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THE SCOOP

on fruits and nuts in Stanislaus County

Consider Alternative Rootstocks for a More Profitable Almond Orchard

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What if your next almond orchard could live longer and be more productive while reducing input costs for fertilizers, soil amendments, and nematicides? It may be possible for many almond growers. The secret could be in choosing the correct rootstock to meet the physical, chemical, and biological challenges inherent to your soil. If your roots are healthier, your orchard will require fewer corrective actions to maximize the performance of your trees. Some rootstocks are better at extracting nutrients from the soil or excluding salts, such as sodium or chloride. Even if you have no significant soil or disease issues, you might consider adding just a little more vigor or hope for better root anchorage.

Beginning many years ago, the almond industry has relied heavily on peach rootstocks, partially because the seedlings are generally easy to grow at the nursery and are uniform and vigorous. Seeds from Lovell canning peach orchards were often used; but with the elimination of Lovell as a commercial variety, some nurseries turned to the use of Halford peach as a rootstock. In 1959, the USDA released Nemaguard which was preferable to Lovell in most cases because of its resistance to root knot nematode, increased vigor, and reduced susceptibility to crown gall. Nemaguard quickly grew to be the most widely planted rootstock for almond and other stone fruit growers in the San Joaquin Valley. Many Sacramento Valley growers continued to use Lovell because of its apparent better tolerance of "heavy" soil where root knot nematode was not a problem.

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The Scoop on Fruits and Nuts in Stanislaus County is a combined effort of UC Cooperative Extension Farm Advisors Roger Duncan, Kari Arnold, and Jhalendra Rijal and covers topics on all tree and vine crops and associated pest management.

Although our office is open to the public, most advisors are working remotely due to COVID-19 restrictions. You may reach us at 209-525-6800 or by email.

Today, most nurseries offer several rootstock choices to better meet the unique challenges of each new orchard. These include: peach rootstocks like Nemaguard, Lovell, Guardian, Empyrean 1, and Cadaman; hybrids of peach and almond, such as Hansen 536, Nickels, Cornerstone, Bright's 5, and other selections of Titan hybrid; plum hybrids like Krymsk 86 (peach x plum) and Rootpac R (almond x plum); and complex hybrids like Viking and Atlas, which are part peach, almond, plum and apricot.

So, how does a grower know which rootstock may be best for their new orchard? For many years, the University of California Cooperative Extension has conducted multiple field trials in commercial orchards throughout the Central Valley of California, comparing most commercially available rootstocks under various soil and climatic conditions. Clearly, many orchards would benefit from using alternative rootstocks.

Nemaguard performs best in sandy loam soils with good drainage. Trees are moderately vigorous, resistant to most root knot nematode species present in California soils, and generally do not show much crown gall. Many growers have been very successful with Nemaguard. However, Nemaguard has several

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flaws. Nemaguard is susceptible to high sodium, chloride, and boron in the soil or irrigation water. It is also inefficient at extracting zinc from the soil. It is susceptible to chlorosis (yellowing) and stunting in soils with even moderate levels of lime or a pH much over 7.0. Despite its name, Nemaguard is susceptible to ring nematodes, which can reduce vigor and are associated with bacterial canker of young trees.

If you like all the good things about Nemaguard but will be planting a second-generation orchard in sandy loam soils with the potential for ring nematode, you may consider **Guardian** peach rootstock. It was developed by Clemson University in South Carolina and is used by stone fruit growers in the Southeast U.S. to help with peach tree short life, a disease similar to bacterial canker. It has vigor and root knot nematode resistance similar to Nemaguard, but it has better tolerance to ring nematode, and thus also bacterial canker. Guardian is susceptible to similar salt, soil chemistry, and disease challenges as Nemaguard and Lovell.

Some growers may choose **Lovell** peach rootstock over Nemaguard in heavier soil. However, the difference in wet soil tolerance between Lovell and Nemaguard is relatively small. Lovell is salt sensitive and is susceptible to root knot nematode and crown gall There are probably few situations where Lovell would be the rootstalk of choice today.

Krymsk 86, a cross of plum and peach, has replaced Lovell as the most planted rootstock in the Sacramento Valley. This is due to its superior anchorage and better tolerance of heavy soil. Although it is half plum, it does not have the root suckering problem of Marianna 26-24 and is compatible with Nonpareil. Krymsk 86 is susceptible to root knot, ring, and root lesion nematodes, as well as high sodium, chloride, and boron. Krymsk 86 may not be the best choice for sandier soils on the floor of the San Joaquin Valley or in the saltier, higher pH soils along some areas of the SJV westside or Delta region. Krymsk 86 may be a good choice for Sierra foothill orchards where drainage problems exist, and nematodes and salt are not an issue. The Monterey variety can sometimes develop yellow, cupped leaves on Krymsk 86, but this is largely attributed to temporary, saturated soil conditions.

Viking, a complex hybrid of peach, almond, apricot, and plum from the Zaiger Genetics breeding program, does all the things we expect from Nemaguard and much more. It is immune to root knot nematode, just like Nemaguard, but is also resistant to ring nematodes and, therefore, bacterial canker, similar to Guardian. It is generally just a little more vigorous than Nemaguard and is more tolerant to sodium, chloride, and moderately high soil pH and lime. Viking has excellent anchorage and has almost always outperformed Nemaguard in UC trials. Viking might be considered one of the most broadly tolerant and best suited rootstocks for sandy loam soils in the San Joaquin Valley and should be strongly considered as a replacement for Nemaguard. Although data is limited, Viking does not appear to offer better tolerance to soil-borne diseases like Phytophthora or oak root fungus than Nemaguard.

Peach x Almond Hybrids Rootstocks that are hybrids of almond and peach are gaining in popularity in the San Joaquin Valley, especially in areas with alkaline and/or saline soils. One of the most widely planted peach x almond hybrids is Hansen, a product of the UC Davis breeding program. Nickels, a lesser-known P x A hybrid from UC Davis, may be a little more vigorous and has a higher chilling requirement. Many nurseries also sell their own proprietary peach x almond hybrid rootstocks. These include Cornerstone, Bright's 5, Titan, Titan II and Titan SG1. There are subtle differences among the many P x A hybrids sold in California nurseries, but as a group, they tend to be very vigorous, are resistant to root knot nematode species common in California, and tend to be the most tolerant rootstocks to alkaline and saline soils. They also exclude or sequester boron better than most other rootstocks. On the negative side, they tend to be fairly susceptible to saturated soil and root diseases, including Phytophthora, crown gall, and Armillaria (oak root fungus). Most are also highly susceptible to ring nematode and therefore bacterial canker. Because of their increased vigor, hull rot can be more prevalent and hull split and harvest can be delayed by at least ten days compared to Nemaguard in some soils, although this can be mitigated somewhat with pre-hullsplit deficit irrigation. This delay in harvest should be considered if late-harvested varieties like

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Monterey or Fritz will be planted, especially in high rainfall areas.

There are other less widely planted rootstocks that may work well under some conditions. **Rootpac R** (a.k.a. Replantpac) is from Spain and is a cross of almond and plum. Rootpac R appears to be more tolerant of heavy soil than Nemaguard but suckers moderately. The niche for Rootpac R may be in heavy soil where chloride is a problem (but not sodium), such as some areas of the San Joaquin Valley westside. Rootpac R has not performed well in lighter-textured soil where it tends to produce a small tree that is also sensitive to ring nematodes.

Atlas is another rootstock of interest. It is a complex hybrid with genetics similar to Viking, but the horticultural characteristics are very different. Atlas is more susceptible to ring nematode, sodium, and high pH soils than Viking. However, it is a little more tolerant of chloride than Nemaguard, also perhaps, with better yield efficiency. Anchorage is similar to Lovell.

Empyrean 1, a hybrid of two peach species, has high vigor similar to peach x almond hybrid rootstocks. Empyrean 1 is tolerant of salt, alkaline soils, and appears to have at least moderate resistance to ring nematode. This rootstock should be considered by growers in ring nematode sites who want high vigor. Anchorage may be of concern in high wind areas.

Do your homework first. Before choosing your rootstock, it is important to sample the soil profile in the prospective orchard site. Soil should be sampled at 12- or 18-inch increments, to a depth of five feet. Test for nematodes and do a complete soil chemistry analysis, paying particular attention to total salts, sodium, chloride, boron, lime, and pH. Look on programs like Google Earth to identify potential problem areas where previous trees underperformed and sample them separately. Once you know the challenges your new orchard will face, make an informed decision on the best rootstock for a more profitable orchard.

Planting a whole orchard on an alternative rootstock can feel like a big commitment. If growers are unsure about making a change, they might consider planting a bundle of one or two alternative rootstocks within the new orchard to see how they compare to the other trees side by side. In a few years, you will have first-hand information for your next orchard.

	Effect of Rootstock on Salt Accumulation and Yield of Ninth-leaf Nonpareil Almonds and July 2020 Sampled Leaves, Westley, CA			
Rootstock	**Yield (lb / a)***	**Weight of 100 kernels (g)**	**Chloride (%)**	**Sodium (%)**
BB 106	4091 a	117.4 a	0.25 ef	0.05 d
Brights 5	3859 ab	109.1 abc	0.17 f	0.04 d
Hansen	3661 ab	104.8 abc	0.27 ef	0.04 d
HM2	3447 abc	105.4 abc	0.39 e	0.10 d
F x A	3190 bcd	110.4 abc	0.28 ef	0.06 d
Empyrean 1	3096 bcde	108.5 abc	0.36 e	0.12 cd
GF677	3084 bcde	112.7 ab	0.16 f	0.04 d
Rootpac R	2826 cde	107.6 abc	0.22 f	0.38 a
Viking	2791 cde	104.8 abc	0.55 d	0.06 d
Nemaguard	2791 cde	95.5 cd	0.94 b	0.25 b
Atlas	2626 de	108.1 abc	0.57 cd	0.22 bc
Krymsk 86	2474 de	101.9 abcd	1.21 a	0.22 bc
PAC9908-02	2470 de	104.1 abc	1.10 a	0.24 b
HBOK 50	2326 ef	99.5 bcd	0.68 c	0.06 d
Lovell	1680 f	87.7 d	0.95 b	0.15 bcd
Cadaman	*Not tested*		0.54 d	0.04 d

*Yield and leaf levels followed by the same letter are not statistically different with at least 95% confidence. Relative rootstock performance is highly dependent on soil and growing conditions. Numbers shown here may be most relevant to orchards in heavy soil with high chloride. Chloride levels above 0.30% are considered excessive. Sodium levels above 0.25% are considered excessive.

Things to Consider When Establishing a New Walnut Orchard

Kari Arnold, PhD, UCCE Area Orchard and Vineyard Systems Advisor, Stanislaus County

Planting a walnut orchard can be daunting. The decisions involved impact a long-term investment and remediation can be difficult. If you are planning to plant this year, hopefully you have already discussed soil/site preparation and plant selection with your local University of California Cooperative Extension (UCCE) Farm Advisor. Below, is a summary of a few critical points when planting bareroot or potted plants, irrigation, fertilizer, and weeds in new orchards.

Planting Bareroot Trees

Although bareroot trees look tough, they are quite vulnerable to the environment and must be treated with care. After pick-up or delivery, plant trees immediately and only pick up as many trees as you can plant that day. While planting, keep trees moist, cool, and protected from sunlight by placing in a warehouse or under a tarp.

When planting, remember that proper soil depth can be tricky with bareroot trees. Preparing the soil during the summer or fall allows time during the winter for settling. Planting into moist soil is best. Avoid planting into overly wet or overly dry soil. Dig holes only as deep as the roots and wide enough to accommodate, roughing up the sides of auger-dug holes with a shovel to avoid glazing. Spread roots away from the trunk in all directions in the hole, do not twist or maneuver to fit the root ball into the hole, this will lead to girdling later in the tree's life. Dig a wider hole if possible. Use Gallex or strain K-84 of *Agrobacterium tumefaciens* as a dip on the root system to reduce the potential for crown gall. Do not wound the roots or trunk, this will provide opportunity for crown gall infection. Plant into previously formed berms or small mounds where drainage is an issue. Fill soil around roots with some light packing (tamping) making sure not to leave air pockets. Mound soil slightly to allow for settling and use a minimum of one-to-two gallons of water, up to five in sandy soils, to tank in trees.

Planting depth is not the only thing to consider when planting bareroot trees. Paint entire trees with whitewash (interior latex paint diluted with 50% water) to prevent sunburn. Wait until the soil begins to dry within the rootzone before applying an irrigation. Do not apply fertilizer inside the hole and avoid planting on hot days. Place stakes at planting 12-inches away from the tree and to the side, which is perpendicular to prevailing winds. Ties should be loose to allow tree movement.

For further information please visit http://www.sacvalleyorchards.com/walnuts/horticulture-walnuts/planting-bareroot-trees/ for a current adaptation of "Guidelines for handling and planting bareroot walnut nursery trees" by UCCE Farm Advisors Carolyn DeBuse and Bill Krueger.

Planting Potted Clonal Plants

Clonal rootstocks are propagated on a large scale by dividing small plants into more small plants in a laboratory. As plants mature, they are moved to soilless potting medium and cared-for in pots. Clonal potted plants can be planted almost anytime during the growing season, depending on their stage of growth, but will need an additional year to become established. Green, actively growing plants can be planted May 15th to June 1st; not actively growing plants, September to October; and dormant plants, November through March 1st. Generally, it is not advised to plant trees in the middle of the summer due to heat and the risk of sunburn.

Potted plants allow for more flexibility in planting time, but there are risks involved. Trees planted during the dormant season are vulnerable to winter freeze, whereas planting in late spring requires attention to irrigation. Proper irrigation is tricky as the potting medium used at the nursery is great for drainage but dries out quickly in the field. It is important to maintain adequate moisture in this medium for at least the first month until roots have grown into the surrounding soil. Careful monitoring is required. The small plants are also susceptible to animals and herbicides and should be protected with grow tubes.

When planting both bareroot and clonal plants, remember to cover the roots, but the other "trunk" portion of the rootstock should be above the soil line. For further information on planting clonal rootstocks please visit http://www.sacvalleyorchards.com/walnuts/horticulture-walnuts/planting-potted-clonal-rootstock/ for an adaptation of "Guidelines for Handling Potted Walnut Clonal Rootstock Plants" by UCCE Farm Advisor Janine Hasey.

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Irrigation

Properly irrigating a young orchard establishes a healthy root system leading to a vigorous, uniform, and productive orchard. It is important to note, young trees do not use much water. Checking the soil moisture and utilizing a pressure chamber are effective means of monitoring the young trees' water status. Since irrigation demands are site-specific, please contact your local farm advisor for further information.

Fertilizer

The three numbers on the package represent the amount of nitrogen, potassium, and phosphorus in the fertilizer in that order. Nitrogen is essential for green growth and plant proteins, while phosphorus and potassium aid in woody tissue development. Although phosphorous and potassium toxicity is not typically an issue, nitrogen can be easily over-applied. This leads to excessive growth, toxicity, and nitrogen build-up in our water resources. Young orchards require about 25-30 lbs. of nitrogen per acre, which is often sourced from residual soil nitrogen during the first year. Think of this as an easy way to save money on a new orchard.

Weeds

Weeds should be managed within new plantings, as they can reduce tree growth. Weeds will starve young trees of nutrients and moisture, and if grown tall enough, will shade new trees from the sun. Additionally, small animals love hiding in weed cover, feeding on tree roots and crowns, killing them. Although weed management is important, walnuts are not resistant to herbicide. Avoid planting directly into herbicide-treated soil by reducing or eliminating the previous season's application. Mounding and filling-in holes with previously treated soil can lead to a higher concentration of herbicide coming in contact with tree roots. Green tissues like early trunk growth, low branches, and leaves on new trees are vulnerable to herbicide. Be mindful of drift by avoiding windy conditions, using proper spray rig height, nozzle angle, and selection. Know your weeds for proper herbicide selection and use different modes of action to avoid resistance. Certain herbicides are registered for use on new trees. Be sure to check current label listings first, such as Agrian (agrian.com/labelcenter/results.cfm) or CDMS (cdms.net/Label-Database) before spraying anything and do not use 2,4-D.

Hopefully, these tips will help you in planting your next orchard. Please contact your local UCCE farm advisor for further information about planting in your region. Other resources include the University of California Agriculture & Natural Resources (UCANR) Sacramento Valley Orchard Source website http://www.sacvalleyorchards.com/walnuts/ as well as the future publication, the Young Orchard Handbook, from which sections covering irrigation, fertilizer and weeds were derived.

Removal of Infested Branches Helps to Minimize Flatheaded Borer Damage in Walnuts

Jhalendra Rijal, PhD, UCCE Integrated Pest Management Advisor, Stanislaus, Merced, and San Joaquin Counties

Pest status and biology

In the last four-to-five years, growers have been reporting a higher level of flatheaded borer infestation in walnut orchards, particularly in the northern San Joaquin Valley. The name 'flatheaded' comes from the enlarged and flattened shape just behind the head of the larvae (*Fig. 1*) of the metallic wood-boring beetles (Insect family - Buprestidae). The insect species attacking walnuts is the Pacific flatheaded borer (*Chrysobothris mali*). This pest is not new to the Central Valley, but has become a problem in newer ways in many walnut orchards. The flatheaded borers are known to cause damage to stressed, wounded, and sunburnt trees, and these trees are still more likely to be attacked by flatheaded borers. However, there is a concerning trend of flatheaded borers attacking healthy trees and not limiting the damage to wounded and sunburn-damaged branches. The observed damage ranged from small pencil-sized twigs to 2-4 inch diameter branches, limbs, and tree trunks.

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The general biological life cycle of the Pacific flatheaded borer commences when females deposit eggs singly in the potentially weaker portions of wood (i.e., sunburnt, freshly pruned, etc.), bark crevices or depressions. Freshly hatched larva bore into the bark, initially feeding on the cambium layer (especially the smaller branches), but can eventually reach to the heartwood by the fall. The borers remain there throughout the winter before pupating and emerging as adults the next summer. There is only one generation per year but there are reports in the literature that a life cycle may be longer (1-3 years) in cooler areas.

We previously did not have much information about the seasonal phenology of the Pacific flatheaded borer in California's walnut orchards so the California Walnut Board funded a recent study to look at adults' emergence pattern from infested walnut branches. In this study, we collected infested branches in the winter, and beetles were reared out from that collection. Based on this, we found most beetles were emerged in mid-June, with the emergence occurring over two months, May through June. The emergence timing can vary from year-to-year based on potential factors such as variety, temperature, locations, drought conditions, etc. More research is needed to understand various factors influencing seasonal emergence and borer incidence in orchards. Also, there are no traps available for growers to use, and we are continuing to do more research on that front; and in the next couple of years, we will be exploring cultural to chemical control options.

At this time, we recommend walnut growers be aware of damage of the flatheaded borer and find out whether flatheaded borer is causing subtle background damage given the fact that damage may not be obvious in the beginning years because other factors may produce similar types of external symptoms (i.e., flagged branches, dead twig, etc.).

Symptoms of flatheaded borer infestation

Winter is the best time to survey infestation as it is easier to detect in trees without leaves. The following are the symptoms used to confirm flatheaded borer infestation in walnut orchards.

1. Scout the orchard to detect dead and flagged branches infested by the flatheaded borer and look for external infestation signs (i.e., larval feeding wound, fresh or old insect frass, *Fig. 2*).
2. For young trees, check the damage on the trunk, especially on the south or west side of the tree. These sides are the preferred sides for egg-laying by females due to higher sunlight exposure and heat. Check the graft union and pruning wounds closely.
3. Use a knife to peel the bark in a suspected branch and look for feeding channels packed with frass (sawdust-like insect waste) and cream-colored larva underneath (*Fig. 3*). Keep in mind, larvae tend to move into the heartwood in late fall for overwintering and would be harder to find. Larval finds may be easier during June through August when feeding occurs just beneath the bark in the cambium layer.
4. Look for any visible wounds on the tree branches and limbs that are prone to sunburn, or have pruning marks, or any other kinds of cracks and injuries (*Fig. 4*).
5. Look for the brown-color sap which has oozed out and spread on the bark surface of the infested part of the tree. (*Fig. 5*).
6. Look for D-shaped exit holes of the beetle on infested walnut limbs (*Fig 6*).

Managing flatheaded borer infestation - winter tasks

Pacific flatheaded borer infestation may be reduced by adopting cultural practices that encourage vigorous, healthy plants; although as previously mentioned, the borer seems to have the ability to attack healthy trees as well.

1. Young trees should be protected from sunburn by applying white latex paint (1:1 paint and water ratio), or using mechanical covers over the trunk (e.g., trunk guard) as sunburnt tissue is more susceptible to borer attack.
2. Orchard sanitation consisting of the removal of weakened, injured, dead, and flagged branches is highly recommended during late fall and winter as when the mature larvae overwinter in the infested wood. Chipping the infested branches kills those larvae.

***Note: We are looking for walnut orchards with flatheaded borer infestations to conduct experiments. Please contact Jhalendra Rijal, jrijal@ucanr.edu if you are interested in becoming a cooperator for this effort.*

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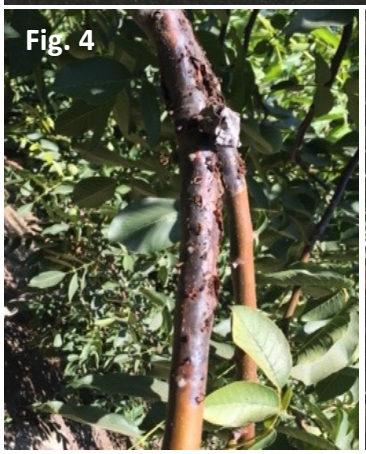

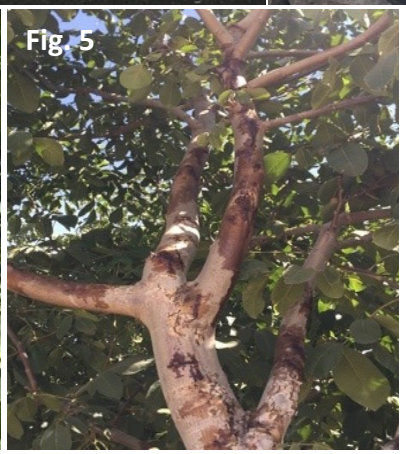

Upcoming Events:

UCCE Virtual Statewide Walnut Series

To keep everyone safe and in response to the virtual nature of meetings during COVID19 stay at home orders, UCCE Walnut Advisors are combining their efforts this year to provide a virtual statewide walnut extension meeting.

When: February 16 - 17, 2021, 9:00 am-12:00 pm

Where: Virtual via Zoom

Topics: Orchard Management, Varieties, Rootstocks, Pests and Diseases

An Agenda will be available in early 2021.

A virtual event by Zoom

2021 San Joaquin Valley Almond Day

Sponsored by the University of California Cooperative Extension

Agenda

When: Thursday, January 14, 2021, 9:00 am—12:00 pm

Fee: $10 before January 11, $15 on or after January 11

CEUs: 1.5 hours of pest management continuing education is pending

Register: http://ucanr.edu/regsjvalleyalmondday

**Due to COVID 19 restrictions, this will be a virtual event on Zoom*

- Dr. Mae Culumber, Orchard Crops Advisor, Fresno County, & Dr. Brent Holtz, Orchard Crops Advisor, San Joaquin County
  - Care of young trees during establishment
  - Nitrogen considerations in replanted orchards following whole orchard recycling.
- Roger Duncan, Orchard Crops Advisor, Stanislaus County
  - Update on local field trials:
  - Effects of close tree spacing over 20 years
  - Field screening of almond rootstocks
  - Effects of compost use on tree performance – year 5
- Dr. Doug Amaral, Orchard Crops Advisor, Kings & Tulare Counties
  - Implementing Best Management Practices for Nitrogen Fertilization in Almonds
- Dr. Mohammad Yaghmour, Orchard Crops Advisor, Kern County
  - Update on management of hull rot, the new invasive peach rootknot nematode and resurgence of Phytophthora diseases in Kern County
- Dr. Phoebe Gordon, Orchard Crops Advisor, Madera and Merced Counties
  - Findings from statewide grower survey on NOW management
- Dr. Jhalendra Rijal, Integrated Pest Management Advisor, North San Joaquin Valley
  - Monitoring and Management of Plant and Stink Bugs in Almonds

For more information, contact UC ANR Support Unit: anrprogramsupport@ucanr.edu or 530-750-1361