Geophysical Research Abstracts
Vol. 15, EGU2013-4418, 2013
EGU General Assembly 2013

The effect of harvest intensity on long-term calcium dynamics in soil and soil solution at three coniferous sites in Sweden

Therese Zetterberg (1), Bengt Olsson (2), Stefan Löfgren (3), Claudia von Brömssen (4), and Per-Olov Brandtberg (2)

(1) IVL Swedish Environmental Research Institute, Gothenburg, Sweden (therese.zetterberg@ivl.se), (2) Swedish University of Agricultural Sciences, Department of Ecology (bengt.olsson@slu.se), (3) Swedish University of Agricultural Sciences, Department of Aquatic Sciences and Assessment (stefan.lofgren@slu.se), (4) Swedish University of Agricultural Sciences, Department of Economics (claudia.von.bromssen@slu.se)

Bioenergy from forests is a mean to reduce fossil fuel related carbon dioxide (CO_2) emissions. The potential to replace fossil fuel with logging residues is large in countries with extensive forest resources such as Sweden where the supply of bioenergy to district heating plants has quintupled since the 1990's, now accounting for 46% of the total energy supply. However, the loss of nutrients and other elements in biomass is higher following harvest for bioenergy purposes (whole-tree harvest, WTH) compared with traditional clear-cutting (conventional harvest, CH).

Calcium (Ca^{2+}) is an important base cation, which buffer soils and surface water against acidification. The loss of Ca^{2+} and other base cations via harvest for bioenergy could therefore result in soil acidification and there is a growing concern in Sweden that the depletion in base cation pools would also lead to surface water acidification associated with lower base cation concentrations in runoff (Swedish Environmental Protection Agency, 2007). Furthermore, WTH may also prevent or delay a recovery from acidification in areas such as the southwestern parts of Sweden, where the pools of exchangeable cations have been substantially depleted as a result of historically high sulfate (SO_4^{2-}) deposition.

In this paper, long-term treatment differences in soil exchangeable Ca^{2+} pools (down to 20 cm) and soil solution Ca^{2+} concentrations at 50 cm soil depth were examined at three coniferous sites in Sweden following CH and WTH in 1974-76.

The results showed that soil water concentrations of Ca^{2+}were -17 μeq l^{-1} (or 40%) lower in WTH plots compared with CH plots, 27-30 years after harvest. The main treatment differences had largely disappeared 32 to 35 years after harvest although site specific treatment differences (ΔWTH-CH: -24 μeq l^{-1}) were still measurable at the well-buffered site in northern Sweden.

These results are in agreement with soil data showing that previously found treatment differences in Ca^{2+} pools had diminished in the forest floor but remained in deeper soil layers
(-0.29, -0.37 and -0.24 $kmol_c$ ha^{-1} in the 5-10, 10-15 and 15-20 cm soil layer, respectively). The effects on soil Ca^{2+} pools appeared to be most pronounced at the well-buffered northern site.

These results indicate that the effect of WTH on soil and soil solution concentrations is temporary but site specific. Contrary to common beliefs, the greatest effects were observed at the well-buffered site where the loss of Ca^{2+} during WTH is less likely to lead to acidification effects. The treatment effects on soil solution at the more acidic sites in southern Sweden were much smaller and probably not large enough to fully counterbalance the general recovery from acidification during the study period.

References

Swedish Environmental Protection Agency, 2007. Bara naturlig försurning. Bilagor till underlagsrapport till fördjupad utvärdering av miljömålen. Rapport 5780. 208 pp. In Swedish.