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Seasonal soil respiration in burned and unburned black pine forests as affected by compound effects of fire types and aspect

Renato S. Pacaldo[1], Miraç Aydın[2], Randell Keith Amarille[2]

[1]College of Forestry and Environmental Studies, Mindanao State University, Marawi City, 9700 Philippines
[2]Faculty of Forestry, Kastamonu University, 3700 Kastamonu, Türkiye;

Abstract

Climate change impacts increased occurrences of wildfires worldwide, accelerating the release of large quantities of CO_2 sequestered in the aboveground biomass and forest litter. Mitigating the CO_2 emissions after wildfires requires a detailed understanding of the different components of carbon cycling, particularly soil respiration (Rs) rates, the main pathway through which the stored C in the belowground biomass and soil returns into the atmosphere. Despite much research on Rs, the compound effects of multiple factors affecting Rs remain uncertain. Whether the seasonal Rs in the post-fire areas significantly change as affected by fire intensities and aspects is a critical question that needs to be better understood. This study aims to determine the effects of crown fire, surface fire, aspects, and their combined effects on seasonal Rs rates. We established a field experiment in a three-year-old post-fire black pine (*Pinus nigra* Arnold) forest at the Taskopru Forest Directorate, Turkiye. We measured Rs in a 15-day interval for a year using an automated soil respiration machinery (Li-Cor BioSciences, NE, USA). We also measured the air and soil temperature and moisture contents with the Rs. Results revealed that irrespective of factor combinations, the Rs ranged from 0.41- to 1.19-µmol s^{-1} m^{-2} in winter, 1.06- to 2.07- µmol s^{-1} m^{-2} in spring, 2.71- to 3.27- µmol s^{-1} m^{-2} in summer, and 1.20- to 2.00- µmol s^{-1} m^{-2} in autumn. The proportional percentages contribution of each season to the total cumulative annual CO_2 emissions were 12.7 %, 23.2 %, 42.7 %, and 21.4 % for the winter, spring, summer, and autumn seasons, respectively. The crown fire exhibited the lowest Rs during winter but the highest during summer. Our study highlights the importance of analyzing multiple factors affecting Rs to increase the accuracy of analyzing the impacts of wildfires on Rs rates.

***Keywords*:** Climate change, wildfire, north-facing slope, south-facing slope, CO_2 emissions