



## Research Article

# EFFECT OF CLIMATIC FACTORS ON DIVERSITY OF LEPIDOPTERAN INSECT PESTS ON CASHEW IN CHHATTISGARH

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Received: April 27, 2018; Revised: May 04, 2018; Accepted: May 05, 2018; Published: May 15, 2018

**Abstract-** Cashew (*Anacardium occidentale* L.) is high remunerative crop of India. But, production of raw nut is not fulfilling the requirement of the processing industries. Chhattisgarh is a tribal state and Bastar is one of the biggest tribal districts to have around 40,000 hectares suitable for cashew plantation. There are various factors responsible for low yield in cashew, in which the insect pest problem is major one. To study the diversity of leaf feeding lepidopteran insect pests a survey conducted by scientists of S.G. College of Agriculture & Research Station, IGKV, Jagdalpur, Chhattisgarh, India during 2007 and 2008 in randomly selected trees in cashew plantation in the surrounding areas of District Bastar, Chhattisgarh and their intensities in forest plantation were recorded at weekly intervals. The leaf caterpillar damage (33.14 % mean damage) was noticed throughout the year with relatively higher damage during November-December. The maximum temperature and evaporation were influenced negatively the leaf caterpillar damages; while, relative humidity and vapour pressure (II) had positively correlated.

The leaf folder was observed (17.14 % mean damage) round the year with maximum in November to January. Leaf folder damage was negatively influenced with maximum temperature, minimum temperature, wind velocity and evaporation; whereas, relative humidity was correlated positively. The leaf miner mean damage observed (9.20%) almost throughout with the peak in November. The maximum temperature and evaporation was negatively correlated with leaf miner; while, relative humidity and vapour pressure (I) were influenced positively. The leaf and blossom webber was appeared (1.54% mean damage) but its damage was seen almost round year. Leaf & Blossom Webber damage was correlated negatively with maximum temperature, evaporation and bright sunshine (hours); while, relative humidity was influenced positively. While, some insect pests present in cashew plantation as minor pests which were: inflorescence caterpillar (0.28 % mean damage) observed during reproductive stage, Semilooper appeared intermittently with peak (0.06 numbers) in November-December, slug caterpillar was appeared in spring and cooler season. The activity of Inflorescence Caterpillar was positively influenced with maximum temperature and evaporation; whereas, relative humidity (morning and evening) were negatively correlated.

**Keywords-** Cashew, lepidoteran insects, abiotic factors, climatic factors, weather parameters

**Citation:** Sahu K.R., et al., (2018) Effect of Climatic Factors on Diversity of Lepidopteran Insect Pests on Cashew in Chhattisgarh. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 10, Issue 9, pp.-5897-5900.

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## Introduction

Agriculture Cashew (*Anacardium occidentale* L.) is dollar earning crop of India. Chhattisgarh is a tribal state and Bastar is one of the biggest tribal districts to have around 40,000 hectares suitable for cashew plantation [1]. This crop was considered as most appropriate for soil conservation, afforestation and wasteland development has now become an important horticultural crop. The cashew (*Anacardium occidentale* L) is an important commercial plantation crop with tremendous potential for foreign currencies. Cashew cultivation in India during 2005-06 concerned on area of 837 thousand hectares of land and produced 573 thousand tones of raw nuts [2]. There are various factors responsible for low yield in cashew, in which the insect pest problem is major one.

Rai has listed 21 species of lepidopterans as leaf feeders [3] of which only two species as *Metanastria hyrtaca* (*Lasiocampidae*) and *Lymantria obfusca* (*Lymantriidae*) cause severe sporadic defoliation in cashew. The early instars of *M. hyrtica* are gregarious on tender leaves, while full grown caterpillars feed voraciously on mature leaves.

Leaf caterpillar *L. obfusca* as new defoliator of cashew from South India [4]. The caterpillars congregate in large number on the ground under dry leaves near the base of the tree in cervices of bark or as lower parts of well shaded branches during day time and are active during night only.

The caterpillars defoliate the cashew trees completely leaving only bare branches. Leaf caterpillar *Metanastria hyrtaca* infecting cashew in an epidemic observed during December 1997-February 1998 in Vridhachalam and Jayakondam Taluk, Tamil Nadu [5]. In Bastar (Chhattisgarh) leaf feeding caterpillar occurrence was found throughout the year. Therefore, present investigation was carried out.

## Material & Methods

To study the seasonal occurrence and intensity of leaf feeding lepidoteran insect pest of cashew, a survey was conducted at S.G. College of Agriculture & Research Station, Jagdalpur (C.G.) during 2007 and 2008 in randomly selected trees in cashew plantation in the surrounding areas of Bastar (Chhattisgarh) and intensities of insects in forest plantation were recorded at weekly intervals by placing a frame of 1.0 sq. m area on the tree canopy on all the four sides. Data was recorded on the following parameters: Number of lateral damaged by leaf caterpillar. Based on the data generated on the above parameters, percent infestation or damage was calculated for the insect pest. The data was also analysed statically by simple correlation and multiple regression analysis to know the influence of abiotic components on the infestation levels.

**Table-1** Seasonal occurrence of Lepidopteran insect pests on cashew during the 2007 and 2008

S. No.	Common Name	Scientific Name	2007			2008		
			Month of occurrence	Range	Mean	Month of occurrence	Range	Mean
1.	Leaf Caterpillars (%)	<i>Metanastria hyrtica</i> Cramer	Throughout the year	6.77 - 48.57	28.30	Throughout the year	14.60 - 57.69	33.14
2.	Leaf Folder (%)	<i>Caloptilia tiselea</i> M.	Throughout the year	0.67 - 24.44	11.67	Throughout the year	1.81 - 31.07	17.14
3.	Leaf Miner (%)	<i>Acrocercops syngamma</i> M.	Throughout the year	0.23 - 42.37	9.20	Throughout the year	0.65 - 35.03	6.56
4.	Leaf and Blossom Webber (% damage)	<i>Lamida monoculalis</i>	Throughout the year	0.11 - 8.69 %	1.54	Throughout the year	0.15 - 11.59	1.05
5.	Slug caterpillar (Numbers)	<i>Latoia lepida</i> Cramer	Intermittently Throughout the year	0.02 - 0.13	0.01	January – February & June to December	0.02 - 0.75	0.05
6.	Inflorescence caterpillar (%)	<i>Euproctis scintillans</i> Walker	Last Feb. to May	0.02 - 3.65	0.37	February to May & December	0.14 - 3.68	0.22
7.	Semilooper (Numbers)	<i>Thallasodes</i> spp.	November to January	0.02 - 0.06	0.00	January, April, May & November	0.02 - 0.04	0.00

**Table-2** Correlation of Lepidopteran insect pest on cashew with corresponding weather parameters during 2007 and 2008

Insect Pests	Years	Value of Correlation Coefficient										
		Max. Temp °C	Min. Temp °C	Rainfall (mms)	Relative Humidity		Vapour Pressure		Wind Vel. (Kmph)	Evap. (mms)	Bright Sunshine (hrs)	Rainy Days
					I	II	I	II				
LC (%)	2007	-0.444**	-0.189	0.028	0.401**	0.244	0.006	-0.140	-0.189	-0.422**	-0.118	0.067
	2008	-0.139	0.031	0.033	0.220	0.386**	0.134	0.461**	-0.105	-0.197	-0.176	0.098
LF (%)	2007	-0.585**	-0.401**	-0.060	0.514**	0.310*	-0.167	-0.036	-0.464**	-0.604**	-0.003	-0.114
	2008	-0.474**	-0.453**	0.118	0.460**	0.203	-0.268	0.073	-0.093	-0.401**	-0.102	-0.127
LM (%)	2007	-0.432**	0.066	0.214	0.494**	0.471**	0.288*	0.002	-0.234	-0.524**	-0.179	0.229
	2008	-0.138	-0.213	-0.135	0.105	0.082	-0.186	0.047	-0.197	-0.093	0.052	-0.142
Shoot LBW (%)	2007	-0.305*	-0.014	0.243	0.394**	0.336*	0.156	0.086	-0.156	-0.399**	-0.140	0.081
	2008	-0.195	0.132	0.493**	0.183	0.328*	0.215	-0.013	0.619**	-0.274*	-0.385**	0.265
Slug caterpillar	2007	-0.272	-0.159	-0.114	0.297*	0.112	-0.065	-0.128	-0.337*	-0.329*	0.135	-0.079
	2008	-0.246	0.008	0.065	0.228	-0.078	0.105	0.184	0.083	-0.306*	-0.182	0.085
IC	2007	0.530**	0.260	-0.160	-0.524**	-0.415**	0.023	-0.117	0.198	0.607**	0.252	-0.091
	2008	0.220	-0.030	-0.086	-0.127	-0.360**	-0.090	-0.263	-0.125	0.068	0.228	0.067

\* - Significant at 5% level of significance

\*\* - Significant at 1% level of significance

**Table-3** Multiple Regression Equation of Lepidopteran Insect Pest on cashew with their corresponding weather parameters in 2007

Insect Pest		Intercept	Value of Regression Coefficient											R <sup>2</sup>
			Max. Temp °C	Min. Temp °C	Rainfall (mms)	Relative Humidity		Vapour Pressure		Wind Vel. (Kmph)	Evap. (mms)	Bright Sunshine (hrs)	Rainy Days	
						I	II	I	II					
						X1	X2	X3	X4					
Y1	LC (%)	133.56	-5.120*	2.399	-0.120	0.114	-0.177	-1.870	1.538**	-2.333	6.276	0.156	0.833	0.31
Y2	LF (%)	92.30	-3.127*	0.919	-0.023	-0.065	0.007	-0.526	0.588	-1.786	4.359*	-0.583	-1.267	0.33
Y3	LM (%)	1.12	-2.912	2.519	0.026	0.689	0.145	-2.587	0.106	-0.239	5.629	0.662	-2.860	0.36
Y4	Shoot LBW (%)	0.72	-0.316	0.115	0.014	0.060	0.002	-0.008	0.012	0.047	0.426	0.232	-0.662	0.16
Y5	IC (%)	-8.65	0.326*	0.006	0.010	0.018	0.010	-0.101	-0.050	0.145	-0.427	0.005	0.055	0.33

\* - Significant at 5% level of significance

\*\* - Significant at 1% level of significance

**Table-4** Multiple Regression Equation of Lepidopteran Insect Pest on cashew with their corresponding weather parameters in 2008

Insect Pest		Intercept	Value of Regression Coefficient											R <sup>2</sup>
			Max Temp °C	Min. Temp °C	Rainfall (mms)	Relative Humidity		Vapour Pressure		Wind Vel. (Kmph)	Evap. (mms)	Bright Sunshi ne (hrs)	Rainy Days	
						I	II	I	II					
						X1	X2	X3	X4					
Y6	LC (%)	12.84	0.022	-0.049	0.001	0.348	-0.088	-0.668	0.374	-0.084	1.700	-1.249	0.116	0.10
Y7	LF (%)	7.26	-0.600	0.125	-0.029	0.103	-0.009	-0.320	0.044	0.414	2.065	1.202	2.715**	0.27
Y8	LM (%)	-14.51	-0.241	1.738	-0.004	0.340	0.028	-2.120	0.042	-0.045	0.040	0.177	0.458	0.10
Y9	Shoot LBW (%)	9.91	0.017	-0.375	0.015	-0.097	0.002	0.322	0.079	0.173	-0.062	-0.219	-0.513	0.36
Y10	IC (%)	1.15	0.063	-0.190	0.003	-0.034	0.007	0.219	-0.037	-0.029	-0.023	0.019	0.026	0.26

\* - Significant at 5% level of significance

\*\* - Significant at 1% level of significance

## Result & Discussions

The finding of present investigation revealed that a survey of pest complex was taken in cashew plantation in the study area comprises Bakawand, Tokapal, Bastar and Lohandiguda blocks of Districts-Jagdalpur (Chhattisgarh), India. The various insect pests as well as natural enemies occurring and their intensities in forest area were recorded and the data is presented in [Table-1], [Table-2].

The extent of insect pest infestation and their seasonal incidence was recorded at weekly interval from twelve randomly selected cashew trees under unsprayed condition throughout the year during the study period (January 2007 to December 2008) to observe the incidence of pest complex of cashew. During the course of study several species of insect pests were noticed causing damage to different parts of cashew tree at various stages *i.e.*, from vegetative to fruiting stage either singly or in an overlapping manner.

### Leaf Caterpillars, *Metanastria hyrtaca* Cramer

The leaf damage by leaf caterpillars was noticed throughout the year during both the years 2007 and 2008. The relatively higher leaf damage was recorded during month of November-December with maximum (48.57 percent) leaf damage in second week of November and minimum infestation (6.77 % leaf damage) was observed in fourth week of May during 2007. Whereas in 2008, the leaf damage by this insect ranged minimum (14.60 percent leaf damage) in second week of March to maximum (57.69 percent leaf damage) in last week of June. Its average infestation was recorded 28.30 and 33.14 percent in 2007 and 2008, respectively. Similarly, Leaf caterpillars are the more important and major ones [6]. While, in South India leaf caterpillar, *Lymantria obfusca* (*Lymantriidae*) recorded as new defoliator of cashew [4]. Leaf caterpillar *Metanastria hyrtaca* infecting cashew and its epidemic infestation observed during December 1997-February 1998 in Vridhachalam and Jayakondam Taluk, Tamil Nadu [5]. The leaf caterpillar damage was noticed throughout the year and its peak activity was recorded during October-November month with infestation ranged from 0.6 to 44 percent leaf damage in earlier finding [7].

### Leaf Folder, *Caloptilea tiselea* M.

In the year 2007 and 2008 the activity of leaf folder was observed round the year. The intensity of this insect pest ranged from 0.0 to 24.44 percent and 1.81-31.07 percent folded leaves with maximum in first week of November and second week of January during 2007 and 2008, respectively. Similar result was observed with peak incidence during April where intensity ranged from 1.13 to 20.39 percent leaf folds in earlier reports [8]. In agreement with present finding leaf folder (*Caloptilea tiselea*) incidence was highest during the second week of November coinciding with new flush and blooming stage and the pest was absent during parts of May, June and July [9]. Whereas, the incidence of leaf folder was observed round the year with a maximum of 23.78 percent leaf damage in earlier findings [10].

### Leaf Miner, *Acrocercops syngamma* M.

The incidence of leaf minor damage during 2007 was observed almost throughout the year except second week of January, last week of March, third and fourth week of December with the peak infestation (42.37 percent mined leaf) in second week of November. While in 2008, the leaf miner infestation ranged 0.00 to 25.03 with peak in third week of November. In contrary, Pillai, *et al.*, (1976) reported that leaf miner *Acrocercops syngamma* Meyr., causing the most damage and found abundantly during post-harvest and post-monsoon flushes. *Acrocercops syngamma* Meyr as major pests with high intensity in September-October, moderate in November and low incidence in December-January. In agreement with present findings the incidence of the cashew leaf miner reported throughout the year in Maharashtra with peaked (18.21%) during September on post monsoon vegetative flush [11]. In accordance with present investigation, *Acrocercops syngamma* Meyr included as main pest with a maximum damage of 18-20 percent [12-16]. In contrary, leaf miner (*Acrocercops syngamma*) considered as secondary important pests [17]. Whereas, it is reported that the leaf miner (*Acrocercops syngamma*) incidence was at its peak during the second week of December with no infestation during May-June and lowest incidence was observed in July in Andhra Pradesh.

### Leaf and Blossom Webber, *Lamida monocsalis* Walk

The leaf and blossom webber was appeared as minor pest but its damage was seen almost round year in 2007 and 2008 with maximum infestation (8.69 and 11.59 percent) during second week of October and in third week of July, during 2007 and 2008, respectively. Similarly, it is reported the damage of this pest in cashew and its larvae web the terminal portions of new shoots and blossom, causing the shoots to dry up [18, 19]. While, this insect active from end of February to end of May with a maximum incidence during second fortnight of April, damaging 4.82 percent of shoots and its activity was drastically reduced after onset of monsoons reported in earlier findings [20]. Whereas, leaf and blossom webber was reported as secondary important pests.

### Slug Caterpillar, *Latoia lepida* Cramer

The slug caterpillar was appeared in spring and cooler season in both the years 2007 and 2008. The population of this insect was ranged 0.02-0.13 numbers and mean of 0.01 numbers per 52 leader shoot with its peak in second week of November in 2007; while in 2008, population varied from 0.02 to 0.75 numbers per 52 leader shoot with mean of 0.05 numbers and its maximum population was observed in last week of July.

### Inflorescence caterpillar (*Euproctis scintillans* (Walker, 1856))

The inflorescence caterpillar observed during reproductive stage of cashew as minor pest in both the years 2007 and 2008 with maximum (3.65 and 3.68 percent) panicle damage in first week of May in 2007 and second week of April in 2008, respectively. Similarly, this pest was also observed in flowering stage of cashew as minor pest. Similar result was also reported that this pest occasionally found in the inflorescence, tender nuts and apples.

### Semilooper, *Thallasodes* spp.

It appeared intermittently and the population ranged from 0.0 to 0.06 numbers per 52 leader shoots in 2007 with maximum infestation in third week of December. In 2008, semilooper population varied from 0.0 to 0.04 numbers per 52 leader shoots with peak in first and third week of November. Its average population of 0.01 numbers was observed in both the years. Similarly, this insect was also observed as minor pest of cashew.

### Slug caterpillar, *Latoia lepida* Cramer

The slug caterpillar was appeared in spring and cooler season in both the years 2007 and 2008. The population of this insect was ranged 0.02-0.13 and 0.02 to 0.75 with peak in second week of November 2007 and last week of July 2008, respectively. This pest was also reported in spring season and isolated plants.

### Effect of Abiotic Factors

The different abiotic factors were influenced the incidence of insect pests of cashew spatially and temporarily. The coefficient of correlation was calculated to study the correlation of different insect pests of cashew with different weather factors. The values of coefficient of correlation for the years 2007 and 2008 were given in [Table-3]. The abiotic factors maximum temperature and evaporation was significantly negatively correlated ( $r = -0.444$  and  $-0.422$ ) with percent leaf damaged by leaf caterpillar; while, relative humidity (morning) was significantly positively correlated ( $r = 0.401$ ) during 2007. In 2008, only relative humidity (evening) and vapour pressure (l) was significantly positively influenced ( $r = 0.386$  and  $0.461$ ) the leaf caterpillar damage. Similarly, the rainy days were positively correlated with leaf caterpillar damage reported in earlier findings.

Percent leaf folded by leaf folder in 2007 was significantly negatively influenced with maximum temperature, minimum temperature, wind velocity and evaporation with correlation coefficient values of  $-0.585$ ,  $-0.401$ ,  $-0.464$  and  $-0.604$ , respectively; whereas, relative humidity (morning and evening) was significantly positively correlated ( $r = 0.514$  and  $0.310$ ), respectively. In 2008, same trend observed that maximum temperature, minimum temperature and evaporation were significantly negatively correlated ( $r = -0.474$ ,  $-0.453$  and  $-0.401$ , respectively); while only relative humidity (evening) was significantly positively correlated ( $r = 0.460$ ) with leaf folder damage.

Similarly, a negative and significant correlation with maximum and minimum temperatures was reported, while a significant positive correlation was observed with morning and evening relative humidity. While, reported that cool temperature conditions were favourable for the build-up of the population densities of leaf folder [21, 22].

The environmental factors, maximum temperature and evaporation during 2007 was significantly negatively influenced ( $r = -0.432$  and  $-0.524$ ) the percent leaf mined by leaf miner; while, relative humidity (morning and evening) and vapour pressure (l) were significantly positively correlated with correlation coefficient values of 0.494, 0.471 and 0.288, respectively. In 2008, all the abiotic factors were found non-significant on the activity of leaf miner. Similarly, leaf miner infestation increased with decline in relative humidity, rainfall and temperature reported in earlier findings. Similarly, it was found that the negative and significant correlation of leaf miner with maximum and minimum temperatures, while a significant positive correlation was observed with morning and evening relative humidity. While, cool temperature conditions were favourable for the build-up of the population densities of leaf miner which was agreement with present findings.

In 2007, the Leaf & Blossom Webber damage was significantly negatively correlated ( $r = -0.305$  and  $-0.399$ ) with maximum temperature and evaporation, respectively; while, relative humidity (morning and evening) was significantly positively correlated ( $r = 0.394$  and  $0.336$ , respectively). In 2008, rainfall, relative humidity (evening) and wind velocity were positively correlated ( $r = 0.493$ ,  $0.328$  and  $0.619$ , respectively), whereas, evaporation and bright sunshine hours was negatively influenced this insect with correlation coefficient values of  $-0.274$  and  $-0.385$ , respectively. In contrary, infestation of leaf and blossom webber on leaves was negatively correlated with relative humidity reported in earlier finding. While, the moderate temperature favoured the growth and development of leaf and blossom webber.

The incidence of slug caterpillar was positively influenced ( $r = 0.297$ ) by relative humidity (morning) and negatively influenced ( $r = -0.337$  and  $-0.329$ ) by wind velocity and evaporation during 2007, respectively; whereas in 2008, only evaporation was correlated negatively ( $r = -0.306$ ).

Maximum temperature and evaporation during 2007 was significantly positively correlated ( $r = 0.530$  and  $0.607$ ) with activity of Inflorescence Caterpillar; whereas, relative humidity (morning and evening) were significantly negatively influenced this insect with correlation coefficient values of  $-0.504$  and  $-0.415$ , respectively. In 2008, only relative humidity (evening) was significantly negatively correlated with correlation coefficient value of  $-0.360$ .

#### Multiple Regression Analysis of Different Insect Pest with their corresponding weather parameters

The multiple regression analysis of different insect pests with their corresponding weather parameters were worked out during the observing years 2007 and 2008 and multiple regression equations calculated were presented in [Table-4] and [Table-5]. The maximum temperature had significant negative contribution and the vapour pressure (l) had highly significant positive contribution of 31 percent towards percentage damage of leaf caterpillar in the year 2007; whereas in 2008, the contribution of all the weather parameters was observed non-significant. In case of percent leaf folder damage, the 33 percent variation was contributed significantly negatively by maximum temperature and significantly positively by evaporation in the year 2007; while in 2008, only rainy days was significantly positively contributed 27 percent towards percent leaf folder damage.

**Application of research:** This research is significant for biodiversity of lepidopteran insect pest of cashew for suitable management options with changing climatic condition to meet out the current demand of cashewnuts in the world as well as in India.

**Research Category:** Biodiversity of lepidopteran insect pest

**Acknowledgement / Funding:** Author are thankful to Dr M.G. Bhat, Former Director, Directorate of Cashew Research, Puttur, Karnataka for technical guideline and support. We are also thankful to Director Research Services, Indira

Gandhi Krishi Vishwavidyalaya, Raipur, 492012, Chhattisgarh for facilitating for research. Authors are also thankful to Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012, Chhattisgarh.

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Research project name or number: PhD Thesis

**Author Contributions:** All author equally contributed

**Author statement:** All authors read, reviewed, agree and approved the final manuscript

**Conflict of Interest:** None declared

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

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