SOIL RESPIRATION RESPONSES TO TEMPORAL, TOPOGRAPHIC, AND SILVICULTURAL FACTORS IN A SOUTHEASTERN OHIO FOREST

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Soil respiration (CO_2 efflux) is an important component of carbon loss from forest ecosystems. Attempts to understand the relationship between silvicultural practices and soil respiration are complicated by physical and biological heterogeneity at the landscape scale. We examined the effects of burning on soil temperature, soil moisture, and respiration while controlling for slope position and thinning intensity. Treatments included unburned control, low intensity fire, high intensity fire, lime fertilization, and leaf litter removal. These treatments (each 2×2 m) were replicated in 20 experimental blocks at different slope positions (upper vs. lower) and thinning treatments (closed canopy vs. 50-percent removal) in a mixed-oak forest in southeastern Ohio. Monthly field measurements were conducted from April to November in 2004. Treatment and slope position were significant factors principally during the growing season. Upslope and thinned plots experienced midsummer soil-water reductions of 6 to 10 percent, respectively. Leaf litter removal reduced respiration by 15 percent compared to the control, while lime fertilization increased respiration by 10 percent compared to the control. From the entire season's data we developed a nonlinear model of soil respiration as a function of soil temperature for each treatment. Model equation parameters differed only for slope position and fertilization treatment, revealing greater sensitivity in respiration rates at lower slopes compared to upper slopes. Overall, thinning did not significantly affect soil respiration, but there was a trend toward reduced soil respiration rates ($P = 0.09$) in the low-intensity burn plots. Resulting values for soil moisture and soil temperature are a function of both topography and land use, leading to unequal effects of thinning and burning across the landscape. While the current study is informative with respect to the microclimatological mechanisms of thinning and burning on soil respiration, the small treatment area prevents a large-scale extrapolation to a thin/burn scenario due to other factors, e.g., mechanical soil disturbance.

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