Weed Management in Walnut Production

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Red Bluff, Ca

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Why Control Weeds?

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- direct competition

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- physical disruption of irrigation

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- direct competition
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- frost protection
- harbor other pests
- ease and quality of harvest

Annual Weeds

Grass weeds	Broadleaf weeds
annual bluegrass	cheeseweed-malva
barnyardgrass	groundsel
large crabgrass	mustards
fall panicum	horseweed
wild barley	pigweeds
wild oat	filaree
witchgrass	lambsquarter
annual ryegrass	purslane

Perennial Weeds

bermudagrass

curly dock

dallisgrass

dandelion

field bindweed

Johnsongrass

nutsedge

Basic Methods of Weed Control

Cultural and Mechanical

Chemical

Basic Methods of Weed Control

Cultural and Mechanical

- Disking
- Flaming
- Mulching (synthetic or organic)
- Hand hoeing
- Covercrop + Mowing

Disking

Advantages

no weed resistance

non-chemical

clean at harvest

Disking

Advantages	Disadvantages
no weed resistance	injury to tree
non-chemical	dust
clean at harvest	compaction


Suburban

Flaming

Advantages

no resistance

no residue

non ‘chemical’

Flaming

Advantages	Disadvantages
no resistance	timing important
no residue	(season and size)
non ‘chemical’	not as good on grass
	cost

Mulching

Advantages

no resistance

can last for years

retain moisture

Mulching

Advantages
no resistance
can last for years
Retain moisture

Disadvantage
can harbor pests
cost
difficulties at harvest
favors perennials
inconsistent control

Hand Hoeing

Advantage

Excellent control

No weed resistance

Non-chemical

Hand Tools

Hand Hoeing

Advantage	Disadvantage
Excellent control	Cost
No weed resistance	Time
Non-chemical	Availability of Labor

Covercrop + Mowing

Advantages

increased water penetration

competition with weeds

orchard access in winter

may increase beneficials

Covercrop + Mowing

Advantages

increased water penetration
competition with weeds
orchard access
in winter
beneficials

Disadvantages

favors low-growing and perennial weeds

leaves summer annuals at harvest

competition if growing near trees

Question: When is a weed not a weed?

Answer: When its resident vegetation

Basic Methods of Weed Control

Cultural and Mechanical

Chemical

Chemical Methods

- total herbicide treatments
- chemical mowing
- strip treatment

Herbicides registered for use in Walnuts

Pre-emergence

norflurazon

simizine

napropamide

oxyflurofen

flumioxazin

thiazopyr

oryzalin

pendimethalin

trifluralin

diuron

rimsulfuron

pronamide

Herbicides registered for use in Walnuts

Postemergence

MSMA
glufosinate
2,4-D
clethodim
fluaizifop

halosulfuron
glyphosate
paraquat
sethoxydim
carfentrazone

Chemical Control

Advantages

- Cost (in some cases)
- Consistent results
- Ease of Application
- Frost Protection
- Easy on tree roots

Chemical Control

Advantages

- Cost (in some cases)
- Consistent results
- Ease of Application
- Frost Protection
- Easy on Vines

Disadvantages

- Cost (in some cases)
- Possible drift damage
- Paperwork
- Resistance

Herbicide Resistance

"The inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide that would normally be lethal to the wild type"

from Prather, DiTomaso and Holt UCANR PUBLICATION #8012

Weeds with some Tolerance to Glyphosate

Annuals

- Green foxtail
- Annual morningglory
- Filaree
- Knotweed
- Stinging nettle
- Horseweed
- Cocklebur
- Puncturevine
- Clovers
- Vetch
- Bristly oxtongue
- Turkey Mullen

Perennials

- Curly Dock
- Bermudagrass
- Dandelion
- Cheeseweed
- Field Bindweed
- Nutsedges
- Buckhorn plantain

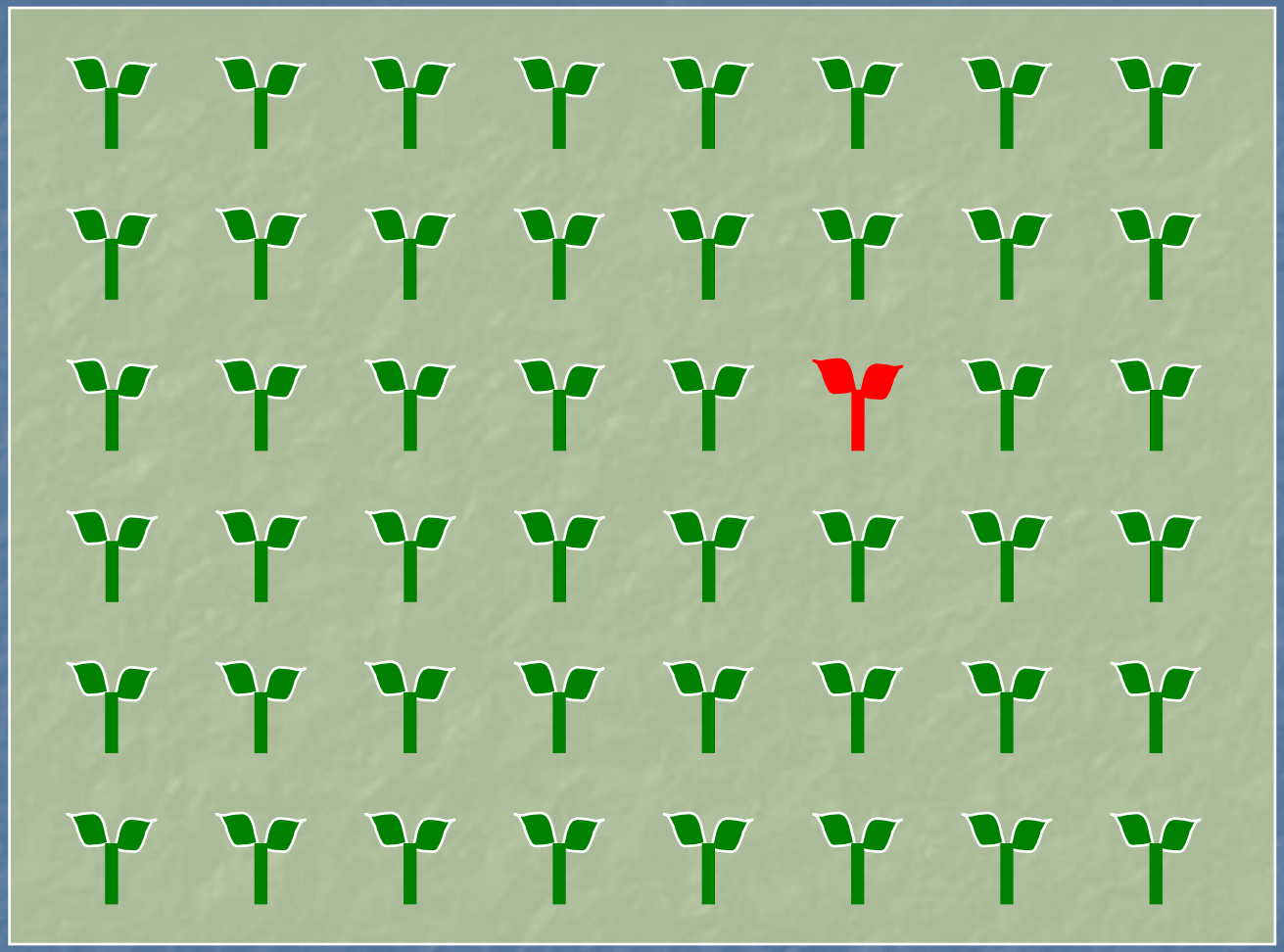
Herbicide Resistance

If you have been spraying the same weeds with the same herbicide for several years and have been getting good control and then you begin to see ‘escapes’-

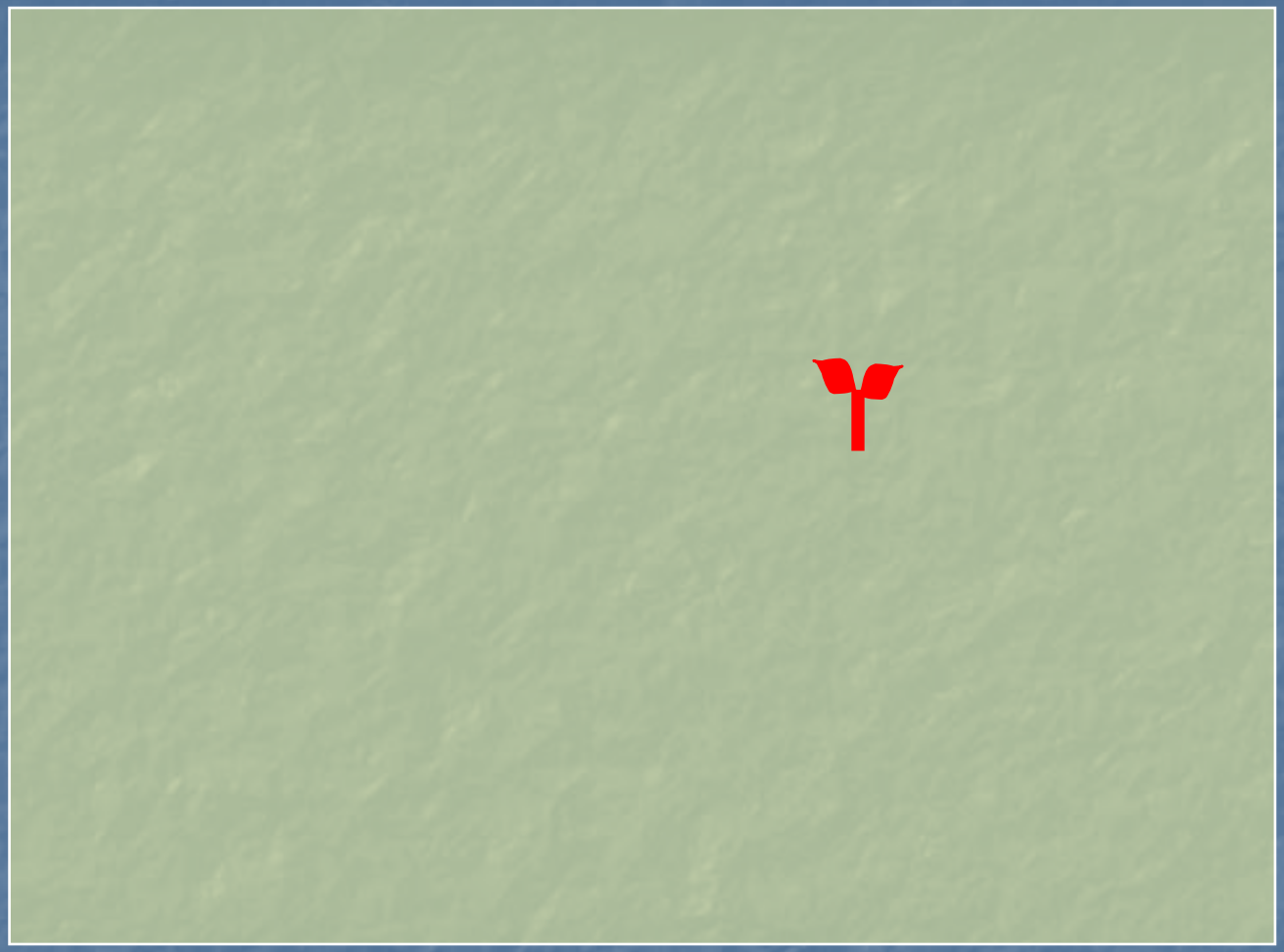
Herbicide Resistance

If you have been spraying the same weeds with the same herbicide for several years and have been getting good control and then you begin to see ‘escapes’-

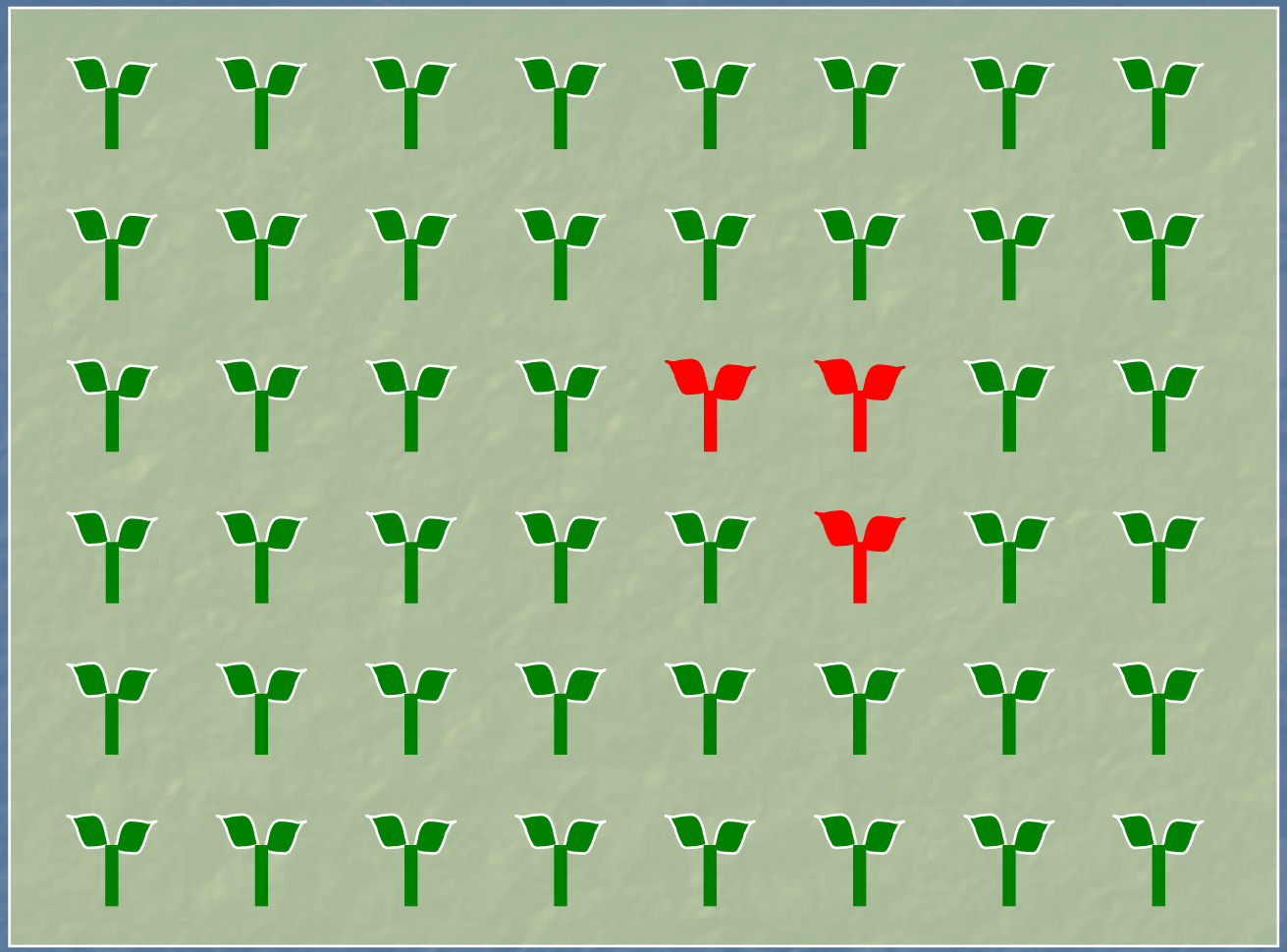
You may have the beginning of resistance!

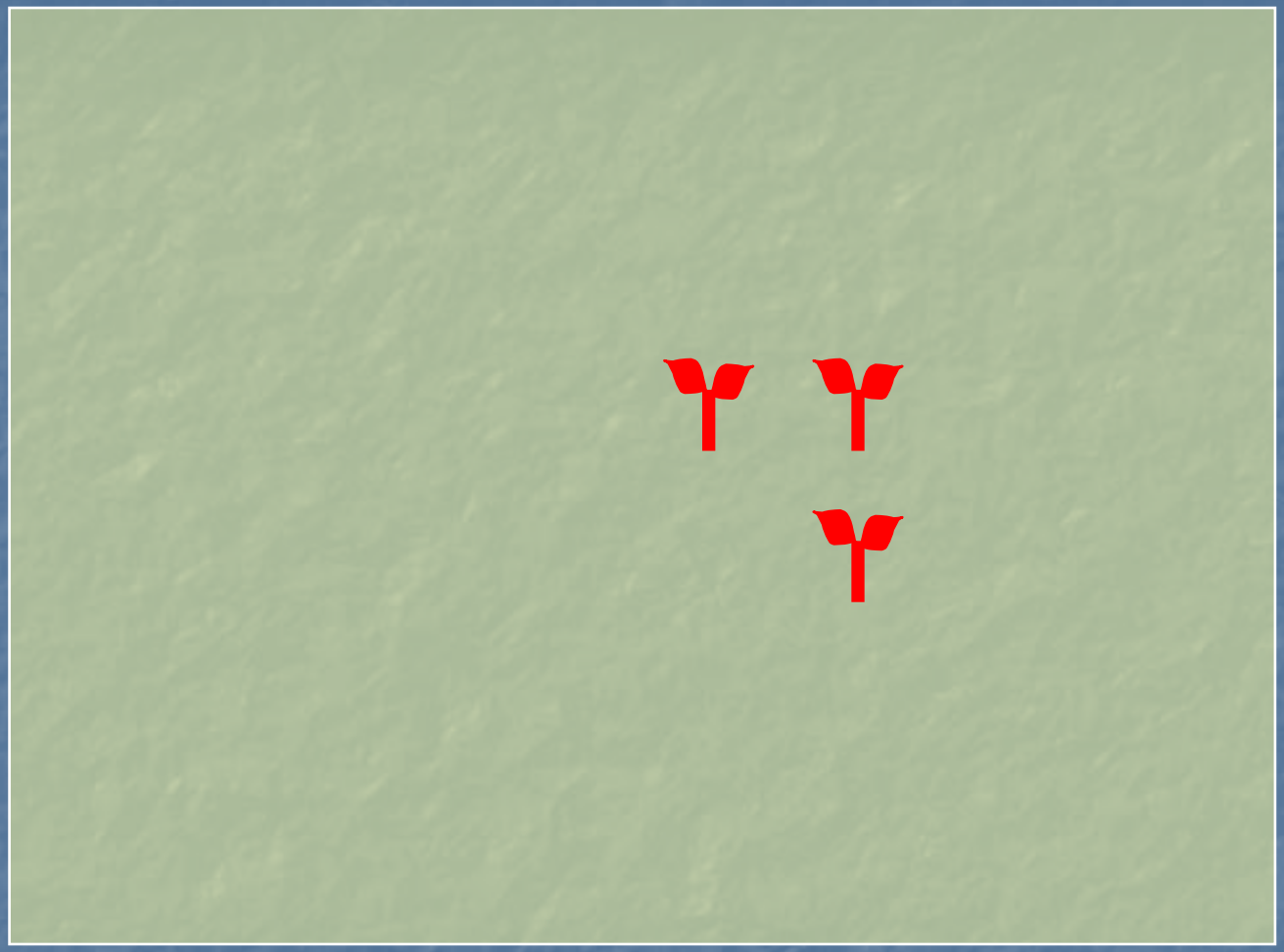


Normal sensitive population



Population still appears sensitive - High level of control





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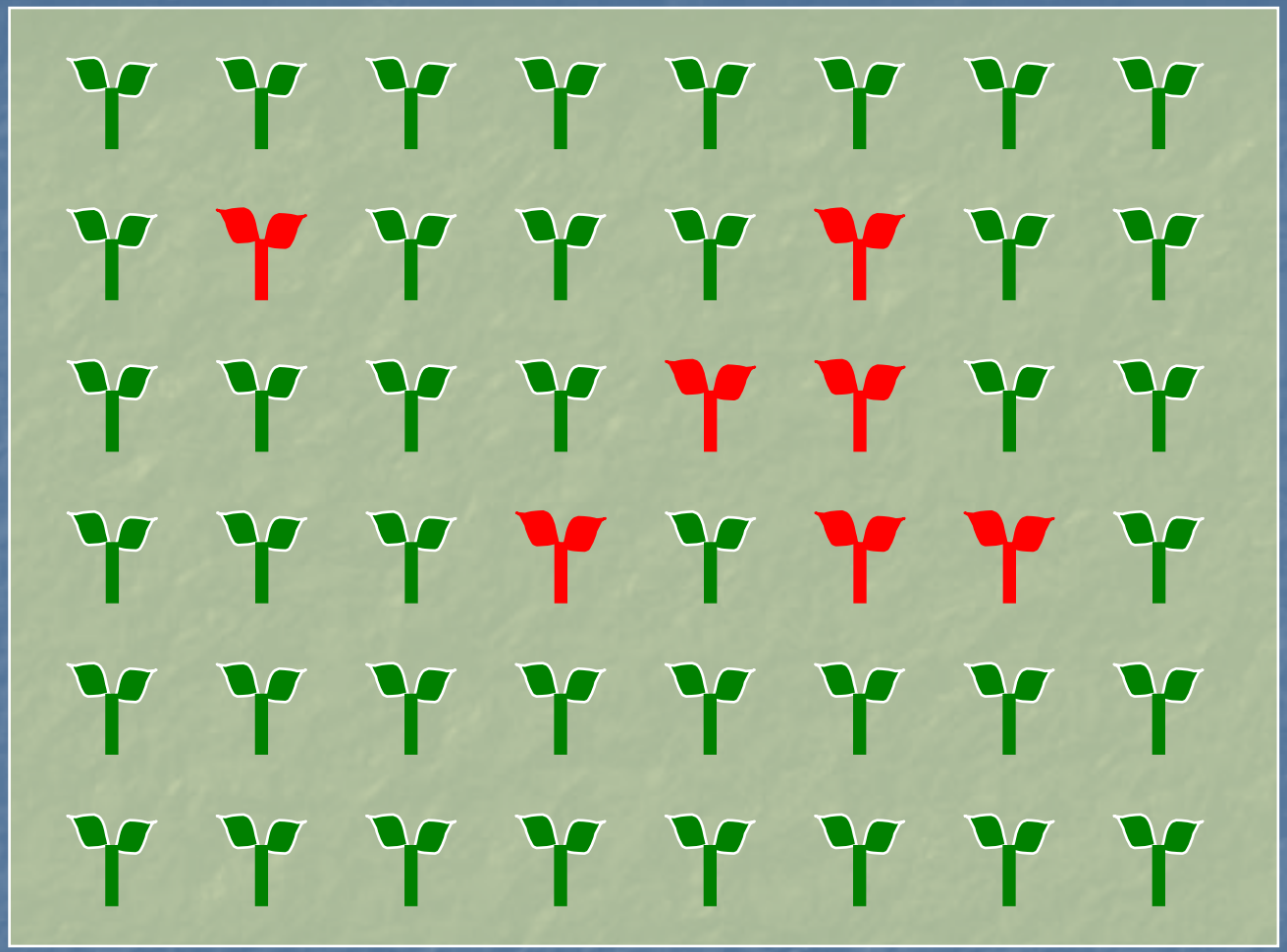
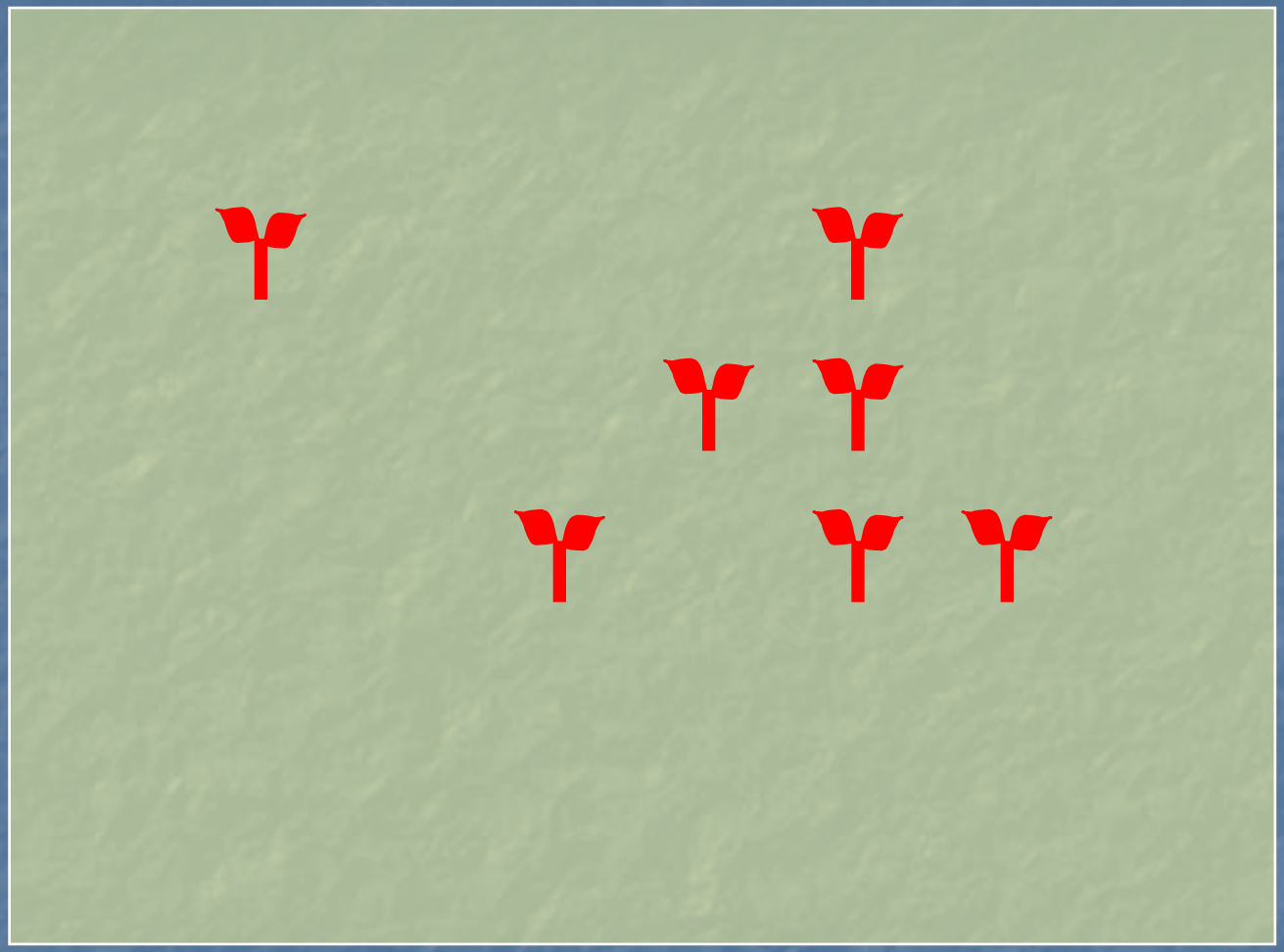
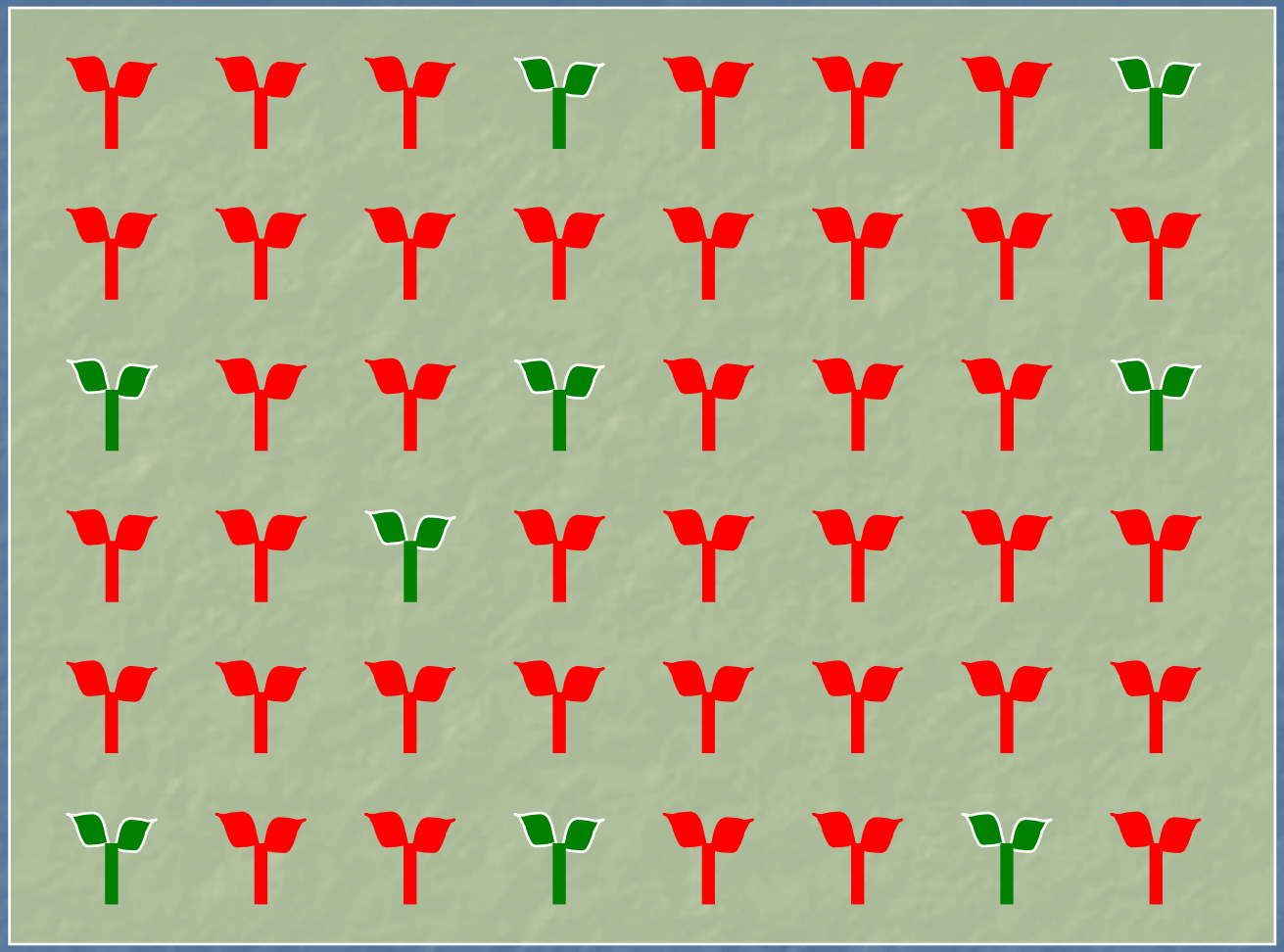




Level of control declining - first suspicion of problems



Majority of population resistant

Weed characteristics that lead to herbicide resistance:

- Annual growth habit

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Weed characteristics that lead to herbicide resistance:

- Annual growth habit
- High seed production
- Rapid turnover of seed bank (little dormancy)
- Several generations per season
- Extreme susceptibility to a particular herbicide
- High frequency of resistant gene

DiTomaso 2000 UC Davis Weed Science School


Ryegrass??

Classification According to MOA

A	Inhibition of acetyl CoA carboxylase (ACCase)
B	Inhibition of ALS (acetolactate synthase)
C_1	Inhibition of photosynthesis at photosystem II (Triazines)
C_2	Inhibition of photosynthesis at photosystem II (Ureas)
C_3	Inhibition of photosynthesis at photosystem II (Nitriles)
D	Photosystem-I-electron diversion
E	Inhibition of (PPO) protoporphyrinogen oxidase
F_1	Bleaching: Inhibition of carotenoid biosynthesis at the PDS
F_2	Bleaching: Inhibition of 4-hydroxyphenyl-pyruvate-dioxygenase
F_3	Bleaching: Inhibition of carotenoid biosynthesis (unknown target)
G	Inhibition of EPSP synthase
H	Inhibition of glutamine synthetase
I	Inhibition of DHP (dihydropteroate) synthase
K_1	Microtubule assembly inhibition
K_2	Inhibition of mitosis
K_3	Inhibition of cell division
L	Inhibition of cell wall (cellulose) synthesis
M	Uncoupling (Membrane disruption)
N	Inhibition of lipid synthesis - not ACCase inhibition
O	Synthetic auxins (action like indoleacetic acid)
P	Inhibition of indoleacetic acid action
Z	Unknown

From Herbicide Resistance Action Committee

Herbicide resistant weeds in California

- **Group A**

  Late watergrass
  Barnyardgrass
  Early wategrass
  Little seed canary

- **Group B**

  Perennial ryegrass
  Smallflower umbrella sedge
  California arrowhead
  Redstem
  Ricefield bulrush
  Long-leaved loosestrife
  Russian thistle

- **Group O**

  Smooth crabgrass

- **Group N**

  Wild oat
  Late watergrass
  Barnyardgrass
  Early wategrass

- **Group G**

  Rigid ryegrass
  Horseweed
  Hairy fleabane
  Junglerice

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From Herbicide Resistance Action Committee

Glyphosate resistant weeds in California

- Rigid Ryegrass (*Lolium rigidum*)
- Horseweed (*Conyza canadensis*)
- Hairy Fleabane (*Conyza bonariensis*)
- Junglerice (*Echinochloa colona*)

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Glyphosate Resistant Ryegrass

Ryegrass Control

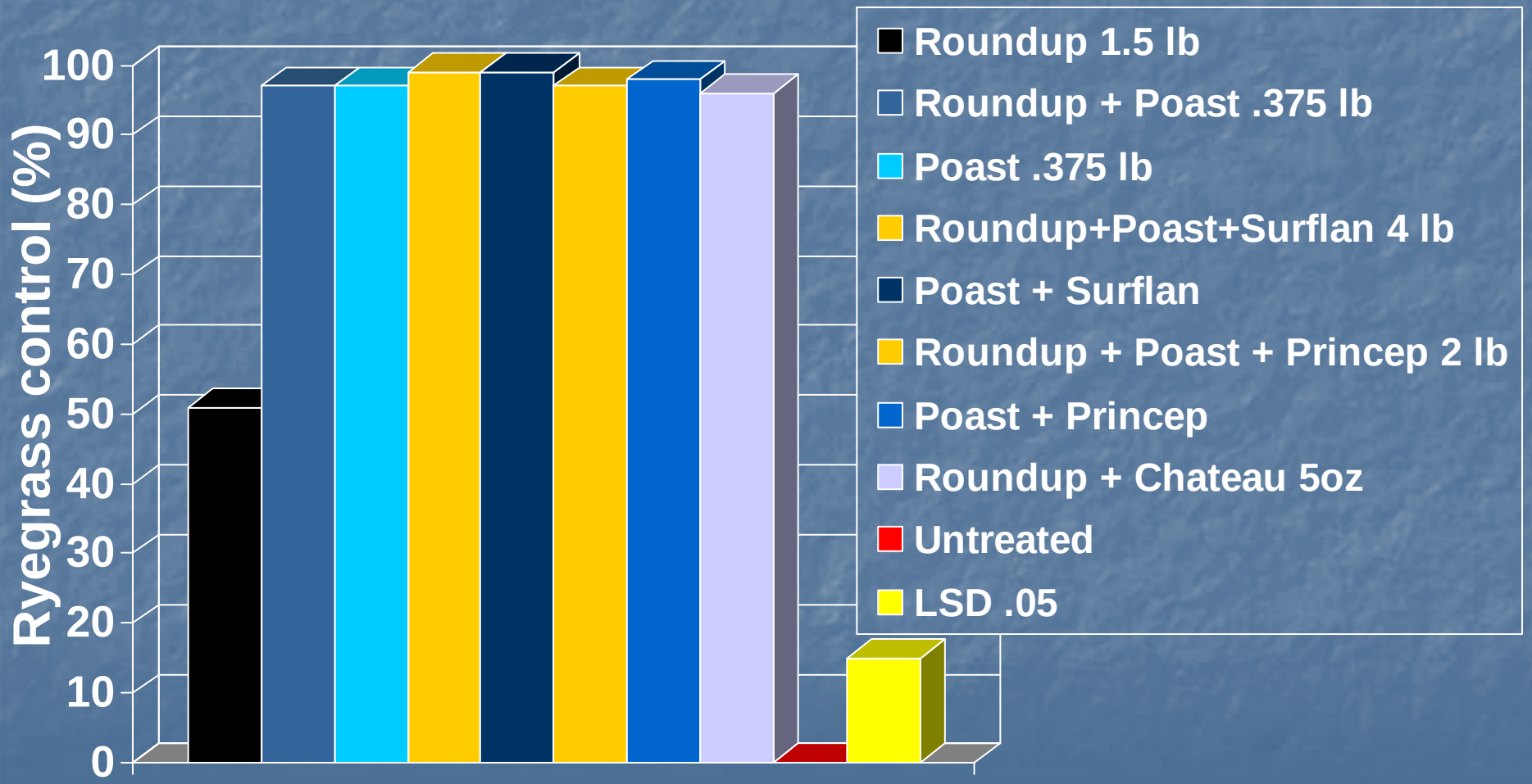
http://wric.ucdavis.edu/

Herbicide	Trade Name	Control Level
ALACHLOR	LASSO	C
BROMACIL	HYVAR	C
CLETHODIM	PRISM, SELECT	C
DIURON	KARMEX	C
FLUAZIFOP	FUSILADE	C
GLYPHOSATE	ROUNDUP, TOUCHDOWN	C
HEXAZINONE	VELPAR, PRONONE	C
IMAZAMOX	RAPTOR	C
IMAZAPYR	ARSENAL, STALKER	C
METHAM	VAPAM, METAM	C
METOLACHLOR	DUAL MAGNUM	C
NAPROPAMIDE	DEVRINOL	C
NORFLURAZON	SOLICAM	C
ORYZALIN	SURFLAN	C
PENDIMETHALIN	PROWL	C
RIMSULFURON	MATRIX	C
SETHOXYDIM	POAST	C
TRIFLURALIN	TREFLAN	C

Ryegrass Control in Walnuts

Herbicide	Trade Name	Control Level
CLETHODIM	**PRISM, SELECT (NB)**	C
DIURON	**KARMEX**	C
FLUAZIFOP	**FUSILADE (NB)**	C
GLYPHOSATE	**ROUNDUP, TOUCHDOWN**	C
NAPROPAMIDE	**DEVRINOL**	C
NORFLURAZON	**SOLICAM**	C
ORYZALIN	**SURFLAN**	C
PENDIMETHALIN	**PROWL**	C
RIMSULFURON	**MATRIX**	C
SETHOXYDIM	**POAST**	C
TRIFLURALIN	**TREFLAN**	C

Control of Ryegrass in Almonds 1 month after treatment



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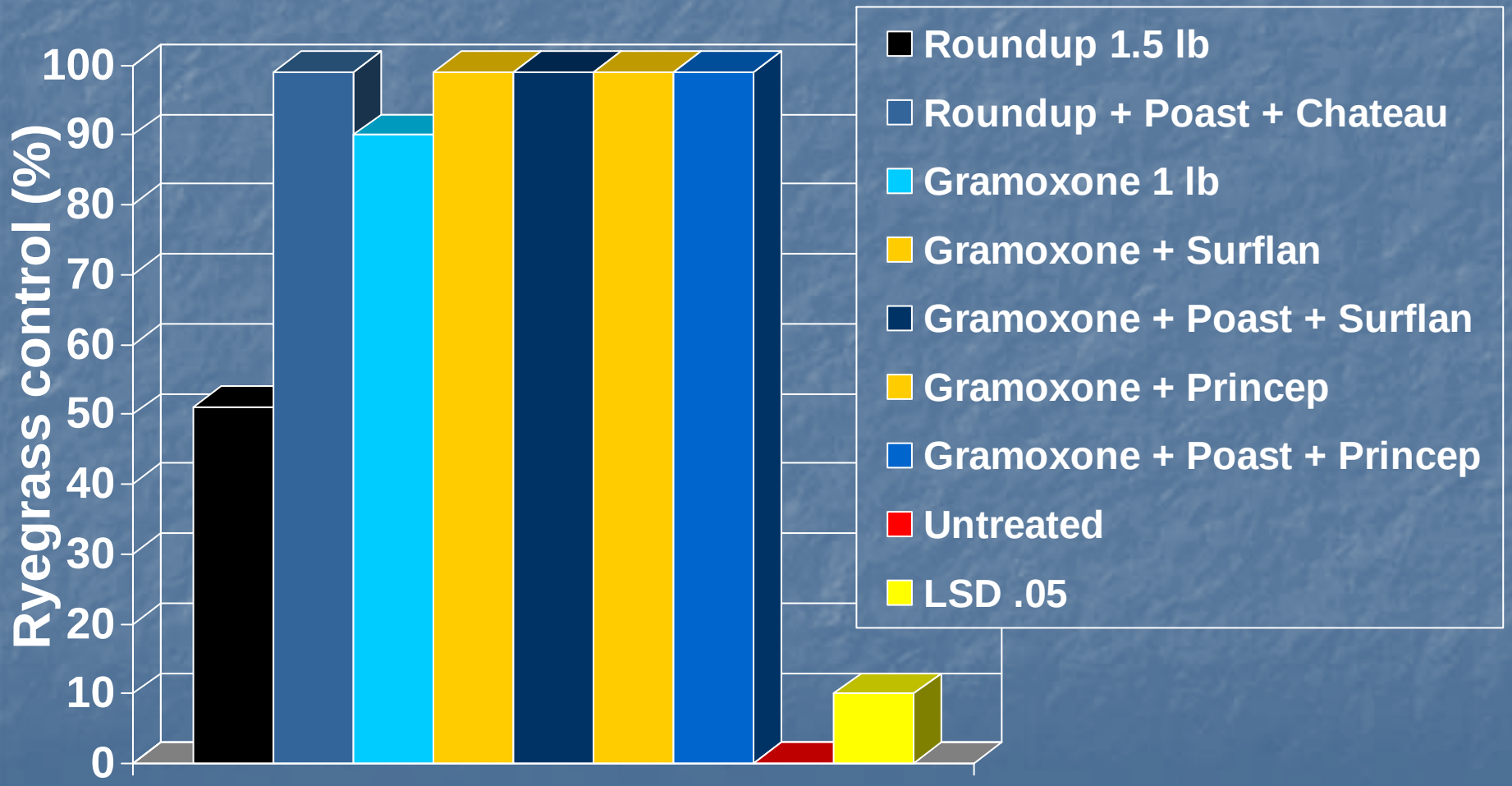


Glyphosate Resistant Ryegrass 41 days after treatment with Poast + Glyphosate


Untreated


Roundup 1.5 lbs


Roundup + Chateau


Poast


Gramoxone + Princep


Gramoxone + Poast + Surflan


Gramoxone + Poast + Princep

Horseweed

Horseweed Control

http://wric.ucdavis.edu/

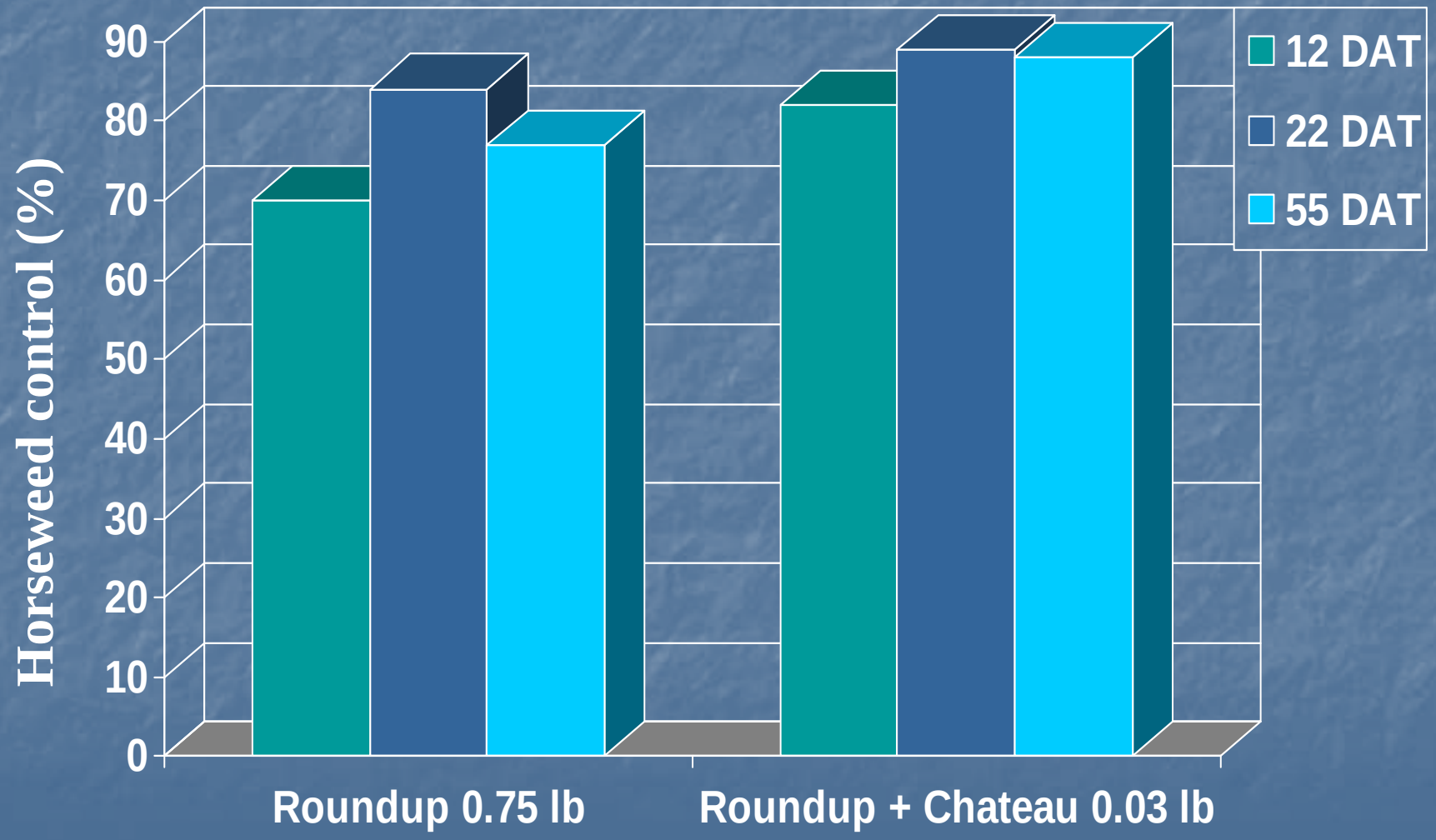
Herbicide	Trade Name	Control Level
2,4-D	2,4-D	C
BROMOXYNIL	BUCTRIL	C
DICAMBA	BANVEL, VANQUISH	C
EPTC	EPTAM, ERADICANE	C
FLUMIOXAZIN	VALOR, CHATEAU	C
GLUFOSINATE	FINALE, RELY	C
GLYPHOSATE	ROUNDUP, TOUCHDOWN	C
HEXAZINONE	VELPAR, PRONONE	C
IMAZAPYR	ARSENAL, STALKER	C
ISOXABEN	GALLERY	C
RIMSULFURON	MATRIX	C
SIMAZINE	PRINCEP	C
THIAZOPYR	VISOR	C
TRICLOPYR	GARLON, REMEDY	C

Horseweed Control

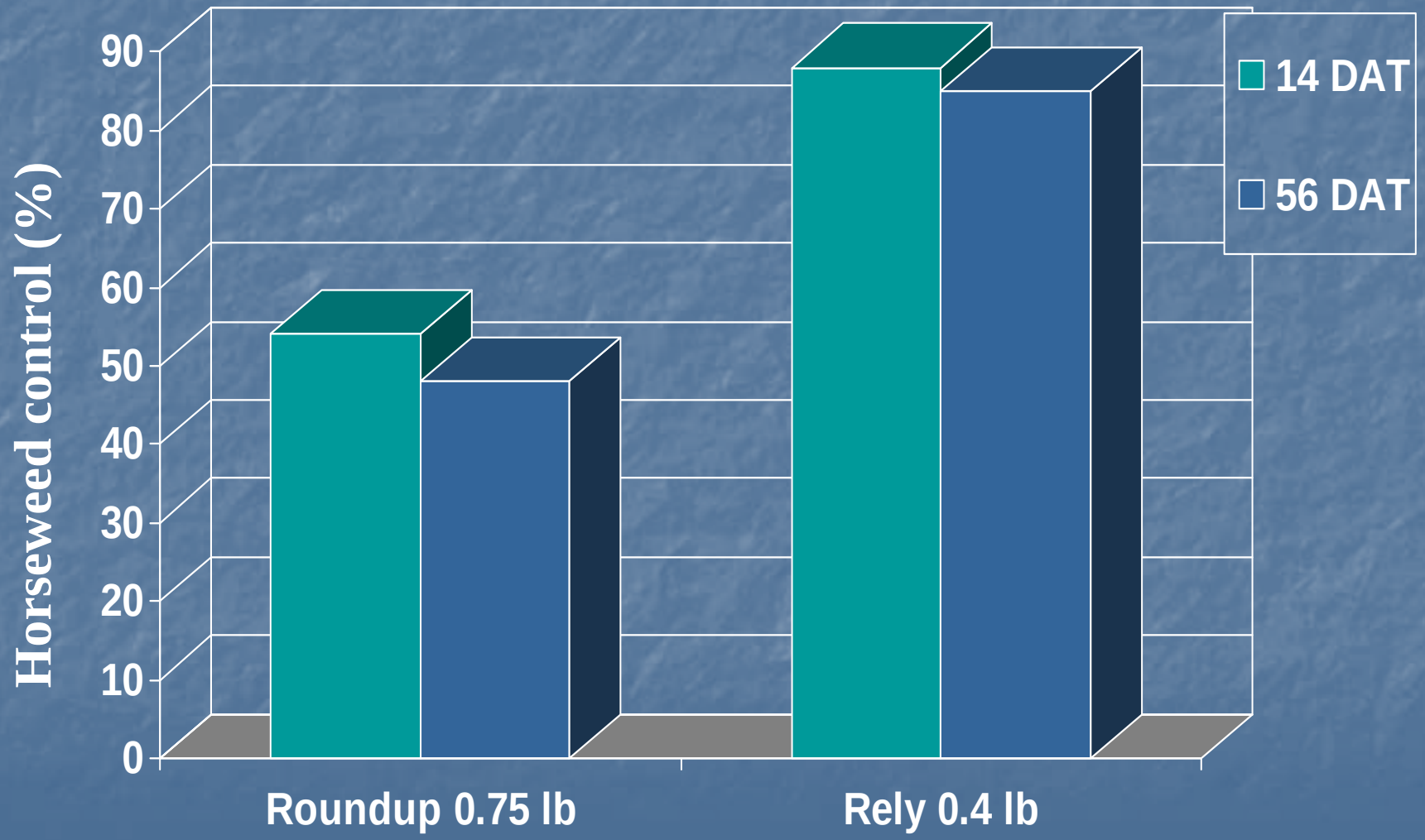
http://wric.ucdavis.edu/

Herbicide	Trade Name	Control Level
2,4-D	2,4-D	C
EPTC	EPTAM,	C
FLUMIOXAZIN	CHATEAU	C
GLUFOSINATE	FINALE, RELY	C
GLYPHOSATE	ROUNDUP, TOUCHDOWN	C
RIMSULFURON	MATRIX	C
SIMAZINE	PRINCEP	C
THIAZOPYR	VISOR	C

Horseweed Control



Horseweed Control



Is there a possibility of resistant horseweed moving into farmland?

~ wind disseminated seed
~ these weeds like undisturbed areas
~ already occur in field margins and several orchards and vineyards


4 lb
2 lb
1 lb
0 lb
Resistant
Susceptible

Case Study-Horseweed

Glyphosate Rate (ai) Mortality (%)

5 to 8 leaves	1 lb	2 lbs	4 lbs
Susceptible	100	100	100
Resistant	0	50	100

From Shrestha, Hembree and Va, California Agriculture 61(2) 67-70

Case Study-Horseweed

Glyphosate Rate (ai) Mortality (%)

11 to 15 leaves	1 lb	2 lbs	4 lbs
Susceptible	90	100	100
Resistant	0	20	80

From Shrestha, Hembree and Va, California Agriculture 61(2) 67-70

Case Study-Horseweed

Glyphosate Rate (ai) Mortality (%)

Bolting to 6 inches	1 lb	2 lbs	4 lbs
Susceptible	70	100	100
Resistant	0	0	10

From Shrestha, Hembree and Va, California Agriculture 61(2) 67-70

Case Study-Horseweed

Glyphosate Rate (ai) Mortality (%)

6.1 to 12 inches	1 lb	2 lbs	4 lbs
Susceptible	30	80	100
Resistant	0	0	0

From Shrestha, Hembree and Va, California Agriculture 61(2) 67-70

The root cause of the problem?

Case Study-Horseweed

The mode of resistance by horseweed to glyphosate appears to be through altered cellular transport and reduced translocation to the roots and other growing points. The glyphosate is not deactivated, nor the enzymatic process changed- the glyphosate stays where it is sprayed!

From Feng, etal., *Weed Science* 52:498-505,2004

How to prevent herbicide resistance

- **Early detection**

How to prevent herbicide resistance

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- **Rotate herbicide**

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- **Early detection**
- **Rotate herbicide**
- **Rotate Crops**

How to prevent herbicide resistance

- Early detection
- Rotate herbicide
- Rotate Crop
- Use Residual herbicides

How to prevent herbicide resistance

- Early detection
- Rotate herbicide
- Rotate Crops
- Use Residual herbicides
- Non-chemical control techniques

How to prevent herbicide resistance

- Early detection
- Rotate herbicide
- Rotate Crops
- Use Residual herbicides
- Non-chemical control techniques
- Clean equipment


Thank you
Any Questions?

Klonsky Walnuts small acreage.ppt