B31J-2215 Empirical and Theoretical Lethal Fire Energy Dose Thresholds for Tree Stems

Wednesday, 13 December 2023

11:30 - 15:50

Poster Hall A-C - South (Exhibition Level, South, MC)

Abstract

Heat energy from combusting fuels is transferred into plant stems during surface fires, where it can damage or kill cambium cells, potentially resulting in stem top-kill or tree mortality. Quantifying energy thresholds that result in cambium death is needed to expand on the dose-response framework used to predict stem top-kill and tree mortality. We empirically quantified lethal energy dose thresholds in a laboratory using heating tape for American sweetgum (*Liquidambar styraciflua*) and loblolly pine (*Pinus taeda*) stems between 1.5-10 cm in diameter. We theoretically estimated lethal energy dose thresholds by assuming consistent thermophysical properties of tree stems. We placed lethal energy doses in context of pine forest fuel loading by relating energy doses to energy release from pine needle litter combustion and considered scenarios where a range of potential energy release (100, 50, 25, and 10%) impinged on tree stems of different diameters. Empirical lethal energy doses were positively related to stem diameter for both sweetgum and loblolly; however, for a stem of the same diameter, it took longer to raise the vascular cambium to lethal temperatures in loblolly compared to sweetgum and the amount of time increased more for loblolly than sweetgum as stem diameter increased. Theoretical lethal energy doses were also positively related to stem diameter for both sweetgum and loblolly; however theoretical lethal energy doses were much lower than empirical doses and there were no differences in theoretical lethal energy doses between species. Assuming 25% energy impingement, sweetgum stems under 10.0 cm and loblolly stems under 1.5 cm in diameter would be top-killed with two years of litter accumulation. Future work

should aim to understand differences between theoretical and empirical dose thresholds and reduce uncertainty regarding the actual amount of energy impinging on a stem.

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