Public Abstract
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Title:Influence of Residue Management on Soil Chemical Properties and Nutrient Flux in Forests Harvested for Woody Biomass.

Altered soil solution chemistry and nutrient flux within forests harvested for woody biomass may result from disturbance, slash removals, slash decomposition, and mineralization. Because of the potential adverse effects of woody biomass harvest to soil nutrient pools and overall soil quality, the Missouri Department of Conservation (MDC) has developed Best Management Practices (BMPs) to retain coarse woody residues associated with biomass harvesting to retain nutrient capital and sustain forest productivity. However, these BMPs remain untested. To investigate the potential impacts of woody biomass harvest and use of BMPs to mitigate deleterious effects, this study examined soil nutrient concentrations and nutrient flux in Missouri Ozark forest soils immediately following harvest to 1.5 years post-harvest. The eight treatments investigated were Missouri's 1/3 harvest residue retention BMP for thinning and commercial biomass harvests and alternative harvest scenarios. Chemical properties of soils within the harvest treatments were quantified immediately after harvest and one year post-harvest, and analysis of variance results are presented. Total organic carbon (TOC) was the only dependent variable that was affected by harvest treatment (p-value = 0.0458); where TOC content for clearcut A (Missouri's BMP) and clearcut B (removal of all biomass) were significantly greater than for clearcut C (alternative BMP). Changes in nutrient flux were monitored using Plant Root Simulator (PRSTM) ion exchange membrane probes provided by Western Ag Innovations. Nutrient flux dynamics differed for the nutrients measured within harvest treatments and at two different depths. Results indicate greater nutrient flux in the clearcut treatments compared to the intermediate thinning and control treatments for specific ionic species measured (Total N, NO3-, S, Fe, and Mn).
Litter decomposition plays a major role in the cycling of energy and nutrients in woodland ecosystems. The influence of woody biomass harvest scenarios were investigated during a one year litterbag experiment in an oak-hickory forest of the Missouri Ozarks. Total nitrogen (TN), total organic carbon (TOC), C:N ratio, and percent mass loss of leaf litter material were analyzed and compared amongst eight harvest treatments. Percent mass loss was positively correlated to total nitrogen. Treatment type and decomposition time had a significant effect on TN ($p = 0.0432$ and $p < 0.0001$ respectively). When comparing the effect of treatment on TN, clearcut B (removal of all biomass) was significantly lower than the control, intermediate A, clearcut A, (current 1/3 BMP) and clearcut C (alternative BMP). To semi-quantitatively assess how decomposition processes vary in leaf litter material across different harvesting treatments, solid-state 13C nuclear magnetic resonance spectroscopy with cross-polarization and magic-angle spinning (CPMAS-NMR) technique was applied to analyze the organic C dynamics of mixed leaf litter. A significant interactive effect of treatment type and decomposition time was found for the concentration of the O-alkyl-C functional group, indicating that the change in concentration of this functional group with decomposition time was significantly different among the different harvest treatments. This research will enhance our understanding of nutrient cycling in a forested ecosystem following a woody biomass harvest, which will aid in maintaining sustainable nutrient concentrations and long-term site productivity. To ensure long-term sustainability and forest productivity, it is recommended to use the current Missouri BMPs or the alternative BMP (retain tops of all cut trees ? 20 cm dbh; remove boles, tops and limbs of all cut trees ? 20 cm dbh). Overall, the biomass guidelines supplement existing forestry rules and guidelines, encourage forest health and productivity, and enhance the full suite for ecological values. The current BMP and alternative BMP provide an opportunity to suggest alternative harvesting techniques, besides the traditional sawlog harvest, to high grading and

damaging practices on the long-term health of the forest ecosystem.