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Growing Grapes in Cold Climate

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Abstract

Twenty grapevines genotypes were evaluated under four winter protections methods at three locations in Quebec (Canada) differing in soil and microclimate conditions. Higher yielding was recorded at Frelighsburg for 'Vandal Cliche' and 'St. Croix' followed by 'ES-4-7-25' and 'St. Pepin' with M1 and M2 winter protection. Geotextile covering (M3) seems more effective for tender and semi-hardy genotypes. Burial method (M4) of 'Seyval blanc' seems not effective; it decreases yield and vigour and increases mortality. Higher survival levels were observed at Frelighsburg compared to other locations due its south slope, sandy well drained soil and excellent winter production by snow cover. In both commercial vineyards more than 50 % mortality was observed for semi-hardy genotypes 'ES-6-12-28', 'GR-7' and 'Lucie Kuhlmann' followed once again by 'Siegerrebe', 'Vidal' and 'SV-18-307' tender genotypes. It seems that site location is the most important limiting factor followed by the choice of cultivar. The use of Geotextile seems to be an excellent alternative to burial soil which causes spoil born diseases and increase the production cost.

Introduction

The major limiting factor to vineyard production in Quebec is low temperature injury (Dubois and Deshaies, 1997). The majority of Quebec commercial vineyards are concentrated between 45° and 47° north latitude where winter minima regularly reach -30 °C and occasionally near -35 to -45 °C (Jolivet et al., 1999). Under these conditions, cold injury is known to occur early in the fall before the vines have fully acclimated or in late spring after sap flow is re-initiated which cause severe yield losses. Thus, the utilisation of cold resistant cultivars and protection of semi-hardy and non-hardy cultivars by snow, soil or fabrics is essential to assure a stable annual production in Quebec commercial vineyards. The aim of this study was to evaluate the winter survival of 20 genotypes thought to be of value to the eastern Canadian viticultural industry and to determine the effects of environmental factors and cultural practices on winter hardiness, vegetative and reproductive growth.

Material and methods

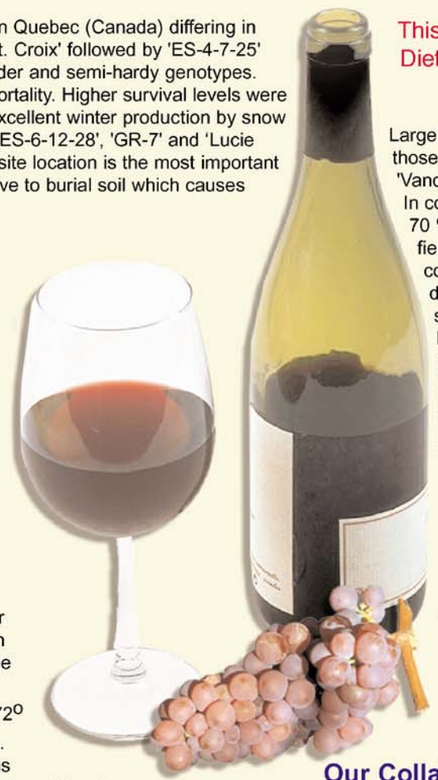
This study was conducted on 20 grape genotypes including interspecific hybrids and one vinifera type, grown on their own roots in 1998. These genotypes had previously been tested for cold climate and classified as hardy, semi-hardy and tender (Table 1). The twenty genotypes were evaluated under four winter protections methods (vine without protection (M1); pinning half of the canes to ground allowing for natural snow cover protection and the remaining canes left attached to the trellis wires without protection (M2); vine removed from the trellis, laid down and covered with geotextile fabric (M3) or soil (M4) at three locations in Quebec (Canada): 1) Agriculture and Agri-Food Canada experimental sub-station at Frelighsburg (45° N-72° W, elevation 205 m). 2) A commercial vineyard l'Orpailleur in Dunham (45° N-72° W, elevation 125 m). 3) A commercial vineyard Dietrich-Jooss in Iberville (45° N-73° W, elevation 43 m).
The experimental design was an unbalanced, randomised, complete block, split plot with four replications (blocks). Each replication had 5 vines spaced 1.5 m in the row and 3 m between the rows. The hardy and semi-hardy genotypes were trained to a Mini-J-Style training system, while tender genotypes were trained to Fan training system and all genotypes were cane pruned.
Winter hardiness was evaluated before pruning, at bud-break, the following spring. Mortality was visually judged in the spring and rated as percentage of shootless nodes. Yield was determined by measuring the total fruit weight of the three middle vines occupying 4.5 m of row.

Statistical analysis

Data were subjected to analysis of variance, achieved by SAS. LSD (Least Significant Difference) test (5%) was used to separate means.

Results and discussion

Mean maximum / minimum temperatures from November to April recorded at Frelighsburg station, L'Orpailleur and Dietrich-Jooss vineyards were of -0.42/-8.0°C, -0.30/-10.3°C and 0.86/-8.31°C, respectively. Absolute minimum temperature recorded at both commercial vineyards was -32 °C.
The 20 grapevine genotypes reacted differently to winter methods and to trial locations. On total yield basis, 'Sabrevois', 'Prairie Star', 'Delisle', 'Mitchurinetz', St. Croix' and 'St. Pepin' seem to be relatively indifferent to winter protection method, their total yield was more or less stable (Table 1), thus showing their genetic potential for these cold areas. However, at Frelighsburg the semi-hardy genotypes such as 'ES-6-12-28', 'GR-7' and 'Lucie Kuhlmann' yielded much more when covered with snow (M2) or geotextile fabric (M3) than some of the hardy genotypes (Table 1), which had a decrease in total yield with these same winter protections compared to the M1, a finding similar to Kondo et al. (1972). 'Vandal-Cliche' was among the highest yielding genotype, followed by 'ES-4-7-25', 'St. Croix' 'St. Pepin' genotypes, whereas 'Siegerrebe' was the lowest yielding. Unexpectedly, buried 'Seyval blanc' (M4) was not effective and yields of this genotype decreased by half from M3 to M4 (17.8 Kg to 8.2 Kg at Frelighsburg and from 5.6 Kg to 2.5 kg in both commercial vineyards).



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Dedication

This Poster is dedicated to Dietrich Joss who passed away on June 25, 2003 after a long battle with cancer. Dietrich initiated this collaborative research work and his contribution to research and development in grape culture and vinology will always be remembered.

Large variation was found in mortality among genotypes in each site. The highest overall survival levels were seen at Frelighsburg for those already exhibiting high levels of cold resistance such as 'Sabrevois', 'St. Croix' and 'Kay Gray' (mortality =< 15%) followed by 'Vandal Cliche', 'St. Pepin', 'Mitchurinetz' and 'GR-7' (between 15 and 25%) for M1 and M2 protection (Table 1).
In contrast, 'Siegerrebe' and 'Vidal' were once again among the tender genotypes group suffering the most injury with mortality rates 70 % and 60% respectively in the M3 protection. Our results are in agreement with those obtained on winter hardiness test from field observations in Minesota, Indiana and Ohio (Bordelon et al., 1997; Hemstad and Luby, 2000). Again, our results with controlled freeze tests, on the same twenty genotypes, showed that hybrids such 'Sabrevois', 'St. Pepin', 'St. Croix' and 'Kay Gray' derived from hardy American species, and 'Mitchurinetz' with V. amurensis in its genealogy were the most hardy, having a higher survival of primary buds at -30 °C. French-American hybrids such as 'Seyval blanc', 'SV-18-307', 'Vidal' and 'Chancellor' were less hardy, being crosses with vinifera in their history and the vinifera genotype 'Siegerrebe' was the most tender genotype (Rekika et al., 2003). Moreover, the highest vigour was found in hardy and semi-hardy genotypes while the tender genotypes were less vigorous for the three trials over the two years (data not shown).
However, site location was the most important factor, which affected vine mortality and total yield. According to Sayed (1992), site location remains the most important factor in minimising the effect of the climate and maximizing the moderating effects or microclimates. Indeed, L'Orpailleur and Dietrich-Jooss vineyards are characterized as low, flat sites with little snow accumulation. Frelighsburg is a higher site with vine planted on a slight south slope that results in good cold air drainage away from vineyard. Moreover, a nearby wind break to the amount decreases the effect of cold winds during the winter, enhancing the warmth of the south slope.
In summary, the selection of a proper site, a proper slope, soil drainage and wind breaks increase yield, decrease mortality and increase vigour and productivity of grapevines. Geotextile fabric winter protection was less time consuming than burying vines. It was costly but it can be use for several years. Geotextile covering or pruning the vines close to the soil level also increase yield and decrease mortality.

Table1. Mean total yield (Kg) and mean percent mortality of shootless nodes of 20 grapevine genotypes grown under different winter protection at Frelighsburg and two commercial vineyards L'Orpailleur and Dietrich-Jooss during two years growing seasons (1999/2000-2000/2001).

		Frelighsburg						L'Orpailleur						Dietrich-Jooss*					
	Winter hardiness Ranking	Total yield (Kg)			Mortality (%)			Total yield (Kg)			Mortality (%)			Total yield (Kg)			Mortality (%)		
Cultivar	Literature	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
Sabrevois	H [1]	9.2	7.7	9.0	6.5	5.3	7.2	1.7	2.5	2.7	40.6	28.1	29.9	1.02	2.13	1.86	45.0	31.2	30.0
Prairie Star	H [1]	4.5	3.9	4.5	14.1	16.8	14.6	0.4	0.9	1.5	58.1	54.0	34.1	0.14	0.23	0.13	52.5	45.0	63.1
ES-4-7-25	H [1]	11.0	12.7	15.9	11.2	15.0	9.4	3.9	8.1	7.3	61.5	57.5	20.4	1.04	2.14	1.87	33.0	25.0	40.0
Delisle	H [2]	5.8	5.3	6.2	17.5	20.6	40.3	0.7	1.4	2.2	63.1	41.2	25.2	0.54	0.88	0.99	41.2	26.2	40.6
Michurinetz	H [1]	7.4	8.7	8.8	9.1	12.4	15.6	1.1	2.0	5.2	60.9	50.9	20.9	1.66	3.52	1.42	62.8	18.3	28.1
St. Croix	H [1]	12.9	11.3	13.9	8.5	10.0	8.7	2.3	3.9	5.2	38.7	30.9	15.6	4.44	3.72	2.72	55.6	31.9	27.5
St. Pepin	H [1-2]	10.5	9.5	12.3	13.7	13.4	24.0	1.6	1.9	5.1	49.6	41.2	31.5	2.99	2.61	1.61	45.6	29.4	44.4
Vandal-Cliche	H [1]	21.3	19.9	22.9	5.6	14.0	10.0	4.4	4.1	6.8	45.9	39.1	15.9	3.33	4.34	3.65	38.7	31.2	20.6
Kay Gray	H [1-2]	9.1	8.3	7.9	6.2	7.2	12.5	0.9	1.6	2.7	20.9	28.4	22.8	0.52	1.45	1.30	31.9	23.7	27.5
ES-6-12-28	-	10.8	8.2	17.8	20.9	35.7	24.1	1.2	2.9	7.1	73.7	63.7	21.3	1.18	3.7	0.73	44.4	28.1	44.4
GR-7	SH [3]	6.0	10.6	10.6	16.2	18.7	17.8	1.1	2.3	5.2	77.9	71.5	13.5	1.71	6.04	5.52	55.0	30.6	35.0
L. Kuhlmann	SH [2]	7.2	7.7	13.5	22.5	20.9	13.4	0.9	2.5	6.7	77.0	68.1	15.3	1.76	6.49	5.20	59.3	29.4	38.1
Chancellor	SH/T [1-4]	-	-	14.3	-	-	37.2	-	-	5.4	-	-	48.4	-	-	4.24	-	-	35.0
Seyval blanc	SH [1-4]	-	-	17.8	-	-	43.1	-	-	5.6	-	-	64.9	-	-	5.52	-	-	43.7
Seyval noir	-	-	-	17.4	-	-	54.6	-	-	5.5	-	-	58.1	-	-	4.21	-	-	47.5
Hibernal	T [1]	-	-	15.1	-	-	25.3	-	-	2.9	-	-	46.5	-	-	5.48	-	-	40.6
Ok. Riesling	-	-	-	9.5	-	-	26.8	-	-	1.8	-	-	54.8	-	-	0.79	-	-	40.0
SV-18-307	T [4]	-	-	9.1	-	-	60.0	-	-	9.5	-	-	80.3	-	-	4.30	-	-	61.9
Vidal blanc	T [4]	-	-	9.1	-	-	65.3	-	-	2.3	-	-	82.8	-	-	1.45	-	-	63.3
Siegerrebe	T [5]	-	-	6.1	-	-	85.3	-	-	0.3	-	-	68.4	-	-	0.10	-	-	68.3
LSD 5%		3.35	3.7	4.3	11.0	13.4	14.7	1.5	2.0	2.7	11.2	9.0	16.2	2.7	2.35	2.65	19.6	13.5	24.7

Data are means of 4 replicates of 3 vines/replicate for a total of 12 plants used for analysis of variance. * Data of 1999/2000 growing season.
Hardiness: Hardy (H), Semi-hardy (SH) and Tender (T). (1) Plocher and Parke (2001), (2) Vignes du Québec (http://vignesduquebec.com), (3) Odneal (1983), (4) Dubois et Deshaies (1997), (5) Reisch et al. (1979). Winter protection: M1 and M2 were used only for hardy and semi-hardy genotypes, M3 was used for hardy, semi-hardy and tender genotypes.