Culture Density and Harvest Productivity of the Alga *Oedogonium*

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Abstract

As the planet is faced with depletion of its natural resources, alternative and sustainable energy sources are becoming increasingly sought after. Research on the growth of algae has revealed their potential as a fuel source for bioenergy applications, their use as an animal feed, and their ability to remove nutrients from wastewater treatment plants. Two 1000 L raceway ponds were inoculated with the filamentous algae, *Oedogonium sp.*, to determine their growth patterns in an outdoor environment with temperature and pH fluctuations. Discovering the optimal conditions for the growth of *Oedogonium sp.* could lead to their ease of cultivation for sustainable purposes in the future. An additional two 1000 L raceway ponds were inoculated with diverse microalgal species to compare their growth and productivity to the filamentous *Oedogonium sp.* The pond cultures were harvested and sampled to determine culture density (mgVSS/L) and biomass productivity (gVSS/m^2-day) over weekly periods. During colder winter months, *Oedogonium sp.* were found to change their morphotype, growth slowed, and the cultures transitioned to a maintenance mode. With warmer temperatures, harvest productivity increased slightly as the cultures entered a growth phase. The algae cells became greener, and their morphology reverted to long, thin filaments.

Introduction

In the future, the use of algae for sustainable purposes could increase because of the multiple environmental benefits they possess. During photosynthesis, algae uptake carbon dioxide from the atmosphere and convert it into their biomass. Algae can be used as a feedstock for biogas production from anaerobic digestion or as a source of animal feed for livestock. Arable land is not required for algal growth so there is no direct competition for the land used for agricultural purposes. Algae remove nutrients and toxins from wastewater streams, helping to keep our water sources free of hazardous materials. Algae can also be converted into a fertilizer for gardening, reducing the dependence on synthetic fertilizers [1].

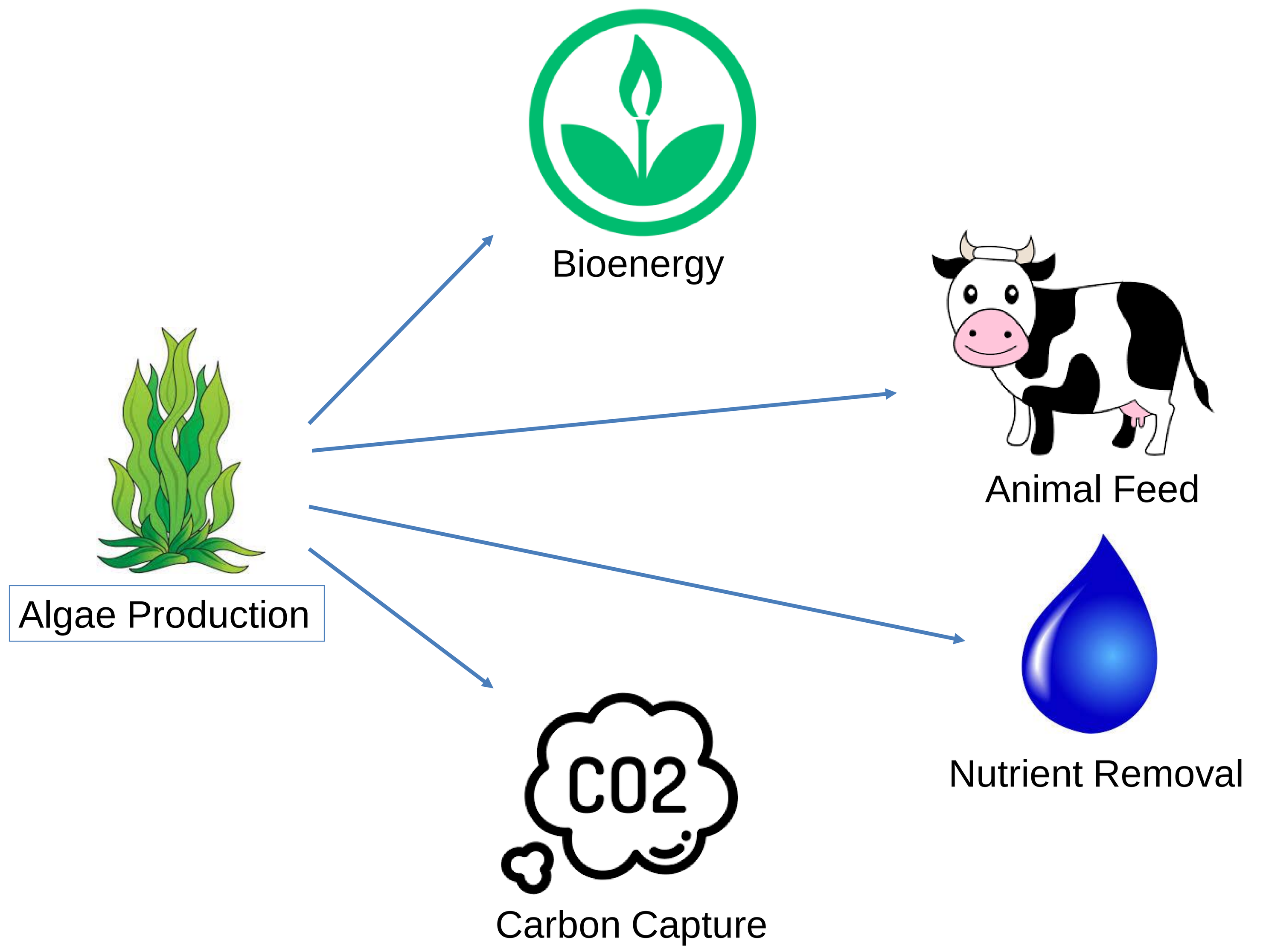

Figure 1. Benefits of Algae Production

Objective

To determine the optimal growth conditions for *Oedogonium sp.* to use in future biomass applications.

Methods

- Cultures of *Oedogonium* and microalgae were maintained in 1000 L open raceway ponds.
- Each week, pH and temperature readings were monitored with a HACH meter and recorded.
- Each pond was sampled with a beaker and photos were taken.
- Ponds were raised to full volume (25cm) if evaporation had occurred and pre-harvest samples were obtained.
- Ponds were harvested to half volume (12.5cm) and brought back to full volume with tote water. Post-harvest samples were taken.
- Samples were filtered in the lab, dried in an oven at 105 °C for 1 hour, and weighed to determine culture density (TSS) and harvest productivity.
- Samples were placed in an oven at 550 °C for 2 hours to determine volatile suspended solids (VSS).
- Each culture was analyzed under a microscope to identify physical changes in algae.
- Filamentous ponds were fertilized with 10.4g of fertilizer and microalgal ponds were fertilized with 41.6g.

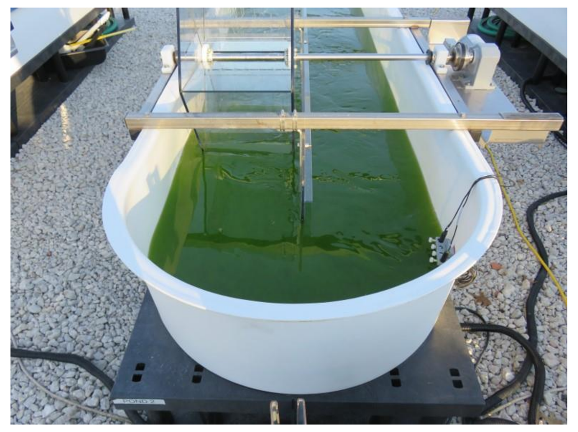

Figure 2. Oedogonium Pond

Figure 3. Filtered Samples

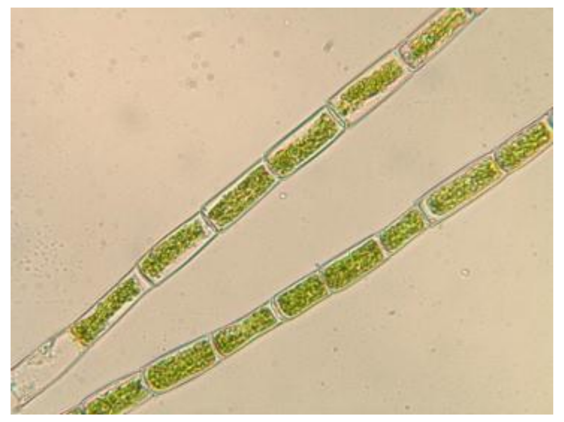

Figure 4. Photomicrograph of Oedogonium

Results

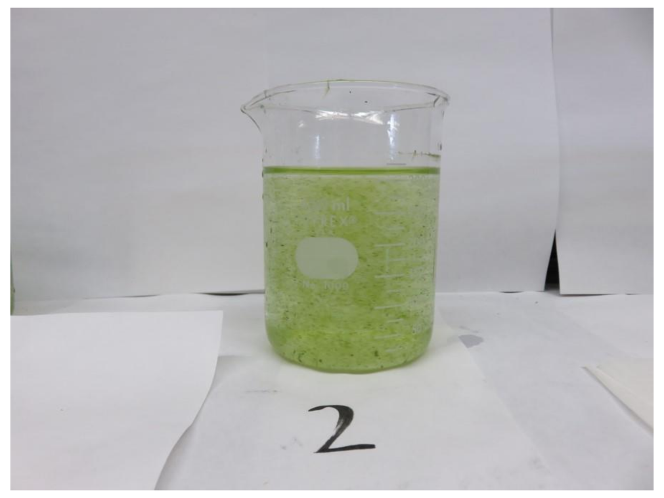

Figure 5. Oedogonium pond sample (December 2017)

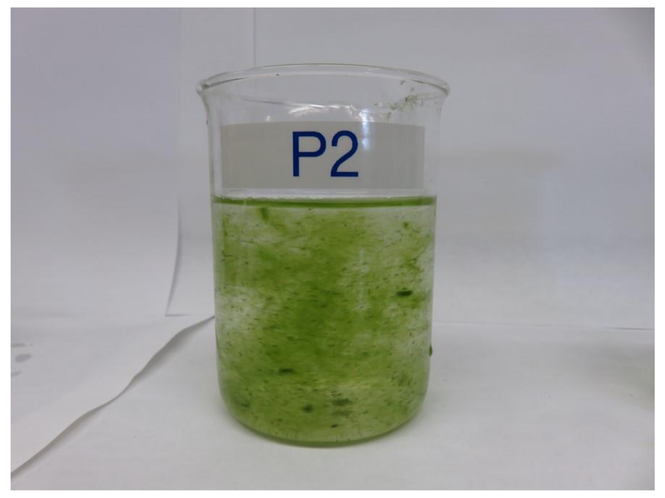

Figure 6. Oedogonium pond sample (February 2018)

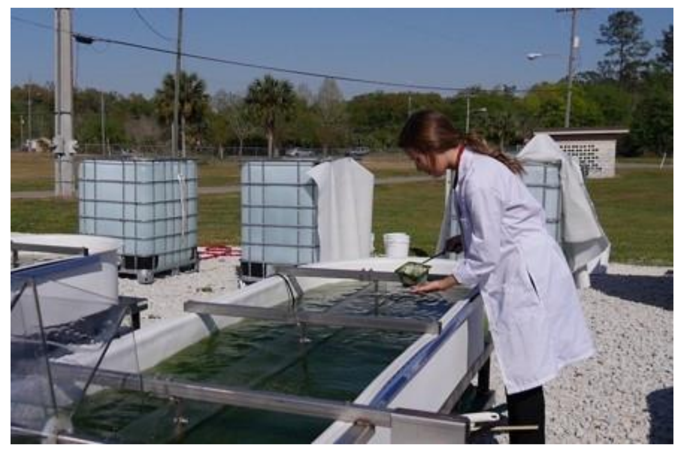

Figure 7. Algae Sampling

Figure 8. Filaments of Oedogonium

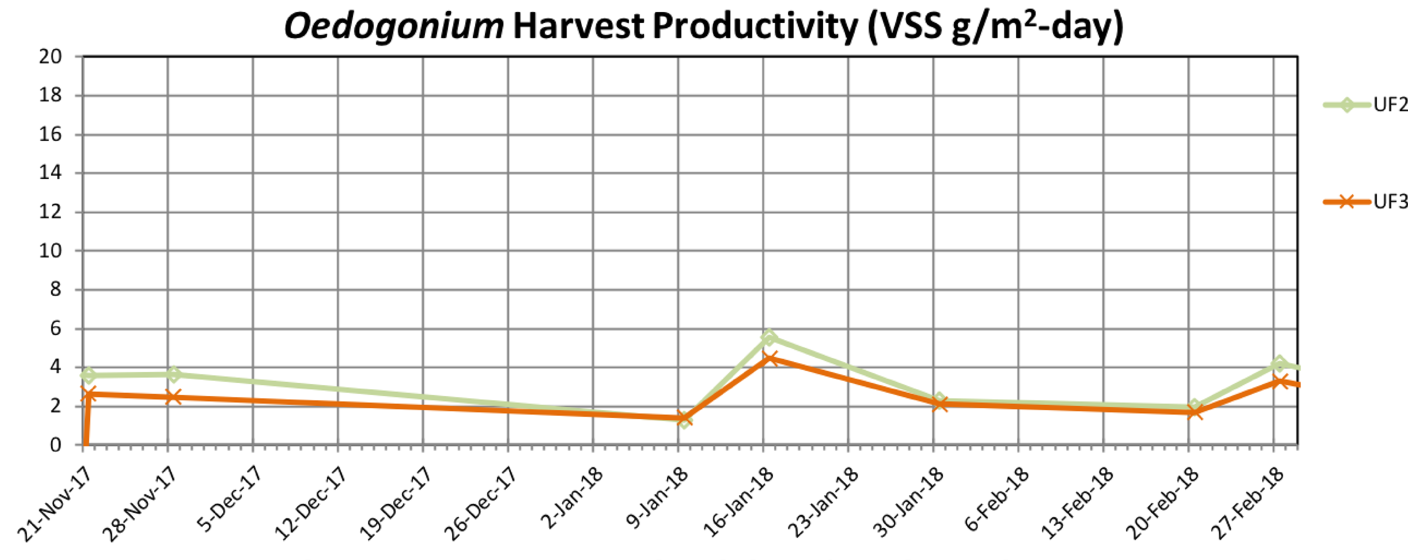

Figure 9. Harvest Productivity of Oedogonium

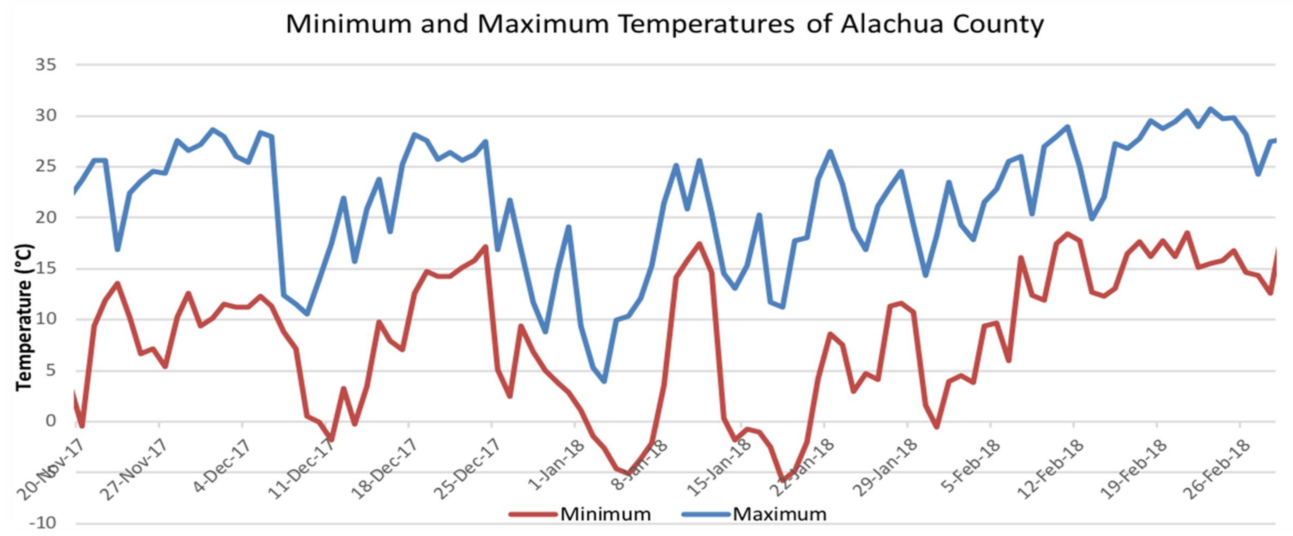

Figure 10. Alachua County Maximum/Minimum Daily Temperature [2].

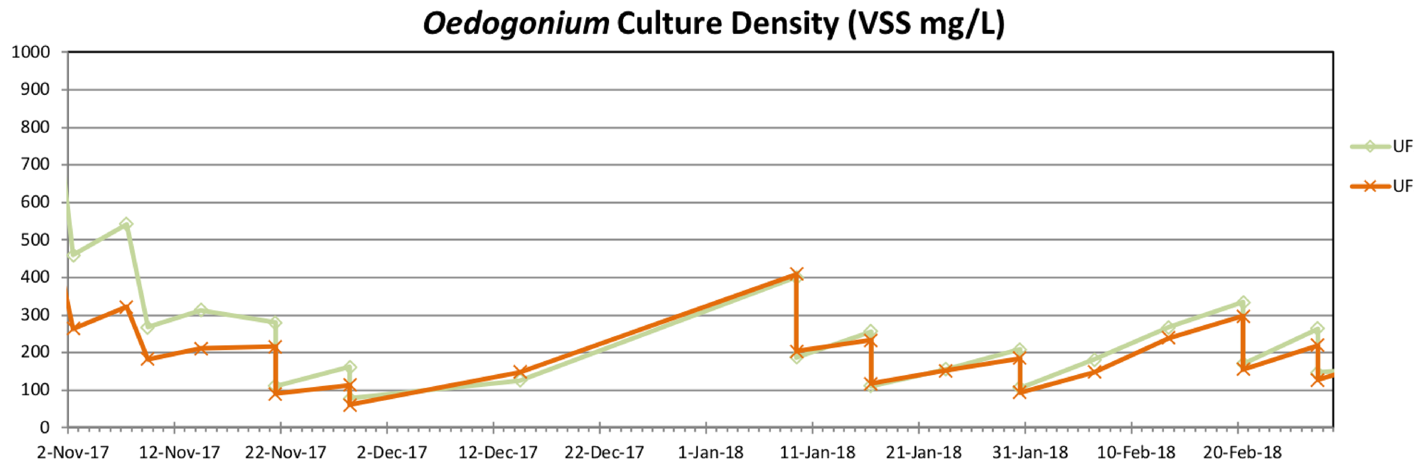

Figure 11. Culture Density of Oedogonium

- As the average temperatures increased, there was a slight rise in harvest productivity of the *Oedogonium*.
- Culture density was able to be maintained around 200-300 mg VSS/L.

Conclusions

- The harvest productivity of *Oedogonium* increased slightly in warmer months compared to colder months.
- In warmer months, both of the pond's morphotypes transitioned towards long, thin filaments.

Future Work

- Carbon dioxide will be added to the *Oedogonium* ponds to determine CO_2 effects on harvest productivity.

References

1. Lawton, R. J., Cole, A. J., Roberts, D. A., Paul, N. A., & Nys, R. D. (2017). The industrial ecology of freshwater macroalgae for biomass applications. *Algal Research, 24*, 486-491. doi:10.1016/j.algal.2016.08.019
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Acknowledgements

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