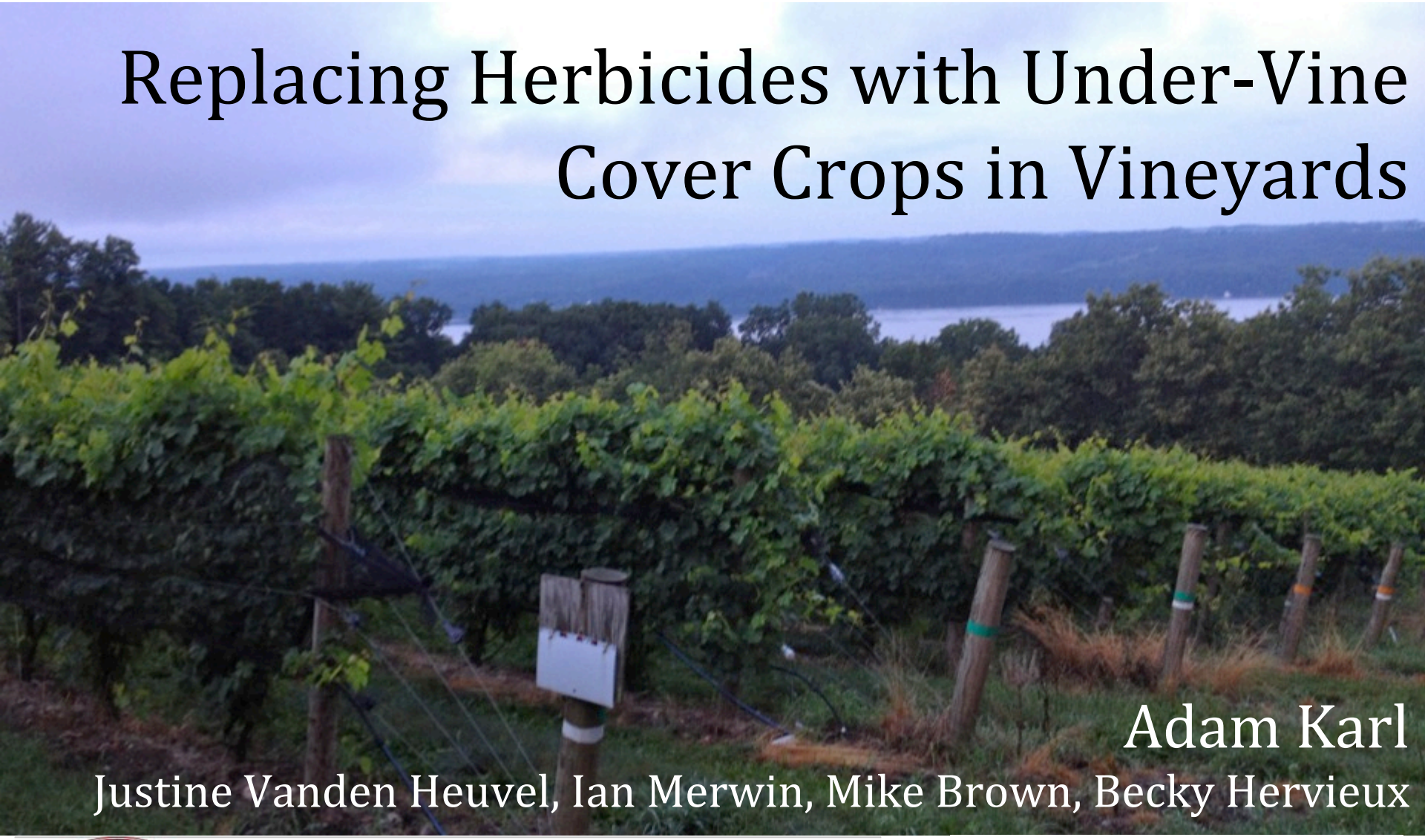
Replacing Herbicides with Under-Vine Cover Crops in Vineyards



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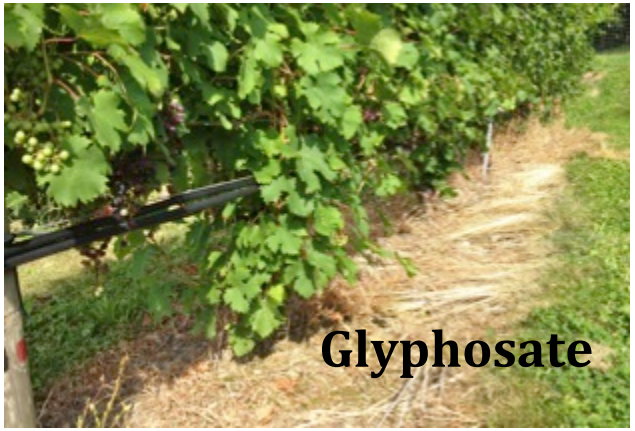
GRAPE & WINE QUALITY
EASTERN U.S. INITIATIVE

Study Design

Cabernet franc/C3309 vineyard planted in 2008 in Lansing, NY.
4 Under-Vine Groundcover Management Treatments established in 2010:

Grapevine Analysis

- Vine size
- Petiole nutrient status
- Stem water potential
- Canopy density (EPQA)
- Yield
- Fruit chemistry
- Sensory analysis of finished wines

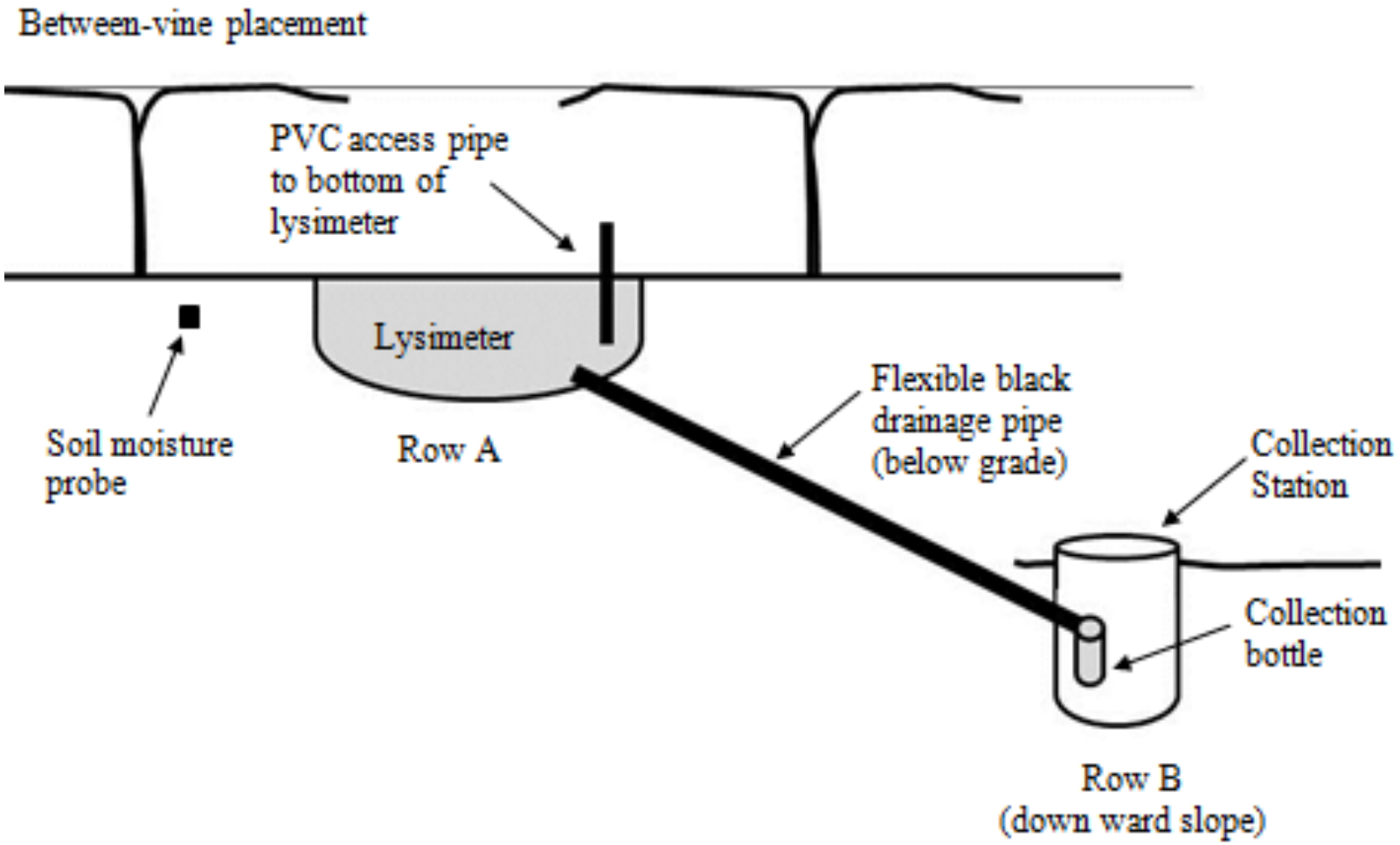


Study Design

Vegetation, Soil and Leachate Water Analysis

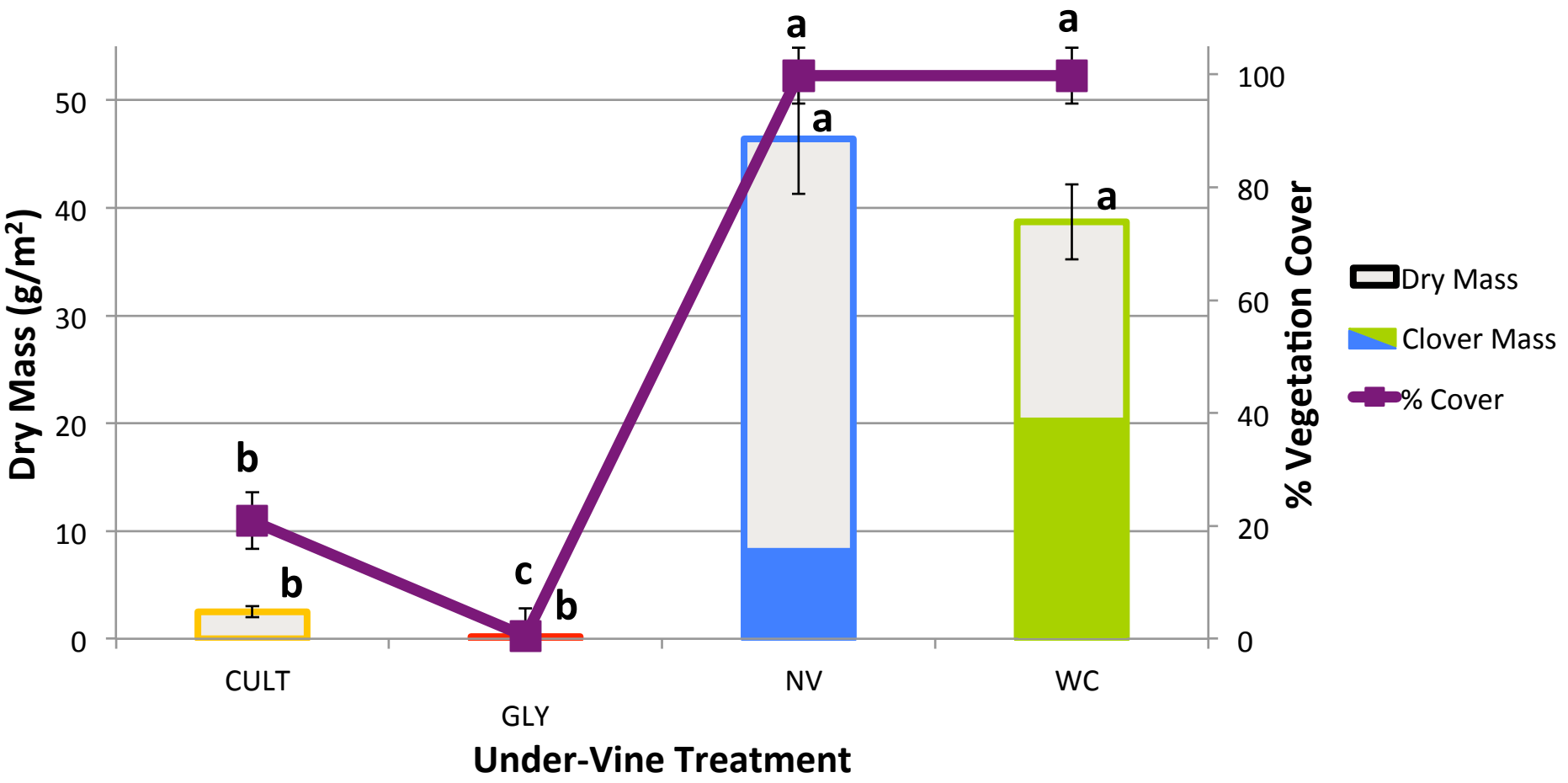
- Leachate: analysis of DOC, total N, and pesticide concentrations
- Soil moisture
- Soil nutrient concentrations
- Physical soil properties: bulk density, porosity, penetration resistance
- Water infiltration rate
- Soil microbial respiration
- Vegetation Sampling

Drainage Lysimeter Design



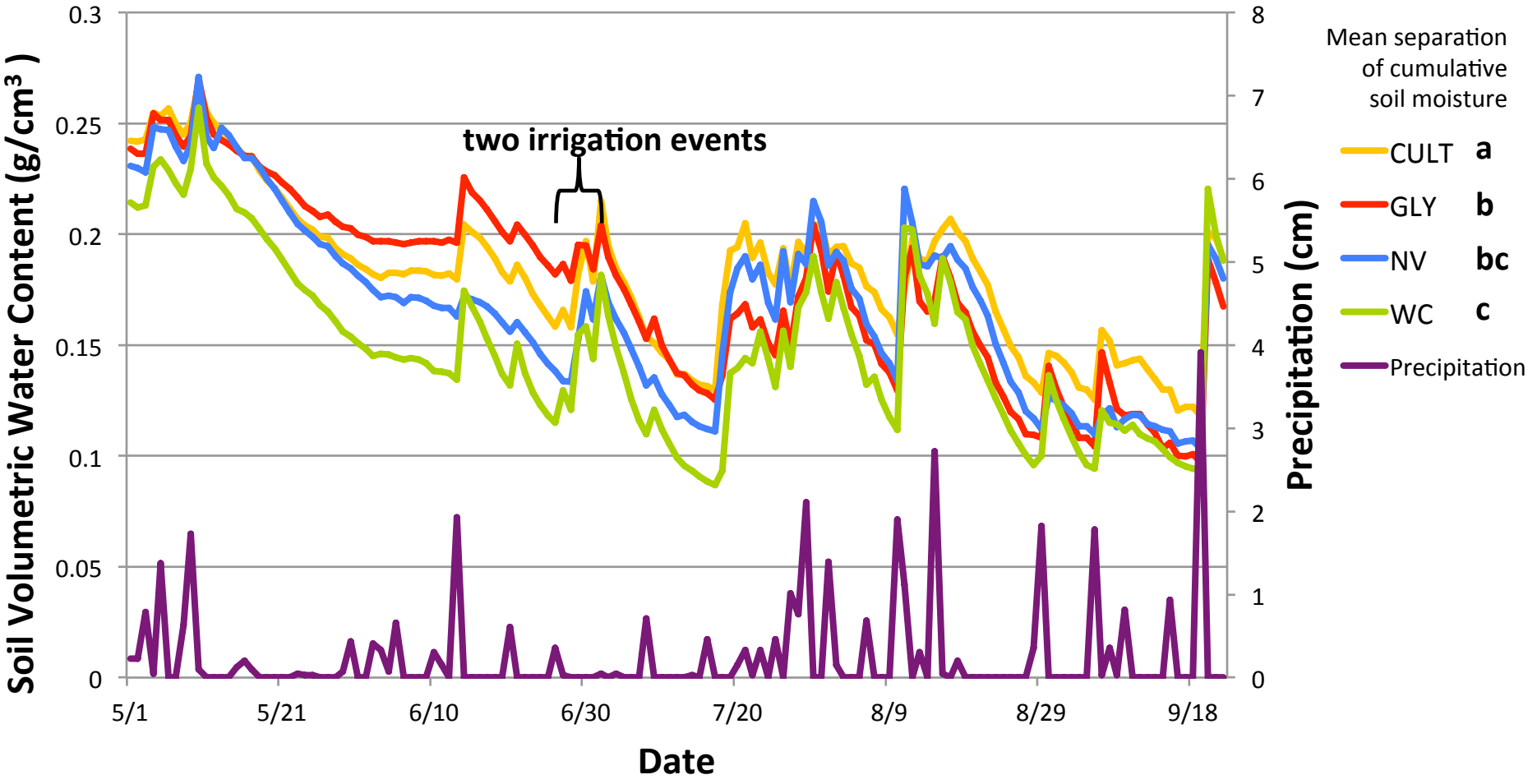
Lysimeter and Moisture Probe Placement

Vegetation Cover 8/27/14



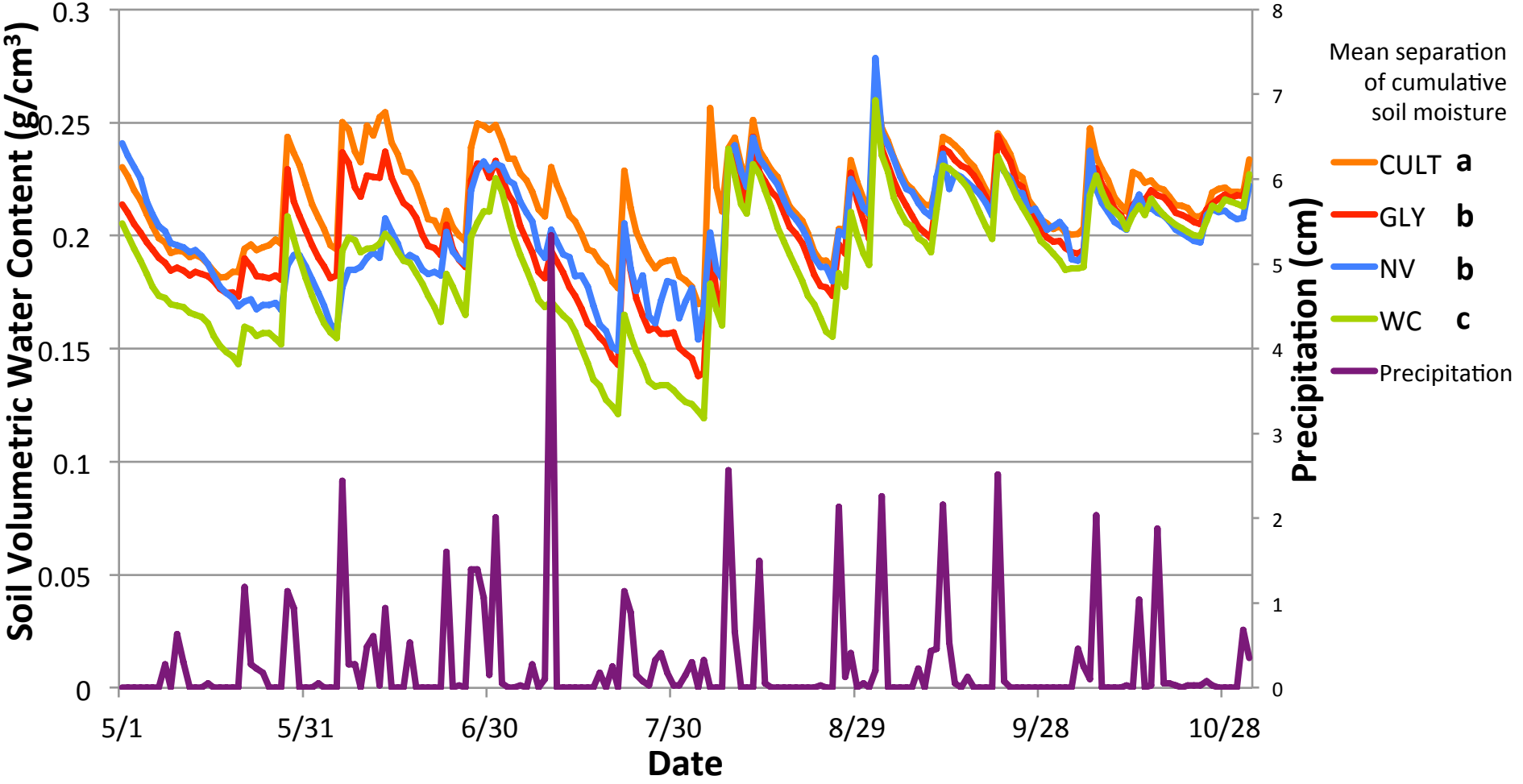
% Undervine row covered with live vegetation and mass of dried vegetation samples (g/m^2) 8/27/14. CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.

Mid-Day Soil Moisture 2012



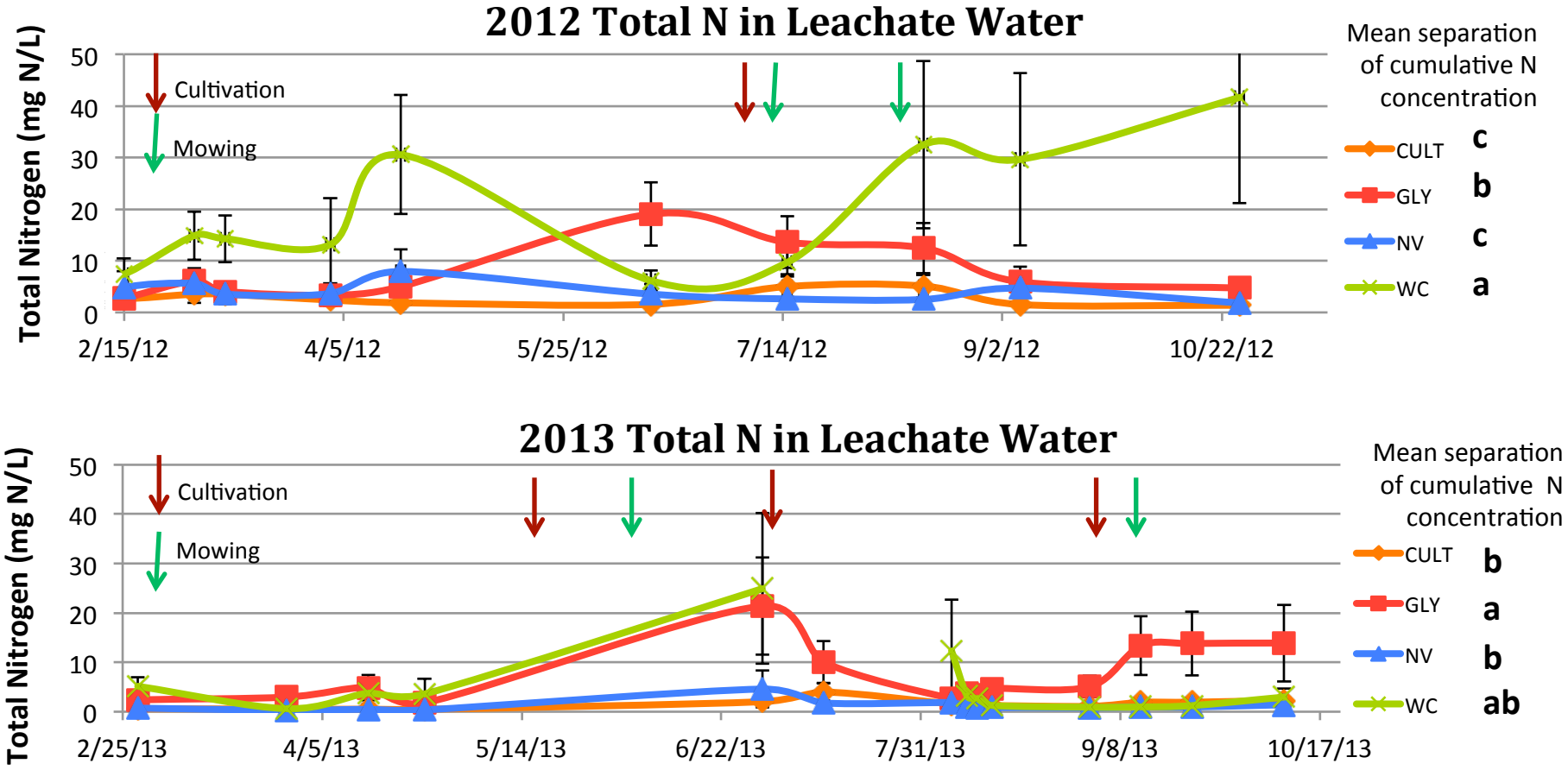
Soil water content (g/cm^3) under four under-vine treatments in 2012.
CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.

Mid-Day Soil Moisture 2013



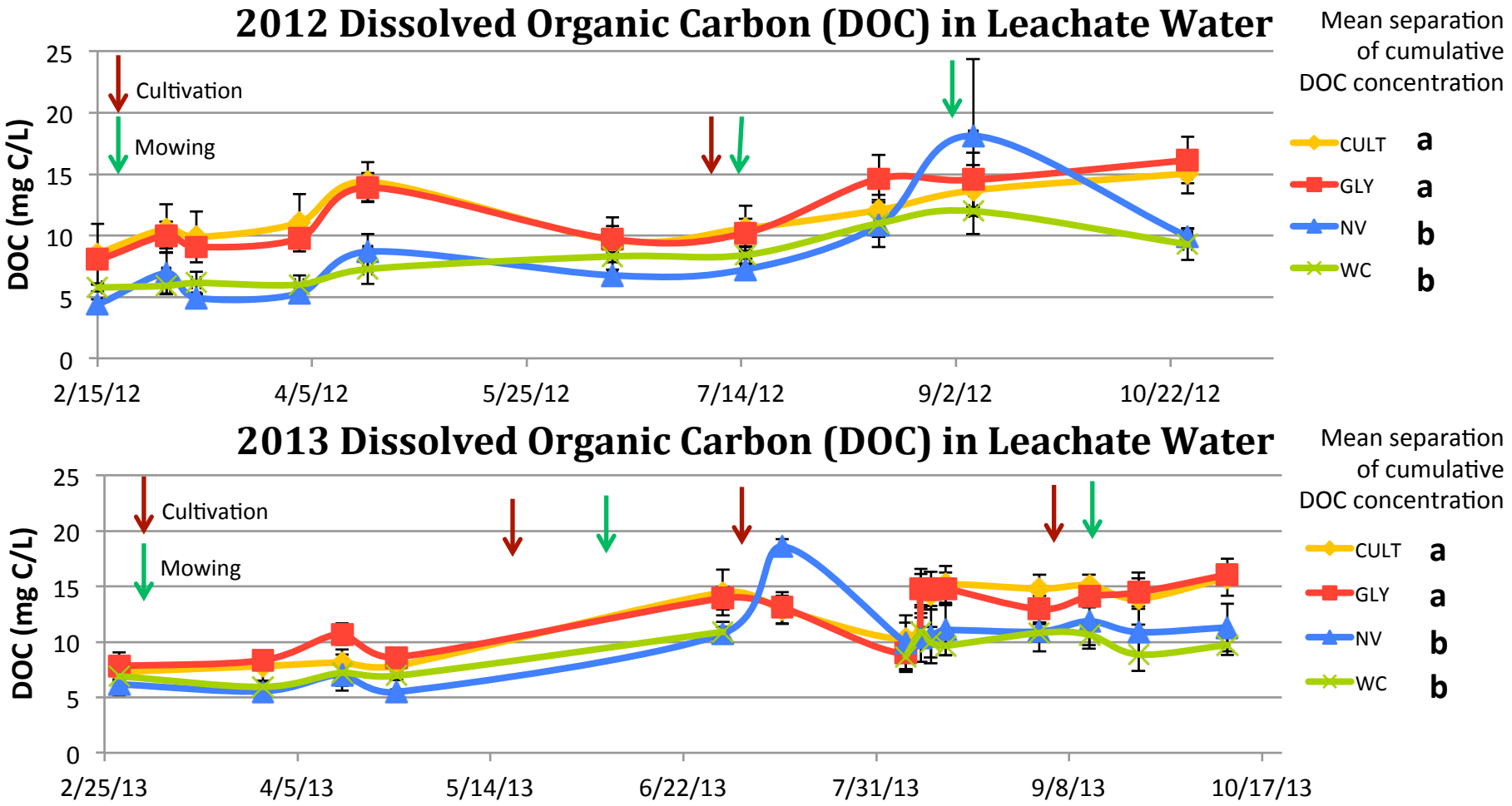
Mid-day soil water content (g/cm^3) under four under-vine treatments in 2013. CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.

Impact on Nitrogen Leaching 2012 and 2013



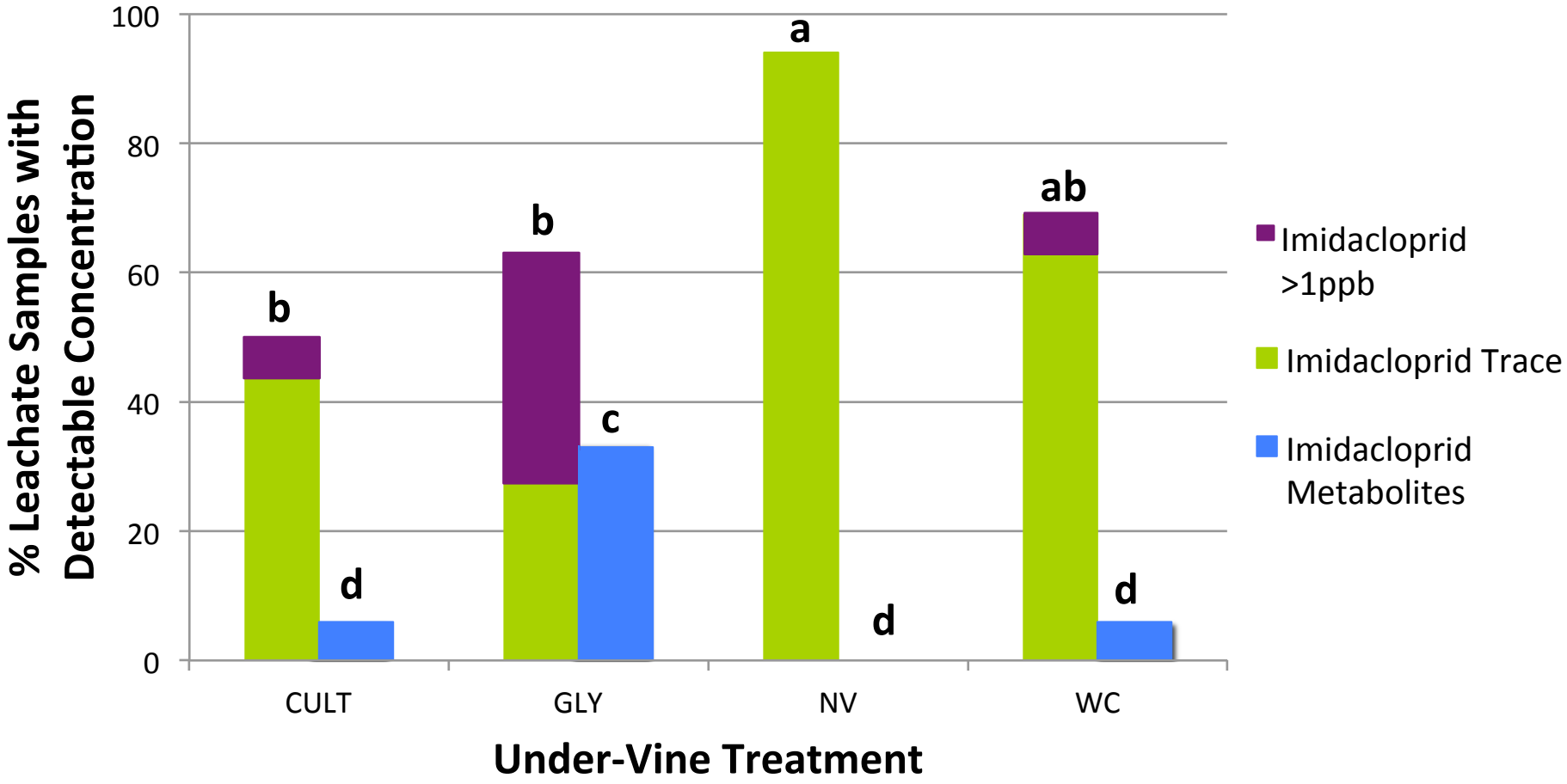
Total Nitrogen concentrations in leachate water, for 2012 and 2013.
CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.

Impact on Dissolved Organic Carbon Leaching 2012 and 2013



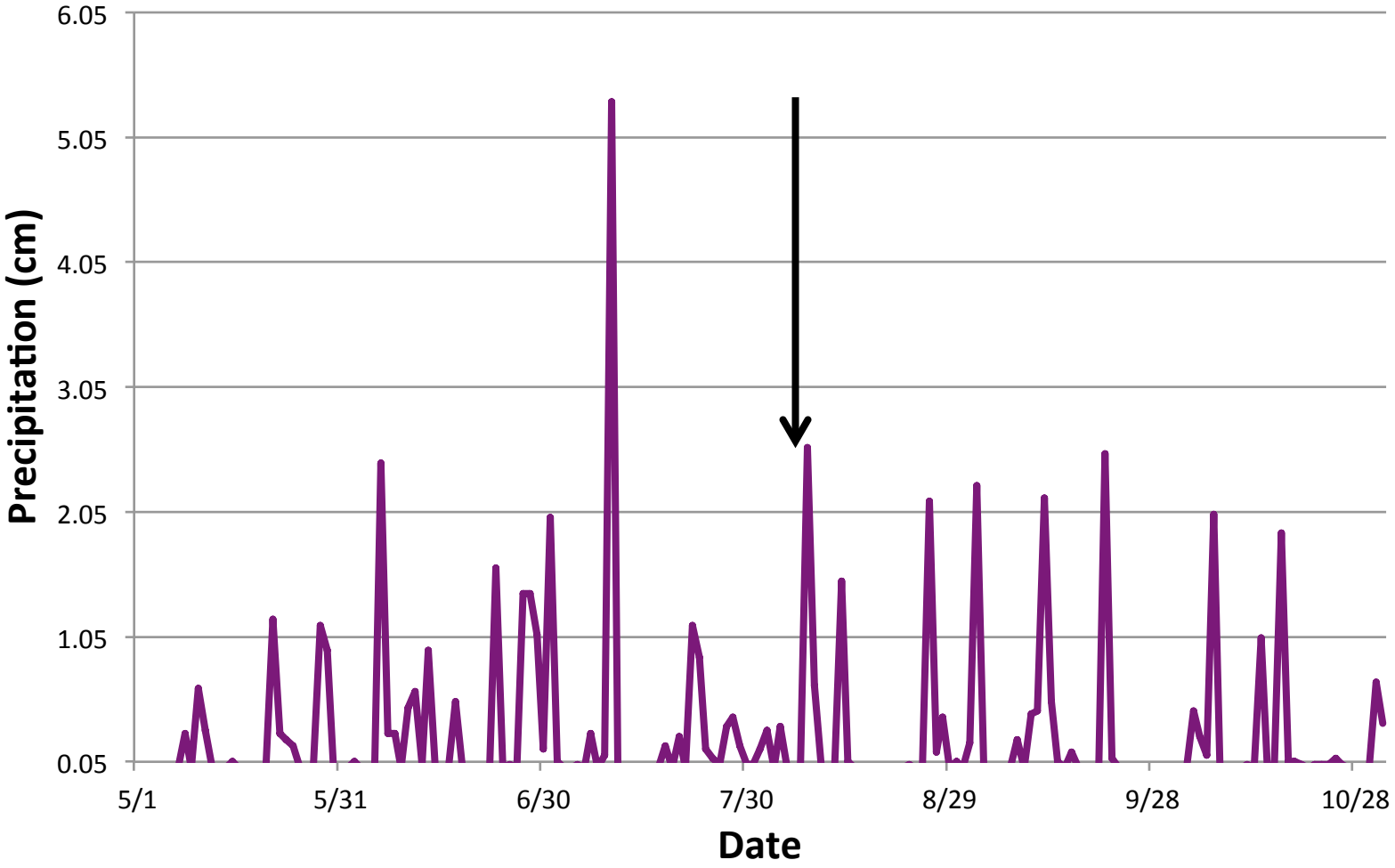
Dissolved Organic Carbon (DOC) concentrations in leachate water, 2012 and 2013. CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.

Imidacloprid and its Metabolites Occurrence in Leachate Samples

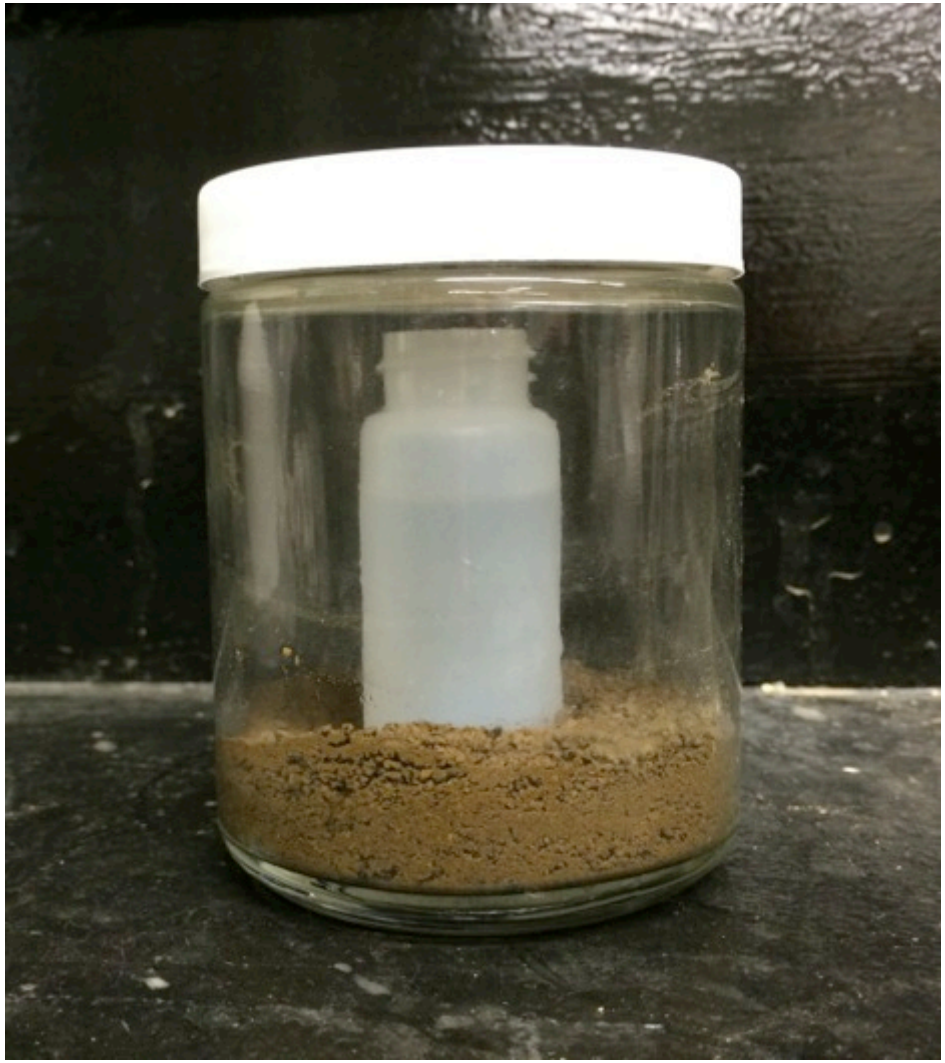


% Leachate Samples with Detectable Concentrations (>1ppb) of Imidacloprid and its Metabolites in 2012 season. CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.

2013 Precipitation



Soil Respiration



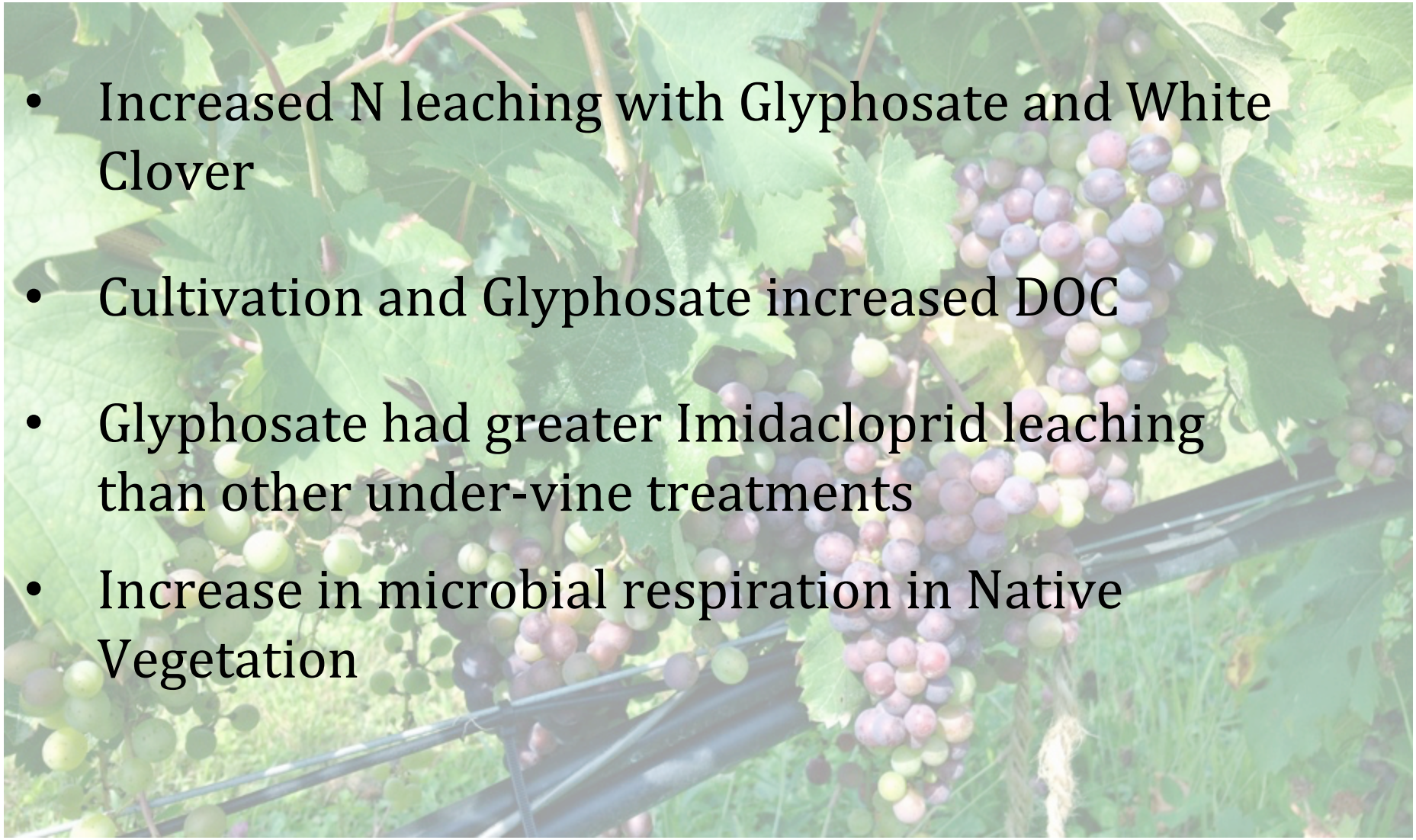
- Dried/sieved soil
- Brought to field capacity
- Sample incubated for 6 weeks at 30°C
- Weekly measurement of NaOH trap conductivity to track CO_2 absorption

Soil Respiration: mg CO_2/ g soil/ week

Treatment	2011	2012	2013	2014
CULT	**0.35 bc**	**1.46 b**	**0.96 b**	**0.67 b**
GLY	**0.33 c**	**1.42 b**	**0.98 b**	**0.70 b**
NV	**0.48 a**	**1.61 ab**	**1.23 a**	**0.96 a**
WC	**0.44 ab**	**1.98 a**	**0.94 b**	**0.75 b**
p-value	**<0.001**	**0.008**	**<0.001**	**<0.001**

CO_2 (mg/g soil/week) produced over six weeks of incubation. CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.

Below ground findings



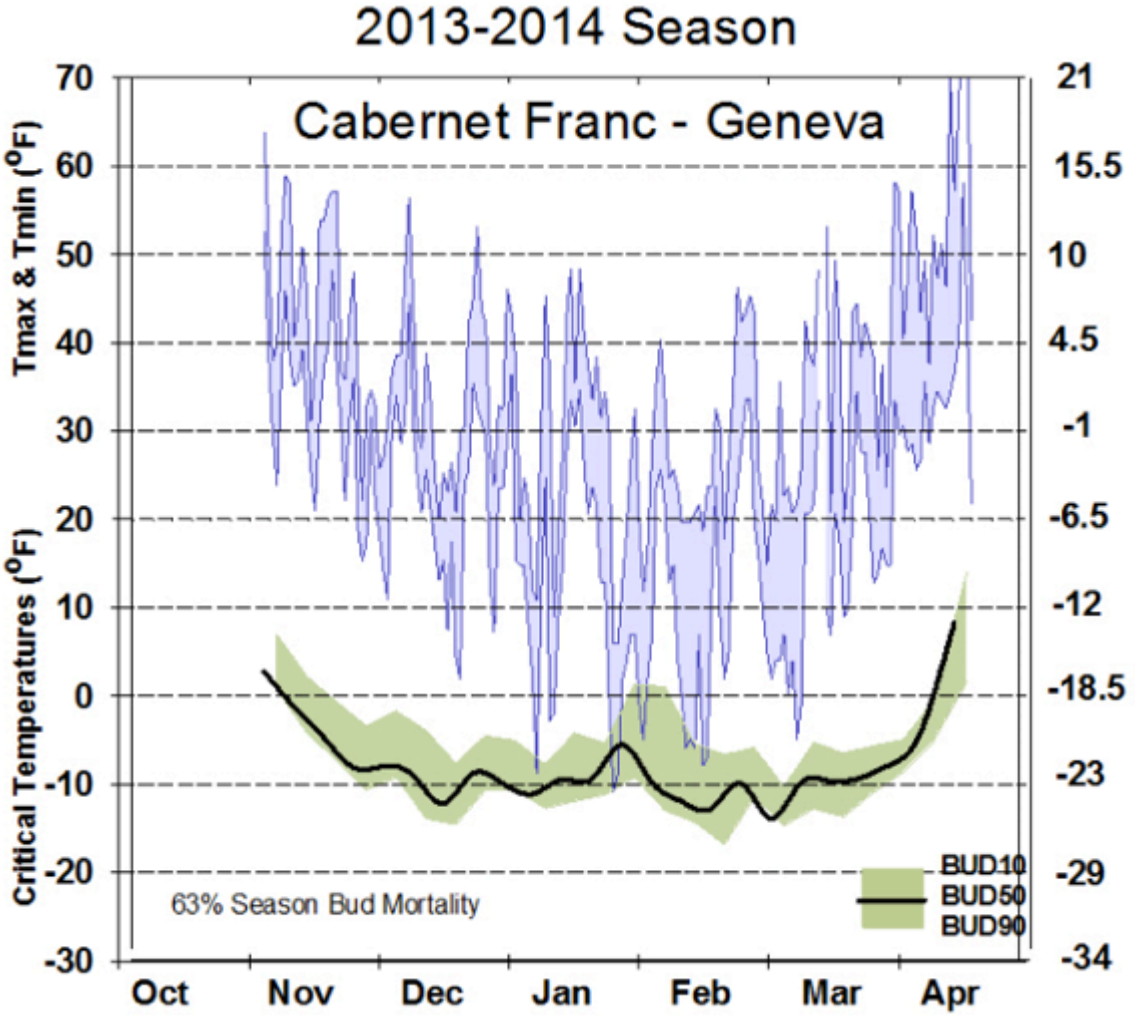
- Increased N leaching with Glyphosate and White Clover
- Cultivation and Glyphosate increased DOC
- Glyphosate had greater Imidacloprid leaching than other under-vine treatments
- Increase in microbial respiration in Native Vegetation

Yield: kg/vine

Treatment	2011	2012	2013
CULT	5.4 ab	2.8 b	6.5 ab
GLY	5.8 a	5.1 a	7.7 a
NV	5.2 ab	2.6 b	6.0 b
WC	4.1 b	3.0 b	7.4 a
p-value	0.03	<0.001	0.01

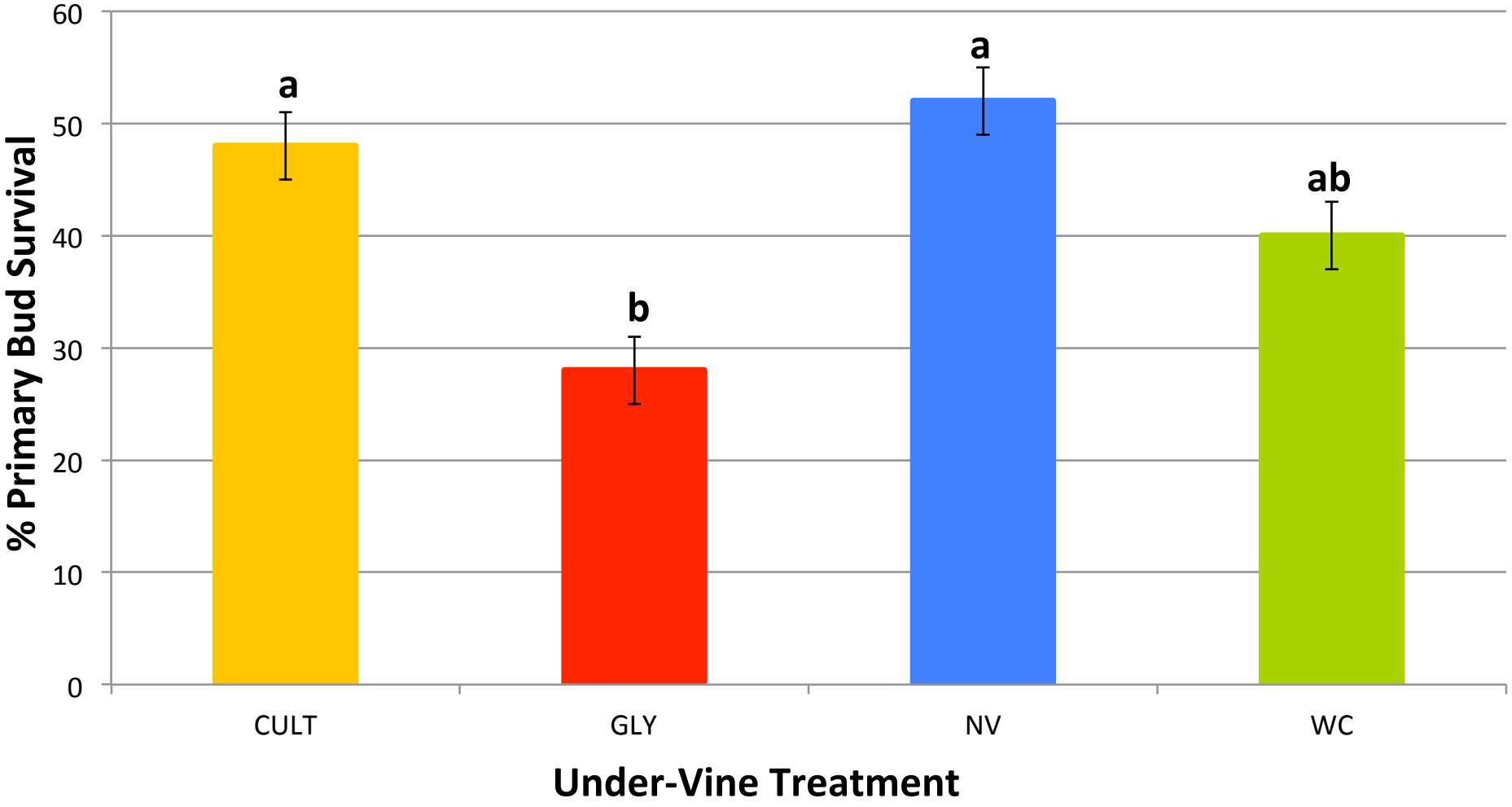
Yield (kg/vine) of treatment vines. CULT=Cultivation, GLY=Glyphosate, NV= Native Vegetation, WC=White Clover.

Winter Cold Damage: 2014



Finger Lakes Grape Program

Primary Bud Survival Spring 2014



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

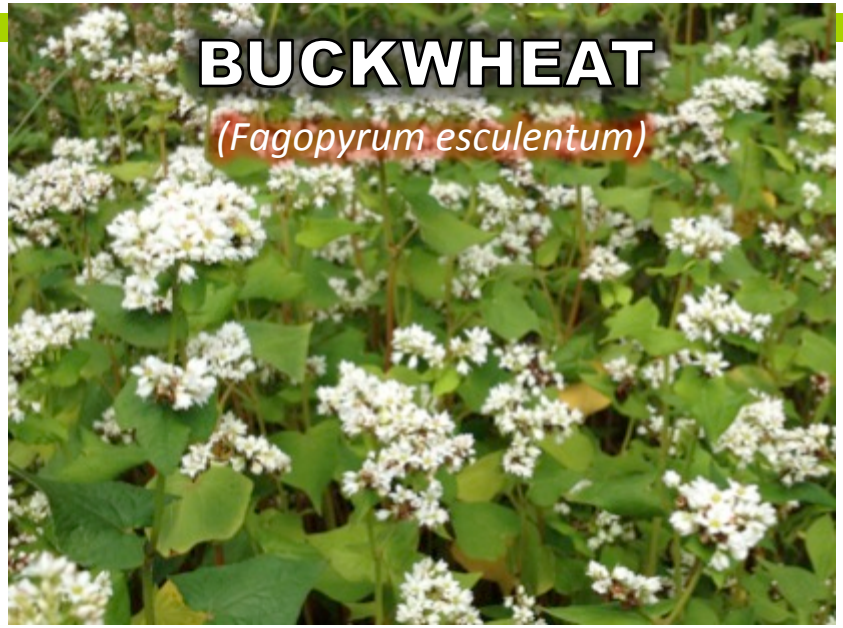
Conclusions

- Glyphosate: Larger Vines, Higher Yields, Greater Imadacloprid, Nitrogen, and DOC Leaching
- Native Vegetation: Smaller Vines, Reduced Yields, Prevented Nitrogen and DOC Leaching, More Active Soil Microbial Community
- Cultivation: Variable Vine Size and Yield, Increased DOC Leaching
- White Clover: Variable Vine Size and Yield, Increased Nitrogen Leaching

Interested in experimenting?

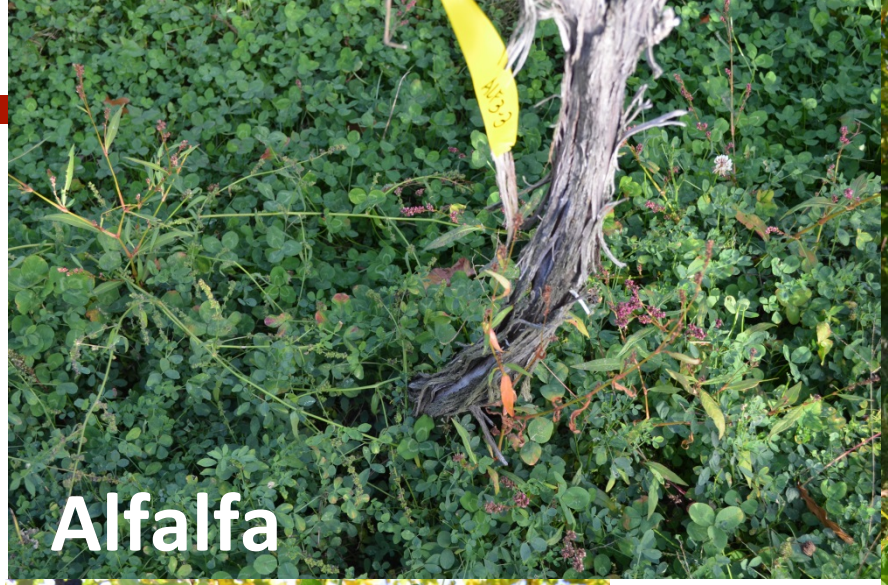
- If you are looking to replace herbicides with a cover crop, you need to experiment
- Best choice will depend on soil type, water availability, desired impact on tree vigor

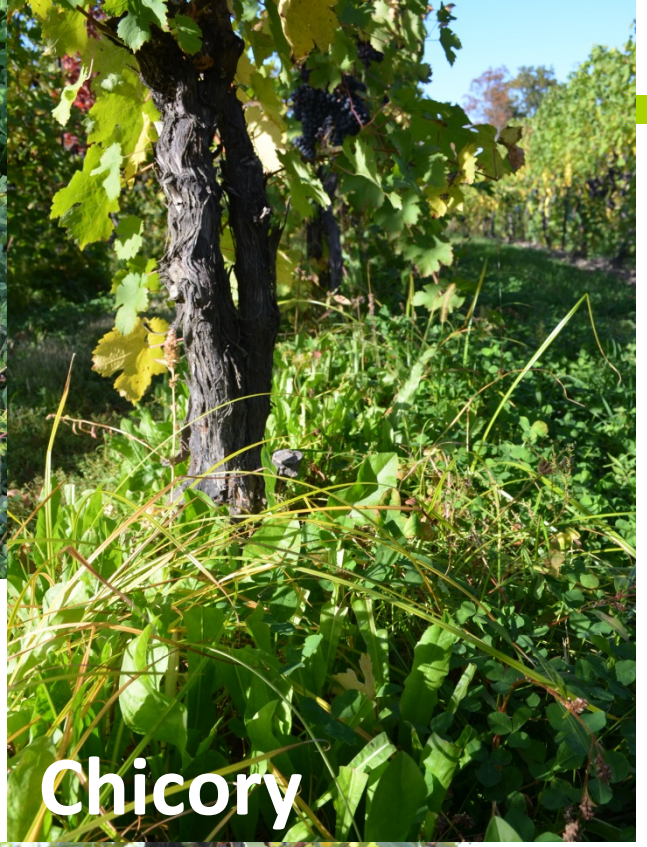

ANNUAL RYE GRASS
(Lolium multiflorum L. perenne var. Italicum)


BUCKWHEAT
(Fagopyrum esculentum)


NATURAL VEGETATION


GLYPHOSATE CONTROL


Alfalfa


Chicory


Tillage
Radish


Fescue grass


Questions?

Native Vegetation Species

Tall Fescue (*Festuca arundinacea*)

Fine Leaf Fescue (*F. duriuscula*)

Large Crabgrass (*Digitaria sanguinalis*)

Green Foxtail (*Setaria viridis*)

Fall Panicum (*Panicum dichotomiflorum*)

Goosegrass (*Eleusine indica*)

Red Clover (*Trifolium pretense*)

White Clover (*T repens*)

Ground Ivy (*Glechoma hederacea*)

Lady's Thumb (Persicaria maculosa)

Common Purslane (*Portulaca oleracea*)

Dandelion (*Taraxacum officinale*)

Chicory (*Cichorium intybus*)

Yellow Toadflax (*Linaria vulgaris*)

Broadleaf Plantain (*Plantago major*)

Common Lambsquarters (*Chemopodium album*)