Insect Biology

The following section outlines insect biology for:

- Leafrollers
- Armoured scale insects
- Greenhouse thrips
- Six-spotted mite

LEAFROLLERS

These are the major pests in New Zealand avocado orchards, and can cause significant fruit loss and scarring if not controlled. Brown-headed leafrollers, Ctenopseustis obliquana and C. herana, predominate on this crop, with the first the most common. The black-lyre leafroller, Cnephasia jactatana, is a distant third-most common. These 3 species are all native to New Zealand and feed on a wide range of host plants. As well as the caterpillar damage to avocado fruit, leafroller moths will lay egg masses on fruit. Thus both eggs and caterpillars can give rise to a quarantine issue if present on fruit at harvest.

Life cycle

Larvae - Leafroller caterpillars commonly infest new growth shoots during the spring / summer flush, without causing significant damage. A little damage is caused by caterpillars feeding in the flower panicules, but most damage to fruit occurs subsequently in the first months after fruitset. Some damaged fruitlets drop. Where fruits grow in clusters, leafrollers will often feed between the contacting surfaces giving rise to extensive damage. Caterpillars generally grow through 6 instars before pupating, and pupa can be found among webbing and damage either on the trees or among sward plants.

Adults - All leafroller moths have a characteristic bell-shape when at rest. Most species are mainly brown in hue, and with variable but distinctive colour patterns. Moths mate and lay eggs in overlapping masses that can contain a few to over 60 eggs.

Eggs - On avocado trees egg batches are laid on the upper surface of leaves and on fruit. Eggs are green when freshly laid but darken as the caterpillars develop inside them. Hatched egg masses are generally easier to find than unhatched, appearing like flecks of white albumen.

Leafrollers have 3 or 4 generations each year. There is no over-wintering stage and the life cycle continues although at a much slower pace as temperatures drop. Where the winters are more severe, few caterpillars survive and they develop with a burst of growth at the onset of spring. In such areas, south of where avocados are grown, spring flights can be more synchronised than in the north where moths fly at any time of year, without reliable peaks of activity.
The brown-headed leafrollers are not caught in pheromone traps as easily as the light-brown apple moth Epiphyas postvittana, the main leafroller pest on pipfruit. This, together with the poor ability to predict damage using flight data for brown-headed leafrollers, severely limits the usefulness of pheromone traps as a monitoring technique in avocados.

Control

Both broad-spectrum older sprays and newer selective products are available to control leafrollers. Limited resistance to some older materials has been recorded (see Resistance Management Strategy). Damage is most critical for the first months after fruit set, but can occur at almost any time of year. The quarantine risk of fruit contamination by eggs or larvae can be overcome by a dip treatment during harvest handling, but this must be done carefully and may not be acceptable to all markets.

ARMOURED SCALES

- latania scale - Hemiberlesia lataniae
- greedy scale - Hemiberlesia rapax

These are the two species of armoured scales on avocados in New Zealand, although internationally latania scale is the most common scale on avocados. It is very difficult to pick these closely related species apart, and the notes below apply to both.

Armoured scales are largely a cosmetic and market access problem which do not affect production or the eating quality of fruit. Market access should cease to be a problem as Quarantine Authorities adopt the approach of Pest Risk Analysis, because these species are virtually universal. However latania scale is not recognised from Japan and will become more important as a fumigation problem if this market develops. Even though scales are small and confined to the skin, large numbers on a fruit are unsightly and may lead to consumer rejection. They can be very conspicuous as Hass fruit darken. The scale body will remains stuck to the fruit even when killed by a spray.

Armoured scales are found on the wood and leaves of avocado trees as well as on fruit, with most movement onto fruit occurring from February to May. Both species are found on a very wide range of plants, including many shelter trees. Lombardy poplars and taraire are examples of shelter trees that can be very heavily infested. (Taraire is a native tree related to tawa and found mainly north of Auckland.) If you have a scale problem coming from the shelter it is critical that you target the shelter as well as the avocado trees. If the shelter is a playing a major role in your problem the avocado trees adjacent to it will generally be more heavily infested than those further away. This is because armoured scale crawlers do not produce silk threads for dispersal, but simply drift in gentle winds.

Life cycle

Armoured scales are sap-sucking insects that live under protective coverings (caps) made of wax, protein and other substances. These caps protect the scale insects not only from the weather but also from sprays. Scales, like all insects, grow in a series of stages or instars. At the end of each instar the scale moults, and the shed skin is added to the inside of the cap, changing its colour when viewed from below and providing an easy way to age scale insects. Adult scales produce eggs that hatch almost immediately into crawlers. Eggs are not laid in batches but are produced a few at a time over an extended period of several months. Thus generations overlap. There are usually only two generations each year, so that scale populations develop slowly. On warm sites or in seasons with a protracted warm autumn, there will be a partial third generation in late autumn.

First Instars - Crawlers are the only mobile stage in the scale life cycle. Once settled an armoured scale stays in the one spot for the rest of its life. When the crawlers settle they are known as white caps because the underside of the cap is white. Both crawlers and white caps are first instar scales and many die during this stage.

Second Instars - When the settled scale moults to the second instar, the shed skin added to the underside of the cap changes the colour to a yellow or light tan colour. The actual colour varies with scale species, latania scale being lighter than the same instar of greedy scale.

Third Instars - The moulted skin of the second instar gives the cap a darker brown appearance when viewed from below. As the scale grows the cap becomes uneven, particularly in greedy scale. Eventually eggs form, and the scale are then said to have reached the Mature or adult phase. No males are known from these two species in New Zealand.

Control

Control of scale on avocados aims to prevent significant numbers of scale settling on the fruit. At present we know of no differences between the 2 species that affects control. The protective cap makes armoured

scales intrinsically difficult to kill. Crawlers as the only exposed stage are more easily killed. However crawlers are not produced all at once as in some soft scales, but trickled out continuously over the several months that an adult scale can live. So coverage, to reach all the cracks and crannies where scale can be found, is more important than timing.

GREENHOUSE THRIPS

Greenhouse thrips Heliothrips haemorrhoidalis is a major pest on avocados due to the fruit scarring caused by their feeding. Damage begins where fruits touch, or where a leaf touches a fruit and can result in significant quantities of fruit being rejected from export. Both adults and larvae cause this brown russetting, but adults are more damaging. Leaves are also damaged, although this is not thought to be significant. Dense populations of adults and larvae can develop under favourable conditions. Greenhouse thrips is another insect pest that is spread widely around the world and feeds a very wide range of host plants. It was first recorded in New Zealand in the 1930s. They are abundant throughout much of the North Island, and can be found as far south as Nelson.

Life cycle

Adult greenhouse thrips are black, about 1.5mm long, with yellowish legs and two pairs of narrow, fringed wings that are held along the body appearing as a pale stripe down the middle of the abdomen. Newly emerged adults are brown and darken with age. Males have not been found in New Zealand. The adults live for up to three months and lay 2-3 eggs per day.

Eggs (0.3 mm long) are laid singly inside the leaf or fruit tissue. When each hatches an almost transparent larva emerges, which becomes white or pale yellow as it grows. There are two actively feeding larval stages, followed by two non-feeding stages, the propupa and pupa. Both pupal stages can be distinguished by the wing buds they have. Feeding larvae carry droplets of liquid excrement on the tips of their abdomens. These are a defence against predators, but if not used are deposited over the feeding site where they harden as tarry blobs. They are distinctive of greenhouse thrips.

The complete life cycle takes less than 5 weeks under optimum conditions, so that there are a number of generations each year. Both cold and hot weather limit population growth, as does dryness. Unfortunately the warm humid conditions in Northland and the Bay of Plenty during late summer and autumn approach being ideal for greenhouse thrips, so that big populations can develop quite rapidly.

Habits

Greenhouse thrips prefer to feed between touching surfaces of leaves and fruit, or under spider webbing. Heavy infestations lead to thrips feeding over the entire surface of fruit and leaves. The leaves become bleached and fresh damage to the fruit appears silvered. This ages to a brown russet littered with characteristic black spots of excrement. Young and mature fruit are equally susceptible to damage.

Natural enemies

Parasites: Thripobius semiluteus was imported from California and released in the Bay of Plenty and Northland on selected avocado and citrus orchards over the last few years. Thripobius is a small wasp that parasitises the larval stages of greenhouse thrips. It has successfully reduced pest numbers overseas, but the success and extent of its establishment in New Zealand has not been determined. It is also now available commercially from Zonda Resources.
Predators: The few recorded predators appear to have little impact on population levels of greenhouse thrips in New Zealand.

Control

Greenhouse thrips is susceptible to a number of sprays, including both older broad-spectrum products, and some newer products. However the eggs in the tissue are protected from sprays so that if populations of

thrips are large or conditions favour a rapid increase, 2 sprays at about a 3-week interval may be required to give effective control.

SIX-SPOTTED MITE

Six-spotted mite (6SM) Eotetrancyhus sexmaculatus can cause extensive premature leaf-fall. This spider mite is found in all the major avocado-growing regions in this country, but populations are greatest in the Whangarei and Far North regions. Although 6SM was first found in New Zealand in 1953, it began to be of concern only relatively recently, rising to become a major pest in the last few years. The reason for the change in pest status is unknown. There has been little research on 6SM in New Zealand and the following account uses both local and overseas information.

Life Cycle

Adult 6SM are very small, approximately 0.3 mm in length. Adults are generally a light yellow colour with a number of irregular dark markings along the body. Despite the name, there are not necessarily 6 clear spots, and number and shape of the markings can vary considerably. Each adult female can lay 25-40 eggs over a 10-20 day period.

The shiny, pale white or cream coloured eggs are globular with a delicate stalk on the upper surface. They are laid singly on the lower surface of the leaves where the adults feed, and take 5 days to 3 weeks to hatch depending on temperature. Once emerged the immature mites pass through a number of stages before becoming adults. There are 3 immature feeding stages, larva, protonymph, and deutonymph, which are each followed by an short stationary resting stage called a photochrysalis, during which the mite moults. The larval development stages can take as little as 8-12 days during the summer temperatures in California, but local evidence is for a slower rate of development in this country.

The whole life cycle takes place on the underside of avocado leaves. As with other spider mites, 6SM disperse through the environment by drifting in air currents, and may also be transported on orchard equipment. Infestations in New Zealand can be localised with considerable variation among trees within a block.

Damage

Six-spotted mites feed on the undersides of leaves, sucking out the contents of cells. Initially this damage appears as a purplish discolouration on the underside along the main veins. Sometimes damage is visible from the top surface of the leaf as pale blotchy areas, and occasionally leaf distortion occurs. However leaf drop is the most obvious sign of serious 6SM infestations. Although in California leaf drop is said to occur when populations reach an average of 5-10 adult mites per leaf, experience in New Zealand suggests that much higher populations can generally be tolerated here. There does not appear to be a simple link between mite numbers and leaf drop.

Control

Overseas 6SM rarely requires intervention on avocados, with numbers being successfully contained by a range of natural enemies.

Chemical control

Thorough spray coverage of the underside of the leaves is essential with any product targeting control of 6SM. Avid (abamectin) and D-C-Tron Plus (mineral oil) are registered for this use, and Mit-é-mec is seeking registration. Growers also report control of this mite can still be achieved with some organophosphate sprays, which is unusual for a spider mite. Avid gives better and more persistent control when sprayed onto young leaves than old hardened ones, and is normally used with 0.5% mineral oil added.

To minimise the risk of 6SM developing resistance to chemicals, a Resistance Management Strategy has

been developed. Do not use one product, or products from the same chemical group, more frequently than recommended in the Resistance Management Strategy. If more applications are required, products with different modes of actions must be used.

Biological control: Overseas this is very effective. In New Zealand several species of predatory mites and a tiny predatory ladybird (Stethorus spp.) have been found associated with 6SM but their effectiveness is uncertain. It is prudent to minimise the impact of sprays on these natural enemies, by using selective products wherever possible and minimising the use of broad-spectrum products against other pests.
To see pictures of six spotted mite, eggs and feeding damage, see link at the bottom of this page.

MEALYBUG

Mealybugs, principally long-tailed mealybug Pseudococcus longispinus, are commonly found on avocado trees. They are present on leaves from November onwards and will infest fruit, especially fruit hanging in clusters. Mealybugs excrete honeydew which can give rise to sooty moulds and can also be of quarantine concern.

BRONZE BEETLE

Eucolaspis brunnea. Adults of this soil-living grub emerge from October and feed heavily on new foliage. Damage to young trees can be severe with significant defoliation occurring, and is often worse close to large areas of pasture or grassy wasteland.

MINOR PESTS

- Cicadas - Amphipsalta zelandica
- Tropical army worm - Spodoptera litura
- Noctuid moth - Graphania spp.
- Katydid - Caedicia simplex
- Passion-vine hopper - Scolypopa australis
- Fullers rose weevil - Asynonychus cervinus
- Green vegetable bug - Nezara viridula

NATURAL ENEMIES

- Ladybirds (Coccinellidae) - range from general to specific predators.
- Tasmanian lacewing larva and adult - Micromus tasmaniae, an aphid predator.
- Tachinid fly -Trigonospila brevifacies, a leafroller parasite.
- Yellow banded wasp - Xanthopimpla rhopaloceros, a leafroller parasite.
- Schellenburg's soldier bug - Oechalia schellenbergii, a general predator.
- Green vegetable bug egg parasite - Trissolcus basalis.
- Greenhouse thrips larval parasitoid - Thripobius semiluteus.