

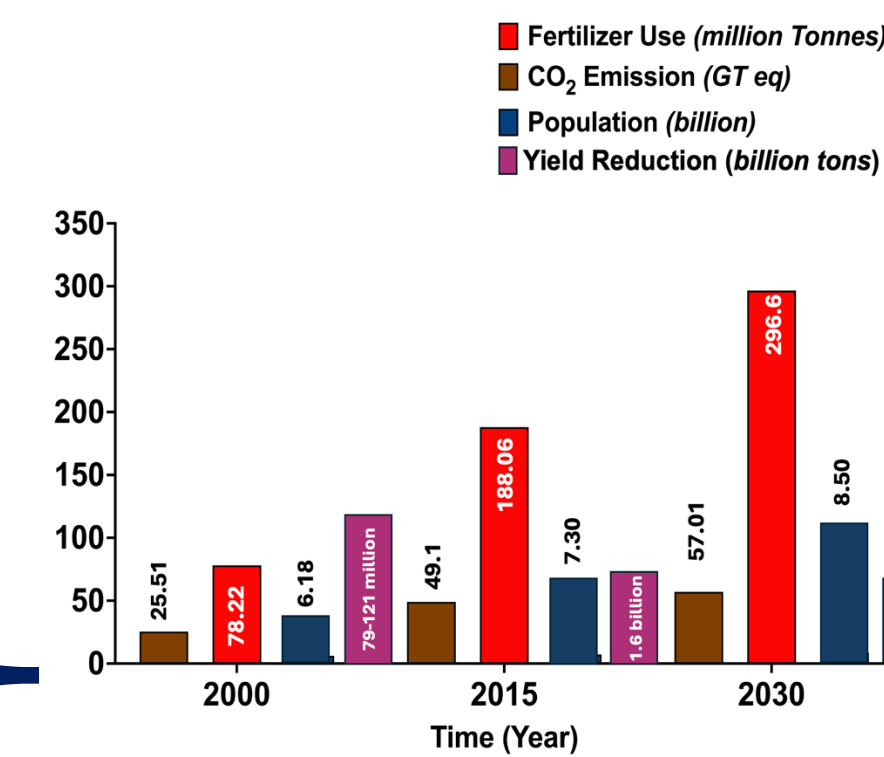
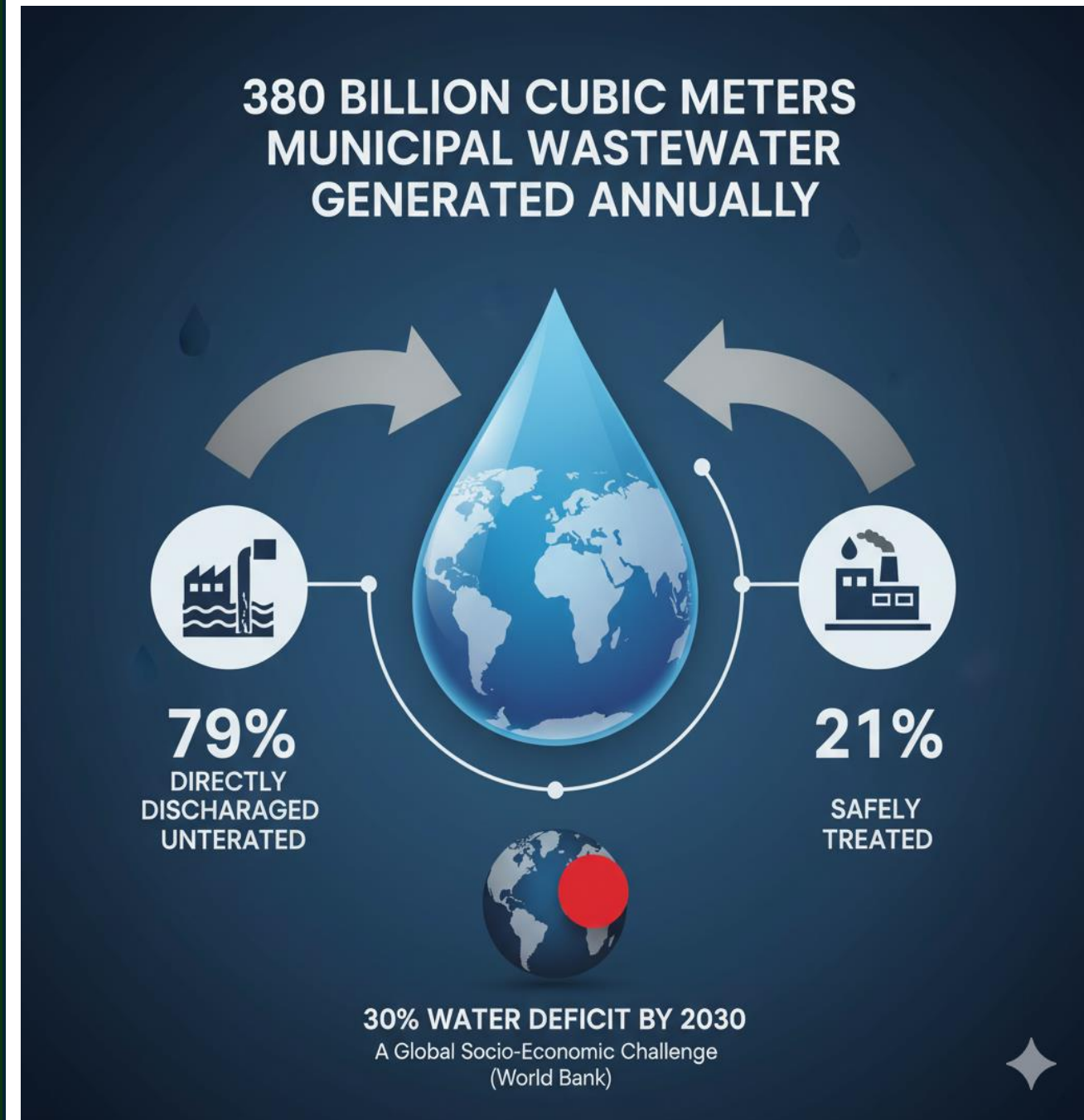
Microalgal species as a green approach for Nutrient Recovery and Clean Water Production from Municipal Wastewater

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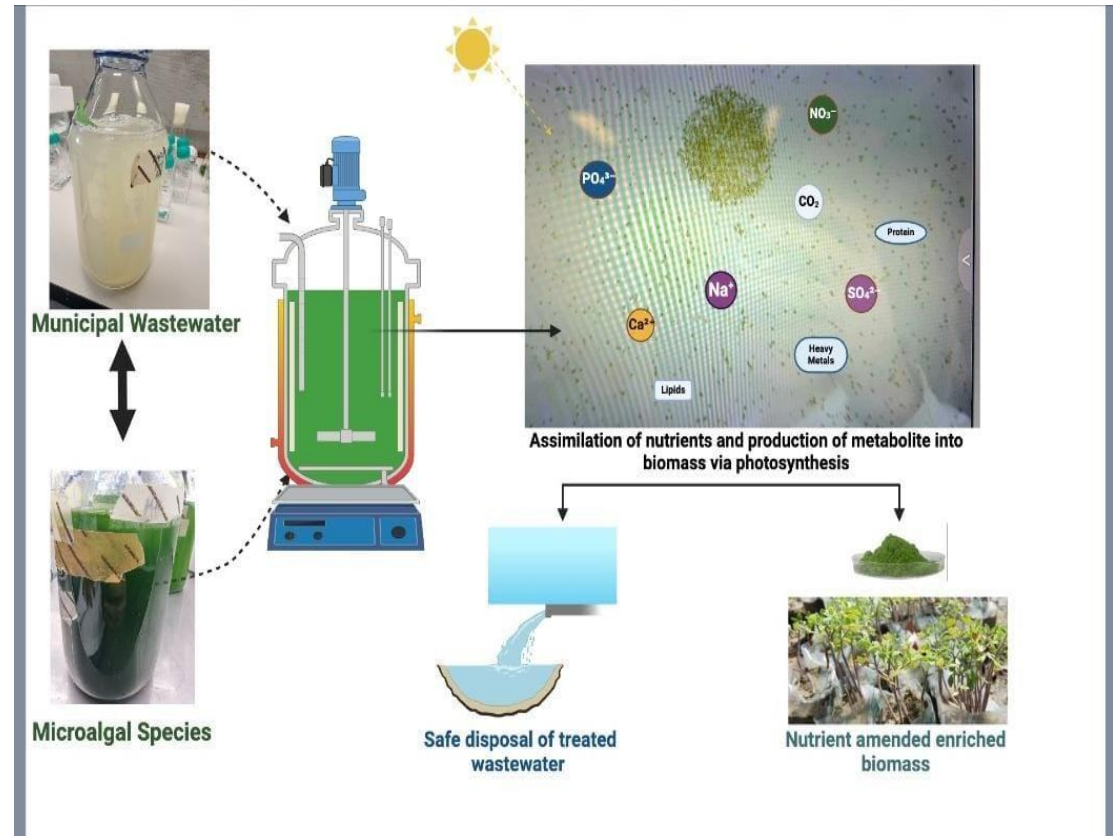
The challenge: the world is confronting today



With the rising global population, fertiliser use has increased to meet food demand; however, excessive and continuous application has led to soil degradation, nutrient imbalance, and declining crop yields over time.

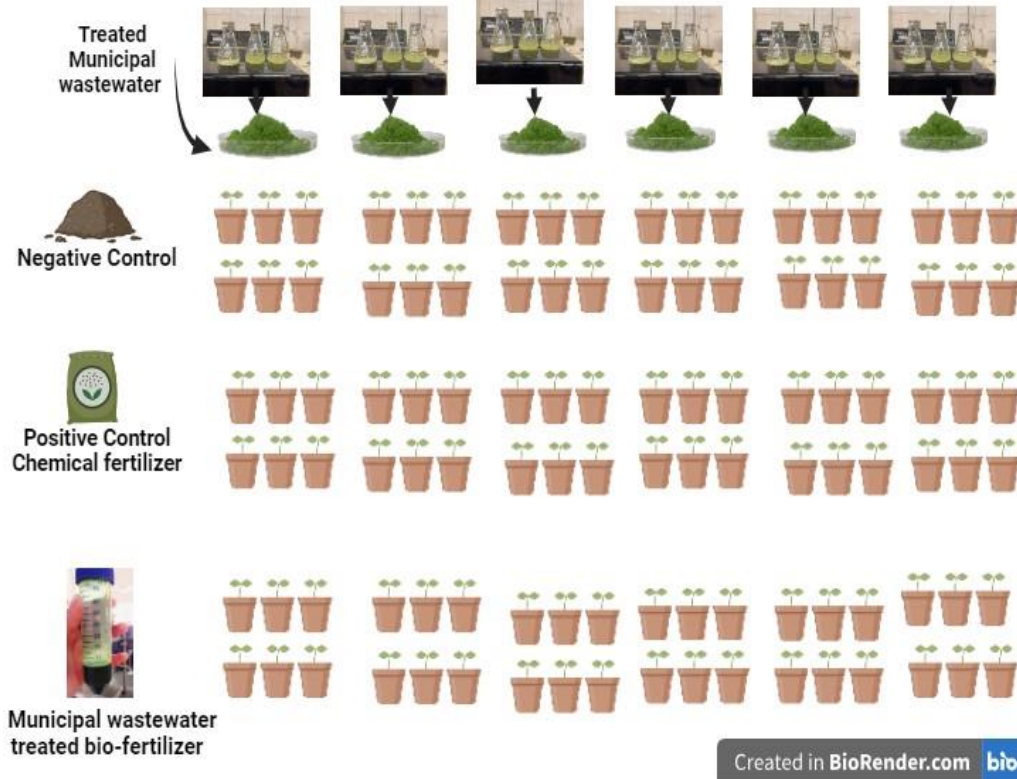
Target SDG#6.6: Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

Conceptual Framework

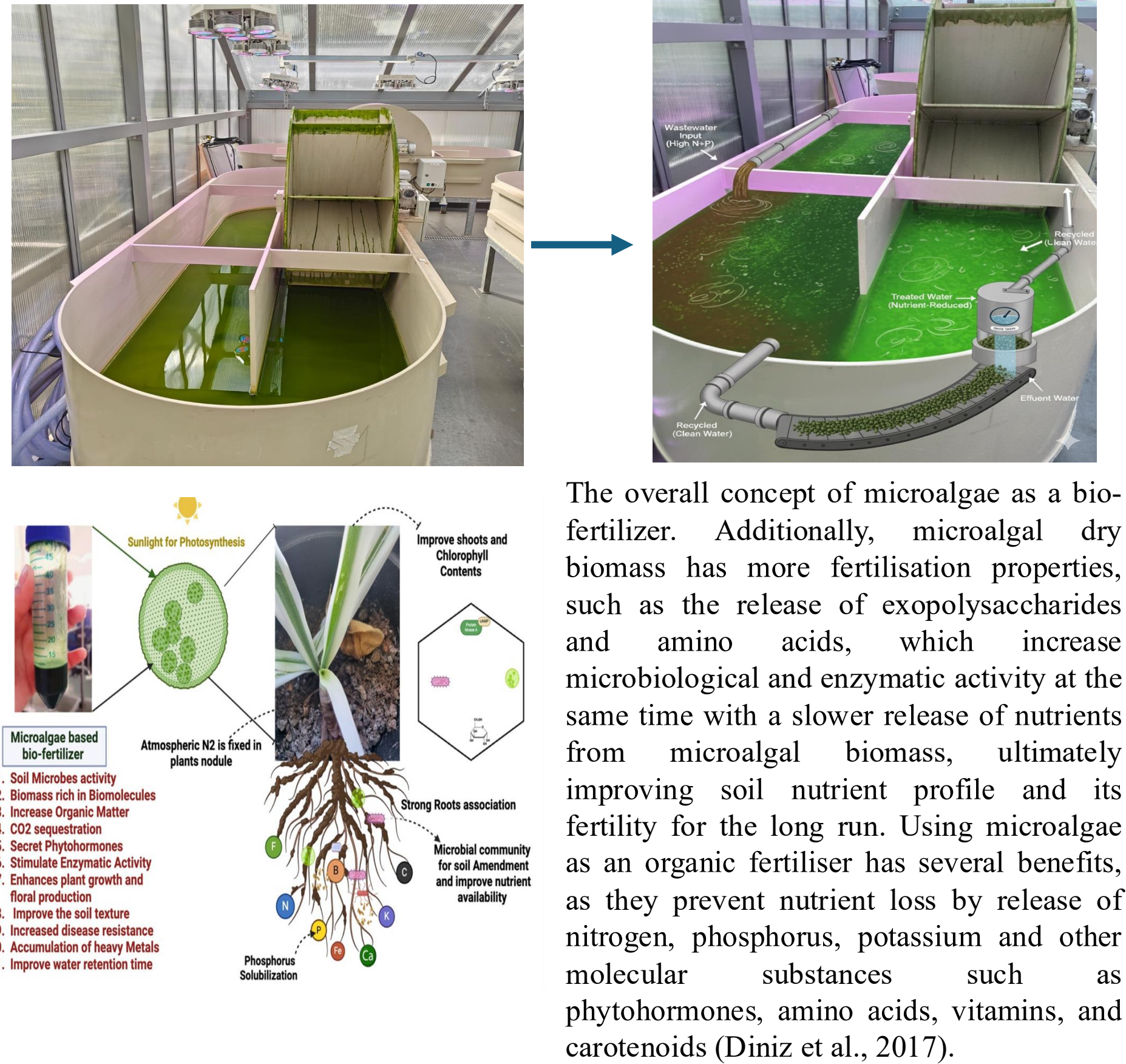


The use of native microalgae in wastewater treatment is a cost-effective method that efficiently recovers nutrients. While the production of bio-chemicals through microalgae alone may not be sufficient, combining it with wastewater treatment and nutrient recycling offers significant advantages

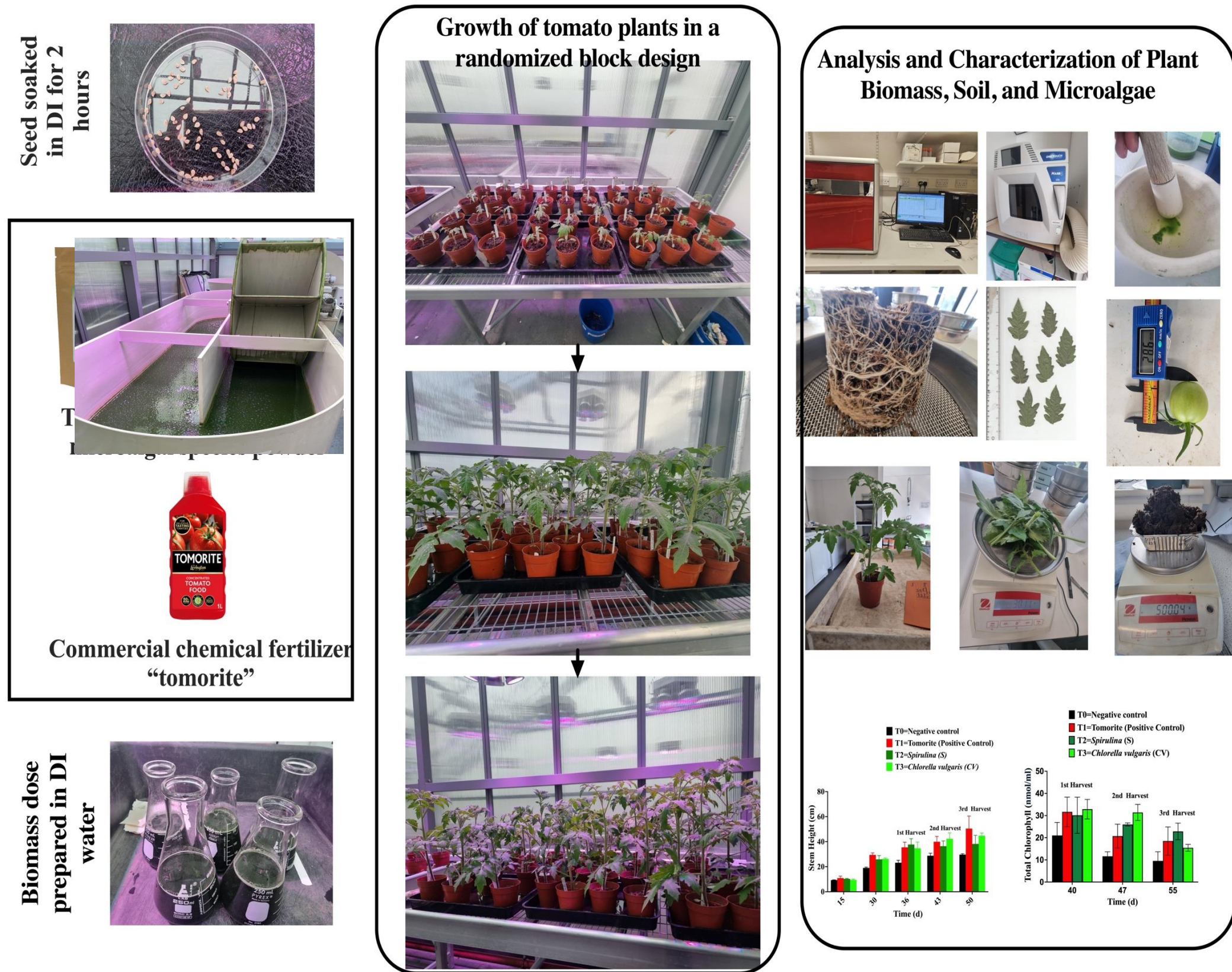
The development of biofertilizers from microalgae is a promising technique to bring sustainability in the water and agriculture sectors to clean the wastewater and produce sustainable crops, respectively.



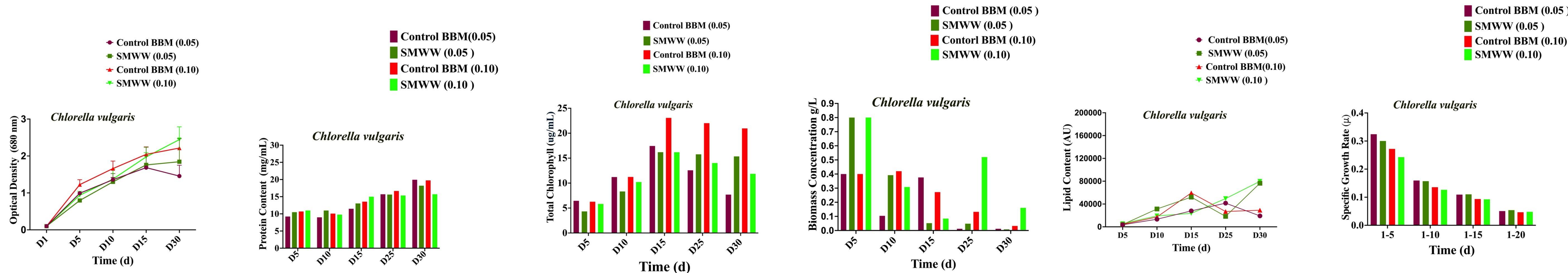
How do they work?



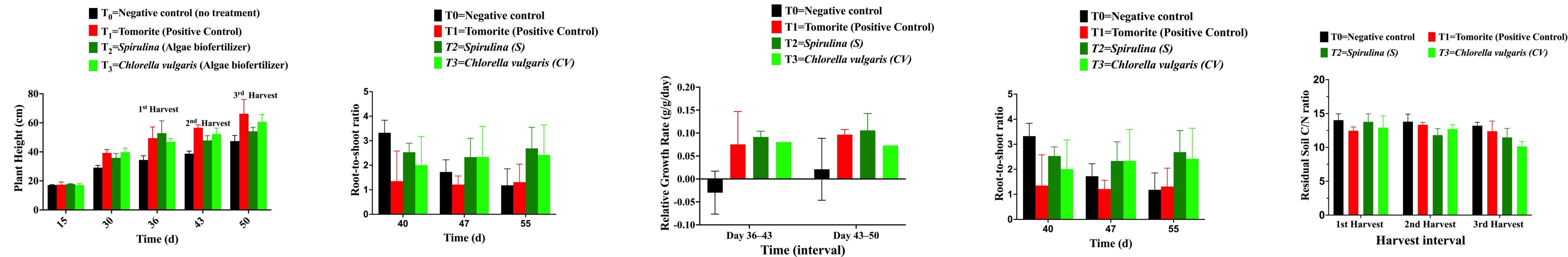
Experimental Methods



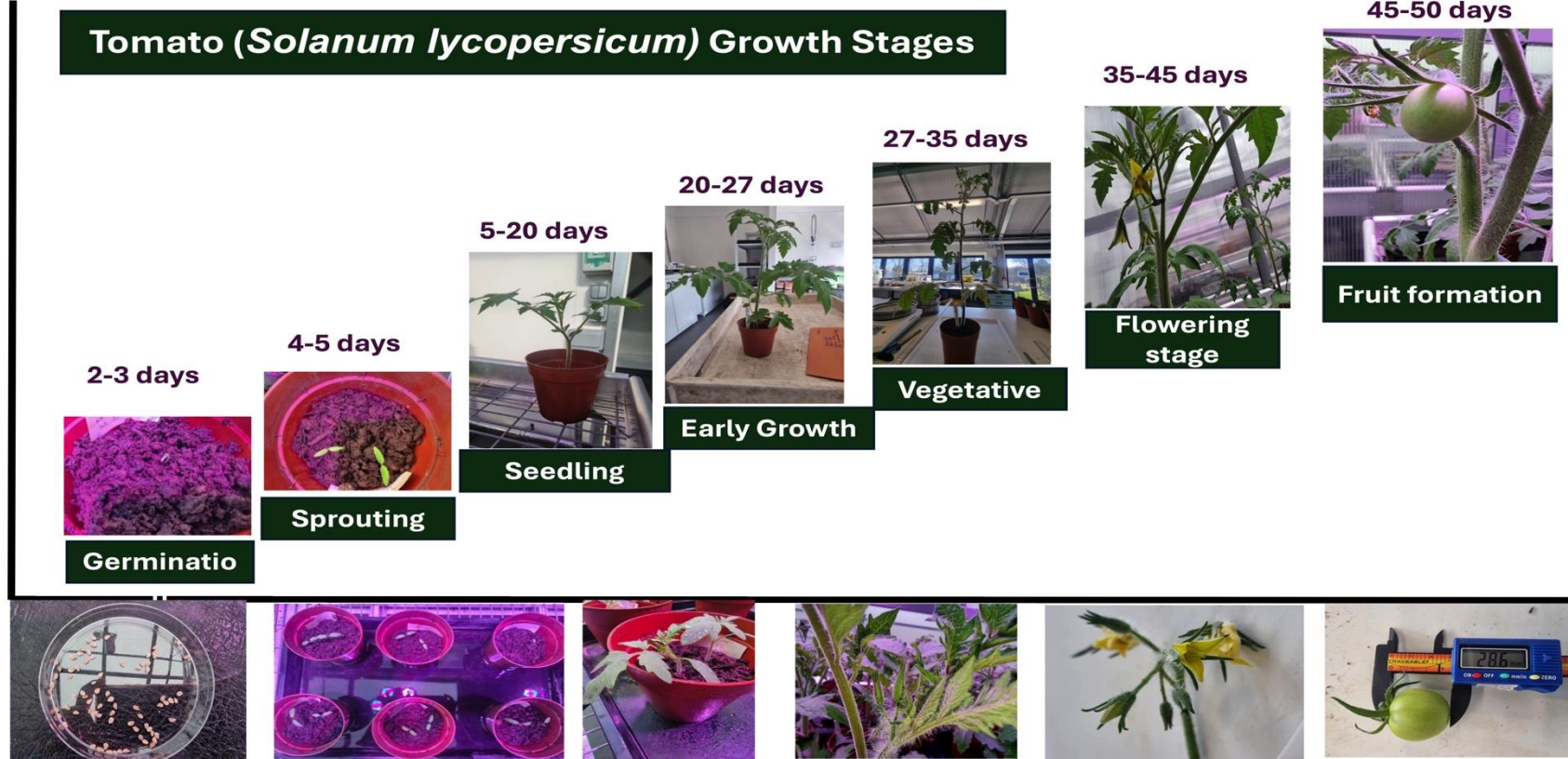
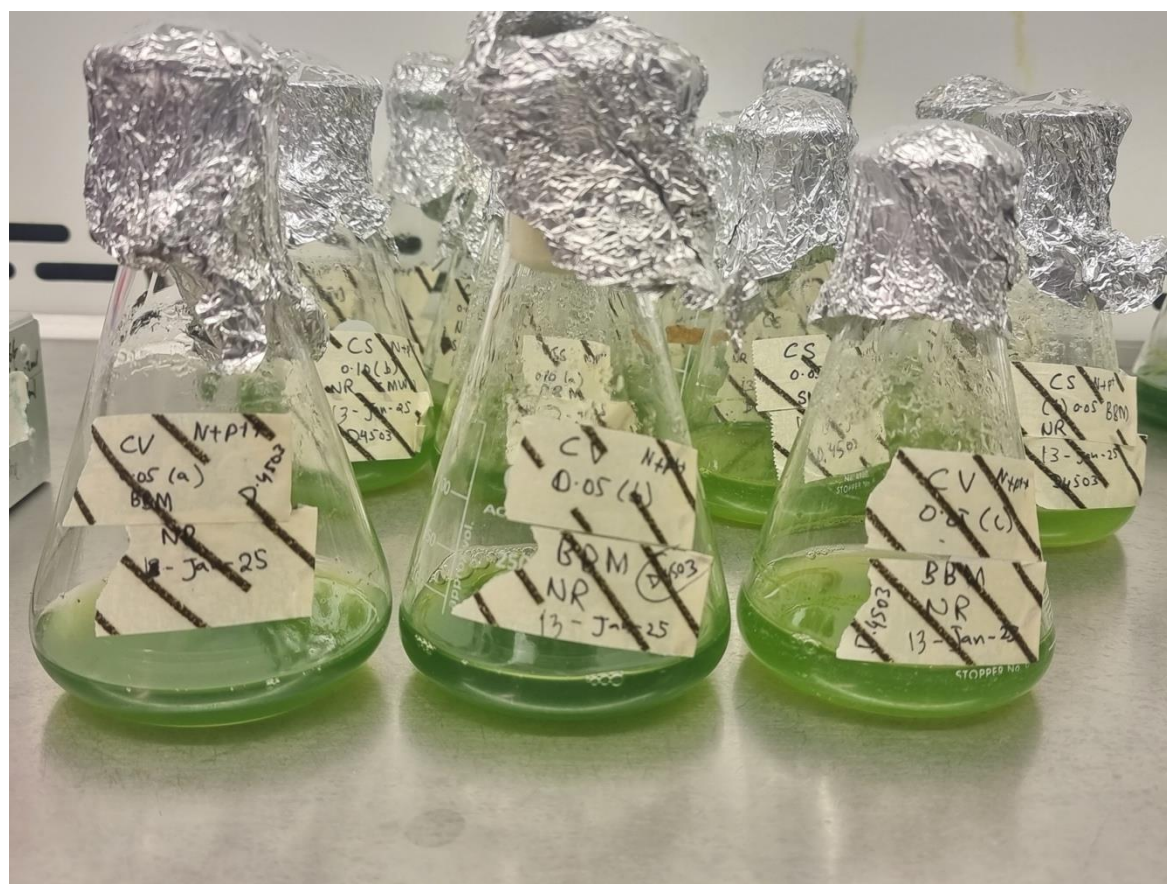
Result and discussion



Chlorella Vulgaris exhibited a significant result with a p-value of 0.0290 for Control BBM (0.05) vs. SMWW (0.05) . All experiments in this study were triplicate averaged to validate the results, statistical analysis was performed using GraphPad Prism, and differences were considered statistically significant using ANOVA, $p < 0.05$ with replicates (n=3).



Microalgae *spirulina* and tomorite outperform the treatment suggesting sustainable option to use as biofertilizer for growing crops. All experiments were triplicate averaged to validate the results, statistical analysis was performed using GraphPad Prism, and differences were considered statistically significant using ANOVA, $p < 0.05$ with replicates (n=5).



The growth stages of tomato plant from seedling to fruit bearing plant

Key achievements

Conclusively, synthetic municipal wastewater supported the higher yield in all microalgae cultivation using two different optical densities. The use of microorganisms in wastewater treatment is a cost-effective method that efficiently recovers nutrients. These nutrients can be used to cultivate microalgae for biomass production. This is a promising way to dispose of treated wastewater and recover nutrients for applications such as biofertiliser production and implementing the Sustainable Development Goals. Overall, the statistical analysis was performed to check the significance of the results by using two-way ANOVA, followed by Tukey's test among all groups with mean and SD.

- Growth Enhancement:** Spirulina and *Chlorella vulgaris* significantly increased plant height, stem dimensions, number of branches, and leaves compared to control and chemical fertilizer.
- Biomass Accumulation:** Both microalgal treatments boosted shoot and root biomass, with Spirulina showing the most balanced root-to-shoot allocation.
- Leaf Traits & Physiology:** Specific leaf area and relative growth rate were highest under Spirulina, indicating improved photosynthetic efficiency and faster growth.
- Overall Trend:** Microalgae treatments outperformed control and were comparable or superior to Tomorite, suggesting strong potential as sustainable biofertilizers.

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Acknowledgments

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