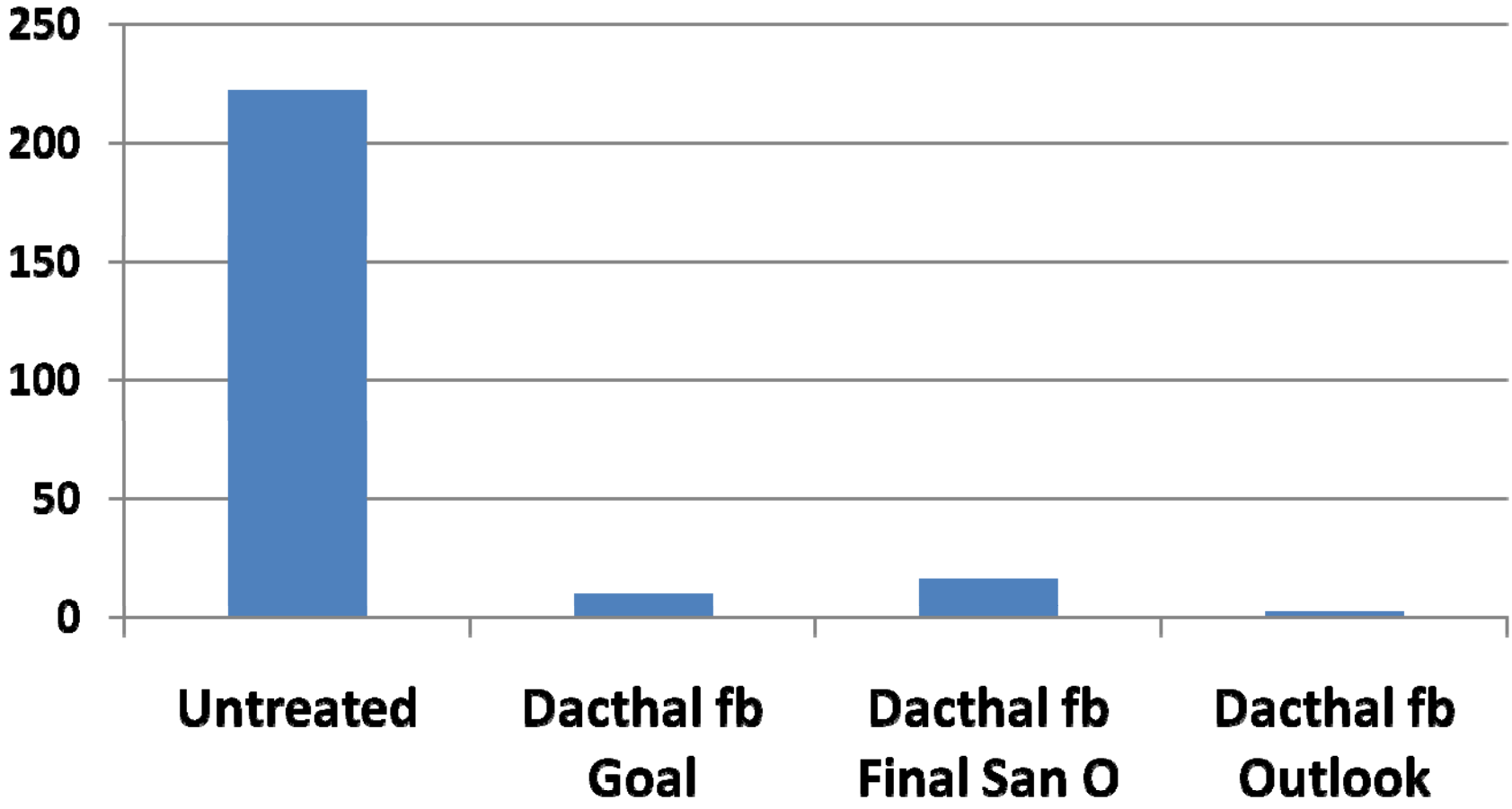
Organic Weed Control in Vegetable Crops

Richard Smith,
Vegetable Crop and Weed Science Farm Advisor,
University of California Cooperative Extension
Monterey County

Weed Control Economics

Hour per Acre to Weed Onions

King City, 2012



Final-San-O = Organic herbicide

Comparison of Organic vs Conventional Leaf Lettuce Production Costs

System	Costs $/A	Percent of Growing Costs
Organic[1]	257	8
Conventional[2]	132	5

1 – Tourte and Smith, 2004

2 – Tourte and Smith, 2001

Organic Weed Control Strategies

- **Cultural**
- **Mechanical**
- **Chemical**
- **Biological**

Key Cultural Practices to Reduce Weed Pressure

- **Not letting weeds go to seed**
- **Pre-germination of weeds**
- **Use of “stale” seedbeds**
- **Planting vigorous varieties in weediest area**
- **Field selection – avoidance:**
  - **Avoiding weedy fields**
  - **Avoiding weediest time of the growing season (i.e. purslane during June to Sept.)**
  - **Plant competitive crops/varieties in weedy areas**

Effects of Preirrigation

No Preirrigation

With Preirrigation

- **Reduces the number of weed seed that are ready to germinate in the top layer of the soil**
- **Can reduce weed emergence in subsequent crop by up to 50%** **(Shem Tov and Fennimore)**

Further Cultural Practices to Reduce Weed Pressure

- Control weeds that aerial disperse from surrounding areas
- Carrying weeds from the field for disposal elsewhere

- Crop rotations
- Deep plowing
- Planting to moisture
- Use of buried drip irrigation
- Solarization
- Mulches
- Transplants
- Cover crops

Soil Seed Bank

Non-dormant

Dormant Weed seed

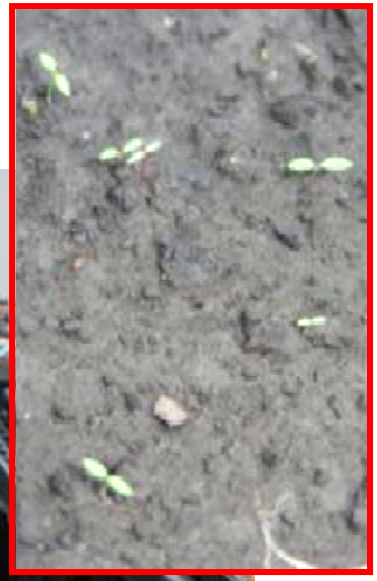
Germination & Emergence

Tillage & other controls

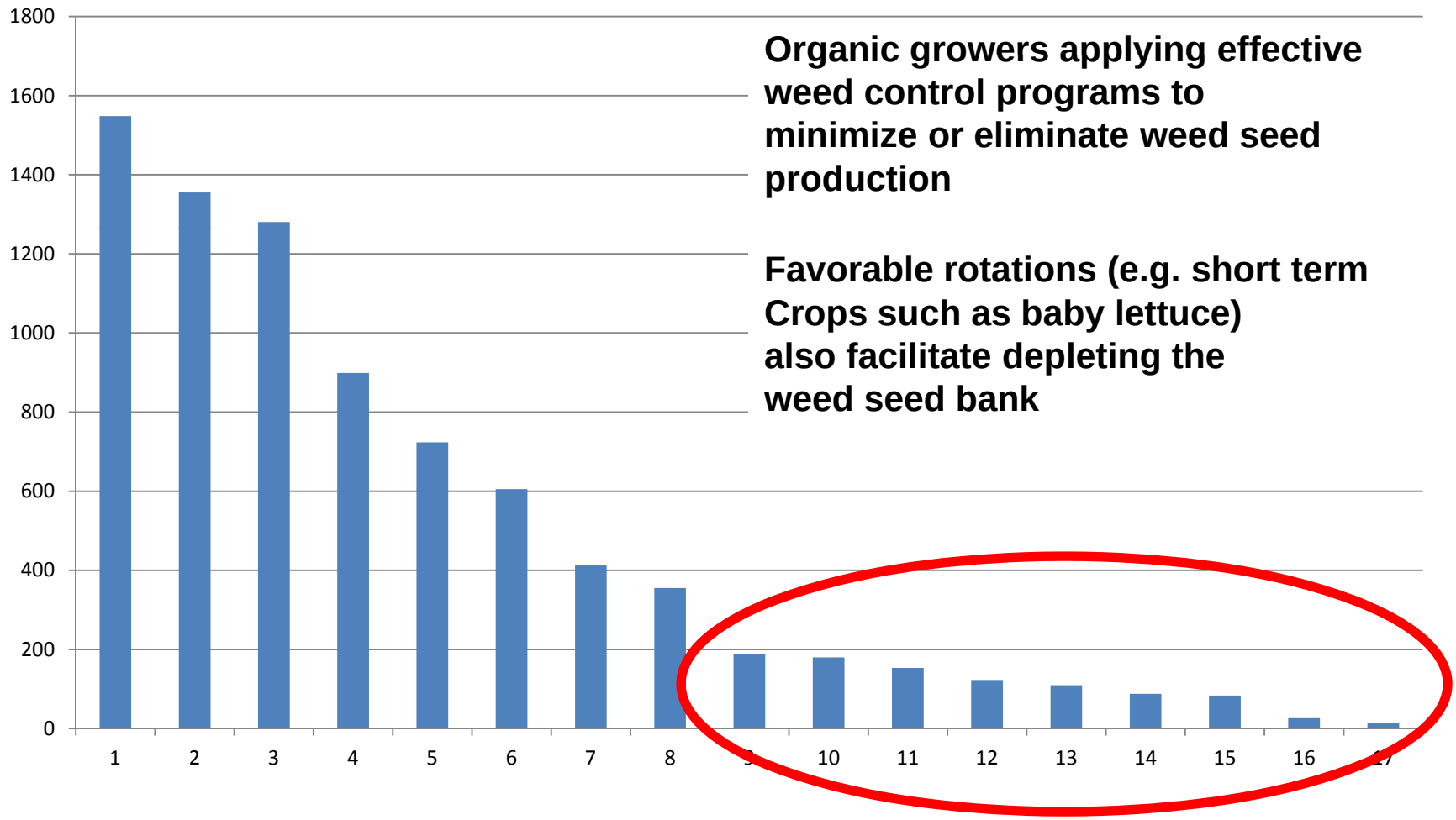
Microbial
Physical
Physiological
Seed degradation

Seed Death

Seedbank Evaluation of Organic Farms 2010-11



Impact of the Organic Weed Management Strategies on Soil Seed Bank



Why Have Some Organic Growers Been So Successful in Managing Weeds

- **Dedication to consistent weed control policy (starts at the top)**
- **Zero tolerance for weeds – year round**
- **Crop mix & rotations (e.g. short term rotations)**

Mechanical Controls

- **Cultivation**
- **Plowing**

Typically 80% of a double row forty-inch wide bed can be effectively cultivated. The fight with weeds occurs in the uncultivated seedline

Precision Guidance of Cultivators

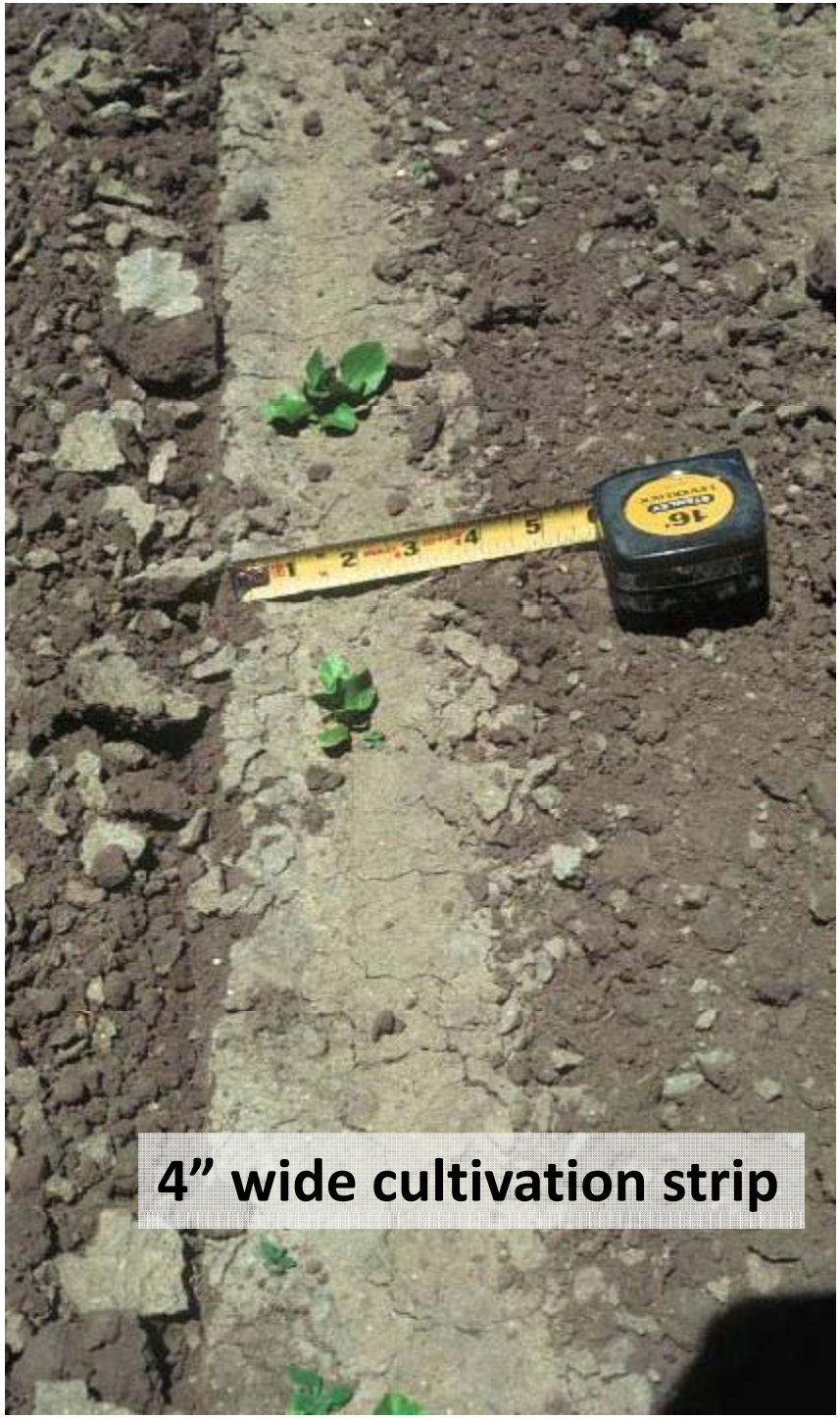
Guided by the Operator

Effective but Slow

Old Technology

Modern Version

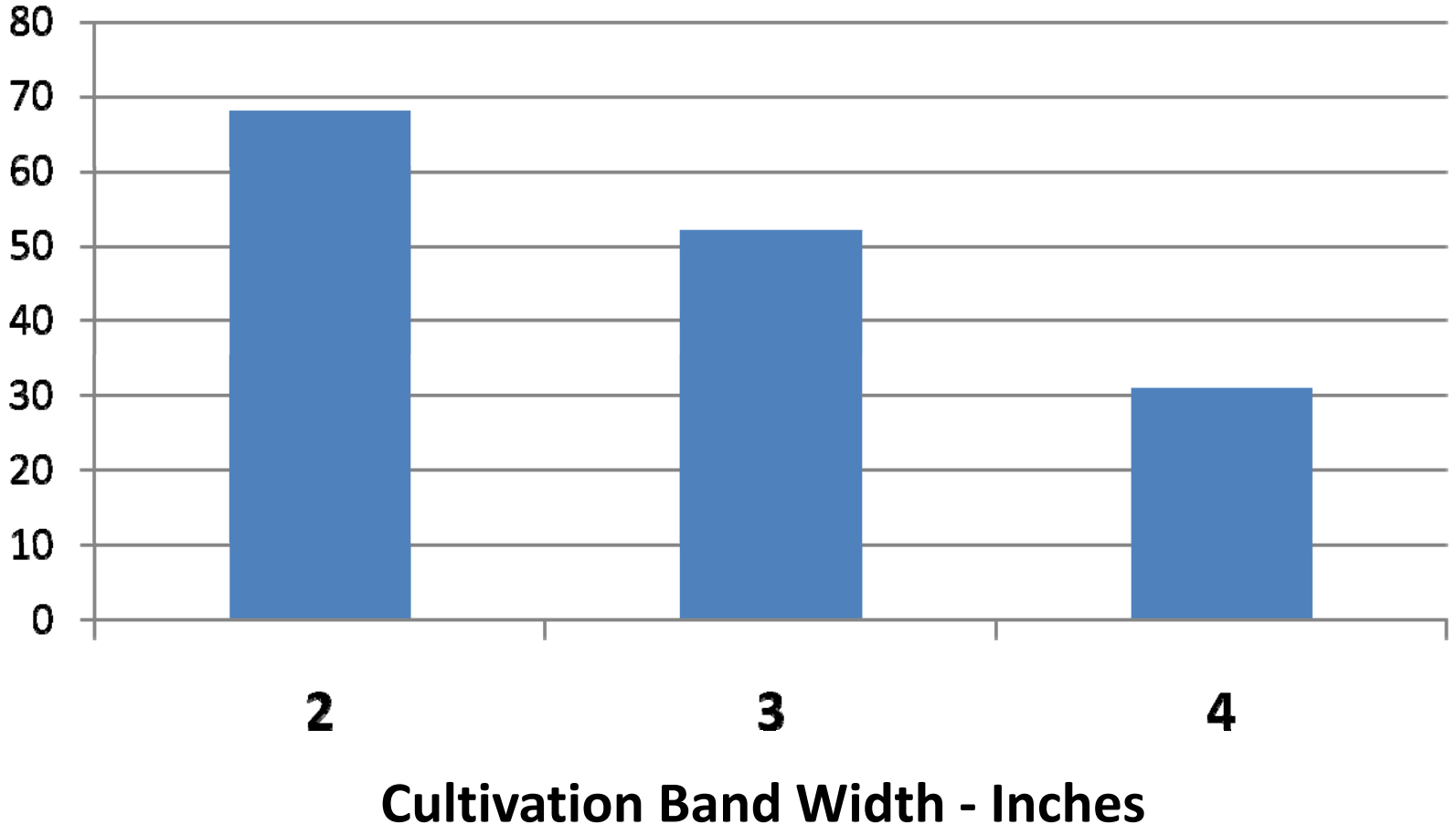
Camera Guidance Systems for Cultivators


4” wide cultivation strip


3” wide cultivation strip

Percent of Weeds Controlled at Different Cultivation Band Widths

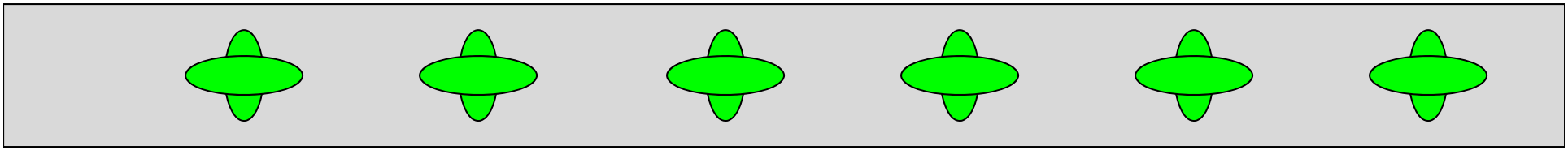
2005 Lettuce Trial No. 1



Removal of Weeds from the Seedline

- **This is the area where we can make great improvements to weed control**
- **High tech ideas**
  - **Robotic weed removal**
    - **Use of vision guidance, GPS, weed recognition**
- **Low tech ideas**
  - **Finger and torsion weeders**

A traditional cultivator does not reach into the seedline



An in-row cultivator weeds around and in the row

Robotic Weeder

- **Current machines utilize a camara that looks for plants (2 dimensions)**
- **Need a large difference in size between the weeds and the crop**

Robotic Weeder

The computer then activates a plant removal mechanism:

- **Spinning blades**
  - **Tillet, England**
- **Split knife**
  - **Steketee, Netherlands**
- **Spray Solution**
  - **Mechtronix, USA**

Automated Thinner/Weeders

Steketee

Tillet

Mechtronix

Example of Spray Mechanism Used for Thinning & Weed Removal

Thinning Evaluation

Blue River Technology and U of Arizona

Salinas, 2012

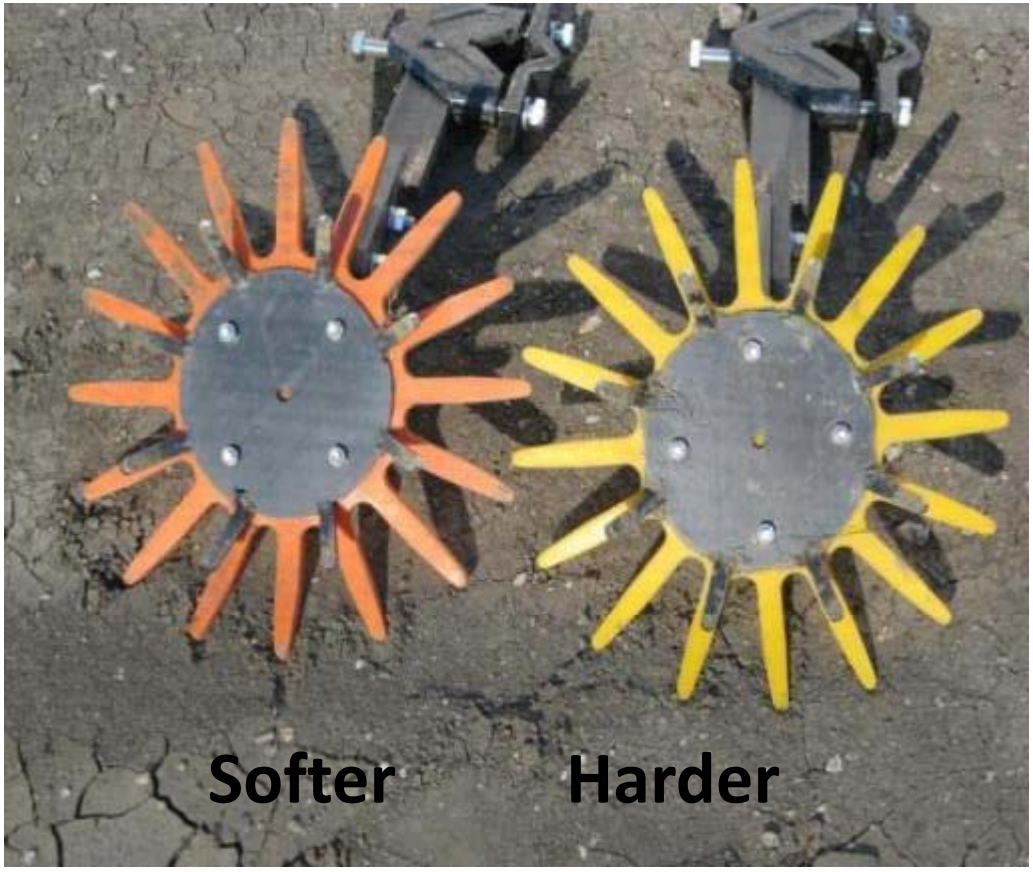
Treatments	Thin hrs/A Aug 28	Post thin doubles/A remaining Aug 30	Weed & double removal hrs/A Sept 11	Total time thin/ weed Hrs/A	Yield Market T/A Oct 23
Standard	4.6	24	2.8	7.4	27.08
Sulfuric acid	---	7,139	5.7	5.7	25.08

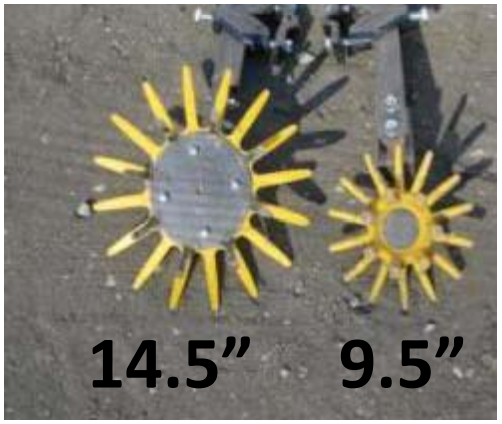
Finger Weeders

- **Originally developed by the Buddingh Company, Michigan**
- **The Kress Company redesigned and sells them out of Germany**
- **Work best with large seeded crops or transplants**
- **Weeds need to be small (<2nd true leaf stage) and crop needs to be firmly rooted**

Finger Weeders

Two sizes and two levels of hardness





Kress Co, Germany


Standard
9.5” yellow

Weed Evaluation of Finger Weeders in Transplanted Radicchio

Gilroy, 2009

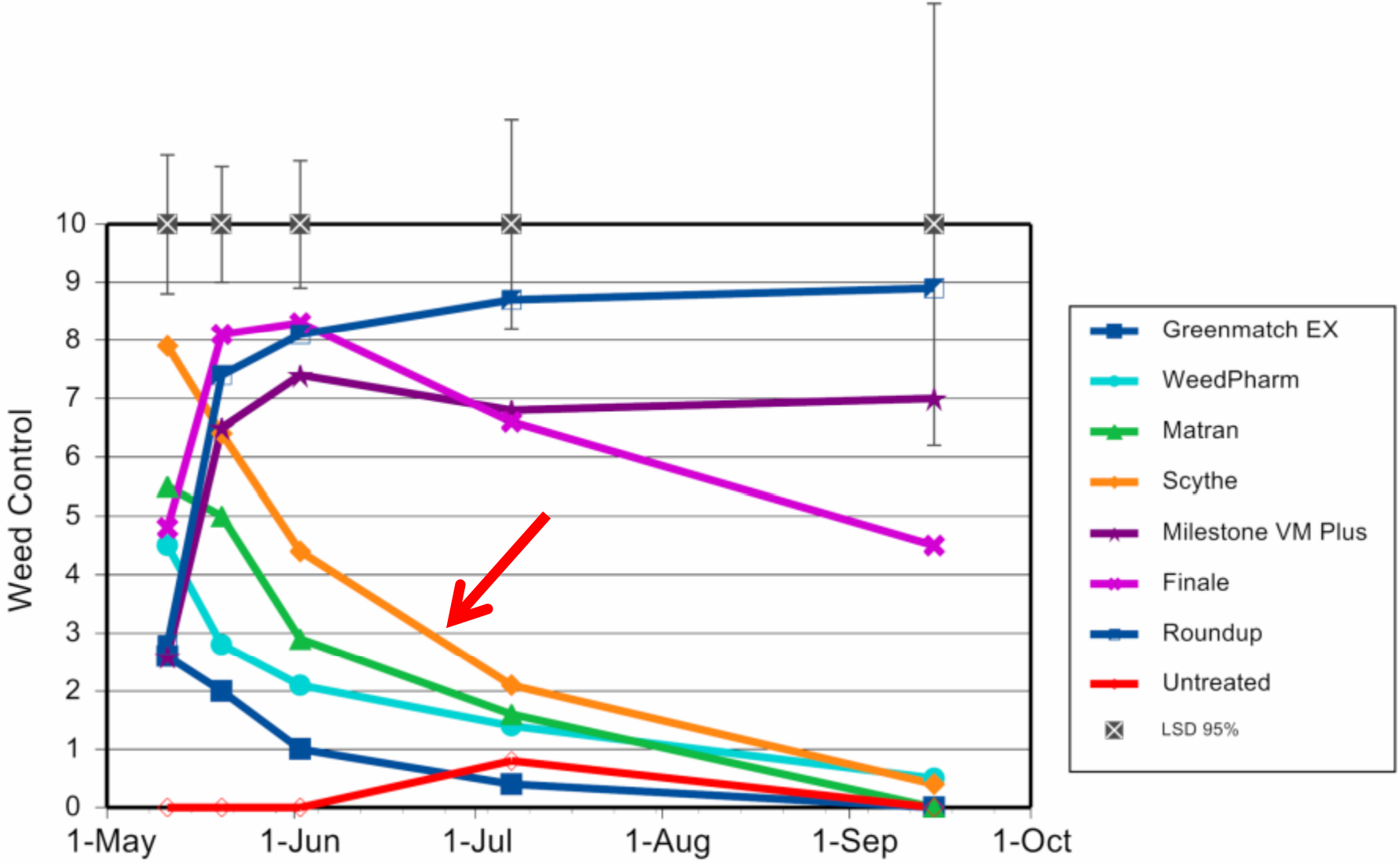
Treatment	Weed Count Post Cultivation	Percent Weed Removal	Weeding Time Aug 7	Weeding Time Aug 14	Total Hand weeding time
Standard	40.3	0.0	8.4	6.9	15.3
Finger Weeders	16.9	64.0	5.9	5.7	11.6

Types of Organic Herbicides:
Non Selective Burn Down Materials

- **Preplant**
  - **Corn Gluten***
  - **Burndown materials used on beds just prior to planting (have to watch the labels as some are not registered for use in crops)**
    - **Fatty acids**
    - **Citric acid**
    - **Acetic acid**
    - **Essential Oils**
      - **Clove oil**

Overall Vegetation Control Ratings

2010 Santa Cruz County

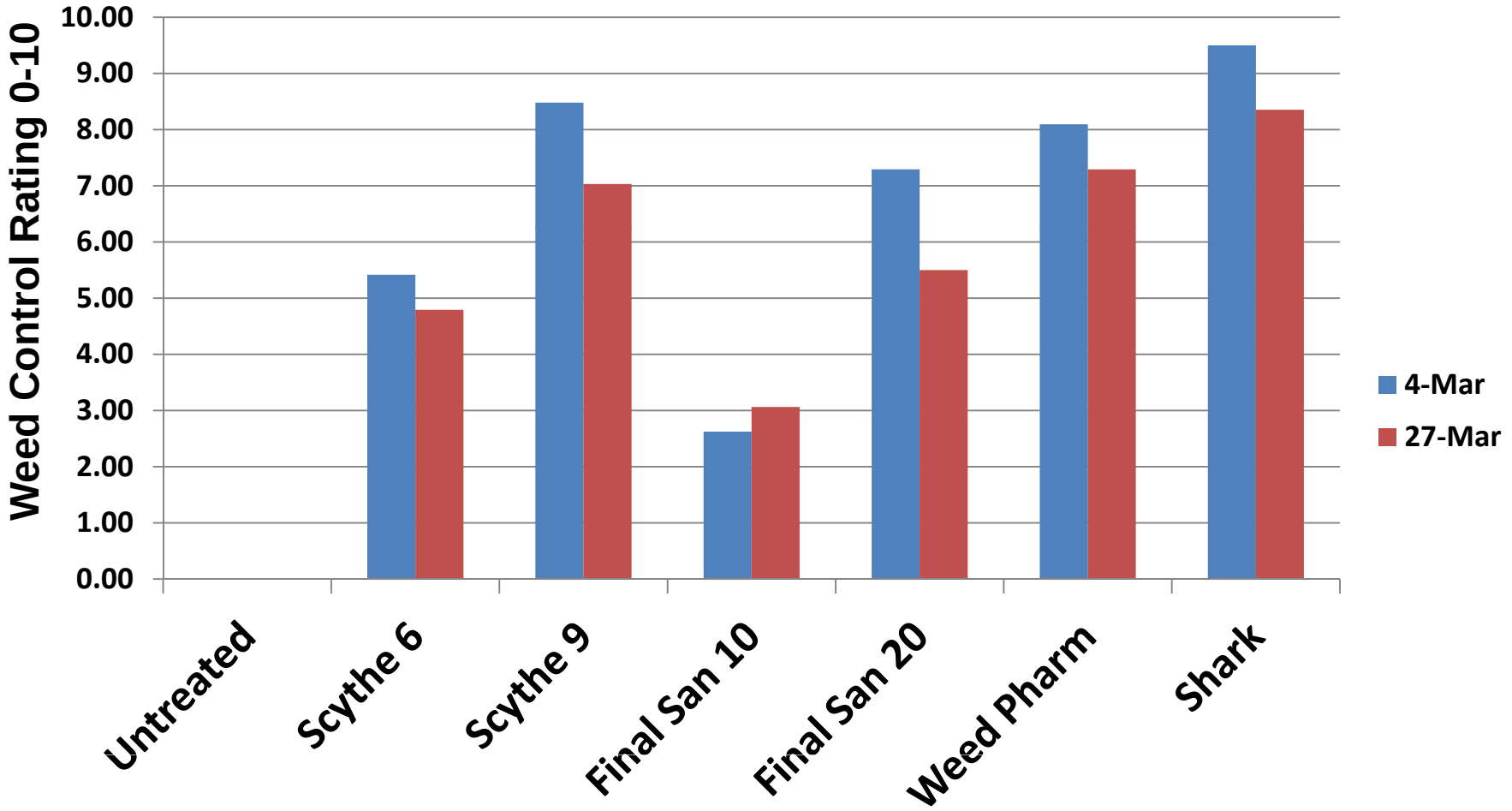


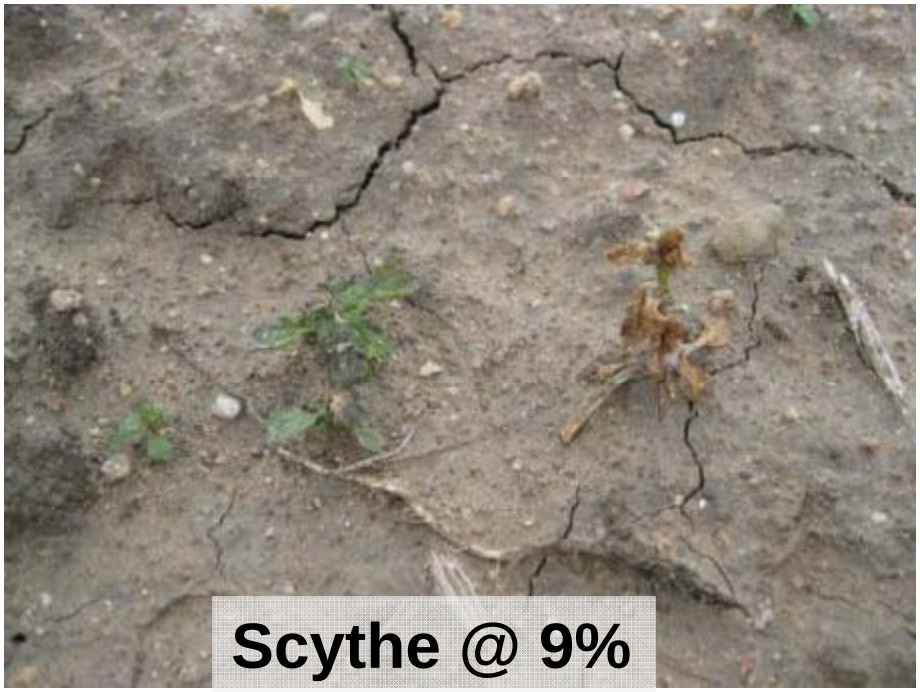
Search for a More Effective Organic Herbicide

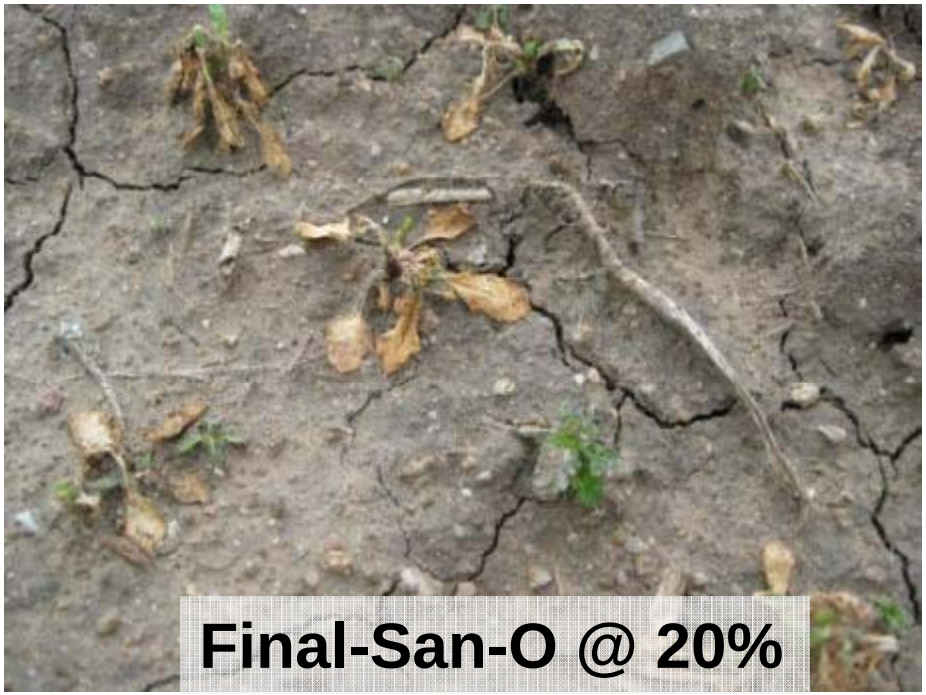
- **Most of the currently available organic herbicides are weak**
- **This year we evaluated Final-San-O**
- **Its is a salt of a fatty acid and this type of organic herbicide has been shown to be more effective than other classes of organic herbicides**

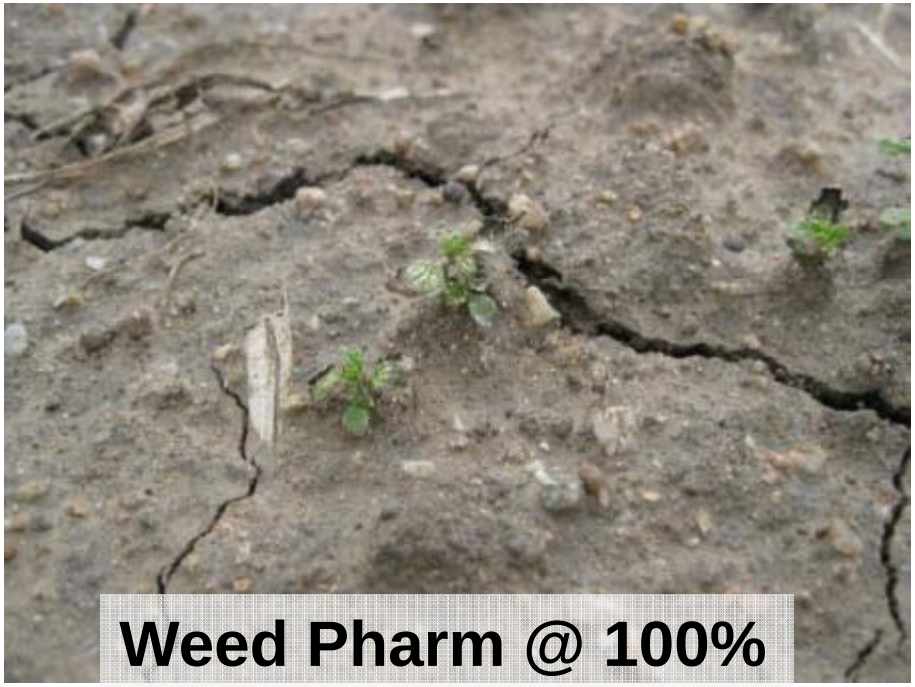
Contact Herbicide Trial

2012




Scythe @ 9%


Final-San-O @ 20%


Weed Pharm @ 100%


Untreated

For Further Information

- **Monterey County Cooperative Extension BLOG**
  - **Search Weed Control and find “Mechanical Weed Control Tools for Vegetables”**
  - **It lists companies that provide mechanical – robotic weeders**
- **YouTube**
  - **Search “alternative vegetable cultivators”**
  - **http://www.youtube.com/watch?v=I4kzebMG6rE**

YouTube alternative vegetable cultivators Bro

Alternative cultivators for organic vegetable production

UCANR Subscribe 82 videos