Disease Susceptibility of Cold-Climate Grapes in Vermont, USA

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INTRODUCTION

- Cold-climate grape production continues to expand in Vermont.
- Development of several new grape cultivars able to survive -34° to -37° C winter temperatures offers growers more cultivar choices appropriate for northern climates.
- These new inter-specific cultivars are also bred to offer disease resistance.
- Evaluation of disease incidence and severity of selected cold-climate wine grape cultivars is necessary to select the best cultivars for Vermont.

METHODS

- The research vineyard was established in 2007 at the UVM Horticulture Research Center in South Burlington, VT (lat. 44.43162, long. -73.20186).
- 'Corot Noir', 'Frontenac', 'La Crescent', 'Marquette', 'Prairie Star' and 'St. Croix' were planted in a randomized complete block design of six blocks with four-vine plots of each cultivar per block at 1794 vines/ha density.
- All vines received the same fungicide treatments and frequency of treatments based on environmental conditions and pathogen lifecycles, totaling five in 2014 and six in 2015.
- Foliar and fruit cluster disease incidence and severity assessments were performed each growing season on twenty leaves per four-vine plot and ten randomly selected clusters per four-vine plot and included: powdery mildew (*Erysiphe necator*); downy mildew (*Plasmopara viticola*); black rot (*Guignardia bidwellii*); Phomopsis leaf spot and fruit rot *(Phompsis viticola*) angular leaf scorch (*Pseudopezicula tetraspora*); anthracnose (*Elsinoe ampelina*); and Botrytis bunch rot and blight (*Botrytis cinerea).*
- Cultivar data were compared using analysis of variance (PROC GLM) and pairwise comparisons Tukey's Honest Significant Difference (HSD) test.

RESULTS

- Powdery mildew was the most prevalent disease on foliage and clusters and was detected in all cultivars in both growing seasons.
- In 2014, 'Corot Noir' had significantly lower foliar powdery mildew incidence than any other cultivar. Severity (area infected) of powdery mildew was significantly higher in 'Prairie Star' foliage compared with all other cultivars except 'La Crescent'. In 2015, 'Corot Noir' ranked the lowest numerically in foliar powdery mildew incidence and exhibited significantly less severe symptoms than all other cultivars except 'La Crescent'.
- In both growing seasons, powdery mildew incidence in clusters was above 93% and there were no significant differences among cultivars. The severity of powdery mildew on 'Prairie Star' clusters was significantly higher than any other cultivar in 2014. In 2015, 'La Crescent' had the highest percent severity.
- In 2014, there were no significant differences among cultivars for foliar downy mildew incidence and severity. In 2015, 'Corot Noir' foliage had the highest amount. Downy mildew was not observed on any fruit clusters in the two years of the study.

Table 1. Comparison of percent incidence and severity of powdery mildew and downy mildew symptoms on grape foliage and clusters in 2014 and 2015.

	Powdery Mildew [1]							
	2014				2015			
	Foliage		Cluster		Foliage		Cluster	
Cultivars	% Inc. [2]	% Sev. [2]	% Inc.	% Sev.	% Inc.	% Sev.	% Inc.	% Sev.
Corot Noir	60.00 b	5.28 c	100.00	7.57 b	90.00	9.77 b	100.00	13.98 ab
Frontenac	89.17 a	22.15 bc	100.00	4.88 bc	100.00	39.96 a	100.00	8.74 b
La Crescent	96.67 a	28.18 ab	100.00	3.04 c	100.00	32.43 ab	100.00	16.87 a
Marquette	97.50 a	20.77 bc	100.00	4.57 bc	99.17	42.60 a	100.00	8.90 b
Prairie Star	100.00 a	46.85 a	100.00	15.12 a	98.33	43.84 a	100.00	14.68 ab
St. Croix	95.00 a	12.42 bc	93.33	4.06 bc	98.33	36.65 a	98.33	11.44 ab

	Downy Mildew [1]							
	2014				2015			
	Foliage		Cluster		Foliage		Cluster	
Cultivars	% Inc.	% Sev.	% Inc.	% Sev.	% Inc.	% Sev.	% Inc.	% Sev.
Corot Noir	10.83	0.47	0.00	0.00	63.33 a	11.68 a	0.00	0.00
Frontenac	0.00	0.00	0.00	0.00	4.17 c	0.10 c	0.00	0.00
La Crescent	16.67	1.91	0.00	0.00	49.17 ab	4.76 ab	0.00	0.00
Marquette	0.00	0.00	0.00	0.00	2.50 c	0.08 c	0.00	0.00
Prairie Star	16.67	5.03	0.00	0.00	32.50 abc	1.03 bc	0.00	0.00
St. Croix	8.33	0.76	0.00	0.00	16.67 bc	0.66 bc	0.00	0.00

[1] Values represent the mean from 6 replicate, four-vine plots per cultivar of 20 leaves or 10 clusters per plot. Disease severity (area infected) was rated using the Horsfall-Barratt scale and converted to percentages using the Elanco's conversion tables. Means followed by the same letters within columns are not significantly different according to Tukey's Honest Significant Difference (HSD) Test ($p \leq 0.05$).
[2] Inc. = Incidence; Sev. = Severity

Table 2. Comparison of percent incidence and severity of black rot, Phomopsis fruit rot, anthracnose and Botrytis bunch rot symptoms on grape clusters in 2014 and 2015.

	Black Rot [1]						Phomopsis fruit rot [1]			
	2014				2015		2014		2015	
Cultivars	% Inc. [2]		% Sev. [2]		% Inc.	% Sev.	% Inc.	% Sev.	% Inc.	% Sev.
Corot Noir	1.67 ab		0.04 ab		8.33 cd	0.20 bc	0.00 b	0.00 b	0.00 b	0.00 c
Frontenac	0.00 b		0.00 b		68.33 a	1.83 a	18.33 a	0.51 a	46.67 a	1.21 ab
La Crescent	10.00 a		0.23 a		20.00 bc	0.47 abc	3.33 b	0.08 b	48.33 a	1.21 ab
Marquette	3.33 ab		0.08 ab		43.33 ab	2.65 a	0.00 b	0.00 b	58.33 a	1.79 a
Prairie Star	8.33 ab		0.20 ab		45.00 ab	1.21 ab	0.00 b	0.00 b	28.33 a	0.66 b
St. Croix	0.00 b		0.00 b		0.00 d	0.00 c	0.00 b	0.00 b	5.00 b	0.12 c

	Anthracnose [1]				Botrytis bunch rot [1]			
	2014		2015		2014		2015	
Cultivars	% Inc.	% Sev.	% Inc.	% Sev.	% Inc.	% Sev.	% Inc.	% Sev.
Corot Noir	1.67	0.04	0.00 b	0.00 b	0.00	0.00	5.00 b	0.12 b
Frontenac	0.00	0.00	1.67 ab	0.04 ab	0.00	0.00	5.00 b	0.12 b
La Crescent	0.00	0.00	8.33 a	0.20 a	0.00	0.00	1.67 b	0.04 b
Marquette	3.33	0.08	0.00 b	0.00 b	3.33	0.08	25.00 a	0.66 a
Prairie Star	0.00	0.00	3.33 ab	0.08 ab	1.67	0.04	0.00 b	0.00 b
St. Croix	0.00	0.00	0.00 b	0.00 b	5.00	0.12	8.33 b	0.20 b

[1] Values represent the mean from 6 replicate, four-vine plots per cultivar of 20 leaves or 10 clusters per plot. Disease severity (area infected) was rated using the Horsfall-Barratt scale and converted to percentages using the Elanco's conversion tables. Means followed by the same letters within columns are not significantly different according to Tukey's Honest Significant Difference (HSD) Test ($p \leq 0.05$).
[2] Inc. = Incidence; Sev. = Severity

- The foliar diseases angular leaf scorch, black rot, anthracnose, *Phomopsis* leaf spot and *Botrytis* blight were not observed or were at low levels and there were no significant differences among cultivars in incidence or severity during the course of the study.
- Higher percent incidences of black rot and Phomopsis fruit rot were observed than anthracnose and Botrytis bunch rot, especially in year two of the study, perhaps in part due to wetter June in 2015.
- Incidence of black rot was zero in 'St. Croix' in both years and numerically highest in 'La Crescent' in 2014 and 'Frontenac' in 2015. 'Frontenac' had significantly more incidence and severity of Phomopsis fruit rot than any other cultivar in 2014 and in 2015.

DISCUSSION

- Disease was higher in 2015 than 2014 perhaps as result of over 11 cm more rainfall during June 2015 compared with June 2014.
- Five (2014) or six (2015) fungicide applications were applied. On average, nine fungicide spray applications during each growing season are typical for wine grapes in the region.
- It is impossible to know whether disease incidence was higher due to ineffective fungicide protection during critical infection periods or whether disease was higher due to higher levels of inoculum since the design of the vineyard precluded the incorporation of non-sprayed plots for comparison.

CONCLUSION

Since innovative training systems may impact fungicide spray penetration and coverage and influence disease incidence, future research incorporating non-sprayed plots, multiple fungicide programs, innovative training systems and assessment of yield and marketability is necessary to critically evaluate and select suitable cultivars for northeast conditions.

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