

# **Oregon Wine Advisory Board Research Progress Report**

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## **Evaluation of Cover Crop Effects in a 'Pinot noir' Vineyard**

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### **ABSTRACT**

Three different cover crop treatments were compared for their effects on vine growth, leaf gas exchange, yield parameters and fruit composition. The treatments were: resident plants, an insectary plant mixture and a grass cover. At veraison (August 21), photosynthesis rate was lowest for the vines with the grass cover treatment, whereas transpiration rate tended to be higher. Water use efficiency was lowest for vines with a grass cover on all three measurement days (post bloom, berries pea-sized, veraison). Shoot growth, leaf area, yield and fruit composition were significantly lower for vines in the grass treatment than in the resident plant treatment. Performance of vines with the insectary plant mixture was intermediate between that of the two other treatments (resident plants and grass).

### **INTRODUCTION**

Use of cover crops is commonly practiced in viticultural areas where precipitation exceeds 600/700 mm (24-28") a year, because they may reduce soil erosion and surface water runoff on hillsides. Cover crops may also contribute to maintaining soil organic matter and nutrient levels. Additionally, a green cover may slow the soil compaction process and subsequent loss of pore space in vineyards where traffic follows the same tracks for up to 25 times per year. The botanical composition of the soil cover can have a dramatic and beneficial impact on the faunistic situation within the vineyard. Botanical diversity increases faunistic diversity and ecological stability (Remund et al, 1989). On the other hand, the vegetation competes with the grapevines for water and nutrients and rodents can invade vineyards with cover crops easier and spread rapidly.

Because green covers impact many other components of the vineyard agro-ecosystem, cover crop management strategies have been studied and effects on weed shift and faunistic diversity surveyed. Cover crop plants and management practices should be selected carefully and adapted to the specific site and local weather conditions to ensure adequate vine growth, yield and grape quality. Several desirable characteristics for a vineyard cover crop species have been suggested: low growing plants that produce enough seeds to regenerate itself are easier to control, nitrogen fixing plants contribute to supply grapevines with nitrogen at little or no extra costs.

### **OBJECTIVES**

1. To demonstrate short-term effects of different cover crop management treatments on grapevine performance.

2. To survey plant composition of the vineyard floor induced by cover crop manageme treatments.
3. To survey insect diversity and abundance within the vineyard.

To meet these objectives, a replicated experiment with three different soil management systems was established at Woodhall vineyard near Alpine, Oregon. Effects of cover crops on grapevine performance, composition of vineyard vegetation and insect abundance and diversity were evaluated.

## **MATERIALS AND METHODS**

### **Experimental design**

Three different cover crop treatments were established in a 17 year old 'Pinot noir' vineyard (clone UCD 22) at Alpine, Oregon. The existing perennial grass cover, composed predominantly of bentgrass (*Agrostis* sp) was compared to a treatment where the soil was tilled in spring to allow other resident species to emerge, particularly broad leaf species, and to a commercial insectary plant mixture of low growing plants sown in spring after tilling. The insectary plant mixture includes species from the Parsley (*Apiaceae*), Mustard (*Brassicaceae*) and Legume family (*Fabaceae*).

Each treatment was replicated four times, the replicates consisting of two adjacent inter-rows. Data were collected from five homogeneous vines per replicate in the rows with the same green cover on both sides. The vine rows with different treatments on each side served as guard rows and were not used for data collection. The plots were alternately mowed three times during the growing season (i.e. row middles were mowed when the plants of the neighboring rows began flowering).

### **Vegetative Growth**

At bloom (July 2), shoot length was measured and main and lateral leaves were counted on five shoots per replicate (one shoot per vine). At harvest (October 10), five average shoots per replicate from five different vines were collected, primary and lateral leaves counted and their leaf area measured.

### **Fruit set**

Prior to bloom, five inflorescence clusters per replicate were enclosed into pollination bags to retain all shed flowers. The bags were removed at the end of July and all the abscised flowers were counted. At harvest, these clusters were picked separately. The number of berries was counted. Number of flowers was calculated as the sum of shed flowers and berries. Percent fruit set was calculated as the ratio of berries at harvest and the total number of flowers per inflorescence.

**Gas exchange measurements** Gas exchange measurements were conducted three times (two weeks after full bloom, berries pea-sized, veraison) on the tenth main shoot leaf of one shoot per data vine (five vines per replicate). Leaf gas exchange was measured with a portable infra-red gas analyzer (Ciras- 1, PP SYSTEMS, Ietchin, Herts SG5 IRT UK). The measurements were carried out between 9:00 and

12:00 a.m., at photosynthetic flux densities above 1200  $\mu\text{mol. m}^{-2} \text{ s}^{-1}$  and cloudless skies. The sampled leaves were fully exposed to the sunlight. The air temperature ranged between 26 and 31°C. The measurement period started two weeks after full bloom.

### **Yield parameters and fruit composition**

The crop was harvested on October 10. Data vines were harvested individually. A sample of 12 clusters per vine was crushed for determination of soluble solids, titratable acidity and pH. A sample of five clusters per vine was used to estimate berry weights and number of berries per cluster. Cluster weight was calculated by averaging weight of the pooled 17 cluster sample.

### Plant composition of vineyard floor

Flowering plants were identified and counted in each plot on randomly selected 6 x 1 ft (0.54 m~) rectangles. Six samples per plot (24 samples or 12.96 m~ per treatment) were surveyed before the first time mowing of the row-middles (June 11).

Insect abundance and diversity Insects were sampled on three randomly selected circular plots (0.27 m2) per replicate. Twelve samples per treatment (3.2 m2) were surveyed. The insects were then collected into vials and stored in 75% alcohol. Identification and classification into 'pest insects', 'beneficial insects' and 'indifferent insects' will determine if only beneficial and indifferent insects increase in number and diversity whereas pest insects remain at a low level with increased botanical diversity as demonstrated in European vineyards.

## RESULTS AND DISCUSSION

Table 1 shows vegetative growth, fruit set and leaf area and table 2 yield parameters and fruit composition as affected by cover crop treatments. With the exception of percent fruit set, percent lateral shoot leaf area, titratable acidity and pH, grapevine responses, including main shoot length, main shoot leaf area, lateral shoot leaf area, yield and fruit composition were significantly lower for the grass treatment than for the resident plants treatment. The vines of the plant mixture treatment performed somewhat in between the vines of the other two treatments.

**Tab.1: Effects of cover crop treatments on grapevine performance**

	<u>Treatments</u>			significant F for treatment means
	resident plants	plant mixture	grass	
<u>vegetative growth</u>				
shoot length (cm)	110.4 a <sup>1</sup>	102.6 a	82.8 b	**2
total leaf area per vine (m <sup>2</sup> )	6.382 a	4.751 a	2.792 b	***
main shoot leaf area per vine (m <sup>2</sup> )	4.208 a	3.347 a	1.955 b	***
lateral shoot leaf area per vine (m <sup>2</sup> )	2.173 a	1.404 ab	0.837 b	*
main shoot leaf size (cm <sup>2</sup> )	119.5 a	113.4 a	78.3 b	***
lateral shoot leaf size (cm <sup>2</sup> )	30.8	29.1	22.4	ns
% lateral shoot leaf area per vine	32	22.6	23.7	ns

<sup>1</sup> means within rows which are separated by different letters are significantly different at the 5% level.

<sup>2</sup> ns, \*, \*\* and \*\*\* indicate not significant and statistically significant at the .05, .01 and .001 levels of probability, respectively.

Tab.2: Effects of cover crop treatments on yield and fruit composition

	<u>Treatments</u>			significant F for treatment means
	resident plants	plant mixture	grass	
<u>yield parameters</u>				
% fruit set	24	25.4	25.4	ns <sup>2</sup>
yield per vine (kg)	5.349 a <sup>1</sup>	3.62 b	2.46 b	**
yield per acre (tons)	4.629 a	3.135 b	2.132 b	**
cluster weight (g)	115.73 a	105.55 ab	85.76 b	*
berry weight (g)	1.16 a	1.19 a	1.02 b	***
<u>fruit composition</u>				
soluble solids (Brix)	22.97 a	23.05 a	22.13 b	***
titratable acidity (g/l)	9.2	9.04	8.79	ns
pH	3.05 b	3.08 a	3.06 b	*

<sup>1</sup> means within rows which are separated by different letters are significantly different at the 5% level.

<sup>2</sup> ns, \*, \*\* and \*\*\* indicate not significant and statistically significant at the .05, .01 and .001 levels of probability, respectively.

Figure 1 shows the gas-exchange patterns on three different measurement dates during the growing season. On July 26 (grape berries pea-sized) and August 21 (veraison), photosynthesis was lowest for plants with a grass cover. There were no significant differences in photosynthetic rate between vines with the plant mixture and vines with the resident cover. Competition for water and nutrients was higher for vines with a grass cover.

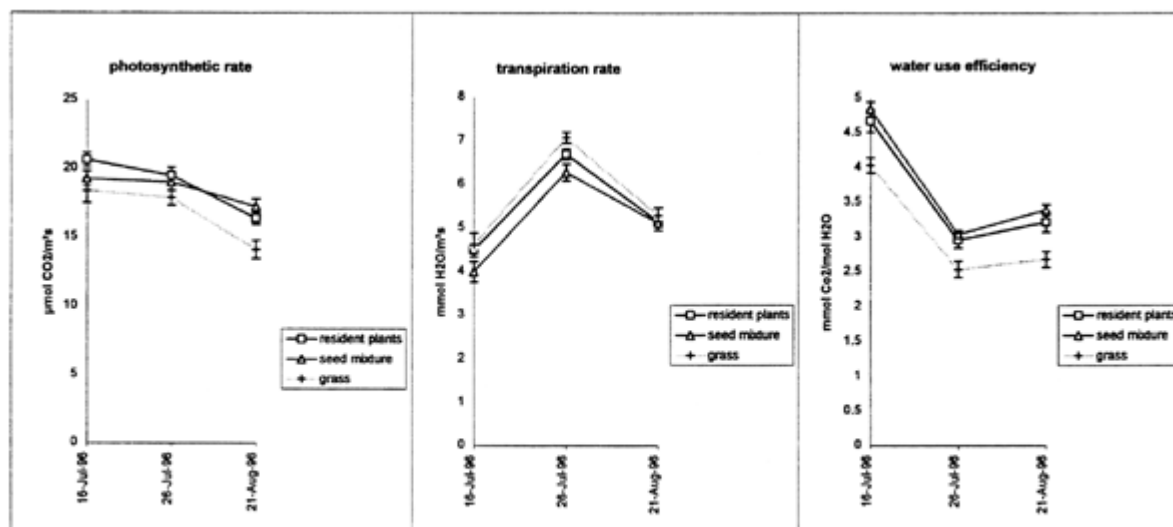


Fig. 1: Cover crop effects on photosynthesis, transpiration and water use efficiency of the 10th main leaf of 17year old 'Pinot noir' grapevines. Measurements taken between 9:00 am and 12:00 noon on three different cloudless, sunny days. Vertical bars indicate standard errors.

Transpiration rate was higher for vines with a grass cover than for vines with the seed mixture at the first two measurement dates (July 16, July 26) but at veraison (August 21) differences were no longer significant. Stomata control the balance between CO<sub>2</sub> entering the leaves for photosynthesis and the transpirational loss of water. A measure of carbon gain in relation to water loss is the water use efficiency (ratio of photosynthesis and transpiration). Water use efficiency of vines with a grass cover was lower than in the other two treatments (resident plants, seed mixture).

Plant composition of the three green cover treatments is listed in table 3. The grass treatment consisted of 98% bentgrass, the climax species in Western Oregon and 2% false dandelion (spotted catsear). The resident treatment had 32% bentgrass, 25% false dandelion (spotted catsear), 19% sowthistle and 24% other species. The insectary plant mix treatment was almost half (48%) covered with bentgrass, 22% clover, 13% sowthistle and 10% false dandelion. Other species were present in low numbers.

**Tab.3: Effects of cover crop treatments on vineyard floor plant composition**

<u>Plant species</u>		<u>Treatments</u>		
		resident plants	plant mixture	grass
		% surface covered		
Achillea sp	(western yarrow)	-	< 1 %	-
Agrostis sp	(bentgrass)	32%	48%	98%
Daucus carota	(wild carrot)	-	< 1 %	-
Hypochaeris radicata	(spotted catsear, false dandelion)	25%	10%	2%
Lolium sp	(ryegrass)	9%	-	-
Poa annua	(annual bluegrass)	4%	-	-
Rumex acetosella	(red sorrel)	-	< 1 %	-
Senecio vulgaris	(common groundsel)	7%	6%	-
Sonchus sp	(sowthistle)	19%	13%	-
Taraxacum officinalis	(common dandelion)	4%	-	-
Trifolium sp	(clover)	-	22%	-

Studies performed in European vineyards have shown that it may take 4 to 6 years for the transition from low to high botanical diversity. During this transition period grapevines will adapt their root systems. Because this is the second year studying a process which may occur gradually over several seasons, more pronounced differences in response to the green cover treatments can be expected in the future.

## REFERENCES

Remund, U.; U.Niggli and E.F.Boller. 1989. Faunistic and botanical survey in a vineyard in Eastern Switzerland. Influence of weed management on the agro-ecosystem. Landwirtschaft Schweiz. 2(7):393-408.