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Biochar: Production, Characterization and Applications

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The influence of biochar on soil characteristics in a temperate agroecosystem

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The influence of biochar on soil characteristics in a temperate agroecosystem

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INTRODUCTION

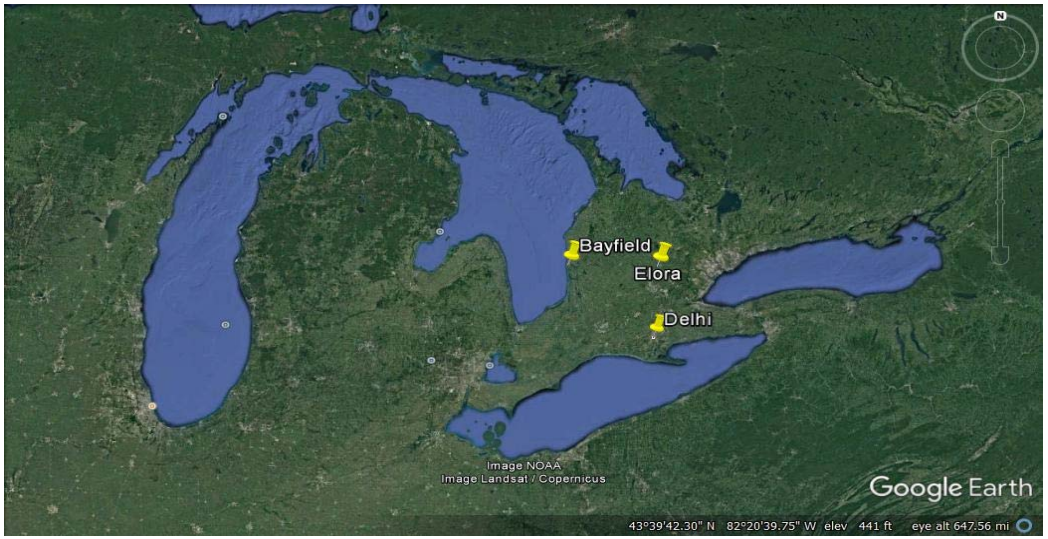
- Amending soil with biochar is an old technique in tropical regions
  - Indigenous Peoples in the Amazon
  - Used biochar more than 2000 years ago to increase soil fertility
- Amending agricultural soils in temperate biomes is recent
  - Research still in its infancy
- Few long-term (field) studies
  - Lack of replicated trials monitored over the long-term
  - Consistency of biochar quality
  - How does biochar affect soil health?

OBJECTIVES

To evaluate soil health characteristics in a conventional temperate agricultural production system amended with biochar under a maize (*Zea mays*) crop in southern Ontario, Canada

STUDY SITE

- Bayfield, ON
  - 43°34'45"N, 81°39'48”W
- Commercial poultry farm
- Maize-soybean rotation
  - Addition ofp oultry manure on 3-year rotation
  - Poultry bedding: switchgrass
  - Addition of 135 kg N/ha in years maize is produced



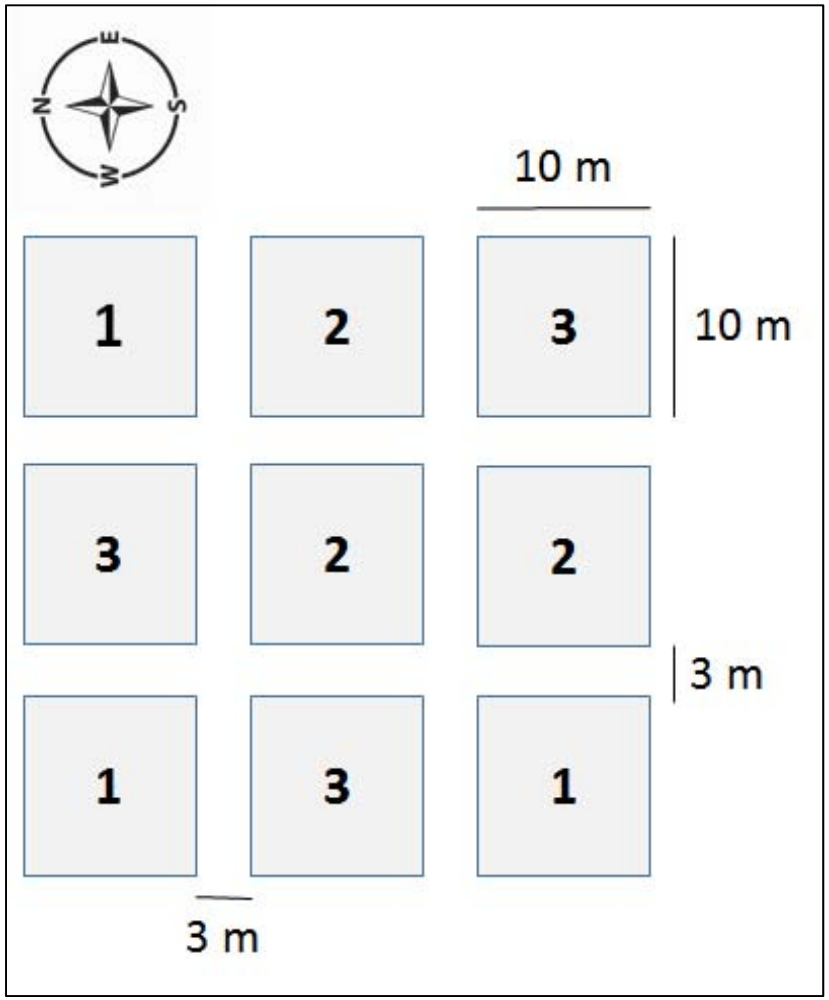
Soil

Grey-brown Luvisol
(Light) loam texture

Site

247 masl
1.5 % slope

Experimental Design



Randomized complete block design with three treatments and three replications.

Treatment 1 (M+N): 6t/ha poultry manure plus 150 kg/ha N fertilizer.

Treatment 2 (M+B): 3t/ha poultry manure plus 3 t/ha biochar.

Treatment 3 (M+N+B): 3t/ha poultry manure, 3 t /ha biochar, 150 kg/ha N

METHODS

- Soil collection
  - 3 samples from each treatment replicate (bulked into one sample)
  - Baseline data
  - After harvest
- Soil depths
  - 0-10 cm, 10-20 cm, 20-30 cm
- Analysis of various soil health characteristics
  - Indicators most sensitive to short-term change
- Results
  - Year 1 of biochar addition
  - Currently collecting data for year 2
  - 2018 growing season will be year 3

BIOCHAR USED IN THIS STUDY

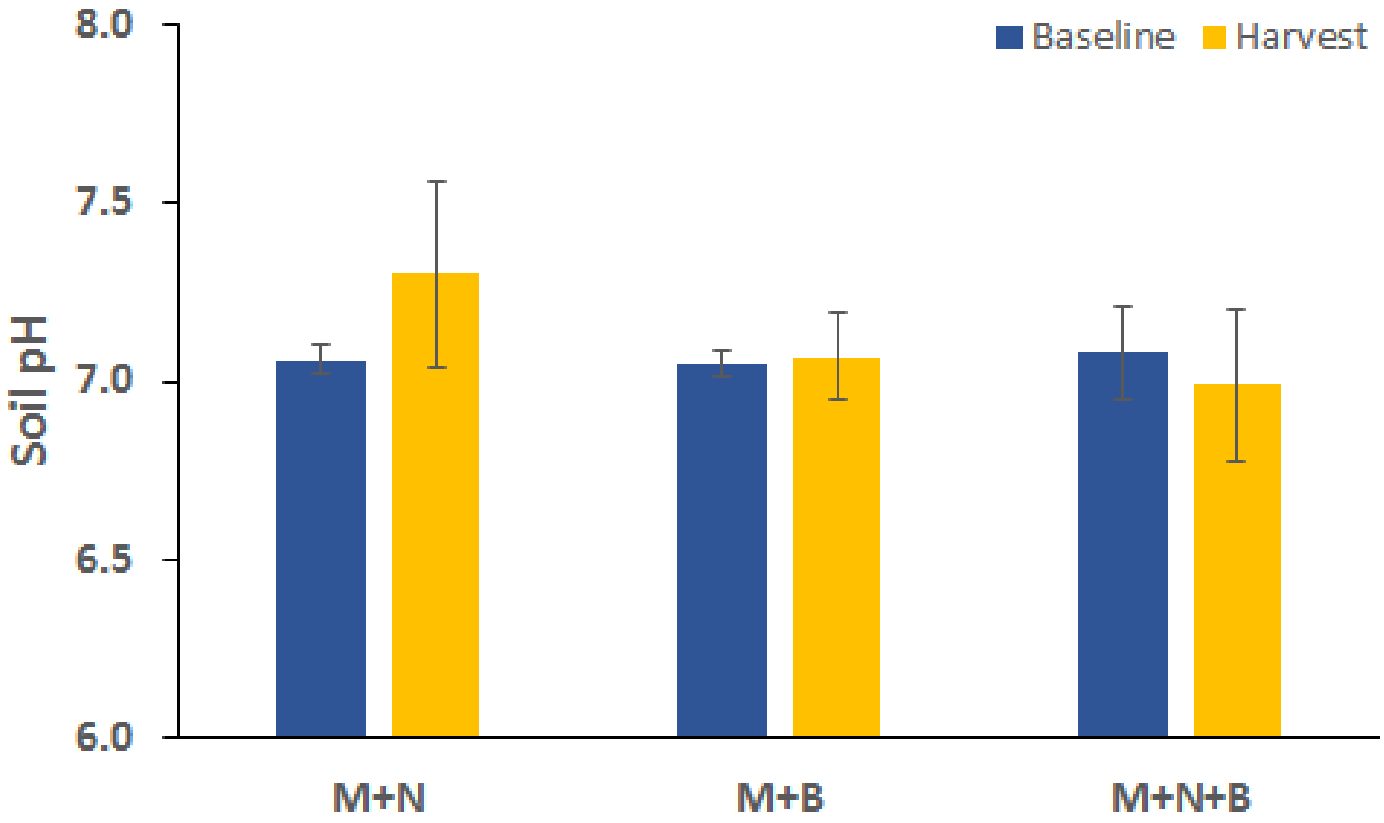
- Mayan Gold Biochar
  - Titan Carbon Smart Technologies
  - Spruce-Pine mix

Biochar Composition

Carbon Content	80%
Ash Content	12%
pH	7.2
Nitrogen	1500 ug/g
Phosphorus	500 ug/g
Potassium	7000 ug/g

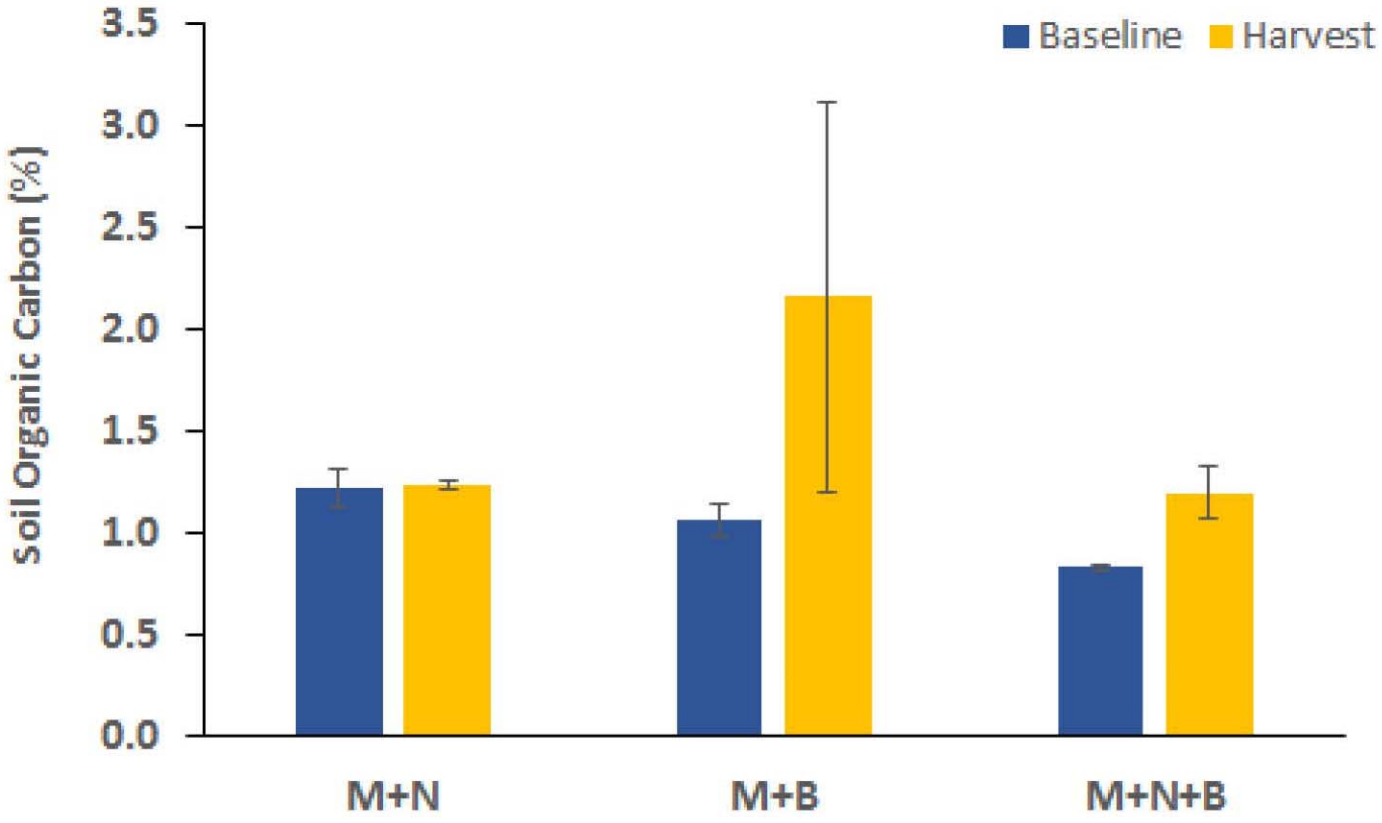
Non-toxic, neutral pH, high carbon content, high surface area, low nutrients, trace metals and micro-nutrients, user friendly (low dust).

Results: pH (0-10 cm)



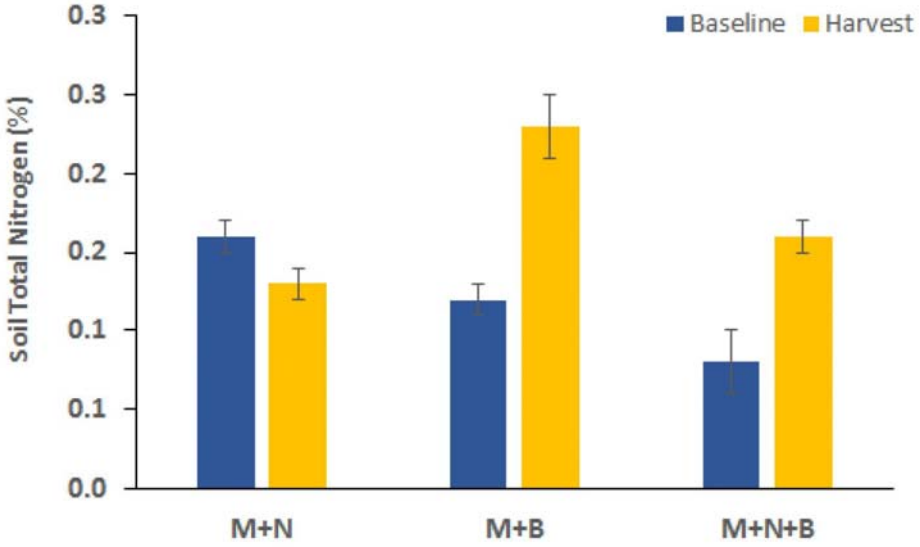
No significant differences among treatments and between baseline and harvest data

Results: Soil Organic Carbon (0-10 cm)

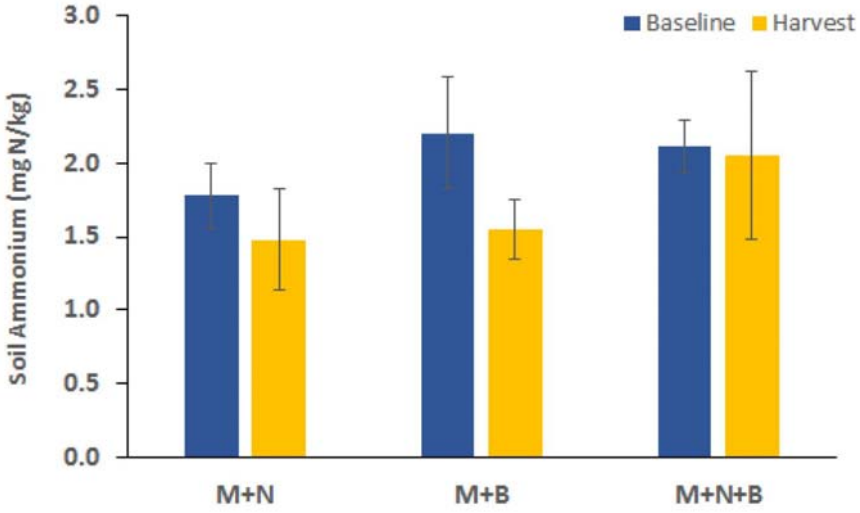


No significant differences among treatments and between baseline and harvest data

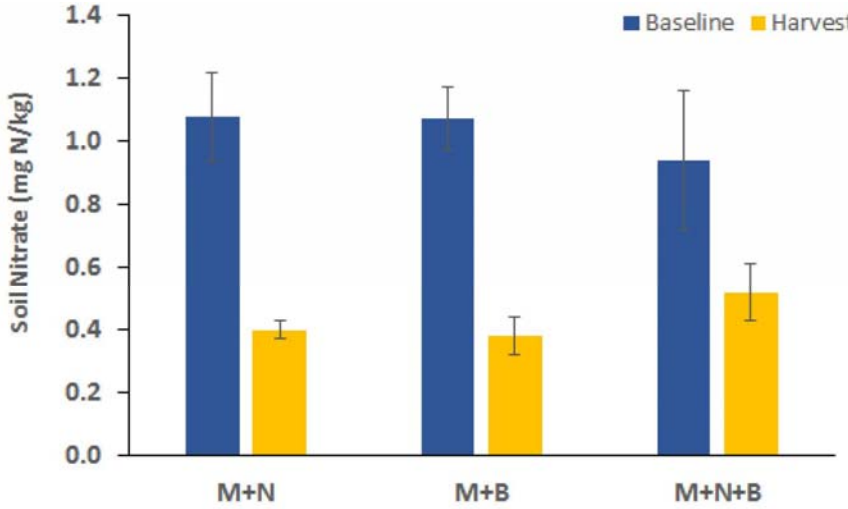
Results: Soil Nitrogen (0-10 cm)



Significantly greater in the M+B and M+N+B treatments at Harvest than at Baseline.

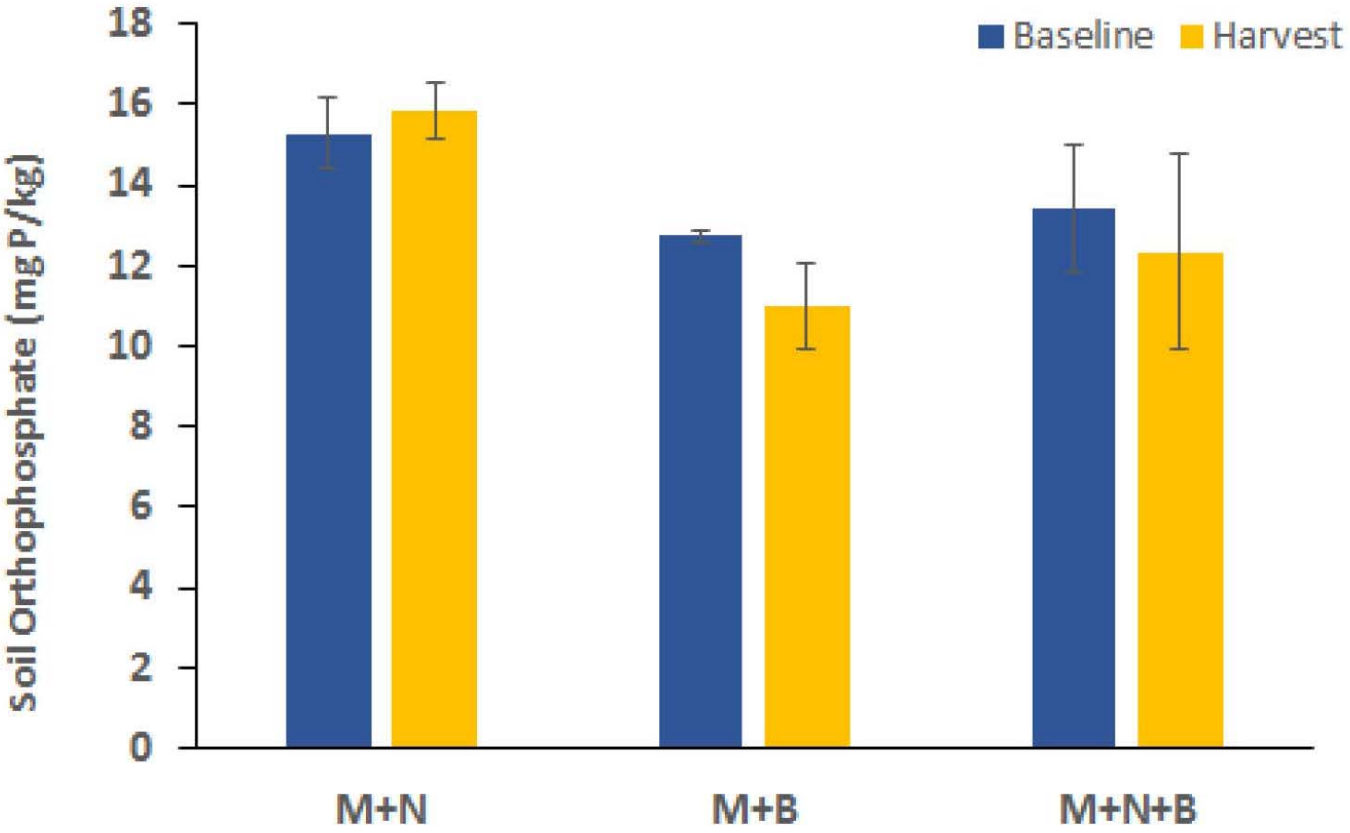


No significant difference among treatments and between Baseline and Harvest.



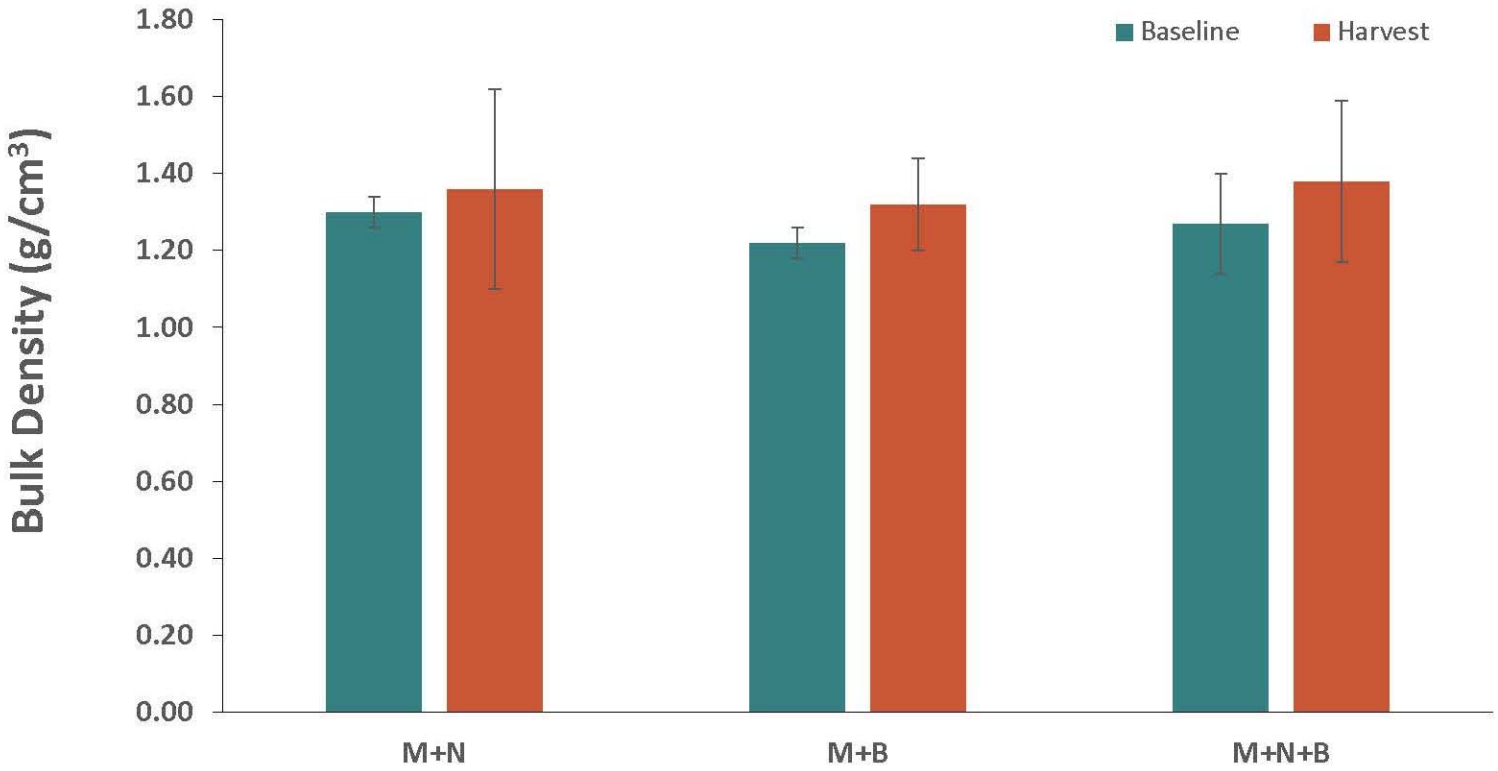
Significantly lower at Harvest compared to Baseline.

Results: Soil Phosphorus (0-10 cm)



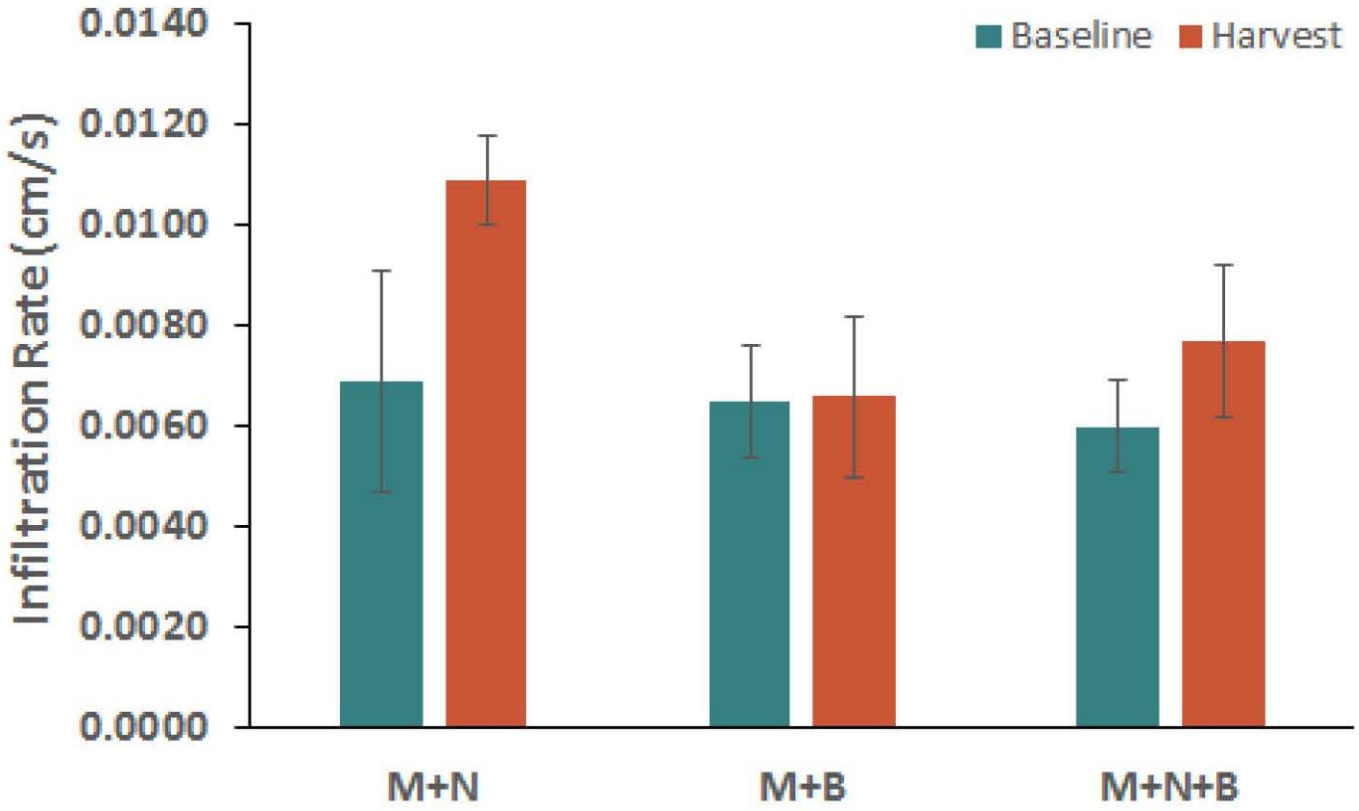
Significantly lower at Baseline and at Harvest in M+B and M+N+B treatments.

Results: Soil Bulk Density (0-10 cm)



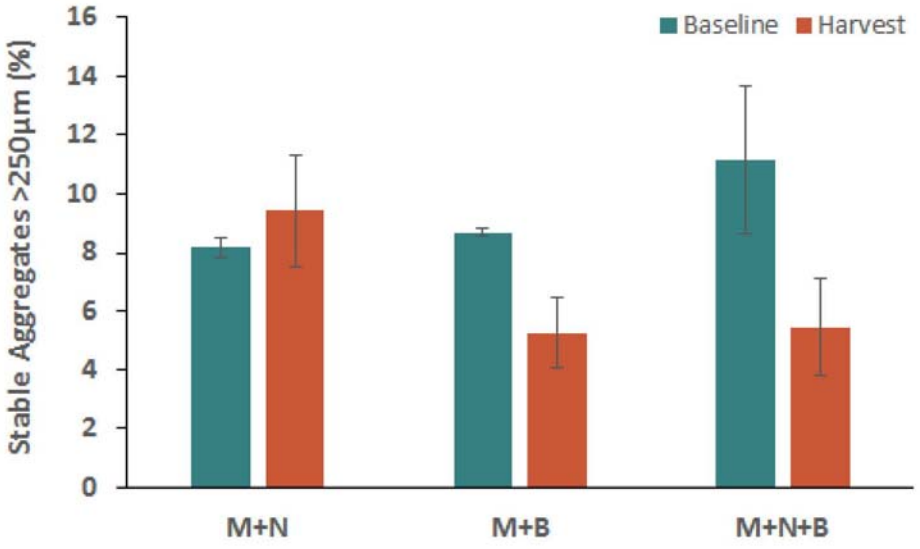
Significantly greater bulk density at Baseline, no significant difference in bulk density among treatments.

Results: Soil Water Infiltration Rate (0-4 cm)

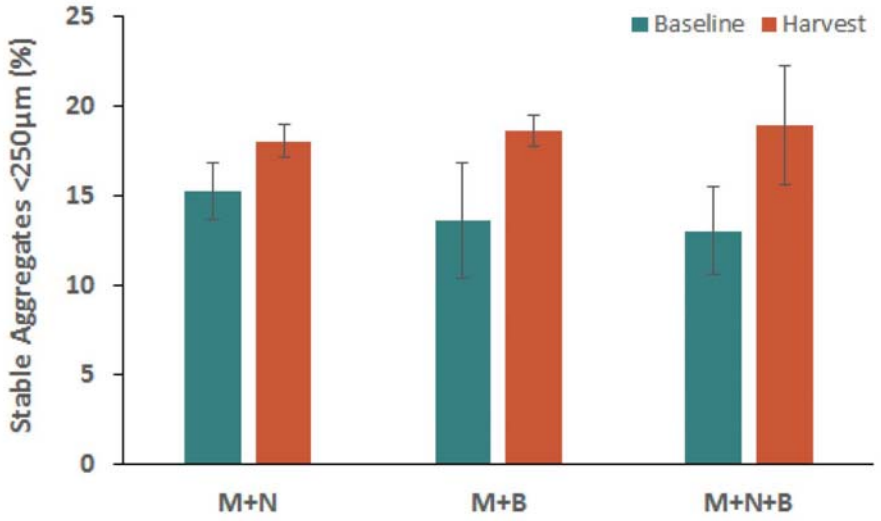


No significant differences among treatments and between baseline and harvest data

Results: Aggregate Stability (0-10 cm)

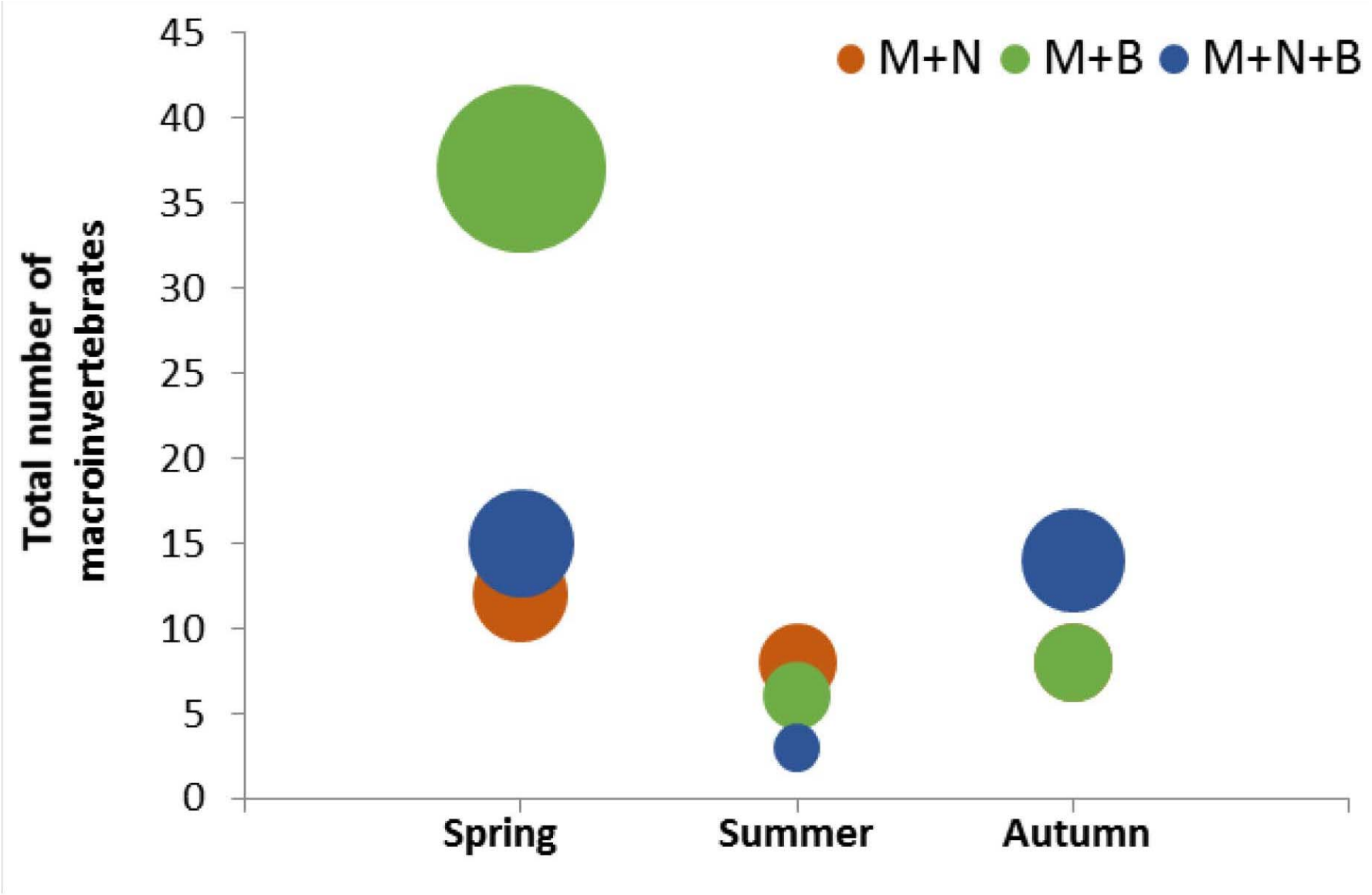


Significantly greater stable soil aggregates greater than 250 µm at Baseline for M+B and M+N+B treatments. No significant difference among treatments.

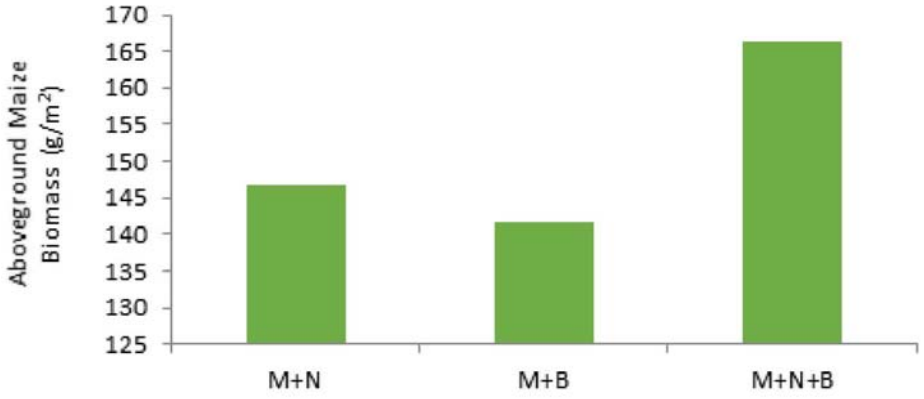


Significantly greater stable soil aggregates smaller than 250 µm at Harvest. No significant difference in among treatments.

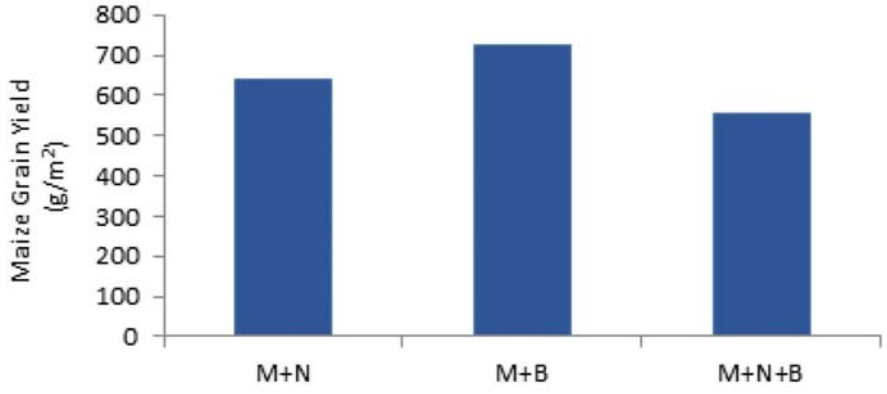
Results: Soil Macrofauna (0-30 cm)



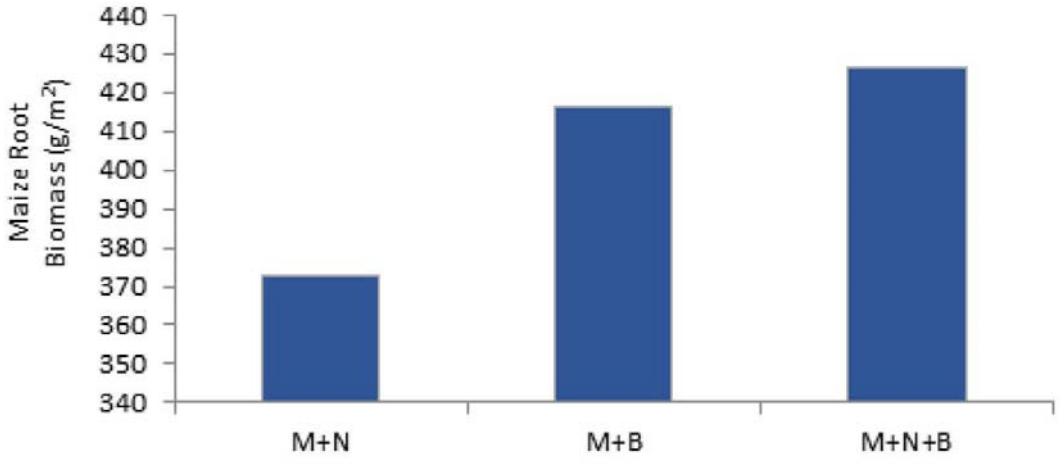
Results: Crop Metrics



No significant differences among treatments



No significant differences among treatments



No significant differences among treatments

Conclusions

Soil Chemistry

- No major influence on soil chemistry
- Soil TN was significantly greater in biochar soils
- Soil P showed a lower trend in biochar soils

Soil Physics

- Not significantly impacted by biochar

Soil Biology

- Change among seasons
- Biochar soils greatest in spring. No differences in summer & fall

Crop Metrics

- Trends of greater above & belowground biomass and maize yield in biochar amended soil
- Dry summer

Overall

- No negative impact of biochar on soil health characteristics

Acknowledgements

Ministry of Agriculture, Food and Rural Affairs