Vineyard Cover Crops and Tillage Practices

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USDA-ARS
Today’s Roadmap

- Reducing Soil Erosion, Runoff, and Dust
- Reducing Greenhouse Gas Production by Altering Tillage Practices
- Soil Biology and Organic Matter
- Weed and Vine Management

Form and Function
Erosion and Runoff

- cover crops gave 45% and 80% reduction in runoff
- dependent upon cover crop type
- nutrient concentrations of runoff were the same among treatments
- **MORE** total nutrients were lost from cultivated soils.
- slope was only 1-2%
- Only 7-9” rain per year!

Larry Bettiga, Michael Kahn, Richard Smith, UCCE Farm Advisors
Smith et al. 2008, California Agriculture
Dust Reduction

- Provide improvements in air quality
- Reductions in dust generation related to reductions in mite pressure
- Potential improvements in predatory mite habitat
- Adopt no-till or reduced tillage practices
Revisiting the Roadmap

- Reducing Soil Erosion, Runoff, and Dust
- Reducing Greenhouse Gas Production by Altering Tillage Practices
• Viticultural activities that produce GHGs
• AB 32 requires monitoring of CO₂ emissions
• N₂O emissions not required to be monitored yet
Fossil Fuel Combustion

- One of largest components of GHG emissions
- Best understood
- Most easily **controlled** and **measured** by growers

- More fuel = more GHG emissions
  - gal. diesel = 12 kg CO$_2$e
  - gal. gasoline = 10.5 kg CO$_2$e

- Management
  - Biofuels can lessen impact
  - Onsite energy generation
  - Minimize fuel usage

- Research needs
Vineyard floor management

- **Conventional tillage** (<30% of crop residues left on the surface, multiple passes)
  - less carbon enters soil organic matter
  - greater production of CO₂
  - some N₂O production
  - greatest requirement for fossil fuels

- **Conservation tillage** (>30% of crop residues left on surface)
  - more carbon enters soil organic matter
  - less CO₂ produced due to soil management
  - less fuel required

- **No-Till systems** (No disturbance of the soil surface)
  - most carbon enters soil organic matter
  - least amount of fuel required
  - cover crops may decrease need for synthetic fertilizers
  - BUT may result in higher N₂O production

- Research needs
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Cover crops vs. Cultivation

Trios 102 or Rye

Cultivation
Cover crops improve soil carbon content

Microbial Respiration

Dissolved Organic C

Soil Organic Matter

‘Trios’, 10.98 ± 0.30 mg C kg⁻¹
‘Rye’, 9.45 ± 0.34 mg C kg⁻¹
‘Cultivation’, 7.18 ± 0.18 mg C kg⁻¹

Steenwerth and Belina, 2008
Cover crops improve soil N dynamics

Potential Nitrification

SAME TREND: Microbial Biomass N and Potential N Mineralization
In-row cover crops?

8-11” annual precipitation
240 gal/vine/year

4-6% of applied N (35 lbs. per acre) was collected on resin in ‘Herbicide’
# Can cover crops reduce nematodes?

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<th>Bacteria feeders</th>
<th>Fungal feeders</th>
<th>Plant parasitic</th>
<th>Omnivorous</th>
<th>Carnivorous</th>
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<td>90% stunt</td>
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</tr>
</tbody>
</table>

S.R. Parker, USDA/ARS
Revisiting the Roadmap

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- Weed and Vine Management
Cover crops suppress weed biomass

**Cover Crops**

- **Rye**
- **Trios**

**Weeds**

- **Rye**
- **Trios**
Cover crop effects on vines?

- Documentation of reduced vigor

- In many cases, no effect on petiole nutrition or yield
  - Merlot, Napa Co. – 3 yrs. Baumgartner et al., 2008
  - Chardonnay, Monterey Co. – 5 yrs. Smith et al., 2008
  - Merlot, San Joaquin Co. – 1 yr., unpublished data

- Yeast assimilable nitrogen content and free amino acids in juice – no effect
  - Cabernet sauvignon, Napa Co. – 2 yrs.
    J. Lee and K. Steenwerth
Cover crop effects on vines?

• Water Stress - no effect on vine leaf water potentials?
  - Findings inconclusive

• Confounding factors: management of canopy and fertilizer, age of vineyard, scion and rootstock, and soil fertility

Hypothesis:
Cover crops enhance water infiltration despite water use via transpiration, potentially offsetting competition for water (Celette et al., 2005).
Cover crops as functional types?

- Build soil organic pools and soil microorganisms
- Enhance nitrogen retention
- Weed biomass reduction
- Shift weed and nematode composition
- Tool for water, nutrition and canopy management
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