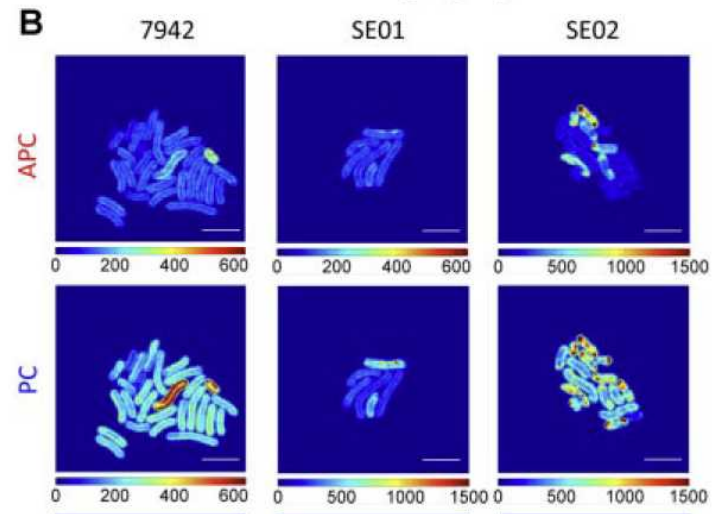
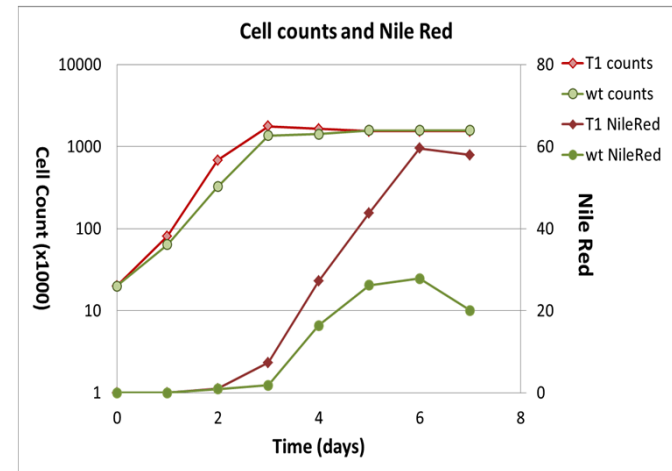


Expertise in Microalgal Engineering at Sandia

- Metabolic engineering
 - Fatty acid metabolism^{1,2,3}
 - Lipid accumulation⁴
 - Carbon flux^{2,5}
- Traditional strain improvement
 - Adaptive evolution
 - High throughput screens for lipid accumulation
 - SNP tracking
- Molecular tool development
 - Transformation techniques⁶
 - Library generation
 - Knockouts and transgene expression
 - CRISPR-Cas9 tools
- Characterization of modified strains
 - RNA-seq⁷
 - Hyperspectral imaging⁸



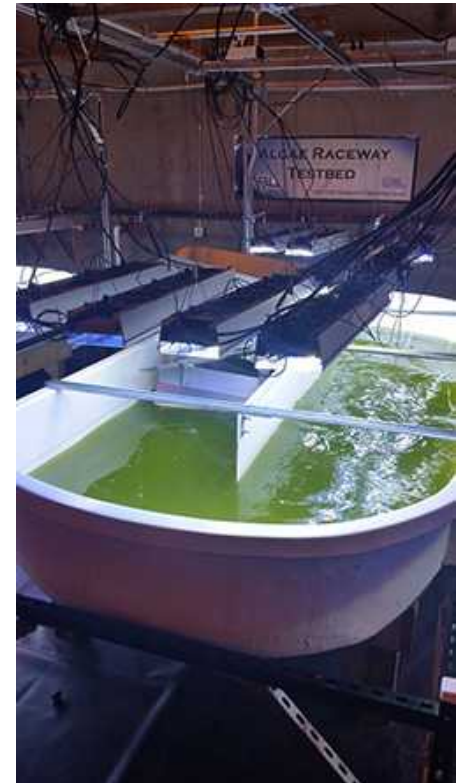
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Barriers to Algal Biofuels

- Better understanding of algal metabolism to improve productivity
 - Understanding algal carbon metabolism (species specific) and how it relates to light accumulation
 - Identification of futile cycles and strategies to eliminate
- Identify a path for elimination of productivity losses
 - Overexpression and knockout/down of targets
 - Adaptive evolution
- Algal toolbox development is key to overcoming these barriers.
- Poor translation of strain properties in the field
 - SNL Testbed for indoor GMO testing with controlled light and temperature conditions that mimic outdoor
 - Currently 3 X 1000L, up to full sunlight, full temperature regulation, bio-contained: Realistic environmental conditions
 - Institutional approval to grow GMO algae

Algae Raceway Testbed - SNL



Future Outlook

- Novel efficient transformation methods for algae
- Development of mating protocols
- Selection marker recycling for multiple targeted modifications
- Development of better expression systems, inducible and tunable promoters
- Better understanding of genetic stability, regulatory RNAs, introns, and other factors that influence gene expression in algae
- Metabolic modeling and multi-omic approaches

Nanoparticle-mediated transformation⁹

