



Algal fertigation – an innovative agronomic approach to reduce greenhouse gas emission from crops production

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Algal fertigation – an innovative agronomic approach to reduce greenhouse gas emission from crops production

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Abstract. Over 50% of the anthropogenic nitrous oxide (N₂O) emission in the UK derives from agriculture, thereby requiring the use of more effective fertilisers. Green microalgal cultivation on wastewater resources was investigated due to its potential for nutrients and water recovery for agricultural crops production (slow-leaching fertiliser and irrigation water). Algal cells are able to store nitrogen and phosphorus in-excess, thus effectively conveying nutrients to crops, which in turn can reduce the fraction of nutrients contributing to (a) diffuse water pollution and (b) greenhouse gas emission. Main objectives: (i) presenting the biogeochemical process framework for microalgal cultivation for crops production; (ii) assessing the effect of feedstock nutrient composition on microalgal culture composition; (iii) assessing microalgal kinetics, and evaluating dynamic fertilisation potential; (iv) proposing process operation and control for photobioreactors for fertigation.

The impacts of dynamic, optimum, influent N-to-P ratio (NPR) on microbial community stability, stored nutrient quotas, and algal biokinetics were assessed. We used continuous laboratory-scale reactors to cultivate a mixed green microalgal culture (*Chlorella sp.* and *Scenedesmus sp.*) and a monoculture of *Chlorella sp.* with high capacities of luxury nutrient uptake from treated wastewater. Decreasing influent NPR can compromise mixed culture stability by the proliferation of diatoms (with reduced nutrient storage capacity) - detected in the influent treated wastewater (Fig. 1). Optimal culture composition was restored by resetting feedstock composition to optimal NPR range.

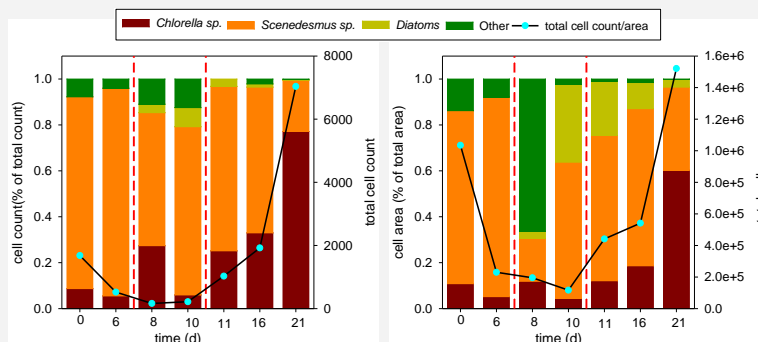


Fig. 1

Chlorella monoculture, challenged by varying influent NPRs kept stable throughout long-term cultivation. ASM-A simulations can accurately predict the photobioreactor performance for both mixed and monoculture using a single parameter subset, i.e. biokinetics was unaltered by varying feedstock composition.

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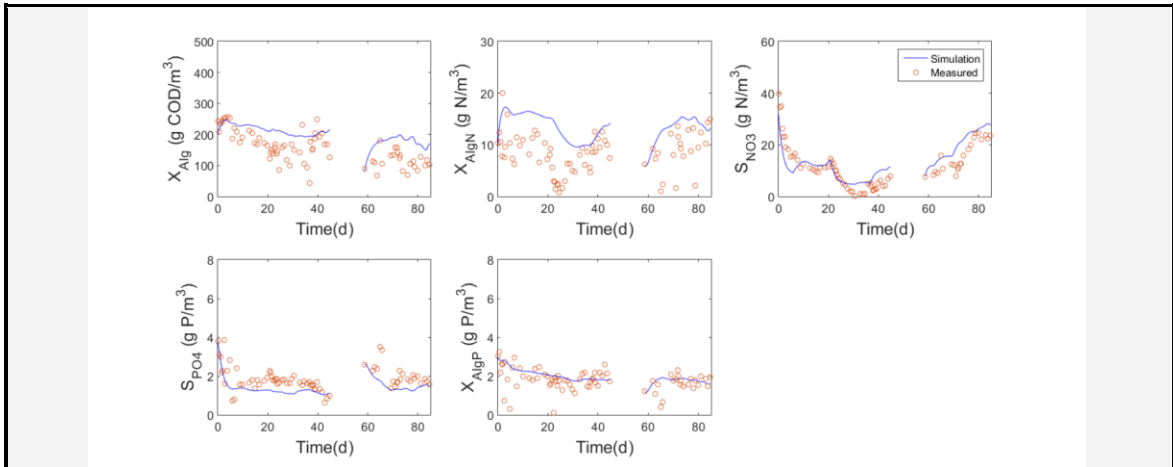


Fig. 2

Process control design reported earlier in literature (e.g. Valverde-Pérez et al., 2016) can be used to optimize the photobioreactor performance to produce microalgae with intracellular stored nutrient content to match crops' nutrient requirements.