

The Study of Insect Pests of *Dalbergia sissoo* Roxb. and Their Seasonal Incidence in Jharkhand, India

Arvind Kumar

Forest Entomology Division, Forest Research Institute, Dehradun, India

Email address:

arvind.ento@gmail.com

To cite this article:

Arvind Kumar. The Study of Insect Pests of *Dalbergia sissoo* Roxb. and Their Seasonal Incidence in Jharkhand, India. *American Journal of Agriculture and Forestry*. Vol. 5, No. 5, 2017, pp. 137-144. doi: 10.11648/j.ajaf.20170505.11

Received: July 6, 2017; **Accepted:** July 24, 2017; **Published:** August 30, 2017

Abstract: Shisham *Dalbergia sissoo* Roxb. is the most popular and valuable timber species found throughout India-Pakistan sub-continent. The present study was undertaken in the province of Jharkhand to find out the insect pest fauna of *D. sissoo* their infestation and seasonal incidence. Total seventeen insect pests were recorded from the region out of which five insects belongs to Coleoptera viz. *Apoderus sissu*, *Anomala dalbergiae*, *Anomala bengalensis*, *Mylocherus undecimpustulatus* and *Mylocherus discolour* were observed. Similarly, five insect pests of order Lepidoptera viz. *Agrotis ipsilon*, *Plecoptera reflexa*, *Ascotis infixaria*, *Dichomeris eridantis* and *Leucoptera sphenograptia* were observed. Six insect pests belonging to order Hemiptera viz. *Lawana conspersa*, *Ceroplastes rusci*, *Leptocentrus taurus*, *Myzus persicae*, *Icerya seychellarum*, *Drosicha dalbergiae* and *Odontotermes obesus*. Among these, two insect pests *Lawana conspersa* and *Icerya seychellarum* were found first time on *D. sissoo*. Additionally, nature of damage, seasonal incidence and their infestation was also observed during the course of study.

Keywords: *Dalbergia sissoo*, Insect Pest, New Record, Insect Infestation, Jharkhand

1. Introduction

Dalbergia sissoo Roxb. is one of the valuable timber species occur naturally and plantation in Southeast Asia. It is a deciduous tree, also known as Shisham, Sisu or Sissoo mainly distributed in northern and central provinces of India. The tree is also known as Indian Rosewood. It is native to Indian subcontinent and southern Iran. It is the province tree of Punjab province of India and the provincial tree of Punjab province of Pakistan. It is primarily found growing along river banks at 900 m elevation, but can be raised naturally up to 1,300 m. It can withstand average in the regions with annual rainfall up to 2,000 mm. Soils range from pure sand and gravel to rich alluvium of river banks; shisham can grow in slightly saline soils. Bihar province is largest producer of *D. sissoo* and it is planted on roadside along canals and farmers field as bund plantation. Timber of this species is internationally known for its grain quality and strength. With its multiple products and qualities growth and productivity of *D. sissoo* forests are adversely affected by frequent outbreaks of insect pests. Several groups of insects belonging to orders, Coleoptera, Hymenoptera, Lepidoptera and Isoptera are the

major pests that cause high economic loss to the nursery, natural and plantations. Among these most important pests are cutworms, termites and cockchafers besides some defoliators, sapsuckers and shoot borers as major pests. *D. sissoo* is attacked by about 207 insect species [1] and 22 phytophagous insect were reported from Madhya Pradesh [2]. Some more scattered works have been done on insect pests of *D. sissoo*, but none of the study has been done for the province of Jharkhand. Hence, this study was undertaken to find out the insect pest fauna associated with *D. sissoo*, their infestation and seasonal incidence in the province of Jharkhand, India.

2. Methods

The study was done in the province of Jharkhand lies at latitude 22°00' and 24°37' N to longitude 83°15' and 87°01' E, mainly geographical area is defined as plateau of Chota Nagpur. This study was undertaken in total 19 districts of Jharkhand namely Bokaro, Chatra, Deoghar, Dhanbad, East Singhbhum, Garhwa, Giridih, Gumla, Hazaribag, Khunti, Koderma, Latehar, Lohardaga, Plamu, Ranchi, Ramgarh,

Saraikela Kharsawa, Simdega and West Singhbhum. These districts are true representative of whole Jharkhand Province. The province has been divided into 3 agro-climatic sub zones viz., Central and North eastern plateau sub zone, Western plateau sub zone and South eastern Plateau sub zone. The soil of Jharkhand province is formed by the break down of rocks and stones and the composition of soil are red soil, micacious soil, sandy soil, black soil, and majority of laterite soil. The average temperature of the province is 25°C, but the lowest temperature may fall at 5°C in winter and in summer it may rise upto 40°C. The annual rainfall in the state is between 1200 mm to 1800 mm with an average of 1400 mm and the main rainy months are June to September [3]. Regular survey of insect pests of natural forest and plantations of *D. sissoo* was done at monthly interval. The random observation of insect pests associated with root, trunk, bark, shoot and leaf were done. The nature of damage done by the insect pest was also recorded in the field and in the laboratory while rearing. The larval stages of unidentified insect pests for *D. sissoo* were brought to the laboratory and reared for adult emergence and preserved for further identification and record. Insect pests were identified with the published literature and then confirmed from Zoological Survey of India (ZSI), Kolkata and Indian Agricultural Research Institute (IARI), New Delhi. Seasonal incidence of insect pests was also recorded on the basis of presence and their infestation in the field. The regular data recorded for three years were pulled and seasonal incidence was plotted for each insect pests. All the numeric data collected was processed for ANOVA through the statistics analysis software SPSS version 21.

3. Results and Discussion

The insect pests of *D. sissoo* and their nature of damage described insect wise (Table 1) revealed that total seventeen insect pests were recorded from the region out of which five insect pests were belongs to Coleoptera viz. *Apoderus sissu*, *Anomala dalbergiae*, *Anomala bengalensis*, *Myloccerus undecimpustulatus* and *Myloccerus discolour* were observed. Similarly, five insect pests of order Lepidoptera viz. *Agrotis ipsilon*, *Plecoptera reflexa*, *Ascotis infixaria*, *Dichomeris eridantis* and *Leucoptera sphenograptia* were observed. Six

insect pests belonging to order Hemiptera viz. *Lawana conspersa*, *Ceroplastes rusci*, *Leptocentrus taurus*, *Myzus persicae*, *Icerya seychellarum*, *Drosicha dalbergiae* and one *Odontotermes obesus* was of order Isoptera. Among these *Anomala bengalensis*, *Lawana conspersa* and *Icerya seychellarum* was found to be first time as a new pest of *D. sissoo* in the world (Figure 1). The insect wise details, their nature of damage, seasonal incidence and their infestation is presented as follows:

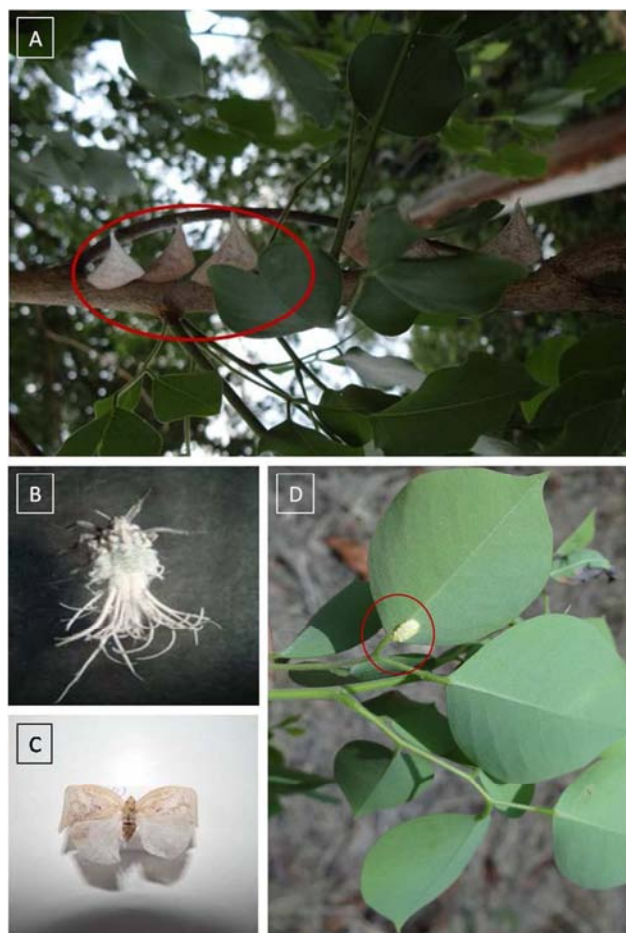


Figure 1. Newly reported insect pest of *D. sissoo* (A- *L. conspersa* adult feeding on *D. sissoo*; B-Nymph of *L. conspersa*; C-Adult of *L. conspersa*; D- *Icerya seychellarum* feeding on *D. sissoo*).

Table 1. Insect pest their status and nature of damage of insect pest infesting to the *D. sissoo*.

Sl.	Name	Family	Common name	Infestation	Status
Coleoptera					
1	<i>Apoderus sissu</i> Marshall	Curculionidae	Leaf rolling	Leaf	Major
2	<i>Anomala dalbergiae</i> Arrow	Scarabaeidae	Leaf beetle	Root/Leaf	Miner
3	<i>Anomala bengalensis</i> (Blanchard)*	Scarabaeidae	Leaf beetle	Root/ Leaf	Miner
4	<i>Myloccerus undecimpustulatus</i> Foust	Curculionidae	Leaf Weevil	Leaf	Miner
5	<i>Myloccerus discolour</i> (Boheman)	Curculionidae	Leaf Weevil	Leaf	Major
Lepidoptera					
6	<i>Agrot ipsilon</i> Huf.	Noctuidae	Surface caterpillar	Root	Miner
7	<i>Plecoptera reflexa</i> Gunee	Noctuidae	Twig defoliator	Leaf	Major
8	<i>Ascotis infixaria</i> Walk	Geometridae	Leaf caterpillar	Leaf	Major
9	<i>Dichomeris eridantis</i> Meyr	Gelechiidae	Leaf folder	Leaf	Major
10	<i>Leucoptera sphenograptia</i> Meyr	Lyometidae	Leaf miner	Leaf	Miner
Hemiptera					
11	<i>Lawana conspersa</i> (Walk)*	Flatidae	Flatid bug	Shoot	Miner

Sl.	Name	Family	Common name	Infestation	Status
12	<i>Ceroplastesrusci</i> Linn	Coccidae	Wax scale	Shoot, leaf	Miner
13	<i>Leptocentrus taurus</i> Febr	Membracidae	Cow bug	Shoot	Major
14	<i>Myzus persicae</i> Sulzer	Aphididae	Aphid	Shoot, leaf	Miner
15	<i>Icerya seychellarum</i> Westw*	Margarodidae	Mealy bug	Shoot, leaf	Miner
16	<i>Drosicha dalbergiae</i> Stebb	Margarodidae	Mealy bug	Shoot, leaf	Miner
Isoptera					
17	<i>Odontotermes obesus</i> (Rambur)	Termitidae	Termite	Bark	Miner

*New record

Apoderus sissu Marshall (Coleoptera: Curculionidae)

Both the adult and larval stages were found to cause damage to new flush either by rolling them off or by cutting through the mid rib and defoliation. Beetle was brightly colored yellowish red or testaceous with dark suffusion having three black spots on the Elytra. Female was larger than male. The activity of this insect was found from March to October, but they were found abundantly in March- April (Table 2). The infestation of *Apoderus sissu* was observed from all the districts and the maximum plant (29.83%) infestation was recorded in Gumla district, while lowest in Deoghar (5.00%) (Table 3). It has also been reported by [4] that leaf rolling weevil *Apoderus sissu* was one of the most serious defoliators of *Dalbergia sissoo* was subsequently it has been recorded by [5] from India.

Anomala dalbergiae Arrow (Coleoptera: Scarabaeidae)

It's both larvae and adult beetle were found to causes damage to the plant. Newly hatched larva feed on roots and rootlets of the seedlings and young plants. Mature larva was about 40-50 mm long, large, curved whitish with large brown head. Adult was found from May-October, (Table 2) appear in swarms after heavy monsoon rain shower and defoliate young plantation. The infestation of *Anomaladalbergiae* was observed from all the districts. The maximum plant infestation (10.17%) was recorded in Koderma district, while lowest in Garhwa (1.33%) (Table 3). This pest was also reported by [4] and [1] as a leaf defoliator of *D. sissoo* from India. Subsequently, *M. dalbergia* was also recorded as injurious insect pest of *D. sissoo* was supported by the results of [6] and [7].

Table 2. Seasonal activity of insect pest infesting to the *D. sissoo*.

Sl	Species/ Months	Jan	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Coleoptera													
1	<i>Apoderus sissu</i> Marshall			+	+	+	+	+	+	+	+		
2	<i>Anomala dalbergiae</i> Arrow					+	+	+	+	+	+		
3	<i>Anomala bengalensis</i> (Blanchard)						+	+	+	+	+		
4	<i>Myloccerus undecimpustulatus</i> Foust					+	+	+	+	+			
5	<i>Myloccerus discolour</i> (Boheman)					+	+	+	+	+			
Lepidoptera													
6	<i>Agrotis ipsilon</i> Huf.						+	+	+	+	+	+	+
7	<i>Plecoptera reflexa</i> Guenee				+	+	+	+	+	+	+		
8	<i>Ascotis infixaria</i> Walk			+	+	+	+	+	+	+	+		
9	<i>Dichomeris eridantis</i> Meyr		+	+	+	+	+	+	+	+	+		
10	<i>Leucoptera sphenograptia</i> Meyr			+	+	+	+	+	+	+	+	+	
Hemiptera													
11	<i>Lawana conspersa</i> (Walk)			+	+	+	+	+	+	+			
12	<i>Ceroplastes rusci</i> Linn	+	+	+	+	+	+	+	+	+	+	+	+
13	<i>Leptocentrus Taurus</i> Febr			+	+	+	+	+					
14	<i>Myzus persicae</i> Sulzer	+	+	+								+	+
15	<i>Icerya seychellarum</i> Westw	+	+	+	+								+
16	<i>Drosicha dalbergiae</i> Stebb	+	+	+	+								+
Isoptera													
17	<i>Odontotermes obesus</i> (Rambur)		+	+	+	+	+	+	+	+	+	+	

Anomala bengalensis (Blanchard) (Coleoptera: Scarabaeidae)

Both grub and beetle stages were found injurious to the plant. The swarming of this insect was occurred in the month of May to June after first rainfall. The infestation of this insect was observed from all the districts except Dhanbad, East Singhbhum, Giridih, and Saraikela Kharsawa. The maximum plant infestation (15.55%) was observed in Plamu, while, in Dhanbad, East Singhbhum and Saraikela Kharsawa no infestation was recorded (Table 2). This was first time observed in this study and none of the workers has reported this insect pest on *D. sissoo* earlier.

Myloccerus undecimpustulatus Foust (Coleoptera: Curculionidae)

Weevil was bright grayish or grayish pink in colour, 5-6 mm in length. The spots and black marking was observed on elytra of this weevil. Only adult stage was found to be injurious to the plant. Adult weevil nibble the leaves from the edges or even near the midrib and make irregular margin and defoliate the plant. The infestation period of this insect was found during May to September (Table 2). The infestation of *Myloccerus undecimpustulatus*, was observed only from six districts viz. Gumla, Hazaribag, Khunti, Latehar, Ranchi and Ramgarh. The maximum plant infestation (18.92%) was

observed in Ramgarh district, while, lowest in infestation (3.83%) was in Khunti and in other districts no infestation was recorded (Table 3). This species was first identified by [8] in the Fauna of British India series and [9] have identified as *Myloccerus undecimpustulatus* Faust, a most serious pest specie of weevils species native to southern India in India and Pakistan.

Myloccerus discolor (Boheman) (Coleoptera: Curculionidae)

Adult weevil of this species was of black in color with pale brown markings on elytra. Body length was about 6.0 mm. This species was found to cause damage to tender shoots and inflorescence. The activity period of this weevil was during May to September (Table 2). The infestation of

Myloccerus discolor was observed only from eight districts viz. Chatra, Gumla, Hazaribag, Khunti, Latehar, Lohardaga, Ranchi and Ramgarh. The maximum plant infestation was (16.25%) was observed in Chatra district, while lowest in infestation (5.25%) was in Khunti, but no infestation was recorded in other districts (Table 3). *Myloccerus discolor* was recorded in this study nibbling the plant leaf and infest to the *D. sissoo* this finding was supported by the [10] in which they has reported *M. discolor* from June to September. It was argued [8] that nymphs and adults of *M. discolor* caused 2 to 45% infestation and damage to foliage and twigs of young plants of *D. sissoo* during February to November in India.

Table 3. District wise extant of insect pest infestation on *D. sissoo* in Jharkhand, India.

S. L	Name of the districts Insect name	<i>Apoderus sissoo</i>	<i>Anomala dalbergiae</i>	<i>Anomala bengalensis</i>	<i>Myloccerus undecimpustulatus</i>	<i>Myloccerus discolor</i>	<i>Agrotis ipilon</i>	<i>Plecoptera reflexa</i>	<i>Ascotis infixaria</i>
1	Bokaro	12.00	3.50	5.33	0.00	0.00	0.00	56.52	53.40
2	Chatra	12.50	8.33	9.33	0.00	16.25	0.00	60.10	41.83
3	Deoghar	5.00	6.83	9.50	0.00	0.00	0.00	53.82	26.67
4	Dhanbad	10.17	2.33	0.00	0.00	0.00	0.00	57.60	36.40
5	East Singhbhum	8.17	7.33	0.00	0.00	0.00	6.02	50.43	48.47
6	West Singhbhum	9.83	3.00	3.58	0.00	0.00	0.00	65.20	54.42
7	Garhwa	11.50	1.33	5.47	0.00	0.00	0.00	65.20	47.17
8	Giridih	9.17	4.83	0.00	0.00	0.00	0.00	58.08	36.82
9	Gumla	29.83	1.67	7.87	11.33	14.05	0.00	74.52	50.50
10	Hazaribag	22.83	2.50	5.35	9.57	10.17	0.00	67.12	49.17
11	Khunti	17.83	3.67	8.92	3.83	5.25	4.33	48.30	46.43
12	Koderma	18.33	10.17	7.12	0.00	0.00	0.00	50.37	57.50
13	Latehar	19.33	2.83	7.52	5.62	10.02	0.00	72.52	37.13
14	Lohardaga	21.67	2.33	9.93	0.00	15.83	0.00	61.27	28.10
15	Plamu	9.67	9.67	15.55	0.00	0.00	0.00	53.27	56.68
16	Ranchi	14.00	3.50	3.50	7.92	9.83	7.00	65.68	32.85
17	Ramgarh	10.83	2.67	5.17	18.92	12.48	0.00	78.40	42.62
18	SaraikelaKharsawa	6.00	4.83	0.00	0.00	0.00	0.00	45.60	46.40
19	Simdega	15.67	5.00	4.75	0.00	0.00	0.00	70.40	47.62
SEM±		2.53	1.23	1.09	0.64	1.09	0.29	5.38	3.67
CD at 5%		7.11	3.47	3.06	1.79	3.07	0.82	15.12	10.33

Table 3. Continue.

S. L	Name of the districts Insect name	<i>Dichomeris eridantis</i>	<i>Leucoptera sphenograptia</i>	<i>Lawana conspersa</i>	<i>Ceroplastes rusci</i>	<i>Leptocentr us taurus</i>	<i>Myzus persicae</i>	<i>Icerya seychellarum</i>	<i>Drosicha dalbergiae</i>	<i>Odontotermes obesus</i>
1	Bokaro	43.80	55.87	0.00	0.00	75.25	54.50	0.00	0.00	91.83
2	Chatra	76.83	82.17	0.00	0.00	86.12	44.27	0.00	0.00	92.13
3	Deoghar	83.55	74.82	0.00	0.00	79.70	47.47	0.00	0.00	93.80
4	Dhanbad	54.73	57.20	0.00	0.00	68.02	38.13	0.00	0.00	87.08
5	East Singhbhum	58.80	67.53	0.00	0.00	79.58	62.88	0.00	0.00	93.50
6	West Singhbhum	47.55	52.70	0.00	0.00	87.68	53.53	0.00	11.28	88.17
7	Garhwa	72.82	68.57	0.00	12.50	91.57	35.83	0.00	5.80	88.55
8	Giridih	74.63	73.45	0.00	0.00	72.55	25.48	10.63	9.17	92.50
9	Gumla	57.88	62.55	9.27	12.83	76.78	44.63	5.80	6.87	94.00
10	Hazaribag	43.38	45.33	0.00	0.00	80.18	37.50	8.80	10.32	90.23
11	Khunti	52.80	58.12	16.85	17.50	71.77	38.60	6.50	0.00	87.68
12	Koderma	86.15	85.87	0.00	0.00	84.42	33.55	0.00	0.00	90.37
13	Latehar	42.28	46.02	0.00	18.15	87.22	36.32	0.00	10.73	93.92
14	Lohardaga	52.50	55.17	3.50	0.00	68.27	39.47	0.00	8.70	88.70
15	Plamu	68.78	65.60	0.00	0.00	64.65	28.55	0.00	5.80	91.10
16	Ranchi	55.22	58.77	15.67	24.15	71.48	42.18	8.70	8.80	94.70
17	Ramgarh	65.93	65.48	14.43	0.00	72.62	37.40	0.00	6.50	91.23
18	SaraikelaKharsawa	56.50	57.57	0.00	0.00	78.50	41.87	0.00	0.00	90.53
19	Simdega	49.37	51.22	12.97	0.00	84.67	38.08	0.00	0.00	95.40
SEM±		3.16	3.06	0.73	0.44	2.84	2.03	0.48	0.64	3.73
CD at 5%		8.89	8.59	2.06	1.25	7.98	5.71	1.35	1.81	10.49

Agrotis ipsilon Rott. (Lepidoptera: Noctuidae)

The larva of this insect was found only in nursery only just below the surface of the soil feeding on the seedlings. Adult of this insect was moth dark colored; medium sized having dark, blackish colour with grayish patches on the dorsal side. Wings expanse 40 to 50 mm. Larva stout bodied having short hairs, cylindrical and earth coloured speckled with white or black. The adult of this pest emerge was emerged out in the month of October and remains active up-to April (Table 2). The infestation of this pest was observed only from nursery plants in three districts viz. East Singbun, Khunti and Ranchi. The maximum nursery plant infestation (7.00%) was in Ranchi followed by East Singbun (6.03%) and Khunti (4.33%). Other sixteen districts were not infested with this insect (Table 3). It has also reported by [1] this insect pest infesting to *D. sissoo* in India. But none of the worker has reported this insect pest from Jharkhand province of India.

Plecoptera reflexa Guenee (Lepidoptera: Noctuidae)

P. reflexa was found to be a major pest and its larval stages was found to cause a major defoliation to the plant in both the nursery and old plantation. Moth was nocturnal in habit. Wing expanse 30-35 mm. Forewings were grayish with oblique irregular bands, underside was grayish white. Adult moths hide in undergrowth vegetation during day time and active in night hours. Caterpillar was semilooper, smooth, cylindrical, green in colour having eight bands on the dorsal side. Mature larva was pinkish. The maximum damage of this defoliator attack was observed during May and June, but the insect was found active up to October (Table 2). Due to severe infestation of larval causes defoliation of the trees. Infestation of *Plecoptera reflexa* was recorded from all the districts and the maximum plant infestation (78.40%) was observed in Ramgarh, while lowest in infestation (45.60%) was in Saraikela Kharsawa (Table 3). Similarly, [11] reported defoliator caterpillar *Plecoptera reflexa* as an important defoliator of *D. sissoo* in Pakistan. In India this pest was reported in the province Madhya Pradesh [12, 13] (Kalia et al., 2000 and Bhan, et al., 2005); in Uttarakhand population dynamics of *P. reflexa* and *Dichomeris eridantis* [14, 15, 16].

Ascotis infixaria Walker (Lepidoptera: Geometridae)

The only larva of this insect was found to be injurious to the plant. Caterpillar was light pale in 25-30 mm long, ochreous black in colour. Larval period was 3 to 5 weeks, completed during June- September, depends upon the favorable condition. Pupation takes place in the soil on in the plant debris. This infestation period of this pest was recorded from April- October (Table 2). The pest population was found highest during summer. Infestation of *Ascotis infixaria* was recorded from all the districts and the maximum plant infestation (57.50%) was observed in Koderma, while lowest in infestation (26.67%) was in Deoghar (Table 3). It was recorded [17] *Ascotis imparata* pest infesting to *D. siaaoo* and studied its biology in Uttarakhand-India. Though, this pest was also reported on *Moringa pterygospermaby* [18] in Madhya Pradesh, India.

Dichomeris eridantis Meyrick (Lepidoptera: Gelechiidae)

The larval stage of insect was found to be injurious to the plant and the caterpillar defoliates the tree, feeding within the leaf fold or rolled leaves. Moth was small wing expanse 16.0 mm. Larva greenish yellow or dark grey with two faint sub-median lines, slightly flattened. Head and Pronotum black. Mature larva 25 mm long. The activity of this insect was observed from February to October (Table 2). Infestation of *Dichomeris eridantis* major insect pest of *D. sissoo* was recorded from all the districts. The maximum plant infestation (86.15%) was observed in Koderma, while lowest in infestation (42.28%) was in Latehar (Table 3). It was recorded by [14] and [15] has also reported that *Dichomeris eridantis* infesting to *D. sissoo* in Uttarakhand- India and subsequently, population dynamics of *Dichomeris eridantis* was studied by [16]. Seasonal incidence of leaf binder, *D. eridantis* was studied by [19] and moderate to maximum occurrence of this pest was recorded from February to October.

Leucoptera sphenograptia Meyrick (Lepidoptera: Lyonetidae)

The larval stage of this pest was found to be causes damage to the plant with mining to the leaves, results discolouration spots and curling of leaves and premature leaf shedding. Moth was small 4.0-4.5 mm long, shining, white in colour. Fore wings were narrow, tipped with ochreous and a black apical spot with fuscous bars. Larva was light green with brown head and tapers posteriorly. This pest was found active during March to November (Table 2). Infestation of *Leucoptera sphenograptia* major insect pest of *D. sissoo* was recorded from all the districts and maximum plant infestation (85.87%) was observed in Koderma, while lowest in infestation (45.33%) was in Hazaribag (Table 2). It was observed by [20] that *Leucoptera sphenograptia* as a leaf-miner on *Dalbergia sissoo* in nurseries and plantations from Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal, and Madhya Pradesh. It has reported [21] that an outbreak of *L. sphenograptia* on *D. sissoo* in Madhya Pradesh, India, in November to January, but none of the study was reported from Jharkhand.

Lawana conspersa (Walker) (Hemiptera: Flatidae)

This was the first observation of this pest infesting to *D. sissoo* in India. Both nymph and adult of this pest were found to be injurious to the plant. The nymph of this insect feed gregariously and adult scattered but some time in group on tender shoot, leaves and fruit of the plant. The body of the adult insect was creamish white with black spots on the fore wings and orange strips on basal portion of forewings. While hind wings were pure off-white. Newly hatched nymphs were white colored having waxy covering on the body and long waxy tail. The activity period was recorded from Match to August (Table 2). The infestation of this insect was observed only from five districts viz. Gumla, Khunti, Lohardaga, Ranchi and Ramgarh. The maximum plant infestation (16.85%) was observed in Khunti district, followed by Ranchi (15.67%), Ramgarh (14.43%), Gumla (9.27%) and lowest 3.50% in Khunti district (Table 3). *Lawana conspersa* insect pest was first time recorded from *D. sissoo* in this study, though this insect has been reported on *Flemingia* sp.

Butea monosperma, *Cajanus cajan*, *Zizyphus mauritiana* and *Dalbergia assamica* [22] and *Flemingia semialata* [23]. Cocoa and Bauhinia spp. damage is caused by nymph and adult by sucking sap from tender leaf, flower and fruits [24] in Malaysia, but this insect pest was never been reported as pest on *D. sissoo* in the world.

Ceroplastes rusci (Linnaeus) (Hemiptera: Coccidae)

This insect was about 3-4 mm, globular and coated with a layer of beige, pinkish and whitish wax. Adult female scale was found permanently attached with the branches or leaves. Both the crawler stage and adults feed upon the succulent parts of the plant. The scale was found on both the upper and lower surface of leaves. The effect of its infestation was resulted leaf yellowing, leaf fall and branch dieback (Table 2). The infestation of this insect was observed only in five districts viz. Garhwa, Gumla, Khunti, Latehar and Ranchi. The maximum plant infestation (24.15%) was observed in Ranchi district, followed by Latehar (18.15%), Khunti (17.50%), Gumla (12.83%) and lowest 12.50% in Garhwa district (Table 3). Similarly, this fig wax scale, *C. rusci* was first time reported by [25] Kumar, (2013) in India, which was considered as the serious scale insect pest of *D. sissoo*.

Leptocentrus taurus Febr. (Hemiptera: Membracidae)

The insect species was found everywhere in the province and found very common. Both the adults and nymphs were found to suck the sap from the tender parts particularly from the shoot during March to June. The adult female was observed to lay their eggs on the shoot inserted in the bark. Newly emerged nymph was light green colored and mature insect in black with two small thorns on the head in addition to one long thorn in backward direction. Body was about 4-5 mm long and 2 mm wide (Table 2). Infestation of *L. taurus* a major insect pest of *D. sissoo* was recorded from all the districts. The maximum plant infestation (91.57%) was observed in Garhwa, while lowest in infestation (64.65%) was in Plamu (Table 3). This is the first report of this pest from *D. sissoo*, though it has been reported that pest feeding on *Parthenium hysterophorus* in Tamilnadu, India [26] and many more countries [27].

Myzus persicae Sulzer (Hemiptera: Aphididae)

This *Myzus persicae* aphid species was found upon the tender leaves and shoot and causes damage by sucking plant sap. They feed gregariously on tender parts including leaves and shoot of the plant. Body was delicate, small, 2 mm long and blackish or purple in colour. They secrete honey dew on which sooty mould develops and hampers the photosynthesis process. The infestation of this insect was observed during November to March (Table 2). Infestation of *M. persicae* a sap sucking insect pest of *D. sissoo* was recorded from all the districts. The maximum plant infestation (62.88%) was observed in East Singhbhum, while lowest infestation (25.48%) was in Giridih district (Table 3). This insect was also reported by [28] and [29] on *D. sissoo* from India and [30] has reported in Pakistan.

Icerya seychellarum (Westwood) (Hemiptera: Margarodidae)

The body of the insect was observed very soft with yellow-

white cottony hairs. Both the nymph and adults stages were observed equally injurious to the plant. Newly emerged nymph feed on the succulent part and leaves of the plant. This insect was secreted honey dew and subsequently, developed sooty mould upon it. Female insect was wingless, orange yellow, covered with white wax, while male was winged. Body of female insect was distinctly segmented. This insect pest was found active during December to April (Table 2). The infestation of *Icerya seychellarum* was observed only from five districts viz. Giridih, Garhwa, Gumla, Hazaribag, Khunti and Ranchi. The maximum plant infestation (10.63%) was observed in Giridih district, followed by Hazaribag (8.80%), Ranchi (8.70%), Khunti (6.0%), and lowest (5.8%) in Gumla district (Table 3). This insect was first time recorded in this study in Jharkhand, India.

Drosicha dalbergiae Green (Hemiptera: Margarodidae)

Both nymph and adult stages of this insect was found feeding to the sap of new foliage and shoots. This insect was secreted honey dew on which sooty mould developed, resulted blocking of stomata and disruption in photosynthesis of the plant. Females adult wingless, orange yellow, covered with white waxy powder. The appendages were black. Body is distinctly segmented. This insect was found active during December to April (Table 2). The infestation of *Drosicha dalbergiae* was observed only in ten districts viz. West Singhbhum, Garhwa, Giridih, Gumla, Hazaribag, Latehar, Lohardaga, Plamu, Ranchi and Ramgarh. The maximum plant infestation (11.28%) was observed in West Singhbhum, while lowest (5.8%) in Garhwa district (Table 3). This insect was also reported by [1] and [31] on *D. sissoo* in India and by [30] in Pakistan.

Odontotermes obesus Rambur (Isoptera: Termitidae)

This insect was found infested to live plant in the nursery to old plantation. The insect was found colonized in soil and feed on the plant root, dead bark and damaged wood of the plant. This insect was found to be the major insect pest throughout the Jharkhand and the major activity period was observed from February to November. The maximum plant infestation (95.40%) was observed in East Singhbhum, while lowest infestation (87.08%) was observed in Dhanbad (Table 3). The infestation of termite was also noticed in the findings of [32] [33] (2005) and Singh and Pandey (2007) that a wide mortality of *D. sissoo* was caused by termites as common enemies of the trees. Subsequently [34] has also reported a termite *Odontotermes redemanni* attacking to *D. sissoo* and many species of *Odontotermes* infecting to *D. sissoo* has been reported [35, 36, 37, 38].

4. Conclusion

About 209 insect pests were already recorded from all over the India, while only seventeen insect pests were recorded from the Jharkhand Province in this study. Among these two insect pests namely *Lawana conspersa* and *Icerya seychellarum* were recorded first time from *D. sissoo* in this study. This may be due variation in vegetation, soil profile, and

climatic condition, additionally, seasonal incidence of the insect pests was also found different from the earlier records. Hence, it may be concluded the infestation of insect pest and their seasonal incidence may be depends on soil type and mainly climatic condition, which may shifted with the change of climatic condition. Therefore, assessment of insect pest of major forestry species should be done at a defined interval so that epidemic of any new insect pests may be avoided.

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