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Improving photosynthetic efficiency and biomass yield in plants and algae

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One of the more environmentally sustainable ways to produce high energy density (oils) liquid transportation fuels is photosynthetic reduction of carbon dioxide into carbohydrates and hydrocarbons and their subsequent conversion into fuels. Photosynthetic carbon capture from the atmosphere combined with bioenergy production (combustion) and subsequent carbon capture and sequestration (BECCS) has also been proposed by the recent Intergovernmental Panel on Climate Change Report as the most effective and economical way to remediate atmospheric greenhouse gasses. To maximize carbon capture efficiency and energy-return-on-investment, we must develop cropping systems that have the greatest aerial biomass yields with the lowest inputs. All photosynthetic organisms, however, convert only a fraction (< 5%) of the solar energy they capture into harvestable chemical energy (reduced carbon or biomass). To increase aerial carbon capture rates and biomass productivity it will be necessary to increase photosynthetic efficiency in plants and algae. We will discuss metabolic engineering strategies to improve photosynthetic efficiency and biomass productivity in algal and plant systems, often borrowing metabolic strategies from one photosynthetic system to transfer into another. These strategies include optimization of photosynthetic light-harvesting antenna size and the introduction of algal inorganic carbon concentrating systems into plants to increase carbon fixation efficiency and biomass yields. To date, these strategies have resulted into up to two-fold increases in biomass productivity in algae and crop yields in outdoor field trials.

Biography

Richard Sayre is a Senior Research Scientist at Los Alamos National Laboratory (LANL) and the New Mexico Consortium (NMC). His research interests include; enhancing photosynthetic efficiency, algal and plant biotechnology, and nutritional biofortification of crop plants. He has directed several large research consortia including: 1) Phase I of the BioCassava Plus Program funded by the Bill and Melinda Gates Foundation. 2) Center for Advanced Biofuel Systems, a Dept. of Energy (DOE) Energy Frontier Research Center focusing on generating advanced biofuels from algae and plants. 3) Scientific Director of the National Alliance for Advanced Biofuels, and Bioproducts, the largest DOE-sponsored algal biofuels consortium funded to date; and 4) Director of the PACE (Producing Algae for Energy and Coproducts) targeted algal biomass and bioproducts program.

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