

Is it a drug? Is an energy crop?

The growing of hemp is controversial due to its association with cannabis.

Charlotte Niemiec assesses the properties of hemp seed and oil and the strict regulations surrounding the crop

In a bid to secure global renewable energy, governments and scientists around the world are searching for a biofuel that is efficient and does not compete with food crops. So far, few have passed the test, though the last decade has seen miracle crop 'fads' such as jatropha and switchgrass. Nevertheless, there are whispers that the answer to the problem is staring the industry in the face. Inconveniently, however, the crop in question is a legal and moral minefield.

Hemp, a cousin to marijuana, is banned in many countries due to its association with the cannabis plant. While marijuana – smoked for its intoxicating effects – contains tetrahydrocannabinol (THC), hemp contains little to no THC and is a hugely versatile plant. It produces durable clothing and can be used to make paper and pulp. Its seeds are exceptionally nutritious, high in both omega-3 and omega-6 fatty acids and a complete protein.

Around 44% of the weight of hempseed is edible oil, containing around 80% essential fatty acids. It has an amino acid profile similar to other sources of protein such as meat, milk, eggs and soybeans. Hemp has been used to replace plastic in the production of car parts and can even be mixed with lime to create 'hemperete', strong building blocks similar to concrete that are energy efficient, non-toxic and resistant to mould, insects and fire.

Most importantly, hemp is a viable contender for the biofuel spotlight. *The Huffington Post* reported in March 2014 that a 2009 study from the University of Connecticut's Biofuel Consortium had found that hempseed oil made a "viable and even attractive" feedstock for producing biodiesel. It proved to be of high efficiency (97% of the hemp oil was converted to biodiesel) and could even be used at lower temperatures than other biodiesels.

Over the past few years, numerous companies and research institutions have examined hemp's advantages. *Biofuels Digest* reported in July 2014 that Extreme Biodiesel and subsidiary XTRM Cannabis Ventures received pre-approval for a US\$5M line of credit to purchase land for the purpose of hemp cultivation. It also noted researchers at the University of Connecticut, who are experimenting with hemp as a potential biodiesel feedstock and are preparing development of a multi-feedstock manufacturing facility. The plant will have a capacity of 200,000 gallons/year and is being built with a US\$1.8M grant from the US Department of Energy (DoE).

Besides biofuels, hemp is a lusted-after crop for farmers. It cleanses the soil, reducing toxins and groundwater. As it is a weed, it naturally fights off most pests and thrives in climates around the world with little water. It is a profitable crop (farmers in Canada are reportedly making US\$300/acre profits from growing hemp); it grows very tightly spaced and has a fast growing rate.



An inconvenient

However, the laws on hemp, particularly in the USA, are extremely strict. While the country is changing its legislation to provide licences to farmers who intend to grow industrial hemp, the legislation is stringent and has been dubbed 'overkill' by farmers trying to grow a crop in which the drug content bears no real threat. Until recently, US drug policy dictated that all cannabis varieties are considered controlled substances under the Controlled Substances Act. That policy, however, was relaxed slightly in 2014 to allow for industrial hemp to be grown for research purposes, including the production of biofuel.

US moves towards legislation change

Nevertheless, as *The Huffington Post* article notes, the USA imports huge amounts of its hempseed and hemp oil from China and Canada, adding that "in 2011, the USA imported US\$11.5M worth of hemp products, up from US\$1.4M in 2000".

Additionally, it highlights the advantages of changing US legislation. "The USA has a chance to create domestic jobs and capitalise on the growing market. Some estimates value the US industrial hemp market at US\$500M/year; Canada's hemp industry is reportedly going to break a billion dollars [in 2014] in earnings."

The Huffington Post explains that 23 US states have now enacted pro-industrial hemp legislation and, since the beginning of 2014, more than 70 bills related to hemp have been introduced in more than half the country's states. The passage of the February 2014 Farm Bill, which legalised the crop for research purposes, further cleared the way for industrial hemp production.

The rules are only slightly more relaxed in Canada, which began issuing licences to grow the

crop for research purposes in 1994, followed by commercial licences in 1998. Currently, according to a 24 July 2013 Congressional Research Service (CSR) report prepared for US Congress, '*Hemp as an Agricultural Commodity*', by Renée Johnson: "To obtain a licence to grow hemp, Canadian farmers must submit extensive documentation, including background criminal record checks, the Global Positioning System (GPS) coordinates of their fields and supporting documents (from the Canadian Seed Growers' Association or the Canadian Food Inspection Agency) regarding their use of low-THC hemp seeds and approved cultivars; and they must allow government testing of their crop for THC levels."

Furthermore, according to the CSR report, Canada's regulation states that all industrial hemp grown, processed and sold in Canada may contain THC levels no more than 0.3% of the weight of leaves and flowering parts (where THC is located in the plant) and there is a maximum level of 10 parts per million (ppm) for THC residues in products derived from hemp grain, such as flour and oil.

Despite the relaxation of the rules in both the USA and Canada, farmers are still finding it very difficult to obtain licences.

Nevertheless, Paul Bobbee – a Canadian hemp grower – explains, hemp is such a staple of the health food industry, with farmers raking in profits up to C\$1,000/45-gallon of hemp oil, that redirecting it to biofuel is not commercially viable. That is not to say that, if production were ramped up, this situation would not change.

The global hemp market

The CSR report notes that hemp is grown in approximately 30 countries in Asia, Europe and

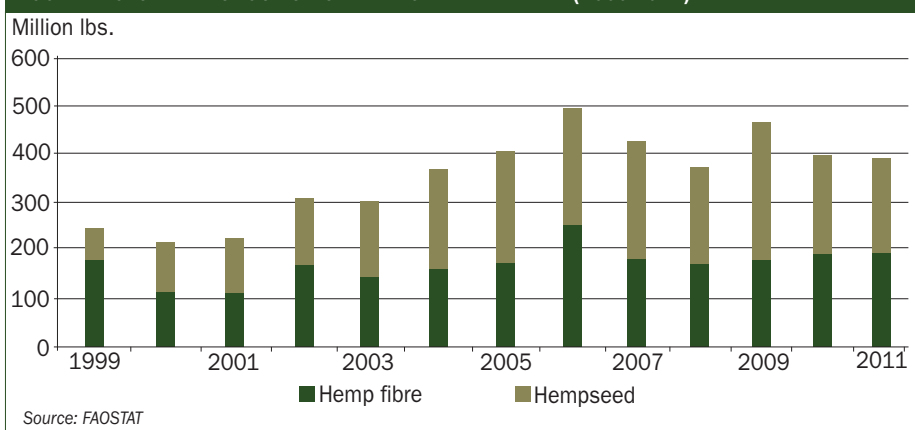


answer

South America. Production in the European Union (EU) is centred in France, Hungary, Romania and the United Kingdom. EU hemp acreage reached around 26,000 acres in 2010, but this signified a decline from previous years, when more than 50,000 acres of hemp were grown. In Canada, 66,671 acres were licensed for cultivation in 2013, according to the Canadian Hemp Trade Alliance.

Canada and China are the largest producers of hemp textiles and related products, which they export to the USA. Other countries with active hemp growers and/or consumer markets are Australia, Chile, Egypt, India, Japan, Korea, New Zealand, Russia, Switzerland, Thailand, Turkey and Ukraine. Worldwide, the CSR report say, "acreage in hemp cultivation ... has been mostly flat to decreasing,

FIGURE 1: GLOBAL PRODUCTION OF HEMPSEED AND FIBRE (1999-2011)



reported at around 200,000 acres globally in 2011. Although variable year-by-year, global production has increased overall by 250M pounds in 1999 to more than 380M pounds in 2011, mostly due to increasing production of hempseed. Upward trends in hempseed production roughly track similar upward trends in US imports of hempseed and oil, mostly for use in hemp-based foods, supplements and body care products."

Not viable for biofuel

Professor David B Levin of the research group at the University of Manitoba has been investigating the use of hemp biomass residues (hurds) as a feedstock for biofuel production (ethanol and hydrogen) using specialised bacteria that can use the cellulose as a food source. However, his research is not altogether encouraging.

He explains: "We have not looked at the use of hemp oil as a source of lipids for biodiesel production. Biofuel production (ethanol or biodiesel) is the lowest value that one can get from a feedstock. In other words, biofuels are a high volume, low value commodity, so whatever you use to make it has to be very low cost to start with. My understanding is that hemp oil has a high commercial value, so it is unlikely that you would want to use it to make biodiesel. However, if there are large volumes of 'waste' hemp oil – oil that is contaminated with something or has oxidised (gone rancid) and has no commercial value – then it

might be worth investigating its use as a feedstock for biodiesel production."

Bobbee agrees. He told *Biodiesel Magazine* in January 2007 that, when the Canadian hemp industry was not as well-established as it is now, he found himself with a surplus on his hands. A large hemp purchasing company went bankrupt and suppliers like Bobbee were faced with low prices and few marketing options. The situation was particularly dire because hemp seed deteriorates after about a year in storage. The seed that Bobbee had was beginning to go rancid. Since it could no longer be used in the food market, he took 20,000 litres of hemp oil and turned it into biodiesel. Not only did the biodiesel have wonderful properties – better cloud point and cetane value than biodiesel made from canola or soya oil – its distinctive green colour was a great marketing tool.

However, it is not economically viable. Arthur Hanks, executive director of the Canadian Hemp Trade Alliance, says that there are too many factors working against the use of hemp as a biodiesel feedstock. Additionally, there's the hurdle of limited supply. Although healthy demand has increased hemp production numbers in Canada, there is just not enough quantity to go around. In 2005, 24,000 acres of hemp were planted in Canada, more than double to 50,000 acres in 2006. "That, particularly, is very much an issue of economies of scale", Hanks says. "It is still very much a speciality crop." ●
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TABLE 1: VALUE AND QUANTITY OF US IMPORTS OF SELECTED HEMP PRODUCTS 1996-2011

	Units	1996	2000	2005	2007	2008	2009	2010	2011
Hempseeds	US\$1,000	–	–	271	2,350	3,111	3,320	5,154	6,054
Hemp oil and fractions	US\$1,000	–	–	711	693	835	726	1,129	839
Hempseed oilcake and other solids	US\$1,000	–	–	–	–	460	1,811	2,369	2,947
True hemp raw/processed (not spun)	US\$1,000	100	525	101	88	57	52	33	41
True hemp yarn	US\$1,000	25	396	68	82	202	212	115	425
True hemp woven fabrics	US\$1,000	1,291	1,617	923	1,579	1,924	751	1,024	1,188
	Total	1,416	2,538	2,074	4,789	6,589	6,872	9,822	11,494
Hempseeds	Tonne	–	–	92	355	523	602	711	623
Hemp oil and fractions	Tonne	–	–	114	99	98	92	134	137
Hempseed oilcake and other solids	Tonne	–	–	–	–	56	201	2,239	298
True hemp, raw/processed not spun	Tonne	53	620	121	102	44	36	28	16
True hemp yarn	Tonne	6	60	8	9	51	45	22	64
	Subtotal	59	680	335	565	772	976	1,134	1,138
True hemp woven fabrics	m ² (1000)	435	654	248	411	479	167	268	251

Source: Compiled by CRS using data from the US International Trade Commission (USITC) and republished in 'Hemp as an Agricultural Commodity', Renee Johnson, 24 July 2013