Mulches & Groundcovers for Sustainable Vineyard Floor Management

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Christina Bavougian
UNL Viticulture Program

University of Nebraska Lincoln

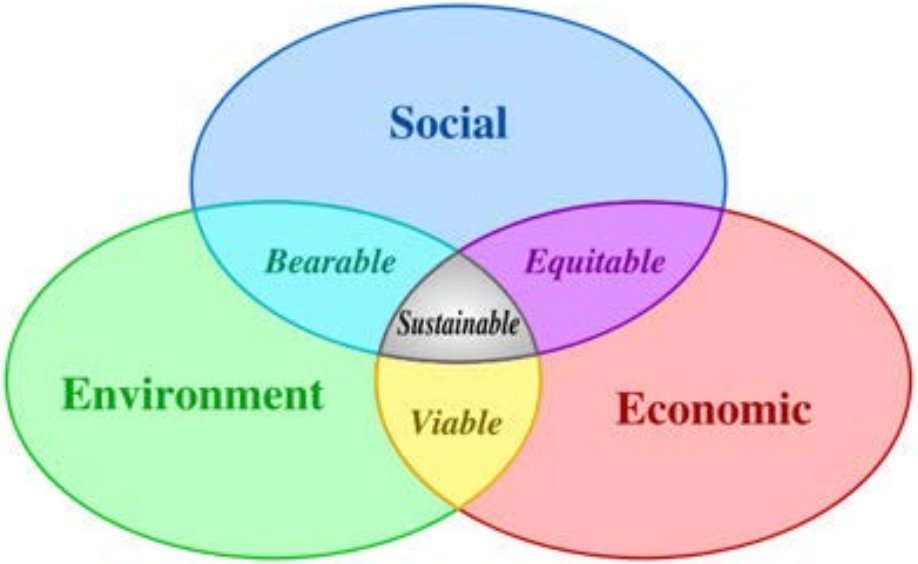
Outline

- Introduction
- Research purpose/objectives
- Experimental design
- Summary of results
- Conclusions & recommendations

Vineyard Floor Management Strategies

- **Cultivation**
  - Common in classic wine producing areas
- **Herbicides**
  - Commonly used under vines and in no-till systems
  - Problems include resistant weeds
  - Trunk splitting & cold hardiness issues (glyphosate)
- **Groundcovers & cover crops**
  - Protect and improve soil
  - Improve vineyard work environment
  - Provide habitat for beneficial organisms
  - ***Compete with vines?***
- **Mulches**
  - Prevent weed seed germination
  - Reduce evaporation
  - Improve soil structure & water infiltration

Sustainability



- Sustainable systems are environmentally sound, socially equitable, economically viable

Potential Benefits of Sustainable Vineyard Floor Management

Environmental:

- Less reliance on synthetic chemicals
- Protect and improve soil
- Habitat for beneficial organisms
- Reduce/eliminate problems with glyphosate

Economic:

- Reduce labor requirements (pruning, spraying, shoot positioning, etc.) by manipulating vine vigor
- Spend less $ on inputs (weed and disease sprays)

Social:

- Better work environment
- Neighbors
- Aesthetic appeal

Midwest “Grower Standard”

- Perennial sod alleyways
- Weed-free strip under vines

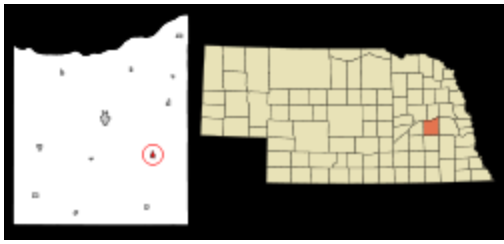
Pros:

– Permanent groundcover over 85-90% of soil
– Soil conservation
– Bare strip improves airflow

Cons:

– Herbicide issues
– Maintenance of weed-free strip may be unnecessary after vines are established
– Excess vine vigor

Research Site & Objectives



- Fox Run Vines in Brainard, NE
- ‘Marquette’ vines planted 2007
- Vineyard floor management study
  - Evaluate alternatives to glyphosate under vines
  - Reduce vegetative vigor with groundcovers







Photos courtesy of Fox Run Vines/Fox Run Farms

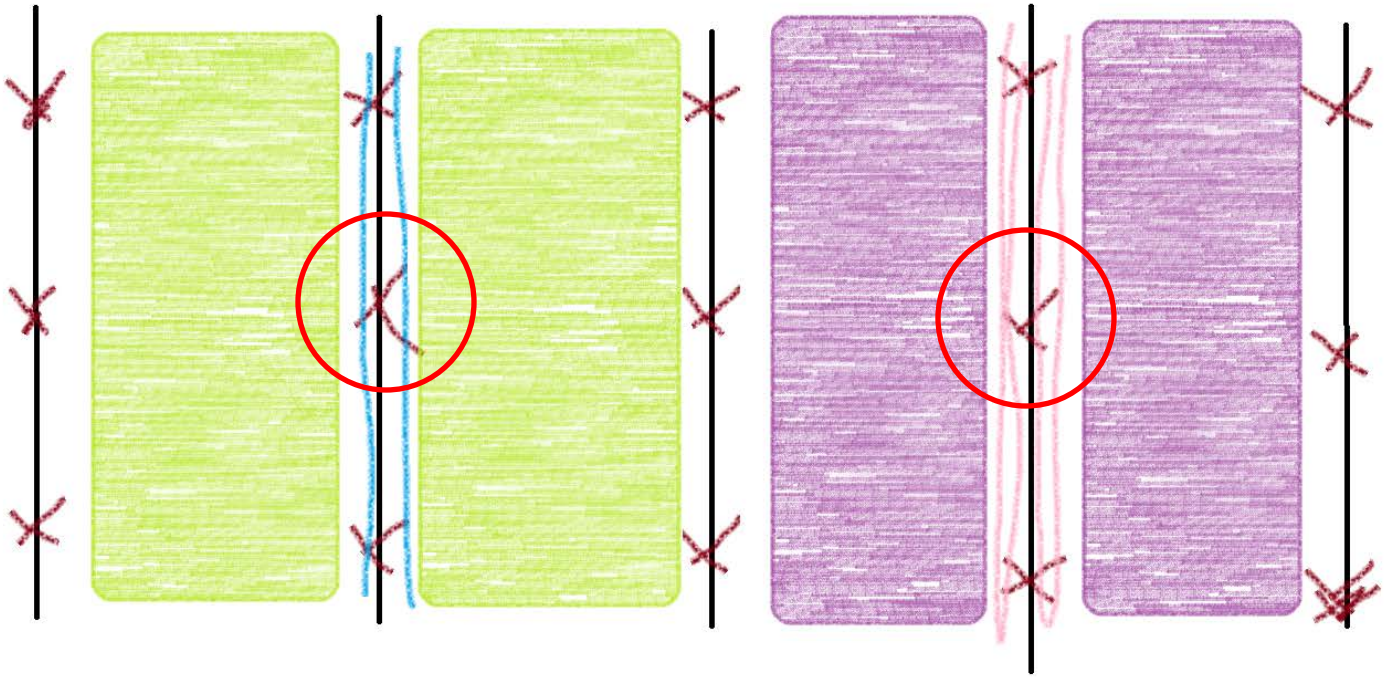

Experimental Design

- 3 alleyway (row middle) treatments:
  - ‘Park’ Kentucky bluegrass
  - ‘Boreal’ creeping red fescue
  - Resident vegetation (orchardgrass)
- 5 under-trellis (in-row) treatments:
  - ‘Boreal’ creeping red fescue
  - ‘~~Dalkeith’ subterranean clover~~ non-sprayed control
  - Recycled crushed glass mulch
  - Dried distiller grains (DDGs)
  - Glyphosate (grower control)

Experimental Design

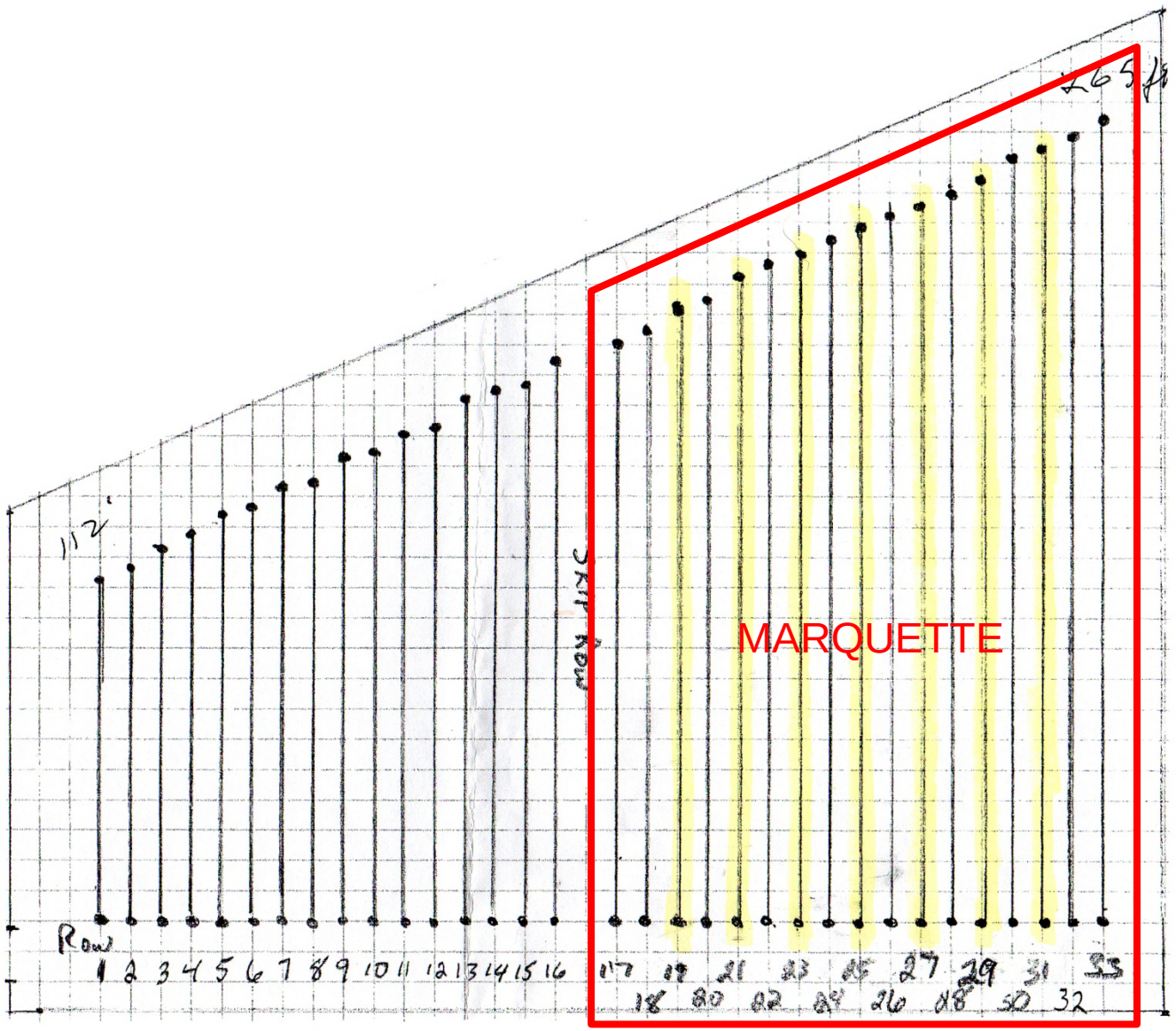
- 3 x 5 factorial design with ~4 replications
- 3 vines (24 feet) = experimental unit
  - Took data/measurements on middle vine
- Alleyway treatments = on both sides of vine rows

Experimental Design



8’ x 10’ vine spacing: 8’ between vines, 10’ between rows

Vineyard Map



Establishment of Research Plots

- Prepared groundcover plots (glyphosate)
- Seeded groundcovers into standing dead vegetation - September, 2010
  - Watered 3 times per week
- Reseeded groundcovers (hand-broadcast) - Spring, 2011
  - No watering
- Subterranean clover plots → non-sprayed control
- Crushed glass and DDGs applied in June 2011

“Novel” Mulching Materials

- DDGs
  - Co-product of ethanol fermentation process
  - Preemergence herbicide
  - Contains ~4% nitrogen
  - Applied ~1/3 lb per square foot
  - 50 pound bag covered 6 vines (48 ft x 3 ft wide)
  - Obtained from UNL feed mill

- Crushed glass mulch
  - Municipal recycled glass
  - Mixed colors
  - Applied ~3” thick

Maintenance of Research Plots

- Glyphosate in-row plots sprayed 2-3 times per season
- In-row groundcover plots mowed once per season
- Alleyways mowed as needed
- DDGs applied twice each season
- Crushed glass reapplied in March, 2013

Research Photos: 2011

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Research Photos: 2011

8 August 2011

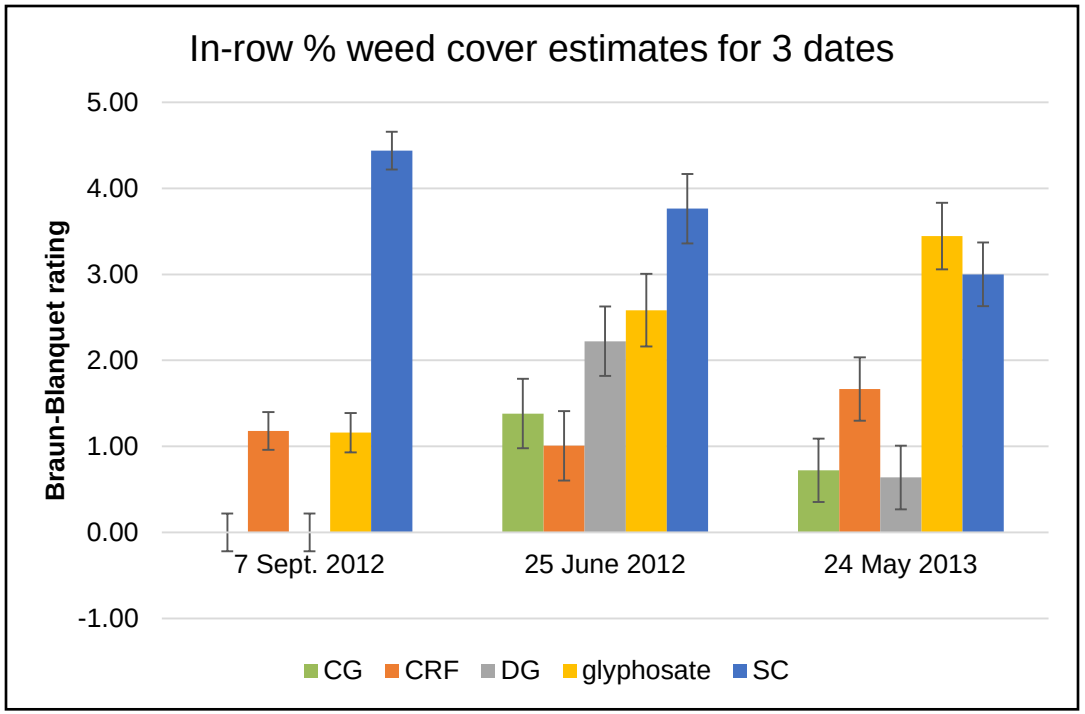
Measurements

- Weed % cover
- Soil temperature
- Solar radiation
  - Soil surface reflectance, canopy transmittance
- Soil & vine water status
- Vine vigor
  - Shoot length, leaf layer number, pruning weight
- Yield & clusters per vine
- Fruit composition
  - Berry size, Brix, pH, TA

Weed Cover

Effects of groundcover and mulch treatments on in-row % weed cover on 3 dates in a SE Nebraska 'Marquette' vineyard. CG and DG had rating of 0 on September 7, 2012. CG = crushed glass; CRF = creeping red fescue; DG = dried distillers' grain; SC = non-sprayed control

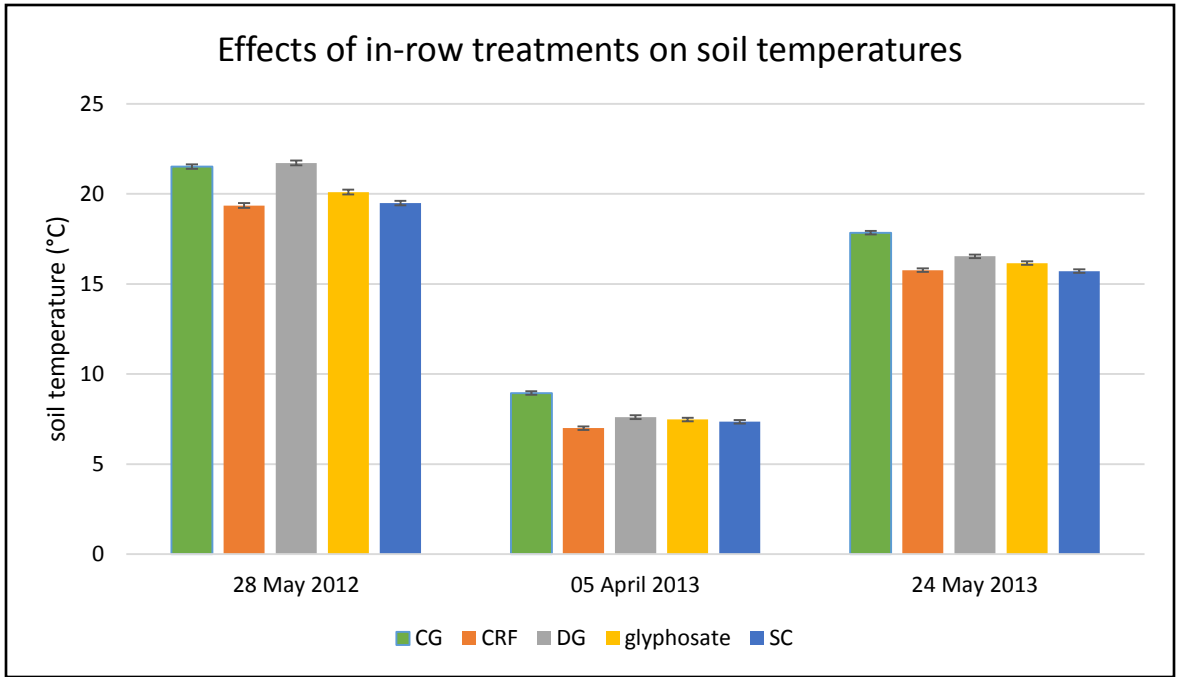
Braun-Blanquet Scale
(visual weed cover estimate)
0 = <1%
1 = 1 – 10%
2 = 11 – 25%
3 = 26 – 50%
4 = 51 – 75%
5 = 76 – 100%



Soil Temperature

- In general, mulches had higher soil temp; groundcovers had lower soil temp (compared to glyphosate)

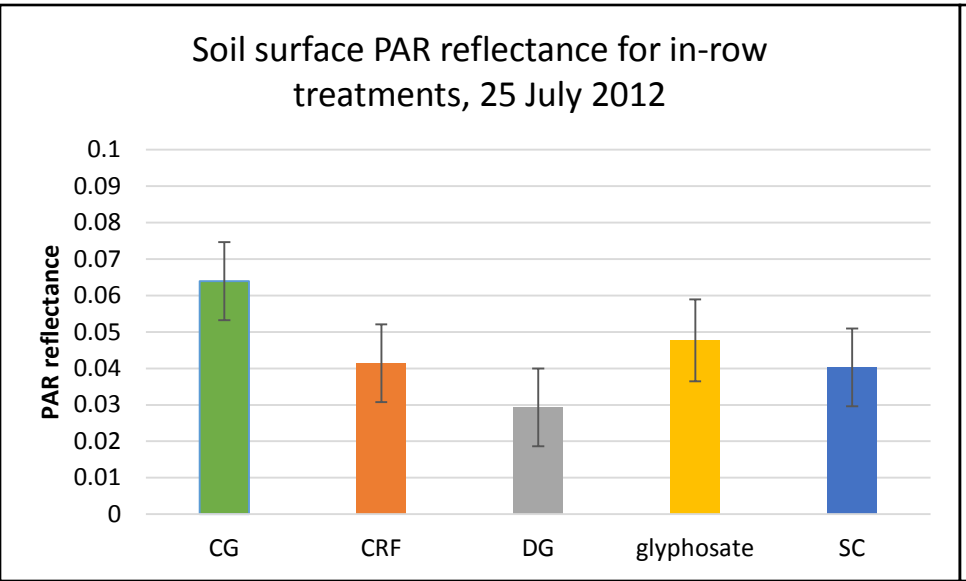
Effects of in-row groundcover and mulch treatments on soil temperatures measured on 3 dates in a SE Nebraska 'Marquette' vineyard. CG = crushed glass mulch; CRF = creeping red fescue; DG = distillers' grain; SC = non-sprayed control

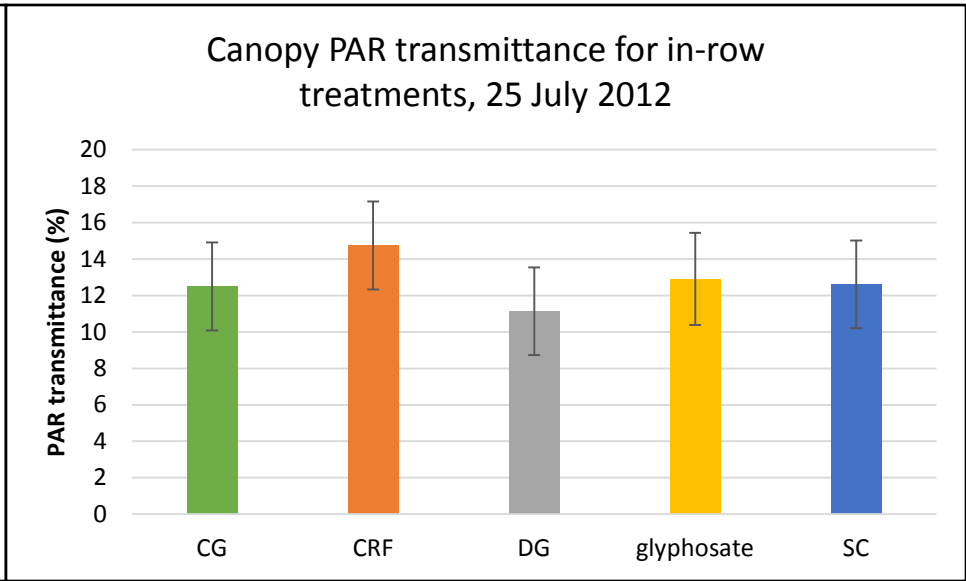


Reflectance & Transmittance

- No significant differences at time of measurement (July 25, 2012).

Effects of in-row groundcover and mulch treatments on soil surface reflectance and canopy PAR (photosynthetically active radiation) transmittance in a SE Nebraska 'Marquette' vineyard. CG = crushed glass mulch; CRF = creeping red fescue; DG = distillers' grain; SC = non-sprayed control

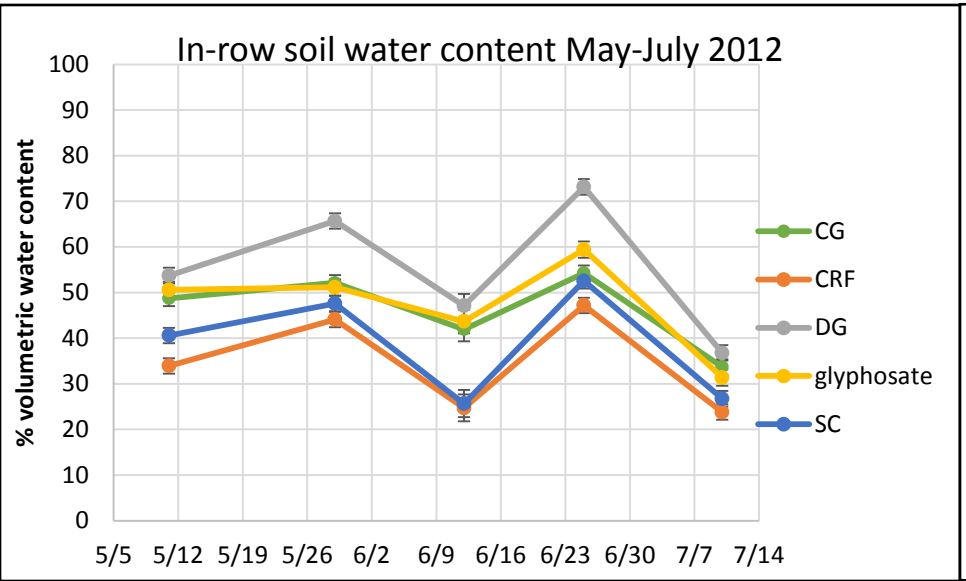


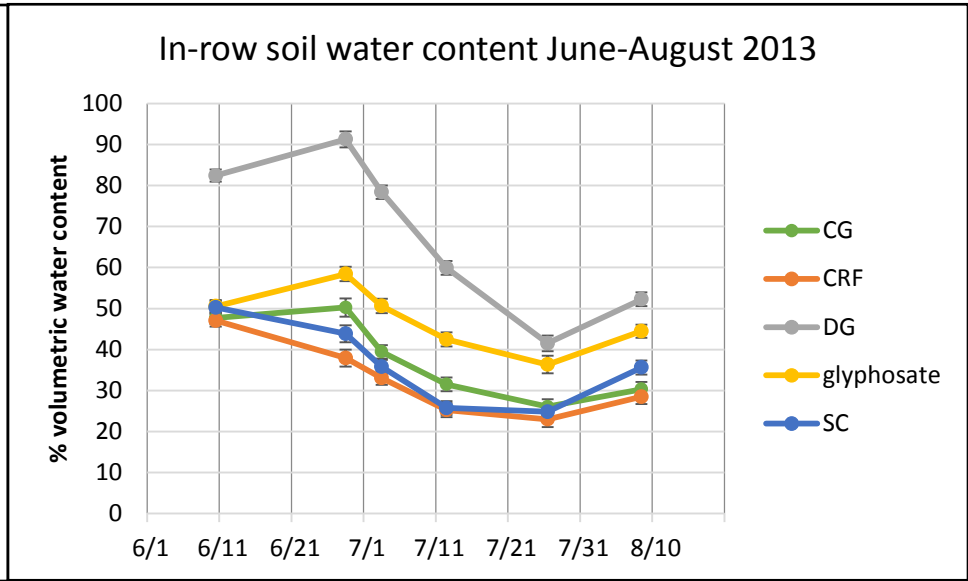


Soil Water Content

- Alleyway treatment effects
  - BG < (CRF = control) for all dates in 2013 and 2 dates in 2012
- In-row treatment effects
  - DG conserved water; CG decreased soil moisture in 2013
  - CRF and SC decreased soil water on most dates

Effects of in-row mulch and groundcover treatments on soil water content in a SE Nebraska 'Marquette' vineyard, 2012 and 2013. CG = crushed glass mulch; CRF = creeping red fescue; DG = distillers' grain; SC = non-sprayed control

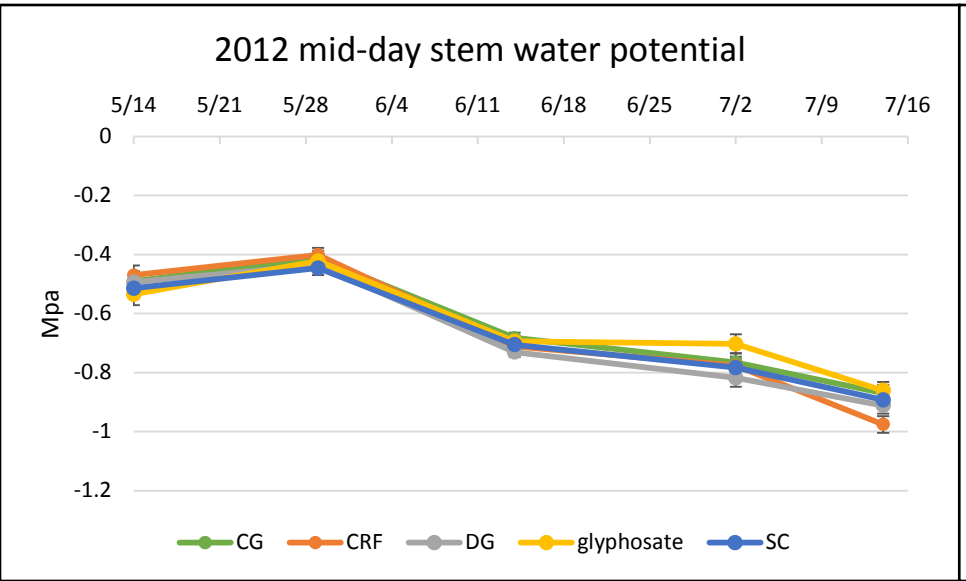


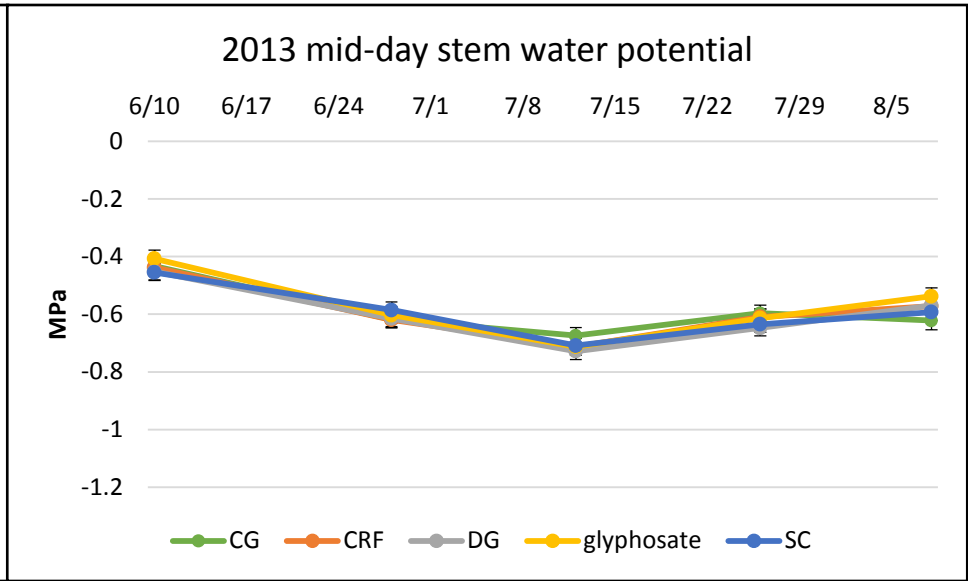


Vine Water Potential

- Not affected by alleyway or in-row treatments

Mid-day stem Ψ was not affected by in-row groundcover and mulch treatments (α=.05) in a SE Nebraska 'Marquette' vineyard. CG = crushed glass mulch; CRF = creeping red fescue; DG = distillers' grain; SC = non-sprayed control





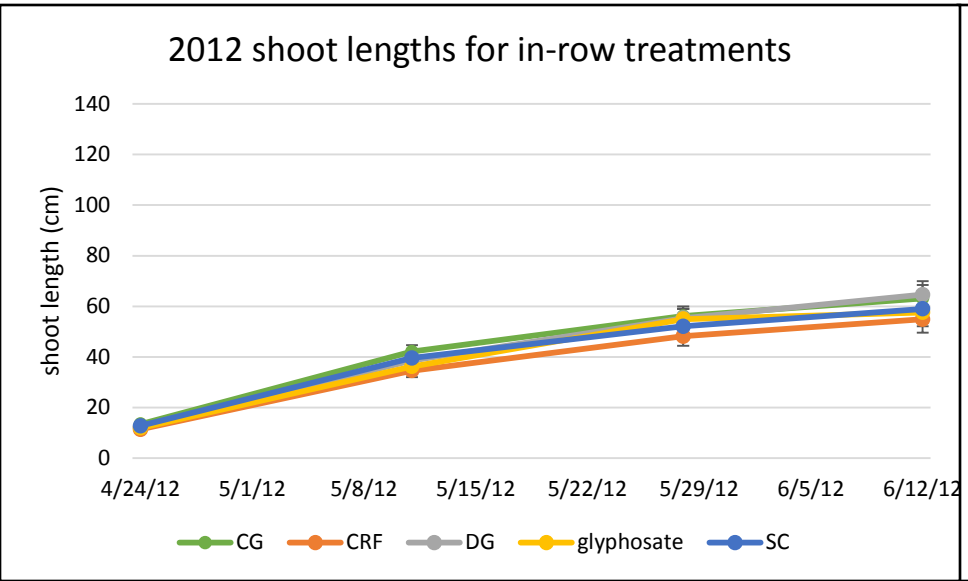
Vine Vigor

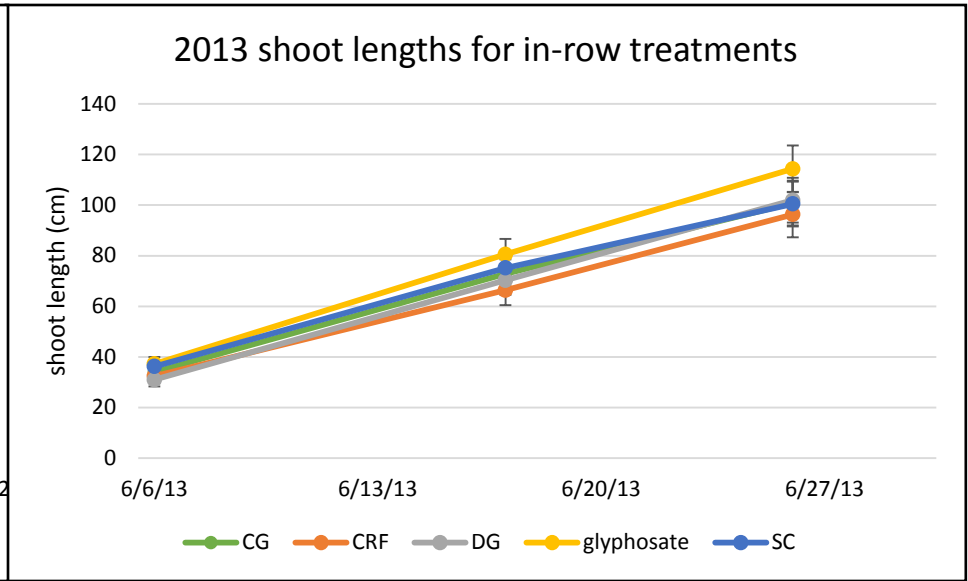
- Shoot length measurements
  - Marked 2 shoots per plant
  - Measured biweekly during shoot expansion
- Point quadrat canopy analysis
  - 3 transects per plant at veraison 2012 & 2013
  - Data used to compute leaf layer number (LLN)
  - Measures canopy density
- Dormant pruning weight
  - March 2012 & 2013

Shoot Length

- Not affected by alleyway or in-row treatments

Shoot lengths of 'Marquette' grapevines measured in 2012 and 2013 in southeast Nebraska. Vineyard floor treatment effects were not significant at α=0.05. CG = crushed glass; CRF = creeping red fescue; DG = distillers' grain; SC = non-sprayed control

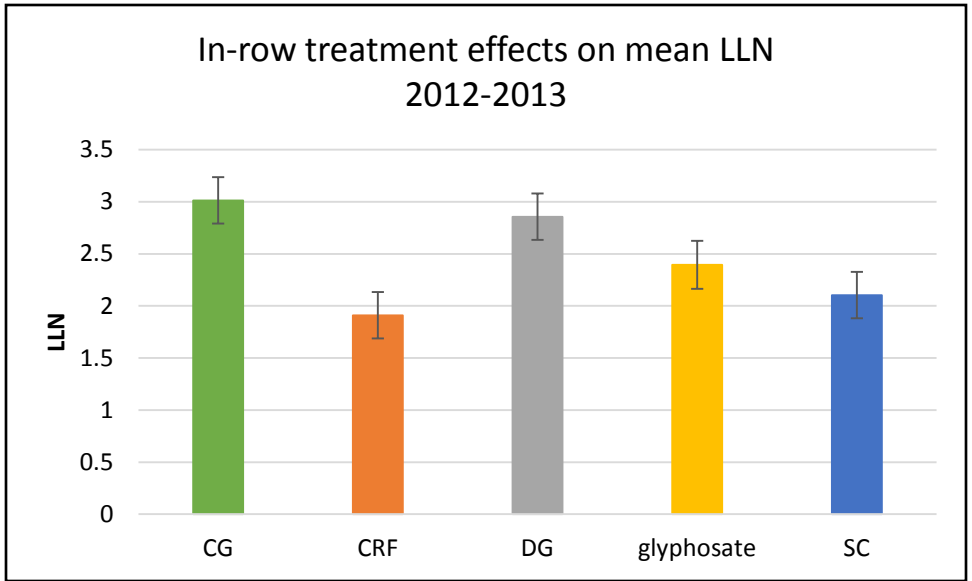




Leaf Layer Number

- Not affected by alleyway treatment
- In-row treatment effects:
  - Generally, mulches > groundcovers
  - CG = only treatment that differed from glyphosate

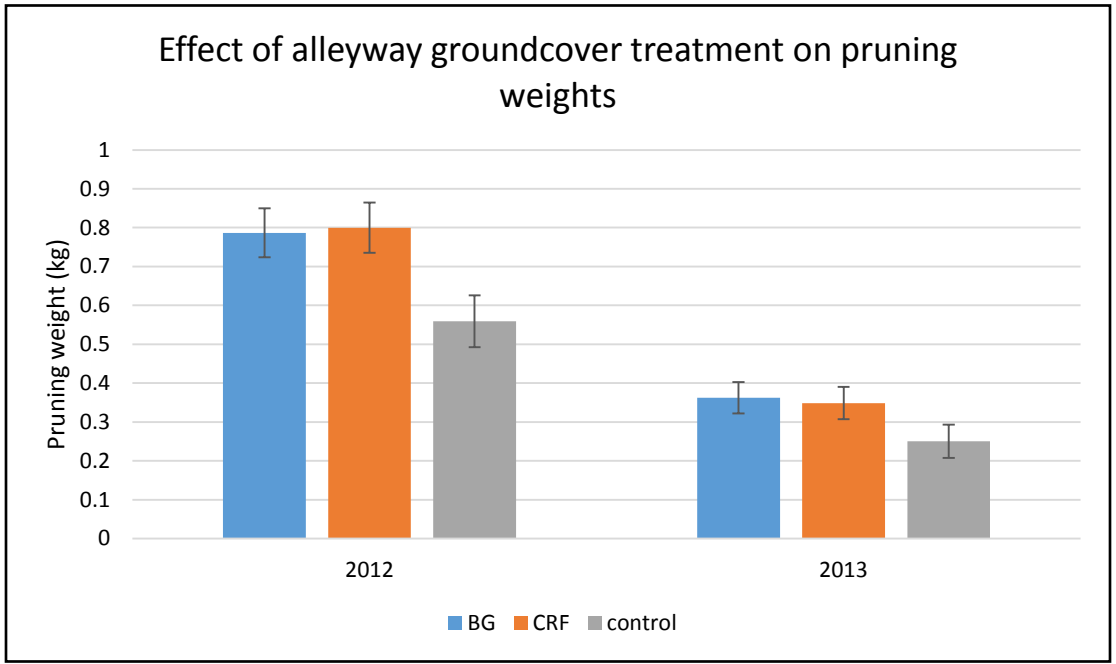
Effects of in-row groundcover and mulch treatments on mean leaf layer number (LLN) in a SE Nebraska 'Marquette' vineyard, 2012-2013. CG = crushed glass mulch; CRF = creeping red fescue; DG = distillers' grain; SC = non-sprayed control



Pruning Weight

- In-row treatments did not affect pruning weights.
- Pruning weights affected by alleyway treatment in 2012 only

Effect of alleyway groundcover treatment on pruning weights for 'Marquette' grapevines in a SE Nebraska vineyard. Main effect of alleyway was statistically significant in 2012 but not in 2013 (P=0.1346). BG = Kentucky bluegrass; CRF = creeping red fescue; control = resident vegetation



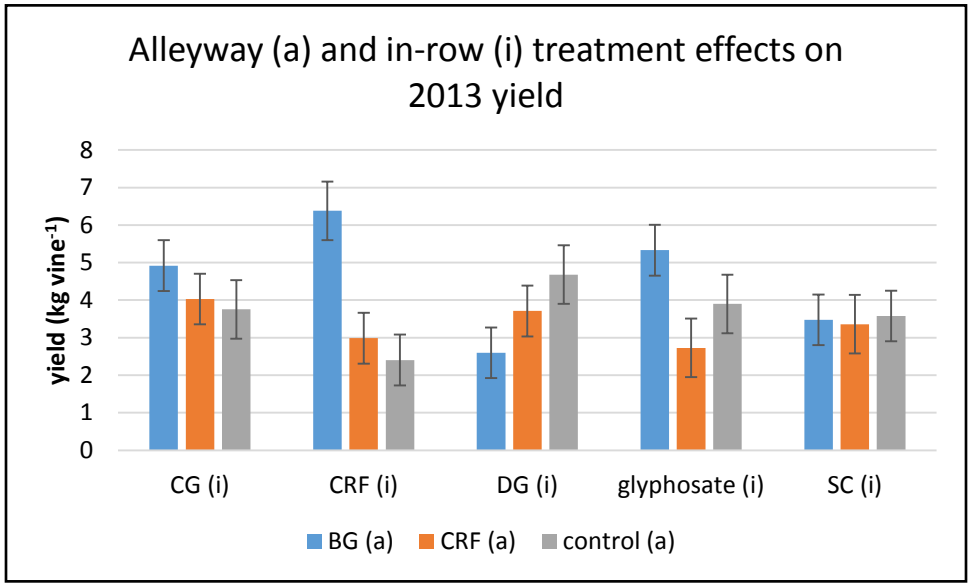
Yield 2012

- Harvested August 3, 2012
- Yield and cluster counts not affected by treatments
  - Average yield 7.9 kg/vine
  - Average 112 clusters/vine

Yield 2013

- Harvested September 7, 2013
- Cluster counts not affected by treatments
  - Average 112 clusters/vine
- Alleyway and in-row treatment interaction for yield (anomaly?)

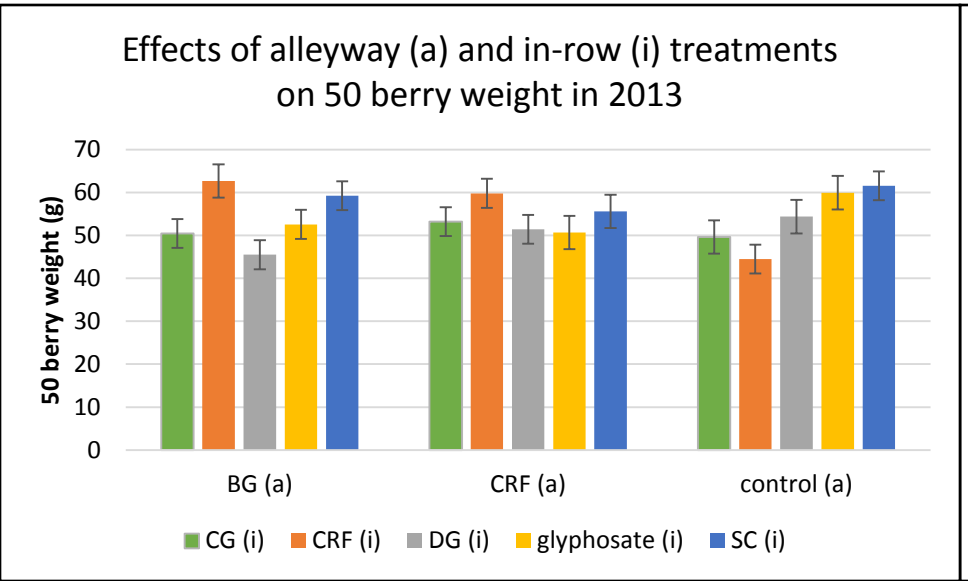
Effects of alleyway and in-row treatments on 'Marquette' yield in a SE Nebraska vineyard, 2013. BG = Kentucky bluegrass; CRF = creeping red fescue; control = resident vegetation; CG = crushed glass mulch; DG = distillers' grain; SC = non-sprayed control

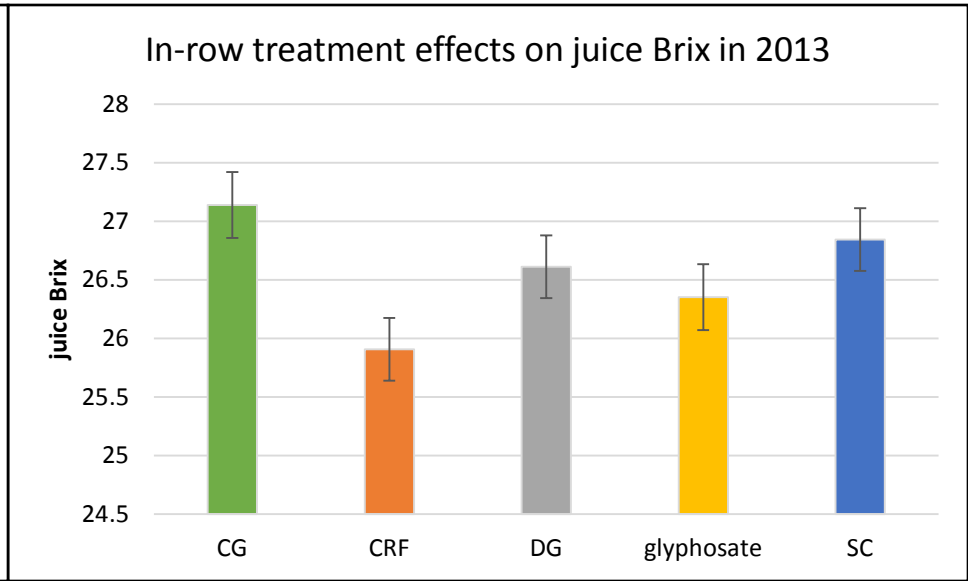


Fruit Composition: Berry Weight & Brix

- Treatment differences for berry weight and Brix in 2013 but not 2012

Effects of vineyard floor treatments on berry weight and Brix of 'Marquette' from a SE Nebraska vineyard, 2013. BG = Kentucky bluegrass; CRF = creeping red fescue; control = resident vegetation; CG = crushed glass mulch; DG = distillers' grain; SC = non-sprayed control

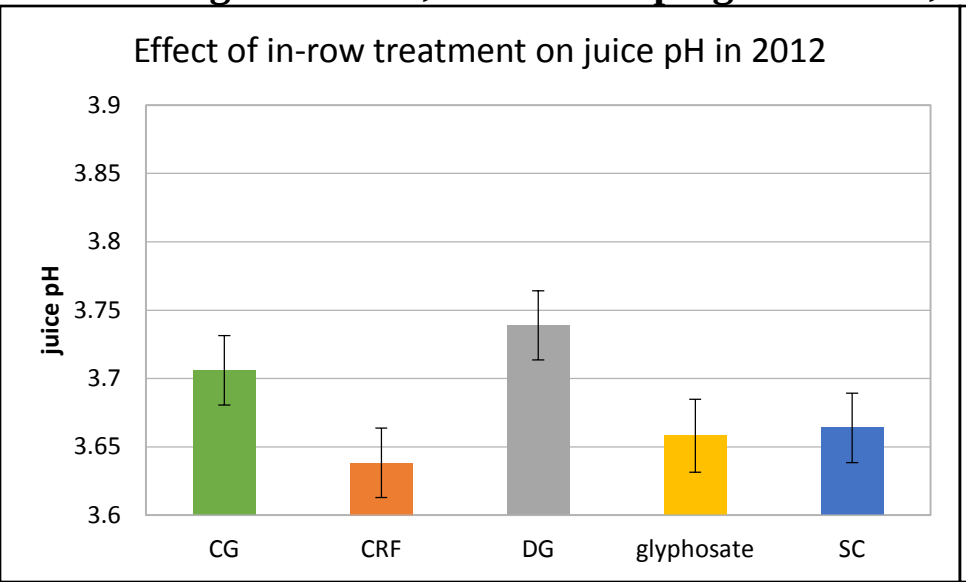


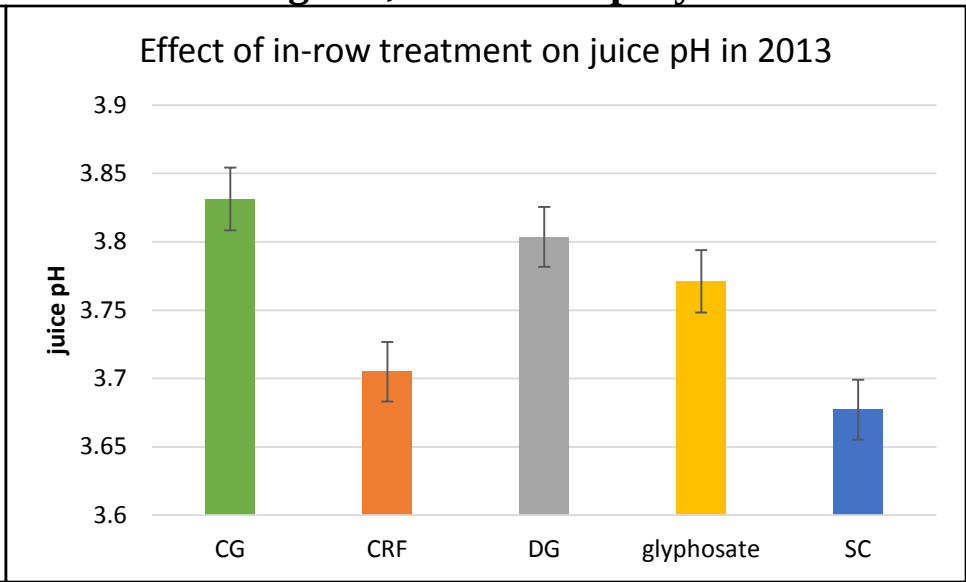


Fruit Composition: pH & TA

- pH was affected by in-row treatment
  - In general, mulches > groundcovers
  - DG > glyphosate in 2012
  - CG > glyphosate; CRF and SC < glyphosate in 2013
- None of the treatments affected TA
  - 2012 average TA = 1.04%
  - 2013 average TA = 0.77%

Effect of in-row treatments on 'Marquette' juice pH from a SE Nebraska vineyard, 2012 and 2013. CG = crushed glass mulch; CRF = creeping red fescue; DG = distillers' grain; SC = non-sprayed control





Summary: Alleyway Treatment Effects

- Affected soil moisture (BG < CRF and control) but NOT vine water potential
- Affected pruning weight in 2012 (BG and CRF > control) but NOT LLN or shoot length
- Did not conclusively affect yield, berry weight
- Did not affect fruit composition

Summary: In-row Treatment Effects

- CG, CRF, and DG controlled weeds
- Mulches increased soil temp (especially CG) while groundcovers decreased soil temp (especially CRF)
- Affected soil moisture but NOT vine water potential
- Affected LLN (CG had higher LLN than glyphosate) but not shoot length or pruning weight

Summary: In-row Treatment Effects

- No consistent effects on yield, cluster number, or berry weight
- CG had higher juice Brix than glyphosate in 2013
- Mulch treatments had higher juice pH than groundcovers, although effects were inconsistent compared to glyphosate
- No treatment effects on TA

Distillers' Grain: Conclusions

- Potentially inexpensive; relatively easy to transport & apply
- Application timing is key
- Acceptable weed control with multiple applications
- Could be useful in newly established vineyards or low-fertility sites, especially near ethanol distillery or feed mill

Crushed Glass: Conclusions

- Relatively expensive and difficult to transport
  - $50/ 55 gallon barrel covers ~50 feet of row ($8/vine)
- Acceptable weed control lasted 2 seasons
- Impractical unless vineyard is near a crushing facility and source of waste glass

Glyphosate: Conclusions

- Good weed control
- Inexpensive, easy to apply
- Multiple applications necessary each season
- Potential problems:
  - Herbicide resistant weeds
  - Trunk splitting/cold injury due to overspray

Creeping Red Fescue: Conclusions

- Inexpensive seed
- Rapid establishment & good soil coverage
- Low maintenance (mow once/season)
- Consistent weed control (<10% weeds)
- Aesthetically pleasing
- Continuous vineyard floor coverage is a viable option for many Midwest growers

Non-sprayed Control: Conclusions

- No cost to establish
- Good soil coverage
- Low maintenance (mow once/season)
- Unkempt appearance
- Results of this research suggest yield, fruit quality, and vine balance were not negatively affected by in-row weeds

Recommendations

- Depend on management goals and vineyard site!
  - Conserve water?
  - Low maintenance?
  - Reduce vegetative vigor?

- In-row mulches could be a good solution for new vineyards
- In-row groundcovers performed well in this study, but should not be used until AFTER VINES ARE ESTABLISHED

Thank you!!!

- Paul Read
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