Preventing Walnut scale and Botryosphaeria canker and blight

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Botryosphaeria canker and blight, known simply as Bot, has been on the increase in walnut orchards statewide over the last several years. Growers have been noticing this disease in the form of blighted spurs, shoots, and branches on their walnut trees and brown to black nuts appearing around harvest time (Photo 1). Over the last decade, we also started noticing in Sacramento Valley walnut orchards increased incidences of scale (mainly walnut scale).

Often, but not always, where we saw scale problems, we also found Bot canker. In 2013, U.C. Plant Pathologist Themis Michailides confirmed that scale insects can increase Bot infection and canker development. Because of this association, we recommend controlling scale insects to help reduce Bot in orchards. In this article presented in two parts, a 2014 walnut scale insecticide study and 2014 research updates and fungicide trials to manage Bot canker and blight are summarized and trial procedures are listed for those wanting more details.

Part 1: Walnut Scale

Although there are several scale species found in walnut orchards, walnut scale (Quadraspidiotus juglansregiae) is the most common. It is found in crusted layers on trunks, scaffolds, and older branches in high populations. It is an armored scale (the cover is separate from the body) and completes two generations per year. When mature, walnut scale appears to have a ‘daisy’ shape which results from male crawlers that form elongated covers, settling under the margin of the female cover.

Before dying, walnut scale females lay eggs underneath the protective cover. These eggs hatch into an immature insect known as a ‘crawler’ which is very small, yellow, and mobile. The young crawlers move around the branches before selecting a new feeding location, settling down, secreting a protective waxy cover, and remaining sedentary for the remainder of their lives. Crawlers are usually active in May with another generation in late summer/early fall. Look for scale on prunings and the trunk during the winter. To monitor crawler emergence, use double-sided sticky tape applied to limbs in April through June for the first generation. For more information on scale insects and photographs see http://cesutter.ucanr.edu/newsletters/Sacramento_Valley_Walnut_News52111.pdf

Walnut Scale Insecticide Trial Results Summary:

Spring/Early June 2014:

- Centaur 70WDG applied post delayed dormant provided excellent control (Fig. 1 top). It had significantly lower walnut scale than all materials applied at crawler timing and lower scale than Seize 35WP, the standard delayed dormant material, which provided acceptable control.
- Assail 30SG (high rate), Centaur 70WDG, and Brigadier 2EC applied at crawler timing provided acceptable control.
- Assail 30WG at the low rate, Movento 2SC, and Sequoia 2SC were not significantly different from the untreated control.

January 2015 Follow-up:

- Centaur 70WDG and Seize 35WP (delayed dormant application) and Movento 2SC, Centaur 70WDG, and Brigadier 2EC (crawler application) provided excellent long-term walnut scale control at eight months after application (Fig. 1 bottom).
- Sequoia 2SC and Assail 30SG at the high and low rate were not significantly different from the untreated check.

Trial Procedures: The insecticide trial was monitored and sprayed in spring 2014 in a Yuba County ‘Vina’ orchard infested with walnut scale. There were nine treatments (Table 1) replicated four times using single tree replicates. Two limbs per replicate were wrapped with double-sided sticky tape March 25, 2014. First crawlers were caught on April 23.
Depending on the material, spray timing is either at delayed dormant (typically March) or after crawlers have emerged (typically May). Our delayed dormant treatments were the insect growth regulators (IGRs) Seize 35WP and Centaur 70 applied on April 8 (delayed due to rain). Treatments targeting crawlers were sprayed on May 6 at early crawler emergence. Sprays were applied using a hand held orchard sprayer at about 200 gal/acre. Good spray coverage is very important when applying IGR insecticides. Walnut scale crawlers per cm of sticky tape were counted weekly from May 5 to June 2 in a lab.

To determine possible delayed effects from the insecticides, in January 2015, small lateral branch sections were sampled per tree. The number of live overwintering second instar and adult female walnut scale were counted under magnification.

Table 1.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate Form/ac.</th>
<th>Date sprayed</th>
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<tbody>
<tr>
<td>Movento 2SC</td>
<td>9.0 fl. oz</td>
<td>6 May</td>
</tr>
<tr>
<td>Assail 30SG</td>
<td>9.6 oz</td>
<td>6 May</td>
</tr>
<tr>
<td>Assail 30SG</td>
<td>5.3 oz</td>
<td>6 May</td>
</tr>
<tr>
<td>Brigadier 2EC</td>
<td>12.8 fl. oz</td>
<td>6 May</td>
</tr>
<tr>
<td>Sequoia 2SC</td>
<td>5.75 fl. oz</td>
<td>6 May</td>
</tr>
<tr>
<td>Seize 35WP (delayed dormant)</td>
<td>5.0 oz</td>
<td>8 April</td>
</tr>
<tr>
<td>Centaur 70 WDG (delayed dormant)</td>
<td>46.0 oz</td>
<td>8 April</td>
</tr>
<tr>
<td>Untreated check</td>
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</tbody>
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*Treatments include 0.25% v/v Latron B-1956

Figure 1. Top: Effects of insecticides on walnut scale crawlers in 2014. Bottom: Effects of insecticides on walnut scale 2nd instar and adult females in January 2015. Dormant = post delayed dormant spray timing; other treatments sprayed at early crawler stage.
Part 2. Botryosphaeria and Phomopsis Canker and Blight
What you need to know to reduce infection and spread of Bot this spring and summer.

Bot Basics - The Pathogens, Infection, and Predisposing Factors

- Bot can infect fruit (nuts), spurs, shoots, and branches.
- Fungi infect the nut, move into the peduncle (nut stem), and then kill the spur and next year’s buds.
- Bot can enter through wounds such as leaf scars (Photo 2), bud scars, and peduncle scars, pruning wounds (Photo 3), blighted fruit and scale infested wounds. Infections will not occur below 50°F.
- Cankers grow slowly when temperatures are low. Above 80°F, cankers grow in 7-10 days.
- Bot fungi can spread by two kinds of spores: 1) sticky spores that spread by water and occasionally insects (pycnidiospores), and 2) spores spread by wind (ascospores). Pycnidiospores are the most common and widespread and they only need 1.5 hours of free water to germinate.
- Fungal inoculum sources on walnut trees include hulls, peduncles, dead buds, dead spurs, petioles, and cankers. Other hosts of Botryosphaeria - other nut crops, cottonwood, blackberry, Eucalypts, willow, etc., - can serve as inoculum sources.

New Research Results in 2014. Immature walnut fruit can be infected by Bot and infections remain latent (no noticeable symptoms), and lead to fruit blight as it matures in August and September. To determine how long pruning wounds remain susceptible to Bot infection, Dr. Michailides inoculated wounds at several intervals up to 28 days in Chandler, Vina, and Tulare. It was surprising that even four weeks after pruning, pruning wounds were still susceptible to Bot infections and canker development was the same as in the earlier inoculations. This means there should be at least one month between pruning and a rain event to avoid infection.

2014 Fungicide Trial Results Summary:

- Most of the treatments applied in mid-May, mid-June, and mid-July were effective in reducing Bot infections and cankered spurs (Fig. 3) and black or brown kernels (Fig. 4 & Photo 4). There was no clear benefit to adding a postharvest spray to the May+June+July treatment in the Colusa trial (Fig 3) or the bloom or postharvest spray in Sutter Chandler trial (data not shown).
- In the Howard orchard, sprays at bloom only, postharvest only, or bloom plus postharvest did not reduce disease significantly from the check (data not shown). Based on 2014 results, we do not recommend bloom or postharvest sprays alone.
- Other fungicides tested in Butte County trials in addition to those listed in table 2 that were effective included K Phite 7LP, Quash, Ph-D, Ph-D + Tebucon, Quilt Xcel, Pristine, Abound, Gem, Luna Sensation, and Manzate. (see 2014 Walnut Research Reports for the efficacy data).
- The fungicides applied in 2014 in Butte County also reduced blighted spurs and Bot infected buds collected in February 2015.

Bot Management - Main Points

Because of the large size of walnut trees and fruitwood distribution, we recommend both cultural and chemical controls.

- Avoid sprinkler irrigation that wets the canopy and also spreads the disease.
- Control scale insects.
- Prune dead branches back to healthy green wood during the summer or immediately following harvest allowing at least one month before heavy rains can spread inoculum to susceptible pruning cuts.
- Removing infected wood from the orchard floor can reduce the inoculum load and is mainly important in orchards with light-to-medium Bot infection.
- Apply a fungicide spray mid-May, mid-June, and mid-July to reduce Bot infections.
**Trial Procedures:** There were five replicated fungicide trials, one each in Butte and Colusa Counties (both Chandler), and three in Sutter County (two Chandler and one Howard). Table 2 lists the fungicides and rates used in the Colusa and Sutter County trials. Using a spray volume of 100 gal/acre, applications were made using airblast sprayers except in Butte County where a hand gun sprayer was used. Nut data was taken at harvest after shaking and spur/shoot infection data on November 13 (Colusa) or December 9, 2014 (Sutter). Treatments were applied in mid-May, mid-June and mid-July except in Howard trial. A post-harvest spray was also applied at the Colusa County site and post-harvest and bloom sprays at one Sutter County site. (All photos by Themis Michailides.)

Photo 1. Blighted fruit caused by Bot showing pycnidia taken on September 3, 2014.

Photo 2. Leaf scar infection taken in fall 2014.

Photo 3. Pruning wound infection covered by pycnidia.

Photo 4. Bot infected kernels: top row black, middle row brown, and third row, mycelia of the fungus present but kernels are not infected.

<table>
<thead>
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<th>Fungicide</th>
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<tr>
<td>Merivon</td>
<td>6.5 fl oz</td>
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<tr>
<td>Luna Experience</td>
<td>10.0 fl oz</td>
</tr>
<tr>
<td>Quadris Top</td>
<td>14.0 fl. oz</td>
</tr>
<tr>
<td>Fontelis + Tebucon</td>
<td>20.0 fl. oz + 8.0 oz</td>
</tr>
<tr>
<td>Untreated check</td>
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</table>
Figure 3. Effects of fungicides on Bot in spurs/shoots. Top: (Colusa Co.); either 3 sprays-May 16, June 16, July 16 or 4 sprays-plus a postharvest (PH) October 15 (harvest Oct. 13); Bottom: (Sutter Co.) 3 sprays-May 15, June 23, July 23.

Figure 4. Effects of fungicides on Bot in black and brown kernels (Colusa Co.) sampled at harvest, October 13, 2014. (1) and (2) represent repeats of the same treatment.