

# *Automated Machine for Thinning, Weeding and Spot Spraying*

Developed and Designed by:

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Skilled Workers  
Tough, Repetitive, Physically Demanding Work – Low Wages

# Specialty Crop Industry

## ■ Labor Shortage

- ◆ Stringent Immigration Policies
- ◆ Aging Worker Population (avg. 45 years)
- ◆ All Specialty Crops

# Specialty Crop Industry

- Specialty Crop Industry at a Crossroad
  - ◆ Hi-tech or else?
- 2008 Farm Bill SCRI Program
  - ◆ \$1 Billion over next 10 Years

“Increase Competitiveness of U.S. Specialty Crops”

# Automated Machine Tasks

- Plant sensing

- ◆ Identify crop plants and their location

- Control system

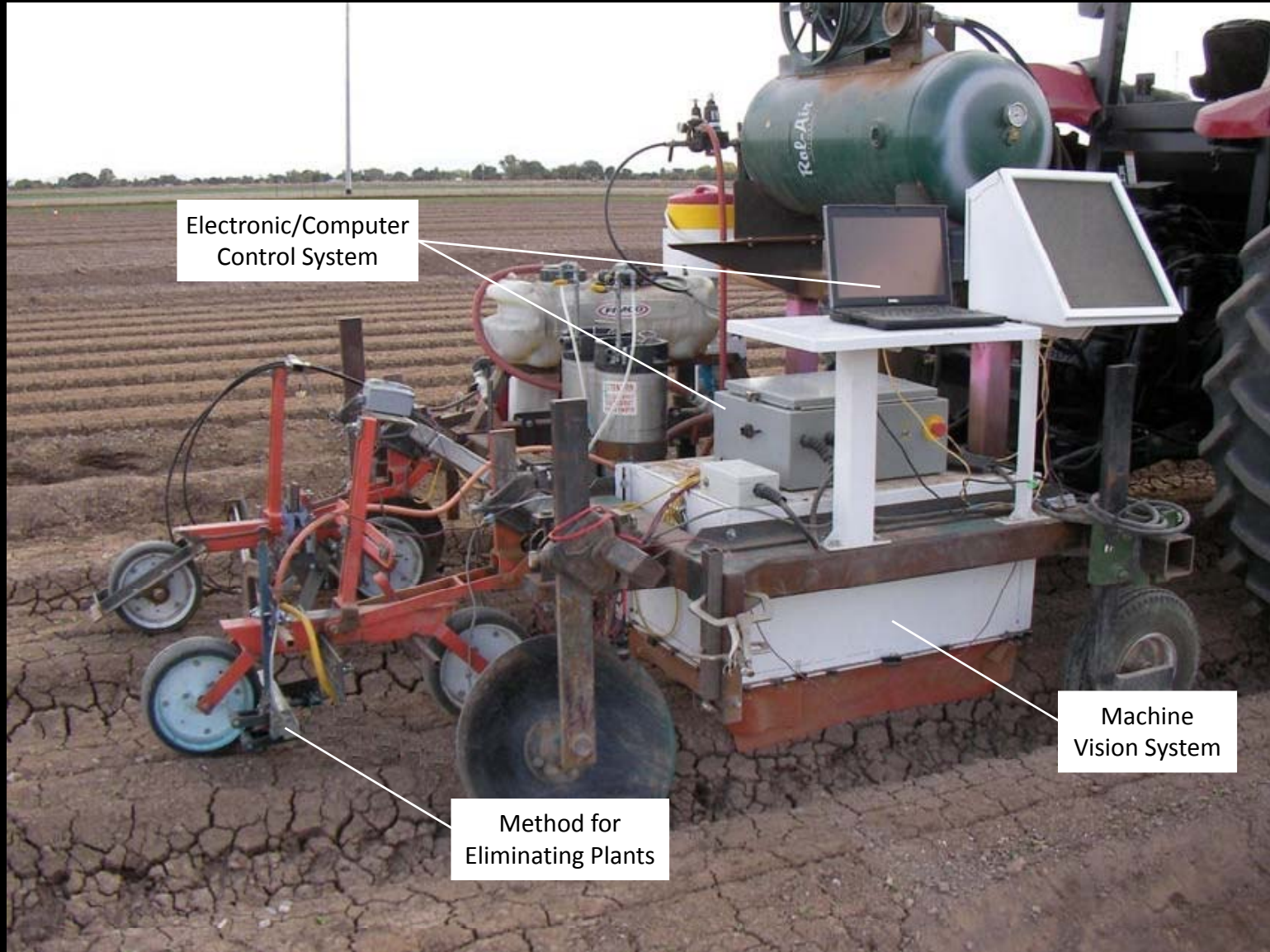
- ◆ Determine plants to keep/eliminate

- ◆ Control operations for selective thinning

- Means for killing plants



Automated Thinning Machine Test Frame



Electronic/Computer  
Control System

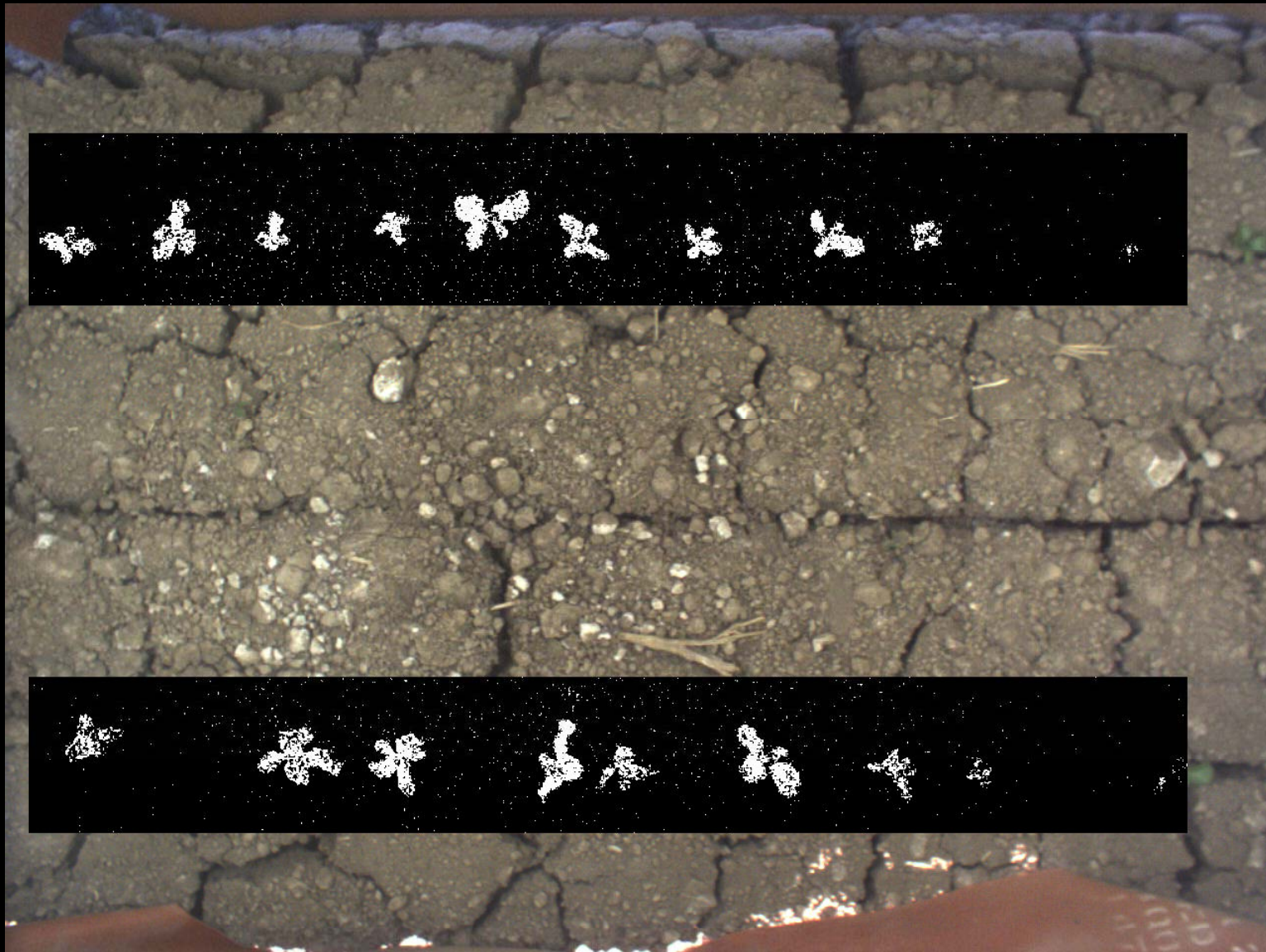
Machine  
Vision System

Method for  
Eliminating Plants

Automated Thinner Prototype



Raw Image



Processed Image



Computer Controlled Plant Selection



Herbicidal Spray Based Thinning







Machine Thinned Lettuce (far left) Post 14 days



Machine Thinned Lettuce (far left)  
47 days post



Machine Thinned Lettuce (far left)  
47 days post

# Replicated Trial

1. AN20 (50%)
2. UAN 32 (50%)
3. Sulfuric Acid (10%)
4. Herbicidal Vinegar (20% Acid)
5. Paraquat (1.3 pints/ac)
6. Hand (Control)

# Replicated Trial

- Products Not Labeled For Use in Lettuce

1. AN20 (50%)

2. UAN 32 (50%)

3. Sulfuric Acid (10%)

4. Herbicidal Vinegar (20% Acid)

5. Paraquat (1.3 pints/ac)

6. Hand (Control)

- Scythe (Pelargonic Acid) Labeled



Stand Establishment Prior to Thinning



AN20 – 12 days post



UAN 32 – 12 days post



Sulfuric Acid – 12 days post



Herbicidal Vinegar – 12 days post



Paraquat – 12 days post



Hand (control) – 12 days post

# Automated Thinner Performance

Kill Method*	Material Cost per acre	Plant Spacing inch	Plant Count per/acre	Hand Weeding hr/acre
Hand	NA	9.5 ab**	28,936 b	2.8 d
Sulfuric Acid	\$4.30	10.2 a	26,758 b	2.7 d
Paraquat	\$0.35	9.6 ab	27,692 b	2.8 d
Vinegar	\$32.27	8.9 b	30,181 b	3.0 cd
AN20	\$20.00	7.5 c	36,715 a	3.3 bc
UAN 32	\$23.09	7.3 c	37,337 a	3.3 b

\* Note: All spray solutions used to kill plants in this study are not labeled for use in lettuce production. Depending on the manufacture, the exception to this maybe vinegar solutions.

\*\* Within columns, means followed by the same letter are not significantly different by Duncan's new multiple range test (P = 0.05).



Undisturbed Soil in Plant Row



Uniform Plant Spacing



Thin and Spot Spray



Thin and Spot Spray



Intra-Row Weeder

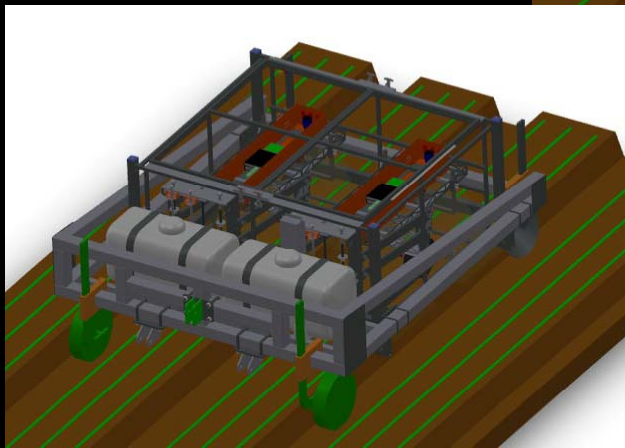
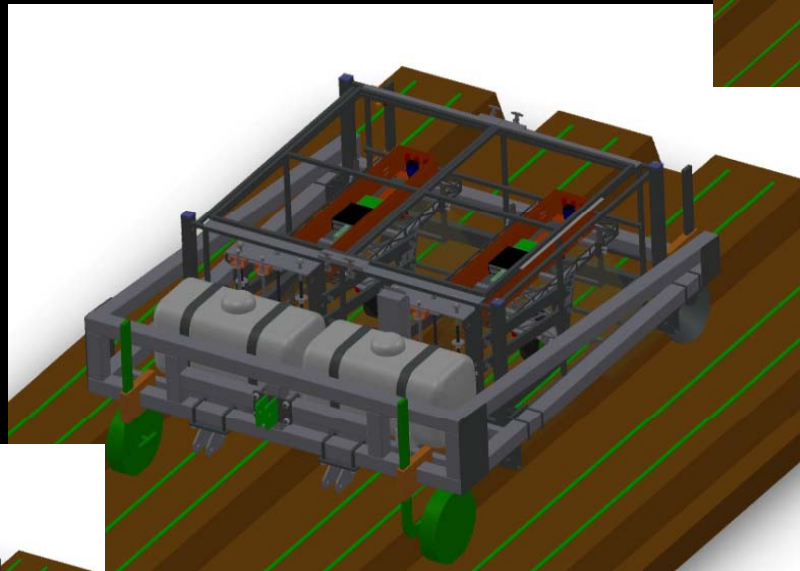
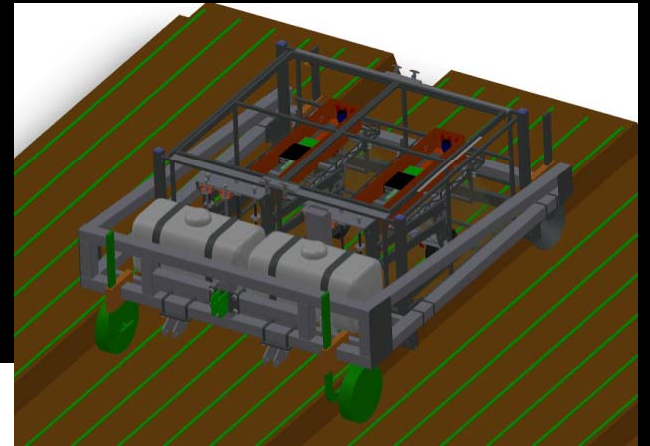


Weed and Spot Spray



Spot Spray





Generation II – Automated Thinner Design



Generation II – Automated Thinner Build Status

# Commercialization

- Provisional patent filed
- UA-OTT interested in licensing technology to manufacturers

# Acknowledgements

- Partial project funding:

Arizona Department of Agriculture  
Specialty Crop Block Grant Program

??? Questions ???





# Specialty Crop Industry

## ■ Labor Shortage

- ◆ Stringent Immigration Policies

- ◆ Aging Worker Population (avg. 45 years)

## ■ Reliant on Workers for many Operations

- ◆ Pruning, Thinning, Weeding, Harvesting

# Specialty Crop Industry

- Complete Industry Wide Automation?
  - ◆ Not Soon, Maybe Never!
- Human Labor Needed



# Specialty Crop Industry

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# Stakeholder Survey

- Input to research and extension program
- Top priority:

Automated Thinning Machine



Labor Availability Concerns  
Cost of Hand Thinning - \$100+/acre



Optical Encoder - Distance Calibration



Pneumatic cylinder

Saved plant

Treated plant

Mechanical Knife



Mechanical Knife Thinned Lettuce (foreground)

# Replicated Trial

1. AN 20
2. UAN 32
3. Sulfuric Acid
4. Herbicidal Vinegar (20% Acid)
5. Mechanical Knife
6. Paraquat
7. Hand (Control)



Mechanical Knife – 12 days post

# Automated Thinner Performance

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Vinegar	\$32.27	8.9 b	30,181 b	3.0 cd
AN20	\$20.00	7.5 c	36,715 a	3.3 bc
UAN 32	\$23.09	7.3 c	37,337 a	3.3 b
Knife Blade	NA	6.8 c	41,071 a	3.7 a

\* Note: All spray solutions used to kill plants in this study are not labeled for use in lettuce production. Depending on the manufacture, the exception to this maybe vinegar solutions.

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# Automated Thinner Performance

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	per acre	inch	per/acre	hr/acre
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