

College of Saint Benedict and Saint John's University

**DigitalCommons@CSB/SJU**

---

Celebrating Scholarship and Creativity Day

Undergraduate Research

---

4-24-2020

## **Maple Syrup and Spile Design: Will More Holes in the Spile Yield More Sap?**

Brigid Mark

*College of Saint Benedict/Saint John's University*, BMARK001@CSBSJU.EDU

Follow this and additional works at: [https://digitalcommons.csbsju.edu/ur\\_cseday](https://digitalcommons.csbsju.edu/ur_cseday)

---

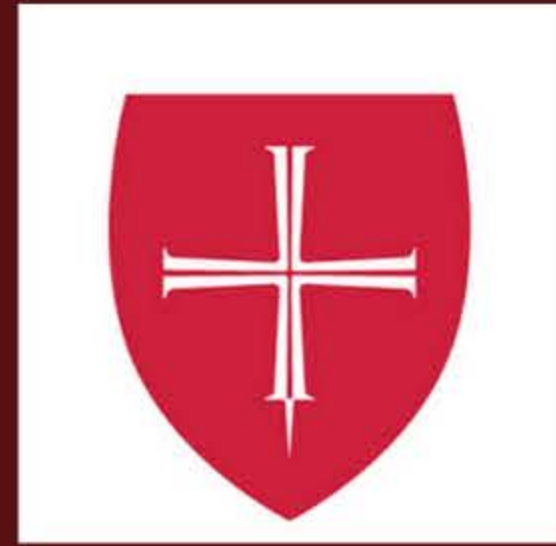
### **Recommended Citation**

Mark, Brigid, "Maple Syrup and Spile Design: Will More Holes in the Spile Yield More Sap?" (2020).

*Celebrating Scholarship and Creativity Day*. 109.

[https://digitalcommons.csbsju.edu/ur\\_cseday/109](https://digitalcommons.csbsju.edu/ur_cseday/109)

This Poster is brought to you for free and open access by DigitalCommons@CSB/SJU. It has been accepted for inclusion in Celebrating Scholarship and Creativity Day by an authorized administrator of DigitalCommons@CSB/SJU. For more information, please contact [digitalcommons@csbsju.edu](mailto:digitalcommons@csbsju.edu).



# MAPLE SYRUP AND SPILE DESIGN

## WILL MORE HOLES IN THE SPILE YIELD MORE SAP?



### INTRODUCTION

Throughout the history of maple syruping, producers have adopted new innovations to increase efficiency and sap volume. Collection methods have included:



More recently, small diameter spiles have become popular, as have check valve spiles which prevent sap flow back into the taphole and microbes.

Despite these advancements, few overall changes have been made to the design of the spile. Spiles typically have one hole at the tip, and, as sap pools in the taphole, it then flows through this hole into the spile for collection. A 5/16th spile has a hole with area 15.9 mm<sup>2</sup>.

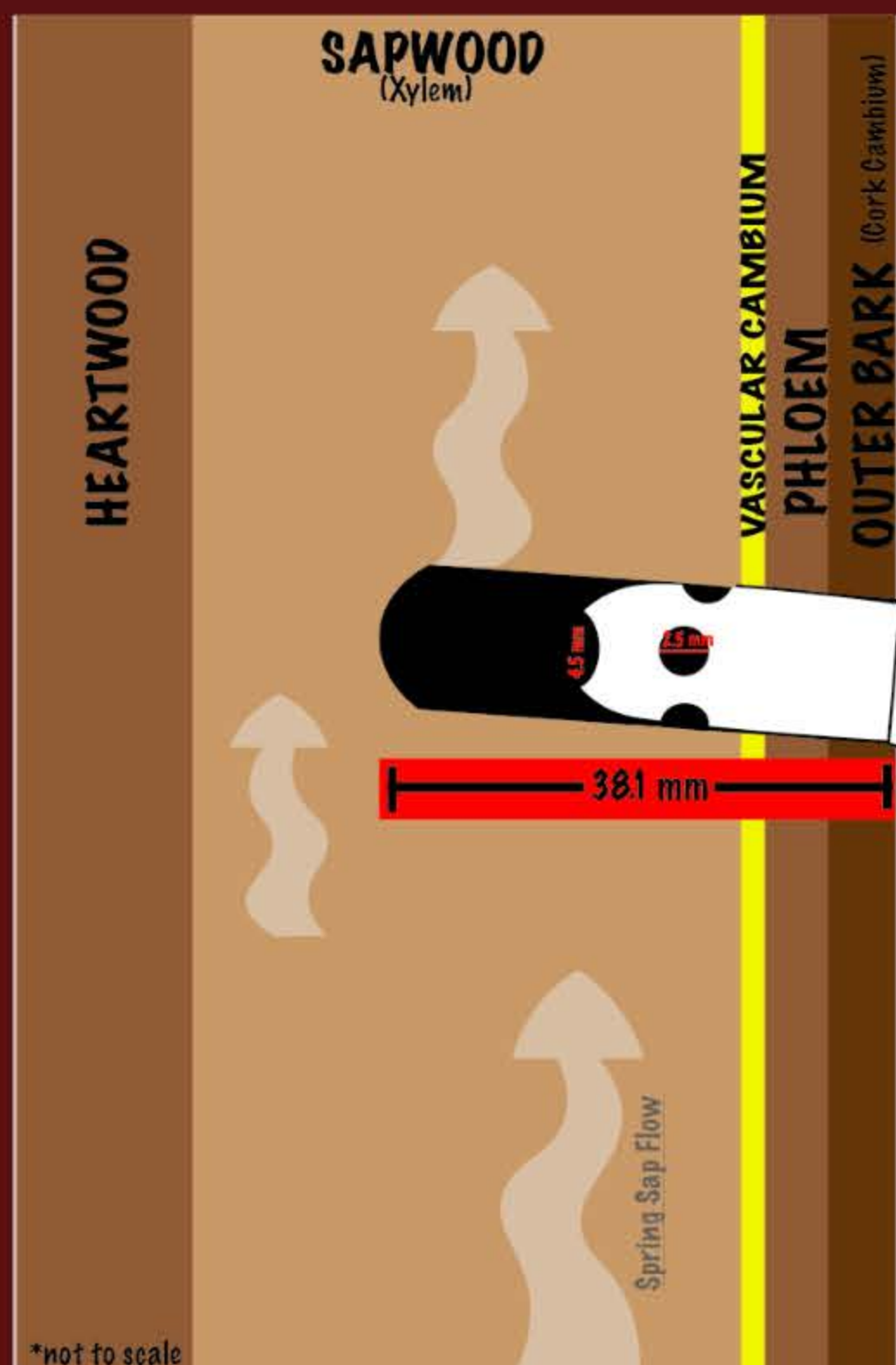
### HYPOTHESIS

Spiles with 2.23 times more surface area permeable to sap (more holes) will increase sap yield by 2.23 times



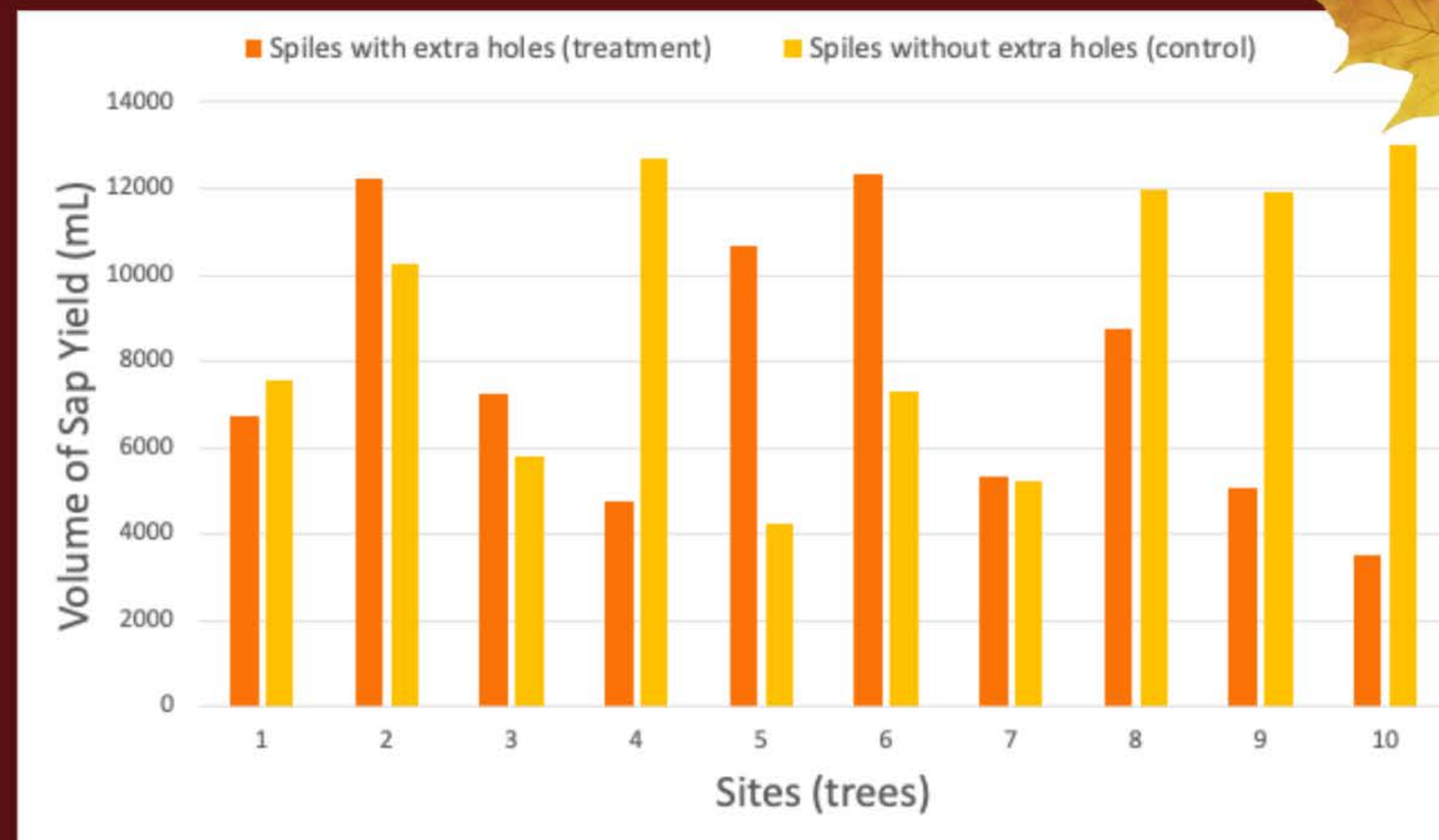
### METHODS

- Drilled 2.5mm diameter holes into the top, bottom, and two sides (4 holes) of ten 5/16" spiles, increasing permeable SA to **35.5 mm<sup>2</sup>** compared with control 15.9 mm<sup>2</sup>
- On March 12th, drilled 1.5" (38.1mm) taphole into 10 maple trees
- Randomly installed either a control or treatment spile, lightly tapped each spile into the tree
- Hung bucket atop spile with short tube inside bucket to ensure sap would flow into the bucket (not through hole for spile)
- Collected frozen sap on March 18th and 23rd
- Measured total sap (mL)
- Taps pulled March 20th due to COVID-19



College of Saint Benedict and St. John's University  
Advisor: Dr. Stephen Saupe  
Brigid Mark

### RESULTS



**Fig 1.** Volume of sap (mL) from spiles with extra holes (orange) and spiles without extra holes (yellow). Each tree was tapped with both a treatment and a control spile

|   | Control | Treatment |
|---|---------|-----------|
| Spile Opening Diameter                      | 4.5     | 4.5       |
| Side Hole Diameter                          | X       | 2.5       |
| Permeable Area of Spile (mm <sup>2</sup> )  | 15.9    | 35.5      |
| Total Sap Recovered (mL)                    | 89870   | 76675     |
| Total Sap Recovered (gal)                   | 23.74   | 20.25     |
| Sap/Spile (mL)                              | 8987    | 7667.5    |
| Sap/Spile (gallon)                          | 2.37    | 2.02      |
| Rate of Sap Flow (mL/day/mm <sup>2</sup> )  | 706.52  | 269.98    |
| Rate of Sap Flow (gal/day/mm <sup>2</sup> ) | 0.18    | 0.07      |
| Percent difference in volume                | 14.68   |           |

The average maple tree in the sugarbush at large yielded 3.48 gallons per tap during the flow period of 12-20 of March.

### ANALYSIS

The difference between sap yield volume (mL) from the spile with extra holes and the control spiles **WAS NOT SIGNIFICANT** according to a paired t-test (p=0.2319), an unpaired t-test (p=0.1901), and an ANOVA test (p=0.1889).

The average sap yield per spile for the treatment (extra holes) was 7,667.5 mL and the control was 9,172.2, with control spiles producing 1,504.7 mL more on average.

### CONCLUSION

Our results demonstrated that there was not a significant increase in sap flow when additional holes were added to a spile. Despite a 2.22 times greater hole area, there was no significant increase in sap volume.

Some possible explanations for this could include: (1) in contrast to the end hole which was fed by sap pooling in the taphole, extra holes abutted wood directly or (2) the holes of the spiles could have been blocked by drilling debris or wood

It is also possible that the additional holes resulted in faster flow on an hourly basis during day, though data was not collected hour by hour.

**Future designs could consider holes placed only on the top of the spile, only on the bottom, etc. or more holes/less holes**