Optimizing algal species diversity in brackish agricultural drainage water for biofuel feedstock production

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Motivation

Outdoor high-rate algal pond facilities have significant long-term potential for cost-effective biofuel feedstock production if problems associated with culture contamination can be overcome. One approach is to cultivate two or more symbiotic strains of high yielding algae to increase system robustness and potentially protect against contamination and algal pond crash. Saline agricultural drainage water is a promising growth medium for future algal biomass facilities.

Technological Challenges

Many advances toward the optimization of algae lipid production have been achieved through studying environmental stressors such as pH, salinity, light, temperature and available nutrients. Engineered algal pond raceways are the most prone to contamination by lower lipid potential algae strains. There are over 300,000 strains of algae to potentially investigate to find suitable candidates that might provide crop protection.

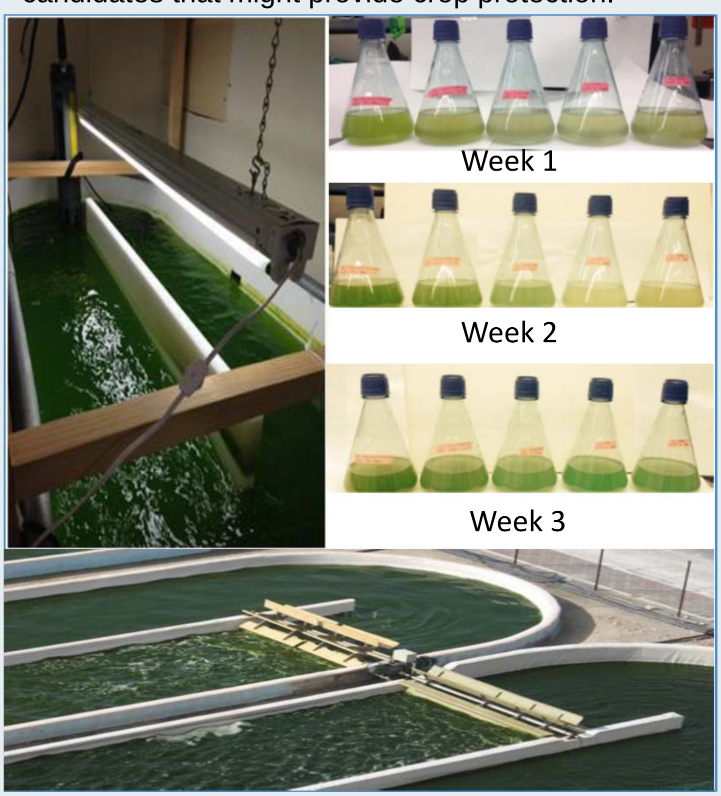

Figure 1. *Algal biomass growth experiments using symbiotic algal strains. Ultimate deployment in full scale high rate ponds*

Experiment	Sample	pH Changes		Biomass Accumulation		Lipid Production	
		Abrupt change observed (days post-inoculation)	Max pH	$\mu(d^{-1})$	Q_p(mm $mL^{-1}d^{-1}$)	Lipids ($\mu g/mL$)*	% change from control
Salinity	Control	None	9.68	0.111	0.007	463	--
	0.15 M NaCl	12	9.63	0.115	0.005	459	-1
	0.20 M NaCl	13	9.65	0.113	0.007	614	32
	0.25 M NaCl	15	9.43	0.109	0.006	687	48
	0.30 M NaCl	14	9.65	0.099	0.005	538	16
Biodiversity	S. quadricauda alone	None	9.03	0.370	0.014	8	--
	S. quadricauda & C. vulgaris	None	9.08	0.762	0.024	69	--

Figure 2. *Performance testing symbiotic strains of algae representative of agricultural drainage water in the San Joaquin Valley of California.*

Research

This study examined pH, biomass accumulation and lipid productivity of *Scenedesmus quadricauda* grown at increased salinity concentrations (from 0 to 0.30 M NaCl) and under biodiverse conditions (cultivated with and without *Chlorella vulgaris*).

Species diversification showed evidence of faster biomass growth rates, superior lipid production and increased ability to adjust to a CO2-limited environment

References

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[2] Lundquist, T.J., I.C. Woertz, N.W.T. Quinn, and J.R. Benemann. 2010. A Realistic Technology and Engineering Assessment of Algae Biofuel Production. Energy Biosciences Institute, University of California, Berkeley, California.

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