Citrus red scale control

G D. Rimes
THE RED SCALE (Aonidiella aurantii Masc.) is widely distributed throughout the world and is a serious pest in countries with semi-arid climates such as California, South Africa, Palestine and Australia. The home of the pest is probably China, but it has been known in Australia for over 70 years and it was introduced into North America from the continent.

Red scale has been described as the most serious insect pest of citrus, and in many countries this is undoubtedly true. In Western Australia it is widely established but is not the major pest that it is in the Eastern States.

Description

The adult female is an almost circular, soft-bodied insect which has no power of movement. It is protected by a hardened, reddish-brown waxy scale about 1/10th of an inch across. The insect has sucking mouth parts, the sucking tube being produced into a hair-like organ much longer than the whole body of the scale.

The male insect is rarely seen. It differs greatly from the female, and has a pair of well-developed wings and a tuft of filamentous threads, forming a kind of tail. It passes its early development covered by a waxy scale, but when it reaches maturity it pushes out from under its covering and goes in search of a mate. The male scales or coverings are smaller than those of the female and are oblong instead of circular in shape.

Life history and habits

The red scale (unlike many other coccids) does not lay eggs but gives birth to living young. The young or larvae may remain under the protecting mother scale for a brief period after birth, especially if the weather is cold.
The young scales, on emergence, are only just visible to the naked eye, and look like tiny yellow specks of sulphur. Under a lens they will be seen to have three pairs of functional legs and a pair of feelers or antennae.

As a rule the young or "crawlers" do not migrate far, but settle down within a few inches of the parent. The active crawling stage may last a few hours or a couple of days, then the mouth parts are inserted into the plant tissue, the antennae and legs are drawn in under the body and the first cottony threads of the covering scale appear.

Once it has settled, the female red scale remains fixed in position throughout its life.

After imbibing sap for some time the young scale molts its skin and at the same time loses its legs and antennae. It grows considerably and adds to the scale covering, then after a second moult it reaches maturity.

The time required to develop from crawler to adult varies with the season of the year and the locality. The main breeding season in Western Australia extends from November to May, when several generations may be developed.

Exact details are not known for local breeding rates, but in South Australia it has been shown that it takes about nine weeks in the summer and about 20 weeks in the winter for a newly-hatched female to be ready to give birth to the next generation.

Females start to produce young in the early summer and may continue for about two months, giving birth to some 150 crawlers. This reproduction may continue on fruits even after they have been picked and held in store.

Normally, red scale does not reproduce during the winter. Individuals which have settled down just before the onset of the cold weather may go on developing slowly and be ready to breed the following summer, but many perish.

**Method of dispersal**

It is clear from what has already been said about the larval scales that their actual movements and activity have little to do with the spread and distribution of the pest.

Red scale is spread mainly by the transport of infested trees, fruit and picking boxes. Wind probably spreads the pest within an orchard as crawlers are known to have been blown 400 ft. Crawlers are also carried far afield by attaching themselves to birds and insects.

**Host plants**

There is no complete list of host plants in Western Australia, but the fact that, in South Africa, no less than 200 plants have been listed as carrying the scale shows that citrus are by no means the only species attacked.

Locally, in addition to all types of citrus it has been recorded on figs, mulberries, roses, apples, plums, vines, nectarines, pears, white cedar, castor oil and zamia palms. Although it is of little economic importance on trees other than citrus, these alternative hosts must be considered when sources of infestation or carry-over in an orchard are being investigated.
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Type of injury

Red scale attacks all parts of the tree—leaves, fruit, twigs and branches. It may become so thick as to form an incrustation of over-lapping scales.

It is the only common citrus scale in the State which actually infests the fruit and consequently it may be easily recognised on this account. Another characteristic is the yellow discolouration which may be seen around the feeding puncture, either on leaves or green fruits. Even when the scale has been rubbed off, this evidence of its presence persists for some time.

The first indication of the adverse effects of the scale is a yellowing and then a dropping of leaves. In bad infestations, the twigs and young branches may die back, to be followed finally by death of the whole tree.

Unlike the black and soft brown scale, the red scale does not secrete honey dew and so the unsightly accumulation of black sooty mould associated with these varieties is absent.

Biological control

Exhaustive efforts have been made in many parts of the world to obtain effective parasites and predators of the red scale.

The small yellow wasp Aphytis chrysomphali (Mercet.), is widely established in some areas and plays a part in controlling scale. This insect was introduced into Western Australia in 1905 and became successfully established in the Chittering area.

In 1943 a second wasp parasite, Comperiella bifasciata (How.), was introduced. This has been periodically recaptured from the field but its actual effectiveness in controlling scale has not been assessed.

In 1960 a further parasite introduction programme was commenced by the Department of Agriculture and a range of insects was obtained from various parts of the world through the Commonwealth Institute of Biological Control.

The following insects have been liberated in the Darling Range, Gosnells, and Chittering districts: Prospaltella perniciosi Tower. Aphytis linganensis Comp. Aphytis melinus DeBach. Aphytis diaspidis How.

Although some recoveries have been made it will take many years to determine whether these will survive and exert any influence on the scale population.

Where biological control is exerting an influence on scale population the indiscriminate use of the organic phosphate and oil mixtures can lead to an increase in scale populations. The citrus red scale parasites can survive the white oil sprays but not the toxic organo-phosphate mixtures.

A common practice in some parts of the world where biological control exerts a partial reduction of the citrus red scale population, is to spray alternate strips of the orchard. The unsprayed trees enable

Unsprayed tops of trees can be an important source of re-infestation. Here a tower attached to the spray unit is used to ensure thorough spraying of tops of tall trees.
parasite populations to build up and spread at a later date to the sprayed trees, which are left unsprayed in the following season.

In this way scale population is kept down chemically and the parasites are able to survive.

A further development of this technique for Western Australia, where parasite populations are an unknown factor, would be to spray the alternate strips with the white oil sprays instead of leaving them unsprayed. The orchard would then have alternate strips of white oil sprayed trees and organophosphate-oil mixture sprayed trees. This would be reversed in the next season.

Where a satisfactory control of scale is achieved with white oil sprays it is most likely that there is some influence being exerted by a parasite. On NO ACCOUNT should an organophosphate mixture be substituted over the whole of the orchard where this is the case.

**Spraying techniques**

In citrus red scale control it is necessary to obtain adequate coverage of both foliage and wood. With a large tree this can be both a difficult and costly operation if adequate spray machinery is not available.

To spray citrus trees, which may be about 20 ft. high, it is necessary to employ high pressure equipment. Machines capable of operating at 500 lb. per square inch and delivering 10 to 15 gallons per minute are desirable.

Examples of this type of machine are the three-cylinder Kent Orchard Sprayer, and the four-cylinder Ronaldson Tippet Sprayer.

A certain economy of spray material is achieved with these machines because the operator can be confident that complete penetration has taken place in the few seconds that the machine is operated in one position. Although the output is high, there is none of the waste that is common when using low pressure equipment, brought about by the overspraying of lower portions when attempting to reach the high areas.

However, it is possible to adequately cover large trees with low pressure (150 to 200 lb. per sq. inch) equipment, provided a spray tower is used and sufficient attention is paid to the inside of the tree. The apron should be pruned up from the ground to facilitate access to the inner parts of the tree.

A large citrus tree yielding 15 bushels of fruit may require from eight to 10 gallons of spray material to achieve satisfactory scale control.

Concentrate type spray machines are not recommended.
RECOMMENDATIONS FOR CONTROL OF CITRUS RED SCALE

White Oil

The mixture is widely used throughout the State and consists of one part of oil to 40 parts of water applied in late summer. It is more effective to apply two sprays to coincide with the emergence of the young crawlers. If this double spray technique is used the concentration of oil may be reduced to one in 80.

Organophosphate Mixtures

Where white oil does not give adequate scale control the following mixtures may be used to advantage if timed to coincide with crawler emergence.

1. Rogor Wettable Powder 25 per cent.: 2 lb. per 100 gallons, plus 1½ gallons of superior summer oil, plus 2 oz. of wetting agent.

2. Azinphos Wettable Powder 25 per cent.: 2 lb. per 100 gallons, plus 1½ gallons of superior summer oil, plus 2 oz. of wetting agent. This mixture will also control both the soft brown and the black olive scale. This mixture will control the brown snail in citrus orchards.

3. Trithion Wettable Powder 30 per cent.: 1½ lb. per 100 gallons, plus 1½ gallons of superior summer oil, plus 2 oz. of wetting agent.

4. Malathion Wettable Powder 25 per cent.: 2 lb. per 100 gallons, plus superior summer spraying oil, plus 2 oz. of wetting agent.

5. Ethion Wettable Powder 25 per cent.: 2 lb. per 100 gallons, plus 1½ gallons of superior summer oil, plus 2 oz. of wetting agent.

Mixing Instructions

1. Do not use salty water.
2. Add oil to spray vat.
   (a) Superior type direct to vat.
   (b) White oil—dilute with water first to form a smooth slurry.
   (c) Use superior oil rather than white oil. White oil may increase risk of damage and spray residues.
3. Fill vat with water, keeping mixture thoroughly agitated.
4. Form a thin slurry with the organic phosphate and water in a bucket. Add 2 oz. of wetting agent.
5. Add slurry to fully diluted oil in spray vat with agitator working.
6. Other pesticides must not be added.

Time of Application

Sprays should be applied to coincide with the emergence of the young crawling stage from beneath the parent scale. This will vary from district to district but should be in late November or early December and again in late February or early March. Both sprays are necessary to achieve control of citrus red scale.

Method of Application

High volume high pressure equipment and thorough wetting of both sides of the leaves and the wood are necessary. A large tree may require up to 10 gallons of spray. A spray tower may be needed. Concentrate equipment is not recommended.

Warning

Organophosphate materials should be handled with care and manufacturers' safety precautions closely followed.
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