Pest Management in Horticultural Ecosystems
Vol. 31, No.1 pp 16-23 (2025)
DOI Number : 10.5958/0974-4541.2025.00003.0

Population dynamics of major insect pests of cashew and their associated natural enemies

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ABSTRACT: Studies on the population dynamics of major insect pests of cashew and their associated natural enemies were conducted during 2021-22 at Zonal Agricultural and Horticultural Research Station (ZAHRS), Shivamogga, Karnataka, India. During the study, leaf miner, *Acrocercops syngramma* Meyrick, tea mosquito bug, *Helopeltis* spp. and thrips, *Scirtothrips dorsalis* Hood were found to be major pests. Leaf miner was predominant with a peak population of 4.54 larvae per 20 leaves during fourth week of November with highest per cent leaf incidence of 22.70. Tea mosquito bug was found at new flushing and panicle stage with peak activity during second week of December with 6.50 bugs per 20 shoots with peak per cent incidence of 32.75. Thrips occurred both at panicle and nut stage with peak population during third week of February (6.70/20 panicles) and peak per cent incidence on nut surface during first week of April (33.75 %). There was a positive correlation of leaf miner and tea mosquito bug with minimum temperature, morning relative humidity, evening relative humidity, sunshine hours and negative correlation with maximum temperature and rainfall, whereas thrips showed positive correlation with maximum temperature, sunshine hours and negative correlation with rainfall, minimum temperature, morning relative humidity and evening relative humidity at ZAHRS, Shivamogga. The natural enemies on insect pests of cashew included predators *viz*., mantidflies, *Coccinella transversalis* (Fabricius), *Chrysoperla* sp., red ants, *Oecophylla* sp. and hover flies, *Ischiodon scutellaris* (Fabricius).

Keywords: Cashew, leaf miner, tea mosquito bug, thrips, natural enemies

INTRODUCTION

Cashew, *Anacardium occidentale* L., a native of Brazil, was introduced to India by Portuguese travelers during the 16th century for afforestation and soil conservation purposes. In India, cashew is cultivated in an area of 10.62 lakh hectares with a total production of 6.91 lakh tonnes with a productivity of 706 kg/ha during 2020-21. In Karnataka, cashew is cultivated in an area of 1.26 lakh hectares with a total production of 0.53 lakh tonnes with a productivity of 461 kg/ha during 2020-21 (Anonymous, 2020). Cashew production is affected by various biotic and abiotic factors. Among the biotic factors, the insect pests are one of the major limiting factors causing a crop loss of about 30 to 40 per cent. More than 180 insect pests attack cashew, of which cashew leaf miner is of considerable importance (Beevi *et al*., 1993). Cashew is attacked by more than one species of insects, mites and vertebrates in India, among which the cashew stem and root borer (CSRB), tea mosquito bug (TMB) and foliage and flower insects (like thrips, leaf caterpillar and leaf miner) are important limiting factors (Sundararaju, 1993b). Many insect pests and their natural enemies are found in cashew crops. Among which, the main pests are *Helopeltis antonii* Signoret, *Plocaederus ferrugineus* L. and considerable damage was also caused by *Scirtothrips dorsalis* Hood, *A. syngramma* Meyrick, *Hypatima haligramma* Meyrick, *Lamida moncusalis* Walker and *Thylacoptila paurosema* Meyrick. *H. antonii* is preyed by five species of spiders and a cocinellid. Larvae of *A. syngramma* are parasitized by the Eulophid and *Sympiesis* sp. (Sundararaju, 1993a). In this view, the study was conducted to record the major insect pests of cashew and their associated natural enemies.

MATERIALS AND METHODS

Experiment was conducted at Agricultural and Horticultural Research Station (AHRS), Bavikere and Zonal Agricultural and Horticultural Research Station (ZAHRS), Shivamogga. Observations on seasonal incidence on major insect pests of cashew were carried out throughout the year. Observations on cashew pests

and its natural enemies were recorded at weekly intervals by selecting five seedlings in nursery and five trees in the main field randomly. A well maintained 15 years old plantation was used for studying population dynamics of major insect pests of cashew. In nursery, in each seedling, five leaves were observed for leaf miner larvae and mean number of larvae per plant was calculated. The data were subjected to suitable statistical analysis and correlated with the weather parameters following the methods of Gomez and Gomez (1984). In cashew orchard, observations on leaf miner larvae were recorded by selecting four branches in each tree bearing new flushes covering all the four directions. From each newly flush bearing branch, five leaves from each side, totally 20 leaves were selected for counting the leaf miner larvae. Per cent infestation was worked out by using formula, Infestation (%) = Number of infested leaves/ Total no. of observed leaves×100. Observations on tea mosquito bug was recorded by selecting five shoots in each tree from each direction and totally 20 shoots from four directions per tree were selected to record TMB damage (in total 100 shoots from five trees). The per cent incidence was worked out by using the formula, Per cent incidence = Sum of all numerical ratings/No. of shoots observed×maximum rating×100. Infestation of thrips was recorded during nut stage on the panicle and nut surface. In each tree, 20 panicles and 20 fruits were selected randomly (in total 100 nuts and 100 panicles from five trees). Mean number of thrips per panicle was recorded and per cent incidence, based on the nut surface damaged, was recorded by using the formula, Per cent Nut surface Damaged = Sum of numerical scoring/ Maximum scoring×Number of nuts observed×100. Natural enemies were collected from affected insect stages from cashew nursery and field.

RESULTS AND DISCUSSION

During the study period, 22 species of insect pests were found infesting cashew plantation (Table 1). Among these, leaf miner, *Acrocercops syngramma* (Meyrick), tea mosquito bug, *Helopeltis* spp. and thrips, *Scirtothrips dorsalis* Hood (Plate 1, 2 and 3) were found as major insect pests of cashew. The mean of weekly observations on incidence and per cent infestation of leaf miner, tea mosquito bug and thrips were recorded on cashew at College of Agriculture, Shivamogga during 2021-2022 and presented in Table 2. The leaf miner incidence mainly occurred in new flush stage of cashew from October, 2021 to February, 2022 and reached its peak with 4.54 larvae/20 leaves in fourth week of November. Peak per cent incidence of leaf miner was found during the fourth week of November (22.70) and minimum per cent incidence was noticed during the third week of February (1.30). These findings are in close agreement with Rao *et al*. (2006) who reported that the leaf miner (*A. syngrammma*) incidence was at its peak during the second week of December with nil infestation during May-June and lowest incidence during July. This is also in agreement with Athalye and Pati1 (1999) who reported that the incidence of the cashew leaf miner was found throughout the year in Maharashtra with peak incidence (18.21 %) during September on post monsoon vegetative flush. The TMB incidence occurred both at new flushing and panicle stage of cashew from October, 2021 to February, 2022 and peak activity was found during second week of December with 6.50 bugs per 20 shoots. Maximum per cent incidence of TMB was noticed during second week of December (32.75) and minimum per cent incidence was recorded during second week of February (4.50). This finding is in close line with the findings of Vidya *et al*. (2015) who reported that TMB was abundant during flushing to fruiting stage of the cashew. Sathapathy (1993) also reported the peak incidence of TMB during January with shoot and panicle damage with the 42.80 and 19.20 per cent, respectively which is also in line with present research findings. The prevalence of thrips occurred both in panicle and nut stage of cashew during December, 2021 to May, 2022 and peak population was found during third week of February with 6.70 thrips/20 panicles. Peak per cent incidence of thrips was noticed during first week of April (33.75) and minimum per cent incidence was recorded during second week of February (1.75). These findings are in line with Sundararaju (1984) who noticed the peak incidence of thrips during December to February in Goa. The leaf miner incidence was studied in nursery stage of cashew during 2021 at AHRS, Bavikere and it was represented in table 3. Peak population of 4.13 larvae was recorded during the third week of November with peak per cent incidence of 16.50. Minimum population was recorded during first week of October with 0.91 larvae per 25 leaves with least per cent incidence of 3.64. These results are in close line with Sundararaju (1984) who reported that leaf miner incidence started during July and reached its peak by November to December. The incidence of major insect pests of cashew were correlated with various weather parameters *viz*., maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rain fall and sun shine hours recorded at ZAHRS, Shivamogga and

Table 1. Insect pests recorded on cashew at ZAHRS, Shivamogga during 2021-22

Common Name	Scientific Name	Plant parts affected	Order: Family
Leaf miner	*Acrocercops syngramma* (Meyrick)	Leaf	Lepidoptera: Gracillariidae
Leaf roller	*Caloptilia iselaea* (Meyrick)	Leaf	Lepidoptera: Tortricidae
Leaf and blossom webber	*Lamida moncusalis* Walker	Leaf and panicle	Lepidoptera: Pyralidae
Apple and nut borer	*Thylacoptila paurosema* (Meyrick)	Immature fruits and nuts	Lepidoptera: Pyralidae
Hairy caterpillar	*Euproctis subnotata* Walker	Leaf and panicle	Lepidoptera: Lymantridae
Tea mosquito bug	*Helopeltis antonii* Signoret	Leaf, panicle and nuts	Hemiptera: Miridae
Tea mosquito bug	*Helopeltis bradyi* Waterhouse	Leaf, panicle and nuts	Hemiptera: Miridae
Mealy bug	*Planococcus citri* Risso	Leaf, panicle and nuts	Hemiptera: Pseudococcidae
Aphids	*Aphis odinae* (van der Goot)	Panicle and nuts	Hemiptera: Aphididae
Scale insect	*Coccus hesperidum* L.	Leaf and nuts	Hemiptera: Coccidae
Brown marmorated stink bug	*Halyomorpha halya* (Stal)	Leaf and Shoot	Hemiptera: Pentatomidae
Gundhi bug	*Leptocorisa acuta* (Thunberg)	Shoot	Hemiptera: Alydidae
Planthopper	*Amrasca biguttala biguttala* (Ishida)	Leaf and shoot	Hemiptera: Cicadellidae
Red banded thrips	*Selenothrips* sp.	Leaf	Thysanoptera: Thripidae
Thrips	*Scirtothrips dorsalis* Hood	Panicle and nuts	Thysanoptera: Thripidae
Long horned grass hopper	*Conocephalus* sp.	Leaf and shoot	Orthoptera: Tettigonidae
Cashew stem and root borer	*Plocederus ferrugenius* L.	Stem and root	Coleoptera: Cerembycidae
Fruit beetle	*Carpophilus* sp.	Apples	Coleoptera: Nitidulidae
Tortoise beetle	*Aspidomorpha* sp.	Leaf	Coleoptera: Chrysomelidae
Weevil	*Myllocerus* sp.	Leaf and trunk	Coleoptera: Curculionidae
Fruit fly	*Drosophila* sp.	Apples	Diptera: Drosophilidae
Termite	*Odontotermus* sp.	Stem and roots	Isoptera: Termitidae

AHRS, Bavikere during 2021-22 and represented in table 4. Correlation studies with weather parameters revealed that maximum temperature (r = -0.178) and rainfall (r = -0.041) had non-significant negative correlation and all the other weather parameters *viz*., minimum temperature (r = 0.321), morning relative humidity (r = 0.282), evening relative humidity (r = 0.314) and sun shine hours (r = 0.022) had non-significant positive correlation with the occurrence of leaf miner. These results are in line with Rao *et al*. (2006) who reported negative and non-significant correlation between the leaf miner incidence and maximum temperature (-0.427) and positive and non-significant correlation with morning relative humidity (0.248). The incidence of tea mosquito bug had significant positive correlation with minimum temperature (r = 0.600*). These results are in line with Vidya *et al.* (2015) who revealed that sunshine hours had a positive relation (0.516) with the activity of TMB. The occurrence of thrips had highly significant negative correlation with evening relative humidity (r = -0.757**) and significant positive correlation with sun shine hours (r = 0.506). These results are in agreement with

a. Infested young leaves

b. Young larvae scraping the leaves

c. Adult of *Acrocercops syngramma*

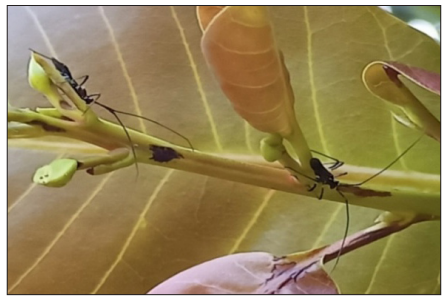
d. Matured larva before pupation

e. Infested leaves in nursery

Plate 1. Leaf miner, *Acrocercops syngramma* damage in the field and nursery

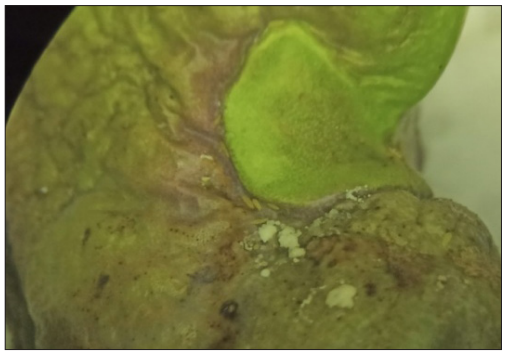
a. *Helopeltis antonii*

b. *Helopeltis bradyi*



c. Infestation of adult tea mosquito bugs on shoots

Plate 2. Damaging symptoms of tea mosquito bug, *Helopeltis* spp. on shoots, leaf stalks, immature fruits and nuts



a. Infestation of thrips, *Scirtothrips dorsalis* on nut surface

b. Crinkling symptoms

Plate 3. *Thrips, Scirtothrips dorsalis* damaging symptoms on nut surface

Table 2. Seasonal and per cent incidence of leaf miner (LM), tea mosquito bug (TMB) and thrips on cashew at ZAHRS, Shivamogga during 2021-22

SMW	Time		Mean No. of LM larvae/20 leaves	Per cent incidence of LM/20 leaves	Mean No. of TMB/20 shoots	Per cent incidence of TMB/20 shoots	Mean No. of Thrips/ 20 panicles	Per cent incidence of thrips/20 nuts
	Month	Week						
35	September (2021)	I	0.00	0.00	0.00	0.00	0.00	0.00
36		II	0.00	0.00	0.00	0.00	0.00	0.00
37		III	0.00	0.00	0.00	0.00	0.00	0.00
38		IV	0.00	0.00	0.00	0.00	0.00	0.00
39	October	I	0.00	0.00	0.00	0.00	0.00	0.00
40		II	0.00	0.00	0.00	0.00	0.00	0.00
41		III	0.00	0.00	0.00	0.00	0.00	0.00
42		IV	1.06	5.30	0.00	0.00	0.00	0.00
43		V	1.96	9.80	1.04	5.25	0.00	0.00
44	November	I	2.30	11.50	1.75	8.75	0.00	0.00
45		II	2.42	12.10	2.85	14.25	0.00	0.00
46		III	3.71	18.55	4.55	22.75	0.00	0.00
47		IV	4.54	22.70	4.80	24.25	0.00	0.00
48	December	I	4.33	21.65	5.49	27.25	0.00	0.00
49		II	3.47	17.35	6.50	32.75	0.00	0.00
50		III	2.69	13.45	6.05	31.75	0.07	0.00
51		IV	2.49	12.45	5.50	27.50	0.10	0.00
52		V	2.21	11.05	4.70	23.50	0.35	0.00
1	January (2022)	I	1.88	9.40	4.50	22.50	0.85	0.00
2		II	1.69	8.45	3.55	17.75	1.50	0.00
3		III	1.29	6.45	2.90	14.50	3.40	0.00
4		IV	1.07	5.35	1.95	9.75	4.08	0.00
5	February	I	0.79	3.95	1.70	8.50	5.65	0.00
6		II	0.60	3.00	0.90	4.50	6.30	1.75
7		III	0.26	1.30	0.00	0.00	6.70	2.25
8		IV	0.00	0.00	0.00	0.00	5.90	4.25
9	March	I	0.00	0.00	0.00	0.00	4.55	7.50
10		II	0.00	0.00	0.00	0.00	3.35	17.25
11		III	0.00	0.00	0.00	0.00	2.25	24.00
12		IV	0.00	0.00	0.00	0.00	1.30	28.25
13		V	0.00	0.00	0.00	0.00	0.45	33.00
14	April	I	0.00	0.00	0.00	0.00	0.00	33.75
15		II	0.00	0.00	0.00	0.00	0.00	29.27
16		III	0.00	0.00	0.00	0.00	0.00	23.00
17		IV	0.00	0.00	0.00	0.00	0.00	16.75
18	May	I	0.00	0.00	0.00	0.00	0.00	11.25
19		II	0.00	0.00	0.00	0.00	0.00	6.50
20		III	0.00	0.00	0.00	0.00	0.00	2.25
21		IV	0.00	0.00	0.00	0.00	0.00	0.00

***SMW- Standard Meteorological Week**

Table 3. Seasonal and per cent incidence of leaf miner in cashew nursery at AHRS, Bavikere during 2021

SMW	Time		Mean No. of larvae/25 leaves	Per cent incidence
	Month	Week		
30	July (2021)	IV	1.68	6.72
31	August	I	1.96	7.84
32		II	2.06	8.22
33		III	1.73	6.92
34		IV	1.27	5.08
35	September	I	1.82	7.26
36		II	2.38	9.50
37		III	2.63	10.52
38		IV	2.02	8.06
39	October	I	0.91	3.64
40		II	1.18	4.70
41		III	1.46	5.84
42		IV	1.88	7.52
43		V	2.08	8.30
44	November	I	2.36	9.44
45		II	3.07	12.26
46		III	4.13	16.50
47		IV	3.52	14.06
48	December	I	4.02	16.08
49		II	2.98	11.92
50		III	2.56	10.22
51		IV	2.27	9.08
52		V	1.06	4.24

***SMW- Standard Meteorological Week**

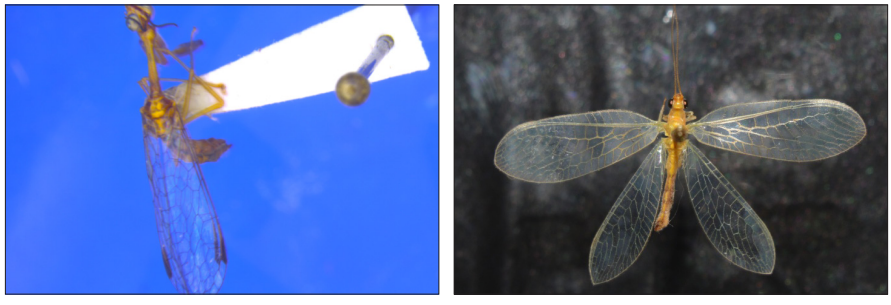
Table 4. Correlation of major insect pests of cashew with weather parameters during 2021-22

Insect pests	Correlation coefficient (r) (ZAHRS, Shivamogga)					
	Temperature (°C)		Relative humidity (%)		Rainfall (mm) (X_5)	Sun shine hours (X_6)
	Max T° (X_1)	Min T° (X_2)	RH I (X_3)	RH II (X_4)		
Acrocercops syngramma	-0.178	0.321	0.282	0.314	-0.041	0.022
***Helopeltis* spp.**	-0.427	0.600*	0.456	0.444	-0.109	0.029
Scirtothrips dorsalis	0.350	-0.135	-0.385	-0.757**	-0.250	0.506*
Insect pest	**Correlation coefficient (r) (AHRS, Bavikere)**					
	Temperature (°C)		**Relative humidity (%)**		**Rainfall (mm) (X_5)**	**Sun shine hours (X_6)**
	Max T° (X_1)	**Min T° (X_2)**	**RH I (X_3)**	**RH II (X_4)**		
Acrocercops syngramma	-0.111	-0.239	-0.461*	-0.625**	-0.293	0.063

****Significant at 1% level; *Significant at 5% level; R^2 = Coefficient of determination**

X_1 = Maximum temperature, X_2 = Minimum temperature, X_3 = Morning relative humidity, X_4 = Evening relative humidity, X_5 = Sun shine hours and X_6 = Rainfall

a. ***Ischiodon scutellaris*** **b.** ***Coccinella transversalis*** **c.** ***Oecophylla*** **sp.**



d. Mantidfly **e.** ***Chrysoperla*** **sp.**

Plate 4. Natural enemies in cashew ecosystem

Table 5. Natural enemies recorded on insect pests of cashew during 2021-22

Common Name/ Scientific Name	Family: Order	Host	Collected from (Stage)
Mantidflies (Unidentified)	Mantispidae: Neuroptera	Tea mosquito bug, *Helopeltis* spp.	Nymphs and adults
Lady bird beetle (*Coccinella transversalis*)	Coccinellidae: Coleoptera	Aphids, *Aphis odinae*	Nymphs and adults
Green lace wing (*Chrysoperla* sp.)	Chrysopidae: Neuroptera	Tea mosquito bug, *Helopeltis* spp. and thrips, *Scirtothrips dorsalis*	Nymphs and adults
Red ants (*Oecophylla* sp.)	Formicidae: Hymenoptera	Tea mosquito bug, *Helopeltis* spp., Mealy bugs, *Planococcus citri* and aphids, *Aphis odinae*	Nymphs and adults
Hover flies (*Ischiodon scutellaris*)	Syrphidae: Diptera	Aphids, *Aphis odinae*	Nymphs and adults

Jalgaokar *et al*. (2015) who revealed that the maximum temperature (0.423) and sunshine hours had positive correlation (0.482), whereas, the minimum temperature (-0.263) and the rainfall (-0.382) had non-significant negative correlation with the red banded thrips incidence. The leaf miner incidence had highly significant negative correlation with evening relative humidity (r = -0.625**) and significant negative correlation with morning relative humidity (r= -0.461*) in cashew nursery. These results are in line with Rao *et al*. (2006) who reported negative and non-significance correlation between the leaf miner incidence and maximum temperature (-0.427). The natural enemies recorded on insect pests of cashew included, different predators *viz*., mantidflies, *Coccinella transversalis, Chrysoperla* sp., red ants, *Oecophylla* sp. and hover flies, *Ischiodon scutellaris* (Plate 4) (Table 5). These results are in line with Sundararaju (1984) who reported that neuropteran predator, *Chrysoperla* was found to feed on tea mosquito bugs in the field. Sundararaju (1993a) also reported that *Helopeltis antonii* was preyed upon by five species of a spiders and a cocinellid. These results are also in line with Naik and

Chakravarthy (2013) who reported the ant, *Oecophylla smaragdina* F. was the most effective predator on TMB.

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MS Received: 02 February 2025
MS Acceptance:24 April 2025