Trends & Comparisons in Sugar Maple Sap Flow & Physiology Over Two Years

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Background

The natively occurring Sugar Maple (*Acer saccharum L*) has allowed for Eastern Canada to be a world leader in the Maple syrup industry. Canada supplies the world with approximately 80% of it's maple syrup supply, with some years being as high as 85%. Quebec, Ontario, New Brunswick and Nova Scotia make up the majority of production with Quebec's contribution being approximately 90.5%. Nova Scotia, although having a growing industry, supplies approximately only 1%. While the number of taps has dramatically increased over the years in Nova Scotia, the yield per tap has declined from 0.432 to 0.325 L/tap giving NS the lowest yield per tap when compared to other eastern provinces and states. The goal of this two year study was to uncover any possible links between environmental, physiological and tissue/soil nutrient content, and sap yield in Nova Scotian sugar bushes.

Methods

Research sites were chosen from ten representative maple production regions in mainland NS (Fig 1). Each of the ten sites were divided into two blocks with five trees randomly selected in each block (ten trees per location). Trees and locations were subjected to soil moisture content (TDR probe), soil water potential (Watermark sensors), leaf area index (LAI-2000 Plant Canopy Analyzer), trunk circumference, and sap sampling. Nutrient analysis were completed on tree cores, leaf, soil and sap samples. Samples were collected monthly over the two years with the exception of core samples, taken bi-monthly, and leaf and sap samples only being collected during the appropriate months. Location specific data including slope, elevation, latitude, longitude and weather was also collected. Data analysis was completed using MiniTab17 using correlation and regression analysis.

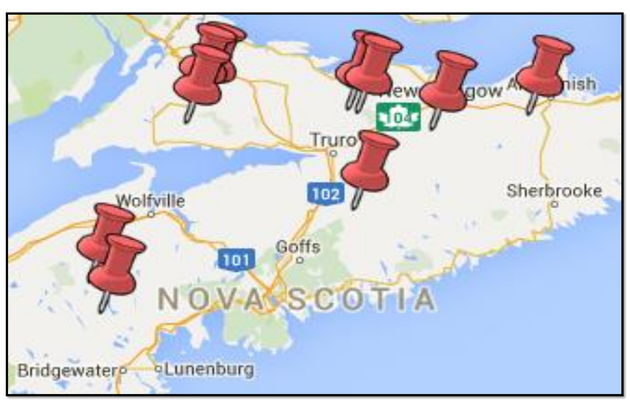

Figure 1: Locations of maple sites across mainland Nova Scotia, Canada. (Image provided by google maps)

Results

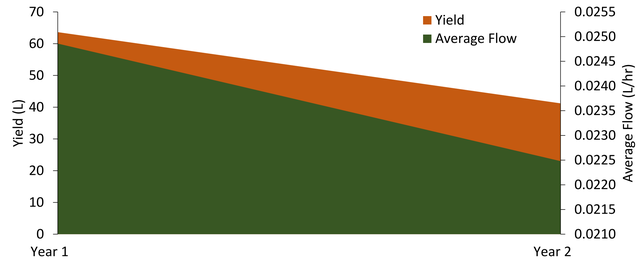

Figure 2: Yield and average flow as compared between the two years.

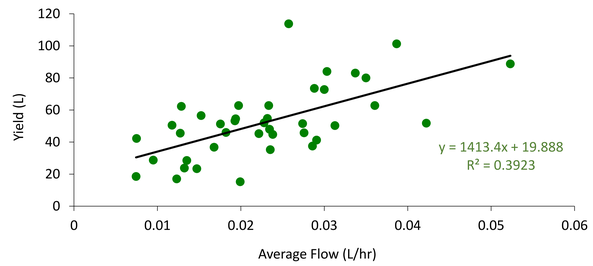

Figure 3: Correlation of sap yield and Average sap flow.

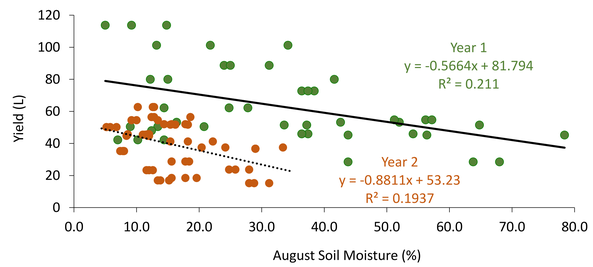

Figure 4: Correlation of sap yield and August soil moisture over the two years

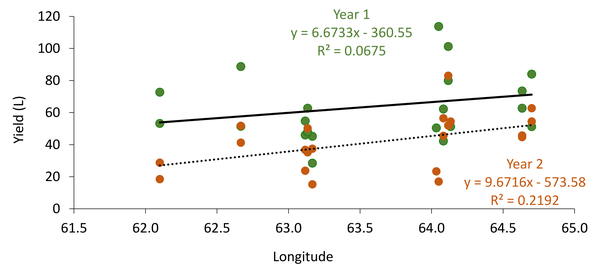

Figure 5: Correlation of sap yield and longitude over the two years.

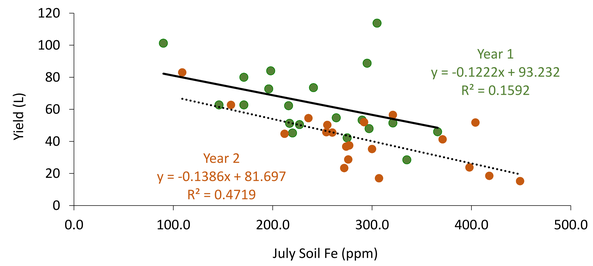

Figure 6: Correlation of sap yield and July soil iron content.

Results

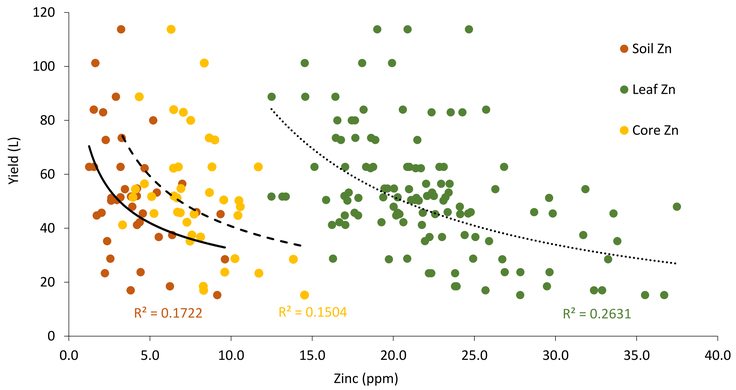

Figure 7: Correlations between October soil zinc, August core zinc and June leaf zinc with sap yield.

Conclusions

Over the two year study both yield and average sap flow decreased (Fig 2). Yield and average sap flow were significantly correlated ($p<0.05$) over both years (Fig 3) with the soil moisture in August playing a significant role in sap yield (Fig 4). Soil moisture was greatly reduced in the year two, which appeared to be one factor to potentially decrease flow and yield. An interesting, significant positive correlation was found between site longitude yield. As the longitude of the sites increases so did the yield (Fig 5).

Nutrients from the soil, core tissue and leaf tissue were analyzed regularly over this study. Amongst all, a significant negative relationship was found consistently over the two years between soil iron and yield that as the soil iron increased, yield decreased (Fig 6). Zinc also proved to have a significant, negative relationships between soil, core tissue leaf tissues and sap yield. Higher concentrations of zinc in the soils of October, in the core tissues of August and in the leaf tissues of June, the yield decreases (Fig 7).

This two year study has proven that there are numerous complex factors affect sap flow and sap yield to various extents. While this study provided a good starting point to understand the factors affecting Nova Scotia maple syrup flow and yield, more research would be required to fully grasp the factors of greatest significance and understand their full role.

Acknowledgements

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