SHEDDING LIGHT ON THE ULVA HOLOBIONT: ALGA-BACTERIA INTERACTIONS WITH IMPLICATIONS FOR INTEGRATED MULTITROFIC AQUACULTURE

Gonzalo Del Olmo[1*], Patricia Ruiz[1], Zujaila Qui[1], Ryan Marchington[1] , Eduardo Casais[2], Javier Cremades[2], Saray Ramírez[3], Thi Kim My Nguyen[3], Patricia Jiménez[3], Ingrid Masaló[3], Thomas Wichard[4], Torsten Thomas[5], Suhelen Egan[5], José Pintado[1]

[1] Marine Ecology and Resources Group. Institute of Marine Research (IIM-CSIC), Galicia, Spain | [2] Coastal Biology Research Group (BioCost). Centro de Investigaciones Científicas Avanzadas (CICA), Universidad de A Coruña, Galicia, Spain | [3] Departament d'Enginyeria Agroalimentària i Biotecnologia. Universitat Politècnica de Catalunya, Catalunya, Spain | [4] Jena School for Microbial Communication, Institute for Inorganic and Analytical Chemistry, Friedrich Schiller University Jena, Jena, Germany | [5] Centre for Marine Science and Innovation. School of Biological, Earth and Environmental Sciences. The University of New South Wales, Sydney, Australia | *Presenting authors email address: gdelolmo@iim.csic.es

BACKGROUND

Macroalgae, like *Ulva* genus, provides an important niche for epiphytic biofilm-forming bacteria, including those of the genus *Phaeobacter* with the ability to antagonize fish pathogens such as *Vibrio anguillarum*, through the production of tropodithietic acid (TDA) [1–3]. *P. gallaeciensis* has previously demonstrated its effectiveness as a probiotic in aquaculture by reducing mortality in fish larvae experimentally infected with this pathogen as well as its colonization of *U. ohnoi* surface [1]. This colonization can be used as a pathogen control strategy in multitrophic fish-algae cultures in recirculating water systems (IMTA-RAS), improving the health of the fish (**Fig. 1**). However, the optimal conditions for the culture of *U. ohnoi* could have a determining influence both on the maintenance of these biofilms and on the production of TDA, especially the intensity of light.

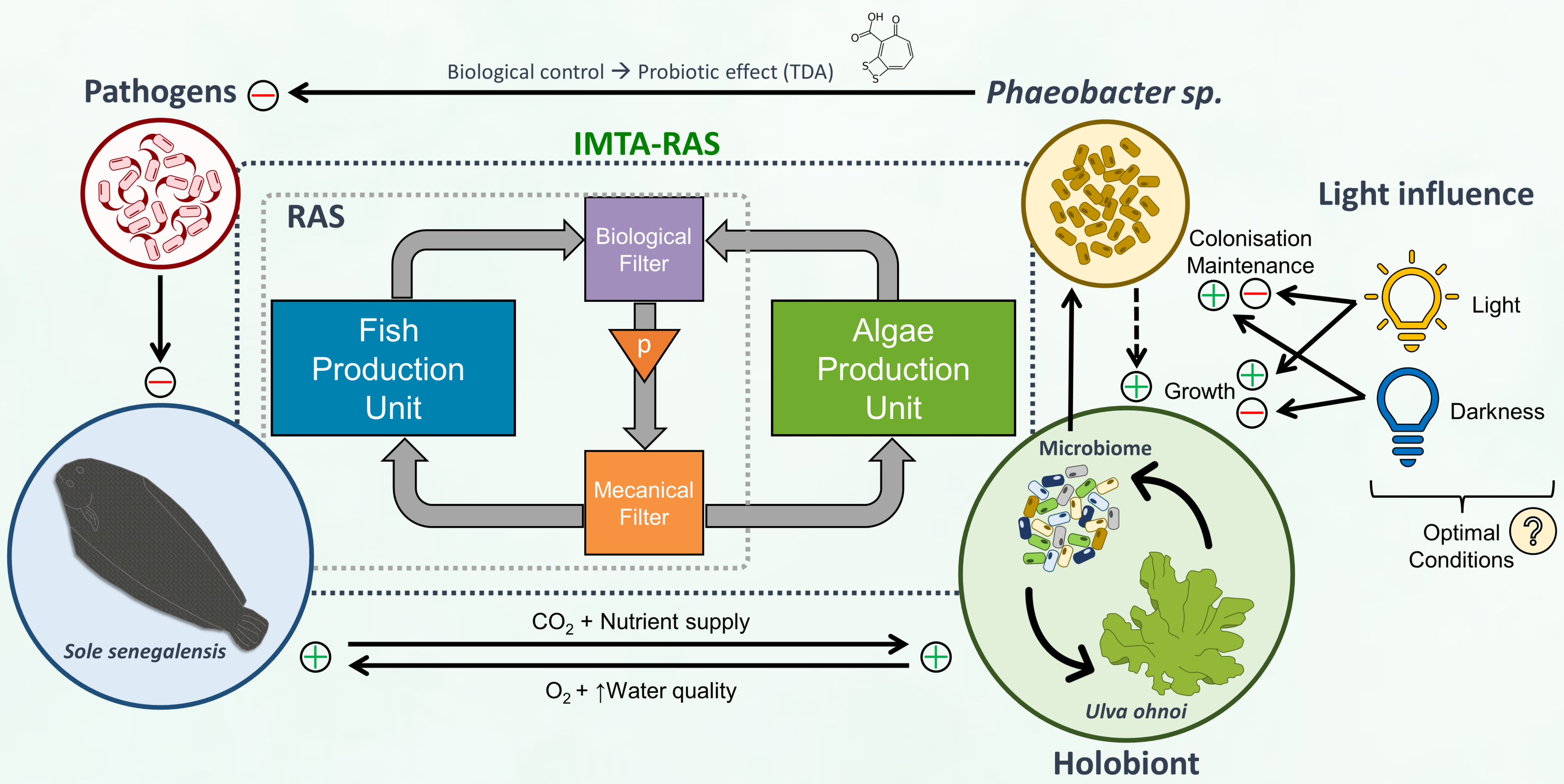

Fig. 1: Positive (+) and negative (-) interactions in an IMTA-RAS composed by *Sole*, *Ulva* and *Phaeobacter*.

OBJECTIVES

Objective 1: Understanding the interaction Light-Ulva-Bacteria

Experiments in Multi-well plates:

- Colonization and maintenance of *Phaeobacter* over *Ulva* with different light intensity and heterogeneity.
- Microbial community analysis (CFU, qPCR, 16S gene sequencing) and chemical profiling (HPLC-MS, GS-MS).

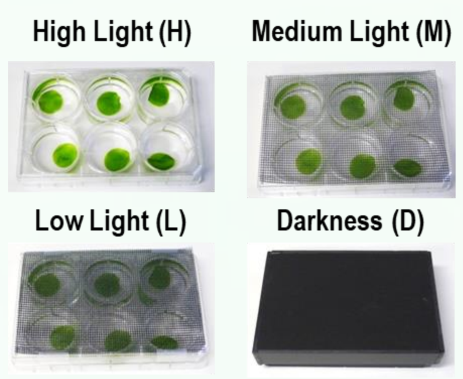

Fig. 2: Multi-well plates with shading meshes

Objective 2: Setting up an IMTA-RAS

Development of a culture protocol for the application of *Ulva* colonized by *Phaeobacter* in a water-recirculating systems and demonstration of its effectiveness for pathogen (*V. anguillarum*) control in the water.

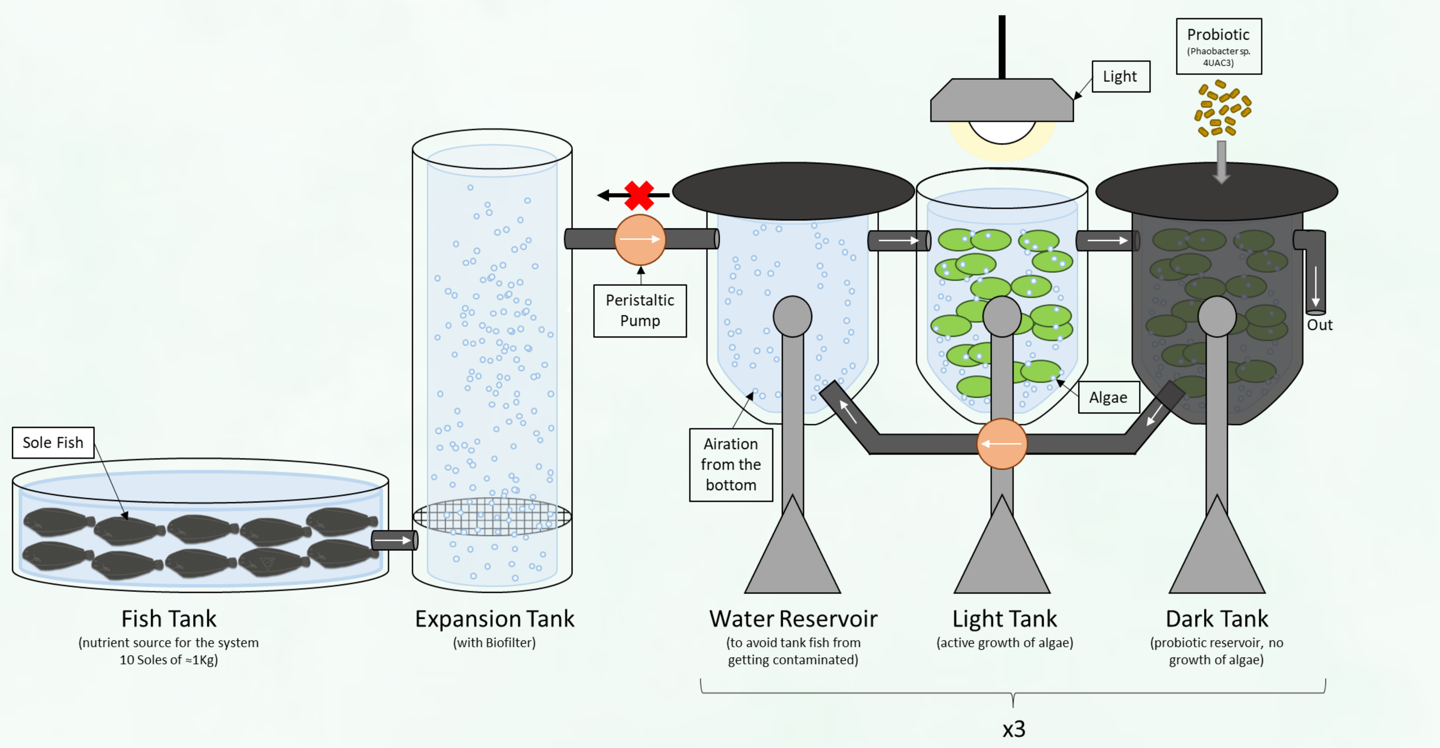

Fig. 3: IMTA-RAS Sole-Ulva-Phaeobacter design.

RESULTS

Influence of light

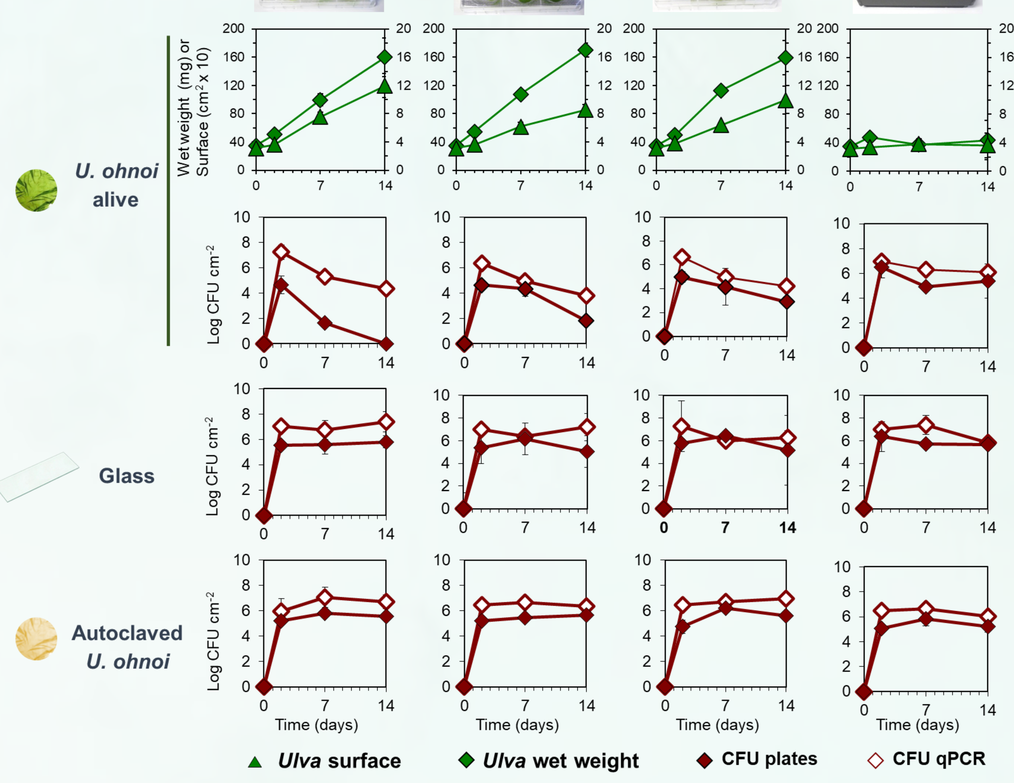

Fig. 4: Algae growth and *Phaeobacter* detection over different surfaces under different light intensities.

Light intensity:

- Does not affect *Phaeobacter* growth directly.
- Affects negatively the maintenance of *Phaeobacter* in *U. ohnoi.*

Conditions for culturing

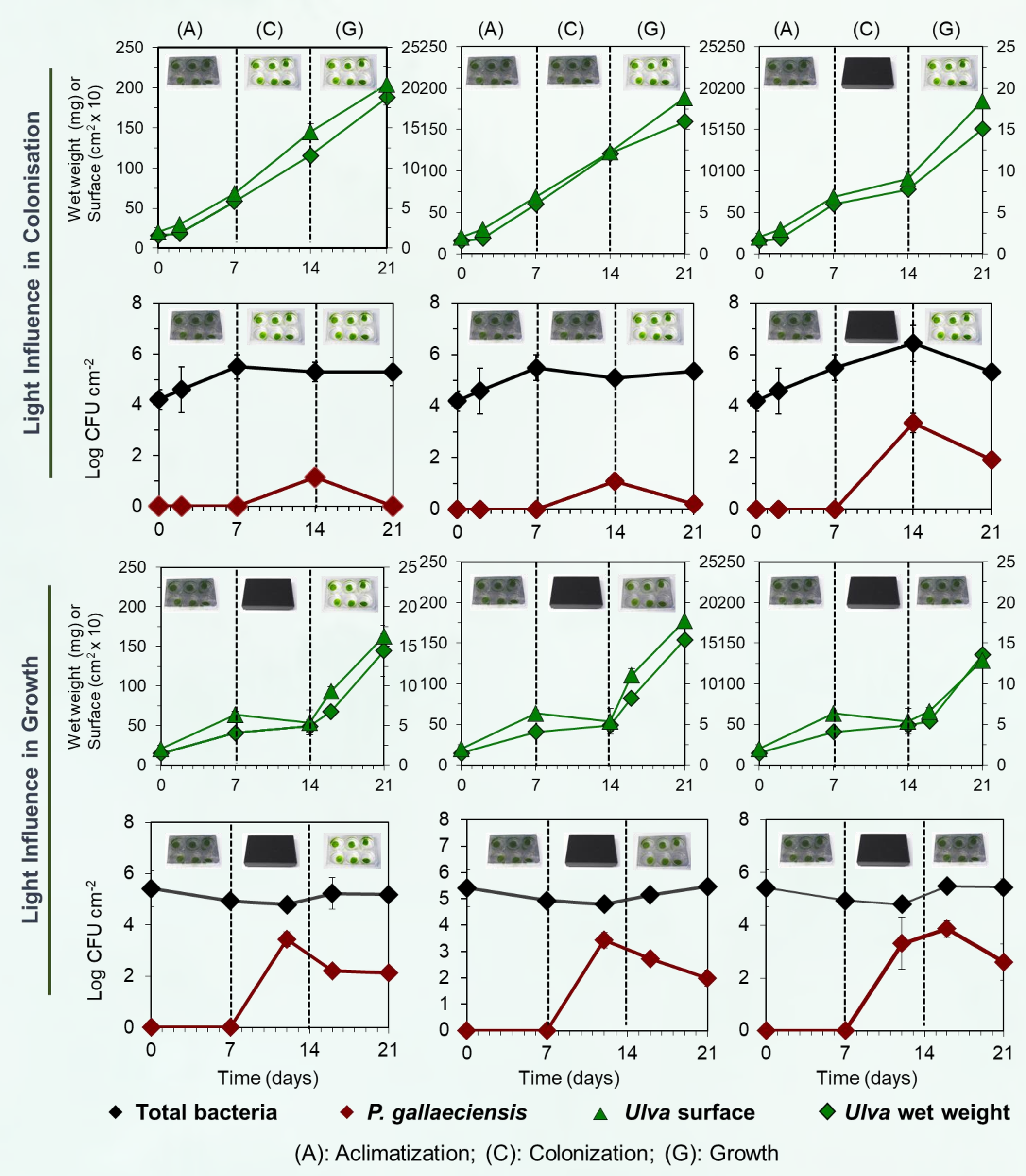

Fig. 5: Algae growth, total bacteria and *Phaeobacter* counts under different light intensities at different culturing periods.

Different light intensities:

✓ *Ulva* growth + *Phaeobacter* colonisation

✗ *Phaeobacter* maintenance in light.

First results in the small INTA-RAS

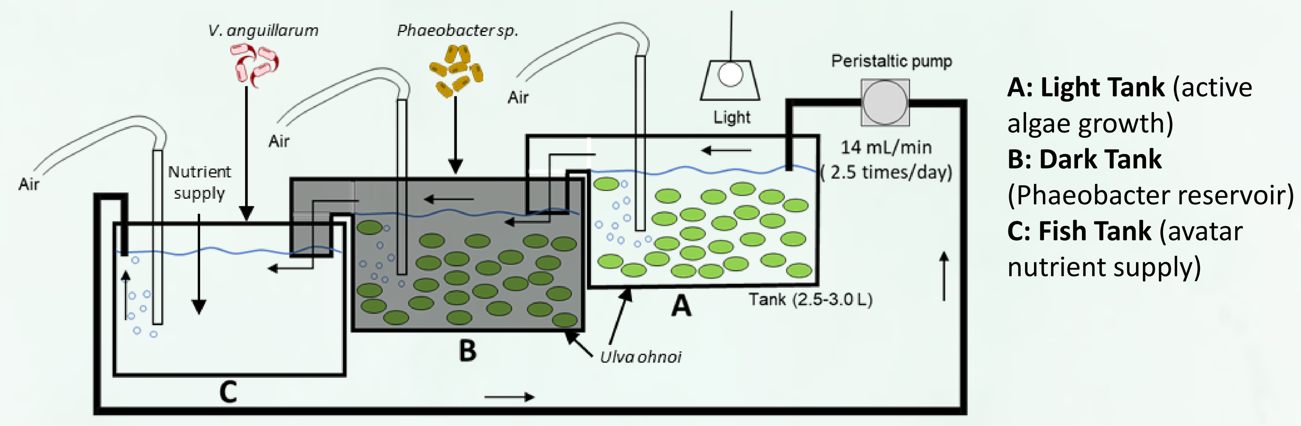

Fig. 6: Small scale IMTA-RAS Sole-Ulva-Phaeobacter design.

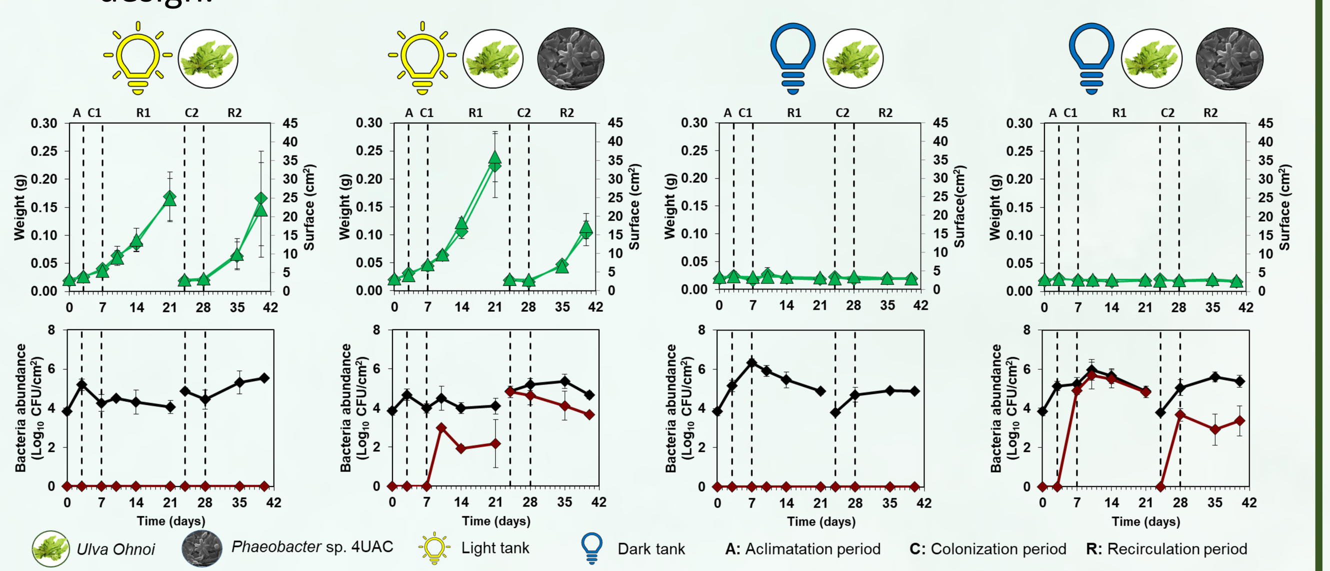

Fig. 7: Algae growth, total bacteria and *Phaeobacter* counts in small IMTA-RAS.

- Despite successful colonisation of *Phaeobacter* in the system, decreases in a successive harvest.
- Algae kept in darkness is able to regrow when exposed to light again.

CONCLUSIONS

Combining dark and light cultures in different connected tanks may be the solution to maintain a balance between optimal algae growth and *Phaeobacter* maintenance. Future analyses (qPCR, sequencing and chemical profiling) will give more information to optimize the system design.

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