Effects of Forest Floor Mosses on Growth of Fine Roots and Emissions of Greenhouse Gases in Boreal Forests after Wildfire

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[Abstract]

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The objectives of this study were to understand effects of forest floor vegetation on carbon dynamics of boreal forests after wildfire in relation to fine root dynamics and emission of greenhouse gases. In August 2009, study plots were established in black spruce (*Picea mariana*) stands in interior Alaska, which were burned by wildfire 5, 10 and 90 years ago (plot 5, plot 10 and plot 90). Forest floor vegetation covered 37% of ground surface at plot 5, whereas it covered 98% at plot 90. Depth from ground surface to organic horizon in plot 5 (8.6 cm) was 25% of that in plot 90 (35 cm). These results indicated changing forest floor conditions after wildfire. Production rates of forest floor vegetation were 33-46 g m^{-2} yr^{-1}, where the largest production rate was observed at plot 5. Production rates of fine roots were 48, 47 and 63 g m^{-2} yr^{-1} at plot 5, plot 10 and plot 90, respectively. Annual carbon inputs into the soil by production of litterfall, fine roots and forest floor vegetation were estimated to be 0.57, 0.51, 0.66 t C ha^{-1} yr^{-1} at plot 5, plot 10 and plot 90, respectively. Soil respiration rates measured in August 2009, February 2010, July 2010 and September 2010 were 62±32, 104±70, 90±50 mg CO_2-C m^{-2} h^{-1}, at plot 5, plot 10 and plot 90, respectively. The soil respiration rates showed a positive correlation with soil temperature at each plot, but the soil respiration rates in plot 5 were smaller than in other two plots within a same range of soil temperature. Annual soil respiration rates were estimated to be 2.10, 2.81, 2.94 t C ha^{-1} at plot 5, plot 10 and plot 90, respectively, in which winter CO_2 flux was 4.5%-6.3%. Methane uptake rates and N_2O emission rates in August 2009 were 38-78 μg CH_4-C m^{-2} h^{-1} and 0.22-2.6 μg N_2O-N m^{-2} h^{-1}, respectively, where the largest CH_4 and N_2O fluxes were observed at plot 5 and plot 10, respectively. In summary, our results suggested that carbon dynamics related to organic matter input into the soil and emissions of greenhouse gases from the soil in *P. mariana* stands would be affected by forest floor conditions changing after wildfire, although variation of the carbon dynamics among the study plots seemed to be less evident as compared with those of forest floor conditions.