred species in breeding programs of jasmine will yield better varieties with greater degree of resistance to jasmine pests.

## Author details

I. Merlin Kamala

Tamil Nadu Agricultural University, Coimbatore, India

\*Address all correspondence to: merlinto@gmail.com

## IntechOpen

© 2020 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

## References

- [1] Huxley AJ, editor. The New Royal Horticultural Society Dictionary of Gardening, 4 volumes. London, England: Macmillan Press; 1992. 3240 pp
- [2] Wunderlin RP, Hansen BF. Guide to the Vascular Plants of Florida. 3rd ed. Gainesville, Florida: University Press of Florida; 2011. 783 pp
- [3] Mabberley DJ. Mabberley's Plant-Book: A Portable Dictionary of Plants, Their Classification and Uses. 3rd ed. New York, New York: Cambridge University Press; 2008. 1021 pp
- [4] Bhattacharjee SK. Native jasmine of India. Indian Perfumes. 1980;24(3):126-133
- [5] Lakshmi J, Ganga M. Floral biology studies in certain lesser known species of jasmine (*Jasminum* spp.). International Journal of Current Microbiology and Applied Sciences. 2017;6(8):2811-2815
- [6] Sharma AJR, Sharma AKS. *Jasminum* species: An overview. 2011. Available from: [https://www.researchgate.net/publication/292575441\\_Jasminum\\_species\\_an\\_overview](https://www.researchgate.net/publication/292575441_Jasminum_species_an_overview)
- [7] Kumari G, Wong KH, Serra A, Shin J, Yoon HS, Sze SK, et al. Molecular diversity and function of jasmitides from *Jasminum sambac*. BMC Plant Biology. 2018;18:144
- [8] Manimaran P, Ganga M, Kannan M. Manipulation of petal senescence in *Jasminum nitidum* flowers with packaging and pre-treatment during storage: Role of phenolics. Journal of Pharmacognosy and Phytochemistry. 2018;7(2):3478-3480
- [9] Sandeep, Paarakh PS. *Jasminum grandiflorum* Linn (Chameli): Ethnobotany, phytochemistry and pharmacology—A review. Pharmacology Online. 2009. Available from: [https://www.researchgate.net/publication/215517134\\_Jasminum\\_grandiflorum\\_Linn\\_Chameli\\_Ethnobotany\\_Phytochemistry\\_and\\_Pharmacology\\_-\\_A\\_review](https://www.researchgate.net/publication/215517134_Jasminum_grandiflorum_Linn_Chameli_Ethnobotany_Phytochemistry_and_Pharmacology_-_A_review) [Accessed: 02 April 2019]
- [10] Bhaguna Y, Singh RM, Juyal V, Gopt V. Antilithiatic effect of flowers of *Jasminum auriculatum* Vahl. International Journal of Green Pharmacy. 2009:654-672. DOI: 10.4103/0973-8258.54910
- [11] Kamala IM. Incidence of blossom midge, *Contarinia maculipennis* Felt on jasmine (*Jasminum sambac* L.) and its natural enemies in Tamil Nadu. Indian Journal of Ecology. 2018;45(2):367-372
- [12] Merlin Kamala I, Kennedy JS. Evaluation of entomopathogens against blossom midge, *Contarinia maculipennis* Felt in Jasmine (*Jasminum sambac* L.). Journal of Biological Control. 2018, 2018;32(2):121-127. DOI: 10.18311/jbc/2018/18923
- [13] David PMM, Hanifa AM, Natarajan S. Evaluation of some insecticides and neem oil against jasmine blossom midge, *Contarinia* sp. Madras Agricultural Journal. 1991;78:82-84
- [14] Neelima Y. Bioecology and management of jasmine pests [MSc (Ag) thesis]. Acharya N.G. Ranga Agricultural University; 2005. Submitted
- [15] Merlin Kamala I. Bioecology and integrated management of major pests of Jasmine (*Jasminum sambac*) [PhD thesis]. Tamil Nadu Agricultural University; 2017. Submitted