Potential New Weed Tools for Lettuce & Spinach

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Collaborators & support

- Surendra Dara
- Richard Smith
- Ran Lati
- Cooperating growers
- California Leafy Greens Research Program
Possible new weed control tools

- In-row “intelligent” cultivators
- Prowl H₂O for transplanted lettuce
- Spin-Aid for spinach
Intelligent cultivators

- These cultivator sense the crop with camera recognition
- Cultivator knives move in and out of plant row – “robotic hoeing”
Intelligent cultivator (IC)
The Robovator

- Computer
- Light
- Camera
- Static knife
- Mobile knifes
- Velocity sensor
Robovator
Weed removal

Sub-surface root pruning

2 hours after cultivation

2 days after cultivation
Robovator
Field evaluation

Methods

- Transplanted leaf lettuce
- Robovator and standard cultivator (SC) with/without Kerb
- One pass
- Evaluations:
  - Stand count
  - Yield
  - Weed density before/after
  - Hand weeding (HW) time

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield (Lb A⁻¹)</th>
<th>Weed Control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC + Kerb</td>
<td>7163 a</td>
<td>89 a</td>
</tr>
<tr>
<td>IC untreated</td>
<td>7608 a</td>
<td>78.5 a</td>
</tr>
<tr>
<td>SC + Kerb</td>
<td>7069 a</td>
<td>68.1 a</td>
</tr>
<tr>
<td>SC untreated</td>
<td>6194 a</td>
<td>42.6 b</td>
</tr>
</tbody>
</table>
Hand weeding time

Salinas – July 2014

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Labor hours/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>No herbicide</td>
<td>A 29.8h</td>
</tr>
<tr>
<td>Plus Kerb</td>
<td>C 27.2h</td>
</tr>
<tr>
<td>IC</td>
<td>B 20.7h</td>
</tr>
<tr>
<td>Standard + Kerb</td>
<td>C 24.1h</td>
</tr>
</tbody>
</table>

-9.1 h savings

-2.6 h savings
The Robovator
Limitations

High weed density\Timing

Overlapping canopies
Intelligent cultivators

- Organic vegetables are probably the most ready application of this technology
Prowl H₂O- Pendimethalin

- A food use tolerance was granted by USEPA for pendimethalin use on transplanted leaf lettuce.
- BASF has provided a proposed Prowl H₂O label for transplanted leaf lettuce.
- The Prowl lettuce rate will be 2.1 pints/A
- Proposed PHI is 20 days
Field evaluations

Preliminary evaluations

- Lettuce Safety and weed control
  Prowl PRE at 5 rates between 1.2 to 12.6 lb/Ac
  - Kerb at 2lb/Ac
- Application timing-
  - PRE transplant
  - POST transplant

Commercial evaluation

- Santa Maria and Las Lomas
  - Red Romaine and Lolla Rosa, respectively
  - Prowl PRE at 2.1 and 4.2 lb/A.
  - Prefar at 6 lb/Ac, Las Lomas
Safety of Prowl to transplanted lettuce

No herbicide

Prowl 25 pt/A (12X)

No significant difference for injury and yield values of all Prowl treatments
No significant difference for injury and yield values of PRE and POST treatments
Application timing had no impact on weed spectrum and control efficacy.
Commercial trials
lettuce yield

Las Lomas (ns)

Santa Maria (ns)

• Prowl had no impact on harvestable lettuce heads per acre
Prowl H₂O

Summary

• Prowl H₂O was found safe for transplanted lettuce
• Weed control at 2.1 lb/A (recommended rate) was better than Kerb
• There is no impact of application timing (PRE vs. POST) on control results
• **Useful and effective new tools for weed management in the transplanted lettuce**
Spin-Aid- (Phenmedipham)

• PS II inhibitor – inhibits photosynthesis
• Control broadleaf weeds and some grasses
• May cause temporary injury
• Registered for use on processing and seed spinach but not for fresh spinach
Field evaluations

- Ro-Neet followed by Spin-Aid
  - Ro-Neet PRE at 2 pts/A + Spin-Aid at 0.5, 1.0 and 1.5 pts/A at 4-leaf
  - Day vs. night applications
Sequential Application

Weed control

Control (% of Ro-Neet)

Hand weed  RN+SA 0.5  RN+SA 1  RN+SA 1.5  Ro-Neet

A  B  B  A

C
Sequential Application

Ro-Neet 2 pt/Ac

Ro-Neet 2 pt/Ac FB Spin-Aid 1.5 pt/Ac
How can Spin-Aid be more useful?

- Ro-Neet PRE at 2 pt/A for all treatments
- Spin-Aid at 0.5 and 1.0 pt/A at 2-leaf
- Spin-Aid at 0.5 and 1.0 pt/A at 2-leaf + 1.5 pt/A at 4-leaf
- Spin-Aid at 1.5 pt/A at 4-leaf (standard)
Spin-Aid 3 pt/A applied at night causes less spinach injury than day applications

Spinach injury, 0 = safe, 10 = dead

Day

Night

Injury 0-10

A

B
Safety

- Night application of reduced Spin-Aid rates at early stages

No significant difference for injury and yield values of all spin aid treatments
Weed control

- Night application of low Spin-Aid rates at early stages
Weed control

• Night application of reduced Spin-Aid rates at early stages
Spin-Aid

Summary

• Low rates of Spin-Aid were found safe and affective for spinach when applied as sequential application after Ro-Neet

• Night application is recommended

• Good weed control by Spin-Aid at 1.0 pt/Ac at 2-leaf stage

• Best weed control at 1.0 pt/Ac at 2-leaf stage + 1.5 pt/Ac at 4-leaf stage
  – 21 day PHI should be considered
Final

- Robotics and machine vision offer new possibilities for vegetable weed control
- Prowl H₂O appears to be a new tool for transplanted lettuce
- Spin-Aid could probably be useful in fresh spinach