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Control of San Jose scale

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With an export rejection rate in excess of 10,000 cases per year, the apple industry in W.A. is continually confronted with the problem of San José Scale control.

The San José scale, *Quadraspidiotus perniciosis* (Comst.), was originally introduced from China to America about 1870. It was first described from this country and was thus given an American name.

As late as 1926 it was described as the most destructive fruit pest in several States of the U.S.A. and was one of the causes for rapid development of spray machinery.

The transport of infested nursery stock over long distances has made this pest almost universal in distribution. However, a few European countries have escaped infestation and these have placed strict quarantine barriers against the entry of San José infested fruit.

As a result of this the control of scale has become a first priority in orchard practice.

**DESCRIPTION**

The San José scale attacks all parts of the tree, including the fruit, as well as the bark from the base of the tree to the terminal twigs.

On the bark the female scale is the one usually seen, and is grey and circular in appearance, with a central raised nipple which may be of a lighter or darker nature than the surrounding area.

The size of the scales will vary due to the presence of several generations at different stages of development, the mature female being about 1/10th of an inch in diameter. Smaller, elongate male scales are occasionally interspersed with the females.

The scale is readily detached to show a small shield-shaped, legless insect attached to the underlying plant tissue. In texture and colour this looks rather like a minute piece of lemon fruit tissue. The long thread-like mouthparts which are embedded in the plant tissue, are sometimes seen when the scale is removed, but usually they are severed when the insect body is moved.

The male insect, on development, is a free-living winged form, and exhibits thread-like plumes which form a tail characteristic of many scale insects.

They are very weak intermittent fliers. When jarred from their host material, they fly to the ground in a descending spiral course. Walking is the chief form of locomotion.
Die-back on a peach tree, caused by a severe infestation of San José scale. Often certain limbs become infested and die before the whole tree is affected, as happened in this case. Any die-back should be carefully examined for the presence of San José scale.

**HOST PLANTS**

San José scale has been listed from some 700 host plants. The most commonly-infested trees are apple, pear, peach, plum, nectarine and cherry. However, almost all deciduous trees and shrubs may be hosts at some time or another and should always be sprayed, if adjoining an orchard property. Rose bushes and pussy willow have been found bearing San José scale in local areas.

**INJURY TO HOSTS**

San José scale occurs on all surface parts of the host from ground level to the tips of the shoots. The scales may occur in large numbers under the loose bark butts of trees, in which situation they are well protected from the external environment and spray materials. Ascending crawlers may disperse from these areas and invade suitable wood during the spring and early summer. Where trees are heavily infested the infestation may easily be overlooked, as the entire bark surface may be covered with the scurfy layer, which superficially resembles the natural bark. Up to 100 scales a square inch have been counted from locally infested trees. Heavily infested trees shed their leaves and gradually die. More often, certain limbs become infested and die before the whole tree is affected.

This death process has been observed in the Roleystone area on peach trees, and follows a definite pattern. The leaves turn a lighter colour and are shed, this quite often being followed by cracks in the bark which exude large masses of gum. A secondary fungal infection may follow. Any die-back in an orchard should be carefully examined for the presence of San José scale.

Following the successful eradication of scale from the heavily infested tree or limb, the branches and buds may be weakened to the extent that no fruit is borne for a season or two. Where crawlers settle on fruits to mature, a characteristic halo-like red discoloration rapidly appears. This red ring remains in evidence after the scale has been removed and is a telltale sign of the scale's presence at one time or another. The calyx and stem cavities of apples and pears are preferred by the scale.

A reddish discoloration is also seen occasionally on the tender Yates and peach wood. Where suspected scale is seen, removal of the outer layers of bark, in these two varieties, will show a bright red discoloration of underlying plant tissue.

The normal orchard practice of dormant spraying keeps San José scale to such low
Various stages of San José Scale, all enlarged about 15 times. A—Adult female scale with immature young of various stages settles around and upon her; B—An adult female scale turned over revealing the insect herself with the bristle-like mouth-parts exposed; C—An adult male scale with two immature winter-stage scales; D—Young crawlers soon after birth.

Levels of population that no damage is suffered by trees.

However, due to the stringent quarantine regulations of some overseas countries the presence of a single scale is sufficient to cause the rejection of an export line.

**LIFE CYCLE**

The scale normally seen on the tree is the female scale.

This gives rise to living young, known as crawlers, which lead an active life, having well-developed legs and antennae. Microscopic examination of locally-collected mature female has shown up to 20 developing embryos within the parent body.

The liberation of the young may occur for some weeks, during which period large numbers of crawlers are liberated. Accurate figures have not been determined locally but an American worker, Marlatt (1906) placed the average figure at approximately 400 in U.S.A., while Ludicke (1950) found that from 50 to 200 crawlers were produced per female in Germany.

The young spend some time under the parent scale before assuming a free life.

Under local conditions crawlers have been traced from the butt of peach trees to the upper limbs, a distance of some six feet. The distance travelled is no doubt influenced to a large degree by the nature of the surface and temperature and humidity of the day.

Many crawlers however will settle in the immediate vicinity of the parent, or beneath the parent scale.

The free life may last up to two days but most crawlers become attached in a much shorter time.

A loose protective wax-like scale has been observed in local orchards, to be deposited within 24 hours from birth. At this stage the legs and antennae are folded beneath the body.

The scale gradually becomes darker and after two to three weeks becomes black, at which stage it is known as the black-capped stage. A moult occurs at this stage and the body appendages are shed.

This first stage nymph has a uniform dark scale without irregularities, and this is the main overwintering stage in West Australian orchards.

The first stage nymph undergoes a second moult before reaching maturity. The total life cycle occupies about six weeks from crawler to adult in peak summer conditions in Western Australia.

Under local conditions the overwintering stages were found to be females containing partially-developed embryos, as well as first stage nymphs formed from the last summer generation.

These females liberate crawlers in mid to late October.

The overwintering first stage nymphs begin rapid development with the onset of the warm weather and reach maturity in December.

The October crawlers also mature during December, thus giving two overlapping generations which give rise to the economic menace.

It appears that four generations occur during the summer months with gravid
females from the fourth generation overwintering, as well as first stage nymphs from an abbreviated fifth generation.

The males are free living winged forms and developed beneath a scale in the same way as the female scales.

When fully developed the male emerges from the scale covering and assumes a free life. The males mate with the fully-developed female scales.

DISPERAL
San José has become almost universally distributed by the shipment of infected nursery stock and fruit.

Distribution in local areas by free movement of insects is limited, by the very short free-living stage, and its rudimentary locomotion. Adjoining trees may infect one another where branches touch.

There is no doubt that the main methods of dispersal within orchards and neighbouring localities are wind, birds, insects and orchard workers.

CONTROL RECOMMENDATIONS
Apples and Pears
Dormant Spraying—
With the advent of the superior dormant spraying oils dormant spraying can be carried out closer to budburst than was formerly possible.

A delayed dormant spray should be applied during September.

A thorough application of spray to all parts of the tree should be made. Before spraying, the butts should be cleaned of debris and loose bark.

The recommended spray mixture is:
Superior Dormant Oil.—3 gal. per 100 gal. water.
Gusathion Wettable Powder:—2 lb. per 100 gal. water.

The gusathion wettable powder should be pre-mixed with a small quantity of water before it is added to the spray vat.

The pre-mixed gusathion must be kept separate from the undiluted superior oil, as the combination of concentrate materials may cause a chemical breakdown of the emulsion. It is best to add the oil to the spray vat after the full quantity of water has been added.

Spring Looper Spray—
The use of gusathion and superior summer spraying oil for apple looper control will also exert a degree of control over San José scale.

This spray should contain:
Superior Summer Spraying Oil.—1½ gal. per 100 gal. water.
Gusathion 25 per cent. Wettable Powder:—2 lb. per 100 gal. water.

Summer Sprays—
When the dormant spray is followed by the looper spray the need for summer sprays is not very high.

However, in bad infestations summer sprays can be used to advantage. These are composed of superior summer spraying oil and gusathion.

The application times vary from district to district and from year to year. These sprays are most effective when they coincide with the release of crawlers from the parent scale. As a guide, depending on the severity of the infestation, the following times are suggested:
Late November to early December.
Mid-January.
Late February.

The spray materials are used at the same concentrations as for the looper spray.

The application of summer sprays after December 31 should be carried out with care and should not be done while the trees are under moisture stress.

Concentrate sprayers are not recommended for San José scale control and particularly so where there has been any build-up. Similarly, Edgehill pistols are not recommended on conventional plants. The Roseberry double type nozzles are satisfactory.

Apple Curculio Spray—
In areas requiring a treatment for apple curculio, the addition of spraying oil will give an added effect against San José scale. As this spray is a butt treatment of 0.5 per cent. dieldrin the oil may be either superior dormant or superior summer spraying oil.
Post Harvest Spraying—
Following the discovery of scale during picking, spraying can be successfully carried out in the following weeks.
Any trees from which scale marked fruit has been picked should be marked.
The normal dormant oil and gusathion sprays may be used, or parathion and oil may be used if adequate precautions are taken.

Stone Fruits
Dormant Spray—
Apply superior oil and gusathion before budburst as recommended for apples and pears.

Summer Spray—
As for apples.

NOTE.—Parathion is a highly dangerous material and all safety precautions recommended by the manufacturers should be carefully followed. Application of parathion should not be made within four weeks of harvesting. When using gusathion the precautions prescribed for the use of organic insecticides must be observed. Concentrate should not be allowed to come in contact with the skin and protective clothing must be worn at all times while spraying.

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