Effect of Soil Moisture on Soil Microbial Biomass in Loblolly Pine (*Pinus taeda*) Stand

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Abstract

In the forest ecosystem, soil microbial biomass (SMB) plays a significant role in plant residue decomposition and subsequent release of plant nutrients to the soil. Many studies have suggested that SMB is affected by various factors, such as the amount of moisture present in the soil. In 2016, a study was carried out for four consecutive seasons to determine the effect of soil moisture content (SMC) on SMB and the seasonal variation in the study site located in Eufaula, Alabama, United States. Soil samples were collected in the winter, spring, summer and the fall from fifteen different plots starting from January 2016. The maximum SMB-C of 156.427 mg/L and the minimum of 18.689 mg/L were recorded in the spring and the fall respectively; the corresponding SMB-N being 14.896 mg/L and 1.778 mg/L in the summer and the fall respectively. A maximum soil moisture content of 0.536 g/g and a minimum of 0.008 g/g were recorded in the winter and the fall respectively.

Introduction

Microbial Biomass (MB)

- Organic material present in living bacteria, fungi, ascomycetes, etc.
- Measured by the amount of Carbon (C), Nitrogen (N).
- Affected by moisture content of the soil, climate, slope, management practices, etc.

Figure 1. Collecting microbial biomass.

Objective

- To assess the effect of soil moisture on soil microbial biomass in commercial *Pinus taeda* stand.

Materials and Methods

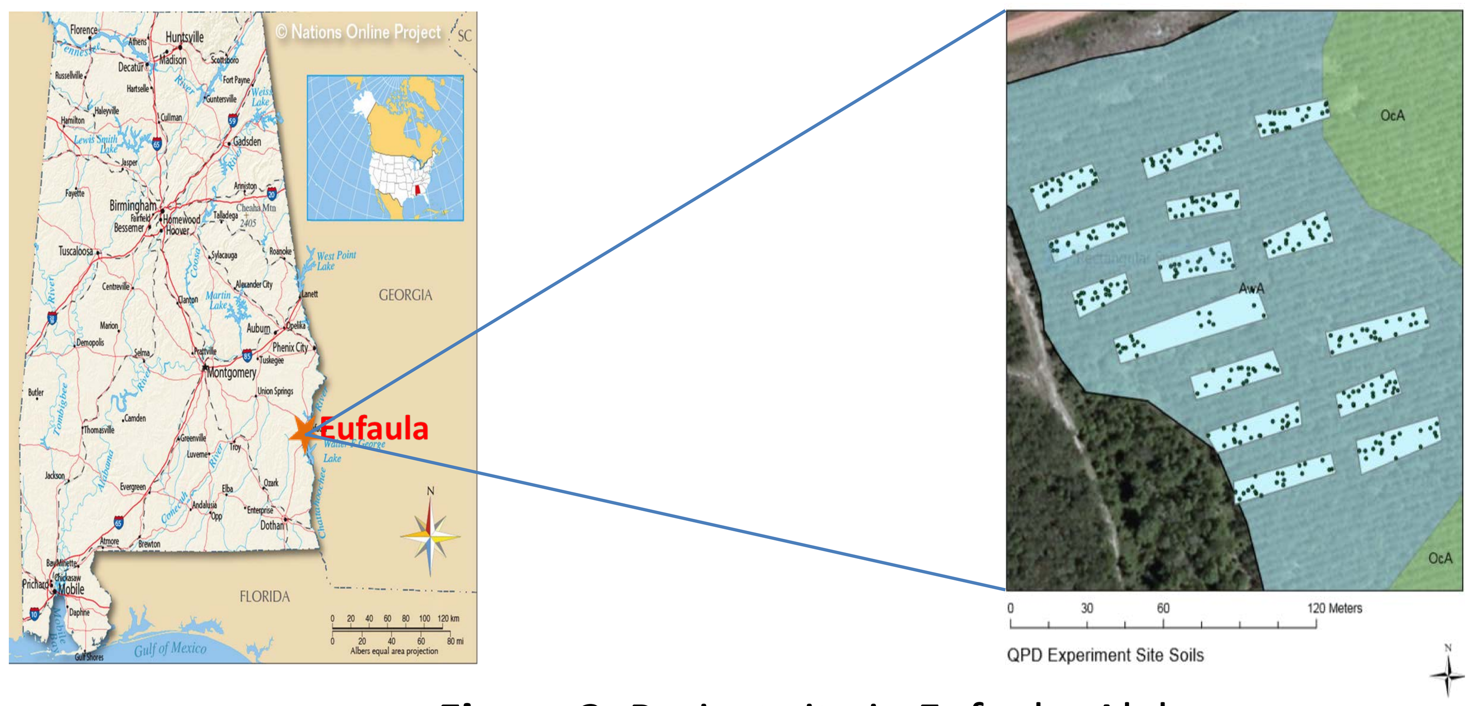

Figure 2. Project site in Eufaula, Alabama.

- Microbial biomass was collected by taking soil samples from the top 10 cm at Eufaula, Alabama (**Fig. 1 & 2**).
- Microbial biomass C and N present in each plot was determined by Chloroform Fumigation Incubation (CFI) method (Horwart and Paul, 1994; Vance et al., 1987) (**Fig. 3**).
- Soil moisture was measured by drying soil in the oven at 105^{0}C for 72 hours.

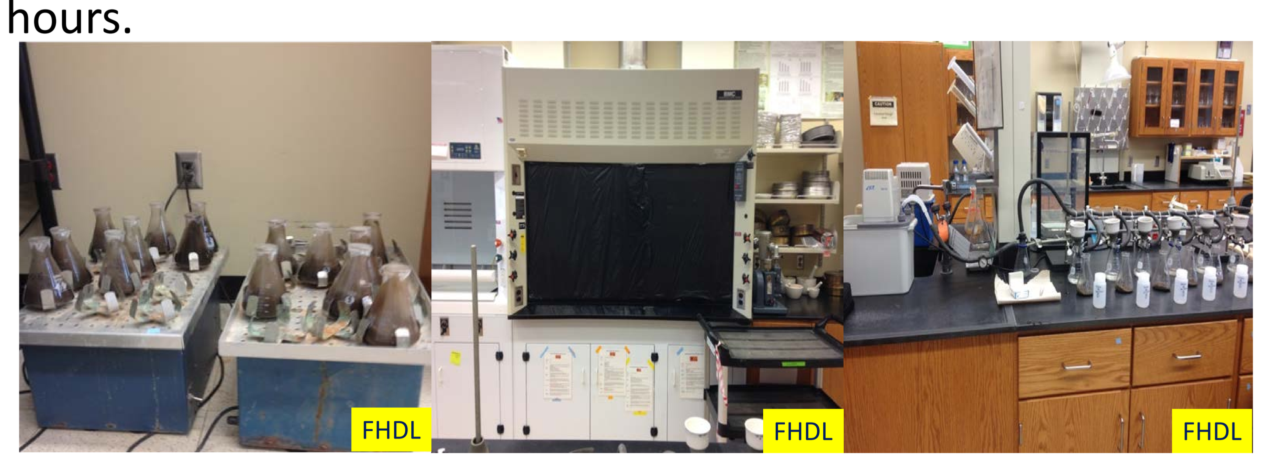

Figure 3. Laboratory setup for CFI.

Results

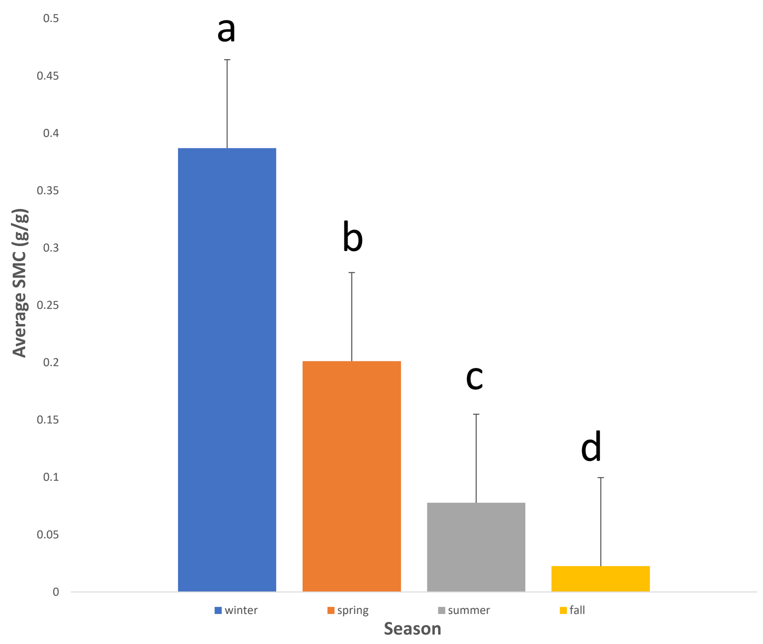

Fig 4. Mean value of soil moisture content (SMC) measured during four collection periods. Different letters indicate significant difference at α= 0.05.

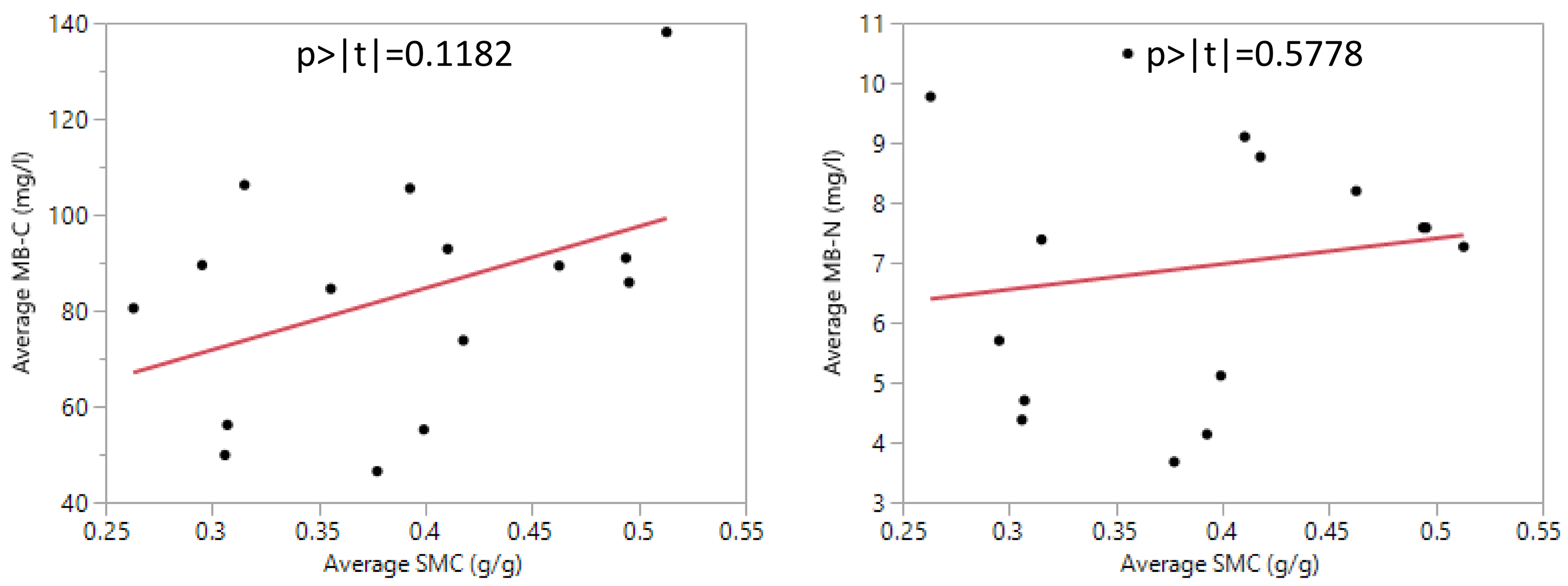

Fig 5. Winter 2016: Bivariate fit of MB-C by SMC and MB-N by SMC respectively.

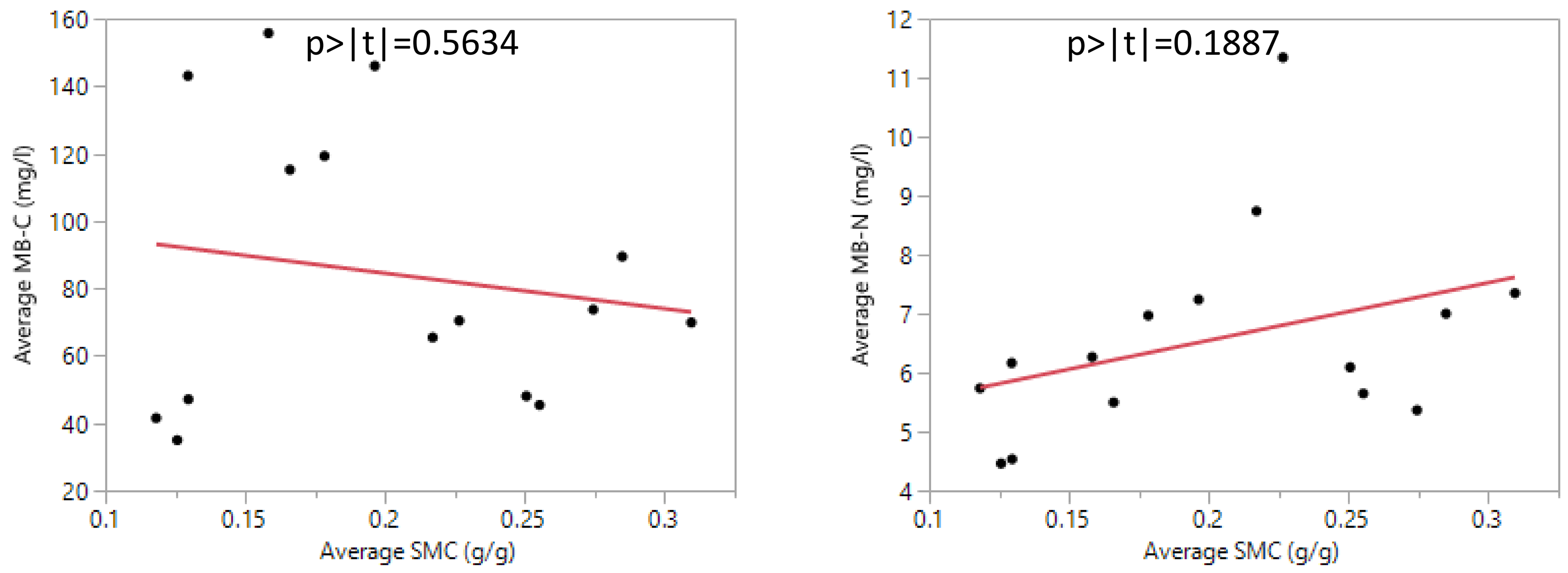

Fig 6. Spring 2016: Bivariate fit of MB-C by SMC and MB-N by SMC respectively.

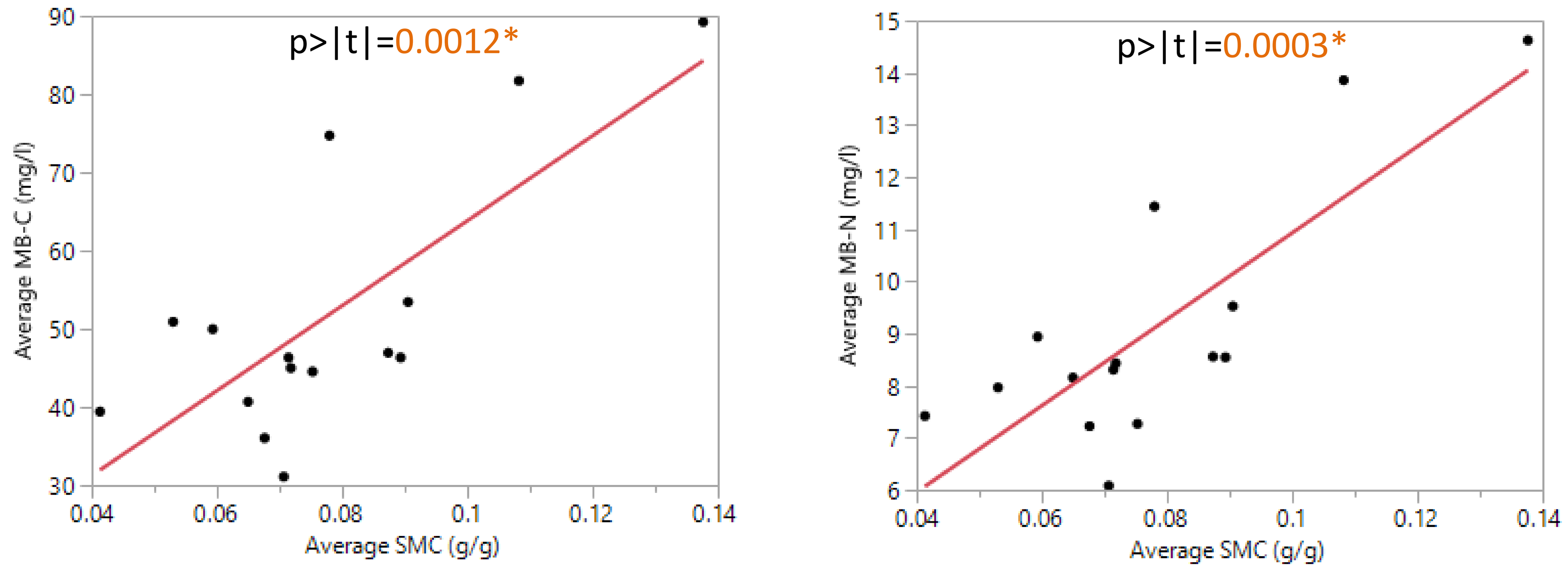

Fig 7. Summer 2016: Bivariate fit of MB-C by SMC and MB-N by SMC respectively.

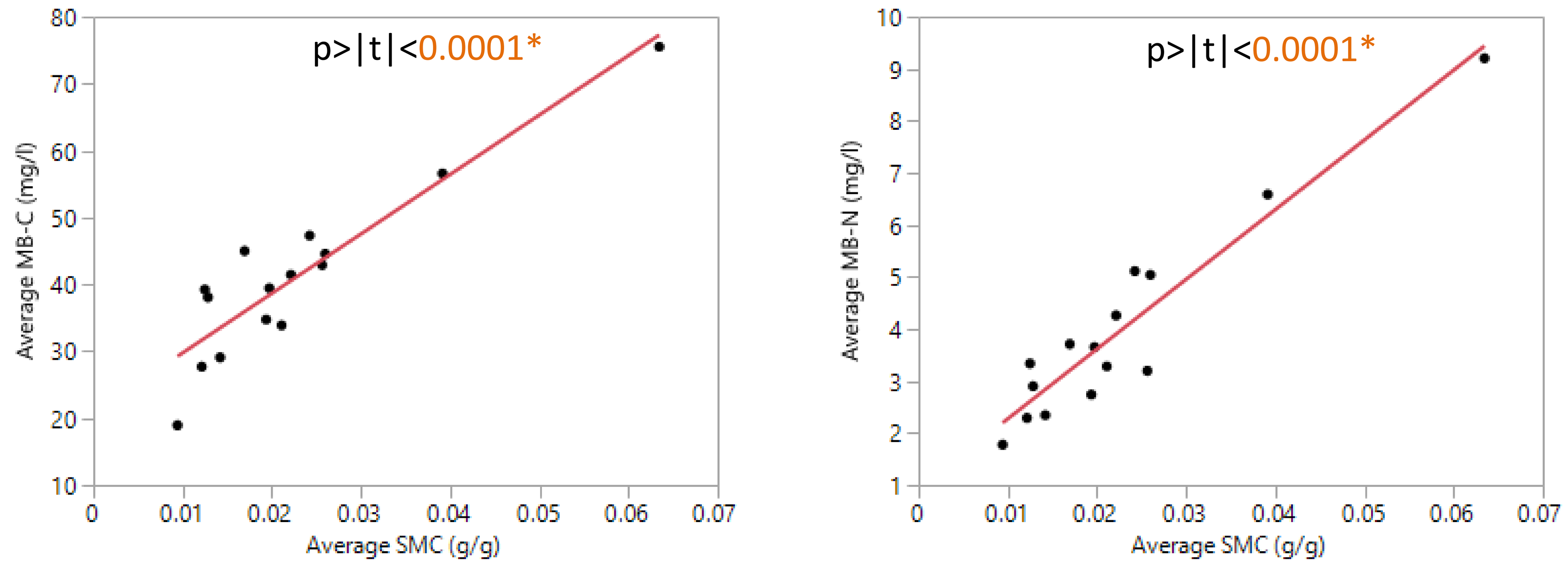

Fig 8. Fall 2016: Bivariate fit of MB-C by SMC and MB-N by SMC respectively.

Discussion

- In every season, soil moisture was observed to be lower than the previous season.
- MB was not affected significantly by the SMC in the winter (p>|t|=0.1182 and p>|t|=0.5778 for MB-C and MB-N respectively) and the spring (p>|t|=0.5634 and p>|t|=0.1887 for MB-C and MB-N respectively).
- However, MB was affected significantly by SMC in the summer (p>|t|=0.0012 and p>|t|=0.0003 for MB-C and MB-N respectively) and the fall (p>|t|<0.0001 and p>|t|<0.0001 for both MB-C and MB-N respectively).
- Soil microbes might be limited due to low moisture availability in the summer and the fall.

Literature cited

- Horwart W.R., and Paul, E.A. (1994). Microbial biomass. Methods of soil analysis: Part 2—Microbiological and biochemical properties. Soil Science Society of America, 753-773.
- Vance, E.D., Brookes, P.C., and Jekinson, D.S. (1987). An extraction method of measuring soil microbial biomass carbon. Soil Biology and Biochemistry, 703-707.

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