Research in Plain English

Under-vine Management Impacts Soil Properties and Leachate Composition in a New York State Vineyard

Research in Plain English provides brief, non-technical summaries of journal articles by Cornell faculty, students, and staff.

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Summary by Alex Koeberle

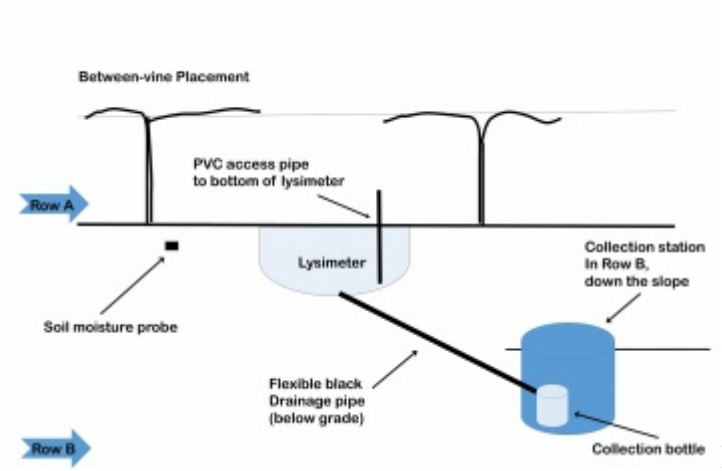
Editor's note: For more information on under-vine management strategies please see: Impact of Undervine Management on Vine Growth, Yield, Fruit Composition, and Wine Sensory Analyses of Cabernet Franc (from Appellation Cornell #25)


From top: Glyphosate herbicide, native vegetation, and hand cultivation. Photos by Justine Vanden Heuvel

Background:
In wet climates such as the Finger Lakes, under-vine cover crops can be used to control excess vigor by competing with vines for water and nutrients. Beyond reducing vigor, cover crops may also protect and improve soils that are sprayed with herbicides or cultivated for weed control. In the Finger Lakes region, vineyards are often located on steep slopes in close proximity to lakes, where there is environmental concern of pollution from runoff and nutrient and agrochemical leaching into the watershed. While weed control through cultivation and herbicide application are effective, they may also adversely impact soil quality. Exposed soils increase the severity of erosion and run off and cultivation may disturb the soil profile over time. The goal of this study is to determine if under-vine cover crop use can improve the physical, chemical, and biological soil properties, and also be a long-term, sustainable management practice for grape growers.

Experimental Design:
This study was conducted at an experimental vineyard on the eastern shore of

Cayuga Lake, New York from 2011-2014. Four under-vine groundcover treatments were planted in 1-meter wide strips under a block of Cabernet Franc vines. These treatments included: Glyphosate herbicide (GLY), hand cultivation (CULT), mowing in native vegetation (NV), and white clover (WC). Data was then collected and analyzed including: weather conditions, plant cover and biomass, soil quality (organic matter, nutrients, and pH), soil stability, respiration, and porosity/density, water infiltration, and the concentration of dissolved oxygen content (DOC), total nitrogen (N), and Imidacloprid (an insecticide) in leachate.



Lysimeter used to collect leachate. Figure by Andi Hawk.

Results:
Overall, this study found little to no difference in soil nutrient concentrations, soil infiltration, and soil core samples among treatments. Ground cover establishment in NV and WC varied year to year, however generally maintained high cover. Imidacloprid was found across leachate samples from each treatment, but was more measurable in GLY (NV only had trace amounts). Additionally, in leachate, DOC is a proxy for soil breakdown while total N leads to eutrophication in aquatic systems. The most significant differences among treatments included:

- **GLY**: Effectively suppressed vegetation growth (in most years – clear of vegetation), higher DOC and total N in leachate, highest concentration of Imidacloprid
- **CULT**: Moderately suppressed vegetative growth, higher DOC in leachate
- **NV**: Higher soil respiration
- **WC**: Higher soil respiration, highest soil stability, higher total N in leachate

Discussion:
Different under-vine treatments influenced the biological soil properties each year of this four-year study. The impact of these treatments on the physical soil structure was only evident during the final year. In 2014, CULT had the greatest bulk density in the top 6cm of soil, indicating aggregated soil compaction over the

course of four years. WC had higher porosity, water holding capacity, as well as increased soil organic matter. In addition, WC and NV displayed an increase in soil microbial activity as a result of greater soil respiration. This suggests that bare cover as a result of herbicide and tillage (GLY and CULT) may decrease nutrient input and microbial activity in the long-run. Lastly, Imidacloprid was found in the highest concentration in GLY, indicating that a lack of plant cover permits more direct uptake in exposed soils. Imidacloprid, which has high leachate potential, may be buffered by the use of cover crops and also broken down by their associated increased microbial activity.

Bottom Line:
Long-term vineyard sustainability is greatly influenced by soil quality. This study demonstrates that herbicide application and cultivation may decrease soil organic matter and soil health. Rather, under-vine cover crops may conserve soil quality over time and also buffer nutrient and agrochemical inputs from leaching into the surrounding environment.

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