Cost Benefit Analysis for Cold Protection of a *Vinifera* Vineyard in Western Massachusetts.

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Cost-Benefit Analysis for Cold Protection Treatments at the Black Birch Vineyard, Hatfield, MA.
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SUMMARY:

Procedures: Eight treatments to protect vines from extreme cold events were tested on Cabernet Franc vines in a western Massachusetts vineyard over a 2-year period. Treatments included: vine burial, a proprietary plant hormone spray (ChillBan) used only in year-1 due to availability, and row coverings with 6 mil sheet plastic in either single or double layers, or with a single layer of a nonwoven geotextile thermal barrier (Hibertex™). In one treatment, the plant hormone treatment was combined with Hibertex covering in year-1, and Hibertex was also used separately both as a low hoop covering and a whole trellis covering; the latter was termed "high trellis hoop". Berry yield value per 12-plant row was calculated based solely on the costs of yearly pruning and harvest. Costs for each treatment were calculated as the cost of the materials required for each treatment, plus the labor costs required to apply the treatment ($18/hr wage). Labor costs for treatment removal or unburial and reattachment of the vine to the trellis was also included when coverings or vine burial was done. Row covering or vine burial was conducted in late November to early December. Covering removal and unburial of vines that were buried was done in early March. All treatments were conducted on 2 rows of 12 vines (24 plants/treatment) except for the Controls which were 3 rows of 36 vines. The second-year results are discussed.

Results and Discussion: Uncovered vines (controls and ChillBan with no cover), and single the plastic covering, generally yielded lower average berry weight per row compared to other treatments (Table 1). Observations of vines after row covering removal in the spring showed that plastic coverings had more rodent damage, and this damage was present even in the upper regions of the cordons. The double plastic low hoop covering provided higher berry yields than the single plastic low hoop covering, but the double plastic treatment still suffered some rodent damage resulting in lower yields compared to the best treatments.

High yielding treatments included the Hibertex high trellis hoop and Hibertex low hoop (with or without ChillBan), and vine burial. The Hibertex high trellis hoop treatment stood out because it was one of the best berry yield treatments providing approximately enough value over and above the costs of materials and labor to also cover the costs of pruning of control vines. In addition, the high trellis hoop Hibertex covering was quicker and easier to install, remove and store without the need to prune extensively prior to covering the vines in the winter. Vine burial stood out because of high berry yield, but labor costs for burial and unburial were high and exceeded the costs of treatment. However, for vineyards with low-cost labor, vine burial may be a good option. The performance of ChillBan could not be assessed because supply was unavailable for year-2 treatments. However, in year 2 the Hibertex low hoop treatment combined with ChillBan was one of the top yielding treatments even though ChillBan without row covering provided no, or even negative, benefit compared to controls. The costs for mist application were high causing this treatment to exceed the added value of the treatment; however, as with all treatments, costs would be reduced with scale-up. Thus some treatments that did not show a net positive value in this study (Table 2) might provide more value once scaled for an entire vineyard. Similarly, mechanization of processes ranging from vine burial to the installation of fabric could reduce costs and improve the net value of treatments.

The data suggest that in northern vineyards with *Vinifera* grafted vines that experience even occasional nighttime temperatures below -20º C that vine coverings with a thermal geotextile can provide significant benefit. Cost and yield calculations (Table 2) show that both low hoop and high trellis hoop coverings with the nonwoven Hibertex geotextile would provide cost-effective treatments for increasing yield. The high trellis hoop Hibertex treatment provided a highly cost-effective treatment because of the boost in yield and ease in installation/removal.

BACKGROUND INFORMATION AND COSTS:
•Labor Costs: $18/h
•One Row of Grapes = 12 plants (vines)
•Value of Grapes to the Vineyard Owner: Based on Cost of Pruning plus Cost of Harvest of Controls ($27/row), divided by Control Yield (4547.3 g/Row): 1000g = $5.94. US$5.94/kg harvest weight
•Conversion of Yield/kg of Grapes per 12-vine Row to US Dollars in Table 1.

Material Costs per Row:
Hibertex Low Hoop (10 yr. lifetime) = $69.72. Divided by 10 yrs = $6.97/y
Hibertex High Hoop (10 yr. lifetime) = $139.44. Divided by 10 yrs = $13.94/yr
Plastic (6 mil) Double (6 yr. lifetime w/ 4yr UV): $75 x 2 = $150. Divided by 6 yrs = $25/yr
Plastic (6 mil) Single (6 yr. lifetime w/ 4yr UV) = $75. Divided by 6 yrs = $12.50/yr.
ChillBan Cost = $0.23/row of 12 plants, 2x applications per year = $0.43/year

Table 1. Grape cluster yield (kg) per 12-plant row and calculated dollar yield per row based on a $5.94/kg of grapes value to Black Birch Vineyard.

Cold protection row treatment	Average Grape cluster yield (g) per vine. [Std Dev]	Grape cluster yield average per row (g)	Grape cluster yield per 12-vine row, converted to US dollars based on $5.94/kg value to Black Birch vineyard
High Trellis hoop – Hibertex	945.5[567.2]	11345.7	$ 67.39
Low hoop – Hibertex + ChillBan	927.4[555.9]	11128.3	$ 66.10
Vine Burial	915.3[958.5]	10983.7	$ 65.24
Low hoop – Hibertex	734.2[502.8]	8810.2	$ 52.33
Low hoop – double plastic	639.4[572.4]	7672.2	$ 45.57
Control (36 vines)	378.9[363.7]	4547.3	$ 27.01
ChillBan No Cover-2	294.8[288.3]	3537.4	$ 21.01
Low hoop – single plastic	164.3[97.4]	1971.4	$ 11.71

Time/Labor Costs Per Row

High Hoop (2x laborers)

Hibertex: winter-placement and spring-removal = 20 min + 10 min = 30 min
Hibertex: Pruning (Spring): 30 min
TOTAL (2 laborers): 120 min = $36/row

Low Hoop (2x laborers)

Hibertex: winter-placement and spring-removal = 30 min + 15 min = 45 min
Hibertex: Pruning (Fall): 30 min
TOTAL (2 laborers): 150 min = $45/row

Plastic: Single layer winter-placement and spring-removal = 30 min + 15 min = 45 min
Plastic: Pruning (Fall) Single layer: 30 min
TOTAL (2 laborers): $45/row

Plastic: Double layer winter-placement and spring-removal = 40 min x 20 = 60min

Plastic: Pruning (Fall) Double layer: 30 min
TOTAL (2 laborers): $54/row

Vine Burial (2x laborers)

Pruning and burial (Autumn, digging not mechanized): 40 min
Unburial and Re-attachment to trellis (springtime): 80 min
TOTAL (2 laborers): $72/row

ChillBan no-cover (single laborer)

Application with Backpack Mist Blower (1 person): 2 hrs x 2x applications/year = 4 hrs
TOTAL (single laborer): $72/row

Controls (2 laborers)

Pruning: 30 min. (2 laborers) = 1 hr. TOTAL: $18/row

Table 2. Total yearly costs per row, and yield value comparison, for each cold protection treatment.

Treatment	Cost of Labor/Row	Cost of Materials/Row	Total Costs/ Row	**$ Value/Row** (from Table 1)	**Net $ Value/Row** (minus Costs)
**Hibertex High Trellis Hoop	$36	$13.94	$49.94	$67.39	$17.45
Hibertex Low Hoop + ChillBan	$45 + $72	$6.97+ $0.43	$124.40	$66.10	-$58.30
Vine Burial	$72	0	$72	$65.24	-$6.76
*Hibertex Low Hoop	$45	$6.97	$51.97	$52.33	$0.36
Plastic Double, Low Hoop	$54	$25 (2-layer)	$79	$45.57	-$33.43
*Controls	$18	0	$18	$27.01	$9.01
Chillban, 2x/yr. no cover (1st yr)	$72	$0.43	$72.43	$21.01	-$51.42
Plastic Single, Low Hoop	$45	$12.50 (1-layer)	$57.50	$11.71	-$45.79

*Treatments where the "Net Value" for application of a specific treatment is positive.

**Treatment where the "Net Value" provided enough benefit to approximately equal costs of all pruning of the control vines.