

Impacts of Biochar on Soil Health, Crop Yields, and Greenhouse Gas Emissions

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Background

Biochar = Charcoal added to soil with the intent of improving it and increasing crop yields^[1]

Used in tropical agriculture for millennia^[2]

- o Increase pH
- o Increase cation exchange
- o Offer microbial habitat
- o Retain moisture
- o Reduced erosion^[3]

Now investigated in temperate agriculture because of potential to lower GHG emissions

General impacts in Temperate Agriculture

- o Decreased GHG emissions^[4]
- o Initial decreased Crop yields^[5]
- o Unclear ecosystem impacts^[6]



Figure 1. Biochar Addition



Figure 2. Bird's Nest Fungus found in biochar plot



Figure 3. Gas Collection

Knowledge Gaps

- o Whether a temperate application can bypass initial negative impacts
- o The soil changes driving emission rates
- o How biochar impacts temperate soil ecology



Figure 4. Bayfield Test Site
H&N Baker Farm, Huron County, Ontario
Grey-brown Podzol (Burford Loam)
1.5% slope

This Project

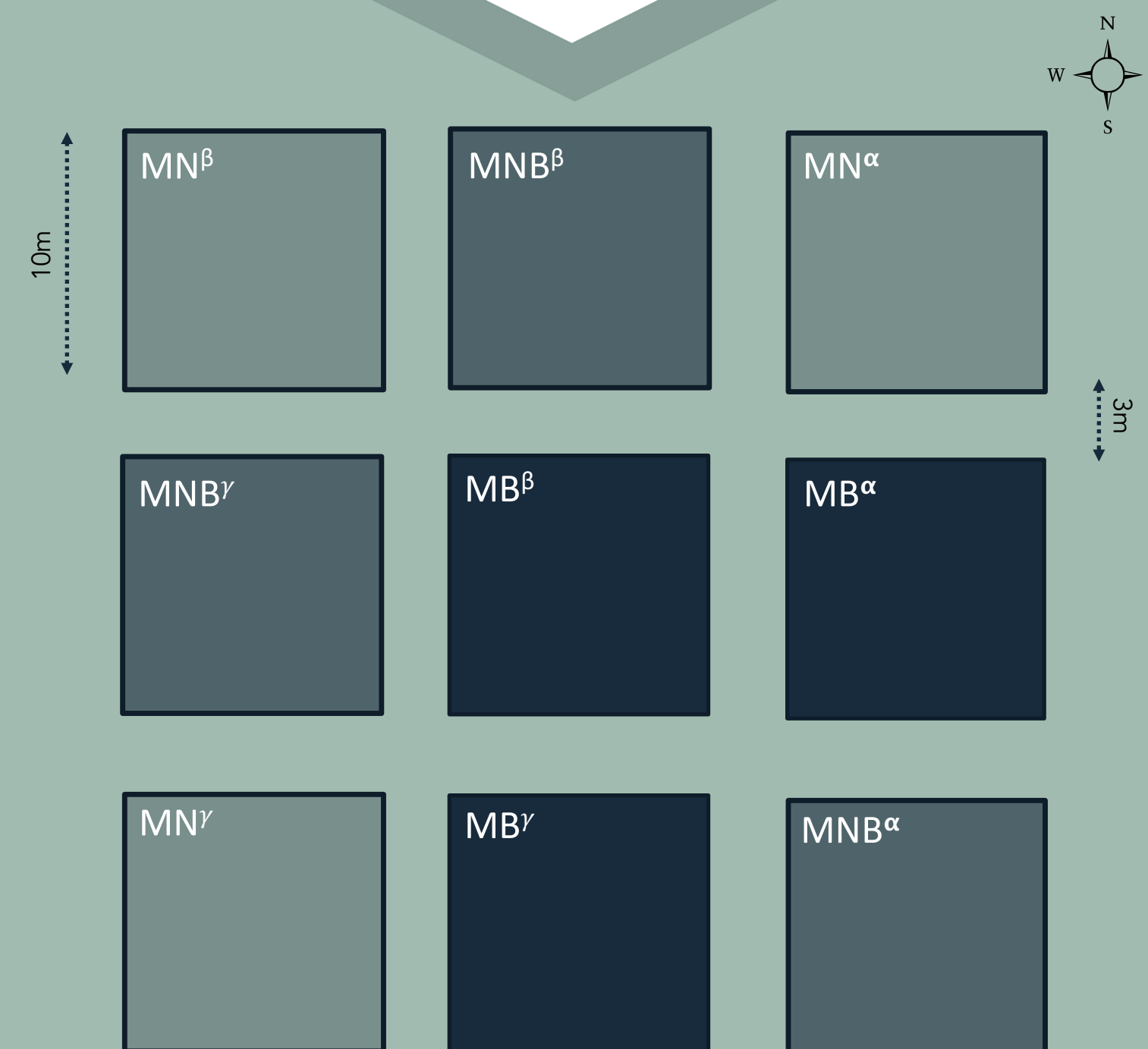
Objective

- o Quantify the changes to soil characteristics, ecology, crop yields, and greenhouse gas emissions between conventional and biochar amendment systems
- o Characterize the impacts of biochar in a traditional temperate agricultural setting (corn-soy rotation)

This project is currently the largest long-term commercial farming biochar field trial and demonstration site in Ontario

Three Treatments

- MN- Manure (Poultry) (6t/ha) & Nitrogen fertilizer (urea) (135kg/ha)
- MB- Manure (3t/ha) & Biochar (wood source material)(3t/ha)
- MNB- Manure (3t/ha), Nitrogen fertilizer (135kg/ha), & Biochar (3t/ha)



Statistical Analysis

Univariate ANOVA analyses were conducted in conjunction with Tukey's Post-Hoc HSD test to determine homogeneity of variance and normality. These were used to determine the impact of the three treatments.

Physical soil characteristics were correlated with gas emissions characteristics using two-tailed Pearson correlations. A linear regression was used to determine the relationship between these factors

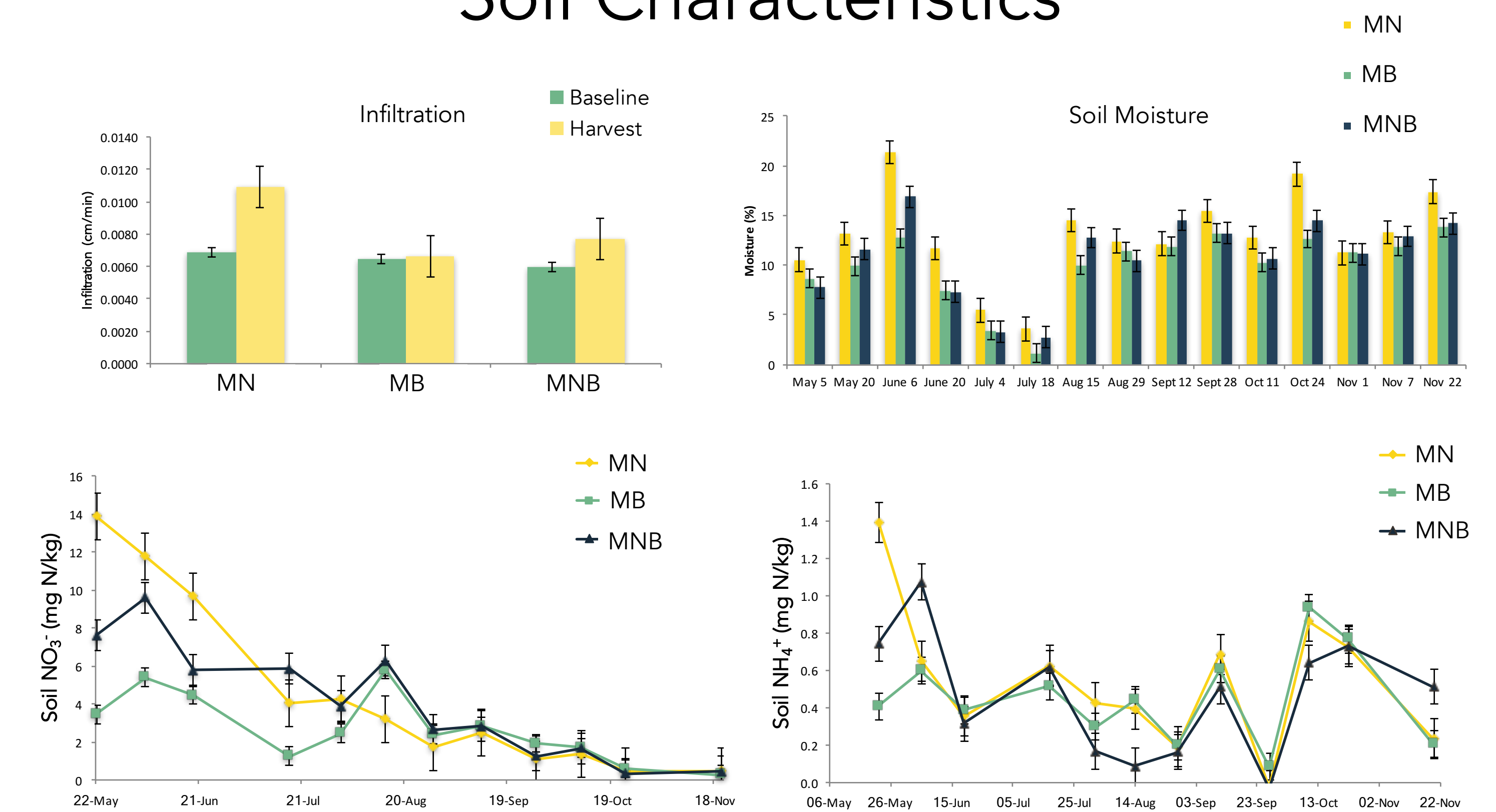
All statistical analyses were carried out on SPSS Statistics for Windows Version 23.0 (IBM Corp., 2013). P<0.05 was the significance threshold for all analyses

References

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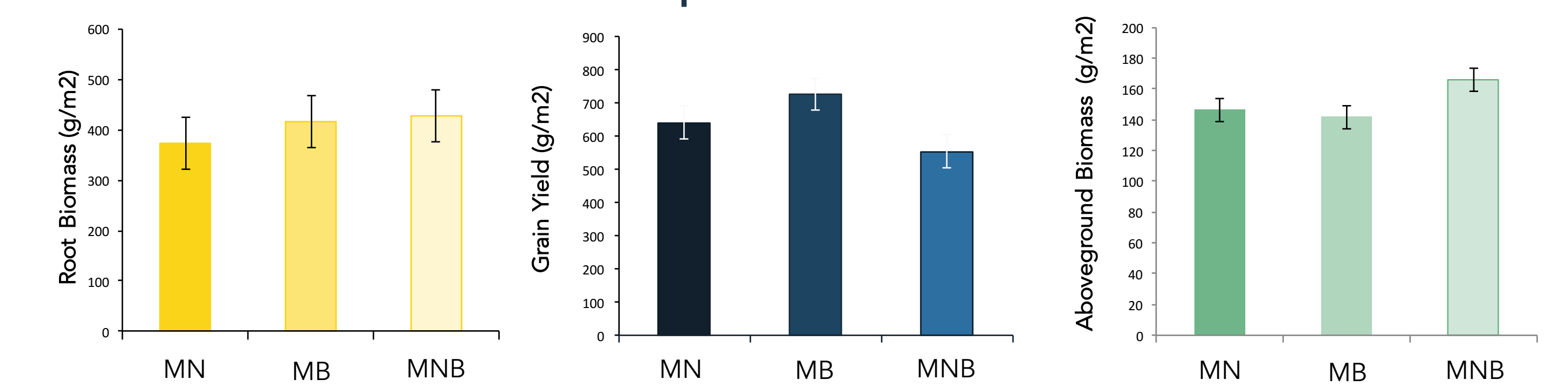
Results

Soil Characteristics



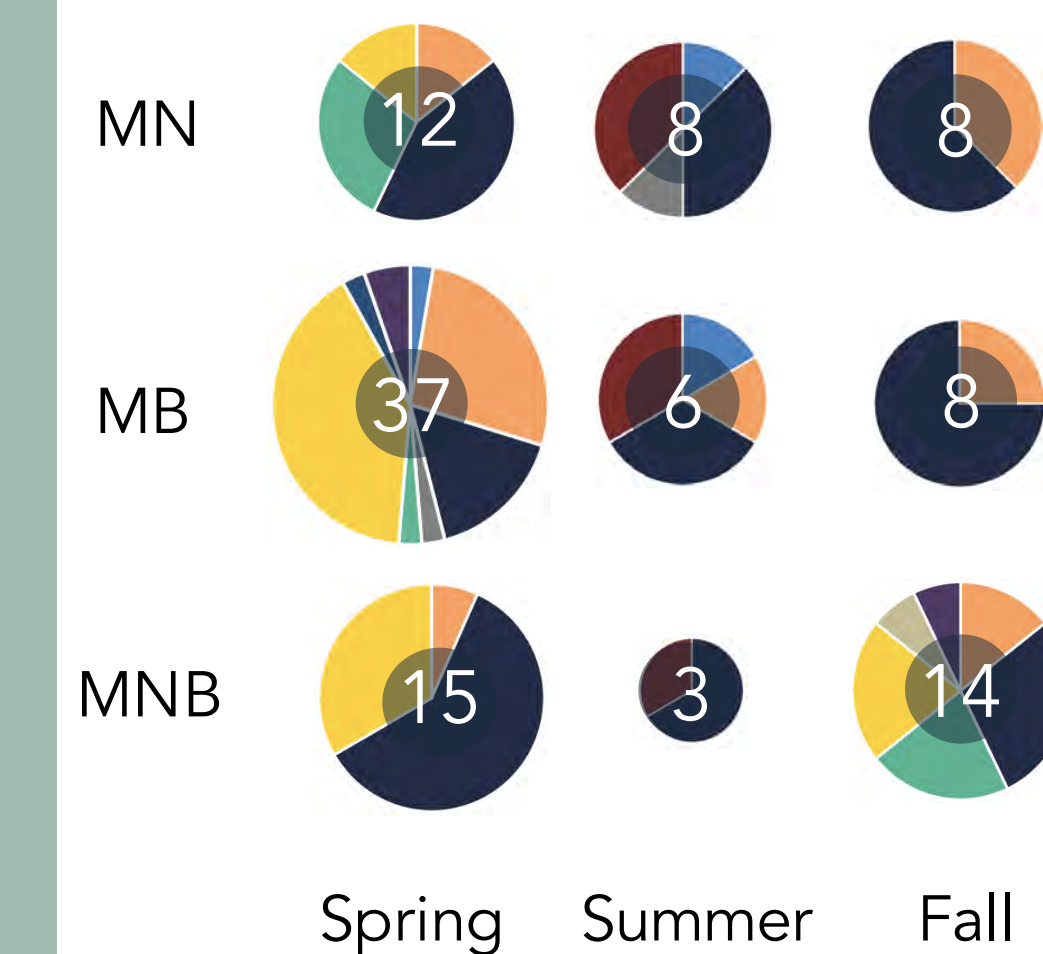
- o Soil nitrogen, phosphorous, moisture, and infiltration rates were significantly lower in biochar treated soils
- o Bulk density, pH, temperature, soil organic carbon, aggregate stability were statistically identical

Crop Yields



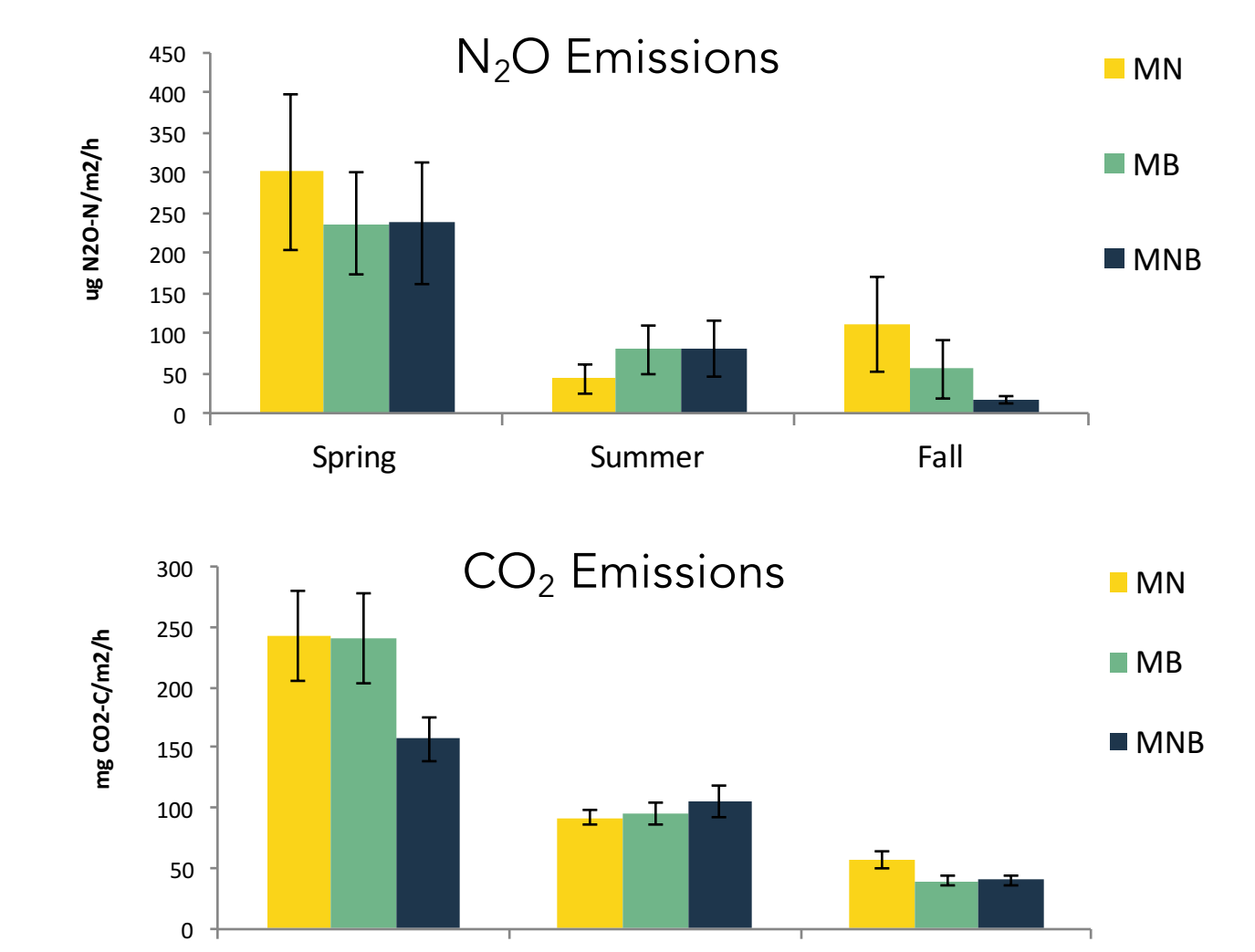
- o Despite lower nutrient and moisture availability all yields were statistically identical
- o As a general trend, biochar treated soils even produced the most biomass
- o Potential decreased yields were not observed

Ecology



- o Biochar allowed for a great diversity of species
- o Biochar buffers disturbances, protects sensitive species

Greenhouse Gases



- o Despite changes to soil characteristics, all treatments found to be statistically identical
- o Biochar treated soil generally produced less N₂O

Conclusions

- o Stable yield and emissions levels achieved
- o Complex interactions impacting crop growth, microbial activity and ecosystem health
- o Expected improved outcomes within 5 years