Under-Vine Cover Crops as an Alternative to Herbicides in Vineyards

Justine Vanden Heuvel, Lindsay Jordan, Adam Karl, Ming-Yi Chou and Michela Centinari

Dept. of Horticulture, Cornell University
Current management
World Health Organization’s International Agency for Research on Cancer classified glyphosate as a probably carcinogen

<table>
<thead>
<tr>
<th>Agent</th>
<th>Activity (current status)</th>
<th>Evidence in animals</th>
<th>IARC classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glyphosate</td>
<td>Herbicide (currently used; highest global production volume herbicide)</td>
<td>Sufficient</td>
<td>2A (probable)</td>
</tr>
<tr>
<td>Malathion</td>
<td>Insecticide (currently used; high production volume chemical)</td>
<td>Sufficient</td>
<td>2A (probable)</td>
</tr>
<tr>
<td>Diazinon</td>
<td>Insecticide (restricted in the USA and EU)</td>
<td>Limited</td>
<td>2A (probable)</td>
</tr>
<tr>
<td>Parathion</td>
<td>Insecticide (restricted in the USA and EU)</td>
<td>Sufficient</td>
<td>2B (possible)</td>
</tr>
<tr>
<td>Tetrachlor -vinphos</td>
<td>Insecticide (restricted in the EU and for most uses in the USA)</td>
<td>Sufficient</td>
<td>2B (possible)</td>
</tr>
</tbody>
</table>
Why not herbicide?

- Negative effects on long-term soil health
- Nutrient leaching
- Vigorous vine growth, increased management costs
- Herbicide resistant weeds
Why not herbicide?

Total Carbon and Nitrogen concentrations in leachate water, for 2012.
CULT=Cultivation, GLY=Glyphosate, NV=Native Vegetation, WC=White Clover.

Nitrogen and DOC leaching from Glyphosate under-vine floor treatment

Karl et al 2014
Why not herbicide?

High detectable insecticide in leachate water from Glyphosate treatment

Karl et al 2014
Why not herbicide?

Primary bud survival rate reduced by Glyphosate

Average primary bud survival measured on 5/10/2014. CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.
Alternatives to herbicide strips

Cultivation

Cover crops
Problem with cultivation/tillage

https://www.youtube.com/watch?feature=player_embedded&v=ToKavHhu4PE
Problem with cultivation/tillage

- Increases soil compaction (especially when soil is wet)
- Degrades soil structure
- Increases organic matter decomposition
- Increased runoff and erosion
- Uses a lot of energy/fossil fuel

Van Es 2015
Smith et al 2008
Under-vine cover crop experiments at Cornell

• **Riesling**
  Glyphosate, Native vegetation, Cultivation, Chicory, Buckwheat and Annual rye grass

• **Cabernet franc**
  Glyphosate, Native vegetation, Cultivation, Chicory, White clover, Tall fescue, Alfalfa and Tillage radish

• **Noiret**
  Glyphosate, Native vegetation, Chicory, Tall fescue, Alfalfa, Tillage radish and seed-mix
White Clover

Cultivation

Glyphosate

Annual Rye Grass
Tillage Radish

Chicory
Under-vine cover crop impacts on vine size

- No impact on vine size: Buckwheat
- Reduction in vine size: Blue chicory
Chicory reduces pruning weight v.s Buckwheat maintains vine size

Pruning Weights (kg/vine) of treatment vines. GLY=Glyphosate, CHI=Chicory, BW=Buckwheat

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLY</td>
<td>1.41</td>
<td>1.16</td>
</tr>
<tr>
<td>CHI</td>
<td>0.63</td>
<td>0.84</td>
</tr>
<tr>
<td>BW</td>
<td>1.15</td>
<td>1.24</td>
</tr>
</tbody>
</table>

kg/vine
Chicory seeded at 5 lbs/acre, results after two years:
- Decrease in petiole N of ~15%
- Decrease in pruning wt of ~28%
- Decrease in yield of ~28%
- Decrease in TA of 1 g/L
- Wines distinct compared to control
Buckwheat seeded at 350 lbs/acre, after 3 years:
- No impact on petiole N
- No impact on pruning wt
- No impact on yield
- No impact on fruit composition
- Wines distinct compared to control
Chicory
Buckwheat
Glyphosate
Impact on cost of production

• Herbicide costs $128/acre per year (Yeh et al., 2014)

• Buckwheat seed cost = $75/acre
• Blue chicory seed cost = $27/acre

• Cost of seeding?
• Cost of mowing?
• Potential savings on canopy management?
## Under-vine floor management cost

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glyphosate</td>
<td>222$/acre</td>
</tr>
<tr>
<td>Cultivation</td>
<td>419$/acre</td>
</tr>
<tr>
<td>Cover Crops</td>
<td>68$/acre</td>
</tr>
</tbody>
</table>

Glyphosate = application*2 + spot application
Cultivation = till*4
Cover crops = seeding + mowing*4

Karl et al 2014
Thank you

Feel free to contact us if you have any related questions or thoughts!

• Prof. Justine Vanden Heuvel
  JEV32@cornell.edu
• Ming-Yi Chou
  MC2478@cornell.edu
Yield: kg/vine

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>CULT</td>
<td>5.4 ab</td>
<td>2.8 b</td>
<td>6.5 ab</td>
</tr>
<tr>
<td>GLY</td>
<td>5.8 a</td>
<td>5.1 a</td>
<td>7.7 a</td>
</tr>
<tr>
<td>NV</td>
<td>5.2 ab</td>
<td>2.6 b</td>
<td>6.0 b</td>
</tr>
<tr>
<td>WC</td>
<td>4.1 b</td>
<td>3.0 b</td>
<td>7.4 a</td>
</tr>
<tr>
<td>p-value</td>
<td>0.03</td>
<td>&lt;0.001</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Yield (kg/vine) of treatment vines. CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.
Partial Budget Analysis

Percentage reduction in revenue per hectare compared to GLY

- 2011
- 2012
- 2013

CULT  NV  WC