Industrial Hemp: Opportunities and Challenges for Washington
The recent passage of I-502 legalizing the production and consumption of recreational marijuana in Washington has heightened interest in the production of industrial hemp. Industrial hemp differs from marijuana in the level of delta-9 tetrahydrocannabinol (THC) present in the plant. THC is the chemical most responsible for the psychoactive properties in marijuana. Industrial hemp has traditionally been defined as having less than 0.3 percent THC, although in some U.S. states it is now defined as having no more than 1 percent THC.

At the federal level, industrial hemp is still classified as a Schedule I controlled substance and under the purview of the U.S. Drug Enforcement Administration (DEA). However, the 2014 Farm Bill signed into law spring of 2014 does provide language in support of industrial hemp research conducted by state departments of agriculture and land grant universities.

In addition to the Farm Bill, 19 states have recently passed some form of legislation in support of a commercial hemp industry. Nine states explicitly legalized the production of industrial hemp by private farmers, while the others provided for various levels of research—from studies of the feasibility of commercial hemp production to actual agronomic research involving hemp production at the research facilities.

Despite a lack of industrial hemp production in the U.S., there are active markets for hemp-based products. It has been estimated that total U.S. sales of hemp products exceeded $581 million in 2013, with double-digit growth in year-over-year sales occurring the last several years.

Because industrial hemp production has not been allowed in the U.S., the feed stocks necessary to satisfy U.S. demand for hemp products are currently imported. While imports originate from several locations, most of the product directed at the food and body care industry comes from Canada (the U.S. is Canada’s largest hemp customer), while the fiber and finished clothing products tend to originate in China.

Research in the U.S. suggests that hemp could be a competitive crop for U.S. farmers, although the most recent work is focused on production in the Midwest and southern states, not the Pacific Northwest. Direct production experience in Canada supports this analysis, with much of its commercial production taking place in traditional wheat producing regions.

Because profitability studies in the U.S. are not based on actual commercial-scale production, the results are somewhat speculative. However, it is likely that profit potential could be improved with active research in commercial hemp production. This includes work on cultivar selection for various production environments, pest and weed management systems, and harvest technology and management, as well as research on the actual market potential for hemp products—in other words, understanding the level of production that would be sustainable, given expected consumer demand for hemp products.
Abstract

The recent initiative in Washington (I-502) allowing for the production and consumption of recreational marijuana has added momentum to efforts to legalize industrial hemp production in Washington. Several states have already legalized industrial hemp production, and others have authorized production for research purposes.

Despite recent changes in state laws, industrial hemp is still classified as a Schedule I controlled substance under federal drug policy, and as such is regulated by the U.S. Drug Enforcement Administration (DEA). This puts federal law and laws in states allowing industrial hemp production in potential conflict. However, the 2014 Farm Bill does have language authorizing industrial hemp research at land grant universities and by state departments of agriculture; thus it appears likely that industrial hemp production for research purposes will not be in violation of federal regulations.

This report reviews the current production of industrial hemp globally, potential international and national market opportunities, and the extent to which industrial hemp might be attractive for Washington producers. It does not focus on other cannabis markets (recreational or medicinal marijuana). The term hemp here will refer to cannabis with less than 0.3 percent THC (delta-9 tetrahydrocannabinol, the primary chemical that leads to marijuana’s psychoactive properties). This is consistent with earlier definitions of hemp found in the literature.

The objective is to provide background for parties interested in evaluating the potential for increased state support for hemp research at both the university and private sector levels. Such research can help identify opportunities and constraints associated with the development of a commercial hemp industry in Washington.

Introduction

Despite restrictions on domestic production, there has been an active movement to legalize industrial hemp cultivation in the U.S. for at least the last two decades. Those in favor of developing a domestic hemp industry point to a host of potential benefits. On the production side these include environmental benefits that result from low pesticide and herbicide requirements, adaptability to a wide range of agronomic conditions, increased profit centers for U.S. farmers, and relatively low water needs (Fortenbery and Bennett 2004).

On the demand side, supporters point to increased efficiency compared to other inputs for some industrial uses (e.g., paper production), health benefits of both hemp oil and hemp seed consumption, competitive use as an input in textile manufacturing, and potential for the development of new uses if supply were sufficient. As noted by R. Johnson (2012), it has been estimated that, globally, hemp and hemp by-products can be found in more than 25,000 products that span nine sub-markets: agriculture, textiles, automotive, furniture, food, personal care, construction, paper, and even recycling.

Opponents of a domestic hemp sector are most concerned with the inability to distinguish between hemp grown for industrial uses and recreational marijuana. They also argue that potential profits are not sufficient to justify the licensing and drug monitoring costs necessary to ensure that industrial hemp is not, in fact, marijuana being produced for illicit markets (Fortenbery and Bennett 2004). However, recent ballot initiatives legalizing marijuana consumption in Washington, Colorado, Oregon, Alaska, and Washington D.C. suggest that these concerns are becoming less valid, at least from a local jurisdictional perspective. Given that the DEA still regulates all cannabis (whether produced for industrial uses or human consumption) as a controlled substance, the concern may still be relevant to federal law enforcement. The extent to which the concern is minimized for federal regulators hinges on whether they decide to aggressively enforce federal restrictions against cannabis production and consumption in those places where local law is no longer a constraint. At the time of this writing, it was still unclear how the differences between state and federal law might impact local market development, and thus the extent to which distinguishing between recreation and industrial production would be an issue.

Despite differences in state and federal policies, however, R. Johnson (2012) has argued that differentiating between industrial hemp and recreational marijuana is not as challenging as critics suggest. Thus, even in states that do not allow marijuana consumption and production, it is unlikely that commercial hemp production would be confused for marijuana, or vice versa. While the plants look similar if not managed, it is different parts of the plants that have value to industrial users as opposed to recreational users. Thus, they would not look similar when being cultivated for their specific end uses.

Background and History

According to both Kraenzel et al. (1998) and Vavilov (1992), hemp was one of the first crops to be domesticated
and cultivated, and predates other fiber crops, including both cotton and flax. Cultivation dates back between 4000 and 6000 years, with China being a major producer early on. (They are still a major producer today.) By the 16th century, hemp was an important cash crop in Europe and was grown for both its fiber and seeds (P. Johnson 2000). As demand for hemp-based products grew, hemp became Russia's largest agricultural export. It was also widely grown across the British Isles, and it was from there that hemp was first introduced to North America (Roulac and Hemptech 1997).

In his article on the history of hemp in the British Isles, Gibson (2006) notes that industrial hemp production in the United Kingdom can be documented as early as 343 BC. The production of hemp across the British Isles helped England develop their naval dominance in the 18th and 19th centuries. As UK demand for hemp increased, imports were required. Most imports were from Russia, but Italy was the supplier of the highest quality hemp. Gibson notes that some UK legislators were concerned with the security implications of relying on the import of raw materials so vital to national defense, and searched for ways to increase domestic production in the 1800s. With the development of steam power and metal ships, however, that all changed, and the British hemp industry essentially disappeared.

Hemp was first brought to New England in 1645 where it was cultivated for its fiber content (U.S. Department of Agriculture 2000). Production spread to Pennsylvania, and then south into Kentucky and Virginia. By 1775, Kentucky hosted a substantial commercial cordage industry with hemp fiber serving as the primary input (Fortenbery and Bennett 2004). Roulac and Hemptech (1997) have identified both Presidents Washington and Jefferson as commercial farmers of hemp, and according to Kraenzel et al. (1998) the first couple of drafts of the Declaration of Independence were printed on hemp-based paper. Other early uses included hemp fabric in colonial solders' uniforms and the first U.S. flag sewn from hemp fabric.

In addition to civilian demand, the U.S. Navy began using large amounts of both cordage and sailcloth made from hemp, and by the mind 1800s production had spread into Missouri and Illinois (Fortenbery and Bennett 2004). Roulac and Hemptech (1997) estimate that by this time there were 160 hemp-based factories employing several thousand workers in Kentucky alone (Kentucky being the largest U.S. producer of hemp at that time).

After 100 years of aggressive growth, however, the U.S. hemp industry began to shrink in the late 1800s. The decline was precipitated by both technological innovation and the discovery of alternative inputs for traditionally hemp-based industries. These included the development of the cotton gin, which greatly reduced the labor needed to refine cotton, thus reducing the cost of cotton fabric, and the development of steam- and petroleum-powered ships, which reduced the demand for sail cloth. In addition, jute and abaca imports increased because of cost. Jute competed with hemp fabric, and abaca exhibited superior qualities for marine cordage due to its greater resistance to salt water and its reduced weight (Dempsy 2000).

U.S. production of hemp was essentially eliminated in 1937 with passage of the Marijuana Tax Act. This placed hemp production under the control of the U.S. Treasury Department (Fortenbery and Bennett 2004). World War II saw a short resurgence in U.S. hemp production as both jute and abaca supplies were interrupted. The legal restrictions were lifted, and the USDA Commodity Credit Corporation contracted with War Hemp Industries, Inc., for production of hemp fiber and seed. This, in turn, led to War Hemp Industries investing in several midwestern hemp processing mills. Following the war, restrictions on domestic hemp production were re-imposed, and imports of jute and abaca re-established. A small fiber industry continued in Wisconsin until 1958, but since then there has essentially been no U.S. hemp production (Fortenbery and Bennett 2004; R. Johnson 2012).

Hemp vs. Marijuana

Industrial hemp and marijuana share the same species, *Cannabis sativa* L, but represent different varieties (Fortenbery and Bennett 2004). As such, there are genetic differences that lead to different chemical characteristics, which, in turn, lead to different uses (Datwyler and Weiblen 2006).

A central argument against legalizing industrial hemp production in the U.S. has been the difficulty in distinguishing between industrial hemp grown for fiber and seed (with low THC)¹ and marijuana grown for its psychoactive properties (with high levels of THC) (Vantreese 1998). However, with the recent legalization of marijuana in some states, this concern has diminished. Further, R. Johnson (2012) has argued that because of the differences in their uses, marijuana and industrial hemp look quite different when under commercial cultivation. Industrial hemp is grown for the stalk and seeds, and maximizing yields results in tall plants with few leaves. Marijuana, on the other hand, is grown for its leaves and tops, the parts of the plant with the largest concentrations of THC. As a result, cannabis grown for its psychoactive properties is generally managed to control height and increase bushiness: that is, encouraging many leaves and branches, thus leading to more flowers and buds.

Cannabis varieties also vary by planting density: marijuana plants are spaced to allow bushiness while industrial hemp plants are planted much closer together to discourage branching and flowering.

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¹THC stands for delta-9 tetrahydrocannabinol, the chemical most responsible for the psychoactive properties in marijuana.
Harvest timing and strategies also vary by variety, again allowing for detection of intended use. Thus, even in states where marijuana is not legal, industrial hemp may be distinguishable from cannabis grown for marijuana, based on visual appearance.

**Western Hemisphere Hemp Production**

While hemp production in the U.S. has essentially been banned for decades, it is actively cultivated in other parts of the world (Figure 1). After dropping significantly from the early 1960s through 1990, world production has been relatively stable, between 100 and 200 million tons of fiber and seed, combined, over the last couple of decades. However, the global distribution of production has experienced shifts in recent years. North America and Europe, for example, have experienced significant growth in production over the last ten years. There has been a resurgence in hemp production from former western producers that had previously ceased production, as well as a focus on developing varieties and production practices that facilitate hemp production in non-traditional areas.

According to R. Johnson (2012), there are about 30 countries in Europe, Asia, and North and South America, that allow for commercial hemp production. While some countries, particularly in Asia, never banned hemp production, many western countries did and have now relaxed those bans. There are currently fourteen countries in Europe alone that host a commercial hemp industry, with most production occurring in the United Kingdom (UK), France, Romania, and Poland. According to the European Industrial Hemp Association, there were as many as 50,000 acres of European crop ground being cultivated for hemp in the mid-2000s. Much of this was in countries like the UK, where hemp had been banned prior to the mid-1990s.

Hemp was re-introduced in Britain in the 1990s, largely as a result of lobbying based on its environmental properties (Gibson 2006). Acreage steadily increased in the 1990s, with most domestic production going to food markets. Other hemp products, such as clothing, are also available to British consumers, but most textiles are made with hemp imported from China.

In addition to the British resurgence, there have been attempts to re-introduce hemp in other parts of Northern Europe where hemp production also disappeared as naval demand softened. For example, there were a series of production trials in Sweden between 1999 and 2000 (Svennerstedt and Svensson 2006). These were the first attempts to develop production in Sweden since the early 1960s. Similar to the U.S., Sweden experienced significant growth in hemp fiber production during World War II, and the industry was relatively stable from 1940 to 1960. However, the industry began to decline in the early 1960s due to competition from synthetic fibers, and, by the mid-1960s, all industrial hemp production was banned in response to growing recreational drug use. The ban was altered when Sweden entered the European Union in 1995 (Svennerstedt and Svensson). Initially experimental cultivation under the supervision of scientific institutions was allowed, and then in 2003 commercial cultivation was legalized.

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2This is based on data from the Food and Agriculture Organization of the United Nations. However, the data appears incomplete due to some countries not being explicitly listed. Thus, this likely under-states actual global production.
Commercial cultivation has also been re-introduced in Finland (Pahkala, Pahkala, and Syrjala 2008) and Italy (Amaducci 2005), both of which had been producers prior to the 1960s. Several other European countries have also seen the redevelopment of a hemp production industry following relaxations of earlier bans.

The only current industrial hemp producer in North America is Canada. Several Canadian universities, provincial governments, and small companies began researching industrial hemp as a Canadian crop in 1994 (Agriculture and Agri-Food Canada 2013). Based on commercial potential coming out of the research, the Canadian ban on industrial hemp production imposed in 1938 was lifted in 1998. In March 1998, the Industrial Hemp Regulations were put into effect. These cover the cultivation, processing, transport, sale, and import and export of industrial hemp. The regulatory system is quite strict, and is administered by the Office of Controlled Substances of Health Canada. They issue licenses for all levels of hemp activity (production, trade, processing), and regulate production to ensure that all hemp grown has a THC level of less than 0.3 percent. They have also established a maximum standard of 10 parts per million (ppm) for THC residue in hemp products, including grain, flour, and oil (Agriculture and Agri-Food Canada 2013).

While highly regulated, the Canadian hemp industry has grown significantly since 1998 (Figure 2). In recent years, Canada has become a major hemp exporter. Export fiber value peaked in 2002 at over Can$274 thousand, but by 2007 (the most recent data available) had fallen to just over Can$102 thousand. However, when all hemp (fiber and seed) is included, total export value in 2007 exceeded Can$3.5 million.

Beginning in 2003, however, Canada became a net importer of hemp fiber (similar to the U.K.), suggesting that Canadian increases in hemp production were focused on producing seed, not fiber. This is confirmed in Figure 3. Once hemp oil and hemp seed are accounted for (data was first available in 2006), Canada is a net exporter of aggregate hemp products. Of the Can$3.5 million in exports in 2007, over Can$2.6 million was from hemp seed, and another Can$700 thousand from oil. According to Laate (2012), by 2010 the total value of Canadian exports of hemp seeds, fiber, oil and oil-cake had exceeded Can$10 million.

Canada’s primary export customer is the U.S. (Figure 4), accounting for 59 percent of its exports in 2007. Another 12 percent went to the United Kingdom, 11 percent to Japan, and 12 percent to Ireland. The remaining 6 percent is scattered across a variety of countries. Laate has confirmed that, as of 2010, the U.S. remained Canada’s number one customer for export of hemp products.

### U.S. Hemp Industry Potential

#### Market Demand

Despite no domestic production, there are several hemp-based industries in the U.S. These industries are completely supported by imports of hemp, and this is one factor, in addition to potential environmental benefits, that has motivated supporters of hemp over the last couple of decades to campaign for legalizing hemp production in the U.S.

Hansen and Geisler (2012) have estimated that the value of hemp food and body care products sold in the U.S. in 2010 was $40.5 million and represented an increase of over 10 percent from the previous year.\(^3\) They further note that the Hemp Industries Association

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\(^3\)The report was originally written by Hansen, and then updated by Geisler. It is not clear who is responsible for which portions, thus they are cited here as joint authors.
(HIA) estimated the total retail value of hemp food, body care, and food supplements to be between $151 and $171 million in 2012. When adding this to other industrial uses (clothing, car parts, building materials, etc.) HIA estimated total hemp product sales of about $500 million in 2012 (Hansen and Geisler 2012).

In 2014, HIA estimated the 2013 U.S. market for hemp food and body care products totaled $184 million, an estimated increase of 24 percent over the previous year (Figure 5). They note that hemp-based non-dairy milk, shelled seeds, soaps, and lotions were areas with large gains in sales. When combined with industrial products (paper, auto parts, building materials, etc.), the U.S. markets accounted for at least $581 million in 2013 sales (HIA).

HIA identifies their data source as SPINS, an information provider for the natural and specialty products industry. According to HIA, SPINS estimates actually represent a lower bound of total hemp sales because they exclude sales from large retailers, including Whole Foods and Costco, that do not segregate hemp sales data. They argue that SPINS under-estimates actual U.S. hemp sales by a factor of three, although they provide no rationale for arriving at that estimate.

R. Johnson (2012) notes that the import value of hemp and hemp products used to support the sales described above are difficult to accurately estimate. Some products, like oilseeds and fiber, have only recently been distinguished from other hemp products, and even then reporting errors are prevalent. For example, export data from Canada does not always match reported U.S. import data for the identical product (R. Johnson 2012).

Recognizing the issues associated with data collection, Tables 1 and 2 nonetheless present estimates of both import values and import volumes for a host of raw hemp products. These are primarily products imported for further processing—they do not generally include finished hemp-based products imported, such as...
Table 1. U.S. Hemp Imports in Dollars.

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<tbody>
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<td>Hemp Seeds, Whether Or Not Broken</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2,333</td>
<td>3,088</td>
<td>3,296</td>
<td>5,125</td>
<td>6,553</td>
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<td>Hemp Oil And Their Fractions, Chemically Modified</td>
<td>4,716</td>
<td>2,602</td>
<td>3,027</td>
<td>2,301</td>
<td>1,481</td>
<td>1,177</td>
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<td>1,833</td>
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<td>Hemp Seed Oilcake &amp; Other Solid Residues</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>460</td>
<td>1,811</td>
<td>2,369</td>
<td>2,947</td>
<td>4,388</td>
<td>6,279</td>
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<td>True Hemp (Cannabis Sativa L.) Raw Or Processed But Not Spun: Tow And Waste</td>
<td>383</td>
<td>200</td>
<td>228</td>
<td>183</td>
<td>155</td>
<td>139</td>
<td>94</td>
<td>181</td>
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<td>Yarns Of True Hemp</td>
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<td>860</td>
<td>904</td>
<td>961</td>
<td>989</td>
<td>531</td>
<td>568</td>
<td>296</td>
<td>580</td>
<td>497</td>
<td>482</td>
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<td>True Hemp Fibers</td>
<td>899</td>
<td>1,382</td>
<td>1,232</td>
<td>1,605</td>
<td>1,826</td>
<td>2,335</td>
<td>894</td>
<td>1,180</td>
<td>1,364</td>
<td>1,362</td>
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<tr>
<td>Total</td>
<td>7,030</td>
<td>5,044</td>
<td>5,391</td>
<td>5,050</td>
<td>6,784</td>
<td>7,730</td>
<td>7,724</td>
<td>10,897</td>
<td>12,771</td>
<td>7,502</td>
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Table 2. U.S. Hemp Imports by Volume.

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<tr>
<td>Hemp Seeds, Whether Or Not Broken</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>355</td>
<td>523</td>
<td>603</td>
<td>712</td>
<td>722</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Hemp Oil And Their Fractions, Chemically Modified</td>
<td>742</td>
<td>328</td>
<td>287</td>
<td>281</td>
<td>189</td>
<td>154</td>
<td>128</td>
<td>215</td>
<td>157</td>
<td>208</td>
<td>450</td>
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<tr>
<td>Hemp Seed Oilcake &amp; Other Solid Residues</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>56</td>
<td>201</td>
<td>240</td>
<td>298</td>
<td>441</td>
<td>601</td>
<td></td>
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<tr>
<td>True Hemp (Cannabis Sativa L.) Raw Or Processed But Not Spun: Tow And Waste</td>
<td>441</td>
<td>171</td>
<td>181</td>
<td>172</td>
<td>151</td>
<td>103</td>
<td>83</td>
<td>42</td>
<td>89</td>
<td>55</td>
<td>72</td>
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<tr>
<td>Yarns Of True Hemp</td>
<td>147</td>
<td>105</td>
<td>113</td>
<td>102</td>
<td>115</td>
<td>78</td>
<td>76</td>
<td>42</td>
<td>86</td>
<td>89</td>
<td>70</td>
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<tr>
<td>Woven Fabrics of True Hemp Fibers</td>
<td>544</td>
<td>559</td>
<td>478</td>
<td>452</td>
<td>470</td>
<td>560</td>
<td>263</td>
<td>284</td>
<td>270</td>
<td>319</td>
<td>224</td>
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Figure 5. Growth of Retail Sales of Hemp Products in the United States. Source: Hemp Industries Association.
Table 3. U.S. Hemp Product Prices

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<tr>
<td>Hemp Seeds, Whether Or Not Broken</td>
<td>US$/kg</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>6.57</td>
<td>5.90</td>
<td>5.47</td>
<td>7.20</td>
<td>9.08</td>
<td>—</td>
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<td>Hemp Oil And Their Fractions, Chemically Modified</td>
<td>US$/kg</td>
<td>6.36</td>
<td>7.93</td>
<td>10.55</td>
<td>8.19</td>
<td>7.84</td>
<td>7.64</td>
<td>8.14</td>
<td>8.53</td>
<td>7.30</td>
<td>5.28</td>
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<tr>
<td>Hemp Seed Oilcake &amp; Other Solid Residues</td>
<td>US$/kg</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>8.21</td>
<td>9.01</td>
<td>8.97</td>
<td>9.89</td>
<td>9.95</td>
<td>10.45</td>
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<td>True Hemp (Cannabis Sativa L.) Raw Or Processed But Not Spun: Tow And Waste</td>
<td>US$/kg</td>
<td>0.87</td>
<td>1.17</td>
<td>1.26</td>
<td>1.06</td>
<td>1.03</td>
<td>1.35</td>
<td>1.36</td>
<td>2.24</td>
<td>2.03</td>
<td>2.38</td>
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<tr>
<td>Yarns Of True Hemp</td>
<td>US$/kg</td>
<td>7.02</td>
<td>8.19</td>
<td>8.00</td>
<td>9.42</td>
<td>8.60</td>
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<td>7.05</td>
<td>6.74</td>
<td>5.58</td>
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<tr>
<td>Woven Fabrics Of True Hemp Fibers</td>
<td>US$/kg</td>
<td>1.65</td>
<td>2.47</td>
<td>2.58</td>
<td>3.55</td>
<td>3.89</td>
<td>4.17</td>
<td>3.40</td>
<td>4.15</td>
<td>5.05</td>
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According to Smith-Heisters (2008), hemp grown for fiber is a low input, low environmental impact crop. This is based on a calculation of the complete life cycle of production, which includes not only the direct impact of hemp production itself on the environment, but also the impacts associated with the manufacture and transport of those inputs needed in hemp cultivation. For example, a crop that requires chemical fertilizers and pesticides would be “charged” for the environmental costs associated with the manufacture, transport, and storage of the chemical inputs in calculating the crop’s total life cycle impact.

Because hemp grown for fiber requires fewer chemical inputs than most other fiber crops, Smith-Heisters (2008) argues that it has a lower life cycle impact than other fiber crops such as cotton, and this results in a net environmental benefit.

When grown for fiber, hemp is seeded at very high densities. Mooleki et al. (2006) recommends seeding at 60 lbs/acre for an eventual plant density of 30 to 35 plants per square foot. Because of the planting density and rapid growth, hemp quickly crowds out competing weeds, resulting in little to no herbicide use during the growth phase. This potential benefit does dissipate, however, when one manages for seed production because both input and management requirements increase. When grown for seed, Mooleki et al. recommend seeding rates in the range of 20–30 lbs/acre, with an eventual plant density of 10 to 12 plants per square foot, which allows more opportunity for weed pressure.

Mooleki et al. also note that root rots and leaf spot can be significant problems, and they suggest avoiding hemp in a close crop rotation with canola, mustard, sunflowers, peas, and dry beans. Thus, the key to maintaining a relatively low life cycle impact revolves around careful rotation management. They recommend that hemp

*These are commonly called positive externalities. Generally, they are defined as societal benefits that are not directly capitalized into the price of a good or service.

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be rotated with cereal or forage crops. However, they also recommend against seeding hemp on wheat or buckwheat stubble. Wheat seed is difficult to separate from hemp seed and thus producers could be subject to significant quality discounts when seeding directly behind wheat.

Smith-Heisters also argues that pesticide use is relatively low in hemp fiber production because of little pest pressure. However, as commercial production expands across the North American continent, it is likely that pesticide use will increase. In addition, Mooleki et al. note that in Saskatchewan where commercial production has been ongoing for over a decade, hemp producers have experienced significant damage from both grasshoppers and the Bertha armyworm. Other insects, including aphids and stink bugs, have also been discovered in hemp and have the potential to both impact yields and serve as disease vectors.

Fertilizer requirements of hemp compared to other crops are less clear. Several authors, including Smith-Heisters and Mooleki et al., suggest industrial hemp may require fertilization equivalent to that required for a high yielding wheat or corn crop, although both also point to limited data from which to make that conclusion. Smith-Heister reports that hemp is currently being produced in Canada with anywhere from 55 to 80 pounds of nitrogen and 40 pounds of phosphate per acre. However, Mooleki et al. cite research that documents increases in seed yield, biomass, plant height, and protein content when nitrogen is increased to about 107 pounds per acre. The same research suggested lower phosphate rates than cited by Smith-Heister, however.

Mooleki et al. also noted that the way in which fertilizer is applied is critical. They suggest that nitrogen should be side-banded, mid-row-banded, or banded in a separate operation because hemp seed is sensitive to seed-placed nitrogen. They also noted that any starter phosphate ($P_{2}O_{5}$) should be kept low, 10-15 lbs/acre, and any additional phosphate needed to correct deficiencies should be side-banded or mid-row-banded.

**Potential Profitability from Hemp Farming**

In 2004 Fortenbery and Bennett concluded that industrial hemp production in the U.S. would generally be more profitable than traditional row crops, but less profitable than other specialty crops. Their analysis was based on a detailed review of the literature prior to 2004 and several budgets developed for North America in the late 1990s. These included budgets Thompson et al. (1998) had developed for Kentucky in 1998, Ehrensing's budgets for the Pacific Northwest in 1998, Moes for Manitoba (1988), and Baxter and Scheifele for Ontario (1999), as well as a couple of others. Given the lack of North American production, however, the budgets were largely speculative (in other words, not based on actual commercial production).

Profits at that time ranged from -$241.30 per acre (Ehrensing 1998) to $316.45 per acre (Thompson et al. 1998) for just fiber production, and as much as $605.91 per acre (Thompson et al.) to as little as -$294.64 per acre (which did not include fixed costs) estimated by Moes (1998) for joint hemp seed and fiber production. Fortenbery and Bennett concluded that hemp could compete favorably with traditional row crops based on these estimates. However, prices for most commodities have increased significantly since the Fortenbery and Bennett study, and Table 3 suggests that prices for most hemp products have not. Thus, the potential competitive position of hemp as an agricultural profit center may not be what it appeared to be in the early 2000s.

More recently, Dietz (2013) has argued that hemp production has been profitable for Canadian farmers as the industry has grown. He argues that costs of seed and fertilizer for hemp production in Western Canada are similar to those of canola. Weed and disease control costs are lower than canola, but there is an increased drying cost for hemp. Hemp is generally harvested at 18 to 20 percent moisture but needs to be dried down to 9 percent or less for marketing.

Most Canadian production is grown under contract. Dietz estimates that one-third of total Canadian production is contracted through Manitoba Harvest Hemp Foods, a Winnipeg food manufacturer. With such a major focus on seed production for the food industry, it is not surprising Canada is a net importer of hemp fiber, although Dietz also states there are other companies and co-ops that contract for both hemp fiber and whole hemp.

Dietz cites contract prices for organic hemp seed in 2012 as being between Can$1.10 and Can$1.20 per pound, with conventional seed selling for between Can$0.70 and Can$0.80 per pound. These are higher than the Can$0.85 to Can$0.95 per pound organic and Can$0.45 to Can$0.60 per pound conventional that Mooleki et al reported. Mooleki et al. note that even though the Canadian industry has been growing over the last several years, markets are still not well established, and the market for fiber is almost non-existent. Therefore, they encourage farmers to have signed marketing contracts before engaging in hemp production.

In calculating potential returns for hemp producers in Kentucky, Robbins et al. (2013) also note that both hemp fiber and oilseed prices are highly uncertain, and thus they rely on a wide range of prices to measure potential profitability. They calculated potential returns to hemp production based on three price scenarios. The low price scenario assumed fiber prices of $50 per ton, and seed prices of $0.50 per pound. These prices are consistent with those reported by Mooleki et al. for hemp seed. The high price scenario assumed fiber prices were $100 per ton and seed prices of $0.90 per pound. These are more consistent with the prices reported by Dietz for Canadian producers.
In addition, Robbins et al. considered a mid-price scenario of $75 per ton for fiber and $0.70 per pound for hemp seed.

Combined with the various price scenarios, Robbins et al. considered four different levels of productivity. These were linked to potential corn production—land capable of producing 100 bushels of corn per acre represented the lowest productive environment, with the upper extreme represented by land capable of producing 175 bushels of corn per acre. Their results for the lowest price range and highest price range across all productivity levels are reproduced in Table 4.

When compared to a corn/soybean rotation in Kentucky, the profit potential of hemp does not compare as favorably as when Fortenbery and Bennett conducted their analysis (which also included profits from production in Kentucky), but hemp is generally expected to be profitable for seed production at the lowest price levels for all but lands with the lowest productivity.

When moving to the midpoint of the prices considered, Robbins et al. estimate positive returns (not including land costs) for both dual production systems (producing for both seed and fiber) and seed-only systems across all levels of land productivity. In every scenario, seed-only production systems appear to have the most profit potential. This is due to two factors: 1) Robbins et al. assume much higher rates of P and K removal with fiber production systems; and 2) higher machinery costs for fiber compared to seed production. These relative costs likely help explain why Canada focuses on seed production and continues to be a net importer of hemp fiber.

When compared to a 50-50 corn/soybean rotation in Kentucky, returns on hemp fiber production never outperform corn/soybean production except in the most extreme situations. For example, it would take 8 tons of fiber per acre at a fiber price of $125 per ton before fiber production outperforms corn with a $4 per bushel price on highly productive land. Based on correlations between corn and hemp yields, Robbins et al. estimate that farm ground expected to yield 175 bushels per acre could be expected to yield 8.1 tons of fiber per acre. Thus, for fiber production to outperform a corn/soybean system it would have to be planted on the best available land in an environment where corn prices are well below recent average prices and where hemp fiber is priced well above historical prices in North America.

Hemp seed production compares more favorably than fiber. Hemp seed on the most productive land would exceed returns from corn/soybeans with corn prices at $5 per bushel or less, soybean prices at $11.25 per bushel or less, and hemp seed prices at $0.80 cents per pound (similar to the prices reported by Dietz). This assumes a corn yield of 175 bushels per acre and a hemp seed yield of 1000 pounds per acre. Robbins et al. estimate the expected hemp seed yield on ground expected to generate 175 bushels of corn per acre would be 1050 pounds.

Based on the results of Robbins et al., it appears that the greatest near-term profit opportunity for U.S. farmers lies with the food and cosmetic industries—markets that utilize hemp seed and oil. But if hemp is grown as an oil...
seed, producers can also access the specialized bird seed market, and the seed can be crushed for oil and used in the manufacture of bio-diesel.

HIA has quoted David Bronner of Dr. Bronner’s Magic Soaps as stating that the U.S. hemp food and body care market is booming but somewhat constrained by a scarcity of hemp seeds in the market place. The inference is that there would be additional growth in this space if there were a hemp production industry to support that growth. It should be noted, however, that Canada only planted about 80,000 acres of hemp in 2013, and was expected to increase that to 100,000 acres in 2014. This is important because North American production is quite small, and if growth in production outpaces the growth in demand suggested by HIA, then prices would likely suffer and the profit scenarios developed by Robbins et al. would deteriorate.

Heisters-Smith argues that growing hemp for the seed-utilizing sector would actually compromise environmental benefits relative to hemp grown for fiber, thus reducing the social benefit derived from hemp production. She claims, however, that growing hemp for fiber not only generates the positive environmental benefits alluded to earlier, but also adds value to the other crops, including food crops, grown by potential hemp producers. She notes that hemp grown in rotation with other crops (like cereals) reduces weed and insect pressure in the other crops, and in China has been used as a barrier to repel insects from vegetable crops. In Canada hemp has been shown to reduce cyst nematodes when grown in a rotation with soybeans. If these benefits were, in fact, realized in U.S. production systems then there could be advantages to hemp fiber producers that go beyond the direct return on the fiber crop itself.

Heisters-Smith further argues that if hemp were grown for fiber in the U.S. there would be market opportunities that have not yet been realized. One is in paper production. She notes that hemp has several qualities that make it an attractive input in paper making. (Recall that the Declaration of Independence was first written on hemp paper.) These qualities include long fibers that add strength to paper, a high level of cellulose which leads to a high pulp yield, and a low lignin content which is desirable because lignin requires significant processing to remove. However, she also notes that, despite the environmental benefits of hemp, it is not currently competitive with trees as an efficient source of pulp.

Hemp fiber grown for the production of cloth has also been pointed to as an untapped market. However, as with some other uses, it is unclear just how large that market might be, and whether domestically produced hemp would compete well with hemp cloth and clothing imported from China. Heisters-Smith again points to environmental benefits of cloth derived from hemp as compared to U.S.-produced cotton, but also notes that the increased efficiency of hemp cloth production (i.e., hemp yields per acre compared to domestic cotton yields per acre) relative to competing fibers is often over-stated by proponents of hemp.

Cherret et al. (2005) conducted a life cycle comparison of water and energy inputs required in various hemp and cotton production systems, as well as the inputs required for the manufacture of polyester. They found that polyester manufacturing required six times more energy than U.S. cotton or hemp cloth production on a per-ton basis. Between cotton and hemp, the differences in energy use were from larger pesticide and irrigation requirements for cotton, but producing hemp yarn required significantly higher energy consumption because of the relatively intense processing necessary.

A third growth area that has been pointed to for hemp is the bio-energy sector. Ethanol can be produced from the cellulose in hemp fiber, but the cellulosic ethanol industry continues to lag expectations for commercial success. Further, it is not clear whether hemp has any advantages over other cellulosic energy crops being considered, such as switch grass. The two share many of the same potential environmental benefits, but there is a much longer research experience in both switch grass production (at least in the U.S.) and its conversion to energy.

Biodiesel markets are more fully developed, and if hemp is grown for seed, the seed can be crushed and the oil used as an input to the biodiesel process. In this case, it would be competing with canola oil and soybean oil. (Recall that Robbins et al. argued hemp produced for seed would be competitive with a corn/soybean rotation if produced on more productive lands.) Biodiesel is also produced from waste oils and greases in the U.S., but the supply of these feedstocks is somewhat limited and will not be able to expand if the biodiesel industry continues to grow (Fortenbery et al. 2013).

Despite both thin and relatively undeveloped markets, many proponents of industrial hemp have suggested that both hemp fiber and whole hemp could, at the least, be a competitive crop if grown in the right regions and targeted to the right industries, and in many cases could be a superior crop to those currently produced by U.S. farmers. Much of this is based on speculation about the potential growth in demand for hemp products, productive potential of hemp cultivated in the U.S., and the ability of demand, thus prices, to out-pace growth in domestic production, were production to be allowed.

Most of the debate on the potential merits and risks of cultivated hemp in the U.S. can only be addressed by systematic research and field experience. It is clear, however, that in some cases the benefits are greatly over-stated. In testimony before the Environmental Resources Committee of the Oregon Senate, Andy Kerr (2007), Board Member of the North American Hemp Council, noted that some supporters of industrial hemp (he called them “hempsters”) are making public claims with no basis in reality. As an example, he quotes a letter to the editor of Ecologist magazine:
In most cases, state legislation provides a timeline by which the researchers must deliver recommendations on the viability of an industrial hemp industry to their respective legislatures. California passed legislation in 2013 requiring industrial hemp growers to register with the state (typical of states that have legalized hemp production) and established both registration and renewal fees for commercial growers. In addition, the law calls for a five-year review of the economic impact of industrial hemp production in California. However, unlike other states, California's law does not become effective until industrial hemp production is explicitly authorized by federal law.

While there is significant variation across states, the last two years have seen substantial movement in the direction of legalizing industrial hemp production in the U.S. This, combined with language in the 2014 Farm Bill (Sec. 7606—Legitimacy of Industrial Hemp Research), suggests that the movement is gaining momentum. While some states have explicitly legalized hemp production, others are engaging in active research focused on developing a knowledge base and production experience that will support a commercial hemp industry in the future.

### Research Opportunities

As noted earlier, recent work implies that industrial hemp production could be competitive with other crops grown by U.S. farmers. However, this is largely based on speculation, due to the lack of a U.S. research base on industrial hemp production, and most comparisons do not reflect the cropping opportunities of producers in the Pacific Northwest. There are several areas of research that could contribute to both a better understanding of commercial possibilities and improvement of profit potential for a PNW commercial hemp industry.

One important area of research is cultivar development and selection. Since there has been no recent commercial production in the U.S., and, in fact, North American production is quite new, there has been little work on the development of cultivars for various U.S. production environments. There has been cultivar work conducted in Canada, but varieties grown there may not provide the greatest production potential in much of the U.S., including the Pacific Northwest.

In Canada producers must purchase certified seed that is authorized by the government. In Manitoba, for example, there are 13 varieties authorized for planting in 2015, and another one being evaluated for authorization (Seed Manitoba 2014). The approved Manitoba varieties have been field-tested for 3 to 16 years. They not only vary in expected yield and tolerance to various environmental stimuli, but also vary by expected market use. Some are better for maximizing fiber production, some for seed production, and some have developed as a dual-crop plant (harvested for both fiber and seed). Thus, breeding programs in Canada have not only focused on production characteristics of...
hemp, but also the development of specific varieties for different end uses. Understanding how the Canadian varieties perform in the Pacific Northwest is a critical starting point for research, but then developing cultivars that maximize production potential given the unique environmental factors in the PNW will be critical to ensuring a successful commercial hemp industry if one is to be developed.

Along with cultivar development, research is needed on the performance of various hemp varieties in crop rotations common across the PNW. This includes understanding both the environmental impacts (nutrient use, water use, etc.) as well as any issues associated with hemp interaction with other established crops in a rotation. Again, the research can build on work already done in the Canadian hemp production system, but the results need to be localized across the various Washington environments and production systems.

Work also needs to be conducted to understand pest pressure, and the extent to which the benefits of hemp production experienced in both China and Canada relative to weed suppression and management of insect pests is transferable to Washington environments. Further, because there has been no production in the U.S. over the last several decades, there are no registered chemicals or recommended application rates for U.S. hemp production. These would need to be established if there were to be a successful commercial hemp industry.

Fortenbery and Bennett stated in 2004 that a major challenge to developing commercial hemp in the U.S. was the lack of research on both production technologies and harvest and handling technologies. They noted that significant resources would be needed to develop less labor-intensive harvest and handling systems in order for the industry to grow and hemp to be adopted as a commercial crop on a broad scale. Significant work has been done in Canada since Fortenbery and Bennett’s work, and there is now a body of research and newer technologies to build from, but there remains a need to evaluate how to apply Canadian innovations and experience to PNW production.

In addition to work on the production side, it will be important to develop an understanding of the overall market potential for domestically produced hemp in the U.S. Is it likely, similar to Canada’s experience, that hemp grown for fiber will not compete with Chinese hemp fiber, so production strategies should focus on producing for the food and body care markets? If this is the case, what are the losses in environmental benefits associated with less dense production on a per-acre basis? R. Johnson has pointed to the potential loss in environmental benefits from seed versus fiber production, but this needs to be carefully quantified for different production environments.

Further, how large is the overall market potential? Is Bronner correct in claiming that U.S. market demand is currently constrained by a lack of domestic production?

If so, how large is the potential market, and what level of production would be sustainable, given growth in consumer demand?

**Summary**

Recent legislation in several states legalizing the production of recreational or industrial cannabis or both has provided new momentum for those interested in pursuing industrial hemp as a U.S. crop. While acreage is quite limited, it does appear that producers of hemp in Canada over the last decade have experienced some success. This has partially been aided by research conducted by Canadian universities and private companies focused on production systems (variety selection, crop management), the expansion of existing markets, and the development of new uses for hemp products.

Most Canadian producers grow hemp under contract because markets are still quite thin and not well developed. Further, Canada has focused mostly on seed production, and has become an importer of most hemp fiber used domestically. However, they have also become the largest supplier of hemp products into the U.S. market, and this leads U.S. supporters to argue that U.S. demand could—and should—be satisfied by U.S. hemp producers.

Despite significant interest in pursuing hemp production from both the agricultural community and domestic users of hemp, little research is being conducted on either hemp production systems for the U.S., or the further development of existing and new markets for hemp. Land grant universities generally, and Washington State University specifically, are well positioned to lead such research efforts if the political environment supported that activity. The U.S. federal Agriculture Act of 2014 (also called the 2014 Farm Bill) gave explicit permission for land grant institutions to pursue research related to industrial hemp production without putting federal grant dollars and other revenues at risk, but industrial hemp continues to be regulated as a Class I controlled substance by DEA.

Given the resource base in much of Washington, it is likely that Washington producers would compete well with current Canadian production on a total yield basis, and with other potential U.S. producers. As noted by several sources, hemp production in Canada requires inputs and management quite similar to that of high quality wheat or corn production, both of which are crops produced successfully in Washington.

What little research that has been done in the U.S. suggests that:

1) industrial hemp production can, at least in some instances, compete with some existing cropping systems on a profitability basis;

2) hemp production can provide environmental and agronomic benefits when incorporated into some existing cropping systems;
3) U.S. hemp could likely compete successfully with Canadian imports in U.S. markets, and
4) hemp can compete with many current inputs in industrial production, at least at current prices.

There may also be opportunities to develop new niche markets or expand existing niche markets with increased access to raw hemp inputs.

What is less clear is how large the potential markets for hemp-based products are, and thus the level of production that would be sustainable. However, these are issues that are often settled by the market itself, and also are a function of technological, agronomic, and industrial innovation. These, in turn, are influenced by the scope and pace of both public and private sector research.

Whether demand growth will be sufficient to sustain a U.S. hemp industry that goes beyond Canada's current production of only 100,000 acres is unclear, but the potential is more readily addressed as an empirical question (involving research and field trials) than as an abstract debate. While Canada's hemp industry is still quite small, it has seen growth over the last decade. It is not unreasonable to expect similar results would be possible in a U.S.-based industry as well.
Appendix I.


State Statutes

California
CA FOOD & AG §81000-81010

- Requires industrial hemp growers to be registered with the state.
- Prohibits the possession of resin, flowering tops, or leaves removed from the hemp plant.
- Establishes registration and renewal fees for commercial growers of industrial hemp.
- Organizes a five-year review of industrial hemp's economic impact.
- While legislation adding this section was enacted in 2013, the law specifies that its provisions do not become operative unless authorized by federal law.

Colorado
CRS § 25-18.7-101 to -105

- Permits growing and possessing industrial hemp.
- Establishes industrial hemp remediation pilot program “to determine how soils and water may be made more pristine and healthy by phytoremediation, removal of contaminants, and rejuvenation through the growth of industrial hemp.”

Connecticut
Public Act No.14-191

(Enacted June 12, 2014; went into effect on October 1, 2014)

- Legalizes a feasibility study on industrial hemp.
- Commissioners of Agriculture, Consumer Protection, and Economic and Community Development shall study the feasibility of legalizing the production, possession, and sale of industrial hemp, respectively.
- By Jan. 1, 2015, a report will be made to the legislature regarding “[...]said commissioners' recommendations on (1) establishing a statutory definition of "industrial hemp," based on the percentage of proposed tetrahydrocannabinol in such industrial hemp, as distinguished from marijuana, (2) amending the general statutes to exclude industrial hemp from the definition of "controlled substance" in section 21a-240 of the general statutes, and (3) establishing a licensing system for industrial hemp growers and sellers.”

Delaware

- Establishes the Industrial Hemp Research act.
- Provides for academic research standards for industrial hemp.

Hawaii
S.B. 2175

- “Authorizes the dean of the College of Tropical Agriculture and Human Resources at the University of Hawaii at Manoa to establish an industrial hemp remediation and biofuel crop research program;
- requires a report on the rate of contamination uptake and efficient uptake from soil and water, the rate of carbon fixation in the Calvin cycle and the viability of industrial hemp as a biofuel feedstock;
- clarifies that the term 'industrial hemp' means the plant Cannabis sativa L;
- provides criminal and civil immunity.”

Illinois
720 ILCS 550 § 15.2

- Establishes Hemp Pilot Project, in which:
  (1) industrial hemp is grown or cultivated for purposes of research conducted under an agricultural pilot program or other agricultural or academic research;
  (2) the pilot program studies the growth, cultivation, or marketing of industrial hemp; and
  (3) any site used for the growing or cultivating of industrial hemp is certified by, and registered with, the Department of Agriculture.
- Before conducting industrial hemp research, the Department of Agriculture and local law enforcement must be informed in writing.
- Institutions of higher education must provide quarterly and annual reports to the Department of Agriculture and are subject to inspection. The annual report is due on or before October 1.
- Allows the Department of Agriculture to adopt rules to comply with federal rules or to adopt emergency rules deemed necessary to public interest safety and welfare.
- Defines industrial hemp.
Indiana
IC 15-15-13-7
• "Industrial hemp is an agricultural product that is subject to regulation by the state seed commissioner."
• The state seed commissioner adopts rules and oversees licensing, production, and management of industrial hemp and agricultural hemp seed.
• Sets the standards for application for hemp license and registration.

Kentucky
KRS § 260.850-.869
• Establishes research on industrial hemp and industrial hemp products.
• "Industrial hemp means all parts and varieties of the plant *Cannabis sativa*, cultivated or possessed by a licensed grower, whether growing or not, that contain a tetrahydrocannabinol concentration of one percent (1%) or less by weight, except that the THC concentration limit of one percent (1%) may be exceeded for licensed industrial hemp seed research.
• "The Department of Agriculture shall promote the research and development of markets for Kentucky industrial hemp and hemp products after the selection and establishment of the industrial hemp research program and the Industrial Hemp Commission..."
• Includes language that "Kentucky shall adopt the federal rules and regulations that are currently enacted regarding industrial hemp and any subsequent changes thereto."
• On Feb. 19, 2014, Kentucky announced five pilot hemp projects that would be used across the state, including one project that would research whether industrial hemp could be used to remediate tainted soil.

Maine
7 M.R.S.A. § 2231
• Requires industrial hemp growers be licensed by the state.
• Permits a person to “plant, grow, harvest, possess, process, sell and buy industrial hemp” if that person holds a license.
• Prohibits the state from issuing a license unless “The United States Congress excludes industrial hemp from the definition of "marihuana" for the purpose of the Controlled Substances Act, 21 United States Code, Section 802(16); or... the United States Department of Justice, Drug Enforcement Administration takes affirmative steps towards issuing a permit under 21 United States Code, Chapter 13, Subchapter 1, Part C to a person holding a license issued by a state to grow industrial hemp.”

17-A M.R.S. § 1101-1117
• Under criminal code, it is an affirmative defense to drug trafficking, furnishing, cultivation or possession charges if the substance so used is industrial hemp.
• "Industrial hemp means any variety of *Cannabis sativa* L. with a delta-9-tetrahydrocannabinol concentration that does not exceed 0.3% on a dry weight basis and that is grown under a federal permit in compliance with the conditions of that permit."

Montana
• States that industrial hemp that does not contain more than 0.3% tetrahydrocannabinol is an agricultural product.
• "...an individual in this state may plant, grow, harvest, possess, process, sell, or buy industrial hemp if the industrial hemp does not contain more than 0.3% tetrahydrocannabinol."
• Requires industrial hemp growers be licensed by the state.
• Creates an affirmative defense to prosecution under criminal code for marijuana possession or cultivation.

Nebraska
NE L 101
• To permit growth and cultivation of industrial hemp by a postsecondary institution or the Department of Agriculture as prescribed;
• To exempt industrial hemp from the Uniform Controlled Substances Act as prescribed;
• To provide powers and duties for the Department of Agriculture;
• And to repeal the original section.

New Hampshire
2014 HB 153
• This bill establishes a committee to study the growth and sale of industrial hemp in New Hampshire.
• The study must report their findings by Nov. 1, 2014.

North Dakota
N.D. Cent. Code, § 4-41-01 to 4-41-03 (2009)
• States that industrial hemp that does not contain more than 0.3 percent is considered an oilseed.
• "...any person in this state may plant, grow, harvest, possess, process, sell, and buy industrial hemp (*Cannabis sativa* L.) having no more than 0.3 percent tetrahydrocannabinol."
• Requires industrial hemp growers be licensed by the state.
• "North Dakota State University and any other person licensed under this chapter may import and resell industrial hemp seed that has been certified as having no more than 0.3 percent tetrahydrocannabinol."

Oregon
O.R.S. § 475.005
• Excludes industrial hemp from definition of "controlled substance."
O.R.S. § 571.300 to .315
• Requires industrial hemp growers be licensed by the state.
• Authorizes "industrial hemp production and possession, and commerce in industrial hemp commodities and products."

South Carolina
S. 839
• "Adds chapter 55 concerning industrial hemp; provides that it is lawful to grow industrial hemp in this state;
• clarifies that industrial hemp is excluded from the definition of marijuana;
• prohibits growing industrial hemp and marijuana on the same property or otherwise growing marijuana in close proximity to industrial hemp to disguise the marijuana growth."

Tennessee
TN AG Code 916
• "Authorizes growing of industrial hemp subject to regulation by the Department of Agriculture;
• provides for license fees;
• provides that industrial hemp is not marijuana but can be categorized as a controlled substance under specified circumstances;
• provides that the department has the right to inspect the hemp crop for compliance."

Utah
UT H 105
• Permits the Department of Agriculture and a certified higher education institution to grow industrial hemp for education.
• Exempts an individual with intractable epilepsy who uses or possesses hemp extract or an individual who administers hemp extract to a minor with intractable epilepsy.
• Provides for a hemp extract registration card; requires maintenance of neurologist medical records and a database of neurologist evaluations.

Vermont
6 V.S.A. § 561 to 566
• "Industrial hemp means varieties of the plant Cannabis sativa having no more than 0.3 percent tetrahydrocannabinol, whether growing or not, that are cultivated or possessed by a licensed grower in compliance with this chapter."
• "Industrial hemp is an agricultural product which may be grown, produced, possessed, and commercially traded in Vermont ..."
• Requires industrial hemp growers to be licensed by the state.

West Virginia
W. Va. Code § 19-12E-1 to 19-12E-9
• "Industrial hemp that has not more than 1 percent tetrahydrocannabinol is considered an agricultural crop in this state if grown for... purposes authorized."
• Requires industrial hemp growers be licensed by the state.
• Creates a complete defense to prosecution under criminal code for marijuana possession or cultivation.
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