AGGP-Agroforestry

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ESTIMATING DBH THROUGH TIME

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Shelterbelts have been planted in the Prairies through the years working as a tool to improve farming conditions. Recently shelterbelt have been considered a potential ally to mitigate and adapt against climate change on agricultural lands. To account for shelterbelts to assist global warming mitigation, periodic carbon stocks need to be estimated very precisely at the local level. To model carbon sequestration for a local approach, a large database of past growth is necessary. Unfortunately, shelterbelt trees have not been measured in regular inventories over the years. To address this lack of needed data, a method to retrieve growth information from increment cores and the error that the procedure yielded was studied.

METHODS

Cross sections were cut from 93 shelterbelt trees and sanded (Figure 1a). Observed circumference of each annual ring was measured with the program ImageJ on each cross section (Fig. 1b), divided by pi, so the observed diameter for each year was determined. It was compared with the estimated diameter for each year. To estimate diameters every year, increment cores were drawn on the cross sections simulating sampling methods, following two approaches, the pith and the center approach. For the pith approach, a number (n) of increment core reached the pith or did not reach (P_n or OP_n) (Fig 1c). On the center approach, a number (n) of increment core reached the center of the cross section or did not reach (C_n or OC_n) (Fig 1d). On each approach, diameters were calculated testing two directions of the error terms, from the bark to the pith and from the pith to the bark. On the bark to the pith direction, the last measured diameter was subtracted by the average increment measured on increment cores on the previous year to determine previous year's diameter and so on. For the pith to the bark approach, each year's diameter was the average of accumulated n increments. In total, 56 combinations were tested (2 (direction) x 2 (approaches) x 14 (modes)).

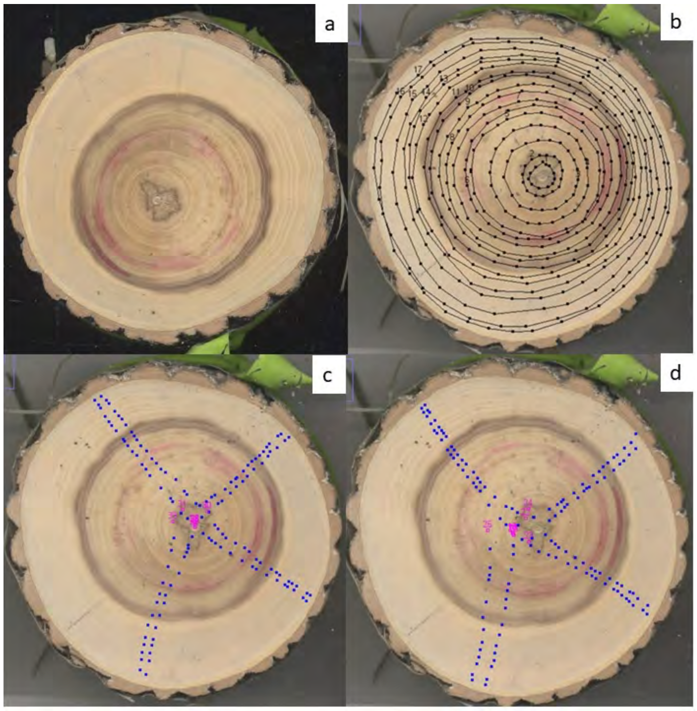

Figure 1 - a) Example of a 17-year-old Manitoba maple cross section, b) annual-ring lengths were drawn and measured with ImageJ, c) the "pith approach": increment core paths were aimed at the cross section's pith, d) while the "center approach" increment core paths were aimed at the cross section's center.

RESULTS

Three was the most optimized number of increment cores needed to calculate past diameters. Diameter calculation from the bark towards the pith yielded more reliable estimates than starting from the pith to the bark (Figure 2).

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For all species tested, the best approach was the pith approach, with all or most increment cores reaching it. The worst approach was the center approach, using one increment cores (Table 1). Figure 3 illustrates divergence between observed and estimated diameters. As we can see, on the method P3 estimations are more accurate than OC1s.

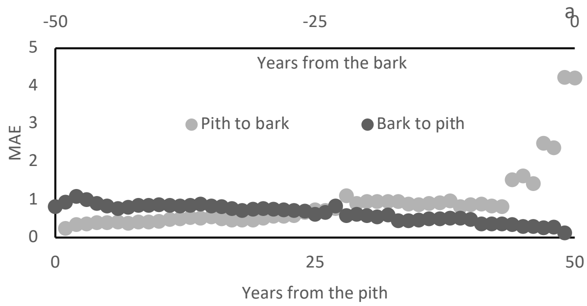

Figure 2 - Ring average MAE (Mean Absolute Error) in DBH for the bark to the pith (B to P) and from the pith to the bark (P to B) approaches.

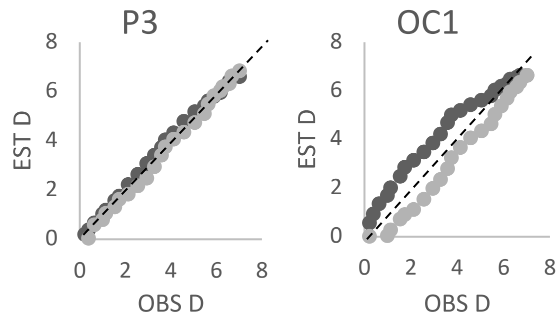

Figure 3 – Observed and estimated diameters (d) by the best (P3) and worst (OC1) methods.

Table 1. Best and wost methods for each species

Species	Best	Worst
Siberian elm (*Ulmus pumila*)	$P_3 OP_1, P_4, P_3$	OP_1, C_1, OC_1
Green ash (*Fraxinus pennsylvanica*)	$P_3 OP_1, P_4, P_3$	OP_1, C_1, OC_1
Manitoba maple (*Acer negundo*)	$P_3 OP_1, P_4, P_3$	OP_1, C_1, OC_1
Hybrid poplar (*Populus deltoids* x *Populus nigra*)	$P_3 OP_1, P_4, P_3$	OP_1, C_1, OC_1
Scots pine (*Pinus sylvestris*)	$P_3 OP_1, P_4, P_3$	OP_1, C_1, OC_1
Eastern larch (*Larix laricina*)	$P_3 OP_1, P_4, P_3$	OC_1, OC_2, OC_3
White spruce (*Picea glauca*)	$P_3 OP_1, P_4, P_3$	C_1, OC_1, OC_2

IMPLICATIONS

DBH can be retrieved accurately from increment cores, and so modeling can be expanded due to the ability to create a greater database of shelterbelt growth from cores through time. Therefore carbon stocks can subsequently be better understood at individual site locations. This precise carbon stock data at an individual farm basis can be used to support policies rewarding carbon sequestration to mitigate climate change and diversify local economies at each individual farm.

FURTHER READING: Mayrinck, R. C. (2021) PhD dissertation, University of Saskatchewan.

CONTACT FOR MORE INFORMATION: SASKAGROFORESTRY.CA/

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