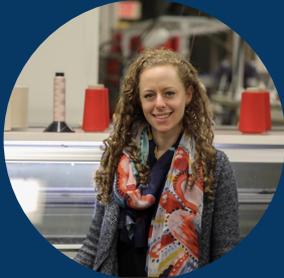




A Review of Hemp Fiber in Global Agriculture and the Textile Industry

By Zoe Newman, Kedena Thompson, and Garry Atkinson

Speaker Introductions



Zoe Newman

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Industry Experience - Product Development and Fabric Design, Knit Programming



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BS - Industrial Design, NC State University
Industry Experience - Textile Testing, Product Development, Woven Technical Design, and Color Matching

Background

- Hemp originated from central Asia, in the Altai mountains thousands of years ago. It spread east to China and India, where humans began to cultivate it.
- Hemp then spread to the Middle East, Russia
→ over time to North and South America, Europe, and Africa



This research examines history, machinery, global market share, regions, end-use, and regulations in each region. An overview of the global hemp market is provided for further development.

Regulatory Considerations for Industrial Hemp



The United States industry requires a THC content of less than 0.3% in dry weight for harvested hemp fiber plants

Hemp is a regulated commodity (2018 Farm Bill)

The Hemp Fiber

Industrial Hemp vs. Commercial Hemp

GROWTH CYCLE (DAYS)

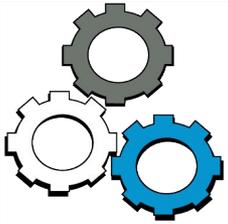
COMMERCIAL
For medicinal, psychoactive use

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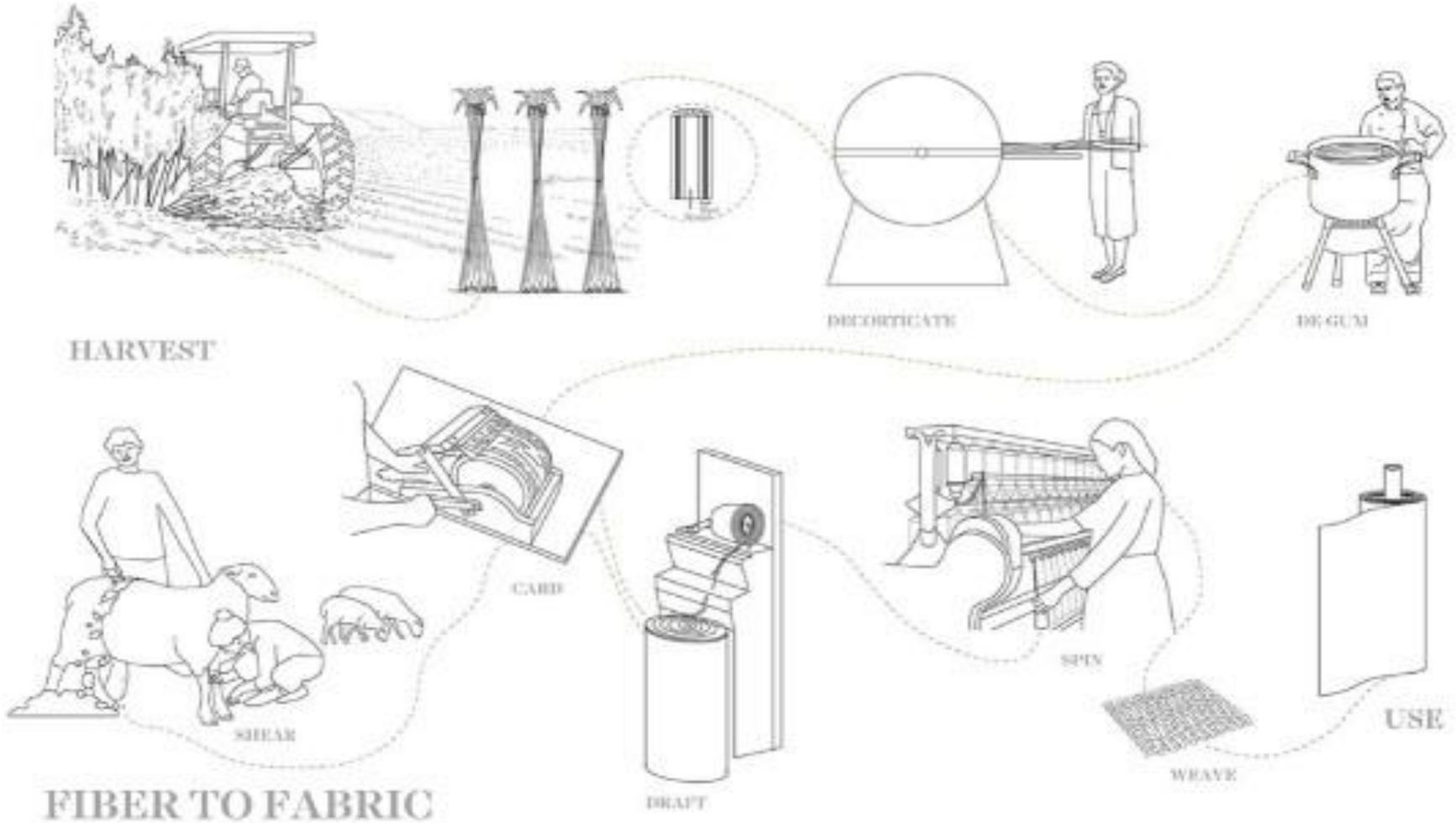
INDUSTRIAL
Less than 0.3% THC
For fibers, composites

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General Fiber to Fabric Processing





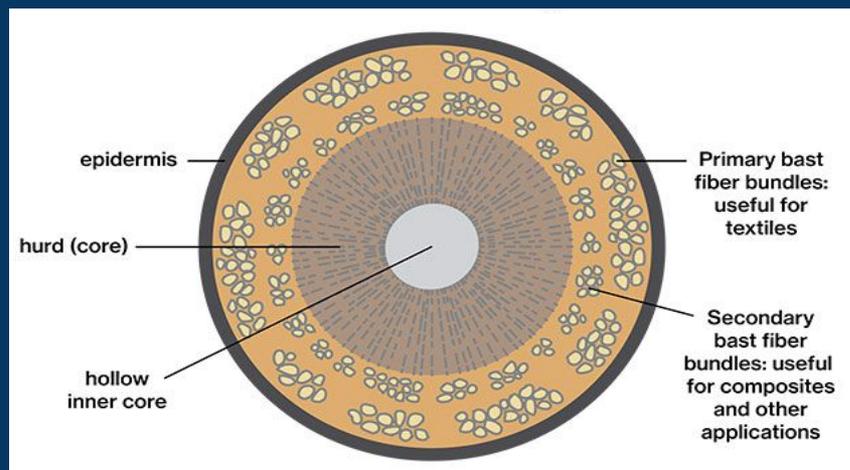
Mechanical Properties & Processing

3 Categories:

Long

Short

Hurd (“shives”)



(Fibershed, 2021)

Bast fibers

Stringy, strong fibers used for textiles, paper, insulation, and other applications.



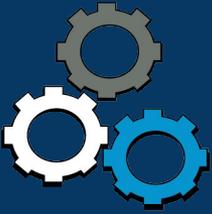
Hurd fibers (“Shives”)

Short fibers used for applications such as animal bedding, pulping, and concrete products.



Characteristics:

- 20-50mm in length
- 70-74% cellulose
- 17.9-22.4% hemicellulose
- 3.7-5.7% lignin
- 0.9% pectin



Considerations

Cellulose content affords the hemp fiber improved stiffness, strength, and high tenacity.

Harvesting timing affects lignin content



Retting Time needed to prevent cracking or burning of the seeds



Hemp seeds without any THC or CBD have health benefits



Growing and Processing Information

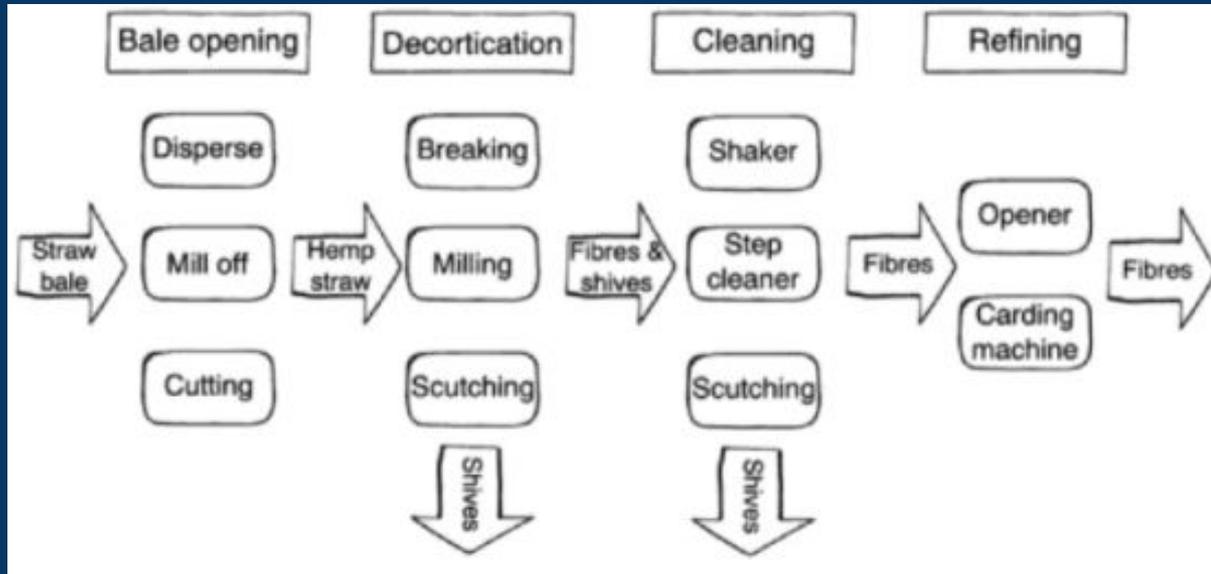
Growing Conditions

- Annual plant; grows year-round
- Grows from seed, reaching up to 16 feet tall
- Grows best in:
 - Temperature between 59F-81F
 - Well-drained soil
 - pH between 6.0-7.5
 - Location: stream banks, lakeshores, ditches.
- Rotational Crop Benefit; an increase crop growth by 10-20%
- Often planted on land with soybeans, tobacco, wheat

Processing Steps

The key steps below are important for performance and usability of fibers.

- Bale opening
- Decortication
- Cleaning
- Refining





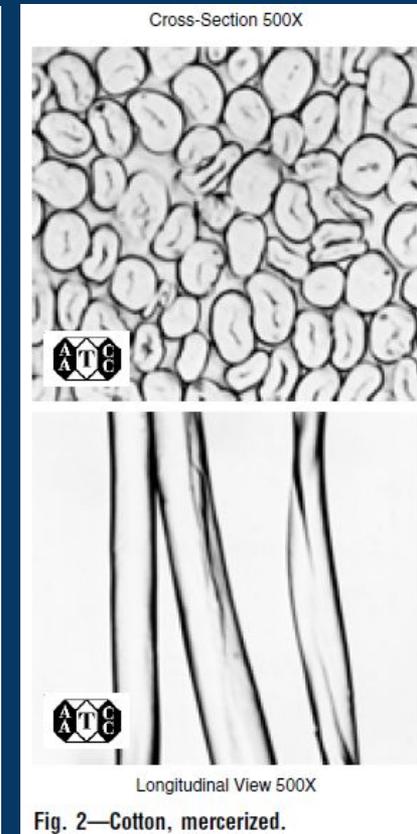
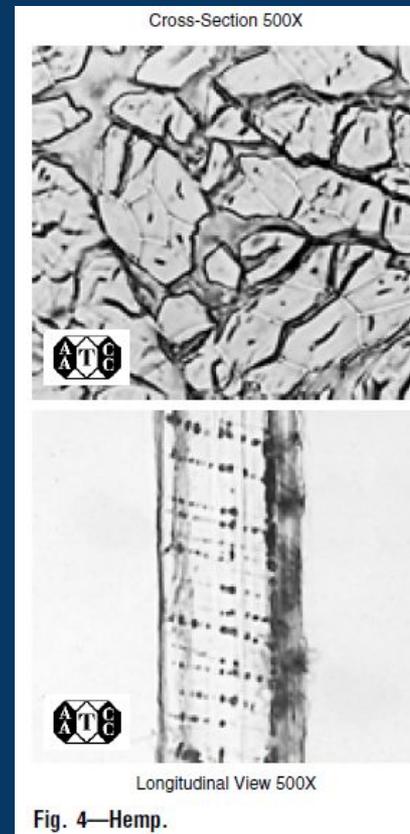
Hemp Fiber Identification & Analysis

Hemp vs. other cellulosic fibers

- Hemp along with Cotton, Linen, Ramie, Jute are soluble in 70% Sulfuric Acid in most blends
- Cotton/Hemp is one of the most common blends
- More bundled together than linen
- Fiber identification is not easy, requires cross section, microscopy

Hemp vs. cotton

- Hemp is more sustainable
- Cotton/Hemp blend can extend the life of a cotton product
- Requires less water in growing
- More hydrophilic than cotton, easier to dye
- Nearly identical fiber properties in chemical analysis
- Cross section comparison is best to decipher the two:
(AATCC TM20-2019t, 2021 AATCC Technical Manual)





Fabric Formation and Properties

Geographical Location

- factors into producing appropriate hemp yarn for the application, due to historical experience, machinery, development of technology, other factors.

Emerging Technologies in Machinery

- HempTrain: Canada based tech and manufacturing company
 - Separates whole-plant hemp feedstock into high-value hemp fiber products.
- BastCore: Alabama based innovative hemp processing company.
 - Uses patented hemp technology for decortication and wet processing/degumming



North America



History

- Introduced in 1645 by Puritans in New England. Used for household spinning and weaving. Later, industry boomed with use in cordage, sailcloth in 1770s-1860s
- Imported jute and development of the cotton gin drove hemp out until the mid 1900s - emerging crop programs at universities; Agricultural Act of 2014 reintroduced hemp production in the US through pilot programs.

Global Market Share

- Hemp farms have increased by 58% in the US with total area under cannabis cultivation increasing by 91% from 2012-2016.
- Market value is difficult to estimate, used in many industries. Pilot programs for growing trials continue, with large scale investments in the US.
- Acreage up to 90,000 reported 2013, largest since 1943.
- Greater ease of import from Europe, China, and India has limited US exports

Region

- As of December 2019, hemp was legal to be grown in all states, except Idaho, Mississippi, and South Dakota. Regulations on growing vary from state to state.

End-Use

- Rope, canvas, fabric/textiles, reinforcement, removal of cobalt agents for wastewater treatments.
- Hempcrete, insulation material; hemp as plastics, composites, bedding, fine hemp paper for cigarettes.

Government/Regulatory

- Marijuana Tax Act of 1937 required licensing of hemp growers with federal government to control psychoactive growth practices.
- Hemp production requires background checks, sampling of THC content, and is regulated per state.

History

- 6000+ years of hemp seed and fiber cultivation. Peak of cultivation during the period of the Hang-Tang Dynasty in ancient China.

Global Market Share

- China is the largest supplier of hemp in the world, produces over half of the world's supply of hemp.
- Sales of up to 1.2 billion (USD) in 2018. Majority is exported to the US. Small amount is exported to growing markets of South Korea and Belgium.
- Challenge in export is fluctuating THC content, with some containing more than 0.3% after shipping

Region

- Shandong Province in China has particularly good soil texture and cation exchange.
- Hemp seed production is most common in Northern China. Fiber hemp cultivation common in North-eastern, Central-eastern, and South-western China.

End-Use

- Mostly fibers, some use for food industry but is on the decline due to growth of wheat, barley, rice market.

Government/Regulatory

- Industrial hemp grown in China for thousands of years, but banned in China from 1985-2010.
- China remains the largest producer of hemp fiber.
- Two Chinese provinces allow CBD production; illegal in rest of China.

Europe

History

- Emerged after 15th century
- Important in the 17th century
- France, other countries prohibited hemp production in early 1700s
- Declined after 20th century
- After WWII hemp production disappeared from Western Europe

Region

- Production centered in France, Netherlands, Lithuania, Romania.
- France is primary producer in the EU.
- EU's secondary hemp grower is the Baltic area (cannabisbusinessplan.eu, 2021).

Global Market Share

- 25% of the Global Hemp market is cultivated in Europe
- 40% of European production is in France.
- 20 other countries contribute to total EU production.
- Over last 25 years, hemp production has increased by 500% (roughly 250% in 8 years) (cannabisbusinessplan.eu, 2021)
- In 2019, European industrial hemp accounted for a revenue share of 22.2%, or about 1 billion euros (cannabisbusinessplan.eu, 2021).

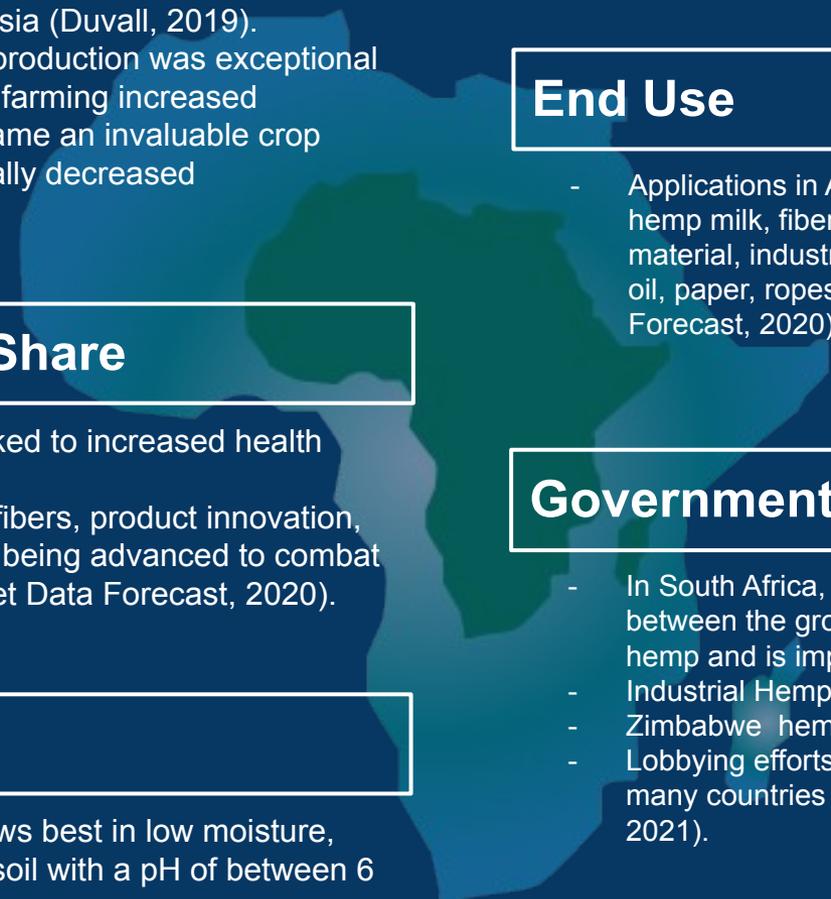
End Use

- Fibers, seeds, pharmaceuticals, industrial use, animal bedding

Government/Regulatory

- Production bans lifted since the 1990s.
- Hemp and flax recently subsidized under the EU's Common Agricultural Policy.
- Green Policy Initiatives subsidized hemp markets over the last 20 years (cannabisbusinessplan.eu, 2021).
- EU moving towards free-market models

Africa



History

- Crop Arrival from Asia (Duvall, 2019).
- Hemp agricultural production was exceptional
- 1900's - uses from farming increased
- African hemp became an invaluable crop
- Production eventually decreased

Global Market Share

- Market share is linked to increased health advantages.
- Growth in textiles, fibers, product innovation, and processes are being advanced to combat the demand (Market Data Forecast, 2020).

Region

- Hemp in Africa grows best in low moisture, well-drained loam soil with a pH of between 6 and 7.5.
- Requires long warm summers.
- Shorter days induce early flowering.
- Common locations: Western Uganda, West Africa, Sierra Leone, and the Ivory Coast.

End Use

- Applications in Africa include, tea, hemp juice, hemp milk, fiber, hemp sacks, biofuel, canvas material, industrial building material, animal feed, oil, paper, ropes, and more (Market Data Forecast, 2020)

Government/Regulatory

- In South Africa, legislation does not distinguish between the growing of cannabis and industrial hemp and is imported in this region (Louw, 2021).
- Industrial Hemp Uganda (IHU) initiatives..
- Zimbabwe hemp growth application approval.
- Lobbying efforts aim to boost the economy of many countries in the continent. (Hemporium, 2021).

South America

History

- Began in Central and South America during Spanish Conquest (1500AD).
- Water resources (80% of rainwater flow from Andes mountains) and ideal climate make hemp production advantageous for Chile.
- Hemp farms across Chile, provided various usage from versatile military use to farm life essentials from sacks to clothing to saddles and animal feed.
- Farming decreased in the 1980s due to onset of synthetic alternatives to hemp.
- Seed and fibers continue to be sold, but environmental laws and lack of farmer education are barriers to growth, compared to larger producing countries.

Global Market Share

- Latin America is holding the highest shares of the market.
- Argentina is leading the market's growth rate due to growing interest in hemp cultivation for medical and scientific purposes.
- Brazil follows Argentina in market share (Market Data Forecast, 2021).

Factors of Growth:

- Government initiatives creating hemp product benefits awareness
- Growing senior citizen populations increase in cancerous diseases fuel demand.
- Hemp seeds are extremely rich in proteins adding value to vegan diet



South America

Region

- Colombia and Uruguay vastly lead in hemp production.
- Production across South and Latin America: centralized and depends greatly on soil conditions, weather patterns, irrigation, and other environmental factors.
- Additional specific country factors include:

Colombia, Ecuador, and Peru:

- good climate conditions that support products of high-quality flowers and biomass.

Paraguay, Uruguay, Brazil, and Argentina:

- ideal climates for grains and fibers like hemp.

Government/Regulatory

- Legality of hemp production is regulated by each country and national legislators; and has changed over the past decade (Guido, et al., 2020).
- Unclear regulations on hemp per country
Ex; Guyana (hemp, marijuana totally banned)
- Colombia, Uruguay: completely legal

End Use

- Used for a wide array of products from industrial and medical to food and fiber.
- Medicinal goods and pharmaceuticals in most of Latin America, farmer sacks, edible hemp seeds, hemp seed oil, CBD hemp oil, fiber, textiles, food, beverages, personal care products, paper, industrial construction materials, and automotive textiles (Market Data Forecast, 2021).

Additional regulatory statutes:

- Law number 27,350 was passed in 2017 under the title “Medical and scientific research on the medicinal use of the cannabis plant and its derivatives”.
- Uruguay - Law number 19,172 covers control and regulation of the state of import, production, acquisition, storage, marketing, and distribution.
- Mexico – 2017 General Health Law and the Federal Penal Code.
- Peru – Law number 30,681.
- Argentina – Law number 17,818 (Guido, et al., 2020)

Agricultural Advancements



Nitrogen Regulation

- Hemp cultivation is good for the soil in that it controls weeds and aerates.
- Hemp takes from the soil in that it's a heavy feeder, depletes soil nutrients, and requires regular irrigation. This can be done with nitrogen irrigation (S. America) or nitrogen-fixing legumes (Chile).

Seed Separation

- Male seeds are removed from the stalk as soon as they begin to flower and are bundled separately from females since they provide a higher quality fiber. They are both retted separately.

Automated Decortication

- Hemp fiber decortication, once very labor-intensive, and performed by slave or indentured labor, has been revolutionized by automated hemp breakers such as the Ferriani decorticator and comber.
- Separates hard wood interior from the soft, fibrous exterior of the stalk.
- There is limited information on hemp processing machinery in Asia.

Reflections and Conclusions

In summary, this work provided a detailed overview of the hemp market across many different countries.

The focus on industrial hemp across these regions allows for focused information related to:

- Growing conditions, soil and earth benefits, fiber processing, and the end-use of hemp fiber.
- The breakdown and analysis of the most well-managed, hemp-producing location (China, in particular), allows for comparison of such a region to other included geographical locations mentioned.
- The future of the hemp industry, around the world, is expected to continue increasing.
- The demand for CBD as it becomes legal in more areas, along with the demand for sustainable, natural fibers, result in a multi-use crop relevant to today's sustainably-minded world.
- As legislatures review the uses of hemp and further understand the industrial uses for such a crop, availability and uses will increase.

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Thank you!

Any Questions?

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