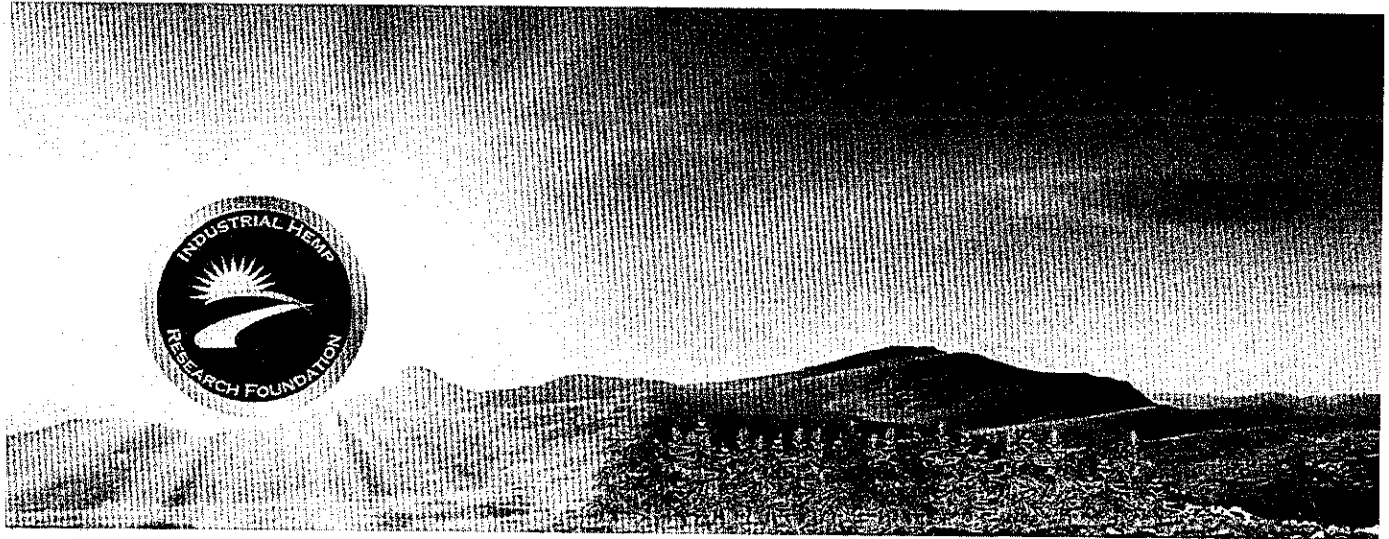
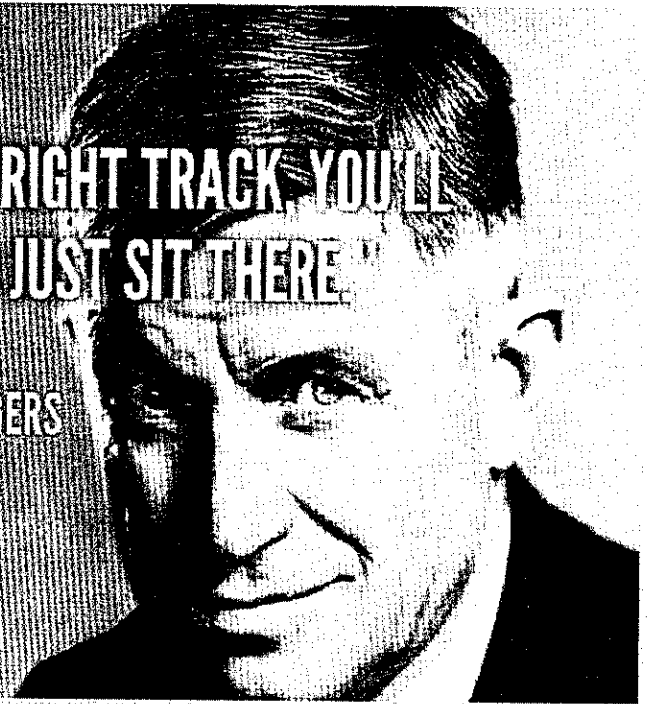


**"EVEN IF YOU'RE ON THE RIGHT TRACK, YOU'LL  
GET RUN OVER IF YOU JUST SIT THERE."**

**WILL ROGERS**



## Validation of Industrial Hemp

Paul Isham, Executive Dir. | Industrial Hemp Research Foundation  
President, New World Hemp Consultants, Inc.

# IHRF Mission Statement

THE INDUSTRIAL HEMP RESEARCH FOUNDATION IS DEDICATED TO SUPPORTING INDUSTRIAL HEMP RESEARCH PROGRAMS AT INSTITUTIONS OF HIGHER LEARNING AND EDUCATION IN COLORADO AND ACROSS THE UNITED STATES. WE AIM TO INCREASE THE BODY OF KNOWLEDGE AND RAISE PUBLIC AWARENESS OF THE MANY KNOWN AND POTENTIAL APPLICATIONS OF INDUSTRIAL HEMP TO IMPROVE LIVING STANDARDS, CREATE JOBS, SAFEGUARD THE ENVIRONMENT, ENCOURAGE COMPLIANCE, AND ENHANCE THE QUALITY OF LIFE FOR ALL PEOPLE.



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- The Foundation
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**HempBizJournal**  
STRATEGIC INFORMATION AND DATA FOR THE HEMP INDUSTRY

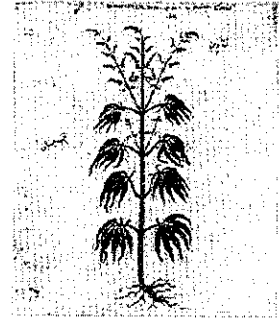


**David Law**



# A Contextual Brief on Hemp

Hemp is one of the earliest domesticated plants known. It has been cultivated by many civilizations for over 12,000 years. Hemp use archaeologically dates back to the Neolithic Age in China, with hemp fiber imprints found on Yangshao culture pottery dating from the 5th millennium BC. The Chinese later used hemp to make clothes, shoes, ropes, and an early form of paper.



Textile expert Elizabeth Wayland Barber summarizes the historical evidence that *Cannabis sativa*, "...grew and was known in the Neolithic period all across the northern latitudes, from Europe (Germany, Switzerland, Austria, Romania, Ukraine) to East Asia (Tibet and China)," but, "...textile use of *Cannabis sativa* does not surface for certain in the West until relatively late, namely the Iron Age."

- In late medieval Germany and Italy, hemp was employed in cooking.
- Hemp in later Europe was mainly cultivated for its fibers, and was used for ropes on many ships, including those of Christopher Columbus.
- The Spaniards brought hemp to the Western Hemisphere and cultivated it in Chile starting about 1545.
- In 1613, Samuel Argall reported wild hemp "...better than in England..." growing along the shores of the upper Potomac.
- The Puritans are first known to have cultivated hemp in New England in 1645.



## A Contextual Brief on Hemp (cont.)

The belief that hemp was one of the most important crops to the common wealth, continued throughout the 19th century. As production increased, more states like Illinois, California, and Nebraska began to grow hemp, with more domestic hemp available, creative ideas for hemp use increased. In 1841, Congress ordered the Navy to buy domestic hemp.

- By the early 20th century, one of the most important inventions to the hemp industry was the Decorticator machine.
- An article from Popular Mechanics magazine (February 1938) spoke of hemp as a cash crop soon to be worth a billion dollars.
- Unfortunately, the year prior, the passage of the Marihuana Tax Act HR 6385 was enacted.

**NOTE:** *The issue for those in opposition of this tax related to the underhanded manner in which this tax was enacted. The conspiracy was against hemp. It threatened certain vested financial and industrial interests especially those in the paper and petrochemical industries.*

Those thought to gain the most were:

- Hearst who owned large timber holdings which fed the paper industry;
- DuPont who dominated the petrochemical market, which manufactured plastics, paints, and other products of fossil fuels; and
- The Secretary of the Treasury and owner of Gulf Oil, Andrew Mellon, who pushed legislation through congress giving tax breaks to oil companies.



# So...What's the Deal?

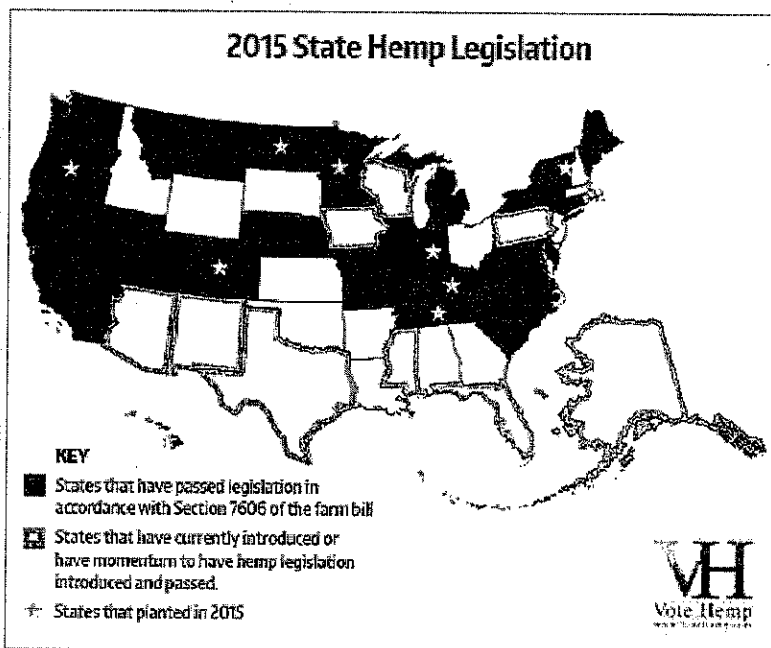
Laws on Industrial Hemp, medical and recreational marijuana are becoming more lax nationwide. Industry analysts say, it's been a long haul, especially for Industrial Hemp.

Lawmakers who support Industrial Hemp cultivation saw an opportunity and pushed the provision that allows academic institutions and state agencies to grow and conduct research on the crop in states where it is legal.

The United States is the largest consumer of finished hemp products in the world!

In June 2015, U.S.-based Compass Diversified Holdings bought Manitoba Harvest Hemp Foods for \$100.4 million. *Hmm...*

*The Industrial Hemp Research Foundation (IHRF) is taking the lead on supporting necessary R&D to ensure this crop reestablishes itself as a leading commodity in the United States again.*



## Current Events: 2015 Updates

- Twenty-seven (27) states have defined industrial hemp as a distinct plant and removed barriers to its production.
  - These states will be able to take immediate advantage of the industrial hemp research and pilot program provision in Section 7606 of the 2014 Farm Bill: California, Colorado, Connecticut, Delaware, Hawaii, Illinois, Indiana, Kentucky, Maine, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New York, North Carolina, North Dakota, Oregon, South Carolina, Tennessee, Utah, Vermont, Washington, West Virginia and Virginia.
- Nine states (Colorado, Hawaii, Kentucky, Indiana, Minnesota, North Dakota, Oregon, Tennessee and Vermont) in 2015 had hemp research crops in accordance with section 7606, the Polis Amendment, to the Farm Bill and state law. Approximately 4,000-4,500 acres were planted.
- Three states (Colorado, Oregon and Vermont) in 2015 licensed or registered commercial farmers to grow hemp under state law. Now, four – with the recent legalization of hemp in North Carolina.
- Three states (Hawaii, Kentucky, and Maryland) have passed bills creating commissions or authorizing research.
- Nine states have passed hemp resolutions: California, Colorado, Illinois, Montana, New Hampshire, New Mexico, North Dakota, Vermont and Virginia.
- Ten states have passed hemp study bills: Arkansas, Connecticut, Illinois, Maine, Minnesota, New Hampshire, New Mexico, North Carolina, North Dakota, and Vermont.
- *Many other states have conducted their own studies without legislative directive.*



# Challenges in Proliferating Hemp

- **The need for full Federal commercial legalization**
  - The 2014 Farm Bill allows for the growth of industrial hemp by research institutions and state departments of agriculture as part of pilot programs, if allowed under that state's law.
  - The farm bill also established a statutory definition of "industrial hemp" as the plant *Cannabis sativa* L. and any part of such plant with a delta-9 tetrahydrocannabinol (THC) concentration of not more than 0.3 percent on a dry weight basis.
    - Advocates and industry experts regard 1 percent THC at dry weight as the more reasonable THC threshold. 1 percent THC is still a trace percentage (not a potent level) and meets the same regulatory goals, but provides a more reasonable breeding and cultivating framework for hemp.
  - Banks, including state-chartered banks, and their reluctance to provide services to hemp growers for fear of being prosecuted for violations of federal laws and regulations.
- **Seed quality and availability**
  - The wording of federal legalization in the 2014 farm bill requires the assistance of state agriculture programs.
  - Setting up certified seed programs will help culture seeds to get germ rates, improve field visits to verify uniformity and verify labels and purity—all of which the industry needs.
- **Federal farm programs and pesticides**
  - With organic certification now available for hemp farmers, the hemp industry is in position to demand other federally appointed funds, including crop insurance, low-interest loans for farm expansion and conservation reserve.
  - Establishing these programs—quickly—will be challenging and is much needed. Additionally, there are no Environmental Protection Agency (EPA) approved pesticides (herbicides, insecticides, fungicides, etc.) currently registered for use on industrial hemp.

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## Hemp Farming Complexities

President Obama signed the Agricultural Act of 2014, or the 2014 Farm Bill, which featured Section 7606 that specifically, allows universities and state departments of agriculture to grow or cultivate industrial hemp if:

- "(1) the industrial hemp is grown or cultivated for purposes of research conducted under an agricultural pilot program or other agricultural or academic research; and*
- (2) the growing or cultivating of industrial hemp is allowed under the laws of the State in which such institution of higher education or State department of agriculture is located and such research occurs."*

The law also requires that the grow sites be certified by—and registered with—their state.

In 2015, a bipartisan group of U.S. Senators introduced the Industrial Hemp Farming Act of 2015 which would allow American farmers to produce and cultivate industrial hemp. The bill would remove hemp from the controlled substances list as long as it contained no more than 0.3 percent THC.

- Some states already allow industrial hemp research and development
- In those states, Farmers and Cultivators still face a number of legal issues
  - Acquisition of viable hemp seeds (still Federally illegal)
    - Interstate shipping is heavily regulated; nearly impossible to move across state lines
  - Still classified as a Schedule I controlled substance
  - Finding trustworthy sources of "certified" seed

# Hemp Opportunities Take Root

The immediate opportunities in the U.S. hemp industry focus on advancements in cultivation techniques and developing processing infrastructure.

- **Innovations across the industrial hemp value chain**
  - Cultivation techniques will advance and large processors are already coming online in Colorado and North Carolina.
  - Early producers are focusing on developing local cultivars and breeding for seed stock while early commercial production will center on oilseed and chaff production until fiber markets come online.
  - The 2015 USDA Prospective Plantings guide projects a sharp decline in corn and cotton and recommends that farmers diversify their crops.
  - A national market for the production of industrial hempseed and fiber still could be just three to five years away.
  - Farmers can put hemp into the ground on par with canola and, despite a higher seed cost, exact a slightly better margins on consumer products.
  - A major focus for the U.S. production of hemp fiber would be its conversion to cellulosic ethanol, which is commercially available across the U.S.
  - The EPA's 2014-2016 rules for the Renewable Fuel Standard Program calls for cellulosic ethanol and advanced biofuels volumes that are seven times higher than 2014 levels of 32,257,131 gallons.
  - Hemp, Inc. (North Carolina) plans to focus first on high-value industrial fiber products for the oil and gas industry and the U.S. Navy. In essence, large volume customer bases.

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## Hemp Opportunities Take Root (cont.)

The immediate opportunities in the U.S. hemp industry focus on advancements in cultivation techniques and developing processing infrastructure.

### Chaff and Fiber

- Current trends in cotton prices present an opportunity for the growth in hemp as an alternative fiber crop.
- Cotton was not included in the 2014 farm bill as eligible for the new Agriculture Risk Coverage and the Price Loss Coverage programs.
- The National Cotton Council survey data suggests that water availability issues and competition from alternative crops will continue to suppress harvests.
- Flax, an alternative fiber and oilseed plant, has seen a 129% increase in acreage between 2013-2015, primarily in the north central U.S., according to the USDA.

### Genetics

- Scientists are focusing on the genetic traits of hemp that improve yields and desirability through genomics-assisted crop improvements and breeding.
- With support from private and university-based research institutes in the U.S., the domestic understanding of cultivar development is advancing as well with attention to increasing yield, improving genetics for mechanical harvesting, lipid enhancement and other desirable genetic traits like drought resistance.
- Plant tissue technology is both a tool for research and an industrial propagation method used widely in crop development.

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# Hemp Opportunities Take Root (cont.)

The immediate opportunities in the U.S. hemp industry focus on advancements in cultivation techniques and developing processing infrastructure.

## Sustainability

- Hemp's wild cousin, feral hemp, has thrived throughout most of the U.S., from Alaska to Florida.
- When cultivated for fiber, industrial hemp consumes less water than crops that are harvested later in the season for oilseed.
- Hemp can be grown for oilseed using far less water than corn.
- Conventionally grown raw cotton can require 50 percent or more water than hemp.
- Cotton accounts for nearly 25% of the world's insecticide use, and 88% of the cotton grown in the U.S. is GMO.
- With hemp, being more sustainable and durable and in following new steam retting techniques, uses an estimated 75% less water in processing compared to the average for cotton.
- Water use in the extraction and manufacture of petroleum-based textiles is 10 times higher than for hemp.
- Hemp is not very susceptible to widespread disease and most contagions can be controlled through seed treatment before planting.
- Researchers have already found significant detoxification and remediation in soil planted with hemp.

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# Hemp Pilot Programs

2015 INDUSTRIAL HEMP PILOT PRODUCTION STATUS

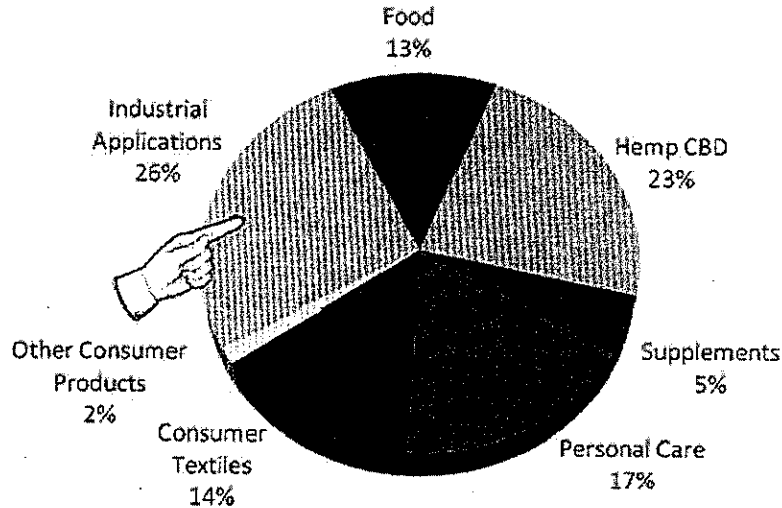
STATE	Control department	Number of licenses	Acres approved	Acres in production
Colorado	Ag Dept	164 registrants w/306 registrations	3520 acres outdoor, 489k sq ft indoor	2000
Hawaii	Health Dept	1		less than 1
Indiana	No Designation	0		0
Kentucky	Ag Dept	127 participants	1742	922
Montana	Ag Dept	15(20)		0
North Dakota	Ag Dept	4		0.2
Oregon	Ag Dept	13 Hemp, 5 Hemp Seed		unknown
Tennessee	Ag Dept	47 applications	1500	1000
Vermont	Ag Dept	20		estimate 4-10

SOURCE: GOVERNING STATE AGENCIES

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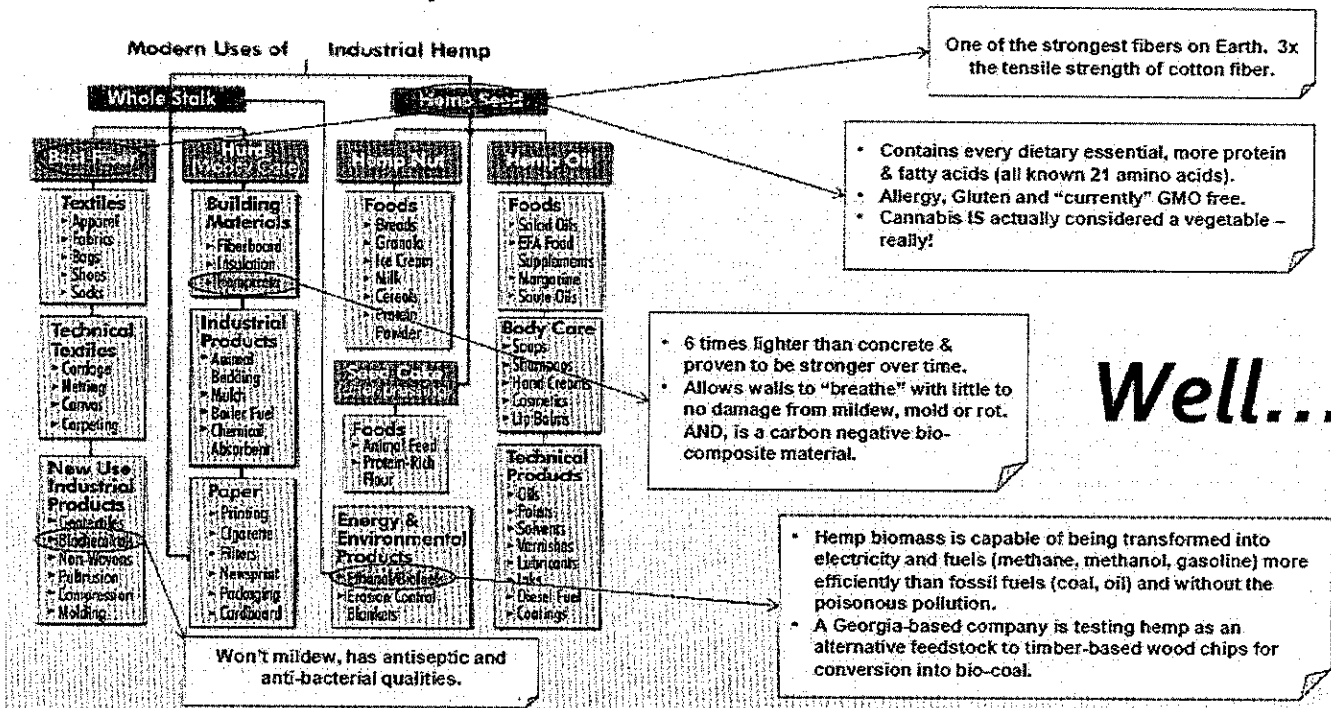
# Hemp Product Estimates

## \$1.5 Billion U.S Hemp-Based Product Sales by Category in 2020e



Source: Hemp Business Journal estimates (consumer sales)

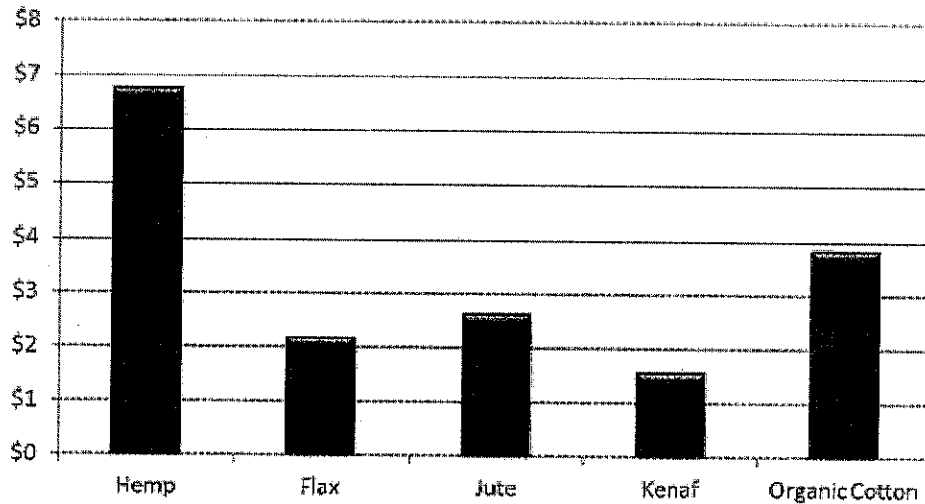
## Industrial Hemp Uses





# Hemp Fiber Example

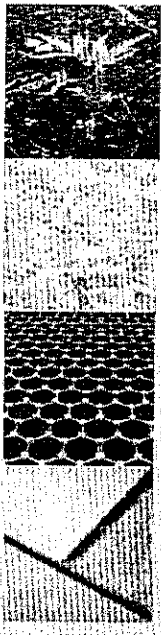
## Natural Fiber Price Comparison



Source: Hemp Business Journal estimates (\$/kg, including estimated average freight charges).

## Hemp Production Potentials

### Industrial Hemp Production



**THE VERY USEFUL INDUSTRIAL HEMP** up to 50,000

**HEMP SEEDS**

HEMP OIL

HEMP PROTEIN

HEMP FIBER

HEMP

**HEMP STALKS**

HEMP FIBER

HEMP

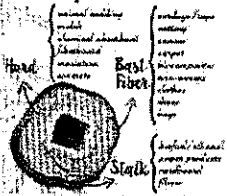
#### Some Examples:

- Proven manufacture of:
  - Interior car parts
  - Pressed fiberboard/insulation
  - Hempcrete
  - Chemical absorbents
  - Paper, packaging & like products
  - Graphene-like battery cores, electrodes, supercapacitors, etc.
  - Oils for many uses (Supplements, health & body, non-allergenic Cosmetics, paints/solvents/ varnishes)
  - Biodiesel & fuel pellets
  - Textiles for apparel
  - Stock for Biochar production
  - Diverse food products with new markets being explored in Health foods and Nutritional
  - Animal bedding
  - Livestock feed

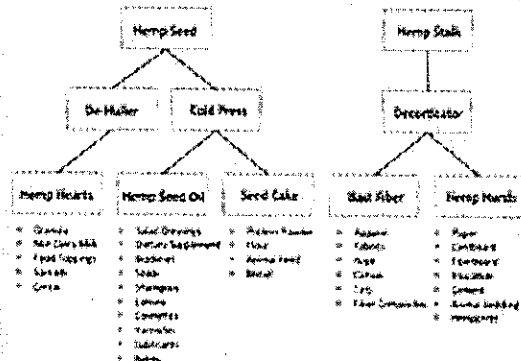
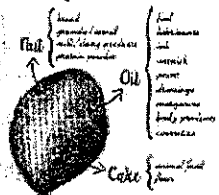
# Hemp Processing

## Industrial Hemp Production (cont.)

### hemp stalk



### hemp seed



### Grain processing

- Hemp seeds must be properly cleaned and dried before storing.
- Extraction of oil usually takes place using a mechanical expeller press under a nitrogen atmosphere, otherwise known as mechanical cold pressing.
- Solvent extraction methods are also emerging for removing oil.
- Refining and deodorizing steps may be required for culinary manufacturers.
- De-hulling removes the crunchy skin from the seed using a crushing machine.

### Fiber processing

- The woody core is separated from the bast fiber by a sequence of rollers, breakers and hammermill.
- The bast fiber is then cleaned and carded. Additional processing includes:
- Washing for the production of non-woven mats and felts.
- Spinning (the breakdown of fiber bundles by chemical and physical methods).
- Steam explosion, a chemical removal of the natural binders to produce a wettable fiber.

### Packaging

- The primary fiber is pressed into a highly compressed bale, similar to other fibers like cotton, wool, and polyester.

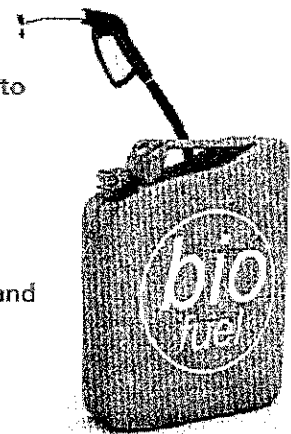
### Paper making

- Bast fibers, used for paper production, are put into a spherical tank called a digester with water and chemicals—process then washed.
- The clean fibers are fed into a machine called a wet-lender presser which cuts the fibers to the desired length and produces the required surface roughness for proper bonding. Bleaching chemicals are sometimes added during this step.
- The bleached pulp is then pumped to the paper machine or pressed to a dryness suitable for transportation to a paper mill at another location.

## Biofuel Market for Hemp

Whether through cellulosic ethanol or traditional seed oil biodiesel production methods, industrial hemp offers clear opportunities in the alternative fuel market.

- In 2014, only 1.24 billion gallons of biodiesel were produced, according to the U.S. Energy Information Association.
- The U.S. production of ethanol from corn was 14.34 billion gallons.
- Industrial hemp produces relatively high or comparable biomass yields compared to other traditional feedstock (corn, soy, switchgrass).
- Using cellulosic ethanol production methods, 1 acre of hemp producing 5 tons of biomass can generate 400 gallons of ethanol.
- If 10 million acres of hemp were cultivated, 4 billion gallons of ethanol (equivalent energy production to 2.64 billion gallons of gasoline) would be created.
- There is no question that industrial hemp should be the next federally subsidized and encouraged feedstock for alternative fuel production in America.



## In Summary...

Paradigm - "a theory or a group of ideas about how something should be done, made, or thought about."

- The current regulatory paradigm of cannabis and hemp regulation is fundamentally flawed. It focuses on the wrong subject matter (marijuana & THC) and does so far too broadly. A new paradigm is needed. A separation of the primary regulations.
- The cannabis plant itself is highly varied and heavily processed. Its actual and potential economic applications are breathtaking in scope.
- The current array of cannabis regulations, which generally seek to prohibit cultivation of the entire cannabis-family plant in order to control the production and use of the THC-producing strain, is tantamount to driving a finishing nail with a sledgehammer; it accomplishes the desired intent, and then some, but in the process, it damages the surrounding structure.
- A rational system of cannabis regulation should focus narrowly on selected products, not the plants.

## Why is Research Important?

*"Organizations that focus on research, development and production will learn that they can be the perfect complement to our world-renowned agriculture heritage in America." - Alan Autry*

# Key Areas of Research

## 1. Social Environment, Cannabis Legalization, and Determinants of Health

- To understand how the changing cultural and legal landscape surrounding cannabis may impact social, economic, psychological, and behavioral determinants of health.

## 2. Harm Reduction in Cannabis

- Reducing the potential for harm – i.e. memory impairment, cognitive processing and/ or dependence development – age related or due to abuse.
  - First and foremost, scientists need to understand the effects of commonly used cannabis strains, as they are used in every day life, as opposed to relying solely on testing the effects of government grown cannabis in controlled laboratory experiments.
- Also, for example, cannabidiol (CBD) appears to mitigate some of the effects of THC, which in turn may have important implications for harm reduction.

The information gained from this research will inform the public about the potential harms of different cannabinoids and strains. It may also have a translational application with respect to identifying THC levels or CBD to THC ratios that could be the focus of future regulatory actions.



# Key Areas of Research (cont.)

## 3. Biomedical Science

- The need for controlled pre-clinical and clinical research on the effects of cannabinoids on health and disease is critical.
  - Preclinical work in laboratory rodents, will examine the effects of cannabinoids on stress-evoked affective disorders (i.e., anxiety, depression, PTSD), seizure models, models of the role of peripheral inflammation in diseases such as diabetes and cardiovascular disease, and models of neuroinflammation, which are relevant for disease states such as chronic pain, traumatic brain injury (concussions), aging, Alzheimer's, etc.
  - Parallel studies in humans will address areas of research fundamental to understanding the medicinal potential of cannabis, such as the pharmacokinetics of different formulations and routes of administration based on products that are currently sold in Colorado with the intention of treating specific diseases.
- Importantly, biomedical research will also extend beyond the therapeutic effects of cannabis products to include investigations of CBD and/or other cannabis products as prophylactic or Nutraceutical compounds.
  - For example, both pre-clinical and clinical studies should be done to test if daily administration of CBD during times of emotional stress (i.e., military deployment, divorce, exams, loss of a loved one etc.) produces positive retaliatory outcomes from these negative health consequences of stress.



## Key Areas of Research (cont.)

### 4. Agricultural/Agronomic

- Includes the development of tools and genetic varieties to promote agriculture, including genetic markers useful in modern breeding programs (particularly marker assisted selection);
- Breeding of varieties optimized for each state's climate and growing season (whether for industrial hemp or cannabis); and
- The development of down-stream processing of raw materials into more valuable products.
  - May also include rearing new plant strains, through traditional breeding methods, which could be used to treat particular illnesses in medical patients, for example.
- Understanding the origins of the *Cannabis* cultivars (including industrial hemp) to refine and improve our understanding of associations between particular genomic regions and key traits.
  - This aim is crucial to our understanding which strains harbor medical properties, and those with other values in a more industrial sense, which is key in order to establish industry regulations.

### 5. Impact on Environment and Sustainability

- Rapid growth in the cultivation of cannabis strains and the production of related products will lead to important questions regarding the impact on the environment as well as sustainability.
  - For example, there is already a looming conflict in California where water is scarce and where the cultivation of cannabis requires considerable water.
  - Likewise, there are important issues regarding the use of energy since indoor cultivation requires considerable energy resources.



## Key Areas of Research (cont.)

### 6. Plant Genetics, and Chemical Analysis

- Additional research areas include genetic mapping to identify the genetic basis of variable traits, chemical analysis of the cannabinoid composition of various strains, identification of the major genetic lineages within the genus *Cannabis* and the relationships among those lineages, and a better understanding of the ecology and evolution of these plants in wild and cultivated environments.
- The chemical analysis of plant-derived cannabinoids and terpenes as well as the development of new superfluid extraction methods of clinically and industrial useful components is also a key area of research.
  - The identification and isolation of key new cannabinoids will permit the future the synthesis of cannabinoids and development of new compounds.
  - For example, the need to purify and standardize cannabis-derived products is great. Research is needed that explores chemical techniques for extraction of various plant materials to remove and purify valuable non-psycho-active CBD and identify and characterize other cannabinoids, terpenoids and plant sterols.
- There is a larger need to investigate the basic biology and genomics of the plant; to educate the public about the scientific findings; and to support the industrial and medical communities by enhancing the cultivation of appropriate strains.
  - This will help identify important genetic variations that could be used for the proven diverse purposes of the plant, as well as answering basic science questions about the genus, as well.



# IHRF Research Project Methodology

- Review /Validation of research project applications/ objectives/ proposed budget
- Documentation of funding plan – whether all, or in part
  - Master research and development agreement (Task orders)
  - Review with project sponsor, project lead and university liaison
- Setup and management of funding distribution/ funds tracking
- Project review milestone schedule and targeted phased objectives
  - Planned project issue resolutions/ escalations (University and Foundation)
  - Checkpoints of project spend and budget mgmt (Plan vs Actual) – countermeasure oversight
- Coordination of project culmination review and findings presentation
  - Next steps management of results, possible IP and findings
  - Funded project expectations (of the Foundation)



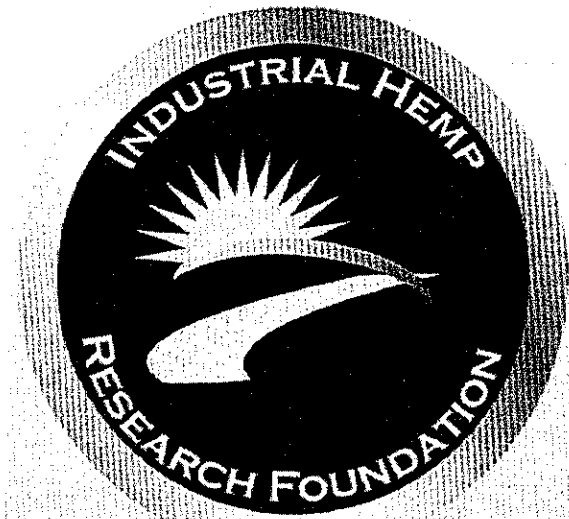
## Success Factors

- What constitutes a successfully funded research project?
  - Satisfied research and university process criteria
  - Met or exceeded project objectives/ goals
  - Completed within estimated budget (*whether fully funded by the Foundation or not*)
  - Results and findings deliverables realized within expected timeline
  - Realization of donor expectations and community/ industry benefit
  - Positive perception of Foundation and its capabilities/ impact on the community and its population



# QUESTIONS?

- *Would you like to be a **Volunteer** for the IHRF or foster a local state Chapter?*
- *Will you be a **Research Sponsor** for the IHRF?*
- *Are you ready to help **Kansas** move forward?*



**Thank You!**

Industrial Hemp Research Foundation

4243 Harlan Street

Wheat Ridge, CO 80033

P 720.282.5806

[www.ihrf.org](http://www.ihrf.org)



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