Using geotextile to modify the grapevine winter microclimate in Québec, Canada

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OBJECTIVES and CONTEXT

Characterize the influence of three commercially available geotextiles on the grapevine microclimate and determine their impact on winter injury, vine phenology and yields.

- Cold temperatures represent the greatest abiotic threat to cool climate viticulture (Fennell 2004)
- Québec is host to 158 wineries, and more than 50% of them grow at least one *Vitis vinifera* cultivar or one cold-sensitive interspecific hybrid (Conseil des vins du Québec 2021)
  - This trend is not going away – the proportion of *V. vinifera* planted in Québec has increased 5-fold since 2014 (Conseil des vins du Québec 2021)
- Mid-winter, the lethal temperatures of these cultivars in the neighbour region of Prince Edward County are between -15°C to -25°C (VineAlert 2022), and the lowest winter temperatures in Québec can reach -30°C or below.
- Québec grape growers are gradually shifting from hilling up (burying in soil) to using geotextile covers to protect the vines during the winter, but there is an important gap in the winter-protection literature regarding their use
- This project is one of many overseen by our research centre with the overarching goals of better understanding how to use geotextiles and characterize their impacts.

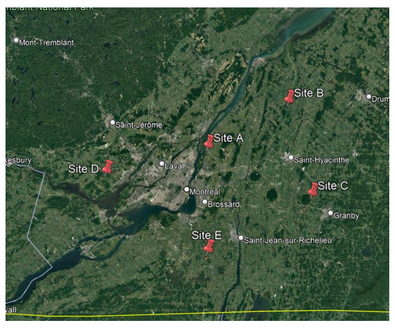
Left: Geotextile cover after installation in November before first snow
Right: Snow cover on the geotextile in the middle of the winter

MATERIALS and METHODS

Experimental design: 5-vines to 7-vines replicates were selected and covered by one of the three geotextile materials in randomized complete block design over four blocks. Cultivar tested were Chardonnay, Pinot noir and Vidal. Experiment was replicated three years in each commercial vineyard. Data was collected for the middle 3 to 5 vines depending on the number of vines.

Table 1: Breakdown of the sites and cultivars studied to evaluate the impact of the types of geotextiles. The study was replicated on all sites for three subsequent years.

Site	Cultivar	Years
Site A	Chardonnay, Pinot noir, Vidal	2018, 2019, 2020
Site B	Pinot noir	2019, 2020, 2021
Site D	Vidal	2020, 2021, 2022
Site E	Chardonnay	2020, 2021, 2022



Microclimate: temperatures and relative humidity (%) were recorded in the vineyard and under each type of geotextile with HOBO sensors.

Winter injury: primary bud survival was determined by dissection following the removal of geotextiles

Vine phenology: phenological stages were determined following the extended BBCH scale (bud break: stage 7; full bloom: stage 65)

Yields: yield per vine and number of clusters for the three to four middle vines in each rep were determined immediately prior to commercial harvest

Statistical analysis: Vineyards were analyzed individually because data collection is ongoing and currently uneven between sites. Two-way analysis of variance (ANOVA) was used to determine the differences between the types of geotextiles on temperatures, yields, and survival within each vineyard and the variation between years. Significantly different means were separated by Tukey post-hoc test ($p < 0.05$). All statistical evaluations were performed with XLSTAT version 2021.4.1 (Addinsoft, Paris, France).

RESULTS

TEMPERATURES

How cold does it get under the geotextiles?

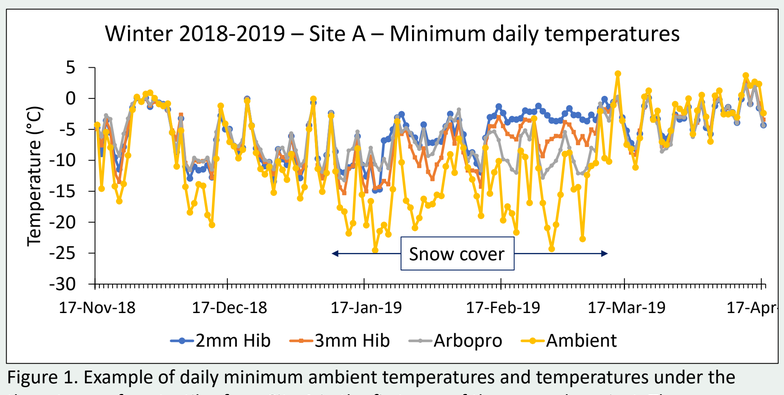


Figure 1. Example of daily minimum ambient temperatures and temperatures under the three types of geotextiles from Site A in the first year of the research project. The snow cover appeared in the first days of January and melted by mid march.

- Temperatures below the geotextiles are above lethal temperatures for *V. vinifera* and interspecific hybrid Vidal
- Presence of snow cover greatly impacted the temperatures below geotextiles.

Is there a difference between the types of geotextiles?

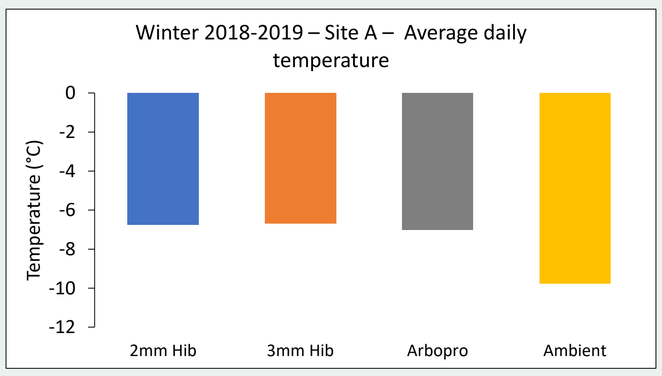


Figure 2: Example of the mean daily temperature under the three geotextiles and the ambient temperatures. There were no significant differences between the three types of geotextiles.

Table 2: Example of the mean daily temperature under the three geotextiles and the ambient temperatures. Data collection is still ongoing for site B, D and E.

	Temperatures under geotextiles (°C)			
Factor	Site A	Site B	Site D	Site E
2mm Hib	-6.1	-3.2 b	-7.5	-6.1
3mm Hib	-6.3	-1.9 a	-6.8	-5.5
Arbopro	-6.0	-2.5 ab	-7.3	-5.7
Significance	NS	0.004	NS	NS
year 1	-6.8	N/A	-5.3	-4.5
year 2	-5.8		-9.2	-7.0
year 3	-5.9		-	-
Significance	< 0.001		< 0.0001	< 0.0001
Geotextile*year significance	NS	N/A	0.048	NS

- There are no differences in temperature under the geotextile regardless of the type of geotextile selected
- There are differences annually in the ambient temperatures on each site (data not shown), and this difference is reflected in the significant differences between the year
- The general lack of geotextile*year interaction signifies that the relationship between the geotextile is stable from year-to-year.

BUD SURVIVAL and PHENOLOGY

Is there an impact on the phenology or on primary bud survival?

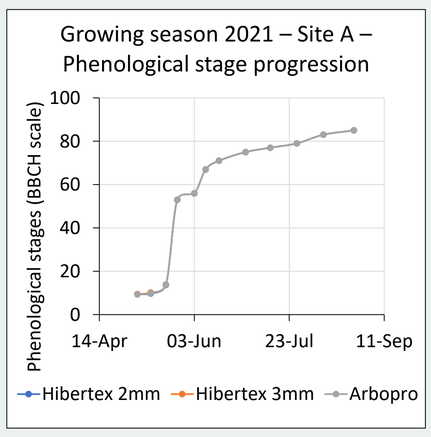


Figure 3: Example of the grapevine development following the 2020-2021 dormant season for the three types of geotextiles

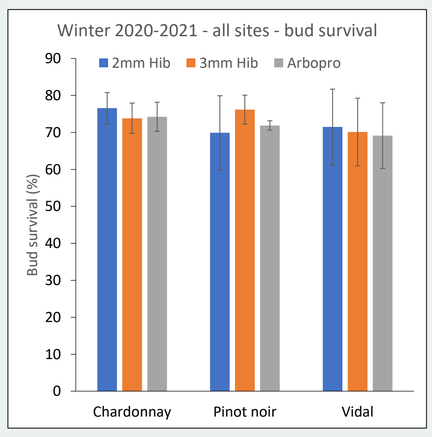


Figure 4: Example of bud survival following the 2020-2021 dormant season. There are not significant differences.

- Because of the lack of impact on temperatures, the types of geotextile did not impact the progression of grapevine development throughout the growing season.
- There were also no differences in primary bud survival between the three types of geotextiles for all cultivars on all site tested ($p > 0.05$).

YIELDS

Are the similarities in bud survival reflected in the number of cluster and yield per vine?

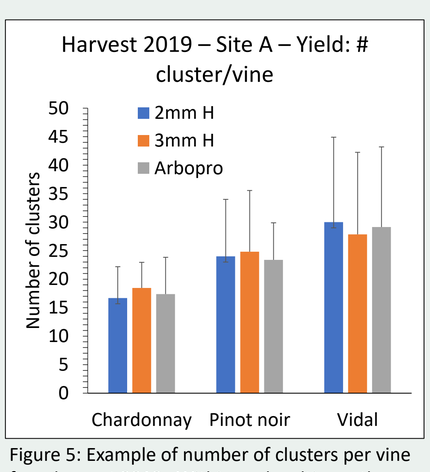


Figure 5: Example of number of clusters per vine from harvest 2019. Within each cultivars, there are no differences between the types of geotextiles

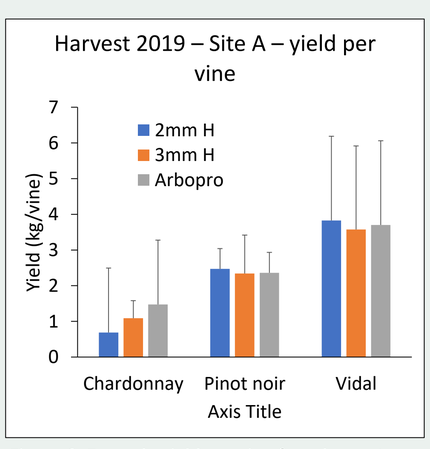


Figure 6: Example yield per vine from harvest 2019. Within each cultivars, there are no differences between the types of geotextiles

- As expected from the lack of difference in bud survival, there were no differences in yield and cluster number.

CONCLUSIONS

- Geotextiles were particularly helpful to increase the temperature around the vines during mid-winter, and the presence of a snow cover was an important contributor to their insulation factor
- Our research does not allow us to identify a superior material or thickness for geotextile fabric. The three geotextiles performed similarly in terms of protecting the vines, and this result was corroborated by our phenology, bud survival and yield observations.

LITERATURE CITED

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