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## Occurrence of new defoliator insect pests on *Dalbergia latifolia* (Roxb.) in Uttarakhand, India

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### Abstract

The present study conducted in Uttarakhand, India with aim to examine the insect pests of *Dalbergia latifolia*. The commonly known as rosewood and naturally not grown in the study area. Rosewood is a significant timber-producing tree species native to South and Southeast Asia and holds economic importance. This species was introduced in Uttarakhand in the year 2010 and again in 2020 another introduction programme was initiated by ICFRE, Dehradun. Though, there was no study on insect pest of *D. latifolia* at introduced regions of Uttarakhand, India. To assess the status of insect pest in newer growing region, periodic survey was conducted and insect pests were observed infesting *D. latifolia* at nurseries and plantations. Total six insect pests were recorded in this study, out of which five insect species viz. *Gastrophysa viridula*, *Chrysochus cobaltinus*, *Apoderus crenatus*, *Ectropis bhurmitra*, and *Hyposidra talaca* were recorded for the first time, while previously recorded *Plecopte rareflexa* was also recorded from Uttarakhand. The research also delved into the nature of damage caused by these insect pests and their seasonal occurrence. By understanding the behavior of these insect pests and the patterns of damage they inflict, researchers can develop effective pest management strategies to mitigate any potential economic losses they may cause. Such knowledge is crucial for the introduction of *D. latifolia* in any newer region and conservation of *Dalbergia latifolia* in the region.

**Keywords:** *Dalbergia latifolia*, rosewood, defoliators, new records

### Introduction

*Dalbergia latifolia* (Roxb.) commonly known as Indian rosewood, Bombay black wood, Indian palisandre and Java palisandre. *D. latifolia* is a native species of India, Nepal and Indonesia and exotic species of other countries like Kenya, Malaysia, Myanmar, Nigeria, Philippines, Sri Lanka, Tanzania, Vietnam and many other parts of South East Asia (Sujatha, 2008; Orwa *et al.*, 2009) [27, 40]. The distribution of this species is very scattered and occurs in mixed deciduous forest throughout the Indian peninsula (Sasidharan *et al.*, 2020) [24]. *D. latifolia* is widely distributed to low-elevation tropical monsoon forests of Central and southern parts of India at altitudes from 900 to 1350 MSL.

*D. latifolia* is one of the important quality timber yielding species and its timber is internationally known for its grain quality, strength, natural dark colour, and its timber is widely used for making furniture, panel, decorative articles, musical instrument industry and other multiple products. Additionally, its bark is used for source of tannin, which is utilised in medicine industry (Anonymus., 2018; Damaiyani & Prabowo, 2019; Chatterjee *et al.*, 2020) [11, 12, 10]. Plantation of *D. latifolia* is widely done due to its ecological services as CO<sub>2</sub> sequester, nitrogen fixation and soil repairing quality (Soerianegara and Lemmens, 1994; Sujatha, 2008; Lahiri *et al.*, 2019) [39, 40]. The species regenerates normally by seeds and occasionally by root suckers, but it is categorized as threatened species under IUCN red data list due to its poor regeneration, slow growth and long rotation period. Subsequently, rapid increase in demand resulted in its over and illegal exploitation in India (Orwa *et al.*, 2009; Treanor, 2015) [27, 42]. It has been recorded that more than forty insect pests pose threat to *D. latifolia* and quality, growth and productivity of this species are adversely affected by frequent outbreaks of insect pests. Some important groups of insects belonging to orders Coleoptera, Hymenoptera, Lepidoptera and Isoptera were recorded as major pests that cause severe damage and high economic loss to the nursery and plantations. Among these, most important pests are cutworms, termites and cockchafers, besides some defoliators, sapsuckers and shoot borers as major pests. In northern India *D. latifolia* was introduced in the year 2003 onwards and many

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plantations under introduction trails were established in Uttarakhand, but insect pest infestation study of *D. latifolia* from Northern region of India is available. Hence, the survey was undertaken to find out the insect pests fauna associated with *D. latifolia* and their nature of damage in Uttarakhand, India.

### Materials and Methods

The present survey of insect pest of *D. latifolia* was done on the plantation established in the year 2010 by the state forest department, Uttarakhand at Forest Research Centre Lalkuan, Silva Sal unit Haldwani, lies (Fig. 3) at lat 29°03'50.5''N to long 79°30'55.3'' E and the nursery established at New Forest campus, Forest Research Institute, Dehradun lies at lat 30°20'31.56'' N and long 77°59'50.28'' E in the state of Uttarakhand, India. The investigation was done over nursery at New Forest Campus and eleven-year-old plantation at Lalkuan site (Fig. 1) of *D. latifolia* round the year from 2021-2023. Weekly field visit was done for collection of insect pests and observation of their nature of damage. Insect pests associated leaves were observed and their nature of damage was recorded simultaneously. Seasonality of the insect pest infestation was recorded on monthly basis. Collected insect pests were brought to the laboratory for further studies viz. nature of feeding, adult emergence and identification. Adult stages were preserved for further record. Field photo of insect pest and their nature of damage was captured using DSLR Canon 7D camera and some of the pictures were captured under stereozoom microscope Leica M205 fitted with camera MC190.

### RESULTS

The result presented in table-1 revealed that *D. latifolia* was found to be infested with six defoliator insect pests belong to three different insect orders viz. Coleoptera, and Lepidoptera, and their nature of damage was also recorded (Table 2).

***Gastrophysa viridula* (De Geer):** Adult beetle was oval in shape of about 5.02 mm long and dark metallic green in colour, with reddish brown legs (Fig. 2A & D). Infestation of this beetle was found at New Forest Campus nursery on young leaves and FRC Lalkuan, Uttarakhand under plantation. Both male and female beetle was recorded feeding on the leaves. Adult beetle feed on young leaves from margin under field and laboratory condition.

***Chrysochus cobaltinus* Leconte:** Adult beetle was oval in shape of about 7.35-7.75 mm long with dark metallic iridescent cobalt-blue exoskeleton and brown legs. The beetle was collected from New Forest Campus nursery found to be infested on young leaves. Both adult male and female specimens have been recovered from young leaves (Fig. 2B & E). Feeding pattern of adult beetle has been monitored under field and laboratory conditions. Through regular observation it was found that the adult beetle feeds gregariously on leaves, tender shoots and cut the leaves from margin.

***Apoderus crenatus* Voss:** The weevil (Fig. 2C) was small about 4.75 mm long, orange red in colour with row of elytra; glabrous rostrum, subconical prothorax, semicircular scutellum and densely pubescent meso and meta sternalepimera. The weevil was different from the *A. sissu*. Infestation of this weevil was recorded from New Forest Campus and FRC Lalkuan under plantation. Adult was mainly found infesting on soft tender leaves making irregular scraping pattern (Fig. 2C). Additionally, female cut the young leaf from the base edge and roll the leaf into a compact

cylindrical shape capsule (Fig. 2F). Female lay eggs one to three in each rolled leaf, and larva feed internally inside the leaf roll till pupation.

***Plecoptera reflexa* Guenee:** The insect adult stage was nocturnal in nature and only larval stage was found to be damaging to the plant. Caterpillar was light green, smooth, and cylindrical in shape (Fig. 2G). Infestation of this bug was recorded from New Forest Campus and FRC Lalkuan under plantation. The young caterpillar was found to be damaging on the lower surface of leaf. Mature larvae of size about 4.0-4.5 cm. Larvae of this species consume whole leaf including petiole and the green shoot. Full grown larvae consume three to four leaves in a day.

***Ectropis bhurmitra* Hubner:** The larva (Fig. 2I) was light grey-brown in colour, body with swollen darkened diagonal ridge that ends at dorsal tubercle. Head light grey with darker brown herringbone pattern on lobes and horizontal streak at top of front diamond on mid-abdominal segments. Infestation of this larva was recorded from New Forest Campus and FRC Lalkuan under plantation. The larva of this species was found damaging the tender leaves of the plant under both nursery and plantation.

***Hyposidra talaca* Walker:** This insect is also known as black inch looper or tea looper size about 5.0-5.5 cm. Only larval stage of this pest was found to be damaging on leaves. Different larval stages of black looper (Fig. 2H) were studied in the laboratory and it was observed that initially larvae were black coloured and creamy brown coloured at maturity. The infestation of this larva was from New Forest Campus nursery. The semi-looper larva was found to damage tender leaf by feeding from margin of the leaf. The study conducted under laboratory condition revealed that the 4<sup>th</sup> and 5<sup>th</sup> instar caterpillar stage are most destructive to young leaves.

### Discussions

The expansion of the ecological niche and host range of insect pests may be influenced by global climatic changes, and this phenomenon is considered part of a dynamic evolutionary process. Studies conducted by Bernays and Chapman (1994)<sup>[7]</sup>, Janz *et al.* (2006)<sup>[20]</sup>, Williams and Liebhold (1995)<sup>[46]</sup>, and Van *et al.* (2004)<sup>[4]</sup> have highlighted the potential impact of climate change on the behavior and distribution of herbivorous insects. In order to successfully expand their range to new habitats or hosts, herbivorous insects often require behavioral adaptations (Henniges-Janssen *et al.*, 2011)<sup>[19]</sup>. However, the regular assessment of geographical and host range extensions of insect pests in forestry is often lacking. This knowledge gap makes it challenging to predict and manage potential pest outbreaks effectively. In this case of *Dalbergia latifolia* the quality, growth, and productivity of this tree species are negatively affected by frequent insect pest outbreaks. There are many insect pests were previously recorded from *D. latifolia* viz. *Karria lacca* Kerr a sap feeder, *Lecanium hesperidum* Linn, *Gragara sordid* Fun., *Oxyrachis mangiferana* Dis., *Oxyrachis trandus* Fun., (Hemipteran sap suckers), *Aulacophora fovecollis* Lucans beetle, *Anomala dalbergiae* Arrow (leaf feeding beetle), *Argyroplote aprobola* Meyrick (Eucosmidae); *Anisodes obrinaria* Guenee, *Ectropis bhurmitra* Walker (Geometridae); *Tapena thwaitesi* Moore, *Tapena thwaitesi* Moore (Hesperiidae); *Cosmotriche laeta* Walker (Lasiocampidae); *Dasychira dalbergiae* Moore (Lymantriidae); *Achaea janata* Linnaeus, *Anoba polyspila* Walker, *Ericcia inangulata* Guenee, *Hamodes aurantiaca* Guenee, *Metachrostis trigona* Hampson, *Midea rectalis*

Walker, *Mocis undata* Fabricius, *Plecoptera quaesita* Guenee, *Plecoptera reflexa* Guenee, *Rhesala imparata* Walker (Noctuidae), *Spataloides costalis* Moore (Notodontidae); *Charaxes polyxena* Moore, *Neptis viraja* Moore (Nymphalidae); *Bocchoris onychinalis* Guenee, *Lamprosema imphealis* Walker, *Maruca testulalis* Geyer, *Nephoteryx* sp. (Pyralidae); *Clanis titan titan* Rothschild & Jordan (Sphingidae); *Striglina scitaria* Walker (Thyrididae) (Lepidopteran defoliators); and bark feeding lepidopteran insect pests: *Labdia molybdaula* Meyrick (Cosmopterygidae); *Opogona xanthocrita* Meyrick (Lyonetiidae); *Hapsifera rugosella* Stainton (Family: Tineidae) (Beeson, 1941; Mathur and Singh 1959)<sup>[6, 25]</sup>.

The present study was conducted on the introduced population of *D. latifolia* in the nonnative distribution range. In this new range we have recorded six insect pests from Uttarakhand province of Northern, India, among *Gastrophysa viridula* leaf beetle, first time recorded feeding on *D. latifolia*. Beetle feed on the young leaves by cutting the leaf from its margin to make a circular pattern in the centre of the leaf. *G. viridula* has been recorded as a pest of *Begonia* (Begoniaceae) (Salisbury & Platoni, 2013)<sup>[33]</sup>, though, it has been considered an important biocontrol agent of dock weed (Swatonek 1972, Barbattini *et al.*, 1986, Hatcher *et al.*, 1997)<sup>[41, 5, 18]</sup>. *G. viridula* was recorded as an effective biocontrol agent due to its high food consumption efficiency and more abundance which decreases the dock population in growing season (Renner, 1970; Brooks & Whittaker 1998)<sup>[30, 9]</sup>. This is the first record of feeding on *D. latifolia*, though Engel (1956)<sup>[16]</sup> has reported about 38 species of ten plant families as occasional or regular hosts, but there was no record of *Dalbergia* sp. This insect was also recorded from *Rheum palmatum* (Balachowsky & Mensil, 1936)<sup>[4]</sup>, *Begoniaceae* UK (Salisbury and Platoni, 2013)<sup>[33]</sup>. This species was also reported as a biological control agent for *Rumex* species (Engel, 1956; Chevin, 1968; Martinková and Honěk, 2004)<sup>[11, 16, 24]</sup>.

The leaf beetle, *Chrysochus cobaltinus* native to North American (Arnett, 1968; Lopatin, 1984)<sup>[3, 23]</sup> have been recorded for the first time in this study. Adults emerge in early summer and adults feed on leaves of *Apocynum cannabinum* (Apocynaceae) and *Asclepias* spp. (Asclepiadaceae) (Dickinson, 1995; Sennblad and Bremer, 1996)<sup>[14, 36]</sup>; *Asclepias speciosa* and *A. eriocarpa* (Sady, 1994; Dickinson, 1995; Dobler & Farrell, 1999)<sup>[32, 14, 15]</sup>. Larvae of this species are obligate root feeders, single generation per year and persist for approximately six weeks (Williams, 1992, Dickinson, 1995)<sup>[14, 45]</sup>. *C. cobaltinus* range in British Columbia south through Washington, Idaho, Montana, Oregon, California, Nevada, Utah and Colorado to Arizona and New Mexico (Peterson *et al.*, 2001)<sup>[28]</sup>.

We have recorded *Apoderus crenatus* Voss species feeding on the leaf of *D. latifolia* for the first time from India. The adult

beetle makes leaf roll similar as done by *A. sissu* in *D. sissoo*. We have identified this species with morphological characters of type of this species at ICAR-Indian Agricultural Research Institute, New Delhi, and the species is entirely different from *A. sissu* Marshall (type collection (NFIC-FRI, Dehradun India). The nature of damage was similar to the *Apoderus sissu*, as its adult stage was found to cause damage to new flush either by rolling them off or by cutting through the mid rib and defoliation (Kumar, 2017)<sup>[21]</sup>.

*Plecoptera reflexa* a well-known defoliator and considered as serious pest of *D. sissoo* in India and poor quality plantations have often been derelict, it was first reported in 1899 and regular annual defoliation was recorded in Pakistan and northern India in the month of April (Beeson, 1941; Rawat & Singh, 2003)<sup>[6, 29]</sup>. We have recorded this species first time from Uttarakhand, Northern India. Roychoudhury and Mishra, 2021 have recorded this species as a major pest of *D. latifolia* Central from India.

*Hyposidra talaca* is distributed throughout the oriental region and it was first reported as a tea pest from Indonesia and later was reported as a destructive tea pest from West Bengal (Biswas *et al.*, 2004)<sup>[8]</sup>. *H. talaca* is a dominantly prefer forest host plants to feed (Shankar *et al.*, 1998)<sup>[37]</sup>, such as *Bombax ceiba*, *Cassia* sp., *Cedrela toona*, *Ficus glomerata*, *Shorea robusta*, *Syzygium cumini*, *Tectona grandis*, but we have recorded this species for the first time from *D. latifolia* in India. Majorly it is a defoliating tea pest, it creates a periodical and regular problem in north-eastern tea plantations of India. It was also reported as weed control against *Chromolena odorata*, as a major biocontrol agent (Muniappan and Viraktamath, 1986)<sup>[26]</sup>. *H. talaca* was also reported from cinchona, tea, coffee, cocoa and fruit trees in tropics (Entwistle, 1972)<sup>[17]</sup>, *Shorea robusta* and Cinchona (Shankar *et al.*, 1998)<sup>[37]</sup>, new pest of forest tree *Quercus incana* (Singh & Singh, 2004), on *Perilla frutescens* (Uniyal & Singh, 2010)<sup>[43]</sup>. It has a short life cycle with multiple overlapping generations. Apart from that, factors like faster multiplication, lack of efficient natural enemies cause high density of larvae and notices more active in winter months (Das *et al.*, 2010)<sup>[13]</sup>.

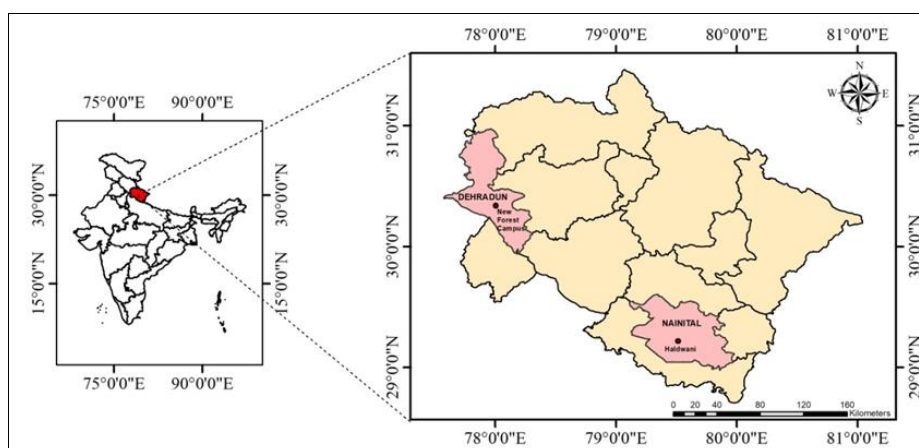
*Ectropis bhurmitra* has a broad distribution in Asian-Pacific regions and well recorded from Borneo, Buru, Java, India, New Guinea, Peninsular Malaysia, Philippines, Solomon Islands Sumatra, Sri Lanka, Sulawesi, Taiwan, and Thailand (Sato, 2007)<sup>[35]</sup>. We have record of *E. bhurmitra* on *D. latifolia*, though this species recorded on this species by Mathur and Singh, (1959)<sup>[25]</sup>. Additionally, on a wide range of host plants, e.g. *Aleurites montana*, *Artemisia vulgaris*, *Bombax malabaricum*, *Lantana aculeata*, *Phoebe lanceolata*, *Shorea robusta* and *Tectona grandis* (Beeson 1941)<sup>[6]</sup>. The presence of large number of alternative host plants has induced the looper problem in tea garden in most of the areas of Assam and West Bengal of India (Antony, 2012)<sup>[2]</sup>.

**Table 1:** Defoliator insect pests of *D. latifolia* and their nature of damage Uttarakhand, India.

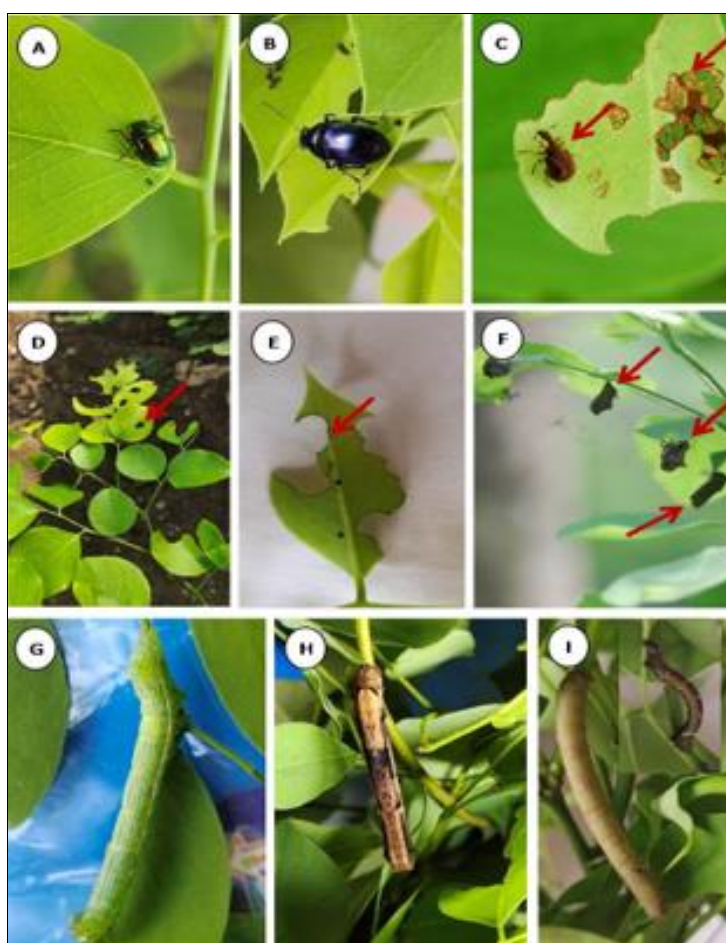
| Sr. no. | Species                               | Order: Family             | Nature of damage |
|---------|---------------------------------------|---------------------------|------------------|
| 1.      | <i>Gastrophysa viridula</i> (De Geer) | Coleoptera: Chrysomelidae | Defoliator       |
| 2.      | <i>Chrysochus cobaltinus</i> Leconte  | Coleoptera: Chrysomelidae | Defoliator       |
| 3.      | <i>Apoderus crenatus</i> Voos         | Coleoptera: Attelabidae   | Defoliator       |
| 4.      | <i>Plecoptera reflexa</i> Guenee      | Lepidoptera: Noctuidae    | Defoliator       |
| 5.      | <i>Ectropis bhurmitra</i> Hubner      | Lepidoptera.: Geomatridae | Defoliator       |
| 6.      | <i>Hyposidra talaca</i> Walker        | Lepidoptera: Geomatridae  | Defoliator       |

**Table 2:** Seasonal incidence of defoliator insect pest infesting to *D. latifolia* in Uttarakhand, India.

| SL. | Insect species                        | January | February | March | April | May | June | July | August | September | October |
|-----|---------------------------------------|---------|----------|-------|-------|-----|------|------|--------|-----------|---------|
| 1   | <i>Gastrophysa viridula</i> (De Geer) |         |          |       |       |     |      |      |        |           |         |
| 2   | <i>Chrysocbus cobaltinus</i> Leconte  |         |          |       |       |     |      |      |        |           |         |
| 3   | <i>Apoderus crenatus</i> Voos         |         |          |       |       |     |      |      |        |           |         |
| 4   | <i>Plecoptera reflexa</i> Guenee      |         |          |       |       |     |      |      |        |           |         |
| 5   | <i>Ectropis bhurmitra</i> Hubner      |         |          |       |       |     |      |      |        |           |         |
| 6   | <i>Hyposidra talaca</i> Walker        |         |          |       |       |     |      |      |        |           |         |



**Fig 1:** Insect pest survey and study area of *D. latifolia*.



**Fig 2(A-I):** Leaf defoliators insects feeding on *Dalbergia latifolia*. A- *Gastrophysa viridula*; B- *Chrysocbus cobaltinus*; C- Adult *Apoderus crenatus* weevil & feeding symptoms; D- leaf feeding symptoms of *Gastrophysa viridula*; E- leaf feeding symptoms of *Chrysocbus cobaltinus*; F- leaf rolling symptoms of *Apoderus crenatus*; G- Larva of *Plecoptera reflexa*; H- *Ectropis bhurmitra*; I- Larva of *Hyposidra talaca*.

## Conclusion

It is noteworthy that some of these insect pests were documented for the first time on *D. latifolia*, indicating the need for further research and monitoring to understand their impact and develop appropriate pest management strategies. The information gathered from such studies is valuable for assessing the potential threats posed by insect pests, improving pest management practices, and safeguarding the health and productivity of *D. latifolia* plantations. The study has given the current status of insect pest of *D. latifolia* of northern India, with some new insect pest records. The infestation of insect pest shows that the introduction of *D. latifolia* in new environment of northern India making the species susceptible and favourable to insect pest to host upon. After observing the insect pests on *D. latifolia* it may also be concluded that in near future these pest may become a serious threat to high valued plantation of *D. latifolia*, therefore, more emphasis will be required for selection of superior / resistant progeny for successful introduction and sustainable growth of *D. latifolia* in Northern India. Though, continued research in this area will contribute to a better understanding of the ecological dynamics and potential impacts of insect pests on this economically important timber species.

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## Conflict of interest statements

We certify that there is no conflict of interest of any authors and there is no funding conflict too.

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