Brad Hanson
Cooperative Extension Weed Specialist

Weed Management

2020 Pistachio Production Short Course
Virtually!
11-12-20

University of California
Agriculture and Natural Resources
UCDAVIS
DEPARTMENT OF PLANT SCIENCES
College of Agricultural and Environmental Sciences


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Why control weeds?

- Compete for water, nutrients, and light with trees
- Interference is especially problematic during establishment years
- Can affect crop management, irrigation, and harvest operations
- Impacts on other pest problems
- Crop quality concerns?

Complex populations

- Rarely just one weed species present
  - Annual vs perennial vs biennial
  - Grass vs sedges vs broadleaf
- Time of emergence
  - Fall vs spring emergence vs year-round
- Reproductive strategy
  - Seed vs vegetative

Factors affecting orchard weeds

- Orchard age and arrangement
  - Shading and space capture
- Irrigation type, timing, and amount
  - Furrow, sprinklers, micros, drip
- Tillage practices
  - Berms, cross-disking, etc.
- Herbicide options
- Orchard access

Integrated weed management

- Using all available strategies to manage weed populations in a manner that is economically and environmentally sound.
  - cultural
  - mechanical
  - chemical

Goals of IWM

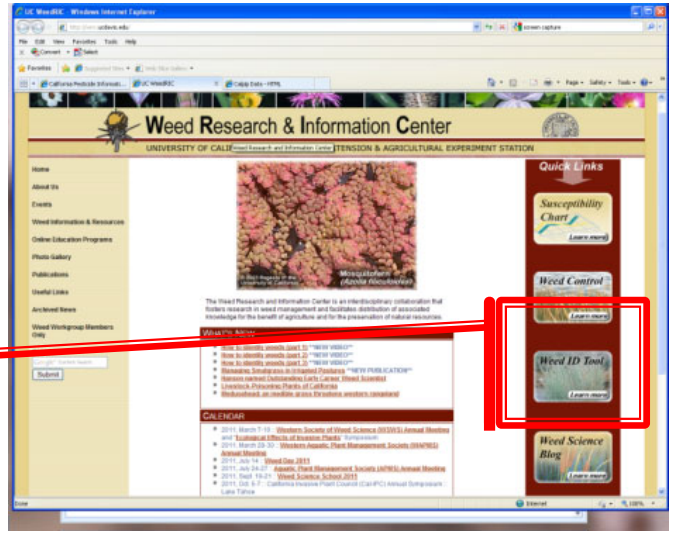
- Both short- and long-term goals
  - Prevent or reduce weed spread
  - Delay and/or suppress weed growth
  - Prevent or suppress weed seed production
  - Reduction of weed seed bank in soil

Weed identification

- Unknown weeds cannot be properly managed
  - No technique controls all weed species
  - Not all weeds cause equal damage (thresholds)
  - Species respond differently to control strategies
    - Even variants within a species (i.e. herbicide resistant biotypes)

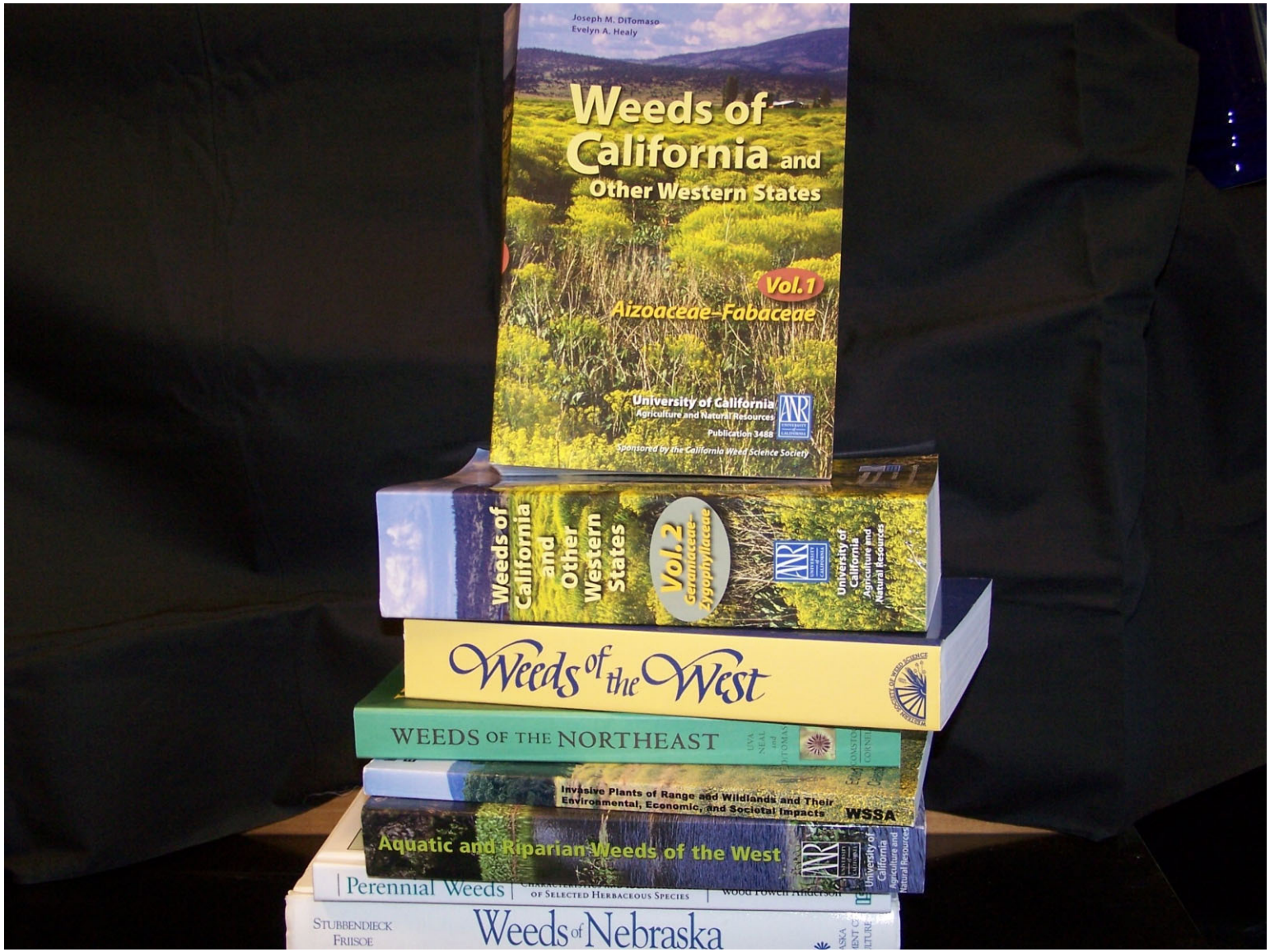
Weed Research and Info Center
http://wric.ucdavis.edu

Online weed ID tool



Weed ID books and pamphlets

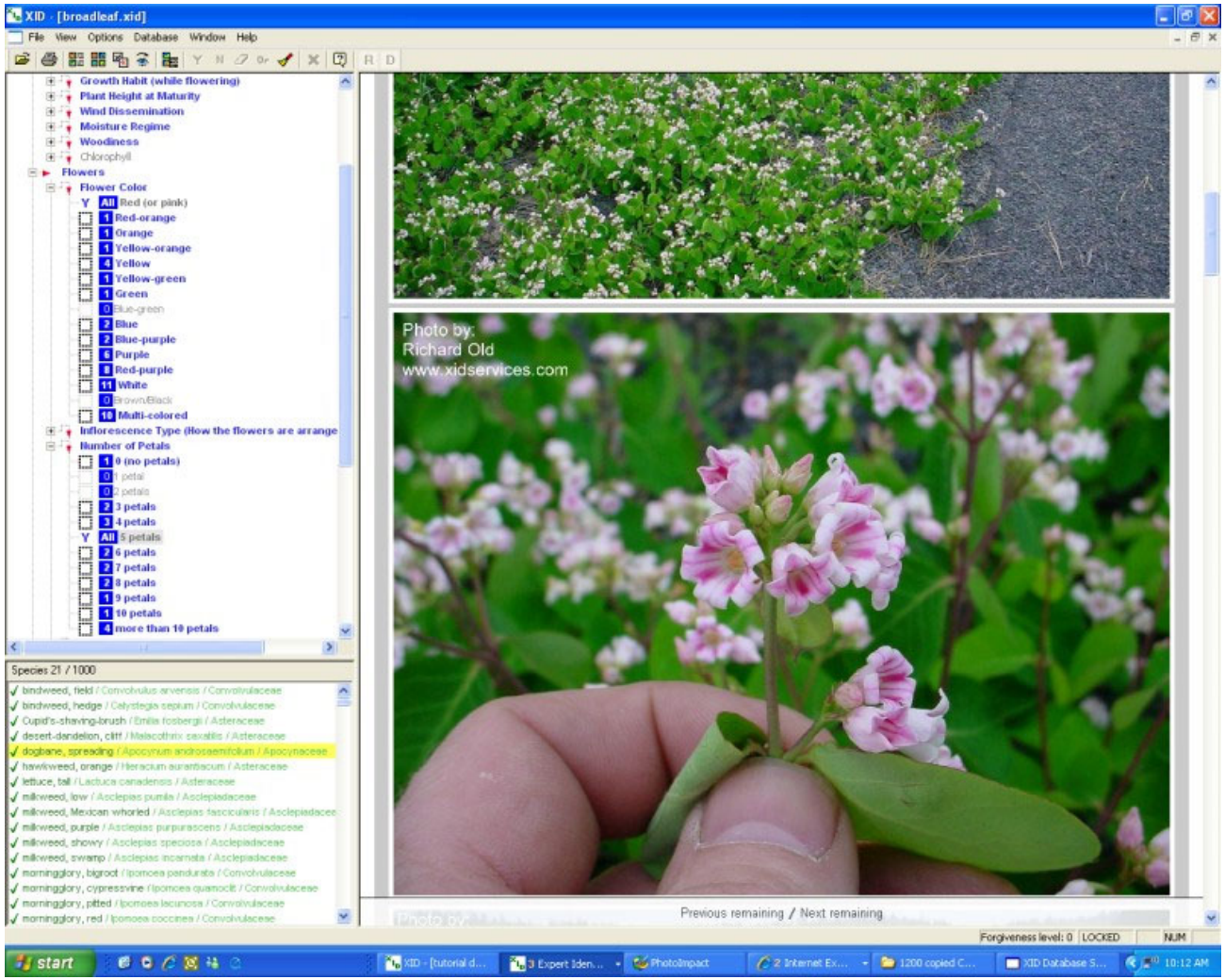
A number of weed books are available



Weed ID - software

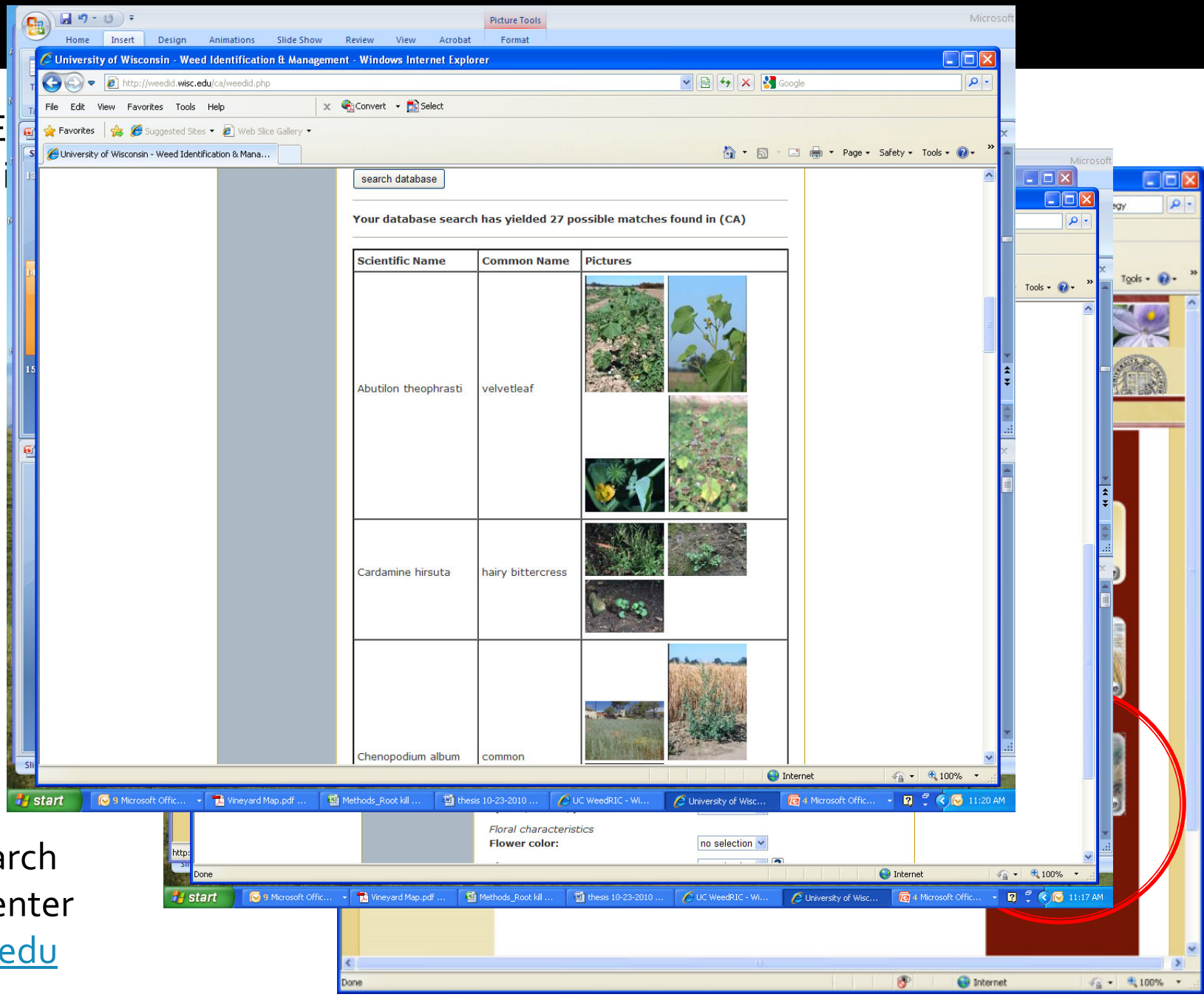
Several available.

I use a set by XID Services
-UC Davis
-WSSA
-WSWS
- others



Online weed ID resources

A few online (FRE
resources are avai

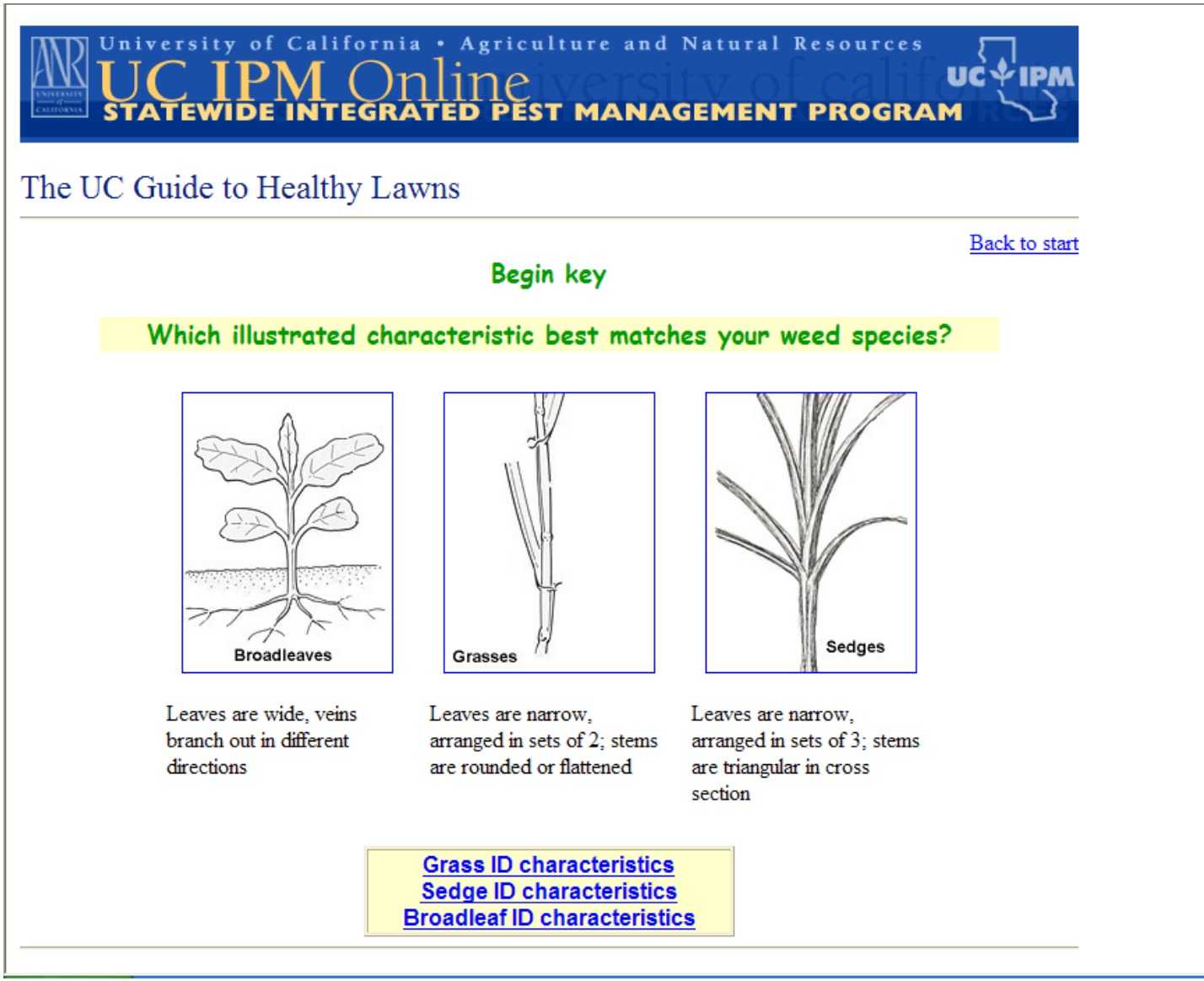


UC Davis Weed Research
and Information Center
www.wric.ucdavis.edu

Online weed ID resources

UC Integrated Pest Management Program

http://ipm.ucdavis.edu/PMG/menu.weeds.html



Weed management

- Orchard and vineyard floors divided into two management zones: middles and crop row
  - Zones may have very different strategies
  - Also may differ during the life of the orchard



How do we manage weeds?

- A few broad categories
  - Exclusion/sanitation
  - Cultural
  - Mechanical
  - Biological
  - Chemical

Sanitation

- Weed management should be an ongoing concern
  - Scout and manage in the orchard
  - Manage weeds on field margins and access roads
  - Clean equipment between sites
  - Scout and prevent seed set of "new" problems

Cultural practices

- Irrigation and fertilizer management
- Canopy management
- Cover crops
- Mulches
- Flaming
- Animals

Cover crops

Cover crop issues

ADVANTAGES

- Winter orchard access
- Reduced soil erosion
  - And pesticide and fertilizer runoff
- Addition of OM
- Soil structure and water/root penetration
- Competes with weeds

DISADVANTAGES

- Need to manage 2nd crop
  - More equipment
- Competes for water and nutrients
- Frost concerns
- Vertebrate and insect pests
- Addition of nutrients (N) may be unwanted (vineyard)

Flaming / heating

- Non-chemical
- High fuel cost
- Just need to "heat" not "burn" weeds
- Best on young broadleaf
- No residual control
- Danger of damage to young trees or vines and irrigation systems

Animals

- Animals can be used to manage vegetation in some cases
  - Can work very well … or very poorly
    - Expensive (own or rent?)
    - Management effort
    - Animal health and welfare limits weed control
    - Can damage trees or vines (buds) if left too long
    - Food safety concerns

Mechanical control

- Tillage / cultivation
- Mowing
- Hand labor

- T&V rows vs middles
  - equipment options and costs

Tillage/Cultivation

ADVANTAGES

- Non-chemical tactic
- Organic matter additions and nitrogen release
- Reduces competition for water
- Reduces frost potential
- Easy control in middles
- No "resistance"

DISADVANTAGES

- Fuel and time costs
- Trunk and root injury
- Dust
- Erosion
- Compaction
- Can spread seed and fragments
- Weeds near tree difficult
- Effects on tree vigor?

Mowing

- **Advantages.**
  - Suppresses weeds, reduces seed set
  - Orchard access and erosion benefits
- **Disadvantages.**
  - Frost potential
  - Weeds still use water and nutrients
  - Favors low growing and perennial weeds
  - Favors grasses *(advantages or disadvantages?)*
  - Cost of repeat operations (slow and frequent)

Chemical control

Herbicides

- CA orchards and vineyard herbicides usually applied to "strips" under the tree/vine row
  - 2-20 ft strip, may treat 20-50% of the floor
  - Middles managed with mowing, tillage, or less intensive herbicide program
  - Often with a "preharvest" broadcast application

Types of herbicides

- Preemergence (PRE)
  - Applied to bare soil and affect germinating seeds and seedlings
  - Provide residual effects (weeks or months)
- Postemergence (POST)
  - "Burn down" treatments applied to the foliage of emerged weeds
  - Can be "contact" or "translocated" materials
  - Some products have residual control, some do not

Factors affecting herbicide choice

- Availability in the crop (registration)
- Weeds to be controlled (weed ID)
- Toxicity and safety (to crop and non-target)
- Soil type and texture
- Cost

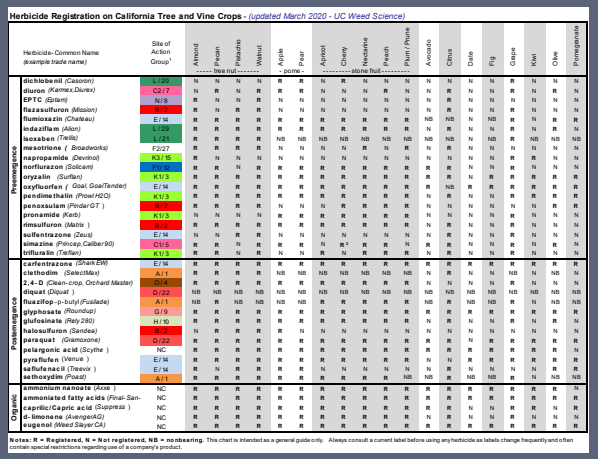
Herbicides registered in pistachio

Preemergence (PRE)

Mission
Chateau
Alion
Trellis
Broadworks
Surflan
Goal
Prowl H2O
Pindar GT
Matrix
Zeus

Postemergence (POST)

Shark
SelectMax
2,4-D
Diquat**
*Fusilade***
Glyphosate
Rely 280
Sandea
Gramoxone
Pelargonic acid
Venue
Treevix
Poast
+organic contact products



Herbicide Registration on California Tree and Vine Crops - *(updated March 2020 - 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,Durex)*	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	R	N	N	N	N	N	N	N
	flazasulfuron *(Mission)*	B / 2	R	N	R	R	N	N	N	N	N	N	N	R	N	N	R	N	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	N	NB	R	NB	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	R	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	N	N	N	R	N	N	N
	oryzalin *(Surflan)*	K1/ 3	R	R	R	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R
	oxyfluorfen *(Goal, GoalTender)*	E / 14	R	R	R	R	R	R	R	R	R	R	R	NB	R	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	R	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	N	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.2	R	R	N	R	R	N	N	R	N	R	N
	trifluralin *(Treflan)*	K1/ 3	R	R	R	R	N	N	R	R	R	R	R	N	R	N	N	R	N	N	N
Postemergence	**carfentrazone** *(Shark EW)*	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	R	R	R	R	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	NB	R	NB	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	R	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	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	pyraflufen *(Venue)*	E / 14	R	R	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R	R
	saflufenacil *(Treevix)*	E / 14	R	N	R	R	R	N	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	**ammonium nanoate** *(Axxe)*	NC	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	N
	ammoniated fatty acids *(Final-San-*	NC	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	caprilic/Capric acid *(Suppress)*	NC	R	R	R	R	R	R	R	R	R	R	R	R	R	N	N	R	N	R	R
	d- limonene *(AvengerAG)*	NC	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	N	N
	eugenol *(Weed Slayer CA)*	NC	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

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.

**Trade names for example only*

*** Registered in NB pistachio only*

CA pistachio herbicide use

	Top active ingredients (2017)	2011 treated acreage	2017 treated acreage
1	glyphosate	270,608	392,611
2	glufosinate (Rely 280)	54,223	144,085
3	oxyfluorfen (Goal, Goaltender)	104,900	141,966
4	saflufenacil (Treevix)	43,674	139,040
5	paraquat (Gramoxone)	27,725	84,066
6	pendimethalin (Prowl H2O)	47,393	65,302
7	rimsulfuron (Matrix)	21,791	42,164
8	indaziflam (Alion)	6,552	40,691
9	pyraflufen (Venue)	2,056	34,599
10	carfentrazone (Shark)	6,514	27,135
11	flumioxazin (Chateau)	28,224	22,435
12	penoxsulam (PindarGT)	16,017	20,459
13	clethodim (SelectMax)	284	16,887
14	oryzalin (Surflan)	29,951	12,296

* strip treatments!

Acreage: 2011 ~226k; 2017~335k

Conventional herbicides

ADVANTAGES

- Can be very cost effective (in some cases)
- Consistent results
- Ease of application (speed)
- Crop safety (generally)
- Erosion benefits (vs tillage)
- Season-long control with some products and combos
- Selectivity can be used to maintain desired cover

DISADVANTAGES

- Cost (in some cases)
- Potential for off-site movement with some products
- Regulations and record keeping
- Herbicide resistance can occur
- Crop injury can occur
- Some market sectors have preference against

Herbicide application considerations

- PRE, POST, or PRE/POST mix?
- Tank mixes
- Weed spectrum controlled
- Surfactants and adjuvants
- Coverage (GPA)
- Timing and weed size
- Sprayer calibration (esp. OC nozzles)
- Nozzle selection
- Litter and debris
- Check current herbicide labels
- Scouting and record keeping
- Training and PPE for handlers and applicators
- Potential for off-site movement?
- Double check calculations and recommendations!

Weed challenges in orchards

- Old favorites:
  - Normal mix of annual grasses and broadleaves
  - Challenge with perennial weeds, especially in new orchards or crops with fewer herbicide options
- New weed problems
  - Most of the "new" issues seem to be related to glyphosate resistance and/or shifting populations to tolerant species
- Changing control options
  - Less tillage, some new herbicides, water issues

Extra challenges in young orchards

- Crop less competitive with weeds
- Greater sensitivity to weed competition
- Greater sensitivity to injury from weed control tactics
- Fewer herbicides registered on new plantings

Orchard weed management

- Weed ID
  - Understand the problem and biology
- Use integrated management tactics
  - Cultural and mechanical approaches
  - Chemical tactics
    - Right herbicide, right target, right time
    - Resistance management considerations
    - Environmental impacts
      - VOC, surface water, ground water

Manage "your" weeds

- Weed management is an annual concern and production cost that must be considered in a local context
- No "one size fits all" solution for all orchards - integrated weed management requires systemic and long-term thinking

T&V herbicide registrations

Herbicide Registration on California Tree and Vine Crops - *(updated March 2020 - 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**	**R**	**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	**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** [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** *(Shark EW)*	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	**R**	**R**	**R**	**R**	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**	**R**	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	**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	**ammonium nanoate** *(Axxe)*	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N
	ammoniated fatty acids *(Final-San-*	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**
	caprilic/Capric acid *(Suppress)*	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	N	**R**	**R**	N	**R**
	d-limonene *(AvengerAG)*	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	N	**R**	N	N	**R**	N	N	N
	eugenol *(Weed Slayer CA)*	NC	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**

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.

Updated annually. Available online - easiest way is to find it is on the UC Weed Science blog

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