

OBJECTIVES and CONTEXT

- In Eastern Canada, the cider industry has been growing for about fifteen years. The varieties of apples used to make alcoholic products in Quebec have traditionally been fruit for the fresh market.
- Recently, new cider apple varieties have been introduced by producers with the challenge that they were not studied under the Eastern conditions of Canada.
- Cider production requires fruits with specific chemical and organoleptic properties, mainly in terms of tannins, acidity and polyphenol content (Bauduin 2006; Jolicoeur 2016; Moinet 2009). Therefore, the choice must be based on criteria such as the organoleptic qualities (polyphenols, tannins, etc.) sought according to the desired product and the agronomic characteristics (productivity, alternation, tree management, phytoprotection).
- Three major families of apples are used to make cider: sweet and bittersweet; bitters; and acids (Jolicoeur 2016). This categorization is generally based on the acidity of the fruits and their tannin content, but the French classification also considers the sugar content.
- Therefore, the objective of this research project was:

To determine the agronomic and chemical potential of new apple varieties for cider production under Eastern Canadian conditions.

MATERIALS and METHODS

Since 2015, 52 varieties have been cultivated and evaluated under Quebec's conditions. The experimental orchard is located at Frelighsburg, QC, Canada.

Studies were conducted for 5 consecutive years and the following parameters were measured:

Agronomic parameters: frost index, lignification, flowering, yield, trunk surface (TCSA), cumulative yield (CY), productivity (CYE)

Fruits parameters: weight, colour, form, pulp texture, maturity index, firmness, total soluble solids (TSS), titratable acidity (TA), pH, taste

Cidermaking: standard monovarietal ciders were made annually following standard practices. Chemical analyses were performed on cider (TSS, TA, pH, polyphenols)

Sensory evaluation: evaluation was carried out by an experts' panel using a modified "rate-all-that-apply" questionnaire followed by a hedonic evaluation on a 5-point scale



RESULTS

Table 1: Summary of agronomic characteristics and chemical properties of cider apple varieties, 2015–2021.

Category	Variety	Frost tolerance	Tree growth	Yield	Fruit size	Biannually tendency	Yield period	Acidity	Polyphenols	Sugars
Sharp	Bramley Seeding	medium	medium	high	large	no	mid-season	high	low	low
	Burgundy	good	medium	high	large	no	early	high	low	low
	Esopus Spitzenberg	good	medium	medium	medium	no	late	high	low	high
	Roxbury Russet	good	medium	medium	large	no	late	medium	low	medium
Bittersweet	Winesap	good	medium	medium	medium	no	late	medium	high	medium
	Brown Snout	good	medium	high	medium	no	mid-season	high	medium	low
	Bulmer's Norman	good	medium	medium	medium	yes	early	low	high	low
	Chisel Jersey	good	medium	high	medium	yes	early	high	medium	low
	Dabinette	good	medium	medium	medium	yes	mid-season	medium	low	high
	Frequin Rouge	medium	low	medium	small	no	mid-season	low	high	high
	Maréchal 1	good	medium	medium	medium	no	mid-season	medium	high	medium
	Michelin	good	faible	low	small	yes	mid-season	low	high	medium
	Porter's Perfection	good	high	medium	small	no	late	high	high	high
	Tremblett's Bitter	low	high	low	medium	yes	early	medium	medium	low
Sweet	Yarlington Mill	low	low	low	small	no	late	low	high	medium
	Cortland Royal Court	good	low	medium	medium	no	mid-season	medium	low	medium
Bittersharp	McIntosh Summerland	good	low	medium	medium	no	mid-season	medium	medium	low
	Kingston Black	medium	low	low	small	yes	mid-season	medium	low	medium



- All varieties resisted cold winter temperatures and had little frost damage (Tab. 1)
- Some varieties showed a tendency to alternation in fruit production: Bulmer's Norman, Chisel Jersey, Dabinette, Michelin, Tremblett's Bitter (Tab. 1).
- The varieties that obtain the highest yields over 4–5 years are Burgundy and Chisel Jersey; and the lowest are: Yarlington Mill, Kingston Black, Michelin, and Tremblett's Bitter (Tab. 1).
- Some varieties produce larger fruits than standard McIntosh like Bramley Seeding, Burgundy and Roxbury Russet (Tab. 1)
- The polyphenol content was variable from year to year and some varieties have very high concentration of polyphenols like Marechal 1 and Frequin Rouge (Tab. 1, Fig. 1).

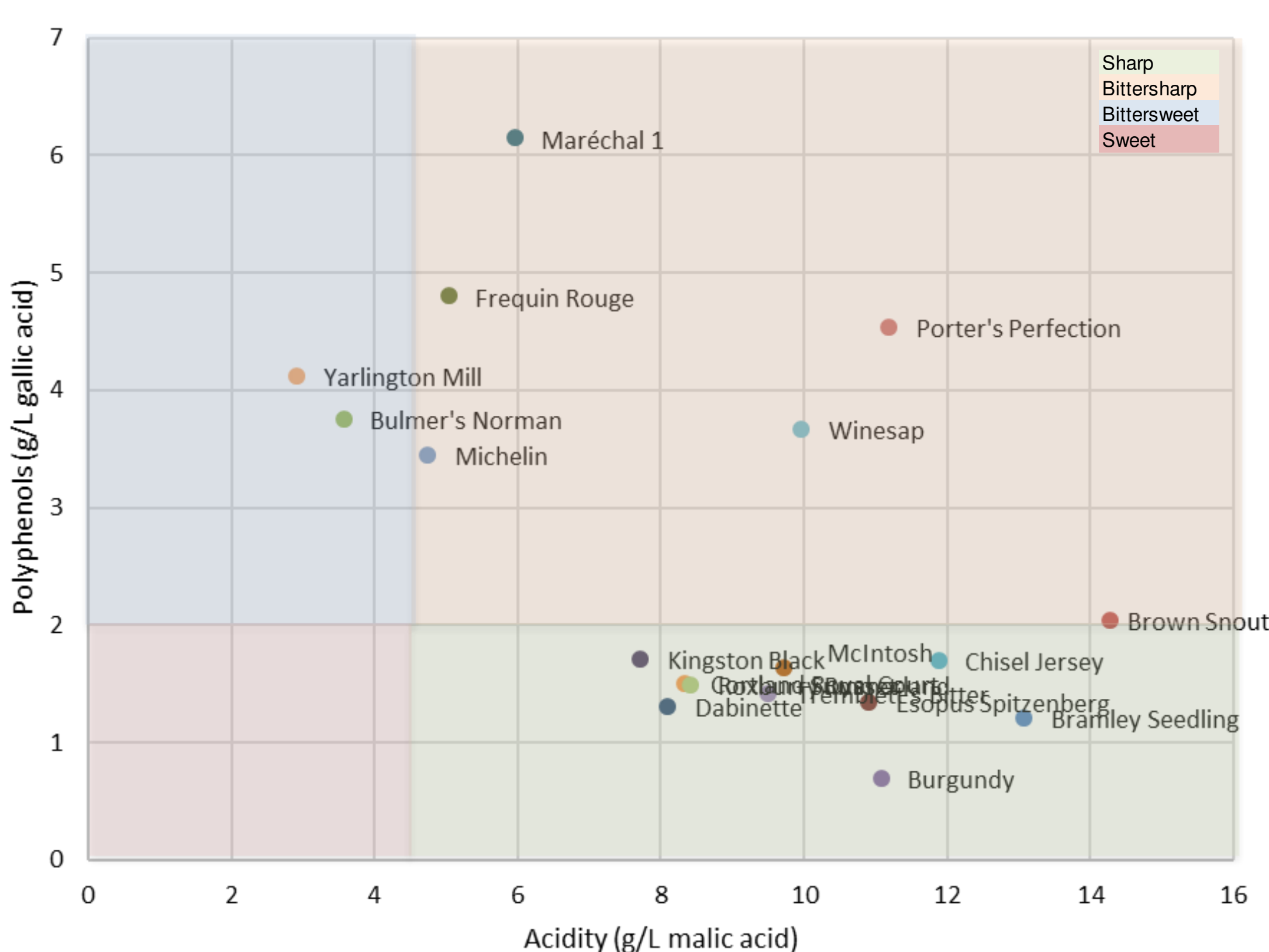


Figure 1: Relation between acidity and polyphenols.

Table 2: Overall cider hedonic rating on a 5-point scale, related to vintage.

Year	Bramley Seeding	Brown Snout	Bulmer's Norman	Burgundy	Chisel Jersey	Cortland Royal Court	Dabinette	Esopus Spitzenberg	Frequin Rouge
2018	3,0	2,9			3,2	3,7	2,7	3,6	3,6
2019		4,1				3,1			
2020	3,8	3,4	3,5	3,4	3,6	3,3	1,9	4,1	4,0
2021	2,1	3,3	2,0	2,8			3,0	3,4	3,2
	Kingston Black	Maréchal 1	McIntosh Summerland	Michelin	Porter's Perfection	Roxbury Russet	Tremblett's Bitter	Winesap	Yarlington Mill
2018	3,3	3,5	3,4	3,3	2,9	3,7	3,6	2,8	3,3
2019	3,5					3,3		2,6	
2020	4,0	2,9	3,4	3,3	1,4	3,0			
2021	3,4	3,8	3,4	3,1	3,4	2,6	3,0	2,8	3,5

- Based on polyphenols and acidity measurements, most apple varieties were classified as sharp and bittersharp. Only two were classified as bittersweet (Fig. 1).
- Most varieties had higher sugar content than McIntosh, except Burgundy (Fig. 1).
- Ciders were produced when the quantity of fruit was sufficient. The overall rating shows that the ciders produced with some varieties are better than others (Tab. 2). However, some varieties would be appropriate in blending and cannot be eliminated solely on the hedonic rating of single-variety ciders.
- Cider aromas and flavours were also noted and should be considered when choosing cider apple varieties

CONCLUSIONS

- Gathering agronomic and oenological data on specific varieties for cider production will make it possible to draw a reliable portrait of the varieties and their potential for cider production under Quebec conditions.
- The availability of new apple varieties specific to cider production will allow producers to develop different products to meet the growing consumers' demand.

LITERATURE CITED

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