Weed Control in Vegetable Production

- Richard Smith, Vegetable Crop and Weed Science Farm Advisor, Monterey County

Why Care about Weeds

- Weeds are not microscopic or small like fungi and insects
- They can always be pulled out
- The issue is their impact on crop yield and on the economics of farming

El Pellisco

Hours/Acre to Weed Carrots

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

Weed Classification

- Annuals
  - Complete lifecycle in less than one year (from seed to seed)
    - Winter – germinate in fall and mature in early spring
    - Summer – May germinate in the fall or spring, but mature in the summer

Winter annuals

Summer Annuals


Purslane

Nightshades

Nettleleaf Goosefoot

Weed Classification

- **Biennial**
  - **Live longer than one year but less than two. Often overwinter as a rosette and resume growth in the spring**
- **Perennial**
  - **Live more than one year. Can be woody or fleshy. May have survive as tubers, roots, nutlets, etc.**
    - **Winter – active in the winter**
    - **Summer – active in the summer**

Soil Seed Bank

Non-dormant

Dormant
Weed seed

Germination
& Emergence

Tillage
& other
controls

Microbial
Physical
Physiological
Seed degradation

Seed Death

Weed Strategies – Crop Areas

- Set Seed Quickly
  - Groundsel, Burning Nettle
- Long lived seed
  - Malva, Burr Clover
- Large Numbers of Seed
  - Purslane & many others
- Set seed in surrounding areas and invade from the edges
  - Groundsel, Sow thistle

Weed Control Strategies

- Cultural
- Mechanical
- Chemical
- Biological
  - Few effective other than seed viability declining in the soil over time

Cultural Practices for Managing Weeds

- Aggressively controlling weeds in all prior rotations and during the fallow period over the winter
- Zero tolerance of weeds going to seed

Cultural Practices to Reduce Weed Pressure

- Field selection
- Avoidance:
  - Avoiding weedy fields
  - Avoiding weediest time of the growing season (i.e. purslane during June to Sept.)
- Pre-germination of weeds
- Use of “stale” seedbeds
- Planting vigorous varieties on weediest area

Effects of Preirrigation

No Preirrigation

With Preirrigation

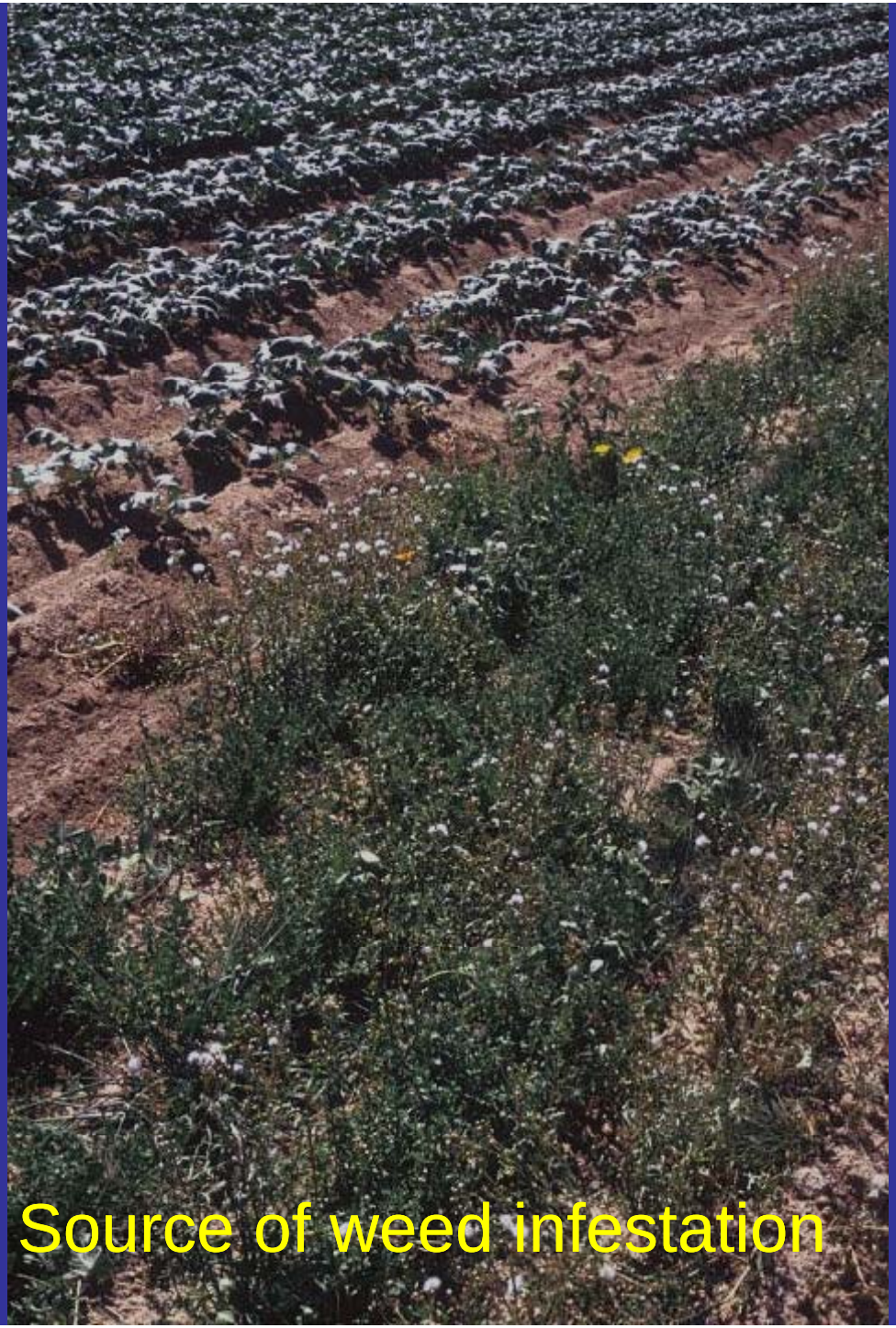
- Reduces the number of weed seed that are ready to germinate in the top layer of the soil
- Can reduce weed emergence in subsequent crop by up to 50% (Shem Tov and Fennimore)

Stale Bed Technique: Pre-germinate and kill flush of weeds on shaped beds, prior to planting cash crop

Cultural Practices to Reduce Weed Pressure

- Control weeds that aerial disperse from surrounding areas
- Not letting weeds go to seed
- 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



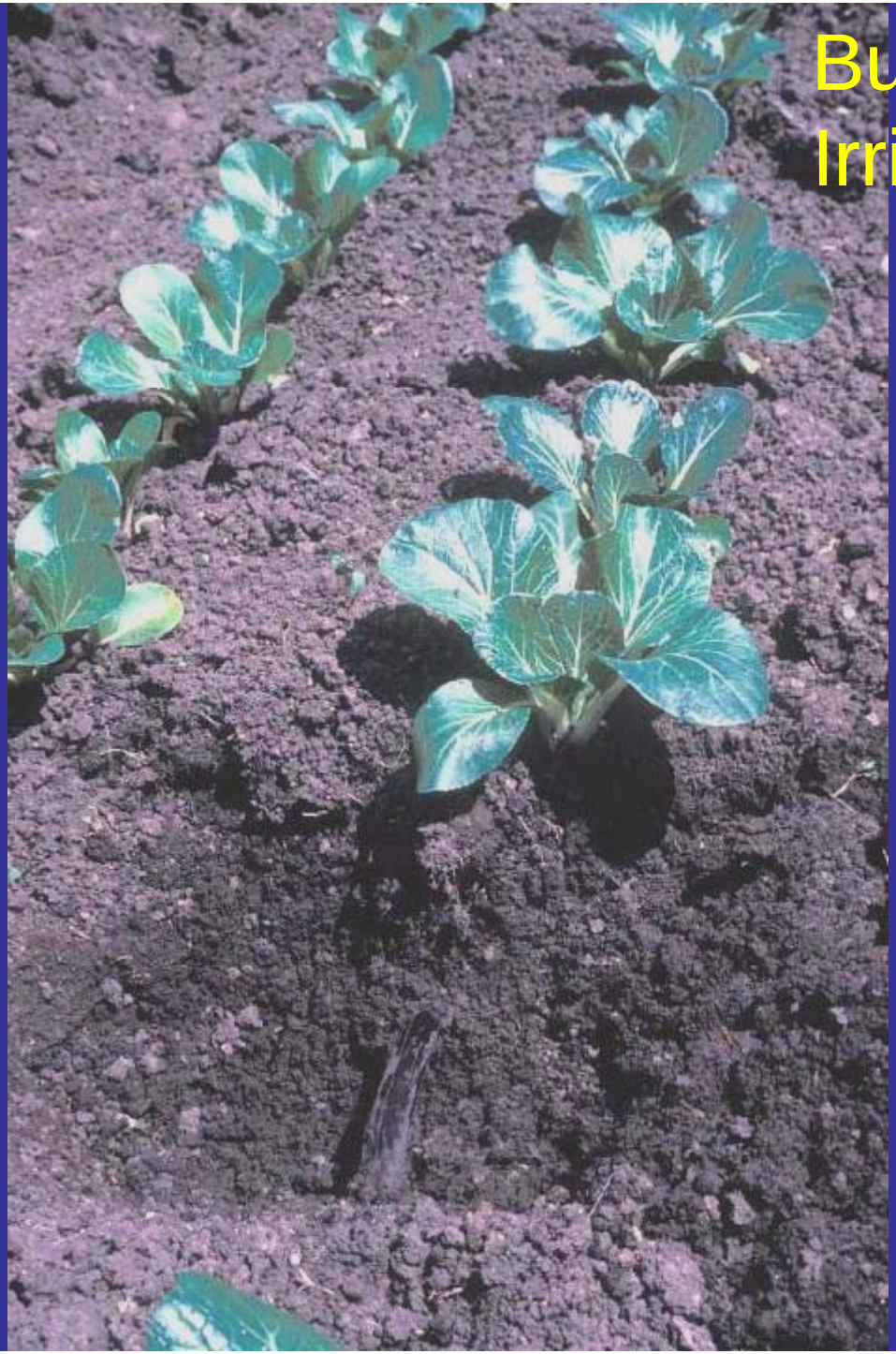
Weeds Around Edge of Field

Carry Weeds Out of Field

Purslane in bags carried to edge of field

Planting to Moisture

Buried Drip Irrigation



Solarization

Colored mulches

Impact of Cover Crops on Weeds

Largest Chickweed Under 3 Cover Crops at 2 Seeding Rates (64 Days After Planting)

	Legume/Rye	Mustard	Rye
1x Seeding Rate	 125 lb/acre	 10 lb/acre	 80 lb/acre
3x Seeding Rate			

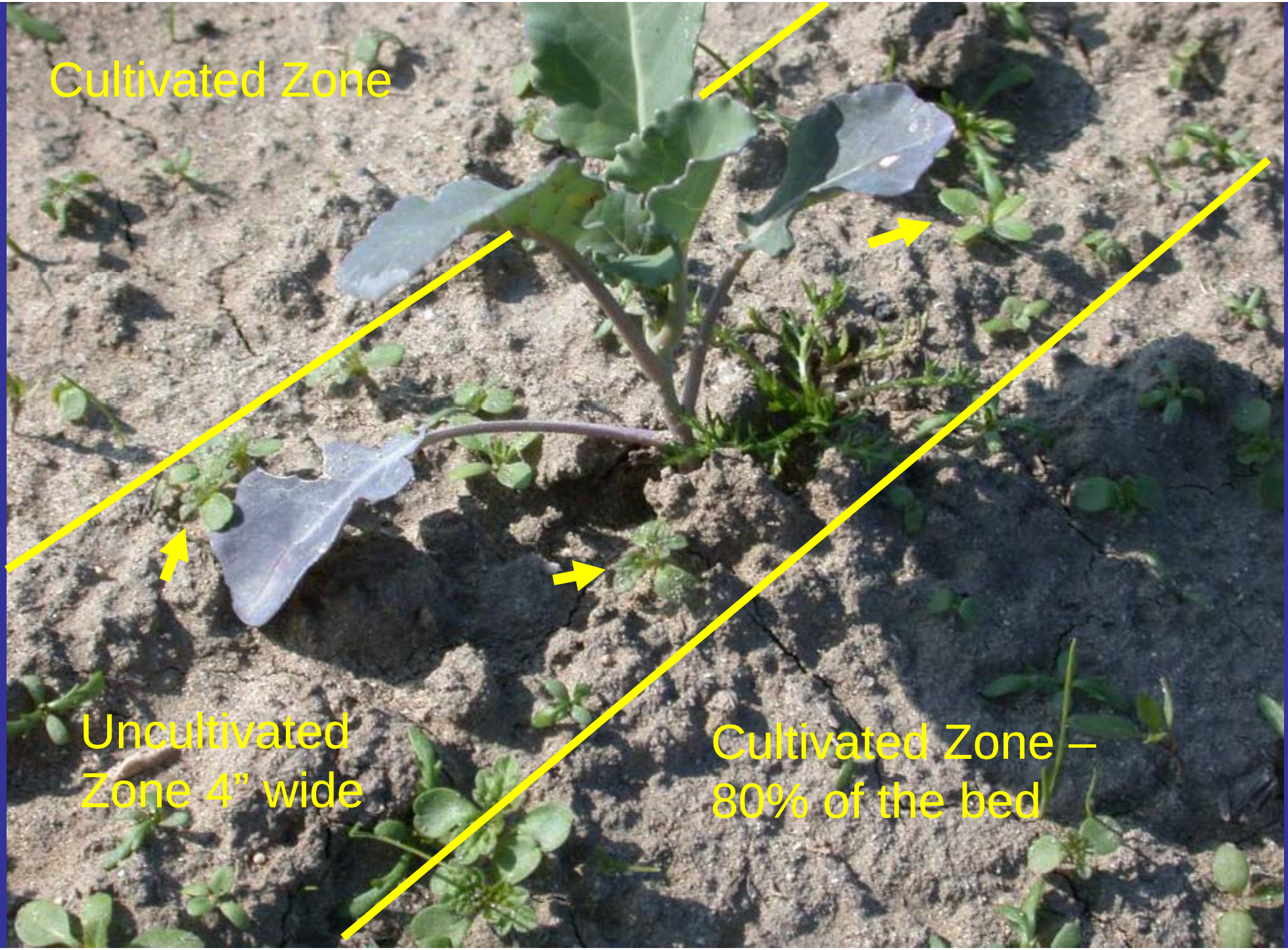
Use of Transplants

- Transplants open opportunities for mechanical weed control
- Transplants give the crop a head start on the weeds
- Transplants are more resistant to physical manipulation
- Transplants are easier for high tech mechanical weeders to recognize (distinguish from the weeds)

Mechanical Controls

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

Standard cultivation with Knives and sweeps


Cultivated Zone
Uncultivated Zone 4” wide
Cultivated Zone – 80% of the bed

Typically 80+% of a 40-inch wide bed can be effectively cultivated. The fight with weeds occurs in the uncultivated seedline

Precision Guidance of Cultivators

Guided by the Operator

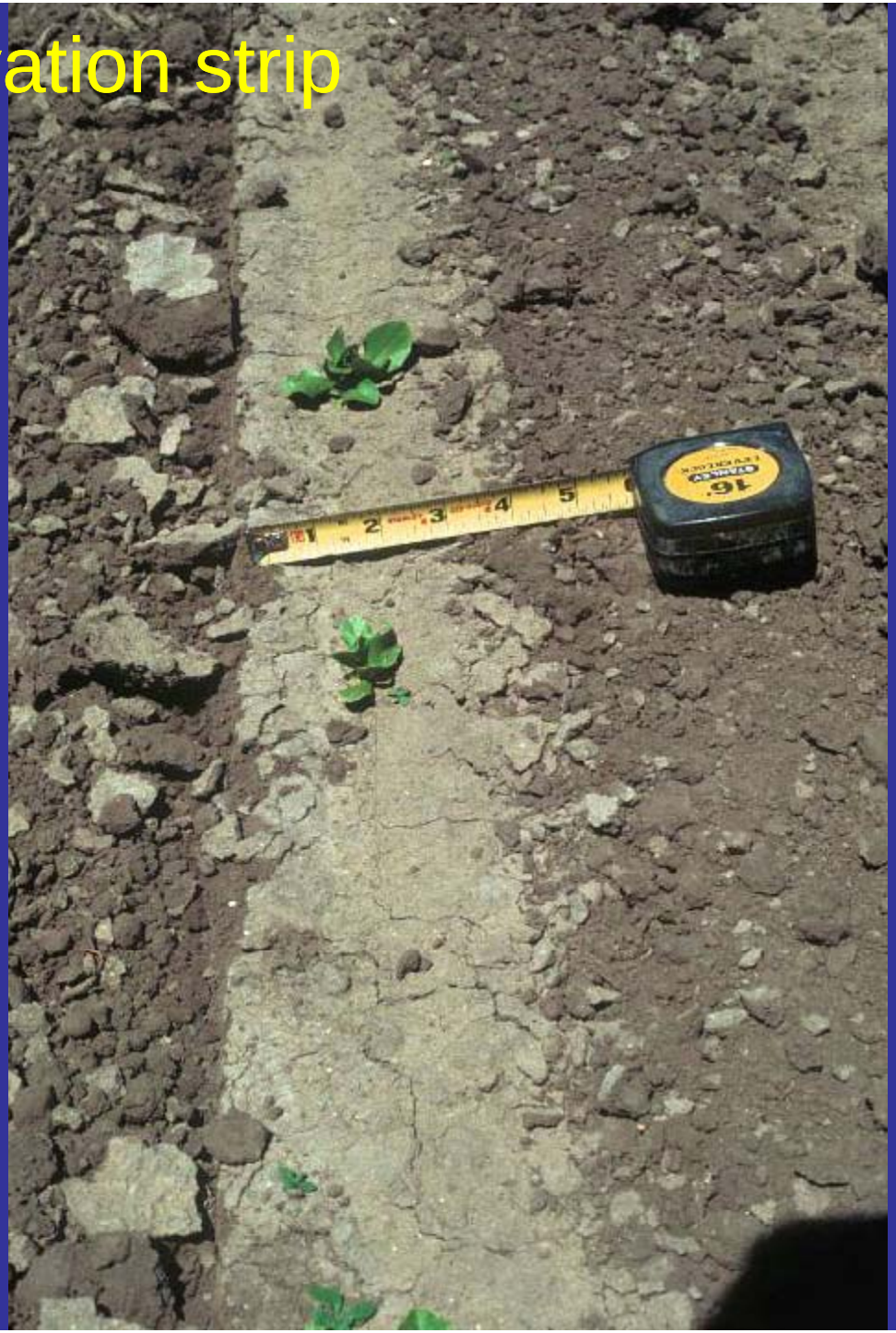
Effective but Slow

Old Technology

Modern Version

Camera Guidance Systems for Cultivators

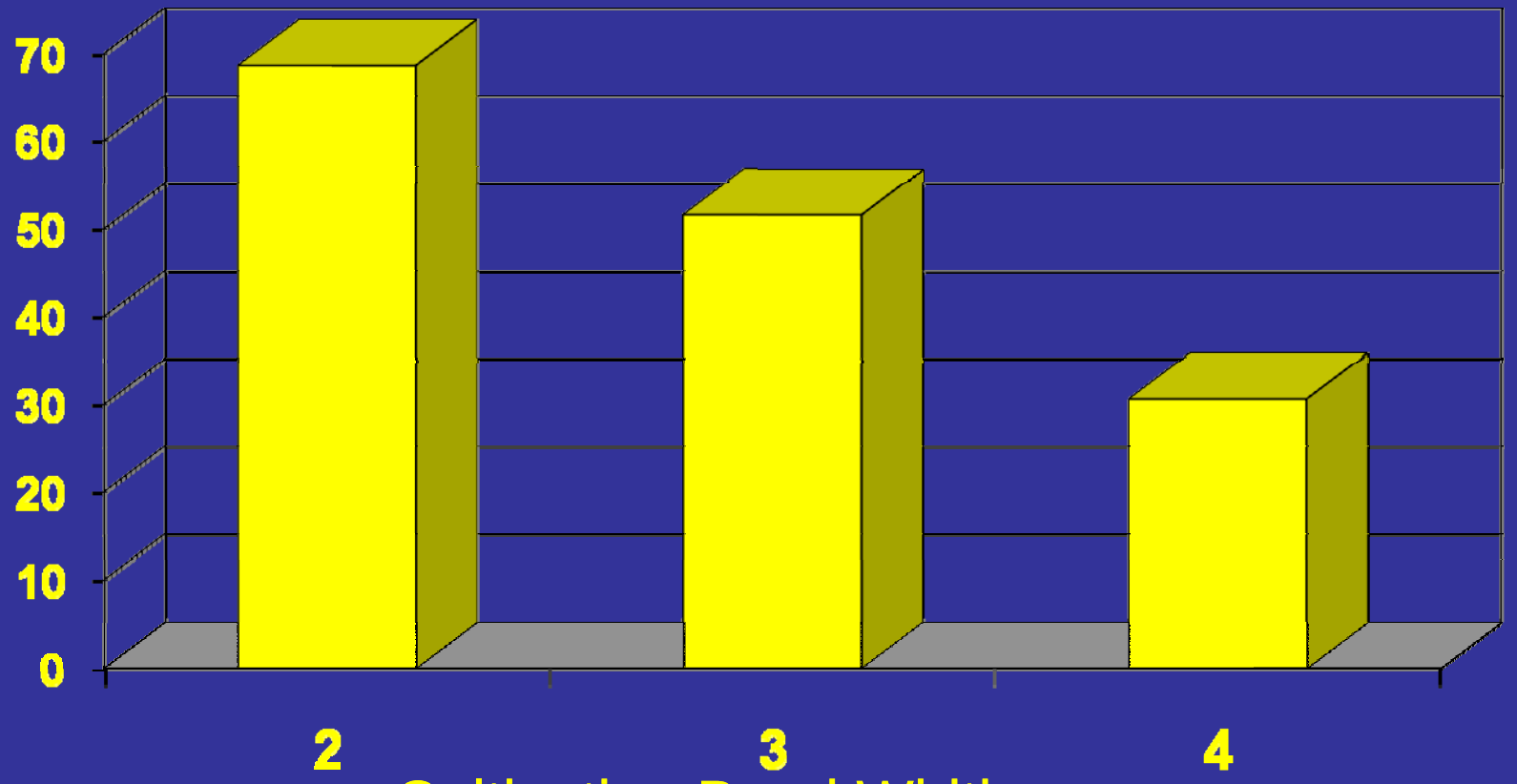
4” wide cultivation strip



3” wide cultivation strip

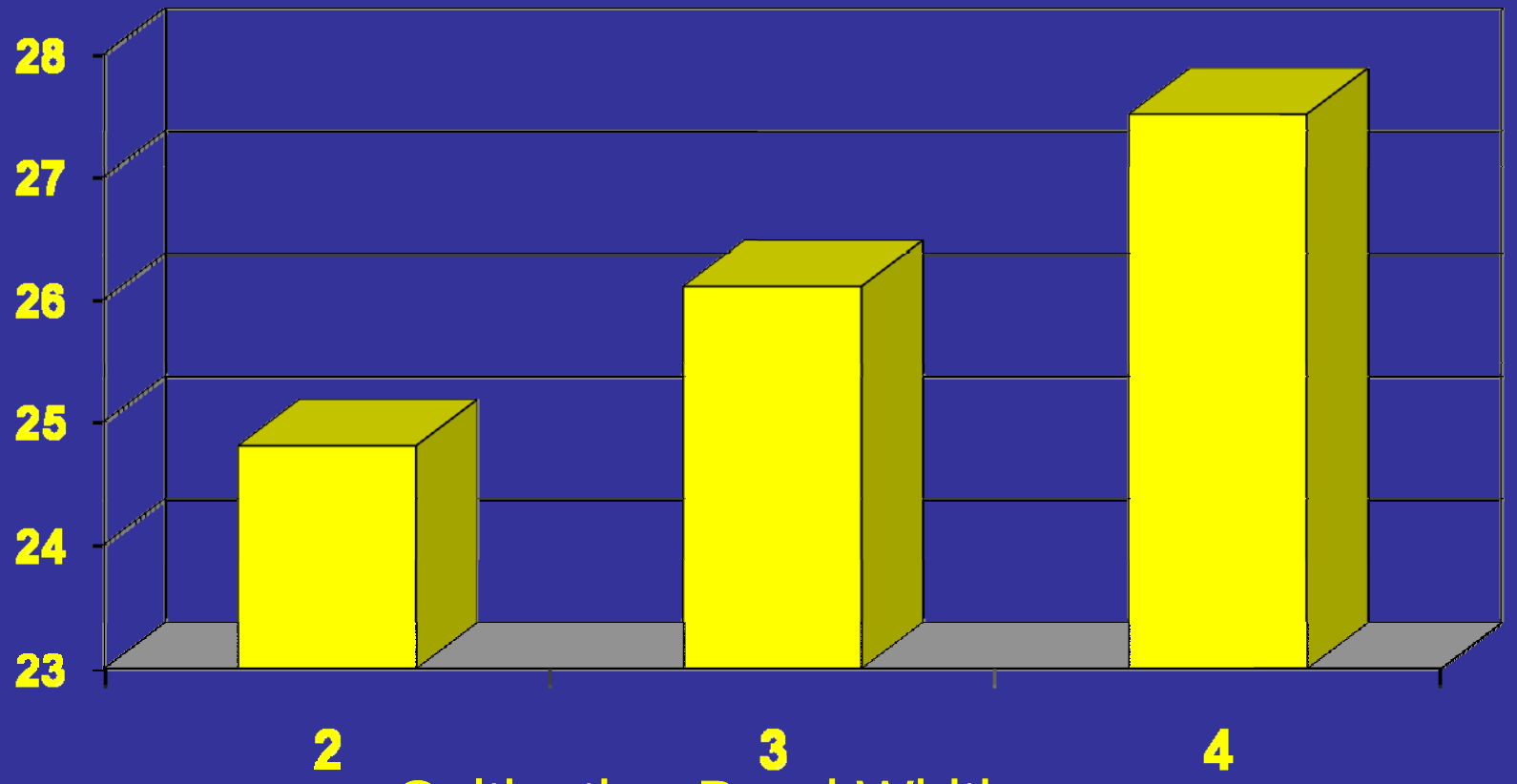
Percent of Weeds Controlled at Different Cultivation Band Widths

2005 Lettuce Trial No. 1



Hours Per Acre to Weed Different Cultivation Band Widths

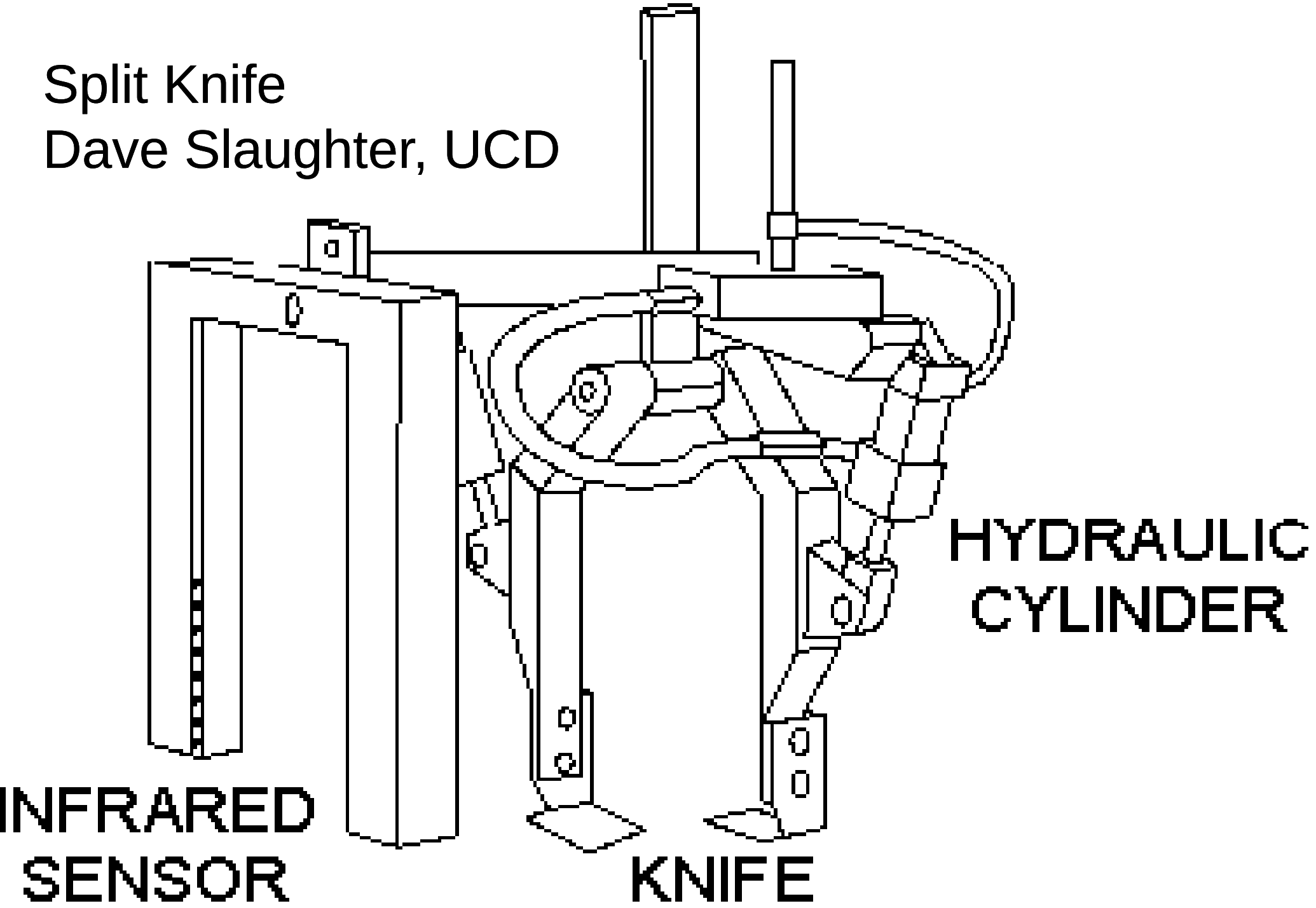
2005 Lettuce Trial No. 1



Removal of Weeds from the Seedline

- High Tech Ideas

Split Knife
Dave Slaughter, UCD



Tillett and Hague Technology Ltd

Lower Tech Ideas for Removing Weeds from the Seedline

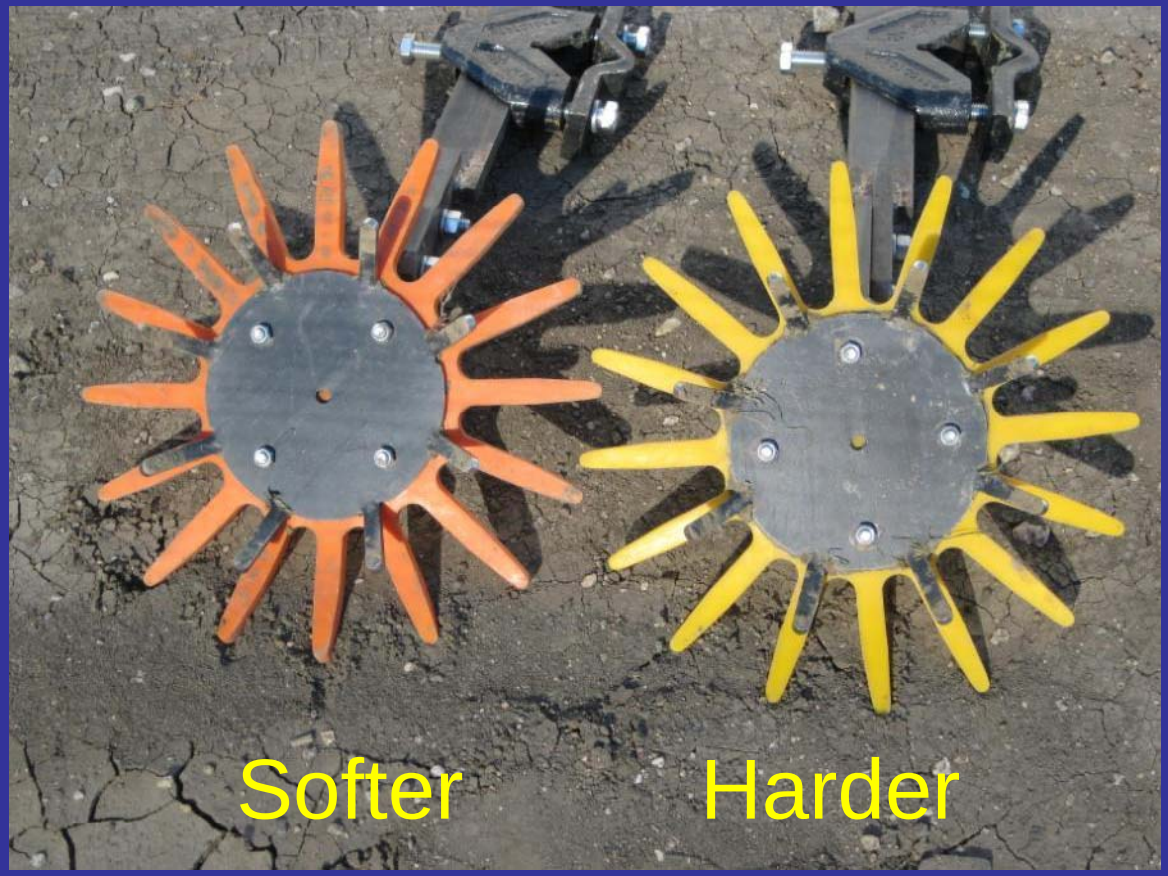
- In Europe where transplanting of vegetables is commonly used, there is wider use of implements that are capable of removing weeds from the seedline

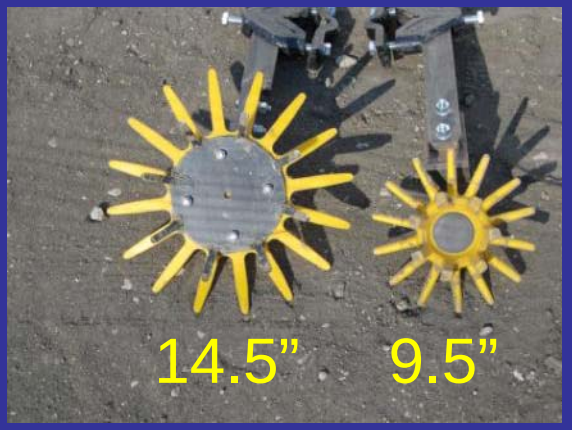
Finger Weeders

- This idea originally came from the US – was invented by the Buddingh Company, Michigan
- The idea was taken to Europe and further developed and refined (now produced by three companies)
- The Europeans claim their designs can operate at higher speed

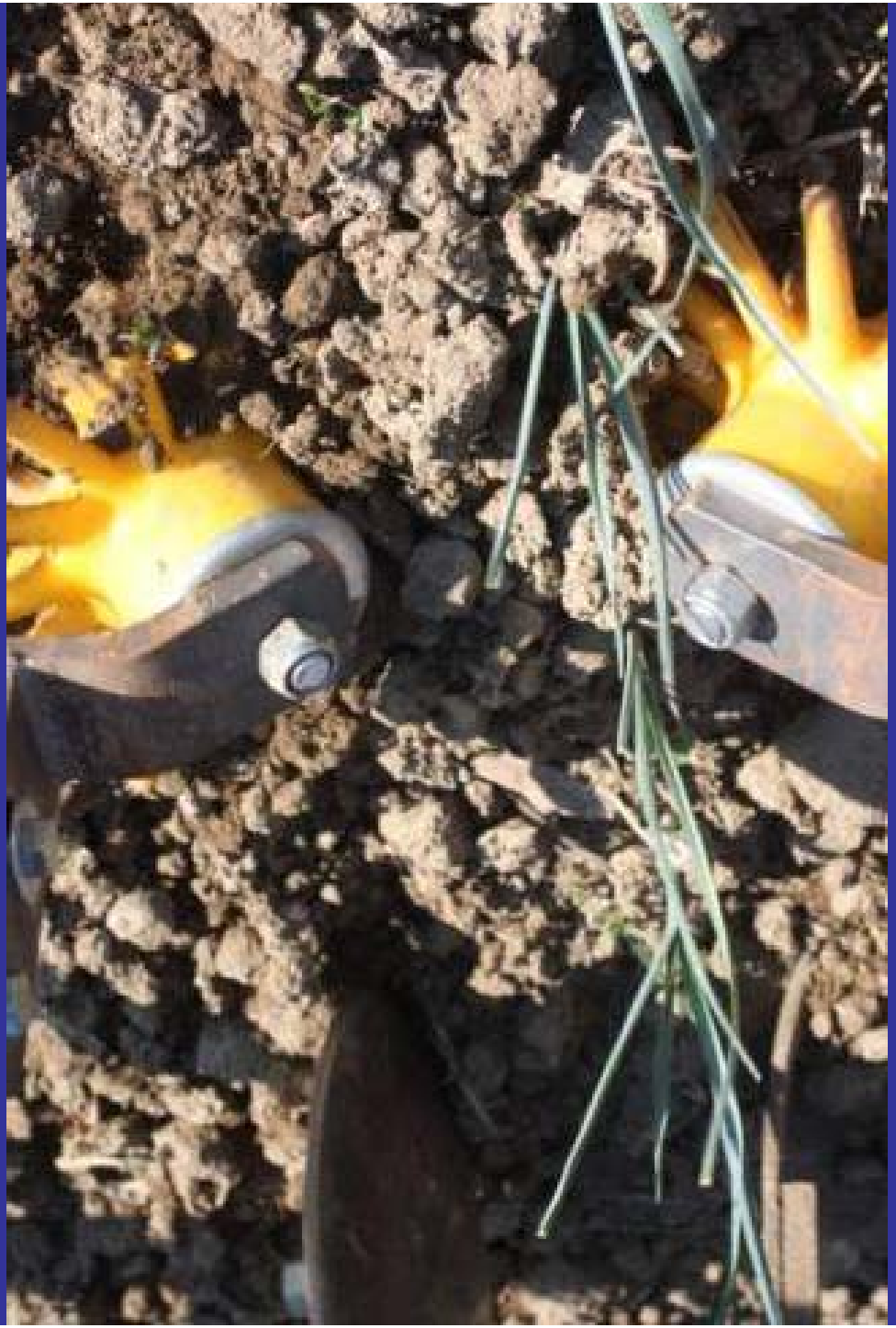
Finger Weeders

Two sizes and two levels of hardness

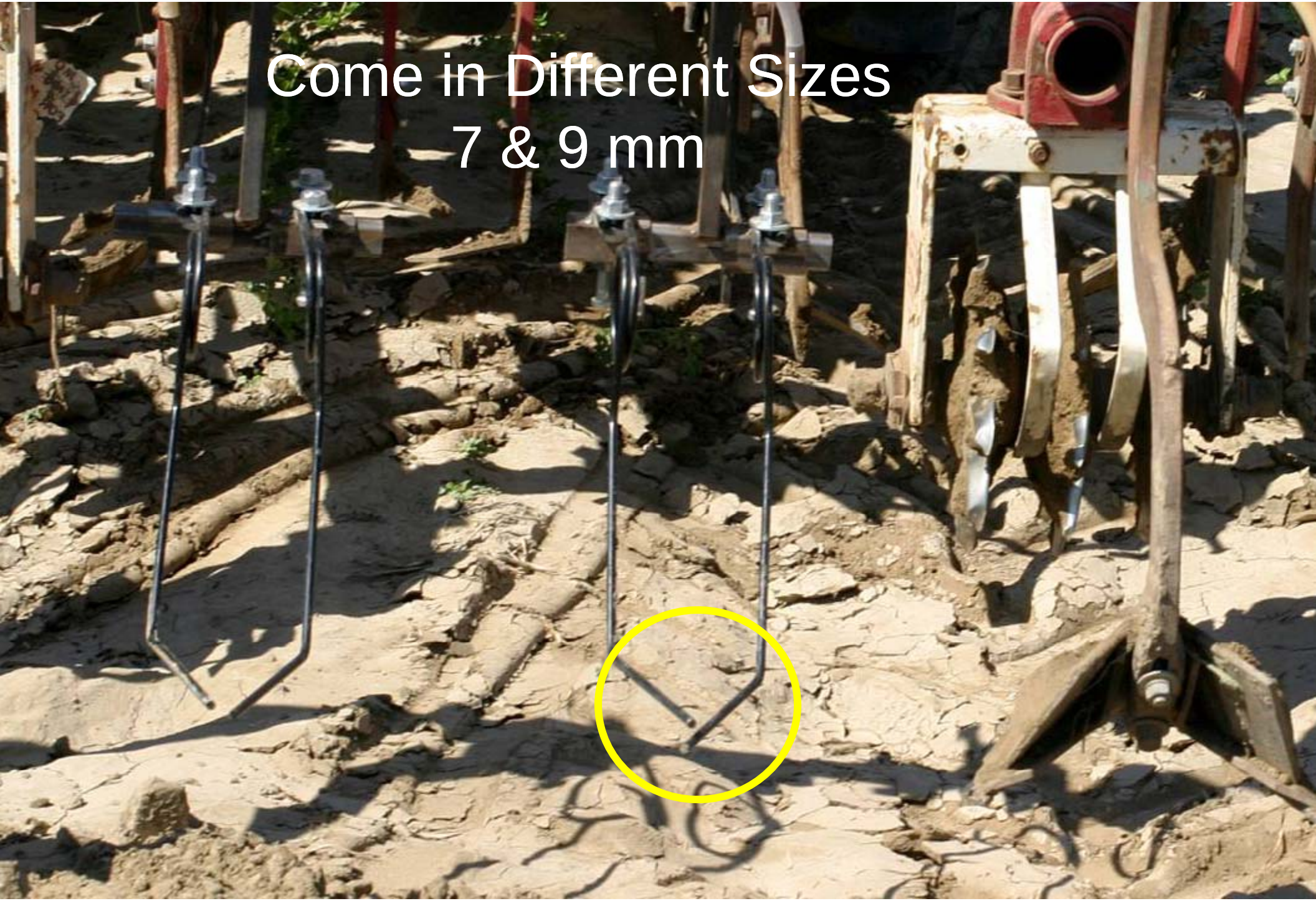


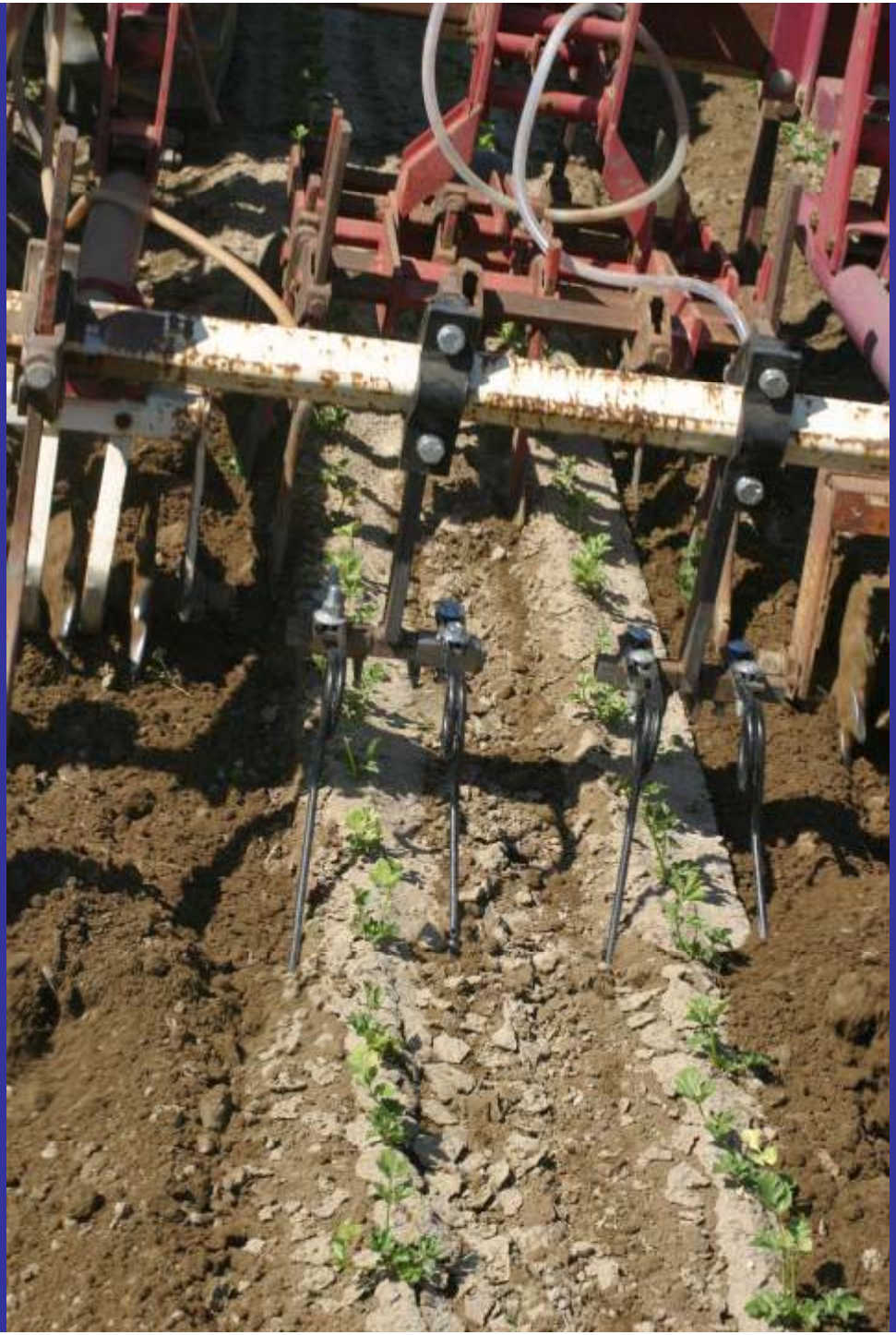


Kress Co, Germany


Torsion Weeder
Erato Corp, Netherlands

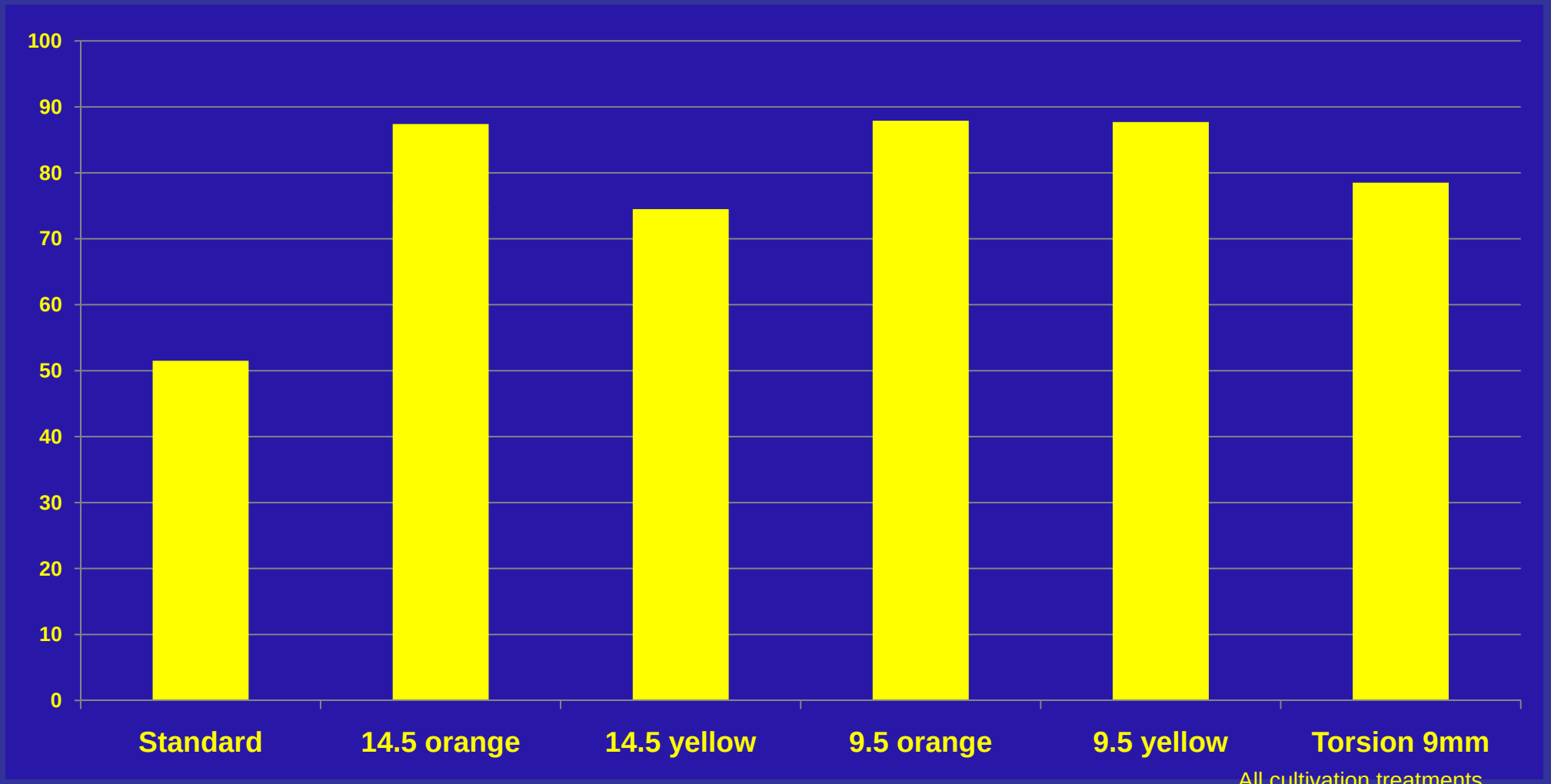

Come in Different Sizes
7 & 9 mm



Transplanted Lettuce Trial No. 1

Percent Removal of Weeds

Small Nettle Dominant Weed

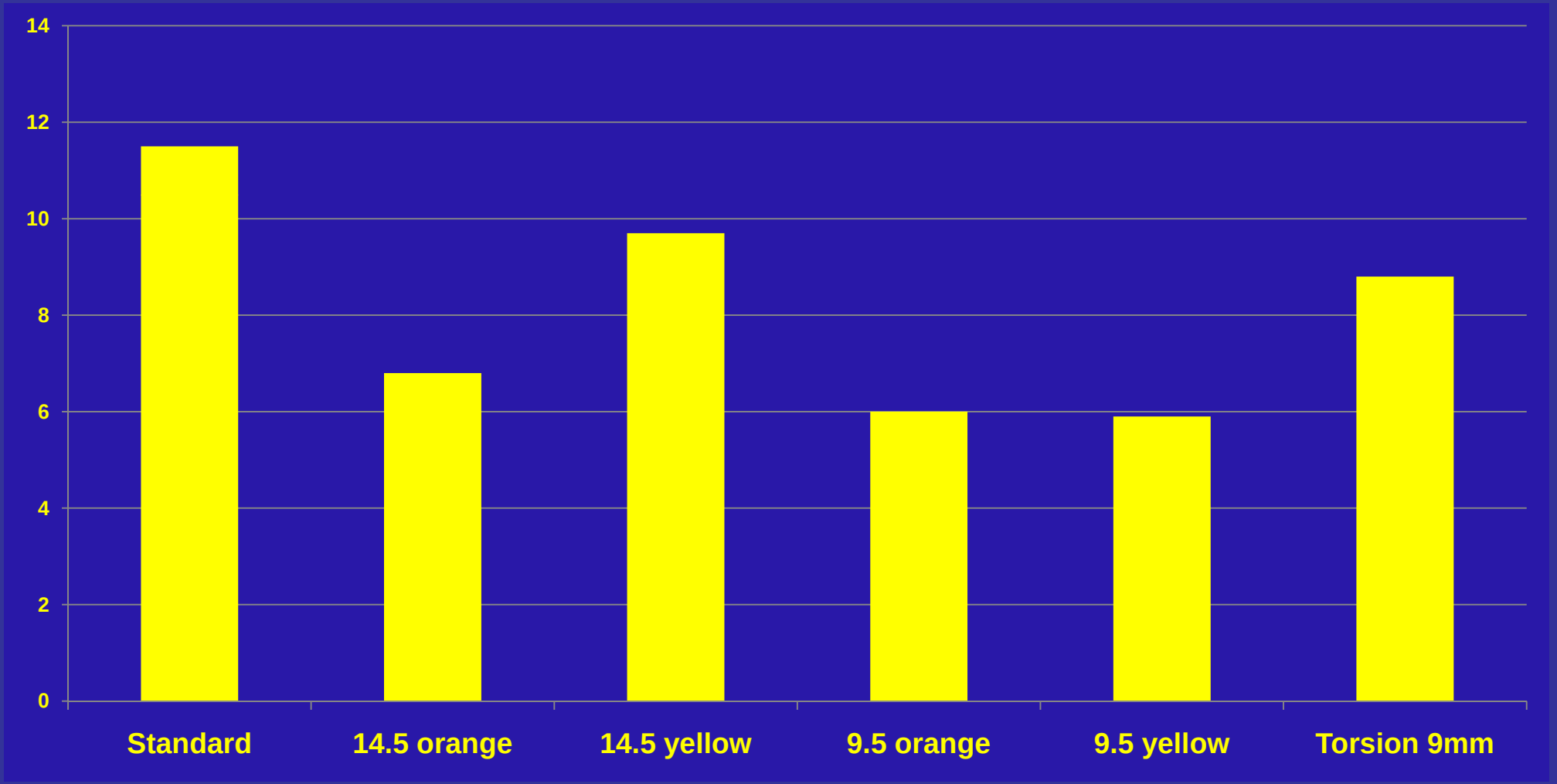


All cultivation treatments

Improved percent removal

Transplanted Lettuce Trial No. 1

Weeding Time hrs/A



Chemical Weed Control for Vegetables

- **Herbicides are an important tool for managing weeds in vegetable production**
- **They greatly reduce the weed population and make subsequent hand weeding operations more efficient**

Types of Herbicides Used

- Preplant
  - Fumigants
    - Metam Sodium (Vapam)
  - Burndown material used on beds just prior to planting
    - Glyphosate (Roundup)
    - Paraquat (Gramoxone)
    - Carfentrazone (Shark)

Types of Herbicides Used

- **Preemergence**
  - **Applied prior to the emergence of the weed**
  - **Often applied at seeding with the crop**
    - **Pronamide (Kerb) on lettuce**
    - **Rimsulfuron (Matrix) on tomatoes**
  - **Can be applied prior to transplanting the crop**
    - **Metolachlor (Dual Magnum) on peppers**

Types of Herbicides Used

- **Postemergence**
  - **Applied after the weeds have emerged in the crop**
    - **Applied as an selective over-the-top application**
      - **Halosulfuron (Sandea) & rimsulfuron (Matrix) on tomatoes**
      - **Prometryn (Caparol) on celery**
      - **Oxyfluorfen (Goal) on onions**
    - **Applied as a directed spray to the base of the plant**
      - **Trifluralin (Treflan) on tomatoes**

Goal 2XL

Goal Tender

1st true leaf


Shepherds Purse
1st true leaf


2nd true leaf


Goal Tender
Weed Burn Down

Untreated

Goal Tender 1st true leaf

Challenges for Chemical Weed Control in Vegetable Production

- Fewer new herbicides being produced for vegetables
- Loss of older herbicide due to economic or regulatory influences

Year of Registration of Key Vegetable Herbicides

Trade Name	Chemical	Representative Crop	Year Registered
Lorox	Linuron	Carrots	1966
Dual Magnum	S-metolachlor	Potato, Peppers	1976
Kerb	Pronamide	Lettuce	1972
Dacthal	DCPA	Broccoli, Onions	1958
Devrinol	Napropamide	Broccoli, Tomatoes	1972
Caparol	Prometryn	Celery	1964

Why few new herbicides?

Why few new herbicides?

Resistant weeds may change the situation

New Use for Old Herbicides

- Lorox on Spinach
- Goal on Broccoli and Onions
- Prowl H2O on transplanted lettuce
- Caparol on Carrots

Summary

- Weed control in vegetables is accomplished by a combination of strategies: Cultural, Mechanical and Chemical
- Effective use of all these tools assists growers in achieving economical weed control