Cool Climate Oenology & Viticulture Institute

Brock University

Research Report: Use of Geotextiles to Reduce Freeze Injury in Ontario Vineyards

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Overview

Freeze injury is one of the greatest threat for success of the grape and wine industry in Ontario. In some areas cold sensitive *V. vinifera* grapes are grown where they cannot survive winter temperatures without some form of protection. In regions such as Prince Edward County, grapevines are commonly buried with soil for protection. Geotextiles are materials used for winter protection of crops, mainly in the nursery industry but are also used in some vineyards in Quebec where winter temperatures can be severe. There has been greater interest in these materials for vineyard use in Ontario and some growers are currently experimenting with them. Growers are concerned that through the process of burying/unburying vines soils can be damaged. Furthermore, bud loss can occur due to physical damage as well as rot, particularly in wet spring and falls. Finally, timing of application and removal and weather conditions are critical for good protection and prevention of premature bud break which can result in bud mortality due to freeze injury. Therefore, the use of geotextiles may be a way to eliminate these concerns and while helping to decrease labour costs and increase yields. There is also potential for these to be used to grow more cold sensitive varieties in Niagara.

Research objectives

1. Determine the effectiveness of geotextiles on mitigating damaging cold temperatures
2. Examine vine microclimate below the geotextile materials and how these impact bud hardiness and bud survival
3. Investigate different types of materials for objectives 1 and 2
4. Examine timing and removal of these materials on bud hardiness, bud survival and bud break
5. Help determine 'best practices' for using geotextile materials for cold protection in Ontario vineyards

Materials and Methods

Site selection and initiation of treatments (October – November, 2012)

Established vineyard blocks in Prince Edward County (Wellington, ON) and the Niagara Peninsula (Vineland, ON) were selected for geotextile trials. Two *V. vinifera* cultivars were chosen including a white (Chardonnay), and red grape (Pinot noir) cultivar. Geotextile materials were purchased from different suppliers based on manufacturer's recommendations and preliminary data from both the supplier and previous research trials (Willwerth and Appleby, 2011-12). The two materials used for this study included Hibertex Pro™ – Frost protection fabric (Dubois Agrinovation, Saint-Remi, QC) and ArboTherm™ (Texel, St. Elzéar de Beauce, QC). Hibertex Pro™ is a white non-woven fabric made of UV resistant polyester fiber. Arbotherm™ is a polyester felt on which a black LDPE has been applied

underneath in order to render it waterproof. Two different widths of these materials were used to ensure proper coverage of the grapevines. 1.75 m (6 ft) widths were used in Prince Edward County whereas 3.5 m (11.5 ft) widths of material were required for use in Niagara.

The geotextile materials were applied in vineyards during the week of November 13, 2012. The experimental design was a randomized block with a factorialized treatment arrangement, with four replicates. Different protection treatments included two geotextile materials, grapevines buried with soil (PEC only), and unprotected vines. Removal of materials at different periods of vine cold deacclimation (early and late) will be imposed on each treatment. At each location, different methods of using geotextiles were used. One method included placing the geotextile above canes which were laid down on a low wire (PEC) and the other where the geotextile was placed on a high wire above the fruiting zone (Niagara). Each treatment replicate consisted of a single panel of 5 vines. For panels of vines covered in geotextiles, canes were retained for the following season's growing season and laid on the low wire or fruiting wire for Prince Edward County and Niagara locations, respectfully (Images 1 and 2). Additional canes (min 8/panel) were also selected for cold hardiness and bud survival testing throughout the dormant period (Image 3). Geotextile materials were cut to length of panel with some additional material to allow for overlap around vineyard posts. The materials were placed above the appropriate wire, wrapped around vineyard posts and fixed to the ground using 15.24 cm (6 in.) galvanized anchor pins supplied by Dubois Agrinovation. HOBO Pro v2 temperature/rH data loggers (Onset Computer Corporation Inc., Bourne, MA) were deployed at each location to measure temperature and relative humidity at the vine microclimate level for each treatment (ambient, under geotextiles, under soil) (Image 4).

Summary of Treatments

- Unprotected vines
- Buried vines [x early and late removal] (PEC only)
- Vines under geotextile [x 2 materials x early and late removal]

Additional treatments: 2 methods (near ground above laid cane vs. tented on high wire above fruiting zone)

Progress and tentative results to date

The 2012/13 geotextile trials to study different winter protection strategies for grapevines commenced in November 2012. In both, Prince Edward County and the Niagara Peninsula experimental blocks were designed and appropriate treatments initiated using different protection strategies as described above. Temperature data loggers were deployed to monitor temperatures of grapevines used for the various treatments. Recent temperature data including monthly mean, maximum and minimum temperatures can be found in Tables 1 and 2. Thus far, geotextile materials have been shown to impact mean vineyard temperatures as well as minimum and maximum temperatures reached during each monthly period. In most cases, all of these temperatures are higher than the control (ambient temperatures) reached during the dormant period. As shown in Table 1, when damaging winter temperatures were reached in Prince Edward County (i.e. events below -20°C), the geotextile materials mitigated these temperatures by a few degrees. Vines that were buried with soil also were protected from these damaging temperatures where bud damage exceeded 50% (data not shown).

Temperature data varied across protection methods and sites. Some materials appear to have more variability in daily minimum and maximum temperatures whereas soil temperatures were more consistent and did not exhibit as wide of a range in temperature extremes (Tables 1 and 2). Materials placed closer to the ground such the experiments in Prince Edward County seem to be more effective in temperature mitigation (Table 1). This may possibly due to more geothermal influence through being closer to the ground and/or due to snow cover. During periods where geotextiles were covered with snow, as shown in Image 2, temperatures were less variable with less extreme temperatures. This is likely due to the snow acting as an additional layer of insulation. Thus far, the larger materials 'tented' over the standard VSP trained grapevines in Niagara do not seem to be as effective in temperature mitigation (Table 2).

Temperatures are continued to be monitored throughout the course of the experiment and documentation of weather events (i.e. snow cover).

Grapevines cold hardiness testing has been ongoing since December and data analyzed to date can be found in Tables 3 and 4. Thus far, the geotextile materials are having some minor impacts on grapevine cold hardiness with some slight reductions in hardiness levels (particularly LTE10 values). These findings are likely due grapevines being exposed to higher temperatures during the dormant period. For example, Chardonnay in Prince Edward County did not acclimate as rapidly and this is likely due to higher temperatures during the months of November and December (see Table 1). No bud testing was possible for buried grapevines however; based on temperatures recorded below the soil these grapevines will have reduced hardiness. Once soils are unfrozen, vines will be uncovered in March and this will allow for bud hardiness comparisons to be made among all protection treatments. As grapevines move from a state of endodormancy to ecodormancy (dormancy induced by temperature only) variations in temperatures imposed by these treatments will likely have a larger impact on grapevine cold hardiness. During deacclimation (in a few weeks) and leading up to bud break these data will be collected and the impact of protection methods will be elucidated.

Future work

Temperature monitoring (March 2013 – May 2013)

Throughout the dormant period temperatures will be recorded under geotextiles, soil, as well as vineyard ambient temperature using temperature and relative humidity data loggers.

Bud hardiness and bud survival assessments (March 2013 – May 2013)

Buds will be sampled for protected vines as well as for those left unprotected. Cold hardiness ratings will be determined through differential thermal analysis every 3 weeks throughout the dormant period. Following removal of textiles and de-hilling, bud hardiness and bud survival assessments will be performed.

Removal of material (March 2013-May 2013)

Removal of soil and geotextiles will occur at two times during deacclimation (early and late) in order to determine the impact on bud break as well as 'best practices' to maximize hardiness and increase survival.

Statistical analysis and report (May 2013)

Statistical analysis and report of findings to date will submitted

Bud break, shoot growth and yield components (May 2013- September 2013)

Following the dormant period, timing of bud break, final bud survival, vine performance and yield components will be documented for the various treatments to determine the impact of different winter protection strategies on production.

Conclusions

This study will provide grape growers information on the use of geotextile materials for winter protection in vineyards in Ontario. Specifically, this project will be one of the first studies to determine the usefulness of these materials and their impact on bud hardiness, bud survival and bud break. Results from this study will be useful for determining best practices for winter protection strategies particularly in colder regions such as Prince Edward County or for use on very cold sensitive varieties in other appellations.

Table 1. Vine microclimate temperatures during the dormant season using different grapevine protection methods within Prince Edward County. Wellington, ON. (2012-13).

November (last 2 weeks of the month)				
	Ambient	Polyester felt	Polyester felt with black LDPE	Under Soil
Monthly mean temperature (°C)	1.01	1.14	1.15	1.76
Absolute Maximum temperature (°C)	12.10	16.54	13.79	9.63
Absolute Minimum temperature(°C)	-8.67	-7.27	-5.95	-2.95
December				
	Ambient	Polyester felt	Polyester felt with black LDPE	Under Soil
Monthly mean temperature (°C)	-0.26	-1.57	0.53	1.22
Absolute Maximum temperature (°C)	15.34	9.26	14.7	10.54
Absolute Minimum temperature(°C)	-11.33	-6.55	-6.99	-3.07
January				
	Ambient	Polyester felt	Polyester felt with black LDPE	Under Soil
Monthly mean temperature (°C)	-3.47	-2.96	-2.78	-1.54
Absolute Maximum temperature (°C)	13.38	17.42	16.37	8.74
Absolute Minimum temperature(°C)	-23.41	-19.07	-19.38	-10.27
February				
	Ambient	Polyester felt	Polyester felt with black LDPE	Under Soil
Monthly mean temperature (°C)	-6.54	-3.74	-3.16	-1.52
Absolute Maximum temperature (°C)	5.54	6.84	5.95	-0.09
Absolute Minimum temperature(°C)	-25.38	-17.64	-13.97	-6.52

Table 2. Vine microclimate temperatures during the dormant season using different grapevine protection methods within the Niagara Peninsula. Vineland, ON. (2012-13).

November (last 2 weeks of the month)			
	Ambient	Polyester felt	Polyester felt with black LDPE
Monthly mean temperature (°C)	0.93	1.13	0.76
Absolute Maximum temperature (°C)	10.12	13.11	14.00
Absolute Minimum temperature(°C)	-5.79	-6.77	-6.55
December			
	Ambient	Polyester felt	Polyester felt with black LDPE
Monthly mean temperature (°C)	2.25	2.32	2.00
Absolute Maximum temperature (°C)	18.27	19.82	19.63
Absolute Minimum temperature(°C)	-11.18	-9.85	-9.92
January			
	Ambient	Polyester felt	Polyester felt with black LDPE
Monthly mean temperature (°C)	-1.09	-0.67	-0.90
Absolute Maximum temperature (°C)	17.13	18.41	17.99
Absolute Minimum temperature(°C)	-15.51	-14.62	-15.16
February			
	Ambient	Polyester felt	Polyester felt with black LDPE
Monthly mean temperature (°C)	-3.61	-2.38	-2.67
Absolute Maximum temperature (°C)	8.64	15.51	11.81
Absolute Minimum temperature(°C)	-13.51	-13.87	-13.35

Table 3. Predicted grapevine bud cold hardiness ratings for Chardonnay and Pinot noir using different protection strategies within Prince Edward County. Wellington, ON. (2012-13).

Chardonnay								
Treatment	Date	LTE10	LTE50	LTE90	Date	LTE10	LTE50	LTE90
Control	05-Dec-12	-21.37	-23.38	-25.15	29-Jan-13	-17.81	-23.75	-25.58
Polyester felt with black LDPE	05-Dec-12	-20.7	-22.56	-25.19	29-Jan-13	-17.54	-23.73	-26.29
Polyester felt	05-Dec-12	-17.81	-21.69	-23.64	29-Jan-13	-20.49	-23.84	-25.79
	Pinot Noir							
Treatment	Date	LTE10	LTE50	LTE90	Date	LTE10	LTE50	LTE90
Control	05-Dec-12	-19.35	-23.31	-25.01	29-Jan-13	-19.14	-24.55	-26.25
Polyester felt with black LDPE	05-Dec-12	-19.98	-22.57	-24.09	29-Jan-13	-18.79	-24.01	-26.12
Polyester felt	05-Dec-12	-20.54	-22.63	-24.14	29-Jan-13	-22.57	-24.79	-25.89

Table 4. Predicted grapevine bud cold hardiness ratings for Chardonnay and Pinot noir using different protection strategies within the Niagara Peninsula. Vineland, ON. (2012-13).

Chardonnay								
Treatment	Date	LTE10	LTE50	LTE90	Date	LTE10	LTE50	LTE90
Control	11-Dec-12	-20.74	-21.9	-23.05	15-Jan-13	-21.54	-22.49	-23.98
Polyester felt with black LDPE	11-Dec-12	-20.06	-21.97	-23.15	15-Jan-13	-20.77	-21.99	-23.58
Polyester felt	11-Dec-12	-18.68	-21.62	-23.17	15-Jan-13	-19.25	-21.93	-23.61
Pinot Noir								
Treatment	Date	LTE10	LTE50	LTE90	Date	LTE10	LTE50	LTE90
Control	11-Dec-12	-21.63	-23.18	-24.57	15-Jan-13	-20.77	-22.71	-24.44
Polyester felt with black LDPE	11-Dec-12	-19.61	-22.47	-24.32	15-Jan-13	-20.69	-23.01	-24.93
Polyester felt	11-Dec-12	-20.94	-22.76	-24.05	15-Jan-13	-20.98	-22.97	-24.58

Image 1. Experimental vineyard using geotextile materials for winter cold protection in the Niagara Peninsula.Vineland, ON.

Image 2. Experimental vineyard using geotextile materials for winter cold protection in Prince Edward County. Wellington, ON.

Image 3. Selection and tying of grapevine canes to be used for cold hardiness testing and bud survival assessments prior to covering with geotextile material.

Image 4. Data loggers used to monitor impact of geotextiles on vine microclimate