# A Dendrochronological Analysis in Canadian Prairie Shelterbelts:

# MacMillan's Farm

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**Table of Contents**

Abstract…….....1
Introduction……..2
Site Information……...2
Methods……....3
Results……..3
Conclusion…….... 5

## 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 MacMillan's Farm, white spruce samples were collected for analyses and it was determined that the oldest trees are aged 66 years at the diameter at breast height.

## Introduction

In the summer of 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:** 11JL **Date:** MAY 26, 2011

**Site Name:** MACMILLAN FARM **Site Contact Info:** NEIL &WILDA

**Latitude:** N 52° 04' 40.2" TOWNSHIP – 36 RANGE - 10

**Longitude:** W 107° 18' 50.5" SEC – 11 ¼ - SE W3

**UTM:** 142, 222

**UTM Zone:** 13 U

**MASL:** 548 m

**Satellites:** 9

**NAD**: 83

**Elevation:** 548 m

**Easting:** 0341427

**Northing:** 5772220

**Species Common Name:** White Spruce

**MAC Lab Species Code:** 200

## 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

The oldest sampled white spruce trees on the property were found to be 66 years old at breast height, suggesting that they were planted in the mid 1940's (Fig. 1). The mean ring-width measurement was determined to be 2.26 mm.

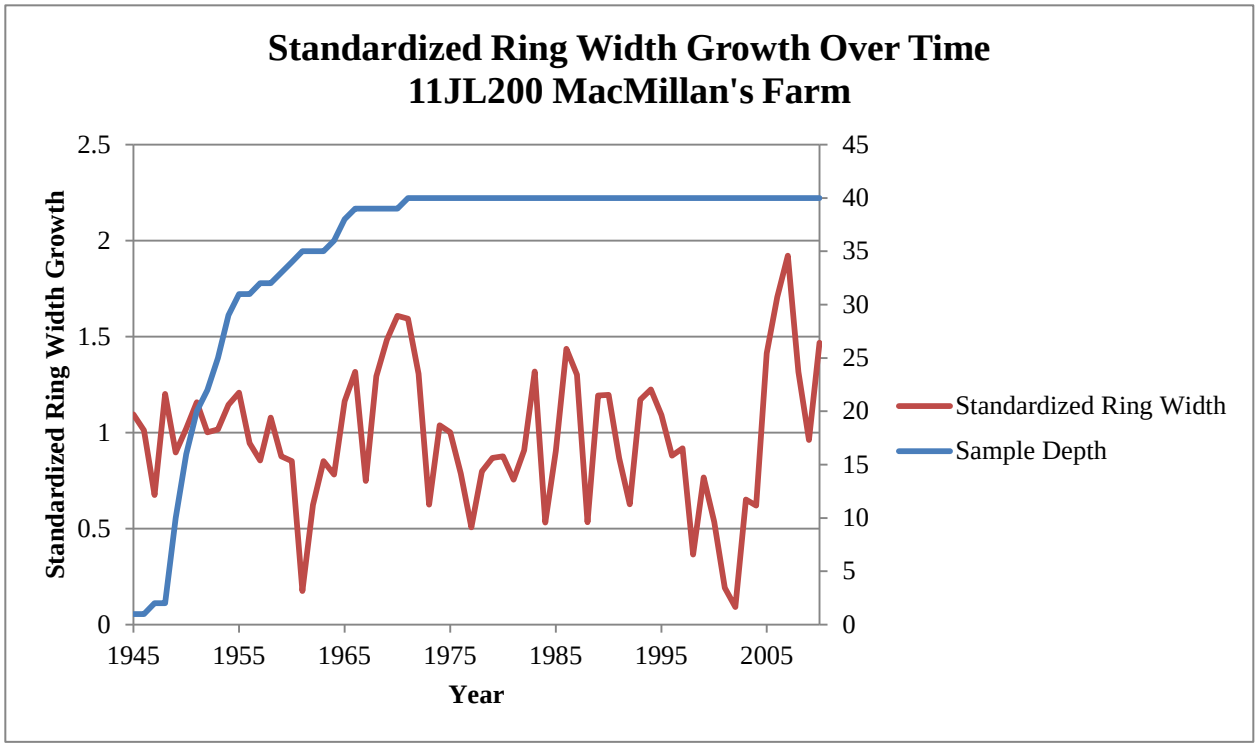


**Fig. 1** Master chronology for white spruce (11JL200) at MacMillan's Farm. A standardized measurement of one indicates an average year of growth, while any value above or below one indicates a year of above or below average growth.

White spruce tree-ring growth appeared to be heavily influenced by the previous year's August temperature (negative correlation), the current years July temperature (negative), previous September precipitation (positive), and current June precipitation (positive). It was found that the three most significant climate factors accounted for 28**%** of the variation in annual growth.

Increased temperatures in August of the previous year negatively influence tree growth in the current year by removing moisture from the soil that would otherwise help white spruce trees to store up resources for the following growth season. For similar reasons, September precipitation of the previous year is positively correlated to growth in the current year. July temperature in the current year negatively effects white spruce by drying the soil, while June precipitation is positively correlated as it restores moisture.

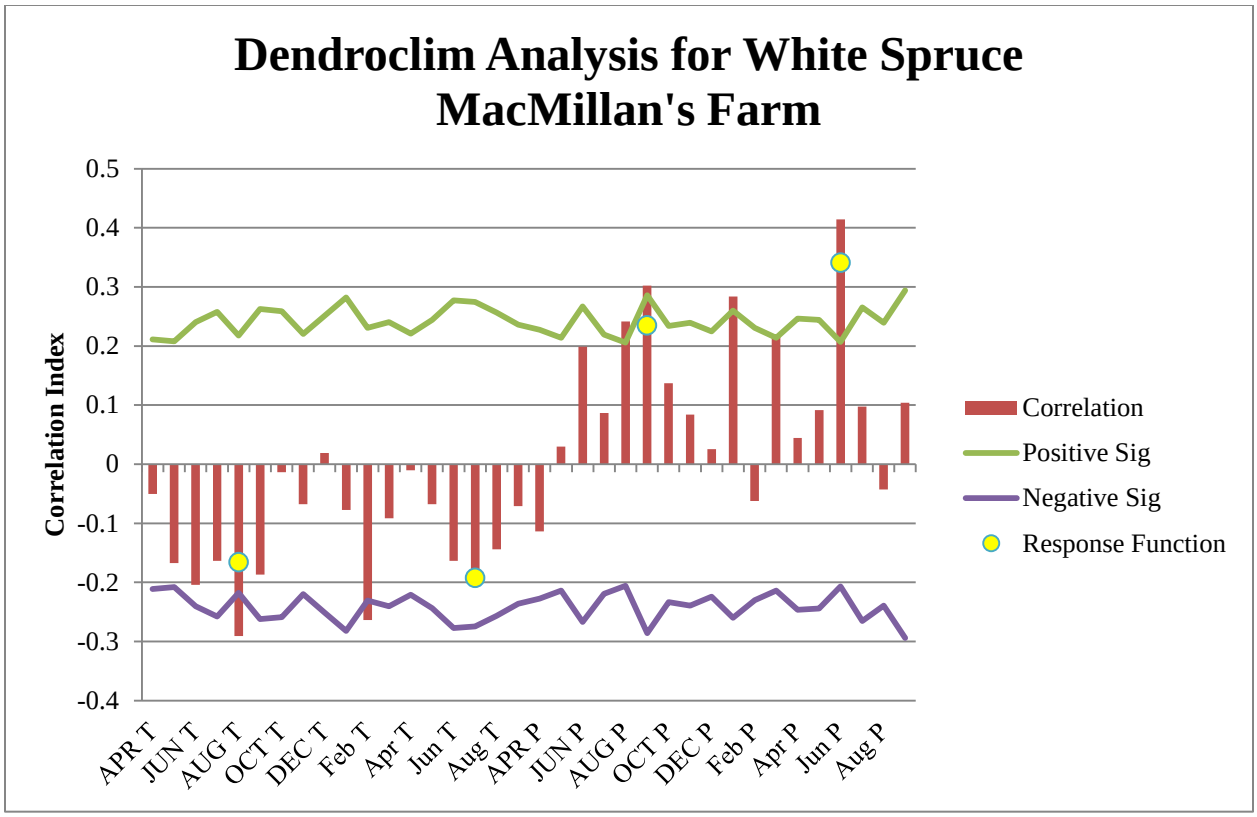


**Fig. 2** Results of the climate analysis comparing annual tree-ring growth to historical temperature and precipitation variables from Saskatoon. Bars represent the degree of correlation between growth and the climate variable, with anything surpassing the linear thresholds being considered significantly 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).

## Conclusion

The results of these analyses have proved useful for determining the significant climatic variables influencing the annual growth of white spruce 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:

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Thank you for your participation in this project!