Sacramento Valley Walnut News

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In This Issue

Submitted by:

Janine Hasey
UCCE Farm Advisor
Sutter, Yuba and Colusa Counties

Orchard Management Considerations: Delayed Dormant through Early Summer

Danielle Lightle, UCCE Orchards Farm Advisor, Glenn, Butte, & Tehama Counties
Emily Symmes, UCCE Area IPM Advisor, Sacramento Valley
Richard Buchner, UCCE Farm Advisor, Tehama County

Cultural Management:

- ✓ For varieties susceptible (especially Tulare or Serr) to pistillate flower abscission (PFA), apply first ReTain® spray at 30-40% female flower bloom. The percent PFA and rate of bloom drives if a second spray is needed. ReTain® cannot be applied within 2 days of a copper application.
- ✓ The first nitrogen applications should wait until May. Roots don't take up nitrogen the first month after leaf-out. Nitrogen applied in April could leach with spring rains. For more on planning your nitrogen for the season: http://ceyolo.ucanr.edu/files/234760.pdf
- ✓ Foliar zinc applications (if needed) are applied shortly after full bloom when shoots are 6 to 10 inches long and followed with a second and third spray at 2 to 3 week intervals depending on deficiency severity.
- ✓ Take a pass through the orchard once the trees have leafed out to check for any large, dead wood that serve as inoculum sources for *Botryosphaeria*. It is easy to spot at this time of year but removal is best done when it is dry to avoid pruning wound infections. See article in this newsletter for latest information on Bot management, including effectiveness of chipping pruned wood.
- ✓ Perform irrigation system maintenance, checking for broken or clogged filters and emitters prior to the start of the irrigation season. Once irrigation has begun (*see article, this issue*), routinely check the system for any problems.

Weed Management:

- ✓ Survey orchards in late spring to early summer (after summer annuals have germinated) to identify any species that escaped previous control and to know if any perennials are present. This can help determine the best material(s) to use if treatment is needed. Use the UC IPM's spring weed survey form to know which weeds to look for and how: http://ipm.ucdavis.edu/PMG/C881/walnut-springweeds.pdf

Insect Management:

- ✓ **Navel orangeworm (NOW)**: Assuming adequate sanitation was completed in and around the orchard to minimize overwintering populations and early-season development sites, the best way to limit NOW damage at this point in the season is through good codling moth and blight management.

- ✓ **Codling moth**: Traps for codling moth should already be out (deployed in early March) to establish biofix. Check traps twice each week until biofix (moths found on consecutive trap check 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 (aerosols, hand-applied, flowables) and are becoming more affordable due to improvements in formulations, release rates, and release intervals. If using mating disruption, hang or apply disruptants ahead of historical biofix in your orchard.

- ✓ **Walnut scale**: Delayed-dormant treatments of insect growth regulators (IGRs) are effective to reduce scale populations. First, make sure treatment is warranted by assessing the orchard population, *especially* if you have treated for scale in recent years. The covers of walnut scales can adhere to branches long after the insect is dead. Remove the scale covers from a random sample of individuals. If the insect beneath is bright yellow and juicy, it is alive. If it is darker and flakes off easily, it is dead. Another option is to postpone treatment and monitor for crawlers in the spring, applying sprays when crawler emergence is detected. This approach can also indicate population abundance relative to prior seasons, which can help you determine whether treatments are necessary this year. Recent research has shown that walnut scale populations continue to be suppressed a full year after treatments. Thus, it is likely not necessary to treat for scale every year.

- ✓ **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.

- ✓ **Aphids**: Begin sampling for aphids in May, examining upper leaf surfaces for dusky-veined aphids and lower surface for walnut aphids. Walnut aphids are another case where 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), and 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.

- ✓ **Husk fly**: Place husk fly traps by June 1 and check twice weekly. Treat as needed according to trap increases or detection of eggs. A summary of adulticide efficacy for walnut husk fly provided by Bob Van Steenwyk, UCCE Entomology Specialist, can be found in a recent meeting presentation at: http://cesutter.ucanr.edu/Orchard_Crops_254/Walnuts_639/Walnut_Insects/.

Disease Management:

- ✓ **Blight**: Wet rainy conditions when walnut bud break occurs increases concern about walnut blight. Blight infection causes a black depressed lesion on the nut and kernel death as the bacteria invades the developing nut. Since California blight bacteria are resistant to copper, tank mixing with an EBDC material is required for control. First spray application timing is critical for successful disease control. Apply the first spray when 40% of buds are at the prayer stage (about 1 inch long). If blight pressure is high, as indicated by bud sample data or severe blight history, first application should be earlier, at about 20% prayer stage. Second applications are applied about 7 days later. The decision to apply additional sprays depends upon the disease risk, variety and weather predictions. Sprays perform by protecting susceptible tissue with an adequate rate of material so excellent spray coverage is essential. A complete walnut blight control discussion can be found at http://cetehama.ucanr.edu/files/23085.pdf.

- ✓ **Bot**: For the latest on managing *Botrysophaeria*, see article in this newsletter.
- ✓ The latest version of the FUNGICIDES, BACTERICIDES, AND BIOLOGICALS FOR DECIDUOUS TREE FRUIT, NUT, STRAWBERRY, AND VINE CROPS is now available at: http://www.ipm.ucanr.edu/PDF/PMG/fungicideefficacytiming.pdf.

The Latest on Managing Bot Canker and Blight – 2015 Research Updates

Janine Hasey, UCCE Farm Advisor, Sutter/Yuba/Colusa Counties
Katherine Pope, UCCE Farm Advisor, Sacramento, Solano and Yolo Counties
Themis Michailides, Plant Pathologist, UC Kearney Research and Extension Center, Parlier

Bot Background

Botryosphaeria (Bot) canker and blight of walnut continued to be a problem through the drought so be alert to disease spread this spring and summer from El Niño rains. Bot reduces yields by killing small fruit wood and large branches and directly infecting the nut. It is most obviously seen in walnut orchards as blighted shoots (dead branches with the leaves still stuck on), blighted twigs (dead, darkened and shriveled) and fruit with the entire hull blackened but still on the tree. Fruit can also be infected early in the season from latent infection, but the tissue death won't be visible until late summer/early fall.

The focus of this article is on 2015 research findings. For more information on the disease, photos, and 2014 fungicide trial results, go to http://cesutter.ucanr.edu/newsletters/Sacramento_Valley_Walnut_News55088.pdf

Spore types

There are two types of spores - the more common water-borne pycnidiospores, and the wind-borne ascospores. Practically-speaking, this means Bot can *spread* by spores dripping and splashing OR by blowing around in the orchard, depending on spore type. Both types need water to trigger infection. Photo 1shows Bot spores oozing out of pycnidia (spore bearing structure) that have grown under the surface of infected wood.

Environmental conditions needed

Bot infection requires susceptible tissue, infective Bot spores and the right environmental conditions - at least ¼" of rain (or irrigation water directly on susceptible tissue) and temperatures at or over 50°F.

What's New –2015

Pruning Wounds & Bot: *Pruning wounds in medium-to-large wood (3- and 4- year old branches) are susceptible to infection for at least* ***four months after the pruning cut is made****.*

- Dr. Michailides pruned branches in early February and inoculated with Bot spores at different intervals over four months.
- For one- and two-year old wood, cankers that grew from pruning wounds were no different in length from the control, indicating that pruning does not make these tissues more susceptible to Bot.
- However, three- and four-year old wood had much longer cankers than control branches even up to **four months** later. It is suspected that the hollow pith inside older walnut branches provide a haven for infection and spore growth.
- Spraying pruning wounds did not consistently reduce infection. Spraying fungicides on pruning wounds inoculated with two different Bot species indicated that two fungicide treatments show promise as tools for reducing Bot canker growth on pruning wounds. Research into this is ongoing.

Fungicide Spray Timing:

If only applying ***one spray, June and July*** *had the most effect (under a low-disease year).*

- Merivon was sprayed just once at bloom, mid-May, mid-June, mid-July, mid-August or post-harvest. Both the mid-June and mid-July sprays significantly decreased blighted shoots when compared with no spray treatment. Research on one spray timing will be repeated in 2016.

Spraying three-to-four times reduces Bot blight more than one spray.

- The best control was achieved in a Butte County trial using the Leaf Wetness Model (LWM) by spraying only when there were environmental conditions conducive to disease (≥¼" rain and temperatures were ≥50° F which occurred April 9, April 26 and Sept 17).
- Equal control was achieved to the LWM using 4 sprays: April (bloom)+May+June+July or May+June+July+November (post-harvest).
- Nutlet stage + May + June + July reduced blighted shoots by about 10 percent compared to the control in a Yuba County trial.

Some fungicides have been fairly consistent in their efficacy.

- There are several fungicides that have reduced blighted spurs compared to the control. These results are fairly consistent with the 2014 trial in the same orchard.
- Fungicide efficacy can be seen at http://www.ipm.ucanr.edu/PDF/PMG/fungicideefficacytiming.pdf.

Chipping and Bot Inoculum: *Chipping pruned wood reduced ability to cause infection by two-thirds, but removal is still best option in light to medium infected orchards.*

- Infected dead wood was pruned, chipped and left on the orchard floor, then sampled regularly for pycnidia presence and spore viability in a Solano County trial.
- Chipping the wood decreased pycnidia presence by 2/3 below those in the unchipped control by the end of the season. However, an average 30 percent of the pycnidia on chipped wood could still produce spores with almost 100% viability by the end of the summer.
- More research is needed to determine whether pycnidia will overwinter in chipped prunings following winter rains.
- Chipping Bot infected wood cannot be relied upon as the only means of disease control.
- When Bot blight is in low levels in an orchard do not chip prunings but remove from the orchard and "destroy" them.

Photo 1. Pycnidia oozing toothpaste-like spores.
Photo by Themis Michailides

Walnuts: When to Begin the Irrigation Season

Allan Fulton, UCCE Farm Advisor, Tehama, Glenn, Colusa and Shasta Counties
Bruce Lampinen, Extension Specialist, UC Davis
Ken Shackel, Pomology Professor, UC Davis

Overly aggressive, early irrigation can saturate soils and deprive roots of necessary oxygen to grow. Soil fungal pathogens such as Phytophthora thrive in saturated soils and infect tree roots. The result is declining tree health, productivity, and higher incidence of tree death.

Delaying the start of irrigation too long can result in trees that are stressed from the lack of water. Impacts may include smaller walnuts and modest declines in yield as a result of lower kernel weight. When delays in spring irrigation are followed by inadequate irrigation in the summer and fall, it may lead to higher crop water stress and more impact on kernel weight, color, and bud development for next year's crop.

Experimenting with Irrigation Start Date

Table 1 summarizes the effect of timing the start of irrigation on Chandler/Paradox walnut yield and nut weight responses in an ongoing irrigation experiment in Tehama County. A randomized and replicated experiment has been underway since 2014. The soils are Columbia silt loam and fine sandy loam. Preliminary results are given for 2015 after two consecutive seasons of evaluation. More seasons are needed to evaluate longer term effects on tree loss, orchard longevity, and consistency of production.

Table 1. Preliminary effects of orchard water stress levels on irrigation start date, dry in-shell yield, and relative water savings measured in 2015 (2nd year of experiment).

Tree Stress Just Before First Irrigation (bars below baseline)	Approximate Irrigation Start Date	Approximate Days After Leafout	Dry In-shell Yield (lbs/acre)	Yield Loss % of highest yield	Relative Water Savings (%)
At or Near Fully Irrigated Baseline[1]	Late April	25 to 30	5170 a [2]	0%	0
1.0	Mid to Late May	45 to 60	4970 ab	-4%	17
2.0	Early to Mid June	60 to 75	4510 ab	-13%	28
3.0	Mid to Late June	75 to 85	4350 ab	-16%	34
4.0	Late June to Early July	85 to 95	4170 b	-19%	25

[1] The fully irrigated baseline represents no tree water stress when soil moisture in the root zone is not depleted at all. The different irrigation start dates represent one bar steps below the fully irrigated baseline that are measured in the experiment with a pressure chamber.
[2] Dissimilar alphabetic letters indicate average yields that are significantly different.

In this experiment, a large window of time (more than 90 days after leafout) is being evaluated to observe the effect of irrigation start on Chandler walnut. Lower nut weight was the first statistically significant (large, highly repeatable) response observed as a result of delaying the start of irrigation. In 2014 (data not shown), nut weight declined significantly by 9 to 12 percent when irrigation was delayed past mid-June or 75 days after leafout. In 2015, nut weight declined even more significantly when the start of irrigation was delayed beyond mid-June or 60 to 75 days after leafout.

In 2014, there was no statistically significant decline in dry in-shell walnut yield (data not shown) across the broad window of irrigation start dates. In 2015, relative yields were only 4 percent lower when the first irrigation was delayed 45 to 60 days after leafout as compared to when the start of irrigation was delayed 25 to 30 days. Dry in-shell yields were not consistently low enough to be statistically different when the start of irrigation was delayed 60 to 75 days after leafout but the yield reductions averaged 13 percent lower and were economically important. When the irrigation start date was delayed more than 75 days after leafout, dry in-shell yield was consistently lower (averaging 16 to 19 percent less) and statistically and economically significant.

Despite worries by many that delaying the start of irrigation in the spring would result in depleted moisture leading to more severe stress later in the summer when cutoff for harvest occurs, this was not the case. The treatments that started irrigation in early to late June were actually less stressed following cutoff of irrigation for harvest than were the treatments that had initiated irrigation in late April. This suggests that the trees with delayed spring irrigation may have improved root growth and/or the spring vegetative growth slowed earlier in the season allowing more time to mature and, thus, stressed less at harvest. Delaying the start of irrigation until mid to late May resulted in a combination of minimal effects on yield and opportunity to save water.

More in-depth results from this experiment can be found in the report to the California Walnut Board, (http://ucanr.edu/repositoryfiles/2015-115-160270.pdf).

Review of this irrigation experiment is not intended to suggest that the start of the irrigation season can be delayed for long periods of time for every walnut orchard. It does indicate that there may be a 30 to 60 day window after leafout to begin irrigation. When optimized, it can protect tree root health from overirrigation, avoid too much crop stress from the lack of water, and reduce irrigation water needs and costs.

A variety of irrigation management tools can help make orchard specific decisions about when to begin the irrigation season. Using at least two of these monitoring tools in combination is encouraged because each tool has limitations.

Starting Based on ETc and Rainfall

One approach is to track estimates of evapotranspiration (ET) that reflect current weather and compare it to the amount of spring rainfall received since leafout. The first irrigation is not necessary until the cumulative ET exceeds the amount of spring rainfall received since leafout by at least the amount of water that will be applied in a typical irrigation event (usually 18 to 24 hours of irrigation). If there is concern about tree loss from root diseases and saturated soils, the first irrigation can be delayed even longer until the difference between cumulative ET and spring rainfall is equivalent to 2 to 4 irrigation events or 36 to 96 hours of irrigation. To acquire real-time ET reports during the irrigation season email aefulton@ucanr.edu for Tehama, Butte, and Glenn, jkhasey@ucanr.edu for Sutter and Colusa Counties, or kspope@ucanr.edu for Sacramento, Solano and Yolo Counties. This approach requires knowing the hourly water application rate of the irrigation system.

Starting Based on Soil Moisture

There are numerous manufacturers and providers of soil moisture sensing equipment. Some detect volumetric soil moisture content and some measure soil moisture tension. Soil moisture levels can be measured manually or automatically with dataloggers and delivered on demand via cellular and internet services. An important aspect of monitoring soil moisture depletion is placement of the soil sensors to achieve good representation of the root zone and soil variability. The decision to begin the irrigation season can be determined by comparing the amount of soil moisture depletion to the amount of irrigation that will be applied and balancing them. Irrigation should begin before 50 percent of the plant available soil moisture is depleted in the root zone.

Starting Based upon Orchard Water Status

The pressure chamber and midday stem water has been the state of the art for monitoring tree water stress for some time. Sustained levels approaching 2 bars below the fully irrigated baseline are a reasonable threshold to begin irrigation. A free on-line UC ANR Publication 8503 describes in detail how to use the pressure chamber to guide water management decisions in walnut.

New walnut variety 'Durham' released

Chuck Leslie, UC Davis Walnut Improvement Program, Dept. of Plant Sciences

The UC Davis Walnut Breeding Program has recently released a new walnut variety, 'Durham'.

'Durham' harvests mid-season, earlier than 'Chandler', with excellent kernel color, well-filled nuts, large plump kernels that are easily extracted in halves, and relatively late leafing and bloom dates. The large oval nuts are uniform in size with good strength, solid seals, and an attractive shell appearance suitable for alternate use in-shell. The expected low blight and kernel quality should be of particular interest to growers in the Sacramento Valley.

'Durham' kernels have large size and excellent color, averaging 95% light and extra light with a high proportion of extra light and averaging 55.4 RLI in trials. The uniform, oval-shaped nuts average 15.1 grams in weight and contain large 8.3 g kernels with excellent appearance. 'Durham' nuts average 55% kernel yield and are expected to produce a good proportion of kernel halves. The shells have a particularly attractive appearance which, in combination with the seal and shell strength and a harvest date earlier than Hartley, suggests dual use as an in-shell nut if desired.

'Durham' leafing, flowering, and harvest dates are similar to 'Tulare' but this variety has larger nuts, better fill and superior kernel color. 'Durham' is 100% laterally fruitful and leafs out a few days before 'Chandler' with a protandrous bloom habit (the catkins shed before the female bloom). Leafing and bloom are later than 'Solano' or 'Ivanhoe' and therefore provide better blight avoidance. Harvest timing is about ten days before 'Chandler'. Canopy structure in grower trials has been upright and without evidence of limb breakage to date. The 'Durham' tree appears to have average vigor and size at maturity, similar to 'Chandler'. Comparable orchard spacing would be suitable for 'Durham' and 'Chandler' can also serve as a pollenizer for this variety.

'Durham', known as selection UC93-028-20 prior to its release, results from a 1993 cross using PI159568, a USDA introduction from Afghanistan, for its nut size, fill, plump kernel shape, and reduced blight susceptibility and 'Chandler' as a parent for kernel color and yield. 'Durham' has performed well in regional selection test blocks in Butte, Yolo and Fresno counties and in grower trials in Butte, Sutter, Yolo, Stanislaus, and Merced counties. Grower feedback from trials has been very positive.

'Durham' is now commercially available and can be ordered from any licensed nursery.

Tree and Vine Crop Herbicide Chart – Updated

Rotating and/or mixing herbicides with different modes of action (MOAs) is critical to good weed management, particularly of herbicide-resistant populations. But MOAs and labeled crops are not always easy to keep track of. Brad Hanson, UCCE Weed Specialist, has organized a chart to help, with herbicide name, a common trade name, the site of action group and the crops for which an herbicide has been labeled for use. This chart is regularly updated at wric.ucdavis.edu/PDFs/T&V_herbicide_registration_chart.pdf. You can find the most recent copy of the chart below. This chart is a helpful tool, but remember that labels change often. Always check the herbicide label before use.

Herbicide Registration on California Tree and Vine Crops -*(updated March 2016 - 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	N	N	N	N	N	N	N	N	N	N	N	N	N	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	N	N	N	N	N	N	N	N	N	N	N	N
	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	R	R	N	N	N	N	N	N	N	N	R	N	N	R	N	N	N
	simazine *(Princep,Caliber 90)*	C1 / 5	R	R	N	R	R	R	N	R[4]	R	R	N	R	R	N	N	R	N	R	N
Postemergence	carfentrazone *(Shark)*	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
	clove oil *(Matratec)*	NC[3]	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	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
	d-limonene *(GreenMatch)*	NC[3]	R	R	R	R	R	R	R	R	R	R	R	N	R	N	R	R	R	N	N
	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	N	N	N	N	N	N	N	R	N	N	R	N	N	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	N	N
	sethoxydim *(Poast)*	A / 1	R	R	R	R	R	R	R	R	R	R	NB	NB	R	NB	NB	R	N	NB	NB

Notes: R = Registered, N = Not registered, NB = nonbearing. This chart is intended as a general guide only. Always consult a current label before using any herbicide as labels change frequently and often contain special restrictions regarding use of a company's product.