



U.S. Farmers' Opportunities and Challenges of Producing Industrial Hemp

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ABSTRACT

The hemp industry is appealing for U.S. farmers wanting to diversify their crops and provides a potential new revenue stream. After a hiatus of nearly 45 years, the 2014 Farm Bill reintroduced hemp production by authorizing hemp research and pilot projects. The 2018 Farm Bill creates huge business opportunities for farmers by authorizing the cultivation of industrial hemp. In 2019, the USDA was directed to assure uniformity in state regulations. Hemp is a source of fiber and oilseed grown in more than 30 nations.

Keywords: Hemp Farming, Productivity, Agricultural Practice

Abbreviations: DEA: Drug Enforcement Administration; USDA: United States Department of Agriculture; THC: Tetrahydrocannabinol; CRB: Cannabidiol

Introduction

Industrial hemp derives from the plant species *Cannabis sativa*. It is used worldwide to produce a variety of industrial and consumer products. Hemp is a source of fiber and oilseed grown in more than 30 nations [1]. The Agriculture Improvement Act of 2018 (2018 Farm Bill), signed by President Donald Trump on December 20, 2018, authorized the production of hemp and hemp products, establishing them as agricultural commodities, and removing them from the purview of the Drug Enforcement Administration (DEA) schedule of controlled substances [2]. This allows farmers' rights to water, crop insurance, and federal agricultural grants, as well as legal access to national banking. Hemp may also be transported across state lines [3].

The 2018 Farm Bill directed the U.S. Department of Agriculture (USDA) to issue regulations and guidance to implement a program to create a consistent regulatory framework around the production of hemp throughout the United States [4]. The USDA established the U.S. Domestic Hemp Production Program through an interim final rule effective October 31, 2019 [2]. The interim final rule governs the production of hemp under the 2018 Farm Bill and outlines provisions for the USDA to approve plans submitted by the states. The interim final rule does not affect industrial hemp that was or is being cultivated under the 2014 Farm Bill programs and remains subject to the requirements [5].

The Agricultural Act of 2014 (2014 Farm Bill), signed by President Barack Obama, includes section 7606, which allows for universities and state departments of agriculture to cultivate industrial hemp, as long as it is cultivated and used for research. Under the 2014 Farm Bill, state departments and universities must also be registered with the state and defer to state laws and regulations for approval to grow hemp [3]. This paper aims to provide a background for farmers interested in evaluating the potential opportunities and challenges associated with the production of industrial hemp.

Hemp History

Hemp has been cultivated for thousands of years globally. Dating back to 26,900 BCE, the oldest documented evidence of hemp cultivation is a rope, which was found in today's Czech Republic. In China, around 10,000 BCE, the earliest known use of hemp was for making clothing, rope, and paper. The Yangshao people wove hemp and pressed it into their pottery for decorative purposes. In Japan around 5000 to 300 BCE, the plant was used for fiber and paper. In Greco-Roman cultures, cannabis played a large role as a source of fiber, intoxication, and medicine. Between 170 and 230 CE, cannabis seeds and hemp being used to make rope were discovered in the ruins of Pompeii, and Greek rhetorician Athenaeus. In the first century BCE, a Roman author and naturalist, Pliny the Elder, referred to cannabis root decoction as a treatment for joint stiffness and gout.

The origin of hemp in the New World is unknown. Hemp is thought to have been introduced to the Americas by Christopher Columbus. However, in Native American civilizations, hemp was discovered that predates Columbus' arrival. William Henry Holmes' "Prehistoric Textile Art of Eastern United States" report from 1896 notes hemp from Native American tribes of the Great Lakes and Mississippi Valley. In Virginia, hemp products from pre-Columbian native civilizations were also found. Vikings might have brought seeds with them when they attempted to colonize the New World and used the plant for making rope and sails [3]. In the early 1600s, Jamestown settlers introduced hemp to colonial America for rope, paper, and other fiber-based products. They also imposed fines on those who did not produce the crop themselves. U.S. Presidents George Washington and Thomas Jefferson were known to grow hemp.

Until 1937, the Marihuana Tax Act obliterated the American hemp industry, hemp was a prominent crop in the United States. In the U.S., the crop saw a resurgence during World War II. It was used to make military items including uniforms, canvas, and rope. In 1942, the USDA promoted the plant as a useful crop for the war cause by releasing a short documentary, "Hemp for Victory,". However, World War II hemp resurgence was short-lived, until the passing of the 2014 Farm Bill, because the Controlled Substances Act of 1970 kept industrial production dormant. Today, hemp is rapidly becoming a lucrative industrial crop [3].

Hemp

Hemp is a variety of *Cannabis sativa* L. It is a dioecious plant that can be separated into male and female plants. For more than 10,000 years, these plants have served a wide variety of purposes for fiber (from the plants' stems), protein (from seeds), and oils and smokeable portions (from the leaves and flowers). Hemp fibers can be used to make items including paper, clothing, furnishing fabric, rope, and building materials. The whole hemp plant, from stalk to seed, can also be used to make fuel and feedstock. Hemp can be divided into four categories: bast fibers, hurds or shives, leaves and flowers, and seeds [3].

Industrial Hemp vs. Marijuana

Industrial hemp and marijuana represent different varieties but share the same species, *Cannabis sativa* L [6]. Hemp and marijuana have genetic differences and different chemical characteristics with different usage [7]. A major 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 tetrahydrocannabinol (THC) levels) and marijuana grown for its psychoactive properties (with high levels of THC) [8]. Johnson (2012) 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 business: that is, encouraging many leaves and branches, thus leading to more flowers and buds [9].

Cannabis varieties also vary by planting density: Marijuana plants are spaced to allow business whereas industrial hemp plants are planted much closer together to discourage branching and flowering. Harvest

timing and strategies also vary by variety, allowing for the 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 [10].

Marketing

Industrial hemp is marketed as a fiber, a seed, or a dual-purpose crop [1]. In an article from Successful Farming [11], growers reported planting 146,065 acres of industrial hemp to the USDA in 2019, up from 90,019 acres in 2018, and ranking between safflower and flaxseed in area [11]. There are a variety of marketing opportunities for hemp. Some clothing lines, such as Patagonia, have introduced hemp clothing items and other companies have explored using hemp fiber as insulation or as a natural strengthening agent in construction and building materials (e.g., hempcrete, concrete with hemp fibers mixed in). Other companies have concentrated on the potential for food, feed, and health products, from Cannabidiol (CBD) and other chemical compounds. Targeting food and health marketing, hemp products have been seen in grocery stores, convenience stores, and other assorted shops over the past couple of years. However, not all potential products that can be created from hemp are legal. Hemp seed oil is legal for food products, but CBD oil is not [12].

According to Cornell University [13], farming hemp tends to yield a profit of approximately \$130 to \$730 per acre. By making use of hemp roots, leaves, flowers, stalks, and seeds, you can produce multiple hemp products for the market from a single plant. Growing organic hemp also expands the range of marketable products you can produce. Setting up a contract with one or more buyers ahead of time will help you know your products will have a venue for distribution [14]. In 2018, total sales of hemp-based products in the U.S. were about \$1.1 billion, and they are expected to more than double by 2022, according to New Frontier Data, a market research firm focused on the cannabis market [15].

Production

A report from Iowa State University Extension and Outreach [12] states that the production process for hemp depends on the targeted market. For the fiber market, producers would choose hemp varieties that can be planted densely, forcing the plants to maximize resource allocation to the stem. For the seed market, planting density would be reduced to maximize seed growth. For CBD production, plant density is reduced even further, to allow the hemp plants to bush out and maximize flower production. Given the desire for hemp flowers for CBD extraction, the male plants are removed to avoid pollination. CBD production in outdoor facilities can be challenging due to the potential for cross-pollination from wild hemp that grows in ditches and other disturbed habitats in the state [12].

Cultivated industrial hemp plants usually consist of a spindly main stalk covered with leaves. Considered a low-maintenance crop, hemp plants typically reach between 6 to 15 feet in height. Depending on the purpose, variety, and climatic conditions, the period between planting and harvesting ranges from 70 to 140 days. One acre of hemp can yield an average of 700 pounds of grain, which in turn can be pressed into about 22 gallons of oil and 530 pounds of meal. The same acre will also produce an average of 5,300 pounds of straw, which can be transformed into approximately 1,300 pounds of fiber [1]. Industrial hemp can be a very good rotating crop from traditional crops because it suppresses weeds and decreases outbreaks of insect and disease problems. Hemp may also rebuild and condition soils by replacing organic matter and providing aeration through its extensive root system [1].

Challenges of Hemp Farming

With the passage of the 2018 Farm Bill, farmers across the U.S. are starting to grow hemp. The following are several challenges associated with growing hemp compared to other crops [14, 15, 16].

1. First-Year Yields Might Not Be Ideal: Some challenges with hemp farming are delayed planting schedules or heavy rains that could result in an initial harvest that is less profitable than expected. The successful growing of a crop is a matter of trial and error. It might take a few years to find your sweet spot [14].

2. More Labor Is Required for Weeding: Growing hemp is a labor-intensive process that requires more manpower and hours compared to other crops. Certain types of hemp plants are put into the ground as seedlings. This means much of the work producing the crop is done by hand [14].

Weeds need to be removed, especially when the hemp plants are still young and small. Otherwise, the weeds will cover the hemp seedlings. When hemp is bigger, weeds will cease posing a threat [15].

Because hemp has no approved chemical insecticides or herbicides, farmers have to hand-weed every day until the hemp of the plants finally closes the gaps in the rows that allow sunlight to reach weeds [15].

3. There Are Limited Mills: When you produce hemp grains you will need to have mill nearby, maximally about 30 miles away. Otherwise, business and transportation will be probably too complicated to be profitable. Unfortunately, there are not many hemp mills in the U.S. It is also good to have a hemp fiber point nearby when growing hemp for fiber or biomass [15].

4. It Is Expensive to Get Off the Ground: Growing hemp effectively on a mass scale requires machinery and additional workers. This means purchasing modern equipment or retrofitting existing equipment could cost tens of thousands of dollars. You will also likely need to hire additional workers for the harvest season [14].

5. Hemp Plants Could Be Stolen: Many hemp farmers are reporting their plants being stolen by people who mistake them for marijuana. This can be financially damaging to a farmer. Some farmers are taking extra steps by hiring guards to watch their fields at night or installing security equipment [14].

6. There Are Limited Markets: A report from the Brightfield Group shows that 285,000 acres of hemp were grown in the U.S. in 2019 a 72% increase from the previous year. However, some farmers struggle to find a market where they can sell it and must compete with established exchanges. There are also other financial issues, such as difficulties in working with banks and obtaining crop insurance [14].

7. A Supply Chain Has Not Been Established : Because industrial hemp production was illegal in the U.S. before the 2014 Farm Bill, procuring the seed used to grow hemp has been a challenge. Because other countries have had legal production for a few decades now, most of the seeds come from Canada and Europe. Additionally, downstream processing for hemp and hemp-derived products has a long way to go in terms of developing the supply chain in the U.S. Even if the consumer demand for a product is there and farmers are growing the crop, the supply chain link between the farmer and the consumer needs to have the capacity to process and develop the product. This will likely take some time [16].

8. More THC Threshold and Genetics Research Is Needed : Because most of the seeds used to produce hemp have been imported from other countries, the U.S. still does not have a very long history of research into how some of these seeds acclimate to this climate. If a farmer brings in seed from Europe, and the hemp crop tests at above 0.3 percent THC at harvest, then that crop becomes illegal and must be destroyed. This is likely more of a short-term issue as producers and researchers develop a better understanding of how different genetics express themselves [16].

Legal Considerations

To grow hemp legally in a U.S. state, you must contact the Department of Agriculture or the city, county, and local zoning agencies and officials regarding any regulations, codes, and conveyances with which you might need to comply. Furthermore, to stay compliant, you must make sure that your hemp has less than 0.3 percent of THC. The Federal Government strictly prohibits cultivating hemp and extracting CBD from it. You can also apply for a permit and license and register with your state as an industrial hemp grower. The process of applying for a license differs between states, but once you get the license it will be valid for several years. After you receive your license you will need to report on your hemp cultivation [13].

Prospective hemp farmers might also need to present documentation proving their crops are also processed in the state. Note that shipping hemp and hemp products outside of your state is subject to federal laws and restrictions [13]. Before you start growing and making your first investment in the hemp business,

you need to educate yourself on hemp cultivation by contacting other cannabis growers, read hemp information, and create a mini business plan and cost estimate. Knowledge and preparation are especially important when it comes to growing hemp [15].

Conclusion

After a hiatus of nearly 45 years, the 2014 Farm Bill reintroduced hemp production by authorizing hemp research and pilot projects. The 2018 Farm Bill creates huge business opportunities for farmers by authorizing the cultivation of industrial hemp. In 2019, the USDA was directed to assure uniformity in state regulations. The establishment of hemp as a regulated commodity also paves the way for U.S. hemp farmers to participate in USDA farm programs. The USDA farm programs help interested U.S. hemp farmers participate and understand hemp production plans, guidelines for sampling and testing procedures, disposing of plants not meeting requirements, and licensing requirements.

The hemp industry is appealing for U.S. farmers wanting to diversify their crops and offers a potential new revenue stream. However, one should consider the challenges that farmers face in carrying out hemp farming. Hemp and marijuana are both cannabis, but their morphology, chemical makeup, and usage are very different. To be successful in the business, farmers must develop plans to benefit and profit from industrial hemp production. If you are planning to grow industrial hemp in the U.S., you might need to contact your state Department of Agriculture to understand state laws and regulations for approval to grow hemp.

Conflicts of Interest

The author declares no conflicts of interest.

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