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EFFECT OF SHELTERBELTS ON STABILIZATION AND COMPOSITION OF SOIL ORGANIC CARBON

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In order to study the qualitative effect of shelterbelts on SOC, physical stabilization and molecular composition of SOC was determined for major shelterbelt species 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*) and adjacent croplands. Physical stabilization was determined by separating SOC into uncomplexed light fraction (LF) and mineral-associated heavy fraction (HF) using sodium iodide solution (NaI, density = 1.6 g cm^{-3}). SOC composition was determined by using attenuated total reflectance Fourier transform infrared (ATR-FTIR) spectroscopy as well as Carbon K-edge X-ray absorption near edge structure (XANES) spectroscopy, followed by deconvolution of spectra through Gaussian peak fitting.

EFFECT OF SHELTERBELTS ON DENSITY FRACTIONS

- SOC concentration of LF and HF was higher for shelterbelts compared to fields at all depths. SOC concentration of shelterbelts increased by 71% for LF and 22% for HF. LF and HF accounted for 7 Mg ha^{-1} (38%) and 10.4 Mg ha^{-1} (56%) of the increase in SOC stocks (18.6 Mg ha^{-1}) for shelterbelts, respectively.
- Maximum increase in LF-C stocks was observed in case of HP, WS and SP shelterbelts (11, 10 and 10 Mg C ha^{-1}, respectively), while maximum increase in HF-C stocks was observed for HP, GA and WS (26, 10 and 9 Mg C ha^{-1}, respectively). Contribution of LF to sequestered SOC was higher in case of SP, WS and CR shelterbelts (50, 49 and 48%, respectively), compared to GA (31%), HP (29%) and MM shelterbelts (29%), and attributed to differences in litter quality (Figure 1).
- LF-C was predominant form of SOC added at 0-10 cm soil depth, while HF-C accounted for majority of SOC sequestered at 10-30 and 30-50 cm depths (Figure 2).

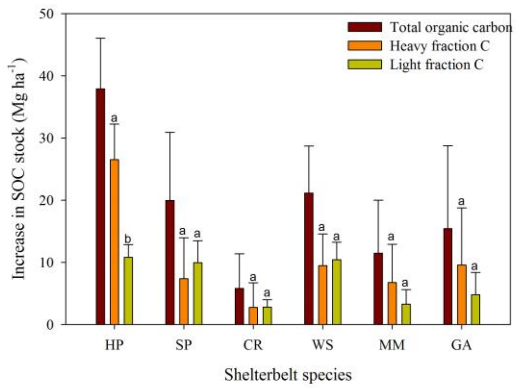

Figure 1. Contribution of LF and HF to increase in SOC stocks for different shelterbelt species.

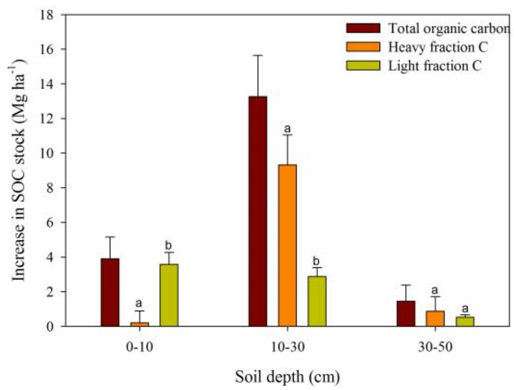

Figure 2. Contribution of LF and HF to increase in SOC stocks at different soil depths.

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Effect of shelterbelts on SOC composition

- ATR-FTIR spectra of shelterbelt and field soil samples were analyzed to determine the relative contribution of polysaccharide-C (1030-1100 cm^{-1}), aromatic and carboxylic-C (1600-1640 cm^{-1}), and aliphatic-C (2850-2920 cm^{-1}; 1430 cm^{-1}) functional groups to SOC composition. Similarly, C K-edge XANES spectra were analyzed to determine relative proportion of aromatic (285 eV), ketone (286.5 eV), aliphatic (287.3 eV), carboxylic (288.5 eV), and polysaccharide (289.5 eV) functional groups.
- SOC composition under shelterbelts and fields was dominated by carboxylic-C and polysaccharide-C followed by moderate amounts of aromatic-C, aliphatic-C and ketone functional groups.
- There was an increase in the relative proportion of aromatic and ketone functional groups for the shelterbelts compared to fields (Figure 3).
- ATR-FTIR spectra revealed that the increase in carboxylic band (1600-1640 cm^{-1}) was directly related to the amount of increase in SOC concentration under the shelterbelts (Figure 4).
- Relative enrichment of microbially synthesized secondary SOM sources such as ketones indicated that SOC under shelterbelts was at an advanced stage of decomposition.

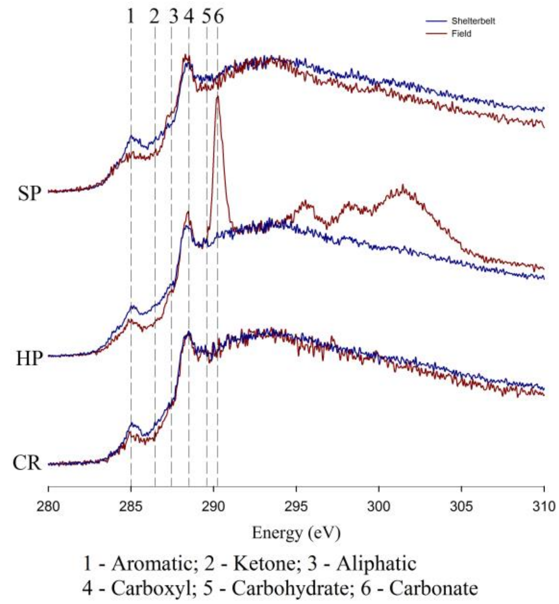

Figure 3. C K-edge spectra of soil samples for shelterbelts and adjacent fields

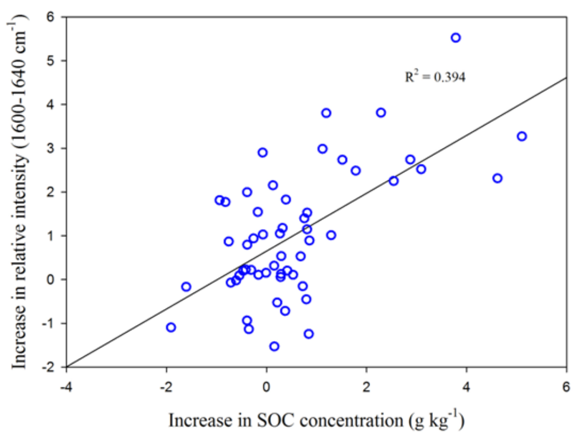

Figure 4. Relationship between increase in carboxylic band and SOC concentration at 0-5 cm depth.

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