UK COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY — COLLEGE OF AGRICULTURE

Industrial Hemp Production

Introduction

Industrial hemp (*Cannabis sativa*) is a versatile plant that can be grown for its fiber, seed, or oil. Hemp fields were once a common site in Kentucky during the state's prominence as the leading hemp producer in the U.S. Although commercial hemp production ceased throughout North America in the late 1950s, there is currently renewed interest in once again growing this crop. While hemp faces significant legal obstacles due to its close relationship to the marijuana plant, there are a number of states, including Kentucky, working toward reviving the hemp industry.

This profile is intended to provide an overview of hemp cultivation and economics should this crop become legalized for commercial production in the Commonwealth. For more information on the current situation of industrial hemp, refer to the companion profile "Industrial Hemp — Legal Issues."

Marketing

Hemp fibers have been used to manufacture hundreds of products that include twine, paper, construction materials, carpeting, clothing, and animal bedding. Seeds have been used in making industrial oils, cosmetics and other personal care products, and medicines. Hemp seed or oil can be found in cooking oil, salad dressings, pasta, and snack products. This crop also has potential as a biofuel.

Currently all hemp products sold in the U.S. are imported

Industrial hemp grown for grain and fiber in France.

or manufactured from imported hemp. American food processors and product manufacturers using imported hemp seed oil and hemp fiber could be interested in a domestic product. Because of the need for processing plants to process hemp from field production, and the apparent lack of such industry in the U.S., substantial infrastructure development would be required for profitable U.S. farm production. Substantial research and infrastructure development would also be required for new uses of hemp, such as biofuels.

Market Outlook

The fact that the production of hemp is legally prohibited in the United States has not deterred substantial interest in the feasibility of U.S.-grown industrial hemp. Many production and market feasibility studies have been conducted by both federal and state research institutions. A number of these studies are listed and summarized in a 2012 Congressional Research Service report, "Hemp as an Agricultural Commodity." This study, like others, notes that potential U.S. producers face not only existing regulatory prohibitions on industrial hemp, but also substantial

Crop Diversification & Biofuel Research Education Center

international competition, particularly from Canadian and Chinese producers. This is due to industry infrastructure development (Canada) and labor cost savings (China) advantages.

Alternatives to hemp fiber products already exist. Faster growing market segments for hemp products may include hemp food and body care products. Notably, hemp and hemp seed oil is an ingredient in some certified organic foods, which have been gaining greater popularity in recent years. Certified organic hemp could be a possible growth market in North America.

Potential industrial hemp commodity production in the United States would need to be accompanied by marketing plans that address advantages held by existing international producers. Adequate hemp processing facilities would also likely need to be in close proximity to potential new producers, with site-specific market and processing feasibility analysis required.

Production Considerations

Despite Kentucky's prior history of production, industrial hemp is basically an untested crop in this state. Agriculture as a whole has changed considerably since hemp's heyday, so past production information cannot be relied upon to determine how the crop should be grown and harvested today. Local research will be needed to provide specific data on cultural requirements, such as plant spacing and nutritional needs, as well as harvest and processing methods. Meanwhile, the following information has been gleaned from other countries, such as Canada, that are currently growing hemp.

Cultivar selection

Industrial hemp and marijuana are genetically different cultivars of the same plant species and are distinguished from one another based on their use and tetrahydrocannabinol (THC) levels. THC is the main chemical that gives marijuana users their "high." While marijuana cultivars typically contain 3 to 15 percent THC by weight, hemp cultivars are bred to contain only trace amounts (less than 1 percent). Fiber yields, fiber quality, seed size, oil content, and oil composition also vary between hemp cultivars. Dual-purpose cultivars are suitable for both fiber and seed uses; however, the current industry trend in other countries seems to be toward selecting varieties specific for one use or the other. Should industrial hemp production return to the Commonwealth, it is anticipated that hemp will be grown under contracts that specify the cultivar.

Industrial hemp production has been legal in Canada since the 1990s. Only varieties included in their List of Approved Cultivars (published by Health Canada) are permitted for production. These varieties contain less than 0.3 percent THC under normal growing conditions and most are of European origin. It is unknown at this time what cultivars would be suitable for Kentucky production.

Site selection and planting

Industrial hemp grows best on well-drained soils with high fertility and rich in organic matter. Soil pH should be neutral to slightly alkaline. Hemp is intolerant of compacted soils and flooding. Yields and quality suffer when plants are grown in poorly drained clay soils, as well as soil low in fertility. Hemp should not follow canola, edible beans, soybeans, or sunflower.

Fields should be plowed in the fall or winter, followed by spring tillage. Hemp requires a fine seedbed for good seed-to-soil contact. Seeding can be accomplished with a standard grain drill. Although seedlings can tolerate some frost in the spring, it is best to seed hemp after the danger of a hard freeze has passed and soil temperatures are 46^{o} F or above. Experience in Canada indicates that early plantings yield more fiber.

Fertility needs have been reported variously as 'less than those required by corn' and 'approximately the same as recommended for high yielding wheat.' Spacing depends on the cultivar and end-use. Generally, hemp for fiber is planted in dense stands to promote taller height and discourage branching and flowering, thus maximizing fiber yields. On the other hand, since flowering and branching are desirable for seed production, plants are spaced farther apart.

Hemp requires good soil moisture for germination and for growth up through the first 6 weeks after seeding. Young plants are particularly sensitive to overly wet soils and flooding.

Pest management

Hemp is the potential host to a number of diseases and insects; however, many of these problems are not widespread or considered insignificant. Canada indicates Botrytis gray mold, Sclerotinia white mold, European corn borer, and grasshoppers have been observed. Since no fungicides or insecticides are registered for hemp, Canadian growers manage these problems by using a 4-year crop rotation program and following good cultural methods.

Hemp is very competitive with weeds, and because it grows quickly, densely planted hemp (for fiber) will shade out most weedy growth after about 3 to 4 weeks. Weed suppression is not as effective at the wider spacings required for seed production. No herbicides are available for use in hemp production.

Tall growing hemp plants are more prone to wind and hail damage. These and other stresses can result in increased THC levels.

Harvest and storage

Small fields can be harvested by hand, with sickle bar mowers, or with hay swathers. Larger fields necessitate the use of mechanical harvesters, such as combines, forage harvesters, or specialized machinery. Industrial hemp fibers are tough on equipment and can cause plugging, as well as wind around moving parts.

HEMP FOR FIBER

Hemp is generally harvested for fiber when plants are between early bloom and seed-set, depending on desired quality of fiber and usage. To preserve long fibers for the highest quality products, hemp stalks should not be broken or cut up.

Hemp consists of two main types of fibers: bast (outer long fibers) and hurds (inner short fibers). Each type of fiber has its own uses in industry. Once cut, hemp must undergo a process known as retting, which begins breaking the chemical bonds that hold these fibers together. Field or dew retting is the most common and least costly method of accomplishing this. Cut stems are left in the field for up to 5 weeks and kept moist with dew and rain, which can be supplemented with irrigation water. Stems are monitored and turned for uniform retting. Stalks need to begin rotting so fibers will separate, but without resulting in deterioration of fiber quality.

Water retting is more expensive and labor-intensive than field retting; however, it results in better quality fibers. Stems are submerged in water for 7 to 10 days; heat may also be applied during some of this time. Chemical retting (chemicals are used to dissolve the bonds between fibers) and green retting (fibers are separated mechanically) have also been used.

After retting, the stems are dried to less than 15 percent moisture and then baled. Baled hemp is then transported to the processing plant. If stored, baled hemp must be placed indoors to prevent further retting and deterioration of fibers.

HEMP FOR SEED

Hemp seeds are combined when 70 percent of the seed is ripe. Combining grain past the optimal time generally results in lower quality seed, losses due to shattering, and possible bird damage. Grain should be dried to below 12 percent moisture for storage and at 8 to 10 percent for long-term storage.

HEMP AS A DUAL-PURPOSE CROP

Dual-purpose hemp is cut when seeds have neared maturity. Seeds can be combined first and then stalks re-cut later. It is also possible to modify the combine to harvest both grain and stalks at the same time. Waiting until seeds are harvestable will result in poorer quality fiber, which is acceptable only for lower value uses, such as pulp.

Labor requirements

Labor needs per acre, according to production data from Canada, are similar to other specialty grain and oilseed crops, such as small grain production for grain and straw, or specialty soybeans.

Economic Considerations

Should industrial hemp production once again be permitted in the U.S., it will most likely be regulated by the federal government, state government, or both. Potential regulatory expenditures might include the costs of licenses and/or permits, background criminal record checks, and laboratory testing of plant THC levels, as well as setting up and following security protocols at production fields. These costs would be a matter of conjecture at this point.

Initial start-up production investments would include land preparation and purchase of seed. The installation of an irrigation system is another potential production cost. Specific data on costs and returns are not currently available for U.S. production. The Department of Agricultural Economics at the University of Kentucky is in the process of developing a preliminary hemp budget summary for the Commonwealth. Once available, that information will be included in this profile.

Selected Resources

Books in print

- A History of the Hemp Industry in Kentucky. James F. Hopkins. 1998. University Press of Kentucky: Lexington, KY. 244 pp.
- *Report to the Governor's Hemp and Related Fiber Crops Task Force.* Sara McNulty, ed. 1995. Commonwealth of Kentucky. 223 pp.

On the Internet

- Industrial Hemp — Legal Issues (University of Kentucky, 2012) http://www.uky.edu/Ag/cdbrec/introsheets/hemp.pdf
- Alberta Hemp Cost of Production and Market Assessment (Alberta Agriculture and Rural Development, 2012) *1.2 MB file* http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/econ14086/$file/hemp_production_marketassessment_report.pdf?OpenElement
- Growing Industrial Hemp in Ontario (Ontario Ministry of Agriculture, Food and Rural Affairs, 2009) http://www.omafra.gov.on.ca/english/crops/facts/00-067.htm
- Feasibility of Industrial Hemp Production in the United States Pacific Northwest (Oregon State University, 1998) http://extension.oregonstate.edu/catalog/html/sb/sb681/
- Hemp (Farmers Bulletin 1935, USDA, original 1943, slightly revised 1952) http://www.industrialhemp.net/pdf/USDA_Bulletin_1935.pdf
- Hemp: A New Crop with New Uses for North America (Purdue University, 2002) http://www.hort.purdue.edu/newcrop/ncnu02/v5-284.html
- Hemp as an Agricultural Commodity (Congressional Research Service, 2012) http://www.fas.org/sgp/crs/misc/RL32725.pdf
- Industrial Hemp Agricultural Marketing Resource Center, 2012) http://www.agmrc.org/commodities__products/fiber/industrial_hemp.cfm
- Industrial Hemp (British Columbia Ministry of Agriculture and Food, 1999) http://www.agf.gov.bc.ca/speccrop/publications/documents/hempinfo.pdf
- Industrial Hemp in the United States: Status and Market Potential (USDA, 2000) http://www.ers.usda.gov/publications/ages/ages001e.aspx
- Industrial Hemp Production in Canada (Alberta Agriculture and Rural Development, 2012) http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/econ9631
- Industrial Hemp Profile (Agricultural Marketing Resource Center, 2012) http://www.agmrc.org/commodities__products/fiber/industrial_hemp_profile.cfm

Reviewed by Dave Spalding, Extension Associate (Issued 2013)
Photo by Aleks, courtesy of Wikimedia Commons **January 2013**