



Toward a Caribbean Circular Bioeconomy: Biochemical Valorization of Lemongrass for Biomethane Production and Digestate as Biofertilizer

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1 BACKGROUND AND RATIONALE

Small Island Developing States (SIDS), including those in the Caribbean, remain highly dependent on imported fuels and fertilizers.

Our research develops a circular system that includes the conversion of organic biomass into biomethane for fuel and biofertilizer for increased crop production, using lemongrass as a model feedstock.

In addition to tackling food security and energy security, it includes the link of waste valorization for proper land management.



2 SCHEMATIC OF THE CIRCULAR SYSTEM



Anaerobic digestion is the central process occurring in the circular system. Methanogens digested the lemongrass to create:

1. biomethane
2. digestate which is a biofertilizer.

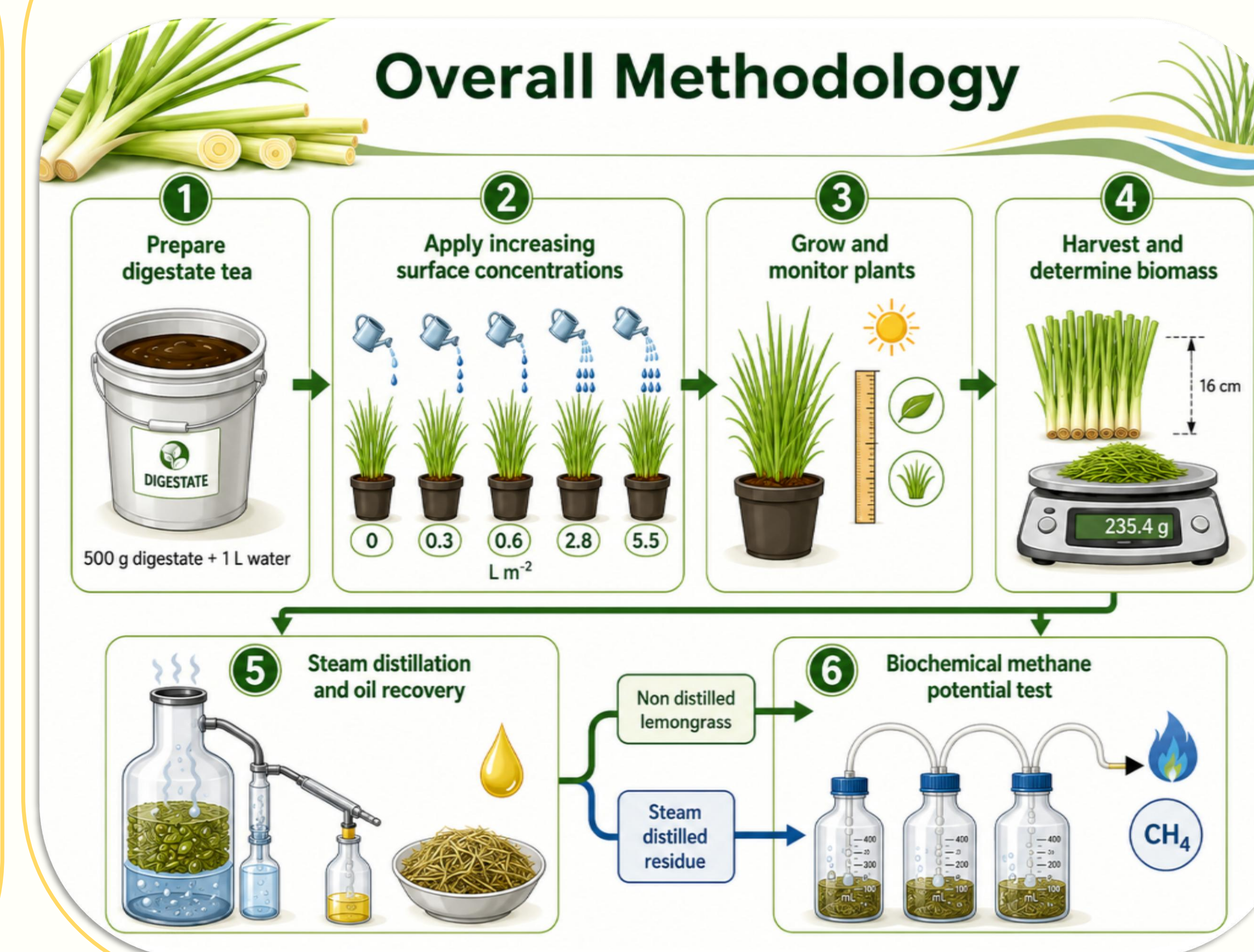
1. Uses of Biomethane

The biomethane is incorporated into the system and used to fuel the lemongrass extraction.

2. Uses of Digestate

The digestate is used as a fertilizer to regrow the lemongrass plants to restart the process, demonstrating circularity in nutrient recovery.

3 METHODOLOGY



Methodology

1. Biomass was steam distilled to recover essential oil and generate residue.

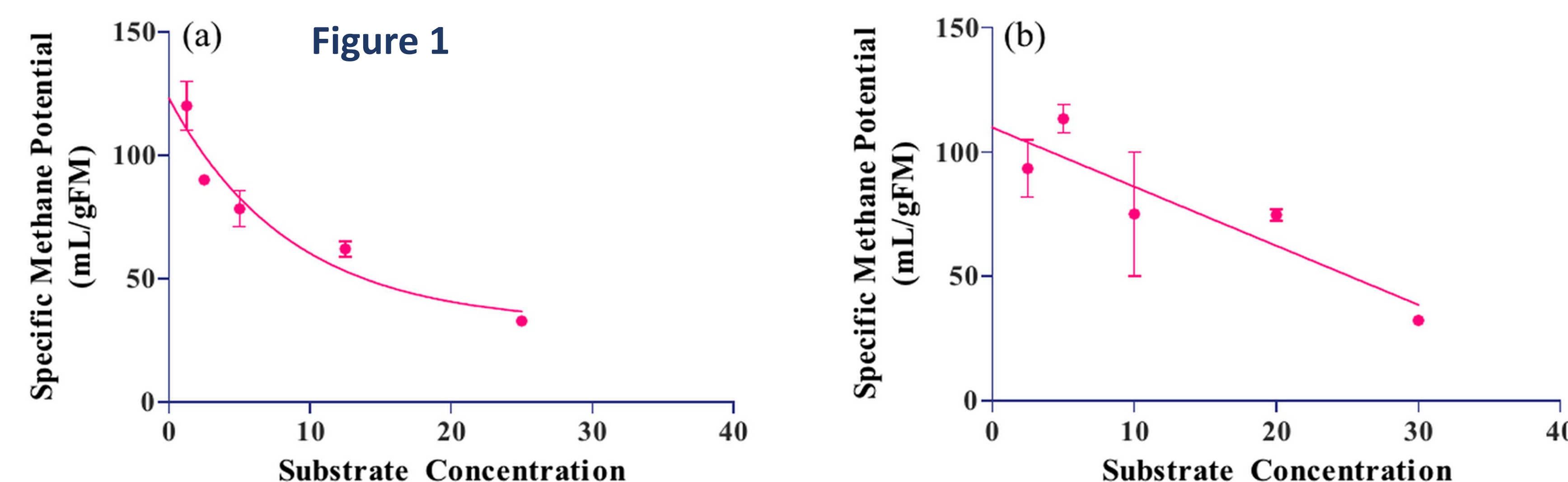
Non distilled and steam distilled biomass were tested for biomethane potential over 42 days.

2. Lemongrass was treated weekly with digestate tea at 0–5.5 L m⁻² for 12 weeks.

Growth was tracked using height, leaves and tillers.

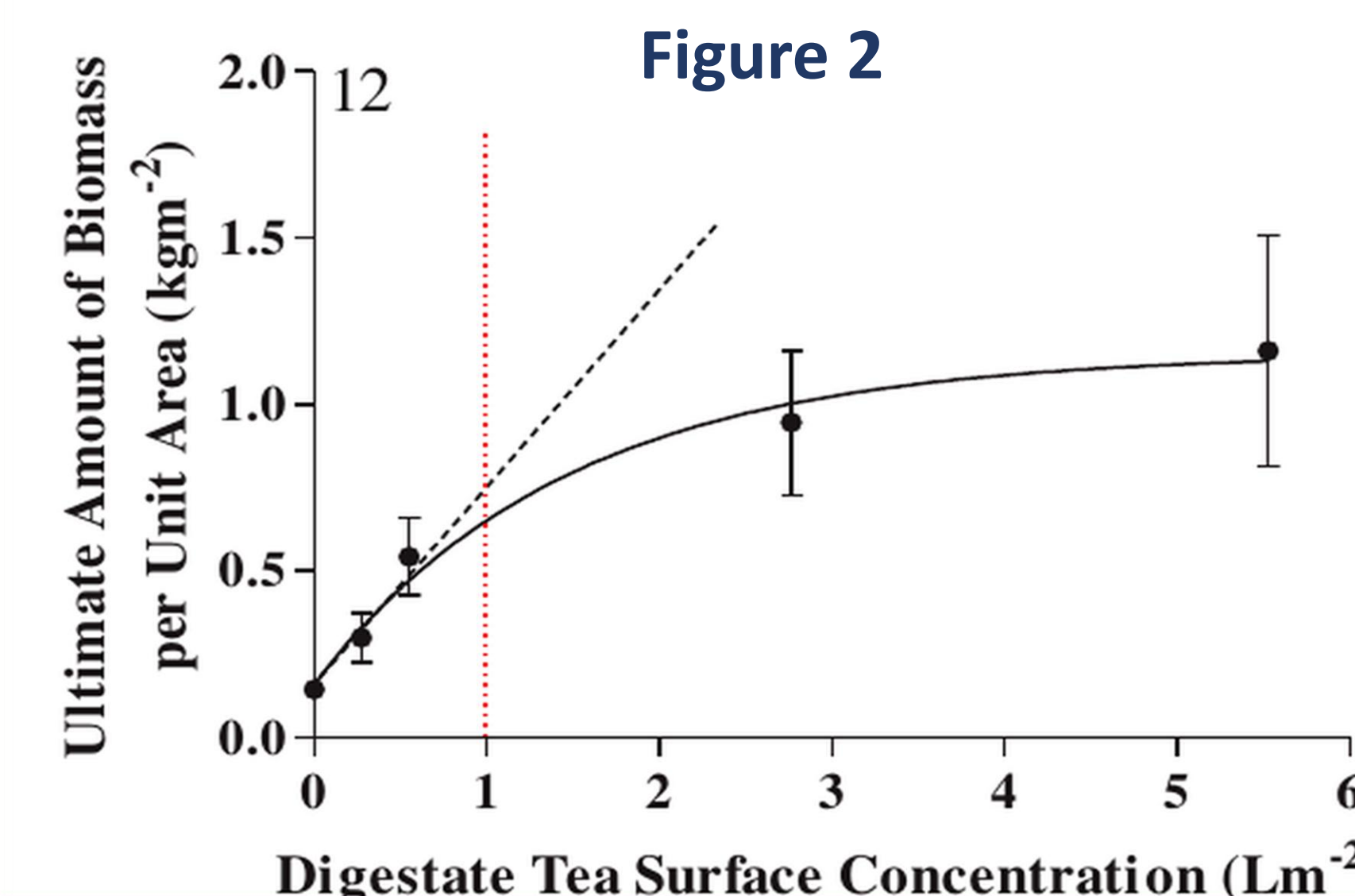
Plants were harvested, cut to 16 cm, and fresh biomass was weighed.

4 RESULTS



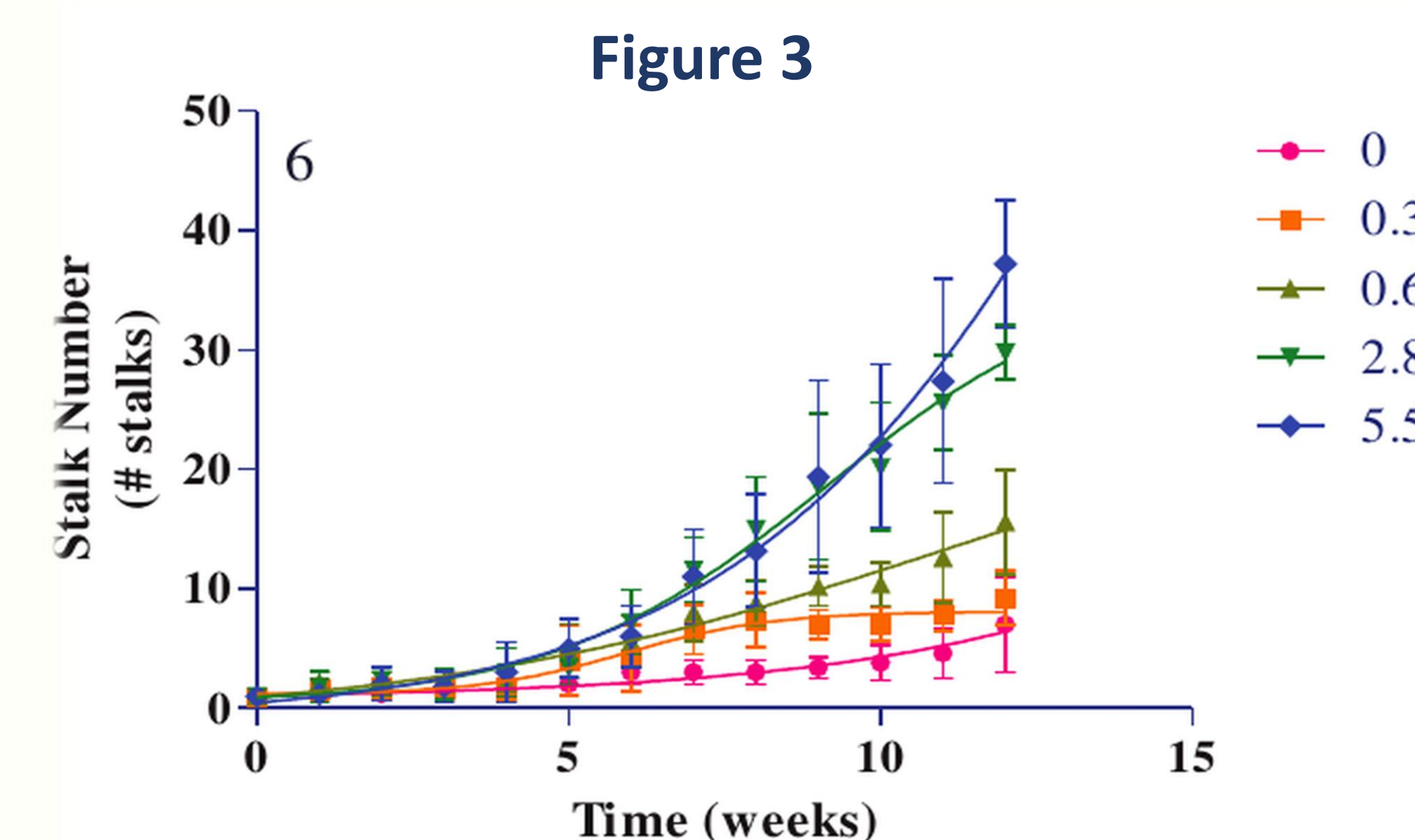
1. Biochemical Methane Potential

Both non distilled and steam distilled lemongrass residues produced measurable biomethane, confirming that lemongrass biomass remains a useful anaerobic digestion substrate after oil extraction. Steam distilled residue maintained comparable methane potential, supporting an oil first, biomethane second circular system, where the lemongrass oil can be extracted as a value added product.



2. Overall Lemongrass Biomass

Digestate tea increased lemongrass biomass, with the highest treatment producing the greatest fresh yield.



3. Tiller Count Over Time

Digestate strongly increased tiller production, especially at higher application rates.

5 CONCLUSION

1. Lemongrass retained biomethane potential after distillation, showing post extraction biomass can be used for renewable energy recovery.

2. Digestate improved lemongrass growth, completing a circular system where residues provide nutrients for regrowth.



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