

# Weed control ideas for lettuce

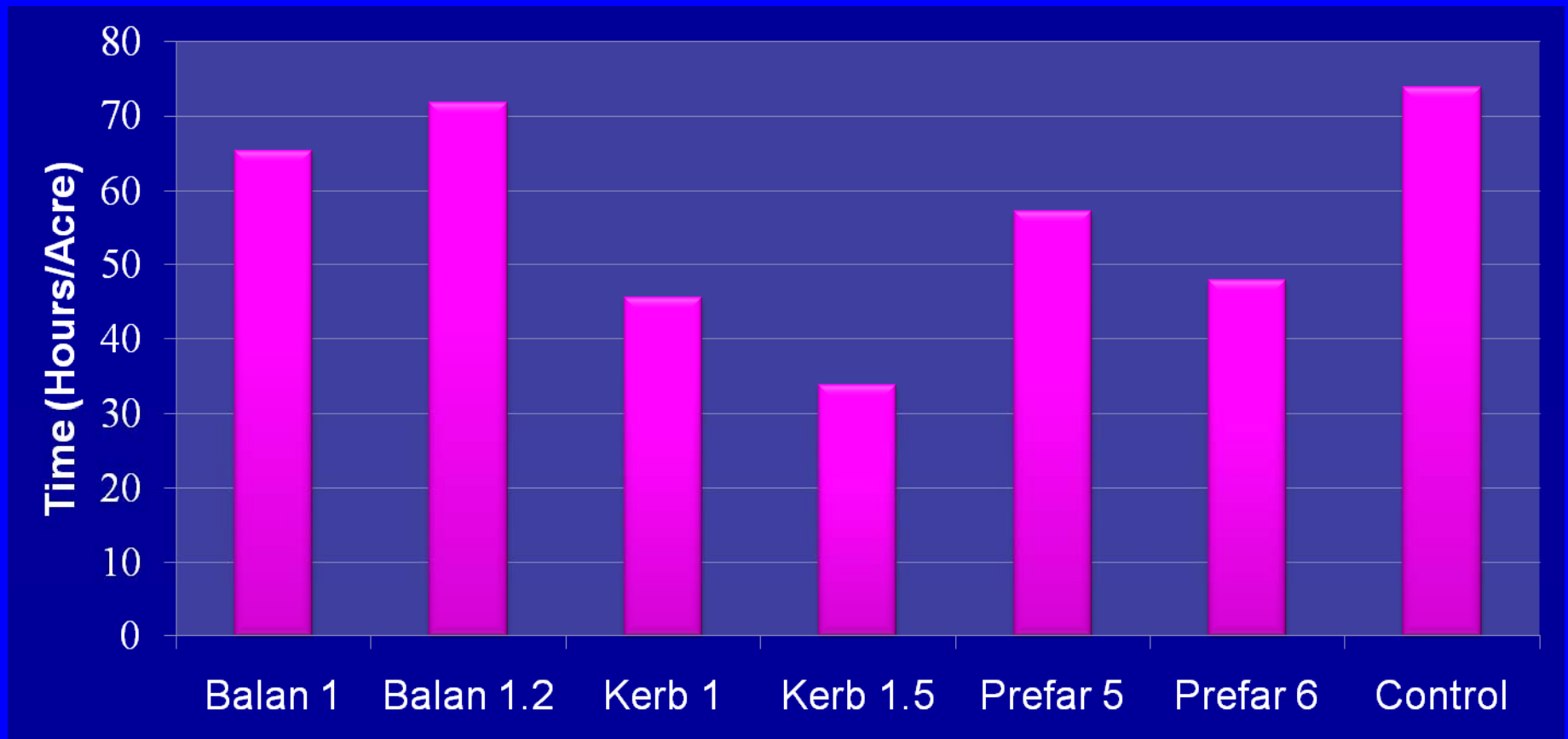
Steve Fennimore, Extension Specialist  
U.C. Davis, at Salinas, CA



# Like to farm this land?



# Lettuce thinning + hand weeding times



Fennimore 1999

# Lettuce herbicides

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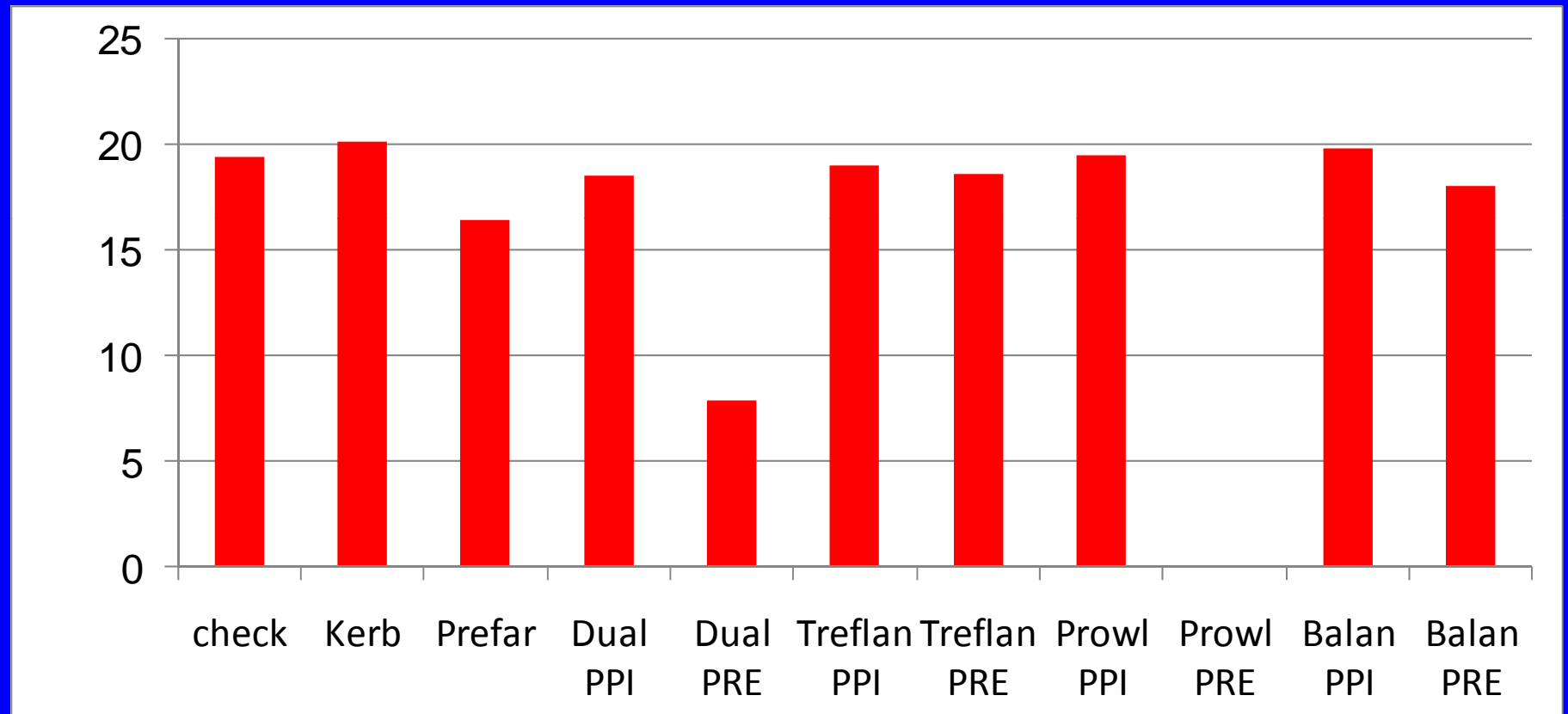
- ❖ Obviously Kerb is the best of the three soil applied herbicides.
- ❖ We have been searching for another herbicide as good or better than Kerb for over 10 years – without success.
- ❖ Our objective is not to replace Kerb, but to find alternatives and increase the options available to lettuce growers.

# Leafy greens weed control

- ❖ **Expand herbicide options for lettuce and spinach**
- ❖ **Transplanted lettuce**
  - ❖ Dual Magnum
  - ❖ Prowl H<sub>2</sub>O
- ❖ **Herbicide tolerance breeding**
  - ❖ Lettuce
  - ❖ Spinach
- ❖ **In-row cultivation**
  - ❖ Thinning
  - ❖ Reduce Hand weeding

<b>TRT</b>	<b>Herbicide</b>	<b>Rate/A</b>	<b>Method</b>
<b>1</b>	<b>Control</b>	<b>0</b>	<b>na</b>
<b>2</b>	<b>Hand weeded</b>	<b>0</b>	<b>na</b>
<b>3</b>	<b>Kerb</b>	<b>2.4 lb/Pr</b>	<b>PRE</b>
<b>4</b>	<b>Prefar</b>	<b>5 qts</b>	<b>PRE</b>
<b>5</b>	<b>Dual Magnum</b>	<b>0.5 pt</b>	<b>PRE</b>
<b>6</b>	<b>Dual Magnum</b>	<b>0.5 pt</b>	<b>PPI</b>
<b>7</b>	<b>Treflan</b>	<b>1 pt</b>	<b>PRE</b>
<b>8</b>	<b>Treflan</b>	<b>1 pt</b>	<b>PPI</b>
<b>9</b>	<b>Prowl H<sub>2</sub>O</b>	<b>1.5 pt</b>	<b>PRE</b>
<b>10</b>	<b>Prowl H<sub>2</sub>O</b>	<b>1.5 pt</b>	<b>PPI</b>
<b>11</b>	<b>Balan</b>	<b>2 lb/Pr</b>	<b>PRE</b>
<b>12</b>	<b>Balan</b>	<b>2 lb/Pr</b>	<b>PPI</b>

# Yield (Tons/A)



# Lettuce herbicides

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- ❖ Most herbicides like Dual Magnum are highly injurious to seeded lettuce.
- ❖ Chances are that without an intervention like breeding for increased herbicide tolerance or technologies yet to be invented, there will be no new herbicides for seeded lettuce for the foreseeable future.
- ❖ Transplanted lettuce is however very tolerant to Dual Magnum.

# Leafy greens weed control

- ❖ Expand herbicide options for lettuce and spinach

## ❖ Transplanted lettuce

### ❖ Dual Magnum

### ❖ Prowl H<sub>2</sub>O

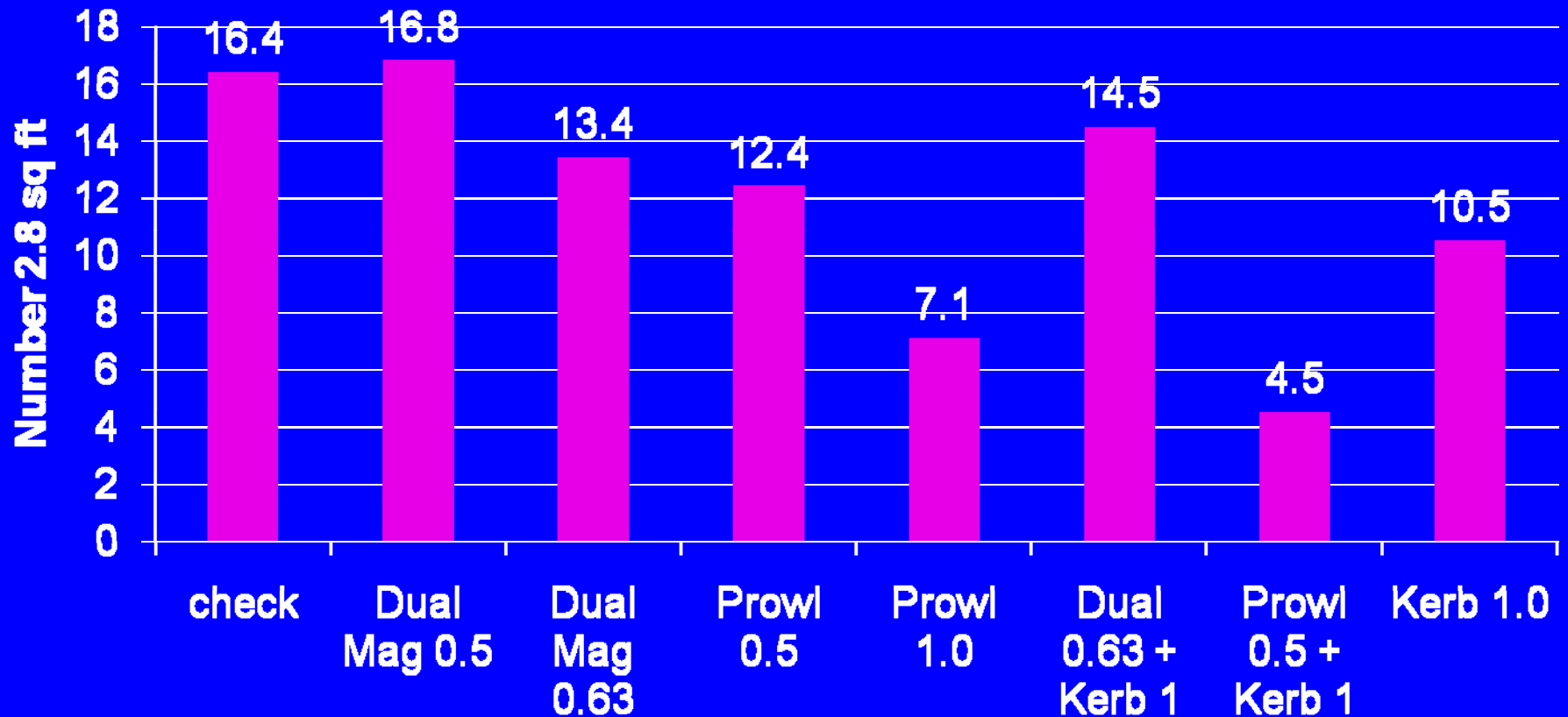
- ❖ Herbicide tolerance breeding
  - ❖ Lettuce
  - ❖ Spinach
- ❖ In-row cultivation
  - ❖ Thinning
  - ❖ Reduce Hand weeding

# New herbicides for transplanted lettuce

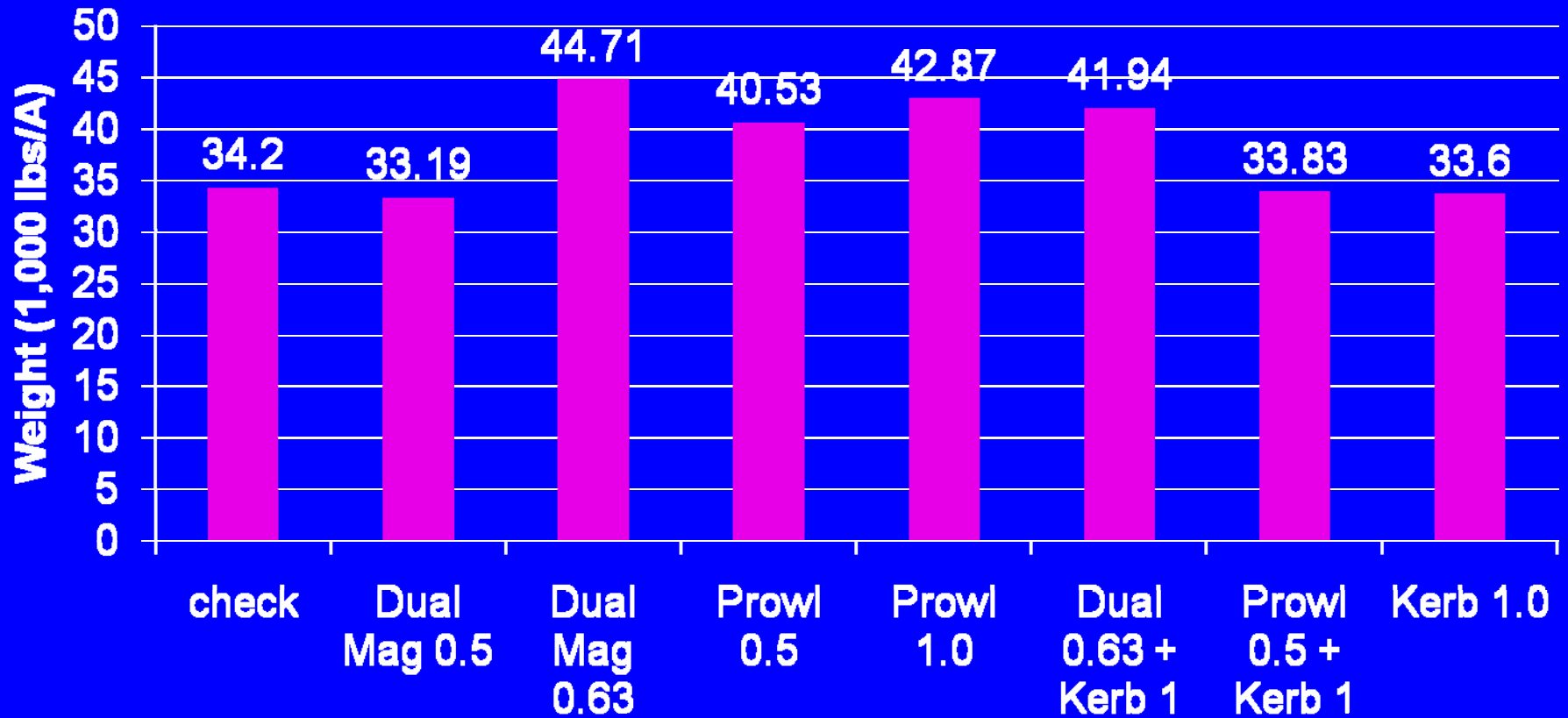
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- ❖ Dual Magnum and Prowl H<sub>2</sub>O are working their way through the EPA and will be granted a lettuce tolerance in the next few years.

# Weed control (densities)



# Lettuce yield



# Transplant lettuce

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- ❖ Transplanted lettuce tolerates much stronger herbicides than seeded lettuce.
- ❖ Herbicides like Prowl H<sub>2</sub>O can provide better weed control than Kerb and can be applied together with Kerb when needed.

# Leafy greens weed control

- ❖ Expand herbicide options for lettuce and spinach
- ❖ Transplanted lettuce
  - ❖ Dual Magnum
  - ❖ Prowl H<sub>2</sub>O

## ❖ Herbicide tolerance breeding

### ❖ Lettuce

- ❖ In-row cultivation
  - ❖ Thinning
  - ❖ Reduce Hand weeding

# Lettuce IDBR1 germplasm

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- ❖ Sulfonyleurea (SU) herbicide tolerant prickly lettuce (*Lactuca serriola*) was back crossed by University of Idaho researchers to bibb lettuce (*Lactuca sativa*) to create SU tolerant lettuce by conventional breeding = IDBR1.

# Lettuce IDBR1 germplasm tolerance to thifensulfuron (Harmony)

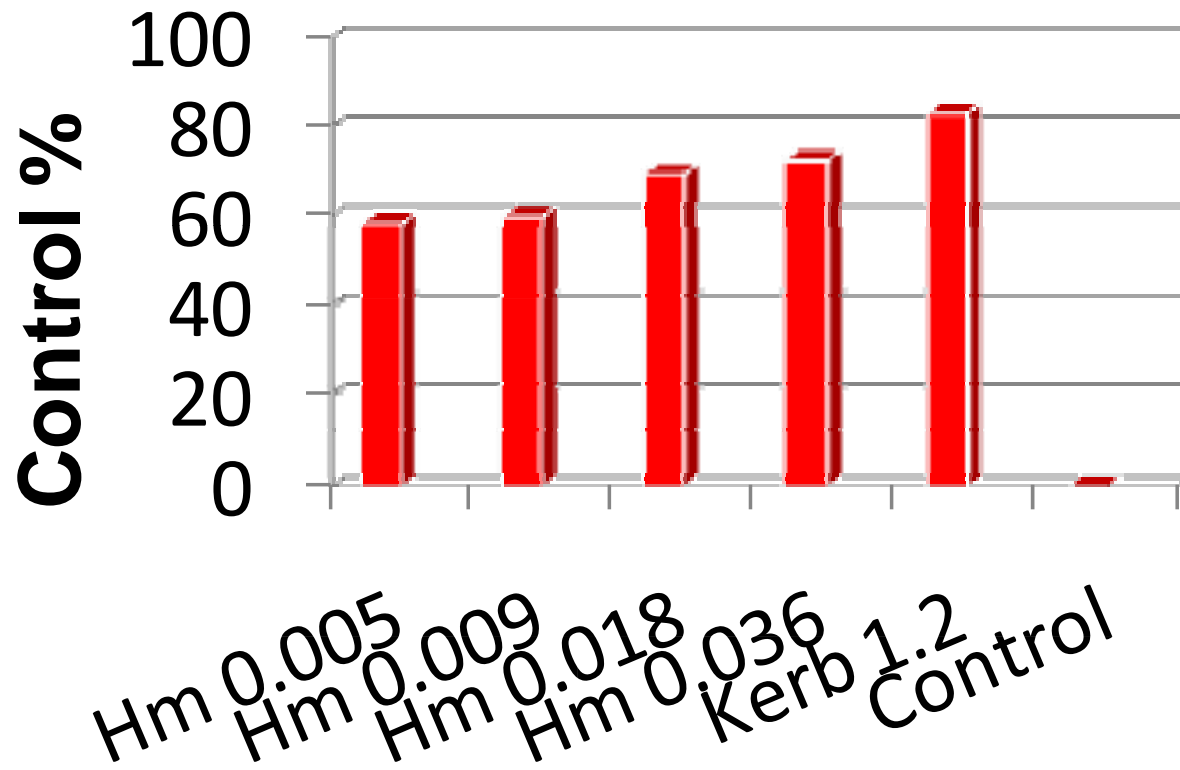
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- ❖ One trial was initiated in Aug. 10, 2010 on the Salinas Field station
- ❖ USDA lettuce breeder Dr. Beiquan Mo used Buttercrunch, Lolla Rossa, Parris Island, and Salinas 88 as parents and moved the SU herbicide tolerance to these varieties.
- ❖ The trial was replicated 4 x

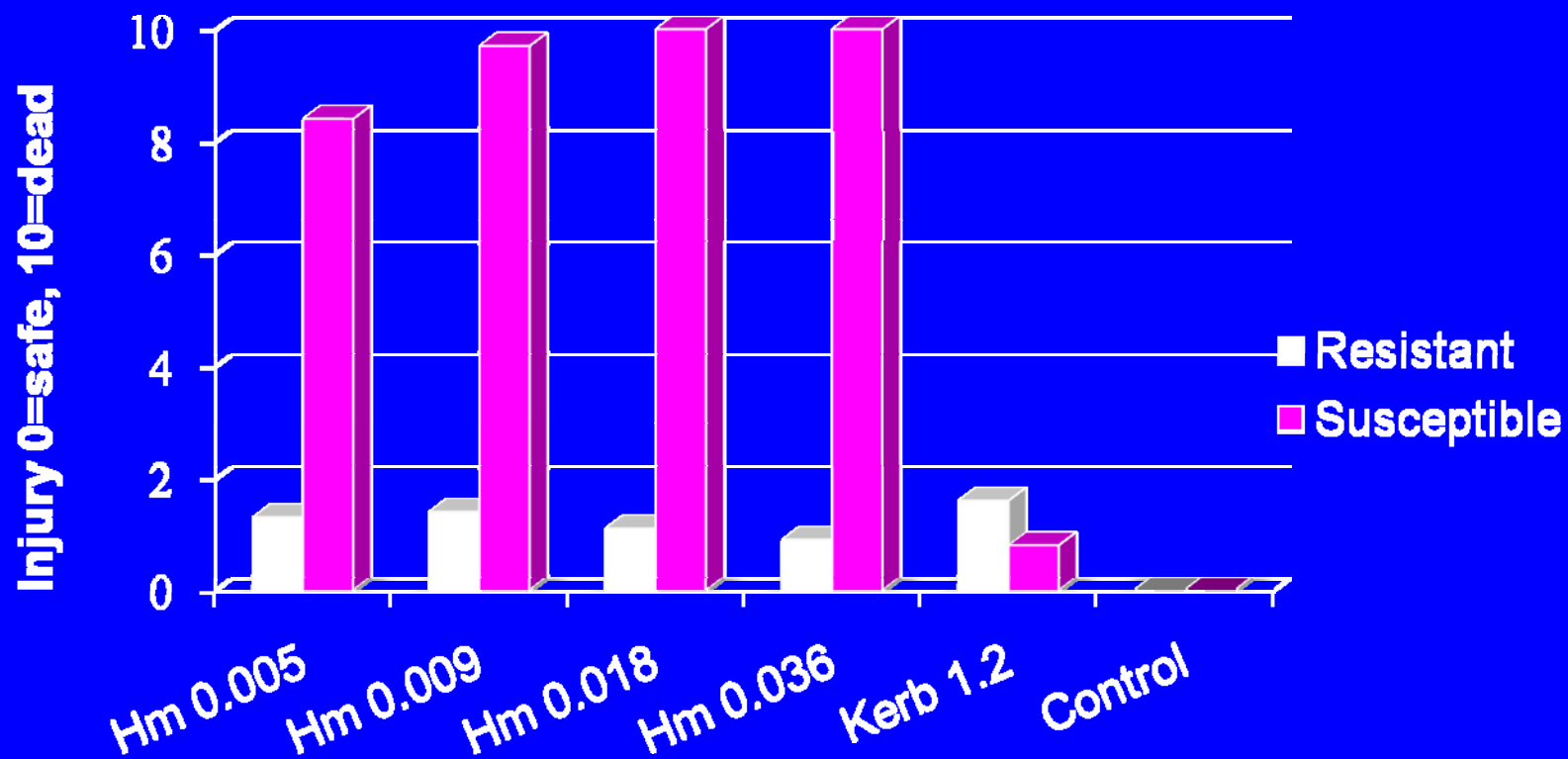
<b>TRT</b>	<b>Herbicide</b>	<b>Form</b>	<b>lb ai/a</b>
<b>1</b>	<b>Harmony</b>	<b>75 DF</b>	<b>0.005</b>
<b>2</b>	<b>Harmony</b>	<b>75 DF</b>	<b>0.009</b>
<b>3</b>	<b>Harmony</b>	<b>75 DF</b>	<b>0.018</b>
<b>4</b>	<b>Harmony</b>	<b>75 DF</b>	<b>0.036</b>
<b>5</b>	<b>Kerb</b>	<b>3.3 SC</b>	<b>1.2</b>
<b>6</b>	<b>Control</b>		<b>0.0</b>



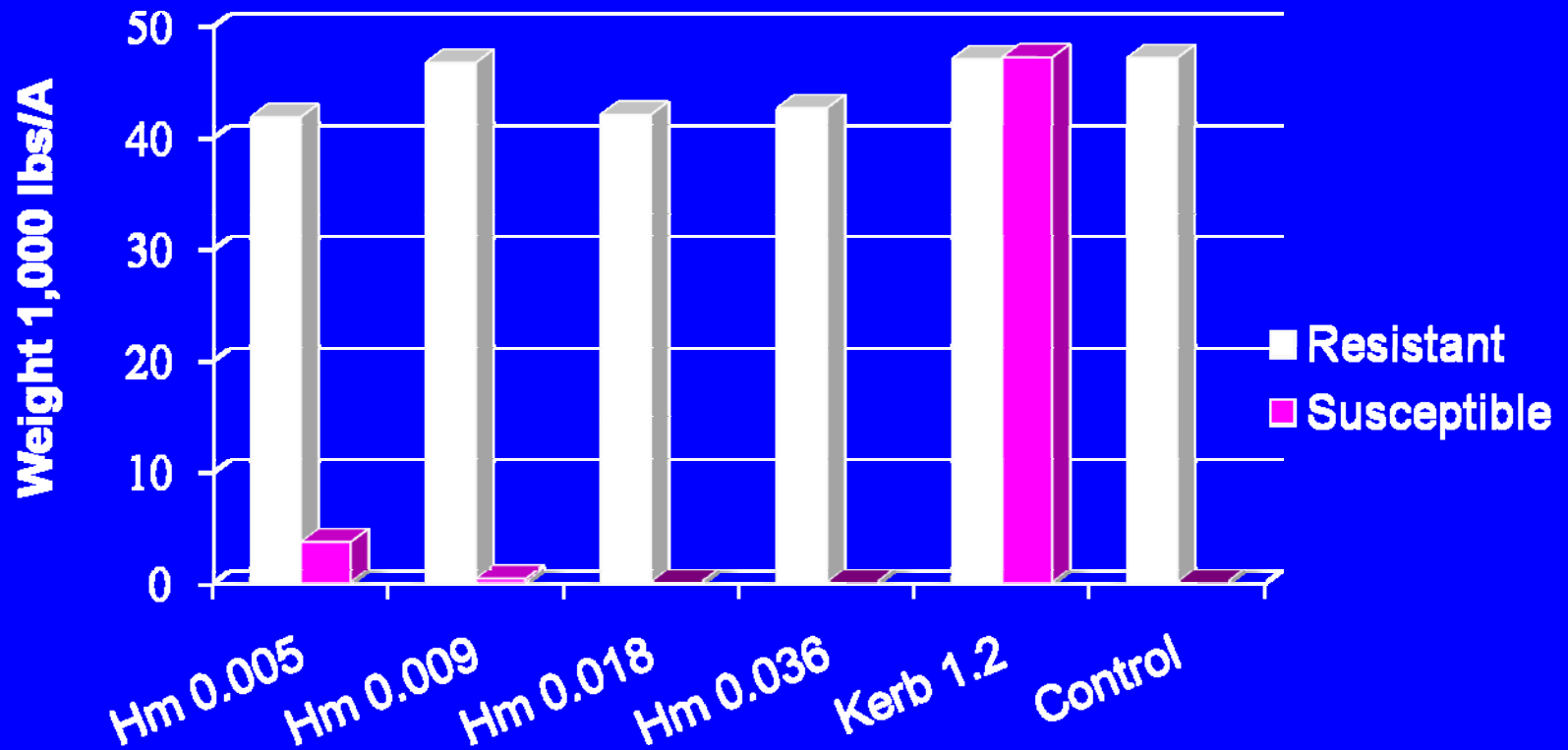
# Weed Control



# Injury estimates- Romaine 704 lettuce



# Yields- Romaine 704 lettuce



P=0.89

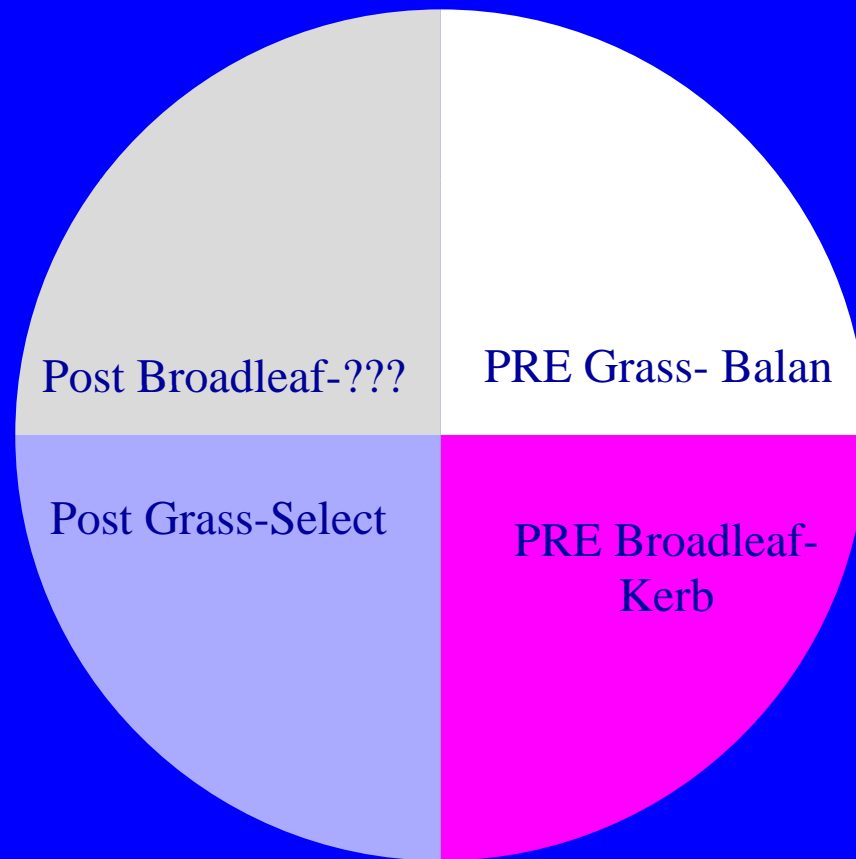
# Summary – IDBR1

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- ❖ The resistance gene is working
- ❖ Weed control with Harmony is fair
- ❖ Resistant Romaine yield indicated tolerance Harmony

# The lettuce herbicide market by application method and weed class

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# Leafy greens weed control

- ❖ Expand herbicide options for lettuce and spinach
- ❖ Transplanted lettuce
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  - ❖ Prowl H<sub>2</sub>O
- ❖ Herbicide tolerance breeding
  - ❖ Lettuce

## ❖ In-row cultivation

❖ Thinning

❖ Reduce Hand weeding

# Sponsors

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- ❖ **California Dept. of Food and Agriculture,  
Specialty Crop Block Grants Program**



## **Weed costs \$/A**

<b>Operation</b>	<b>Romaine</b>	<b>Head</b>	<b>Organic Romaine</b>
<b>Herbicide</b>	<b>\$60</b>	<b>\$50</b>	<b>\$0</b>
<b>Cultivate</b>	<b>\$8</b>	<b>\$10</b>	<b>\$34</b>
<b>Thin</b>	<b>\$137</b>	<b>\$100</b>	<b>\$219</b>
<b>Hand weed</b>	<b>\$68</b>	<b>\$80</b>	<b>\$162</b>

Tourte et al 2009; Smith et al 2010; Smith et al 2009

# Collaborators

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- ❖ **Richard Smith, UCCE Monterey**
- ❖ **Laura Tourte, UCCE Santa Cruz**
- ❖ **Michelle Lestrangle, UCCE Tulare**

# Cultivation

A traditional cultivator does not reach into the seedline



An in-row cultivator weeds around and in the row

# Standard cultivation



# **Robotic thinning/weeding objectives**

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- ❖ **Determine if we can thin lettuce and weed celery, lettuce and tomato**
- ❖ **Determine if need for hand weeding and thinning can be reduced**
- ❖ **Measure effects on celery, lettuce and tomato yields**

# Tillet cultivator



# Tillet cultivator before



# Tillet cultivator - after



# 2010 lettuce studies

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- ❖ Richard Smith study at Gonzales, CA May 20 to July 22, 2010. Cultivation/thinning was performed on June 16.
- ❖ Determine if need for hand weeding and thinning can be reduced
- ❖ Measure effects on lettuce yield

# Lettuce thinning

# Initial and final lettuce stand, thin time

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<b>Tool</b>	<b>Initial</b>	<b>Final</b>	<b>Thin time</b>
	<b>1,000 plants/A</b>		<b>hr./A</b>
<b>Standard</b>	<b>115</b>	<b>30.6</b>	<b>13.2 a</b>
<b>Tillet</b>	<b>119</b>	<b>27.1</b>	<b>6.4 b</b>

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Smith, Gonzalez 2010

# Initial and final lettuce stand, thin time

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<b>Tool</b>	<b>Initial</b>	<b>Final</b>	<b>Thin time</b>
	<b>1000 Plants/ A</b>		<b>hr./A</b>
<b>Standard</b>	<b>60.7 a</b>	<b>14.1 b</b>	<b>11.2</b>
<b>Tillet</b>	<b>17.8 c</b>	<b>9.3 c</b>	<b>10.6</b>

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# Weed control

# Weed densities

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<b>Tool</b>	<b>Before</b>	<b>After</b>	<b>Control</b>
	<b>No. (1000s) / A</b>		<b>%</b>
<b>Standard</b>	<b>134</b>	<b>65 ab</b>	<b>51</b>
<b>Tillet</b>	<b>163</b>	<b>34 cd</b>	<b>79</b>

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**Harvest**

# Lettuce yield

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<b>Tool</b>	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>
	-----Tons/A-----		
<b>Standard</b>	<b>28</b>	<b>14.7</b>	<b>17.3</b>
<b>Tillet</b>	<b>24</b>	<b>12.6</b>	<b>18.9</b>

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Smith, 2010.01, & .02

**Costs**

# Costs used in partial budget 2009

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- ❖ Costs included for equipment, fuel, lubrication, repairs, materials, labor and interest on capital.
- ❖ The partial budget was prepared by Laura Tourte.

# Production costs & net returns seeded head lettuce

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<b>Tool</b>	<b>Yield</b>	<b>Gross returns</b>
	<b>Cartons/A</b>	<b>\$/A</b>
<b>Tillet</b>	<b>943</b>	<b>10,467</b>
<b>Standard</b>	<b>1,068</b>	<b>11,855</b>

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2009.03 by L. Tourte

# Production costs & net returns seeded head lettuce

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<b>Tool</b>	<b>Production costs</b>	<b>Net Returns</b>
	<b>\$/A</b>	<b>\$/A</b>
<b>Tillet</b>	<b>445</b>	<b>10,022</b>
<b>Standard</b>	<b>549</b>	<b>11,306</b>

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2009.03 by L. Tourte

# Summary

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- ❖ The in-row weeder can be used to thin and for in row weeding. The accuracy of this machine needs to be improved.
- ❖ The in-row robotic weeder appears to reduce labor costs for thinning and weeding but reduce the harvestable lettuce and reduce net returns – preliminary results.

# Summary – lettuce weed control

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- ❖ There is no simple answer to improve lettuce weed control programs.
- ❖ The best we can hope for is to create some options that put together with other tools will improve or increase the effective set of weed control tools for lettuce.