Industrial Hemp Production in Georgia

Timothy Coolong, *Department of Horticulture*

Background

With the passage of the 2018 Agriculture Improvement Act (U.S. farm bill), the federal government removed industrial hemp (*Cannabis sativa* L.) from the list of Schedule I drugs and opened up opportunities for farmers to produce this once widely grown crop. More information on the hemp rules and regulations can be found at agr.georgia.gov/hemp-program.

Although the brief guide that follows is not exhaustive, it is meant to provide basic information for growers who are considering hemp production of floral materials meant for the cannabinoid market. Cannabinoids may include CBD, CBG, etc. Although there has been some interest in hemp production for fiber and seed, the majority of growers have expressed an intent to grow for the CBD market. The production of hemp for fiber and seed differs greatly from that of floral material and subsequent publications will focus on these end uses. Because of the changes in rules and regulations that may occur, we recommend readers look to the Georgia Department of Agriculture and the U.S. Department of Agriculture for any clarification or questions they may have regarding the regulation of hemp production in Georgia.

The plant

Hemp and marijuana are both *Cannabis* plants; however, hemp is defined by law as those plants with total tetrahydrocannabinol (THC) levels at or below 0.3%. Total THC may include delta-9-tetrahydrocannabinol and THC A (the acid form of THC) as well as other minor forms of THC found in the plant. Plants testing above 0.3% (plus a measurement of uncertainty) are considered marijuana. Hemp plants grown for floral material may look and smell no different than a marijuana plant grown under the same conditions, but they will differ in their presence of secondary metabolites. Many of the newest hemp cultivars have been bred specifically for the CBD market and have high CBD to THC ratios. Regular testing for THC during flowering is recommended so that growers can be sure to harvest their crop if THC levels begin to approach the legal threshold during flower maturation.

Most hemp cultivars will flower when exposed to day lengths of fewer than approximately 13 to 14 hr. There are also some autoflowering (day neutral) cultivars that will initiate flowering a certain number of days after seeding, regardless of the day length. Knowing flowering times is critical for the production of hemp. Because Georgia has a long growing season, farmers may be tempted to plant hemp early in the spring, after the risk of frost has passed. But if planted when days are less than approximately 14 hr (mid-May), hemp may begin to flower before the plants have had a chance to undergo any vegetative growth. Similarly, if growers plant too late in the season, plants may flower prematurely. In 2019 trials, most common day-length-sensitive hemp cultivars began flowering during the first week of August when planted in early June. Some crops planted in mid-July also began to flower at the same time, despite having very little vegetative growth.

As mentioned, there are some autoflowering hemp cultivars that will flower a certain number of days past seeding. While these cultivars offer the promise of multiple crops per year in states like Georgia, they do require nuance in their production. Most autoflowering cultivars are very sensitive to any stress early in growth. When being grown as transplants, flowering can be initiated with even the slightest amount of root restriction. Often by the time the transplants can be pulled easily from a tray, they are already stressed from being root-bound and have initiated flowering. Viable options may include direct-seeding autoflowering cultivars or growing transplants in grow cubes that can be planted easily without having to pull a plant from a tray (Figure 1).

Hemp plants that typically are used for cannabinoid production are also dioecious, meaning that they usually produce male and female flowers on different plants. Occasionally, hermaphrodite plants are found that contain both male and female floral material. Although CBD and other cannabinoids can be found in trace amounts in the leaves of the hemp plant, the

Figure 1. An autoflowering hemp cultivar is grown using grow cubes (left) and later flowers in the field (right).

highest concentrations are found on the trichomes of unpollinated female flowers. Because of this, hemp grown for the CBD market is almost always produced from female plants, with male plants being undesirable. Hemp grown for fiber and seed may be monoecious, with both male and female flowers on the same plant.

Cuttings and transplants

Because of the need for female-only plantings, growers may notice that hemp for CBD production is often grown from rooted cuttings taken from female "mother" plants. Greenhouses supplying cuttings need to maintain a crop of mother plants to supply cuttings for the growers to plant in the field. In order to maintain vigorous vegetative growth, mother plants are often maintained under 18–24 hr of light. In some cases, only enough light is supplied to ensure that plants do not flower, while in others supplemental light is provided in high enough quantities to both stimulate growth and enhance day length. It is not recommended to take cuttings from plants that are actively flowering, as it will significantly reduce chances of success for rooting cuttings.

Ensuring that mother plants are growing vigorously will allow for multiple cycles of cuttings to be taken from a single plant. Experience has shown that cuttings typically will send out new roots in under 10 days. Often cuttings are stuck into a preformed medium, which allows them to be planted shortly after rooting. Cuttings are usually dipped in a solution of indole-3-butyric acid (IBA) rooting hormone (sold under a variety of trade names) after being removed from the mother plant and then stuck in a rooting medium and placed under a misting system. Leaves are often cut or partially removed from cuttings to reduce water loss from the cuttings before they successfully root. Mist systems used for cuttings are often shaded and some low-intensity supplemental light may be necessary to extend the day lengths.

When growing or purchasing cuttings, take care not to allow cuttings to sit for too long prior to planting. Most cuttings can be planted within 2 to 3 weeks of being taken. Cuttings that are left in the greenhouse for several more weeks may become stunted. Observations of farms in the Southeastern U.S. have shown that cuttings that are left in trays for too long may become stunted, subsequently hurting growth (Figure 2).

Figure 2. A cutting that sat for too long prior to planting grew stunted and never recovered.

Growers can also purchase "feminized" seeds. Hemp seeds are feminized by treating female plants with colloidal silver or silver thiosulfate and subjecting them to a reduced (12-hr/12-hr day/night) lighting schedule. This reduces ethylene production, allowing for the production of "male" flowers on female plants. After flower production, the pollen from these flowers is used to pollinate female flowers, producing a high percentage of female seeds. Feminized seeds can then be planted and grown as you would any other transplant. Transplant production time is typically about 3 to 3-1/2 weeks using a 128-cell tray. Although the feminization process has the ability to produce feminized seeds that can produce upward of 95% to 98% female plants, males may still be present. If planting 2000 plants per acre at a 95% success rate, growers must identify and cull 100 male plants per acre. This will require careful scouting during the growing season. In some cases, growers have reported that the feminization process has not been successful and they have been left with an even split of male and female plants, which can result in ruining a crop.

Figure 3. Hemp transplant from seed 3.5 weeks after seeding.

Males can be identified through the presence of male flowers on the plant (often called pollen sacs). These small flowers hang down from leaf axils and are

Figure 4. Male flowers on hemp (left), a hermaphrodite displaying both male and female flowers (center) and a female flowering plant (right).

readily identifiable. The pollen from male plants is light and can travel great distances via wind. Therefore, if not used for breeding purposes, any male plants should be removed and destroyed so that aberrant pollen does not negatively impact nearby crops.

The benefits of growing plants from feminized seed include reduced labor and costs compared to rooted cuttings, but the presence of male plants can ruin a crop, so growers must be careful when choosing this route of production. Some growers have chosen to direct-seed hemp for CBD in the field. Low emergence rates resulting from uneven seed quality can be problematic. In addition, the wide spacing required for hemp grown for floral material can make it difficult to control weeds in direct-seeded hemp. Hemp grown for fiber or seed is usually direct-seeded at very high rates similar to other agronomic crops.

Some growers in nearby states have experimented with growing a crop from nonfeminized (regular) seed and culling the male plants in the field during production. While the initial costs are significantly lower, the labor costs associated with regularly removing male plants in the field can be prohibitive.

Planting in the field

Once day length is adequate, growers can plant into the field. In Georgia, day length exceeds 14 hr in mid-May. The planting window for day-length-sensitive hemp cultivars in Georgia seems to be from mid-May to late June, but continued research may result in changes to recommended planting dates. Growers need to ensure adequate vegetative growth prior to flower induction in early August, and planting date trials must be conducted to determine the optimal planting time for hemp throughout Georgia.

At this time, the University of Georgia has not conducted adequate research to determine optimal fertilizer rates for hemp produced for CBD in the state. Empirical evidence from farms in the Southeastern U.S. has suggested that approximately 100–150 lb/acre nitrogen is sufficient to grow a successful crop of hemp (personal observation; Williams & Mundell, 2018). However, crops grown on soils with a high clay content found in the Piedmont region likely require less fertilizer and irrigation inputs, and those in the Coastal Plain may need more. Further, successful hemp crops have been grown at soil pH values (5.7–6.0) that are lower than what is typically required for most agronomic crops. More research will be required to determine the ideal pH range for planting hemp. Successful crops are being grown in Watkinsville, Georgia, with 50 lb/acre nitrogen applied preplant and an additional 50–80 lb applied through fertigation during the season. Planting date, plant density, and maturation time will all affect fertilizer recommendations. It must be stressed that additional research is required before scientifically based fertilizer recommendations for hemp production can be made in Georgia.

Much of the acreage of hemp grown for floral material is being produced using plastic mulch and drip irrigation. This is primarily because of a lack of synthetic herbicides labeled for hemp production, so growers are relying on plastic mulch for in-row weed control. Because of the late-spring planting period for hemp, white-on-black mulch is recommended, as black plastic mulch would likely be too hot and damage young seedlings. Between-row weed control is being managed in a variety of ways, from cultivating

Figure 5. Hemp grown using plastic mulch in Georgia.

using a high-clearance tractor with sweeps or tine weeders to using wide row spacing to allow for mowing or tilling between rows. Some growers are also planting cover crops between rows to suppress weeds. Hemp grown for floral material can become quite large, shading the between-row areas. Several growers in the Southeastern U.S. have used bare-ground production combined with timely cultivation with good success.

If using plastic mulch, growers will also use drip irrigation for production. Hemp has a large root system and can tolerate fairly dry conditions. Hemp cannot tolerate wet conditions and excessive soil moisture will cause significant crop losses to diseases such as southern blight. Water management is perhaps the most critical decision growers make when growing hemp in a wet climate such as Georgia.

Field pest control

Please refer to the U.S. Environmental Protection Agency for pesticides registered for hemp production (https://www.epa.gov/pesticide-registration/pesticide-products-registered-use-hemp).

Cercospora leaf spot (*Cercospora cf. flagellaris*; Figure 6) has been reported in several states in the Southeastern U.S. (Doyle et al., 2019) and was identified on hemp in Georgia in summer 2019. The disease can cause complete defoliation on some cultivars. Powdery mildew (*Golovinomyces* sp.) and botrytis mold (*Botrytis cinerea*) can also affect hemp leaves and flowers. If floral material is significantly affected by botrytis, it can render the crop unmarketable. Southern blight (*Sclerotium rolfsii*) is a common disease of peppers and tomatoes in Georgia and was found on hemp growing in Georgia in 2019. Because of the lack of approved pesticides to combat some of these diseases, growers must use cultural practices to help reduce the presence of inoculum

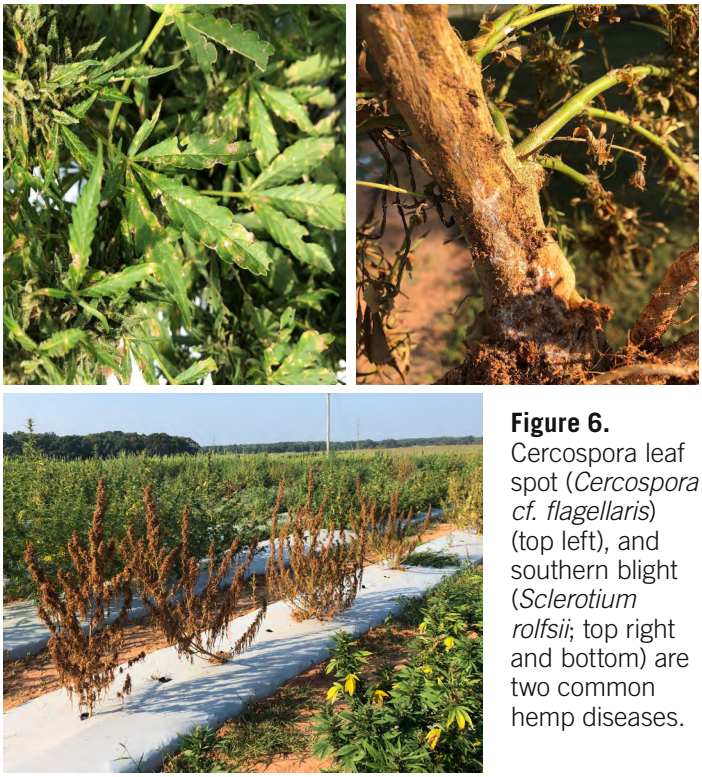

Figure 6. Cercospora leaf spot (*Cercospora cf. flagellaris*) (top left), and southern blight (*Sclerotium rolfsii*; top right and bottom) are two common hemp diseases.

and susceptibility of plants. This includes using drip irrigation and preventing waterlogged soils. Wider row spacing may also increase air flow and reduce leaf wetness.

Hemp russet mites (*Aculops cannibicola*) are found in many hemp-producing regions of the United States. Hemp russet mites are typically too small to be observed with hand lenses, typically requiring 20x magnification. These mites can cause hemp leaves to yellow and curl. Severe infestations may reduce plant growth. Because of the year-round production of mother plants for cuttings, hemp mites can survive throughout the year in protected culture. Although not yet detected in Georgia, hemp russet mites have been found in Florida.

"Budworm" is a generic term given to a variety of worm species that feed on developing flowers in hemp (Figure 7). Several types of armyworms and

Figure 7. Budworms feeding on female hemp flowers.

bollworms (e.g., corn earworms) have been identified in Georgia. Fields should be regularly scouted at flowering, as budworms can cause significant damage when unchecked.

Harvest

After flower initiation, hemp plants may continue to flower for 45 to more than 100 days, depending on the cultivar. After flowering is initiated, growers should begin sampling with guidance from their processors to determine the optimal harvest time. Because growers are paid based on CBD yield per acre, it is ideal to maximize biomass and CBD production. However, because of the 0.3% THC threshold (on a dry weight basis) for hemp to be legal, growers must make a decision on when to harvest based on CBD and THC values in the floral material. Currently, growers must notify the Georgia Department of Agriculture prior to anticipated harvest in order for the state to conduct appropriate sampling and testing. For compliance rules and regulations, growers should contact the Georgia Department of Agriculture.

Much of the hemp grown for floral material is currently hand harvested, particularly on a smaller scale, in order to avoid damaging trichomes (glandular structures on the female flowers) and ultimately reducing the yield of CBD. After harvest, floral material is dried. Growers use a variety of drying techniques and are careful to avoid exposing the harvested plant to excessive heat. Farmers may hang plants to dry in barns (Figure 8) or repurposed chicken houses with fans on but no cooling pads, or they may use tobacco dryers.

Handling and drying techniques should be balanced with the demands of processing large volumes of material. Hemp plants are large and take up much more room than a similar acreage of tobacco plants. Harvesting and handling methods will also be determined by the final market for the product. Broad-spectrum extracts containing terpenes and multiple cannabinoids will be handled differently from those wishing to produce a single isolate. Processors will play a large role in determining harvesting and drying processes.

After drying—typically to 10% to 15% moisture content—growers may remove the floral material. Flower can also be removed from "green" or freshly harvested material, but it is more common to dry material first. Flower material can be removed by hand stripping or using a bucking machine. Machines vary in their ability to strip entire plants or single branches. Before investing in a stripping or bucking machine, growers are encouraged to consider labor availability and their time frame to strip material from plants.

This publication is an introduction to hemp production for floral material in Georgia. It is not meant to be exhaustive, as hemp production is as complex as any other crop. Unlike crops such as cotton or corn where there are many decades of research focusing on a myriad of cultural practices, there is far less research-based information for hemp production in the Southeastern U.S. This means that growers may be doing some experimentation as they work out the best system for their production.

Figure 8. Recently harvested hemp plants hang in a pole-barn for drying.

References

Doyle, V. P., Tonry, H. T., Amsden, B., Beale, J., Dixon, E., Li, H., Szarka, D., & Gautheir, N. W. (2019). First report of *Cercospora cf. flagellaris* on industrial hemp (*Cannabis sativa*) in Kentucky. *Plant Dis., 103*(7), 1784. https://dx.doi.org/10.1094/PDIS-01-19-0135-PDN

Williams, D. W., & Mundell, R. (2019). *An introduction to industrial hemp and hemp agronomy* (Publication No. ID-250). University of Kentucky Cooperative Extension Service. http://www2.ca.uky.edu/agcomm/pubs/ID/ID250/ID250.pdf

The permalink for this UGA Extension publication is extension.uga.edu/publications/detail.html?number=B1530

Bulletin 1530 **Revised August 2023**

Published by the University of Georgia in cooperation with Fort Valley State University, the U.S. Department of Agriculture, and counties of the state. For more information, contact your local UGA Cooperative Extension office.