TEXT & PHOTOS BY LYNETTE MORGAN, PH.D.

Feasting at

Part 2–Growing Edge continues its look at critters that chomp, suck and chew leaves, stems, flowers and fruit, and how growers can get some control

Above: The long-tailed mealy bug is one of the most common mealy bug species found on hydroponic plants. *Below:* Larvae such as the leafroller caterpillar can also burrow into fruit, in this case under the calyx, to develop inside. *Bottom:* Leafroller caterpillars often roll back leaf margins to create a protective environment in which to feed and grow.

Some insect pests make themselves very obvious. They chew large holes in leaves, deposit little piles of black excrement, also called frass, all over the hydroponic system, even take bite-sized chunks out of flowers and fruit. Others are more discrete and can cause major damage while remaining under cover. The key to preventing and solving insect pest problems is first to be able to recognize the enemy and then apply the right tools to keep them at bay. Luckily, these days there is quite a wide range of pest-control options, from chemical insecticides to biological control, natural predators and parasites, cultural control and even the old hunt-and-squish technique which is still a favorite with many smaller growers.

Caterpillars

Common hydroponic pests which are large and obvious are mostly caterpillars, slugs and snails. There are a number of different caterpillar species which will attack hydroponic plants, and damage can range from large ragged holes in leaves, flowers and fruit to rolled leaves and larvae found inside fruit at harvest. Caterpillars are the immature (larval) stages of butterflies and moths, which themselves are not often

Above: A large caterpillar can cause severe damage feeding on leaves, often reducing small plants to skeletons. *Below:* Mealy bugs can infest leaves, stems, flowers and root systems

Your Expen$e

Above: Caterpillars of the white butterfly attack brassica crops such as this cabbage. *Right:* Leafminers are small fly larvae that eat their way through to the inside of the leaf and begin tunneling there. The tunnels they create are visible on the leaf as squiggly lines.

noticed in the growing environment. They come to lay eggs then seemingly disappear. Caterpillars start life as very small larvae, hatching from eggs laid, usually on the lower leaf surface, often going unnoticed on plants until they are large enough to cause highly visible damage. Small caterpillars may cause a windowing effect on the leaf as the young larvae remove only the lower surface of the leaf between the veins. As the caterpillar grows, it molts and begins constant feeding, getting larger all the time and developing the ability to chew right through the leaf. Caterpillars also leave many piles of black excrement which is a vital clue to not only their presence but also their whereabouts on the plant.

Various caterpillar species are potential pests of hydroponic plants. The most common worldwide are the green looper and leafroller. The green looper is easy to recognize by the characteristic looping movement as it moves forward to feed and it is also a distinctive bright green color. Loopers can grow to 4-5 cm in length and may develop fine white stripes along the body as they reach maturity. Leafroller caterpillars can be a little less obvious than the looper. These species are small (2 cm) larvae that make themselves a shelter by using webbing to glue two leaves together or by rolling leaf margins over and sticking them down. Leafrollers can also chew their way into developing fruit, such as bell peppers, and develop inside. Often these pests leave only a small entry whole and are not discovered until the fruit is cut open. Inside these leaf and fruit shelters they feed safe from predators and any contact insecticides which might be applied to the plants.

Some caterpillars only attack certain types of plants. Growers of hydroponic brassica vegetables, herbs and flowers (cabbages, cauliflowers, flowering stock, mustard, etc.) should be especially wary of the white butterfly caterpillar, a notorious pest of these plants. The white butterfly adult is easily recognized as a white/yellow butterfly with dark spots on the wings which flit over the leaves of the plants on warm days, usually in summer and fall. Seeing these butterflies hovering over any hydroponic brassicas is a sign that action needs to be taken soon. The adults will lay many eggs on the undersides of leaves. The eggs hatch into tiny larvae about a week later. These pests are particularly damaging as many eggs will be laid all at the same time, resulting in a plague of larvae which can remove all the foliage on a plant in a short time, reducing a once magnificent brassica crop to a pile of leaf skeletons. White butterfly larvae are a dull green caterpillar which can grow to 3 cm in length, making them easy to see and identify once the damage has started.

Fruit worm caterpillars are another highly damaging and annoying pest. These prefer to feed on fruits, buds and flowers and can be serious problems in tomatoes, capsicum and other vegetable fruits.

Leafminers, a type of fly, are another larvae pest which are not as obvious as the larger caterpillars as they live within the leaf itself. It's not until the feeding damage of the large leafminer larvae shows up as highly visible whitish tunnels on the leaf surface that their presence can be detected. Leafminer damage of this sort tends to be more of a cosmetic problem, particularly on foliage crops such as salad greens, ornamental plants and herbs. Leafminers emerge from eggs laid by the adult flies on the leaf surface. They begin mining

the leaves immediately by creating winding, whitish tunnels between the upper and lower surfaces of the leaves. The adult flies emerge from the leaf mines at maturity and pupate on the leaf surface after 8-10 days. In many cases the pests have long left the leaf before much damage has been noticed by the grower. Leafminers, like leafrollers, are protected inside the leaf surface and this makes them difficult to control with contact sprays and insecticides. Smaller growers often just remove the affected leaves and dispose of them with the larvae still inside. This is usually enough to control small outbreaks.

Whitefly

Whitefly has become the major pest of commercial greenhouse hydroponic producers worldwide, and its one that can cause significant damage and loss in yields. An infestation of whitefly is usually highly visible. Small, white, delicate and moth-like, whiteflies rise up in large clouds as the plants are disturbed and then settle back on the undersides of the leaves. Whitefly have an amazing ability to find their way into most growing environments, even indoor grow rooms, and are especially troublesome where year-round heating allows a continual population to be present. Whitefly is not a true fly but belongs to an order of insects called Homoptera that includes scale, aphids and the green vegetable bug.

High populations of whitefly in a hydroponic system have the potential to be extremely damaging. Plants can become seriously weakened by the heavy infestations which can remove large volumes of sap within a short period of time, particularly where there are developing nymphs (juvenile stages of the whitefly) on the leaves. A heavily infested plant will become stunted and grow poorly. The foliage may turn yellow and drop prematurely, and yields and quality will be seriously affected. What many growers find most annoying about whitefly is the production of a sticky substance called honeydew, which is excreted in large quantities as the pest feeds. A single whitefly nymph has the ability to excrete 20 drops of sticky honeydew per hour, and a single leaf can easily contain over 2,000 nymphs. This sticky honeydew provides an ideal medium for the growth of sooty mold, a black fungus which uses this sugar for growth and development. Black sooty mold over large surfaces of the plant looks unsightly and it interferes with photosynthesis and transpiration of the leaf, thus stressing the plant further. Many inexperienced growers often assume this black sooty mold is a separate disease problem and try to control it without addressing the actual source of the problem: whiteflies and honeydew they excrete. To make matters worse, both the greenhouse whitefly and the sweet potato

Top: Small-scale growers can often control large pests such as these caterpillars by picking them from the plants before significant damage is caused. *Above left:* Adult whiteflies are small, white, moth-like. The juveniles are scale-like and can suck large volumes of sap from plants. Both stages can be seen in this image. *Above right:* A leafroller caterpillar is exposed showing the webbing used to glue leaves together. *Below:* A heavy infestation of mealy bugs is sometimes mistaken for a fungal disease.

whitefly are two species which are known to transmit over 25 different virus diseases of plants.

Whiteflies can enter a hydroponic crop in a number of different way. Usually they first appear after a plant or seedlings was introduced to the growing area that had either adult whitefly, eggs or nymphs already present. However, whitefly, despite its delicate appearance, can travel quite some distance, and adults may come into growing areas, greenhouses and grow rooms through doors and vents and may even hitch in on clothing and equipment. Whitefly can spend the winter in protected environments, ready to start a population explosion again in spring or as heaters are turned on for a new growing season.

Many whitefly problems exist because complete eradication of the pest never occurs, and there is always the odd adult or juvenile ready to create another infestation when conditions are just right. As with most insect pests, whitefly developmental rate is highly dependant on temperature. The time taken for the eggs laid by the flying adult to hatch depends on temperature. The higher the temperature the faster the life cycle and rate of population growth. With warm greenhouses often heated to 25 C, whitefly breeding is rapid. A few adults coming in on some seedlings can become a huge population within a few weeks if no controls are applied.

Many smaller growers use simple control methods. Whiteflies are attracted to the color yellow, and so yellow sticky traps can be used to monitor and trap some insects. Screening of vents helps prevent infestations as does raising your own seedlings in a fully screened area. It's also a good idea to carefully check incoming seedlings and plants for signs of infestation. Adult whiteflies can't survive long without a plant host, so a regular and thorough cleaning of the hydroponic system and growing area after a major infestation also helps with whitefly control.

Some growers practice integrated pest management (IPM). One technique involves buying insect enemies such as Encarsia Formosa, a small wasp parasite of whitefly, to introduce into the growing area. However, one disadvantage of IPM is it can be a little difficult to keep going, and growers may find they have to buy and release more insect enemies to keep their numbers high enough for adequate control.

Mealy Bugs

One of the most highly visible and familiar pests of hydroponic plants is mealy bug. Growers who have not come across these pests before often mistake the first signs of these pests—a white, waxy or floury looking deposit—as some sort of disease rather than an insect pest. While this white cottony growth does look similar to a fungal growth, it is in fact the waxy covering of the mealy bug. The adult female is about 3 mm long, oval and wingless, with short antennae and a fringe of filaments around the body. One of the most common mealy bug species found in hydroponic systems is the long tailed mealy bug, which has two very long filaments at the tail end of the insect. Underneath the white waxy covering the insect is usually yellow or grey and may have a darker strip running down the middle of the back.

Most mealy bugs lay eggs, up to 600 at a time, in a loose cottony waxy deposit on the undersides of the leaves. As the young mealy bugs settle down to feed they begin to exude the white waxy material that soon forms a covering over the whole body.

Some common types infesting hydroponic systems can produce live young, and populations can build up rapidly. Each female long-tailed mealy bug, for example, can give birth to as many as 200 crawlers, with as many as 3-4 generations per year, depending on climate. Under cooler winter conditions, the insects tend to retreat under bark, into crevices and other places to hide until temperatures warm up.

These insects have piercing and sucking mouth parts which they use to suck sap from the plant. A heavy infestation can suck a plant dry, stopping growth and yellowing foliage, leading to plant death.

Mealy bugs feeding will often disfigure foliage and fruit. These insects also excrete honeydew, which forms a sticky deposit on plant leaves. Sooty mold may eventually grow on the honeydew, resulting in a black tacky mess that inhibits plant photosynthesis.

The best method of control is regular inspection of plants and taking action as soon as mealy bugs are detected. Mealy bugs are difficult to control with conventional sprays because the adult is protected by a water repellent waxy covering. In addition, they tend to hide in leaf axils, buds and other places where sprays don't penetrate for adequate control. For an individual plant, its often recommended that mealy bugs be brushed with a solution of alcohol or methylated spirits, which dehydrates the pests. However, this can be extremely time consuming and often doesn't provide adequate control.

Slugs and Snails

Slugs and snails are another large and obvious pest of many hydroponic crops, particularly outdoor and backyard systems. Slugs and snails tend to come out to feed at night, especially when it's suitably wet for comfortable travel. They leave behind silvery trails, and this is something growers should look for. During the day these pests hide away in damp, dark places, and from time to time growers should go on search-and-destroy missions.

Growers with outdoor systems should practice manual control and use bait especially during damp times. Slugs and snails are often more of a problem in propagation areas where they can munch through trays of young seedlings overnight. Greenhouse growers too should be vigilant. Slugs and snails can crawl up supports and onto media beds where vulnerable crops are growing. The pests can also lie dormant inside growing areas and then resume feeding when moisture levels increase.

In my next "Beginner's Corner" I'll finish my discussion of pests and look at more control options for hobbyists and small- to medium-scale growers.

Lynette Morgan is co-owner of SUNTEC Hydroponic Consultants, New Zealand (www.suntec.co.nz).