



PURDUE UNIVERSITY INDUSTRIAL HEMP INITIATIVE



Dr. Janna Beckerman
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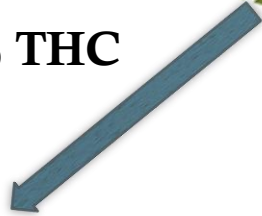
AG RESEARCH AT PURDUE
People Making an Impact

Cannabis sativa in production

Cultivated for over 4,500 years



<0.3% THC



Hemp

Agricultural
Production



Fiber



Oil



Food/Feed

Glasshouse
Production



**Cannabinoids
(CBDs)**

Marijuana

Glasshouse
Production



THC



**Cannabinoids
(CBDs)**

Comparison between Hemp and Marijuana



**Both are *Cannabis sativa* but have been bred
and selected for different uses**

Industrial Hemp developed in Canada

VARIETY	COUNTRY WHERE MAINTAINED	EXEMPT FROM THC TESTING under subsection 16(1) of the <i>Industrial Hemp Regulations*</i>
<i>Alyssa</i>	<i>Canada</i>	<i>Exempt in MB and QC only</i>
<i>Anka</i>	<i>Canada</i>	<i>Exempt in ON and QC only</i>
<i>Canda</i>	<i>Canada</i>	<i>Exempt in MB only</i>
<i>CanMa</i>	<i>Canada</i>	<i>Exempt in QC and SK only</i>
<i>Carmagnola</i>	<i>Italy</i>	<i>No</i>
<i>Carmen</i>	<i>Canada</i>	<i>No</i>
<i>CFX-1</i>	<i>Canada</i>	<i>Yes</i>
<i>CFX-2</i>	<i>Canada</i>	<i>Yes</i>
<i>Crag</i>	<i>Canada</i>	<i>Yes</i>
<i>CRS-1</i>	<i>Canada</i>	<i>Yes</i>
<i>CS</i>	<i>Italy</i>	<i>No</i>
<i>Delores</i>	<i>Canada</i>	<i>Exempt in MB only</i>
<i>Deni</i>	<i>Canada</i>	<i>No</i>
<i>ESTA-1</i>	<i>Canada</i>	<i>No</i>
<i>Fasamo</i>	<i>Germany</i>	<i>No</i>
<i>Fedrina 74</i>	<i>France</i>	<i>No</i>
<i>Felina 34</i>	<i>France</i>	<i>No</i>
<i>Ferimon</i>	<i>France</i>	<i>Exempt in QC only</i>

VARIETY	COUNTRY WHERE MAINTAINED	EXEMPT FROM THC TESTING under subsection 16(1) of the <i>Industrial Hemp Regulations*</i>
<i>Fibranova</i>	<i>Italy</i>	<i>No</i>
<i>Fibriko</i>	<i>Hungary</i>	<i>No</i>
<i>Fibrimon 24</i>	<i>France</i>	<i>No</i>
<i>Fibrimon 56</i>	<i>France</i>	<i>No</i>
<i>Finola**</i>	<i>Canada (Finland)</i>	<i>No</i>
<i>Georgina</i>	<i>Canada</i>	<i>No</i>
<i>GranMa</i>	<i>Canada</i>	<i>No</i>
<i>Grandi</i>	<i>Canada</i>	<i>No</i>
<i>Joey</i>	<i>Canada</i>	<i>No</i>
<i>Jutta</i>	<i>Canada</i>	<i>Exempt in ON only</i>
<i>Katani</i>	<i>Canada</i>	<i>No</i>
<i>Kompolti</i>	<i>Hungary</i>	<i>No</i>
<i>Kompolti Hibrid TC</i>	<i>Hungary</i>	<i>No</i>
<i>Kompolti Sargaszaru</i>	<i>Hungary</i>	<i>No</i>
<i>Lovrin 110</i>	<i>Romania</i>	<i>No</i>
<i>Petera</i>	<i>Canada</i>	<i>No</i>
<i>Piccolo</i>	<i>Canada</i>	<i>No</i>
<i>Silesia</i>	<i>Canada</i>	<i>No</i>
<i>UC-RGM</i>	<i>Canada</i>	<i>No</i>
<i>Uniko B</i>	<i>Hungary</i>	<i>No</i>
<i>USO 14</i>	<i>Canada (Ukraine)</i>	<i>Yes</i>
<i>USO 31</i>	<i>Canada (Ukraine)</i>	<i>Yes</i>
<i>Victoria</i>	<i>Canada</i>	<i>No</i>
<i>X-59 (Hemp Nut)</i>	<i>Canada</i>	<i>Yes</i>
<i>Yvonne</i>	<i>Canada</i>	<i>No</i>
<i>Zolotonosha 11</i>	<i>Canada (Ukraine)</i>	<i>Exempt in MB only</i>

Many French, Hungarian, Polish, Romanian, Ukrainian, Russian, Italian, Serbian, German and China cultivars

NO U.S. CULTIVARS

Table 1. Industrial Hemp Varieties Cultivated in 2014 in Canada

Variety	Alberta		Other Provinces		Total	
	hectares (ha)	acres (ac)	hectares (ha)	acres (ac)	hectares (ha)	acres (ac)
Finola	7,402.5	18,292	6,263.97	15,479	13,666.47	33,771
CFX-2	1,394.37	3,446	10,142.05	25,062	11,536.42	28,505
X-59	1,470.75	3,634	6,455.92	15,953	7,926.67	19,587
CRS-1	65	161	6,262.26	15,474	6,327.26	15,635
CFX-1			1,253.89	3,098	1,253.89	3,098
Canda			1,150.75	2,844	1,150.75	2,844
Delores			1,017.21	2,514	1,017.21	2,514
CanMa			274.72	679	274.72	679
Anka			263.83	652	263.83	652
Ferimon			215.29	532	215.29	532
USO 31			108.07	267	108.07	267
Alyssa			74.98	185	74.98	185
USO 14			59.88	148	59.88	148
Joey			8	20	8	20
Carmen			4.05	10	4.05	10
Other	10	24.7	11.04	27	11.04	27
Total	10,342.62	25,557	33,565.91	82,943	43,908.53	108,500

Cannabis Biology

- Hemp is a short day plant.
- Hemp is dioecious, meaning plants can be male or female.
 - Think asparagus
- Specially bred hybrids can be mostly monoecious plants and female
 - so-called “all-female,” these generally also produce some hermaphrodites and occasional males.
- **No pesticides (insecticides, herbicides or fungicides) are registered for use on hemp in the United States.**



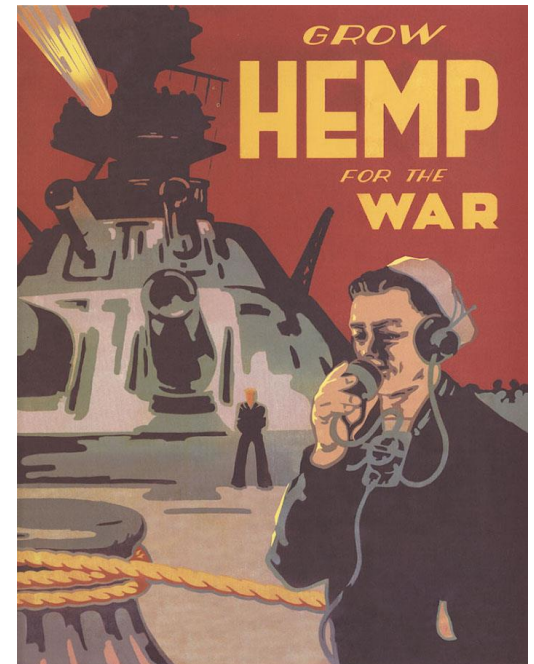
Federal Regulation

The first federal law restricting hemp production was the Marijuana Tax Act of 1937

- *Pull back of law WWII* (~146,200 AC in 1943 to zero by the 1950s)

The Controlled Substance Act 1970 – **declared all cannabis varieties** as a controlled substance and under the regulatory authority of DEA (Drug Enforcement Authority)

Cannabis (including hemp) declared schedule one narcotic



Marihuana Tax Act of 1937 defined hemp as a narcotic drug, requiring that farmers growing hemp hold a federal registration and special tax stamp, effectively limiting further production expansion

US Farm Bill sec. 7606. LEGITIMACY OF INDUSTRIAL HEMP RESEARCH

Industrial hemp is grown or cultivated for **purposes of research** conducted under an agricultural pilot program or other agricultural or academic research; and the growing or cultivating of industrial hemp is allowed under the laws of the State....(2014)

Section 543 / 763 of Public Law 114-113: preclude federal funds from being used “to prohibit the transportation, processing, sale or use of industrial hemp that is grown or cultivated in accordance with” the Agricultural Act of 2014. (Protects hemp research as defined in 7606.)

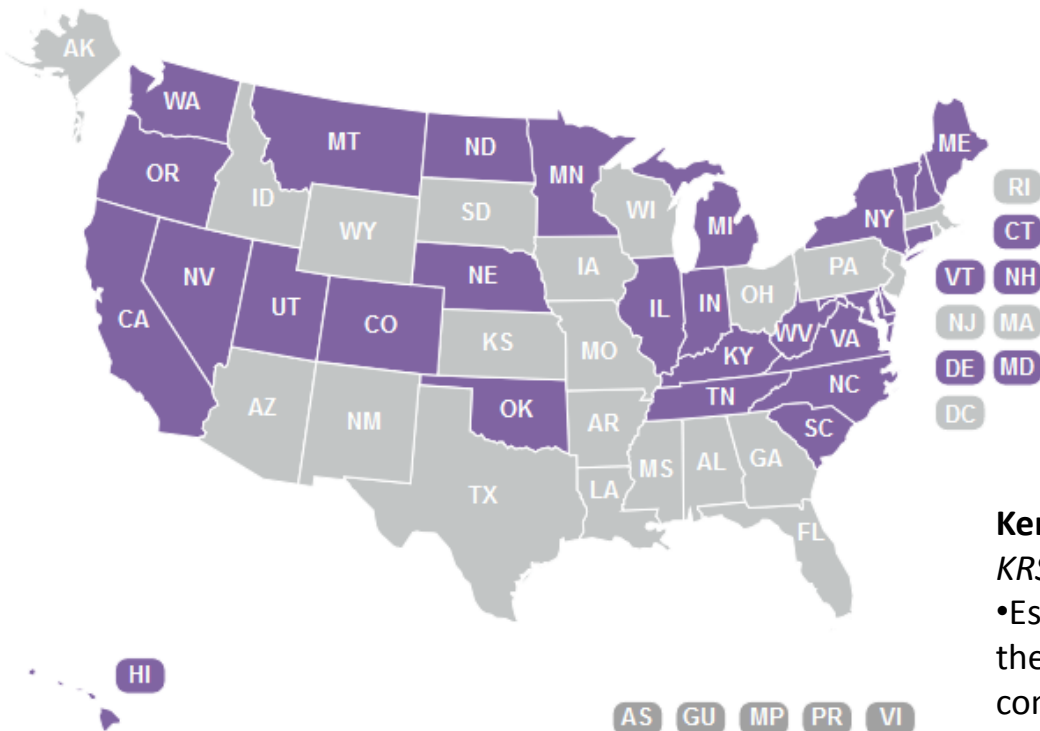
US Farm Bill sec. 7606

The farm bill established a statutory definition of “industrial hemp” as the plant *Cannabis sativa L.* and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than **0.3 percent** on a dry weight basis

State Laws Related to Industrial Hemp

Allows cultivation of hemp for commercial, research or pilot programs

Does not allow cultivation of hemp.



31 States

<http://www.ncsl.org/research/agriculture-and-rural-development/state-industrial-hemp-statutes.aspx>

Indiana

IC 15-15-13-1 to 15-15-13-17

- Authorizes the production of, possession of, scientific study of, and commerce in industrial hemp in Indiana by license holders.
- “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 an industrial hemp commission to promote the research and development of industrial hemp, and commercial markets for Kentucky industrial hemp and hemp products.
- Establishes a five year industrial hemp research program, to be directly managed by the University of Kentucky Agricultural Experiment Station to conduct research on industrial hemp for a variety purposes.
- Establishes an industrial hemp licensing program.
- Includes language that "Kentucky shall adopt the federal rules and regulations that are currently enacted regarding industrial hemp and any subsequent changes thereto."

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.

Buying seed & the Permitting Process for Hemp

State must allow industrial hemp research

Licensing

Need to meet state requirements for production license

Need to acquire a DEA Schedule One Research license

Develop research plan seek approvals with state and local authorities

Purchase seed

Need to find a seed source: International (no US genetic materials) establish MTA

Need to apply for a DEA 357 import form (on-line system)

- Sources are prescreened by DEA

Receive permit by US mail from DEA and then send **paper copy** to your seed supplier

International source, must have internal approvals to export

- USDA phytosanitation rules **MUST BE Met**


Shipping by air freight (min bag size 25kg)

Entry approval and ground transport to field site -- Field site security

2015
Indiana Industrial Hemp License

authorizes the license holder listed hereon to engage in research projects on Industrial Hemp in accordance with Section 7606 of the 14 Farm Bill of the United States and applicable laws of the State of Indiana (IC 13-15-13).

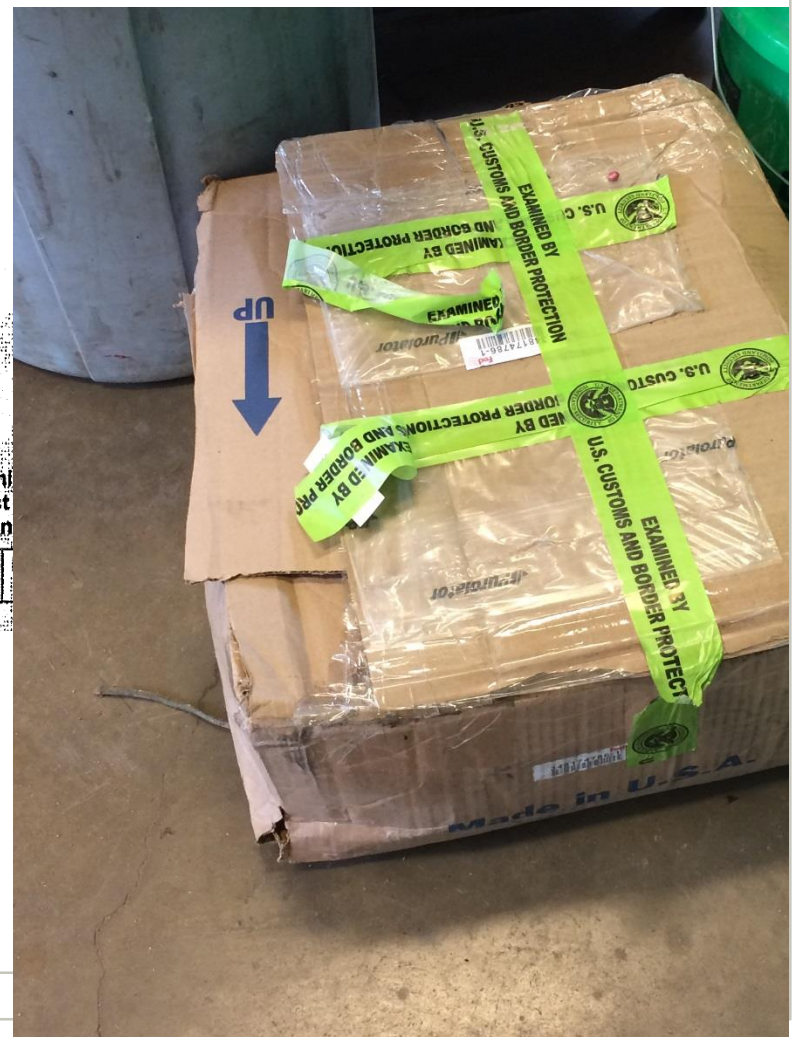
ED BY:
of Indiana Seed Commissioner
University St.
University
fayette, IN 47907




LICENSE NUMBER: 2015-02
EXPIRATION DATE: 31-DEC-2015
LICENSE CATEGORY: RESEARCH
ISSUE DATE: 20-FEB-2015

“We are properly permitted”

DEA REGISTRATION NUMBER	THIS REGISTRATION EXPIRES	FEE PAID	CONTROLLED SUBSTANCE REGISTRATION CERTIFICATE UNITED STATES DEPARTMENT OF JUSTICE DRUG ENFORCEMENT ADMINISTRATION WASHINGTON D.C. 20537 Restricted to Government personnel for official duties only. Sections 304 and 1008 (21 USC 824 and 958) of the Controlled Substances Act of 1970, as amended, provide that the Attorney General may revoke or suspend a registration to manufacture, distribute, dispense, import or export a controlled substance. THIS CERTIFICATE IS NOT TRANSFERABLE ON CHANGE OF OWNERSHIP, CONTROL, LOCATION, OR BUSINESS ACTIVITY, AND IT IS NOT VALID AFTER THE EXPIRATION DATE.
	06-30-2016	FEE EXEMPT	
SCHEDULES	BUSINESS ACTIVITY	ISSUE DATE	
1,	RESEARCHER (I)	04-23-2015	
AGRICULTURAL RESEARCH PROGRAMS, PROFESSOR PURDUE UNIVERSITY			



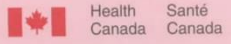


U.S. Department of Justice
Drug Enforcement Administration

PERMIT TO IMPORT

The Administrator of the Drug Enforcement Administration, being the official charged with the administration of the Importation of the dangerous drugs to which the Controlled Substances Import and Export Act applies, authorizes and permits the following importation of controlled substances from the United States:

DATE OF ISSUE APRIL 28, 2015	EXPIRATION DATE OCTOBER 28, 2015
IMPORTER AGRICULTURAL RESEARCH PROGRAMS	



EXPORT PERMIT

Controlled Drugs and Substances Act

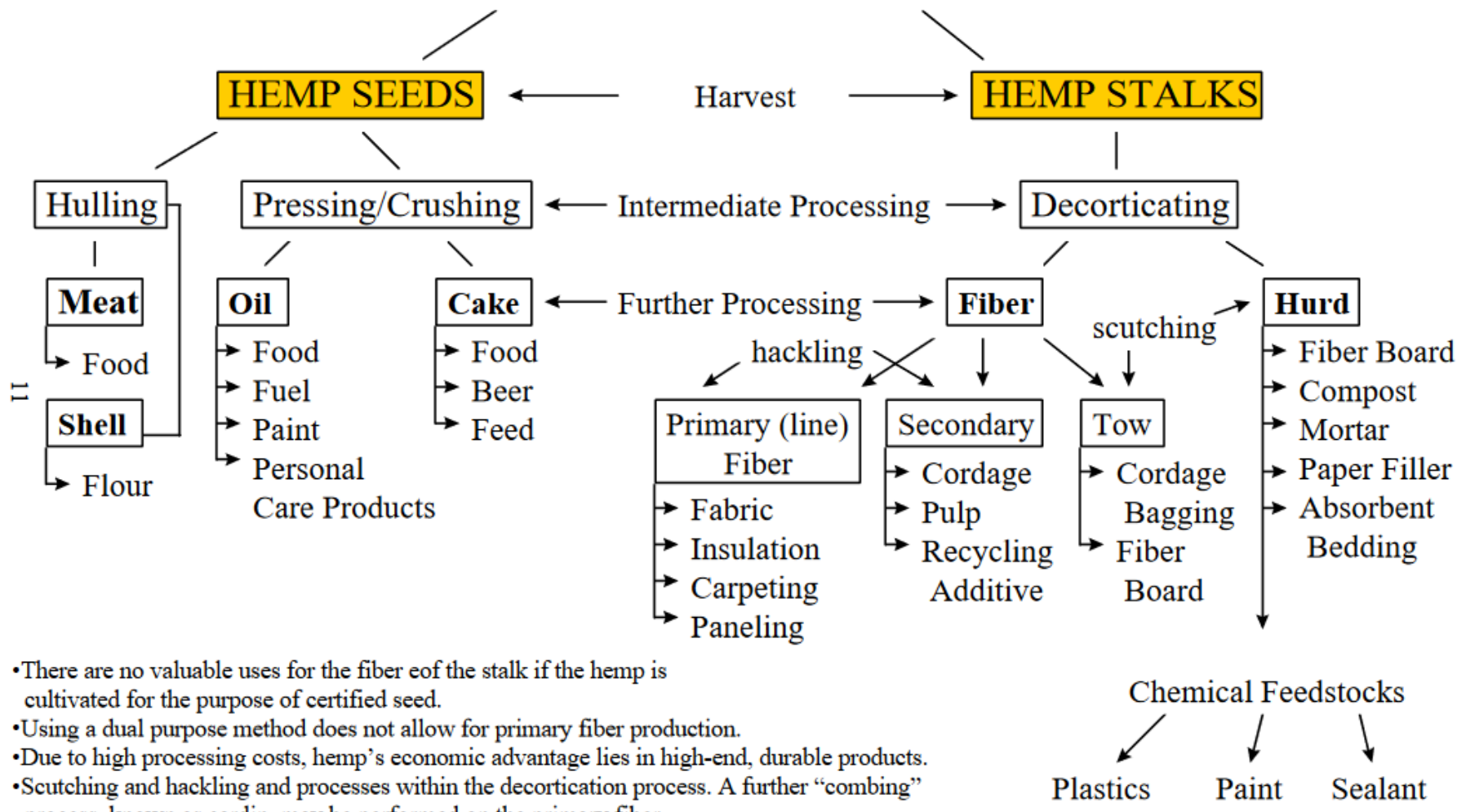
PERMIS D'EXPORTATION

Loi réglementant certaines drogues et autres substances

Permit No. / N° de permis
PE-15-P0075-C-01/004

Expiry date / Date d'expiration
August/Août 22, 2015

INDUSTRIAL HEMP



- There are no valuable uses for the fiber of the stalk if the hemp is cultivated for the purpose of certified seed.
- Using a dual purpose method does not allow for primary fiber production.
- Due to high processing costs, hemp's economic advantage lies in high-end, durable products.
- Scutching and hackling and processes within the decortication process. A further "combing" process, known as cardin, may be performed on the primary fiber.

Figure 4. Hemp Products Flowchart. Processing to End Product Groups. Dustin Mathern, Undergraduate, Jodi L. Young. Department of Agricultural Economics, North Dakota State University, 1998.

Why Hemp?

HEMP SEED



SAMPLE COMMERCIAL USES

Oil



cosmetics
foods
lubricants

paint
resins

Seed / Seed Cake



beer/liquor
birdseed
cosmetics

gluten-free flour
non-dairy milk
protein powders

HEMP STRAW



SAMPLE COMMERCIAL USES

Bast / Fibre



automotive parts
bio-composites
canvas
carpets
caulking
containers

geo-textiles
insulation
packaging
paper
rope/twine
textiles (apparel)

Shive / Hurd



animal bedding
building materials
fibreboards

insulation
stucco/plaster

Hemp as feed or food?



- Hemp seed added is great source of polyunsaturated essential fatty acids.
 - positive effect on cardiovascular function, organ function, immunity levels, inflammation and muscle recovery.
- 30-40% of weight of hemp seed edible oils
- Contains all 20 amino acids including 9 essential
- high in protein and good fatty acids, including the essential fatty acids
 - **alpha-linolenic acid** (an omega-3 fatty acid)
 - **linoleic acid** (an omega-6 fatty acid).

Seed/Oil/Meal



- Seed Yield-300-1200 lbs. per acre
- \$.40-1.00 per pound
- Specialty oilseed crushing mills that could accommodate hemp seed do exist in the United States.
 - Mostly in North Dakota

Fiber

- Yields 1-5.5 tons per acre of fiber
- 12,000 lbs. straw per hectare = 5,000 pound acre
- 25% of straw = fiber 1215 pounds
- Fiber price \$70-\$180 per ton
- Fiber \$100-\$900

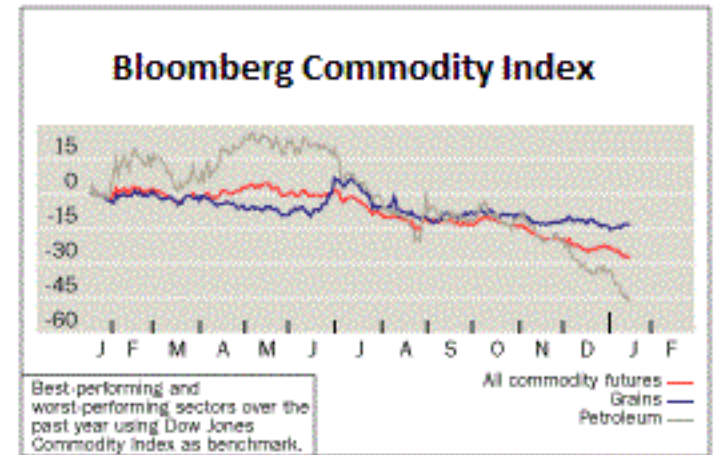
- Total estimates \$400-\$1400
- Best guess \$900-\$1100



http://www.frankferrisco.com/hemp_casting/hemp_casting_fiber.html

Economic Impact

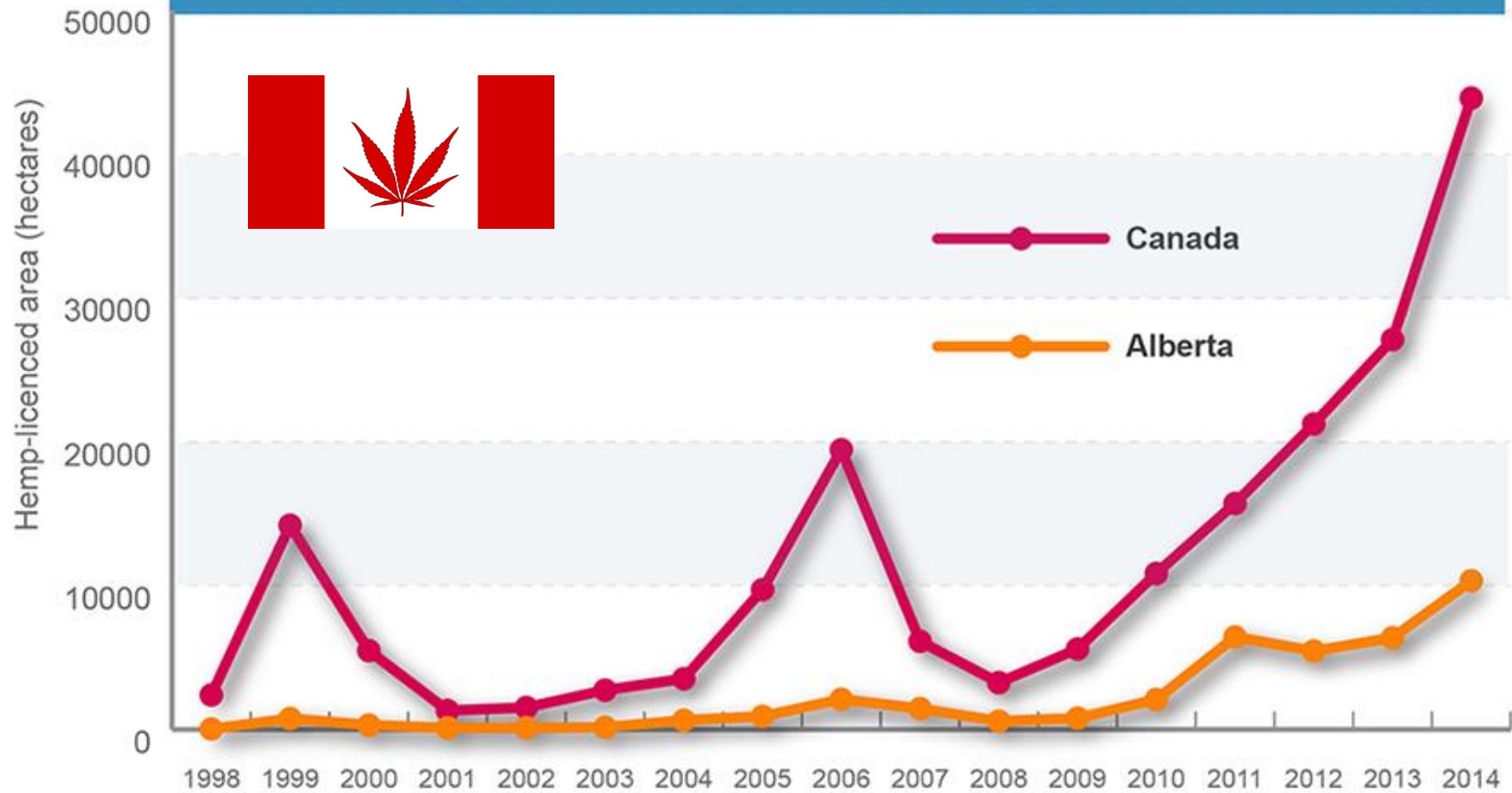
- The profitability potential is real
 - So are the obstacles to development
- Seed – Contracts
 - Foods Alive
- Processing and Manufacturing
 - Flex Form (Elkhart, IN)
- Oil
- Corn, Wheat, and Soybean Prices to Fall in 2016



World view

- 55,600 metric tons, with China, South Korea and the Russian Federation as the lead producers (none of these countries has ever made industrial hemp cultivation illegal).
- 70% of total world supply.
- Hemp is government subsidized in these countries.

Hemp-licensed Area in Alberta and Canada



Canada had 38,828 licensed acres in 2011.

Over 80 percent of this was for seed production

Canada estimated gross revenue of between \$30.75 million to \$34.17 million

Purdue Hemp Research



Fertilizer Rates

	Hemp	Corn
Nitrogen	100-200 lb/acre	120-240 lbs /acre
Phosphorous	45-70 lb/acre	25-125 lb/acre
Potassium	50-70 lb/acre	50-200 lb/acre

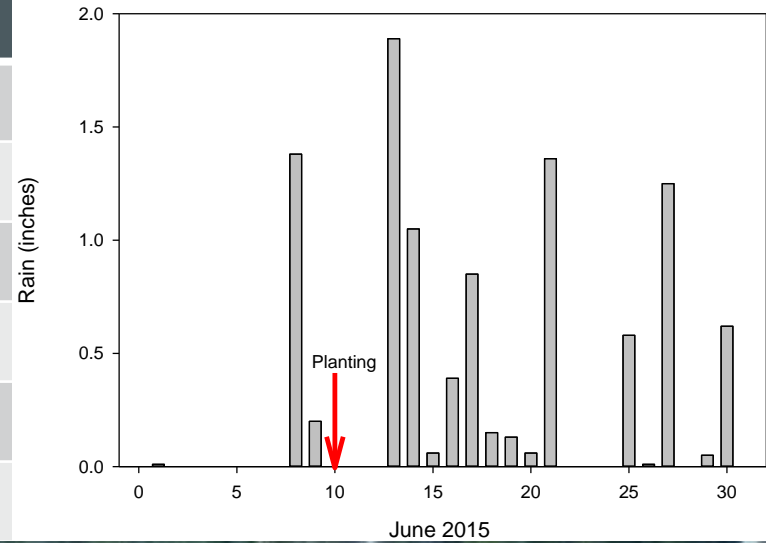
6/18/2015



7/10/2015



Month	Normal	2015	Over/under
April	3.58 in	3.61 in	+0.03 in
May	4.76	4.37	-0.39
June	4.09	10.41	+6.20
July	4.21	7.19	+2.98
August	3.62	1.23	-2.39
Sept	3.58	3.44	-0.14





9/1/2015

Yields for 2015 Limited data set

Canda

Alyssa

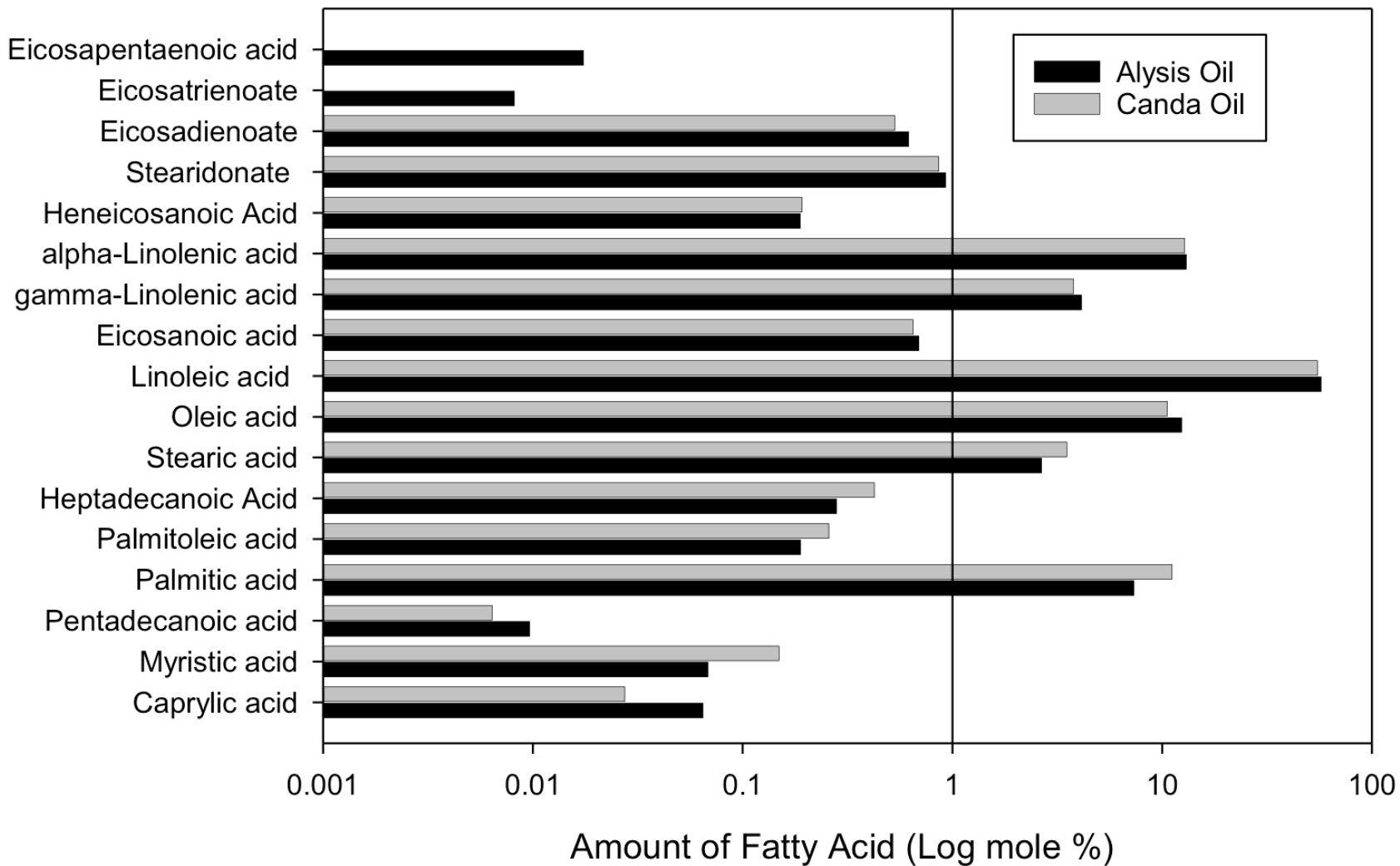
1241 lbs of seed/ac

1281 lbs of seed/ac

172 lbs of oil / ac

253 lbs of oil /ac

Average THC = 0.11% +/- 0.043



Yield Fiber

- Yields can be about 3-5 tons fiber/acre
- Most conventional equipment cannot handle the fibers of hemp, specialized machinery has been developed



(Willie Nelson Peace Research Institute)

Hemp and Disease



Hemp Foliar Disease



- Hemp is susceptible to several foliar diseases, including:
 - Cercospora leaf spot results in circular, depressed sunken centers.
 - Phoma leaf spot has been reported to reduce yield.
- McPartland (1995) described these and other pathogens, but did not describe the economic impact of these species.

Land races v. ditchweed



All Cannabis is Schedule 1

- Prevents the research needed to sustainably manage hemp.
 - Numerous fungicides used in conventional agriculture are highly effective and are labeled to manage these pathogens on other crops--including tobacco.
 - To date, only those minimum risk pesticides that meet certain criteria are exempt from federal registration under section 25(b) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and can be used for any and all Cannabis production;
 - These pesticides have limited efficacy data against plant pathogens compared to fungicides already approved for other crops

No EPA approval for Hemp Pesticides

- No one knows which pesticides would be effective and safe because no one can do the research.
- States are offering FIFRA 25b pesticides.
- On biological control to manage plant pathogens, the findings of one meta-analysis stated "investigators often attempt unsuccessfully to compensate for anticipated poor performance in antagonist–disease combinations by making more applications."

Summary

- Hemp is presently a niche market
- Agricultural supply chain needs to be re-established.
- Breeding for varieties with modern attributes are needed.
- Harvesting equipment needs upgrade.
- Processing and manufacturing need to be modernized
- New opportunities identified

BILLION-DOLLAR CROP

petition with coolie-produced foreign fiber while paying farmers fifteen dollars a ton for hemp as it comes from the field.

From the farmers' point of view, hemp is an easy crop to grow and will yield from three to six tons per acre on any land that will grow corn, wheat, or oats. It has a short growing season, so that it can be planted after other crops are in. It can be grown in any state of the union. The long roots penetrate and break the soil to leave it in perfect condition for the next year's crop. The dense shock of leaves, eight to twelve feet above the ground, chokes out weeds. Two successive crops are enough to reclaim land that has been abandoned because of Canadian thistles or quack grass.

Under old methods, hemp

(Continued to page 144A)



Top, modern version of linen duster made from hemp. Bottom, harvesting hemp with a grain binder. Hemp grows luxuriously in Texas

Purduehemp.org

PURDUE
UNIVERSITY

HEMP PROJECT

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THE PURDUE HEMP PROJECT

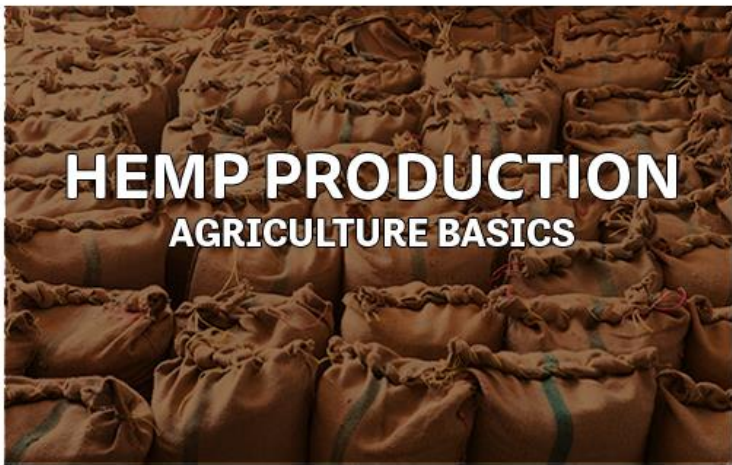
THE PURDUE HEMP PROJECT

This website provides information to support 21st century hemp (*Cannabis sativa L.*) cultivation in the Midwest. All crops have issues with respect to production; however, with a crop like hemp, which was banned in the United States for over eighty years, large information gaps have developed with regards to production, pest management and economic impact. Unlike other agronomic crops, U.S. hemp production faces additional obstacles in form of U.S. government drug policies.

The goal of this website is to inform the public about industrial hemp as a crop, and to identify the challenges faced by modern industrial hemp producers in the North Central Region—from the legal production of the crop, to the pest management that will be necessary to produce long-term sustainable yields of hemp. We have tried to use our present experience growing hemp and years of additional experiences with other cropping systems to inform our production practices. What we have learned sometimes conflicts with “conventional wisdom”. We hope this website continues to improve on what we know and provides a sound foundation for those interested in growing industrial hemp.

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 **INHIA** @IndianaHIA 5 Nov
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 **Jamie** @JamieINHIA 10 Nov
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@noonedition Thank you for sharing #HoosierHemp facts ! Proud to have @PurdueHemp and @RealHempLLC participating! #votehemp #TeamHemp
Retweeted by Purdue Hemp

FACEBOOK

 **Purdue Hemp**
Liked 343 likes

You like this



 **Purdue Hemp** shared Indiana Hemp Industries Association's post.
November 29, 2015

 **Indiana Hemp Industries Association**
November 18, 2015

Because there is no such thing as too much #HoosierHemp coverage, here's a fab radio interview conducted by WFIU Public Radio's Drew Daudelin just after the ...

[See More](#)



The Science of Industrial Hemp



THE SCIENCE OF

Industrial Hemp CONFERENCE

July 27–29, 2016 | Denver, CO



AG RESEARCH AT PURDUE

People Making an Impact