A Dendrochronological Analysis in Canadian Prairie Shelterbelts:

Gentes' Farm

Mount Allison
Dendrochronology Lab

Emma L. Davis and Colin P. Laroque

MAD Lab Report 2012-14

Mount Allison University, Department of Geography and the Environment
Mount Allison Dendrochronology Lab

Table of Contents

Abstract…………………………………………………………………………………………........1
Introduction………………………………………………………………………………………..2
Site Information…………………………………………………………………………………...2
Methods……………………………………………………………………………………….....3
Results……………………………………………………………………………………………..3
Conclusion……………………………………………………………………………………...... 7

Abstract

To determine the carbon storage capacity of shelterbelt trees and their response to climate variables, the Mount Allison Dendrochronology Lab conducted a tree-ring analysis on nine of the most commonly planted shelterbelt species in the Canadian Prairies. Traditional cross-dating and climate analyses techniques were used to reveal a variety of temporal patterns in tree-growth. At the Gentes' Farm, siberian elm and Manitoba maple samples were collected for analyses and it was determined that the trees are aged 55 and 57 years respectively at the diameter at breast height.

Introduction

In summer 2011, the Mount Allison Dendrochronology Lab travelled to Saskatchewan to sample shelterbelt trees as part of the Agricultural Greenhouse Gas Program (in association with the University of Saskatchewan). The objective of the larger project is to determine the carbon storage capacity of shelterbelt trees in order to determine their ability to off-set carbon emissions and act as potential carbon credits for landowners.

Samples for this project were collected around south-central Saskatchewan throughout the summer of 2011 for a dendrochronological (tree-ring) analysis in an effort to reveal the climatic factors that have had the greatest impact on annual-tree growth for the tested species. The objective of this sampling was to determine the age and growth patterns of nine of the most commonly planted shelterbelt species. As a landowner and thus 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: 11CL

Date: MAY 22, 2011

Site Name: GENTES FARM

Site Contact Info: JENNY AND OWEN GENTES

TOWNSHIP – 36, RANGE - 8

SEC – 31, ¼ - SW, W3

Latitude: N 52° 07’ 49.2”

Longitude: W 107° 08’ 42.2”

UTM: 317, 770

UTM Zone: 13 U

MASL: 503 m

Satellites: 6

NAD: 83

Elevation: 503 m

Easting: 0353178

Northing: 5777704

Species Common Name: Siberian Elm

MAD Lab Species Code: P00

Species Common Name: Manitoba Maple

MAD Lab Species Code: O00

Methods

Forty tree cores were sampled from each species using a 5.1 mm increment borer. The samples were stored in plastic straws and transported to the Mount Allison Dendrochronology Lab for analysis. The samples were glued into slotted mounting boards, and then sanded and buffed to a fine polish in order to reveal the tree rings. Annual-growth rings were counted and measured using a mounted measuring stage and 60X microscope. The individual core measurements were crossdated (pattern-matched) against other cores within their group to establish the years that had increased or suppressed radial growth. A master chronology was established for each species at each site, demonstrating the overall tree-growth patterns through time.

Annual tree-ring measurements were then compared to historical temperature and precipitation data from the Saskatoon climate station in order to determine the major environmental factors influencing the tree's growth. The resulting statistical correlations allow us to infer the climate variables that play the most significant role in the growth of each shelterbelt species.

Results

Manitoba Maple

The oldest sampled Manitoba maple trees on the property were found to be 57 years old, suggesting that they were planted in the early 1950's (Fig. 1). The mean ring-width measurement was determined to be 2.19 mm.

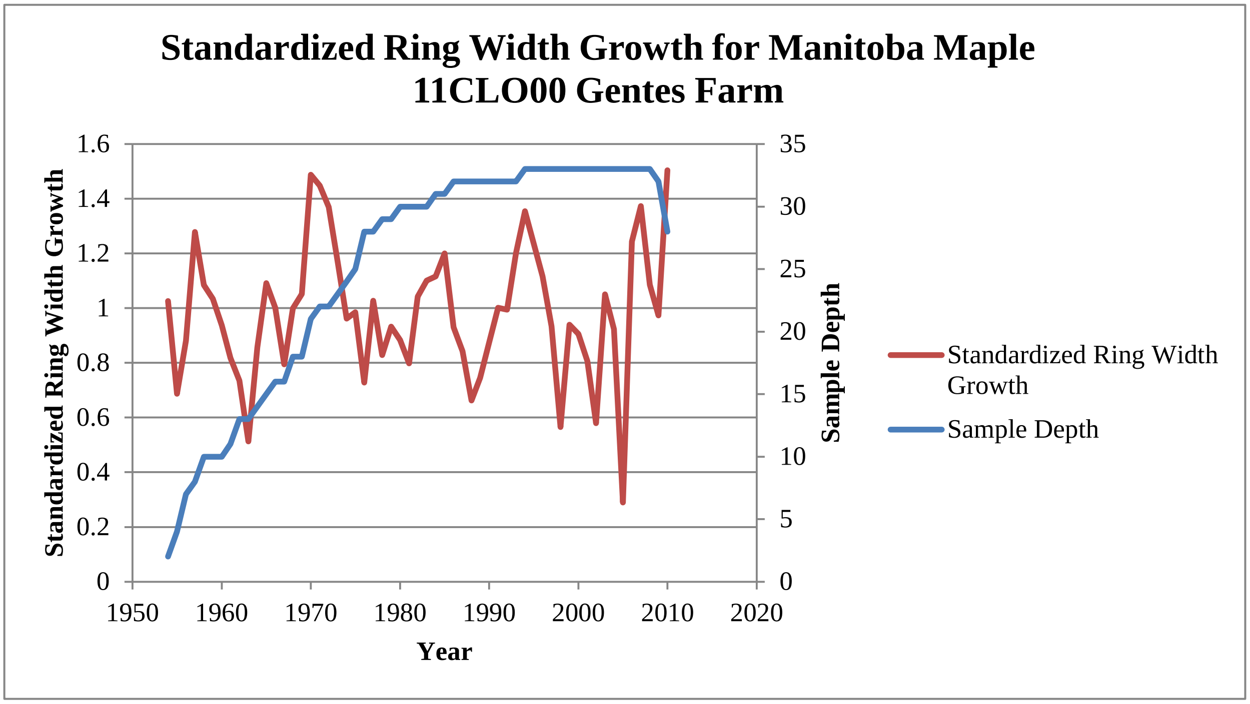

Fig. 1 - Master chronology for Manitoba maple (11CLO00) at Gentes Farm. A standardized measurement of one indicates an average year of growth, while any value above or below one indicates a year of above or below average growth.

Current September temperature (negative correlation) appeared to be the most dominant climate variable, in addition to the temperature in October of the previous year (negative) and previous December temperature (negative) (Fig. 2). These three variables combined to account for 21% of the annual variability of ring-width growth. The autumn temperature signals probably relate to soil moisture loss. When temperatures are warm in the fall, more water is evaporated from the soil and the trees grow poorly. The negative winter temperature relationship suggests that if it is a warm December, there is little snow present that would provide important melt water in the following summer.

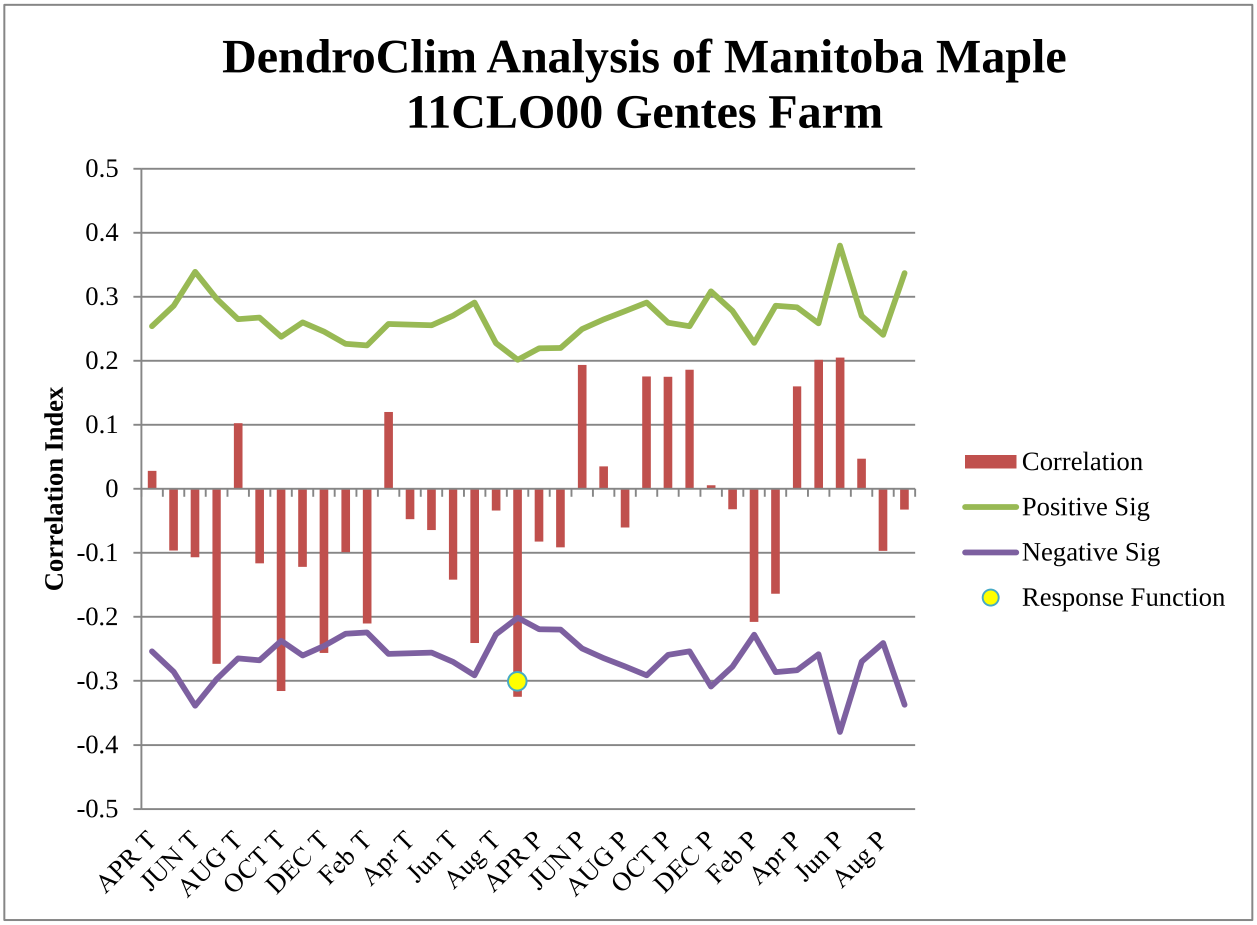

Fig. 2 - Results of the climate analysis comparing annual tree-ring growth to historical temperature and precipitation variables from Saskatoon. Bars represent the degree of correlation between growth and the climate variable, with anything surpassing the linear thresholds being considered significantly correlated. The uppercase letters (i.e. APR T) present variables from the previous year (for example, the conditions of the previous fall often have an impact on tree growth during the current year).

Siberian Elm

The master chronology for Siberian Elm was 55 years in length (1955-2010). The mean annual growth measurement was 2.72 mm (Fig. 3).

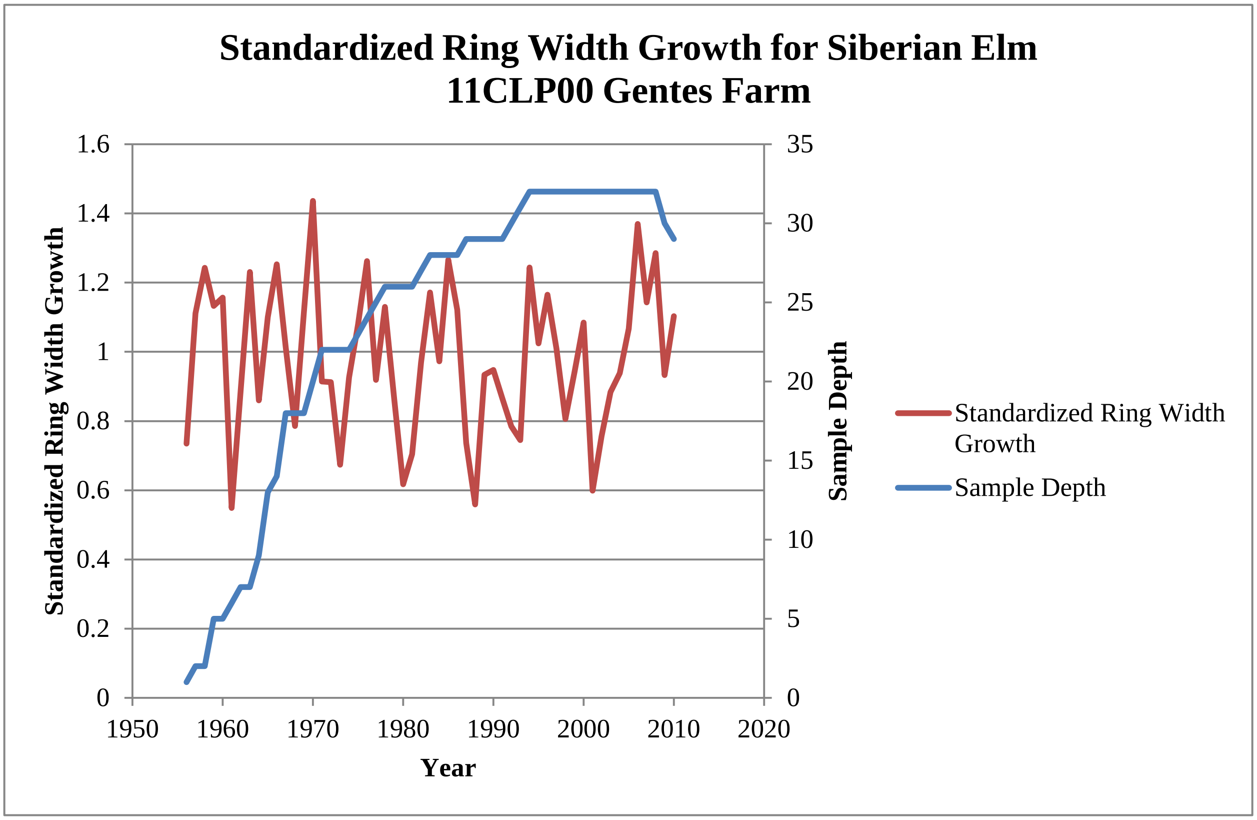

Fig. 3 - Master chronology for Siberian Elm at Gentes Farm. A standardized measurement of one indicates an average year of growth, while any value above or below one indicates a year of above or below average growth.

The most significant climate variables influencing the annual growth of this species were previous September precipitation (positive correlation), current June temperature (negative), and current June precipitation (positive) (Fig. 4). This indicates that the species' annual growth is heavily linked to the environmental conditions in the month of June. Precipitation in late summer (September) positively influences tree growth by introducing moisture to the soil. In the month of June, precipitation is an important factor driving the growth of the trees – when the temperature is too warm, water that would otherwise be used to help the tree grow is evaporated. This explains why June precipitation is positively correlated to tree growth, while June temperatures are negatively correlated.

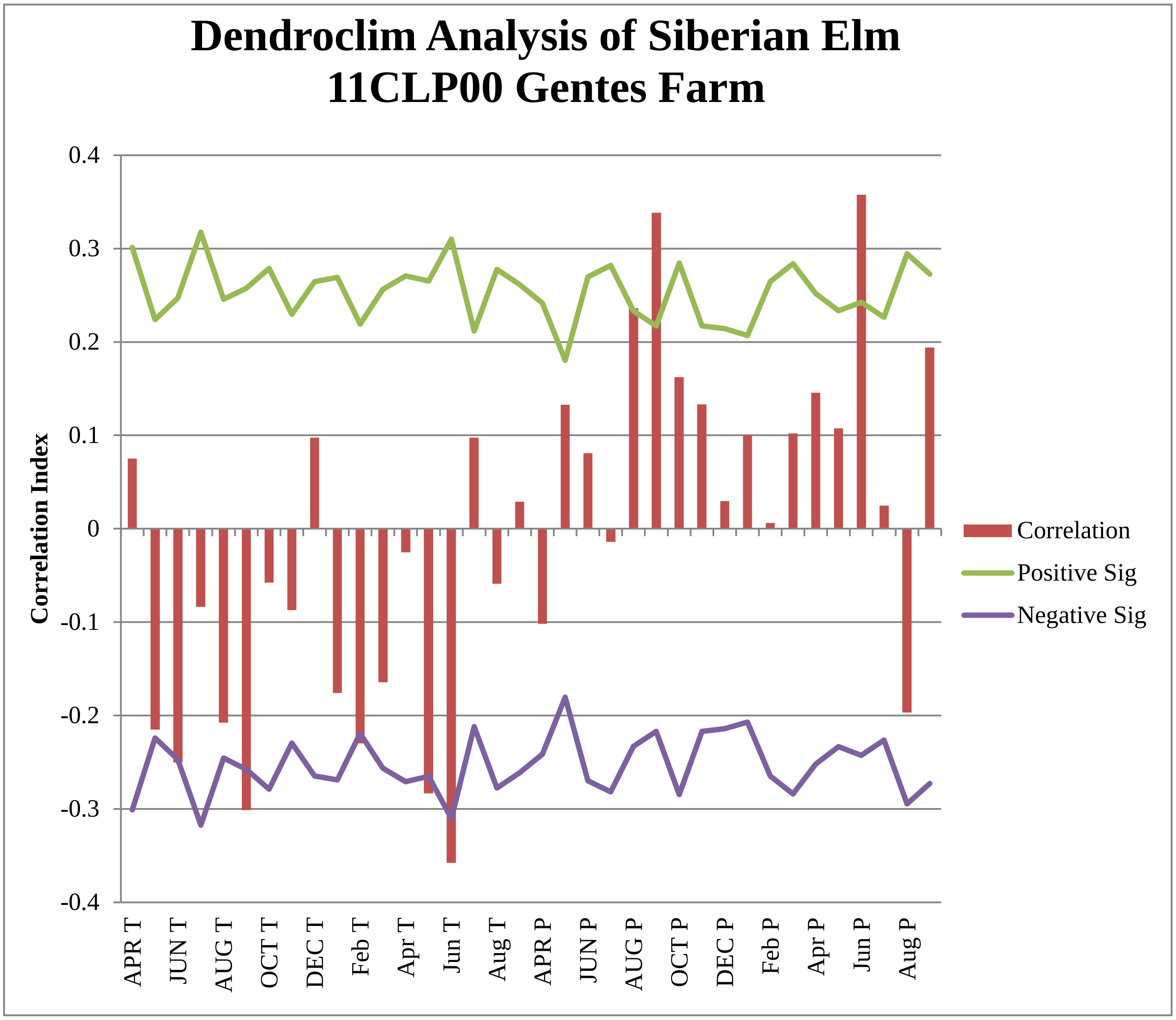

Fig. 4 Results of the climate analysis comparing annual tree-ring growth to historical temperature and precipitation variables. Bars represent the degree of correlation between growth and climate variable, with anything surpassing the linear thresholds being considered significantly correlated. The uppercase letters (i.e. APR T) present variables from the previous year (for example, the temperatures of the previous fall may have an impact on tree growth during the current year).

Conclusion

The results of these analyses have proved useful for determining the significant climatic variables influencing the annual growth of Manitoba maple and Siberian elm in shelterbelts in south-central Saskatchewan. The data obtained through this study will aid in inferring the future growth trends of shelterbelt species under different future climate change scenarios. The eventual aim is to use this information to quantify the amount of carbon sequestered by each shelterbelt tree on an annual basis to demonstrate their potential as carbon credits.

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

Dr. Colin Laroque

Mount Allison Dendrochronology Lab

RoomG3, Avard-Dixon Building
Mount Allison University
144MainStreet
Sackville, NB E4L 1A7

claroque@mta.ca

506-364-2390

Thank you for your participation in this project!