

and sale of hemp products in the U.S. are the subject of much legal debate. For a more thorough explanation, read the articles in the reference section at the end of this document.

The 2014 Farm Bill allowed for establishment of hemp pilot programs administered by universities or states. Subsequent legislation blocked the DEA and federal law enforcement agencies from interfering with hemp producers participating in pilot programs and blocked the USDA from prohibiting interstate transport of hemp grown as part of these pilot programs. However, seed imports are still under DEA control, and seed sources for growers are limited.

In 2015, the Wyoming legislature passed HB0032 allowing the supervised use of hemp extracts for the treatment of epilepsy. These extracts must contain at least 5 percent CBD and less than 0.3 percent THC. In 2017, the Wyoming Legislature passed HB0230 designating hemp (THC < 0.3 percent) as an agricultural crop in the state. However, no funding was provided for the Wyoming Department of Agriculture to acquire the necessary equipment to establish a pilot program and test hemp seeds and plants for compliance with THC levels. There are 39 states that currently allow the cultivation of hemp for research or pilot programs. In March 2019, [HB0171](#) was signed into law. Among other things, it requires the Wyoming Department of Agriculture to submit a plan to USDA for the regulation of hemp production and appropriates funding for a regulatory program. At the time of this writing, **hemp cannot legally be grown in Wyoming.**



Figure 2. Hemp oilseed head ready for harvest with a combine. Photo courtesy Canadian Hemp Trade Alliance.

AGRONOMICS

There are four kinds of hemp cultivars: oilseed, cannabidiol (CBD), fiber and dual purpose (oilseed and fiber). Oilseed and fiber cultivars are grown as field crops, while the high-value CBD cultivars are produced as horticultural crops. There are considerable differences between cultivars in seed size, height and yield. Hemp grown for seed requires a longer and warmer growing period than hemp grown for fiber. According to Hemp Genetics International (HGI), Canadian hemp oilseed crops mature at 100-115 days, while some Colorado growers claim maturity in 85-100 days.

Oilseed hemp cultivars are typically planted at 20-40lbs/A, with the population goal of 10-15 plants/ft². Fiber hemp cultivars are planted at 40-80 lbs/A, with a goal of 30-35 plants/ft². There are about 27,000 hemp seeds per lb. Under ideal conditions, plants will emerge within seven days, reach 12 inches in height three to four weeks after planting and aggressively suppress weeds with heavy ground shade. Seeds should be planted 0.5 to 1.25 inches deep on a 6-7 inch row spacing when soil temperatures are around 50° F. Seedlings can tolerate some exposure to frost and in most areas can be planted after spring grain and before corn.

CBD strains of cannabis have been developed from plants that originally had substantial amounts of THC. The CBD is concentrated in the trichomes (hairs) of the female flowers and is extracted from the floral buds (Fig. 3). For this reason, CBD producers primarily rely on clones instead of seeds to propagate plants. To date it has been challenging to get feminized seeds for CBD production that has genetic consistency to generate the high-CBD yields, and still be confident that all plants under management contain less than 0.3% THC. With regulations on the amount of THC allowed in CBD plants, the safest source of material for planting would be verified clones. If CBD plants are found to have too much THC, they may have to be destroyed. High quality CBD clones can be expensive and bulky to transport. CBD production requires an in depth knowledge of cannabis and is more intensive than seed production. Since CBD plantings are less dense, weed control is more demanding. There is so much misinformation available online that it can be challenging to arrive

at accurate details. Since some end users of CBD are children, CBD floral material for processing is often tested for extraneous chemical residues. Corn Earworm (*Helicoverpa zea*) is one pest that can be devastating on hemp grown for CBD. While CBD plants are grown in large outdoor fields in neighboring Colorado, much of the global CBD production is currently conducted in highly controlled green houses and a large amount of future CBD production may involve biosynthesis.

Like most field crops, hemp will perform best in well-drained, medium-textured soil with adequate water, good fertility and high organic matter. Maximum production will be realized with inputs similar to a high yielding grain. Hemp Genetics International recommends that for oilseed hemp, growers manage soil fertility similar to canola and with 10-20 percent more nitrogen. Hemp fiber quality can be reduced by high levels of available nitrogen. Hemp can also perform on marginal ground with lower inputs, but yields will be lower.

While a mature stand is somewhat drought tolerant, hemp does need abundant water during the first six weeks of growth for seedling establishment. Depending on growing conditions, it typically requires 20-30 inches of available water per year. It does not thrive in heavy, poorly drained soils. Hemp is a relatively deep-rooted



Figure 3. Female flower of a hemp CBD cultivar growing in a greenhouse. Note the sticky trichomes around the flower that are the source of CBD. Photo: [Debbie Roos](#).

plant that may offer some soil benefits when grown in rotation with crops with lower soil biomass like sugar beets or corn.

Hemp is dioecious (male and female flowers on separate plants) and is photoperiod sensitive. This means there

Table 1. Nutrient and Water Use of Industrial Hemp Compared to Major Crops

Crop	Days to Maturity	Water Use (in/yr)	Nutrient Needed (lbs/A)
Sugar Beets	150	22-28	N: 180 P ₂ O ₅ : 80 K ₂ O: 60
Malting Barley	90	15-20	N: 120-130 P ₂ O ₅ : 30-40 K ₂ O: 30
Dry Beans	85-95	18-20	N: 80 P ₂ O ₅ : 60 K ₂ O: 50
Corn	80-110	20-25	N:180-220 P: 40-50 K: 30-40
Hemp	85-115	20-30	N: 80-120* P ₂ O ₅ : 30-45* K ₂ O: 40-60*

*estimated

are both male and female plants, and they do not start forming flowers until day length is less than 12 hours. There are modern cultivars that have been developed to be monoecious (male and female flowers on same plants) and produce primarily female flowers. This allows for higher seed and fiber yields as male flowers die after flowering and do not produce seed. Field isolation that is important for certified seed growers and CBD producers require there be no hemp fields with male plants 3 miles up wind from these fields. Production of CBD would be compromised if the all-female crop were pollinated by a neighboring hemp field.

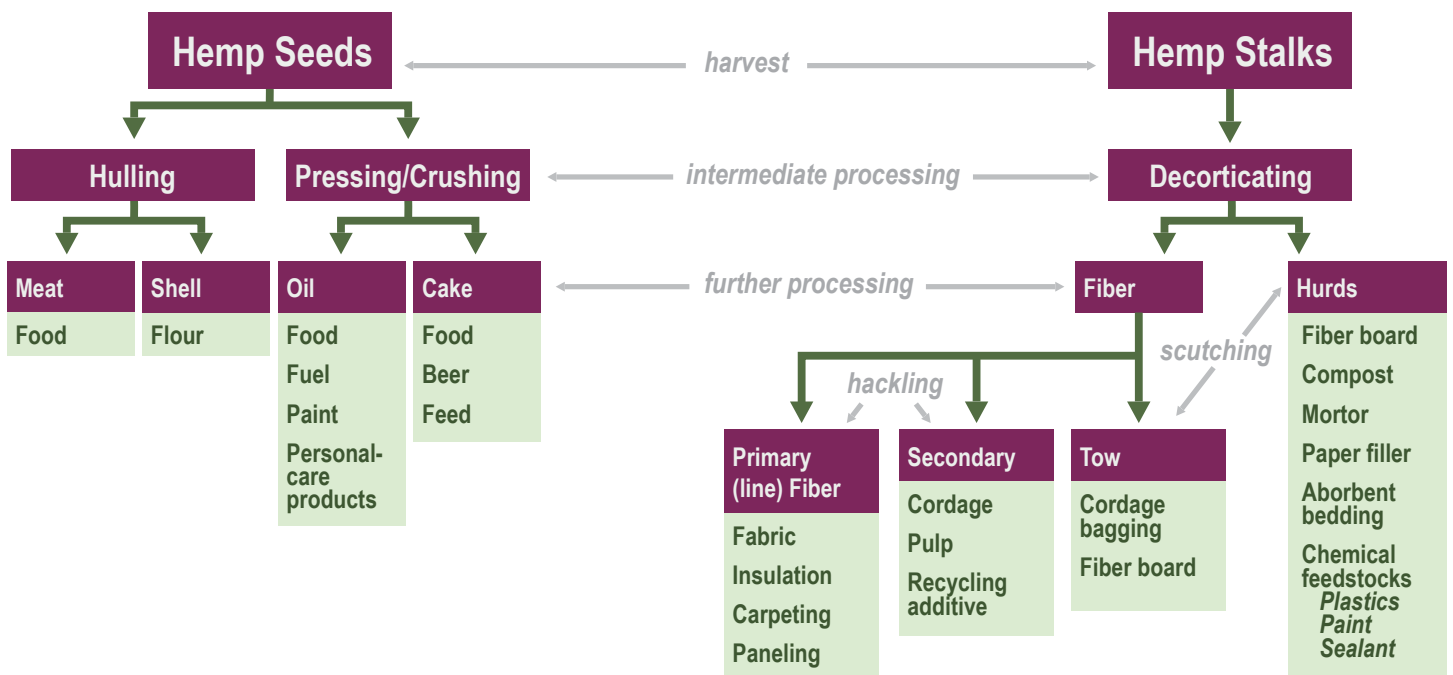
There are many diseases and insect pests of hemp but very few that commonly cause damage beyond the economic threshold. This is most likely due to the fact hemp is not widely grown. As production acres increase, insect and disease pressure will likely increase as well. Hemp is a host of the northern root rot nematode (*Meloidogyne hapla*), which is a common sugar beet pest. Hemp is also susceptible to *Pythium* and *Fusarium*, both common soil-borne diseases that affect many crops including sugar beets, barley and beans. Birds have also been reported as pests in hemp crops grown for seed.



Figure 4. Harvesting an industrial hemp crop for seed in Kentucky. Photo courtesy of [Eli Pace](#).

Purdue University Extension suggests hemp be grown on a four-year rotation and not be planted directly following dry edible beans or sunflowers. Growers in Kentucky have not experienced significant disease or pest pressure in field scale production since 2014, when production became legal in the state. There are no pesticides labeled for use on *Cannabis sativa* in the United States. A healthy stand of hemp is highly competitive against weeds, including quackgrass and bindweed, but hemp does readily escape cultivation and can become somewhat

Industrial Hemp



Source: [University of Wyoming Graphics](#), adapted from D. G. Kraenzel et al., "Industrial Hemp as an Alternative Crop in North Dakota," AER-402, North Dakota State University, July 23, 1998.

weedy itself. Growers are advised to maintain good field border sanitation.

Production costs and returns are highly speculative at this point, as the hemp industry is limited to a few licensed growers with highly regulated access to seed and restricted markets for their products. For a useful study on production costs and returns, see the University of Kentucky document titled “Economic Considerations for Growing Industrial Hemp”

<http://bit.ly/Economics-Industrial-Hemp>.

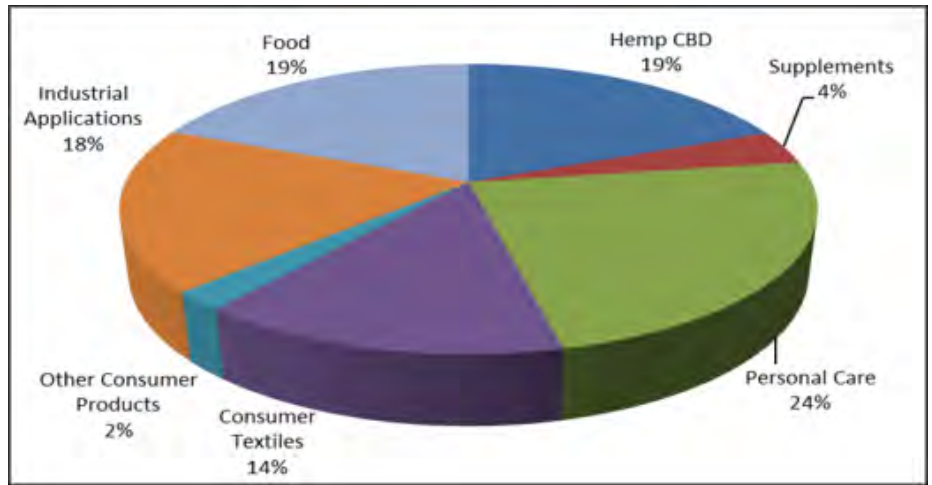


Figure 5. U.S. Hemp Based Product Sales by Category, 2016. Image courtesy of the Congressional Research Service.

PRODUCTS

Many sources claim over 25,000 industrial food or feed products can be made from hemp fiber, seeds and plant tissue.

Fiber

Hemp stems are 25-33 percent fiber, consisting of long outer fibers called basts and short inner fibers called hurds. The bast fibers can be used for fabric, rope, paper, carpeting, construction and composites. The shorter hurd fibers are highly absorbent and can be used for animal bedding, oil spill clean-up and insulation.

Seeds for food and oil

Hemp seeds are high in protein and used in a wide range of food products including raw or roasted hemp hearts, hemp milk, hemp seed oil and hemp flour. Hemp seed oil is very high in essential fatty acids and contains omega-6 and omega-3 in the “ideal” ratio of 3:1. The seeds and oil do not contain THC or CBD. A bushel of hemp seeds weighs 44 pounds. Oilseed hemp cultivars produce seeds that contain 29-34 percent oil, which is very high in unsaturated fatty acids and similar to other drying oils like linseed and tung. The oil is popular for use as a health supplement and in personal care products like lotions and soaps. It can also be used as a wood finish and in the manufacture of lubricants, paints and plastics.

Table 2. Average Wholesale Prices and Number of Licensed Growers in the Top 10 Hemp Producing States in 2017

State	Licensed Growers	Average wholesale price (\$/lb)		
		Fiber	Seed	Flower
Colorado	386	0.10	9	28
Kentucky	209	-	0.75	35
Oregon	233	-	0.50	100
North Dakota	35	-	0.50	-
Minnesota	38	0.05	0.50	-
New York	21	-	1.38	100
North Carolina	97	0.10	1	25
Tennessee	79	0.19	10	100
Vermont	90	0.10	1	100
Nevada	23	0.10	10	100

Source: Kristin Nichols. Hemp Report: Top 10 U.S. States. Hemp Industry Daily. www.hempindustrydaily.com

Cannabidiol for medical and health use

Some cultivars produce high levels of CBD, which has many purported health benefits including the treatment of epilepsy and pain. Cannabidiol is extracted from the plant tissues (primarily the female flower and surrounding leaves) using CO₂, ethanol or oil. This extraction is then used to make tinctures, supplements, lotions, salves, etc.

Livestock feed or forage

Hemp is not approved by the Food and Drug Administration (FDA) as an acceptable ingredient for commercial animal feed. Feed containing hemp-based ingredients would be considered “adulterated” and could not be legally distributed.

MARKETS

In 2017, U.S. manufacturers imported \$67.3 million dollars’ worth of hemp seed, oil and fiber. Hemp imports have steadily increased from \$5.7 million in 2005, when a legal dispute over hemp imports was resolved and the market opened up. These imported products are converted into consumer goods in the U.S. Data is not available on imports of consumer goods or industrial materials containing hemp.

The Hemp Industries Association (HIA) estimates total retail sales of hemp products in the U.S. were \$573 million in 2015 and \$688 million in 2016 (Fig. 5). They attribute much of the growth of the industry since 2011 to sales of body products, supplements and foods. In 2017, Hemp Industry Daily published a report on the Top-10 hemp producing states, which include Colorado and North Dakota. Flowers (primarily grown for CBD) are the highest value part of the crop, followed by seed and fiber (Table 2).

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This document was developed for policymakers and economic development organizations. Information in this document has been gathered from University Extension bulletins, congressional documents, and print media. Please contact the authors for copies of reference documents. It is not yet legal to grow industrial hemp in Wyoming. Updated on 6/19/19.



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