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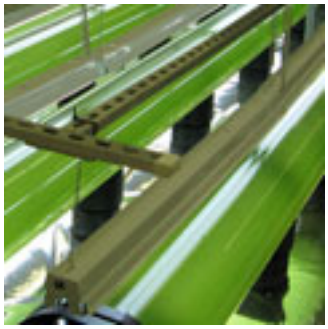
University of Dayton, Ohio (url: http://www.udayton.edu/index.php)



Amazing Algae

10.01.2009 | Research, Science Algae — the tiny scourge of backyard ponds and lakes — is destined to be a mighty hero in efforts to reduce carbon emissions headed for the atmosphere and wean America from its dependence on foreign oil, according to scientists at the University of Dayton Research Institute working on a two-year, $980,000 Air Force pollution-reduction contract from the Air Force Research Laboratory at Wright-Patterson Air Force Base.

While lead researchers are on target to identify the most efficient methods to sequester carbon dioxide by feeding it to algae, other researchers in the program are working to identify the best varieties of algae for the job, the optimal growing conditions and the most efficient methods to extract oil from the marine organisms. Algae oil accounts for as much as 70 percent of the organism's body weight in some strains and can be used as stock for food and biofuel.

"It's a beautifully symbiotic system," said Sukh Sidhu, who leads the Sustainable Environmental Technologies group in UDRI's energy and environmental engineering division. "Algae feed on carbon dioxide and convert it to a highly desirable lipid. So we can capture carbon dioxide from stacks of coal boilers and other combustion processes before it's released into the atmosphere and run it through algae growing systems. In turn we can extract the oil for a variety of uses. We consider this a far better alternative for dealing with CO2 emissions than geosequestration, where carbon dioxide is pumped deep into the earth."

Because algae also needs nitrogen and phosphorus to survive, it can remove those elements from wastewater before it's discharged into rivers and lakes, reducing the need for expensive treatments typically used to clean wastewater. It can also be used to capture fertilizers in agricultural runoff and then be used as a fertilizer itself.

As an oil crop, the slimy stuff is hundreds of times more viable than corn, soybeans and canola, Sidhu said. Compared with corn yields of 20 gallons of oil per acre and soybean yields of 50 gallons per acre, the "fattest" varieties of algae — those with the highest lipid contents — yield more than 14,000 gallons of oil per acre, 700 times the yield of corn.

"You would need to take every single acre of food and nonfood cropland that exists in the United States today, multiply it by eight and dedicate it solely to corn to produce enough corn-based ethanol to meet even half the nation's transport fuel needs. But only 1 percent of the equivalent of existing acreage would be needed to produce the same amount of biodiesel, jet fuel and ethanol from algae," Sidhu said, noting that no actual cropland need be disturbed to farm algae, which does not require arable land to grow.

"Land that is not desirable for food crops can still be perfect for algae, which does not compete with food but can supplement food," he said. Composed of carbohydrate, protein and lipids, algae can be a good source of nutrients such as omega-3 fatty acids and beta carotene.

Algae holds great potential to address pressing domestic and global issues, Sidhu said, but standards are needed.

"It is a readily available, prolific and inexpensive renewable resource that can clean our air and wastewater, address our fuel needs and serve as a food source," he said. "The challenge is that while there are some efforts in industry now to use algae for biofuel and pollution control, no one really knows yet how best to use it. Different programs are using different processes. There are no best methods, no industry standards. One of our objectives is to define those standards."

In UDRI's new algae labs, researchers are testing a wide variety of strains to learn which will yield the most oil; which will be best for air, water and agricultural pollution control; and what types of water and growing conditions will foster the greatest production of algae — already one of the fastest-growing organisms on the planet. Test strains have come from a number of states, including Michigan, Texas, the Carolinas and "right here in our own back yard," Sidhu said, adding that researchers want to focus on using "naturally optimized" native strains that thrive in Ohio weather and have evolved to best survive predators and contamination by toxins or similar other organisms.

Researchers also will determine the most efficient ways to milk the algae for its oil, one of which involves adding a

biocompatible solvent to algae water which breaks down the organism's cell wall, allowing oil to ooze out and float to the top but which does not kill the algae.

"In fact, milked algae grows faster," Sidhu said.

Tom Naguy, senior program manager in the Air Force Research Laboratory's Materials and Manufacturing Directorate, said algae will be used to reduce the carbon footprint of the AFRL's new Assured Aerospace Fuels Research Facility at Wright-Patterson Air Force Base. Researchers from UDRI and AFRL are working to determine best practices for creating jet fuel out of coal and biomass. Algae can be used in that program as both a fuel feedstock and to sequester carbon dioxide in the process.