



# Discussing preemergence herbicide programs for vineyard systems

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University of California  
Agriculture and Natural Resources

**UCDAVIS**  
DEPARTMENT OF PLANT SCIENCES  
College of Agricultural and Environmental Sciences

# Weed research and extension

- Continuing focus on orchards and vineyards, but also working in some annual crops
  - Chemical weed management
  - Evaluating and managing herbicide resistance
  - Weed biology and mechanisms of resistance
  - Crop safety and herbicide registration research



# Herbicides

- CA vineyard herbicides usually applied to under vine strips
  - 2-5 ft strip, may treat 20-50% of vineyard floor
  - Middles managed with mowing and/or tillage



# 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



# 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



# T&V herbicide registrations

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

Herbicide- Common Name <i>(example trade name)</i>	Site of Action Group <sup>1</sup>	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 -----															
<b>Preemergence</b>																					
dichlobenil ( Casoron)	L/20	N	N	N	N	R	R	N	R	N	N	N	N	N	N	N	R	N	N	N	N
diuron (Kamex, Diurex)	C2/7	N	R	N	R	R	R	N	N	N	R	N	N	R	N	N	R	N	R	N	N
EPTC (Eptam)	N/8	R	N	N	R	N	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	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	R
indaziflam (Allion)	L/29	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	R	N	N
isoxaben (Trellis)	L/21	R	R	R	R	NB	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	N	N	N	N	R	N	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	N
norflurazon (Solicam)	F1/12	R	R	N	R	R	R	R	R	R	R	R	R	R	N	N	R	N	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	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	R
pendimethalin (ProwlH2O)	K1/3	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	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	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	N
rimsulfuron (Matrix )	B/2	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	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	N
simazine (Princep, Caliber 90)	C1/5	R	R	N	R	R	R	N	R <sup>2</sup>	R	R	N	R	R	N	N	R	N	R	N	N
trifluralin (Treflan)	K1/3	R	R	N	R	N	N	N	N	R	R	R	N	R	N	N	R	N	N	N	N
<b>Postemergence</b>																					
carfentrazone (S hark)	E/14	R	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	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	N
diquat (Diquat )	D/22	NB	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	NB
glyphosate (Roundup)	G/9	R	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	N
halosulfuron (Sandeia)	B/2	N	R	R	R	N	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	R
pelargonic acid (Scythe )	NC <sup>3</sup>	R	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	R	R	R	R	R	R	R	R
safinacil (Treevix )	E/14	R	N	R	R	R	R	N	N	N	N	N	N	R	N	N	N	N	R	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	NB
<b>Organic</b>																					
Caprylic/Capric acid (Suppress )	NC <sup>3</sup>	R	R	R	R	R	R	R	R	R	R	R	R	R	N	N	R	R	N	R	R
ammoniated fatty acids (Final-San-	NC <sup>3</sup>	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
d-limonene (AvengerAG )	NC <sup>3</sup>	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	N	N	N
Ammonium nanoate (Axxe )	NC <sup>3</sup>	R	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 any herbicide as labels change frequently and often contain special restrictions regarding use of a company's product.

<sup>1</sup> Herbicide site of action designations are according to the Herbicide Resistance Action Committee (letters) and the Weed Science Society of America (number) systems. NC = no accepted site of action classification; these contact herbicides are general membrane disruptors.

<sup>2</sup> Simazine is registered on only tart cherry in CA.

Weed susceptibility information and the most up to date version of this table can be found at the Weed Research and Information Center (<http://wric.ucdavis.edu>)

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

# Herbicides registered in grape

## *Preemergence (PRE)*

Casaron	Surflan
Diuron	Goal
Mission	Prowl
Chateau	Kerb
Alion	Matrix
Trellis	Zeus
Devrinol	Princep
Solicam	Treflan

## *Postemergence (POST)*

Shark	Rely 280
<i>SelectMax**</i>	Gramoxone
2,4-D	Venue
<i>Diquat**</i>	Poast
Fusilade	
Glyphosate	

## *Organic (POST)*

Suppress  
Final-San-O  
AvengerAG  
Axxe

*\*Trade names for example only*

*\*\* Registered in NB grape only*

# CA grape herbicide use (all grape)

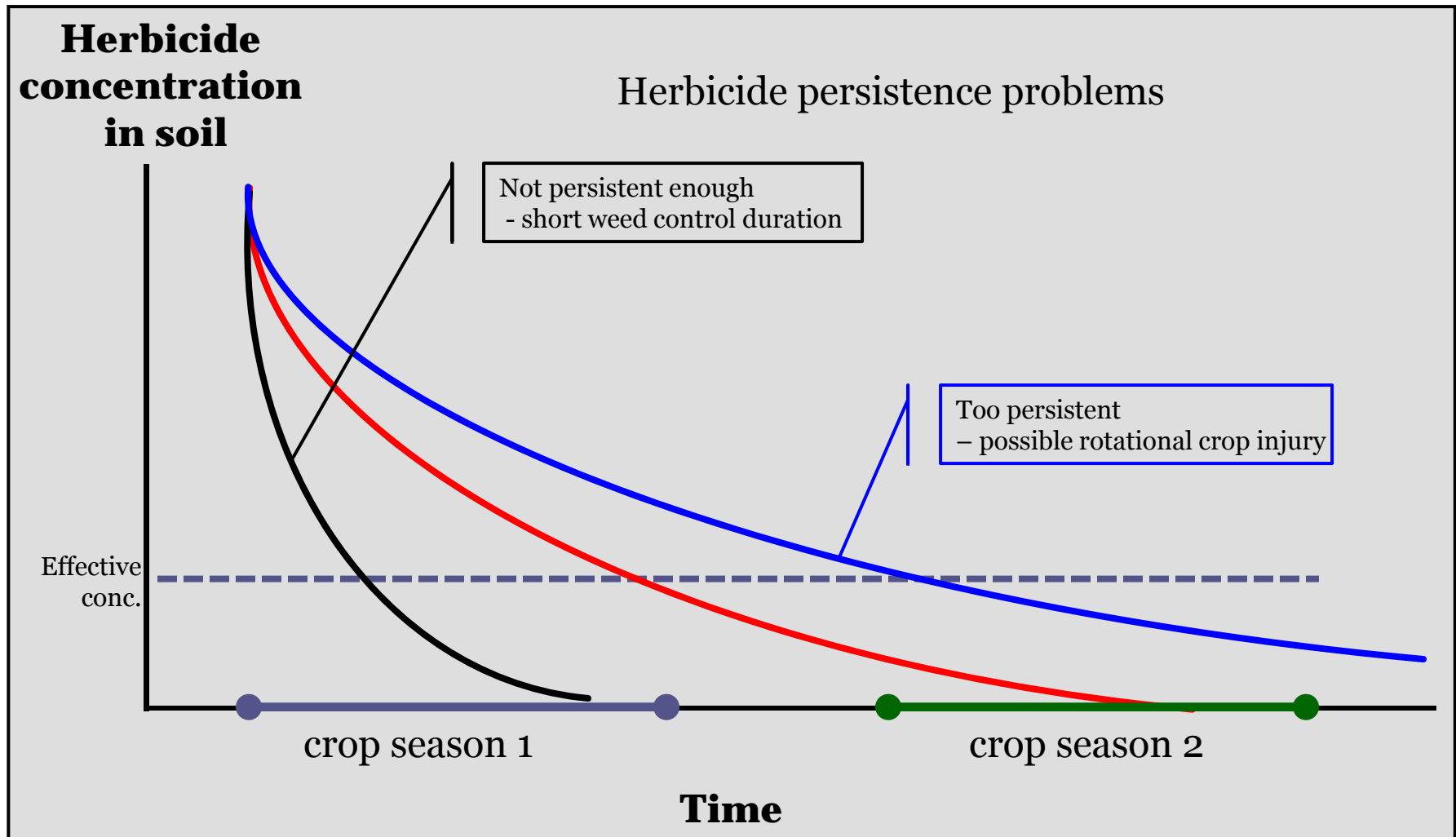
	Top 14 active ingredients (2015)	2014 treated acreage	2015 treated acreage
1	glyphosate	610,716	632,969
2	oxyfluorfen (Goal, Goaltender)	311,886	343,130
3	glufosinate (Rely)	141,727	314,216
4	paraquat (Gramoxone)	239,085	181,667
5	rimsulfuron (Matrix)	123,840	134,558
6	pendimethalin (Prowl H2O)	107,066	123,367
7	flumioxazin (Chateau)	93,510	121,960
8	pyraflufen (Venue)	139,827	111,609
9	indaziflam (Alion)	76,789	96,992
10	carfentrazone (Shark)	111,794	92,930
11	simazine (Princep)	68,482	49,923
12	oryzalin (Surflan, etc)	41,184	42,985
13	trifluralin (Treflan)	55,282	31,289
14	2,4-D	14,130	24,701

2014  
 615,000 A wine grapes  
 121,000 A table grapes  
 192,000 A raisin grape  
 1.2 million total acres 201

# How do PRE herbicides work?

- They are not soil sterilants and do not affect seed
- Most affect seedling right at germination or at very early growth stages
  - Absorbed by the seedling root, shoot, or both
  - Some translocate within the plant, others do not
- Balance among solid/liquid/gas phases of the soil.
  - Herbicide in the liquid phase is available for plant uptake.
  - Function of herbicide and soil chemistry and physical characteristics

# Soil active herbicides



# Registered PRE herbicides for CA vines

- ALS inhibitors:
  - Rimsulfuron, flazasulfuron
- PPO inhibitors
  - Flumioxazin, oxyfluorfen, sulfentrazone
- PSII inhibitors
  - Diuron, simazine
- Root mitotic inhibitors
  - Pendimethalin, oryzalin, pronamide, napropaminide, trifluralin
- Cellulose biosynthesis inhibitors
  - Indaziflam, isoxaben, dichlobenil
- Carotenoid inhibitors
  - Norflurazon

# CA grape herbicide use (all grape)

PRE?

	Top 14 active ingredients (2015)	2014 treated acreage	2015 treated acreage
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1.2 million total acres 201

# Herbicide evaluations

- Recent focus on residual herbicides
  - Several new products
    - Additional MOA for resistance management
  - Tank mixes and sequential applications
  - Also burn down partner comparisons





# Herbicide program opportunities

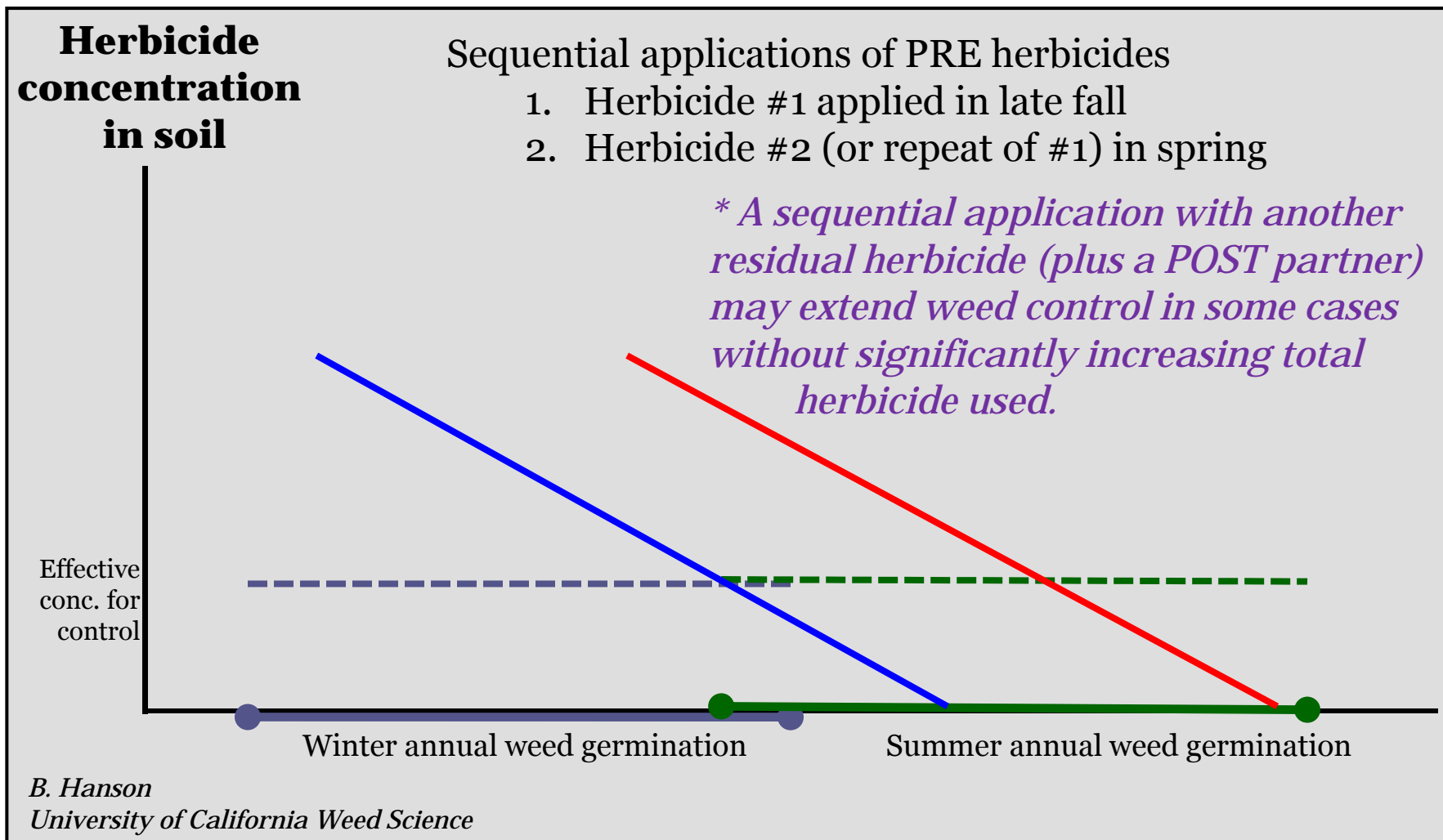
- Several new(er) PRE and POST active ingredients
  - Value of POST tankmixes being recognized
  - PRE herbicide programs increasingly important
- Sequential PRE programs to extend control
  - Focus on summer-emerging grasses
- Rethinking zone management strategies
  - Focused on glyphosate-tolerant perennial species



# Sequential PRE approaches

- The relatively new challenges with glyphosate-resistant summer weeds in orchard (less so in vineyards so far) systems may require some different approaches
- We have a number of herbicides available – can we use them more effectively for summer grasses?
  - Can we do it without minimal increases in herbicide load and cost?

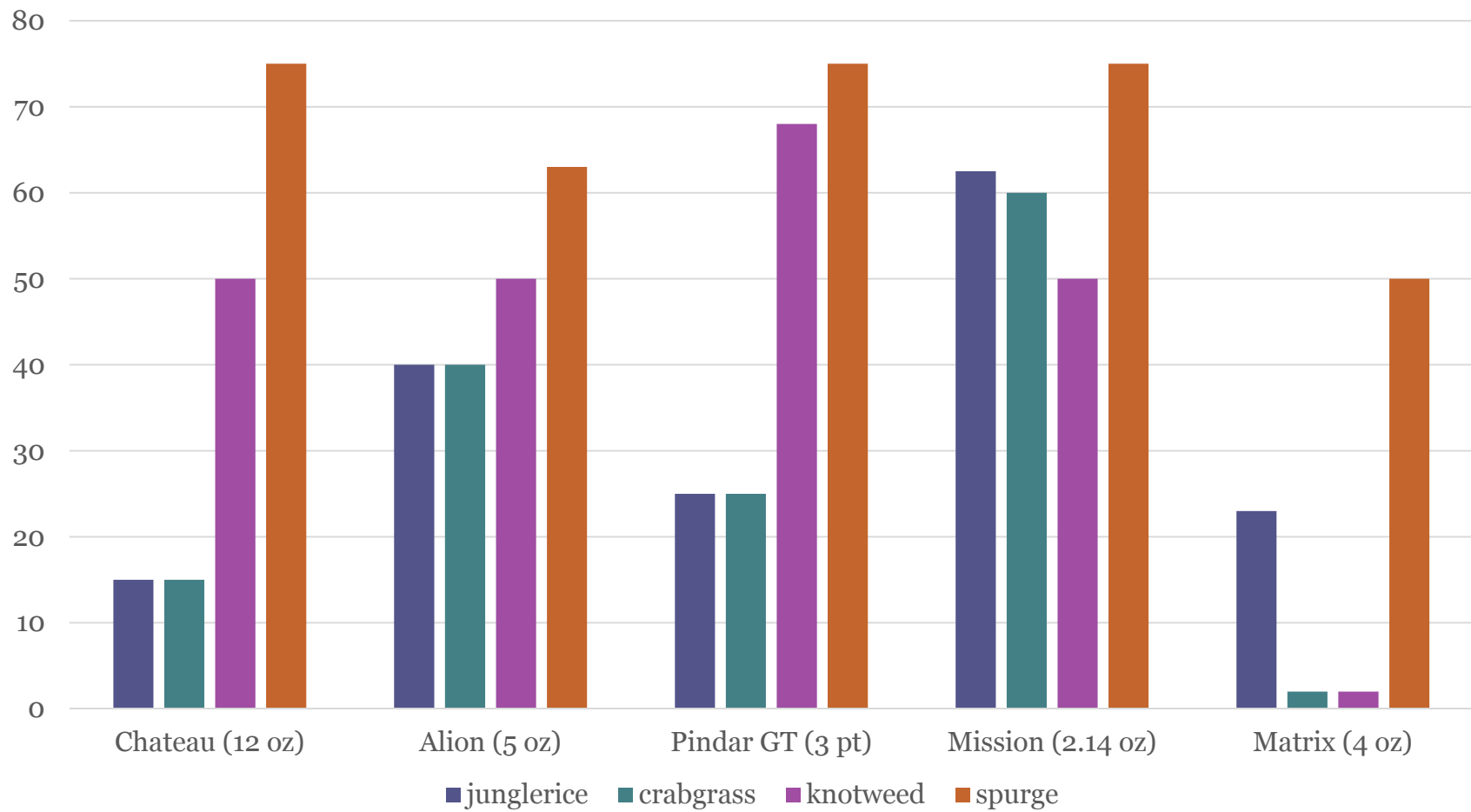
# Residual herbicide scenarios (2)



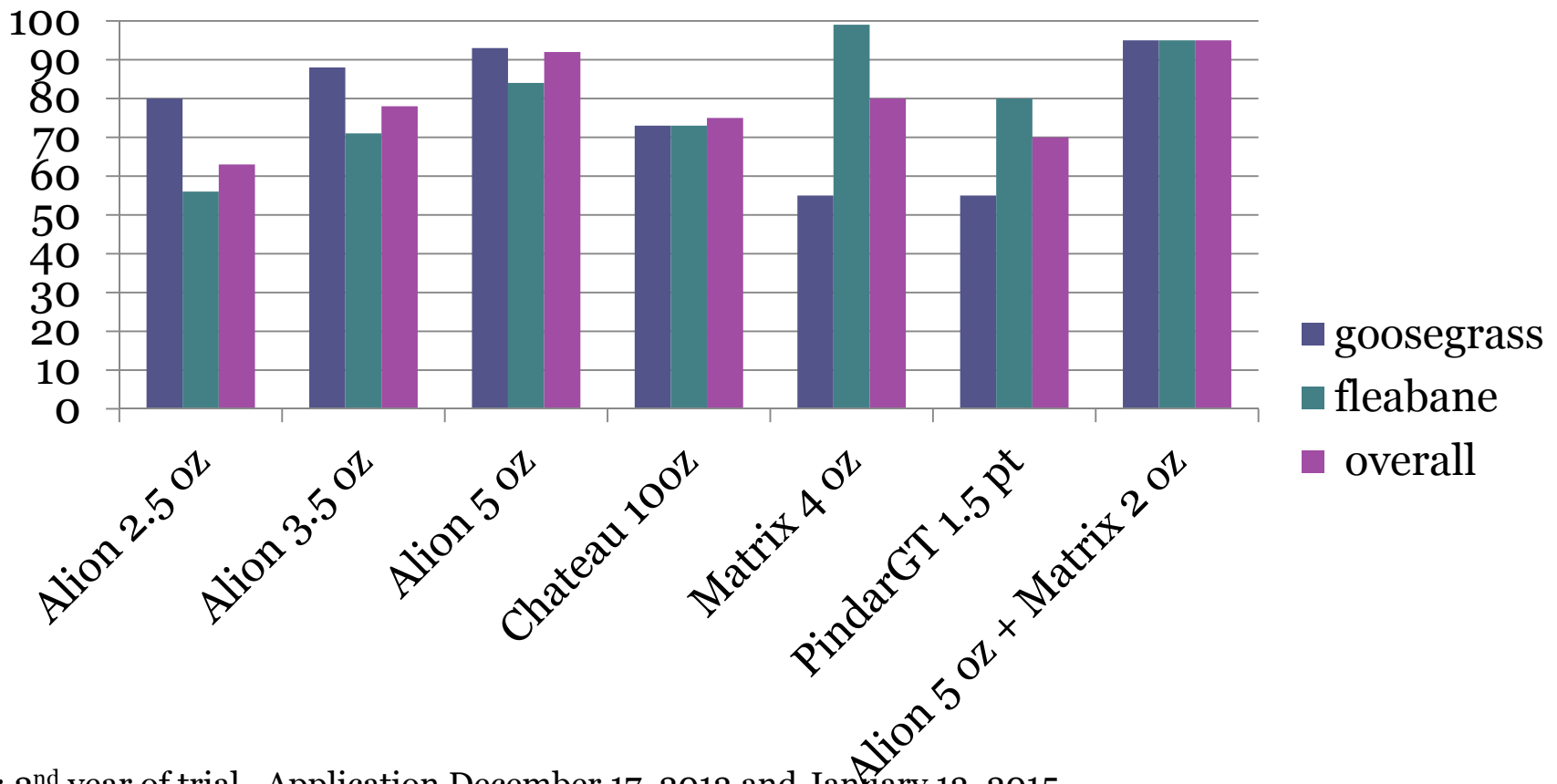
# Enough talk, let's see some data



## 2015-16 Davis almond site (Brunharo) – 122 DAT

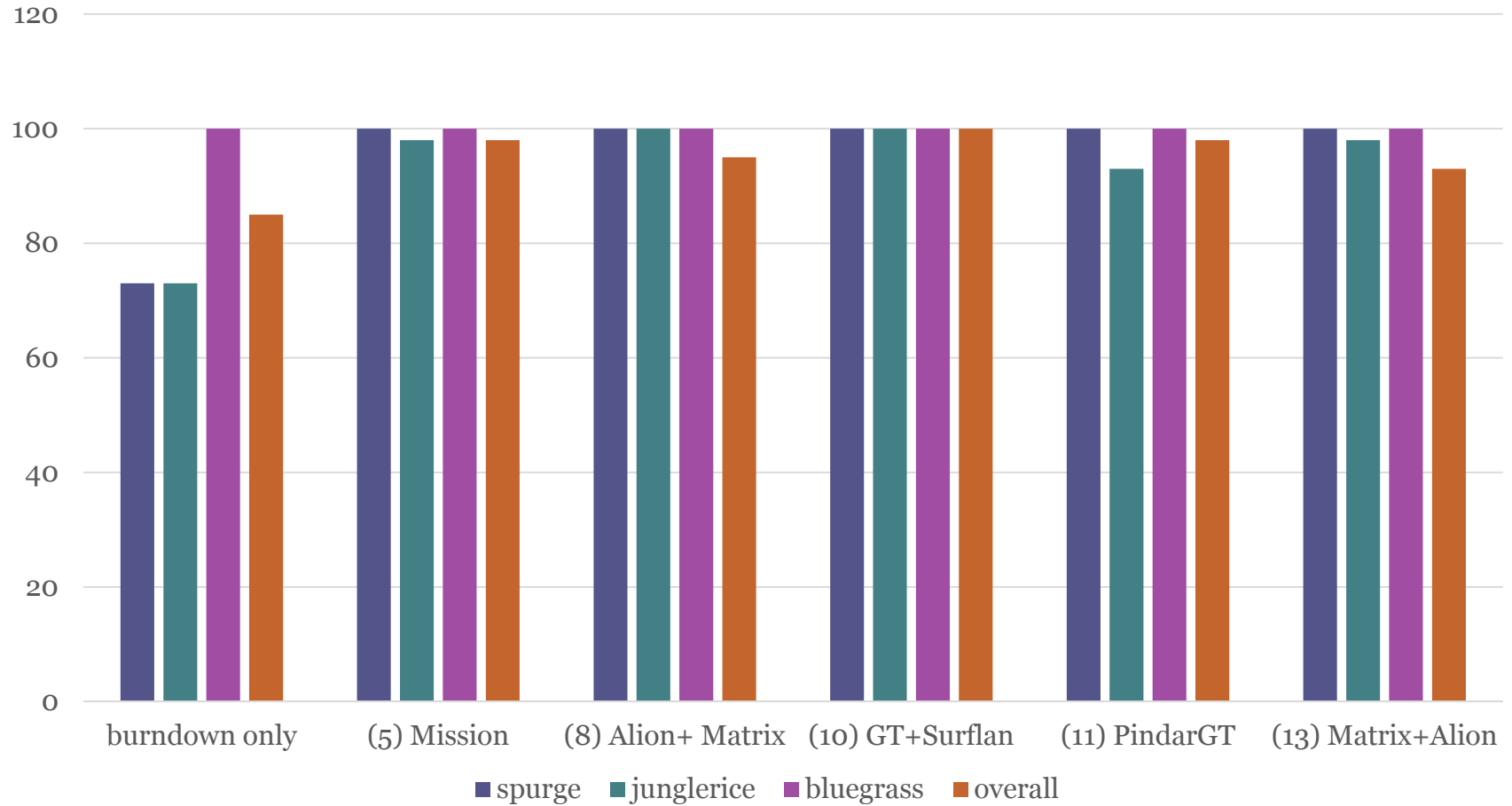


## Almond Alion tankmix trial 128 DAT (Escalon)



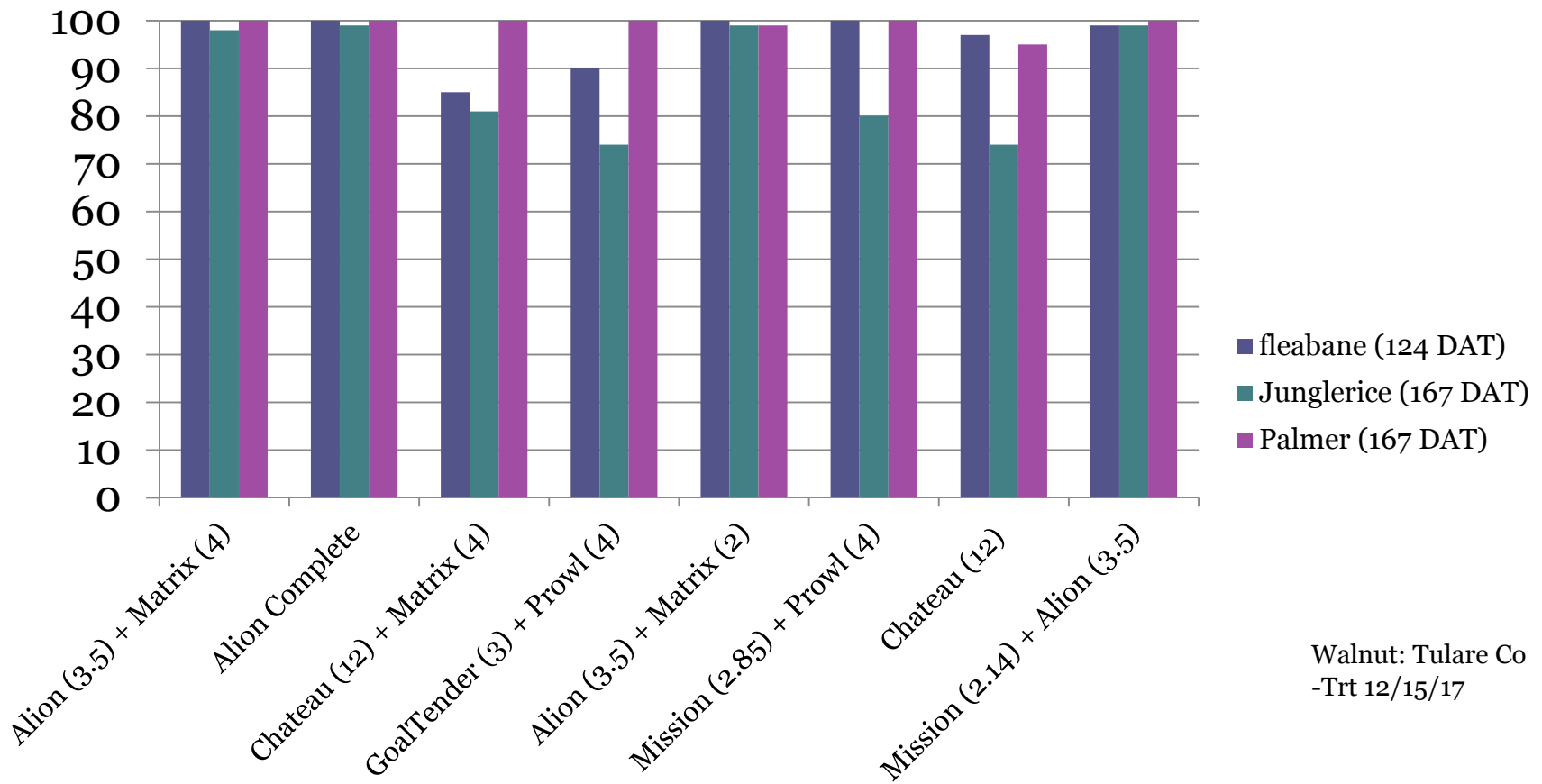
Note: 2<sup>nd</sup> year of trial. Application December 17, 2013 and January 13, 2015  
All treatments included glyphosate and glufosinate for burndown in both years.

## 2016-17 Davis almond site (Watkins) – 121 DAT





Gly/glu at PRE, plus glyphosate in March

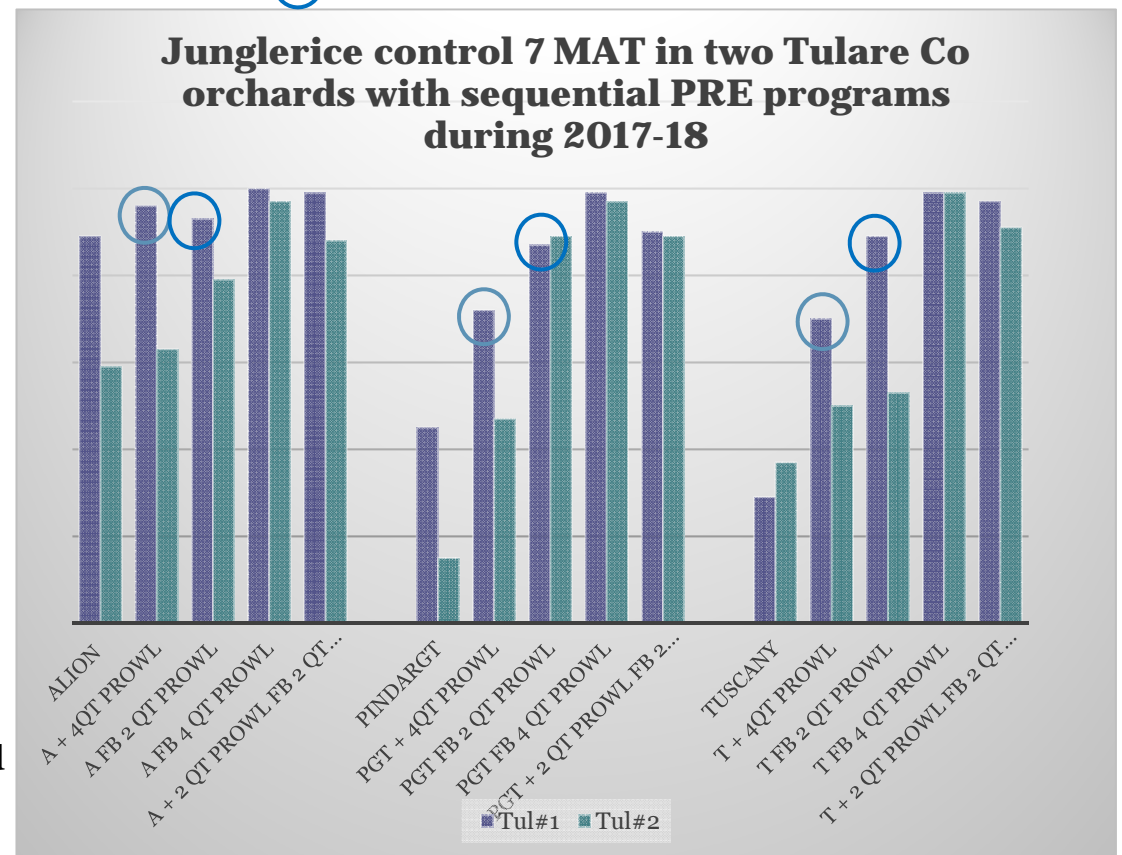
## PRE tankmix trial (Tulare)



# Example of a sequential approach

- Goal:
  1. control of winter weed complex
  2. and control of summer-emerging grasses
- Evaluated:
  - Sequential approach using a targeted PRE
  - Alion, PindarGT, and Tuscany as foundation
  - Added Prowl to help with grasses
    - 4 qt in winter with foundation
    - 2 qt in March
    - 4 qt in March
    - 2 qt in winter + 2 qt in spring
- -junglerice emerges ~May-Aug  
 -pendimethalin is effective on many grasses, but a high rate of pendimethalin in Dec is needed for it to “last” until July
- ? Can we use a lower rate but apply it later to achieve the same outcome (with economic and environmental benefits)?

 = foundation prog. tankmix w 4 qt Prowl H2O  
 = foundation prog. & seq 2 qt Prowl H2O





## Integrated Weed Management (IWM)

- All weed management choices, including doing nothing, have consequences
- Herbicides are tools that can provide efficient and effective weed control
- However, should not be the only tool considered.
- Instead herbicides better as part of an integrated management plan that fully considers the specific situation and recognizes the tradeoffs and opportunities of the available options

- The right tools, used well, and at the right time, make orchard weed management a much easier, cheaper, and effective proposition





# A few take home messages

- Good burndown programs are essential
- Heavy weed pressure may take several years to clean up (seed bank)
- We have several really good PRE herbicides available in trees and vines if we use them correctly
- Herbicide-soil contact is crucial for max efficacy
- MOA rotations for proactive resistance management
- May need sequential programs if facing both winter and summer weeds
- Consider middles management intensity
- More herbicide is not always the answer (crop safety, \$, and environ.)

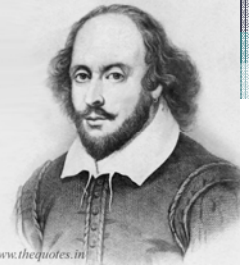
# Questions and discussion?

- I have a few potential categories...



To be, or not to be, that is  
the question.

*William Shakespeare*



www.thequotes.in

# What “age” is a new planting?

- What are the weed control (esp herbicide safety) considerations in new plantings?
  - “pot dormant”, “dormant green vine”, etc.
  - Sleeved young vines.
  - What is a “year old” plant with regards to herbicide label?

# 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



## In the news...

- Glyphosate as “probable carcinogen” in 2015
- IARC evaluation
  - New interpretation of existing data
  - Other agencies (USEPA, EU) previously interpreted these data – and more - differently
- What does this mean for CA ag?
  - Added to CA Prop 65 list in 2017
  - I anticipate relatively little near term impact (ag)\*

# Glyphosate likely to remain in the news

- Currently, a lot of litigation related to alleged glyphosate-caused cancer
  - Thousands (8-10k?) plaintiffs
- Several important cases in CA state and Federal court jurisdictions

If you or someone you know has been exposed to Roundup in any way and been diagnosed with cancer, your first step toward recovery against Monsanto is directly in front of you.



CALL TOLL-FREE AND SPEAK DIRECTLY TO AN ATTORNEY  
FREE CASE EVALUATION • NO OBLIGATION



## In the news (2)...

- EPA currently evaluating several important herbicides for trees and vines:
  - Paraquat – likely will see more changes in who can use and how it must be handled
  - Simazine – under even more scrutiny due to environmental concerns (mostly water-related)

# Herbicide symptomology website

The screenshot shows a web browser window displaying the website <http://herbicidesymptoms.ipm.ucanr.edu/>. The page features a navigation menu on the left with options like 'Home / Search', 'More Information', 'Herbicide Damage', 'Modes of Action', 'Herbicides (Active Ingredient & Trade Name List)', 'Plants', and 'About Us'. A 'Contact Information' box for Kassim Al-Khatib, Professor at the University of California, Davis, is also visible. The main content area is titled 'Home / Search' and includes a search bar and a 'Sample selection from gallery:' section. A dropdown menu is open under the 'Herbicides' tab, listing various herbicide names such as 2,4-D, EPTC, MCPA, MSMA, acetochlor, acifluorfen-Na, alachlor, aminopyralid, amtriole, atrazine, benfenf = benfuralin, bensulfuron-methyl, bensulfide, bentazon, bispynbac-Na, bromacil, bromoxynil, carfentrazone-ethyl, chlormuron-ethyl, chlorsulfuron, clothodim, clomazone, dlogrylid, cycloate, cyhalofop-butyl, dicamba, dichlobenil, dimethanamid, and dinoseb. The footer contains the University of California logo, 'Division of Agriculture and', 'Site Information', 'Get PDF Reader', and '© 2015 Regents of the University of California Nondiscrimination Statement'.

<http://herbicidesymptoms.ipm.ucanr.edu/>

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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	N	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 (ProwlH2O)	K1/3	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	R	R
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simazine (Princep, Caliber 90)	C1/5	R	R	N	R	R	R	N	R <sup>2</sup>	R	R	R	R	R	N	N	R	N	R	N
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<b>Postemergence</b>																				
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 <sup>3</sup>	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	R	R	R	R	R	R	R
safinacil (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
<b>Organic</b>																				
Caprylic/Capric acid (Suppress)	NC <sup>3</sup>	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 <sup>3</sup>	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
d-limonene (AvengerAG)	NC <sup>3</sup>	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	N	N
Ammonium nanoate (Axxe)	NC <sup>3</sup>	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 any herbicide as labels change frequently and often contain special restrictions regarding use of a company's product.

<sup>1</sup> Herbicide site of action designations are according to the Herbicide Resistance Action Committee (letters) and the Weed Science Society of America (number) systems. NC = no accepted site of action classification; these contact herbicides are general membrane disruptors.

<sup>2</sup> Simazine is registered on only tart cherry in CA.

Weed susceptibility information and the most up to date version of this table can be found at the Weed Research and Information Center (<http://wric.ucdavis.edu>)

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

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