Cover crops can reduce the cost of under-vine weed control

Jake Howie, Chris Penfold*, Tom Nordblom, Mark Norton and Melanie Weckert
Under-vine Cover Cropping

Project Aims

• To reduce the need for repeated herbicide use in the under-vine zone
  – herbicide resistance; future of glyphosate?
• To improve under-vine soil health
• To grow plants under-vine which are beneficial to the grapevine, potentially leading to improved yields and/or quality
• To improve vineyard profitability and sustainability
Under-vine zone: Industry std. herbicide control
Why spray and when is a weed a weed?

- Aesthetics, garden mentality, “the vibe”
  - Nice, neat & tidy, military rows, work ethic ...
- Amenity (eg caltrop, innocent weed, jacks)
  - Dogs, pickers, boots, tyres
- Height (eg prickly lettuce, fleabane ....)
  - drip lines, foliage, accidental harvest
- Competition for moisture
# Under-vine soils

B. Hughes, PIRSA (2014), Adelaide Hills Wine Region

<table>
<thead>
<tr>
<th><strong>Issue</strong> <em>(study of 13 sites, most spraying under-vine)</em></th>
<th><strong>Extent</strong></th>
<th><strong>Possible Solutions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low and falling organic matter/carbon under-vine <em>(nb. zone of greatest conc. vine roots)</em> compared with mid-row</td>
<td>Wide-spread, sprayed sites ..</td>
<td>Add composts inc. mid-row DM and slash into under-vine zone grow pastures under vine row</td>
</tr>
<tr>
<td>• Leading to poor under-vine soil structure (incl. surface sealing, reduced infiltration, increased runoff)</td>
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</tr>
</tbody>
</table>
Nuriootpa R.C. (26/9/17)

Herbicide control

- Medic residues

- Low OM/OC
- Poor soil structure
- Surface sealing
- Run-off/wheel tracks
- Reduced infiltration
Many variable traits of cover-crops

- Life cycle: annual vs. perennial?
  - annuals: early/mid/late maturing?
  - perennials: active growth/summer dormancy?
- Type: grass vs. legume?
- Growth habit: prostrate vs. upright
- Are they host for pests eg LBAM, earwigs?
- Vigour/competitiveness: low vs. high DM?
- Role of mixtures eg grass + legume?
- Site specific; pH, avg. rainfall ……
### Project under-vine treatments/crops

<table>
<thead>
<tr>
<th>10 trt’s: plant/variety/sp.</th>
<th>Plant type/comment</th>
<th>SR (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Triticale mulch</td>
<td>Control</td>
<td>~ 50 t/ha</td>
</tr>
<tr>
<td>2. Kasbah cocksfoot</td>
<td>Perennial grass; summer dormant?!</td>
<td>8</td>
</tr>
<tr>
<td>3. Wallaby grass (<em>Rytidosperma geniculata</em>)</td>
<td>Perennial grass, native; evergreen</td>
<td>10</td>
</tr>
<tr>
<td>4. Rat-tail fescue (<em>Vulpia myuros</em>)</td>
<td>Annual grass; self-regenerating, short</td>
<td>10</td>
</tr>
<tr>
<td>5. Cavalier burr medic &amp; Bindaroo button medic</td>
<td>Annual pasture legumes; self-regen’, early maturity</td>
<td>20/20</td>
</tr>
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<td>--------------------------------------</td>
<td>---------------------------------------------------------</td>
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</tr>
<tr>
<td>6. Angel strand medic &amp; Sultan barrel medic</td>
<td>Annual pasture legumes; self-regen’, early maturity</td>
<td>20/20</td>
</tr>
<tr>
<td>7. Scimitar burr medic &amp; Safeguard annual rye grass</td>
<td>Annual grass/pasture legume mix; self-regen’, soft-seeded medic</td>
<td>20/30</td>
</tr>
<tr>
<td>8. Sheep fescue &amp; Palestine strawberry clover</td>
<td>Perennial grass/pasture legume mix;</td>
<td>20/20</td>
</tr>
<tr>
<td>9. Mintaro subclover &amp; Prima gland clover</td>
<td>Annual pasture legume mix; self-regenerating, RLEM resistant</td>
<td>20/7</td>
</tr>
<tr>
<td>10. Herbicide control</td>
<td>Glyphosate</td>
<td>NA</td>
</tr>
</tbody>
</table>
How was it sown?

- Sown Autumn 2014
- Taege disc seeder
- Single row, ~20cm either side of vines
- ~1cm depth, chains
- Plot ~18m row, 3 panels x 3 vines
- Legumes inoculated
- Insecticide applied (RLEM/LF/Sitona)
- 2014 was dry – some resown in 2015
- Compacted topsoil, mounded – tricky
Clare
20th Sept. 2016

Wallaby grass
Kasbah cocksfoot
• height?
What did we measure?

• Cover-crops
  – Botanical composition, DM growth, …

• Soils
  – Nutrients, moisture, compaction
  – Microflora/fauna: worms, mycorrhizae …..
  – Allelopathy

• Grapevines
  – Vegetative: leaf canopy/LAI, cane weights, petiole N
  – Grapes: 50 berry wt, bunch #/wt, total yield, YAN, sugars/acids, wine quality
“Botanal - a comprehensive sampling and computing procedure for estimating pasture yield and composition”
Tothill et al (1996) CSIRO
Nuriootpa botanical composition
Green DM (excl. dry residues), May 2017

DM (kg/ha)

Average of Grass (other)
Average of B'leaf (other)
Average of Strawberry clover
Average of Fescue
Average of Medic (sown)
Average of Vulpia (eg Zorro)
Average of Wallaby
Average of Kasbah
Average of Triticale mulch
Nuriootpa harvest yield 2016

(nb. v. dry spring/summer)
Nuriootpa harvest yield 2017

(nb. wetter spring/summer)
Nuriootpa annual costs ($/ha)
Tom Nordblom et al (62 AARES Conf., 2018)
12 years district yields/prices => 2400 simulated harvests

<table>
<thead>
<tr>
<th>Under-vine costs</th>
<th>$/ha</th>
<th>Other vineyard</th>
<th>$/ha</th>
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</thead>
<tbody>
<tr>
<td>Straw mulch ($3000/4 yrs)</td>
<td>750</td>
<td>Fungicide &amp; application</td>
<td>470</td>
</tr>
<tr>
<td>Herbicide $x \sim 5$ applications</td>
<td>333</td>
<td>Mowing mid-rows</td>
<td>150</td>
</tr>
<tr>
<td>Cover-crops (5 yrs)</td>
<td>40-80</td>
<td>Fertiliser (MAP soluble)</td>
<td>32</td>
</tr>
<tr>
<td>NB Wallaby grass</td>
<td>175</td>
<td>Pruning/hedging</td>
<td>1,339</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irrigation (0.8 MI)</td>
<td>560</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Harvesting</td>
<td>800</td>
</tr>
<tr>
<td><strong>Avg. total costs if using herbicide ($/ha)</strong></td>
<td>~ 3,700</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Nuriootpa: simulated gross margins using known vineyard costs and yields from 2016 & 2017 vintages
General observations

• NB 2 years data only
  – Needs ongoing site & data collection to validate results
• Yield the biggest GM driver – moisture availability
• Perennials
  – Good weed suppression; slow to establish; reliable (?)
  – Reduced yields (eg wallaby, cocksfoot, fescue & strawberry clover, Microlaena); summer dormancy?
• Annuals
  – Faster but fickle w.r.t. regeneration, insects,
  – Better matched to vine growth cycle
Langhorne Creek Harvest, 2016

(nb. v. dry spring/summer)
Conclusions

• Cover crops can reduce the cost of need for under-vine weed control

• Growing desirable species under-vine can:
  – improve vine yield (and grape/wine quality)
  – reduce costs/increase gross margins
  – and may inc. microbial diversity & activity; soil organic matter/carbon; improve soil structure & infiltration

• Much more to learn in the next 3 years eg.
  – soil/water/vine relationships
  – the role of allelopathy; mycorrhizae ……
  – grazing and mowing options for perennials?
Self-regenerating background medic in mid-row & under-vine =>
- Living/self-mulching
- Weed suppression
- Inc. organic matter/carbon
- N fixation
- self-regenerating at no cost

Friend or foe?

$0 vs. $232/ha
Trial sites/co-operators/variety

- Nuriootpa Research Centre (SARDI); Shiraz
- Oxford Landing (Yalumba); Merlot
- Eden Valley (Eden Hall); Shiraz
- Langhorne Creek (CMV Farms); Cabernet Sauvignon
  - & additional satellite sites in Clare, Coonawarra, McLaren Vale, Adelaide Hills.
Wine score: Chris’s Nuriootpa Shiraz 2016
Barossa Vine Improvement Society (26 panel members)

- Expt. Wine batches
- 7 selected trts
- 20 point scale
- no 95 Halliday points but
- ..... Gawler show medal

Effect of reduced yield?
Nuriootpa 2016: soil moisture tension at flowering

Probe depth (cm)

kPa

Bare soil  Straw  Medic  Cocksfoot

15  40  70  100
Nuriootpa 2017: soil moisture tension at harvest

**Medic/ARG**
- Better soil structure?
- Improved infiltration?
- PRZ drying?
- Mycorrhizae?
- More research!
Eden Valley Harvest 2017

Yield (t/ha)

- Weeping Grass (Microlaena)
- Wallaby grass
- Herbicide control
- Kasbah cocksfoot
- Triticale mulch
- Cavalier burr/Bindaroo button
- Safeguard RG/Mintaro sub clover
- Zorro fescue
- Angel strand/Sultan barrel medic
Penetration Resistance 10-20 cm
Nuriootpa 2016

~ max. soil strength for roots
Langhorne Creek Sept. 2017

<= sown medic in plot

self-regenerating medic in mid-row & under-vine
Nuriootpa 2016

Mintaro regen’ but v. little Prima
Vineyard subsoils

the case for cover crops?

• In duplex soils (Barossa, Sunraysia, MIA), sub-soil structure is generally poor, and cannot decline much further (Murray et al, 2010)
  – Infiltration rates (< 1 mm/hr) and air-filled porosity were low, penetration resistance was high
  – Unfavourable to root growth and respiration at field capacity and drier

• Poor microbial activity (Barossa, Rawnsley 2010)
One of 12 moisture meters (@ 15, 40, 70, 100 cm)

Nuriootpa: Herbicide control
Industry standard 2
- Straw mulch
“Botanal
- A comprehensive sampling and computing procedure for estimating pasture yield and composition”

• JC Tothill et al (1996), CSIRO Division of Tropical Crops and Pastures
  – Dry-weight-rank method: 1, 70%; 2, 21%; 3, 9%.
  – Visual score: std. reference quadrats scored for DM (eg 1-10), cut to calibrate visual scores.
  – Groundcover; % green DM
  – XLS based program