

Getting the full benefits of under-vine cover crops

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Show Me Grape and Wine
Conference and Symposium



Penn State **Extension**

Current under-vine management

A vegetation-free zone is traditionally kept under vines

Green growth under vines is often viewed as detrimental, competing with vines for water and nutrients



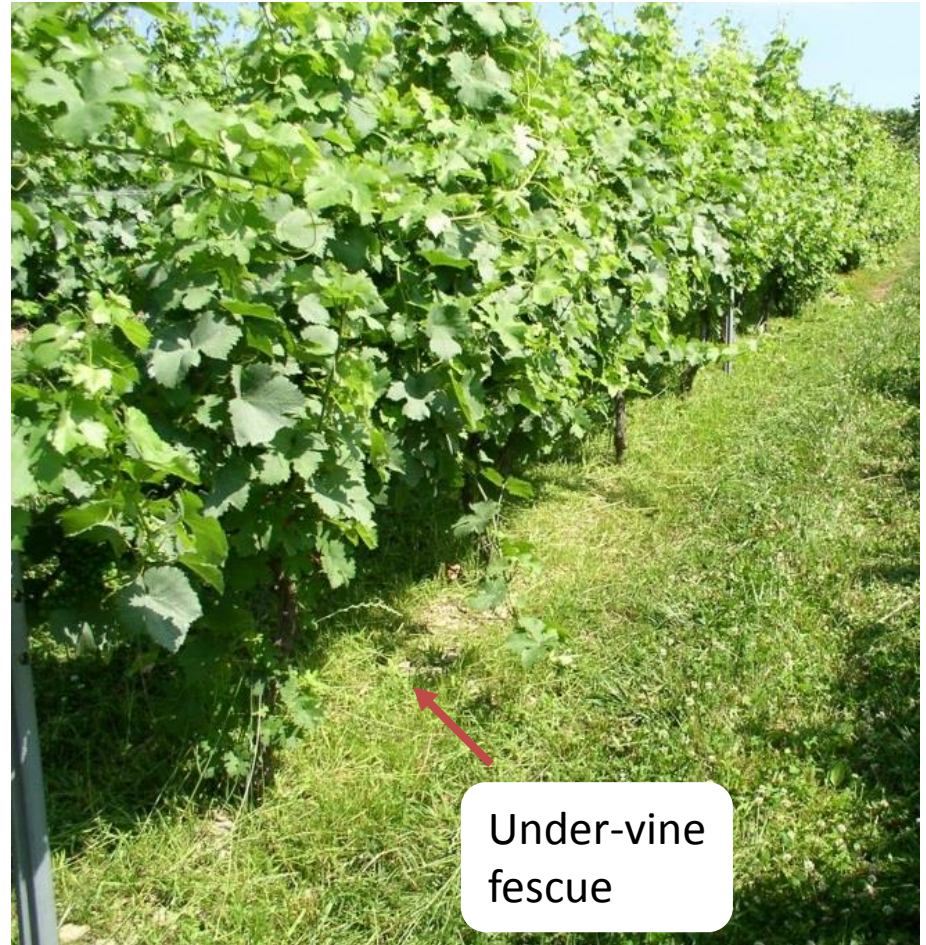
Current under-vine management



Rainfall, fertile and deep soils, and vigorous cultivars all contribute to excessive vegetative growth in many eastern US vineyards

Herbicides pose risks of increased resistance in the weed community, leaching, runoff, and environmental contamination

Under-vine cover crops



Alternative: under-vine cover crops (UVCC)

Primary motivations for exploring UVCC

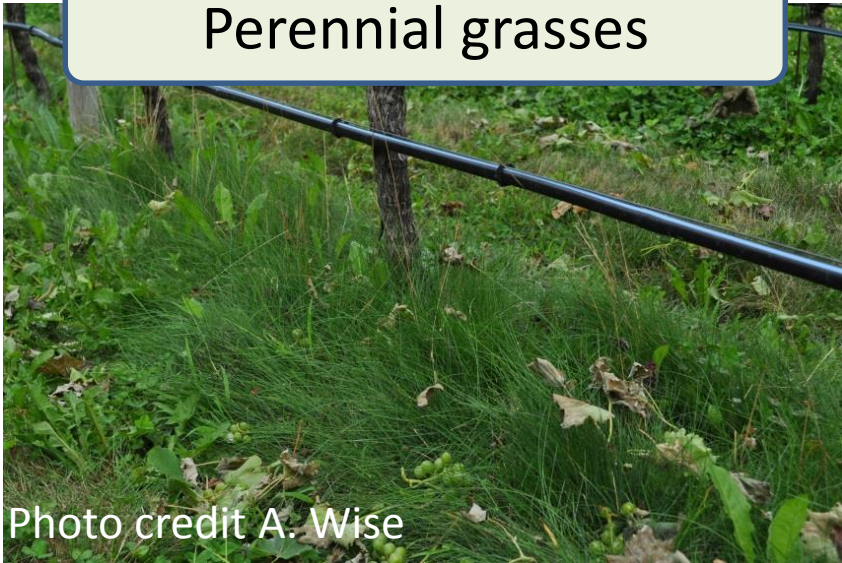
(Survey of 100 regional growers; A. Wise, Cornell Cooperative Extension)

- Elimination of herbicide
- Groundwater protection
- Control of excess vine vigor



Green cover options

Perennial grasses



Annual cover crops



Native vegetation



White clover



Clovers planted beneath the vines

Dutch white clover

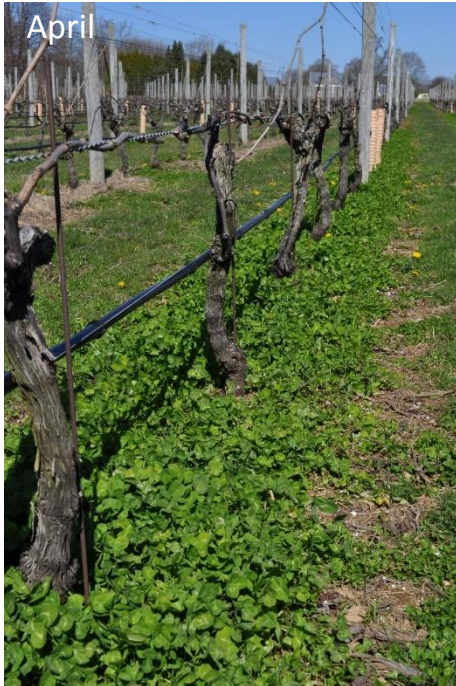


Photo credit A. Wise

Crimson clover and red clover

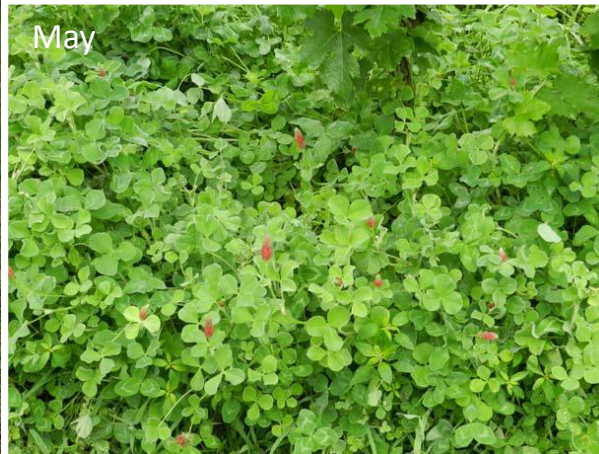


Photo credit D'Attilio



UVCC effect on pruning weight and yield of mature vines



Little to no effect	Moderate effect	Significant effect
Buckwheat	Tillage Radish	Chicory
Rosette-forming turnip	Alfalfa	Annual ryegrass
	Fescue	
	Native vegetation (depending on weed composition)	

Adapted from Vanden Heuvel J., Wine & Viticulture Journal

Note: results will differ based on water and nutrient availability, and climate.



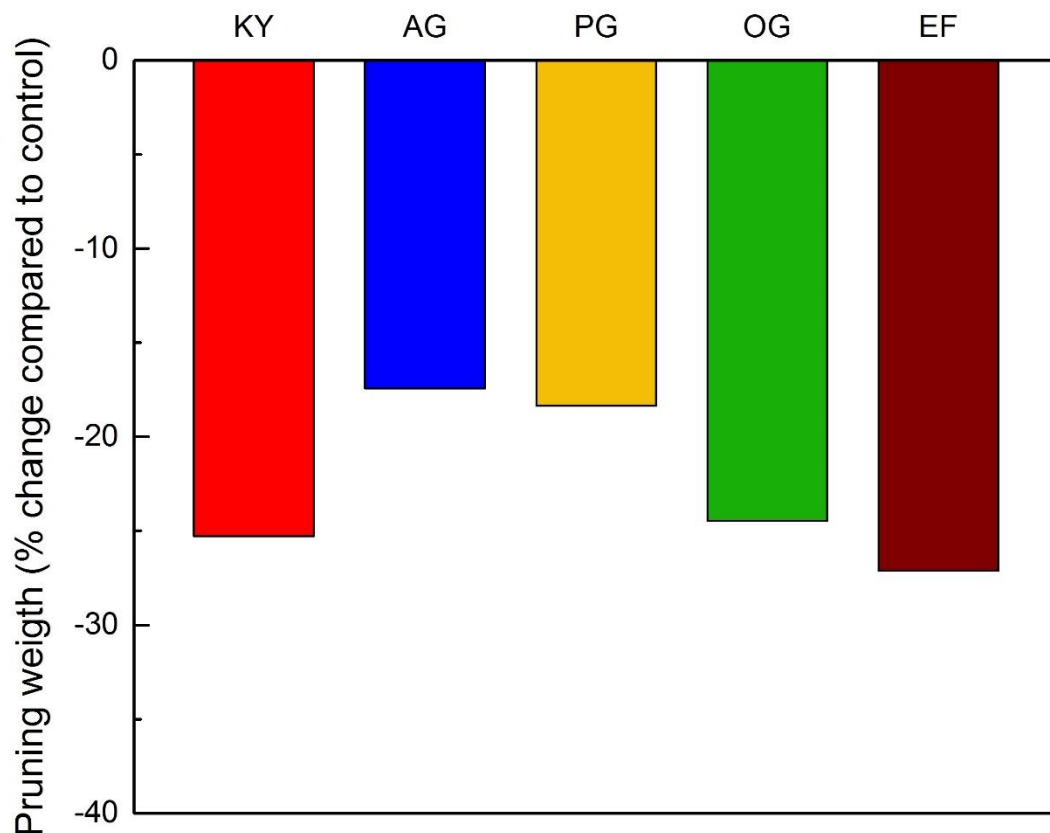
Glyphosate

Photo credit J. Vanden Heuvel

Chicory
(*Chicorium intybus* L.)

Perennial grasses

- Long term (7-year) studies



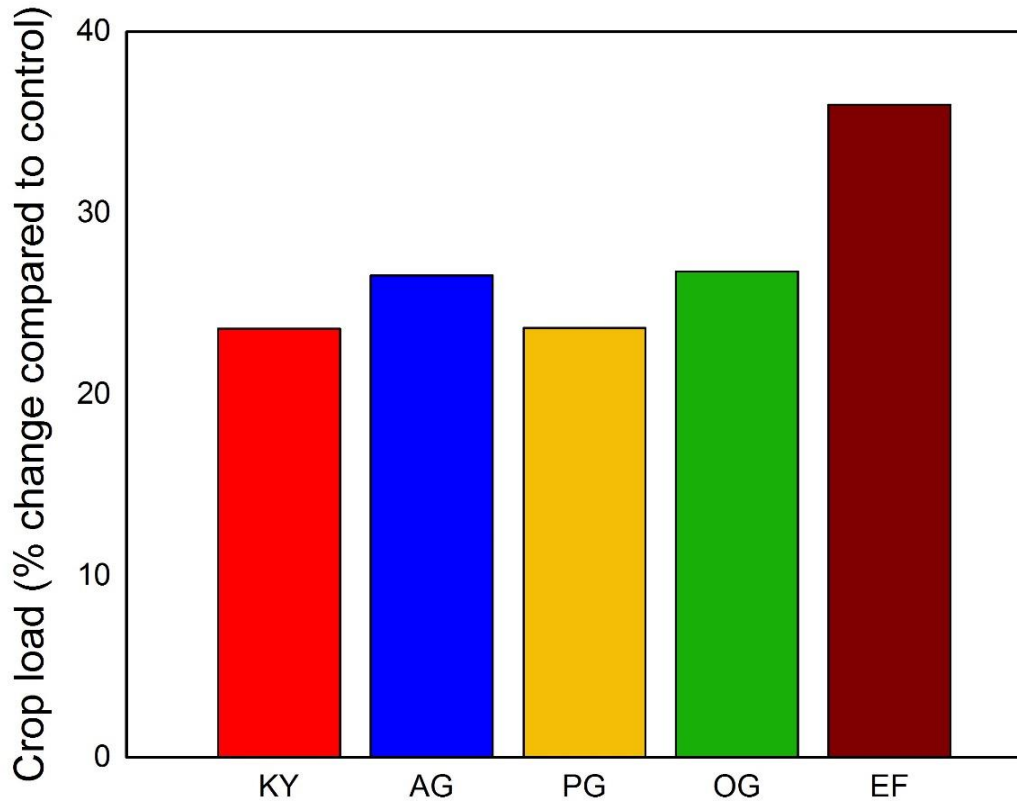
Fescue established in a mature vineyard



KY = tall fescue cv. KY-31;
AG = hard fescue cv. Aurora Gold;
PG = perennial ryegrass;
OG = orchard grass;
EF = turf-type tall fescue cv. Elite II;
Control = herbicide-treated strip

Perennial grasses

- Long term (7-year) studies



Crop load = Ravaz Index
(yield / pruning weight)

KY = tall fescue cv. KY-31;

AG = hard fescue cv. Aurora Gold;

PG = perennial ryegrass;

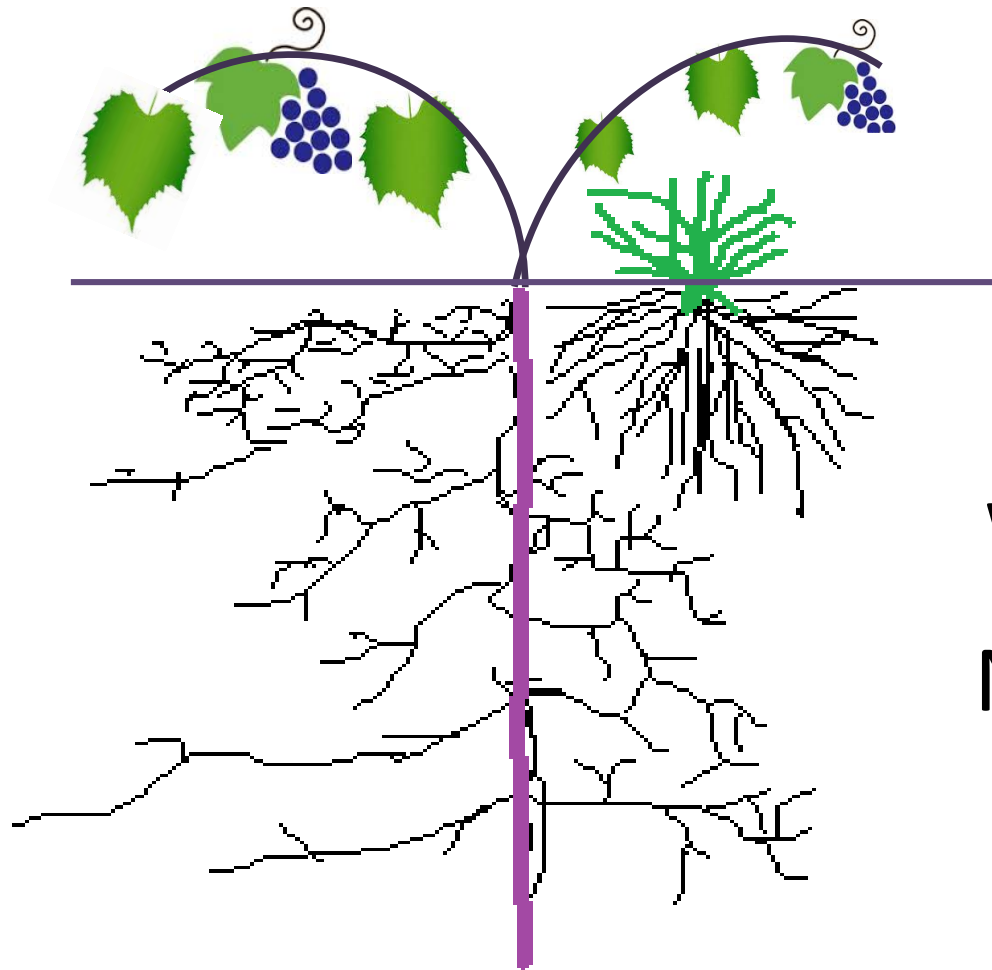
OG = orchard grass;

EF = turf-type tall fescue cv. Elite II;

Control = herbicide-treated strip

KY, AG, PG, OG, EF (mature vineyard): minimum impact on crop yield

What causes the reduction in vine size?



Water?

Nutrients?

Accessing roots and soil

- Vertical soil cores

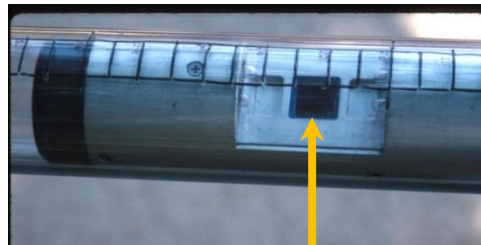


Accessing roots

- Minirhizotron system for root observation



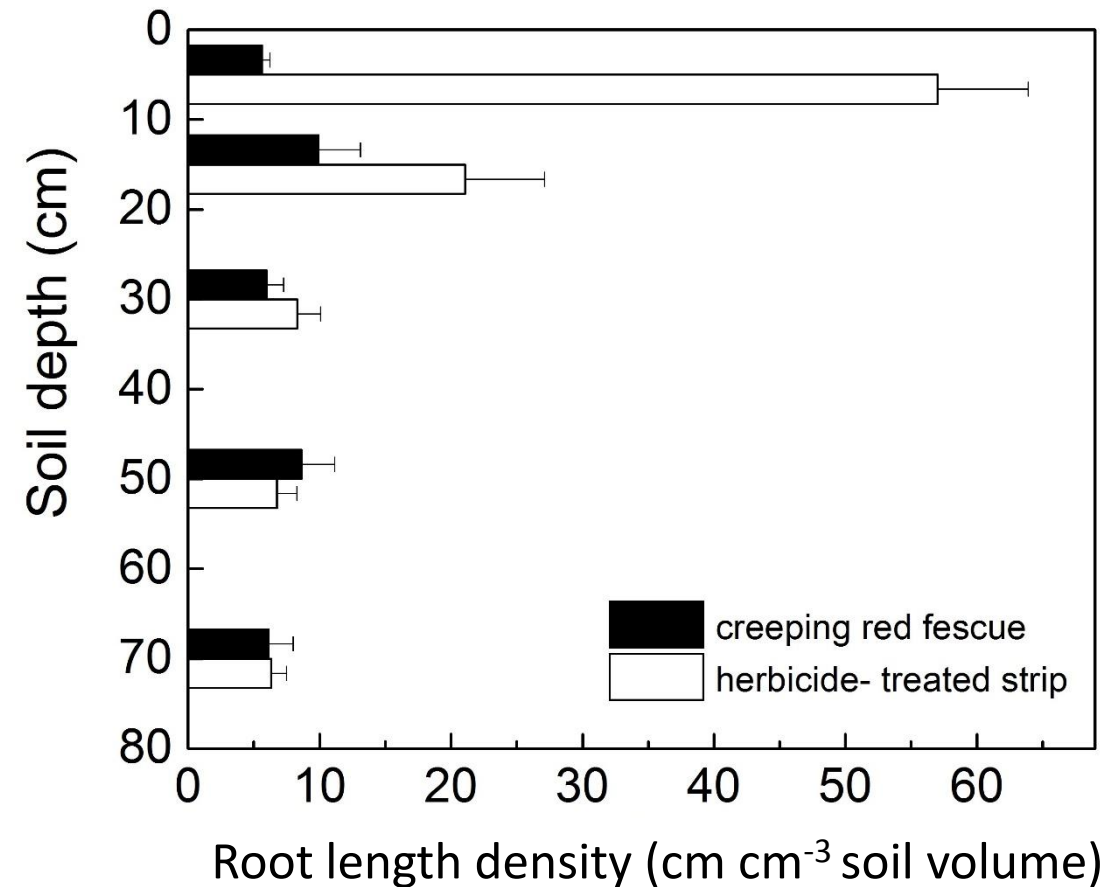
Clear observation tube



Video camera in tube



How much does vine root distribution shift in response to competition with UVCC?



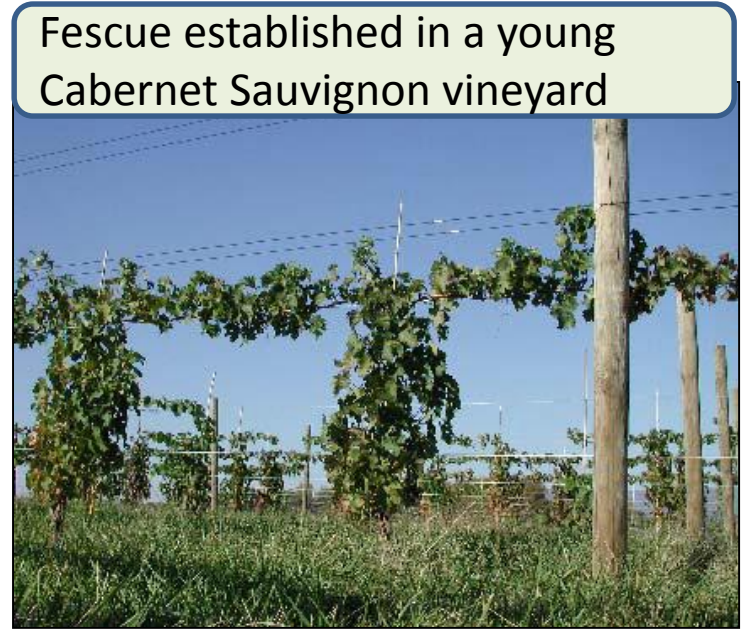
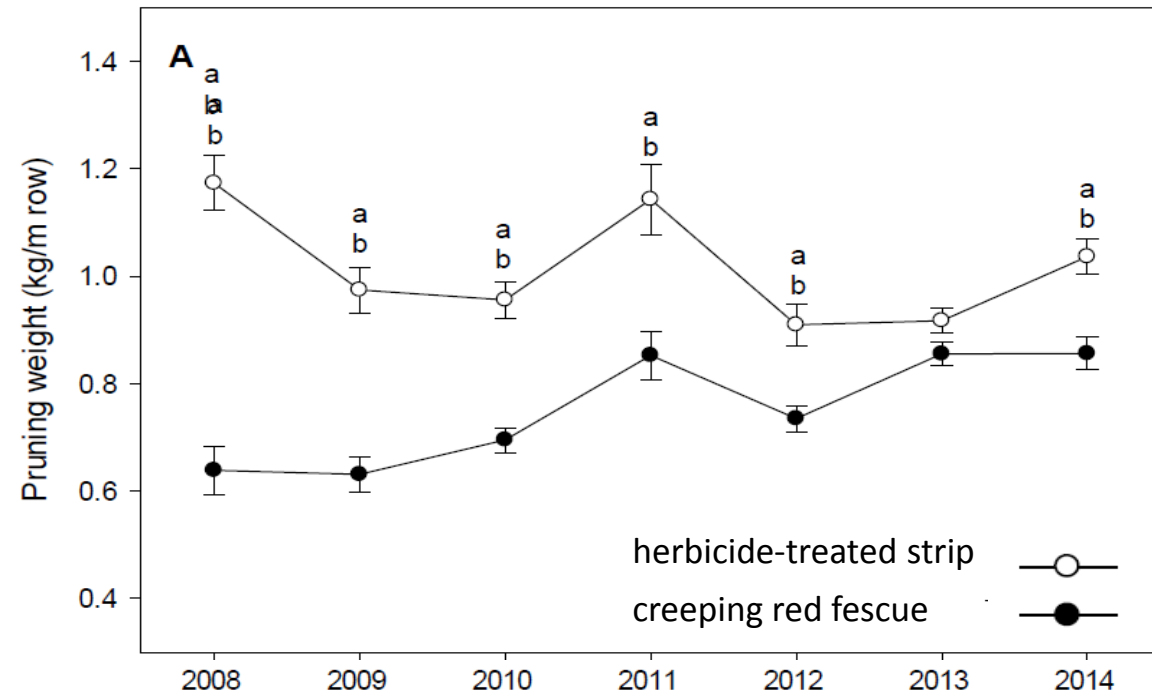
Competition between grapevine and cover crop roots resulted in a lower root production in shallow soil layers

Exclusion of roots from nutrient-rich, shallow soil layers in the presence of the UTCC

The timing of competition for water and nutrients is affected by the choice of under-vine cover crop



The age of vines will impact how they respond to the competition with UVCC

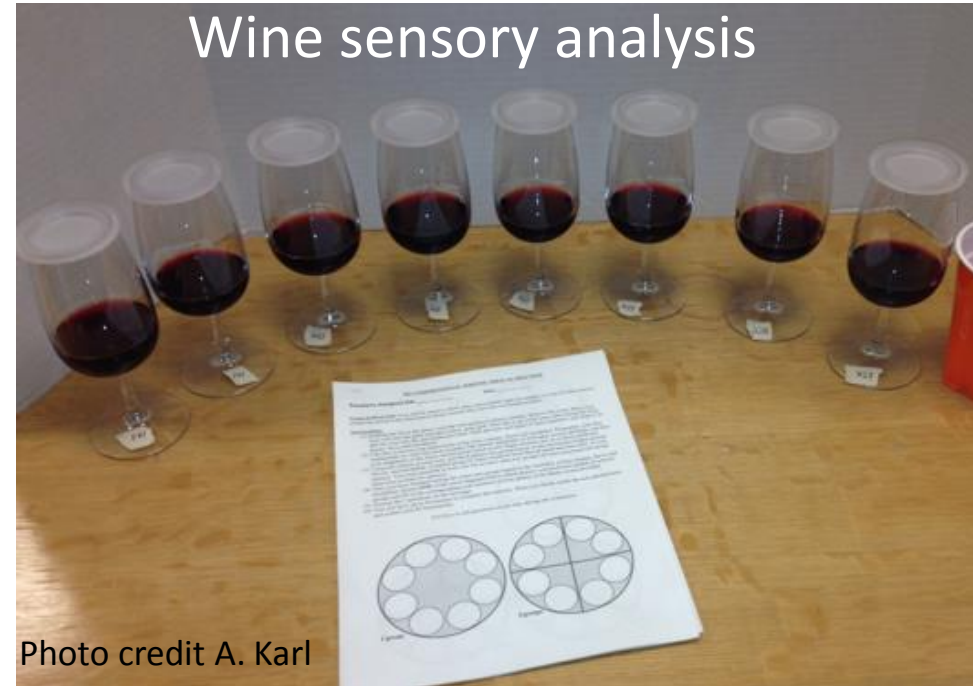


Hickey et al. AJEV 2016

Impact of UVCC on fruit composition and wine quality



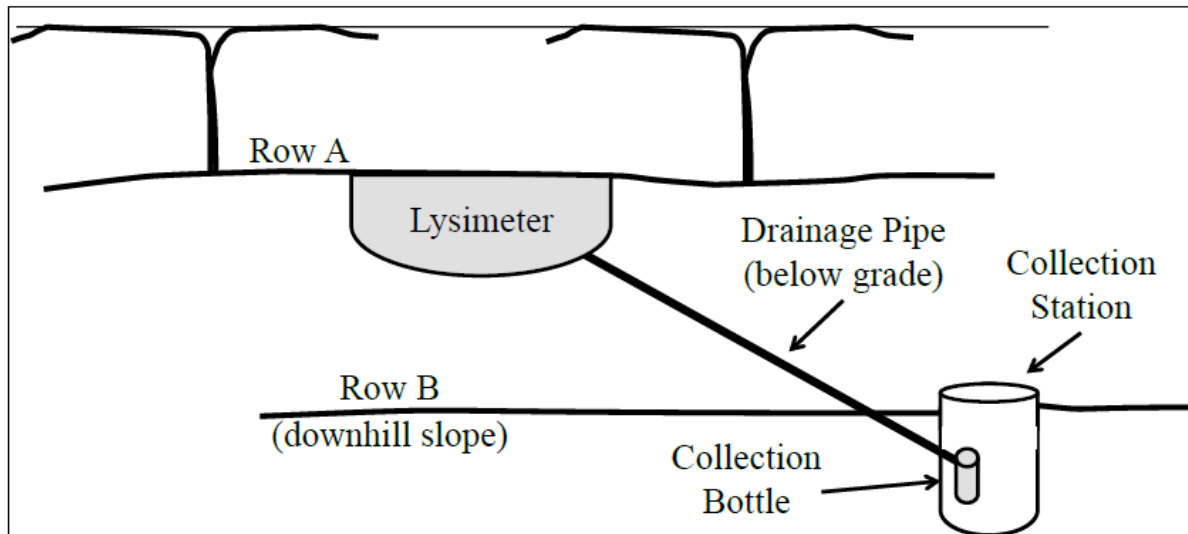
Wine sensory analysis



Inconsistent impact on fruit composition and wine sensory perception

UVCC improve soil health while reducing leaching of nutrients and agrochemicals

Drainage lysimeter design



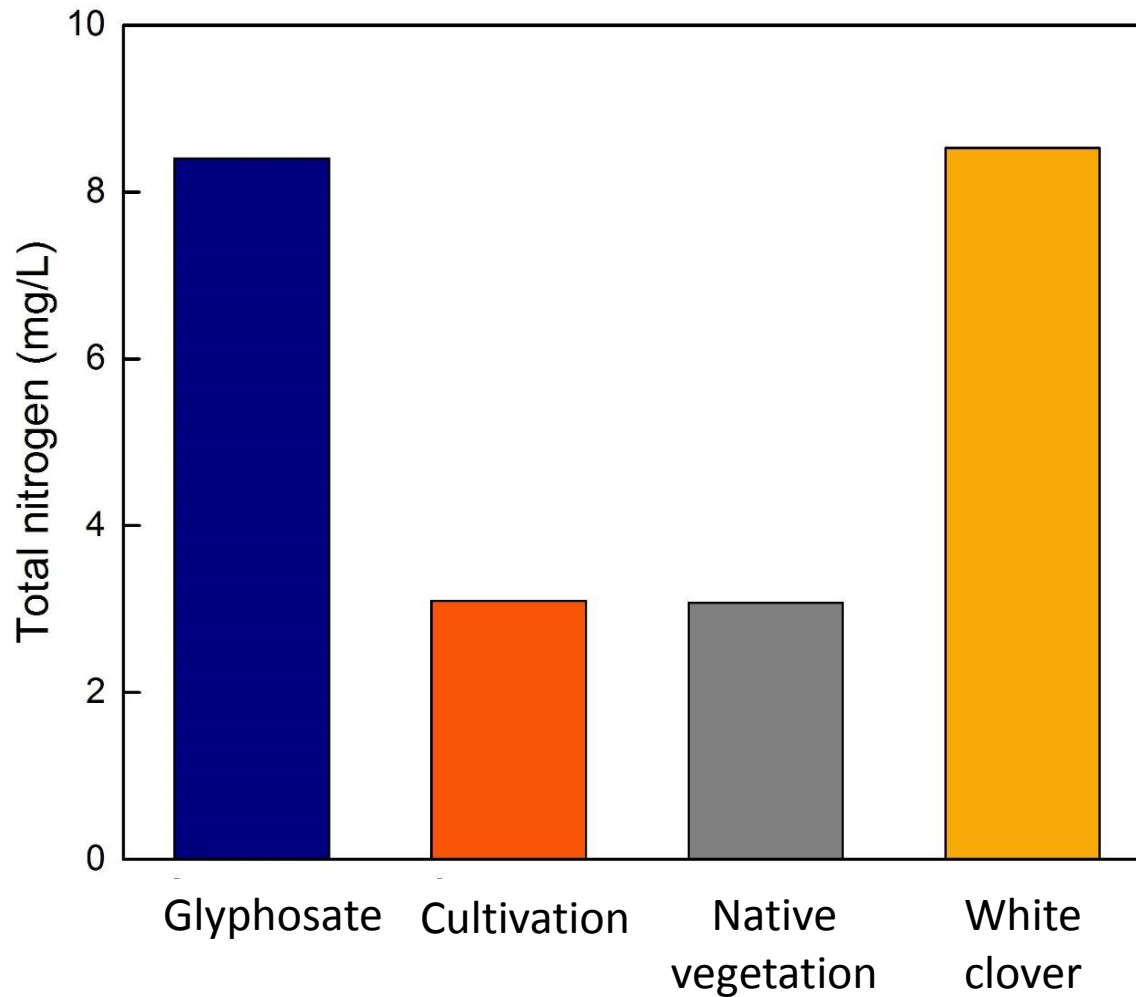
Leachate samples were collected after rain and irrigation events

Impact of under-vine management on leachate composition

Location: Finger Lakes region (Upstate NY, USA); Cabernet franc /C3309

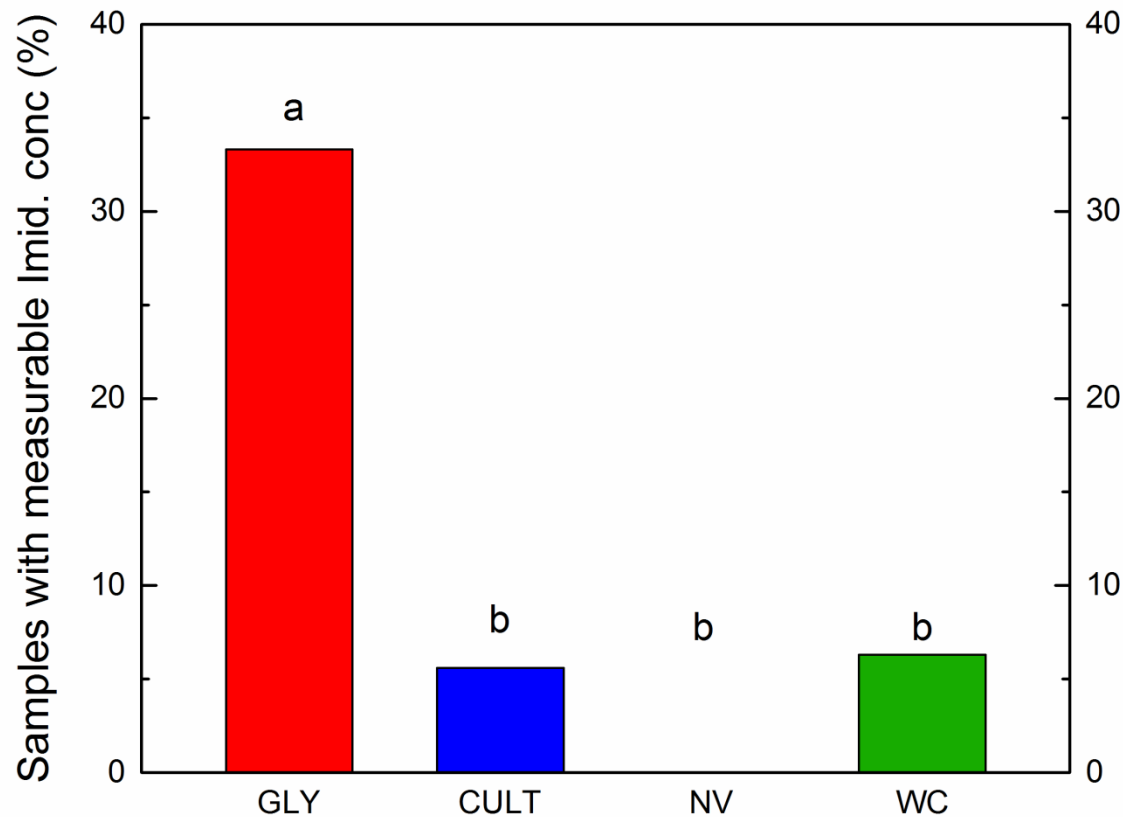


Total Nitrogen leaching



Imidacloprid occurrence in leachate samples

Imidacloprid is a systemic neonicotinoid insecticide. The second most widely applied agrochemical in the world



GLY = glyphosate; CULT = cultivation; NV = native vegetation; WC = white clover

Estimated costs of different under-vine management strategies



Under-vine management strategy (40" strip beneath vine row)	Cost of under-vine management (\$/acre)	Fruit yield (ton/acres)	Crop value (\$/acre)	Crop value minus cost of under-vine management
Glyphosate	222	6.8	8984	8762
Cultivation	419	5.8	7634	7215
Native vegetation (weeds)	34	5.3	7046	7012
White clover	68	6.5	8632	8564

Summary of partial budget model variables and parameters used to determine revenue per acre can be found in Karl et al. (2016) AJEV .

Yield was significantly impacted by under-vine cover crops as vines were very young

Under-trellis native vegetation mowing (Long Island, NY)



Photos credit: A. Wise, Cornell Cooperative Extension

Under-trellis native vegetation mowing reduced vine size (pruning weights) from 8.5 to 14% as compared to herbicide-treated strip (2011-2014)

Take home message



- Under-vine cover crops (UVCC) can serve different purposes
 - Groundwater protection
 - Proactive and long-term measure to reduce excessive vine vigor
 - Eliminate the use of herbicide
- Competition imposed by cover crop will differ based on water and nutrient availability, and climate.
- Cautious approach, monitor sentinel vines (pruning weight, vine nutrient status)
- No relevant impact on fruit composition and wine sensory properties
- Revenue per hectare associated with UVCC may be reduced by lower yields

Thank You

Questions?



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