Biological Forum – An International Journal **15(8): 22-27(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Influence of Floral Traits of *Jasminum sambac* L. Genotypes on Damage by Flower Feeding Insects

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(Received: 28 May 2023; Revised: 27 June 2023; Accepted: 25 July 2023; Published: 15 August 2023)
(Published by Research Trend)

ABSTRACT: Jasmine is a commercially important flower crop in India and utilized in decoration, religious rituals, perfume industry and so forth. Insect pest damage leads to significant yield reduction as well as quality of jasmine flowers. To restrain the damage, the stake holders are using huge quantity of insecticides which pose several problems in the ecosystem. India has rich diversity and jasmine also has several species and genotypes. Assessing insect pest damage on different genotypes of commonly cultivated *Jasminum sambac* and its relation with flower morphological traits is an important criteria for development of new resistant varieties and cultivars against flower feeding insects. This will lead to decrease in pesticide spraying. A study was taken up to screen 31 accessions of *Jasminum sambac* (*J. s.* Acc) against flower feeding insects. Three major flower feeding insects *viz.*, bud worm *Hendecasis duplifascialis* Hampson, blossom midge *Contarinia maculipennis* Felt and flower thrips *Frankliniella scultzei* Trybom were recorded during the period. The incidence of budworm was highest in *J. s.* Acc. 3 (13.99%) and lowest in *J. s.* Acc. 16 (2.88%) whereas blossom midge damage was highest in *J. s.* Acc. 13 (14.24%) and lowest in *J. s.* Acc. 20 (4.94%). *J. s.* Acc. 26 had the highest flower thrips infestation (3.33 thrips/flower cluster) and the lowest in *J. s.* Acc. 15 (1.52 thrips/flower cluster). The present study affirmed that few morphological factors *viz.*, diameter of flower bud, total bud length, bud stalk length and number of petals influenced the damage and susceptibility to flower feeders in jasmine genotypes.

Keywords: Jasmine, insect pests, flower feeders, genotypes, damage, floral parameters.

INTRODUCTION

Jasmine, a member of the Oleaceae family is a tiny, woody, perennial deciduous shrub found mostly in tropical and subtropical regions (Kalaiyarasi *et al.*, 2018; Raman, 1955). It was grown for its appealing, one-of-a-kind pleasant aroma which was utilised in the perfume industry. India leads in jasmine production, with Tamil Nadu producing the most, 180.67 tonnes of lose flower, followed by Karnataka, 23.88 tonnes (Annon., 2023). Jasmine is exploited for the extract (concentrate) of the essential oil which is used in perfume industry (Murthy and Khanna 1971) and for the production of attars and hair oils (Hanelt *et al.*, 2001). India markets jasmine flowers to Singapore, Malaysia, Japan, the United Kingdom, the United States, Eastern Europe, and the Gulf nations (Mukundan *et al.*, 2007).

Jasminum sambac L. (Gundu malli) is the common jasmine species grown widely in India. There are several insect pests attacking jasmine plants and causes reduction in the flower yield as well as quality. The insect pests *viz.*, bud worm (*Hendecasis duplifascialis)* Hampson, leaf web worm *Nausinoe geometralis* Guenee, blossom midge *Contarinia maculipennis* Felt, thrips *Frankliniella scultzei* Trybom, and red spider mite *Tetranychus urticae* Koch are some of the major pests documented in jasmine cultivars (Harini *et al.*, 2018; Kamala and Kennedy 2018; Pirithiraj *et al.*, 2022). The bud worm damage extended upto 19.61 per cent in Trichy and Erode district of Tamil Nadu, India (Soundararajan and Ganesan 2023) during peak flowering period. Farmers use more pesticides in order to control these pests. This inturn increases pesticide load in the cropping system and has a negative impact on the ecosystem. Alternate strategies such as host plant resistant and growing resistant genotypes can reduce the pesticide load. Principal component analysis confirmed the anticipated association between biophysical features, insect occurrence and natural enemies (Pirithiraj and Soundararajan 2023). The incidence of the leaf web worm (*Nausinea geometralis* Guenee), the population of hymenopteran an wasps, and the trichomes on the top surface of jasmine plants all interacted positively. The correlation of leaf web worm (r = 0.891) and wasp population (r = 0.937) with upper surface trichomes revealed interactions with both parameters. Blossom midge (*Contarinia maculipennis* Felt) exclusively infected *J. sambac* and did not infect *J. auriculatum* or *J. grandiflorum.* Eriyophid mite *Aceria jasmini,* a non-insect pest affects *J. auriculatum* plants but has no effect on *J. sambac or J. grandiflorum*. Identifying genotypes with less pest damage and characterization of resistance will provide base to understand the insect-plant interaction for jasmine pest management. The present study was aimed to screen different genotypes of *J. sambac* for the damage by flower feeders and its interaction with floral morphological traits.

MATERIALS AND METHODS

Field experiments were carried out in the botanical garden (11.0148° N; 76.9315° E), Department of Floriculture and Landscaping, Tamil Nadu Agricultural University, Coimbatore, India. The jasmine garden was maintained with 31 accessions of *J. sambac*. The accessions were planted with a spacing of 45 cm × 30 cm and maintained with normal agronomic practices and insecticide-free condition during the study period. Insect pests on flowers and buds were recorded during February '23 to May'23 at weekly interval. Ten plants were chosen at random in different accessions and the insect pest damage was recorded. Budworm (*H. duplifascialis*), blossom midge (*C. maculipennis*) and thrips *(F. scultzei)* were recorded in the flowers of different genotypes during this period. The methodology described by Harini *et al.* (2018); Prithiraj *et al.* (2022) were followed to assess the damage. Budworm damage was assessed by counting the number of bored/damaged buds and the total number of buds in five branches per plant and expressing the results as per cent damage. Similar methodology was followed for blossom midge incidence and reported as per cent damage. Three flower clusters were randomly selected and gently tapped on a white sheet to record population of flower thrips. Thrips were counted and expressed as number of thrips per flower cluster.

Budworm and blossom midge damage =

$$\frac{\text{Number of damaged buds}}{\text{Total number of buds}} \times 100$$

Morphological parameters of flowers were recorded in different accession of *J. sambac.* The traits such as total flower bud length, bud length, bud stalk length, flower stalk length, number of petals in a flower, length of petals, breadth of petals, length of corolla tube, and bud diameter were measured as per standard procedure. The quantity of trichomes (nos. /sq.cm) and length of trichomes in calyx of the bud (µm) were measured using Leica M205A stereo zoom microscope. The data on mean damage by flower feeders were computed and subjected to AGRES statistical software and means are compared in ANOVA. The statistical tool, SPSS software was used to carry out correlation analysis between the incidence of floral feeders and morphological attributes of the flowers.

RESULTS AND DISCUSSION

A. Damage by flower feeders in different accessions of J.sambac

The incidence of budworm, blossom midge and thrips recorded in different *J. sambac* accession revealed a significant variation (Table 1). Budworm incidence ranged from 2.88 to 13.99 per cent and maximum in *J. s.* Acc. 3 (13.99%) and minimum in *J. s.* Acc. 16 (2.88%). The cultivar Ramnad local Gundumalli (*J. s.* Acc. 1) is commonly cultivated type in South India especially Tamil Nadu. Mean budworm incidence in this *J. s.* Acc. 1 is 11.25 per cent. *J. s.* Acc. 3 has more incidence of budworm and *J. s.* Acc. 16 has less incidence of budworm than the local cultivar. Unprotected jasmine plants had the highest budworm infection (68.30%) in October 2017 (Murugan and Ravi 2019). According to Pirithiraj *et al.* (2021) *H. dulplifascialis* caused 31.63 per cent damage to buds in Sevandhanagar region, Tamil Nadu in *J. sambac*. According to Kiran *et al.* (2017) the most common incidence of jasmine budworm occurred during the first two weeks of August, with a damage percentage of 31.87 per cent. Harini *et al*. (2018) showed that budworm incidence peaked during the first two weeks of October, with a damage percentage of 36.43 per cent. The dipteran blossom midge mean damage was highest in *J. s.* Acc. 13 (14.24%) and lowest in *J. s.* Acc. 20 (4.94%). Blossom midge incidence in local variety (*J. s.* Acc. 1) was 8.05 per cent. *J. s.* Acc. 13 is more susceptible to blossom midge damage than local cultivar. Maximum damage of *C. maculipennis* (48.66%) was recorded in the second week of September in *J. sambac* (Prithiraj *et al.*, 2022). During field surveys in Tamil Nadu it was found that the maximum incidence of blossom midge was in Madurai district with damage of 34.27 per cent (Kamala and Kennedy 2018). Blossom midge was the most devastating pest, causing up to 34.05 per cent damage in *J. sambac* during the second week of August, 2019 (Prithiraj *et al.*, 2021) in recent times.

The sucking insect, flower thrips infestation was highest in *J. s.* Acc. 26 (3.33 thrips/flower cluster) and lowest in *J. s.* Acc. 15 (1.52 thrips/flower cluster). Thrips population in Ramnad local (*J.s.* Acc. 1) was 2.64 thrips/flower cluster. *J. s.* Acc. 26 is more susceptible to thrips incidence than Ramnad local variety whereas *J. s.* Acc. 15 is resistant to thrips incidence than Ramnad local variety. In January, the chilli thrips *S. dorsalis* incidence in chilli reached a maximum of 99.86/terminal (Gopal *et al.,* 2018). Pirithiraj *et al*. (2022) found a maximum of 4.12 thrips per flower cluster in *J. sambac* in Horticultural form at Trichy district, Tamil Nadu. Kiran *et al.* (2017) noticed highest thrips incidence during the first two weeks of May, with nil occurrence from June to September in *J. sambac*.

B. Correlation analysis of flower feeders with floral parameters

There was substantial variation in floral morphological characteristics such as bud diameter, total flower bud length, bud length and bud stalk length among accessions of *J. sambac* (Table 2, Fig. 1-4). The facts on genetic diversity should be understood in order to properly preserve various genotypes and cultivars of a plant (Rao and Hodgkin 2002). Safeena *et al.* (2017) conducted morphological studies on *Jasminum* species *viz J. sambac, J. auriculatum, and J. grandiflorum* and reported significant variation in the number of petals, petal colour, petal shape and size among these species. Flowers were categorised based on their morphology, such as globose buds of gundu mallige (*J. sambac)* and conical buds of suji mallige (*J. auriculatum*) (Raman, 1955). Khan *et al.* (1970) investigated and reported on the morphological properties of the jasmine flower, such as its length, diameter, as well as its stalk length. All these morphological parameters like corolla tube length, globose or conical buds, diameter of bud, length of bud stalk, length of flower stalk, total length of flower or leaf length, leaf area, leaf width, trichomes in leaf surface etc. either has positive or negative impact on incidence of pests. Nirmala *et al.* (2017) reported morphological modifications in both vegetative and reproductive phases of 33 different jasmine genotypes, including *J. sambac, J. multiflorum, J. auriculatum, J. rigidum, J. angustifolium, J. dichotomum*, and others. The changing scenario of insect pest incidence under untreated field condition indicated the preference of insect towards the specific plant. It demonstrates the influence of plant biophysical and biochemical characters can be influencing the pest outbreak (Pirithiraj and Soundararajan 2023). In the present study it was realized with correlation analysis that few of the flower parameters had great impact on preference and level of damage done by the flower feeders.

Correlation analysis of floral characters with budworm incidence in the present study revealed that length of bud (r = - 0.119), flower stalk length (r = - 0.157), length of petals (r = - 0.160), length of corolla tube (r = - 0.258) and number of trichomes in calyx (r = - 0.207) had a negative correlation with budworm incidence, whereas number of petals (0.249), length of trichomes in calyx (r = 0.071) and number of sepals in calyx (r = 0.288) had a positive correlation (Table 3). Flower diameter (r = 0.571) and petal width (r = 0.368) had significant positive connection with budworm incidence. Budworm incidence was maximum in *J. s.* Acc 3 because its diameter (3.16 cm) is greater than that of *J. s.* Acc 16 (2.04 cm). If diameter of the bud is more, the larva might feed more and may have sufficient space to grow. It can complete several instars of larval stage within a single flower itself. This reduces the need of larva to move out in search of flowers and in turn reduced risk of being parasitized or consumption by a predator. In *J. s.* Acc 3 petal width (1.06 cm) is greater than that of *J. s.* Acc 16 (0.46 cm). When the petal width is more the larva might get more coverage, more area to feed and also it gets better protection form enemies.

The parameters like total bud length (r = - 0.460), bud stalk length (r = - 0.504), flower stalk length (r = - 0.522), length of corolla tube (r = - 0.516) and number of trichomes in calyx (r = - 0.660) were significant and negatively correlated with blossom midge incidence. Flower diameter (r = 0.585), number of petals (r = 0.673), width of petals (r = 0.435), length of trichomes in calyx (r = 0.376) and number of sepals in calyx (r = 0.802) were all significant and positively correlated to blossom midge occurrence. Bud length (r = 0.049) and petal length (r = 0.006) are positively correlated to blossom midge incidence. Blossom midge incidence is greater in *J. s.* Acc 13 and lower in *J. s.* Acc 20 because total bud length is more in *J. s.* Acc 20 (2.22 cm) and less in *J. s.* Acc 13 (1.66 cm). If the total bud length is more, larva must travel more to move from one flower to another in search of food or even for pupation. Hence, the larva may prefer flowers with less bud length.

Total bud length (r = - 0.382), bud stalk length (r = - 0.559), flower stalk length (r = -0.556), corolla tube length (r = - 0.471) and number of trichomes in calyx (r = - 0.704) are significant and inversely associated to thrips occurrence. Thrips incidence was inversely linked with bud length (r = - 0.233). The diameter of flower (r = 0.585), number of petals (r = 0.785), length of trichomes in calyx (r = 0.387) and number of sepals in calyx (r = 0.842) were all significantly and positively related to thrips occurrence. However, length of the petals (r = 0.052) and the breadth of the petals (r = 0.292) were positively correlated. *J.s.* Acc 26 had maximum incidence of thrips and *J. s.* Acc 15 had the least incidence of thrips because the bud stalk length was more in *J. s.* Acc 15 (0.80 cm) and less in *J. s.* Acc 26 (0.64 cm). Mostly thrips are said to be occasional pollinators and they lay eggs and breed near the reproductive parts of the flower. If the stalk length is more than the thrips, it has to travel a lot to reach the reproductive parts (corolla tube). So they might prefer flowers with short stalk. Also the number of petals was more in *J. s.* Acc 26 (27.40 petals) than *J. s.* Acc 15 (15.40 petals). If there are more petals in a flower, it provides more protection and more space to dwell in it. It provides more compactness and well-guarded castle for thrips to thrive. So thrips might prefer flowers with more petals rather than fewer petals.

Table 1: Damage by flower feeders in different *J.sambac* accessions.

Sr. No.	Cultivars	Budworm* (%)	Blossom midge* (%)	Thrips* (nos./ flower cluster)
1.	*J. s.* Acc. 1 (Ramnad Local)	11.25(19.60)	8.05(16.48)	2.64(1.62)
2.	*J. s.* Acc. 2	11.90(20.17)	10.05(18.48)	2.22(1.49)
3.	*J. s.* Acc. 3	13.99(21.96)	5.24(13.24)	1.93(1.39)
4.	*J. s.* Acc. 5	5.81(13.94)	5.97(14.15)	1.75(1.32)
5.	*J. s.* Acc. 6	9.04(17.50)	7.45(15.84)	1.80(1.34)
6.	*J. s.* Acc. 8	11.13(19.49)	10.22(18.65)	1.88(1.37)
7.	*J. s.* Acc. 9	10.84(19.22)	9.11(17.57)	1.84(1.35)
8.	*J. s.* Acc. 11	4.58(12.35)	11.16(19.51)	2.06(1.43)
9.	*J. s.* Acc. 12	7.80(16.21)	12.22(20.46)	2.27(1.50)
10.	*J. s.* Acc. 13	3.34(10.53)	14.24(22.17)	2.36(1.53)
11.	*J. s.* Acc. 14	7.40(15.78)	7.36(15.74)	2.51(1.58)
12.	*J. s.* Acc. 15	6.06(14.26)	8.55(17.00)	1.52(1.23)
13.	*J. s.* Acc. 16	2.88(9.78)	6.41(14.67)	1.69(1.30)
14.	*J. s.* Acc. 17	4.13(11.73)	5.16(13.14)	2.41(1.55)
15.	*J. s.* Acc. 18	7.23(15.60)	8.35(16.79)	2.18(1.47)
16.	*J. s.* Acc. 19	7.27(15.64)	8.91(17.37)	2.16(1.47)
17.	*J. s.* Acc. 20	3.65(11.02)	4.94(12.84)	2.07(1.43)
18.	*J. s.* Acc. 21	10.81(19.19)	5.87(14.02)	2.00(1.41)
19.	*J. s.* Acc. 23	10.25(18.67)	7.96(16.38)	1.75(1.32)
20.	*J. s.* Acc. 24	12.79(20.95)	10.75(19.13)	2.04(1.43)
21.	*J. s.* Acc. 25	3.07(10.09)	10.67(19.06)	1.90(1.38)
22.	*J. s.* Acc. 26	5.75(13.88)	10.85(19.23)	3.33(1.82)
23.	*J. s.* Acc. 27	6.52(14.79)	10.55(18.95)	2.56(1.60)
24.	*J. s.* Acc. 28	6.63(14.92)	8.75(17.21)	1.80(1.34)
25.	*J. s.* Acc. 29	6.48(14.74)	6.64(14.93)	2.28(1.51)
26	*J. s.* Acc. 30	4.40(12.11)	8.18(16.62)	2.00(1.41)
27	*J. s.* Acc. 31	6.27(14.50)	9.63(18.08)	2.14(1.46)
28.	*J. s.* Acc. 32	3.14(10.21)	6.70(15.01)	2.18(1.47)
29.	*J. s.* Acc. 33	7.79(16.21)	10.00(18.43)	1.68(1.29)
30.	*J. s.* Acc. 34	5.06(12.99)	7.96(16.38)	2.33(1.52)
31.	*J. s.* Acc. 35	13.82(21.82)	12.13(20.38)	2.75(1.66)
	SEd	0.1700	0.1966	0.0161
	CD	0.3400	0.3932	0.0322

* Figures in the parenthesis are arcsine transformed values; ** Figures in parenthesis are square root transformed value

Table 2: Floral traits of different jasmine accessions.

Parameter	Range
Total length (cms)	1.42 – 2.76
Bud length (cms)	0.66 – 1.58
Bud stalk length (cms)	0.52 – 1.52
Diameter of bud (cms)	1.58 – 3.42
Flower stalk length (cms)	0.90 – 1.84
Number of petals (nos.)	13.40 – 27.40
Length of petals (cms)	0.96 – 2.64
Width of petals (cms)	0.44 – 1.78
Length of corolla tube (cms)	0.64 – 1.16
Number of sepals (cms)	7.0 – 8.0
Number of trichomes in calyx (per cm^2)	98.84 – 213.25
Length of trichomes in calyx (µm)	271.68 – 533.75

Table 3: Correlation analysis of flower feeders with floral traits of *J.sambac* accessions.

Floral traits	Correlation coefficient (r value)		
	Budworm damage	Blossom midge damage	Thrips incidence
Total bud length	-0.087	-0.460**	-0.382*
Bud length	-0.119	0.049	0.233
Stalk length	-0.006	-0.504**	-0.559**
Diameter of flower	0.571**	0.585**	0.585**
Length of flower stalk	-0.157	-0.522**	-0.556**
Number of petals	0.249	0.673**	0.785**
Length of petals	-0.160	0.006	0.052
Width of petals	0.368*	0.435**	0.292
Length of corolla tube	-0.258	-0.516**	-0.471**
Number of trichomes in calyx	-0.207	-0.660**	-0.704**
Length of trichomes in calyx	0.071	0.376*	0.387*
Number of sepals in calyx	0.288	0.802**	0.842**

**. Correlation is significant at the 0.01 level; *. Correlation is significant at the 0.05 level

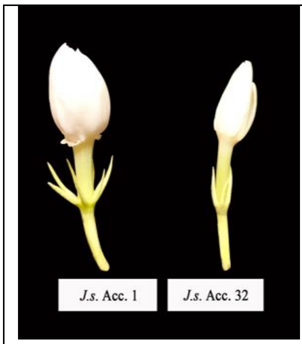

Fig. 1. Flower buds of susceptible and resistant jasmine accessions.

Fig. 2. Trichomes in sepals of susceptible and resistant jasmine accessions.

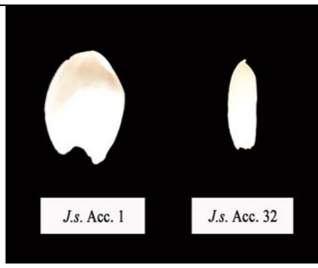

Fig. 3. Variation in petal shape of susceptible and resistant jasmine accessions.

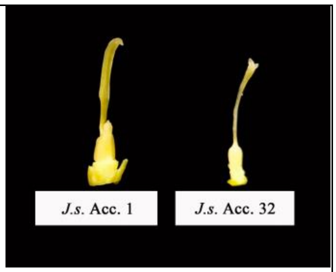

Fig. 4. Distinction in corolla tube of susceptible and resistant accessions of jasmine.

CONCLUSIONS

All the 31 *J. sambac* accessions screened in the study recorded damage by three flower feeding insects but with significant difference in the level of infestation. The entries also showed significant variation in flower morphology. The major morphological traits of flowers that interferes the susceptibility to pests are diameter of the bud, total bud length and bud stalk length and number of petals. *J. s.* Acc. 32 was noticed with less infestation and considerable resistant to budworm incidence (3.14%), whereas the incidence of blossom midge (6.70%) and thrips (2.18 thrips/flower cluster) were also low. The accession *J. s.* Acc. 2 is susceptible to budworm (11.90%), blossom midge (10.05%) and thrips (2.22 thrips/flower cluster).

FUTURE SCOPE

J. s. Acc. 32 can be studied in detail and used in jasmine crop improvement programmes and breeding resistant varieties against insect pests. The major factors contributing pest resistance such as less bud diameter, reduced number of petals, long bud stalk with more bud length can be considered as important phenomenon in the breeding programme.

Author contribution. V.A conducted the experiment and drafted the manuscript. RPS conceptualized the research idea and fine-tuned the manuscript. M.G. developed the jasmine garden, maintained and provided base input for the study. T.E. and M.K. succoured the research work and publication. All authors read and approved the manuscript.

Acknowledgement. The authors thankfully acknowledge Professor& Head, Department of Floriculture, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India for permitting to conduct the field experiment in Botanical garden. The authors also thankfully acknowledge the Professor and Head, Department of Agricultural Entomology and Dr. N. Chitra, Professor (Agrl. Entomology) for encouragement and providing laboratory facilities to record the floral traits of different jasmine genotypes.
Conflict of Interest. None.

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How to cite this article: Aswini V., Soundararajan R.P., Ganga M., Elaiyabharathi T. and Kannan M. (2023). Influence of Floral Traits of *Jasminum sambac* L. Genotypes on Damage by Flower Feeding Insects. *Biological Forum – An International Journal*, *15*(8): 22-27.