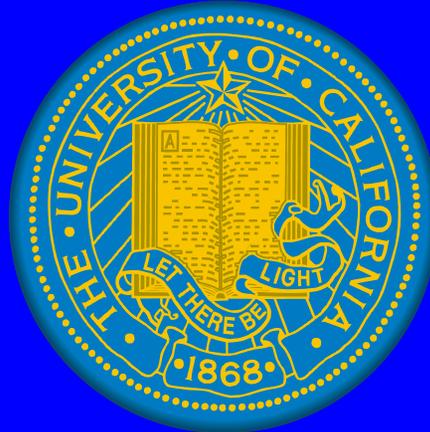


Potential Technology to Improve Herbicide and Labor Use Efficiency in Vegetables

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AGRICULTURE

Growers expect worker shortage

Winter harvest in Yuma expected to face severe labor problems

By **DAWN WITHERS**
The Salinas Californian

Salinas Valley growers predict this year's winter harvest in Yuma, Ariz., will be marred by another severe worker shortage.

Last year's winter harvest in Yuma also saw a starkly reduced labor pool, attributable in part to the federal gov-

IMPACT

A labor shortage for field workers in Yuma, Ariz., may mean a big financial hit to Salinas-based growers starting their winter harvest there.

ernment's increased presence of Border Patrol agents along the U.S.-Mexico border.

John D'Arrigo, president of Salinas-based D'Arrigo Bros. Co., said that he's never seen such strict border enforcement and that it's making it nearly impossible to get enough workers for his fields.

"It's causing me to have less workers through my entire organization," D'Arrigo said.

His winter crop includes leaf lettuce, broccoli, cauliflower and fennel, among others, and covers 12,000 acres and requires a work force of 1,500 field workers to harvest.

By next month, when the harvest kicks into high gear, the severity of the worker shortage should be more clear, Salinas-area growers say.

D'Arrigo said he'll be growing there until mid-March, and if more workers aren't available in the next week, he'll be forced to disk fields and leave produce behind.

When the company returns

See **GROWERS**, Page 5A



JACK KURTZ/FOR THE SALINAS CALIFORNIAN

Norma Verduzzo bags head lettuce during the harvest on the Mellon Farm in Dome Valley, northeast of Yuma, Ariz.

Salinas Californian 11.24.06

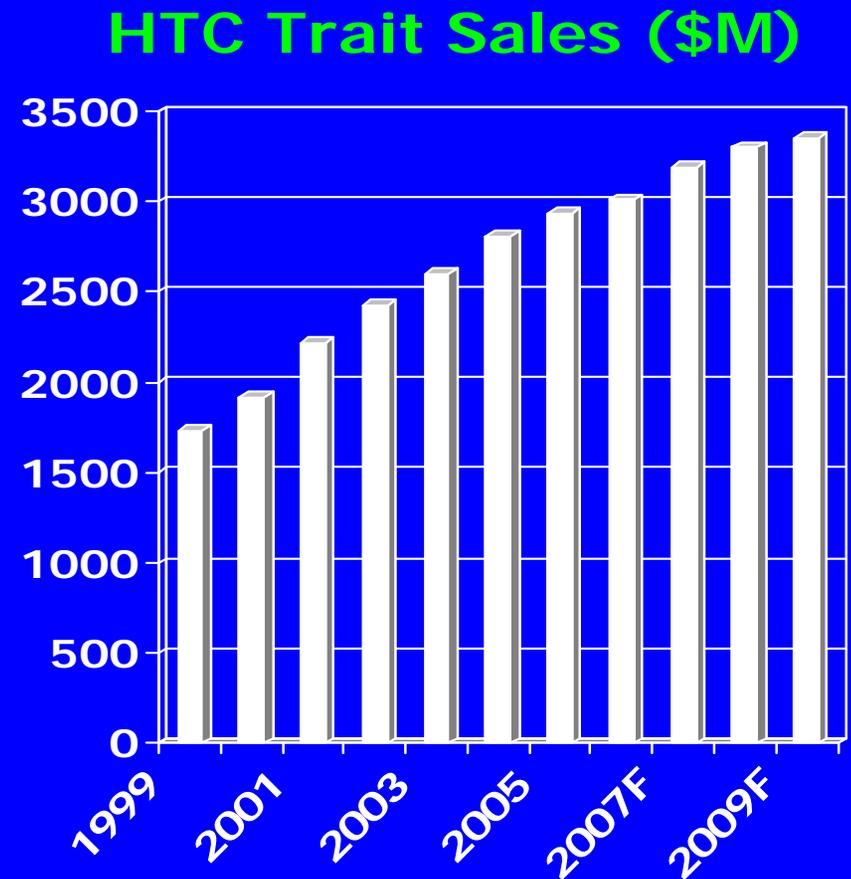


Shortages

- ◆ Labor
- ◆ New herbicides
- ◆ Profits

Impact of HTC Crops

- ◆ Significant impact on conventional markets & projected to continue growth
- ◆ Corn, soybean, cotton & canola most impacted
- ◆ Discovery into selective herbicides for these markets has likely diminished

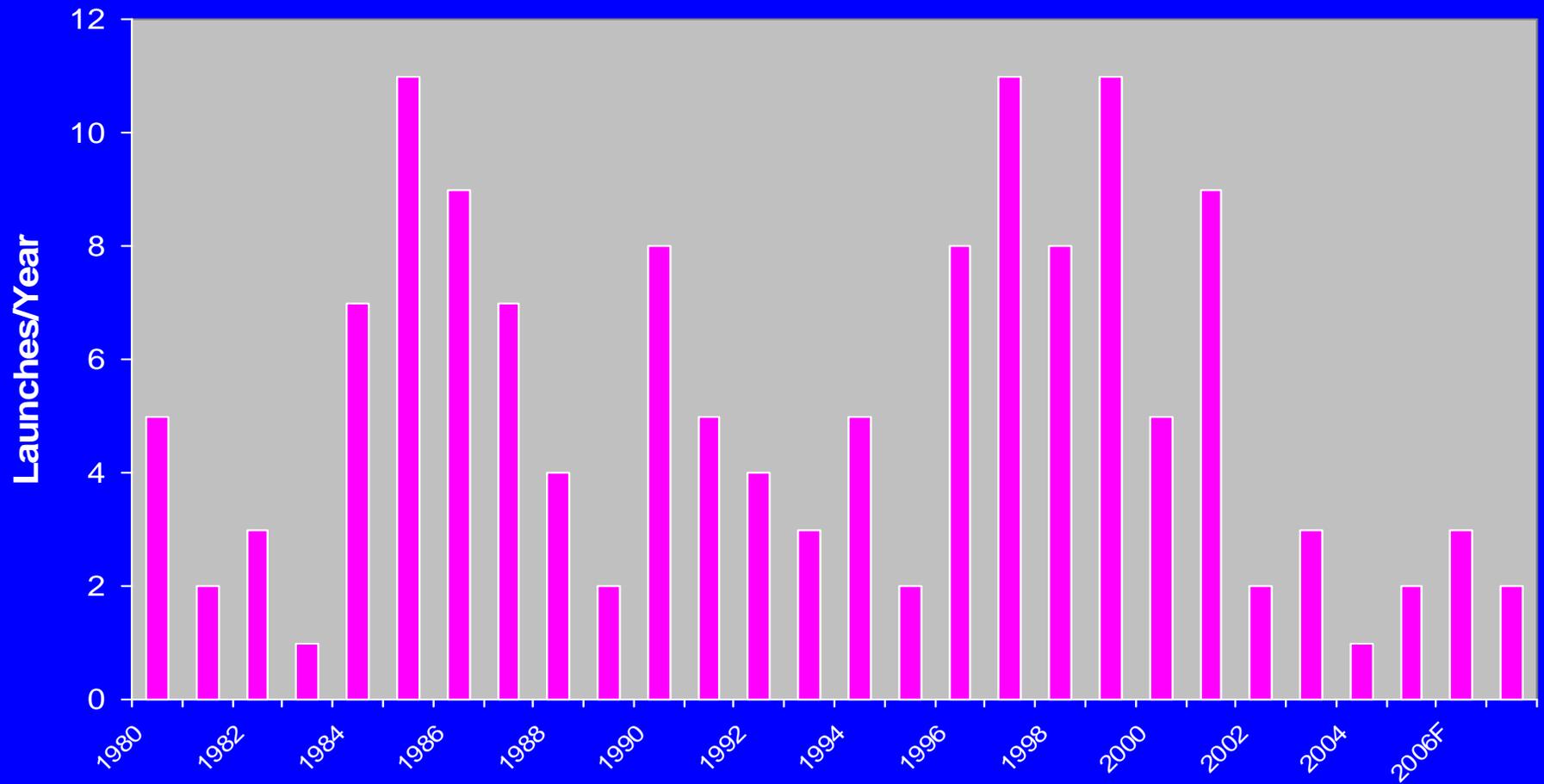


Gast 2006

Increased R&D Costs

- ◆ In 1975-80 the cost of bringing a new product through research, development and registration averaged \$23.1 million
- ◆ Recent studies have shown that this figure has increased to \$152 million in 1995 and \$184 million in 2000.

Global Herbicide AI Launches



Gast 2006

Bottom line

- ◆ **Less industry funded research on herbicide discovery.**
- ◆ **Fewer new herbicides for major crops = fewer new herbicides for specialty crops.**
- ◆ **Intense competition, rising costs (energy, labor, transport) keep profits low for vegetable producers.**

Which directions should we go?

New herbicides &

Seedbank
biocontrol

Weed
physiology

Soil
pasturization

fumigants



Herbicide
tolerance
breeding

Cultural
controls

Robotics &
cultivation

Vegetable
Transplants



Objectives

- ◆ To determine if we could use the Eco-Dan cultivator to increase the efficiency of herbicide and labor use
- ◆ Find the best combination of herbicide & uncultivated bands to reduce costs

Herbicide rates

- ◆ Pronamide rate was 1.2 lb ai/A
- ◆ DCPA rate was 7.5 lb ai/A
- ◆ The herbicides were applied at planting behind the planter with an 8004E nozzle centered on the seed line at 125 GPA

Trial design

- ◆ Split plot with 4 replicates
- ◆ Herbicide band width: 0, 3 & 5 inches
- ◆ Uncultivated band width 2, 3, 4 & 5 inches
- ◆ Analyzed as a split-plot using SAS. LSD's $P=0.05$ were used for mean separation
- ◆ Budget Planner software was used to prepare a partial budget

Time line

◆ Broccoli

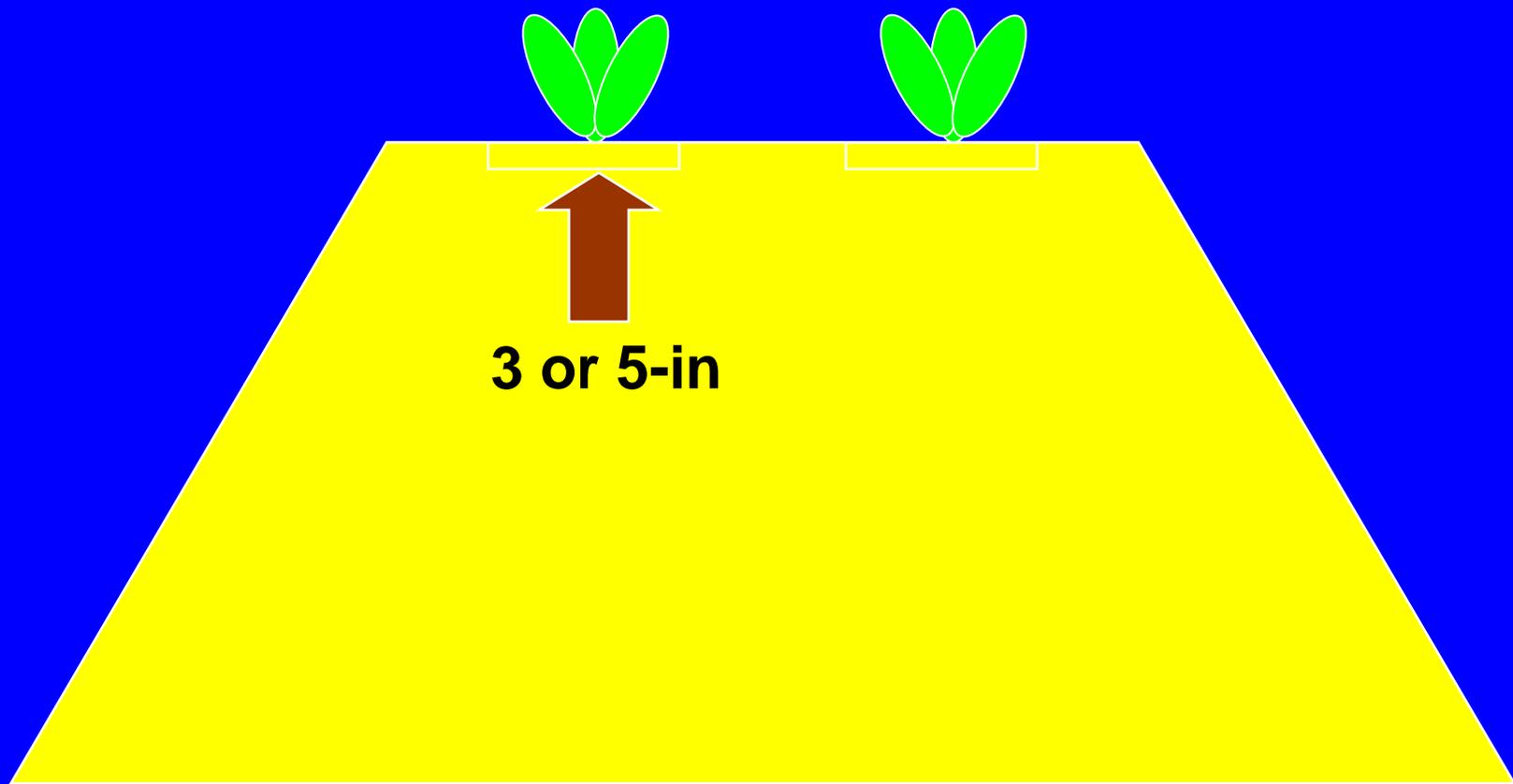
- Sept. 2005 to Jan. 2006
- Aug. to Nov. 2006

◆ Lettuce

- June to Sept. 2005
- Aug. to Oct. 2006



Herbicide band widths of 0, 3 or 5 in



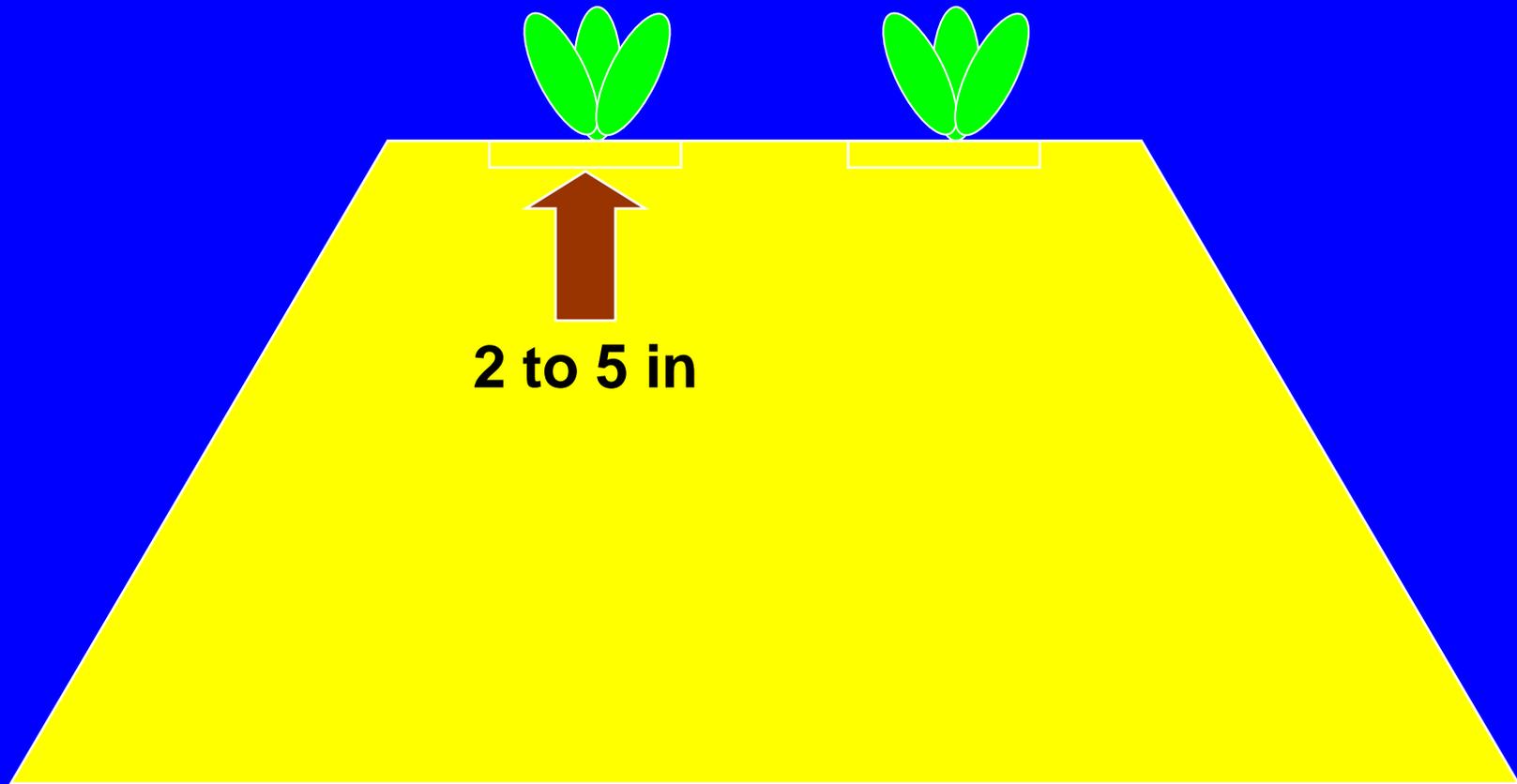
Weed control and labor inputs - broccoli

DCPA	Weed control		Labor time	
Band	2005	2006	2005	2006
in	1000/A	%	hr /A	
0	75.3 A	80.6 B	31.2 A	55.9 A
3	20.4 B	90.2 A	19.7 B	37.5 B
5	13.2 B	89.3 A	19.3 B	38.6 B
P-value	0.0001	0.0001	<0.0001	<0.0001

Herbicide band width conclusions

- ◆ A 3 in. DCPA band plus cultivation controlled weeds as well as well as a 5 in. band
- ◆ Hand weeding inputs were no greater for the 3 in. herbicide bands than the 5 in. band
- ◆ Broccoli yields were not different between the 3 and 5 in. herbicide bands

Uncultivated band widths 2, 3, 4 or 5 in.



Uncultivated bands



Uncultivated band width - broccoli

Cultivator	Weed control		Labor time	
Band	2005	2006	2005	2006
in	1000 /A	%	hr /A	
2	19.5 B	90.1 A	20.9 B	41.5
3	24.2 B	89.7 A	22.8 B	44.0
4	36.0 B	86.4 A	23.5 B	42.8
5	65.5 A	80.7 B	26.3 A	47.7
P-value	<0.0001	0.003	0.0008	0.44

Influence of cultivator band width on weed control

- ◆ **The closer you can get to the seed line the better the weed control**
- ◆ **Closer cultivation did not necessarily result in faster hand weeding**
- ◆ **Yield was not affected by close cultivation (however 2-inches may be too close)**

Broccoli production costs related to weed control - 2006

DCPA	Uncultivated band width (in.)			
Band	2	3	4	5
in	Cost \$ /A			
0	\$279.00	\$306.00	\$307.00	\$355.00
3	\$205.05	\$217.05	\$241.05	\$269.05
5	\$240.00	\$256.00	\$254.00	\$261.00

Conclusions

- ◆ Reducing the DCPA band width from 5 down to 3 inches and using an uncultivated band of 2 to 3 inches may help reduce costs





Effect of robotics on VOC reduction

- ◆ For high density crops like carrot or spinach that use metam sodium it is a big challenge as cultivation is difficult or impossible.
- ◆ One idea is to use machine-vision to guide a directed sprayer.
- ◆ For lower density crops like cole crops, lettuce, melons, onions, pepper & tomato, there is potentially a much larger role for machine vision cultivation to reduce herbicide use.

Prototype Intra-row weeder



Garford Farm Machinery



Dedousis 2007

Which directions should we go?

New herbicides &

Seedbank
biocontrol

Weed
physiology

Soil
pasturization

fumigants



Herbicide
tolerance
breeding

Cultural
controls

Robotics &
cultivation

Vegetable
Transplants

Vegetable transplants

- ◆ Already the use of transplants is 100% for celery, cauliflower and fresh market tomato.
- ◆ Use of transplants for processing tomato is 70% of the acreage.
- ◆ Use of broccoli transplants is common in Santa Maria but direct seeding dominates in Salinas
- ◆ Transplanted lettuce is only a small portion of the market compared to direct seeding in California.

Kubota automatic vegetable transplanter

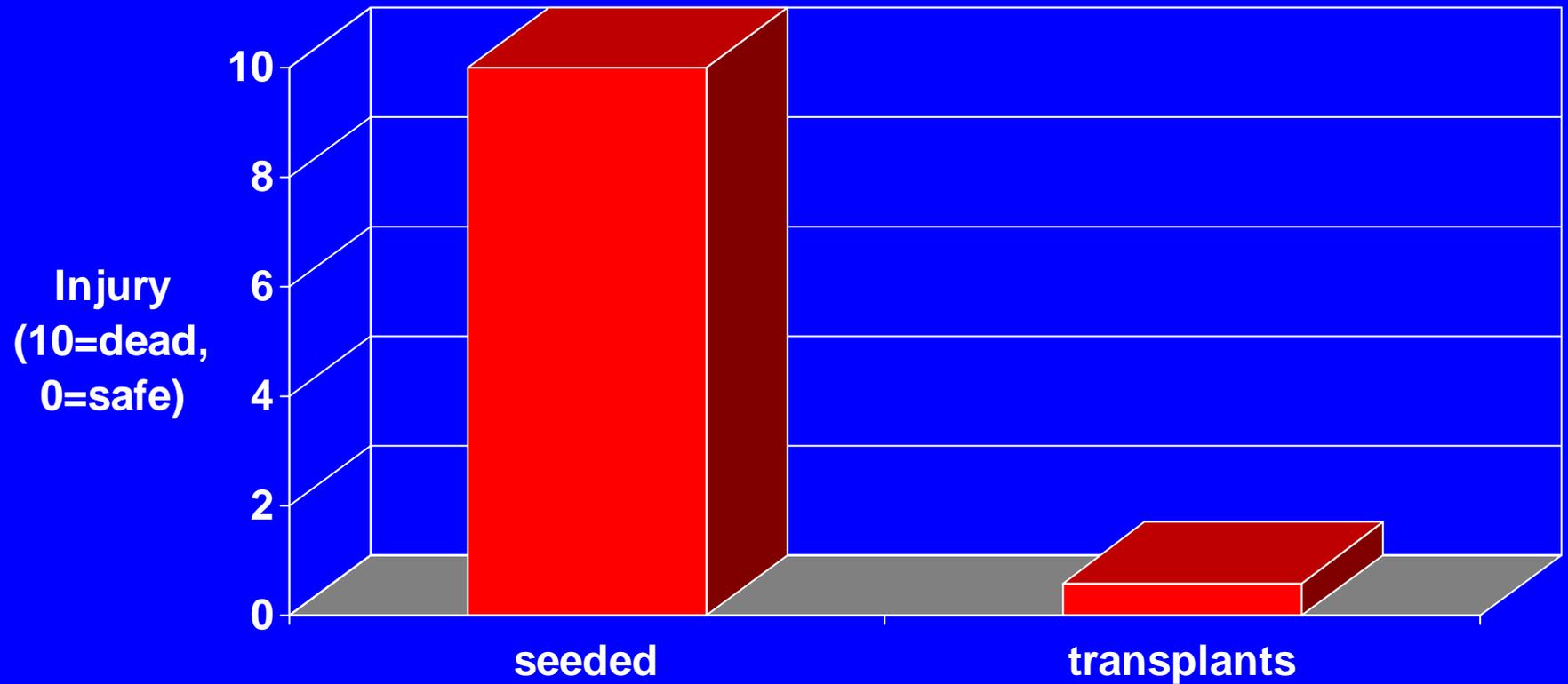




Why increase the use of vegetable transplants?

- ◆ Shorter time in field (-30 days), lower land costs
- ◆ Better fertilizer and water use efficiency
- ◆ Fewer irrigations, lower pumping costs
- ◆ No thinning costs
- ◆ Can use stronger herbicides, no hand weeding
- ◆ Less herbicide injury
- ◆ Better harvest uniformity?
- ◆ Less disease?
- ◆ Fewer insects?
- ◆ F₁ hybrids (lettuce)?

Prowl H₂O 0.75 lb ai/A injury on lettuce



Lettuce label for Prowl?

- ◆ We are requesting a food use tolerance for Prowl on transplanted lettuce through the IR-4 program.
- ◆ Would the use of transplanted lettuce, drip irrigation and Prowl permit lettuce production without any hand weeding?

Summary

- ◆ The number of new specialty crop herbicides is low and will remain low.
- ◆ We need new reliable, predictable and economical weed control tools for specialty crops.
- ◆ New robotic tools appear to be the most promising methods to increase the efficiency of weed control programs in the future.

Top 10 VOC Contributors San Joaquin Valley- 2002

Site	% emissions
Carrot	19.2
Cotton	13.3
Almond	7.7
Grapes	6.1
Potato	5.8
Orange	5.2
Right of way	3.3
Nursery	3.2
Alfalfa	2.6
Onion	2.5

Top 10 VOC Contributors Desert - 2002

Site	% emissions
Carrot	28.2
Peppers	14
Strawberry	6.1
Celery	5.7
Structural	4.9
Fallow	4.6
Artichoke	4.2
Watermelon	4.1
Onion	3.3
Cantaloupe	3.3

Final comment

- ◆ Machine vision guidance cultivation best fits into low density crops.
- ◆ More testing should be done with use of machine vision to guide directed herbicide spray applications as this may allow use in high density plantings.

Acknowledgments

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