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Studies on pest complex and seasonal incidence of major pests of *Jasminum sambac* cv. Mysuru Mallige

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Abstract
Jasminum sambac cv. Mysuru Mallige, a Geographical Indication (GI) crop of the Mysuru region in Karnataka, has encountered challenges such as a restricted flowering period and escalating pest infestations, resulting in a decline in cultivation among farmers in and around Mysuru. Consequently, this study marks the inaugural comprehensive investigation into the pest complex and seasonal incidence of major pests affecting *Jasminum sambac* cv. Mysuru Mallige. Thirteen pests, including insects and mites, were documented, comprising four sucking insects, two defoliator pests, three borer pests, and a mite pest. Notably, the incidence of budworm (*Hendecasis duplifascialis*), bud and shoot worm (*Elasmopalpus jasminophagus*), shoot web worm (*Margaronia unionalis*), leaf web worm (*Nausinoe geometralis*), thrips (*Thrips orientalis*), and red spider mite (*Tetranychus urticae*) was relatively higher. Their incidence varied with crop stage and season, as detailed in this study.

Keywords: *Jasminum,* Mysuru mallige, pest, mites

Introduction
Jasmine, a versatile flowering shrub belonging to the Oleaceae family and the order Oleales, is widely cultivated across India, covering approximately 8,000 hectares and yielding flowers worth eight to ten crores annually (Muthuswamy and Shanmugavelu, 1982) [6]. Tamil Nadu leads in jasmine production, with an annual output of 77,247 tons from 9,360 hectares, while Karnataka ranks second with 1,600 hectares and 20,000 tons of flowers produced (Anon., 2000) [1]. Presently, jasmine cultivation in Karnataka spans 5.76 thousand hectares, yielding 36.91 metric tons of flowers with a productivity of 86.41 metric tons (Anon., 2016).

Jasminum sambac cv. Mysuru Mallige, a specific cultivar of jasmine, holds the prestigious status of a Geographical Indication (GI) crop in the Mysuru region of Karnataka, India. Revered for its enchanting fragrance and delicate white flowers, this cultivar has faced challenges such as a limited flowering period and increased pest infestations, leading to a decline in cultivation among farmers in and around Mysuru. However, systematic studies on pests affecting this GI crop have been lacking until now. Therefore, this study represents the first comprehensive investigation into the pest complex and seasonal incidence of major pests affecting *Jasminum sambac* cv. Mysuru Mallige.

Material and Methods
A fixed plot survey was conducted from June 2017 to May 2018 at the College of Horticulture, Mysuru, to document the natural occurrence of insect and mite pests affecting *Jasminum sambac* cv. Mysuru Mallige. Pest incidence observations were recorded fortnightly from ten randomly selected tagged jasmine plants. For each plant, observations were made on four branches in four directions, along with one central shoot. Three flower clusters per branch were examined to record insect infestations on jasmine flowers.

To investigate the seasonal occurrence of insect and mite pests of *Jasminum sambac* cv. Mysuru Mallige, a separate experiment was conducted on one-year-old plants at the College of Horticulture, Mysuru.

Ten plants were chosen and tagged for the study. Fortnightly observations were conducted from June 2017 to May 2018 to document the seasonal occurrence of major pests. The data collected during the study on seasonal pest incidence were analyzed for correlation and regression with various abiotic parameters to understand their influence on pest incidence.
The methodology employed to assess the incidence of major pests on jasmine is outlined below:

Budworm (*Hendecasis duplifascialis*): The total number of buds and the number of buds damaged by budworm (evidenced by bored holes on the corolla tube) were recorded in five randomly selected shoots per tagged plant. The extent of damage was quantified as the percentage of bored buds.

Bud and shoot worm (*Elasmopalpus jasminophagus*): The total number of buds and the number of affected buds were recorded in five randomly selected shoots per tagged plant. The degree of damage was expressed as the percentage of affected buds.

Shoot web worm (*Margaronia unionalis*): Given its tendency to damage terminal shoots, the total number of damaged shoots per plant was tallied in five randomly selected shoots from each of ten tagged plants. The extent of damage was represented as the percentage of shoots affected.

Leaf web worm (*Nausinoe geometralis*): The total number of webbings produced by this pest across ten tagged plants was counted and expressed as the average number of webs per plant.

Thrips (*Thrips orientalis*): Three flower clusters were randomly chosen in each tagged plant. These clusters were gently tapped onto a white cardboard sheet, and the dislodged thrips were counted using a magnifying lens. The incidence of thrips was measured as the number of thrips per flower cluster.

Red spider mite (*Tetranychus urticae*): Three leaves each from the top, middle, and bottom portions of the tagged plants were sampled. The mite population (including eggs and active stages) on these leaves was observed under a stereo binocular microscope in the laboratory. The extent of damage was expressed as the number of mites per leaf.

Results and Discussion

Write conclusion in 100-120 following

During the study period, various insect and mite pests affecting *Jasminum sambac* cv. *Mysuru Mallige* were documented. Among them sucking pests were thrips (Thrips orientalis Bagnall), blossom midge (*Contarinia maculipennis* Felt), brown spotted stink bug (*Antestiopsis cruciate* Fabricius), and tingid bug (*Corythauma ayyari* Drake). Additionally, two defoliator pests were observed, namely leaf web-worm (*Nausinoe geometralis* Guenee) and sphingid moth (*Acherontia styx* Westwood). Furthermore, three borer pests, including bud worm (*Hendecasis duplifascialis* Hampson), bud and shoot worm (*Elasmopalpus jasminophagus* Hampson), and shoot web-worm (*Margaronia unionalis* Hubner), were documented. Additionally, the presence of one mite pest, red spider mite (*Tetranychus urticae* Koch), was recorded. Similar observations of different pests on jasmine have been reported by earlier researchers (David, 1958) [3].
The incidence of bud borer, bud and shoot worm, shoot web worm, leaf web worm, red spider mites, and thrips was notably high among the various pests recorded. Consequently, the seasonal occurrence of these major pests and their correlation with weather parameters were analyzed.

Bud borer, *Hendecasis duplifascialis*: The presence of the bud borer, *H. duplifascialis*, coincided with the flowering period of jasmine, as noted in previous studies by Sudhir (2002) [12] in Raichur and Roopini (2016) [9] in Bengaluru. Observation of bud borer activity spanned from February to September, with the highest population observed in August (35.41% bored buds), aligning with the flowering season. Similar observations were reported by Gunasekaran (1989) [4] during the monsoon period in Tamil Nadu and by Vanitha (2001) [13] in September. Sudhir (2002) [12] also reported peak incidences in May (23.15%) and July (18.32%) in Raichur, consistent with findings by Kiran (2017) [5] in Shivamogga, who noted the highest incidence (31.87%) in the first fortnight of August. The lowest incidence occurred during the second fortnight of February (12.32%), corroborating Kiran's (2017) [5] findings. The incidence of bud worm showed a significant positive correlation with minimum temperature (r=0.642) and non-significant positive correlations with morning relative humidity (r=0.326), evening relative humidity (r=0.275), and rainfall (r=0.289). However, there was a non-significant negative correlation with maximum temperature (r=-0.009). These correlations were consistent with Gunasekaran (1989) [4] from Tamil Nadu and Shobitha (2001) [10] from Bengaluru, who also found no significant correlation between weather parameters and bud borer damage. However, minimum temperature showed significant positive correlation, suggesting its influence on bud borer incidence. Regression analysis indicated that 49% of the variation in bud borer population could be attributed to weather parameters, with minimum temperature being the primary influencing factor. Kiran (2017) [5] from Shivamogga observed a slightly higher influence of weather parameters at 55.60% on pest incidence, with minimum temperature exerting the most influence on bud borer incidence.

Bud and shoot worm, *Elasmopalpus jasminophagus:* The incidence of the bud and shoot worm persisted throughout the year, with the peak population occurring in January, as reported by Shobitha (2001) [10] from Bengaluru and Kiran (2017) [5] from Shivamogga. The highest incidence was observed during the first fortnight of January, with 28.75% of affected buds, consistent with findings by Roopini (2016) [9] from Bengaluru and Kiran (2017) [5] from Shivamogga. Conversely, the lowest occurrence was noted during the second fortnight of April (6.83%), aligning with observations made by Shobitha (2001) [10] from Bengaluru and Kiran (2017) [5] from Shivamogga, who reported the lowest incidence during the first fortnight of May and the second fortnight of April, respectively. However, Roopini (2016) [9] from Bengaluru suggested that the lowest occurrence was during the first fortnight of August and the second fortnight of December, attributed to the study's termination before April. There was a significant negative correlation between minimum temperature (r=-0.685) and the incidence of bud and shoot worm, while all other weather parameters, including maximum temperature (r=-0.301), morning relative humidity (r=-0.061), evening relative humidity (r=-0.233), and rainfall (r=-0.029), showed non-significant negative correlations with pest incidence. These findings were consistent with those of Roopini (2016) [9] from Bengaluru and Kiran (2017) [5] from Shivamogga. Regression analysis indicated that weather parameters influenced the seasonal incidence of bud and shoot worm by 51%. However, Kiran (2017) [5] from

Shivamogga observed a slightly lower influence of weather parameters at 30% on pest incidence, with minimum temperature primarily affecting the population of bud and shoot worm.

Shoot web worm, *Margaronia unionalis*: The peak incidence of the shoot web worm occurred during the second fortnight of October, with 12.72% of affected shoots, while the lowest occurrence was noted during the second fortnight of December, with only 0.57% of affected buds. This finding closely aligns with Sudhir's (2002) [12] report of the pest's maximum occurrence between September and October and minimum incidence between November and December. Morning relative humidity (r=0.700), evening relative humidity (r=0.518), and rainfall (r=0.635) exhibited significant positive correlations with the incidence of shoot web worm, whereas maximum temperature showed a negatively significant correlation. However, minimum temperature did not show a significant correlation. These results are consistent with Sudhir's (2002) [12] findings. Roopini (2016) [9] also observed a strong positive association of *M. unionalis* with rainfall. Regression analysis indicated that weather parameters influenced the seasonal incidence of shoot web worm by 69.3%, with morning relative humidity, evening relative humidity, and rainfall being the primary influencing factors.

Leaf web worm, *Nausinoe geometralis*: The study on the seasonal occurrence of the leaf web worm revealed its prevalence throughout the year. The highest incidence of the leaf web worm was observed during the cooler months, particularly in November (4.85 webs per plant) and October (4.35 webs per plant). These findings are consistent with previous studies by Shukla and Sandhu (1983) [10], who identified June and October as peak periods for leaf web worm activity, as well as Gunasekaran (1989) [4], who noted higher incidences during November. Sudhir (2002) [12] reported that the pest's maximum occurrence was in September (3.69 webs per plant) and November (2.76 webs per plant). Neelima (2005) [7] also observed peak populations during September and October, with incidences of 24.5 webs per 20 twigs and 26 webs per 20 twigs, respectively. Similarly, Kiran (2017) [5] reported the highest incidences during November (4.45 webs per plant) and October (4.15 webs per plant). The occurrence of the leaf web worm, *N. geometralis*, showed a significant and positive correlation with morning relative humidity (r= 0.501) and evening relative humidity (r=0.463), consistent with Kiran's (2017) [5] findings of a significant positive correlation with evening relative humidity. A negative and significant correlation was found with maximum temperature (r=-0.438). However, Sudhir (2002) [12] observed a non-significant negative correlation with maximum temperature. Meanwhile, the leaf web worm population exhibited non-significant positive and negative correlations with rainfall and minimum temperature, respectively. Similarly, Neelima (2005) [7] reported a positive correlation of minimum temperature and rainfall with the leaf web worm population. Regression analysis indicated that weather parameters influenced the incidence of the leaf web worm by 43.9%. Overall, the study suggests that morning relative humidity and evening relative humidity primarily influenced the incidence of the leaf web worm.

Thrips, *Thrips orientalis:* Studies on the seasonal incidence of thrips revealed their presence throughout the study period, except during June, July, August, and the first fortnight of September. The absence of thrips during these periods may be attributed to low temperatures and high rainfall. These findings align with those of Neelima (2005) [7], who also reported no thrips incidence during July, August, and October. The peak incidence occurred during the first fortnight of May, with 13.43 thrips per flower cluster, likely due to higher temperatures. This observation is consistent with Neelima (2005) [7], who noted the maximum thrips population during the second fortnight of April. Similarly, Kiran (2017) [5] reported the highest incidence during the first fortnight of May. The seasonal incidence of thrips exhibited a significant positive correlation with maximum temperature and a significant negative correlation with morning relative humidity. Minimum temperature showed a non-significant positive correlation with thrips incidence. These results are consistent with those of Neelima (2005) [7], who reported a positive correlation with maximum temperature and a negative correlation with relative humidity and rainfall. Roopini (2016) [9] also found a significant positive relationship between maximum temperature and jasmine thrips incidence, while morning relative humidity showed a significant negative correlation. Regression analysis indicated that 73.50% of the variation in thrips population was attributed to the mentioned weather parameters. In conclusion, it can be inferred that maximum temperature and morning relative humidity primarily influenced the incidence of thrips.

Red spider mite, *Tetranychus urticae*: The study on the seasonal incidence of the red spider mite, *T. urticae*, revealed its prevalence throughout the study period, consistent with findings by David (1958) [3] and Rajkumar *et al.* (2005) [8] on jasmine. The peak population of mites occurred during the second fortnight of April, with 5.92 mites per leaf, likely due to high temperatures and reduced rainfall during that period. Conversely, the lowest occurrence was observed during the first fortnight of July and August, with only 0.27 mites per leaf. These results align with Rajkumar *et al.* (2005) [8], who attributed the maximum population during April and May to dry spells and lack of rainfall. Similarly, Kiran (2017) [5] reported the highest incidence during April's second fortnight and the lowest during July's first fortnight, possibly due to heavy rainfall. The population fluctuation of the red spider mite correlated significantly and positively with maximum temperature, consistent with Kiran (2017) [5], who also reported a significant positive correlation with maximum temperature. Sudhir (2002) [12] observed a significant positive correlation of mite population with maximum temperature, with a one-degree Celsius increase resulting in a 0.28% rise in mite population. Rajkumar *et al.* (2005) [8] also noted a significant positive correlation with maximum temperature, influencing the population by 60.30%. The mite population exhibited a non-significant positive correlation with minimum temperature, while morning relative humidity showed a significant negative correlation. Evening relative humidity and rainfall displayed non-significant negative correlations. These findings are consistent with Sudhir (2002) [12], who reported a negative correlation of rainfall and morning relative humidity with mite population, affecting the population by 40.10%. Neelima (2005) [7] similarly reported a non-significant negative correlation with relative humidity, while Rajkumar *et al.* (2005) [8] reported a positive and non-significant relationship with mite population and minimum temperature. Regression analysis indicated that 61.40% of the variation in the red spider mite population was attributed to the mentioned weather parameters. In conclusion, maximum temperature and morning relative humidity primarily influenced the incidence of the red spider mite.

Table 1: Seasonal incidence of major insect and mite pests of *Jasminum sambac* cv. Mysuru Mallige at College of Horticulture, Mysuru during 2017-18

Period (Fortnight)	*Hendecasis duplifascialis* (% bored buds)	*Elasmopalpus jasminophagus* (% affected buds)	*Margaronia unionalis* (% damaged shoots)	*Nausinoe geometralis* (No. of webs/plant)	*Thrips orientalis* (No. of thrips/ flower cluster)	*Tetranychus urticae* (No. of mites/leaf)
Jun I	20.68	10.8	4.89	1.70	0	0.86
Jun II	25.27	11.24	5.37	1.80	0	0.68
Jul I	28.66	10.47	5.98	2.20	0	0.27
Jul II	29.23	9.36	6.44	2.40	0	0.58
Aug I	35.41	11.18	9.56	2.70	0	0.27
Aug II	33.33	12.71	10.24	3.10	0	0.35
Sep I	28.32	13.54	10.58	3.40	0	0.32
Sep II	19.79	15.51	11.26	3.80	2.12	0.43
Oct I	0	20.50	12.22	4.20	4.13	0.53
Oct II	0	19.44	12.72	4.50	4.90	0.60
Nov I	0	20.68	6.83	4.90	5.58	1.56
Nov II	0	18.64	4.42	4.80	3.82	1.64
Dec I	0	19.83	1.22	3.70	3.00	1.58
Dec II	0	12.53	0.57	3.20	4.23	1.72
Jan I	0	28.75	0	2.10	4.76	1.80
Jan II	0	25.54	0	1.90	6.44	0.72
Feb I	0	19.64	0	1.20	6.10	1.76
Feb II	12.32	15.42	0	1.10	7.00	2.64
Mar I	15.09	12.35	0	1.30	9.37	3.20
Mar II	16.12	11.60	0	1.40	10.00	3.86
Apr I	17.85	12.23	0	1.60	8.17	4.93
Apr II	18.42	6.83	1.64	1.70	10.24	5.92
May I	18.64	8.67	2.16	1.90	13.43	1.84
May II	19.38	9.46	2.83	1.60	8.21	1.23

Note: Values in the table are mean of ten plants used for observations.

Table 2: Correlation and regression analysis for incidence of major insect and mite pests of *Jasminum sambac* cv. Mysuru Mallige with weather parameters during 2017-18

Pest	Correlation coefficient					R2	Regression equation
	Min. Temp. (°C) (X1)	Max. Temp. (°C) (X2)	RH-I (%) (X3)	RH-II (%) (X4)	RF (mm). .(X5)		
H. duplifascialis	0.642*	0.009	0.326	0.275	0.289	0.491	Y= 13.096+6.833X1+2.859X2+0.456X3+ 0.280X4+ 0.49982X5
E. jasminophagus	-0.685*	-0.301	-0.061	-0.233	-0.029	0.518	Y= 48.819-2.460X1-0.121X2-0.044X3-0.082X4- 0.240X5
M. unionalis	0.361	-0.405*	0.700*	0.518*	0.635*	0.693	Y= -25.394+0.954X1-1.448X2+0.503X3+ 0.225X4 +0.401X5
N. geometralis	-0.053	-0.438*	0.501*	0.463*	0.347	0.439	Y= -3.317-0.272X1+0.005X2+0.025X3+ 0.104X4 +0.062X5
T. orientalis	0.038	0.788*	-0.805*	-0.340	-0.328	0.735	Y= -0.110+0.599X1+0.024X2-0.235X3- 0.066X4-0.143X5
T. urticae	0.114	0.646*	-0.651*	-0.233	-0.338	0.614	Y= 6.271+0.856X1+0.737X2-0.247X3-0.142X4- 0.041X5

*Significant at 5% level of probability df: 22

Note:

X1: Maximum temperature (°C)

X2: Minimum temperature (°C)

X3: Morning relative humidity (%)

X4: Evening relative humidity (%)

X5: Rainfall (mm)

Conclusion

In conclusion, the study period revealed a comprehensive documentation of various insect and mite pests affecting Jasminum sambac cv. Mysuru Mallige. Notable among them were thrips, blossom midge, brown spotted stink bug, tingid bug, leaf web-worm, sphingid moth, bud worm, bud and shoot worm, shoot web-worm, and red spider mite. The incidence of bud borer, bud and shoot worm, shoot web-worm, leaf web-worm, red spider mites, and thrips was notably high among the recorded pests, prompting a detailed analysis of their seasonal occurrence and correlation with weather parameters.

The study elucidated the seasonal patterns and correlations of various pests with weather parameters. Bud borer, bud and shoot worm, shoot web-worm, leaf web-worm, thrips, and red spider mites exhibited distinct seasonal occurrences and correlations with temperature, humidity, and rainfall. Maximum temperature and morning relative humidity emerged as primary influencing factors for many of these pests, affecting their incidence significantly.

Overall, the findings underscore the intricate relationship between pest dynamics and environmental conditions, providing valuable insights for pest management strategies. Further research in this domain could enhance our understanding and contribute to more effective pest control measures, ensuring the sustained health and productivity of Jasminum sambac cultivation.

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