Vineyard Cover Crop Management in the North Willamette Valley

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Introduction

The objectives of this study are to determine:

- How vine vigor and fruit composition vary in different alleyway management regimes: solid vegetative cover vs. every other alleyway of vegetative cover removed
- What differences are observed in different alleyway management regimes within a vineyard
- What differences are observed in different alleyway management regimes between vineyards with similar soil type

The first year of this study (2006 growing season) is intended to focus on achieving baseline data for all sites.

Justification of Research

Vineyard alleyway management is an important aspect of growing healthy grapevines and producing high quality fruit. Each vineyard is unique in terms of how alleyways should be managed in order to achieve a specific goal. Soil type, slope, vine density, and water availability should be considered when making decisions about how to manage vineyard alleyways (5).

Vineyards located in the North Willamette Valley of Oregon experience an average annual rainfall of 40" (4). Most of this rainfall occurs between October and June. Available Water Holding Capacity of the soils in this area range from 6.5-10.3 inches (1). A challenge that grape growers face in the North Willamette Valley is to manage relatively high amounts of available water in the spring and potentially low amounts of available water in the summer during fruit ripening. Strategically managing the vegetative cover to influence water availability and the implementation of irrigation are two tools that Willamette Valley Growers have used to deal with this challenge.

When vegetative cover is actively growing it is competing for water and nutrients with the grapevine (2,3). This can be advantageous in a vineyard that receives high winter rainfall on soils with high water holding capacity. Early season water competition can help grow a smaller, less vigorous, canopy (5) that is easier and less expensive to manage. Growing a smaller canopy can also reduce shading and disease pressure which will result in higher fruit quality.

If a grower's goal is to reduce water and nutrient competition, vegetative cover can be removed in early spring. Typically this has been done by tilling the cover in when soil conditions and equipment availability allow. Tilling the cover in will reduce competition while adding biomass to the soil (2,5). The thought being that nitrogen is being put back into the vineyard system for the vine to use later (3).

It is known that grapevines use plant nitrogen reserves for growth from budbreak until bloom. Grapevines start to use soil available nitrogen when 5-7 leaves have expanded until fruit set. The maximum amount of soil available nitrogen uptake occurs at fruit set. After fruit set the use of soil available nitrogen declines and redistribution of nitrogen that has accumulated in the vine canopy is used during stage three of fruit ripening. Translocation of nitrogen from the canopy continues until leaf senescence. There is a brief period after harvest and prior to leaf senescence that soil available nitrogen can be taken up if conditions allow (6).

Managing alleyways to manipulate vine growth and physiology is a matter of timing and intensity. It is the goal of this study to consider the degree to which competition from vegetative cover is beneficial in commercial vineyards in the North Willamette Valley and eventually consider the best times to impose or remove competition.

Materials and Methods

<u>Experimental Design</u>

This experiment is being conducted in three commercial vineyards located in the North Willamette Valley: Stoller Vineyard, Archery Summit, and Domaine Drouhin Oregon (DDO). Table 1 describes site details for all three vineyards.

Vineyard Details

Table 1: Site details for Stoller Vineyard, Archery Summit Vineyard, and DDO

	Stoller	Archery Summit	DDO
Treatment comparisons	alternate row removal of cover crop (EO) vs. solid cover crop (S)	alternate row removal of cover crop (EO) vs. solid cover crop (S)	alternate row removal of cover crop (EO) vs. solid cover crop (S) vs. complete cover crop removal (CR)
Treatment organization	Complete randomized block design	Complete randomized block design	Complete randomized block design
Treatment replication	Replicated five times on groups of 16 vines	Replicated five times on groups of 24 vines	Replicated three times on groups of 16 vines
Cover crop composition	Mix of reemerging red fescue (seeded 2002) and Kentucky bluegrass (seeded Sept. 2005)	Perennial blend (Bailey Seed Pathway Blend)of 60% Elf perennial ryegrass, 20% creeping red fescue, 20% hard fescue (seeded winter 2006 in clean cultivated rows from 2005)	Perennial grass plus volunteer species (seeded fall 2005)
Cover removed for Alternate (EO) and Complete (CR) treatments	April 19, 2006	April 19, 2006	May 8th, 2006
How cover was removed	tilled	spaded	tilled
Irrigation	yes	no	no
Plant material	Pommard/Riparia	667/101-14	Pommard/3309
Year planted	1999	1996	1989
Budbreak	April 19, 2006	April 15th, 2006	April 26th, 2006

Parameters of Interest

Vegetative vigor – Pruning weights were collected per vine on December 7th, 2006 at Stoller and DDO. Pruning weights were determined by weighing all of the one-year old wood per vine.

Shoot count – The number of shoots per vine were determined post-harvest at Stoller and DDO.

Ripening dynamics – Brix, pH, and TA were monitored during ripening. Sampling began at the onset of véraison and occurred on a weekly basis until harvest. 5 clusters per replicate were collected in the morning and processed immediately. Soluble solids (brix) of juice samples were determined using a hand held refractometer. pH of juice samples was determined using a Scholar 425 pH meter and Sentix 62 electrode. Titratable acidity was determined using the titrametric procedure using NaOH as described by Zoecklein *et al* (7).

Fruit composition at harvest – Each treatment replicate was harvested separately. 25 clusters per replicate were collected in the morning and processed immediately. Must samples were delivered to ETS Laboratories (McMinnville) for analysis. Basic juice profile was determined using ETS Laboratories methods for brix, pH, titratable acidiy, L-malic acid, tartaric acid, potassium, glucose and fructose, alpha-amino compounds, and ammonia.

The affects of cover crop management on vine vigor and fruit composition were analyzed using the ANOVA procedure and subjected to the t-test. All statistics were performed using the SAS System version 9 statistical package.

Results
The experimental block at Archery Summit was lost following fruit set. Therefore, no results were obtained from that site. Fruit from the DDO site was lost at harvest. Therefore, fruit composition at harvest was not evaluated.

Stoller
Ripening dynamics - No treatment differences were observed in juice soluble solids, pH, or titratable acidity (TA) during ripening or at harvest (Figure 1a, Figure 1b, and Figure 1c). The alternate row (EO) treatment tended to have higher brix during the last three weeks of ripening (Figure 1a). The increase in brix, for both treatments, between September 20th and harvest (September 29th) may be due to precipitation that occurred during this week followed by high temperatures. Berry dehydration may have occurred. A similar increase in pH was observed in both treatments (Figure 1b).

Fruit composition at harvest - Malic acid and alpha-amino compounds were significantly higher in the solid cover treatment (S) at harvest (Table 2). The literature suggests that reducing vegetative competition may enable vines to translocate nitrogen stored in the canopy to the fruit during ripening (3). These results do not support that theory. This suggests that the solid cover treatment did not have a negative affect on nitrogen accumulation in the fruit prior to harvest. This may be due to the fact that this vineyard site is irrigated and vines were able to continue translocation regardless of vegetative competition.

Vine vigor - Table 3 and Table 4 illustrate vine vigor in 2005 and 2006 respectively. Pruning weights decreased in both treatments in 2006 (Table 4). There was a greater decrease in vigor in the solid cover treatment (S) between 2005 and 2006. This suggests that regardless of this site being irrigated these vines may have undergone greater competition for resources than the alternate row treatment (EO).

DDO

Ripening dynamics - On one date during ripening (Figure 2a) the solid cover treatment (S) had significantly higher brix than the alternate row (EO) or complete removal treatment (CR). On the final sampling date prior to harvest, no treatment differences in brix were observed. Treatment differences in titratable acidity were observed on September 6th and September 13th (Figure 2c) with the alternate row treatment (EO) having higher TA on both dates. The complete removal treatment (CR) also had higher TA than the solid cover treatment (S) on September 13th. No treatment differences were observed in pH (Figure 2b).

Vine vigor - Table 5 and Table 6 illustrate vine vigor in 2005 and 2006 respectively. No treatment differences were observed and vigor tended to decrease in all treatments between 2005 and 2006.

Summary and Future Work

Results from the first year of this study suggest that manipulating vegetative competition in the alleyway can manipulate vine vigor and the vines ability to translocate material from the canopy to the fruit during ripening. However, imposed vegetative competition can possibly be overcome by irrigation.

Future work on this project will seek to improve experimental design by adding a complete cover removal treatment to serve as a control at all three sites. Additional canopy density data will be evaluated during the growing season. Collaborators and other industry participants have also determined that additional fruit and wine composition parameters need to be evaluated. Specifically, aroma and flavor precursors in the fruit and wine will be evaluated. Future collaboration with The Department of Food Science and Technology, OSU, will address these new research questions in 2007.

Figure 1: Juice soluble solids (a), pH (b), and titratable acidity (c) of juice during ripening and at harvest at Stoller Vineyard (2006). *, **, and * indicate statistically significant at the 0.05, 0.01, and 0.001 levels of probability, respectively.**

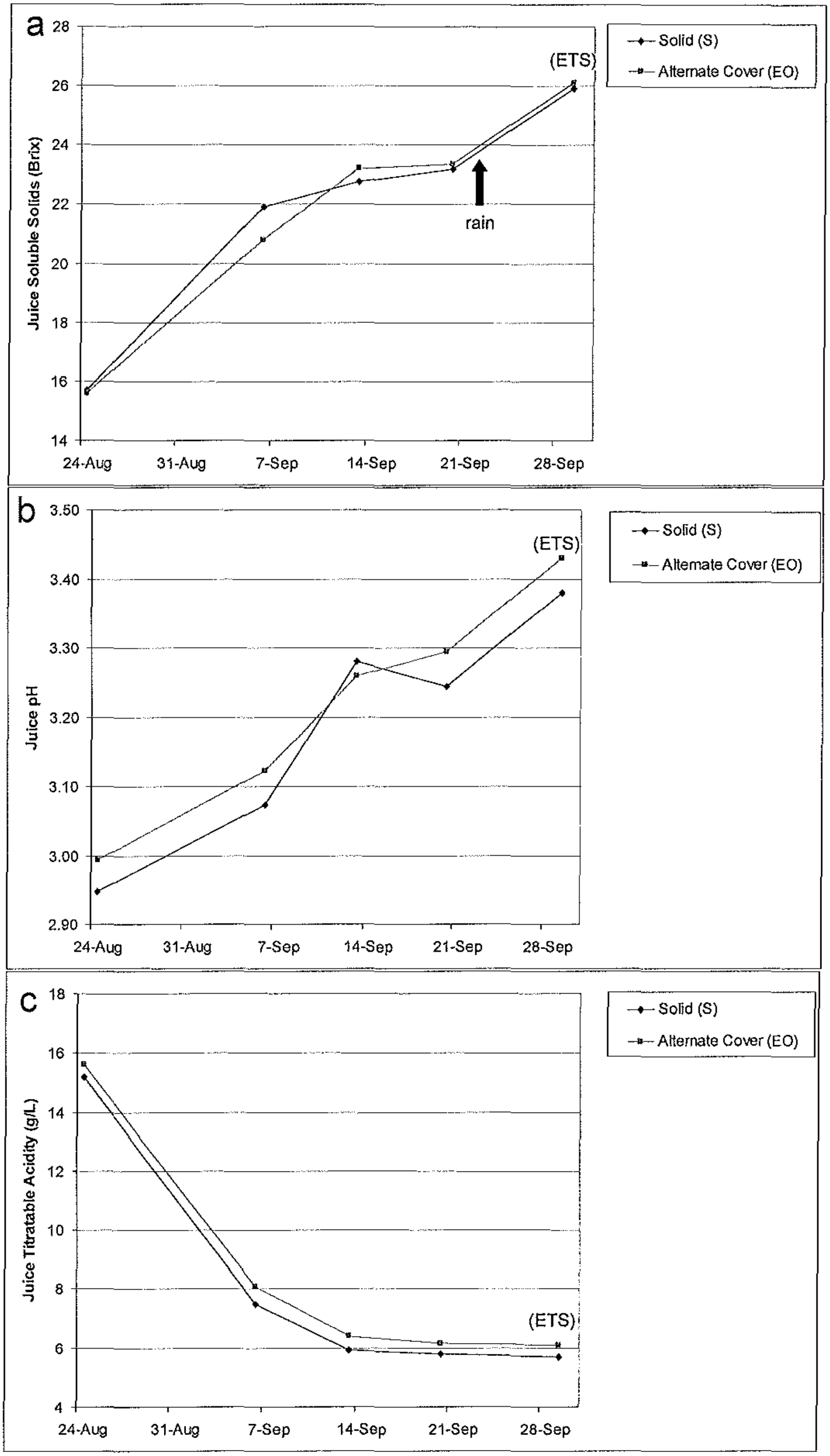

Figure 2: Juice soluble solids (a), pH (b), and titratable acidity (c) of juice during ripening at DDO Vineyard (2006). *, **, and * indicate statistically significant at the 0.05, 0.01, and 0.001 levels of probability, respectively.**

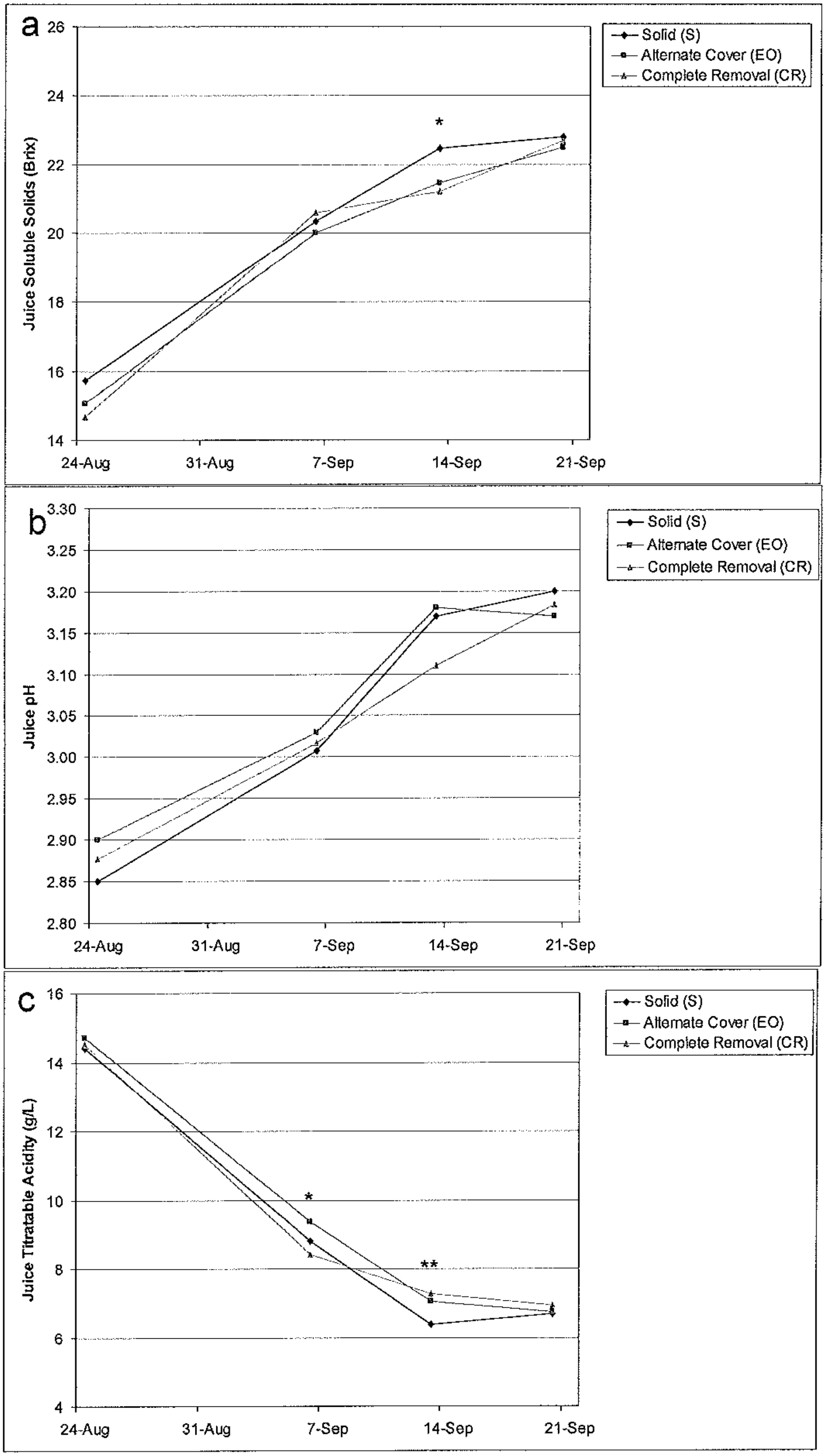

Table 2: Basic juice profile means of Stoller Vineyard at Harvest (September 29, 2006)

	Solid Cover (S)	**Alternate Cover (EO)**	**Significance (pvalue)**
brix (°)	26.1	25.9	ns (0.6817)
pH	3.43	3.38	ns (0.0618)
titratable acidity (g/100mL)	0.61	0.57	ns (0.2461)
potassium (mg/L)	1022	964	ns (0.1717)
L-malic acid (g/L)	3.06	2.40	* (0.0470)
tartaric acid (g/L)	4.52	4.81	ns (0.0601)
glucose + fructose (g/100mL)	28.76	28.34	ns (0.4992)
alpha-amino compounds (mg/L)	232.20	190.00	* (0.0348)
ammonia (mg/L)	180.0	159.6	ns (0.1260)

ns, *, **, and *** indicate not significant, and statistically significant at the 0.05, 0.01, and 0.001 levels of probability, respectively.

Table 3: Vine vigor at Stoller Vineyard (2005)

	Solid Cover (S)	**Alternate Cover (EO)**	**Significance (pvalue)**
pruning weight (kg/vine)	2.27	2.33	ns (0.7039)
shoots per vine	21	21	ns (0.7632)
pruning weight per shoot (g)	107.39	112.19	ns (0.4343)

ns, *, **, and *** indicate not significant, and statistically significant at the 0.05, 0.01, and 0.001 levels of probability, respectively.

Table 4: Vine vigor at Stoller Vineyard (2006)

	Solid Cover (S)	**Alternate Cover (EO)**	**Significance (pvalue)**
pruning weight (kg/vine)	1.47	1.76	* (0.0415)
shoots per vine	20	20	ns (0.5684)
pruning weight per shoot (g)	73.66	86.35	ns (0.0956)

ns, *, **, and *** indicate not significant, and statistically significant at the 0.05, 0.01, and 0.001 levels of probability, respectively.

Table 5: Vine vigor at DDO Vineyard (2005)

	Solid Cover (S)	**Alternate Cover (EO)**	**Complete Removal (CR)**	**Significance (pvalue)**
pruning weight (kg/vine)	0.61	0.60	0.59	ns (0.7865)
shoots per vine	9	9	9	ns (0.0775)
pruning weight per shoot (g)	68.03	69.35	65.30	ns (0.3795)

ns, *, **, and *** indicate not significant, and statistically significant at the 0.05, 0.01, and 0.001 levels of probability, respectively.

Table 6: Vine vigor at DDO Vineyard (2006)

	Solid Cover (S)	**Alternate Cover (EO)**	**Complete Removal (CR)**	**Significance (pvalue)**
pruning weight (kg/vine)	0.58	0.60	0.59	ns (0.7651)
shoots per vine	10	10	10	ns (0.5062)
pruning weight per shoot (g)	61.96	59.92	60.88	ns (0.8952)

ns, *, **, and *** indicate not significant, and statistically significant at the 0.05, 0.01, and 0.001 levels of probability, respectively.

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