



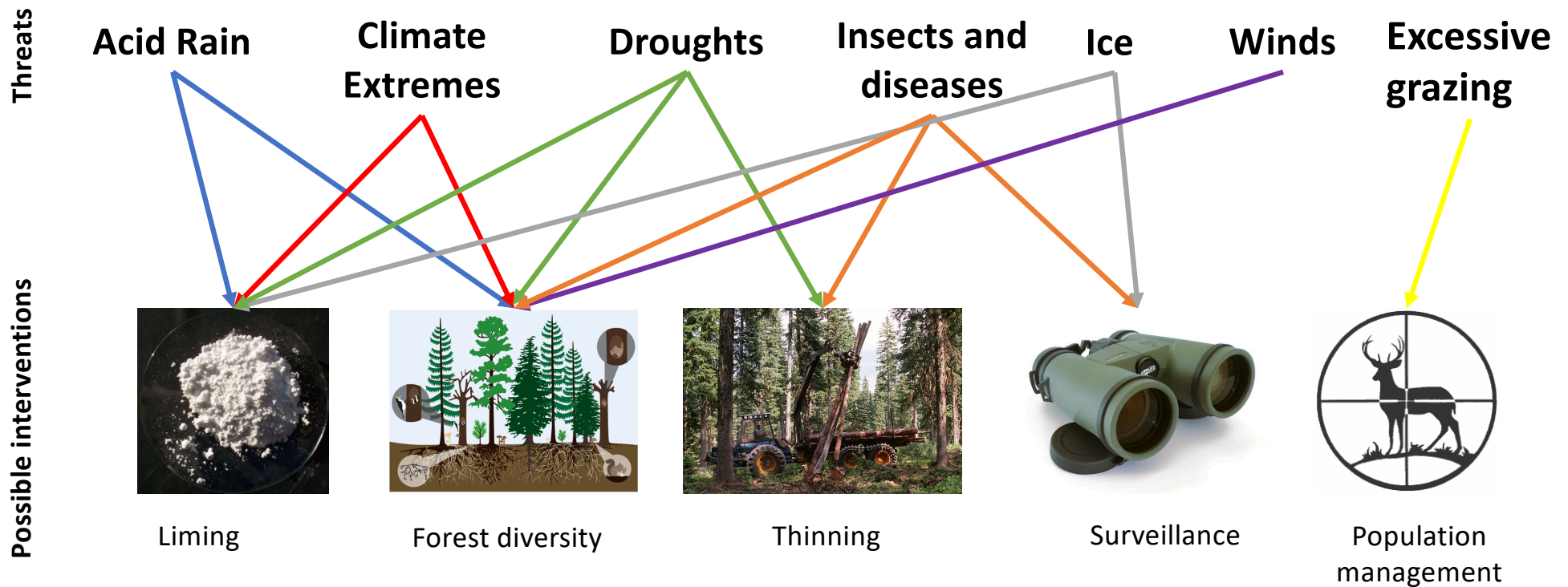
Scientific opinion on the recommendations for tapping in Quebec to ensure the sustainability of maple production

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This report aims to provide an overview of the scientific knowledge on the following aspects:

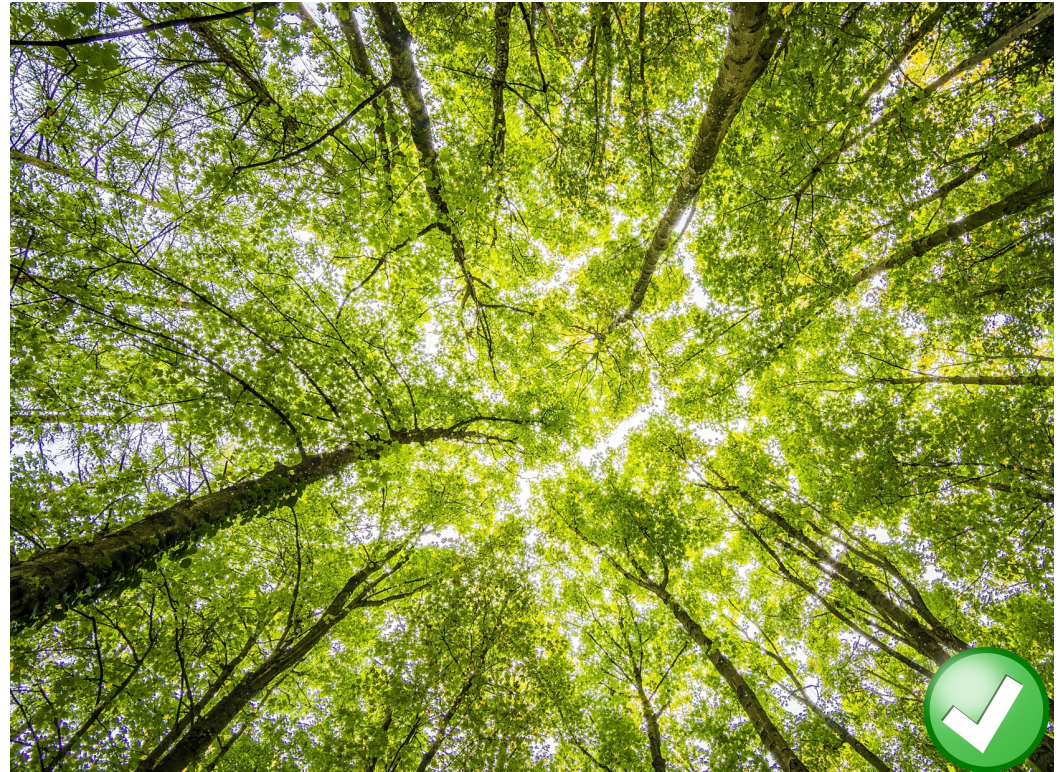
- **The medium- and long-term sustainability of maple syrup production in Quebec in the context of global change.**
- **The effects of repeated tapping on the compartmentalization, health and vigour of maple trees.**
- **The effects of different tapping techniques and of the material and equipment used on the health and vigor of maple trees.**

Major long-term biological and climate threats and interventions to reduce their negative impacts



What is a healthy maple?

- **Less than 10% dieback in its crown**
- **Full crown and little competition from dominants or codominants**
- **No defoliation or major branch loss in the last 2 years**



What is a healthy maple?

- No or few signs of stress caused by insects and/or diseases
- Healthy trunk with no major defects or injuries
- No signs of internal rot

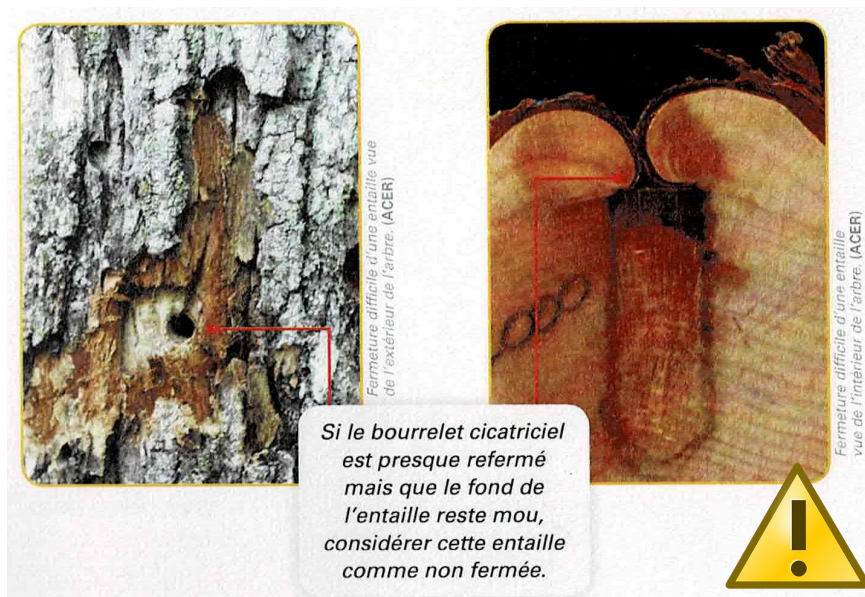


Maple drill



What is a healthy maple?

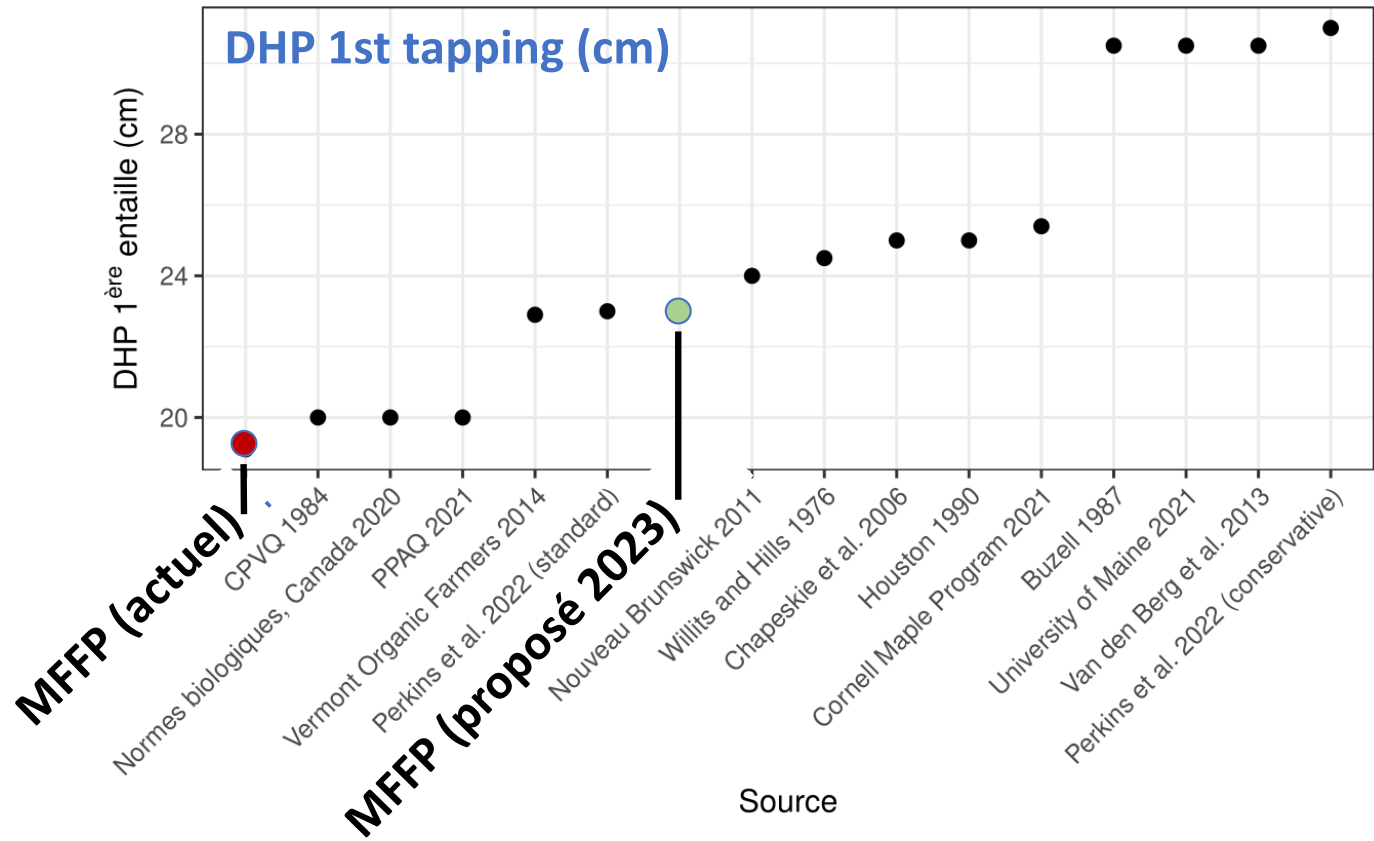
- Rapid notch closure (2 years or less)
- No significant drought in the last 2 years



Anneco et al., 2012



Comparison of regulations and recommendations by different organizations here and elsewhere



Are the tapping standards sustainable?



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RAPPORT FINAL

**MODIFICATIONS DES NORMES D'ENTAILLAGE SUR TERRE
PUBLIQUE :
ANALYSE DE LA DURABILITÉ DE L'ENTAILLAGE ET DES
IMPACTS FINANCIERS DES CHANGEMENTS PROPOSÉS PAR LE
MFFP**

Par : Martin Pelletier, ing. f.

Présenté à : Producteurs et productrices acéricoles du Québec (PPAQ)

Model developed by M. Pelletier

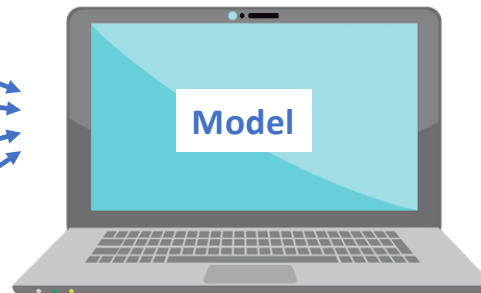
Variables

DHP tapping
(standard)

Depth of the tap

Diametre of the spout

Growth of the trees



Thickness of wood over
the first tap when
returning to tap over it



Sustainable or **Not sustainable**

Model developed by M. Pelletier

Constants Conditions

- Healthy tree
- Trunk = a perfect cylinder
- 100 cm drop
- Tapping above and below the lateral
- Spouts distributed randomly over the entire area accessible by the fall
- Horizontal margin between cuts of 10 cm
- Vertical margin between 60 cm taps

Radial growth of sugar maples in Quebec

Sous-région écologique	Région correspondante	Croissance radiale moyenne (mm/an)
1a-T	Plaine du bas Outaouais et de Kamouraska	1,46
2b-T		0,97
2c-T		1,39
3c-T		0,79
3d-M		1,32
3d-S		1,27
3d-T	Coteaux du Lac-Etchemin	1,42
4f-M	Collines du Témiscouata	1,56
4f-S	Collines du Lac Humqui	1,86
4f-T	Collines et coteaux du Lac Pohénégamook	1,39

**Average radial growth
of sugar maples in
Quebec :
1.34 mm/year**

Source : Grenier et al., 2008

Results of simulations M. Pelletier

Average radial growth
of sugar maples in
Quebec :
1.34 mm/year

Standard	Radial growth		
	2 mm/an	1 mm/an	0,5 mm/an
MFFP actuel, chalumeaux 5/16", entailles de 50 mm	Sustainable	Not sustainable	Not sustainable
MFFP 2023, chalumeaux 5/16", entailles de 50 mm	Sustainable	Near sustainability	Not sustainable
MFFP 2023, chalumeaux 1/4", entailles de 50 mm	Sustainable	Sustainable	Not sustainable
PPAQ, chalumeaux 5/16", entailles de 50 mm	Sustainable	Not sustainable	Not sustainable
PPAQ, chalumeaux 1/4", entailles de 25 mm	Sustainable	Sustainable	Limited sustainability

Latest recommendations from the « North American Maple Syrup Producers Manual »

Tapping guide based on diameter, tree health and harvesting method

State of the tree's health	Harvest method	Diametre of the spout (inches)	Depth of the tap (mm)	Min. diametre of the tree(cm)	Number of taps / tree
Conservative					
Optimal	Gravity	7/16	25 – 64	31 +	1
Sub-optimal	Gravity or vacuum	1/4 – 5/16	25 – 38	31 +	1
Standard					
Optimal	Gravity or vacuum	1/4 – 5/16	38 – 50	23 – 31	1
				46 – 56	2

D'après Perkins et al., 2022

Summary of the main recommendations proposed in this report for sustainable maple tapping in Quebec.

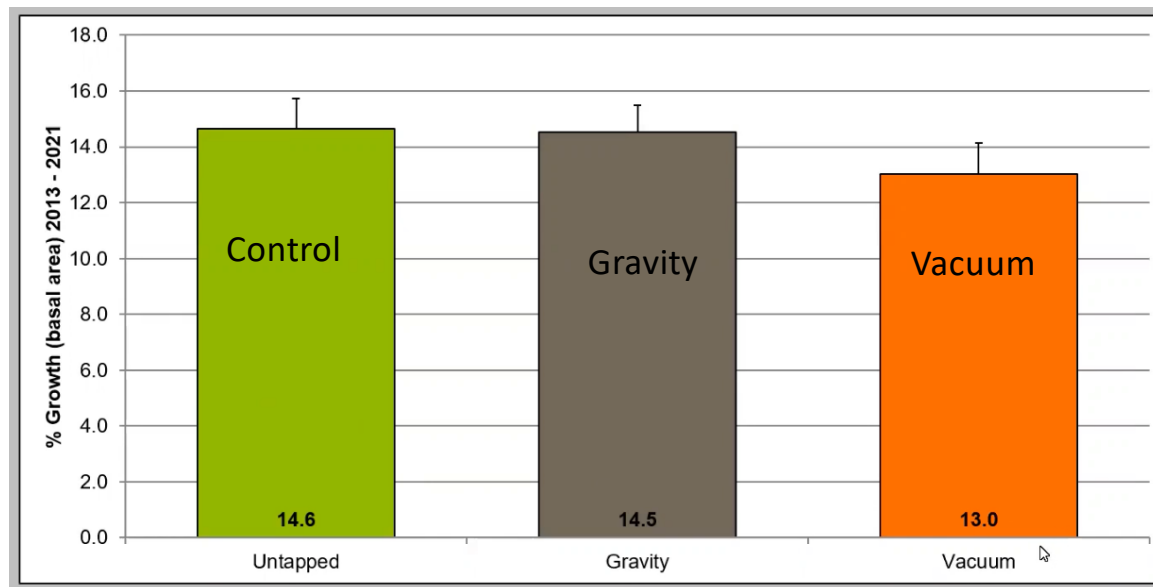
Santé globale de l'arbre	Diamètre maximal du chalumeau	Profondeur maximale de l'entailage (avec écorce)	Diamètre minimal de l'arbre à 1,3 m	Nombre d'entaille maximal par arbre à partir de 40 cm
Croissance radiale optimale (plus de 1,25 mm/an)				
Bonne	5/16"	45-50 mm	23,1 cm	2
Mauvaise	5/16"	45-50 mm	31 cm	2
Mauvaise	1/4 ou 5/16"	45-50 mm (si chalumeau de 1/4") ou 25-30 mm (si chalumeau de 5/16")	23,1 cm	2
Croissance radiale sous-optimale (moins de 1,25 mm/an)				
Bonne	1/4 ou 5/16"	45-50 mm (si chalumeau de 1/4") ou 25-30 mm (si chalumeau de 5/16")	23,1 cm	2
Bonne	5/16"	45-50 mm	31 cm	2
Mauvaise	1/4"	25-30 mm	31 cm	1
Croissance radiale très faible (moins de 0,50 mm/an)				
Bonne ou Mauvaise	1/4"	25-30 mm	31 cm	1

Other important points

- Pelletier's model is for perfect conditions
- Recommendations consider tapping above and below the lateral
- Tapping has a non-significant effect on growth
- Maple seems to be able to compensate for the loss of sugar and xylem caused by tapping
- A study is needed to update and specify the radial growth of maples in Quebec according to regions and sub-regions
- The growth of maple trees over the last ten years should be measured locally and monitored
- The effect of tapping on the compartmentalized zone is crucial and studies are rare
- At least 20% of companion species should be retained, mostly other than red maple

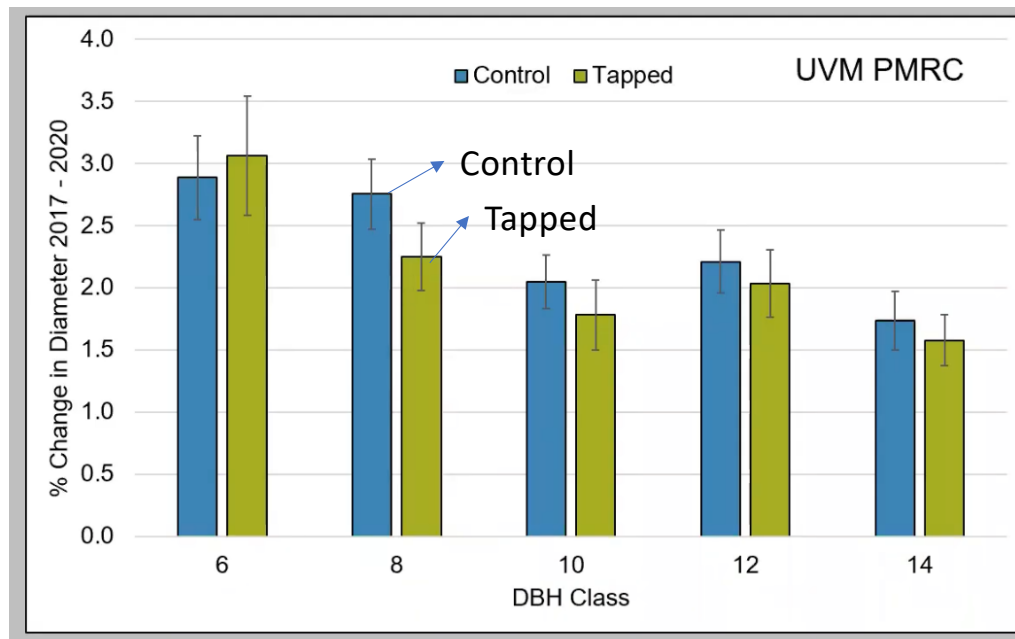
How does tapping impact the radial growth of maples?

No significant differences



Source : communication de Abby van den Berg, U. Vermont

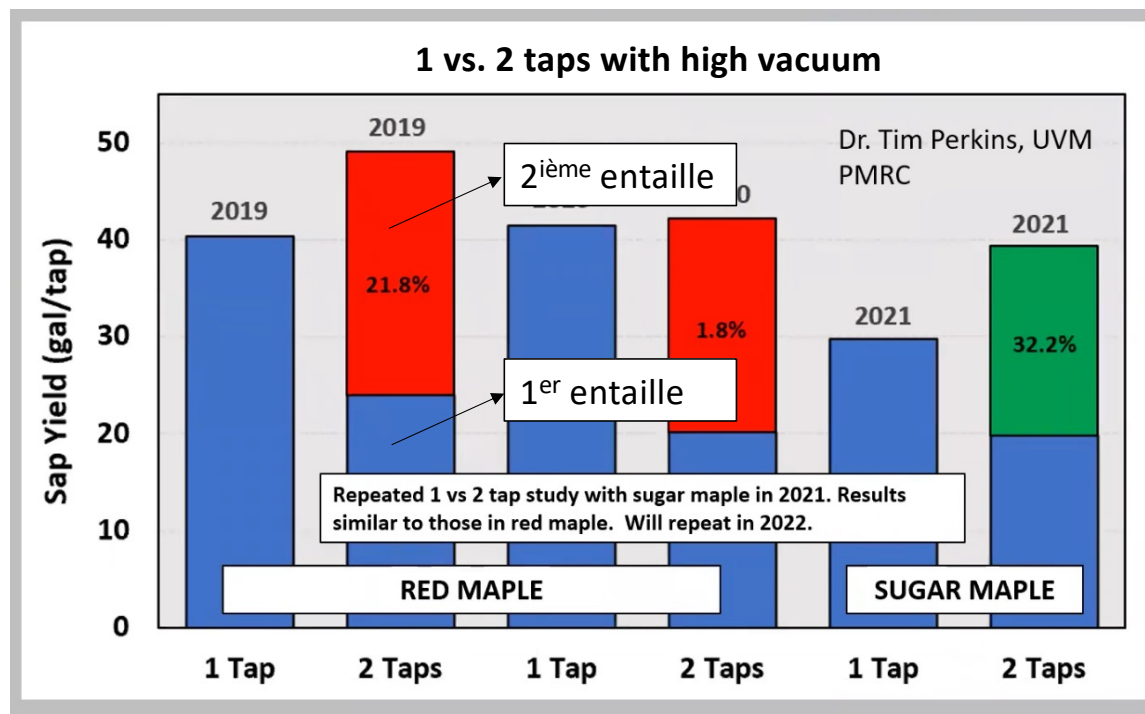
Long-term impacts of tapping on radial growth of maples



No significant differences

Source : communication de Abby van den Berg, U. Vermont

Effects of tapping practices on yield



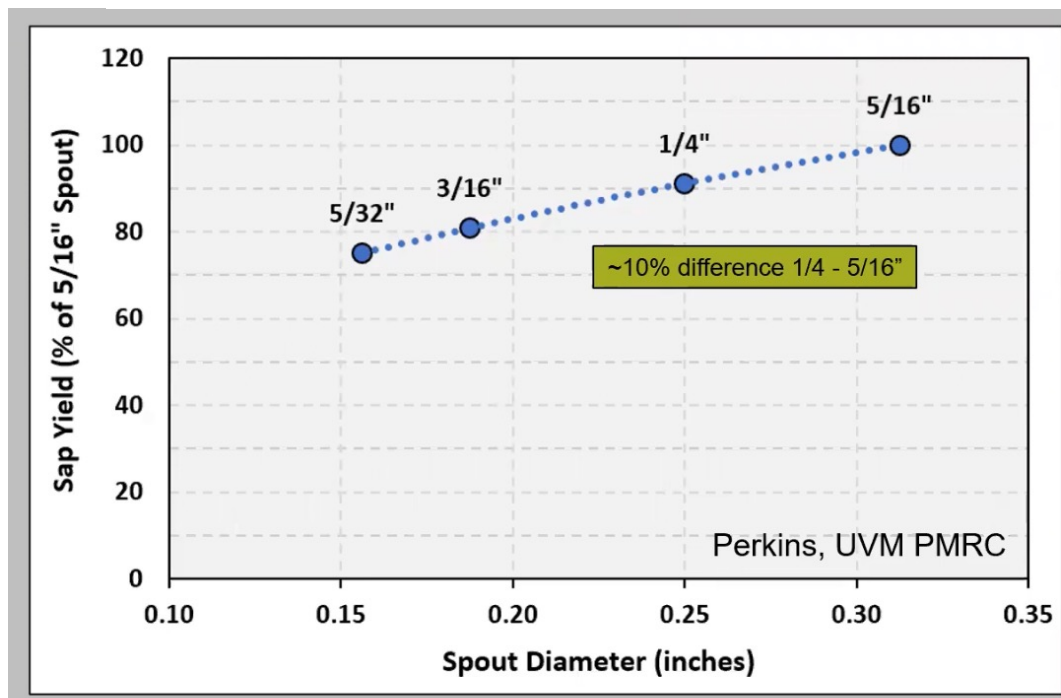
The yield can increase with the number of taps per tree, but :

- Not always and it does not double
- Higher vacuum and lower dbh reduces the gain

Source : communication de Abby van den Berg, U. Vermont

Effects of tapping practices on yield

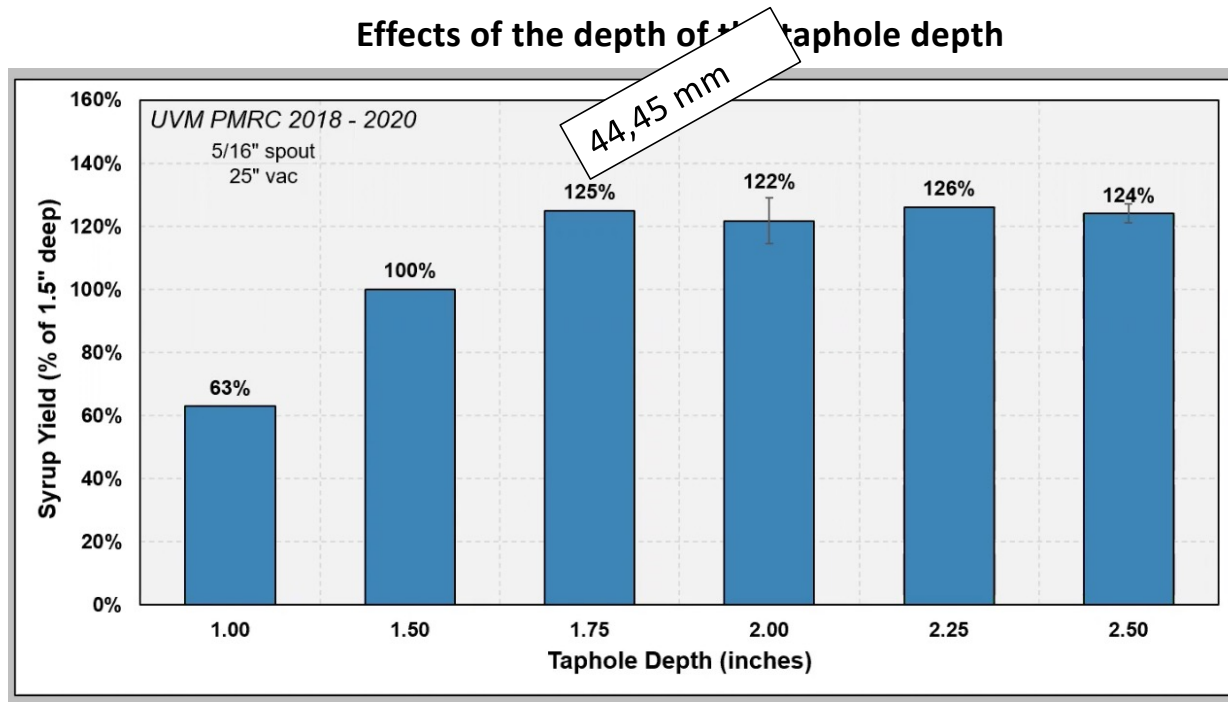
Effects of the spout diameter



The output increases with the diameter of the spout

Source : communication de Abby van den Berg, U. Vermont

Effects of tapping practices on yield




Deeper cuts increase yield, up to a threshold

Source : communication de Abby van den Berg, U. Vermont

Priority of knowledge acquisition

- Effects of tapping on maple growth,
- Effects of new tapping techniques on the amount of water collected
- Effects of new tapping techniques on the spatial distribution of compartmentalization in the sapwood of maple and the causes of this high variability
- The dynamics of reserves in maple trees in spring and its effects on the long-term growth of maple trees
- The loss of hydraulic conductivity of the tree caused by the compartmentalization of the sapwood following tapping, particularly following a dry summer
- The resilience of maples to various stresses such as dry summers, winters with significant thawing and significant defoliation during the summer, considering the decrease in reserves and the proportion of conductive xylem
- Importance of companion species for maple health and management to increase the resilience of maple stands to global changes



**Thank
you!**