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Soil CO_2 Effluxes in Post-fire and Undisturbed *Pinus nigra* Forests: A Soil Moisture Manipulation Study

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Abstract: Climate change impacts are driving hydrological extremes and frequent occurrences of forest fires. Whether these impacts result in dramatic changes in the soil CO_2 efflux (F_{CO2}) remains poorly understood. This study seeks to understand the changes in the soil F_{CO2} in recently burned forest (post-fire) and an undisturbed black pine (*Pinus nigra*, Arnold) forest in Türkiye. A field experiment in a three-way factorial randomized complete block design experiment was established with four replications and three factors; shaded (west) and exposed (east), types of forest fires (surface, crown, and control) and soil moisture regimes (dry, wet, and control). A dynamic survey chamber soil respiration machinery (LI-8100A) was employed to measure simultaneously the soil Fco_2, the soil temperature, and the soil moisture for a total duration of one-year. The soil F_{CO2} showed significant differences among treatments ($p<0.0001$), time ($p<0.0001$), and moisture regimes ($p<0.0001$), but not with the interaction effects between treatment and time (p = 0.0058), aspects (p = 0.95410), and types of forest fires (p = 0.0059). A dry soil in the crown fire site situated in the exposed aspect exhibited a significantly different and lowest soil F_{CO2} compared to other treatments. No statistically significant differences in the F_{CO2} in the wet soil were detected among treatments. The soil and air temperatures showed a strongly positive correlation (r = 0.78), suggesting that a near-surface air temperature provides a good approximation of the soil temperature. This piece of information is a vital input for the projection of future trajectory of soil CO_2 emissions and conservation of C stocks in the forest fire and undisturbed forests.

Keywords: Forest fire, Climate change, Soil temperature, Air temperature, Dry soil, Wet soil.