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INCIDENCE AND ENVIRONMENTAL FACTORS INFLUENCING SUCKING PEST INFESTATION ON MULBERRY (*MORUS* SPP.) IN KISHANGANJ REGION OF BIHAR INDIA

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ABSTRACT

Sericulture is an ancient and highly significant rural cottage industry in India, characterized by its unique blend of agriculture and industry. The present investigation aimed to evaluate the incidence of sucking pests of mulberry plants and their correlation with weather parameters. The experiment was carried out in randomized block design. The mulberry variety used in the objective was C-2038. Study on prevalence of sucking insect pests in the field showed that a range of sucking pests including mealy bug, thrips, whitefly were identified on mulberry plants. Among these insects, mealy bugs emerged as the major sucking pest. The results on mealy bug population density showed that the lowest mealy bug population was observed in the first two weeks of March month (0.33 insects/ top 10cm twig) and the highest population was observed in the last week of July (57.22 insects/ top 10cm twig). The highest mean population of thrips was observed during last week of March (16.48/top five leaves) and the thrips population was lower during last week of May (3.80/top five leaves). The highest mean population of whiteflies was observed during last week of July (77.25/ top 10cm twig) and the whitefly population was lowest during first week of March (00.00/ top 10cm twig). It was found that the whitefly population was significantly positively correlated with minimum temperature (C^0) and relative humidity (%) whereas thrips population was significantly negatively correlated with the weather parameters mentioned. However, mealy bug population for the same parameters were like the relation observed in case of whitefly, i.e. significantly positively correlated. The rest of the weather parameter was not having any significant correlation with the three important sucking pests of mulberry.

***Keywords*:** Morus alba, Population dynamics, sucking pests.

Introduction

Mulberry (*Morus* spp.) is the only basic food for silkworm, *Bombyx mori*. It is a perennial, deep rooted, fast growing and high biomass producing foliage plant and cultivated in all types of soils as either row, paired row or pit system. It thrives under various climatic conditions ranging from temperature to tropical located north of the equator between 280 N and 550 N latitude. Most of the Indian varieties of mulberry belong to *M. indica* which are utilized in silkworm rearing. Though mulberry cultivation is practiced in various climates, the major areas is in the tropical zone covering Karnataka, Andra Pradesh and Tamil Nadu states, with about 90 per cent production. In the sub-tropical zone, West Bengal, Himachal Pradesh and the North-eastern states have major areas under mulberry cultivation (Babu, 2006).

In India, the total production of mulberry silk was 690 MT in 1938, which increased to 8987 MT in 1987 and further rose to 14, 500 MT in the year 2000-2001.

As of the latest data in 2020-2021, the raw mulberry silk production has reached approximately 23, 896 MT (CSB-2020-21). In Bihar, mulberry production covered an area of 557 hectares in 2018-19, resulting in a raw mulberry silk production of 17 MT (Seri-states-profile-2019). India holds the second position as the world's largest silk producer. However, it accounts for only 14% of the global raw silk production (Giridhar *et al*., 2009).

The mulberry tree is highly valued for its economic significance and serves as a vital food source for silkworms. Jaiyeola and Adeduntan 2002, acknowledged mulberry as a crucial resource generation in sericulture. The leaves of the mulberry tree are abundant in protein, making them suitable for cattle feed and promoting milk production (Adeduntan and Oyerinde, 2010). The quantity of mulberry leaf production per unit area directly impacts the yield of cocoons, making it a pivotal economic factor in sericulture. The presence of morin, β-sitosterol and swallowing factors in mulberry leaves makes them the exclusive and essential food for mulberry silkworms (*Bombyx mori*) (Babu *et al*., 2006).

According to Narayanaswami (1996), approximately 300 species of insects and non-insect pests are known to feed on mulberry plants. Given that mulberry plants are perennial and monocultural techniques are used, the risk of pest infestation persists throughout the year (Santhi and Kumar, 2010). Various factors, such as environmental conditions, diet and microorganisms make silkworms susceptible to diseases, leading to a continuous year-round mortality rate and decreased cocoon production (Shashidhar *et al*., 2018). Mulberry trees face insect pests like mealy bugs, hairy caterpillars, thrips, cutworms and leaf Webbers, with the pink mealy bug being a significant menace. This pest not only affects the mulberry crop but also causes a specific disease called Tukra, resulting in a substantial loss of leaves estimated at 34.24% and 4500 kg/ha/year (Manjunath *et al*., 2003; Anonymous, 2019).

Thrips, mealy bugs and whiteflies are the primary sucking pests that affect mulberry trees throughout the year, consistently causing significant damage. Their presence and abundance lead to qualitative and quantitative losses in leaf yield, ranging from 10% to 25% in various seasons. Thrips in particular, have been responsible for a reported leaf damage of approximately 22.17%. Among the whiteflies found in mulberry, *Dialeuropoda dicempuncta* Quaintaince and Baker, as well as *Aleuroclava penta tuberculata* Sundararaj and David have been identified, collectively contributing to a leaf yield loss of around 24% (Lalitha *et al*., 2018).

Studying mulberry pests is of utmost importance, especially in regions where sericulture can serve as an alternative source of income to enhance the quality of life for tribal communities. Embracing mulberry sericulture on a larger scale can significantly improve the socioeconomic conditions in the area, considering its popularity. Ensuring the health of mulberry plants is essential for the success of sericulture and understanding the behavior of insect pests and effective control measures are vital for the prosperity of mulberry gardens.

Materials and Methods

The present investigation was conducted at the Advance Centre on Sericulture in Kishanganj, Bihar, from March to August 2023, to investigate the incidence of sucking pests in mulberry. Kishanganj district, geographically situated between 26°15'59.1"N and 88°01'49.3"E, with an average elevation of 55 meters above sea level, experiences three distinct seasons: summer, winter, and monsoon. The humid climate features temperatures ranging from 5°C in January to 41°C in May, with an average annual rainfall of 2250 mm, 80% of which occurs during the monsoon. Field experiments were carried out on an established mulberry (C-2038) garden. A fixed plot survey was conducted from March to August 2023, on unprotected mulberry plants, with weekly observations recorded from a fixed plot of eight plants, with data collected randomly within the plot. These observations were averaged on a per-plant basis, and the population dynamics of insect pests were correlated with weather parameters, including temperature, relative humidity, and rainfall, recorded at the agrometeorology observatory at Dr. Kalam Agricultural College. The experiment, conducted using a randomized block design, featured a plot size of 6 m × 2 m and included tools such as a hand lens, microscope, and scale. Pest populations were monitored using the absolute method, with adults and nymphs visually counted from a 10 cm section of twig on three randomly selected shoots, while thrips populations were recorded by examining the top five leaves of each plant with a hand lens.

Results

During the study of incidence of sucking pests of mulberry plants in Kishanganj, the insect pests in the field showed that a range of sucking pests, including mealy bug, thrips, and whitefly, were identified on mulberry plants at the research site during March to August 2023. Among these insects, mealy bugs emerged as the major sucking pests, while the other insects were considered secondary pests.

The different sucking pests observed during the study are listed in Plate 1. Table 1 provides details of the identified sucking pests, including the papaya mealy bug (*Paracoccus marginatus*) of the family Pseudococcidae and order Hemiptera, whitefly (*Tetraleurodes mori*) of the family Alyerodidae and order Hemiptera, and thrips (*Pseudodendrothrips mori*) of the Thripidae and order Thysanoptera.

The mealy bug population density was monitored in three replications from March to August 2023, revealed that the population was initially rare across all treatments but began to increase over time. The lowest mealy bug population was observed in the first two weeks of March (0.33 insects per top 10 cm twig), followed by the third week of March (0.44 insects per top 10 cm twig). The highest population was recorded in the last week of July (57.22 insects per top 10 cm twig), followed by the last week of August (57.00 insects per top 10 cm twig). After peaking in late July, the population declined abruptly before gradually increasing again, reaching nearly the same level in the last week of August.

The mean thrips population ranged from 4.50 to 16.48 thrips per top five leaves during March to August 2023 (Table 1). The highest mean population of thrips was observed during the last week of March (16.48 per top five leaves), followed by the third week of March (15.00 per top five leaves) and the last week of August (12.89 per top five leaves). The thrips population was lowest during the last week of May (3.80 per top five leaves), followed by the third and fourth weeks of June (4.50 per top five leaves). From Table 2, it is evident that the population incidence of thrips has a negative correlation with relative humidity and a significantly negative correlation with minimum and maximum temperatures.

Table 1: Incidence of Mealy bug population on mulberry plant from March to August, 2023

Date of reading	Mealy bug				Thrips				Whitefly			
	Mean	Standard Dev	Min	Max	Mean	Standard Dev	Min	Max	Mean	Standard Dev	Min	Max
09-03-2023	0.33	0.50	0.00	1.00	6.60	5.07	0.00	16.20	0.00	0.00	0.00	0.00
16-03-2023	0.33	0.50	0.00	1.00	14.70	4.50	10.80	24.30	0.11	0.33	0.00	1.00
23-03-2023	0.44	0.73	0.00	2.00	15.00	7.03	8.10	24.30	0.33	0.50	0.00	1.00
30-03-2023	0.67	0.71	0.00	2.00	16.48	6.41	8.10	25.00	0.22	0.67	0.00	2.00
06-04-2023	0.67	0.71	0.00	2.00	12.30	9.56	0.00	21.60	0.56	0.73	0.00	2.00
13-04-2023	0.56	0.53	0.00	1.00	14.70	6.90	2.70	24.30	0.11	0.33	0.00	1.00
20-04-2023	0.56	0.73	0.00	2.00	9.30	3.60	5.40	13.50	0.56	0.88	0.00	2.00
27-04-2023	0.78	0.67	0.00	2.00	6.90	4.07	2.70	13.50	2.00	2.09	0.00	6.75
03-05-2023	3.07	2.41	0.00	8.64	9.90	7.14	0.00	18.90	2.00	2.09	0.00	4.50
10-05-2023	4.03	4.57	0.00	13.82	9.30	7.65	0.00	18.90	3.50	3.40	0.00	11.25
17-05-2023	8.06	5.86	1.73	17.28	8.70	5.53	0.00	16.20	5.00	3.86	0.00	11.25
24-05-2023	9.41	7.44	1.73	20.74	7.50	6.72	0.00	18.90	6.50	6.60	2.25	18.00
31-05-2023	8.64	6.69	1.73	17.28	3.80	3.66	0.00	10.00	3.50	2.78	0.00	9.00
07-06-2023	8.26	4.12	3.46	13.82	4.89	4.71	0.00	10.80	8.00	8.28	0.00	22.50
14-06-2023	12.48	9.26	0.00	25.92	5.20	4.02	0.00	10.80	13.25	9.51	0.00	27.00
21-06-2023	20.54	8.35	8.64	32.83	4.50	1.91	2.70	8.10	27.50	12.96	0.00	42.75
28-06-2023	23.42	10.51	8.64	38.02	4.50	3.82	0.00	13.50	30.25	14.37	11.25	49.50
05-07-2023	20.93	8.83	8.64	38.02	11.70	5.40	0.00	18.90	16.25	13.58	0.00	40.50
12-07-2023	25.92	9.50	13.82	41.47	10.80	4.05	5.40	16.20	25.25	22.97	0.00	63.00
19-07-2023	35.71	15.01	8.64	58.75	8.40	3.68	2.70	13.50	42.75	32.39	0.00	101.25
26-07-2023	57.22	10.84	41.47	72.58	6.60	3.60	2.70	10.80	77.25	22.84	49.50	108.00
02-08-2023	30.14	10.66	17.28	48.38	10.20	2.95	5.40	13.50	56.00	16.05	27.00	76.50
09-08-2023	35.14	12.03	13.82	55.30	9.60	5.07	5.40	21.60	48.75	6.66	40.50	56.25
16-08-2023	53.95	7.27	39.74	60.48	10.20	6.85	2.70	24.30	52.00	13.52	31.50	72.00
23-08-2023	55.67	3.67	52.00	61.00	10.33	2.45	6.00	14.00	51.17	5.61	40.50	60.00
30-08-2023	58.22	3.99	51.00	64.00	12.89	2.26	10.00	17.00	53.39	6.01	40.50	60.00

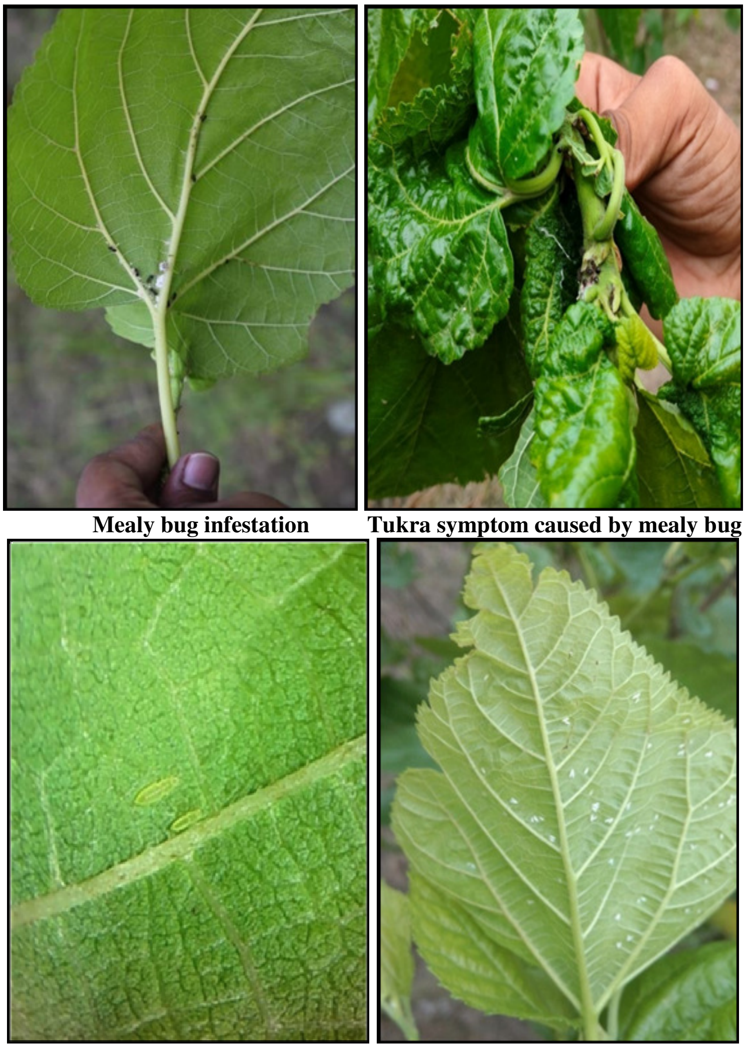

Fig. 1: Insect pest recorded in Mulberry field

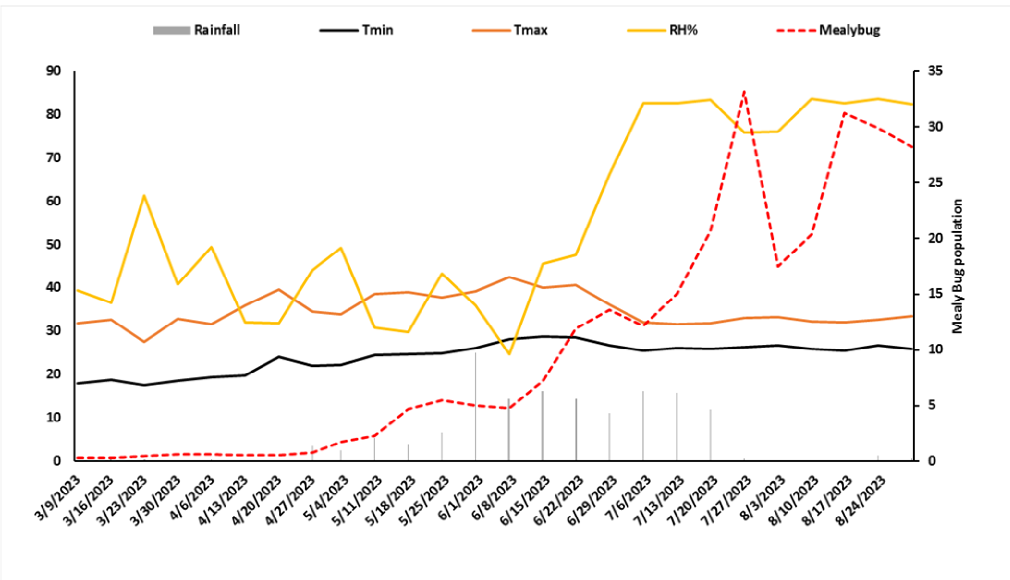

Fig. 2: Incidence of mealybug in relation to different weather parameter

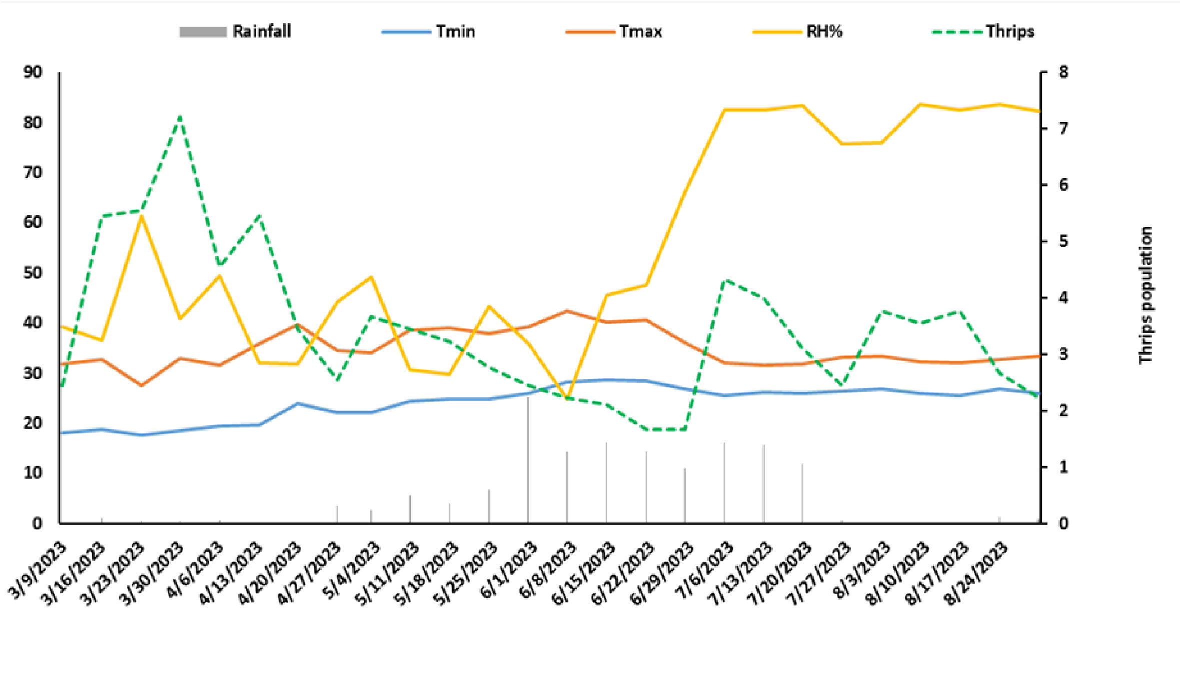

Fig. 3: Incidence of Thrips in relation different weather parameters

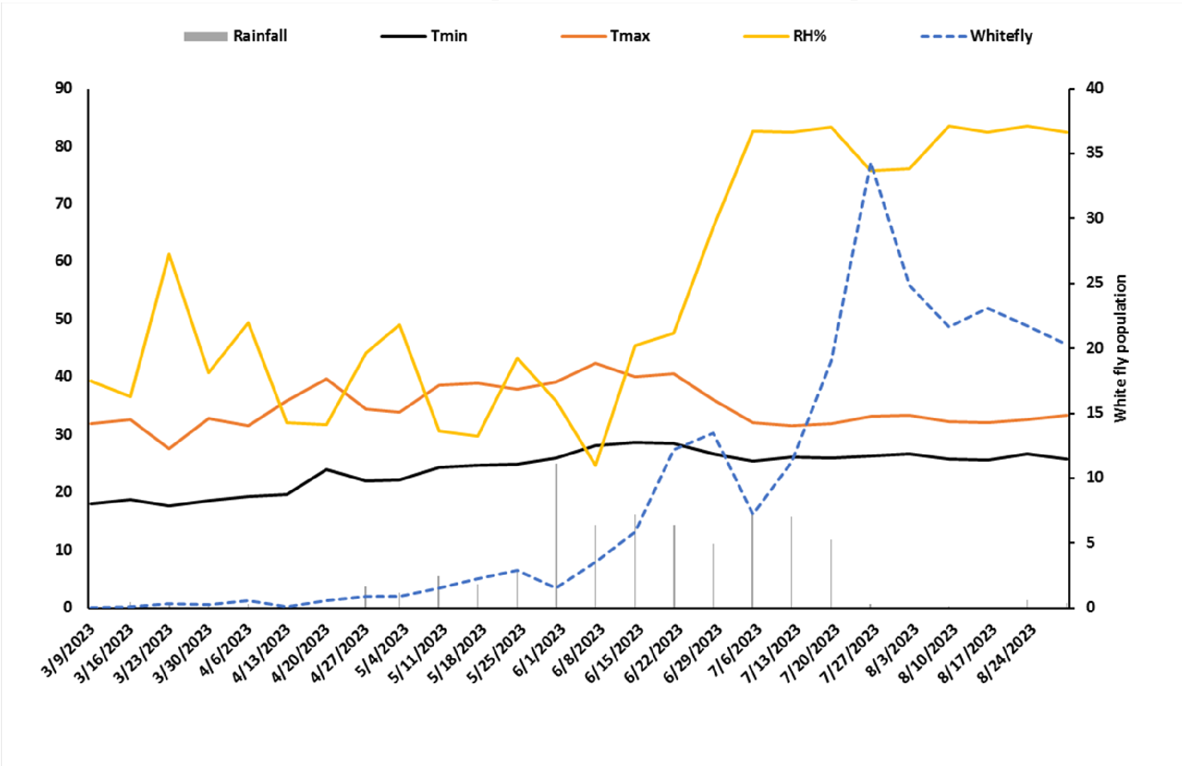

Fig. 4 : Incidence of whitefly in relation different weather parameters

Table 2: Correlation between weather parameters and different sucking insects of mulberry

Correlations				
	T min	**T max**	**RH**	**Rainfall**
Whitefly	0.573**	-0.257	0.800**	-0.114
Thrips	- 0.703**	- 0.496*	- 0.080	-0.401*
Mealybug	0.585**	-0.260	0.825**	-0.054

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Similarly, the mean whitefly population ranged from 0.00 to 77.25 whiteflies per top 10 cm twig during March to August 2023 (Table 1). The highest mean population of whiteflies was recorded during the last week of July (77.25 per top 10 cm twig), followed by the first week of August (56.00 per top 10 cm twig) and the last week of August (53.39 per top 10 cm twig). The whitefly population was lowest during the first week of March (0.00 per top 10 cm twig), followed by the second and third weeks of March (0.11 and 0.22 per top 10 cm twig, respectively). From Table 2, it is evident that the population incidence of whiteflies has a positive and significant correlation with minimum temperature and relative humidity, and a negative correlation with rainfall and maximum temperature.

The correlation analysis (Table 2) reveals that the population of sucking insects on mulberry plants is influenced by various weather parameters. The population incidence of whiteflies shows a positive and significant correlation with minimum temperature (0.573**) and relative humidity (0.800**), while it is negatively correlated with maximum temperature (-0.257) and rainfall (-0.114). Thrips exhibit a significantly negative correlation with minimum temperature (-0.703**) and maximum temperature (-0.496*), along with a negative correlation with rainfall (-0.401*), but show no significant correlation with relative humidity (-0.080). The mealybug population has a positive and significant correlation with minimum temperature (0.585**) and relative humidity (0.825**), whereas it is negatively correlated with rainfall (-0.054) and maximum temperature (-0.260). These findings highlight how specific weather variables can positively or negatively affect the population dynamics of different insect species.

These results are in close conformity with earlier reports of Manjunath *et al*. (2003) when the pink mealy bug, *Maconellicoccus hirsutus* infests mulberry plants the affected area swells and takes on a deep green color. This combination of symptoms is collectively known as the "tukra" symptom; Rahmathulla *et al*. (2015) studied on the influence of abiotic factors on the population of major pests in mulberry. Their research identified 15 species of defoliators, 11 species of sap suckers and two species each of borers, mites and termites infesting mulberry fields during various seasons; Basavana Gouda *et al*. (2013), described that papaya mealy bug, *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae), has emerged as a significant pest affecting mulberry in various regions of Karnataka.

These findings align with earlier studies by Ghosh *et al*. (2000), who reported thrips population distribution peaking on the third to fifth leaves from the top, correlating positively with elevated temperature, relative humidity, and rainfall. Lalitha *et al*. (2018) identified six major thrips species affecting mulberry in West Bengal, with *Pseudodendrothrips mori* being a primary pest in Tamil Nadu but minor in Karnataka and Andhra Pradesh. Jyothi (2012) observed that thrips, mites (*Polyphagotarsonemus latus*), and whitefly populations peaked during summer months, with spiraling whitefly (*Aleurodicus disperses*) infections reported in Tamil Nadu.

Rajagopal *et al*. 2001 reported that incidence of whitefly hitherto confined to horticultural crops and also fast spreading to mulberry crops. The population of the whitefly was observed to have a positive correlation with temperature but a negative correlation with humidity (Vijayakumari, 2014).

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Competing Interests

Authors have declared that no competing interests exist.

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