Post-Hurricane Wood Debris Management Practices: Soil Particle Size Influence Carbon Thermal Stability

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Hurricane Michael resulted in a massive deposition of wood debris on the forest floor at Chipola Experimental Forest. The wood debris was managed through drum chopping and prescribed fire. However, it remains unclear how these management practices influence soil particle size, carbon (C) content, and thermal stability. Therefore, this study determined the influence of wood debris drum chopping and prescribed fire on carbon concentration and soil C thermal stability based on bulk and fractionated soil. The soil was fractionated according to particle size, which included <250 µm, 250-500 µm, and 500-2000µm. Carbon thermal stability was determined by multi-element scanning thermal analysis (MESTA), and C concentration was determined using a CN analyzer.

The bulk soil C concentration significantly decreased along the soil profile, with the highest C concentration in the topsoil in all three treatments ($P<0.0001$). However, the 0-2 cm depth (topsoil) exhibited significantly higher C concentration after a fire compared to baseline and drum chopping ($P=0.0031$). It is evident that after the prescribed fire, the C concentration exhibited a 300% increase within the 0-2 cm depth. Generally, the R400 index decreased with increasing soil depth. After soil fractionation <250 µm, soil particles exhibited the highest R400 index in the topsoil compared to 250-500 µm and 500-2000µm particle sizes in all treatments. For 250-500µm particles, the R400 index decreased from 0.68 in the baseline to 0.45 after drum chopping, and this pattern persisted after the fire, suggesting a decrease in soil C lability. This study indicates that management practices employed on debris management that have the potential to alter soil particle size distribution could also potentially influence the lability of C.