Project Number & Title:

4A-109: Co-cultivation of microalgae and macroalgae for the efficient treatment of anaerobic digestion piggery effluent (ADPE)

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Aims and Objectives:

1. Develop a sequential method for the efficient treatment of anaerobic digestion piggery effluent (ADPE) using both microalgae and macroalgae.
2. Evaluate the growth, biomass productivity, photo-physiology and nutrient removal (C, N and P) of microalgal and macroalgal treatment when grown individually and when combined together in sequence.
3. Growth optimisation for maximising biomass productivity and nutrient removal rates.

Key Findings:

The potential and viability of co-culturing microalgae and macroalgae together in ADPE to increase the overall efficiency of ADPE treatment and improve the economics of algal biomass production was evaluated in this study. When grown by its own, the macroalgae *Cladophora* sp. was able to grow on anaerobic digestate piggery effluent (ADPE) with up to 150mg L^{-1} NH_4^+. On the other hand, microalgae consortium consisting of *Chlorella* sp. and *Scenedesmus* sp. was able to successfully grow and treat undiluted ADPE.

Nevertheless, when co-cultivated together, despite the different conditions evaluated, the growth and photo-physiology of *Cladophora* sp. was found to decline and resulted in culture loss due to the dominancy of the microalgal culture. This was mainly due to microalgal higher efficiency in competing for nutrients and available resources.

Subsequently, based on this outcome, an outdoor inclined reactor was customized to evaluate the potential use of attached macroalgal culture as a way of scrubbing available nutrients and microalgae biomass from ADPE post microalgal treatment. Although, the inclined system was very efficient in scrubbing and harvesting microalgae biomass, nevertheless, nutrient removal rates (i.e. ammonium and nitrate) of the co-cultivated system was much lower than the control which was operated using macroalgae only.

Application to Industry

In this study, despite multiple different approaches and cultivation systems, both algal groups were unable to co-exist for efficient growth in ADPE due to direct competition for available resources and the negative interaction of both algal groups. Nevertheless, through this study, it has been demonstrated that macroalgae could be potentially used for harvesting microalgae grown in ADPE. Thus, there is great potential in exploiting microalgae for the bioremediation of undiluted ADPE and biomass production while targeting the use of macroalgae as a cost-effective harvesting agent/option for microalgae grown in ADPE.