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Mechanisms of Action of Activators of Algal Biomass Production and Lipid Accumulation Grown at Pilot Scale on Anaerobic Digestate of Agricultural Waste Products

Abstract.

Demands for petroleum-based fossil fuels continue to rise, while supplies are predicted to be exhausted within this century. Currently, fossil fuels provide about 34% of the global energy demands. The U.S. Energy Information Administration estimates about 87 million barrels of petroleum are now consumed per day (April 2014) and world consumption will grow by about 60% by 2040. This level is clearly unsustainable and other sources of liquid hydrocarbon fuels are required. One potential source of hydrocarbon-based fuels is lipids derived from microalgae. However, production of oils in algae is limited by problems including the need to employ severe growth stresses to induce oil production and storage. In research supported by NCESR cycle 7 funding, we performed a high throughput screen of about 44,000 small synthetic compounds for those that induced lipid production without compromising growth or photosynthetic capacity. We confirmed that 360 compounds induced lipid accumulation and did not reduce biomass accumulation. Additionally, we found 39 compounds that increased biomass production. The selected compounds have been sorted into structural families and a subset of each class has been selected for in-depth analyses. In the present proposal, we will evaluate growth and physiological parameters that are altered by treatment of algal cells with our lead hits that induce biomass yield alone or in combination with a set of lead hits that increase lipid accumulation. Additionally, we will explore the effectiveness of the compounds at scale in bioreactors and artificial ponds at the Agricultural Research and Development Center, a pilot-scale biorefinery that will employ using digestate and runoff water from open lots.