

Walnut Scale: an insidious pest of walnut in California

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Walnut scale (*Quadraspidiotus juglansregiae*) is a common pest of walnut throughout California's Central Valley. Populations of the pest in commercial walnut orchards (Figure 1 A and B) appear to have increased over the past decade, inciting a recent surge of research on the biology and management of walnut scale. University of California researchers have recently monitored crawler emergence patterns in multiple walnut growing regions, thus improving the phenological models utilized in timing insecticide applications. Other studies have focused on evaluation of insecticide chemistries for management of the pest, including softer insecticide chemistries and insect growth regulators (IGRs). Additionally, walnut scale has been found to interact with canker-causing, plant pathogenic fungi in the canopy, thus exacerbating diseases that may further compromise orchard productivity (Figure 1 C, D and E).

Despite its name, walnut scale is not unique to walnut. It is native to North America and has a wide host range including woody shrubs, deciduous plants, and conifers. In California, walnut scale populations sampled from commercial orchards all represent a single species; however, the population composition of walnut scale across other hosts and regions has not been assessed at a genetic level. In California walnut orchards, walnut scale has historically been considered a minor pest. In fact, early studies in the 1970s and 1980s had suggested that the pest was not of economic importance to the crop. In the past decade, the insect has transitioned from an orchard inhabitant to a pest as the effective insecticides for walnut scale control have been cancelled.

The cause(s) of walnut scale's recent emergence as a pest is currently unknown. It is speculated that populations of walnut scale are higher than they were thirty and forty years ago. The interaction of scale with canker fungi, such as *Botryosphaeria* spp., may also be a new relationship for walnut scale. These pathogenic fungi have recently emerged as economic pathogens of walnut despite having been previously endemic in California. Generally, disturbances in natural or agricultural ecosystems may induce changes in the roles of ecosystem inhabitants, such as insects, pathogens, weeds, and other microbes. For example, prior to the introduction of DDT and other similar chemical insecticides for the management of codling moth, scale insects were not considered economic pests of walnut orchards in California. Utilization of these insecticides disrupted natural enemies (Figure 1F) of several scale species, resulting in a disruption in the orchard ecosystem and necessitating management of scale populations.

Walnut Scale and Botryosphaeriaceae. Walnut scale predisposes trees to infection by *Botryosphaeriaceae* fungi both directly and indirectly. A direct association between scale and fungal infection is observed when the scale body is lifted from the shoot to reveal a developing canker (Figure 1D). In this direct interaction between the scale and the pathogen, the feeding activity of the insect likely created an infection court (mode of entry) for

the pathogen to infect and colonize the branch (Figure 1E). Infestation of twigs by walnut scale also predisposes new growth to infection and disease development. In this indirect interaction between the insect and the pathogen, the canker develops on plant tissue that remains uncolonized by the insect (Figure 1C). Research studies with three different pathogens in the *Botryosphaeriaceae* family suggest that disease levels are 60-70% higher on branches colonized by scale than on uncolonized branches.

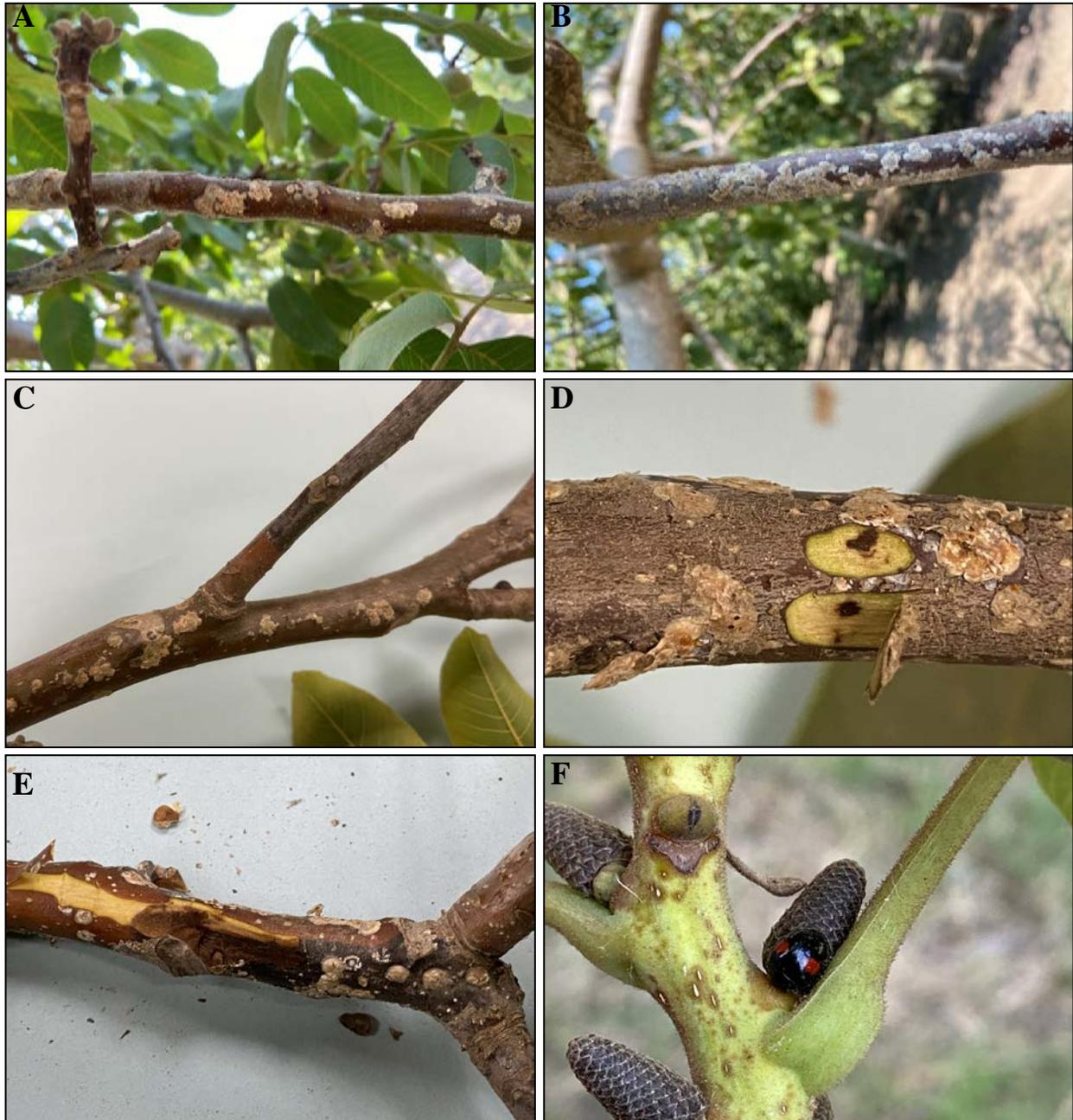
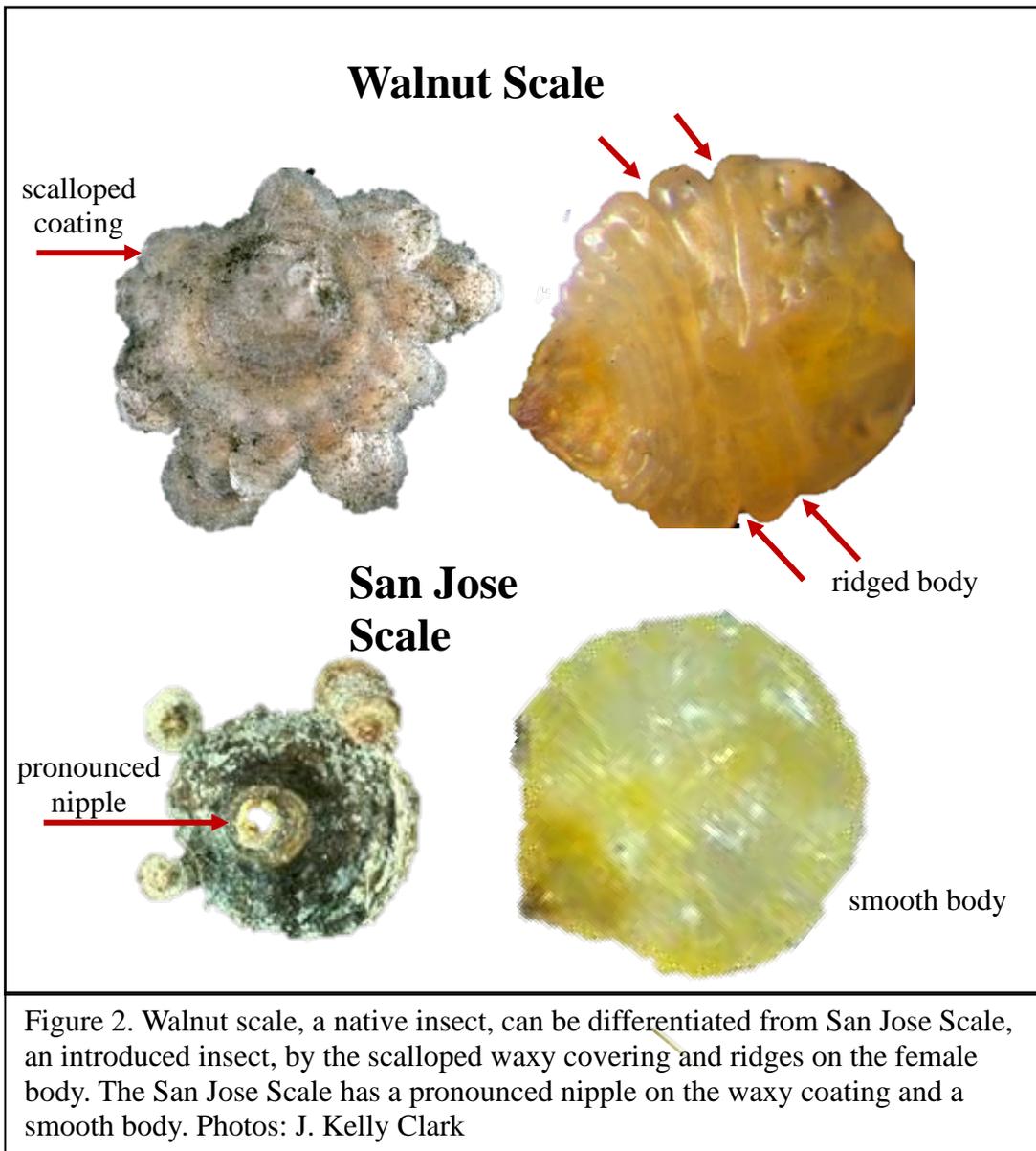


Figure 1. Walnut scale populations vary and may be low (A) or high (B) on given branches. Scale on a prior year's growth may predispose new growth to disease (C). Scale may also provide an infection court, facilitating infection by canker fungi (D). Once infected, fungal pathogens can colonize branches (E). The twice-stabbed lady beetle is a natural enemy of walnut scale found in California orchards (F).



Walnut Scale Identification. Walnut scale is an armored scale with a scalloped waxy coating (Figure 2). The adult female scale is revealed by lifting the waxy coating. The body of the adult female walnut scale can be differentiated from that of the San Jose Scale (a non-native armored scale) by the ridges on the body. Conversely, the adult female San Jose Scale has a smooth body and a pronounced nipple on the coating (Figure 2).

Walnut Scale Lifecycle. Walnut scale nymphs overwinter in orchards and metamorphose to the adult stage in spring. The females remain non-motile, but the adult male is winged and able to fly. After mating, the females lay eggs and the eggs hatch in two to three days and then the crawlers emerge. Crawler emergence is in late April to mid-May in California, depending on the climate and location. For example, initial crawler emergence has been observed as early as mid-late April in Contra Costa and Tulare County orchards, and as late as early May in Tehama County orchards (Table 1).

Table 1. Phenology of crawler emergence in commercial walnut orchards in California (2015).*				
Site	First Generation (G1) Crawlers		Second Generation (G2) Crawlers	
	Emergence	Peak Activity	Peak Activity	Last Crawler Detected
Tehama 1	4-May	26-May	24-August	28-September
Butte 3	< 3-June	No data	4-September	30-October
Butte 4	< 15-May	No data	12-August	30-October
Yuba 5	5-May	21-May	31-August	> 19-October
Yuba 6	24-April	21-May	31-August	> 19-October
Solano 7	24-April	19-May	8-September	22-September
C. Costa 10	< 22-April	4-May	31-August	> 14-November
C. Costa 11	< 22-April	28-May	24-August	31-August
Tulare 12	< 24-April	14-May	26-August	4-September

*Adapted from Symmes and Lightle, 2015. Walnut Research Reports

Female crawlers move around, allowing the scale to colonize the current season’s shoots. Once a female crawler finds a place to settle and begin feeding, she secretes the scale cover. Male crawlers migrate to the margins of the female cover and settle. Initially the scale cover is white, but it changes to gray or brown in about a week. The female then goes through two instar stages and the male goes through four instars before maturing to the adult and a second generation is initiated in the same season. Second generation crawlers emerge in late July to early August with crawler populations peaking in late August to early September. Second generation crawler activity is generally complete by the end of October; however, at some sites, crawlers may be active into mid-November. These second-generation crawlers will settle and molt before winter.

Detection of Crawler Emergence. To target insecticide applications to the crawler stage, double-sided sticky tape can be wrapped around walnut scale-infested branches in mid-April (Figure 3A). Emerging crawlers stick to the tape as they navigate to find feeding sites. Tapes should be changed weekly and checked under a magnifying glass to observe crawlers (Figure 3B).

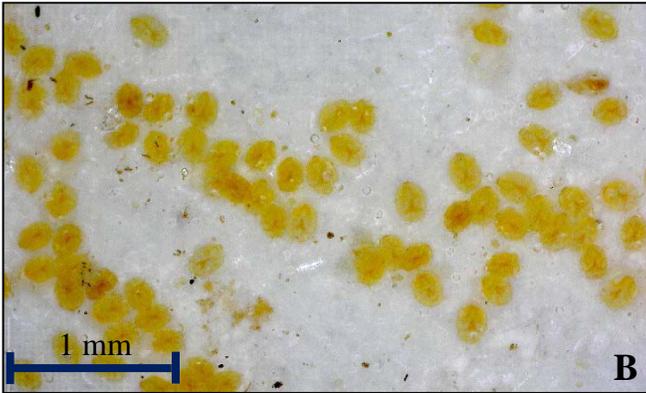


Figure 3. Double-sided sticky tape (A) is wrapped around branches by mid-April to detect crawlers. Crawlers stick to the tape while migrating on the branches and can be seen with a dissecting scope or hand lens (B). Photo A: E. Fichtner. Photo B: E. Symmes

Chemical Control. Walnut scale can be managed with either broad-spectrum insecticides or IGRs. IGRs are a preferable tool for use in an integrated pest management program because they are less disruptive to natural enemies than contact insecticides. IGRs work by disrupting the molting process; therefore, their activity is not realized immediately but rather over time as the insect develops. When applied at the delayed dormant stage (ie. March), IGRs would have the opportunity to inhibit the maturation of the overwintering scale to the adult stage. When applied in late spring (ie. late April-early May), IGRs may impact egg hatch as well as the development of the first-generation nymphs.

IGRs including buprofezin and pyriproxyfen are effective for management of walnut scale. In UC trials, pyriproxyfen was only tested as a delayed dormant application, whereas buprofezin was tested both at the delayed dormant and the crawler stage timings. In season, the delayed dormant buprofezin application was superior to the crawler application for reducing crawler populations; however, applications of the product at either timing yielded similar suppression of scale populations in the subsequent season. Only one IGR application per year should be adequate for management of the pest. Effective monitoring and decision-support can help determine the need to treat on a yearly basis. For more information, on

monitoring visit the Sac Valley Orchards website (<https://www.sacvalleyorchards.com/walnuts/insects-mites-walnuts/walnut-dormant-monitoring-and-treatment-decisions/>).

Products other than IGRs also exhibit efficacy in walnut scale management. In UC trials, acetamiprid (9.6 oz/acre), spirotetramat (9.0 oz/acre), and bifenthrin/imidacloprid (12.8 oz/acre), when applied at the crawler stage, were effective for scale management. The full impact of both spirotetramat and bifenthrin/imidacloprid were not fully realized until the following season.

Summary. Walnut scale has become an insidious pest in walnut orchards. Orchards with high disease pressure caused by fungi in the *Botryosphaeriaceae* family will benefit from both management of walnut scale and pathogens. If populations of the scale are high, or appear to have increased, it may be time to apply an IGR for scale management. IGRs may offer scale suppression over multiple years and often the efficacy of products may not manifest until successive seasons due to the mode of action.

For more information on walnut scale and other pests and diseases of walnut, visit the UC IPM website (ipm.ucdavis.edu). Research reports from studies conducted with support from the California Walnut Board are posted online (walnutresearch.ucdavis.edu). Mention of any chemistries or trade names does not constitute a recommendation and are for informational purposes only. Always consult with your licensed crop consultant and adhere to the pesticide label and local and state regulations. Additionally, check with certifier to determine which products are organically acceptable.

Almond Variety Trial Field Day

May 5, 2022

9:00 AM to 11:00 AM

Meeting location: Avenue 26 and Road 19. There will be a guide to direct you to the trial location, starting at 8:30 AM. The trial is located on private property, please respect our host, and do not attempt to find the trial outside of the event. **Varieties will not be marked until the day of the event.**

Speakers: Tom Gradziel: Almond variety development and selections in the trial

Phoebe Gordon: Results of the almond variety trial through 2021

Water, snacks, & coffee will be provided. RSVPs are appreciated.

Contact: pegordon@ucanr.edu



Walnut Field Meeting

Growth and yield performance of standard and new clonal walnut Paradox rootstocks

Plus...

Hands-on Workshop: How to Use a Pressure Chamber for Irrigation Scheduling

Date: Wednesday June 1, 2022

Location: Lindcove Research and Extension Center, 22963 Carson Ave, Exeter, CA 93221.

Agenda

8:30 -9:00 am: Registration and refreshments

Refreshments courtesy of PMS Instrument Company and PressureBomb Express

9:00 - 10:00 am: Clonal ‘Paradox’ walnut rootstock plot tour

- Discussion of growth characteristics and yield performance of commercially available clonal Paradox rootstocks and new clonal Paradox genotypes developed by UC Davis’ Walnut Improvement Program (WIP).
- Tour replicated research plot composed of ‘Chandler’ on eight rootstocks

Janine Hasey, UCCE Farm Advisor Sutter/Yuba/Colusa Counties Emeritus

Elizabeth Fichtner, UCCE Farm Advisor Tulare and Kings Counties

10:00-11:30 am: Hands-on Pressure Chamber Workshop

- Discuss using the pressure chamber for irrigation timing
- Practice using the pressure chamber and interpreting the results

Workshop Leaders:

Doug Amaral, UCCE Farm Advisor, Kings and Tulare Counties

Caleb Crawford, UCCE Staff Research Associate, Tulare and Kings Counties

Mae Culumber, UCCE Farm Advisor, Fresno County

Elizabeth Fichtner, UCCE Farm Advisor, Tulare and Kings Counties

Phoebe Gordon, UCCE Farm Advisor, Madera and Merced Counties

Janine Hasey, UCCE Farm Advisor, Sutter/Yuba/Colusa Counties Emeritus

Mohammad Yaghmour, UCCE Farm Advisor, Kern County

Questions: Please call the UCCE Tulare County Office 559-684-3300

2.5 Hours CCA credits requested

Virtual Statewide Walnut Series and Statewide Pistachio Day Presentations Available Online

Elizabeth J. Fichtner, Farm Advisor, Tulare and Kings Counties

The pandemic thwarted the opportunity for UC ANR to host many of the typical winter extension meetings that serve to both deliver science-based information and provide a platform to bring industry members and academics together to share thoughts and ideas. One benefit of these “virtual” meetings, however, is the ease of which presentations can be recorded and archived online for future reference.

If you missed the 2022 Virtual Statewide Pistachio Day and Statewide Walnut Series extension presentations in January and February 2022, the videos of all educational presentations are available online. The fourteen walnut presentations are available on YouTube and can be accessed by the URL below. Each walnut presentation has been uploaded individually for online streaming. The 13 pistachio presentations are available on YouTube and divided into groups of those presented on day 1 and day 2 of the meeting. Perusal of the Pistachio Day agenda will aid in navigating to the topic(s) of interest within the video posts. Additionally, videos of presentations from the 2020 Pistachio Production Short Course are now available online.

2022 Virtual Statewide Walnut Series

https://youtube.com/playlist?list=PLCS00JbWUwgod_h1GvLQGDIAMlipSnhS

2022 Virtual Statewide Pistachio Day

Agenda: <https://ucanr.edu/sites/pistachioday/Agenda/>

Day 1: <https://youtu.be/gZwWsmcuNU0>

Day 2: <https://youtu.be/kZQ6Z5CIm8M>

2020 Pistachio Production Short Course (Virtual)

<https://fruitsandnuts.ucdavis.edu/pistachio-production-short-course-2020>

We are currently anticipating in-person meetings for both Statewide Pistachio Day on January 18, 2023, and Tri-County Walnut Day on February 2, 2023. If the status of the Covid-19 pandemic is not conducive to in-person meetings in winter 2023, UC ANR will continue to adapt extension program formats to maintain our dedication to providing clientele with timely access to research-based information.

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Tulare County
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April 2022

In A Nutshell

If you would like to be removed from any of our mailing lists,
please call our office at 559-684-3300.

Elizabeth Fichtner
Doug Amaral
Farm Advisors

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