AN INTRODUCTION TO

Fiber Hemp Production in Georgia

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With the passage of the 2018 farm bill, the U.S. federal government legalized the widespread production of industrial hemp. Industrial hemp (*Cannabis sativa* L.) is defined as having a total potential tetrahydrocannabinol (THC) concentration of 0.3% (+/- a measurement of uncertainty) on a dry-weight basis. Hemp can be grown for its cannabinoids (extracted from floral growth), fiber, or seed, and sometimes multiple crops (dual use) from the same plant. By far the most popular use of hemp production systems today is growing hemp for the cannabinoid (i.e., CBD) market. This production system is addressed in the UGA Cooperative Extension publication *A Preview of Industrial Hemp for Flower Production in Georgia*, which is available through the UGA Cooperative Extension website.

Many agricultural producers hear the term *industrial hemp* and immediately think of hemp fiber products, such as rope or other textiles. However, processed hemp fiber has a wide range of uses: textiles, rope, animal bedding, biofuels, paper, insulation, and even as an additive to concrete. A hemp stalk is made up of the outer *bast* fibers, which are derived from the bark and phloem and the inner core fibers (Chabbert et al., 2013; Figure 1). The bast fibers are longer and stronger than the core fibers and are commonly utilized for textiles or cordage (Allegret, 2013). The inner core fibers undergo industrial processes to make products such as insulation. Historically, hemp primarily was grown for fiber or seed, and varieties were developed with this purpose in mind. Most of the fiber hemp varieties that are planted in the United States today were developed in Europe and in parts of Asia, where the production of industrial hemp was routine throughout the 20th century. With that in mind, be careful when selecting a fiber hemp variety to make sure that it was developed in an area with a similar climate to Georgia, or that it has been shown to grow well in the southeastern United States. Varieties that are developed in northern latitudes (with longer summer day lengths) may have a relatively short vegetative stage when grown in Georgia's latitudes (with shorter summer day lengths). Varieties that are developed in East Asia

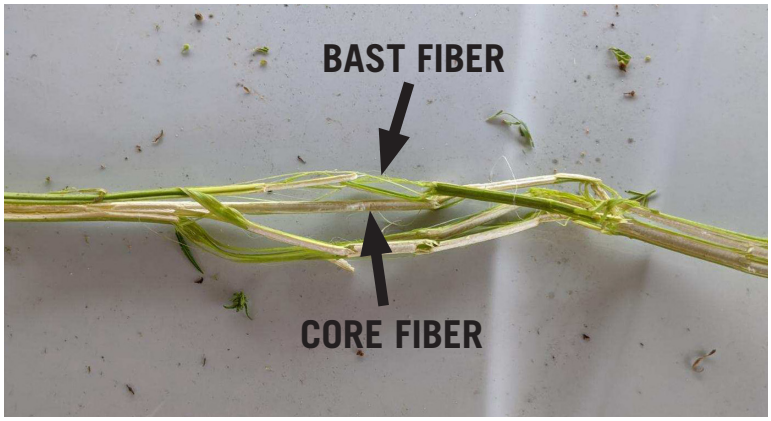

Figure 1. Outer bast fibers and inner core fibers from the stem of industrial hemp.

Figure 2. The dense spacing of a fiber hemp planting (top) compared with the wide spacing of a hemp crop grown for the flower (cannabinoid) market (bottom).

may be more suitable for the shorter day lengths encountered in the southeastern United States as they may have a longer vegetative stage during our summer growing season. A longer vegetative stage enhances the yields of bast fibers compared to core fibers (Stringer, 2018).

Growing hemp for fiber is relatively new for Georgia farmers. While it was done in the past, commercial hemp crops were not produced legally in the state for more than 70 years until the 2020 production season. Given the current market trends, most of the hemp grown in Georgia is for cannabinoid production, though there has been an interest in hemp for fiber production. As of mid-2021, there are no commercial processors for fiber hemp in the state of Georgia. This lack of processing capacity will limit the production of hemp for fiber in the state. As with many processed crops, transportation over long distances to be processed is not economically viable due to the large volumes of product grown when producing fiber hemp. Should a market develop, trials of fiber hemp production are underway at the University of Georgia in order to develop research-based production guidelines in Georgia.

Figure 3. The presence of male flowers in fiber hemp.

Fiber hemp is grown in a similar manner to many row crops, with populations of up to or more than one million plants per acre (Roseberg et al., 2019). Depending on seed size and germination percentage, the seeding rate for fiber hemp can range widely. Though recommendations typically are in the range of 40–50 lb per acre for seeding, some recommendations call for up to 80 lb per acre of seed for fiber hemp production. The reason for high plant populations is so that the fiber hemp has little to no branching with tall straight stems. Branching reduces the quality of fiber, and taller and thinner stems will generally produce a greater percentage of bast fibers so long as they are harvested in a timely manner. This contrasts with the wide spacing used in hemp grown for cannabinoid (flower) production, where branching is encouraged (Figure 2). While the stalks of hemp grown for flower production may have some additional industrial uses, they are generally not suited for textile production. Specific fiber varieties should be grown for textiles. In addition to improving quality, high plant populations can help shade out weeds, which can be problematic for fiber hemp production due to a lack of labeled herbicides. Another important distinction between fiber hemp and hemp grown for the flower market is the presence of both male and female plants in fiber hemp. Hemp grown for flower production is generally *dioecious*, where male and female reproductive organs (flowers) are on separate plants. To avoid pollination and a subsequent decrease in the yield of cannabinoids, exclusively female plants are used to produce hemp for cannabinoid extracts. This is done either with cuttings from female plants or from using feminized seed. Fiber hemp may be dioecious (Figure 3) or *monoecious* (male and female flowers on the same plants). Monoecious varieties are typically more uniform in height and maturity but may be lower yielding than dioecious types (C. Stringer, personal communication). In either scenario, male plants are not removed and pollen is freely produced when growing hemp for fiber. The movement of pollen, while not an issue in fiber production, can

be problematic if it were to contaminate nearby plantings of hemp grown for the cannabinoid market. Therefore, if you are growing a fiber hemp crop, be sure to make other hemp growers that are located close to your plantings aware in order to avoid any issues with pollinating their crop.

Hemp seeds are typically 1/8 to 3/16 in. in diameter (Figure 4) and should be planted at a depth of 1/2 to 3/4 in. into a prepared seedbed. Good seed-to-soil contact and soil moisture are critical for germination. Hemp is fairly drought tolerant once established, and growers in the Piedmont region of Georgia may be able to grow a fiber hemp crop with minimal irrigation. In the Coastal Plain region of the state, irrigation would be generally recommended. In trials at the J. Phil Campbell Research Center in Watkinsville, GA, fiber hemp was seeded using a grain drill that was manually calibrated for the hemp seed at rates of 40 and 80 lb per acre (Figure 5).

Industrial hemp typically has better germination and emergence when exposed to cooler soil and air temperatures (59–82 °F; Roseberg et al., 2019). The temperatures during May in Georgia often exceed 85 °F, which can reduce germination in some cases. One trial resulted in less than 30% germination of fiber hemp seeded in the field in early June with seed that had tested at 90% germination in the lab. Much of this loss in germination was attributed to excess heat. However, because fiber hemp can flower under shorter days (< 13.5–14 hr of daylength), seeding too early in the spring may be problematic because of early flowering. The proportion of dry weight attributed to bast fibers decreased in fiber hemp during flowering, with a corresponding increase in core fibers in research conducted in Kentucky (Stringer, 2018). Further, the same research reported that floral components, which are not necessarily desired in single-use fiber production, made up a significant percentage of the total dry matter produced when plants were allowed to grow flowers and senesce. Enhancing the time period for vegetative growth is important to optimize the yield of fiber hemp.

Figure 4. Typical fiber hemp seed size.

Figure 5. Hemp planted with a grain drill with rows 7.5 in. apart. Hemp in this picture was seeded at approximately 80 lb per acre because of issues with low germination caused by heat.

With the exception of autoflower varieties, hemp plants flower in response to daylength. Hemp will grow vegetatively when daylengths are longer than 14 hr, which in occurs from mid-May to late July in Georgia. While the air and soil temperatures in Georgia may be warm enough for hemp production in early spring, our daylengths are less than 14 hr. This may lead to premature flowering in young hemp plants.

Current recommendations for nitrogen fertilizer for hemp grown for cannabinoids in Georgia range from 100 to 150 lb of nitrogen per acre in the Piedmont and Coastal Plain regions, respectively. However, nitrogen recommendations for producing fiber hemp are considerably less. Many nearby states recommend 50 to 100 lb of nitrogen per acre for fiber hemp. This difference in fertilization rate is due to the shorter growing season, as well as the lower profit margins for fiber hemp compared to hemp grown for the cannabinoid market. Fertilization rates are subject to change as more research is conducted.

Two varieties of fiber hemp were grown in 2020 trials conducted by the University of Georgia. The varieties *Białobrzeskie* and *Jin Ma* were planted in mid-May. Overall, *Jin Ma* had yields averaging 4–5 tons of total dry weight per acre, while *Białobrzeskie* had yields of less than 0.5 ton per acre of dry weight. While some of this was due to differences in germination, *Jin Ma* remained vegetative for longer than *Białobrzeskie*. *Jin Ma* was harvested in mid-September (126 days), which was 30 days later than *Białobrzeskie* (96 days). Both varieties were harvested when they were flowering, but not yet senescing. *Białobrzeskie* was initially bred by the Institute of Natural Fibers and Medicinal Plants in Poznan, Poland, which resides at 52.4°N latitude. *Jin Ma* was developed by the Economic Crops Research Institute of Shanxi Province Academy of Agricultural Sciences in Fenyang, China, which resides at 37.2°N latitude. For comparison's sake, Watkinsville, GA (where the trial was conducted), resides at 33.8°N latitude. The longer vegetative growth period and delayed flowering of the variety developed in China may be reflective of the latitude (daylength) and climate in which it was developed. This suggests that varieties that were developed in lower latitudes with warmer climates and shorter summer days may be better suited to production in Georgia (Figure 6).

Figure 6. Hemp Jin Ma at harvest. Most plants of this variety were roughly 6 ft in height at harvest and were flowering heavily. An earlier harvest may be preferred to improve the percentage of bast fibers relative to core fibers.

It should be noted that the yields previously mentioned were for dried hemp plants, which were primarily stems with some floral material attached. Leaves fell off during the drying process. We did not separate fiber from the stems and therefore fiber yields would be expected to be considerably less than total dry-weight yields (Economic Research Service, 2000). In addition, plants were not retted after harvest. *Retting* is a microbially mediated process by which the stems break down, allowing separation of the bast fibers from the core fibers. Retting may be done in the field, where stems are cut from the plants and allowed to begin to break down, or the stems may be submerged in water to facilitate the process. After retting, stalks are to be dried and baled, and then processed for further mechanical separation. The publication *Industrial Hemp in the United States: Status and Market Potential* (Economic Research Service, 2000) gives a more thorough overview of the processes involved in fiber hemp production.

The lack of market opportunities currently restricts the development of a fiber hemp market in Georgia. However, it should be noted that despite the hemp pilot programs started after the 2014 farm bill, it was not until the 2018 farm bill and subsequent USDA hemp rules that clearly defined hemp production nationwide. Therefore, it may be expected that industrial uses for fiber hemp will grow as this industry continues to develop.

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