Annual Report: 2009-2010: Organic Wine Grapes

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TITLE: Weed Management in a Newly Established Organic Wine Grape Vineyard

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OBJECTIVES

1. Conduct a trial of organic and sustainable methods for weed management in a newly established wine grape vineyard that is in transition to organic certification.
2. Establish a 3 acre replicated organic wine grape block for future research in organic wine grape production.

SUMMARY

The number of wine vineyards in western Washington has grown from 5-10 in 2000 to more than 70 in 2010. This is significant growth in the number of farmers who seek vineyard management recommendations for western Washington. Weed management in new wine grape vineyards was identified by local growers and wine makers in a 2007 meeting at WSU Mount Vernon NWREC as the primary constraint to establishing organic production in the region. This project investigates weed management options in two wine grape cultivars, Pinot Noir Precoce and Madeleine Angevine, grafted on Couderc 3309 rootstock. The experiment was established at WSU Mount Vernon NWREC in a 3-acre newly established (2009) transition to organic vineyard, and includes 5 weed control treatments: standard control of rototilling and mowing, the Wonder Weeder (a new vineyard cultivator) for in-row cultivation, and three cover crop treatments: winter wheat at 300 lbs/A, winter peas at 300 lbs/A, and wheat:peas at 200 and 100 lbs/A, respectively. Cultivars and weed control treatments were selected by the local growers and wine makers. Results from this study indicate that Madeline Angevine has more vigorous growth than Pinot Noir Precoce in this region, and that all cover crop treatments tended to reduce shoot growth (new vine length), vine pruning weights, and change in vine diameter of both grape cultivars. Weed and cover crop biomass did not differ by grape cultivar in the two establishment years measured in this study. Weed and cover crop biomass did differ by weed management treatment and tended to be lowest in the standard treatment, next lowest in the Wonder Weeder treatment, and highest in the cover crop treatments both years. Of the cover crop treatments, weed biomass tended to be highest in the wheat:pea treatment, however this difference was not significant. Time for weed management was significantly greater in the standard and Wonder

Weeder treatments than in all the cover crop treatments, especially in the first year of establishment.

METHODS

The vineyard experiment was established in 2009 at Washington State University Mount Vernon Northwestern Washington Research & Extension Center (WSU Mount Vernon NWREC) and is arranged in a split-plot randomized complete block design with three replications. The sub plots are two wine grape cultivars, Madeleine Angevine (white) and Pinot Noir Precoce (red). The main plots are weed control treatments:

1.) Standard/current control practices for organic vineyard management: cultivating in alleys and hand weeding under vines as necessary to maintain in weed-free condition.
2.) Use of a "Wonder Weeder," a new vineyard cultivation tool for under-vine cultivation, with red fescue/perennial ryegrass seeded in alleys at 10 lbs/A, and maintained by mowing .
3.) Winter wheat seeded in alleys at 300 lbs/A with mowing in alleys and string weed mowing under vines.
4.) Winter peas seeded in alleys at 300 lbs/A with mowing in alleys and string weed mowing under vines.
5.) Winter wheat seeded in alleys at 200 lbs/A mid-June plus winter peas seeded at 100 lbs/A to equal 300 lbs/A cover crop total with mowing in alleys and string weed mowing under vines.

Sub plots each contain four rows of Madeleine Angevine or five rows of Pinot Noir Precoce with 14 plants per row. Data areas of two (Madeleine Angevine) or three (Pinot Noir Precoce) rows with 10 plants per row were centered within each sub plot (Figure 1). Sub plot data area size was calculated to provide sufficient grapes to produce 5 gallons of wine, the minimum quantity needed for future wine research (Objective 2). Total number of plants is 1,946: 840 Madeleine Angevine (300 data plants and 540 border plants), and 1,106 Pinot Noir Precoce (656 data plants and 450 border plants. Transition to organic certification was completed in October 2010, and the vineyard will be certified organic in 2011.

Installation of the vineyard irrigation and trellis systems was completed by June 1, 2009. Grape vines of the selected cultivars Madeleine Angevine and Pinot Noir Precoce, both grafted on Couderc 3309 rootstock, were planted the first week of June 2009. Cover crop treatments were planted in mid-June 2009 using a drill.

In 2009, alleys in the cover crop treatment plots were mowed on August 4, September 8, and October 7, and in-row areas were maintained by string-trimming on August 11. Alleys in the standard treatment plots were rototilled on August 4, and disked on September 8 and October 7. The Wonder Weeder was used under the vines in those plots and alleys were disked on August 4 and October 7. In April 2010, companion grass was seeded in the alley ways of the Wonder Weeder plots and winter wheat and winter peas were re-seeded in the alley ways of the cover crop plots. Alleys of the Wonder Weeder and cover crop plots were mowed in early May and on June 1, July 6, August 3, and September 30. The in-row areas of the cover crop treatments were maintained by string-trimming on May 14, June 14, July 6, August 3, September 7, and September 30.

Maintenance times were recorded for each main plot treatment, and included time for alley mowing and in-row string-trimming in the cover crop treatments, alley disking in the control

treatment, in-row disking in standard and Wonder Weeder treatments.

Biomass of weeds and cover crops was measured on August 3 and September 27, 2009, and on July 23 and September 28, 2010. Both years, the first biomass measurement was seven weeks following hand-weeding/string-trimming and four weeks after mowing, while the second biomass was six weeks after hand-weeding/string-trimming and seven weeks after mowing. For weed measurements, non-grape plant material within 0.13-m^2 quadrats was removed from the soil, separated by species, dried, and dry weight was recorded. Two quadrats were measured in-row and two quadrats were measured between-row in all treatments.

In the center of each sub plot, 5 grapevines were flagged and vine length (shoot growth) was measured for 5 grapevines, twice in 2009 on July 30 and August 13, and biweekly in 2010 from May 27 through August 19 for a total of six measurements in 2010. Vine diameter at 15 cm. above ground level was measured with a caliper on the 5 flagged vines on June 8, 2010. On February 16 and 18, 2010 the grape vines were pruned back to two buds, and pruning weights were collected and recorded in the sample plots.

RESULTS

***Vine length (shoot growth)*:** Mean vine length was significantly reduced when grapevines were grown with cover crops as compared to standard and Wonder Weeder treatments in both 2009 and 2010 (Table 1). In the first year of establishment, shoot growth tended to be lower with the winter wheat cover crop, whereas in the second year of establishment shoot growth tended to be lower with the wheat:pea cover crop, however these differences were not significant. Shoot growth of Madeleine Angevine was significantly greater than that of Pinot Noir Precoce at all measurement times. There were no significant interactions between treatment and cultivar, indicating that both Madeleine Angevine and Pinot Noir Precoce responded similarly to weed control treatments.

***Dry weight of weeds and cover crop*:** Weed plus cover crop biomass was significantly different in-row and between-row, so data were analyzed separately. However, biomass did not differ by grape cultivar, so data were pooled across cultivar. In-row biomass was the same across treatments in August 2009, however by late September winter pea and wheat:pea treatments tended to have greater biomass than all other treatments (Table 2). In 2010, in-row biomass was consistently greater in cover crop treatments than in standard or Wonder Weeder treatments. In 2009, between-row plant biomass was greater in cover crop treatments than in standard or Wonder Weeder treatments at both evaluation dates. Biomass did not differ in cover crop treatments in August, but in September biomass in winter pea treatment was significantly less than in winter wheat. In 2010, there were few significant differences among treatments, however the standard treatment tended to have the lowest biomass at both dates. This was likely due to the decline in winter wheat and winter pea biomass by the September sampling date (data not shown).

***Dry weight of primary weeds species*:** Weed species were sorted by type, and biomass was measured in 2010. Species did not significantly differ by grape cultivar or by row location (in-row and between-row) and so data were pooled. White clover biomass tended to be less in the standard and Wonder Weeder treatments as compared to the cover crop treatments and was greatest in the wheat:pea treatment both sampling dates (Table 3). Italian ryegrass biomass was lowest in the standard treatment as compared to all other treatments at both sampling dates. Biomass of other weeds was generally lowest in the Wonder Weeder treatment on both sampling

dates. Total weed biomass at both sampling dates was lowest in the standard treatment and was highest in the wheat:pea treatment both sampling dates.

***Weeding time*:** Weeding operations used in 2009 and 2010 included two flail mowings between rows for every treatment. In addition, the standard treatment was disked between rows and hand weeded in-row, while the Wonder Weeder treatment was disked between-row, Wonder weeded in-row, and hand weeded in-row as needed. There was no significant difference in weeding times for the two grape cultivars and there was no interaction between grape cultivar and treatment, so data were pooled. In both 2009 and 2010, weeding time was significantly less in cover crop treatments than in the standard or Wonder Weeder treatments (Table 4).

***Pruning weights*:** Vine pruning weights were measured in February 2010, and Madeleine Angevine had substantially more growth than Pinot Noir Precoce (Table 5). All cover crop treatments tended to reduce pruning weight, though these differences were not significant for Madeleine Angevine.

***Vine diameter*:** Vine diameter (mm) was measured with a caliper on June 8 and October 5, 2010, and the change in diameter was calculated for each treatment and both cultivars. Change in vine diameter tended to be greatest in the standard treatment and least in the winter pea treatment (Table 6).

DISCUSSION

This study is an M.S. student project and results presented in this report are preliminary and data analysis is on-going. Preliminary results indicate cover crops used in this study reduced vine vigor and weeding time, and increased non-grape vine biomass as compared to both the standard and Wonder Weeder treatments. However, future research is needed to determine if any of these factors positively or negatively impacts fruit yield and quality. The standard current organic weed management strategy resulted in the lowest non-grape plant biomass but had the highest labor use of all the treatments. The Wonder Weeder provided good in-row weed management but the equipment caused significant damage to the young vines and so it could not be used to manage weeds directly around plants, and these had to be controlled by hand weeding.

Dissemination of information resulting from this study is in process through workshops, field days and web sites. In addition, we are developing an Extension publication on establishing a new organic vineyard. We propose to utilize the organic vineyard established by this project to investigate organic disease management options in western Washington.

ACKNOWLEDGEMENTS

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FUND STATUS	**2009**	**2010**
Washington State Wine Advisory Commission	$ 10,000	$ 16,000
WSU-CSANR Organic Cropping Research	$ 32,916	$ 36,108
Washington State Center for Pesticide Registration	$ 10,500	$ 11,123
NARF and Puget Sound Wine Grape Growers	$ 5,000	$ 5,000

OUTSIDE PRESENTATIONS OF RESEARCH:

Miles, C., J. Roozen, G. Sterrett, and J. King. 2010. Organic vineyard establishment: trellis and planting stock considerations. Sustaining the Pacific Northwest. WSU Extension newsletter, Vol 8(2):5-8. http://csanr.wsu.edu/publications/SPNW/SPNW-v8-n2.pdf

Miles, C., J. Roozen, G. Sterrett, and J. King. 2010. Organic vineyard establishment: trellis and planting stock considerations. Web page http://maritimefruit.wsu.edu/Establishing_Organic_Vineyard.pdf

Bolton, C., T. Miller, and C. Miles. 2010. Weed management in an organic wine grape vineyard. NARF field day, July 8, WSU Mount Vernon NWREC.

Bolton, C., C. Miles, G. Moulton, M. Olmstead, J. Roozen, and T. Miller. 2010. Organic weed control in a newly established vineyard. Western Society for Weed Science, annual conference poster session, March 8-11, 2010, Marriott Resort, Waikoloa, Hawaii.

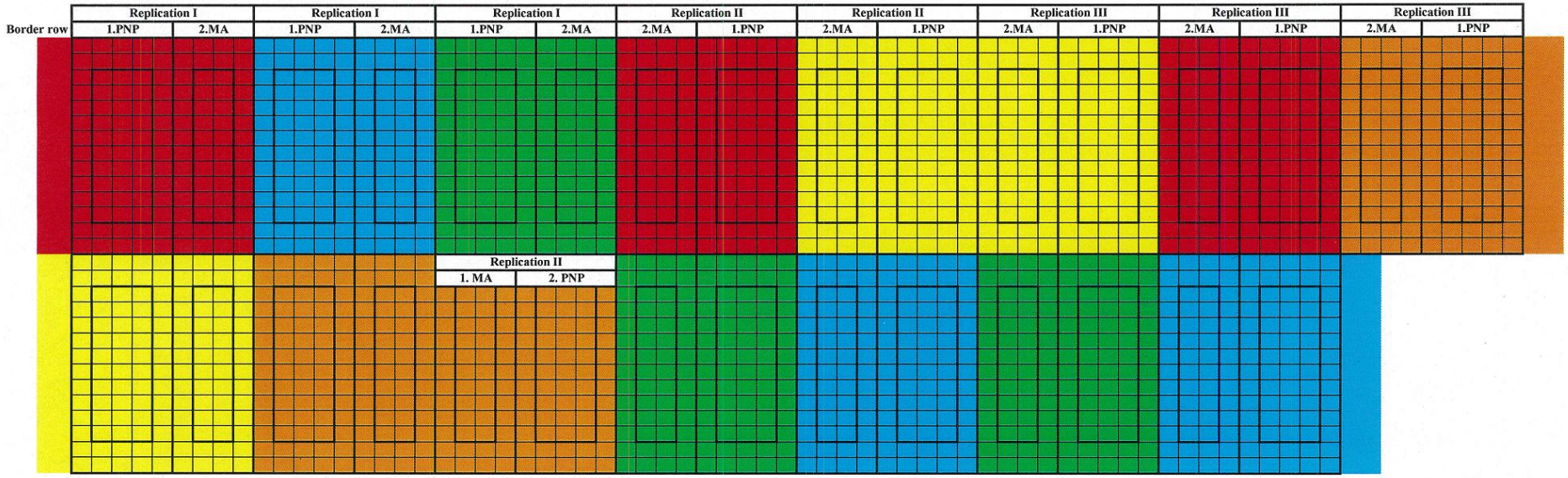
Bolton, C., T.W. Miller, J. Roozen, G.A. Moulton, and C. Miles. 2009. Organic wine grape research at WSU Mount Vernon NWREC. Wine Grape Workshop, WSU Mount Vernon NWREC, September 12, 2009.

Bolton, Callie. 2009. AVAs of Washington State. Graduate seminar, April 2009, Pullman, WA.

Miles, C., T.W. Miller, G.A. Moulton, M. Olmstead, J. Roozen, and T. Thornton. 2009. Weed management in establishing an organic wine grape vineyard. Tilth Producers Quarterly Spring 2009.

Miles, C., M. Olmstead, C. Bolton, S. Johnson, G. Sterrett, and J.King. 2009. Web page: Organic Viticulture Resources. http://winegrapes.wsu.edu/organic.html

2010 ORGANIC PLOT PLAN WITH BOTH RED AND WHITE GRAPES



Main Plot

1. Pinot Noir Precoce (red)
2. Madeleine Angevine (white)

Split Plot

Treatment 1 - Control, below
Treatment 2 - Above program but use Wonder Weeder for under-vine cultivation
Treatment 3 - Control treatment plus a grass/rye cover crop
Treatment 4 - Control treatment plus a pea cover crop
Treatment 5 - Control treatment plus grass:pea cover crop

Control - High mowing in alleys and under vines early April.
Under vines - plow and rotovate in mid April; harrow if needed for quack grass control;
periodic disking as needed; hill in late June or early July;
disk, harrow and hill again if weedy in late August.

Figure 1. Plot plan for organic wine grape weed control study established in 2009 at WSU Mount Vernon NWREC.

Table 1. Mean vine length (shoot growth) (cm) of two grape cultivars under several weed management regimes in a newly established transition to organic vineyard at WSU Mount Vernon NWREC in 2009 and 2010.

	Vine Length (shoot growth)							
	2009		2010					
Treatment	**7/30**	**8/13**	**5/27**	**6/10**	**6/24**	**7/8**	**7/22**	**8/14**
Standard	35.4 ab[x]	52.1 a	35.4 a	49.5 a	36.2 a	85.2 a	110.9 a	136.3 a
Wonder Weeder	37.9 a	55.8 a	31.1 ab	42.9 ab	56.9 ab	71.8 ab	90.6 a	103.9 b
Winter wheat	29.8 b	34.4 c	25.6 bc	35.6 bc	47.2 bc	57.0 bc	65.4 b	74.4 c
Winter pea	34.4 ab	42.0 b	29.5abc	39.5 bc	49.6abc	56.8 bc	66.5 b	78.9 c
2:1 wheat:pea	34.4 ab	39.6 bc	23.8 c	30.9 c	41.1 c	50.3 c	59.4 b	67.8 c
Cultivar								
Madeleine Angevine	42.3 a	90.0 a	30.5 a	41.5 a	55.1 a	70.1 a	87.5 a	104.4 a
Pinot Noir Precoce	25.9 b	55.2 b	27.6 a	37.8 a	48.1 b	58.3 b	69.6 b	80.1 b

[x]Means in the same column followed by the same letter are not statistically different (P<0.05).

Table 2. Dry weight (g/0.13m^2) of weeds and cover crops at two sample dates in 2009 and 2010 in a newly established organic vineyard at WSU Mount Vernon NWREC.

	2009		2010	
	In-row	**Between-row**	**In-row**	**Between-row**
Measurement 1[y]				
Standard	26.9[x]	0.1 b	6.23 c	8.56 c
Wonder Weeder	40.6	0.9 b	14.55 c	42.68 bc
Winter wheat	28.1	35.4 a	64.26 abc	57.21 abc
Winter Pea	34.4	39.1 a	90.39 ab	58.04 abc
2:1 wheat:pea	33.7	37.2 a	127.79 a	58.44 abc
Measurement 2				
Standard	6.9 c	0.4 c	4.28 d	6 cd
Wonder Weeder	8.8 abc	3.7 c	2.8 d	33.5 abc
Winter wheat	7.8 abc	14.1 a	50.75 a	21.11 bcd
Winter Pea	12.9 a	9.3 b	44.96 ab	22.58 bcd
2:1 wheat:pea	12.7 ab	13.5 ab	47.33 ab	30.52 abcd

[y]Measurement 1 taken 8/3/2009 and 7/23/2010; measurement 2 taken on 9/27/ 2009 and 9/28/ 2010.

[x]Means in the same column without a letter, or followed by the same letter are not statistically different (P<0.05).

Table 3. Dry weight (g/0.13m^2) of weed types at two sample dates in the second year of establishment (2010) in an organic vineyard at WSU Mount Vernon NWREC.

	Weed biomass (g/0.13 m^2)			
July 23	**White clover**	**Italian Ryegrass**	**Other weeds**	**Total**
Standard	0.1 b[x]	0.8 c	6.5 bc	7.4 c
Wonder Weeder	5.6 b	25.7 ab	1.4 c	28.6 bc
Winter wheat	22.0 ab	15.4 bc	25.5 a	60.7 ab
Winter pea	22.3 ab	36.1 a	15.9 ab	74.2 a
2:1 wheat:pea	54.9 a	17.6 bc	20.6 a	93.1 a
September 28				
Standard	0.9 c	0.4 b	3.9 ab	5.1 c
Wonder Weeder	5.6 bc	11.9 a	0.6 b	18.2 bc
Winter wheat	22.0 ab	6.7 ab	7.2 a	35.9 a
Winter pea	15.8 abc	10.9 a	7.1 a	33.8 ab
2:1 wheat:pea	26.7 a	5.1 ab	7.1 a	38.9 a

[x]Means in the same column followed by the same letter are not statistically different (P<0.05).

Table 4. Time required to implement treatment strategies in a newly established organic vineyard at WSU Mount Vernon NWREC in 2009 and 2010, in weeding time/A (hr/person).

Treatment	**Hours/Acre**	
	2009	**2010**
Standard	87.33 a	35.33 a[x]
Wonder Weeder	91.33 a	21.33 b
Winter wheat	10.00 b	15.33 d
Winter pea	10.00 b	18.67 c
2:1 wheat:pea	10.00 b	17.33 cd

[x]Means in the same column followed by the same letter are not statistically different (P<0.05).

Table 5. Pruning weights of Madeleine Angevine and Pinot Noir Precoce grape vines in a newly established organic vineyard at WSU Mount Vernon NWREC in February 2010.

Cultivar	**g/vine**	**Treatment**	**g/vine**
Madeleine Angevine	9.47 a	Standard	17.60 a
		Wonder Weeder	16.61 a
		Winter wheat	3.00 b
		Winter pea	5.39 b
		2:1 wheat:pea	4.48 b
Pinot Noir Precoce	3.18 b	Standard	5.33 b
		Wonder Weeder	6.14 b
		Winter wheat	1.14 b
		Winter pea	1.86 b
		2:1 wheat:pea	1.42 b

Means in the same column followed by the same letter are not statistically different (P<0.05).

Table 6. Change in caliper measurement (mm) of grape plants 'Madeleine Angevine' (MA) and 'Pinot Noir Precoce' (PNP) from June 8, 2010 to October 5, 2010, in the second year of establishment (2010) in an organic vineyard at WSU Mount Vernon NWREC.

Treatment	Madeleine Angevine	Pinot Noir Precoce
Standard	2.47a[x]	2.27ab
Wonder Weeder	1.85abc	0.71bc
Winter wheat	0.88abc	0.78bc
Winter pea	1.07abc	0.38c
2:1 wheat:pea	1.48abc	1.34abc

[x]Means in the same column followed by the same letter are not statistically different ($P<0.05$).