10 Health management

Citrus health management

In its broadest sense, "citrus health management" means managing the health of citrus trees in a way which gives a net profit by integrated measures, including Integrated Pest Management (IPM), soil and water management and cultural practices. This chapter discusses IPM measures to keep disease-free seedlings free of pests and diseases once they have been planted out in the orchard.

The greatest threats to the health of citrus orchards in Asia are virus diseases and citrus greening, both of which are widespread in the region. Once a tree is infected with either virus or citrus greening, the infection spreads throughout the orchard.

These conditions are progressive and incurable. Infection is always followed by some decline in vigor and fruit yield, sometimes to a drastic extent. Eventually, the tree may die.

Prevention of virus diseases and citrus greening depends on two basic measures.

Healthy planting stock

Citrus seedlings must be free of disease when they are planted. This means that growers must have access to certified healthy planting stock.

Keeping trees free of disease

The seedlings must be kept free of disease after they are planted, by the control of sucking insects and other measures.

Growers must then take measures to keep their trees free of disease throughout the year.

Protecting trees at the sprouting stage

In every country, the growth of citrus trees comes in spurts, when new sprouts appear on the ends of branches. These bursts of new growth are often called "flushes". Sometimes sprouting begins in the spring, sometimes at the end of the dry season when rain begins to fall. This period of new shoots and rapid growth may occur several times a year.

For example, in subtropical Taiwan, citrus trees usually sprout three times a year. The spring flush is the main period of growth, from March to May. Summer shoots grow from May to June, and autumn shoots appear irregularly during August and September

In tropical Thailand, sprouting occurs in response to the annual monsoon, which brings plentiful rain and moisture. In the southwest of the country, the monsoon season falls between the months of May and October.

Greening disease and citrus tristeza

The transmission of the greening organism (GO) by citrus psyllids (*Diaphorina citri*) occurs mainly when trees are at the sprouting stage. The transmission of citrus tristeza virus (CTV) by aphids also mainly occurs at this time.

Both psyllids and aphids must be controlled by a foliar spray of 44% Dimethoate (1000X). An alternative spray is 50% Malathion (800X) or some other effective insecticide. Another alternative is to apply a new systemic insecticide, Winner 200 SL (Confidor) to the trunk of the tree.

Timing of the spraying is critical. It must be based on the population dynamics of the vector insects in the field. When the trees are sprouting and the danger of infection is high, trees must be sprayed repeatedly every 10-20 days. Growers must take care to apply insecticides early, so that populations of the insects do not have time to build up.

Citrus canker

Citrus canker is caused by the bacterium *Xanthomonas campestris* pv. *citri*. Infection begins early in the growing season, starting with the spring shoots. This is followed by the continuous infection of young fruits and twigs as they appear.

Citrus canker can be prevented by spraying the trees with a copper fungicide, such as Bordeau mixture (500X), Kasugamycin + Copper oxychloride (1000X) or Cuproxate (500X).

Canker easily becomes epidemic during the rainy season, and additional sprays should be applied after a rainstorm. It is important to remove infected twigs and branches by pruning. This eliminates the primary source of the pathogen.

Leaf miners

Leaf miners (*Phyllocnistis citrella*) are insects which feed on the leaves, particularly the young leaves. By defoliating trees, they reduce their productivity, so that there is a decline in yields.

Leaf miners reproduce fast, and may produce three or four generations in each growing season.

They are controlled by spraying the trees with Methomyl (1000X). Other suitable insecticides are Omethoate (1000X), or Dimethaote (1000X). Another alternative is to apply Winner 200 SL (Confidor) to the trunks of the trees.

Protecting the trunk of the tree

White-spotted longicorn beetle

The white-spotted longicorn beetle (*Anoplophora macularia*) lays its eggs at the base of the trunk. After the larvae hatch, they bore into the bark and xylem, causing tree decline and ultimately wilting. Invasion by the beetle can be prevented by covering the bottom part of each tree trunk to a height of about half a meter with nylon netting or a plastic sheet.The plastic or net must reach right down to the soil, and be firmly anchored with sticks or stakes.

Alternatively, the beetles can be controlled by painting the tree trunks with lime containing 20% sulfur powder. The tree trunks must be covered with this mixture during the growing season. It protects not only against the beetles, but also against Phytophthora foot rot.

Foot rot

Foot rot, gummosis, and root rot are all caused by the fungus *Phytophthora* spp., and are found in orchards with poorly drained soil. All three diseases can be controlled by spraying the fungicides Metalaxyl or Fosety-A1. Both of these are systemic fungicides, which are absorbed by the plant and enter into the roots, stems and leaves.

They should be combined with improved drainage, and the use of resistant rootstocks (citrange, citrimelo and trifoliate orange). In areas where *Phytophthora* is a problem, soil should be disinfected with a soil fumigant or by heat sterilization before new seedlings are planted.

Protecting the canopy and fruit

Fungus diseases

Black spot

Black spot is caused by the fungus *Guignardia citricarpa*. It infects young fruits, giving rise to dark spots with a gray center on the fruits and leaves. The fungus overwinters in fallen leaves and twigs without any symptoms.

Young fruits should be protected by spraying them with a fungicide such as Mancozeb (500X), Benomyl (3000X) or Mancozeb (650X) + Summer oil (200X). Spraying should begin one week after the flower petals fall, and should be repeated four times at two-week intervals.

Melanose

Melanose is caused by the fungus *Diaporthe (Phomopsis) citri*, and affects fruit appearance by producing raised black dots on the fruits, leaves and twig. Control measures are the same as for black spot.

Insects

Scale insects and mealybugs

A wide range of scale insects are found on citrus trees, including citrus black scale (*Parlatoria zizyphi*), red scale (*Chrysomphalus aonidum*), chaff scale (*P. pergandii*), green coffee scale (*Coccus viridis*), and cottony-cushion scale (*Icerya purchasi*). Mealybug species include the citrus mealybug (*Planococcus citri*) and the globular mealybug (*Nipaecoccus filamentosus*).

All these species attack the leaves, twigs and fruits. They cause injury by sucking sap from the tree and excreting large amounts of honeydew. This honeydew serves as a medium for the growth of sooty mold fungus. Sooty mold deposits on the fruit require extra scrubbing on the packing line for removal.

Continual sucking of the sap by scale insects and mealybugs from foliage and twigs lowers the vitality of the tree. Heavy infestations can result in severe defoliation.

Growers should watch for a build-up of mealybugs and scale, and apply a timely spray of the insecticide Malathion (800X) combined with summer oil, Citrol (100X) or Dimethoate (1000X). Treating the trunk with Winner 200 SL may also be effective.

Overwintering insects should be eliminated by pruning infested branches, and spraying a mixture of insecticide and oil. Carrying out these measures after harvesting the fruit is indispensable to prevent scale and mealybug problems the following season.

Mites

Mites, including rust mites (*Phyllocoptruta oleivora*) and red spiders mites (*Panonychus citri*), attack the leaves and fruits. Rust mites in particular cause the atrophy of leaves and buds, and turn fruit a rusty brown color.

Mites are controlled by spraying an acaricide once a week throughout the growing season. At least two different kinds of acaricides should be applied in rotation, to prevent the mites rom becoming tolerant of the chemical. Spraying over the winter and pruning are the same as for scale and mealybug.

Fruit fly

Fruit flies (*Bactrocera dorsalis*) attack fruit when it is ripe or maturing. The adults lay their eggs in the fruit. The eggs hatch into yellowish white larvae which burrow into the fruit. Infected fruit have little market value, and often drop before they are ripe.

This pest may be controlled by trapping the adult males in plastic containers containing methyl eugenol, which acts as a lure. In some areas, especially on small islands, fly populations have been reduced or even exterminated by the mass release of sterile male fruitflies.

Orchard sanitation and pruning

Maintaining good sanitation in the orchard is very important in citrus health management. Twigs and fallen leaves should be collected from under and around the trees, and either buried or burned.

Pruning is also important, because like good sanitation it helps eliminate the source of pathogens and insects. In winter, growers should prune twigs which show signs of die-back.

They should also remove any twigs which show symptoms of canker, melanose, pink disease, scab (*Elsinoë fawcetti*), anthracnose (*Collectotrichum acutatum*) or stem-end rot (*Diaporthe citri and Diplodia natalensis*).

Many scale insects and mites may survive in the canopy over the winter in a dormant state. The trees should be sprayed at least once during the cold months with summer oil or citrol. This should kill any over-wintering insects such as scale insects, rust mites, red spiders and spiny blackfly (*Aleurocanthus spiniferus*).

Covering the soil surface with a grass or straw mulch is an effective way of reducing levels of disease, as well as improving the soil. Covering the soil within 30 cm of the trunk with a layer of straw helps prevent infection of the roots with fungus diseases caused by *Phytophthora.*