The Background

- US consumes 60 billion gallons of petroleum diesel and 120 billion gallons of gasoline per annum
- US needs about 140.8 billion gallons of biodiesel per annum to replace all the transportation fuels used
- Total area of algae ponds required to produce biodiesel to replace all petroleum transportation fuels: 9.5 million acres (3.5 million ha)
- Equivalent acreage required if using soybean to produce biodiesel: 2,970 million acres (1,094.2 million ha)
- Crude oil import bill of US per annum: $100-150 billion

The Need

- Investigation on novel and alternative feedstocks for biofuel production is dire need.
- Microalgae is regarded as an emerging renewable energy source that offers the promise of enhanced biomass yield, carbon sequestration and concomitant waste-stream bioremediation

The Research Objectives

- Propose a combined biotechnological scheme for processing/treatment of agricultural and industrial wastewater for the production of microalgae biomass
- Examine the algal growth and lipid content under various levels of carbon dioxide concentration, nutrients, temperature, light and salinity to determine the optimal growth conditions for enhanced growth
- Develop cost-effective large-scale microalgae cultivation systems
- Develop technologies for harvesting algal cells and extraction and conversion of lipids into biodiesel or bio-oil
- Examine the algal biomass for production of value added products
- Conduct Life Cycle Analysis of biofuel production from microalgae

Why Algae Biodiesel?

- Development of cost effective large-scale microalgae cultivation system
- Significant increase in renewable biomass feedstock productivity on a per land basis
- Utilization of land and water (saline / brackish / wastewater) which otherwise can not be used for conventional agriculture; thereby freeing land and water for other beneficial uses
- Algae biomass / biofuel feedstock production process coupled with waste stream treatment will cleanup and recycle waste nutrients, thereby improving water conservation and the environment
- Algae acts as carbon dioxide sinks for carbon recycling

Oil Yield per acre per year of algae compared to various oilseed crops:

<table>
<thead>
<tr>
<th>Algae</th>
<th>5000 - 15000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Palm</td>
<td>635 gallons/acre</td>
</tr>
<tr>
<td>Coconut</td>
<td>287 gallons/acre</td>
</tr>
<tr>
<td>Jatropha</td>
<td>207 gallons/acre</td>
</tr>
<tr>
<td>Rapeseed/Canola</td>
<td>127 gallons/acre</td>
</tr>
<tr>
<td>Peanut</td>
<td>113 gallons/acre</td>
</tr>
<tr>
<td>Sunflower</td>
<td>102 gallons/acre</td>
</tr>
<tr>
<td>Safflower</td>
<td>83 gallons/acre</td>
</tr>
<tr>
<td>Soybean</td>
<td>48 gallons/acre</td>
</tr>
<tr>
<td>Hemp</td>
<td>39 gallons/acre</td>
</tr>
<tr>
<td>Corn</td>
<td>18 gallons/acre</td>
</tr>
</tbody>
</table>

*Sources: [http://www.unh.edu/p2/biodiesel/article_alge.html](http://www.unh.edu/p2/biodiesel/article_alge.html), [http://oakhavenpc.org/cultivating_algae.htm](http://oakhavenpc.org/cultivating_algae.htm)

The Impacts

- Maximum sustainable photosynthetic efficiency, biomass productivity and oil productivity will be determined
- Capital costs of microalgae cultivation systems need to be reduced substantially

The Constraints/Challenges

- Propose a combined biotechnological scheme for processing/treatment of agricultural and industrial wastewater for the production of microalgae biomass
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