

ENTOMOLOGY

Spatial variation of important mulberry pests and their natural enemies

A. Mohan,¹ J. Ravikumar², D. Senthilkumar¹¹Department of Zoology, Kandaswami Kandar's College, Namakkal; ²Regional Sericultural Research Station, Salem, India

Abstract

Mulberry is a silkworm food plant (*Bombyxmori*. L) that is seriously affected by many insect pests. The incidence of *Diaphania pulverulentalis* (Hampson), *Maconellicoccus hirsutus* (Green), *Paracoccus marginatus* (Williams and Granara de Willink), *Aleurodiscus dispersus* (Russels) and *Pseudodendrothrips mori* (Niwa) and their natural enemies, viz. coccinellids and spiders (/100 plants), were observed through survey and surveillance for 3 months. In February 2013, the incidence of insect pests in Vaikkalpattarai and Reddipudur villages (India) was: *D. pulverulentalis*, 1.20 and 0.85%; *P. marginatus*, 6.80 and 33.10%; *P. mori* 42.98 and 45.50%, respectively. Further, the infestation of *M. hirsutus* (1.40%) and *A. dispersus* (59.72%) was also observed in February at Vaikkalpattarai. The population of coccinellids was high in December (1.02 and 0.84/100 plants), but the spider population was even higher in February and January (1.04 and 1.81/100 plants). Population of pests had a significant positive correlation with relative humidity. The population of coccinellids and spiders have positive correlation with temperature and mulberry pests infestation. The natural enemies observed in the study were mostly the ladybird beetles, *Psyllobora bisoetonota* and unidentified species of spiders.

Correspondence: Mohan Arthanari, Department of Zoology, Kandaswami Kandar's College, Namakkal, Tamil Nadu, India.
Tel.: +91.9443.982040.
E-mail: elur.mohan@gmail.com

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Introduction

Like other agricultural crops, mulberry is also prone to attack by many insect pests, which cause quantitative and qualitative damage resulting in a decrease in sericultural productivity. According to Narayanaswamy (1996), more than 300 insects and non-insect species of pests are known to attack mulberry. The important pests of mulberry are mealy bugs, leaf webber, thrips, Bihar hairy caterpillar and cut worms (Carsai *et al.*, 2014). Among these, pink mealy bug (*Maconellicoccus hirsutus*) is a major pest-causing *tukra* in mulberry. The average incidence and loss in mulberry leaf yield caused by these pests is estimated to be 34.24% and 4500 kg/ha/year (Manjunath *et al.*, 2003). In this study an attempt was made to find the occurrence of five major pests and their natural enemies in mulberry fields at Salem and Namakkal districts of Tamil Nadu.

Materials and Methods

A survey on the incidence of five major mulberry pests and natural enemies was carried out at Salem and Namakkal, the two major sericultural districts in Tamil Nadu (<http://tnsericulture.gov.in/sericultureNov12/BriefNoteOnSericulture.htm>). The observations were made at weekly intervals for about three months (December 2012 – February 2013). The study was conducted in Randomized Block Design at Regional Sericultural Research Station (RSRS), Central Silk Board, Vaikkalpattarai in Salem District and Reddipudur village in Namakkal District. In each village, a mulberry gardens was chosen for study. The 100 plants (20each in 4 corners and 20 plants in centre of the plot) were observed for a week in each holding. The natural enemies of mulberry pests were identified with the help of the website http://www.angelfire.com/bug2/j_poorani/. Meteorological data such as temperature, relative humidity and rainfall during the study period were also recorded to assess the influence of these factors on the pest and natural enemies incidence. The correlation coefficients were worked out by using the GNU PSPP statistical software (Version 0.7.9 for Linux Mint 17.1).

Results

Table 1 shows the temperature, relative humidity and rainfall in Vaikkalpattarai and Reddipudur (India) during the study period (December 2012 – February 2013). The lowest (24.77°C) and

highest (28.29°C) temperature was recorded in Vaikkalattarai and Reddipudur during Jan 2013 and Feb 2013 respectively. The relative humidity (RH) was higher in Vaikkalattarai than Reddipudur (less than 50%). There was light rain (0.09-0.32 mm) in Vaikkalattarai and no rainfall was registered in Reddipudur during our work (Figure 1).

The incidence of mulberry pests such as Leaf Webber (*D. pulverulentalis*), Pink mealy bug (*M. hirsutus*), Papaya mealy bug (*P. marginatus*), Spiralling white fly (*A. dispersus*), Thrips (*P. mori*) was recorded in Table 2. The incidence of pests was higher in Vaikkalattarai (5 species) than Reddipudur (3 species). Occurrence of *P. mori* gradually increased from Dec 2012 to Feb 2013 in both stations, similarly the *A. dispersus* in Vaikkalattarai, *P. marginatus* in Reddipudur showed increased trend in the same period (Figure 2).

The occurrence of natural enemies such as Coccinellids and spiders in the mulberry fields of Vaikkalattarai and Reddipudur was also recorded in Table 2. The occurrence of Coccinellids was highest in first two months of our study period and lowest in the last month.

But the spider population was high in Feb 2013 in Vaikkalattarai and Jan 2013 in Reddipudur (Figure 3).

Table 3 indicated the correlation between weather factors, mulberry pests and their natural enemies at Vaikkalattarai station. There was no correlation between temperature and relative humidity, but temperature was well correlated with pest *A. dispersus* (0.70), *P. marginatus* (0.67) and natural enemy spider (0.63). Relative Humidity showed positive correlation with Rainfall (0.98), Coccinellids (0.96) and negative correlation with all pests and spiders. Rainfall had negative correlation with all pests and spiders and positive correlation with Coccinellids population (0.88). All the mulberry pests showed positive correlation with spiders and negative correlation with Coccinellids in Vaikkalattarai station.

Temperature showed positive correlation with mulberry pests (*D. pulverulentalis* 1.00; *P. marginatus* 0.70; *P. mori* 0.95) and negative correlation with their natural enemies (Coccinellids and spiders, -0.99). In Reddipudur, there was negative correlation between pests and their enemies (Table 4).

Table 1. Meteorological data on Vaikkalattarai village (Salem district) and Reddipudur village (Namakkal district).

	Vaikkalattarai village			Reddipudur village		
	Dec 2012	Jan 2013	Feb 2013	Dec 2012	Jan 2013	Feb 2013
Avg temp (°C)	25.69	24.77	26.68	26.02	26.08	28.29
Avg RH (%)	60.26	50.22	51.03	48.03	47.99	44.1
Rainfall (mm)	0.32	0	0.09	0	0	0

Table 2. Incidence of pests and natural enemies in Vaikkalattarai village (Salem district) and Reddipudur village (Namakkal district).

	Vaikkalattarai village			Reddipudur village		
	Dec 2012	Jan 2013	Feb 2013	Dec 2012	Jan 2013	Feb 2013
<i>D. pulverulentalis</i>	0.60	1.07	1.20	0.57	0.59	0.85
<i>P. marginatus</i>	3.47	4.59	6.80	22.78	30.60	33.10
<i>M. hirsutus</i>	0.30	0.84	1.40	0.00	0.00	0.00
<i>P. mori</i>	5.60	29.68	42.98	14.99	25.27	45.50
<i>A. dispersus</i>	8.52	23.67	59.72	0.00	0.00	0.00
Coccinellids	1.02	0.52	0.38	0.84	0.74	0.28
Spiders	0.36	0.92	1.81	0.95	1.04	0.46

Table 3. Correlation coefficients (r) of weather factors vis-a-vis Mulberry pest's infestation and natural enemies in Vaikkalattarai village of Salem district.

	Avg temp	Avg RH	Rainfall	<i>D. pulverulentalis</i>	<i>P. marginatus</i>	<i>M. hirsutus</i>	<i>P. mori</i>	<i>A. dispersus</i>	Coccinellids	Spiders
Avg temp	1.00	0.05	0.25	0.23	0.67	0.53	0.37	0.70	-0.23	0.63
Avg RH		1.00	0.98	-0.96	-0.71	-0.82	-0.91	-0.68	0.96	-0.75
Rainfall			1.00	-0.89	-0.55	-0.69	-0.81	-0.51	0.88	-0.60
<i>D. pulverulentalis</i>				1.00	0.88	0.95	0.99	0.85	-1.00	0.90
<i>P. marginatus</i>					1.00	0.98	0.94	1.00	-0.88	1.00
<i>M. hirsutus</i>						1.00	0.98	0.98	-0.95	0.99
<i>P. mori</i>							1.00	0.92	-0.99	0.96
<i>A. dispersus</i>								1.00	-0.85	0.99
Coccinellids									1.00	-0.90
Spider										1.00

Discussion

A positive correlation between temperature and mulberry pests is in agreement with previous studies (Mahimasanthi *et al.*, 2015). Here it is proved that increase in temperature increases the mealy bug population and infestation, but prolonged high temperature for longer period reduces mealy bug infestation. This is in agreement with well defined temperature limits observable in arthropods, beyond which mortality is observed, as expected in ectoderm animals (Aswathi, 1997; Hemalatha & Shree, 2008). This study demonstrated also that Pink mealy bug may cause damage to the mulberry crop throughout the year, as opposite to other findings (Benchamin *et al.*, 1997) where a maximum damage ranging from 0.79 to 11.69 % of severity was observed from July to August.

In the present study relative Humidity showed negative correlation with all mulberry pests. Similar results were reported by other authors (Mani & Thontadarya, 1987; Narendra Kumar *et al.*, 2006; Rahmathulla *et al.*, 2015) in different areas of Southern India. The infestation of the pest however, was low during rainy and winter season. This could be due to the fact that in cooler climate, females remain inactive in sheltered parts of plants or over-winter in the egg stage.

Rainfall in Vaikkalpattarai station shows negative correlation with all mulberry pests. Venugopalapillai & Krishnaswami (1983) reported that high rainfall and humidity were not favourable for thrips resulting in low peaks of thrips population on mulberry.

D. pulverulentalis infestation in Vaikkalpattarai and

Reddipudur was the least serious in the study period. But many workers (Sengupta *et al.*, 1990; Siddegowda *et al.*, 1995; Geethabai *et al.*, 1997; Rajadurai *et al.*, 1999) reported a high percentage of infestation caused by lepidopteran leaf roller *D. pulverulentalis* in the south of India during rainy and winter months.

During the study period the spider population was abundant only in January and February 2013 in both stations. The effect of a

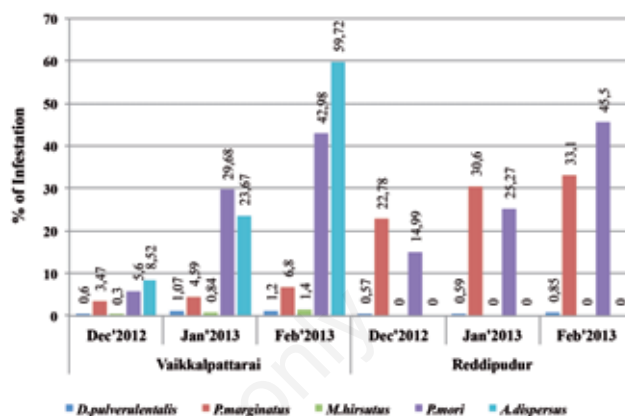


Figure 2. Incidence of pests in Vaikkalpattarai village (Salem district) and Reddipudur village (Namakkal district).

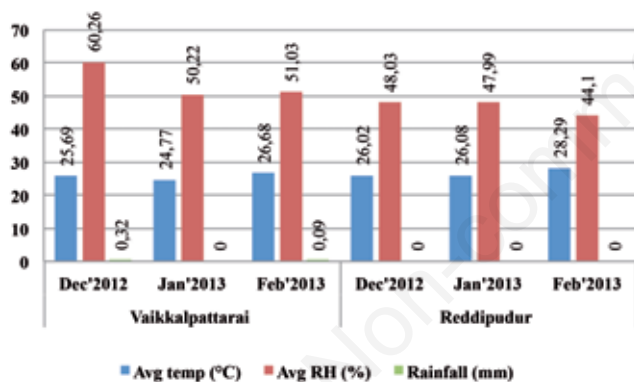


Figure 1. Meteorological data of Vaikkalpattarai village (Salem district) and Reddipudur village (Namakkal district).

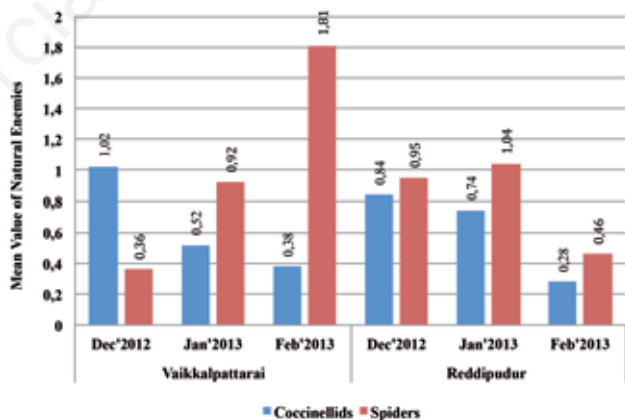


Figure 3. Mean Value of Natural enemies in Vaikkalpattarai village (Salem district) and Reddipudur village (Namakkal district).

Table 4. Correlation coefficients (r) of weather factors vis-a-vis Mulberry pest infestation and natural enemies in Reddipudur village of Namakkal district.

	Avg temp	Avg RH	<i>D. pulverulentalis</i>	<i>P. marginatus</i>	<i>P. mori</i>	Coccinellids	Spider
Avg temp	1.00	-1.00	1.00	0.70	0.95	-0.99	-0.99
Avg RH		1.00	-1.00	-0.69	-0.95	0.99	0.99
<i>D. pulverulentalis</i>			1.00	0.73	0.96	-0.99	-0.98
<i>P. marginatus</i>				1.00	0.89	-0.80	-0.58
<i>P. mori</i>					1.00	-0.99	-0.89
Coccinellids						1.00	0.95
Spider							1.00

spider species on a pest population may be enhanced if the spider population increases rapidly in response to a rich supply of nutritious alternative prey (Jeffries & Lawton 1984; Axelsen *et al.*, 1997). Spiders play a key role, together with the other dominant natural enemies, in suppressing pest populations (Zhang, 1992). Small pests, such as thrips, midges and aphids, may die by being caught in the webs of large spiders, even when they are ignored by the spider (Nentwig, 1987). The spider population might even kill more pests than if the pests were a high-quality preferred prey, because spiders would remain unsatiated (Alderweireldt, 1994). Coccinellids such as *Synona rougeti* Mulsant, *Epilachna vigintioctopunctata* Fabricius, *Cheilomenes sexmaculata* Fabricius, *Nephus lentiformis*, *Illeis bielawskii* Ghorpade, *Psyllobora bisoctonotata* Mulsant control the pest populations in the mulberry fields of present study. Our results are in agreement with the finding other authors (Cock, 1985; Kumashiro *et al.*, 1983; Ignacimuthu, 2002).

Conclusions

The different geographical position of the two stations and the abiotic factors – temperature, relative humidity and rainfall influenced the changes in the pest and natural enemies populations of mulberry fields.

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