Sacramento Valley Walnut News

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In This Issue

Submitted by:

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2018 IPM Breakfast Meetings

Join Area IPM and Farm Advisors to discuss current pest management and production issues. We will largely focus on orchard crops (but everything is on the table for discussion!). These meetings are open to all interested growers, consultants, PCAs, CCAs, and related industry.

Meetings will be held the third Friday of each month (7:30-9:00 am) from March through October and will cover a wide range of timely pest and orchard management topics. Meeting locations will be rotated throughout the Sacramento Valley each month. Please contact Emily Symmes to request topics or bring your questions to the meeting!

Upcoming meetings:

- Yuba-Sutter-Colusa Counties: April 20th (Perkos Café, Yuba City)
- Tehama County: May 18th (Rockin R Restaurant, Red Bluff)
- Glenn County: June 15th (Berry Patch Restaurant, Orland)
- Butte County: July 20th (Red Rooster Café, Durham)

UC IPM

Full 2018 schedule is available on the events page at sacvalleyorchards.com or by contacting UC IPM Advisor Emily Symmes at (530) 538-7201 or ejsymmes@ucanr.edu.

Orchard Management Considerations

Dani Lightle, UC Orchards Advisor, Glenn, Butte & Tehama Counties
Emily Symmes, UC Area IPM Advisor, Sacramento Valley

APRIL

- *Walnut blight*: new spray rotations may be available for blight control this year (see article on Kasumin 2L, this newsletter). Stay on top of spray timings. For basics of blight management, see: sacvalleyorchards.com/walnuts/diseases-walnuts/walnut-blight-management
- For varieties susceptible to pistillate flower abscission (PFA) (especially Tulare or Serr), apply first ReTain® spray at 30-40% female flower bloom. The percent PFA and rate of bloom determines if a second spray is needed. ReTain® cannot be applied within 2 days of a copper application.
- Apply *foliar zinc* (if needed, based on leaf sample analysis) when shoots are 6 to 10 inches long, when zinc can be easily absorbed through the leaf surface. If the deficiency is severe, additional sprays can be applied two more times every 2 to 3 weeks.
- *Bot*: Limbs that have been killed by Bot canker are easy to identify between budbreak and full leaf expansion, but wait to prune until rain is no longer forecast. If timing Bot treatment based on the Leaf Wetness Model, watch for storms that bring ≥¼" rain and temperatures ≥50 F. The Leaf Wetness Model can be found at:

sacvalleyorchards.com/walnuts/diseases-walnuts/the-latest-on-managing-bot-canker-and-blight-in-walnut-2016-research-updates/

- Perform irrigation system maintenance now, before irrigation is necessary and system problems cause tree stress. Check for broken or clogged filters and emitters. See: micromaintain.ucanr.edu for more tips on maintaining micro-irrigation systems.
- *Codling moth*: Traps for codling moth should have been deployed in early- to mid-March to establish biofix. Check traps twice weekly until biofix (moths found on consecutive trap checks AND sunset temperatures above 62°F) and weekly thereafter. After biofix, begin accumulating degree days to track development and inform application timing(s) if population densities necessitate treatment. Many effective mating disruptants are available for codling moth; if using mating disruption, hang or apply disruptants ahead of historical biofix in your orchard. In mating disruption orchards (or orchards in proximity to disrupted orchards), make sure to use combination lures to track the population (CMDA), rather than pheromone lures only (1X or L2), as pheromone traps will be shut down or far less sensitive.
- *Navel orangeworm*: Sanitation activities (removal and destruction of mummy nuts in the orchard and surrounding areas) should be completed by mid-March. Data shows that increasing levels of mummy destruction have the greatest impact on NOW mortality (shredding > double-disking > intact mummies in weeds > intact mummies on bare berms). Consider placing pheromone and kairomone (bait bag) traps in the orchard to monitor adult male and female flights and abundance, respectively.

MAY

- *Nitrogen* fertilization applications should begin in May. Walnut trees only use stored nitrogen the first month after leaf-out, so N applied before May will likely be leached. Walnut tree nitrogen use is fairly steady over the growing season. Evenly dividing nitrogen application in 3-4 doses between May and mid-August will improve N uptake compared to 1-2 applications.
- *Codling moth*: Continue monitoring traps. Look for 1B flight peak approximately 600 to 700 degree days (DD) after first biofix. If populations are high, or the orchard has a history of significant codling moth damage, consider treating according to UC IPM guidelines (link below) if populations are high, the orchard has a history of significant codling moth damage, and/or the residual period from the 1A treatment (if applied) has elapsed. Ideal treatment timings will depend on material (roughly 650 to 700 DD after first biofix – confirm with trap activity).
- *Navel orangeworm*: Continue monitoring trap activity. Research still indicates that best treatment timing for NOW is late season (husk split). Trap data can provide information regarding relative population abundance and flight activity as husk split approaches.
- *Aphids*: Begin sampling for aphids in May, examining upper leaf surfaces for dusky-veined aphids and lower surface for walnut aphids. Walnut aphid natural enemies (parasitoid wasps) tend to provide good levels of control if not disrupted. Evaluate the level of parasitism in your orchard (abundance of aphid mummies relative to non-parasitized). Consider treatment only when the number of non-parasitized aphids exceeds an average of 15 per leaflet in a sample of 50 leaflets from 10 trees.
- *Weeds:* Survey weeds to see which weeds were not controlled by fall or winter treatment. The UC Weed ID Tool at weedid.wisc.edu/ca/weedid.php can help with identification

JUNE

- *Bot:* If applying only one fungicide spray for Bot canker, a mid-June to mid-July spray timing significantly reduced blighted shoots compared with a no spray treatment. Prune out dead branches to reduce inoculum now that threat of rain has passed.
- *Codling moth and NOW:* Continue monitoring traps and developing nuts for evidence of infestation.
- *Spider mites*: Start looking for spider mites and predators (especially predatory mites and sixspotted thrips) in late spring and map areas of concern for summer monitoring. Begin summer monitoring in June or early July (erring on the early side if warmer temperatures). Good predator abundance early in the year can provide significant natural control later in the year IF not disrupted by broad-spectrum pesticides or miticides.

- *Husk fly*: Hang traps by June 1. Yellow sticky traps charged with an ammonium carbonate lure work best. Check traps 2 to 3 times per week and treat based on detection of eggs in trapped females or increases in trap catches. For more details on treatment decision-making, see sacvalleyorchards.com/walnuts/insects-mites-walnuts/walnut-husk-fly-biology-monitoring-and-spray-timing/

ADDITIONAL RESOURCES

Fungicides, Bactericides and Biologicals for Deciduous Tree Fruit, Nut, Strawberry and Vine Crops: ipm.ucanr.edu/PDF/PMG/fungicideefficacytiming.pdf

Herbicide Registration on California Tree and Vine Crops (also included in this newsletter): wric.ucdavis.edu/PDFs/T&V_herbicide_registration_chart.pdf

Walnut Pest Management Guidelines (updated August 2017): ipm.ucanr.edu/PMG/selectnewpest.walnuts.html

A New Tool in the Fight Against Blight

Luke Milliron, UC Cooperative Extension Farm Advisor for Butte, Tehama, and Glenn Counties
Dr. James Adaskaveg, Professor of Plant Pathology at UC Riverside

For many, 2017 will be remembered as a tough year for walnut blight. A long, wet spring meant conditions were ideal for *Xanthomonas arboricola* pv. *juglandis* (*Xaj*), the bacterium that causes walnut blight. If there was ever a time when a new tool to manage this viciously destructive disease would be especially welcomed, it would be now as many orchards head into the 2018 season with a tremendous amount of overwintering disease inoculum.

A new tool becoming available?

A new tool in the fight against walnut blight, Kasumin 2L (kasugamycin) was federally registered on March 1st (US EPA PRIA date). Kasumin 2L will be available March 16/17th when the walnut label for California is scheduled to be through a final hurdle with DPR in time for the upcoming walnut blight season. Kasugamycin has been in the regulatory pipeline for over eleven years, in-part because of its classification by the EPA as an antibiotic.

What does kasugamycin offer walnut growers facing a perennial fight with blight? Dr. Jim Adaskaveg, Plant Pathology Professor at UC Riverside has found Kasumin 2L to have excellent and consistent efficacy when applied with either copper (e.g., Champion++, Kocide 3000, Badge X2, etc.) or mancozeb (e.g., Manzate, Dithane). However, kasugamycin is not a silver bullet. Used alone, kasugamycin has more moderate efficacy and is at an elevated risk for *Xaj* resistance development.

The introduction of kasugamycin opens a new chapter in walnut blight management because of the opportunity to finally rotate chemistries. Kasumin 2L used in combination with copper (Cu) or with mancozeb[1], as well as the current industry standard of Cu-mancozeb can be used to form a three-part rotation. Dr. Adaskaveg found the Cu-mancozeb, kasugamycin-mancozeb[1], kasugamycin-Cu rotation to be highly effective. These two material rotations work well because each of the chemistries has a different mode of action (MOA) in targeting bacteria, denoted by the FRAC group M1 for copper, M3 for mancozeb, and 24 for kasugamycin.

Use of Kasumin 2L

When Kasumin 2L is available, it will be important to carefully follow its labeled use and restrictions. The labeled rate is 64 fluid ounces per acre with a minimum of 100 gallons of water by ground rig, with no off-label use rates. No application by air is permitted. You must have a sufficient volume of spray to attain good coverage, with a reduced spray volume possible on small trees. Once available, only two applications of Kasumin 2L will be allowed in the

2018 season. Upon further environmental toxicology documentation, four annual applications (a total of 256 fl oz, or 4 applications x 64 fl/oz per application) may be allowed in future years. If four applications are possible in future years, Kasumin 2L may only be used in a maximum of two applications consecutively. There will also be a minimum interval of seven days between applications. In addition, alternate row spraying will not be allowed with Kasumin 2L. These restrictions are aimed at reducing the risk of resistance development.

Other restrictions include a pre-harvest interval (PHI) of 100 days, which may be around the middle or end of June depending on the walnut variety. Finally, some additional restrictions are specific to its classification as an antibiotic (reducing exposure to non-target bacteria), such as prohibiting its use in orchards with animal grazing or fertilization from animal manure sources. As with any pesticide, it's critical to carefully read and follow the labeled use. In 2018, introducing one or two applications of kasugamycin paired with copper or mancozeb will allow you to add rotation and resistance management into your blight management program.

Management Fundamentals Remain

Kasugamycin is a highly effective spray partner with copper and with mancozeb. However, the material applied is only a single component in the management program of any pest or disease that requires spray application as a part of its integrated management. If the fundamentals of spray timing, rate, and coverage are not adhered to, the best materials will do little to control this tenacious disease capable of prolific spread and significant economic impact.

For more information on the fundamentals of walnut blight management please go to: sacvalleyorchards.com/walnuts/diseases-walnuts/walnut-blight-management/

Walnut blight can spread rapidly, and spray materials represent only a single part of the fight against the disease. However, it is also true that the copper-mancozeb (or maneb) combination has been the only thing keeping the walnut industry in the fight against blight for nearly 27 years. If the effectiveness of the copper-mancozeb combination was lost due to resistance, it would be an incredibly tough hit to the industry, particularly in the Northern Sacramento Valley. A third efficacious bactericide allows the industry to open a new chapter in the fight against walnut blight, one where we can finally rotate modes of action and preserve the effectiveness of copper-mancozeb for many years to come.

*The authors of this article and the University of California Agriculture and Natural Resources do not prescribe or recommend the application of any pesticide or other agrichemical. UC guidelines can be found at ipm.ucanr.edu/PDF/PMG/fungicideefficacytiming.pdf.

2018 Winter and Early Season Irrigation Considerations in Walnut

Allan Fulton, UC Irrigation and Water Resources Advisor

THIS WINTER

This year is different from most. Winter rainfall has been well below normal and recent precipitation has been highly variable across the Sacramento Valley. Rainfall in the last two weeks has been heavier in the south Valley than the north Valley. From February 9 through March 6, 2018 CIMIS weather stations reported higher precipitation ranging from 2.21 to 2.37 inches in the Verona and Dixon areas, 1.08 to 1.34 inches in the Durham and Woodland areas, and 0.68 and 0.47 inches in the Williams and Gerber (Corning-Red Bluff) areas. Chances are that without more rainfall or winter irrigation before Chandlers leaf out in early April, orchards will start out with a drier soil profile than usual and need irrigations earlier in the growing season.

Soil moisture levels were measured with a portable soil moisture detector in several orchards in Tehama County on February 9, 2018. The results showed on average that 4.0 inches of soil moisture had been stored in these orchard soils since mid-October 2017. Increases in stored soil moisture ranged from as little as 3.0 inches to as much 5.5

inches. The increases in soil moisture storage were observed to a depth of about two to four feet depending on the soil texture and related water holding capacity and the amount of rainfall and winter irrigation that had occurred up to that point. The additional rainfall received since February 9 may only be enough to refill soil storage at most an additional foot deeper.

If the scattered rainfall pattern continues and soil moisture monitoring in your orchards is similar as described above, one or two winter irrigations delivering about 2 to 4 inches of water before leaf out may still help refill the soil profile a foot or two deeper and allow a delay of the first crop irrigation in the spring. Delaying the start of crop irrigations can help protect trees from low oxygen levels when the trees leaf out and are growing new roots. Also, it helps lessen root diseases that thrive in saturated soils and should provide better access into orchards for pest management.

FACTORS IN IRRIGATION MANAGEMENT THIS COMING SEASON

There can be a tendency to over-irrigate in spring and under irrigate in summer. It's important for root and tree health to not begin irrigation too early, irrigate too frequently, or for too long of a duration in the spring as trees begin to grow. It is also important to use stream splitters, grow tubes, and other methods to keep the crown of trees as dry as possible. An ongoing northern Sacramento Valley irrigation experiment in 'Chandler' walnut has shown after four years of evaluation that irrigation may not be necessary during the month of April and that the start of the irrigation season may be delayed until sometime in May. When to begin irrigation in May will be orchard specific and dependent upon the water holding capacity of the orchard soils and how the absence of rain and winter irrigation was managed.

UC research in the late 1980's at the Kearney Agricultural Research and Extension Center and more recent research from 2011-17 in the northern Sacramento Valley indicates a reasonable estimate for seasonal evapotranspiration (ET) is 40 to 42 inches for mature walnut orchards. This represents a reasonable upper limit or total seasonal water needs for mature walnut. About one fourth of the seasonal ET will occur from leaf out (about April 1) through hull and shell enlargement (mid-June). The remaining three quarters of the seasonal water use occurs mid-June through mid-November as the kernel inside the shell develops, matures, and is harvested. Soil moisture reserves from winter rainfall or winter irrigation can contribute significantly towards this total seasonal ET and lessen irrigation needs during the growing season. Most orchard soils can contribute at least four inches (10 percent) and as much as 12 inches (30 percent) or more of stored water towards seasonal ET if they have been replenished from winter rainfall, winter irrigation, or if capillary movement of water from nearby stream and river beds are a contributor.

Age of the orchard makes a difference. Young trees with smaller, developing canopies have lower seasonal water requirements. Young trees in their second and third leaf with an established root system may favor a longer delay in the start of irrigation than a mature orchard. Also, the interval between irrigations may be longer in young, developing trees. The exception is the first year, especially early in the season. Potted trees or bare root trees with limited root systems need earlier, light, and frequent irrigations until the transplanted tree is able to grow new roots and establish a root system. Once the newly planted tree becomes established, light, frequent irrigations may not be necessary if the tree can acquire stored water from a larger, deeper soil profile. Pruning strategies that affect canopy size and development can also affect water use and irrigation needs.

Irrigation systems that apply water uniformly and in controlled quantities also lessen irrigation needs during the irrigation season. Flooding the entire soil surface should be avoided in very young orchards. Flood irrigations apply a lot of water in areas where the young trees have not yet developed a root system to use the water. This often results in more weed competition and lower irrigation efficiencies. Furrow irrigation about 18 inches from the tree row can be used for the first year on some soils where water infiltrates uniformly and moves laterally. This also reduces weed pressure and loss of water when compared to flood irrigation. However, furrow irrigation can still be risky on highly variable orchard soils. Furrow irrigation should be avoided when first establishing potted trees or bare root trees with small root balls. Micro irrigation systems with drip emitters or a capped micro sprinkler located near the transplanted trees will be more efficient.

It is best to have your own set of diagnostic tools to evaluate onsite conditions and optimize irrigation management throughout the growing season. The general options are to monitor soil moisture, tree water stress, and budget water

applications using flow meter measurements, ET estimates, and irrigation system performance information. Often there is value in employing more than one of these approaches.

Some additional information and technical support resources found online:

- Potted Trees: sacvalleyorchards.com/almonds/irrigation/potted-tree-irrigation-after-planting-getting-the-first-year-right/
- Weekly Crop Water Use Reports: sacvalleyorchards.com/et-reports/
- Soil Moisture Monitoring: sacvalleyorchards.com/blog/soil-moisture-sensor-selection-is-confusing/
- Using a Pressure Chamber: ucanr.edu/datastoreFiles/391-761.pdf
- Irrigation System Maintenance: sacvalleyorchards.com/almonds/irrigation/irrigation-system-maintenance/
- Mobile Irrigation Lab: tehamacountyrcd.org/services/lab2.html

2017 Flood Damaged Trees - Research Results and What to Do this Spring

Janine Hasey, UCCE Farm Advisor, Sutter/Yuba/Colusa Counties
Greg Browne, USDA Plant Pathologist, UC Davis
Astrid Volder, Plant Sciences, UC Davis
Bruce Lampinen, UCCE Walnut Specialist, UC Davis

2017 brought us unprecedented high and fluctuating water flows in the Sacramento and Feather Rivers, damaging orchards from direct flooding and indirectly via under-levee seepage. Many trees had a long exposure to waterlogged conditions through the winter and spring. We responded by sampling seepage, river water, and trunk cankers for *Phytophthora*, sampling roots in a waterlogged young orchard, and observing conditions where trees died or survived. This season we expect to see effects from last year's flooding in several orchards. This article details our observations and research on survival, disease, recovery, and minimizing losses in 2018 in flood-impacted orchards. Previous flood articles written in 2017 newsletter issues can be viewed at sacvalleyorchards.com/walnuts.

Key factors/conditions leading to survival or mortality of flooded trees

- Dormant trees often survive winter flooding due to low soil temperatures, low root respiration, cold water, and a lack of active roots. Walnut root activity begins about a month after leaf out, which is in May for Chandler, and peaks in the summer. Last year, however, many orchards were still flooded into May or even longer.
- Thousands of trees died as a result of waterlogging ("anoxia", meaning lack of oxygen), mainly next to the levees, but many trees survived these conditions. Why? In many cases, temperature or continued water movement maintained high enough levels of oxygen in the water that roots could still survive. Except for low areas and swales where stagnate water remained into summer, the water was cold. Cold water holds more oxygen than warm water and oxygen is essential to generate energy and growth in roots. Also, orchards in river bottoms and near rivers where seepage occurred are often on lighter sandy or sandy loam soils and oxygen diffuses more readily through lighter soils compared to clay soils. Additionally, water moving as a result of river flow, pumping, or trenching tends to contain more oxygen than stagnant water, thereby enabling tree survival.
- Survival rate was poor where the water table was still close to the surface at the end of summer.
- Shoots from adventitious buds were seen in late June continuing through the summer/ fall on many waterlogged trees. These latent buds sprout when needed from trunks, limbs, or roots. Trees with vigorous shoot growth from these buds especially in the lower limb/upper trunk area in late summer/fall often have the best chance of survival the year after flooding. (see last section).

Research Results

Our approach was to study two potential problems of concern: 1) diseases caused by *Phytophthora* and 2) impact of waterlogging (anoxia) on the root system.

- *2017 Phytophthora* results in the Feather River bottoms where walnut trees were partially submerged for prolonged periods.
    - Water sampling: Since we know the "water mold" *Phytophthora* is found in surface water and infested soils, we sampled water in the Sacramento and Feather Rivers, in swales of standing flood water in the Feather River bottoms, and in seepage water from under levees along both rivers for the presence of *Phytophthora* in May 2017. High-throughput sequencing of DNA extracted from the water samples will be used to detect and identify species of *Phytophthora* present in the water (in progress).
    - Tree trunk and rootstock samples: We isolated *Phytophthora citricola* and *P. gonapodyides* from bleeding rootstock and aerial trunk cankers sampled in mid-May and August (Photos 1 & 2). Trees differed in severity of infection with some almost girdled by cankers. Last fall, the crowns of most infected trees still looked fine but we will monitor these sites for declining trees through the summer to determine how damaging this disease will be.

- Impact of long-term (January to early May) waterlogging (anoxia or oxygen starvation) from continued seepage on walnut root health.
    - Root sampling in a fourth leaf Chandler orchard on RX1 rootstock: Some flooded Chandler trees leafed out about a month later while most failed to push by the end of June when roots were sampled using soil cores. However, RX1 rootstocks with failed grafts were growing vigorously. Standing water was only 25 inches below the soil surface. Soil cores to 20 inches depth were taken by Chandler trees on higher ground outside the seepage zone, as well as Chandler trees that had failed to push and ungrafted trees with pushing rootstock, both in the seepage zone (Photos 3-5).
    - Chandler-grafted trees that were in the seepage water zone did not push and had much lower standing root length (root length per volume of soil) than Chandler trees on higher ground. These seepage zone Chandler trees also had much greater average root diameter, suggesting that fine roots had either not been produced or had decayed. In contrast, rootstocks with a failed graft located in the seepage zone had greater standing root length than Chandler trees on the higher ground. Below 8 inches soil depth, these rootstock-only trees in the seepage area had similar standing root length as the Chandler trees on higher ground, but they had much greater standing root length at the shallower 0-8-inch depth.
    - These data indicate that more research is needed on the resistance of different rootstocks under waterlogged conditions.

Minimizing losses in 2018

Trees infected with aerial Phytophthora:

- We advocate a "wait and see" approach, keeping trees as long as they are economically productive.
- Trees girdled or nearly girdled with *Phytophthora* may not survive, but some scion cankers may stop or "die out" in heat.
- In previous research, phosphonate (also known as phosphite) treatments were found to suppress canker expansion caused by *Phytophthora citricola*.
- It is advisable to replace trees killed by *Phytophthora* with clonal Paradox RX1 rootstock, which offers resistance to the pathogen.

Trees affected by waterlogging:

- In saturated soils, fine roots die, and depending on the extent of flooding, larger roots can die as well. It takes time for the root system to regain functionality and re-start new fine root production after flooding.
- Consider topping trees with vigorous shoot growth on lower limbs. From grower experience, these trees often recover by producing new shoot growth and it's usually obvious within the season if a topped tree will respond and grow or not (Photo 6). In contrast, trees that have very little **new** shoot growth (Photo 7) often don't survive the season after flooding so topping is unlikely to promote tree survival.

When to start irrigating: (see irrigation article)

- In many cases, root growth may still be rebounding from root death last season. Keep in mind that flooded orchards are likely dealing with a shallower, less developed root system than in previous years.
- Where water tables remain high, consider the following points:
    - Capillary rise is the process by which water moves into soil above a water table resulting in soil in this zone being above field capacity. In medium loam to fine clay, expect approximately 3 feet of capillary rise. The finer the soil texture the farther up water can move by capillary rise but the slower the rate of movement.
    - It is easy to saturate the soil, particularly when the water table is close, so irrigate judiciously, ideally using both soil moisture monitoring and plant pressure chamber data to aid in determining irrigation duration and frequency.
    - Water management in such settings is very difficult. Carefully monitor soil water levels using Watermark® or other soil moisture sensors installed at different depths. Soil-based monitoring will let you know the level where the soil is saturated as the water level drops, as well as the amount of water that is being moved up above this level of saturation by capillary rise.
- When using pressure chamber measurements, do not irrigate until trees are at least 2-3 bars below the fully watered baseline (more dry) and only irrigate enough to bring the trees back up to about 1 to 1.5 bars below the baseline. Be aware that pressure chamber measurements may not be appropriate where roots have been compromised, as the observed water stress in the tree may be the result of the inability of the root system to take up water rather than low water availability in the soil. Irrigating under those conditions would only serve to compromise the root system further.
- Where trees have been topped or have new shoot growth, apply nitrogen fertilizer in small amounts during May through early August when roots are active. Topped trees will have no crop until the following year so little nitrogen is being removed this season.

Photos 1 & 2 (By Janine Hasey).

Bleeding cankers associated with aerial Phytophthora on a river bottom walnut tree (taken in August 2017).

Photos 3-5 (By Astrid Volder) Chandler on RX1 (4th leaf) – soil cores collected on June 29, 2017. There was standing water at 25" soil depth.

Trees located on higher ground

Trees failing to push in the seepage zone

Graft failure RX1 trees with growth in the seepage zone

Photos 6 & 7. (By Janine Hasey)

Top/Head this tree where indicated by red line.

Topping/heading this tree is unlikely to help in tree survival.

Tree and Vine Crop Herbicide Chart – Updated (2018)

Here's the most updated tree and vine crop herbicide chart organized by Brad Hanson, UCCE Weed Science Specialist and Mariano Galla, Agronomy & Weed Science Farm Advisor in Glenn, Butte and Tehama Counties. What's new in 2018? Mission was registered on walnut, pistachio and citrus; Pindar GT label was extended and now it can be used on stonefruit, pomegranate and olive; Treevix was registered on pomegranate and olive. Zeus (sulfentrazone) is under review by CDPR and currently is not registered in any tree and vine crop, but we anticipate that it will be registered again on several crops during 2018.

Remember that rotating and/or mixing herbicides with different modes of action (MOAs) is critical to good weed management, particularly of herbicide-resistant populations. Notes: R = registered, N = Not registered, NB = registered only for Non-Bearing. Always check the herbicide label before use.

Herbicide Registration on California Tree and Vine Crops *-(updated February 2018 - UC Weed Science)*

	Herbicide- Common Name *(example trade name)*	Site of Action Group[1]	Almond	Pecan	Pistachio	Walnut	Apple	Pear	Apricot	Cherry	Nectarine	Peach	Plum / Prune	Avocado	Citrus	Date	Fig	Grape	Kiwi	Olive	Pomegranate
			----- tree nut -------				- pome -		---------- stone fruit ---------												
Preemergence	dichlobenil (*Casoron*)	L / 20	N	N	N	N	R	R	N	R	N	N	N	N	N	N	N	R	N	N	N
	diuron *(Karmex,Diurex)*	C2 / 7	N	R	N	R	R	R	N	N	N	R	N	N	R	N	N	R	N	R	N
	EPTC *(Eptam)*	N / 8	R	N	N	R	N	N	N	N	N	N	N	N	R	N	N	N	N	N	N
	flazasulfuron *(Mission)*	B / 2	R	N	R	R	N	N	N	N	N	N	N	N	R	N	N	R	N	N	N
	flumioxazin *(Chateau)*	E / 14	R	R	R	R	R	R	R	R	R	R	R	NB	NB	N	NB	R	N	R	R
	indaziflam *(Alion)*	L / 29	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	R	N
	isoxaben *(Trellis)*	L / 21	R	R	R	R	NB	NB	NB	NB	NB	NB	NB	NB	NB	N	NB	R	NB	NB	NB
	mesotrione (*Broadworks*)	F2/27	R	R	R	R	N	N	N	N	R	N	R	N	R	N	N	N	N	N	N
	napropamide *(Devrinol)*	K3 / 15	R	N	N	N	N	N	N	N	N	N	N	N	N	N	N	R	R	N	N
	norflurazon *(Solicam)*	F1 / 12	R	R	N	R	R	R	R	R	R	R	R	R	R	N	N	R	N	N	N
	oryzalin (*Surflan*)	K1 / 3	R	R	R	R	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R
	oxyfluorfen (*Goal, GoalTender*)	E / 14	R	R	R	R	R	R	R	R	R	R	R	R	NB	R	R	R	R	R	R
	pendimethalin *(Prowl H2O)*	K1 / 3	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	R	R
	penoxsulam *(Pindar GT)*	B / 2	R	R	R	R	N	N	N	R	R	R	R	N	N	N	N	N	N	R	R
	pronamide *(Kerb)*	K1 / 3	N	N	N	N	R	R	R	R	R	R	R	N	N	N	N	R	N	N	N
	rimsulfuron *(Matrix)*	B / 2	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	N	N
	sulfentrazone *(Zeus)*	E / 14	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	R	N	N	N
	simazine *(Princep,Caliber 90)*	C1 / 5	R	R	N	R	R	R	N	R[2]	R	R	N	R	R	N	N	R	N	R	N
	trifluralin *(Treflan)*	K1 / 3	R	R	N	R	N	N	R	N	R	R	R	N	R	N	N	R	N	N	N
Postemergence	carfentrazone *(S hark)*	E / 14	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	clethodim (*SelectMax*)	A / 1	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	N	R	N	N	NB	N	NB	N
	2,4- D *(Clean- crop, Orchard Master)*	O / 4	R	R	R	R	R	R	R	R	R	R	R	N	N	N	N	R	N	N	N
	diquat *(Diquat)*	D / 22	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB
	fluazifop- p- butyl *(Fusilade)*	A / 1	NB	R	NB	NB	NB	NB	R	R	R	R	R	NB	R	NB	NB	R	N	NB	NB
	glyphosate *(Roundup)*	G / 9	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	glufosinate *(Rely 280)*	H / 10	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	R	N
	halosulfuron *(Sandea)*	B / 2	N	R	R	R	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	paraquat (*Gramoxone*)	D / 22	R	R	R	R	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R
	pelargonic acid *(Scythe)*	NC[3]	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	N
	pyraflufen *(Venue)*	E / 14	R	R	R	R	R	R	R	R	R	R	R	N	N	R	R	R	R	R	R
	saflufenacil *(Treevix)*	E / 14	R	N	R	R	R	R	N	N	N	N	N	N	R	N	N	N	N	R	R
	sethoxydim *(Poast)*	A / 1	R	R	R	R	R	R	R	R	R	R	NB	NB	R	NB	NB	R	N	NB	NB
Organic	Caprilic/Capric acid *(Suppress)*	NC[3]	R	R	R	R	R	R	R	R	R	R	R	R	R	N	N	R	R	N	R
	ammoniated fatty acids *(Final- San-*	NC[3]	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	d- limonene *(AvengerAG)*	NC[3]	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	N	N
	Ammonium nanoate *(Axxe)*	NC[3]	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	N

Notes: R = Registered, N = Not registered, NB = nonbearing. This chart is intended as a general guide only. Always consult a current label before using anyherbicide as labels change frequentlyand o ften contain special restrictions regarding use o f a company's product.

[1] Herbicide site o f action designations are according to the Herbicide Resistance Action Committee (letters) and the Weed Science Societyo f America (number) systems. NC = no accepted site o f action classification; these contact herbicides are general membrane disruptors.

[2] Simazine is registered on onlytart cherryin CA.

Weed susceptibilityinformation and themost up to date version o f this table can be found at the Weed Research and Information Center (http://wric.ucdavis.edu)