Industrial Hemp for CBD
Agronomics and Cultivation Practices

Industrial Hemp (*Cannabis sativa*), an annual crop, is dioecious in nature (male and female plants are separate) and is wind pollinated. Industrial hemp is considered distinct from other forms of Cannabis as it contains <0.3% THC. The plant naturally produces over 60 cannabinoids, including THC A and CBD A.

**Planting Materials:**

Hemp can be grown either from seeds or clones. Seed grown plants are often hardier but if seed is not feminized can contain both male and female plants, which would result in the loss of almost 50% of crop population once male plants are pulled. Hemp can also be grown from feminized seeds. For feminized and non-feminized, seeds are started in green houses or grow houses and then transplanted into fields after 3-4 weeks. Plants need to be hardened before transplanting.

Hemp also be grown from clones – cuttings from a mother plant that are rooted in soil. By using clones, a grower can be assured of female plants and uniform genetics. When moving cloned plants from a greenhouse to field, plants still need to be hardened.

**Starting Seeds:**

The seedlings are started in planting cells – 144’s or 128’s -deep cell. Seedlings need adequate water, however over watering should be avoided. Planting depth is a between 0.75 and 0.5 inches. The plants need to be transplanted when they are smaller (smaller the better). If the plants are too big or mature, transplantation shock will be higher, and the plant will take time to overcome shock, leading to the loss of time that could be used for potential growth. Plants should stay no longer than 4 weeks in the green house.

Cuttings (clones) take approximately 8 to 10 days to put out roots. Then they are allowed for growth for another 4 weeks in the green house. As pointed to earlier, seedlings from seeds/ cuttings/ clones need to be hardened before transplanting, particularly if lights are used. Leaving the seedlings outside under shade or shade cloth works.

**Planting: Time of the year**

Direct seeding of industrial hemp can be done from mid-May to early June. Transplanting of either clones or seedlings not more than 4 weeks old started in Vermont by late June or early July. Transplanting can also be done throughout June. In New York, transplanting occurred in early July. However, these are in farther northern latitudes. In Wisconsin, planting should be started late May through mid-June.

The time of planting is very important as hemp is day length sensitive – starts to flower as day length shortens. Therefore, the crop needs to be out in the field for a good amount of time before flowering to have good vegetative growth to support flowering.
Field soil type:
The crop should be grown on non-marginal and high yielding lands as it is a high profit crop. Well drained soils are suitable as hemp does not like wet soil or excessive moisture. In Wisconsin, transplanting little later in the season is advantageous as there is less rainfall. However, light also needs to be considered due to hemp’s daylength sensitivity. Loamy soils, light soils are helpful for higher production as hemp is a high nutrient feeder. Clay or compaction can be hard on roots. Hemp prefers a pH of 5.9 to 6.5, but also up to 7.5.

Field Preparation:
Field preparation varies for the crop. In a no till situation, the crop can be planted into strips of clover (provides N), rye (crimped), or green mats. There is a wide variation in spacing and the cover crop helps cover the barren soil between plant rows. If the soil is tilled, then a cover crop can be established, prior to or in conjunction with transplanting. It is recommended to till once, let the weed flush to come up and then till again before planting (hit twice) to avoid weed competition. If cover crop is not chosen, then black plastic mulching is done which provides the same services as cover crop. Growers can also use plastic for field cover. Use of straw is not recommended in Wisconsin due to the weather which enhances the moisture and mold problem.

Fertility:
Hemp is a high nutrient use crop. Nitrogen is generally applied at 100 – 120 lbs/acre at planting. Additional N @ 50 lbs/acre is applied approximately one month later, before flowering. This helps boost the CBD of the flowers. There is some nitrogen addition through clover too. Target the area to be fertilized. If plastic mulch is used, the field must be fertilized before laying it. Potassium is an important nutrient at flowering and some growers will apply prior to flowering.

Spacing:
Different recommendations are available about spacing. Direct seeding is often done 30” centers (corn planter), and in row 12 – 16”. Seed rate is ½ lb/acre @ 24,000 seeds /lb, at 50:50 male: female plant ratio (from Colorado). Pulling male plants eventually will increase spacing.

If transplanted, there are a lot of different spacings available – 1’ x 1’ to 6’ x 6’, which works out to 1500 to 4000 plants an acre. A spacing of 1 x1 would mean 43,560 plants, 3 x 3 means 4840 plants and 5 x 5 would be 1742 plants/ acre.

Planting equipment depends on how the field is prepared. Direct seeding can be done using sorghum plates, as seeds are similar in size to sorghum. Transplanting can be done using whatever equipment is available including water wheels, closing wheel transplanters, tobacco setters, and depends on field preparation - no till, roller crimped, prep beds, plastic beds.

Managing Males:
Using non-feminized seeds means that there will be a field population of male plants. Additionally, with feminized seeds there is not always a guarantee that there will be no males. Field scouting is always important so that the male plants can be tracked in the field as well as nearby feral hemp (ditch weed). Plants can be mowed early to not cause worry about potential pollination. Pollen is incredibly prolific –
experts recommend up to 10 miles between CBD hemp and fiber/grain hemp. When flowers are pollinated, CBD synthesis is drastically reduced.

**Water Management:**

A quantity of 25 – 30” is recommended for marijuana, and a similar recommendation is adopted for this crop. Hemp prefers drier than wetter. Approximately 6 gallons per plant a week (Colorado) is the norm. Drip tape, linear or center pivot irrigation or a travelling gun can be used. Drip fertigation could serve water and nutrient needs simultaneously.

**Nutrient Management:**

Hemp removes almost 200 kg N, 47 kg P and 211 kg K/ha from the soil (Canadian Fertilizer Institute). Pre-plant applications of nitrogen have already been discussed. Adding nitrogen at flowering helps increase biomass and flower yield. More N goes to the leaf and stem, followed by flower and seeds. Phosphorus requirement is low. Potassium is very important. K levels must be kept in the medium to high range of > 250 ppm. K is mostly present in the stalk and vegetation. Greatest uptake is at the start of flowering.

**Weed Management:**

Due to the large spacing between plants, weed management is incredibly important in CBD production. There is no labelled synthetic herbicides or pesticides for use in industrial hemp. Thus, ground cover can be used for weed management whether by plastic or cover crops. Row cultivators or hoes could also be used as mechanical weed control options.

**Pest Management:**

**Insects**

There are a host of insects that target industrial hemp. Particularly damaging are stalk and flower borers such as European corn borer, Eurasian hemp borer, as well as corn earworm. Aphids, mites and thrips, are sucking pests, can attack hemp particularly in indoor grow operations. Insects that chew leaves exist as well along with caterpillars, beetles and grasshoppers.

Pest control: No use of synthetics. Biopesticides, soaps and oils can be used. State approved least toxic pesticides. The crop is to be monitored visually and with sticky traps. Infested plants are to be pruned, caterpillars, etc. are to be removed by hand picking. This is labor intensive, but since it is a high value crop, it is worth it. Insectary plants grown around the perimeter can provide beneficial insects like green lacewings, syrphid flies, collops beetle and damsel bugs.

**Diseases**

Since Wisconsin climate is more humid than the west, hemp diseases can be challenging. Powdery mildew (*Podosphaera macularis*) and grey mold (*Botrytis cinerea*) occur frequently. Botrytis causes “bud rot” where the flower rots from inside out, which is hard to see until after the damage is done. Monitoring of the flowers throughout the growing season is very important. Powdery mildew appears as white and powdery spots on leaf tops, which will then spread. The affected areas should be pruned before it can spread across.
A version of the Webinar: Agronomics of Hemp: CBD Production by Dr. Leah Sandler, Education Director/Research Agronomist, MFAI @https://fyi.extension.wisc.edu/hemp/webinars-videos/april-18-2019-webinar/cbd-production/