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

UC CE





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# Background

- Matrix (rimsulfuron)post-transplant applications
- Robovatorautomated weeder using vision technology
- Finger weedermechanical 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 smetolachlor
  - 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 smetolachlor
  - Standard cultivation 2x, hand hoe 1x
  - Plots: 1 bed x 905 ft, 4 replications

# Treatments

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

- + Matrix (rimsulfuron) posttransplant (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/posttreatment
  - 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			
С	5	10	10			
С	10	18	12			
С	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



Average % Weed Control 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	а	2:39	\$248.04	а	

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

### **Tomato yield-Colusa**

90.00 80.00 70.00 60.00 50.00 40.00 30.00 20.00 10.00 0.00 **Finger Weeder** Robovator **Field Avg** Control

2020 Average tons/acre

**Finger weeder** 

Control

**Field Avg** 

Robovator

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

### **CTRI Cultivator Trial Merced County 2020**



## **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	С
2.	Robovator	4:42	\$ 293.28	b
3.	Stekatee finger weeder	0:49	\$ 50.96	С
4.	No Matrix or cultivation (UTC)	7:27	\$ 464.88	а

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.

	plants/acre (2)	weeds/acre (3)			Yield			PTAB		
Treatment (1)	19-May	2-Jun Jun	18-		control	T/A	col SS	or		рН
1grower standard, no Matrix	6586	5837	9235a			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

Photo credits: S. Stoddard

# 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





