



## Biodiesel - Your Farm Has Fuel

**It's possible to grow and produce your own fuel--such as biodiesel--from your farm.**

By Carol Ekarius

### About the Author

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Fatty acid methyl ester. It's a mouth full, but this chemical concoction is changing the way we think about fuel. Fatty acid methyl ester is the scientific name for "biodiesel," a fuel created when vegetable oils and/or animal fats chemically react with an alcohol.

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Biodiesel is one of three emerging biofuels; (the other two are ethanol and biosyngas)it's garnering lots of press and for good reason: It can be burned as a pure fuel, or in a mix with petroleum-based diesel (in these mixtures, as little as 20 percent biodiesel--also known as B20--has proven to have significant environmental benefits). The base constituents are biodegradable, renewable and readily available in this country. It can be prepared from virgin oils, from oils that are a byproduct of some other process (such as the oil released when cotton seed or soybeans are pressed into meal for livestock feed) or from some of the five billion gallons of waste cooking oil produced by America's restaurants and institutions. And, biodiesel burns more cleanly than petroleum-based diesel (petrodiesel), meaning less greenhouse gases and less particulates are emitted, thus reducing potential health impacts (diesel contributes to asthma) and the potential for climate change.

### Top Crops for

BiodieselPlantGallons/AcreAvocado270Pecans183Rapeseed/Canola122Peanuts109Sunflowers98Rice85Mustard59Pumpkin seeds55Soybeans46Cotton33Best of all, it may help wean us of our dependence on foreign oil while at the same time helping America's family farmers.

### Basics of Biodiesel

Anyone who owns a diesel vehicle can run biodiesel without making any adjustments to their engine, which is particularly good news for farmers, who often have pickup trucks, tractors and even generators that run on diesel. Biodiesel has lower energy, but higher combustibility, than petrodiesel, so those who are already using it report that they don't notice any difference in performance over petrodiesel. In fact, when net energy is calculated, biodiesel has the highest net energy of any available fuel!

We wouldn't have silver linings if we didn't have clouds. There are three small clouds to be considered for biodiesel:

Biodiesel gels at higher temperatures than petrodiesel, so in cold-weather months it will need to be used in a blend not exceeding B20 or an engine pre-heater will need to be Fill 'er Up!

New Holland has approved use of 20 percent biodiesel (B20) in all of its equipment using New Holland engines. This is the first Original Equipment Manufacturer (OEM) to announce full support of B20 in all of the diesel engines it produces. New Holland is offering technical advice and special programs to aid customers with the implementation of biodiesel use in its equipment. Other collaborations include a partnership with John Deere, which is filling its tractors with biodiesel at the factory and DaimlerChrysler approving B20 use in its 2007 Dodge Ram pickup trucks for government, military and commercial fleets. used. Researchers are working on the development of additives, similar to those added to petrodiesel for winter use, that will reduce gelling problems. Once the engine is warmed, there are no problems running it. The exact gelling point varies depending upon which type of base oil was used to brew the biodiesel (for example, biodiesel prepared from rapeseed or soybeans works at colder temperatures than biodiesel prepared from animal fat).



When burning high-concentration biodiesel (50 percent biodiesel, aka B50, or greater) in a vehicle that has burned petrodiesel in the past, it will break up accumulated gunk in the engine will break up, plugging fuel filters. When converting to high-percentage biodiesel mixtures or pure biodiesel, have a few spare fuel filters on hand and change them at the first sign of trouble. Clogged filters are a short-term problem. Old vehicles and tractors (pre-1980) may have a type of rubber fuel line that is incompatible with biodiesel. If you are thinking of running biodiesel higher than B20 on older vehicles, first change out the fuel lines.

#### Down-on-the-farm Diesel

One of the most exciting things about biodiesel for farmers is that it can provide a local or home-grown fuel supply. Ian Heatwole, of Weyer's Cave, Va., is a dairy farmer who loves to "preach the gospel of biodiesel."

**Tip** To find places that currently sell biodiesel, check out the locator at the National Biodiesel Board's Web site. For other alternative fuels, such as ethanol, hydrogen, or liquid natural gas located near you, check out the Alternative Fuel Station Locator. This site is a service of the Department of Energy's National Renewable Energy Lab. Ian became interested in biodiesel about six years ago. "I kept hearing about soy-diesel," he says. "So, I started hounding our supplier, 'When are we going to get soy-diesel?'"

"I figured I would rather keep my money here—somewhat local—than have it going over to unstable countries." Then one day, about three years ago, Ian called his diesel supplier and before he could ask the question, the supplier said, "I got biodiesel!" Ian began purchasing it right away and has been using at least B20 ever since.

As he began reading more about biodiesel on the Internet, he came across information that indicated it was actually pretty easy to make, so about a year ago he began experimenting. His first batches were small: "I've made a bunch of two-liter batches from various oils. They lasted five minutes in the tractor," he says with a laugh, "but they worked well."

Based on the success of those batches, Ian is in the process of purchasing equipment and gearing up for community-scale, on-farm biodiesel production. He sees a number of advantages.

#### Did you know

Biodiesel burns cleaner than petroleum-based fuels. According to the Department of Energy, it results in:

Up to a 20 percent reduction in unburned hydrocarbons Up to a 12 percent reduction in carbon monoxide Up to a 12 percent reduction in particulate matter

"Two principles have always governed the way I operate," he says. "I want to make as much of my own feed as I can and I want to keep my soil covered as much of the time as possible, which means I grow a lot of different crops and use crop rotations to protect my soil. On-farm biodiesel production fits in well. It will not only supply me with fuel from a variety of crops, but it will also provide benefits for the soil and the feed.

#### Advocates for Biodiesel

There are lots of folks pushing biodiesel production. The American Soybean Association is one of the biggest advocates. Soybeans, a major crop in the United States that are subsidized by the government, are grown on over 73 million acres. The soybean market has been sluggish to downright dismal in recent years, so biodiesel production appeals to growers around the country.

#### Do It Yourself

These sites have good information on the how-to aspects of producing your own Biodiesel:ATTRA (or call (800) 346-9140 and requesting the publication "Biodiesel Primer") Journey to Forever Farm Aid founders Willie Nelson and Neil Young are both advocates for biodiesel and fuel their tour fleets with the environmentally friendly fuel. "We have been running our equipment on biodiesel for the past couple of years," Willie says, "and it is a huge light at the end of the tunnel as far as helping us become less dependent on foreign energy. More plants are being built now to produce biodiesel than ever before and more people are realizing that this is what we need to be doing."

Farm Aid also has used proceeds from its concerts to give grants to organizations that are pursuing on-farm production and usage of alternative energy sources, including biodiesel. One such group is the Institute for Agricultural Trade Policy (IATP) in Minneapolis, Minn.



I ATP is a strong proponent of biofuels and other bio-based products,” says Mark Muller, Director of the Agriculture and Environment Program at IATP. “We are really enthusiastic about what is happening in this arena, but with a couple of big caveats: Simply put, biofuel production needs to benefit rural communities and it needs to be done sustainably.”

#### Ethanol—The other biofuel

Ethanol is gaining a corner in the marketplace, with over five billion gallons of it flowing into our nation’s fuel supply this year according to the American Ethanol Council. Currently ethanol is mainly produced using government-subsidized corn and is chiefly used as a fuel additive. When mixed with gasoline in the 5% (E5) to 10% (E10) range it increases the octane, thereby burning cleaner, and at a mixture up to E10, it can be burned in standard engines with no modifications. In the last few years auto makers have developed “Flexible Fuel Vehicles” that can burn anything between pure gasoline and E85 (a mixture of 85% ethanol with 15% gasoline), with E85 pumps showing up around the country. A study released by the National Academy of Sciences in July shows that biodiesel provides more environmental benefits than ethanol, and many economists believe that corn-based ethanol will never make sense, but others believe ethanol from other starchy crops, crop waste, crops produced on marginal lands (such as switchgrass), and algae that are fed flue gas from coal-burning power plants, may provide greater environmental and economic benefit in the future. In spite of the caveats, Mark is enthusiastic. “I don’t think this is just a pie-in-the-sky thing. Domestically produced energy is where more and more of our agriculture—particularly here in the Midwest—is going to be moving toward.”

#### Brewing Your Own Biodiesel

Biodiesel isn’t particularly hard to brew in small batches; in fact, some biodiesel brewers liken it to making homemade wine, beer or soap. Currently, biodiesel production involves dissolving a catalyst (usually sodium hydroxide) in alcohol (methanol) and then agitating the mixture with oil for a few hours. The mixture is then allowed to sit for up to 24 hours while the chemical reaction takes place. What remains after the reaction occurs is biodiesel, which has to be neutralized with acid (usually hydrochloric acid), and glycerin, a byproduct that is separated out and typically used in soap-making.

The whole process requires tremendous care and caution, as the chemicals used in the reaction are hazardous and the process is dangerous: methanol is very toxic, extremely volatile and highly flammable; sodium hydroxide is an extremely caustic substance; hydrochloric acid can also cause burns. In other words, if you want to brew your own, safety has to be your top priority—and safety considerations range from using proper personal protective devices, such as goggles, heavy rubber gloves and aprons, to an external-air-supply respirator when handling methanol, to having a well-ventilated work area and explosion-proof electrical fixtures.

All this means that a lot of farmers aren’t going to rush to make their own. But, Goran Jovanovic, a chemical engineering professor at Oregon State University hopes his “microreactor” will make it more practical for farmers to produce biodiesel throughout the country. Goran’s microreactor eliminates the mixing, the standing time for separation and the need for a dissolved catalyst.

“Most people think large-scale, central production of energy is cheaper because we’ve been raised with that paradigm,” Goran says “But ‘distributed energy production’ means you can use local resources; farmers can produce the energy they need from what they grow on their own farms, often from farm byproducts such as oil from pressed cottonseed meal—a livestock feed.”

The reactor has proven its mettle in the laboratory, but there are other “engineering challenges” that need to be worked out in field-scale demonstration units before the reactors are ready for broad deployment in the marketplace. Goran gives a couple of examples: “We need to learn what happens when you run this machine for a month straight. What kind of filtering would we need to do to remove the particles in the oil so they don’t plug the unit? Free fatty acids and proteins are different from one type of oil to the next. How will these differences in the quality of oil affect long-term operation?”

The laboratory-scale reactor is the size of a credit card, but Goran estimates commercial prototypes that could produce enough biodiesel to power several farms, or about a 100,000 gallons per year, would be about the size of a suitcase. The University won’t produce and test these demo units themselves, but will license the technology to private business. Goran is excited by the potential and thinks field-scale units will be ready for demonstration within eighteen months.

“Wind and solar energy technologies also faced difficulties in their early days, but we are at a perfect-storm time for this technology to jump ahead,” says Goran. “It seemed outrageous a year ago when fuel hit \$2 per gallon, but people are realizing that fuel prices will only continue to go up. We can produce biodiesel from waste or local, cheaper sources of vegetable oil or animal fat that, sometimes, cost money to dispose of. It will cost fewer dollars to produce biodiesel, but think, that puts dollars back into our community’s pockets.”

“It is a beautiful thing,” says Goran.



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