A Dendrochronological Analysis of Green Ash in Prairie Shelterbelt Systems: Aganetha Martins

Jason Maillet, Emily Hogan, Cecilia Jennings, Mariana Trindade and Colin P. Laroque

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Mount Allison University, Department of Geography and the Environment

Mount Allison Dendrochronology Lab

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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 Aganetha's property, green ash samples were collected from 20 trees, and the oldest samples were 62 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) 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: 12JLM00

Date: May 7th 2012

Site Name: Aganetha's Ash

Site Contact Info: (306) 421-5292

Latitude: N 49°10'30.0"

Longitude: W 103°35'12.1"

UTM: 0603049 5447924

UTM Zone: 13U

MASL (m above sea level): 599 m

Satellites: 7

Precision: ± 6m

Species Common Name: Green Ash

MAD Lab Species Code: M00

Methods

The MAD Lab sampled 20 green ash (*Fraxinus pennsylvanica*) 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 Brunwsick, 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 Estevan 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 green ash samples were determined to be 62 years old at breast height. This suggests they were planted prior to 1950, which is in agreement with the database provided from the Prairie Farm Rehabilitation Association, which indicates that green ash were delivered here between 1947 and 2001. The tallest tree was 10.03 m tall while the widest tree had a diameter of 37.8 cm (see Table 1). The average ring-width measurement was determined to be 1.54 mm (see Figure 1 for the standardized growth of the trees over time). The climate data from the Estevan station indicated that May and June precipitation from the previous year were the strongest climate variables affecting the trees growth (see Figures 2 and 3).

Table 1: Diameter (DBH) and heights of trees sampled on Aganetha's property.

Tree	DBH (cm)	Height (m)
1	21.6	7.23
2	37.8	8.23
3	20.6	9.83
4	23.4	9.53
5	18.9	9.43
6	20.2	9.73
7	21.3	8.03
8	23.0	10.03

9	23.4	9.73
10	23.9	9.43
11	20.6	8.63
12	25.8	9.23
13	23.5	7.43
14	33.8	8.23
15	20.5	7.93
16	30.6	8.83
17	18.3	8.53
18	19.8	8.43
19	27.2	9.23
20	22.1	8.03

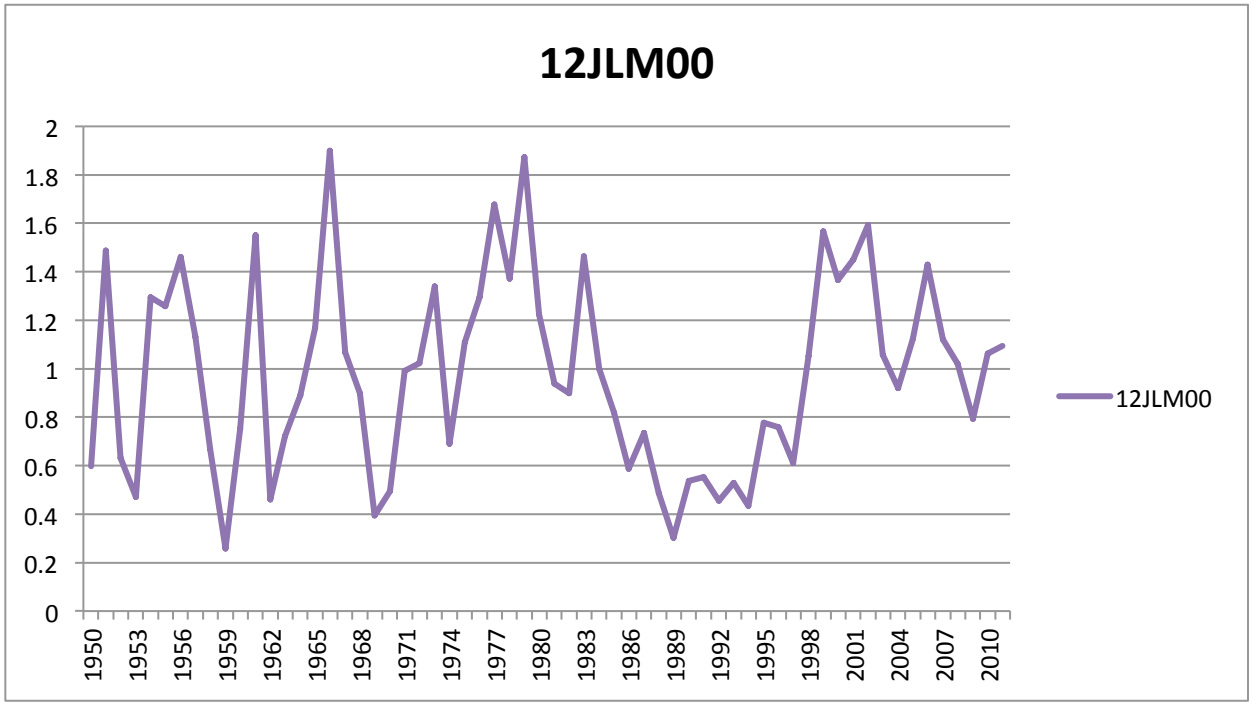

Figure 1: Standardized master chronology for green ash at Aganetha's property. Standardized measurements of 1 indicate an average year of growth (in this case, 1.54 mm), while any value above or below one indicate a year of above or below average growth.

The next two figures represent the results of the climate analysis comparing annual tree-ring growth to historical climate variables from Estevan, 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. At Aganetha's property, the previous year's May and June precipitation (negative), October precipitation (positive), and current year's temperature (negative) are all strongly associated with green ash growth.

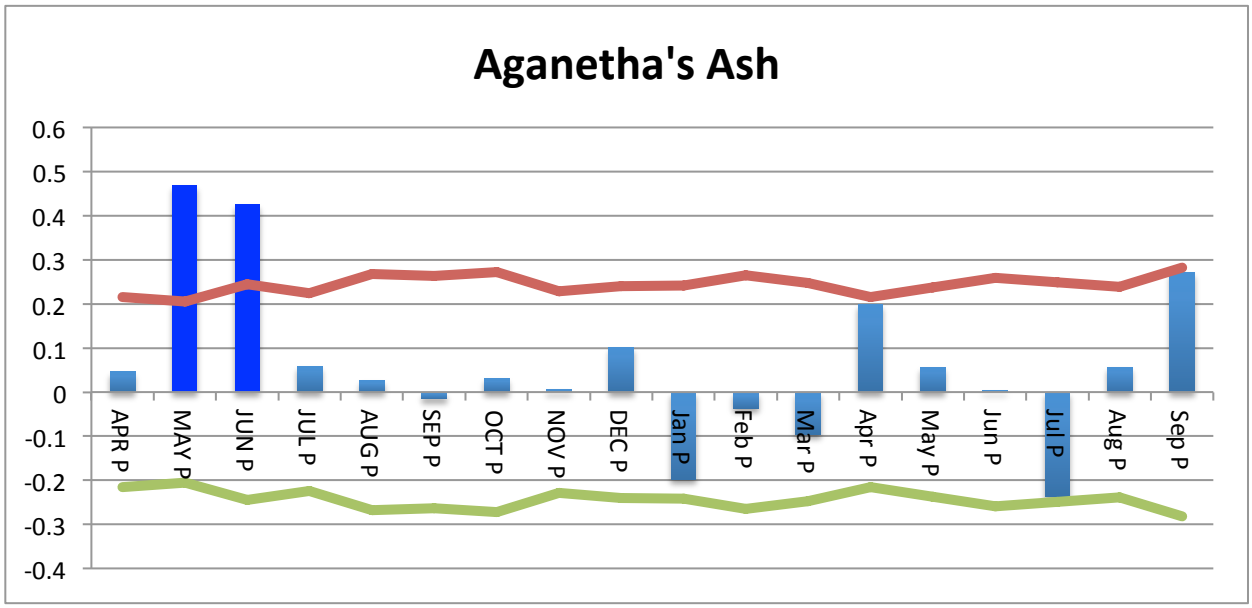

Figure 2: Results of the climate analysis comparing annual tree-ring growth to historical precipitation in Estevan, SK.

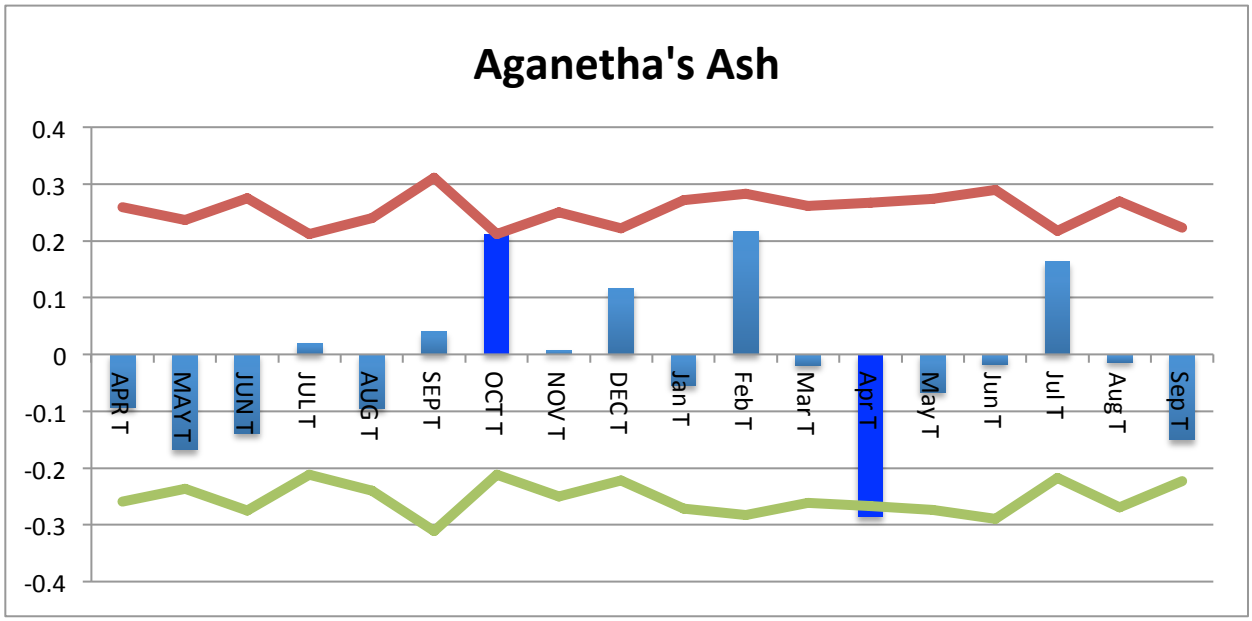

Figure 3: Results of the climate analysis comparing annual tree-ring growth to historical temperature in Estevan, SK.

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 the most southerly site and it is very strongly influenced by this climate variable. The data 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:

Dr. Colin Laroque
Professor, MAD Lab Director
University of Saskatchewan
Department of Soil Science
Room 5C10, Agriculture Building
51 Campus Drive,
Saskatoon, SK
S7N 5A8

Phone: 306-966-2493
Fax: 306-966-6881
E-mail: colin.laroque@usask.ca