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Review of *Gasoline, Diesel, and Ethanol Biofuels from Grasses and Plants*, by Ram B. Gupta and Ayhan Demirbas.

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Gasoline, Diesel, and Ethanol Biofuels from Grasses and Plants. By Ram B. Gupta and Ayhan Demirbas. New York: Cambridge University Press, 2010. xiv + 230 pp. Illustrations, tables, reference list, index. $75.00 cloth.

Any discussion of biofuels today must match the seriousness of the economic implications of U.S. dependence on foreign oil. The U.S. now imports nearly 60% of its oil consumption at great and growing costs. As global oil production nears its peak, oil is now over $90 dollars per barrel and projected to continue to increase, up from ~$20 per barrel in 2000. The cost of foreign oil consumed 2.7% of U.S. gross domestic product in 2008 at $393 billion and contributed 48% to the U.S. trade deficit. Dependence on foreign oil also contributes to economic instability, adds to U.S. debt, and hampers economic growth needed to emerge from the "Great Recession." In these circumstances, biofuels that can efficiently substitute for petroleum-based fuels are of the highest regional and national importance.

A new book on the production of biofuels by Gupta and Demirbas provides technical insight into the conversion processes that could provide a range of domestic fuels from plant materials to substitute for foreign oil. It focuses primarily on conversion processes for production of cellulosic ethanol, Fischer-Tropsch diesel, pyrolysis bio-oil, and hydrothermal biocrude from biomass resources, as well as "first-generation" grain ethanol and biodiesel from vegetable oil. In addition to a detailed summary of these chemical processes, the book provides a briefer treatment of related matters such as biofuel policy, economics, and environmental issues.

The book does discuss the limitations to many aspects of the conversion processes, but does not strive to identify the main constraints for developing the biofuel industry, nor does it sufficently emphasize these problems. These limitations are problematic because the U.S. Energy Independence and Security Act of 2007 requires 16 billion gallons of cellulosic ethanol to be produced annually by 2022 (larger than the current U.S. corn-ethanol industry); industry growth, however, is well below mandated levels, as recently reported in the journal *Science* ("Is There a Road Ahead for Cellulosic Ethanol?," August 13, 2010). Technical and economic issues such as the high costs of capital for biomass pretreatment and biomass burning as well as the high and uncertain costs of enzymes for conversion of biomass to ethanol (also mentioned in the book) have restricted industry growth for this primary "second-generation" biofuel. The other non-first-generation biofuels discussed are at similarly insignificant levels of production, or have not been commercialized on a large scale.

Because of high production costs, abundant and inexpensive biomass feedstocks such as crop and forestry residue will be developed first. Among the possible second-generation biofuels, federal and private funding have recently gone predominantly to the use of corn residue for ethanol production. Great Plains grasses have variable and low yields and will likely be one of the last biomass resources to be developed for advanced biofuels. Furthermore, research has shown that continuous high productivity grassland needed for biofuel production will require much higher levels of nitrogen fertilizer applications than assumed by many observers, and these systems will likely also encounter challenges in harvest, transport, and storage. The Great Plains receives limited attention in this book, and the references cited concerning projected biofuel production in the region are likely overly optimistic.

There are formidable challenges in developing a profitable, competitive, and sustainable large-scale second-generation biofuel industry, and it is unlikley these challenges will be easily and rapidly solved, although many hope otherwise. **Adam J. Liska**, *Departments of Biological Systems Engineering and Agronomy and Horticulture, University of Nebraska–Lincoln.*