9.2.4 Thrips

Vietnamese name: Bä c¸nh t¬
Scientific names: *Heliothrips haemorrhoidalis, Mycterothrips setiventris, Scirtothrips bispinosus,* or *Scirtothrips dorsalis*
(Order Thysanoptera, Family Thripidae). Several of these species may be present at the same time. Other species of thrips sometimes are found on tea.

During the recent five years, thrips has become a very big problem for the tea growing locations in Bac Can and Thai Nguyen. Even a few thrips feeding on a bud can lower the quality of the bud, making the dried buds brittle (easy to break) and making the processed tea bitter with a yellow liquor (tea water).

Description and Behavior

Thrips hide from light, and are concentrated inside folded buds, inside flowers, or on the undersides of the youngest leaves. They are very small, narrow insects shaped like tiny grains of rice (see drawing and picture). Because they are so small, you may see only the damage they cause (see "Plant damage and plant tolerance", below).

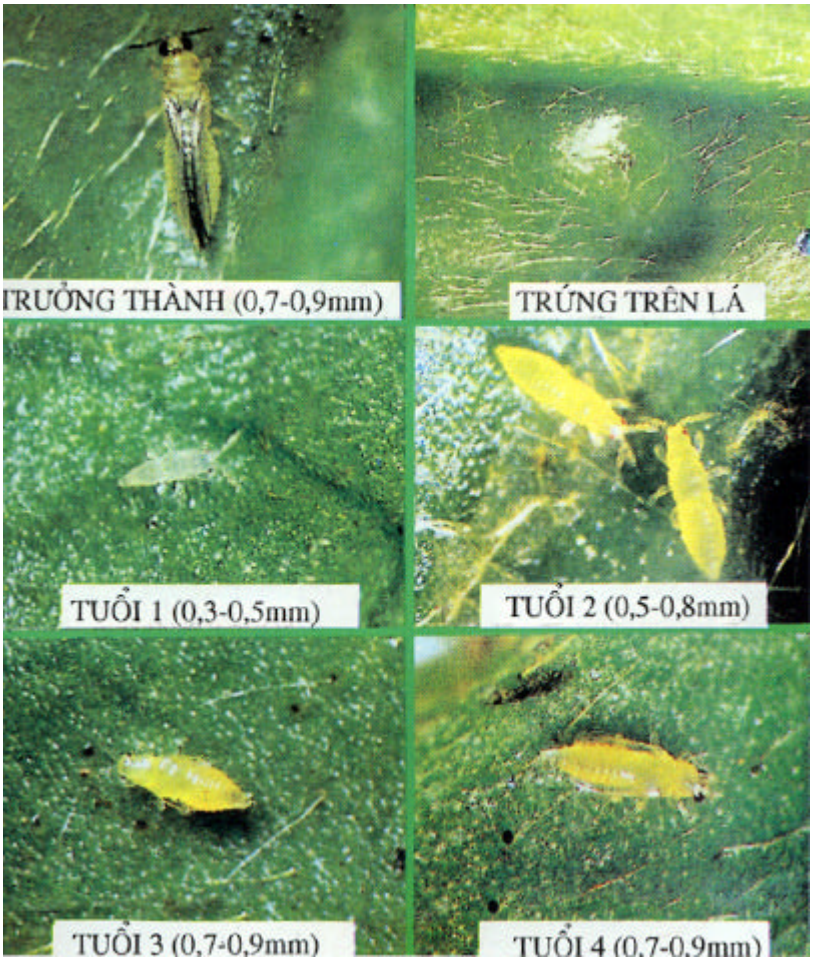
The **adult** thrips is about 0.5 - 1.2 mm long, and is just barely visible with the unaided eye. They range in colour from pale brownish-red to flesh-colour to pale green-yellow. Many do not have wings. When present, the wings are very small and transparent, and are composed of many small light hairs. **Nymphs** look like small adults with no wings. Eggs are so small that you probably will not be able to see them.

Thrips walk very slowly, although they can fly from plant to plant fairly quickly.

Life cycle

The **eggs** are inserted singly into the leaf tissue, usually next to a vein. There are two active **nymph** stages that feed by sucking plant sap. Next comes the **pre-pupa** stage when the insect is not very active and does not feed. The pre-pupa can be identified by having the antenna pointing backwards, and having two small wingpads. The pre-pupa sheds its skin to produce the **pupa**, which does not move unless touched, does not feed, and has larger wingpads. The pupa is often found in fallen leaves under the tree or in the soil, but sometimes in old leaves of tea that have been webbed by caterpillars, dead leaves hanging from bushes, cracks in bark, or moss and lichens on the tea trunk. **Adults** emerge from the pupae.

The development duration of each stage depends very much on the temperature:
egg 8-16 days, active nymph stages 8-16 days, pre-pupa 1-4 days, and pupa 4-7 days. Thus, thrips can complete a generation (from eggs to new adults ready to lay eggs) in 21-42 days. Adults live for 5 - 19 days.



Life cycle of tea thrips. *Stages 1 and 2 are active (they move and feed). Stages 3 and 4 are called the pre-pupa and pupa; they are inactive (only move if they are touched, and do not feed). The adult in the picture has wings, but many adults do not have wings.*
Source: Nguyen Phong Thai (editor). 1998. Insect pests, diseases, and weeds of tea and prevention methods (in Vietnamese). Agricultural Publishing House, Hanoi, Viet Nam.

Plant damage and plant tolerance

a. <u>Feeding inside rolled-up buds</u>

Thrips, right after coming out from the egg, can start sucking the sap. Often the attack begins inside the rolled-up bud. The affected buds are small, crisp and easy to break (may fall off). When the damaged bud unfolds, the leaves have a brown line of dry scars (like cork) along either side of the main rib (parallel to the main vein). Be careful: yellow mites cause similar damage; see the picture in the section on yellow mites. But, thrips feeding usually does <u>not</u> cause the leaves to curl up like yellow mite.

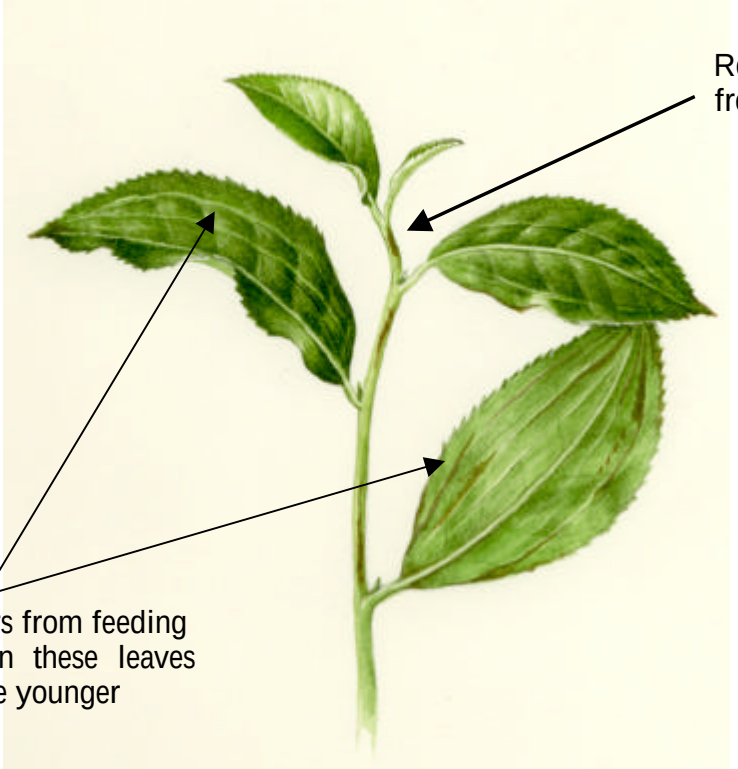
b. <u>Feeding on young open leaves</u>

Thrips also feed on the youngest open leaves. The sucking marks often are made one after one, forming thin pale lines on the underside of the leaf. These lines are parallel to the main vein (see picture). Leaves that have a lot of this type of damage become dotted with tiny pale patches, and are often described as "silvered". The undersides of leaves may have many black dots, which are the excrement of the thrips.

After being damaged, leaves become thicker and harder than the normal ones, duller (not shining) and having darker green color, and may be puckered or deformed (see pictures).

c. Feeding on young stems

Thrips also feed on the surface of stems, but only near the tip of a young shoot. This stem feeding causes rough, brown dots or patches on the surface of the stem.



Young shoot showing several symptoms of thrips feeding. *Source: painting by Wendy Gibbs.*

Young leaf with scars from thrips.
Source: Nguyen Phong Thai (editor). 1998. Insect pests, diseases, and weeds of tea and prevention methods (in Vietnamese). Agricultural Publishing House, Hanoi, Viet Nam.

Older leaf, made thick and hard by thrips.
Source: Suh-Neu Hsiao. 1983. Monograph on tea pests and diseases (in Chinese). Wen Shan Tea Plant Improvement Station, Taipei, China.

Importance of thrips feeding

Even a few thrips feeding on a bud or young shoot can lower the quality of the shoot, in three ways:

1. The dried bud will be more brittle (easily breaks into pieces).
2. The processed tea will have a more bitter flavour.
3. The liquor (tea water) will be more yellow, not as green as it should be.

Heavily damaged leaves become black and drop off, leaving only crown buds (some farmers call this "mangy buds"). A tea bush with many thrips is often stunted and dry.

Natural enemies

Lady beetle, small black spider, ant, carabid beetle, and web spider are natural enemies of thrips. They can kill both nymph and adult thrips. In other Asian countries, lacewing larvae (like *Chrysopa*) and predatory mites are important predators. Also, there are several kinds of tiny parasitoid wasps that attack the eggs (families Eulophidae and Scelionidae). The application of pesticides, especially those with wider range of functional effectiveness, will reduce very much the population of these natural enemies.

Management practices: prevention and control

a. Prevention

Grow a strong crop that can tolerate thrips

Thrips are often a bigger problem in old, stunted and dry tea fields. Therefore, good tending and management practices (including balanced fertilization) will reduce the damage to tea plants. Watering also helps plants recover. Thrips attacks seldom last more than a few weeks, and the plants often grow out of the damage quite quickly if well-tended.

Protect natural enemies by using less pesticides

Preservation of natural enemies is very important to limit the population of thrips. Reduce the use of insecticides as much as possible. Especially, avoid broad-spectrum insecticides that kill many natural enemies.

Use shade or mulching to increase humidity

Thrips are favored by dry and hot weather conditions. Planting shade trees is one of the best ways to reduce thrips populations. Mulching also helps to increase humidity in the field.

Frequent plucking to remove thrips and their eggs

Because thrips feed mostly on buds and the youngest leaves, plucking can greatly reduce the number of thrips. Frequent ("fine") plucking reduces thrips more than plucking only once a month.

b. Field monitoring and decision making

Thrips are most abundant during hot dry weather (27-33 °C). There are often two outbreaks per year:

1. From the April-August (others say from March-April and again in July-September), which is a long lasting problem and affects a big area. During this time, the tea is producing its flush of new foliage.
2. From mid - October until late November, which is much shorter than the first outbreak and also happening in a smaller area.

During these periods, farmers should pay special attention to thrips during their agro-ecosystem analyses. Use a magnifying glass to count the average number of thrips found per bud. But as for any pest, don't base your decision only on how many pests you have, but also consider:

- how the number of thrips has been changing for the past few weeks (going up or going down?)
- number of natural enemies you find in the field
- weather forecast (rains and cool humid weather may help control thrips)
- the age of the tea (young tea trees are more vulnerable)
- whether you could control the thrips without pesticides (for example, by plucking frequently).

c. Control methods

If you decide you need to spray, try to find an insecticide that is less toxic for natural enemies. If thrips are abundant in the buds, they will be sheltered from the insecticide. Therefore, you will need to use an insecticide that can move within the plant tissues (in other words, a systemic or translaminar insecticide). If thrips are on leaves, direct the spray at the undersides of the leaves.

9.2.5 Aphids

Vietnamese name: RÖp
Scientific name: *Toxoptera aurantii*
(Order Homoptera, Family Aphididae).

Aphids are minor pests that seldom cause economic damage. They cause symptoms (curled, deformed leaves) that can be confused with mites and mosquito bugs.

Description and Behavior

You will probably first notice aphids because of the symptoms they cause. Young shoots infested with aphids curl downwards at the tip. Leaves on which aphids are feeding usually curl up and become distorted.

Another clue that you may have aphids is the presence of sooty mold or ants. Aphids use their tube-like mouthparts to pierce the green tissue and suck sap. Like scale insects, aphids excrete a sugary liquid that causes sooty mold to grow on the leaves. Ants often protect aphids because they like to drink the sugary liquid.

Aphids occur in groups on the buds and the undersides of the youngest leaves (see picture). They are dark brown, about 1.5 - 2 mm long, and have rounded bodies shaped like a tiny pear (see drawing). At the back of the body are two “horns” that produce a liquid that helps repel natural enemies. Some adults have delicate transparent wings, though many do not have wings. A group of aphids often includes many white, empty shed skins.

Large group of aphids on tea stem.

One adult and many nymph aphids.
This adult does <u>not</u> have wings.

One adult and many nymph aphids.
This adult <u>has</u> wings.

Source of all three photographs: Nguyen Phong Thai (Editor). 1998. Insect pests, diseases, and weeds of tea and prevention methods. Agricultural Publishing House, Hanoi, Viet Nam.

Life cycle

Adult females with wings travel for kilometers on the wind, then land on tea bushes. They do not lay eggs, but instead give birth to wingless **nymphs**. Nymphs shed their skins several times as they grow into adults that do not have wings. The aphid can complete a generation (from new-born nymph to adult) in 6-15 days. Each female produces about 50 nymphs, so aphid populations can grow very rapidly. After several generations without wings, eventually adults with wings are produced (usually after tea has finished its flush of new growth).

Plant damage and plant tolerance

Damage is from the loss of sap and, sometimes, from the heavy growth of sooty mold that reduces photosynthesis. Large tea bushes can tolerate moderate numbers of aphids without yield loss. Young bushes are more susceptible. In some crops (citrus and coffee), this aphid spreads virus diseases as it moves from plant to plant. It is not known whether aphids spread viruses in tea in Viet Nam.

Natural enemies

Ladybird beetles and lacewing larvae are important predators. Hoverfly larvae, when present, are efficient predators. Tiny parasitoid wasps also attack aphids, causing them to stop moving, swell up (see picture in Chapter 8), and turn brown. Predatory ants also attack ants. But, other types of ants often protect aphids by fighting with natural enemies, because these ants like to drink the sugary liquid produced by aphids.

Management practices: prevention and control

Frequent plucking ("fine plucking") removes aphids and is often the only control necessary. Eliminating host plants is difficult because this aphid species also feeds on citrus, cocoa, coffee, mango, rambutan, soursop, and many other trees.

If ants are protecting aphids, try to control the ants by destroying their nests or spraying with soap mixed with water. Aphids almost never cause enough damage to justify using insecticides. Before deciding whether to spray, it is important to check how many aphids have parasitoids inside them (parasitized aphids are swollen and don't move). Aphids with parasitoids inside them do not feed and will die, so it makes no sense to spray if many aphids are parasitized.

9.2.6 Scale insects

Soft or wax scales:

Vietnamese name: RÖp s¸p
Scientific names: *Ceroplastes* spp., *Coccus viridis*, *Parabemisia myricae*, *Saissetia coffeae*, or *Trialeurodes vaporariorum*.
(Order Homoptera, Family Aleyrodidae and Family Coccidae)
(Several of these species may be present at the same time):

Hard or armored scales:

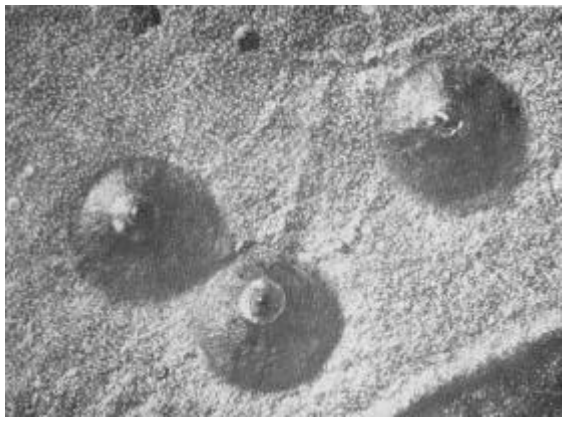
Vietnamese name: RÖp phÈy tr¾ng
Scientific names: *Aonidiella* spp., *Aspidiotus destructor*, *Chrysomphalus aonidum*, *Hemiberlesia* spp., *Pseudaonidia duplex*, or *Pseudaulacaspis pentagona*.
(Order Homoptera, Family Diaspididae)

Scale insects are relatively unimportant on traditional tea varieties in Viet Nam. However, they seem to be becoming more abundant on new varieties imported from other Asian countries.

Description and Behavior

At first glance, scale insects seem to be dead. They are "glued onto" the undersides of leaves (especially along the midvein) or onto green shoots, and do not move. Most scales are protected underneath waxy shields that may be soft or quite hard. Shields may be round or elongated (shaped like an oyster shell), and are about 2-6 mm long (see pictures).

Soft wax scales on leaf and stem.
This is just one example; other soft scales look different.



Armored scales, greatly enlarged, on leaf.
This is just one example; other hard scales look different.

Source: J.E. Cranham. 1966. Insect and mite pests of tea in Ceylon and their control. Tea Research Institute, Talawakelle, Sri Lanka.

The actual body of the scale insect is found underneath the shield. It looks something like an aphid, but with very short legs and antennae. The insect uses its sharp tube-like mouthparts to pierce the leaf or shoot and suck the sap.

Like aphids, scales excrete a sugary liquid that causes sooty mold to grow on the leaves. Ants often protect scales because they like to drink the sugary liquid. The presence of sooty mold or ants are good clues that you may have a problem with scales.

Life cycle

Female adults lay **eggs** under their shields. Active **nymphs** (called "crawlers") hatch from the eggs and walk to other shoots on the bush, or are carried by the wind to other bushes. Sometimes ants carry crawlers to new bushes. Once nymphs finds a good place to feed, they secrete a waxy liquid that hardens over their bodies to form the shield. As they grow larger, they secrete more wax, and their shield also gets larger. Eventually, they mature into **adults**. Adult males are shaped like tiny mosquitoes, and fly to search for females for mating. But, adult females remain under their shields for their entire life. Adult females do not move to new bushes to lay eggs; instead, it is only the young crawlers that infest new bushes. Scales take about 4-6 weeks to complete a generation (from eggs to adults).

Plant damage and plant tolerance

Damage is from the loss of sap and, sometimes, from the heavy growth of sooty mold that reduces photosynthesis. Large tea bushes can tolerate moderate numbers of scales without yield loss. Young bushes are more susceptible.

Natural enemies

Very small ladybird beetles (both larvae and adults) are important predators. Many tiny parasitoid wasps also attack scales. But, some types of ants often protect scales by fighting with natural enemies, because these ants like to drink the sugary secretions of the scale insects. In humid rainy weather, fungus diseases can kill many scales.

Management practices: prevention and control

Eliminating host plants is difficult because scales also attack coffee, citrus trees, *Cinchona*, guava, rubber, cassava, and many garden and forest shrubs. Scales usually do not occur in large numbers on healthy, vigorous tea plants. If scales are abundant on traditional varieties, the farmer probably needs to improve his or her tending (balanced fertilizer, mulching, etc.). However, scales sometimes are more abundant on some of the new tea varieties imported from other Asian countries.

If ants are protecting scales, try to control the ants by destroying their nests or spraying with soap mixed with water. High numbers of scales may require control by spraying mineral oil ("crop oil") or insecticides. But before deciding whether to spray, it is important to peel off many of the hard shields and check whether there are living insects underneath. Dead empty shields can remain glued onto the plant for months, making it look like the scale population is much higher than it really is.

9.3 Caterpillars on leaves or buds

Most caterpillars chew holes in leaves. Because holes are so easy to see, farmers are often alarmed by caterpillar feeding. But tea can tolerate substantial amounts of caterpillars without reducing yield.

9.3.1 Bud rollers, leaf tiers, and leaf folders

English name	Vietnamese name	Scientific names:
Tea tortrix or tea bud tier	S©u cuèn bóp	*Homona coffearia* (Family Tortricidae)
Smaller tea tortrix		*Adoxophyes* sp. (Family Tortricidae)
Tea leaf roller	S©u cuèn l¸ non	*Caloptilia (= Gracillaria*) *theivora* (Family Gracillariidae)
Leaf roller	S©u xÕp l¸	*Agriophora rhombata* (Family Tineidae)
Flushworm		*Cydia leucostoma* (Family Tortricidae)

Several of these species may be present at the same time.

These caterpillars produce silk and use it to roll or fold leaves to make a "nest". They are usually not of economic importance.

Description and Behavior

Caterpillars make "nests" by connecting leaves with silk threads, sometimes of one leaf rolled up, or sometimes of two or more leaves together. Caterpillars can be found inside the rolled and tied leaves. Caterpillars of the bud tier are about 2 cm long, dark-green color with shiny brown-black head. Caterpillars of the tea leaf roller are about 1 cm long, white or pale green color, with the head also pale.

Life cycle

Eggs are laid on the leaves. Bud tier lays eggs in masses of 100-150 eggs on the upper surfaces of leaves; the egg masses are thin, pale, and look like gelatin. Tea leaf roller lays eggs one by one on the undersides of leaves. **Caterpillars** hatch from eggs and start feeding on the young leaves, either by making leaf nests (bud tier) or by burrowing inside the leaf (tea leaf roller). Older caterpillars of both species make larger nests, on both flush and mature leaves. The **pupa** is found inside the nest (bud tier) or covered with silk on the surface of the leaf (tea leaf roller). The **adults** are small brown moths. These species need 5-9 weeks to complete a generation (from egg to adult).

Plant damage and plant tolerance

Damage is mostly from the loss of leaves, which reduces photosynthesis. However, tea can tolerate a moderate loss of leaves without reducing yield. In addition, some buds cannot be plucked because they are ruined by leaf nests.

Natural enemies

Parasitoid wasps are important natural enemies. The immature stages of the parasitoids can be found inside the leaf nests. The immature parasitoids look like masses of small "caterpillars"

or masses of small cigar-shaped silk cocoons. The immature parasitoids eat the pest caterpillar and then pupate themselves (in the small cigar-shaped cocoons) to turn into tiny parasitoid wasps. If you think you have found a group of immature parasitoids inside a leaf nest, do an insect zoo to see what kind of adult insects develop from them.

If pest populations are high and weather is wet, virus diseases may develop in the pest caterpillars. Sick caterpillars inside the nests stop moving, become limp and soggy, and may have a bad smell.

Management practices: prevention and control

When controlling other pests, avoid the use of broad spectrum insecticides to protect the natural enemies (parasitoid wasps) that help control leaf folders and bud tiers. Usually leaf folders and bud tiers do not require any control. If populations are high, and if some caterpillars appear to be sick, collect them and mash them in some clean water. Then, spray the water onto other leaf nests to spread the disease. Spray during late afternoon, because the disease is killed by bright sun.

9.3.2 Case worms and bag worms

Vietnamese names: S©u kÌn tæ l¸, S©u kÌn tói to, S©u kÌn m¸i chïa, S©u kÌn bã cñi
Scientific names: *Brachycyttarus (= Acanthopsyche) subteralbatus, Cryptothelea* spp., *Eumeta* spp., or *Pagodiella (= Pagodia) hekmeyeri*
(Order Lepidoptera, Family Psychidae).
Several of these species may be present at the same time.

These caterpillars live inside portable "houses" made from silk covered with pieces of leaves or twigs (see pictures). The caterpillars stick their heads out of their houses to chew holes in the leaves. Sometimes they eat most of the way through the leaf but leave a thin membrane covering the damaged leaf (see picture). They usually are not important pests.

Life cycle

Female adults lay **eggs** inside their houses. Young **caterpillars** hatch inside the house and crawl out onto leaves, where they start making their own houses. Caterpillars transform into **pupae** inside their own houses. **Adult** males are moths, which fly out of their houses to search for females. But adult females never leave their houses. Adult females have no wings and look almost like caterpillars.

Natural enemies

Several types of parasitoid wasps attack the caterpillars inside their houses.

Management practices: prevention and control

Active feeding caterpillars are most common in May-June and October-November. It is easy to collect and kill the "houses" and cocoons (burn or crush them). Be sure to remove even the old houses that are hanging on the bushes, because they may contain adult females or eggs. Insecticides are not very effective, because the caterpillars are protected inside their "houses".

9.3.3 Nettle caterpillars and saddleback caterpillars

Vietnamese names: Bä nÑt xanh, Bä nÑt tr¬n kh«ng gai
Scientific names: *Aphendala recta, Cania bilinea, Chalcocelis albiguttatus, Cheromettia* (= *Belippa*) *laleana*, *Darna* sp., *Narosa conspersa, Parasa lepida, Scopelodes* spp., *Setora nitens,* or *Thosea* spp.
(Order Lepidoptera, Family Limacodiidae).
Several of these species may be present at the same time.

Farmers and pluckers should learn to recognize these caterpillars, because they have stinging spines that can cause painful burns. The caterpillars chew holes in mature leaves, but usually don't cause enough damage to reduce yields.

Description and Behavior

The caterpillars are usually found on the undersides of mature leaves. They have thick, fleshy bodies of green colour. Some species have stripes or "saddles" of white or brown colour on their backs (see pictures). Unlike most caterpillars, their bodies do not appear to be divided into separate segments. Also, their legs are very tiny (some have sucker disks like octopus underneath their bodies). Most of the species have groups of branched spines around the outside of their body. When mature, the caterpillars are about 1-1.5 cm long.

Two kinds of nettle caterpillars. The photograph on the right includes cocoons.
Source: J.E. Cranham. 1966. Insect and mite pests of tea in Ceylon and their control. Tea Research Institute, Talawakelle, Sri Lanka.

Life cycle

A typical caterpillar life cycle. Female moths lay **eggs** on the mature leaves. **Caterpillars** hatch out and begin feeding on the undersides of mature leaves. Large mature caterpillars drop off the bush and pupate (form **cocoons**) on the ground. Cocoons look a bit like large seeds. They are spherical, about 5-15 mm in diameter, and consist of a hard papery shell covered with a thin layer of silk. Cocoons are found buried in the soil (within the top 2 cm), or among dead leaves, or in crevices among stones. **Adults** (small brown moths) emerge from the cocoons.

Natural enemies

Several types of parasitoid wasps attack the caterpillars. If caterpillar populations are high and weather is wet, diseases may develop in the pest caterpillars. Sick caterpillars stop moving, become limp and soggy, and may have a bad smell.

Management practices: prevention and control

DO NOT touch these caterpillars with bare skin. They have stinging hairs that can cause painful burns. It is possible to collect these caterpillars by hand and burn or crush them, but use gloves when collecting them. Also, it is very useful to collect the cocoons on the ground (search among fallen leaves and in soil under trees) and then burn them.

If populations are high, and if some caterpillars appear to be sick, collect the sick caterpillars and mash them in some clean water. Then, spray the water onto the undersides of mature leaves to spread the disease. Spray during late afternoon, because the disease is killed by bright sun. Avoid spraying the buds, because some tea drinkers might be sensitive to the spines from the mashed-up caterpillars.

9.3.4 Cluster caterpillars

Tea tussock moth, or lappet (caterpillars have tufts of long hairs):

Vietnamese names: S©u rãm
Scientific names: *Euproctis pseudoconspersa* (Order Lepidoptera, Family Lymantriidae)
Orgyia postica (Order Lepidoptera, Family Lymantriidae)

Smooth cluster caterpillars (caterpillars do not have long hairs):

Vietnamese names: S©u chïm
Scientific names: *Andraca bipunctata* (Order Lepidoptera, Family Bombycidae)

These caterpillars are found in groups on tea branches (see pictures). They chew holes in leaves, but seldom cause enough damage to reduce yields. However, the hairy caterpillars stop farmers from plucking, because their hairs release a poison that irritates farmers' hands.

Life cycle

A typical moth-caterpillar life cycle. Masses of round yellow eggs are laid on the undersides of leaves. Dark-brown pupae are found at the bases of large branches. Adult is a small yellow moth.

Management practices: prevention and control

These caterpillars are most abundant in March-April and in October-November. It is easy to collect these caterpillars by hand and burn or crush them. If the caterpillars have hairs, use gloves when collecting them, because the hairs will irritate your hands. Also, the adults (moths) are attracted to lights at night, and can be trapped and drowned using a light above a basin filled with a mixture of water, kerosene, and a little soap.

9.4 Red borer in branches or stems

Vietnamese names: S©u ®ôc th©n ®á
Scientific names: *Zeuzera coffeae* and *Z. leuconotum*
(Order Lepidoptera, Family Cossidae).
Both species are present in Viet Nam, but *Z. coffeae* is more common.

Borers are large caterpillars that chew tunnels inside branches or stems. Usually a minor pest, causing only the death of a few branches here and there. May kill young tea plants if it bores into the main stem.

Description and Behavior

The pest is easiest to recognize by the presence of excrement, like large pieces of sawdust, on the ground under the bush. Also, leaves on damaged branches are dried and shriveled but usually remain attached.

Eggs are laid in cracks in the bark of tea stems, and look like small amber beads strung together in a ropy mass. The **caterpillar** hatches from the egg and starts boring into small shoots or branches. Older caterpillars extend their tunnels into larger branches or even into the main stem; the tunnel can be as much as 60 cm long. Caterpillars are pink to dark-red in color and 3-5 cm long when fully grown [see picture]. The **pupa** is found inside the tunnel, and is about 2-3 cm long and brown in color. The **adult** is a large pretty moth, sometimes called the "leopard moth". Its wings are white with black and steel-blue spots, and when open extend for 4-5 cm.

Branch cut open to expose red borer caterpillar inside tunnel. *Source: Photograph by Ho Cheng Tuck, from K.K. Chong et al. 1991. Crop pests and their management in Malaysia. Tropical Press Sdn. Bhd., Kuala Lumpur, Malaysia.*

Life cycle

The life cycle is rather slow, usually taking 4-5 months from egg to adult but taking up to one year in cooler areas such as higher elevations.

Plant damage and plant tolerance

An affected branch may be completely hollowed out. Leaves on the branch dry out and die, but usually remain hanging on the tree. This pest is important only on young tea, where it may bore into the main stem, even below ground level, and often killing the plant.

Natural enemies

It is known from other Asian countries that several parasitoid wasps (families Braconidae and Ichneumonidae) kill the caterpillars of red borer.

Management practices: prevention and control

Eliminating host plants is difficult because this pest can reproduce on more than 30 species of trees and shrubs (including coffee, cocoa, and many forest trees). Male moths are somewhat attracted to artificial light, so it may be possible to trap and drown them with a light above a basin filled with a mixture of water, kerosene, and a little soap.

Attacks are most abundant in March-April and June-August. During these periods, inspect tea plants for dried-out leaves or excrement ("sawdust") on the ground. Prune the affected branches below the hole where the caterpillar went in. Burn the pruned branches.

9.5 Termites on roots and stems

Description:	Scientific name:	Vietnamese name:
Eat living wood, nest inside trees	*Postelectrotermes militaris* Order Isoptera, Family Kalotermitidae.	Mèi
Eat living wood, nest in the soil	*Coptotermes* spp. (Order Isoptera, Family Rhinotermitidae)	Mèi
Eat dead wood, nest in the soil	*Macrotermes* spp., *Microtermes* spp., or *Odontotermes* spp. (Order Isoptera, Family Termitidae).	Mèi

Several of these species may be present in the same field.

Termites eat the woody roots, branches, and stem. They can cause great damage to tea on hills.

Description and Behavior

Termites resemble ants, but have softer white bodies that are shaped like a tube (do not have a narrow "waist" like ants).

Some termites eat only dead wood. The most damaging termites are those that attack living wood. They enter through the roots and work their way upward, finally destroying the heartwood. They make their nest inside the trunk of the tea tree. Above-ground symptoms are wilting leaves and a poorly-growing plant. Tubes of mud or sawdust (which cover trails used by termites) are often seen on the trunk or branches.

Life cycle

Termites changes very little as they grow from **nymphs** to **adults**. They live in nests in the soil, in dead trees, or inside the trunks of living trees. Many thousands of termites may live in one nest. At some times during the year, winged adults fly away to start new nests.

Plant damage and plant tolerance

A heavy infestation of termites that attack live wood can reduce yields by 10-15%. Termites that attack live wood can kill even large mature tea bushes. They can also harm shade trees. Even termites that eat only dead wood make the wood moist and dirty, and therefore more susceptible to fungus diseases.

Management practices: prevention and control

Termites that eat living wood do not travel through soil to reach their food supply. Instead, they first enter a tea bush from roots of another tree that are touching the roots of the tea bush. Therefore, when clearing land to plant a new tea field, it is very important to remove stumps and dead trees, including their roots.

Once a tea bush becomes infested, the first step is to observe if the termites are eating living wood or only dead wood (wood already killed by sunscorch, die-back after pruning, or diseases). If the termites are eating living wood, there are few options besides the use of insecticides. At pruning time, cut the branches back so that you expose at least two openings into the nest inside the trunk. Then, spray insecticide into the nest. You must spray immediately after pruning, because the termites will quickly block up the openings with mud. The alternative is to dig up and burn the infested bush, and replant. Before replanting, check to make sure that neighboring bushes are not infested.

If the termites are eating only dead wood, prune off infested branches and clean away any sawdust or mud tubes from the surface of the tree. If possible, find and destroy the nest (dig it up or use insecticides). The nest will be located in the soil or in a dead tree.