AGGP-Agroforestry

SOIL ORGANIC CARBON SEQUESTRATION FOR SASKATCHEWAN SHELTERBELTS

No. SASK-20

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Soil organic carbon (SOC) sequestration potential of six major shelterbelts including green ash (GA; *Fraxinus pennsylvanica*), hybrid poplar (HP; *Populus* spp.), Manitoba maple (MM; *Acer negundo*), white spruce (WS; *Picea glauca*), Scots pine (SP; *Pinus sylvestris*) and caragana (CR; *Caragana arborescens*) was determined. Soil samples were collected for the shelterbelts and adjacent agricultural fields at 0-5, 5-10, 10-30 and 30-50 cm soil depths and measured for SOC concentration. Effect of shelterbelt design and overstory structure on SOC sequestration potential was determined using Pearson correlation and hierarchical multiple regression analyses.

SOC SEQUESTRATION UNDER SHELTERBELTS

- SOC concentration of shelterbelts was higher compared to croplands at all soil depths (Figure 1). Increase in SOC concentration of the shelterbelts was highest at 0-5 cm (11.5 g kg^{-1}) and declined with soil depth at 5-10 (6 g kg^{-1}), 10-30 (6.5 g kg^{-1}) and 30-50 cm (0.9 g kg^{-1}).
- Average SOC sequestered under shelterbelts varied with tree species, with highest SOC sequestration under HP (38 Mg ha^{-1}), followed by WS (21 Mg ha^{-1}), SP (20 Mg ha^{-1}), GA (15 Mg ha^{-1}), MM (11 Mg ha^{-1}) and CR (6 Mg ha^{-1}) (Figure 2). An additional 3.1-8.3 Mg ha^{-1} was contained in tree litter layer with the highest C in litter layer stored for SP and WS shelterbelts.
- Younger shelterbelt plantations showed a loss in SOC compared to the agricultural fields (Figure 3), attributed to mineralization of SOC during plantation establishment. Out of 16 sites that showed SOC loss, 13 sites had a stand age of 20 years or less.

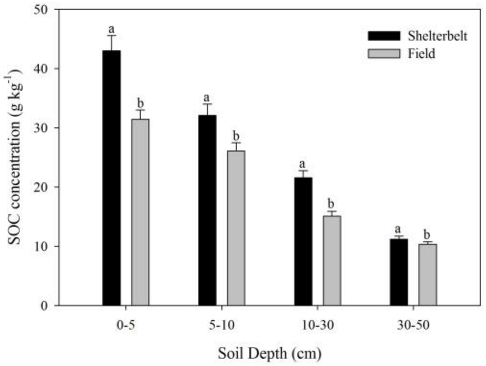

Figure 1. Increase in SOC concentration compared to fields at different soil depths

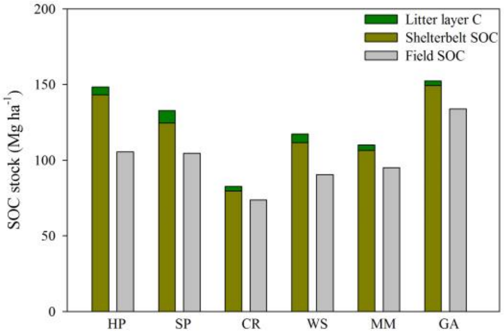

Figure 2. C stocks in the litter layer and mineral soil (0-50 cm) for shelterbelts and adjacent fields

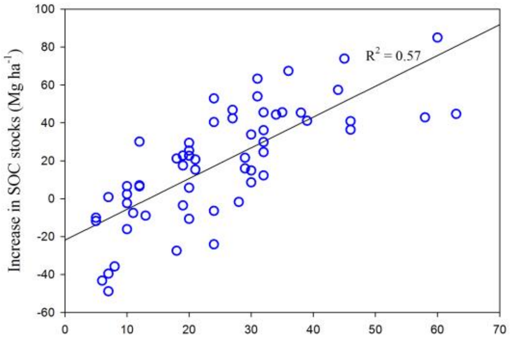

Figure 3. Relationship between the increase in SOC stocks of shelterbelts and shelterbelt age

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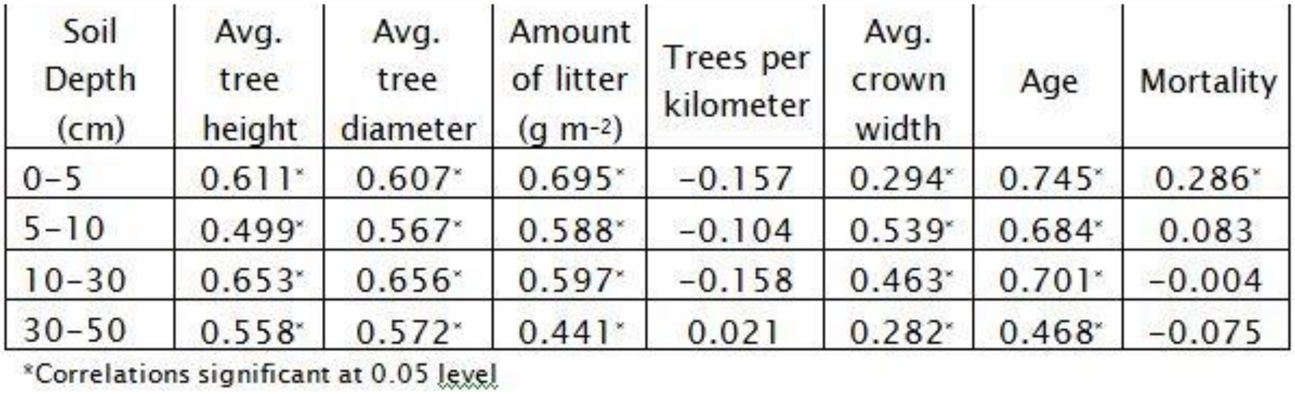
EFFECT OF SHELTERBELT CHARACTERISTICS ON SOC SEQUESTRATION

- HP, WS and SP shelterbelts were composed of larger trees with higher crown width, tree height and diameter, compared to GA, MM and CR shelterbelts. Density of litter layer was also the highest in case of SP, WS and HP.
- Increase in SOC content was positively related to stand characteristics such as tree age, average tree diameter and tree height, average crown width of the trees and amount of litter (Table 1).
- Hierarchical multiple regression analysis revealed that stand age was the most important determinant of increase in SOC concentration of shelterbelts, followed by density of litter layer, and tree physiological characteristics including crown width and tree height. Together these factors explained 56-67% of the variability in the increase in SOC concentration within sites.
- Shelterbelt design characteristics such as tree density, tree spacing and number of tree rows did not affect the increase in SOC storage.

Table 1. Pearson correlations between the major shelterbelt characteristics and increase in SOC concentrations ($g\ kg^{-1}$) at 0-5, 5-10, 10-30 and 30-50 cm soil depth.



Soil Depth (cm)	Avg. tree height	Avg. tree diameter	Amount of litter ($g\ m^{-2}$)	Trees per kilometer	Avg. crown width	Age	Mortality
0-5	0.611*	0.607*	0.695*	-0.157	0.294*	0.745*	0.286*
5-10	0.499*	0.567*	0.588*	-0.104	0.539*	0.684*	0.083
10-30	0.653*	0.656*	0.597*	-0.158	0.463*	0.701*	-0.004
30-50	0.558*	0.572*	0.441*	0.021	0.282*	0.468*	-0.075

*Correlations significant at 0.05 level

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