

A Dendrochronological Analysis of Green Ash in Prairie Shelterbelt Systems: Runaway Row



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Abstract

As a part of the Agricultural Greenhouse Gases Program, which seeks to determine the carbon sequestration capabilities of shelterbelt trees and their response to climate and climate change, the Mount Allison Dendrochronology Lab conducted a tree-ring analysis of a few choice species across latitudinal and longitudinal gradients in Saskatchewan. Using dendrochronological cross-dating techniques and climate analysis, patterns in tree growth were revealed and a relationship to climate variables was established. At the Runaway Row site, green ash samples were collected from 20 trees, and the oldest samples were 57 years old.

Introduction

The Mount Allison Dendrochronology Lab is currently involved in the Agricultural Greenhouse Gases Program, in conjunction with the University of Saskatchewan, which is investigating the capability of shelterbelt trees to store carbon. The carbon storage capability of these trees will inform their ability to off-set carbon emissions and potentially act as carbon credits. The objective of the larger project is to determine the current and future capacity of carbon sequestration in these shelterbelt trees.

In the summer of 2012, samples for this project were collected across most of Saskatchewan. These samples were used to complete three separate studies, which used dendrochronological (tree-ring) analysis, with the intention of investigating whether the sensitivity of the trees (in this study, green ash (*Fraxinus pennsylvanica*)) to major climate factors changed depending on their location. In order to do so, the ages and growth patterns of green ash were determined for each site, and their sensitivity to climate factors was compared to those established at other sites along a latitudinal transect. As a landowner, and therefore a stakeholder in this project, we would like to provide you with the results of our findings on your property.

Site Information

MAD Lab Site Code: 12PLM00

Date: May 9th 2012

Site Name: Runaway Row

Site Contact Info: NA

Latitude: N 51°18'59.6"

Longitude: W 103°38'09.1"

UTM: 0595087 5685938

UTM Zone: 13U

MASL (m above sea level): 686 m

Satellites: 3

Precision: ± 13m

Species Common Name: Green Ash

MAD Lab Species Code: M00

Methods

The MAD Lab sampled 20 green ash trees, using a 5.1 mm increment borer to take two core samples from each tree at approximately breast height. These samples were stored in plastic straws and taken back to the Mount Allison Dendrochronology Lab in Sackville, New Brunswick, for analysis. The diameter at breast height and the total height were also measured for each tree. The samples were glued into slotted mounting boards and labeled with the appropriate site code. The samples were sanded with progressively finer sandpaper (60 to 600

grit) and then buffed in order to reveal the cell structure and tree-rings. The annual growth rings were measured under a microscope using a Velmex staging system with a precision of 0.001 mm. The measurements from each core created a growth pattern which could then be matched against the other cores from that site, in order to create a standardized chronology which would demonstrate the overall tree-growth patterns through time for that site.

In order to determine the environmental factors influencing the tree’s growth, annual tree-ring measurements were compared to historical climate data from the Kelliher weather station, using the program DendroClim. The program provides statistical correlations which allow us to identify which climate variables influence the growth of the trees at each site.

Results and Discussion

The oldest samples were determined to be 57 years old at breast height. This suggests they were planted prior to 1955, which is in agreement with the database provided from the Prairie Farm Rehabilitation Association, which indicates that green ash were delivered here between 1950 and 1968. The tallest tree was 13.43 m tall while the widest tree had a diameter of 25.1 cm (see Table 1). The average ring-width measurement was determined to be 1.41 mm (see Figure 1 for the standardized growth of the tree over time). The climate data from the Kelliher station indicated that May precipitation from the previous year and February temperature were the strongest climate variables affecting the trees growth (see Figures 2 and 3).

Table 1: Diameter (DBH) and heights of trees sampled at the Runaway Row site.

Tree	DBH (cm)	Height (m)
1	23.7	12.03
2	19.1	11.83
3	18.0	11.83
4	21.0	12.03
5	25.1	10.23
6	22.1	12.63
7	20.2	13.43
8	24.5	13.23
9	21.3	13.03

10	23.7	13.23
11	15.0	8.43
12	19.3	10.83
13	16.5	8.53
14	16.6	10.03
15	15.1	9.63
16	17.5	10.03
17	17.7	10.03
18	17.8	9.63
19	17.5	10.23
20	20.2	9.63

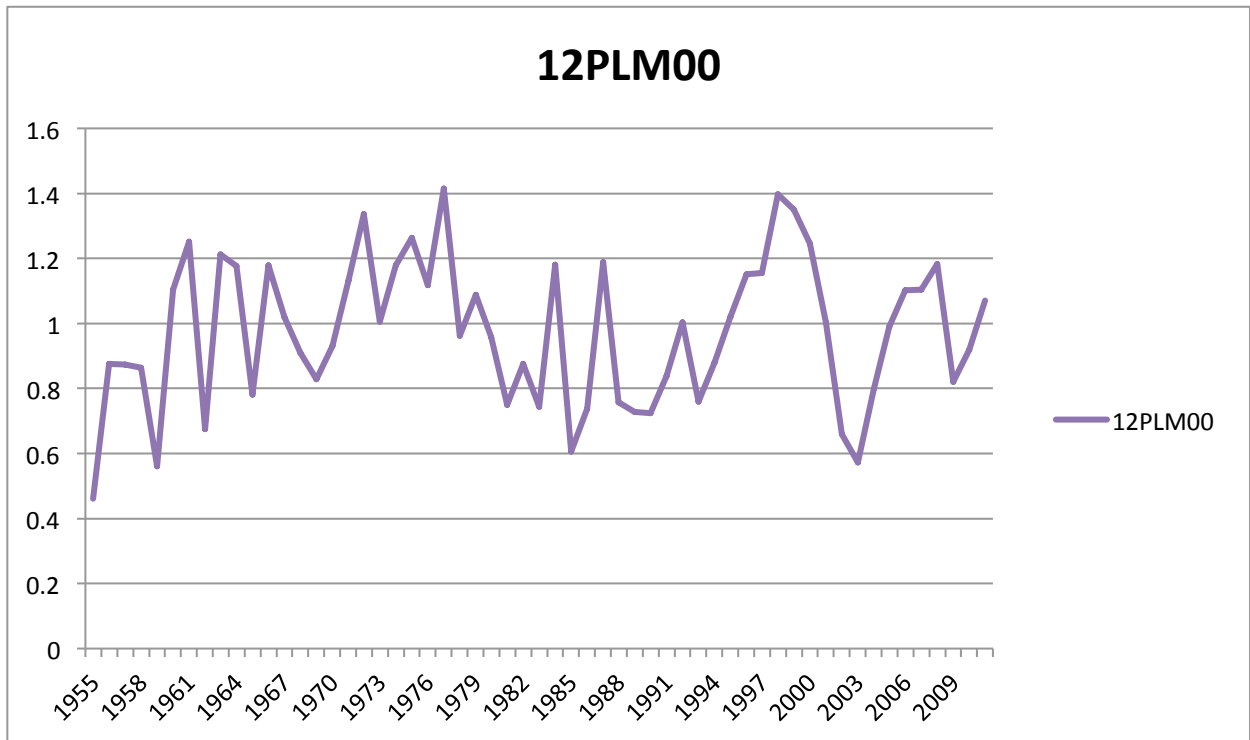


Figure 1: Standardized master chronology for green ash at the Runaway Row site. Standardized measurements of 1 indicate an average year of growth (in this case, 1.41 mm), while any value above or below one indicate a year of above or below average growth.

The next two figures represent the results of the climate analysis comparing annual tree-ring growth to historical climate variables from Kelliher, SK. The bars represent the degrees of correlation between the tree growth and the climate variable. The places where the bars cross the linear threshold are considered significantly correlated, marked by the change in color. The uppercase letters (ie. APR) label the previous years' variables.

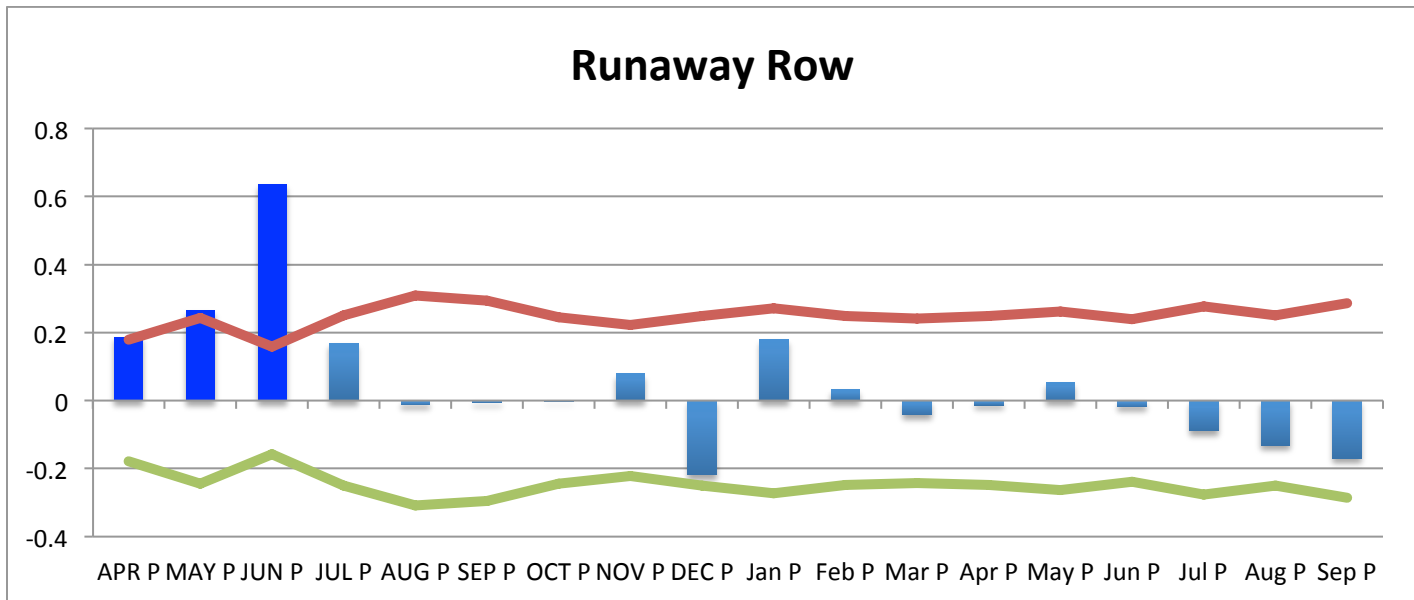


Figure 2: Results of the climate analysis comparing annual tree-ring growth to historical precipitation in Kelliher, SK.

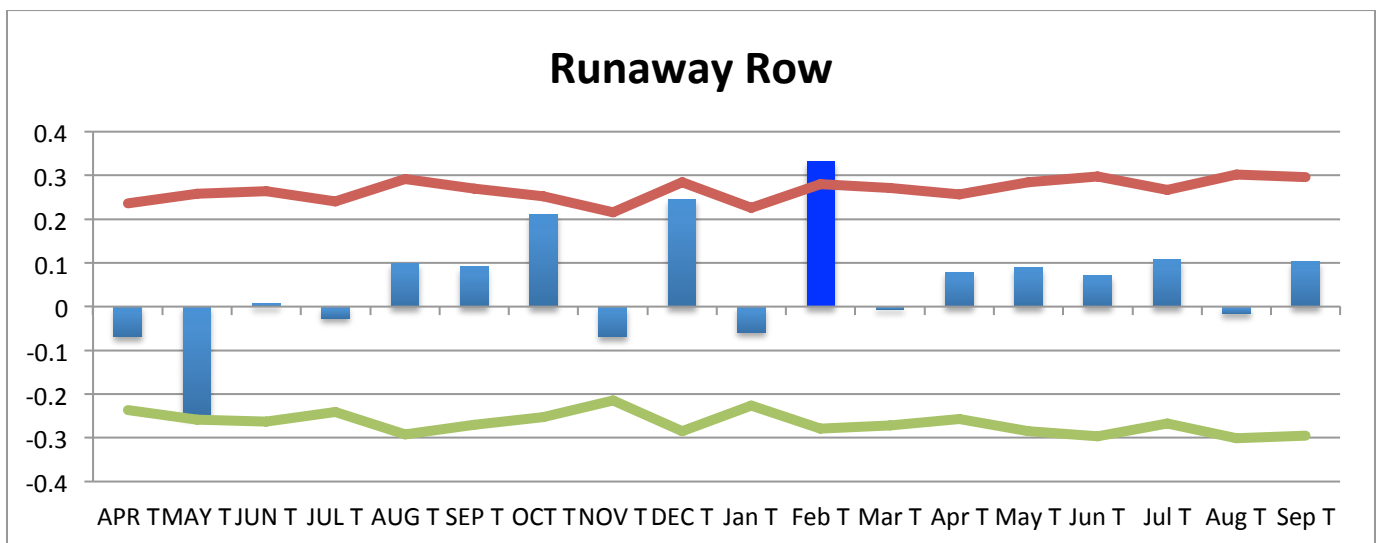


Figure 3: Results of the climate analysis comparing annual tree-ring growth to historical temperature in Kelliher, SK.

Conclusion

The results of this analysis give a strong indication of the important climate variables in southeast Saskatchewan. The importance of spring precipitation from the previous year in influencing tree-growth seems to decrease as sites are further north, and this site fits with the trend, as it is one of the north most sites and is less influenced by this climate variable. The data used from this site will be used in future studies, which will attempt to determine future growth trends and the amount of carbon sequestered by green ash to determine its potential and viability in carbon sequestration.

This research was conducted at the Mount Allison Dendrochronology Lab in Sackville, New Brunswick, and funded through the Agricultural Greenhouse Gases Program. Any questions regarding the findings of this report should be directed to:

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