

## Introduction

- A substantial quantity of poultry manure is readily available in Maryland due to the region's concentrated broiler production.
- Repeated application of poultry manure on cropland has contributed to nutrient runoff and eutrophication in the Chesapeake Bay watershed. Transforming poultry manure into biochar through pyrolysis offers a sustainable and circular solution to waste management, environmental threats, and soil health challenges (Fig 1).
- The potential benefits of poultry manure biochar have not been characterized in vegetable production in the Mid-Atlantic.

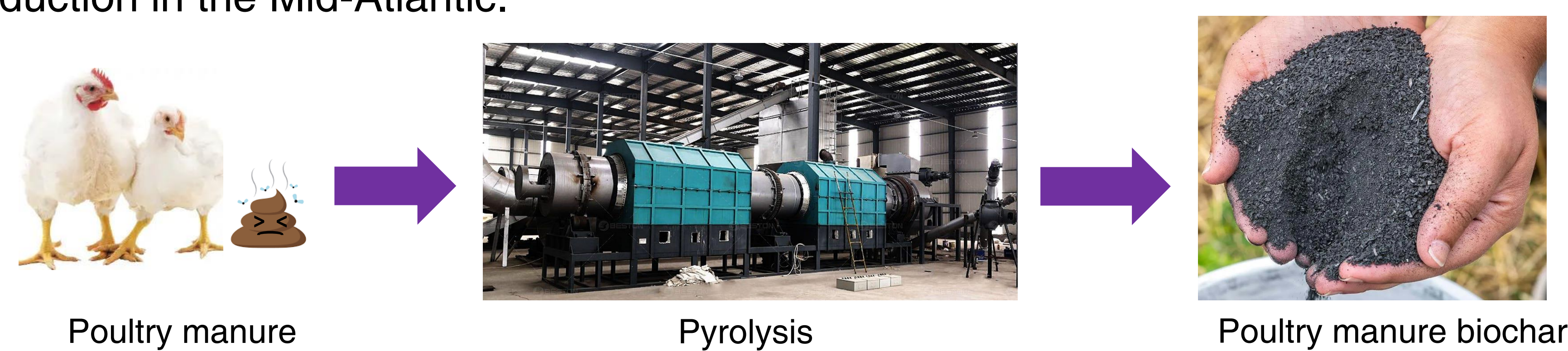


Fig 1. Poultry manure biochar production process.

## Objective

- Evaluate the effects of poultry manure biochar in Swiss chard grown in the Mid-Atlantic.

## Materials and methods

- Plots with Swiss chard (*Beta vulgaris* subsp. *vulgaris*) planted in 2025 were arranged in a randomized complete block design with 3 replications.
- Treatments of 6.73, 20.18, and 33.63 tons/hectare of poultry manure biochar were applied and mixed with the top 15 cm soil. A no biochar control was also included.
- Swiss chard was harvested 70 days after seeding. Plant height and canopy size were measured right before the harvest. Above-ground plant tissue was harvested and weighed for wet biomass, then dried to measure the dry biomass.
- From each plot, a composited soil sample was collected in Oct. 2025. Soil samples will be measured for pH, organic matter content, cation exchange capacity, aggregate stability, nutrient and heavy metal concentrations, and microbial communities (Fig 2).
- Dried leaf samples will be analyzed for macro- and micro-nutrient and heavy metal concentrations (Fig 2).

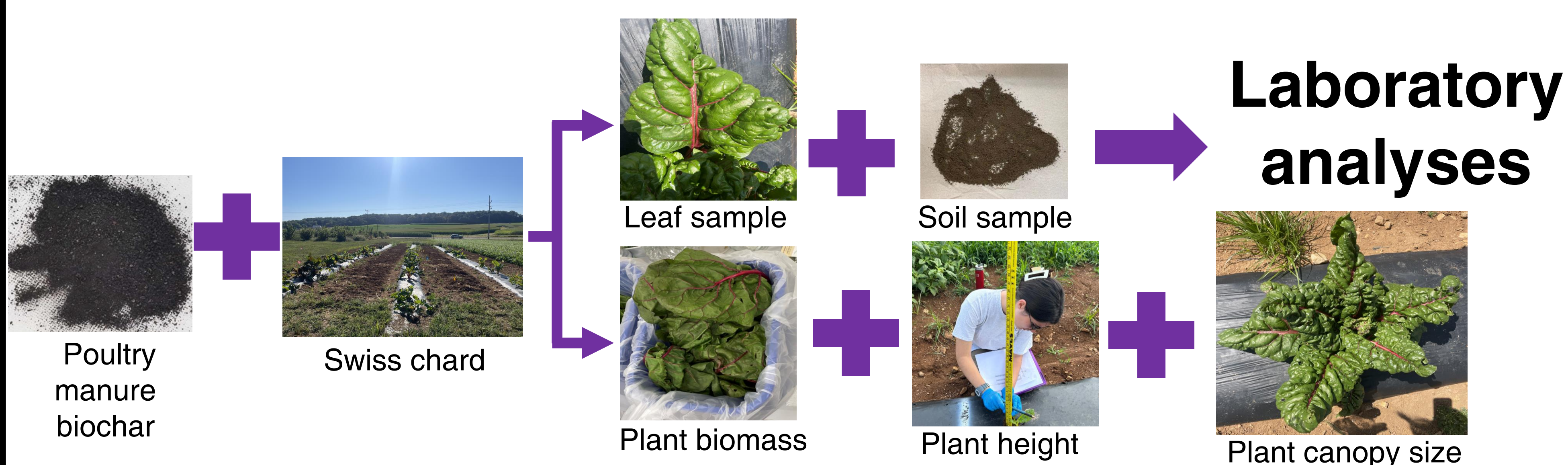


Fig 2. Experimental procedure flow chart.

## Results

Table 1. Physical characteristics and chemical compositions of poultry manure biochar pyrolyzed at 550 °C.

Characteristic	Value
Density (g/cm <sup>3</sup> )	0.52
pH	10.5
Organic matter (%)	60.2
Total N (% dry weight)	1.55
Mehlich 3 Extractable Nutrients	
P (mg/kg)	2312.39
K (mg/kg)	52219.35
Ca (mg/kg)	831.46
Mg (mg/kg)	1830.82
S (mg/kg)	224.94
Fe (mg/kg)	215.14
Cu (mg/kg)	4.37
Zn (mg/kg)	32.28
Mn (mg/kg)	21.47
B (mg/kg)	10.04
EPA3051 Digest	
As (mg/kg)	<3.0
Cd (mg/kg)	<0.2
Co (mg/kg)	2.81
Cr (mg/kg)	4.70
Pb (mg/kg)	< 2.5

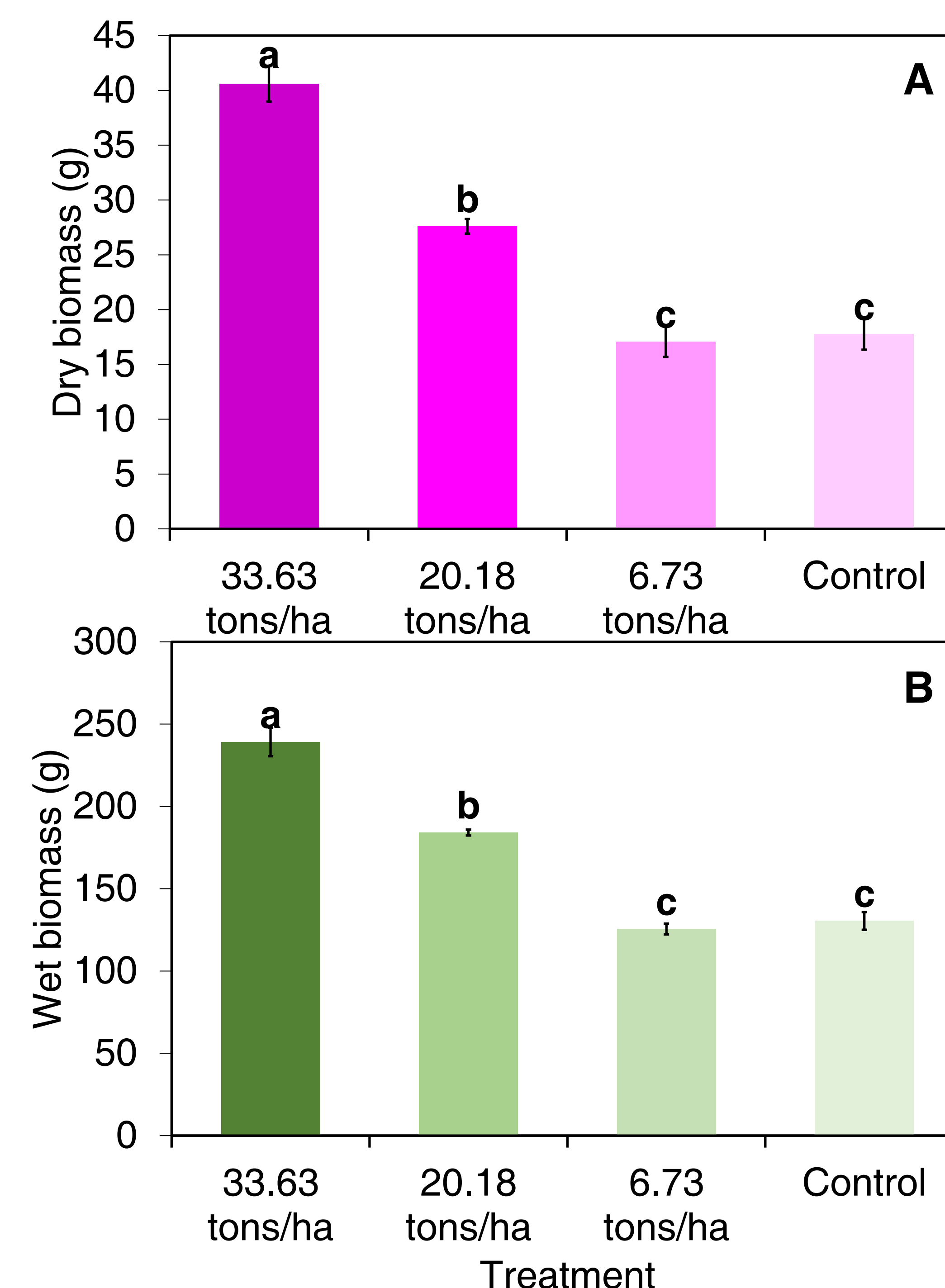


Fig 3. Swiss chard plant tissue dry biomass (A) and wet biomass (B) by poultry manure biochar rate treatments. Bars displayed are means  $\pm$  standard error (SE) (n=9). Different lowercase letters indicate significant differences at alpha = 0.05. Both dry and wet biomass differed significantly across treatments.

## Discussion and conclusions

- This is the first study to evaluate the effects of poultry manure biochar for specialty crops in the Mid-Atlantic region. Plants that received 33.63 tons/ha of biochar had the greatest dry and wet biomass compared to other treatments, indicating the positive impact of poultry manure biochar on plant productivity (Fig 3).
- The continuous release of essential macro- and micro-nutrients from poultry manure biochar (Table 1) and its potential to improve soil structure and stimulate soil microbial activity may have led to enhanced plant biomass in high-rate treatment (Ye et al., 2020).

## Reference, future work, and acknowledgements

**Reference:** Ye, et al. 2020. Biochar effects on crop yields with and without fertilizer: A meta-analysis of field studies using separate controls. *Soil Use and Management*, 36(1), 2–18. <https://doi.org/10.1111/sum.12546>.

**Future work:** The research will be replicated in the following 3 years to monitor the long-term effect of biochar on plant productivity and soil health.

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