News from the WCROC

June 10, 2015

Renewable Energy from Solar Microorganisms

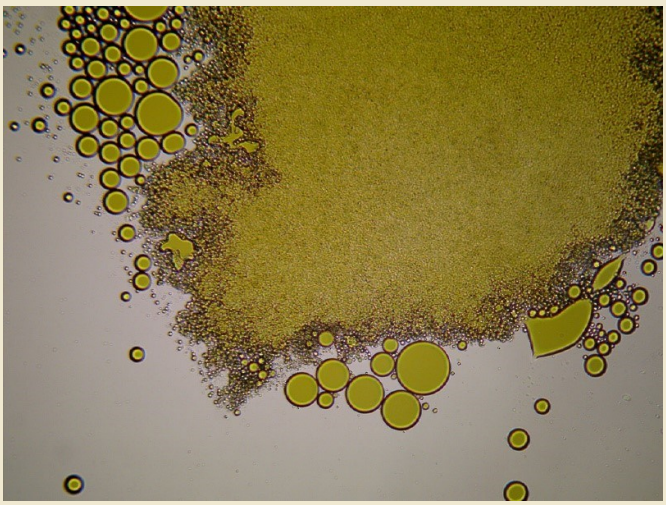
Rob Gardner, Assistant Professor

Millions of years ago the earth looked quite different, super continents had not split along tectonic lines leaving fewer but large oceans covering most of the planet. The earth had just gone through an oxygen revolution where the atmosphere changed from mainly methane and carbon dioxide to one rich in oxygen. That revolution was due to photosynthetic life appearing two billion years ago. During this time, the sun was becoming more luminous and the earth should have gotten warmer. However, the decrease in methane and carbon dioxide (both greenhouse gases) cooled the planet into an ice age. Life thrived in the ocean.

Prehistoric zooplankton and algae settled to the sea (or lake) bottom in large quantities and mixed with mud. Over geological time, this mixture was buried under multiple heavy layers of sediment. The heat and pressure of the earth chemically converted the organic matter into petroleum. Coal on the other hand, was formed later using land-based forests. So, modern day crude oil that we drill from the earth is essentially fossilized zooplankton and algae, and recently there has been an increased interest in again turning to algae as a renewable fuel source.

Algae are phototrophic microorganisms that convert sunlight, as a renewable energy source, into biomass that can be further processed into biofuels. We can take a lesson from earth's history and use heat and pressure to turn it into green crude. Using modern-age fermentation technology, it can be converted into ethanol. Or, we can take fatty algae, many strains accumulate a lot of fat, and convert that fat to biodiesel. There are a few algal companies out there trying to produce enough algae to offset some of the US transportation fuel demand on petroleum, and they are focusing on heat and pressure to make green crude. This makes sense if you have a large production operation, think thousands of acres of algal ponds. However, if you want to cultivate algae for biodiesel use on a rural conventional farming operation, much smaller scale, producing fatty algae makes much more sense. The conversion process is much less energy intensive and the resulting biodiesel can be used with minimal processing.

The Gardner Research Group at the West Central Research and Outreach Center, and housed in the USDA-ARS Soil Conservative Laboratory, is investigating optimal ways of cultivating algae for future agricultural application. One of our primary foci, is how to produce fatty algae at useful scale here in rural Minnesota. This includes investigation on cold weather cultivation, crop protection, and research on shunting carbon, which was fixed from carbon dioxide, into fat storage within the algal cells. Hopefully someday in the future, this technology can be an additional farming practice that synergistically enhances rural farms.



Fat droplets forming around algal biomass

West Central Research & Outreach Center
46352 State Hwy 329 Morris, MN 56267
Phone: (320) 589-1711
Web: wcroc.cfans.umn.edu