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## **Biodiversity of Insect Pests associated with Teak (*Tectona grandis* L.f.) in Eastern Uttar Pradesh of India**

<sup>1</sup>V. Pandey, <sup>1</sup>A.K. Singh and <sup>2</sup>R.P. Sharma

<sup>1</sup>Department of Entomology, N.D. University of Agriculture and Technology,  
Narendra Nagar, (Kumarganj), Faizabad-224 229 (UP), India

<sup>2</sup>Department of Entomology and Agril. Zoology,  
B.H.U., Varanasi-221005 (UP), India

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**Abstract:** The present investigation on arthropod succession on teak (*Tectona grandis* L.f.) conducted during 2004 and 2005 revealed that a total of 12 arthropods were associated with this plant. Among these, three viz., *Tettigoniella ferruginea* F., *Hyblaea puera* Cramer and *Eutectona macheralis* W. were major and five viz., Pentatomid bug, (*Aspongopus janus* F.), cow bug (*Phenococcus insolitus* C.), grass hopper, (*Cartoons* sp.), hadda beetle (*Henosepilachna vigintioctopunctata* F.) and red cotton bug (*Dysdercus koenigii* F.) were recorded as minor arthropods. Two species of Coccinellids (*Coccinella septempunctata* L. and *Cheilomenes sexmaculata* Fab.) and predatory spider (*Oxyops* sp.) were recorded as natural enemies associated with this plant. In addition to above black ants were also noticed.

**Key words:** Biodiversity, arthropod, succession, teak

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### **INTRODUCTION**

Teak (*Tectona grandis* L.f.) is an economically important plant known as Sagun and Sagwan. It belongs to family Verbenaceae. It is a large deciduous tree which is light demander and sensitive to frost, drought, coppices and pollards vigorously (Troup, 1921). About 174 species of insects are associated with teak (Mathur, 1960). Many of these insects are minor or occasional pests and very few are recognized as major pests. Among the various insect-pest infesting teak plants, 136 are defoliators belonging to order: Lepidoptera, Coleoptera and Orthoptera. Out of these the most important are the Lepidopterans, teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) and teak skeletonizer, *Eutectona maturalis* Walker (Lepidoptera: Pyraustidae) causing defoliation, skeletonizing and browning of teak leaves, adversely affecting growth (Mathur and Singh, 1960). Ghude *et al.* (1993) reported teak plants are vulnerable to attack by a number of insect-pests. More than 187 insect species have been found feeding on the living teak tree in India (Hutacharern and Tubtim, 1995). A survey of insect pests attacking teak plantation was carried out in Karnataka. A total of 45 species were recorded from the teak plantations (Katagal *et al.*, 2000). Appanah *et al.* (2000) studied 28 insect-pests associated with it. Katagal *et al.* (2000) reported a total of 45 species; 22 defoliators, 19 sucking and 4 bark feeders. The differences between the findings of the present and earlier workers may be due to difference in ecological

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**Corresponding Author:** Vageesh Pandey, Department of Entomology and Agril. Zoology,  
Institute of Agricultural Sciences, B.H.U., Varanasi-221005, India  
Tel: 919918301393

setting, area covered and period involved. Three species of insects, viz., Cicadellid (*Tettigoniella ferruginea* F.), teak defoliator (*Hyblaea puera* C.), teak skeletonizer (*E. macheralilis*) have been found causing severe damage to teak. These insects also have been reported as major pests of this plant at several places (Ghude *et al.*, 1993; Appanach *et al.*, 2000; Loganathan *et al.*, 2002). The investigations were carried out in teak plantations at Yellapur, Mundgod, Haliyal and Sirsi Forest Divisions from May 2003 to April 2005 to find insect pests associated with teak (Jayaregowda and Naik, 2007). Hence, the present investigations were aimed to determine arthropod succession on teak (*Tectona grandis* L.f.).

## MATERIALS AND METHODS

The present study on arthropod succession on teak (*Tectona grandis* L.f.) was carried out during 2004 and 2005 at the Main Experiment Station (MES) in Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (UP). Knowledge on forest pests is very necessary due to less work done by the researchers. Morphological and taxonomic characters are essential part of entomological techniques and molecular studies are generally based on morphological as well as taxonomic parameters. In case of forest pests biodiversity studies was done so that required informations can give further molecular analysis of teak pests. The experimental sites fall under subtropical climatic zone of Indo-Gangatic plains and situated at 26.47°N latitude and 82.12°E longitudes at an altitude of 113 m from sea level. The region receives a mean annual rainfall of about 1200 mm of which about 80% is concentrated from mid June to end of September. The winter months are very cold, whereas summer months are hot and dry. Westerly hot winds start from the month of April and continue till the onset of monsoon (Tripathi *et al.*, 2005). Ten plants each of age group two, three and thirteen years were randomly selected in front of D-type colony (plot size 10×100 m, plants spaced 3.3 m apart), near University Guest House (plot size 50×50 m, plants spaced 3.3×3.3 m) and MES of Forestry Department (plot size 10×100 m, plants spaced 2.5 m), respectively. All agronomical practices were adopted for raising the above plants. Populations of all arthropods present on three age group of plants were recorded separately in the morning hours at fortnightly interval. Observations on the plants of age groups 2 and 3 years were taken on the entire plants while in case of thirteen years old plants, three branches of approximately similar size were selected one each from lower, middle and upper portion of the canopy of ten randomly selected plants for taking the observations.

## RESULTS AND DISCUSSION

In all, 12 arthropods (Table 1, Fig. 1a-k) were recorded at different stages of plant growth. On the basis of their nature of damage/activity, they have been grouped into following different categories:

### Sappers

In all, 3 sap feeding arthropods were recorded during plant growth of 2004 and 2005.

### Cicadellids (*Tettigoniella ferruginea* F.)

It is evident from the data given in Table 2a-c that this pest appeared on all the three age group of plants. On two years old plants it first appeared during II fortnight of October 2004 and the population level was 0.1 insect/plant. On three years old plant it made its first

Table 1: List of arthropods observed on teak (*Tectona grandis* L.f.) during 2004-05

Common name	Scientific name	Family	Order
<b>Sap feeder</b>			
Cicadellid	<i>Tettigoniella ferruginea</i> F.	Cicadellidae	Hemiptera
Pentatomid bug	<i>Aspongopus janus</i> F.	Pentatomidae	Hemiptera
Cow bug	<i>Penococcus insolitus</i> C.	Coccidae	Hemiptera
<b>Defoliators</b>			
Grasshopper	<i>Chrotogonus</i> sp.	Acrididae	Orthoptera
Teak defoliator	<i>Hyblaea puer</i> C.	Hyblaeidae	Lepidoptera
Teak skeletonizer	<i>Eutectona macheralis</i> W.	Pyraustidae	Lepidoptera
<b>Other arthropods</b>			
Hadda beetle	<i>Henosepilachna vigintioctopunctata</i> Fab.	Coccinellidae	Coleoptera
Red cotton bug	<i>Dysdercus koenigii</i> Fab.	Pyrrhocoridae	Hemiptera
Black ant	<i>Camponotus</i> sp.	Formicidae	Hymenoptera
<b>Natural enemies</b>			
Coccinellid	<i>Coccinella septempunctata</i> L.	Coccinellidae	Coleoptera
Coccinellid	<i>Cheilomenes sexmaculata</i> F.	Coccinellidae	Coleoptera
Predatory spider	<i>Oxyops</i> sp.	Santicidae	Araneae

appearance during II fortnight of August 2005 with population of 0.5 insect/three branches. On thirteen years old plants it appeared in the II fortnight of November 2004 with population level of 0.2 insect/plant. However, the maximum population of 3.1 insects/plant in I fortnight of September 2005 at a temperature range of 28.5-35.0°C and RH range 62-92%, 0.5 insect/plant in II fortnight of August 2005 at a temperature range 24.5-34.8°C and RH range 92-95% and 1.1 insect/three branches in I fortnight of May 2005 at a temperature range 20.5-38.0°C and RH range 48-89% were recorded on 1, 2 and 13 years old plants, respectively. Maximum population was recorded on 2 years old plants and minimum population on three years old plants while 13 years old plants harboured intermediate population of *T. ferruginea*.

#### **Pentatomid Bug (*Aspongopus janus* F.)**

The bug, *A. janus* made its first appearance in the II fortnight of January 2005 on two and three years old plants with population of 0.1 and 0.2 bug/plant respectively while on thirteen years old plants it appeared first during II fortnight of March 2005 with population of 0.3 bug/three branches. However, the maximum population of 0.3 bug/plant and 0.1 bug/three branches was recorded during II fortnight of February 2005 on two and thirteen years old plants respectively while 0.2 bugs/plant was reported during II fortnight of January 2005 on 3 years old plants. The minimum, maximum temperatures and RH during respective fortnights were 11.2-30.0°C and 71% and 6.5- 23°C and 68%. The maximum numbers of bugs were recorded on two years old plants and minimum on thirteen year old plants while intermediate population was found on three years old plants.

#### **Cow Bug (*Phenococcus insolitus* C.)**

Both nymphs and adults of *P. insolitus* were recorded sucking sap from leaves and tender shoots of the plants. The first appearance of this pest was noticed during II fortnight of October 2004, I fortnight of November 2004 and II fortnight of November 2004 on three thirteen and two years old plants respectively. However, maximum population of 0.8 bug/plant on 3 years old plants at varying temperature of 17.0-30.0°C and RH 70%, 0.4 bug/plant on 2 years old plants at a temperature range 25.0-35.0°C and RH 85% and 0.2 bug/three branches on 13 years old plants at variable temperature 28.0-35°C and RH 67% were recorded, respectively.

#### **Defoliators**

The following 3 defoliators were recorded feeding on leaves of teak plants.





Fig. 1: Arthropods recorded on teak plant. (a) *Tettigoniella ferruginea* F., (b) *Aspongopus janus* F., (c) *Penococcus insolitus*, (d) *Componotus* sp., (e) *Henosepiachna vigintioctpunctata* Fab., (f) *Dysdercus koenigii* Fab., (g) *Chrotogonus* sp., (h) *Coccinella septumpunctata* L., (i) *Cheilomenes sexmaculata* F., (j) *Oxyops* sp. and (k) *Hyblaea puera* C.

#### Grass Hopper (*Crotogonus* sp.)

It is evident from the data in Table 2a-c that the pest appeared only on two years old plants in II fortnight of October 2004 and in I fortnight of February 2005. The maximum population observed was 0.1 hopper/plant during II fortnight of October 2004 and I fortnight of February 2005 at temperature range 17.0-30.0°C and RH 70% and 9.0-18.5°C and RH 89%, respectively.

#### Teak Defoliator (*Hyblaea puera* Cramer)

The caterpillars of this pest first appeared during II fortnight of June 2005 on two years old plants and I fortnight of July 2005 on three and 13 years old plants, respectively. It continued its feeding till I fortnight of October 2005 on two years and II

fortnight of September 2005 on three and thirteen years old plants, respectively. The population fluctuated between 0.1-2.1 caterpillars/plant. In case of two years old plants, 0.1-1.1 caterpillars/plant in three years old plants and 0.1-1.5 caterpillars/three branches on

Table 2a: Mean population of arthropods on two years old teak/plant during 2004-05

Fortnight	Month	1	2	3	4	5	6	7	8	9	10	11	12
II	October, 04	0.1	0.1										
I	November, 04	0.0											
II		0.0		0.1									
I	December, 04	0.0											
II		0.0											
I	January, 05												
II					0.1	0.1	0.1	0.1					
I	February, 05		0.1	0.1			0.2	0.2					
II							1.1	0.3	0.2				
I	March, 05				0.4	0.1			0.3	0.2	0.2		
II					0.7	1.0			0.3				
I	April, 05	0.2		0.2		0.1	0.1		0.5	0.5			
II		0.3				0.1	0.1		0.6	0.6			
I	May, 05	0.3			0.2	0.3	0.3		0.3	0.4	0.5		
II						0.3	0.4			1.3	0.2		
I	June, 05	0.5								4.8			
II		0.5			0.1		0.2			3.2		0.3	
I	July, 05	0.4					0.1			5.9		0.5	
II		0.5								1.3		0.9	
I	August, 05	0.3		0.4					0.2	2.0		2.1	
II										0.6		1.2	
I	September, 05	3.1							0.1	0.9		0.8	0.1
II		1.0								0.8		0.2	
I	October, 05	0.2		0.1						0.5		0.1	

1: *Tettigoniella ferruginea* F., 2: *Chrotogonus* sp., 3: *Penococcus iusolitus* C., 4: *Henosepilachna vigintioctopunctata* Fab., 5: *Coccinella septumpunctata* L., 6: *Cheilomenes sexmaculata* F., 7: *Aspongopus janus* F., 8: *Oxyops* sp., 9: *Comptonotus* sp., 10: *Dysdercus koenigii* Fab., 11: *Hyblaea prera* C., 12: *Entectona macheralis* W.

Table 2b: Mean population of arthropods on three years old teak/plant during 2004-05

Fortnight	Month	1	2	3	4	5	6	7	8	9	10	11	12
II	October, 04	0.8											
I	November, 04	0.5											
II													
I	December, 04												
II													
I	January, 05												
II			0.1	0.1	0.2								
I	February, 05												
II				0.1	0.3	0.1							
I	March, 05						0.1						
II					0.1		0.1						
I	April, 05							0.1					
II		0.3			0.1		0.1	0.5					
I	May, 05					0.6			0.1				
II		0.2				0.5		1.7					
I	June, 05		0.1			0.6		2.3					
II						0.1		1.7					
I	July, 05							2.4		0.4			
II								0.7		0.9			
I	August, 05							0.2		1.1			
II		0.2					0.3	1.4		0.2	0.5		
I	September, 05	0.2					0.2	1.1		0.1	0.2		
II							0.1	0.5		0.1		0.1	
I	October, 05	0.1						0.4			0.1		

1: *Penococcus iusolitus* C., 2: *Henosepilachna vigintioctopunctata* Fab., 3: *Coccinella septumpunctata* L., 4: *Aspongopus janus* F., 5: *Cheilomenes sexmaculata* F., 6: *Oxyops* sp., 7: *Comptonotus* sp., 8: *Dysdercus koenigii* Fab., 9: *Hyblaea prera* C., 10: *Tettigoniella ferruginea* F., 11: *Entectona macheralis* W., 12: *Chrotogonus* sp.

Table 2c: Mean population of arthropods on thirteen years old teak/3 branches during 2004-05

Fortnight	Month	1	2	3	4	5	6	7	8	9	10	11	12
II	October, 04												
I	November, 04	0.1											
II			0.2										
I	December, 04												
II													
I	January, 05												
II													
I	February, 05												
II				0.1									
I	March, 05			0.1									
II				0.1	0.1								
I	April, 05			0.4									
II				0.1	0.1								
I	May, 05		1.1			0.6	0.1						
II		0.2	0.6	1.4		0.5							
I	June, 05			0.8		0.6							
II			1.0	1.2		0.1							
I	July, 05		0.4	2.1					0.2				
II			0.6	0.9					0.7				
I	August, 05		0.2	1.5					1.5				
II			0.5	0.8					0.5				
I	September, 05		0.4	0.5					0.2				
II				0.4					0.1				
I	October, 05		0.2	0.2									

1: *Penococcus iusolitus* C., 2: *Tettigoniella ferruginea* F., 3: *Comptonotus* sp., 4: *Aspongopus janus* F., 5: *Coccinella septempunctata* L., 6: *Dysdercus koenigii* Fab., 7: *Hyblaea prera* C., 8: *Eutectona macheralis* W., 9: *Henosepilachna vigintioctopunctata* Fab., 10: *Cheilomenes sexmaculata* F., 10: *Oxyops* sp., 12: *Crotogonus* sp.

thirteen years old plants, respectively. The maximum population of 2.1, 1.1 caterpillars/plants on two, three years old plants and 1.5 caterpillars/three branches on thirteen years old plants were recorded during I fortnight of August 2005 at a temperature range of 25-35°C and RH 85%, respectively.

#### Teak Skeletonizer (*Eutectona macheralis* W.)

The larva of *E. macheralis* feed on the leaf surface with in skeletonized leaves leaving only a thin membrane outside. Its infestation was noticed for the first time during I fortnight of September 2005 on two years old plants, II fortnight of September 2005 on three years old plants and II fortnight of July 2005 on 13 years old plants. However, mean population of 0.1 caterpillar/plant was recorded on two and three years old plants during I and II fortnight of September 2005 at temperature range 28.5-35°C and RH 76% and 25.5-29.5°C and RH 92.5%, respectively. In thirteen years old plants the population ranged from 0.20-0.40 caterpillar/three branches during II fortnight of July and I fortnight of August 2005.

#### Other Arthropods

##### Hadda Beetle (*Henosepilachna vigintioctopunctata* Fab.)

Presence of *H. vigintioctopunctata* was noticed for the first time on two and thirteen years old plant in II fortnight of January 2005 and the population level was 0.1 bug/plant. However, no hadda beetles were observed on three years old plants. The population went on increasing and reached at its maximum of 0.7 bug/plant on two years old plants during I fortnight of January 2005 and 0.1 bug/3 branches on thirteen years old plants during II fortnight of March 2005 and I fortnight of June 2005 at a temperature range of 13.0-32.5°C, 26.0-43.5°C and RH 28, 65%, respectively.

**Red Cotton Bug (*Dysdercus koenigii* Fab.)**

Adults of *D. koenigii* appeared for the first time on two years old plants during I fortnight of March 2005 while in three and thirteen years old plants it appeared only during I fortnight of May 2005. The highest population of 0.5 bug/plant on two years old plants was recorded during I fortnight of May 2005 at a temperature range 21.5-43.0°C and RH 58%. The population level on three and thirteen years old plants remained 0.1 bugs/plant and 0.1 bug/three branches, respectively.

**Black Ant (*Camponotus* sp.)**

Black ants were noticed for the first time in II fortnight of February 2005 on thirteen years old plants and in I fortnight of March 2005 on two and three years old plants with respective population level of 0.1 ant/three branches and 0.2 and 0.1 ant/plant. However, the maximum population of 5.9, 2.4 ants/plant and 2.1 ants/three branches was recorded on 2, 3 and 13 years old plants, respectively during I fortnight of July 2005 at a temperature range of 26-32°C and RH 83.5%.

**Natural Enemies**

**Lady Bird Beetles**

***Coccinella septempunctata* L.**

This insect was noticed on two and thirteen years old plants only during II fortnight of January 2005. The maximum population of 1.0 beetle/plant on two years old plants and 0.1 beetle/3 branches on thirteen years old plants was recorded during II fortnight and I fortnight of March 2005, respectively. The minimum, maximum temperatures and RH during respective fortnights were 13.0, 32.5°C and 65.5% and 11.0, 31.0°C and 72.5%.

***Cheilomenes sexmaculata* F.**

Other species of lady bird beetle recorded on teak was *C. sexmaculata* which appeared for the first time during II fortnight of January 2005 and continued till I fortnight of July 2005 on two years old plants and till II fortnight of June 2005 on thirteen years old plants, respectively. However, in three years old plants its presence was recorded only in I fortnight of February 2005. The maximum population of 1.1 beetle/plant was recorded on two years old plants during II fortnight of February 2005 at temperature range 11.5-30.0°C and RH 71%. In case of thirteen years old plants the maximum population of 0.6 beetles/three branches was recorded during I fortnight of May and June 2005 at a temperature range 20.5-38.0°C and RH 68.5 and 28%, respectively. It is also evident from the data that all three age group of plants harboured different population of *C. sexmaculata* during study period.

**Predatory Spider (*Oxyops* sp.)**

*Oxyops* sp., was noticed for the first time during II fortnight of February 2005 on two and three years old plants with respective mean population of 0.1 and 0.3 spider/plant on both age groups of plants. In case of thirteen years old plants initial population of 0.1 spider/three branches was recorded during I fortnight of March, 2005. The maximum population of 0.6 and 0.3 spider/plant was recorded on two and three years old plant during II fortnight of April and August, 2005 at temperature range 17.5-39.0°C, 24.5-38.5°C and R.H. 58 and 93.5%, respectively. However, in thirteen years old plant the highest population level observed was 0.1 spider/three branches during I fortnight of March, 2005 to II fortnight of October, 2005 at variable temperature range and relative humidity. It is also evident from the data that all



the three age group of plants harboured more number of *Tettigoniella ferruginea*, *Aspongopus janus*, *Phenococcus insolitus* and *Hyblaea puera*, along with predators, i.e., ladybird beetles and spiders.

Studies on arthropod succession on teak revealed association of twelve arthropods (Table 1) with this plant in this area. Ghude *et al.* (1993) reported teak plants are vulnerable to attack by a number of insect-pests. Appanch *et al.* (2000) studied 28 insect-pests associated with it. Katagall *et al.* (2000) reported a total of 45 species; 22 defoliators, 19 sucking and 4 bark feeders. The differences between the findings of the present and earlier workers may be due to difference in ecological setting, area covered and period involved. Three species of insects, viz., Cicadellid (*Tettigoniella ferruginea* F.), teak defoliator (*Hyblaea puera* C.), teak skeletonizer (*E. macheralilis*) have been found causing severe damage to teak. These insects also have been reported as major pests of this plant at several places (Ghude *et al.*, 1993; Appanch *et al.*, 2000; Loganathan *et al.*, 2002). Nymphs and adults of *T. ferruginea* were noticed sucking sap from lower and upper surface of tender leaves. It had also been reported earlier by Katagall *et al.* (2000) and Appanch *et al.* (2000). Low population of psyllid bug viz., *Aspongopus janus* recorded in present studies had been reported earlier by Katagall *et al.* (2000) and Appanch *et al.* (2000). Cow bug, *P. insolitus* recorded feeding on tender leaves, has been reported as sap feeder of this crop earlier also (Ghude *et al.*, 1993). Hadda beetle, *H. vigintioctopunctata*, scraped chlorophyll from epidermal layer of leaves, red cotton bug (*Dysdercus koenigii* F.) sucked the sap from the tender leaves, while grass hopper (*Chrotogonus* sp.), defoliate the teak leaves. Similar damage by these pests has been reported by several workers (Ghude *et al.*, 1993; Appanch *et al.*, 2000; Katagall *et al.*, 2000). The population of two Coccinellid beetles viz., *C. septumpunctata* and *C. sexmaculata* recorded in present studied had not been reported earlier and hence are a new report. Predation by the spider (*Oxyops* sp.) on insects viz., Cicadellid; *H. puera*, had also been recorded earlier by Loganathan and David (1999). Black ants *Componotus* sp., was observed feeding on honey dew secreted by Cicadellids. Wiwatwitaya (1996) had observed its presence on teak in Northern part of India.

## CONCLUSION

Therefore, the present investigation was carried out for knowing occurrence and abundance of insect pests associated with teak in eastern Uttar Pradesh so that molecular study can be done to establish insect pest relationship with forest plants.

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