Weed control and cost-benefit analysis of automated cultivators to control within-row weeds in processing tomatoes

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Background

- Hand weeding costs
- Matrix: post-plant applications
- Robovator: automated weeder using vision technology
- Finger weeder: mechanical weeder for in-row weed control

←Photo credit: S. Stoddard

Hypothesis and Objectives

- **Mechanical/automated implements to control weeds within the plant row significantly reduce hand hoeing costs in conventional processing tomatoes**
- **To evaluate weed control, time, and costs associated with using mechanical/automated cultivators as part of a conventional weed management program**

Field sites

- Colusa site
  - Field in Colusa, CA
  - Drip-irrigated
  - 60” beds, double row
  - BP13
  - Transplanted March 21, harvested July 24
  - PPI Medal + Triflurex
  - Cultivation 1x, hand hoe 1x
  - Plots: 5 beds x 250 ft, 3 replications
  - Nightshades, bindweed, lambsquarters, pigweed, velvetleaf, jimsonweed

- Merced site
  - North of Dos Palos
  - Drip-irrigated
  - 72” beds, double row
  - SV1082
  - 2nd year in tomatoes
  - Transplanted April 26, harvested Sept 3
  - PPI Dual Magnum + Treflan
  - Cultivation 2x, hand hoe 1x
  - Plots: 1 bed x 905 ft, 4 replications
  - History of heavy nightshade pressure
  - Pigweed, lambsquarters, barnyardgrass, Johnsongrass

Treatments

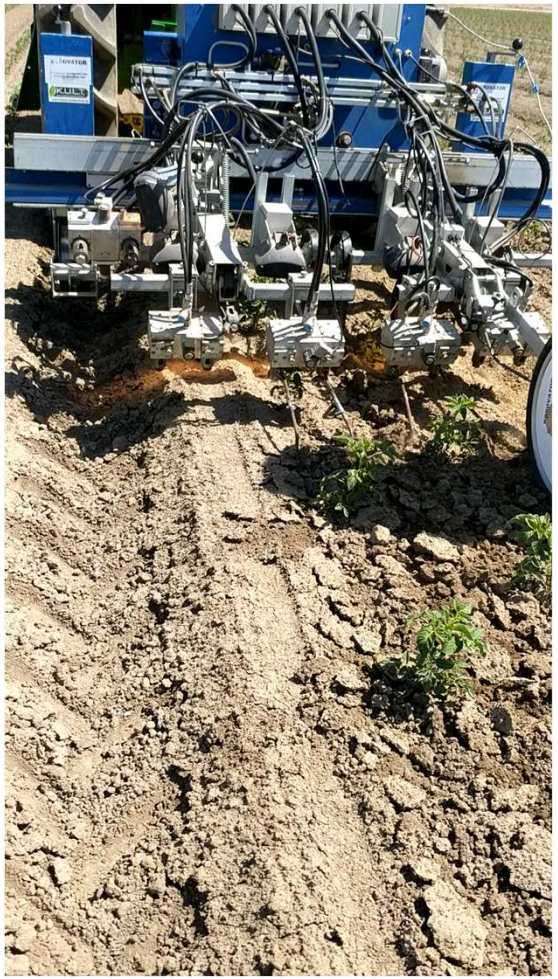
Grower standard=(Treflan (trifluralin) and Dual Magnum (S-metolachlor) pre-plant incorporated, cultivation outside of seed line, hand-hoeing crew 1x)

1. **+ Matrix (rimsulfuron) post-transplant (10 – 14 days after transplanting)**
2. **+ Finger weeder post-transplant (14 days after transplanting)**
3. **+ Robovator post-transplant (14 days after transplanting)**
4. **Grower standard, no Matrix and no in-row cultivation (Control)**

Robovator

Merced

Colusa



Finger weeder

Merced

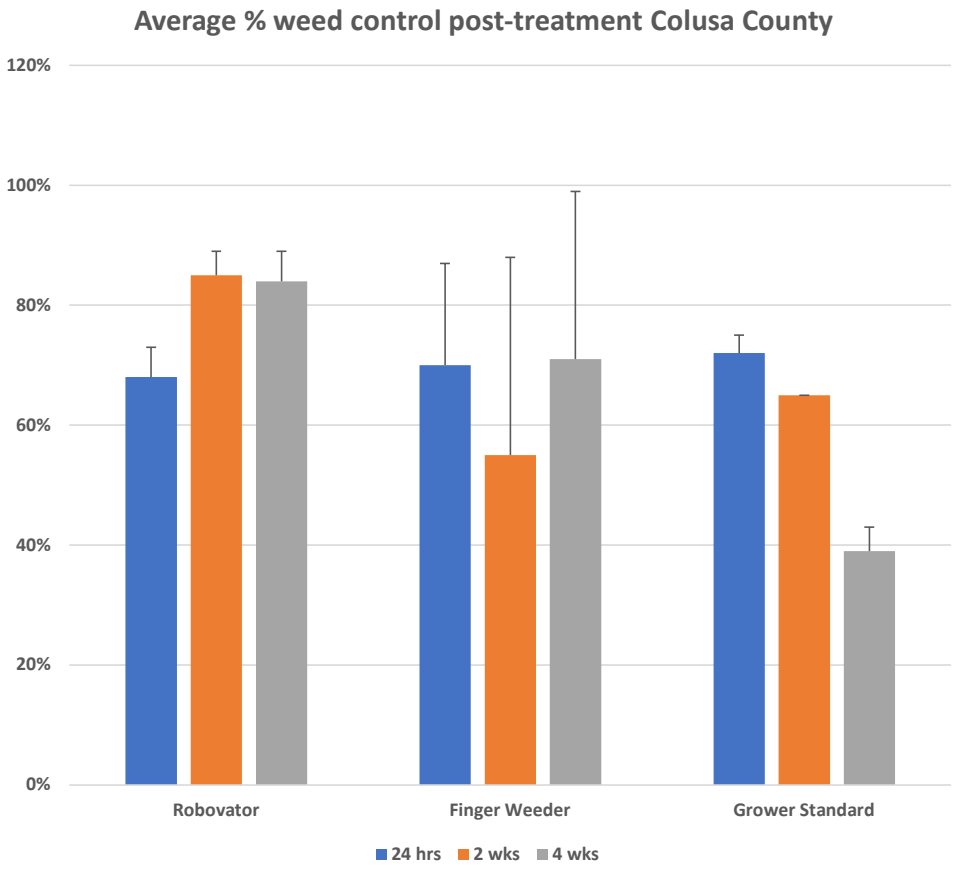
Colusa

Measurements

- Plant stand pre/post-treatment to determine crop injury (~2-3 days after treatment)
- Time it takes for mechanical cultivators and hand weeding crews to move through plots
- Weed control evaluation pre/post-treatment
  - Post-treatment assessments at 2 weeks and 4 weeks after treatment
  - Additional pre/post-hand-weeding assessment (~2 months post treatment)
- Yield
- Cost: a cost-benefit analysis

Results-Colusa

- High variation between plots
- No significant differences between cultivator treatments and grower standard (Matrix)
- No significant yield differences between treatments, but plot area yields were significantly higher than field average



Results-Colusa

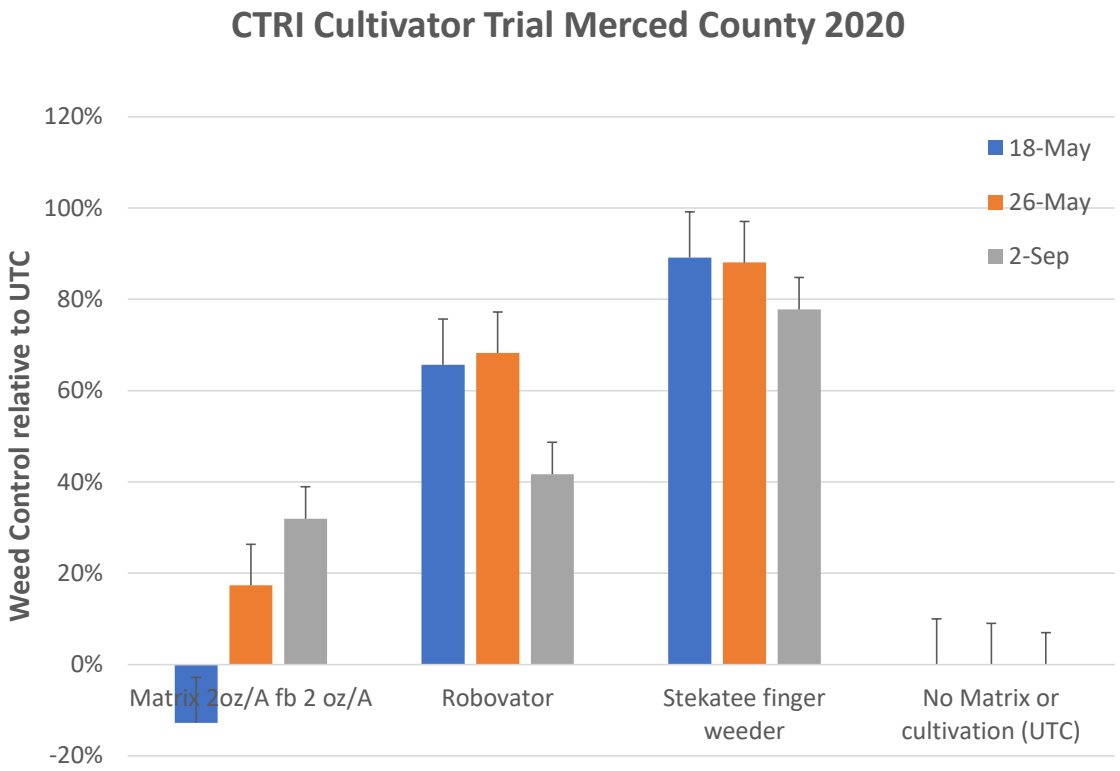
Hand hoeing costs in Matrix herbicide and cultivator treatments were significantly less than the untreated control.

Treatment		Hand hoe hours/A	cost $/A	
1.	Matrix 2oz/A	0:27	$24.30	b
2.	Robovator	0:36	$32.40	b
3.	Finger weeder	0:41	$36.90	b
4.	No Matrix or cultivation (UTC)	1:51	$99.90	a

Estimated time for 4 people to hoe 1 acre. Costs calculated based on $13.50 per hour.

Results-Merced

- **Stekatee finger weeder provided excellent weed control, no crop injury**
  - **Significant reduction in weeds**
- **Matrix treatments had significantly better yield than other treatments**



Results-Merced

Hand hoeing costs in Matrix herbicide and finger weeder treatments were significantly less than the others.

Treatment		Hand hoe hours/A	cost $/A	
1.	Matrix 2oz/A fb 2 oz/A	1:46	$ 95.40	c
2.	Robovator	4:42	$ 253.80	b
3.	Stekatee finger weeder	0:49	$ 44.10	c
4.	No Matrix or cultivation (UTC)	7:27	$ 402.30	a

Estimated time for 4 people to hoe 1 acre. Costs calculated based on $13.50 per hour.

Summary

- In Colusa…
  - Field variation and weed species influenced weed control and pressure
  - Both in-row cultivators provided long-term control
  - Finger weeder was able to cover 5 beds and move quickly through the field compared to the Robovator
  - All treatments reduced hand weeding costs and time compared to the control
- In Merced…
  - Stekatee finger weeder did excellent job of weed control on all plots with no crop injury
  - Difficulty with the Robovator
    - Crop injury exceeded 30% in some locations
  - Matrix herbicide performed as expected, good nightshade control and minimal crop injury
  - Control had significantly more weeds
  - Matrix herbicide or the finger weeder reduced hand weeding time and cost by 83%

Key Takeaways

- High interest for within-row mechanical cultivators
- Larger plots in Colusa field would have been helpful to gain a better understanding of weed control because of field variation
- Robovator provided very good weed control in Colusa field, but caused significant crop injury in Merced field
- Finger weeder provided excellent weed control in both fields, except for one plot in Colusa field with heavy bindweed
- Matrix and finger weeder treatments reduced costs and time for hand weeding in Merced, and Matrix and both cultivators reduced costs in Colusa

Photo credit: S. Stoddard

Next steps

- Repeat in both counties in 2021
- Adding automated transplanters
  - AgriPlanter vs Standard

Photo credits: S. Stoddard

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Thank you!