WEED CONTROL AUTOMATION IN VEGETABLES

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ROBOTIC WEEDERS

- What are they?
- How do they work?
- Are they any good?
- Are they commercially available?
ROBOTIC WEEDING: TWO STEPS

1. Detection of the crop row
2. Actuation – control of the weed
PLANT DETECTION AND ACTUATION

- Detection system
  - Camera
  - Electronic controller
  - Algorithm to classify plants
    - Color threshold
    - Spatial classification
- Actuator
  - Spray solenoid
  - Cultivator knife
  - Other device

Siemens 2014
Actuator: Intra-row cultivator on the Robovator
ROBOVATOR IN TOMATO
Plants are tagged with a biodegradable, colored label at planting.
CROP SIGNALING RESULTS

Plant Labels
<table>
<thead>
<tr>
<th>Cultivator</th>
<th>No. acre</th>
<th>% weed reduction</th>
<th>Time hr./A</th>
<th>% time reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated</td>
<td>377 B</td>
<td>82</td>
<td>46.3 B</td>
<td>39</td>
</tr>
<tr>
<td>Standard</td>
<td>2074 A</td>
<td>0</td>
<td>76.0 A</td>
<td>0</td>
</tr>
<tr>
<td>P-value</td>
<td>&lt;0.0001</td>
<td></td>
<td>0.0021</td>
<td></td>
</tr>
</tbody>
</table>

Davis, CA  May 2017
Robovator Costs – based on lettuce

- Contract costs in Salinas 80 inch bed $110/A (6 seedlines)
- Can do 1 acre in 48 min at 1.5 mph
- Can operate at night
AUTOMATION IN VEGETABLE CROPS

Lettuce thinners
- BlueRiver
- Ag Mechtronix
- Vision Robotics
- Mantis Ag Tech

Robotic Cultivators
- Robovator
- Steketee IC
LETTUCE THINNING- INTERMITTENT SPRAYERS
WEEDING TECHNOLOGY

- The robotic weeders we have now are the first generation
- The US & California need to develop our own homegrown technology
- We need faster, better & cheaper machines