OP237

Partial or Complete Removal of Understory Components Enhances or Limits Nutrient Availability for Tree Growth

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Aim of the study: Conifer seedlings need to be released from competition with understory until seedlings overtop shrubs during the stem exclusion stage. The question arises as to whether partial or complete removal of understory components enhances or limits nutrient availability for tree growth in new plantations. Although competing species can be detrimental to seedling growth in the early stages of stand establishment, excessive understory vegetation control may, in some cases, be ecologically undesirable. In this study, an effort was made to analyze the soil isotopes, δ13C and δ15N properties for interpreting effects of understory vegetation removal on nutrient cycling at the ecosystem level.

Material and Methods: This study utilized a previously established, large-scale project where the understory vegetation was differentially controlled in Douglas-fir plantations in Oregon, USA. The experiment used a randomized block design with four blocks. Treatments included 3 randomly assigned levels of salmonberry (*Rubus spectabilis* Pursh) and herbaceous vegetation control. After the understory were cleared, Douglas-fir seedlings (2-0 bare-root stock) were planted at a 3 x 3 m spacing. A control plot received no vegetation removal after initial establishment with Douglas-fir seedlings (DFC). On one of the plots, shrubs were completely removed, leaving only herbs and Douglas-fir (DFH). Finally, complete removal of shrubs and herbs was included in the array of treatments, leaving only Douglas-fir (DFO). Each treatment was maintained manually through the growing seasons for five years. Soil samples were collected from 0-7.5 cm and 7.5-15 cm soil depths at 5 randomly selected locations on each plot. Soil samples were separated as light (LF)- and heavy-fraction (HF) organic material. Stable isotopes ^{13}C and ^{15}N of the LF and HF were analyzed for their ^{13}C and ^{15}N stable isotope values using a continuous flow method.

Results: Total understory vegetation removal significantly enriched soil $\delta^{15}N$ on DFO sites at age 5 yr. Soil on DFO plots had the highest $\delta^{15}N$ values. $\delta^{13}C$ signatures of < 2 mm soil light (LF) and heavy fractions (HF) were not different between plots, but the differences between LF and HF were significantly affected by understory removal ($P < 0.04$). Our data imply that organic matter on DFC sites decomposed faster due to the fact that these sites were dominated by shrubs and herbs. In contrast, the forest floor on DFO sites decomposed slowly due to the more recalcitrant properties of needles. Further research is needed to investigate changes in soil C and nutrients in the future with the presence and absence of understory as part of ecosystem.

Keywords: Understory removal, stable isotopes, mineralization.