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Influence of abiotic factors on major insect and mite pests of jasmine, *Jasminum sambac* L

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Abstract
Jasmine is an important ornamental crop with attractive fragrant flowers, fetches instant revenue to the farmers. It is attacked by several insect pests and cause considerable economic loss. Studies on seasonal occurrence of insect pests of jasmine was studied during 2019-20 at Tiruchirappalli, India. Among different insect pests, blossom midge was recorded with maximum incidence during August II (34.05% Infested buds). Occurrence of midge was positively correlated with maximum temperature (r = 0.159) and minimum temperature (r = 0.505). The multiple linear regression on damage with weather parameter was worked out and it indicates that the cecidomyid pest was 85.4% influenced by various weather parameters. The incidence of other insect pests *viz*., bud worm, leaf web worm and red spider mite was recorded and correlated with weather parameters.

Keywords: Jasmine, insect pests, bud worm, blossom midge, leaf web worm, red spider mite, seasonal occurrence, weather parameters

Introduction
Jasmine is an important ornamental flower crop widely cultivated and venerate for its attractive fragrant flowers. Jasmine is considered as the "Queen of fragrance" which belongs to the family Oleaceae. Apart from India, it is distributed in Sri Lanka, Pakistan, Nepal, Malaysia, China, Indonesia, France, Spain, Hawaii and tropical Australia [1]. *Jasminum sambac* is shrub, evergreen vine, it grows up to 3 m height with decorative leaves and flowers [2]. *J. sambac* is native to India cultivated in 12,250 ha with a production of 65,230 tonnes of loose flowers and 1,700 tonnes of cut flowers. India is the largest producer of jasmine in which the state Tamil Nadu ranks first in the production. Madurai, Dindugal, Salem, Thirunelveli, Virudhunagar and Tiruchirappalli are major jasmine growing districts in Tamil Nadu. There are around 50 distinctive insect species affecting jasmine covering eight insect orders in their microhabitats [3]. Jasmine crops affected by various insects, mites, diseases and nematodes which pose serious threat to jasmine cultivation. Major pests affecting jasmine are jasmine budworm (*Hendecasis duplifascialus* Hampson), galleryworm (*Elasmopalpus jasminophagus* Hampson.), leaf webworm (*Nausinea geometralis* Guenee.), leaf roller, (*Glyphodes unionalis* Hubner.), blossom midge (*Contarinia maculipennis* Felt.) and red spider mite (*Tetranychus urticae* Koch). Studying the intensity of infestation of the pest is a pre requisite to develop the management strategy [4]. The present study aimed to study the seasonal incidence of different major insect pests of Jasmine at Tiruchirappalli, India and their influence with abiotic factors associated during the period.

Materials and Methods
Field studies on periodic occurrence of major insect and non-insect pests of jasmine were carried out in farmer's field in Navalur Kuttapattu village, Tiruchirappalli, Tamil Nadu (10.76713ºN; 78.57762ºE). Seasonal incidence of insect pests in jasmine plants was recorded in ten jasmine plants randomly and tagged. From the tagged plants fortnightly observations were documented from July second fortnight of 2019 to January first fortnight of 2020. The incidence of bud worm, *Hendecasis duplifascialis*, blossom midge, *Contarinia maculipennis*, leaf web worm *Nausinoe geometrialis* and red spider mite, *Tetranychus urticae* were noticed and recorded during the period. The methodology followed was described for each insect pests [5].

Bud worm: Total number of buds and number of bored buds were recorded in 5 randomly selected shoots in 10 plants. The damage of budworm was assessed by round boreholes in the bud where the caterpillar feeds the inner content. Two or more buds usually webbed together and are seen with excreta. The extent of damage was expressed in per cent bored buds.

Blossom midge: Total number of buds and number of infested buds were recorded in 5 randomly selected shoots in 10 plants. The extent of damage was expressed in per cent bored buds. The blossom midge damage can be distinguished from bud worm damage. The damage by blossom midge produce pale brown discolored buds with stunted appearance. The sepals are seen with unusual thickening and curved outwards. The maggots are present at the base of the corolla tube which can be visualized upon careful dissection of the bud.

Leaf web worm: Total number of webbings made by the larvae were counted and expressed as number of webs per plant. A cluster of leaves were webbed together. Skeletonized and defoliated leaves are present in the webs due to feeding of early and late instars of the worm.

Red spider mite: Total number of mites present on apical three leaves of plant were collected and brought to laboratory. Then counted under microscope and expressed as number of mites per leaf. The mites are seen on the undersurface of the leaves with webbings. On severe infestation some are seen roaming in the buds also.

Statistical analysis

Results obtained from study on seasonal prevalence of pests of jasmine were correlated and regressed with various weather parameters. The weather parameters at the experimental site were obtained from the nearby meteorological observatory of Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu.

Results and Discussion

Bud worm damage

The peak damage of budworm, *H. duplifascialis* was recorded during the first fortnight of November (16.26% damaged buds). It was followed by October first (15.11) and August (14.24%) first fortnight observations. Nil damage was recorded in September first fortnight and from November second to January first fortnight (Table 1). The incidence was positively correlated and statistically non-significant with maximum temperature (r = 0.392), minimum temperature (r = 0.418), wind velocity (r = 0.110), sunshine hours (r = 0.063) and evaporation (r = 0.265) (Table 3). The incidence was negatively correlated and non-significant with morning relative humidity (r = -0.243), evening relative humidity (r = -0.251) and rainfall (r = -0.096). The regression equation obtained with weather parameter was $Y = -304 + 5.42\ X_1 + 2.05X_2 + 1.43X_3 – 0.28X_4 – 2.15X_5 – 1.81X_6 – 1.18X_7 – 1.35X_8$ (Table 4). The R^2 value obtained was 0.626 which indicates that the pest was 62.6% influenced by the weather parameters. The regression equation indicates that one unit increase in maximum and minimum temperature leads to 5.42 and 2.05 percent increase in damage by bud worm. A maximum incidence of budworm (21.50%) in the month of September and minimum incidence of budworm (0%) in the month of November was reported at Coimbatore, India [6]. An increase of 1 °C of maximum temperature would lead to an increase of 4.27 and 6.56% of shoot damage and fruit damage/five plant/week in case of bhendi shoot borer, *E. vitella*.. However, 1 °C increase in minimum temperature decreased the shoot damage by 0.23/plant/week during rabi season in bhendi crop [7].

Leaf web worm

The leaf webworm, *N. geometrialis* damage was not noticed during the early period of the present study. The incidence was started from second fortnight of November and gradually increased in the following period. The maximum occurrence was recorded in the first fortnight of January (0.8 webs/plant) and minimum occurrence was recorded in the second fortnightly interval of November (2.2 webs/ plant). The incidence was significant and negatively correlated with maximum temperature (r = -0.662), minimum temperature (r = -0.842) and evaporation (r = -0.563). The incidence was non-significant and positively correlated with morning relative humidity (r =0.482) and evening relative humidity (r = 0.346). There was a non-significant and negative correlation of wind velocity (r = -0.417), sunshine hours (r = -0.110) and rainfall (r = -0.183) with pest incidence (Table 3). The regression equation of leaf webworm with weather parameters was $Y = 14.80 - 0.13\ X_1 – 0.34\ X_2 – 0.05\ X_3 + 0.03\ X_4 + 0.19\ X_5 + 0.117\ X_6 – 0.06\ X_7 + 0.0X_8$. The R^2 value obtained was 0.898 which indicates the pest was 89.8% influenced by all the weather parameters. The regression equation in an earlier study indicated that 1 °C increase in maximum and minimum temperature would decrease the pest occurrence by 0.13 and 0.34 percent respectively, whereas increase in 1 km/hour of wind velocity increases the pest by 0.19%. In another study a mention that leaf web worm incidence was nil during December, January, February, March, and April and maximum occurrence of *N. geometralis* was observed during first fortnightly of November (4.6 webs/ plant) [8]. In the present study the maximum incidence was seen during the January first fortnight (2.2 webs/plant) which coincides with the morning relative humidity (89.9%).

Blossom midge

Among different pests infesting jasmine, more damage was recorded by blossom midge, *C. maculipennis* in the present study. Maximum occurrence of midge was recorded in second fortnight of August (35.05%) (Figure 1). The minimum incidence was noticed in the second fortnightly interval during July (7.07%). The blossom midge damage was significant and positively correlated with minimum temperature (r = 0.505). The incidence was non-significant and positively correlated with maximum temperature (r = 0.159), morning (r = 0.006) and evening relative humidity (r = 0.142), evaporation (r = 0.143) and rainfall (r = 0.203). Non-significant and negative correlation was observed with wind velocity (r = -0.074) and sunshine hours (r = -0.017). The regression equation of blossom midge with weather parameters was $Y = -425 + 4.29\ X_1 + 3.46\ X_2 + 1.82\ X_3 + 1.05\ X_4 – 5.37\ X_5 – 0.85\ X_6 + 7.84\ X_7 – 1.01\ X_8$. The R^2 value obtained was 0.854 which indicates the pest was 85.4% influenced by all the weather parameters (Table 4). The regression equation indicates that the every one unit increase in maximum and minimum temperature increases the damage by 4.29 and 3.46 percent respectively. Every 1 unit increase in morning, evening relative humidity and evaporation tend to increase 1.82, 1.05 and 7.84 percent increase in damage by

blossom midge. Unit increase in wind velocity, sunshine hours and rainfall would decrease the incidence of pest by 5.37, 0.85 and 1.01 per cent respectively. Similar report was obtained in an earlier study. The occurrence of blossom midge at Thothukudi, Tamil Nadu indicate the midge infestation varies from 0.00 to 46.74 per cent from October 2017 (first fortnight) to April 2018 (second fortnight) [9].

Red spider mite

The incidence of red spider mite, *T. urticae* was less while comparing the other pests of jasmine. It was observed only at two fortnightly observations. The peak occurrence was noticed during first fortnight of October (5.33 mites/ leaves). The population of mite was significant and positively correlated with sunshine hours (r = 0.526). It was non-significant and positively correlated with maximum (r = 0.095) and minimum temperatures (r = 0.219). Non-significant negative correlation was observed with morning (r = -0.049) and evening relative humidity (r = -0.128), wind velocity (r = -0.171), evaporation (r = -0.054) and rainfall (r = -0.269). The regression equation of red spider mite was $Y = -27.5 + 0.28 X_1 + 0.97 X_2 + 0.12 X_3 - 0.18 X_4 - 0.18 X_5 + 0.12 X_6 - 1.12 X_7 - 0.23 X_8$. The R^2 value 0.808 indicates the 80.8% influence of weather parameters on the pest population. The equation explains the every one unit increase in the maximum, minimum temperature, morning relative humidity and sunshine hours would increase the pest occurrence up to 0.28 and 0.97, 0.12 and 0.12 per cent respectively. In contrast, one unit increase in evening relative humidity and rainfall will decrease the pest population by 0.18 and 0.23 percent respectively. However, earlier studies indicated that red spider mite, *Tetranychus* sp. occurrence on jasmine plants throughout the year [8]. The maximum incidence was recorded in the month of April with a mean population of 5.8 mites/leaf. The peak population coincided with low rainfall and high temperature. In the present study maximum occurrence was observed only during first fortnight of October (5.33 mites/ leaf) which coincides with the peak sunshine hour (8.2 hours/day) recorded during the study period (Table 2).

Conclusion

Four major pests *viz*., jasmine bud worm, leaf web worm, blossom midge and red spider mite were recorded in the farmers' field at Tiruchirappalli, Tamil Nadu. Blossom midge damage dominate among the insect pests and recorded upto 34.05% damage during second fortnight of August, 2019. The incidence of budworm, leaf webworm, blossom midge and red spider mite was peak during November I (16.26%), January I (2.2 webs/plant), August II (34.05%) and October I (5.33 mites/leaf) accordingly the management practices can be carried out. The correlation and regression studies indicated that incidence of blossom midge was positively significant with minimum temperature. The incidence of red spider mite was significant and positively correlated with sunshine hours. The population of an individual pest insects is not static during the study period, fluctuation occurs in every fortnightly intervals. Host specific IPM can be carried out, during the peak incidence of the pest for effective management.

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Table 1: Seasonal occurrence of insect and mite pests

Period/ Fortnight	Bud worm damage (%)	Leaf web worm damage (webs/ plant)	Blossom midge damage (%)	Red spider mite (No./leaf)
July – II	11.84±3.53	0.00	7.07±3.03	0.00
August – I	14.24±2.57	0.00	0	0.00
August – II	10.83±1.33	0.00	34.05±2.68	1.06±0.49
September – I	0.00	0.00	17.56±1.15	0.00
September - II	7.91±2.51	0.00	15.64±1.78	0.00
October – I	15.11±2.57	0.00	20.04±2.44	5.33±2.78
October – II	11.50±1.30	0.00	13.20±1.21	0.00
November – I	16.26±1.86	0.00	22.46±1.47	0.00
November – II	0.00	0.80±0.37	24.73±1.77	0.00
December – I	0.00	0.8±0.37	0.00	0.00
December – II	0.00	1.2±0.58	0.00	0.00
January – I	0.00	2.2±0.58	0.00	0.00

* Mean of 10 plants ± SEd

Table 2: Mean weather data during the study period

Period/ Fortnight	Max. temp. (°C)	Min temp (°C)	RH Mrng. (%)	RH Evng, (%)	Wind Velocity (km/hr)	Sun Shine (hrs)	Evapo-ration	Total Rainfall (mm)
July – II	39.65	25.93	68.18	34.06	9.13	5.23	8.51	17.6
August – I	35.96	25.73	79.53	40.93	10.62	3.52	7.44	0
August – II	36	25.5	82.37	47.62	7.1	4.38	6.82	49.2
September – I	37.93	27.5	74.46	41.33	10.45	5.94	8.48	29.2
September – II	34.7	25.5	84.9	51.1	4.9	6.6	4.9	102.8
October – I	35.0	25.6	82.3	47.9	3.7	8.2	3.8	2
October – II	34.1	23.9	88.0	58.4	3.5	2.1	2.4	160
November – I	32.8	24.2	87.0	61.4	2.8	3.7	3.3	14.5
November – II	31.8	24.5	88.3	63.0	3.7	2.0	2.7	75.4

December – I	31.5	22.8	85.7	58.3	3.3	3.6	2.5	79
December – II	31.8	21.8	86.9	49.9	3.5	3.1	2.9	10.4
January – I	32.7	20.9	89.9	57.9	4.7	7.8	2.3	0

Table 3: Correlation of jasmine insect pests with weather parameters

Insects	Correlation coefficient (r)							
	Max. temp.	Min. temp.	RH Mrng.	RH Evng.	Wind velocity	Sun Shine hrs	Evapo- -ration	Rainfall (RF)
Bud worm	0.392	0.418	-0.243	-0.251	0.110	0.063	0.265	-0.096
Leaf web worm	-0.662*	-0.842*	0.482	0.346	-0.417	-0.110	-0.563*	-0.183
Blossom midge	0.159	0.505*	0.006	0.142	-0.074	-0.017	0.143	0.203
Red spider mite	0.095	0.219	-0.049	-0.128	-0.171	0.526*	-0.054	-0.269

*Significant at 0.05% level of significance

Table 4: Multiple linear regression analysis of major pests (Y) and weather parameters (X)

Variables	Partial regression coefficient	Standard error	't' value	R^2
Budworm				
X_1 - Maximum Temperature	5.420	3.544	1.52*	0.626
X_2 - Minimum Temperature	2.052	2.672	0.76*	
X_3 - Morning Relative Humidity	1.430	1.234	1.15*	
X_4 - Evening Relative Humidity	-0.286	0.797	-0.35^{NS}	
X_5 - Wind Velocity	-2.155	2.594	-0.83*	
X_6 - Sunshine Hours	-1.817	1.610	-1.12*	
X_7 - Evaporation	-1.180	5.251	-0.22^{NS}	
X_8 – Rainfall	-1.351	1.134	-1.19*	
Leaf webworm				
X_1 - Maximum Temperature	-0.133	0.192	-0.696*	0.898
X_2 - Minimum Temperature	-0.346	0.144	-2.390*	
X_3 - Morning Relative Humidity	-0.050	0.066	-0.759*	
X_4 - Evening Relative Humidity	0.031	0.043	0.734*	
X_5 - Wind Velocity	0.190	0.140	1.351*	
X_6 - Sunshine Hours	0.117	0.087	1.350*	
X_7 - Evaporation	-0.064	0.284	-0.226*	
X_8 – Rainfall	0.000	0.061	0.014^{NS}	
Blossom midge				
X_1 - Maximum Temperature	4.291	3.757	1.142*	0.854
X_2 - Minimum Temperature	3.463	2.832	1.222*	
X_3 - Morning Relative Humidity	1.829	1.308	1.397*	
X_4 - Evening Relative Humidity	1.051	0.845	1.244*	
X_5 - Wind Velocity	-5.377	2.750	-1.954*	
X_6 - Sunshine Hours	-0.856	1.707	-0.501*	
X_7 - Evaporation	7.849	5.567	1.409*	
X_8 – Rainfall	-1.012	1.202	-0.841*	
Red spider mite				
X_1 - Maximum Temperature	0.280	0.576	0.486*	0.808
X_2 - Minimum Temperature	0.972	0.434	2.238*	
X_3 - Morning Relative Humidity	0.124	0.200	0.621*	
X_4 - Evening Relative Humidity	-0.185	0.129	-1.429*	
X_5 - Wind Velocity	-0.183	0.422	-0.435*	
X_6 - Sunshine Hours	0.126	0.262	0.481*	
X_7 - Evaporation	-1.125	0.854	-1.317*	
X_8 – Rainfall	-0.236	0.184	-1.280*	

*significant at 0.05% level, ^{NS} Non-significant.

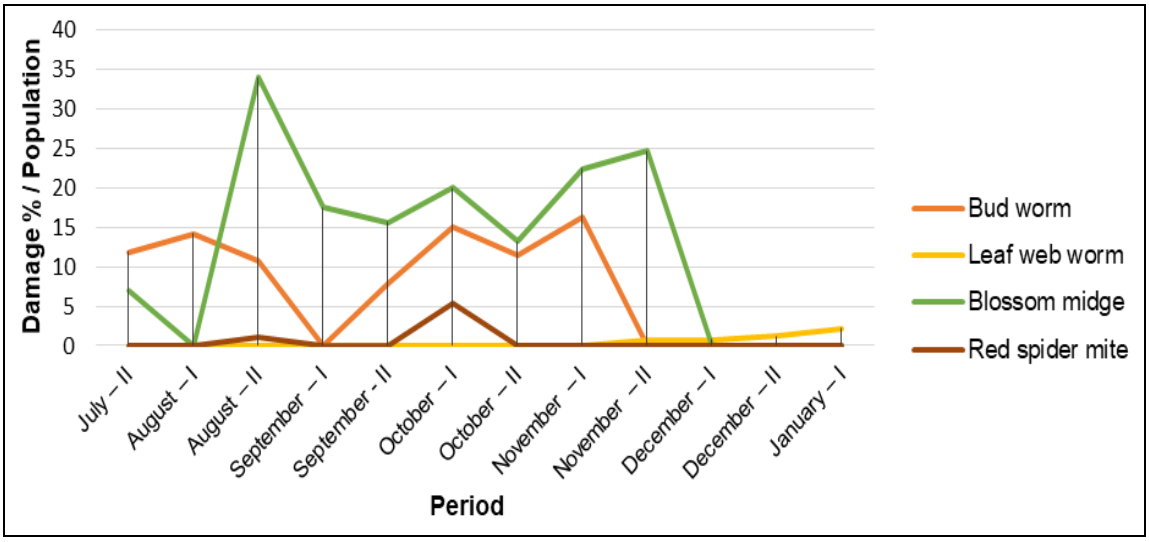

Fig 1: Seasonal occurrence of major insect and mite pests of jasmine during 2019-20

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