Widespread use of loblolly pine (Pinus taeda) has greatly increased the suitable habitat for southern pine beetle (Dendroctonus frontalis). Southern pine beetles (SPB) impact different species in forests as an effect of their wintertime habits. This study aims to fill gaps of literature describing the biogeochemical and hydrological fluxes in stemflow and throughfall from southern pine beetle (SPB) infestations. We hypothesize that affected trees will produce more stemflow than control trees and this stemflow will have different biogeochemical make-up as well. In this study we treated ten trees to simulate bark beetle impacts. This was done by girdling and treating five stems with blue stain fungus, and five stems with nutrient agar, meanwhile five untreated trees acted as controls for this study. Stemflow volume was then collected using collars and collection bins. Stemflow volume was then calculated to quantify hydrological fluxes to give a better understanding of the impacts that bark beetles have on southern hardwoods. Water and soil samples were collected, water was filtered, and stored in refrigeration at 22.2°C for further analysis. Soil samples were ground, dried, and stored at room temperature in Whirl-paks. Preliminary results show no significant differences in stemflow or throughfall depths between treatment groups and control specimens. This is probably due to a small temporal scale.

Introduction

Up to 5% of precipitation is partitioned to the forest floor as stemflow, this water moves nutrients into the soils near tree roots by funneling action done by the canopy (4, 6, 7). The stemflow is enriched by canopy exchange and dry deposition (9). The preferential funneling of nutrients provides soil microbes near the base of the tree critical resources they need to break down the leaf litter and other falling debris from the tree. In deciduous stands, dissolved organic matter in stemflow has been seen to be lower during leafless season than the leaf bearing season (19). In the United States outbreaks of SPB have been seen to kill large volumes of standing timber (20). This leads to increases in organic nitrogen on loblolly pine soils as associated with tree mortality. These impacts could be similar to those seen by Griffin et al. (20) Turner in stands near Yellowstone (21). This research is part of a multifaceted project aiming to examine the effects of SPB on southern forest. For this study we hypothesize that: (1) trees affected by SPB will produce less stemflow per storm event on average as crown die-off occurs. (2) Trees impacted by SPB will have higher concentrations of organic nitrogen, and dissolved organic matter in their stemflow over the first few years of study. (3) Higher CO2 flux concentrations will occur near the base of treated trees (22).

Methods

Study Site: the study was located in a north-central Mississippi remnant pine plantation (23). In the study site the stand consists of 60-year old loblolly pine in the overstory and a hardwood midstory of sweetgum (Liquidambar styraciflua), red maple (Acer rubrum), winged elm (Ulmus alata), and red oak species (Quercus spp.). Overstory basal area is 28.1 m² ha⁻¹ with 417 trees ha⁻¹. The midstory basal area is 17.9 m² ha⁻¹ with 713 trees ha⁻¹. The primary soil type on this site is Urba silty clay loam (24, 25).

- Treatments applied: 10 trees girdled with a chainsaw in July 2015. 5 girdled trees inoculated with blue stain fungus in November 2015. 5 girdled trees inoculated with nutrient agar in November 2015.
- Measuring hydrologic fluxes: Stemflow collectors placed on 15 study trees, three 1L throughfall Nalgene collection bottles placed near trees (26-28).
- Onset Data Logging Rain Gauges (Onset HOBO, R2G3-M). Measuring water qualities: Stemflow and throughfall collections taken, filtered, and stored within 24-hours of storms, and assessed using fluorescence spectroscopy to find DOM, HIX, and FPI (29).
- To measure Soil CO₂, a Li-Cor 8100A and a 20cm survey chamber were used to measure CO₂ respiration chambers (30).

Results

Discussion

These preliminary results are based on a relatively short time frame, but they show a distinct difference in DOM constituents (31-33). These differences in DOM quality could impact forest soils, and further study to assess these impacts should be completed (34, 35).

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