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Using Southern Yellow Pine Biochar and Wood Vinegar to Remediate Poultry Litter Compost

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Outline

- Background
- Objectives
- Methods
- Current Results
- Conclusion

Background

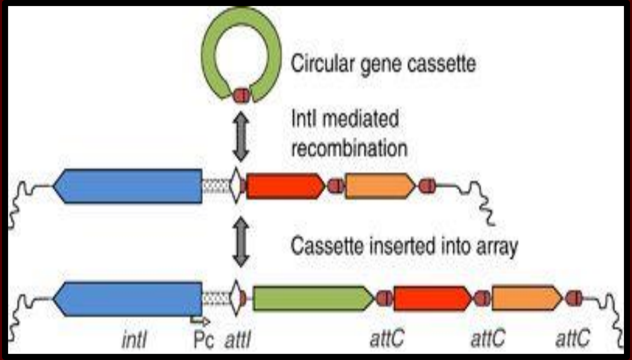
- Improve agricultural sustainability
  - Utilize waste products
    - Biochar
    - Wood Vinegar
    - Poultry Litter

Composting Poultry Litter

- Converts organic waste into a stable and nutritious fertilizer
- Destroys pathogens
- Economic
- Some drawbacks
  - Leaches nutrients
  - Releases pollutants
  - Does not significantly reduce all ARGs and MGEs

Class 1 integrons

- Genetic sequence in some bacteria
- Captures and integrates antibiotic-resistance genes
  - Integrase
- Function of natural selection
- Not significantly reduced by composting



Objectives

- Determine how co-composting poultry litter with southern yellow pine biochar and wood vinegar affects:
  - Nutrient profiles
  - Class 1 integron (*intI1*) expression
  - Compost maturity rates

Methods

- Preliminary Study - Detect *intI1*
- Set up compost blends
- Sampled at day 0, 57, and 112
  - Nutrient analysis: N, P, K, C:N
  - Microbial analysis: bacteria and fungi
  - Screen for *intI1*
  - pH
  - Compost maturity tests

Preliminary Study Results

- 36/38 (95%) of PL was positive for *intI1* (Fig 1)
- 10/16 (62%) of PL + 10% BC was positive for *intI1* (Fig 2)

Fig 1: *intI1* isolated from PL

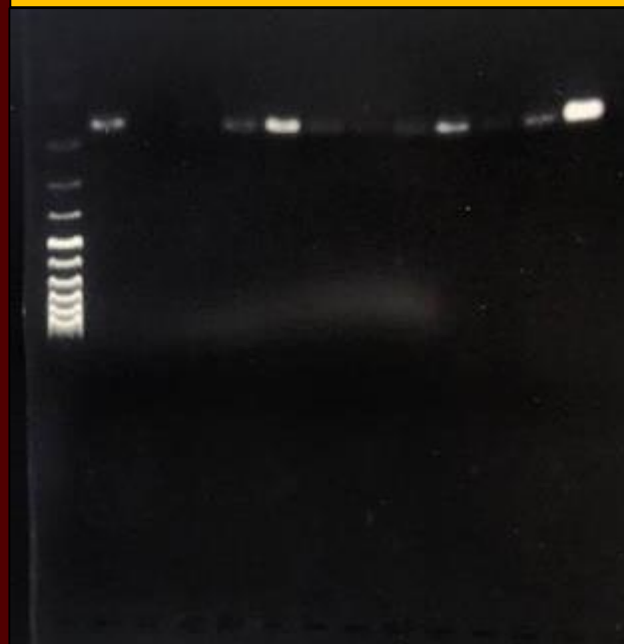
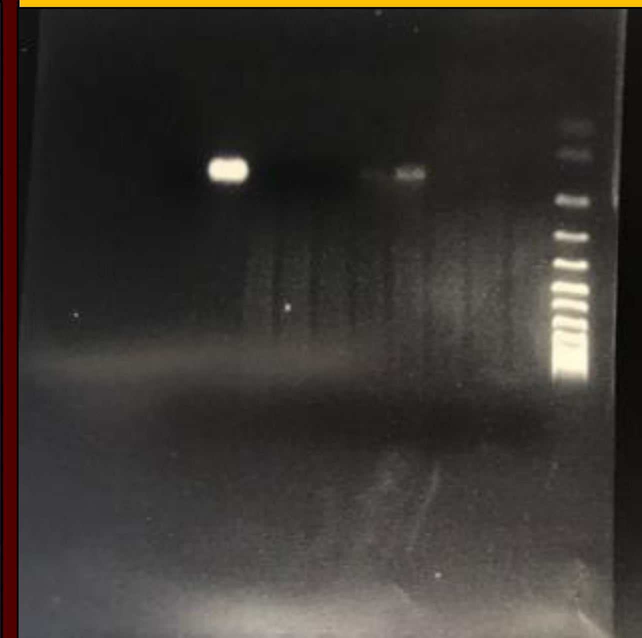


Fig 2: *intI1* isolated from PL + 10% BC



Compost Set up

- 11 kg total material
- 8 treatments, 5 reps
  - Poultry Litter (Control)
  - 5% Biochar (BC)
  - 10% BC
  - 20% BC
  - 2% Wood Vinegar (WV)
  - 5% BC + WV
  - 10% BC + WV
  - 20% BC + WV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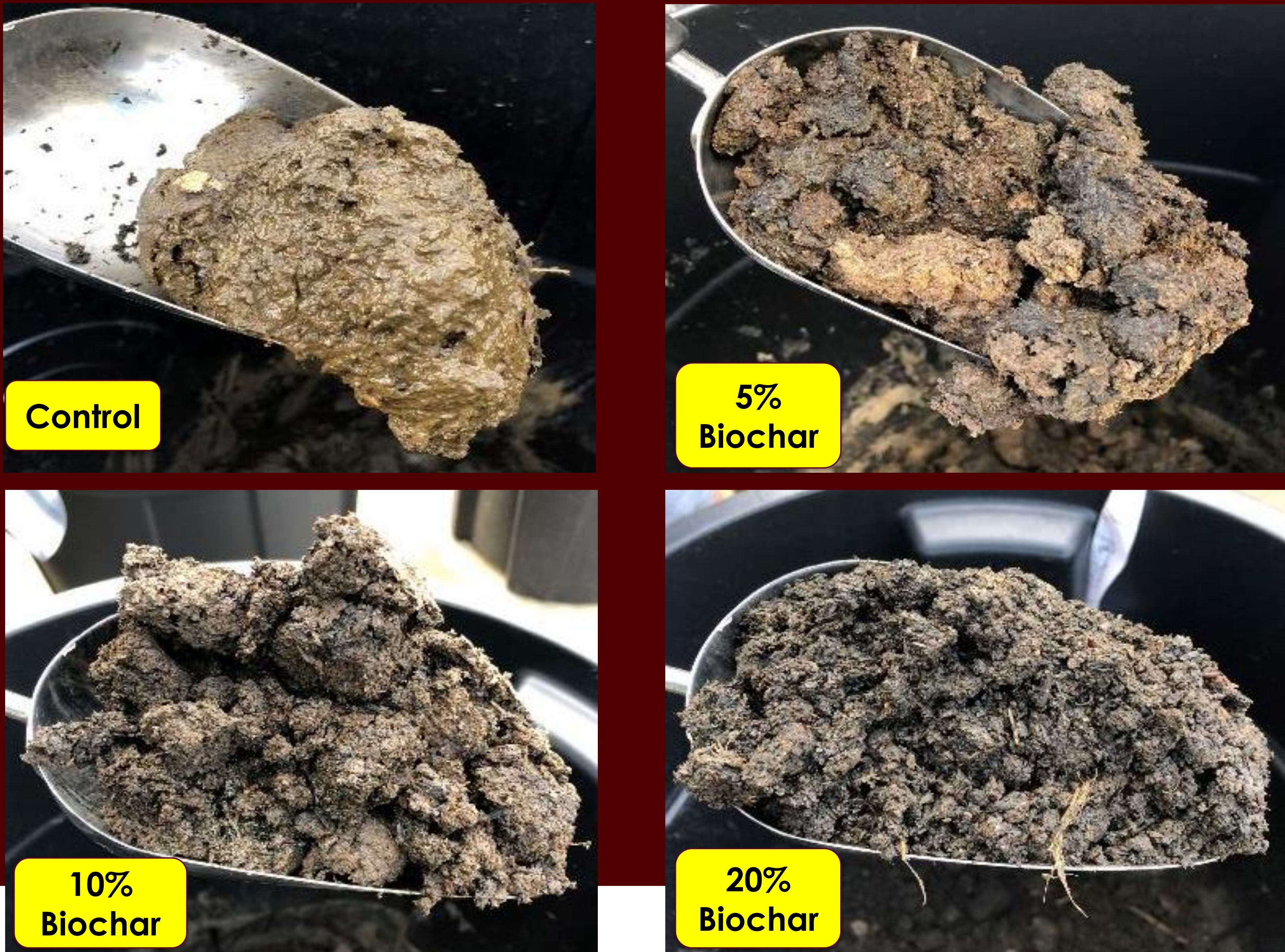
Water Logging


Control


5% BC

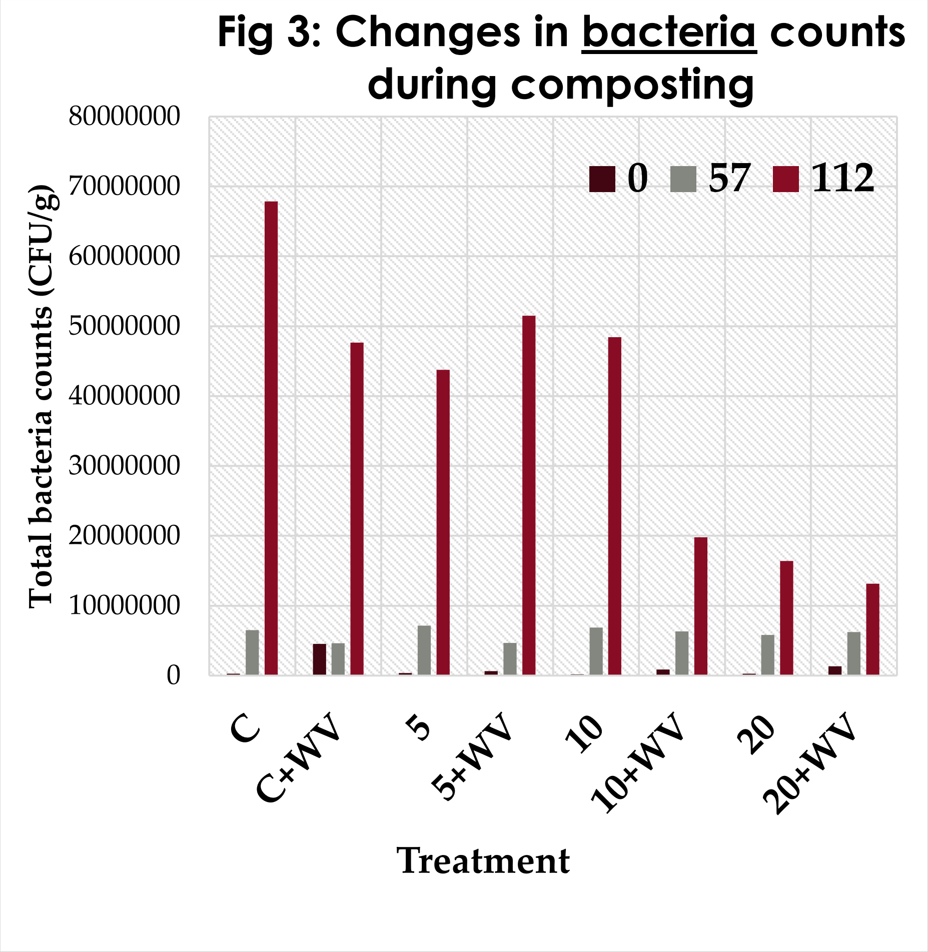

10% BC

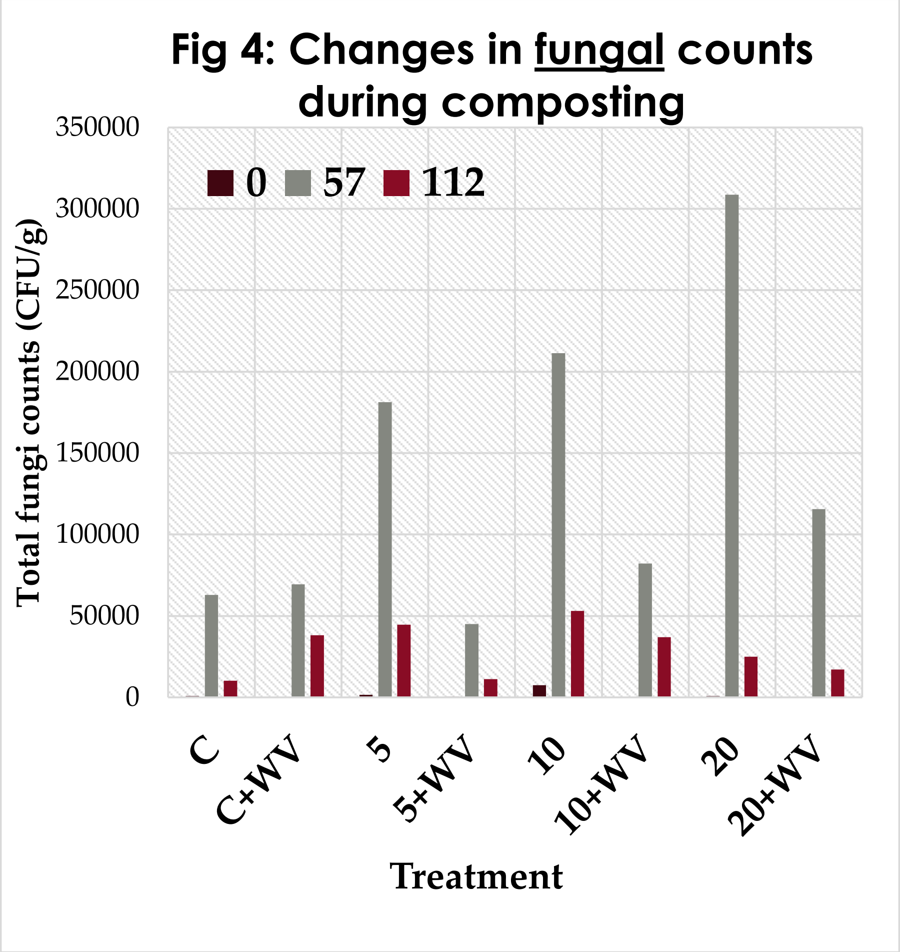

20% BC


Control
5% Biochar
10% Biochar
20% Biochar

Current Results

- Temperatures did not reach thermophilic phase
- Control (No biochar)
  – Prevented water drainage (compaction)
- Increasing biochar % reduced:
  – Compaction
  – Accumulation of standing water
  – Odor
  – Fly

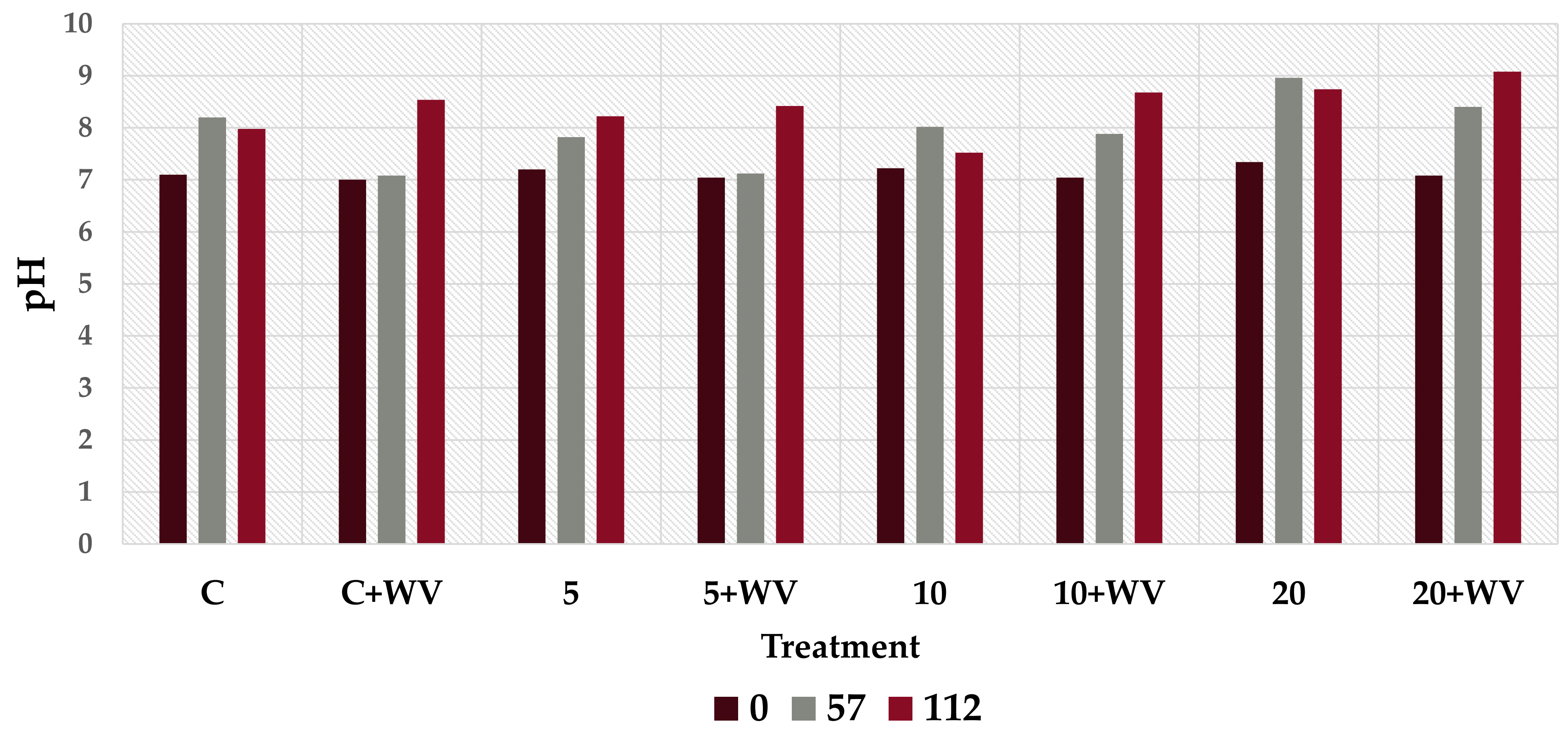




Bacteria counts were significantly higher on Day 112, and increasing biochar % and adding wood vinegar decreased bacterial abundance.

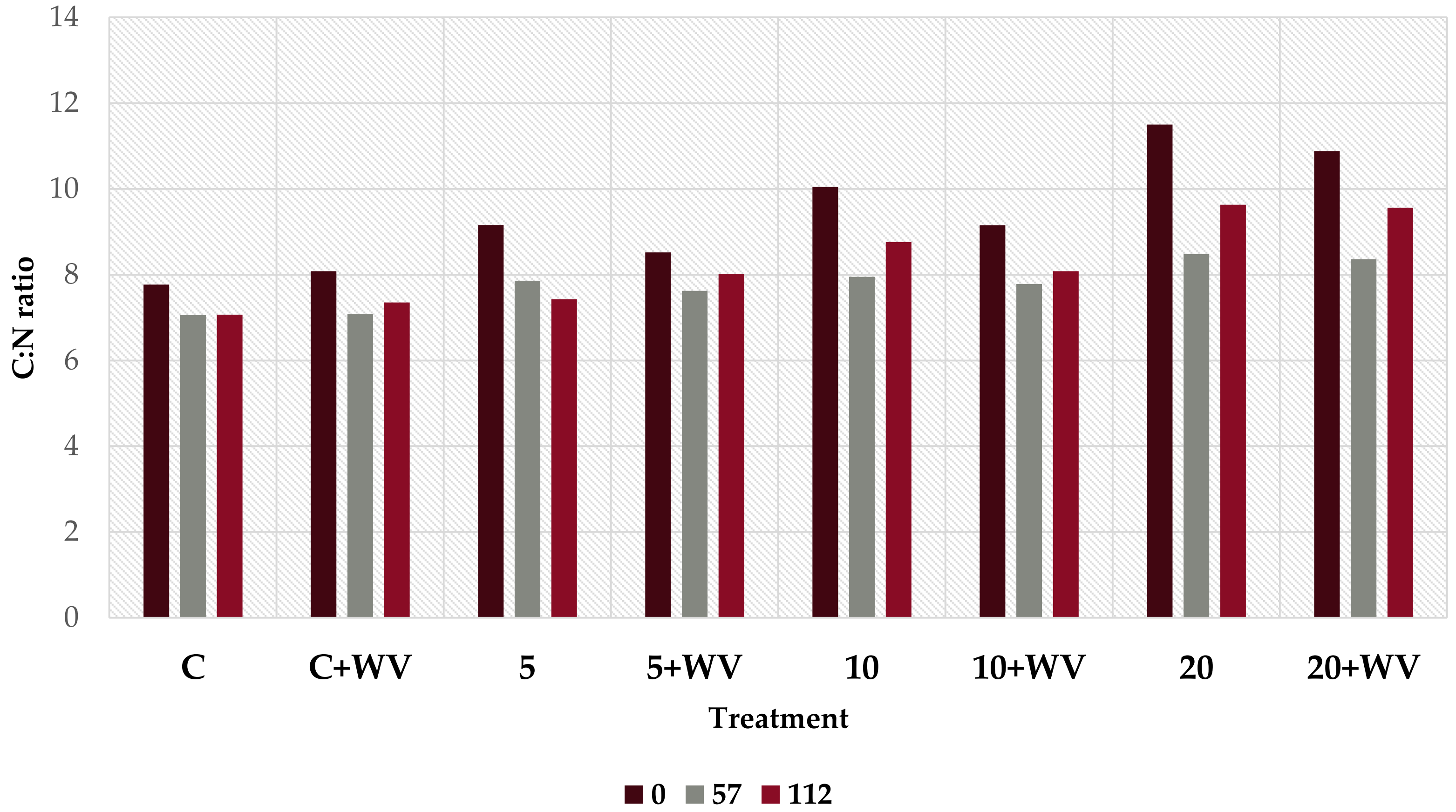
Fungi counts were sig. higher at the Day 57, were inhibited by WV, and increasing biochar % increased fungal abundance.

Fig 5: Changes in pH during composting



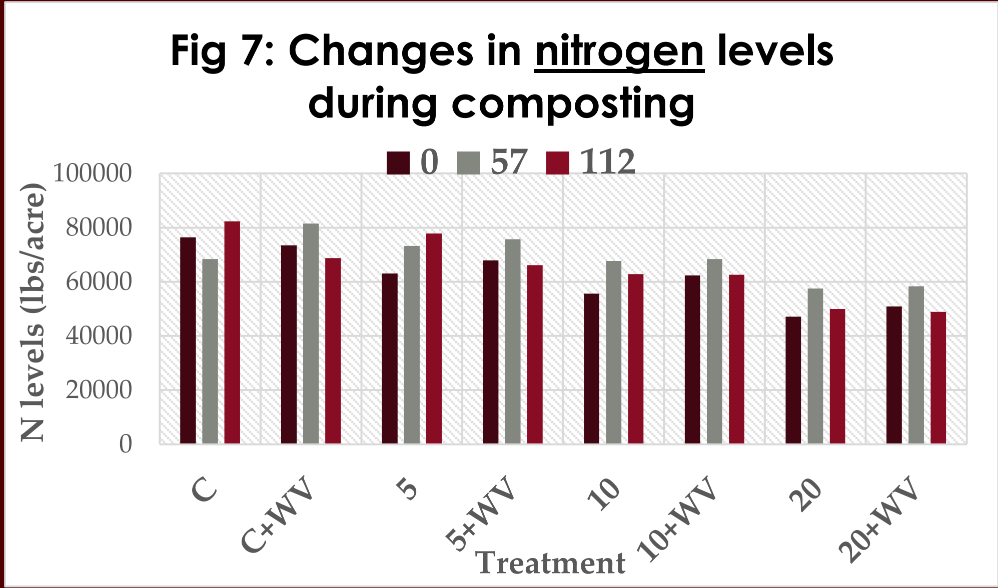
pH increased over time within treatments, and increased with higher biochar % and in wood vinegar treatments

Fig 6: Changes in C:N ratio during composting



- **C:N ratio decreased over time within treatments, and increased with increasing biochar %**

- Nitrogen levels significantly decreased with increasing biochar %
- Treatments with biochar and WV had more stable N levels
- More time needed to observe N stability and retention



- Phosphorus levels significantly increased over time within treatments
- No significant differences between day 57 and day 112
- WV appears to have a stabilizing effect on P levels

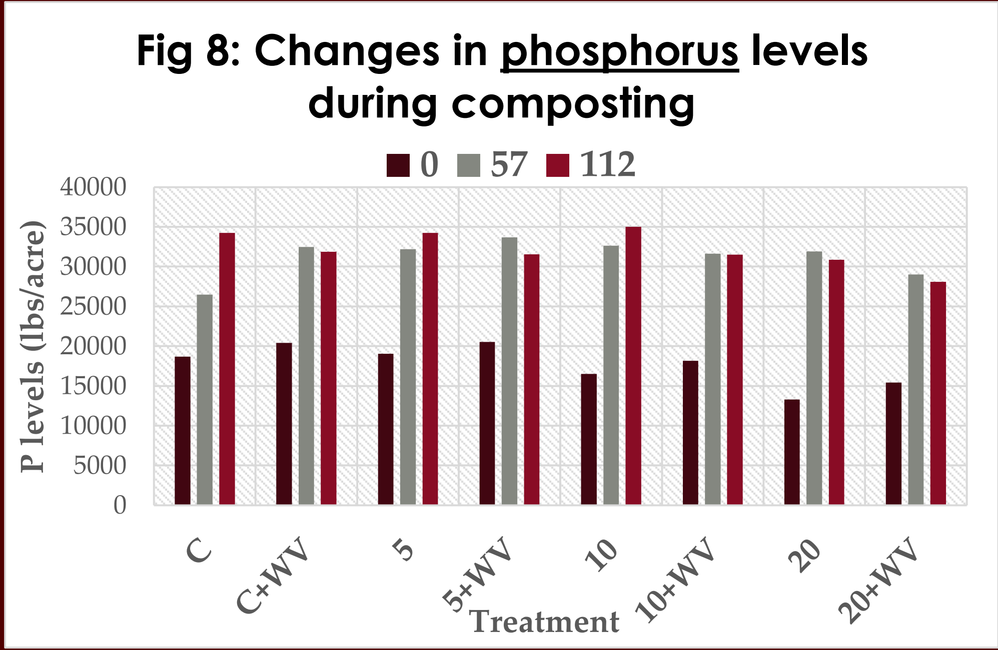
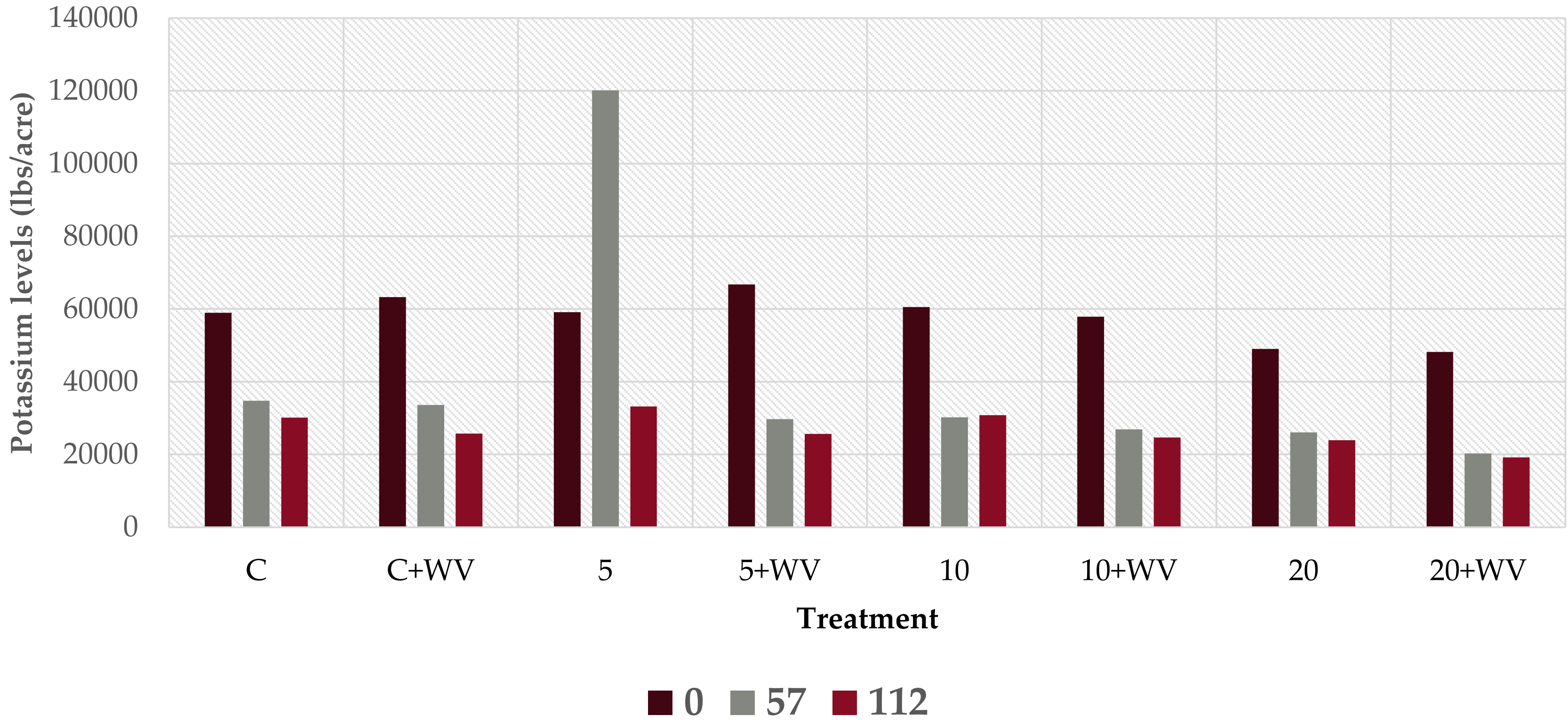


Fig 9: Changes in potassium levels during composting



- Potassium (K) levels significantly decreased from Day 0 to Day 57.
- K levels at Day 57 and 112 were not sig. different.
- K levels were not sig. different between treatments
- Increasing biochar % appears to stabilize K levels

Conclusions

- Biochar may inhibit *intI1* expression
- 20% Biochar provided best physical properties
- Biochar had an inverse effect on bacteria and fungal growth
- More time is needed to fully describe nutrient retention over time
  - BC and WV appeared to show stabilizing effects on some nutrient

Future Work

- Increase the volume of compost materials
  - Scale up experiment
- Increase carbon content
- Test varying wood vinegar concentrations
- Extend the length of the study to better characterize nutrient retention
- Apply compost blends in field trials
- Analyze fungal and bacteria populations between compost blends

Acknowledgements

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Thank you!