

Evaluation of mechanical and automated in-row cultivators for weed control in conventional processing tomatoes



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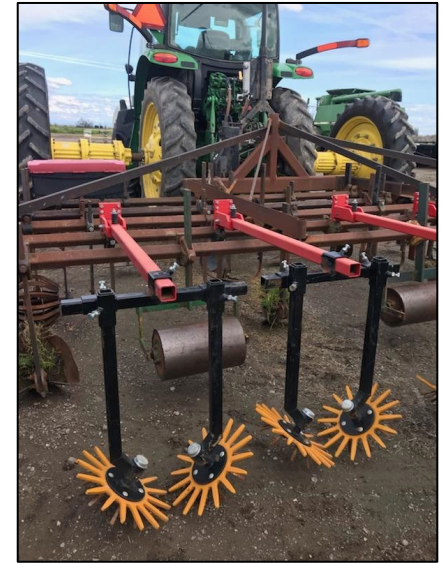
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Merced and Madera counties**

Background

- **Matrix (rimsulfuron)-post-transplant applications**
- **Robovator-automated weeder using vision technology**
- **Finger weeder-mechanical weeder for in-row weed control**
- **High costs of hand weeding later in season**



←Photo credit: S. Stoddard



Objectives

- Evaluated weed control, time, and costs associated with using mechanical/automated cultivators as part of a conventional weed management program in 2020 and 2021
- Compared in-row cultivators to grower standard practice and postemergence herbicides



Field sites

- **Colusa site (2020 and 2021)**
 - Field in Colusa, CA
 - Drip-irrigated
 - 60” beds, double row
 - PPI trifluralin and s-metolachlor
 - Standard cultivation 1x, hand hoe 1x
 - Plots: 5 beds x 250 ft, 3 replications
- **Merced site 2020**
 - North of Dos Palos
 - Drip-irrigated
 - 72” beds, double row
 - 2nd year in tomatoes
 - PPI trifluralin and s-metolachlor
 - Standard cultivation 2x, hand hoe 1x
 - Plots: 1 bed x 905 ft, 4 replications

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. + no Matrix and no in-row cultivation (Control)**



Measurements

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



Weed counts-Colusa 2021

- Counted weeds in center bed of each plot (in the plant row)
- Wide variation between areas of the field and weed pressure



Weed Counts-Robovator

Trmt	Pre: 5/4/2021	2 wks: 5/18/21	4 wks: 6/1/21
Robo	48	24	82
Robo	3	0	0
Robo	66	24	20

Weed Counts-Finger Weeder

Trmt	Pre: 5/4/2021	2 wks: 5/18/21	4 wks: 6/1/21
FW	10	4	2
FW	37	13	8
FW	16	9	10

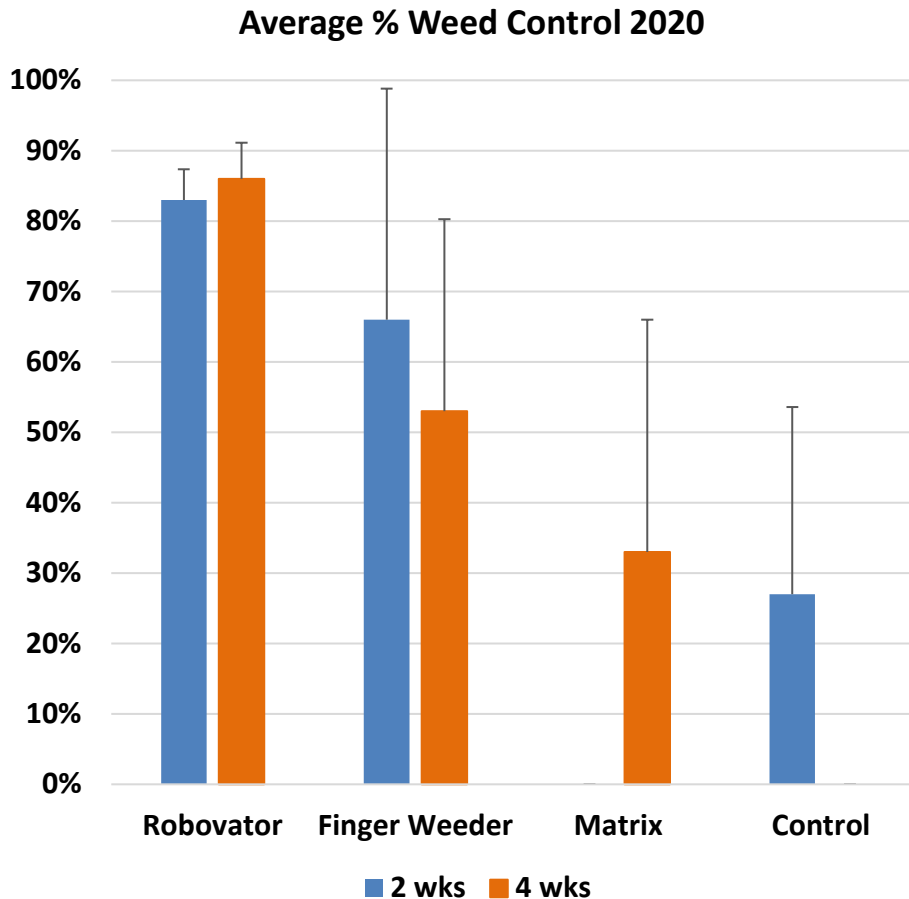
Weed Counts-Grower Standard/Matrix

Trmt	Pre: 5/4/2021	2 wks: 5/20/21	4 wks: 6/3/21
Matrix	14	14	21
Matrix	14	3	0
Matrix	167	127	116

Weed Counts-Control

Trmt	Pre: 5/4/2021	2 wks: 5/18/21	4 wks: 6/1/21
C	5	10	10
C	10	18	12
C	185	96	9

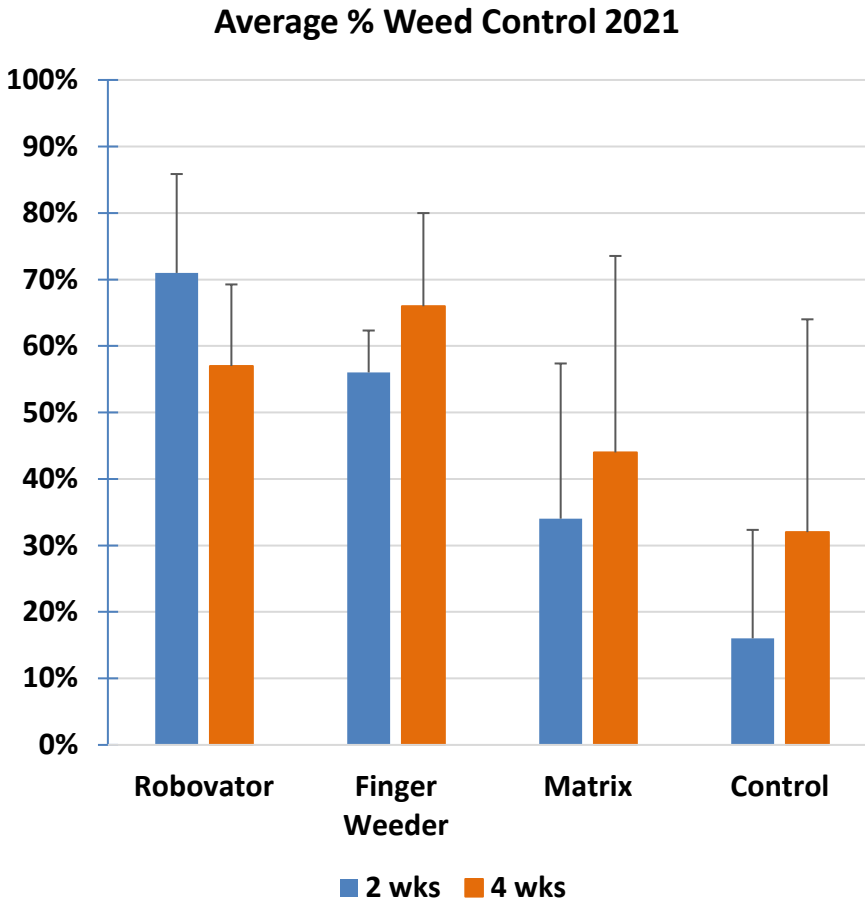
Weed control results-Colusa-2020



- >95% control in 2/3 finger weeder plots after 2 weeks
- Lower weed pressure compared to 2021
- Robovator >80% weed control
- Grower standard/Matrix not very effective



Weed control results-Colusa-2021



- Both cultivator treatments >50% control on average
- Robovator weed control 70% after 2 weeks
- Neither cultivator as effective as in 2020
- Matrix showed better control after 4 weeks than 2 weeks in 2020 and 2021
- Heavier weed pressure in 2021

Cost savings-Colusa

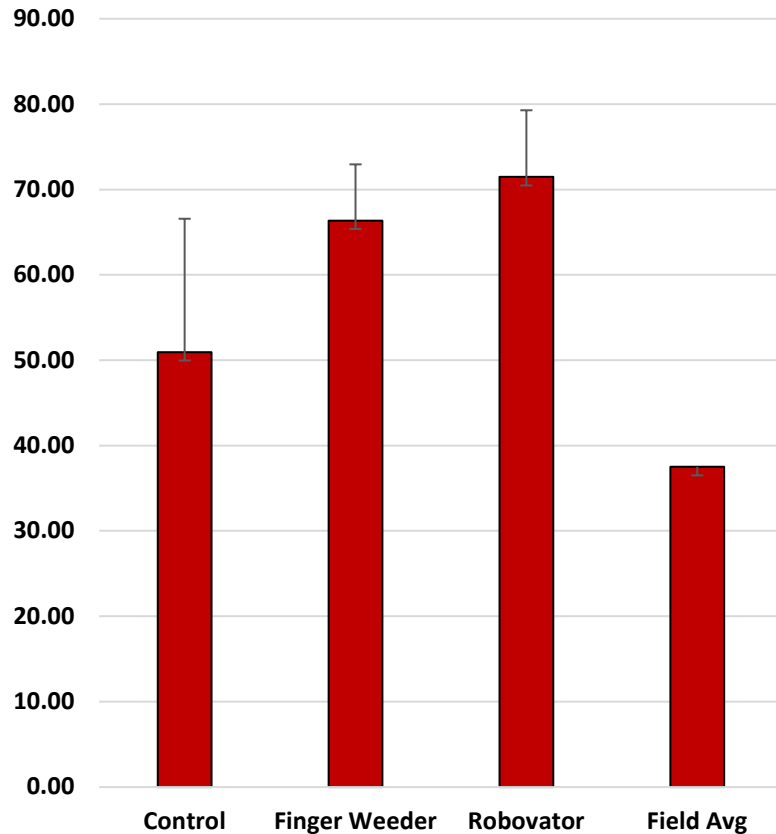
- All treatments significantly reduced costs of hand-weeding compared to the control.

Treatment		2020			2021		
		Hand hoe hours/A	Cost \$/A	Significance	Hand hoe hours/A	Cost \$/A	Significance
1	Matrix (rimsulfuron) 2oz/A (Grower standard)	0:31	\$48.36	b	1:29	\$138.84	b
2	Robovator	0:37	\$57.72	b	1:03	\$98.28	b
3	Finger weeder	0:42	\$65.52	b	1:29	\$138.84	b
4	No Matrix or cultivation	1:49	\$170.04	a	2:39	\$248.04	a

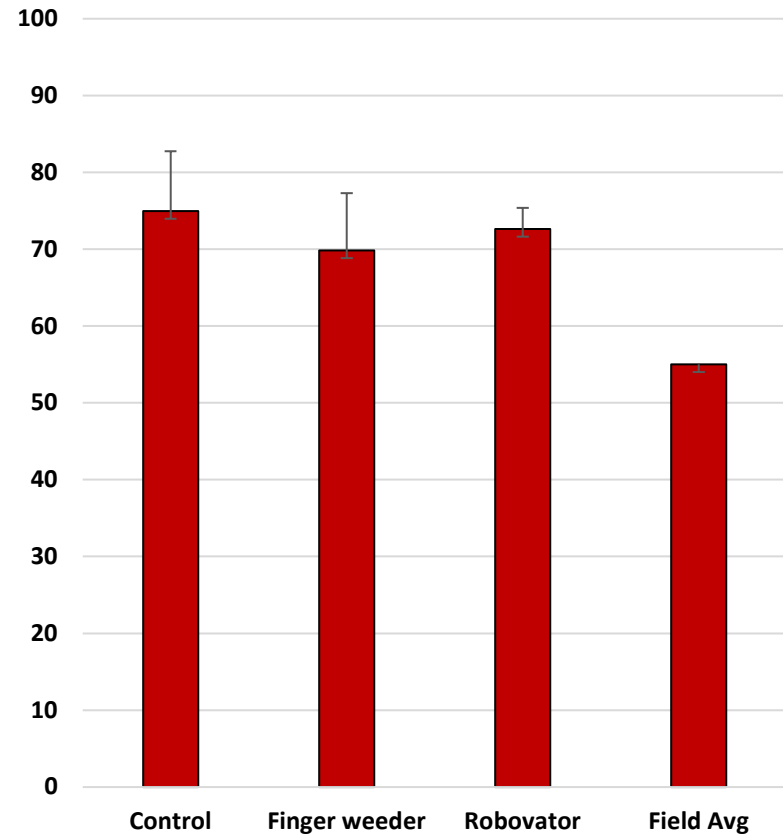
Estimated time for 6 people to hoe 1 acre. Costs calculated based on \$15.50 per hour.

Tomato yield-Colusa

2020 Average tons/acre



2021 Average tons/acre



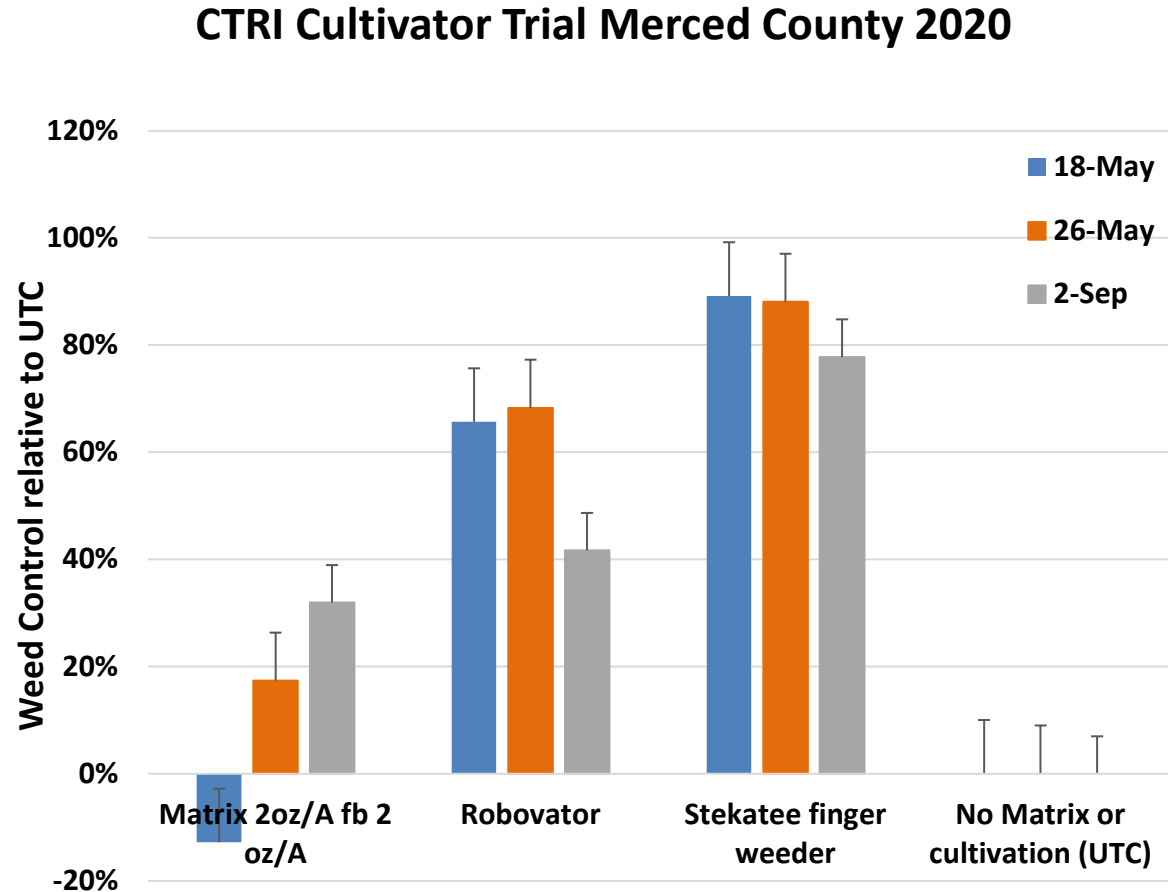
Summary-Colusa

- No significant differences for weed control between cultivator treatments, Matrix and control, but cultivators performed well
- High variation between plots (same treatment but different areas of field)
- No significant yield differences between treatments
- Crop injury and technical issues from Robovator in 2021 did not have a negative effect on weed control or yield



Results-Merced, 2020

- Significant reduction in weeds
- Matrix treatments had significantly better yield than other treatments
- Robovator crop injury



Cost savings-Merced, 2020

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	\$ 110.24	c
2.	Robovator	4:42	\$ 293.28	b
3.	Stekatee finger weeder	0:49	\$ 50.96	c
4.	No Matrix or cultivation (UTC)	7:27	\$ 464.88	a

Estimated time for 4 people to hoe 1 acre. Costs calculated based on \$15.50 per hour.

Merced 2022

Table 2. Processing tomato plant stand, weed control, and yield as affected by treatment, Merced County 2022.

Treatment (1)	plants/acre (2)		weeds/acre (3)			Yield_____PTAB			pH
	19-May	2-Jun	18-Jun	control	T/A	color	SS		
1 grower standard, no Matrix	6586	5837	9235 a	---	36.741	24	5.5	4.55	
2 Matrix 2oz/A fb 2 oz/A	7022	0	174 b	98.0%	---	---	---	---	
3 Steekatee finger weeder	6621	0	174 b	98.0%	37.871	---	---	---	
4 Robovator	6551	0	261 b	97.0%	37.649	---	---	---	
LSD 0.05	ns	--- p = 0.007		ns	ns	---	---	---	
CV, %	6.1	---	65	3.9	2.2	---	---	---	

1) Treatments applied June 17 and 19. Matrix was applied by the grower.

2) Plant stand estimates taken 2 days after cultivation treatments.

3) Estimated from 50 ft center of each plot at 2 locations. These values were square root corrected for statistical analysis.

LSD 0.05 Least significant differences at the 95% confidence interval. NS = not significant.

CV = coefficient of variation

--- not enough data to evaluate

Takeaways

- Robovator provided excellent control in Colusa in 2020 and Merced 2022, but caused crop injury in Merced in 2020, and in Colusa in 2021
 - High winds/non-upright plants affect precision of Robovator and led to higher % crop injury
- Finger weeder provided excellent weed control in both fields in 2020 and Merced in 2022, 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 compared to the control

Photo credits: S. Stoddard

