

Selecting and Managing Vineyard Cover Crops to Reduce Net Consumption of Basin Water

Fritz Westover, MS and Craig D. Macmillan, Ph.D. | Westover Vineyard Advising and Vineyard Team

ABSTRACT

- This project investigated whether and to what degree the depletion of soil moisture over the winter by certain cover cropping practices might affect the quantity of groundwater pumped for irrigation to replace these losses.
- This study consisted of two experiments conducted over two seasons. One experiment investigated whether the timing and method of terminating a grass cover crop affected the depletion of soil moisture over the winter. The second experiment evaluated the effects of cover crop selection (species) on the depletion of soil moisture over the winter.
- Neither the timing and method of terminating a grass cover crop nor the selection of cover crop species differed consistently in terms of soil moisture depletion compared to clean cultivation or no-till controls.
- These outcomes suggest that growers have the freedom to choose cover cropping management practices based on factors other than potential soil moisture depletion in this area during low-rainfall years.

OBJECTIVES

- Evaluate five cover crop species for their impact on water infiltration, soil moisture retention, and use of plant available water in the vineyard.
- Evaluate treatments to suppress and terminate cover crops and their impact on water infiltration, soil moisture retention, and use of plant available water in the vineyard.

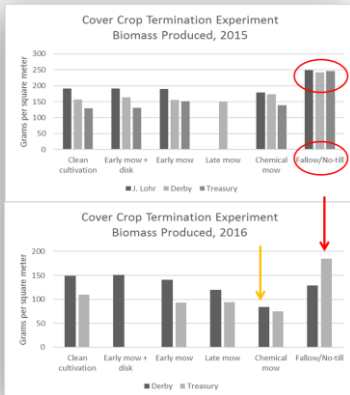


Figure 3. Mean dry matter biomass of cover crop termination treatments in 2015 and 2016.

MATERIALS AND METHODS

Experimental Design - Cover Crop Species Experiments

Three sites for the cover crop species experiment were selected along the "46 East" corridor east of Paso Robles, California.

The experimental designs were randomized complete block designs consisting of five treatments plus a control in three blocks. The treatments were different species of cover crops planted at the recommended rate per acre within the experimental plot. The control for comparison was clean cultivation which was executed as disking the plot at the same time the other plots were prepared as seed beds, but nothing was planted. The species of cover crops planted were Blando Brome, Barley (UCD 937), Triticale (Trios 888), Peas (Dundale), and Medic (Parragio). All seed and planting services were provided by Helena Chemical Company.

Experimental Design - Cover Crop Termination Experiments

Three sites for the experiment were selected along the "46 East" corridor along the southern border of the Paso Robles Estrella District AVA east of Paso Robles, California. The experimental designs were randomized complete block designs consisting of five treatments plus a control in three blocks. The treatments were different timings and methods of terminating a Blando Brome cover crop in the spring. The control for comparison was clean cultivation which was executed as disking the plot at the same time the other plots were prepared as seed beds, but nothing was planted. The plots of the no-till treatment were not disked at any time during the period of the experiment. For the other treatment plots a seed bed was prepared and they were planted with Blando Brome at 25 lbs./per acre. All seed and planting services were provided by Helena Chemical Company. The treatments in the experiment were 1) No-till, 2) mow 30 days after bud break, 3) mow at bud break, 4) mow and disk at bud break, 5) chemical mow with glyphosate at bud break, and 6) the unplanted control.

Experimental plots in all the experiments consisted of the middles (or "tractor avenues") on either side of a vine row. The width of the plot including the vine row was 20 feet. The length of the plot was nine vines equating either 45 ft. or 54 ft. depending on vine spacing. The total area of the experiment equaled about 0.40 acres at each site. All data were collected from the area around the middle three vines of the experimental plot. The same cover crops were planted in the same plots in November 2014 and November 2015. Samples for measuring plant biomass and soil moisture were collected in late April/early May of both years.

Data Collection

Plant samples were collected from each plot using a 20" X 20" quadrat thrown at random into the plot. All plants originating from within the quadrat were clipped at approximately 1" above the soil surface and collected in paper bags. This was done three times in each plot yielding three subsamples per plot. The bags containing the plant material were dried at 100°C in a forced air drying oven for 24 hours. Samples were then weighed to determine dry matter reported in grams per square meter.

Soil samples were taken at 18" and 36" on one side of the vine row near the halfway point of the length of the plot. Samples were placed in plastic bags. Forty grams of soil were weighed into a sample can and were dried at 100°C in a forced air drying oven for 24 hours. Samples were then weighed to determine gravimetric soil moisture reported as a percentage.

Statistical Analyses

Data were analyzed using ANOVA in SPSS Version 24. Treatment and block were included in the models and Tukey's HSD at the 0.05 level of significance was used to separate significant means.

RESULTS

Cover Crop Species Experiments

- There were no significant differences in the depletion of soil moisture between the species and varieties of cover crops compared to the control or compared to each other.
- There were statistically significant differences in biomass production at the J. Lohr site ($F=7.425, p < .001$) and the Opolo site ($F=13.843, p < .001$) in 2015.
- Tukey's HSD means separation found that Dundale peas produced more biomass than the other treatments at the J. Lohr site and both Dundale peas and UC 937 barley produced more biomass than the other treatments at the Opolo site. See Figure 1.

- There were no significant differences between treatments in terms of biomass produced at the J. Lohr site in 2016.

Cover Crop Termination Experiments

- There were statistically significant differences between treatments in terms of gravimetric soil moisture content at the J. Lohr site in 2015 and 2016 (2015: $F=4.084, p = .0028$; 2016: $F=4.112, p = .027$). See Figure 2.
- In 2015, Tukey's HSD means separation found the unplanted control to be different from the late mow treatment.
- Also in 2015, the unplanted control had the highest level of gravimetric soil moisture content and the late mow treatment had the lowest.
- In 2016, Tukey's HSD means separation found the early mow plus disk treatment to be significantly different than clean cultivation.
- The early mow plus disk treatment had the highest gravimetric soil moisture content and the unplanted control had the least.
- There were statistically significant differences in the biomass produced at all three sites in 2015 and at two sites in 2016. See Figures 3.
- In all these cases the no-till treatment produced more biomass than the other treatments at all three sites in 2015 and at one site in 2016.

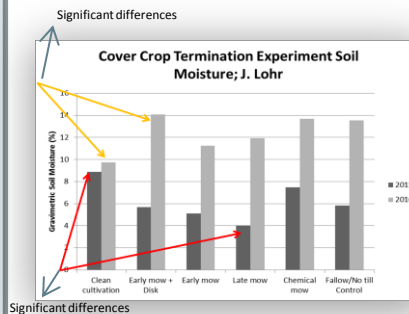


Figure 2. Mean gravimetric soil moisture content in five treatments of cover crop termination and a cultivated control in 2015 and 2016 at the J. Lohr vineyard.

CONCLUSIONS

- Although there may be seasonal and site specific differences in biomass production and cover crop water use, these differences are not consistent even on the same site and are minimal in their impact on soil moisture.
- As an example, Dundale pea crop produced more biomass than the other cover crops in 2015, this was not true in 2016.
- This suggests that either 1)2015 was a better year for growing a pea cover crop than 2016 or 2) there is some other factor affecting the success or failure of that crop.
- The J. Lohr site was the only site across three sites of the termination experiment and two sites of the species experiment where statistically significant differences in soil moisture between treatments were found.
- These differences were not consistent with the cultivated treatment having the highest soil moisture content one year and the lowest soil moisture content the next.
- The most consistent results were the production of biomass in the no-till treatments in the cover crop termination experiments.
- The no-till treatment produced more biomass than the other treatments at all three cover crop termination sites in 2015 and one of the three sites in 2016.

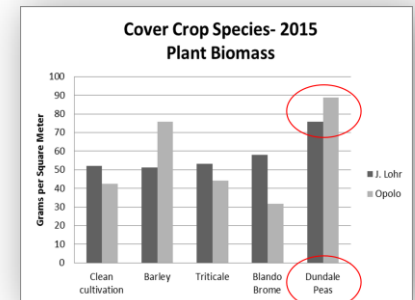


Figure 1. Mean dry matter biomass of five species of cover crop and an unplanted control. Different letters indicate significant differences ($p < .05$).

ACKNOWLEDGEMENTS

Special Thanks To: Paul Croust and Nate Miller of Helena Chemical Company without whose help this project could not have been completed.

Technical Support: Craig Stubler, Natural Resources and Environmental Sciences Department, Cal Poly San Luis Obispo

Cooperating Growers: Scott Welcher- Opolo Vineyards, Anji Perry- J. Lohr Wines and Vineyards, Steve Vierra- Derby Wine Estates, Jason Yeager- Niner Wine Estates, Kaly Navone- Treasury Wine Estates.