

# New records of insect pests infesting *Dalbergia latifolia* (Roxb.) from Uttarakhand, India

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## Research Article

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# Abstract

The present study conducted in Uttarakhand, India aimed to investigate the insect pests associated with *Dalbergia latifolia*, commonly known as rosewood. Rosewood is an economically important timber-producing tree species indigenous to South and Southeast Asia. Although insect pests have been reported to attack rosewood trees, their impact and threat to nurseries and plantations in India have been insignificant thus far. The periodic survey was done and insect pest were recorded infesting *D. latifolia* nursery and plantation.

The study recorded ten different insect species on *D. latifolia* in the region, with eight of them being reported for the first time on this particular species. The newly recorded insect species included *Gastrophysa viridula*, *Chrysochus cobaltinus*, *Apoderus crenatus*, *Hyposidra talaca*, *Ricania speculum*, *Leptocorisa acuta*, *Leptocentrus taurus*, and *Dorsicha stebbingi*. Further, nature of damage caused by these insect pests, and seasonal incidence was also studied. This investigation aimed to gather valuable information on the insect pest fauna associated with rosewood in Uttarakhand, India, and assess their potential effects on this valuable timber species. By studying the insect pests and their damage patterns, researchers can develop effective pest management strategies to mitigate any potential economic losses caused by these pests. Such information is crucial for the sustainable management and conservation of *Dalbergia latifolia* in the region.

## INTRODUCTION

*Dalbergia latifolia* (Roxb.) commonly known as Indian rosewood, Bombay blackwood, 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). The distribution of this species is very scattered and occurs in mixed deciduous forest throughout the Indian peninsula (Sasidharan et al., 2020). *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 (Anon., 2018; Damaiyani and Prabowo, 2019; Chaterjee et al., 2020). 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 & Lemmens, 1994; Sujatha, 2008; Lahiri et al., 2019). 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). 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

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 METHOD

The present survey of insect pest of *D. latifolia* was done at New Forest campus, Forest Research Institute, Dehradun lies at lat 30° 20' 31.56" N and long 77° 59' 50.28" E and Forest Research Centre Lalkuan, Silva Sal unit Haldwani, lies at lat 29°03'50.5"N to long 79° 30'55.3" E in the state of Uttarakhand, India (Fig. 3). The investigation was done over nursery at New Forest Campus (Fig. 4A) and eleven year old plantation at Lalkuan site (Fig. 4B) of *D. latifolia* during 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 with root, bark, shoot and leaves were observed, collected 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 ten insect pests belonging to three different insect orders viz. Coleoptera, Lepidoptera and Hemiptera and their nature of damage was also recorded.

### Defoliator insect pest

#### *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. 1A & D). Infestation of this beetle was found at New Forest Campus nursery on young leaves and FRC Lalkuan Uttarakhand 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. 1B & 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. 1C) 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 sternal epimera. 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. 1C). Additionally, female cut the young leaf from the base edge and roll the leaf into a compact cylindrical shape capsule (Fig. 1F). 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. 1G). 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. 1I) 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. 1H) 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 4th and 5th instar caterpillar stage are most destructive to young leaves.

## **Sap sucking insect pests**

### ***Ricania speculum* Walker**

The adult has dark brown wings with central wavy horizontal bands and irregular transparent patches of different sizes. The precostal area of the forewings showed dense transverse veinlets and the costal margin was distinctly convex near the base (Fig. 2C & D). Infestation of this bug was recorded from New Forest Campus and FRC Lalkuan under plantation. Both the nymph and adult were found feeding on the tender parts of the plants.

### ***Leptocorisa acuta* Thunberg**

The bug was greenish yellow to yellow-brown in colour (Fig. 2E & F). Head was longer than wide, rostrum relatively shorter; the scutellum (triangular shaped plate) was found on the thorax, posterior to the pronotum. The fourth antennal segment was curved. Infestation of this bug was recorded from FRC Lalkuan under plantation. Both nymph and adults were found to be feeding on leaves and tender shoots of the plant. Nymph feed gregariously on the tender shoots, resulted in wilting and drying of tender shoots.

### ***Leptocentrus taurus* Fabricius**

The insect commonly known as tree hopper, triangular shaped body measured 4–7 mm long, yellow eyes, winged with three pairs of legs, two curved horns like projections on the thorax (Fig. 2A). Infestation of this hopper was recorded from aerial apical parts of *D. latifolia* from FRC Lalkuan plantation. Both nymph and adult suck the plant sap from tender parts of the plant. The hopper fed on apical portions of the shoot apices, making them rough and woody in appearance, brown in colour that gradually dried and apical leaves shed off.

### ***Drosicha stebbingi* Green**

Commonly known as mango mealy bug of about 1.0-1.5 cm long, oval white body (Fig. 2B). Infestation of this bug was recorded from FRC Lalkuan under plantation only. The nymph and adult the stages were observed to be infesting on tender parts of the plant. The late instar nymph and adult female was flat, oval and waxy white. They remained stationary and adhered to the total length on shoots. Infested shoot part was covered by the sooty mould.

The seasonal incidence (Table 2) of leaf cutting beetle i.e. *G. viridula* and *C. cobaltinus* was recorded infesting new from April to June. The infestation of *A. crenatus* was recorded to be during April to July, while leaf defoliator larvae of *P. reflecta* was appeared in the month of April and remain infesting to the *D. latifolia* plantation up to August. The larvae of *E. burmitra* were recorded infesting the leaves of the plant during July to September; and *H. talaca* were recorded feeding on *D. latifolia* leaves during the month of May to August. The infestation of *R. speculum* was recorded during hot months of May to July, while the infestation of *L. acuta* was recorded during April to August. The infestation of *L. Taurus* was recorded during March to October, while infestation of *D. stebbingi* was recorded to be during premonsoon to monsoon period from February to August.

Table 1  
Insect pests infesting *D. latifolia* in Uttarakhand and their nature of damage.

Sr. no.	Species	Order: Family	Nature of damage
1.	<i>Gastrophysa viridula</i> (De Geer)	Coleoptera: Chrysomelidae	Defoliator
2.	<i>Chrysocus 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
7.	<i>Ricania speculum</i> Walker	Hemiptera: Ricanidae	Sap sucker
8.	<i>Leptocorisa acuta</i> Thunberg	Hemiptera: Alydidae	Sap sucker
9.	<i>Leptocentrus taurus</i> Fabricius	Hemiptera: Membracidae	Sap sucker
10.	<i>Drosicha stebbingi</i> Green	Hemiptera : Margarodidae	Sap sucker

Table 2: Seasonal incidence of Insect pest infesting to *D. latifolia*

SL.	Insect species	January	February	March	April	May	June	July	August	September	October
1	<i>Gastrophysa viridula</i> (De Geer)										
2	<i>Chrysocus 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										
7	<i>Ricania speculum</i> Walker										
8	<i>Leptocorisa acuta</i> Thunberg										
9	<i>Leptocentrus taurus</i> Fabricius										
10	<i>Drosicha stebbingi</i> Green										

## DISCUSSION

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), Janz et al. (2006), Williams and Liebhold (1995), and Van et al. (2004) 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). 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 the 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), *Argyroploce aprobola* Meyrick (Eucosmidae); *Anisodes obrinaria* Guenee, *Ectropis bhurmitra* Walker (Geometridae); *Tapena thwaitesi* Moore, *Tapena thwaitesi* Moore (Hesperidae); *Cosmotriche laeta* Walker (Lasiocampidae);

*Dasychira dalbergiae* Moore (Lymantriidae); *Achaea janata* Linnaeus, *Anoba polyspila* Walker, *Ericeia 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, *Nephopteryx* 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, Chatopadhyay, 2021).

In the present study we have recorded ten 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), though, it has been considered an important biocontrol agent of dock weed (Swatonek 1972, Barbattini et al., 1986, Hatcher et al., 1997). *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 and Whittaker 1998). This is the first record of feeding on *D. latifolia*, though Engel (1956) 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), *Begoniex tuberhybrida* in UK (Salisbury and Platoni, 2013). This species was also reported as a biological control agent for *Rumex* species (Engel, 1956; Chevin, 1968; Martinková & Honěk, 2004).

The leaf beetle, *Chrysochus cobaltinus* native to North American (Arnett, 1968; Lopatin, 1984) 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 & Bremer, 1996); *Asclepias speciosa* and *A. eriocarpa* (Sady, 1994; Dickinson, 1995; Dobler & Farrell, 1999). Larvae of this species are obligate root feeders, single generation per year and persist for approximately six weeks (Williams, 1992, Dickinson, 1995). *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).

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).

*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). We have



recorded this species first time from Uttarakhand, Northern India. Roychoudhury & 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).. *H. talaca* is a dominantly prefer forest host plants to feed (Shankar et al., 1998), 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 & Viraktamath, 1986). *H. talaca* was also reported from cinchona, tea, coffee, cocoa and fruit trees in tropics (Entwistle, 1972), *Shorea robusta* and Cinchona (Shankar et al., 1998), new pest of forest tree *Quercus incana* (Singh & Singh, 2004), on *Perilla frutescens* (Uniyal & Singh, 2010). 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).

*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). We have record of *E. bhurmitra* on *D. latifolia*, though this species recorded on this species by Mathur and Singh, (1959). 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). 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).

*Leptocentrus taurus* was found to be feed on apical part of *D. latifolia* first time, though this insect pest was recorded on *Dalbergia sissu*, *Zizyphus jujuba* and on *Solanum melongena*, Parthenium hysterophorus in Tamilnadu, India from India (Thangavelu, 1980; McKamey, 2017; Biwas et al., 1994, Kumar, 2017). We have recorded that female of this insect lay egg in the tender shoots and both nymph and adult feed gregariously on tender shoot. The insect species was found everywhere in the province and found very common. Kumar (2017) have also observed that both the adults and nymphs were found to suck the sap from the tender parts particularly from the shoot during March to June and about 91% plants of *D. sissoo* were infested in Jharkhand.

*Drosicha stebbingi* both nymph and adult suck the plant sap from stem of the plant. *D. stebbingi* is a major polyphagous sap sucking pest of forestry, horticulture and agriculture species as it has recorded to be infesting on *Shorea robusta* later from *Mangifera indica*, *Carica papaya*, *Zizyphus jujuba*, *Prunus persica*, *Prunus domestica*, *Artocarpus heterophyllus*, *Bauhinia variegata*, *Helianthus annuus*, *Rosa indica*, *Althaea rosea*, Citrus sp., *Nerium odorum*, *Eugenia jambolana*, *Eriobotrya japonica*, *Vitisvini fera*, *Jasminum sambac*, *Aloizzia lebbek*, *Hibiscus* sp., *Pyrus malus*, *Juglans regia*, and *Pyruscom munis*, *Litsaea polyantha*, *Butea frondosa*, *Holarrhena antidysenterica* and *Mallotus philippinensis* (Dutt, 1925; Latif, 1949; Beeson, 1941; Rahman, 1944).

*Leptocorisa acuta*, commonly known as the rice ear bug, is a significant pest of rice in India. Both the nymphs (immature stages) and adult bugs have been observed feeding on the young tender parts of plants in various locations. We have recorded both nymph and adult of *L. acuta* feeding on young tender part of the plant at FRI nursery and at Lalkuan plantation. *L. acuta* was also recorded infesting to *Dalbergia sissoo* and causing considerable damage by sucking the sap of tender shoot and leaves in nursery and young plantations in Jharkhand (Chattopadhyay, 2021), on *Calotropis procera* in Madhya Pradesh (Chandra et al., 2011) and on nutmeg trees (Abraham & Mony, 1977).

In our study *Ricania speculum* recorded to be the new insect pest of *D. latifolia* in India. This hopper commonly known as black plant hopper and it is distributed mainly in Asia, Australia and tropical Africa (Mazza et al., 2014; Rossi & Lucchi, 2015). It has also been recorded in Genoa and La Spezia, China, Indonesia, Japan, Korea, Philippines, Taiwan, and Vietnam (Bourgoin, 2016). *R. speculum* broadly polyphagous pest, females lay eggs into the woody twigs of many host plants, and subsequently nymphs feed the sap of the plant and develop (Mazza et al., 2014; Rossi & Lucchi, 2015; Rossi et al., 2015).

## 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.

## Declarations

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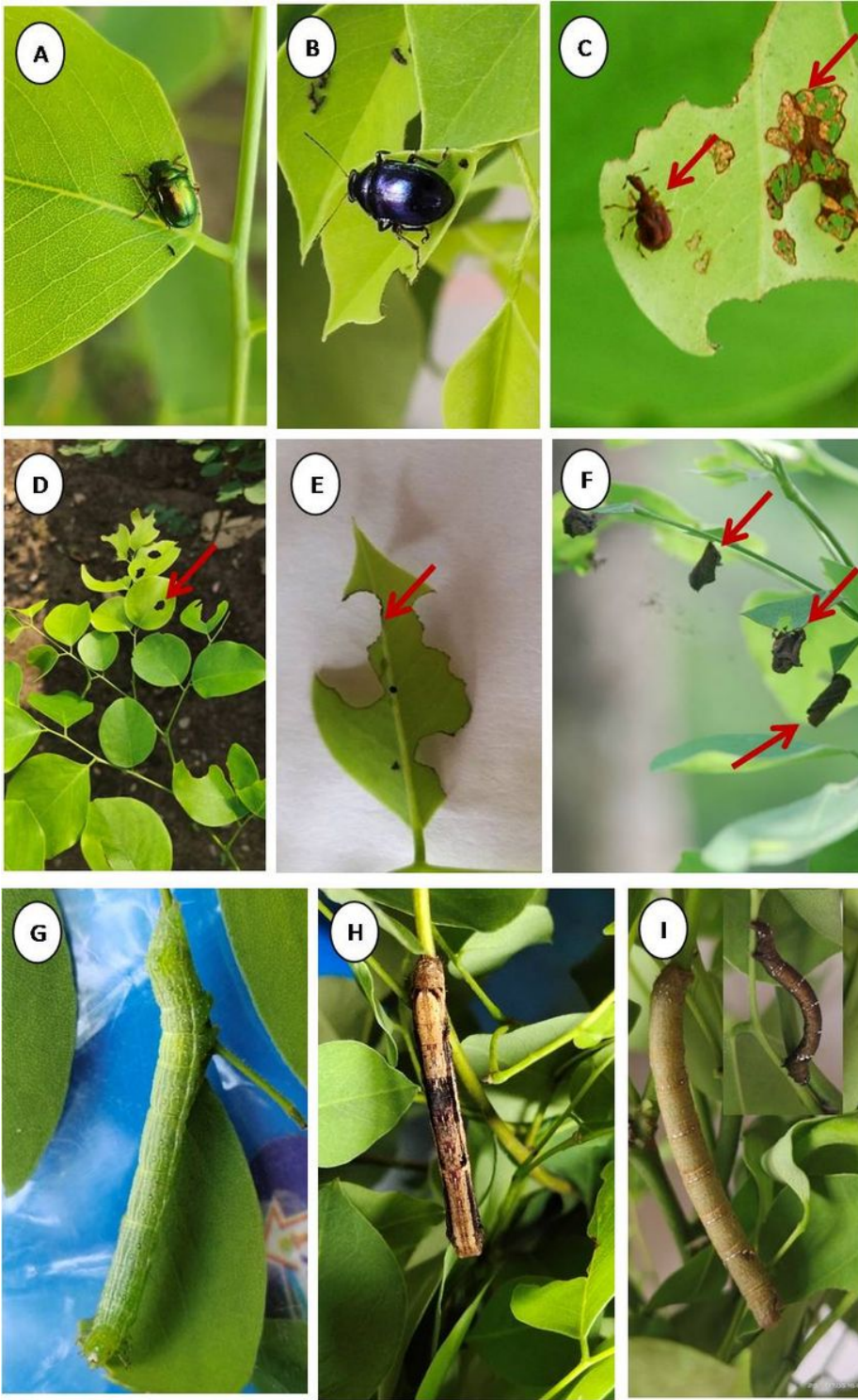
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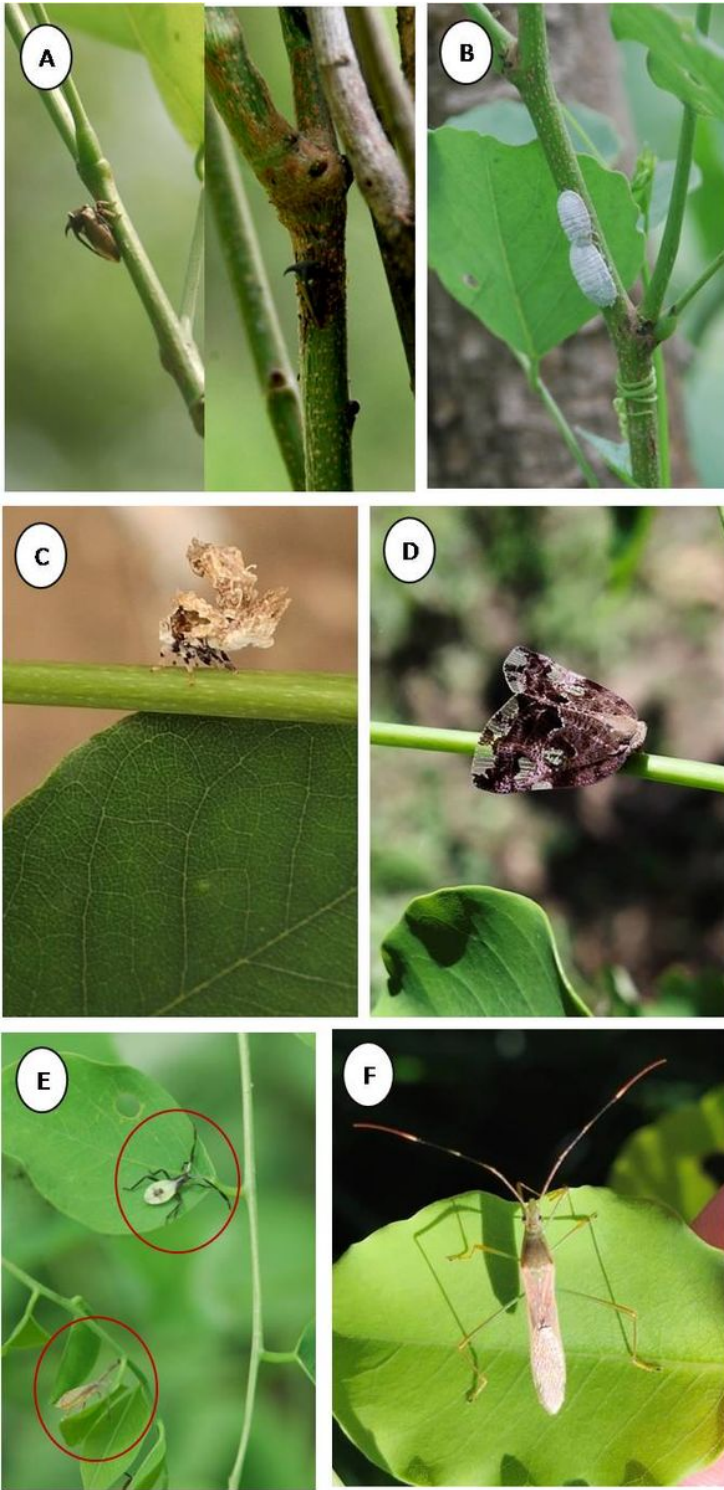
## Figures



**Figure 1**

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

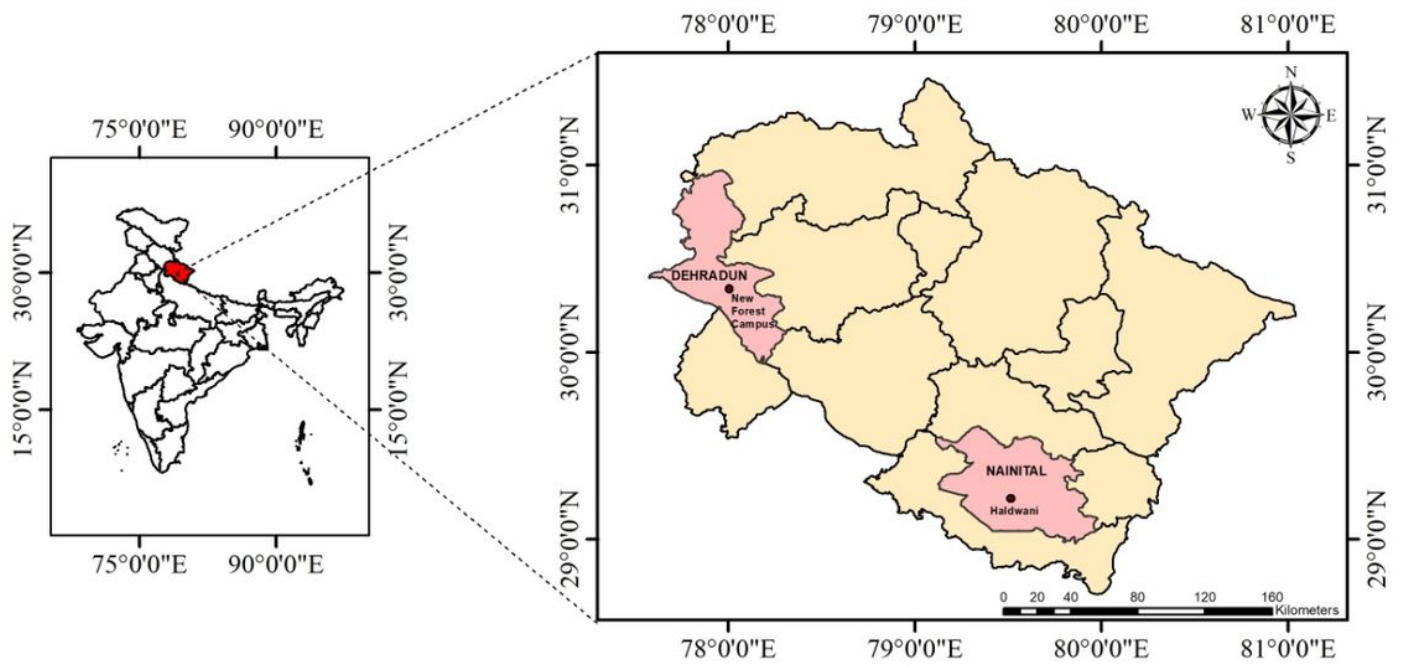




**Figure 2**

**(A-F):** Sap sucking insects feeding on *Dalbergia latifolia*. A- *Leptocentrus taurus*; B- *Drosicha stebbingi*; C&D Nymph & Adult of *Ricania speculum*; E&F- Nymphs & Adult of *Leptocorisa acuta* .





**Figure 3**

Insect pest survey and study area of *D. latifolia*



**Figure 4**

(A) Nursery of *D. latifolia* at New Forest Campus; (B) plantation of *D. latifolia* at Lalkuan