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INSECT PESTS OF *SHOREA LEPROSULA* (DIPTEROCARPACEAE; MERANTI TEMBAGA)

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INTRODUCTION

Shorea leprosula in the family Dipterocarpaceae is distributed in the lowland to the hill dipterocarp forests in Malaysia, Indonesia, Brunei and Thailand. This species is highly valued for its timber, which is known under the timber trade name of light red meranti or red meranti. Populations of *S. leprosula* are Near Threatened in the recent International Union for Conservation of Nature (IUCN) Red List assessment (Pooma & Newman, 2017) due to rapid deforestation and timber extraction.

Based on the results from the trial plantings, *S. leprosula* appears to be a promising species for reforestation due to its robust growth characteristics such as fast growth rate in the early years and thrives in open conditions (Appanah & Weinland, 1993; Otsamo et al. 1996; Widiyatno et al. 2014). Hence in 2014, the common garden experimental plot of *S. leprosula* was established at Bukit Hari in Forest Research Institute Malaysia (FRIM) to study the genetic basis of complex traits such as life history, morphological and physiological traits by growing individuals from different populations in a common environment. *Shorea leprosula* has also been used in the reforestation of Lentang Forest Reserve in Pahang under the "Restoration, Reclamation and Rehabilitation of Degraded Forest" project by the Forestry Department of Peninsular Malaysia.

Pest problems are often common on young or newly planted trees as they are exposed to various environmental stressors in a new planted area. About 10 insect species were recorded in the nursery and study plot of *S. leprosula* in FRIM from continuous pest surveillance between 2018–2020. The biology of these species is discussed, in addition to the recommendations for pest management.

Figure 1 A two-year-old *Shorea leprosula* plot in Bukit Hari, FRIM

Defoliators

1) Tussock moth, *Olene mendosa* (Lepidoptera: Lymantriidae)

The larva of *Olene mendosa* has four yellow tussocks or hair tufts on its greyish body and bristles at the anterior and posterior end of its body, black and white bristles at the sides and a red-coloured head. The larva spins a cocoon made of silk and larval hairs just before it pupates (Figures 2–4). Pupation lasted 16 days and the adult moth emerged 6 days later (Figure 5). The larva has a wide host range of at least 43 plant genera including *Shorea* (Holloway, 1999). This species was also recorded on the endemic *Shorea waltonii* and *Shorea kudatensis* in Sabah with minor damages (Chung et al. 2013).

Figure 2 The larva of *O. mendosa* with four yellow dorsal brushes, a characteristic of a tussock moth larva

Figure 3 The shed skin and head capsule of the newly moulted larva

Figure 4 The larva spins a cocoon covered with its larval hairs for protection before pupating

Figure 5 An adult female moth with a wingspan of 42 mm

2) Tussock moth, *Olene inclusa* (Lepidoptera: Lymantriidae)

Olene inclusa larva is rather brownish with four brown dorsal brushes and not as brightly coloured as *O. mendosa* (Figure 6–8). It is also a polyphagous species but has a smaller host range of 22 plant genera compared to *O. mendosa* (Holloway, 1999). This species was also recorded on the endemic *S. waltonii* and *S. kudatensis* in Sabah with minor damages on trees (Chung et al. 2013).

Figure 6 The larva of *O. inclusa*

Figure 7 The pupa of *O. inclusa* covered with urticating hairs

Figure 8 Female moth of *O. inclusa* with a wingspan of 52 mm

3) Bagworm, *Eumeta* sp. (Lepidoptera: Psychidae)

The bagworm larva of *Eumeta* sp. constructs a protective case or bag usually made of broken twigs bound together with silk thread as a protection against natural enemies (Figure 9). The larva feeds by partially protruding its head from the bag and retreats when threatened or disturbed. The life cycle of *Eumeta* sp. bagworms can last up to a year (Rhainds et al. 2008).

Figure 9 A bagworm (*Eumeta* sp.) larva on the stem of a seedling in the nursery

4) Pagoda bagworm, *Pagodiella heckmeyeri* (Lepidoptera: Psychidae)

The pagoda bagworm is a generalist feeder and severe infestation can cause complete defoliation on a mature tree or may even kill the attacked seedling or sapling. Signs of a pagoda bagworm attack are the presence of circular holes and skeletonised leaf (Figure 10). The larva feeds by scraping off the surface of the leaf and avoids the leaf veins. The leaf fragments are then added onto its protective bag, which enlarges as the larva grows (Figure 11). This species was previously misspelled as *Pagodiella hekmeyeri* (Sobczyk, 2011).

Figure 10 Circular holes on the leaves caused by the pagoda bagworm

Figure 11 Excised leaves are added onto the bag of the pagoda bagworm in a spiral pattern

Sap-suckers

1) Spiralling whitefly, *Aleurodicus dispersus* (Hemiptera: Aleyrodidae)

Whiteflies are generalist feeders on various nursery plants and agricultural crops (Figure 12). Adult female lays its eggs on the underside of leaves with deposits

of white wax in a spiral pattern. The eggs hatch into first instar nymphs or crawlers, which are mobile and able to disperse by wind or crawling to new feeding sites. Once the crawlers have settled on suitable hosts, they will undergo moulting and become immobile, and continue feeding on the plants until pupation. The life cycle of *A. dispersus* from the egg stage to adult emergence is 37 days (Wong, 2016). Their sap-sucking habits cause yellowing of leaves and honeydew secreted as a by-product causes the growth of sooty mould fungus. When the infested leaves are disturbed, the adults will fly off the leaf surface, which creates specks of the white dust that can cause irritation.

Figure 12 Whiteflies resemble tiny moths. The adult measures about 2 mm in length

2) *Aleurocanthus* sp. (Hemiptera: Aleyrodidae)

Aleurocanthus sp. is another species of whitefly, which has a dark appearance and sometimes called as blackfly. Both the adults and immatures can be found on the underside of the infested leaves (Figure 13). The leaf damages are similar to that caused by the spiralling whitefly.

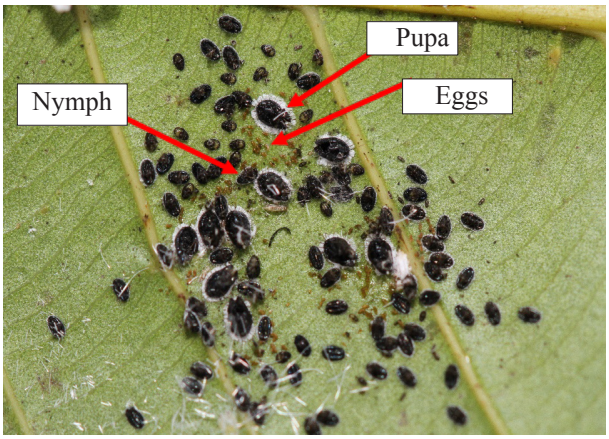

Figure 13 Eggs, nymphs and pupae of *Aleurocanthus* sp. The pupa measures about 1 mm

3) Giant scale insect, *Icerya* sp. (Hemiptera: Monophlebidae)

Scale insects in the family Monophlebidae retain their legs throughout their entire life span in contrast with some family of scale insects such as the soft scales. Both the nymph and adult female of the giant scale insect are covered in white cottony masses. Males are uncommon therefore females usually reproduce through parthenogenesis. Once the eggs hatch, the pale red crawlers emerge from the underside of the female's body and disperse to locate new feeding sites (Figure 14). They settle along the midrib of leaves and moult to subsequent instars (Figure 15). When a nymph moults, its cast skin is left behind on the leaf (Figure 16). Honeydew is excreted as a by-product of the sap-sucking habits of the giant scale insect (Figure 17) and droplets of honeydew can cause the growth of sooty mould fungus.

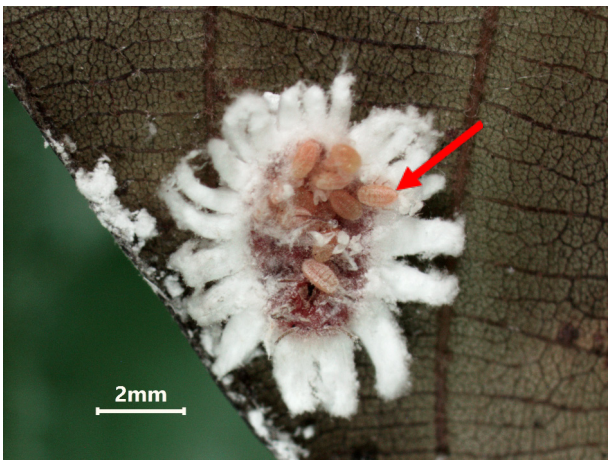

Figure 14 Eggs hatched into crawlers or first instar nymphs (arrow) on the underside of the female's body

Figure 15 Young nymphs settling on the midrib of a leaf

Figure 16 Cast skin of the nymphs (arrow) as they moult to increase in size

Figure 17 An adult female of *Icerya* sp., about 5 mm in body length, with thick waxy filaments at the sides of its body. Note a droplet of honeydew being expelled from its body

4) Scale insect, *Pedroniopsis* sp. (Hemiptera: Sternorrhyncha)

Not much is known about the *Pedroniopsis* sp. scale insect. The only described species, *Pedroniopsis beesoni,* was recorded on *S. robusta* in India and *Dipterocarpus tuberculatus* in Myanmar (Hodgson & Williams, 2016). The molecular identification of the cryptic *Pedroniopsis* scale that was found on the *S. leprosula* trees is still on-going, therefore we could not determine the family name. The sub-order Sternorrhyncha which generally includes the scale insects is used instead. Honeydew secreted by the scale insect is collected by the yellow crazy ants, *Anoplolepis gracilipes* (Figure 18). Severe infestation by the *Pedroniopsis* sp. scale insect was observed to cause branch dieback on the *S. leprosula* trees (Figure 19).

Figure 18 Yellow crazy ants tend the *Pedroniopsis* sp. scale insect for honeydew. Note the swollen gaster (arrow) on the ant that is filled with honeydew

Figure 19 Branch dieback due to the heavy infestation of *Pedroniopsis* scales

Wood borers

1) Long-horned beetle, *Euryphagus lundii* (Coleoptera: Cerambycidae)

Long-horned beetles typically have a pair of long antennae that can be longer than the body. The female *Euryphagus lundii* has a bright red and black colouration (Figure 20) while the male is yellowish orange. Eggs are deposited on the tree bark by the female beetle. Once the eggs hatched, the larva will

start to bore into the wood, expanding the tunnel and deeper into the heartwood as it grows bigger (Figures 21 & 22). In general, larval development can take several months to years. Pupation occurs in a pupal chamber constructed at the end of the larval tunnel. To exit, the adult emerges by chewing through the wood. Most of the long-horned beetles attack stressed and weakened trees. The boring activity of the larvae damages the cambium layer and disrupts the uptake of water and nutrients in the tree, leading to stem dieback and eventually tree death (Figure 23). The hollowed stem is also prone to breaking during storms and strong winds.

Figure 21 Wood damaged by the tunnels of the long-horned beetle larva (arrow)

Figure 20 An adult female of *Euryphagus lundii*, 20 mm in body length. The female beetle has a pair of bright red elytra with black tips and a pair of antennae about two thirds of its body length

Figure 22 The bore hole of the long-horned beetle larva

Figure 23 Symptoms of stem dieback and tree death due to the boring activity of the long-horned beetle

2) Flat-faced long-horned beetle, *Glenea* sp. (Coleoptera: Cerambycidae)

Little is known about the biology of *Glenea* sp. (Figures 24 & 25). This species had attacked a smaller branch on the tree damaged by *E. lundii*. Stem dieback and tree death could be attributed to simultaneous attack by these two species of long-horned beetles.

Figure 24 Pupa of *Glenea* sp.

Figure 25 An adult of *Glenea* sp., 8 mm in body length

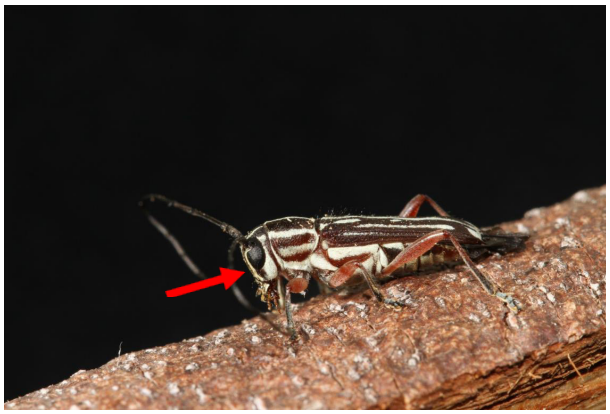

Figure 26 The common name of flat-faced long-horned beetle is derived from its rather flat head (arrow)

Insect pest management

The leaf-feeding caterpillars can be removed manually with a pair of forceps when they are present in low numbers. Due care must be taken to avoid coming into contact with the irritating hairs on the caterpillars that can cause skin allergies. Bio-pesticide such as *Bacillus thuringiensis* can also be used. It targets specifically on caterpillars and acts as a stomach poison when treated leaves are ingested by the caterpillars. Severe bagworm infestation can be controlled using contact insecticides such as cypermethrin and lambda-cyhalothrin (Hasber et al. 2015).

Soft-bodied sap-sucking insects can be dislodged with a forceful spray of water directly on the underside of leaves. Oil emulsion spray, which consists of a mixture of soapy water and oil can also be used against these pests. These treatments need to be repeated on a regular basis, but not necessary during the rainy season as the rain will wash away and kill off the pests. For scale insects protected under layers of wax, control is most effective during the mobile crawler stage whereby neem oil or contact insecticide can be applied directly on the surface of the plants.

For general control of wood borers, a water-based aerosol spray can be sprayed directly inside the bore hole and the hole is plugged with a stopper or plasticine for the condensation of the aerosol mist. Pheromone traps for long-horned beetles are available commercially and useful for monitoring and controlling their populations. Infested trees can be treated with systemic insecticide such as imidacloprid but the efficacy is limited to young larval stages feeding in the cambium and sapwood (Poland et al. 2006). Trees should be cut down in severe infestation cases.

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Shorea leprosula is highly demanded for its timber and a promising species for reforestation. A common garden experimental plot was established in FRIM as a germplasm bank to study the genetic basis of *S. leprosula* complex traits. Pest surveys carried out in the study plot between 2018–2020 recorded four species of defoliators, four species of sap-suckers and two species of wood borers. The biology and recommendations for pest management are discussed in this fact sheet.

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