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Closing the circle for urban food waste anaerobic digestion: The use of digestate as fertilizer for tomato plant cultivation

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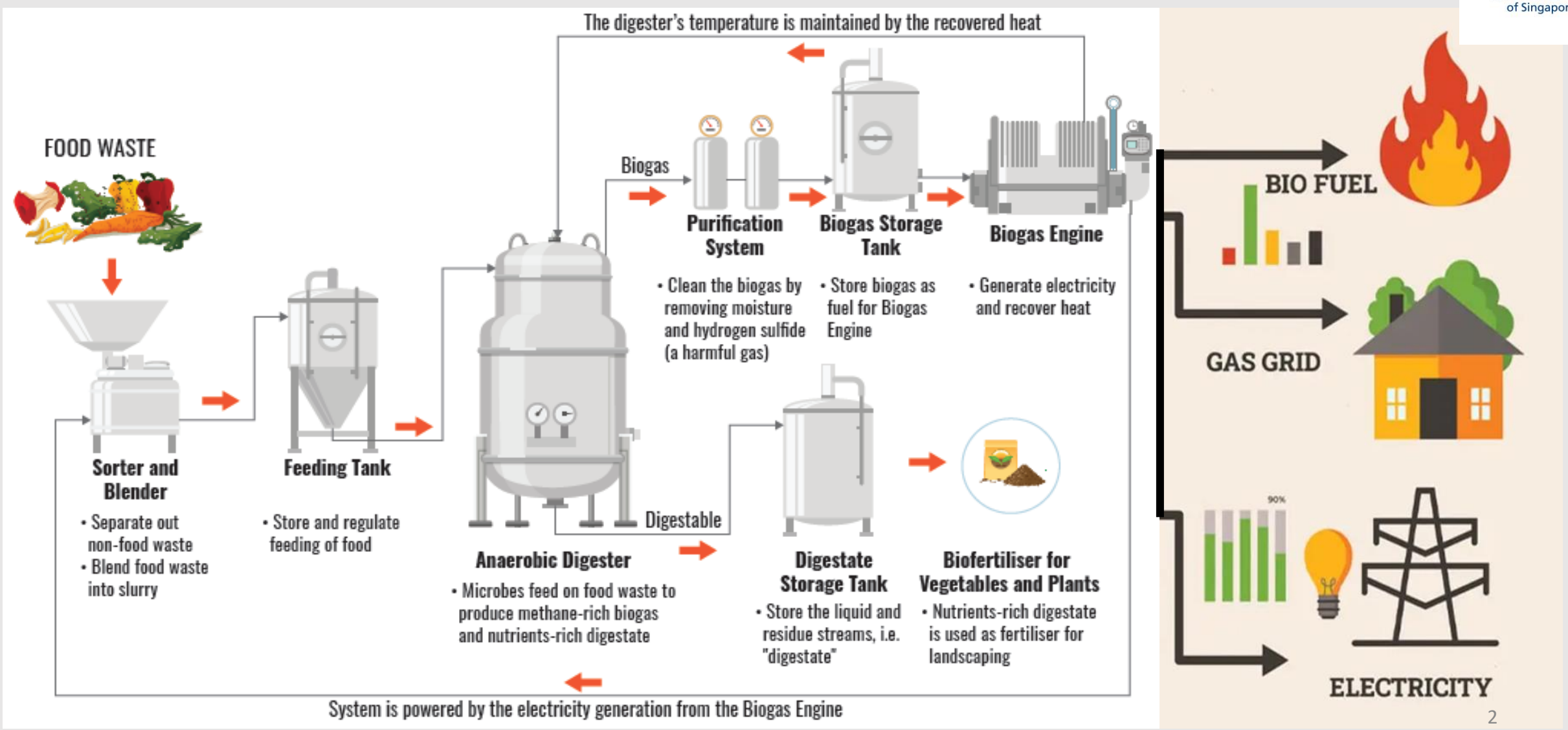
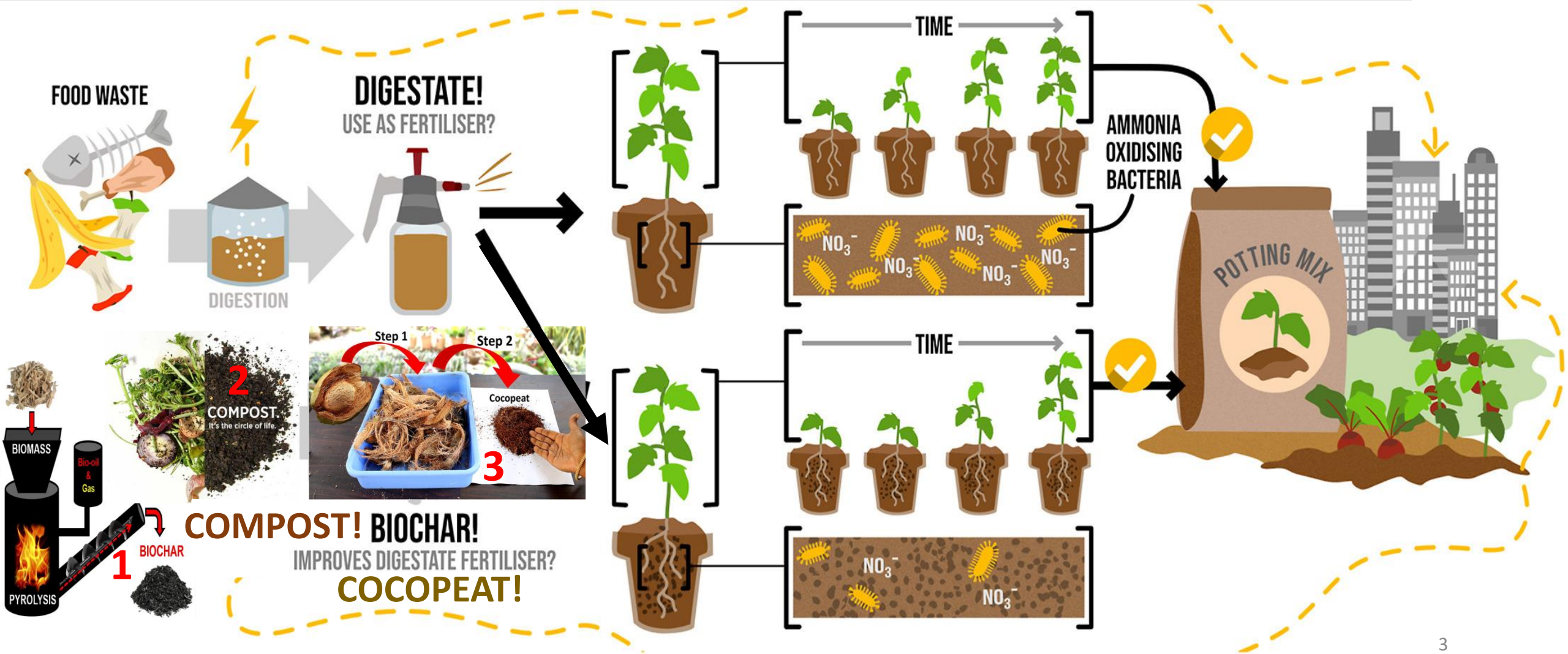
Research background – Anaerobic digestion



Tiong, Y.W. et al. 2023, Chemosphere. 318

Research overview – Digestate fertiliser



Food waste-derived digestate

Pasteurization at 70°C for 1 hour

- reduce the risk of plant pathogens and weed seeds carrying through in the digestate.

Chemical composition of food-waste-derived digestate

Total phosphorus	290 mg/L
Total nitrogen	5000 mg/L
Total carbon	3.5 %
Ammonia-N	3,800 mg/L
Potassium	160 mg/L
pH	7.4

In comparison with commercial NPK fertilizer

Seed germination to plant growth

Day 1

Day 14

Transplant

Day 14

Day 34

Irrigation system set to 3 min of irrigation each at 9 am, 12 pm and 3 pm daily.

Experimental design

5 replicates each!

Soil Control Commercial fertilizer	**Soil** Blank control	**Soil** Control ✓ digestate	**Soil:biochar 60:40** ✗ digestate	**Soil:biochar 60:40** ✓ digestate	**Soil:compost 60:40** ✗ digestate	**Soil:compost 60:40** ✓ digestate	**Soil:cocopeat 60:40** ✗ digestate	**Soil:cocopeat 60:40** ✓ digestate
								

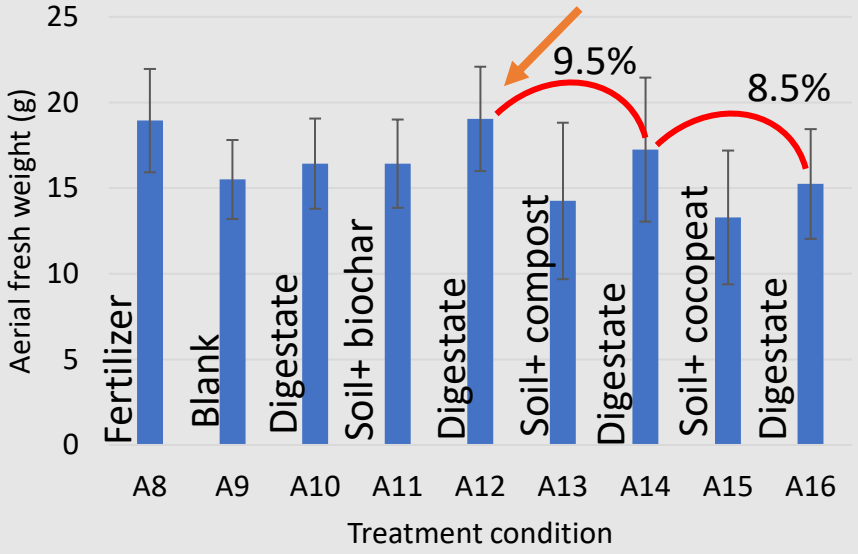
250 ml
Digestate added
on Day 16 and 26

- Aerial fresh weight (yield)
- Aerial dry weight (biomass)
- Chlorophyll content index (CCI)
- Number of leaves
- Microbial community analysis

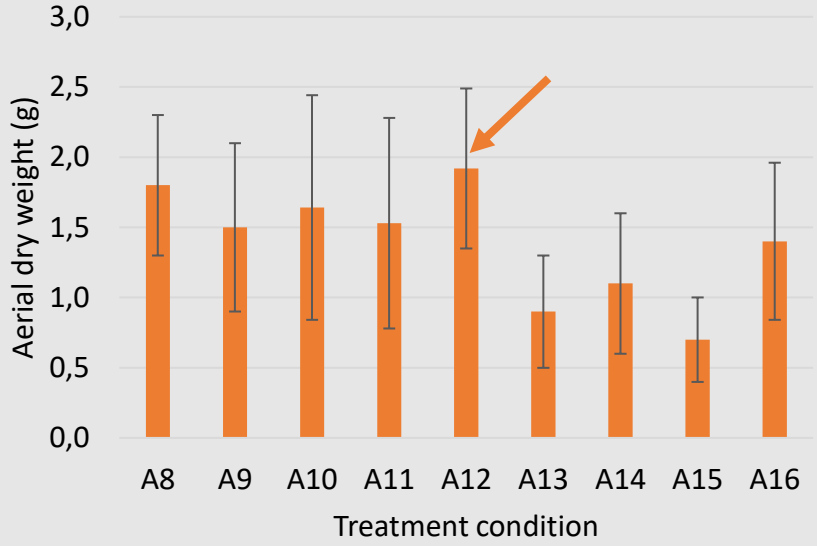
Cheong, J.C. et al. 2020, Science of the Total Environment. 715

Results – Harvesting on Day 34

Plant yield (aerial fresh weight)



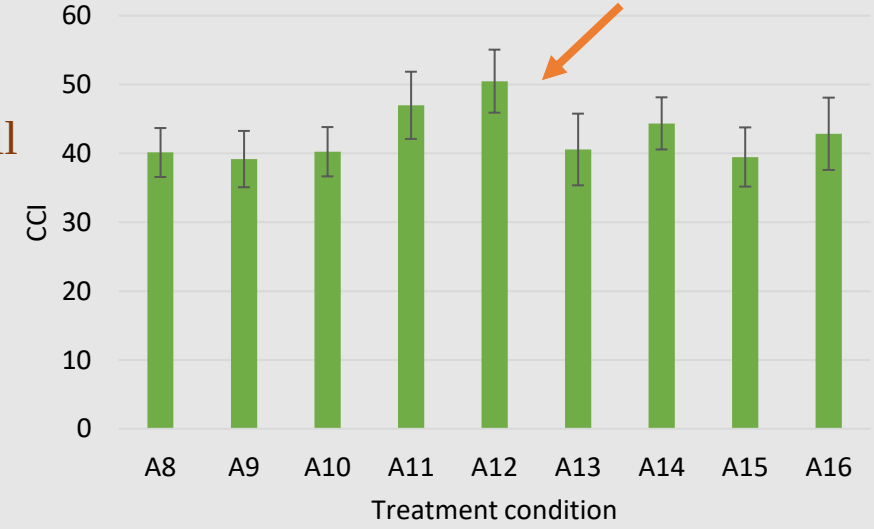
Plant biomass (aerial dry weight)

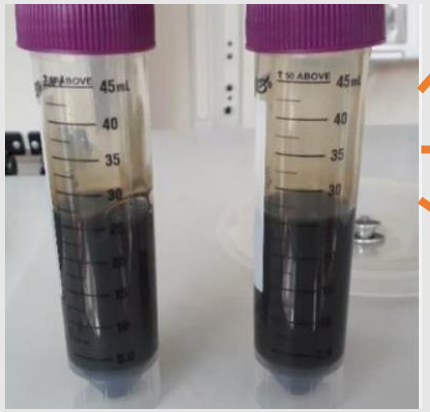


Coupling soil amendments with digestate application

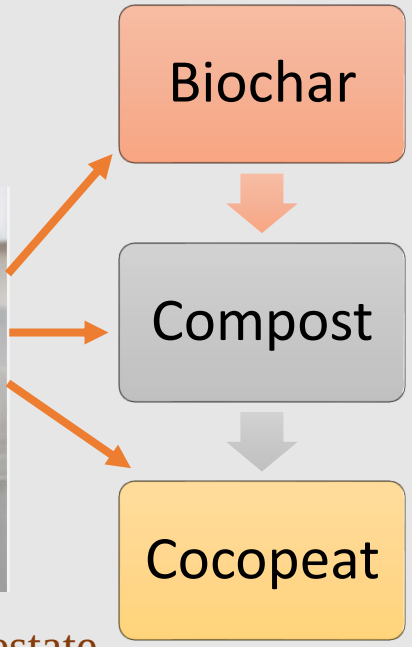
12.8-17.3 %

Plant chlorophyll content index (CCI)



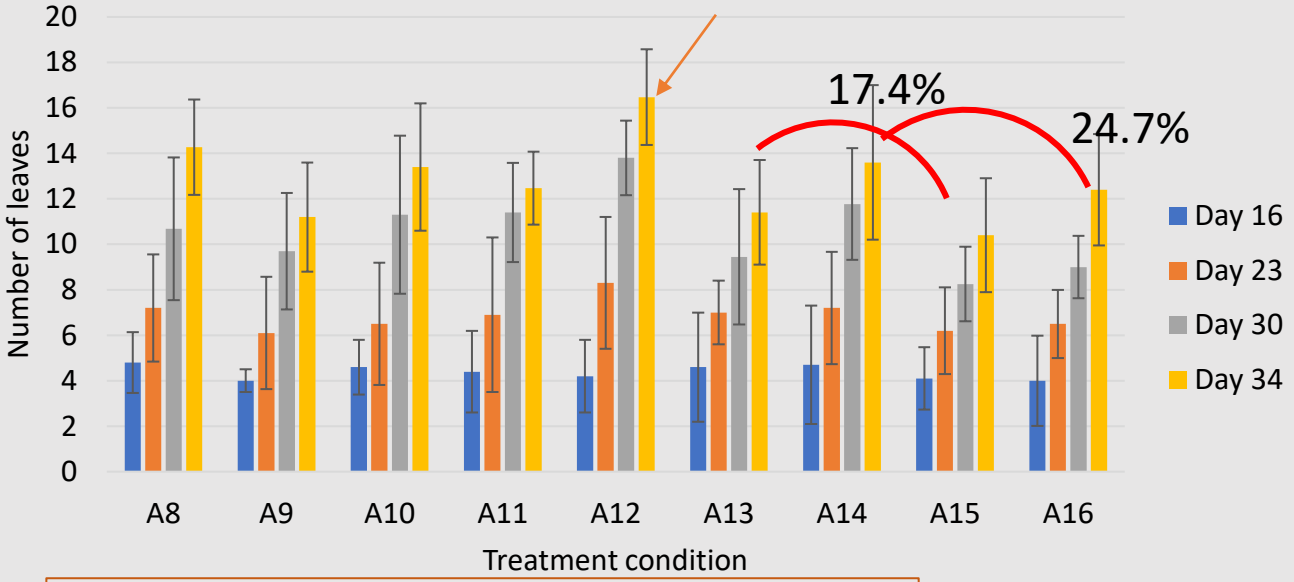


Food waste derived digestate



Results

Number of leaves



Biochar-soil mix exhibited substantial improvement on soil properties:

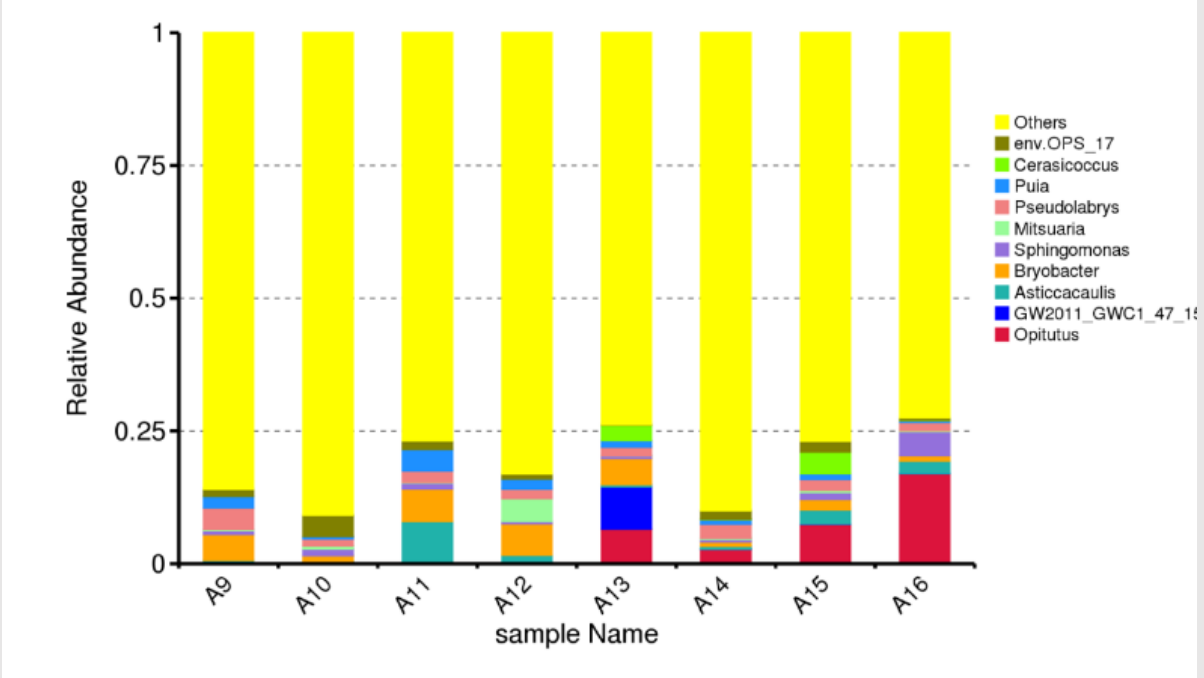
TOC (58–65%)

NO_3^- (44-50%)

TAN (103-125%)

Total phosphorus (30–42%)

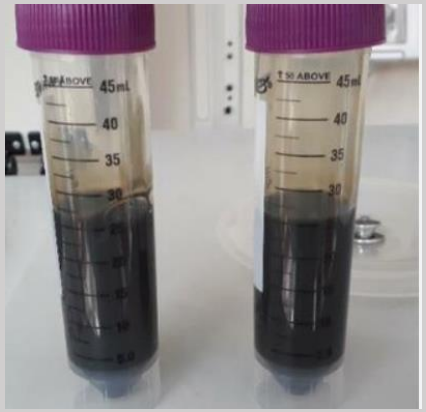
Leaves properties: CCI SPAD (8-15%)



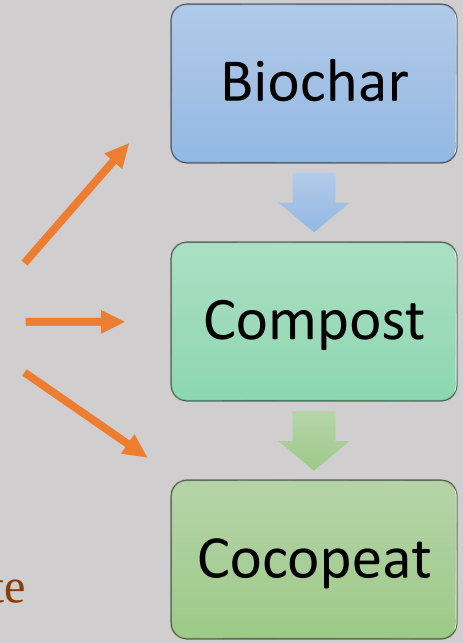
***Opitutus* sp. (*Verrucomicrobia* phylum)** being the most dominant phyla play a role in carbon and nutrient cycling in soil ecosystems.

biochar > organic compost > cocopeat

Conclusion



Food waste derived digestate



Coupled biochar-soil amendment with the digestate

- Significant enhancement in chlorophyll content, biomass yields and leaves number by enriching the soil's fine and dissolved organic matter, providing both quick and sustained release of nutrients.
- All the coupling amendments exhibited better performance with the presence of digestate, recorded an increment range of **12.8-17.3 % yield**.
- Food waste derived digestate demonstrated an advantageous agronomic effect, with significant fertilization efficiency.

Acknowledgement

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- Teammates: Dr. Bu Jie, Dr. Pooja Sharma

Thank you!
Q & A …

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