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

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Background

• Matrix-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
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 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
  • Additional pre/post-hand-weeding assessment (~2 months post treatment)

• Yield
Weed control results-Colusa

Average % Weed Control 2020

Average % Weed Control 2021

Robovator
Finger Weeder
Matrix
Control

2 wks 4 wks

2 wks 4 wks
Cost savings-Colusa

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

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hand hoe hours/A</td>
<td>Cost $/A</td>
</tr>
<tr>
<td>1 Matrix (rimsulfuron) 2oz/A (Grower standard)</td>
<td>0:31</td>
<td>$41.88</td>
</tr>
<tr>
<td>2 Robovator</td>
<td>0:37</td>
<td>$49.98</td>
</tr>
<tr>
<td>3 Finger weeder</td>
<td>0:42</td>
<td>$56.70</td>
</tr>
<tr>
<td>4 No Matrix or cultivation</td>
<td>1:49</td>
<td>$147.18</td>
</tr>
</tbody>
</table>

Estimated time for 6 people to hoe 1 acre. Costs calculated based on $13.50 per hour.
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.

<table>
<thead>
<tr>
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<th>Hand hoe hours/A</th>
<th>cost $/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Matrix 2oz/A fb 2 oz/A</td>
<td>1:46</td>
<td>$ 95.40</td>
</tr>
<tr>
<td>2. Robovator</td>
<td>4:42</td>
<td>$ 253.80</td>
</tr>
<tr>
<td>3. Stekatee finger weeder</td>
<td>0:49</td>
<td>$ 44.10</td>
</tr>
<tr>
<td>4. No Matrix or cultivation (UTC)</td>
<td>7:27</td>
<td>$ 402.30</td>
</tr>
</tbody>
</table>

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

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

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