Cost Benefit Analysis of Robotic Cultivators and Finger Weeders in Processing Tomatoes

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Merced County Trials, 2020 - 2022

2020	2021		2022
Todd Dietrich, Dos Palos	Seth Rossow, Dos Palos	Gary Giampaoli, LeGrand	George Seasholtz, Merced
DR72 beds, Seminis SC1082, April 25	DR80, June 1	1-row 60” beds, Fresh Market June 29	1 row 60” beds, H1662, May 4
Treatments: May 8	June 15	July 8	Treatments: May 17 - 20
Hand weed: June 15	None	None	Early July
1 bed x 905 ft, 4 reps	1 bed x 950 ft, 4 reps	1 bed x 880 ft, 4 reps	1 bed x 1250 ft, 5 reps
Sept 3	Did not harvest	Did not harvest	Sept 8

1. Banded post application of Matrix (rimsulfuron) 2 oz/A ~ 2 & 4 WAT

2. Robovator ~ 2 WAT

3. Stekatee finger weeder ~ 2 WAT

4. Dual + Treflan PPI + standard cultivation, no Matrix (control)

- 3 and 5 weeks after transplanting (WAT)

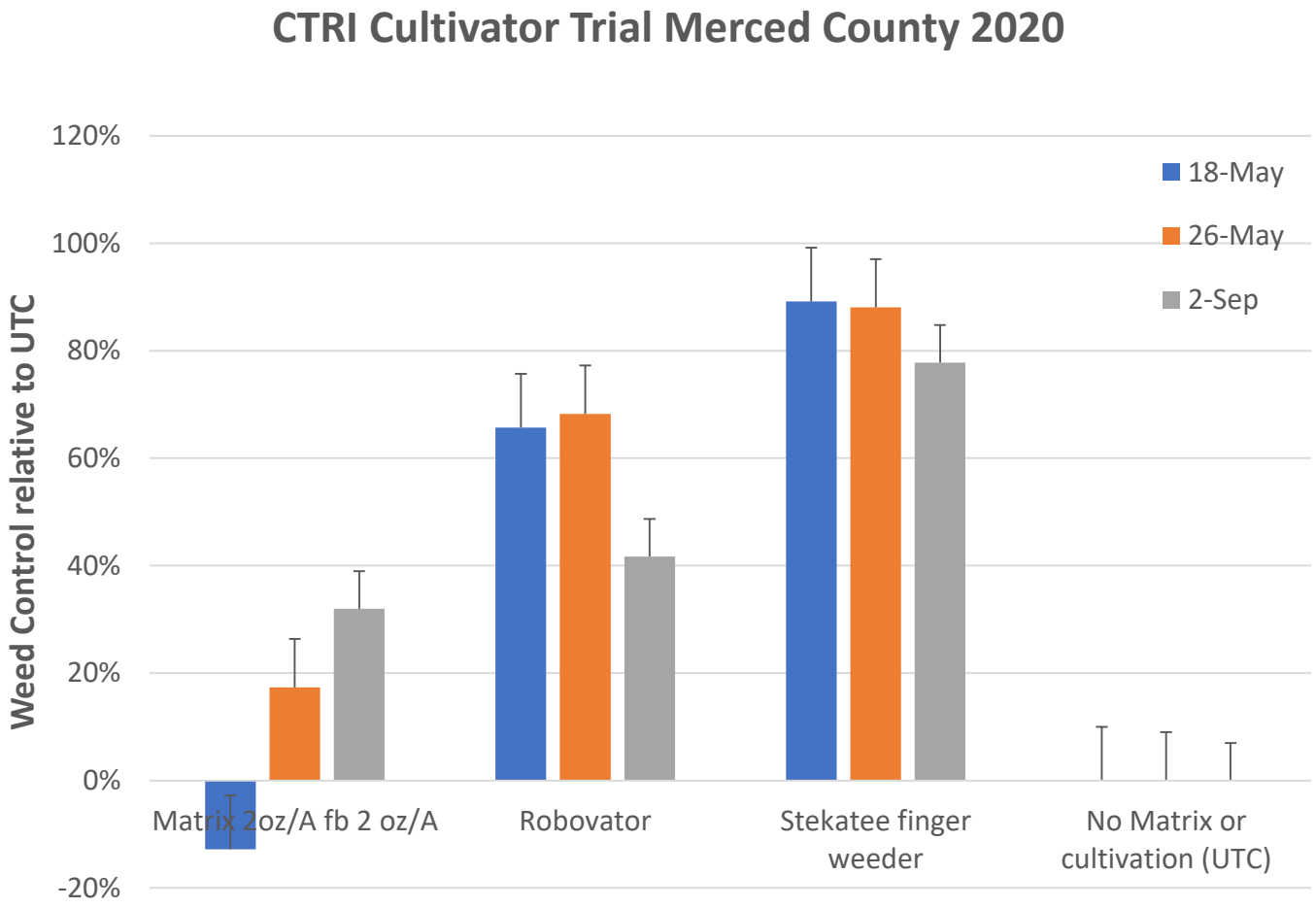
Target weed size at treatment was at cotyledon or 1st leaf

Hand hoe

- June 15, 2020
- 1 person per bed
- Timed to weed both sides
- Main weeds: hairy and black nightshade
- 2021: did not occur
- 2022: Performed, not timed

Results 2020

- Significant reduction in weeds
- Significant reduction in hand hoeing time
- Matrix treatments had significantly better yield than other treatments.



Results

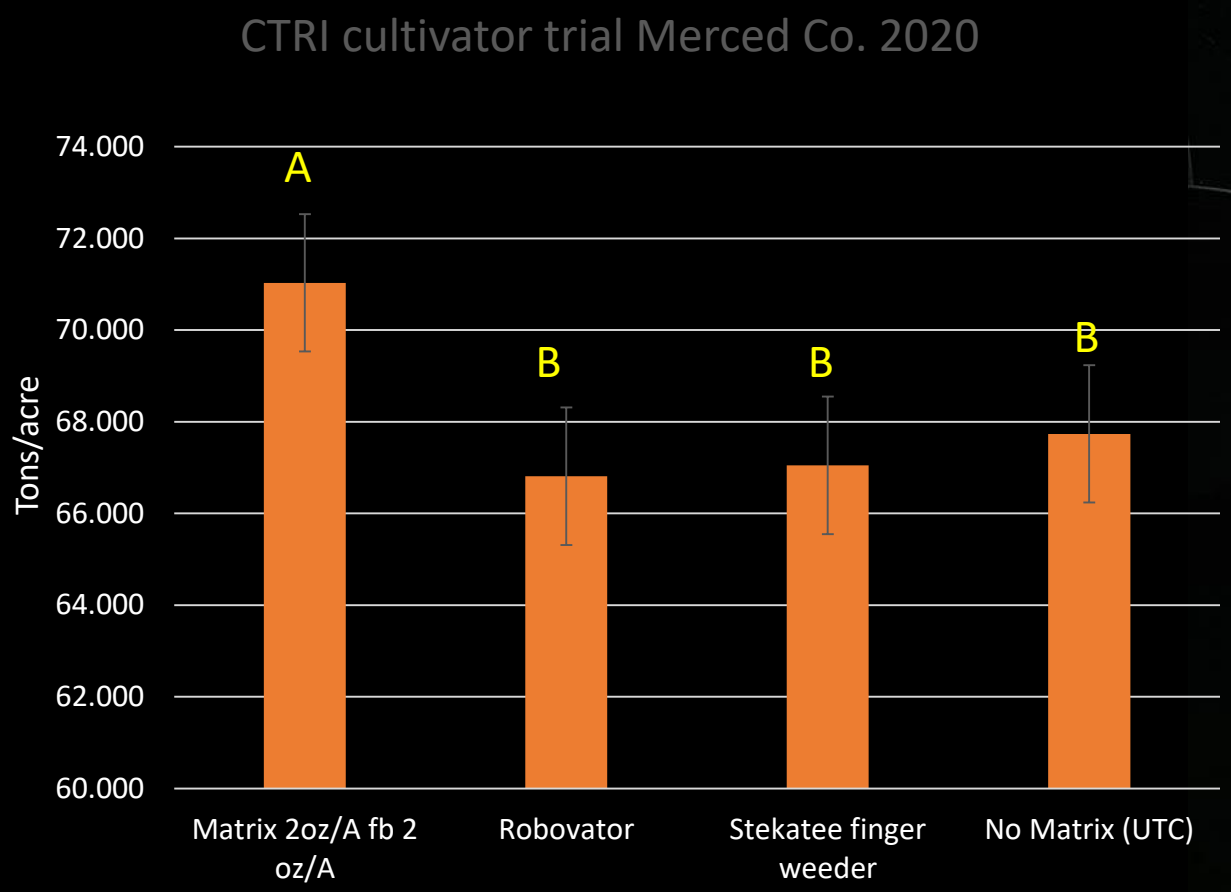
Hand hoeing costs in Matrix herbicide and finger weeder treatments were significantly less than the others.

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.

Issues: ~20% cultivator plant loss with Robovator

Yield


CTRI cultivator trial Merced Co. 2020
74.000
72.000
70.000
68.000
66.000
64.000
62.000
60.000
Tons/acre
A
B
B
B
Matrix 2oz/A fb 2 oz/A
Robovator
Stekatee finger weeder
No Matrix (UTC)

2021 Trial


finger weeder - POST


finger weeder - PRE

Equipment Challenges

Results 2021

Table 1. Tomato plant stand and weed control at 1 and 2 weeks after treatment, Merced County 2021.

		plants per acre (2)		# weeds per acre (3)	
	Treatment (1)	**Dos Palos**	**LeGrand**	**Dos Palos**	**LeGrand**
1	grower standard	6861	6389	0	726
2	Matrix 2oz/A fb 2 oz/A	---	---	0	678
3	Steekatee finger weeder	7006	6437	0	968
4	Robovator	---	6050	0	871
	LSD 0.05	ns	311	---	ns
	CV, %	17.7	2.9	---	35.7

1) Treatments applied June 15 and July 8. Matrix was not applied at either location.

2) Tomato plant stand estimates taken 1 week after cultivation treatments on June 22 and July 19, 2021

3) Estimated from 15 ft sections of each plot at 3 locations 4 weeks after transplanting.

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

CV = coefficient of variation

2022 Trial

2022 Methods

- Insulation on Robovator
- No PPI herbicides
- Main weeds: pigweed, purslane, alkaliweed
- Hand weeded, but not timed for economic analysis
- Partial harvest

Results 2022

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

		plants/acre (2)	weeds/acre (3)				Yield	PTAB		
	Treatment (1)	19-May	2-Jun	18-Jun		control	T/A	color	SS	pH
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 anlysis.

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

CV = coefficient of variation

--- not enough data to evaluate

Significant increase in weed control compared to treatment 1 until hand weeded.

1. Grower std, no Matrix

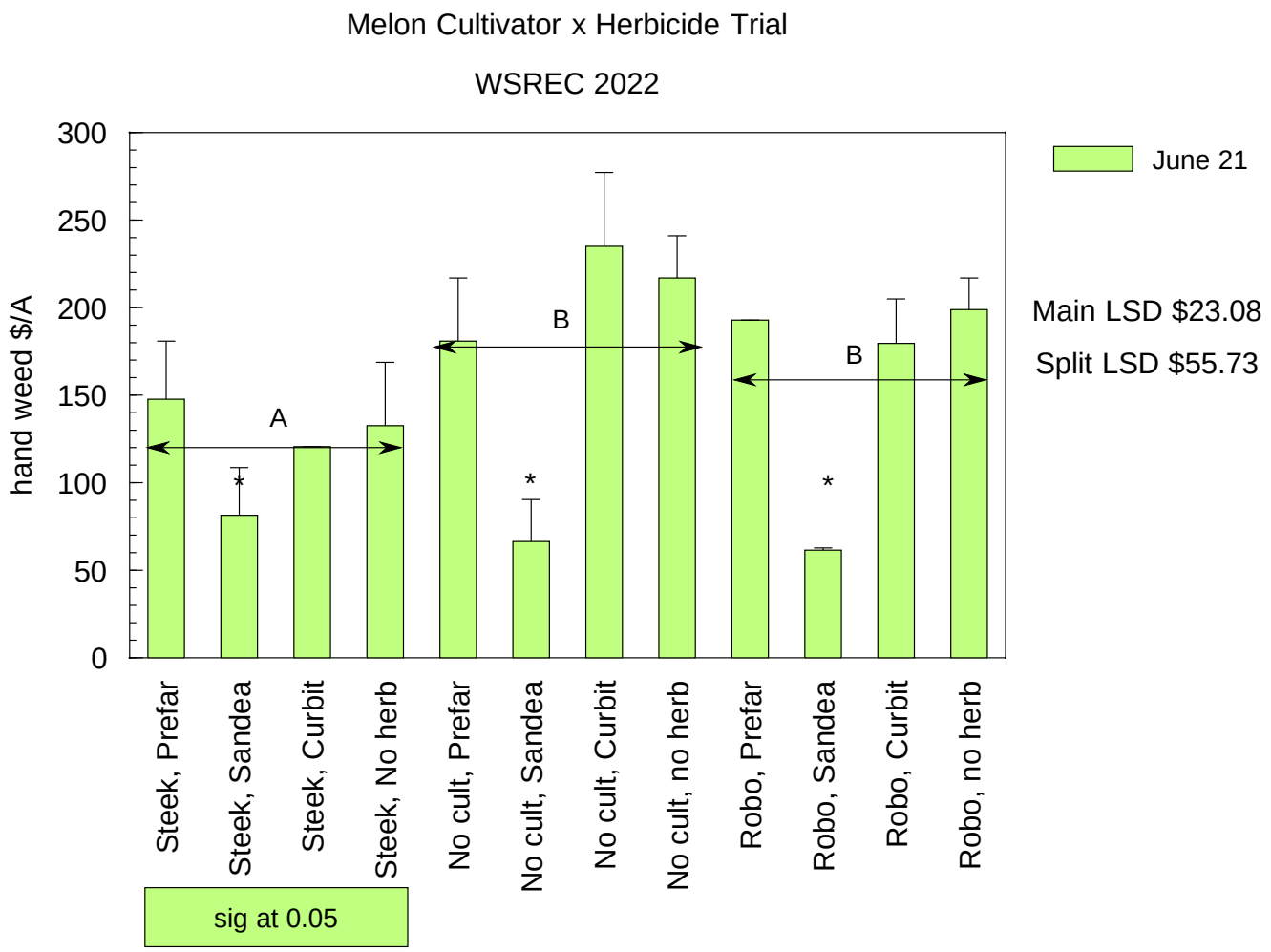
2. + Matrix 4 oz/A

3. Finger weeder

4. Robovator

Melon Trial 2022

- Savings ~ $75 per acre (37%) with finger weeder.
- Matrix superior.
- Similar to lettuce trials (Richard Smith, UCCE Monterey)



Summary

- Finger weeders and Robovator significantly reduced weeds in the plant row in 2 of 4 locations.
- Processing tomato stand reductions occurred, especially in the Robovator treatments.
- Timing critical.
- Economic analyses: only in 2020, hand weeding savings of $150 - $300/A (38 – 75%)

Acknowledgements

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- CTRI