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THE SCOOP
on fruits and nuts in Stanislaus County

2024 Post-Season Thoughts on Almond Insect Pests

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Invasive carpophilus beetle. Everybody might have heard of carpophilus beetle, *Carpophilus truncatus* at this point. This is a newly-emerging pest of almonds and pistachios in California, detected officially in 2023.

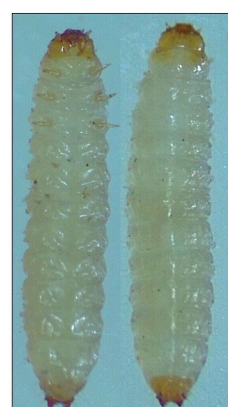
Carpophilus beetle adult

This insect has been causing 2-5% almond damage annually since its detection in 2013 in Australia. In California, I have witnessed over a dozen almonds and a few pistachio orchards damaged by this pest in the northern San Joaquin Valley, with the field damage exceeding 20% in some of them. They are now known to be present in pretty much all counties of San Joaquin Valley.

The tiny beetle (1/10th inch) and its larvae actively feed on the nut after the hullsplit and cause direct damage – more or less similar to the navel orangeworm damage. In 2024, as soon as hullsplit begins around early July, we begun to see the beetle activity in hullsplit nuts. After emergence from the mummy nuts on the orchard floor, adults fly up to the trees, laying eggs on the nut, and both larvae and adults feed on the nutmeat. Recently we published a visual guide to differentiate carpophilus beetle and its damage from other insects such as navel orangeworm and ants. Download the visual guide by scanning this QR code, or you can visit https://www.ipmcorner.com.

This insect has multiple generations even after the hullsplit, and multiple rounds of attacks from different generations are expected. The most important thing to note is that they rely solely on ground mummies for their overwintering and throughout the season survival until hullsplit occurs.

Carpophilus beetle damage to almonds



Carpophilus beetle larva

In this issue…

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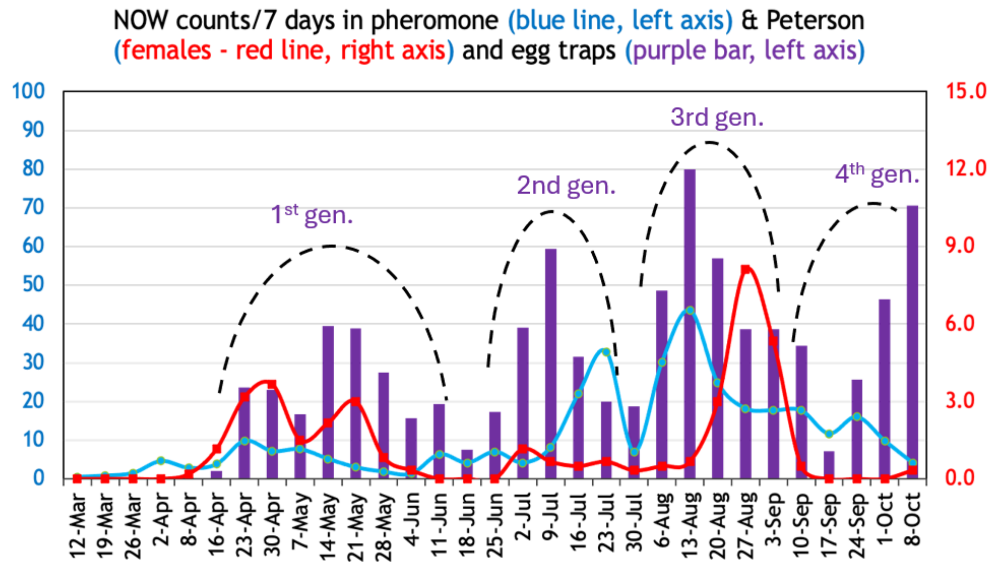
The Scoop on Fruits and Nuts in Stanislaus County is a combined effort of UC Cooperative Extension Farm Advisors Jhalendra Rijal and Abdelmoneim Z. Mohamed and covers topics on all tree crops, irrigation and soils, and associated pest management. You may reach us at 209-525-6800 or by email.

So complete mummy sanitation is the most effective practice to control this insect. Insecticide applications at hullsplit did not yield satisfactory results, and almond growers and industries from Australia are sharing similar stories.

Navel orangeworm. Unfortunately, the level of navel orangeworm damage in the San Joaquin Valley has not decreased much in 2024, with a statewide average being around 3.5%. This number is higher than the 2017 damage and a little less than the 2023 damage – both considered the worst damage years in recent history. The common culprits are summer heat, abundant/low-input orchards, and poor sanitation. Based on observations, only about 50% of the orchards in the Modesto area were sanitized in 2024, which is undesirable given the heightened pressure and damage caused by this pest in recent years. Overall, navel orangeworm pressure and egg laying in the orchard seemed continuous throughout the season. Due to the late-season normal-than-average temperatures, we did observe pretty good fourth-generation navel orangeworm activities from late September through October, which I have not observed in recent years – note the egg-laying activities in the figure (purple bars).



Brown spot and hemipteran pests. Brown spot damage has increased in the last 5-7 years, with significant damage observed in 2024. Multiple hemipteran pests can feed on almonds at different times of the season. Since all have piercing-sucking mouthparts, their feeding results in spots on the kernel; some look distinct, while others are more subtle. Based on our surveys of the almond orchards, leaffooted bugs, brown marmorated stink bugs, and green stink bugs are the most damaging species in northern San Joaquin Valley, and the increased damage seems to be associated more with increased green stink bug activity in almond orchards. Although orchards near tomato, corn, cotton, and alfalfa fields likely have more damage, increased green stink bug residential populations within the almond orchard in recent years seem to be critical, too.

Better winter survival and the presence of green stink bugs in the spring and early summer within the orchards might have worsened the situation in recent years. There are commercial traps and lures available for leaffooted bugs and brown marmorated stink bugs, both of which can also result in early-season nut drops in addition to the in-season brown spot damage. Although challenging, utilizing those trapping tools along with diligent visual sampling of bugs in the orchard should help early detection. No effective traps for the green stink bug monitoring are available for orchard systems .

Spider mites. Spider mites took off in the summer this year, much earlier than most years. Their feeding on leaves can ultimately result in premature leaf drop, impacting trees' health and reducing crop yield in the following year. The scorching heat for an extended period of summer, coupled with dry orchard conditions, are conducive for spider mites. We observed some orchards with significant leaf drops in July of this year. The use of broad-spectrum (pyrethroids) targeting hemipteran pests and potentially carpophilus beetle in some orchards might have impacted the predators, such as six-spotted thrips and *Stethorus* beetle populations. Although we may not have a better choice of action in certain years, understanding the impacts of the environment and pest management programs can help in decision-making.

Concluding thoughts. No year is perfect for managing pests effectively. However, some years are better than others. Having said that, it is important to utilize the tools that we know work, such as winter sanitation for navel orangeworm and carpophilus beetle. I don't see how we can effectively manage these two pests without using mummy sanitation practices. Although not a trivial task, proactively detecting insect activity through visual surveys and using traps early can help reduce the brown spot damage. Understanding the role of external factors and biological control can help growers and PCAs to think through and use available tools in a compatible manner to manage mites effectively.

Is Your Field Suitable for Groundwater Recharge? Learn How to Assess and Maximize Recharge Potential

Abdelmoneim Mohamed, UCCE Irrigation and Soils Advisor for Northern San Joaquin Valley, UCCE Stanislaus County

Irrigated agriculture in California is largely impacted by drought and the competition for water from other sectors. Groundwater is a main source of irrigation water during droughts in the Central Valley of California. Winter groundwater recharge during wet years could be used to replenish overdrafted aquifers. During the recharge process, water infiltrates through the soil profile and could be reached and stored in the aquifer for use later on during the growing season.

Groundwater recharge (GWR) could be accomplished on some fields utilizing existing surface irrigation infrastructure. Very little modification is needed to the existing surface irrigation system and there is no need for dual irrigation systems (for irrigation and surface system for GW recharge). However, modernization of irrigation districts or surface water delivery to farms is needed.

Alfalfa has less of a potential issue with nitrate leaching as compared to other crops. However, there are some other major crops such as almond, grape, etc that could be utilized for GWR. Fields with the proper soil type (medium to high infiltration rates) are ideal locations for GWR in California. This GWR will address the Sustainable Groundwater Management Act (SGMA) in California. SGMA is an act to protect groundwater resources and help reduce the overdraft in a sustainable way. Pulsed application of water is preferred for GWR for a healthy crop that is linked to site-specific soil drainage characteristics (Dahlke et al. 2018). GWR has many benefits such as surface protection, increased water supply and water security, and improved water quality, and can be a good source of income for the grower (Dahlke et al. 2018).

Surface Irrigation and GWR Principles

In surface irrigation, total applied water is the sum of root zone storage, runoff, and deep percolation. Application efficiency (AE) is a term used to describe how efficiently a surface irrigation system performs. AE of surface irrigation systems is the amount of water stored in the root zone (A) and beneficially used by the crop to the total amount of applied water which includes: the amount of water stored in the root zone (A), surface runoff (B), and deep percolation (C), which is the amount of water that left the root zone and was used to replenish groundwater.

The AE is defined as:

$$AE = \frac{A}{A + B + C}$$

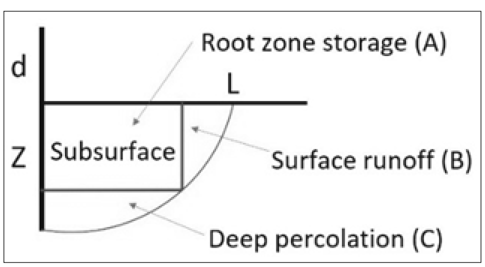


Figure 1. An illustration of total applied water in a surface irrigation event.

To achieve higher irrigation efficiency during the growing season with surface irrigation, surface runoff and deep percolation need to be minimized (Fig. 1). While this concept is used during the growing season to improve irrigation efficiency, a similar concept could be utilized to evaluate the efficiency of groundwater recharge.

The groundwater recharge efficiency (GWRE) is defined here as the ratio of deep percolation (C) to the total amount of applied water (A+B+C).

$$GWRE = \frac{C}{A + B + C}$$

To achieve high GWRE, eliminate B and minimize A (Fig. 2). Plant health should be taken into consideration while doing GWR by installing oxygen sensors to measure the oxygen percentage in the root zone. Oxygen levels in the root zone above the critical 5% are needed to maintain a healthy root system.

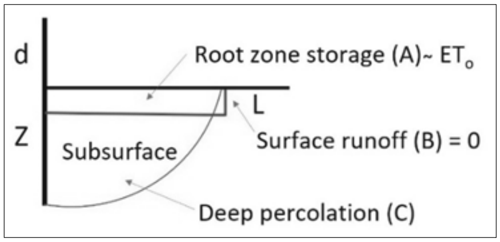


Figure 2. An illustration of the concept of groundwater recharge.

You can test if the field is a good candidate for GWR by knowing the infiltration rate. Infiltration rate is the rate at which water enters into the soil layers. There is air between the soil particles, and when the water infiltrates into the soil, it fills the air pores with water. When all pores are filled up with water, the soil is fully saturated and reaches its saturated hydraulic conductivity that is known as constant infiltration rate, and then water percolates into groundwater. You can know when the soil starts to percolate if a watermark sensor is used and gives a zero reading of soil moisture potential. You can quickly check your field infiltration rate online from Web Soil Survey:

https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Different soil types with different saturated hydraulic conductivities can be in the same field. That's why this method can be useful for the large-scale fields. However, it is recommended to conduct a double-ring infiltrometer test. A double-ring infiltrometer is the most well-known method to measure infiltration rate.

Items needed to run the infiltration test in your field include:

1. A total of three double-ring infiltrometers (These can be handmade by buying two different diameter PVCs and cutting them into three pieces. It is recommended to install a total number of three double-ring infiltrometers (Fig. 3) to get repeatable numbers.)
2. Marker and measuring tape
3. Bucket and graduated cylinder or a scale
4. Source of water to fill the bucket
5. Piece of wood and a rubber hammer or a sledge for the hard soils
6. Notebook

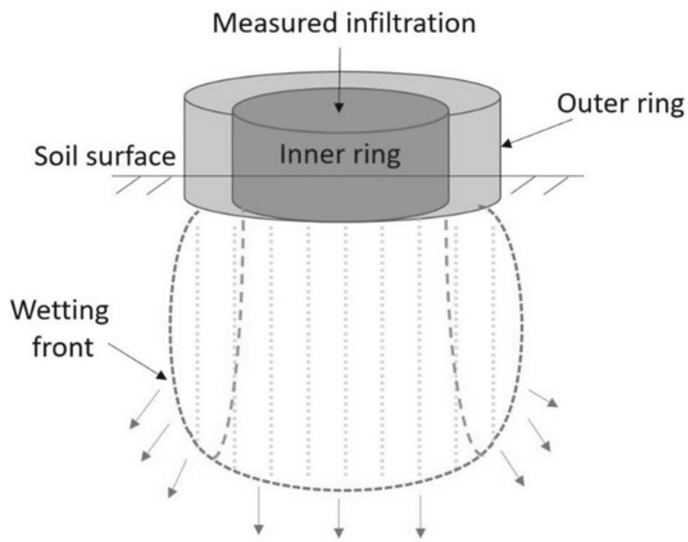


Figure 3. Infiltration test with a double ring infiltrometer (adapted from Youngs 1991)

After preparing the three double-ring infiltrometers, sharpen one side through a grinder so that they can be easily installed into the soil. You can start with the inner ring to drive it into the soil and then the outer ring for about 4-5 inches (Fig. 4).

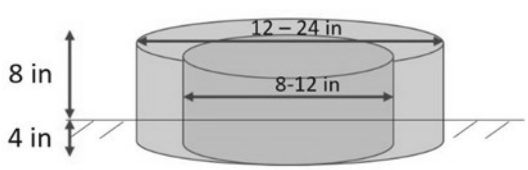


Figure 4: Dimensions of double ring infiltrometer

This can be done by placing the wooden piece at the top of the ring and using the rubber hammer to drive them uniformly into the soil without disturbing the surrounding soil. Mark the refill sign inside the inner rings about 4-6 inches from the ground using the measuring tape and write the number of the rings on the wall of the outside rings.

The procedure to carry out the infiltration test:

1. At time zero (the starting time), pour a known volume of water into the first inner ring to the refill sign, then pour water between the inner and the outer ring to the same fill line sign in the inner ring.
2. Allow 5 minutes and repeat step 1 with the second infiltrometer.
3. Allow 5 minutes and repeat the previous step with the third infiltrometer.
4. Now that the three rings are filled up, wait for 30 minutes or an hour and start to fill water to the fill line using a graduated cylinder.
5. Write down the added water in mL and add water in the outer ring to the same level of water in the inner ring. If the water in the outer ring is not within the same water level of the inner ring, this can affect and slow the infiltrated water in the soil.

5. Repeat steps 4 and 5 to the second infiltrometer after 5 minutes.
6. Repeat steps 4 and 5 to the third infiltrometer after 5 minutes.
7. Once done, redo steps 4-7 every one or two hours until you achieve a constant infiltration rate.

In sandy soil, water will infiltrate quickly and you might need to refill the rings at shorter times. Then you may increase the refill time to an hour or so (depends on how fast water infiltrates into the soil). However, in some clay loamy soils, you might take the measurements every two hours as the infiltration rate is slow. Many parameters can affect the infiltration rate such as the condition of field surface (compacted or cracked), soil characteristics, initial soil water content, depth to groundwater, and the type of method or the equipment used (Johnson, 1963). It is preferred to have a dry field before the test. Initial soil water content can affect the time to reach the constant infiltration rate. Table (1) shows an example of the collected infiltration data in a grower's field in Northern California.

Ring #1		Ring#2		Ring#3	
Time	volume (ml)	Time	Volume (ml)	Time	Volume (ml)
11:20*	3705	11:30*	3705	11:40*	3705
11:50	860	12:00	982	12:10	990
12:20	350	12:30	338	12:40	426
12:50	290	13:00	340	13:10	425
13:20	314	13:30	200	13:40	260
13:50	185	14:00	250	14:10	286
14:50	500	15:00	500	15:10	716
15:50	482	16:00	482	16:10	600

Table 1. Volume of infiltrated water in ml

**The amount of added water to the rings at the starting time (time zero)*

You can calculate the infiltration rate using the following equation. Table (2) is an example of the calculated infiltration rate in (in/hr) at each measurement point. Then calculate the average infiltration at each point from the three infiltrometers.

Infiltration rate at each measurement point:

$$\text{(in/hr)} = \left[\frac{\frac{amount\ of\ added\ water\ (ml)}{16.387}}{(3.14 \times (\frac{Inner\ ring\ diameter\ (inches)}{2})^2}\right] \div Time\ (hr)$$

Time (hr)	Ring#1 In/hr	Time (hr)	Ring#2 In/hr	Time (hr)	Ring#3 in/hr	Avg. Infiltration In/hr
0	4.5	0	4.5	0	4.5	4.5
0.50	2.09	0.50	2.39	0.50	2.41	2.29
1.00	0.43	1.00	0.41	1.00	0.52	0.45
1.50	0.23	1.50	0.28	1.50	0.34	0.28
2.00	0.19	2.00	0.12	2.00	0.16	0.16
2.50	0.09	2.50	0.12	2.50	0.14	0.12

Table 2. Infiltration rate and average infiltration in inches/hr

You can see from Table (1), the initial infiltration rate began at maximum, then it decreased until it reached a constant value known as the basic infiltration rate.

The cumulative infiltration in inches is the sum of the water infiltrated at the current point and the previous points from Table (2). Cumulative infiltration is important in designing irrigation systems.

Table (3) is an example of the calculation of cumulative infiltration from the three infiltrometers and the average cumulative in inches from the three infiltrometers.

Time (hr)	Ring #1 Cumulative (in)	Time (hr)	Ring #2 Cumulative (in)	Time (hr)	Ring #3 Cumulative (in)	Avg. Cumulative (in)
0	4.50	0	4.50	0	4.50	4.50
0.50	6.59	0.50	6.89	0.50	6.91	6.79
1.00	7.01	1.00	7.30	1.00	7.42	7.24
1.50	7.25	1.50	7.57	1.50	7.77	7.53
2.00	7.44	2.00	7.69	2.00	7.92	7.69
2.50	7.53	2.50	7.81	2.50	8.06	7.80
3.50	7.70	3.50	7.99	3.50	8.31	8.00
4.50	7.83	4.50	8.12	4.50	8.47	8.14

Table 3. Cumulative infiltration and average cumulative infiltration in inches

Plot the infiltration rate and the cumulative infiltration and you can see the basic infiltration rate in Fig. (5), which is 0.14 in/hr. By knowing this rate, you can calculate how much water will be deep percolated. As you can see from Fig. (4), after 2.5 hours, soil reaches its saturated hydraulic conductivity and if the flood continues for 6 hours, 0.84 inches of water will be percolated and stored in the aquifer. However, this can cause runoff as the infiltration rate is low.

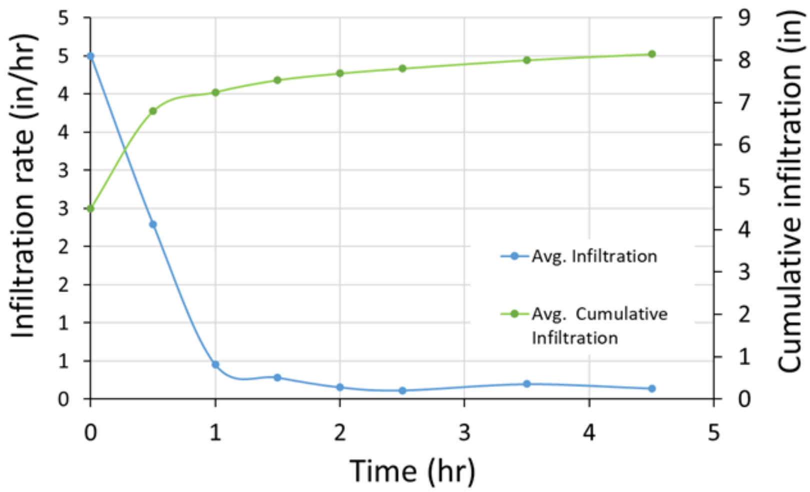


Figure 5. Average infiltration rate and average cumulative infiltration

Also, you can know soil suitability for groundwater recharge from the Groundwater Banking Index (SAGBI): https://casoilresource.lawr.ucdavis.edu/sagbi/ (O'Geen et al. 2015). However, not all the irrigated fields in California are covered by SAGBI. Information on surface water rights are needed and you might need a permit for groundwater recharge. Please refer to Groundwater Recharge Permitting - Frequently Asked Questions at:

https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/faqs.html.

References:

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United States Department of Agriculture. Web Soil Survey. Available online at: https://websoilsurvey.sc.egov.usda.gov/ . Accessed [11/25/2024].

Developing Monitoring Traps for Flatheaded Borers in Walnuts

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Background. The incidences of flatheaded borers attacking walnuts have been high in 2024, potentially due to consistently high temperatures over several weeks in the summer.

The flatheaded borer, specifically the Pacific flatheaded borer, *Chrysobothris mali* Horn (Coleoptera: Buprestidae), is a reemerging pest in tree crops, particularly in walnuts in California. Adults are tiny beetles (1/4 to 1/2 inch long), and the larval stage (borer) is the one causing damage to trees. In San Joaquin Valley, adults typically begin to emerge in May and continue through August, with peak flight around mid-June.

Adult flatheaded borer

Adult females deposit their eggs individually within cracks and crevices of the bark on host trees. The larvae hatch from the eggs and quickly tunnel through the outer bark, feeding on the cambium and phloem tissues. In the process, mature larvae reach the deeper layer of the branch or trunk in the fall to overwinter, pupate in the following spring, and emerge as adults.

The feeding process creates elongated galleries packed with their excrement (i.e., frass). Larval feeding on subsurface vascular tissues often leads to the death of these tissues, resulting in visible symptoms such as bark splits, darkened or discolored bark, and branch and young plant dieback. Infestations may remain unnoticed until adult beetles emerge, leaving characteristic D-shaped exit holes behind.

The flatheaded borer damage is often misdiagnosed as other physiological or minor disease-related problems and thus ignored until it's too late. Damage can occur on both the branches and trunk of the tree. The Pacific flatheaded borer can attack walnut branches of all sizes, ranging from very young and small branches to the largest ones. Although it is one generation per year, adults have an extended emergence from May through August.

The flatheaded borer is a challenging pest to control once the population is established in the orchard. Therefore, the focus should be on detecting this pest activity before it's too late. A few cultural practices help to prevent and reduce this pest attack in walnuts.

For young trees, painting trunks with 50:50 white latex paint:water helps to protect from sunburn and, thereby, from the flatheaded borers; repainting might be necessary. In older trees, the best way to avoid infestations is to keep your trees healthy, sound, and vigorous to prevent attacks.

For infested orchards, prune out infested branches that harbor overwintering flatheaded borer larvae and burn or chip them before their emergence next spring. Once established in the orchard, insecticides have limited efficacy to control them. Using larvicidal insecticide targeting the flatheaded borer larvae and/or other walnut pests during summer can help reduce the damage to a certain degree. Still, the one year of insecticide applications will likely not improve the tree's health substantially.

Flatheaded borer monitoring studies.

Since the Pacific flatheaded borer is native to western states, this pest was never considered an economic problem until 2018 when many growers reported the damage, particularly in the northern San Joaquin Valley. In the last few years, we have been testing various traps and lures in order to find a reasonable monitoring tool to detect and track the beetle populations in walnut orchards.

In 2023, along with researchers from other states, we tested purple panel traps (12 x 9 inch) with experimental lures, and purple triangular traps (4-feet tall, 4-inch side) without a lure, all installed at a 4-feet height from the ground using wooden stakes (Figure 1). The outer surface of these traps was smeared with a sticky substance. In this trial, the purple triangular trap significantly captured the highest number of flatheaded borer adults (Figure 2). However, the number of adults was still lower than expected based on the degree of infestations we observed in the orchard. So we continued our effort and tested multiple colors of the triangular trap in 2024.

In 2024, we evaluated the triangular traps of six different colors in two walnut orchards in San Joaquin County, intending to improve the trap capture rates. Six trap colors were used: black, grey, yellow, red, green, and purple. Each treatment (i.e., trap color) was replicated in separate tree rows four times. Individual traps were separated by five trees apart within the row and by three tree rows across the rows. Traps were installed in mid-April at both locations.

Figure 1. a) purple panel trap (left) and purple triangular trap (right).

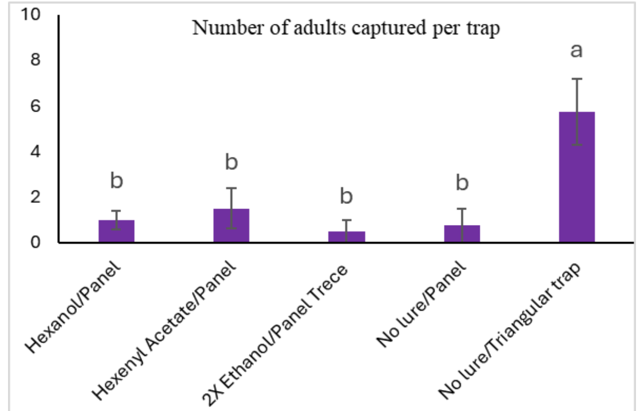

Figure 2. Effectiveness of purple panel and triangular traps for capturing flatheaded borer adults, 2022

At Location 1, the first adult beetle was captured in the first week of May, with activity continuing until the end of August. Red and yellow traps captured the statistically highest number of adult beetles, followed by black and purple traps (Figure 3).

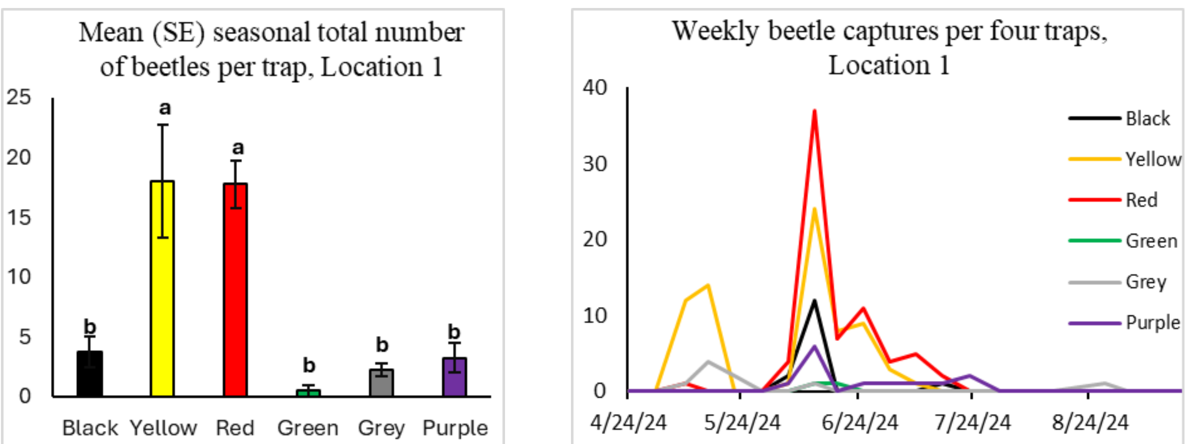

Figure 3. Performance of different color traps in capturing flatheaded borer adults, Location 1. Means with the same letter are not statistically different.

At Location 2, the first adult beetle was captured in the third week of May, with activity continuing until the end of July. Yellow traps attracted the most beetles in this location, followed by red. Grey and black traps captured some (Figure 4).

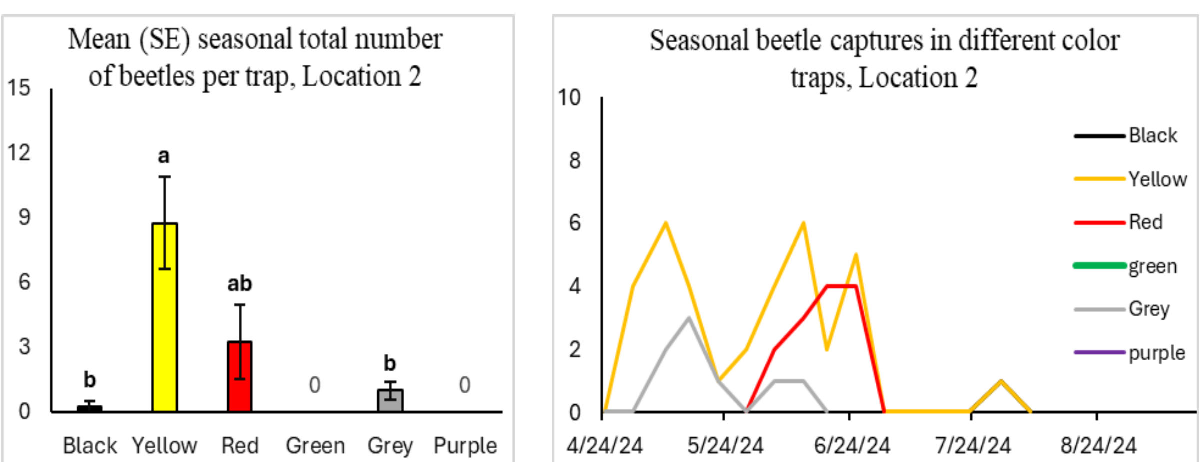

Figure 4. Performance of different color traps in capturing flatheaded borer adults, Location 2. Means with the same letter are not statistically different.

Summary.

Our results show that yellow and red triangular traps captured the greatest number of flatheaded borer adults in walnut orchards. Since the yellow trap captured the beetles more consistently throughout the season, we recommend using the yellow triangular trap to detect flatheaded borer activity in walnut orchards. Further studies will focus on improving the trapping efficacy using new/experimental lures in yellow and red triangular traps.

Save the Dates!

North San Joaquin Valley Almond Day

January 21, 2025

Modesto Centre Plaza

1000 L St, Modesto, CA 95354

Tree & Vine IPM Breakfast Meetings

March 5, 2025
March 19, 2025
April 2, 2025
April 16, 2025

May 7, 2025
May 21, 2025
June 4, 2025
June 18, 2025

Old Mill Café

600 9th Street, Modesto, CA 95354

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