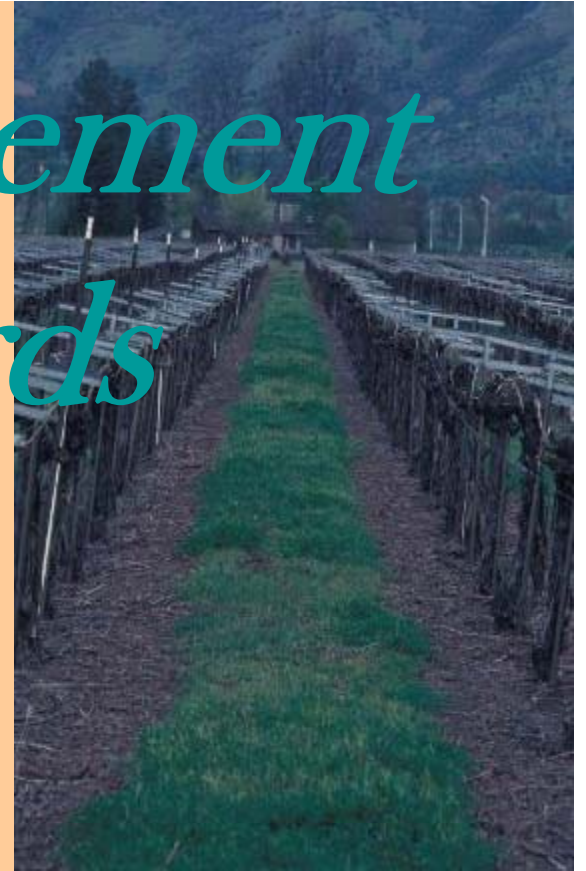




# *Weed Management in Vineyards*



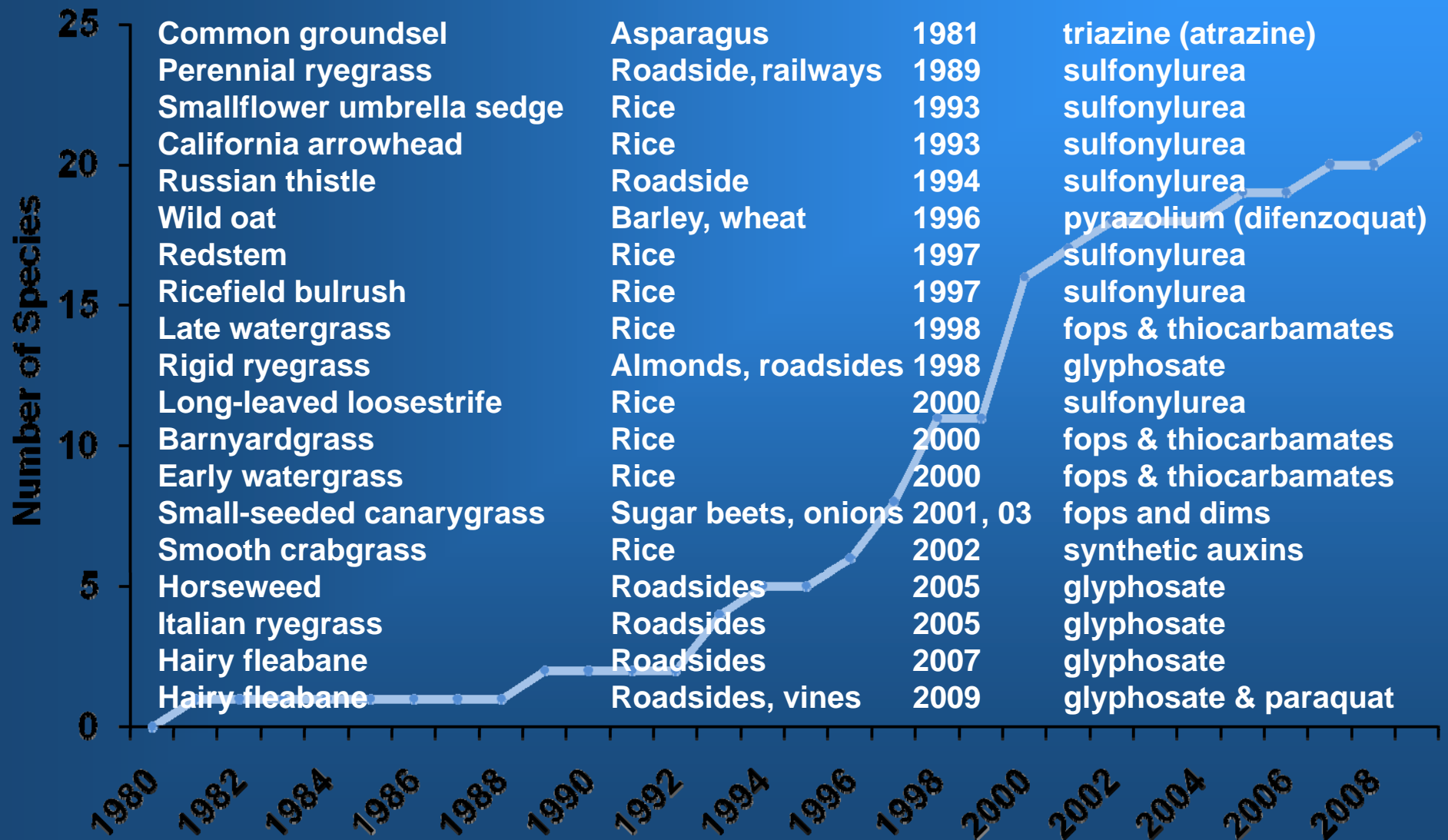
John Roncoroni  
UCCE Weed Science  
Farm Advisor



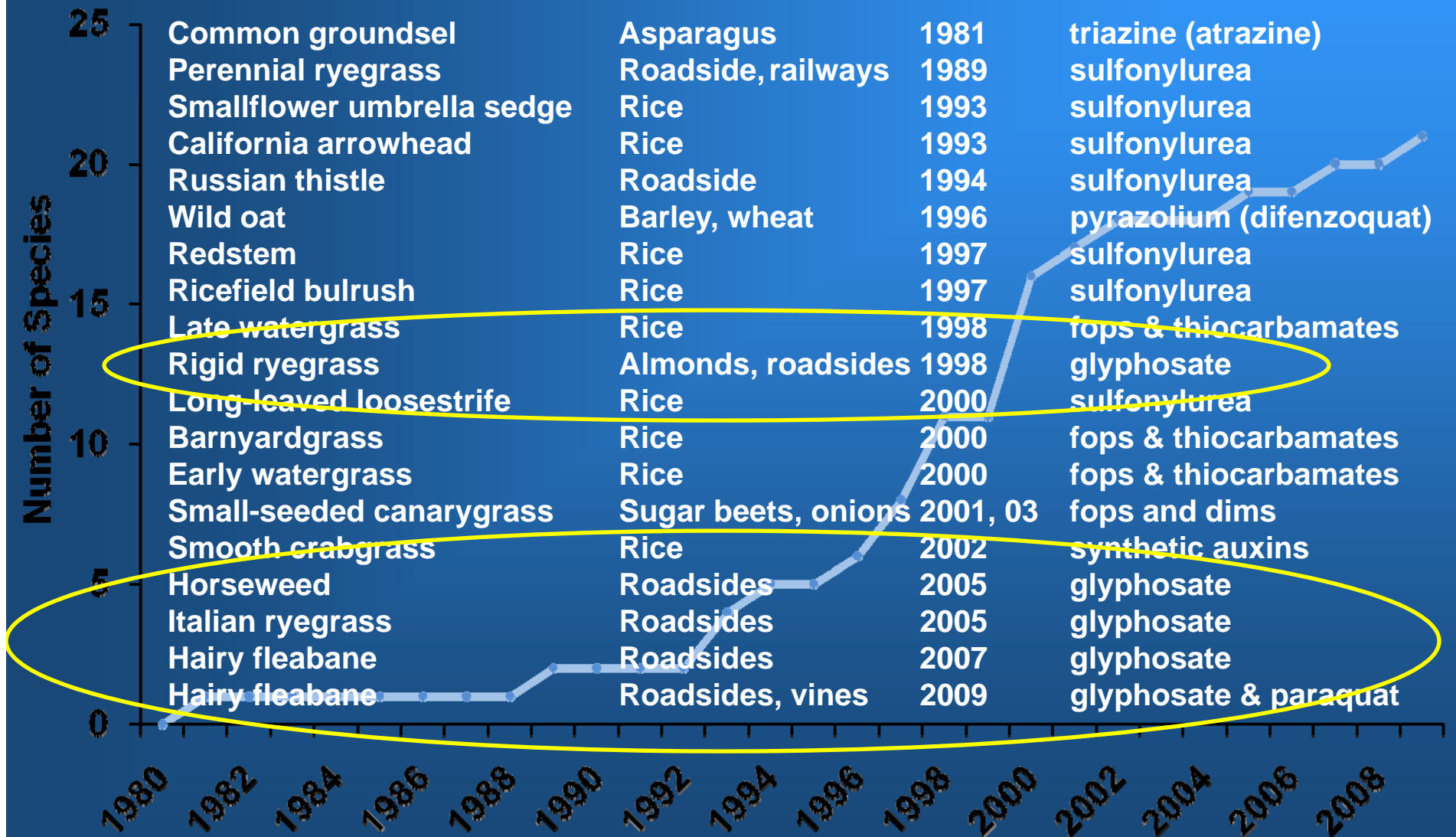
Lodi Grape Day  
February 2, 2010



# Herbicide resistant weeds in California



# Herbicide resistant weeds in California



# Definitions

- **Herbicide resistance**: the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type

*“We used to be able to control this weed with this treatment but it doesn’t work as well anymore...”*

# Rigid and Italian Ryegrass

(*Lolium rigidum* and *L. multiflorum*)

- Often co-exist (swarm)
- Annual grass
- Obligate outcrossers
- Throughout CA but more common weed in northern Central Valley
- 2 to 15-fold resistance
- Usually target site mutation



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# Italian Ryegrass

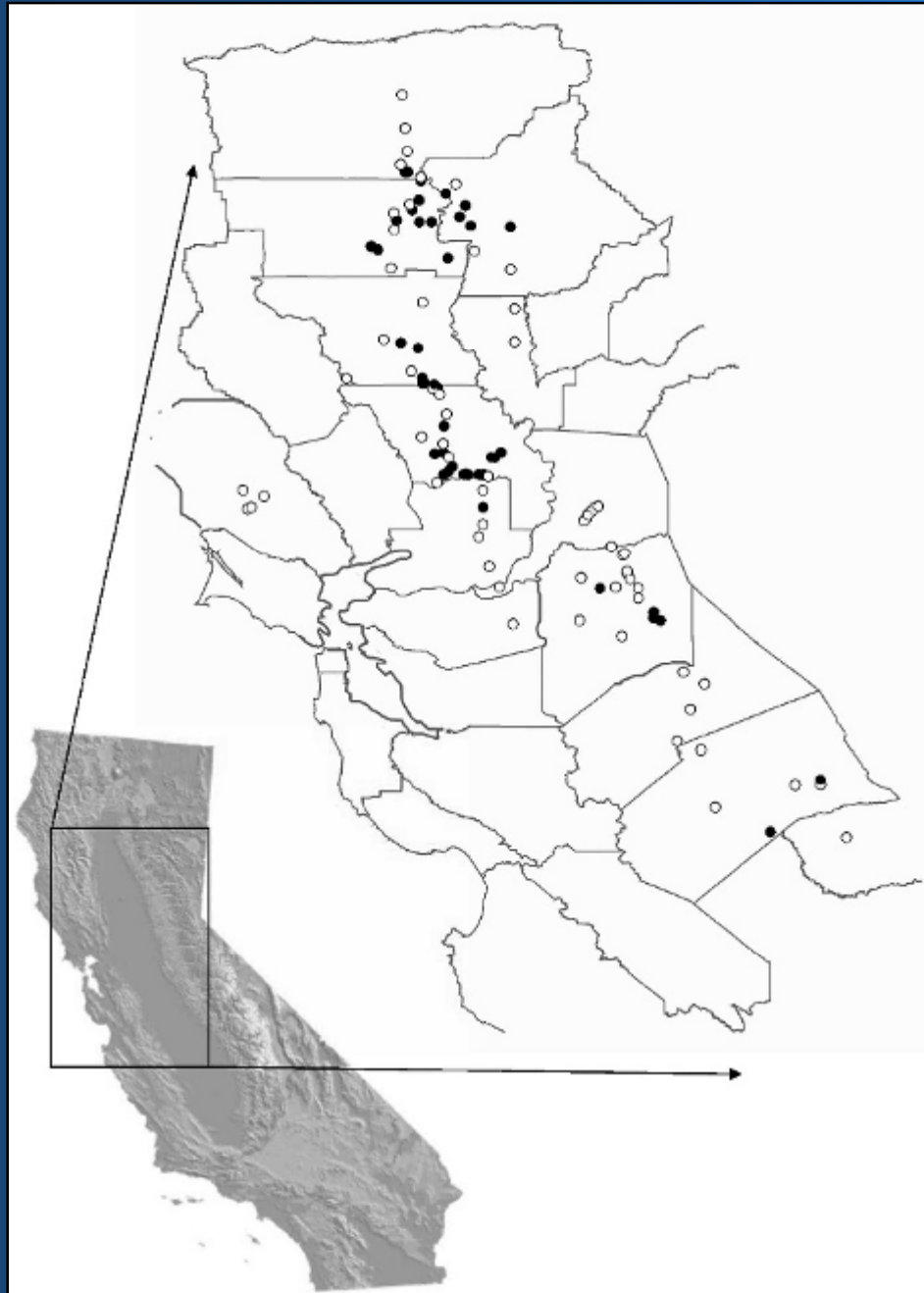


Figure 1. Map of California showing the geographical distribution of Italian ryegrass populations sampled for this study. Closed circles indicate populations with more than 20% seedlings surviving treatment with glyphosate t 866 g ae / ha; open circles indicate populations with 5% (two populations) or no surviving seedlings. Forty seedlings from each population were tested for glyphosate response.

From Jasieniuk et al. 2008.  
Weed Sci 56:496-502

# Horseweed (*Conyza canadensis*)

- AKA mare's tail
- Annual weed
- Prolific seed producer
- Wind-blown seed
- Early colonizer
- Doesn't tolerate disturbance
- 6-fold resistance (whole plant)
- 4-8 fold resistance (in vivo)
- Mechanism not know. Suspected translocation mutation



# Horseweed Survey – 2006-07

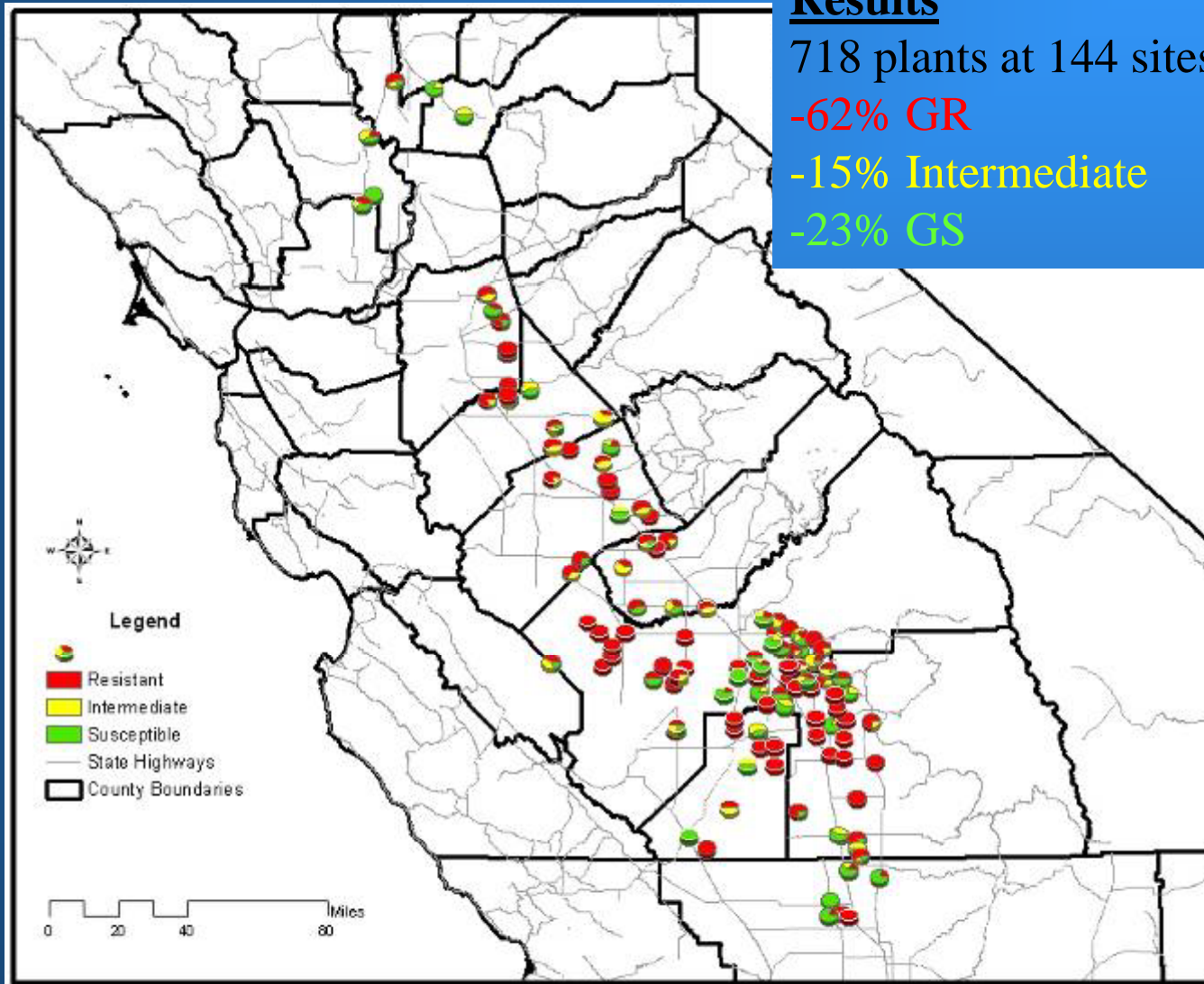
## Results

718 plants at 144 sites

-62% GR

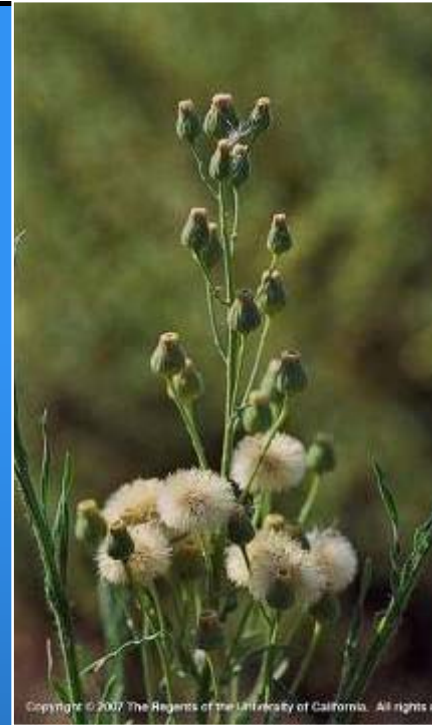
-15% Intermediate

-23% GS

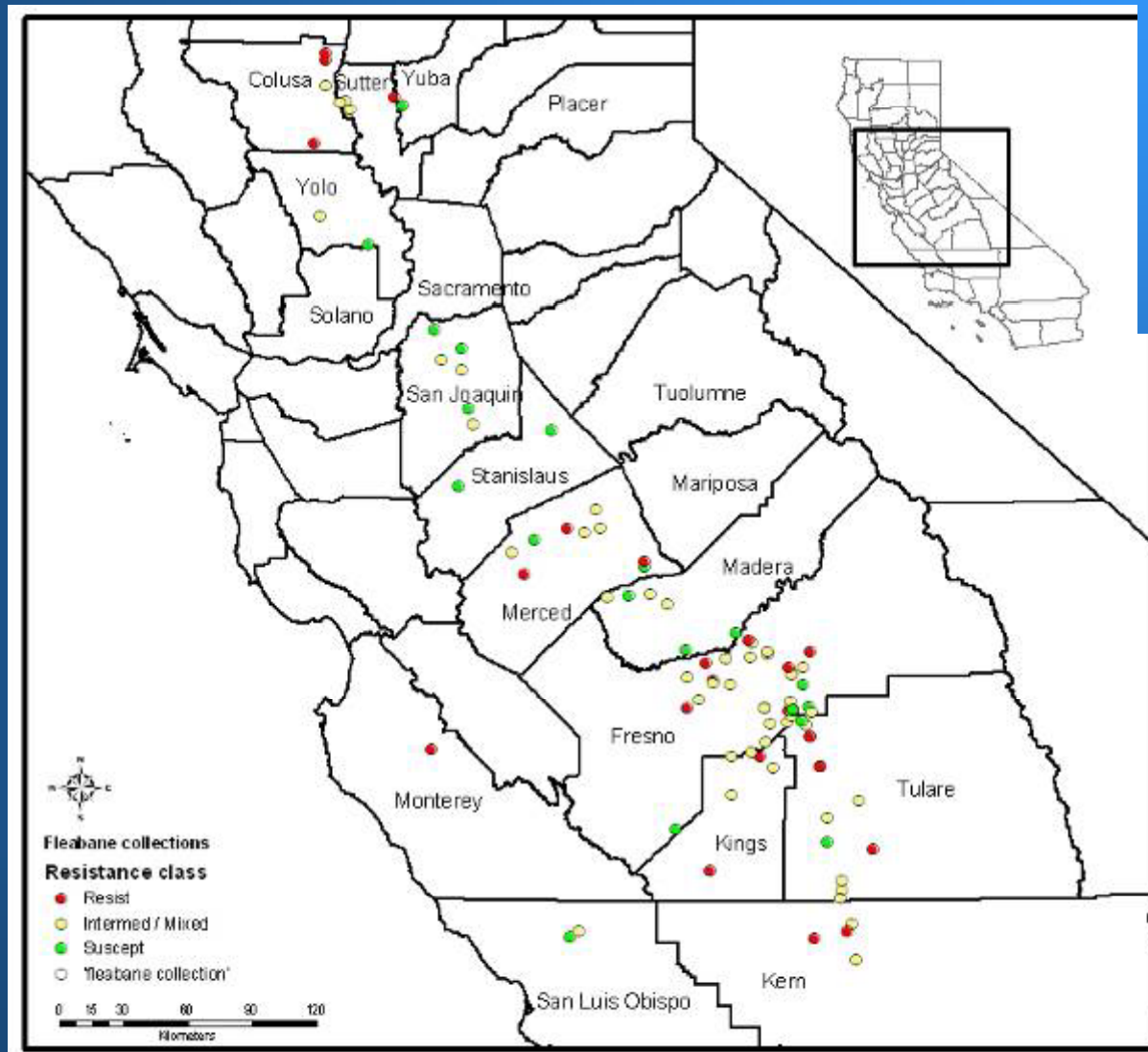


# Hairy Fleabane (*C. bonariensis*)

- AKA flaxleaf fleabane
- Annual weed
- Wind-blown seed
- Early colonizer
- Doesn't tolerate disturbance
- 3 to 10-fold resistance (whole plant screening)
- ~ 4-fold resistance in vivo
- Mechanism not known



# Hairy Fleabane Survey - 2009



## Prelim Results

75 populations

-27% GR

-52% Mixed

-21% GS

Zozaya et al. 2010  
CWSS poster session

# Napa Herbicide Applications in Wine Grapes 2007

Compound	Acreage sprayed	% of total
Glyphosate	31,711	61.6%
Flumioxazin	8,203	15.9%
Oxyfluorfen	6,585	12.8%
<hr/>		
<b>top 3</b> Total for	<b>46,500</b>	<b>90.3%</b>
Oryzalin	1903	3.7%
Simazine	1128	2.2%
Glufosinate	1045	2.0%
Carfentrazone	280	0.5%
2,4-D	202	0.4%
<hr/>		
Total for top 8	51,058	99.1%

Total for  
Pendimethalin, Paraquat, Sethoxydim, Napropamide, Diuron, Diquat, Norflurazon <1%

# Herbicides registered for use in Grapes

Surflan  
Chateau  
Princep  
Goal  
Solicam  
Kerb

Casoron  
Karmex  
Devrinol  
*Gallery\**  
Prowl  
Matrix

Glyphosate  
Gramoxone  
Rely  
Goal  
Shark

2,4-D  
Poast  
Venue  
*Prism\**  
*Fusilade*  
\*

*\* Registered for non-bearing grapes only*

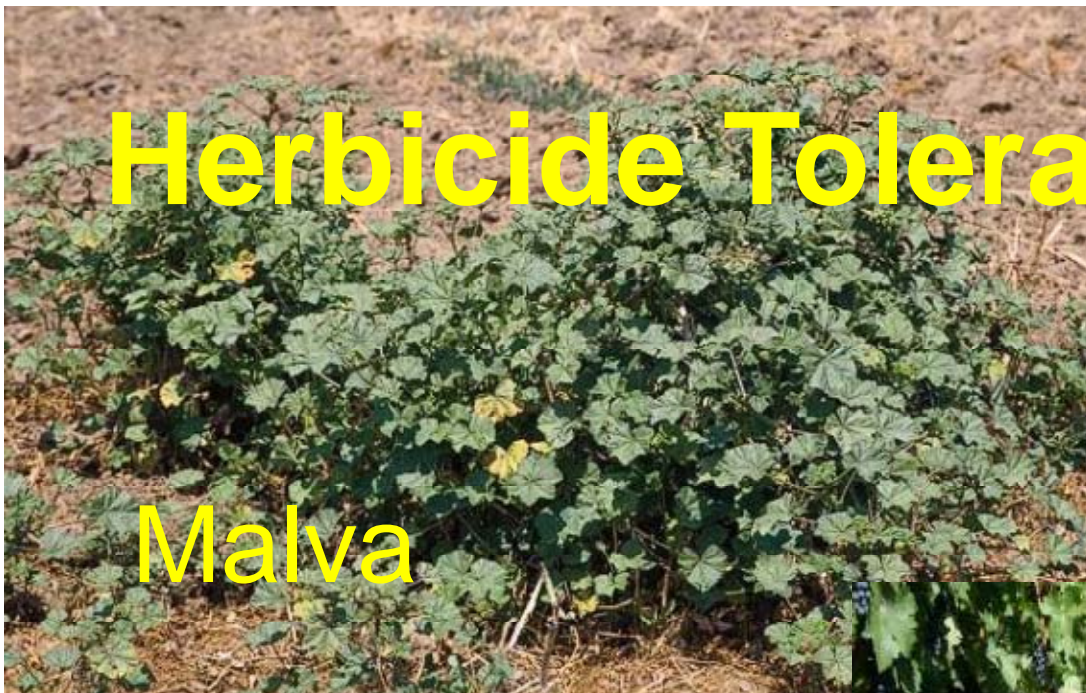
# Definitions

**Herbicide tolerance**: the inherent ability of a species to survive and reproduce after herbicide treatment; implies no selection or genetic manipulation to make the plant tolerant

*“We’ve never gotten dependable control of this weed with this herbicide...”*

# Herbicide Tolerant Weeds

Malva



Willowherb

Filaree





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C155-13

Malva



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C155-15

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C155-12

# Cheeseweed *Malva sp.*

- Several *Malva* species- all annual to short lived perennial
- Heart-shaped cotyledons
- Usually a problem in non-cultivated or no-till vineyards
- Large plants are difficult to control with post emergent herbicide applications



# Tall annual willowherb



# Tall annual (panicle) Willowherb

*Epilobium brachycarpum* C. Presl

- Germinates in fall through late spring.
- Seed capsules slender straight, open widely at apex by 4 back-curved valves
- Erect summer annual to 2 meters tall
- Taproot simple or branched and weakly woody



Willowherb growing in vineyard

November 28



# Willowherb on Feb 28



# Roundup on willowherb





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G139-06



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G139-08



Filaree



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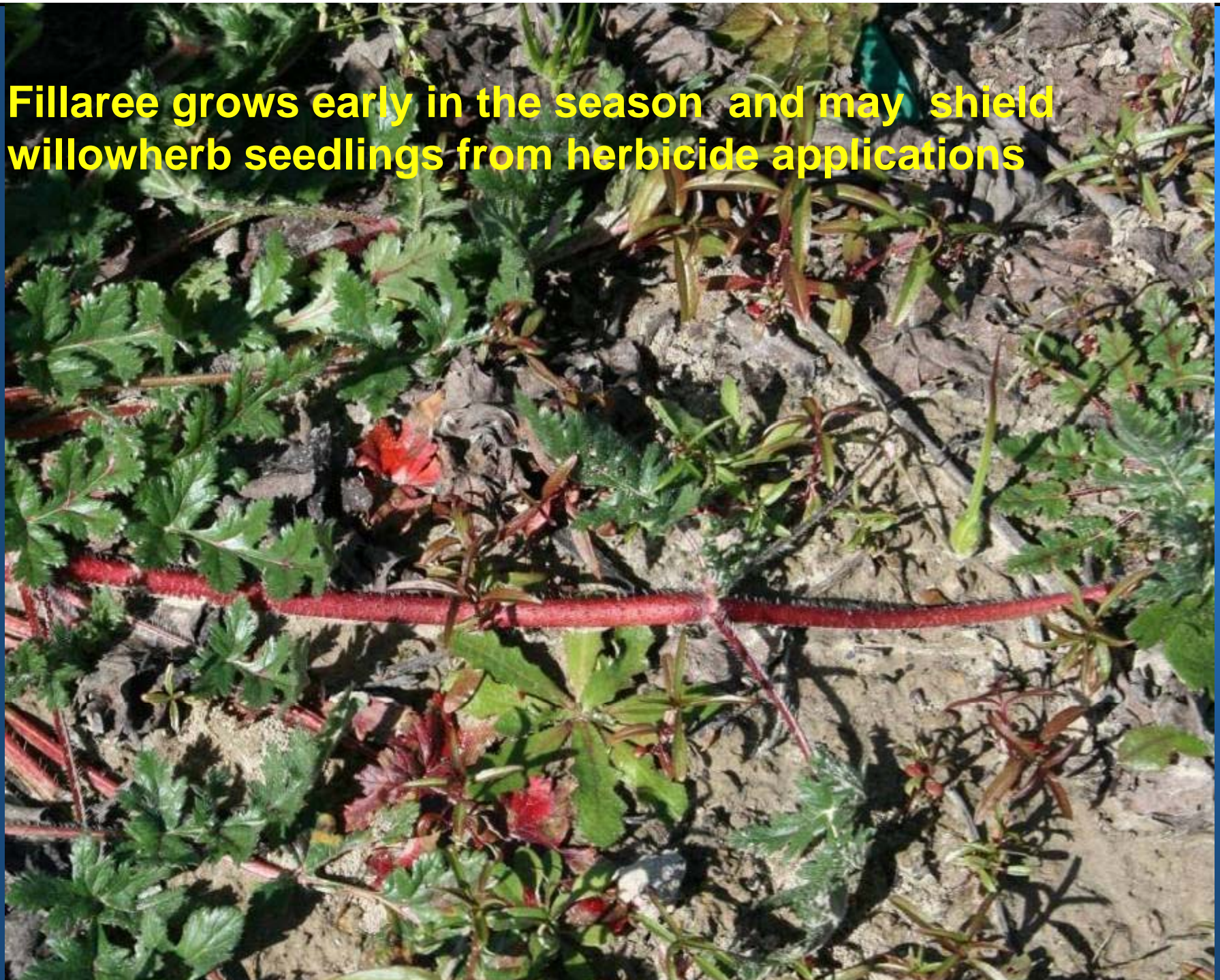
# Fillaree

*Erodium botrys, moschatum, and cicutarium*

- 3 species considered weeds in North Coast area- Broadleaf, whitestem and redstem: reproduces by seed
- Winter annual to biennial-
- Deep taproot
- Not easily controlled with postemergent herbicides



**Fillaree grows early in the season and may shield willowherb seedlings from herbicide applications**



# Perceived Resistance

---

Several growers have seen an increase in Willowherb population in Napa vineyards.

Some growers have seen a decrease in Filaree control from Chateau herbicide.

Resistance?

# Raking Study

# Raking Study

- **Purpose: to determine if leaf cover interferes with herbicide efficacy**

# Raking Study

- 8 sets of paired treatments- either leaves raked or leaves left.
- Plots raked at 11:30 AM 12/19/07
- Plots treated 12:30 PM 12/19/07
- Treated with 10 oz Chateau +24 oz Roundup with OC nozzles sprayed from both sides of row.
- Each plot 4 vines (24 feet) long
- Merlot grapes

# Raking Study

- Weeds Present-
  - Groundsel 6-14 leaves and flowering
  - Willowherb cotyledon- 4 inches
  - Spiny Sowthistle- 6-10 inch rosette
  - Filaree- mostly up to 6 inches- not rosette
- Each Quadrat 1 meter by 0.5 meter



Unraked plot

After Raking



- December 19



• December 19

# Percent leaf cover pre treatment Dec 19

	% leaf cover in unraked plot
Pair 1	60
Pair 2	50
Pair 3	50
Pair 4	40
Pair 5	25
Pair 6	33
Pair 7	40
Average	

Feb 29 2008

## % Fillaree Cover

	% leaf	Raked	Not Raked
Pair 1	60	5	50
Pair 2	50	7	30
Pair 3	50	15	40
Pair 4	40	3	20
Pair 5	25	5	20
Pair 6	33	1	15
Pair 7	40	5	10
Average		6 %	26 %

# Pair 1 (1 & 2)

**Raked pre-treatment**



**Raked post treatment**



**Unraked pre-treatment**



**Unraked post treatment**



# Raking Study

		Rating 0-10											
		2/29/2008		3/21/2008		5/5/2008		6/12/2008				8/22/2008	
% Leaf Cover	%Fillaree Cover		Overall Ratings		Ratings		Willowherb		Fluvellin		Overall Ratings		
	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not	
60	5	50	9	4	9	5	10	7	7	7	6	5	
50	7	30	8	5	8.5	5	10	5	8	10	7	3	
50	15	40	7	4	8	6.5	9	4	9	10	9	7	
40	3	20	8	5	9	6	9	5	10	10	10	6	
25	5	20	9	4	9	6	10	7	9	10	10	7	
33	1	15	9	5	9.5	6	9	7	10	6	10	6	
40	5	10	7	6	9.5	7	10	7	8	8	8	6	
Ave	8.30%	28%	8.1	4.6	8.7	5.8	9.6	6.0	8.7	8.7	8.6	5.7	

# Raking Study

		Rating 0-10											
		2/29/2008		3/21/2008		5/5/2008		6/12/2008				8/22/2008	
% Leaf Cover	%Fillaree Cover		Overall Ratings		Ratings		Willowherb		Fluvellin		Overall Ratings		
	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not	
60	5	50	9	4	9	5	10	7	7	7	6	5	
50	7	30	8	5	8.5	5	10	5	8	10	7	3	
50	15	40	7	4	8	6.5	9	4	9	10	9	7	
40	3	20	8	5	9	6	9	5	10	10	10	6	
25	5	20	9	4	9	6	10	7	9	10	10	7	
33	1	15	9	5	9.5	6	9	7	10	6	10	6	
40	5	10	7	6	9.5	7	10	7	8	8	8	6	
Ave	8.30%	28%	8.1	4.6	8.7	5.8	9.6	6.0	8.7	8.7	8.6	5.7	

# Raking Study

		Rating 0-10											
		2/29/2008		3/21/2008		5/5/2008		6/12/2008				8/22/2008	
% Leaf Cover	%Fillaree Cover		Overall Ratings		Ratings		Willowherb		Fluvellin		Overall Ratings		
	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not	
60	5	50	9	4	9	5	10	7	7	7	6	5	
50	7	30	8	5	8.5	5	10	5	8	10	7	3	
50	15	40	7	4	8	6.5	9	4	9	10	9	7	
40	3	20	8	5	9	6	9	5	10	10	10	6	
25	5	20	9	4	9	6	10	7	9	10	10	7	
33	1	15	9	5	9.5	6	9	7	10	6	10	6	
40	5	10	7	6	9.5	7	10	7	8	8	8	6	
Ave	8.30%	28%	8.1	4.6	8.7	5.8	9.6	6.0	8.7	8.7	8.6	5.7	



Willowherb

# Raking Study

		Rating 0-10										
		2/29/2008		3/21/2008		5/5/2008		6/12/2008			8/22/2008	
% Leaf Cover	%Fillaree Cover		Overall Ratings		Ratings		Willowherb		Fluvelin		Overall Ratings	
	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not
60	5	50	9	4	9	5	10	7	7	7	6	5
50	7	30	8	5	8.5	5	10	5	8	10	7	3
50	15	40	7	4	8	6.5	9	4	9	10	9	7
40	3	20	8	5	9	6	9	5	10	10	10	6
25	5	20	9	4	9	6	10	7	9	10	10	7
33	1	15	9	5	9.5	6	9	7	10	6	10	6
40	5	10	7	6	9.5	7	10	7	8	8	8	6
Ave	8.30%	28%	8.1	4.6	8.7	5.8	9.6	6.0	8.7	8.7	8.6	5.7



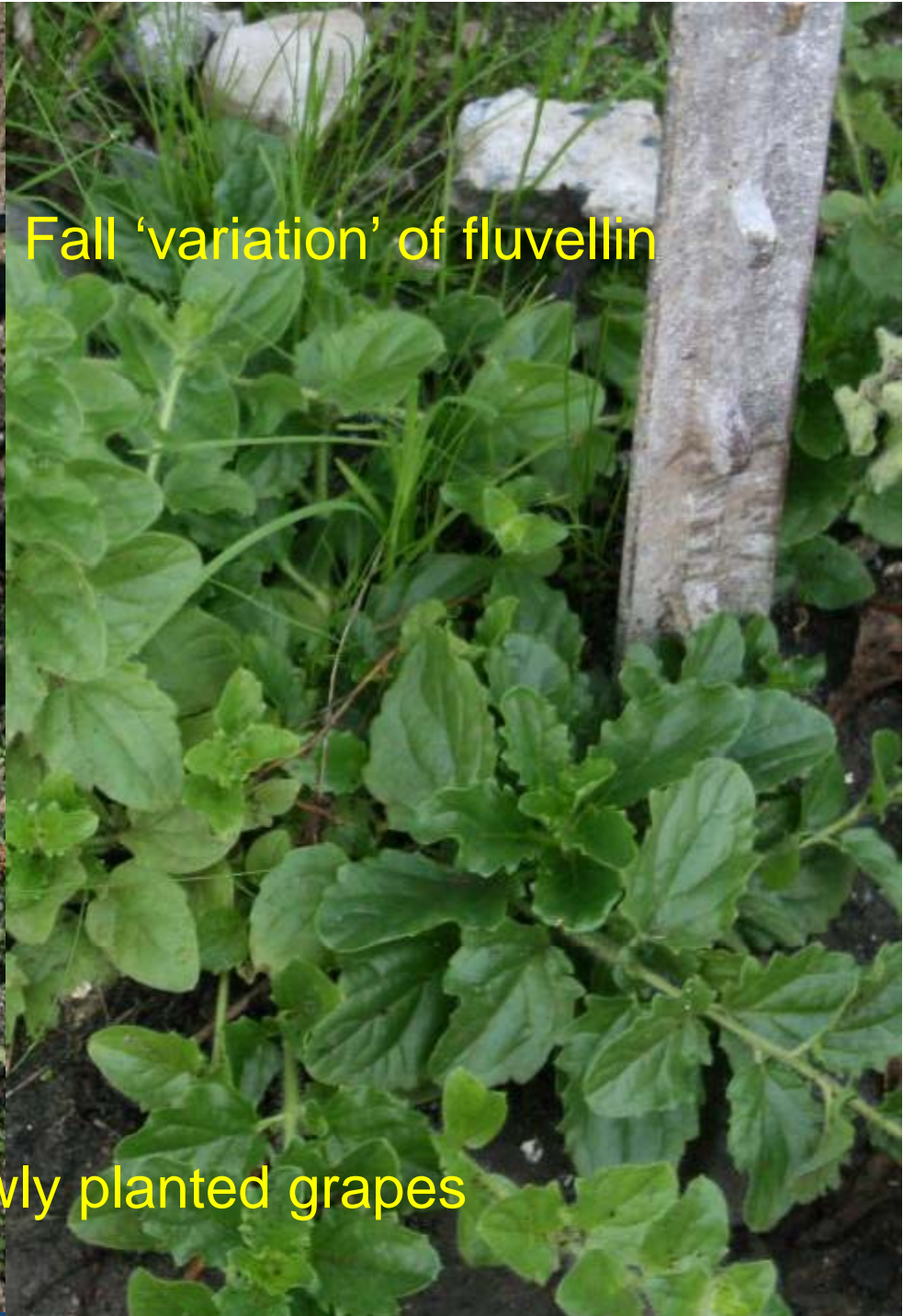
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Sharp-point Fluvellin  
*Kickxia elatine*(L.)Dumort.



**There is a milk carton under this plant!**

**Fluvellin competing with newly planted grapes**



**Fall 'variation' of fluvellin**



# Raking Study

		Rating 0-10										
		2/29/2008		3/21/2008		5/5/2008		6/12/2008			8/22/2008	
% Leaf Cover	%Fillaree Cover		Overall Ratings		Ratings		Willowherb		Fluvelin		Overall Ratings	
	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not	Raked	Not
60	5	50	9	4	9	5	10	7	7	7	6	5
50	7	30	8	5	8.5	5	10	5	8	10	7	3
50	15	40	7	4	8	6.5	9	4	9	10	9	7
40	3	20	8	5	9	6	9	5	10	10	10	6
25	5	20	9	4	9	6	10	7	9	10	10	7
33	1	15	9	5	9.5	6	9	7	10	6	10	6
40	5	10	7	6	9.5	7	10	7	8	8	8	6
Ave	8.30%	28%	8.1	4.6	8.7	5.8	9.6	6.0	8.7	8.7	8.6	5.7

Pictures taken 9/12/08



Raked



60% leaf cover





**Raked**



**25% leaf cover**

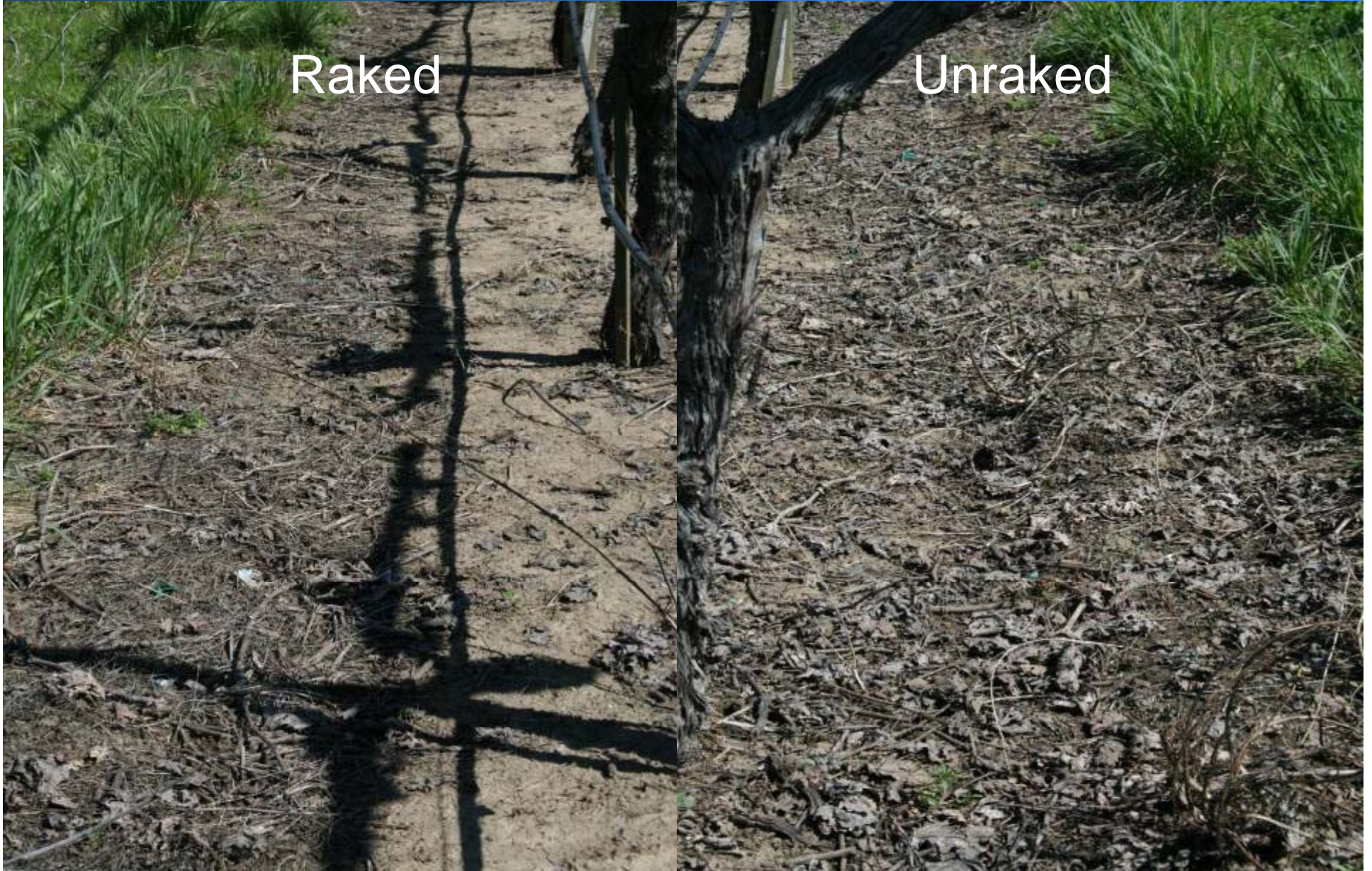




# Rutherford River Ranch 2009

Raked

Unraked



# Rutherford River Ranch 2009

		Jan 21/Mar20	April 20		May 13	
			Raked	Not Raked	Raked	Not Raked
1	UTC		2.5	1.5	2.0	1.0
2	Rely 200	2 Qt/ 2Qt	7.3	8	5.8	7.3
3	Rely 200	- / 3Qt	6.9	6.6	4.5	5.0
4	Roundup WM	1 Qt/ 1Qt	6.3	4.8	5.5	4.8
5	Roundup WM	- / 2Qt	7.5	6.6	7.9	6.3
6	Rely 200+ Chateau	2 Qt + 6oz	9.4	9	8.4	8.4
7	Rely 200+ Chateau	2 Qt + 12oz	9.5	8.9	9.3	8.5
8	Roundup + Chateau	1 Qt + 6 oz	8.8	8	8.6	7.9
9	Roundup + Chateau	1 Qt + 12 oz	9.5	9	9.6	8.9
10	Rely 200 + Matrix	2 Qt + 2oz	9.1	8.3	8.3	8.1
11	Rely 200 + Matrix	2 Qt + 4 oz	9.6	9.1	9.4	8.4
12	Roundup WM + Matrix	1 Qt + 2oz	7.5	7.5	7.3	7.6
13	Roundup WM + Matrix	1 Qt + 4oz	9	7.8	8.9	7.5
14	Roundup+ Chateau + Prowl H2O	1 Qt+ 6 oz + 2 qt	8	6.5	8.4	6.6
14	Roundup + Matrix + Prowl H2O	1 Qt+ 2 oz + 2 qt	7	6	7.0	6.3
16	Roundup WM+ Goal 2X	1 Qt + 2Qt	8.8	7.8	8.5	7.9
17	Roundup +Goaltender	1 Qt + 1 Qt	8.1	6.3	7.4	5.5

# Rutherford River Ranch 2009

		Jan 20/Mar 21	Sept 11 09			Sept 11 09		
			Raked			Unraked		
			overall	wh	fluv	overall	wh	fluv
1	UTC		2.75	2.75	8.75	1.50	1.50	6.50
2	Rely 200	2 Qt/ 2Qt	2.75	10.00	2.75	5.25	10.00	5.25
3	Rely 200	- / 3Qt	2.75	9.50	2.75	3.50	9.25	3.75
4	Roundup WM	1 Qt/ 1Qt	2.50	5.00	3.33	3.00	3.00	7.25
5	Roundup WM	- / 2Qt	6.25	7.75	6.50	4.25	5.00	5.25
6	Rely 200+ Chateau	2 Qt + 6oz	7.00	10.00	6.88	8.00	9.38	8.38
7	Rely 200+ Chateau	2 Qt + 12oz	7.88	10.00	7.88	7.75	8.75	8.00
8	Roundup + Chateau	1 Qt + 6 oz	6.50	9.75	6.50	6.50	8.75	7.00
9	Roundup + Chateau	1 Qt + 12 oz	9.13	9.88	9.13	8.88	9.00	9.13
10	Rely 200 + Matrix	2 Qt + 2oz	6.00	9.75	6.13	6.00	9.00	6.00
11	Rely 200 + Matrix	2 Qt + 4 oz	8.88	10.00	8.50	7.75	9.75	7.75
12	Roundup + Matrix	1 Qt + 2oz	6.25	8.75	7.00	6.00	7.75	7.00
13	Roundup + Matrix	1 Qt + 4oz	7.50	9.00	8.00	6.25	6.75	8.50
14	RUWM +Chateau + Prowl H2O	1 Qt+ 6 oz + 2 qt	5.00	8.00	6.13	5.75	7.75	7.75
14	RUWM + Matrix + Prowl H2O	1 Qt+ 2 oz + 2 qt	4.63	4.75	9.88	4.50	5.00	8.50
16	Roundup WM+ Goal 2X	1 Qt + 2Qt	7.00	8.25	8.50	5.75	6.25	9.00
17	Roundup WM + Goaltender	1 Qt + 1 Qt	4.75	6.50	6.25	4.25	4.75	7.75

# Rutherford River Ranch 2009

			September 11 2009					
			Raked			Unraked		
			overall	wh	fluv	overall	wh	fluv
6	Rely 200+ Chateau	2 Qt + 6oz	7.00	10.00	6.88	8.00	9.38	8.38
7	Rely 200+ Chateau	2 Qt + 12oz	7.88	10.00	7.88	7.75	8.75	8.00
8	Roundup + Chateau	1 Qt + 6 oz	6.50	9.75	6.50	6.50	8.75	7.00
9	Roundup + Chateau	1 Qt + 12 oz	9.13	9.88	9.13	8.88	9.00	9.13
10	Rely 200 + Matrix	2 Qt + 2oz	6.00	9.75	6.13	6.00	9.00	6.00
11	Rely 200 + Matrix	2 Qt + 4 oz	8.88	10.00	8.50	7.75	9.75	7.75
12	Roundup + Matrix	1 Qt + 2oz	6.25	8.75	7.00	6.00	7.75	7.00
13	Roundup + Matrix	1 Qt + 4oz	7.50	9.00	8.00	6.25	6.75	8.50

# Rutherford River Ranch 2009

			September 11 2009					
			Raked			Unraked		
			overall	wh	fluv	overall	wh	fluv
6	Rely 200+ Chateau	2 Qt + 6oz	7.00	10.00	6.88	8.00	9.38	8.38
7	Rely 200+ Chateau	2 Qt + 12oz	7.88	10.00	7.88	7.75	8.75	8.00
8	Roundup + Chateau	1 Qt + 6 oz	6.50	9.75	6.50	6.50	8.75	7.00
9	Roundup + Chateau	1 Qt + 12 oz	9.13	9.88	9.13	8.88	9.00	9.13
10	Rely 200 + Matrix	2 Qt + 2oz	6.00	9.75	6.13	6.00	9.00	6.00
11	Rely 200 + Matrix	2 Qt + 4 oz	8.88	10.00	8.50	7.75	9.75	7.75
12	Roundup + Matrix	1 Qt + 2oz	6.25	8.75	7.00	6.00	7.75	7.00
13	Roundup + Matrix	1 Qt + 4oz	7.50	9.00	8.00	6.25	6.75	8.50

# Rutherford River Ranch 2009

			September 11 2009					
			Raked			Unraked		
			overall	wh	fluv	overall	wh	fluv
6	Rely 200+ Chateau	2 Qt + 6oz	7.00	10.00	6.88	8.00	9.38	8.38
7	Rely 200+ Chateau	2 Qt + 12oz	7.88	10.00	7.88	7.75	8.75	8.00
8	Roundup + Chateau	1 Qt + 6 oz	6.50	9.75	6.50	6.50	8.75	7.00
9	Roundup + Chateau	1 Qt + 12 oz	9.13	9.88	9.13	8.88	9.00	9.13
10	Rely 200 + Matrix	2 Qt + 2oz	6.00	9.75	6.13	6.00	9.00	6.00
11	Rely 200 + Matrix	2 Qt + 4 oz	8.88	10.00	8.50	7.75	9.75	7.75
12	Roundup + Matrix	1 Qt + 2oz	6.25	8.75	7.00	6.00	7.75	7.00
13	Roundup + Matrix	1 Qt + 4oz	7.50	9.00	8.00	6.25	6.75	8.50

# Summary

- If leaf cover is more than 40% of area, removal is important for effective willowherb control
- Some late summer germinating weeds may increase due to higher soil temps
- Rely (glufosinate) is more effective on willowherb; Roundup (glyphosate) is more effective on fluvellin.
- Leaves cover willowherb, they will collect more leaves, cover more willowherb, collect more leaves, cover more...

# Organic Herbicides



# Organic Herbicide Research

- **Acetic Acid 20%**
- **Matran (Matratec)**- 50% Clove Leaf Oil  
( + wintergreen oil, Butyl Lactate and Lecithin)
- **Weed Zap** -Clove Oil 45% + Cinnamon Oil 45% + Lactose + water 10%
- **GreenMatch** – d-limonene ( citric acid)

# Organic Herbicides

Work as contact herbicide

Usually need warm to hot weather  
to work well

Work better on small weeds-  
better on broadleaves

# Organic Herbicides

**Sunflower cultivation  
approximately**

**2 weeks prior to first application**

**Applications made on December  
11, 2007 and February 15, 2008**

**Weather on both days clear and  
sunny- but not hot.**



untreated

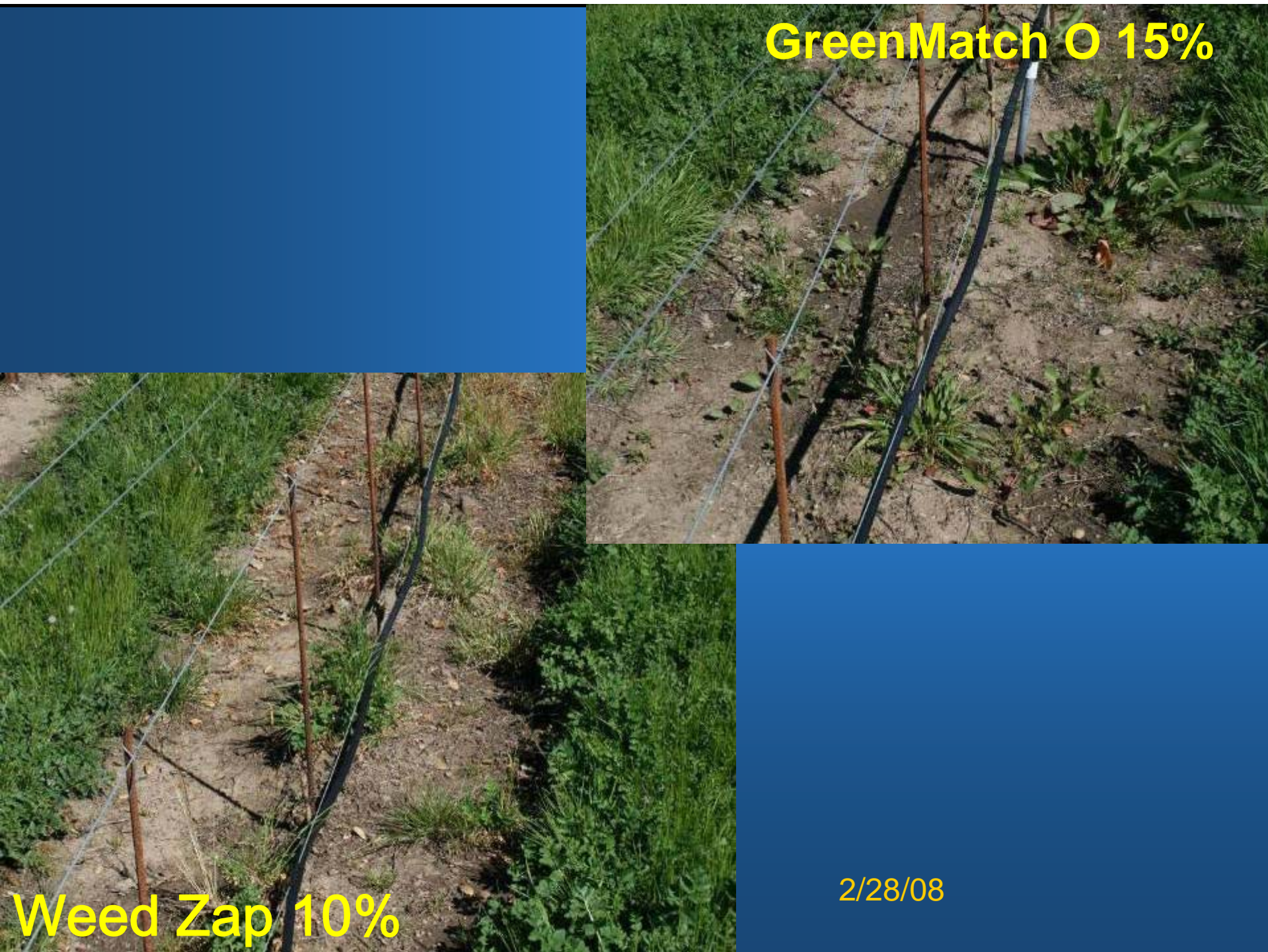


Acetic Acid 20% + Nufilm P<sup>2/28/08</sup>

**GreenMatch O 15%**

**Weed Zap 10%**

2/28/08



Matran 5%



Matran 10%

# Organic Herbicides

Registration of compounds as pesticides

Costs

Must use high gallonage <60 GPA

Contact only-multiple application

Maybe best combined with cultivation

No data tables- everything grew back



Stinkwort  
(*Dittrichia graveolens*)



# Stinkwort (*Dittrichia graveolens*)

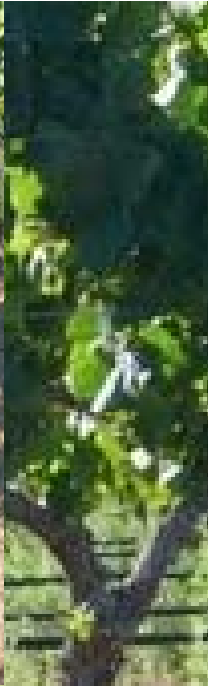
- Native to Mediterranean region
- Also invasive in Australia
- First reported in Alameda County in 1995
- Now found in at least 6 counties in Northern California
- Unpalatable to livestock
- Resembles Russian thistle, but is more similar to tarweeds (Asteraceae)
- Erect, fall flowering, aromatic annual about 2 feet tall.



# Stinkwort (*Dittrichia graveolens*)

- Spreads very rapidly, wind dispersed seeds can stick to hair, feathers vehicles and equipment
- Moving quickly along highways
- Can form dense infestations on disturbed sites
- From Weeds of California “Stinkwort is not included in most California flora... Stinkwort appears to be expanding range rapidly...”





*Any Questions?*

