San Jose Scale

*Quadraspideiotus perniciosus*

by Michael E. Reding and Diane G. Alston

Do You Know?

- San Jose scale is a sporadic pest in well maintained commercial fruit orchards. Severe infestations can kill limbs, cause deformed and poor colored fruit, reduce yields, and eventually kill the tree.
- Adult and immature scales feed on limbs, fruit, and leaves by sucking tree sap.
- Monitor fruit during picking and packing (check cull bins) and tree limbs during pruning for signs of scale and their injury.
- The first opportunity for control is during the delayed dormant period. Apply a superior oil plus insecticide.
- If a summer spray is necessary, there is a degree-day model that can be used to time sprays, which should target the crawler stage. The crawler stage is the most vulnerable to control treatments.

San Jose scale occurs in almost all fruit growing districts of the United States, but in well maintained orchards populations are generally too low to cause damage. Infested backyard trees, wild trees, and poorly cared for orchards can be sources of infestation for commercial orchards. Severe infestations of scale can cause tree and fruit injury. Scale is primarily a problem on large, older trees where it is difficult to achieve good spray coverage. The scale is easiest to detect on fruit, leaves, and one-year-old wood. A delayed dormant spray targeted to control overwintering scale can dramatically reduce pest incidence.

San Jose scale is a tiny, unusual insect that spends most of its lifetime attached to a tree where it sucks plant juices. This pest attacks limbs, fruits, and leaves. The male is the only stage that flies, while the young and females remain on the tree. Although it is not a very mobile insect, populations on a tree can reach high numbers within a season. A single female and her offspring can produce several thousand scales in one season. The San Jose scale generally has two generations per year in Colorado, Idaho and northern Utah, but can have as many as three in warmer areas such as Arizona and southern Utah. If left uncontrolled, scale can make fruit unmarketable and even kill the tree.

**Hosts**

- apple
- pear
- cherry
- peach
- apricot
- plum
- nut trees
- berries
- ornamental trees and shrubs
**Life History**

**San Jose Scale Life History**

<table>
<thead>
<tr>
<th>Nymphs</th>
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<td>Crawlers (Mobile nymphs)</td>
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<td>Monitoring time PK</td>
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(Males are winged and fly, females are immobile scales on the tree)

**Black Cap Nymph—Overwintering Stage**

- **Size, shape, and color:** less than 1/25 inch in diameter; protective scale covering is circular with no legs; black bands surround a lighter cap
- **Where:** on tree bark
- **When:** development resumes when spring temperatures exceed 51°F
- Survival of black cap nymphs is greater following mild winters
- The scale’s covering grows in diameter as the insect becomes larger
- It passes through several molts while maturing
- Final molt occurs 3–4 weeks later
- Male scales pass through two non-feeding stages before the final molt to the adult stage

**Adult**

**Female—Damaging Stage**

- **Size, color, and shape:** scale covering is about the size of a pinhead; gray, circular, and slightly raised; it often has a ringed appearance from molting; females can reach 1/12 inch in diameter; the soft body underneath is yellow with no wings or legs
- **Where:** female stays under scale covering for the remainder of her lifetime
- Releases a sex pheromone to attract males for mating
- Each female produces several hundred live crawlers over a 6-week period

**Male—Winged and Monitoring Stage**

- **Size, color, and shape:** about 1/25 inch long; body is gold with a dark band across the back; has wings and long antennae
- **Where:** males emerge from their nymphal scale covering to fly for a few days and mate with females
- **When:** first flight often occurs during apple bloom in late April to early May

*Note: There is no visible egg stage.*

**Nymph—Damaging Stage**

- Female scales produce live young that emerge from under her protective covering
- There are several molts per stage: crawler, white cap, and black cap

**Crawler—Mobile and Monitoring Stage**

- **Size, color, and shape:** about 1/100 inch long and 1/250 inch wide, bright yellow, and oval
- **Where:** after exiting the female scale’s cover, the nymph walks or is carried by air currents, farm machinery, or other means to a new site on the bark, fruit, or leaves of a tree
- **When:** emergence of first generation crawlers generally occurs about 4 to 6 weeks after bloom (early June) and crawlers may be produced continuously until early August
- Within a few hours after emerging, a crawler will settle, tuck in its legs and antennae, and insert its long bristled mouthpart into the host to begin feeding on the tree’s sap
- Scale crawlers resemble larval spider mites except that mites do not have antennae; also resemble first instar pear psylla but lack the red eyes of psylla nymphs

**White Cap Nymph**

- As a nymph feeds, it secretes a white waxy scale covering

**Black Cap Nymph**

- The waxy covering turns from white to black and then to gray as the scale goes through several molts before maturing
- Generations overlap and all stages can be found on the tree at the same time during summer

**Host Injury**

- San Jose scale that occur on twigs and stems can cause an overall decline in tree vigor, growth, and productivity. Severe infestations can kill twigs, limbs, and even the entire tree if not controlled.
- Feeding on fruit causes a slight depression and a red to purple spot around the feeding site and can decrease the cosmetic quality of the crop. Light infestations on fruit are usually concentrated at the calyx end.
- Early season fruit infestations may result in small, deformed, and poorly colored fruit.

**Timing Control**

**Dormancy**

Usually the first indication that San Jose scale has infested an orchard is finding a small number of infested fruit and injury during harvest or packing, or finding infested tree limbs. If a scale infestation is detected:
Scout the orchard during dormancy to determine the level of infestation. Infestations can be detected during pruning.

Look for trees that have retained their leaves during winter as this is a good indication of scale infested twigs or limbs. Remember that scale infestations are rarely distributed evenly in a tree or throughout an orchard.

Carefully check the tops of trees and around tree trunks as scale populations often build up there first.

Flag infested trees or areas in an orchard to ensure that control sprays are targeted for these problem spots.

**Spring and Summer**

The first flight of males can be monitored with pheromone traps in spring. However, because male scales are weak fliers and because erratic spring weather can greatly influence their activity, the efficiency of pheromone traps can be highly variable. Monitoring the crawler stage with sticky tape may be easier and more reliable. If pheromone traps are used, determine biofix using a degree-day model to predict crawler activity and the optimal time for control treatments.

**Pheromone Trap Placement**

- Tent-style pheromone traps can be used to monitor adult male activity.
- Traps are baited with the female sex pheromone; lures are effective for 4 to 6 weeks.
- Place traps in orchards at the pink stage of apple fruit-bud development (see Table 1).
- Position traps on the northern or eastern side of the tree at a height of 6 to 7 feet.
- Use at least three or four traps, regardless of orchard size.
- Check traps every 1 to 2 days until the first male scale is caught.

**Male Identification**

- Use a hand lens to inspect the surface of sticky traps.
- Male scales are tiny (about 1/25 inch long) yellow insects with long antennae and a dark band across the back between the wings.

**Biofix**

- Once the first male is caught, check traps daily. When the first consistent flight occurs (trap catch on two or more consecutive days), the “biofix” is established.
- Monitoring beyond biofix is not necessary unless you want to know general male population densities.

**Degree-day Model**

- After the first male scales have been trapped, begin calculating degree-days (DD) to predict crawler emergence.
- Daily degree-day accumulations can be determined by using daily maximum and minimum temperatures and the degree-day look-up table (see Table 2).
- The lower and upper temperature thresholds for San Jose scale development are 51°F and 90°F.

Because the lower temperature threshold for development is similar to that for codling moth, the codling moth degree-day model can be used to provide an estimate of trapping and management events for San Jose scale.

**Timing Sprays**

- Crawler emergence begins at about 405 DD after biofix (see Table 1).
- Optimum timing for a crawler control spray is 600 to 700 DD after biofix (based on California studies; not validated for Utah).

**Crawler Traps**

- An alternative to using pheromone traps is to wrap two-sided sticky tape around tree limbs where San Jose scale infestations have been detected.
- Sticky tape can be a more effective monitoring method than pheromone traps.
- Crawlers emerging from female scale coverings and migrating to new feeding sites will be caught on sticky tape.
- Tape should be checked frequently, beginning about 4 to 6 weeks after bloom, for the presence of crawlers.
- Optimum timing for a crawler control spray using sticky tape is 200 to 300 DD after the first crawlers are trapped (based on California recommendations; not validated for Utah). (See Table 1.)
- Crawler activity can also be monitored by periodically checking new shoot growth in infested trees. Crawlers will be concentrated on new growth.

**Management**

The best approach to managing San Jose scale is to prevent infestations from becoming established and spreading. One of the best ways to do this is to apply horticultural oil plus an insecticide at the delayed dormant timing. This treatment is more effective at preventing scales from becoming established in orchards than late spring or summer treatments. However, late spring treatments that target the crawlers can prevent infestations of the fruit. Closely monitoring for signs of scale and injury on harvested fruit during picking or in the packing shed or on tree limbs during pruning can help identify scale infestations before they become a major problem. It is also important to examine young trees not receiving a full spray program. Controlling infestations in the early stages will not only protect tree vigor but will prevent infestations from spreading to other trees in the orchard.

**Insecticides**

**Dormancy**

Use of a delayed dormant spray targeting overwintering scale is the best approach once a scale infestation has been
identified.

Recommended chemicals:
- Superior type oil alone*
  - or +
    - methidathion (Supracide)*
    - or
    - chlorpyrifos (Lorsban)*

*Oil alone is not as effective as in combination with an
insecticide, but can be used to maintain an organic or low-
spray program.
*EC and liquid formulations are recommended with oil
*Not on apricots

**Spring and Summer**

If scale infestations are severe enough to warrant further
clean up, insecticide sprays may also be timed with crawler
activity based on male catch in pheromone traps or crawler
catch on sticky tape (see Timing Control section).

Recommended chemicals:
- chlorpyrifos (Lorsban)*
- diazinon (Diazinon)

*On apple, pear and sour cherry only.

Note: Check preharvest interval and registered crops before
using any of these chemicals.

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**Table 1. Major events in San Jose scale management. Timing of events are based on degree-day accumulations.**

<table>
<thead>
<tr>
<th>Degree Days (DD)</th>
<th>Management Event</th>
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<tr>
<td>If San Jose Scale was present the previous season:</td>
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<tr>
<td><strong>Dormant</strong></td>
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<tr>
<td><strong>Spring and Summer</strong></td>
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</table>
| 215 DD (approx. pink stage of apple)  
  (beginning January or March*) | Apply a delayed dormant spray (oil + insecticide). |
| 275 DD  
  (beginning January or March*) | Place pheromone traps in orchard. |
| 0 DD (biofix)*  
  405 DD (after biofix)  
  600–700 DD (after biofix)  
  or  
  200–300 DD (after first crawlers are trapped on sticky tape) | First males expected. Check traps every 1–2 days until biofix is determined.  
First consistent male catch. Reset DD to 0.  
First crawlers expected. Place sticky tape if trapping for crawlers.  
Apply spray targeting control of crawlers. |

* Begin accumulating degree days after daily temperatures begin to exceed 51°F, typically on January 1 for Arizona and southern Utah or March 1 for Colorado, Idaho, and northern Utah.
* Biofix has occurred when at least one male is captured in a pheromone trap on two or more consecutive nights.

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**Biological Control**

There are a number of predators and parasites that attack
San Jose scale. Certain lady beetles and wasps are
documented natural enemies of San Jose scale in California.
These predators and parasites may help reduce scale
populations in Utah, but generally they do not provide
enough control to prevent damage when scale populations
are high. Natural biological control is only considered a
supplement to chemical control. Keep in mind that using
insecticides during the growing season can disrupt the
biological control of many orchard pests, including the scale.

**Pruning**

Good pruning practices can help reduce scale problems.
Pruning out infested limbs and water sprouts can help reduce
spring and summer scale populations as well as open up the
canopy to allow better spray coverage in tree tops where
scales are often concentrated.