



Hemp Pilot Program

Plant Protection Division

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Introduction

The Minnesota Industrial Hemp Development Act (IHDA), Minnesota Statutes 18K, became law at the conclusion of the 2015 legislative session. Industrial hemp is defined as *Cannabis sativa* L. with a delta-9 tetrahydrocannabinol (THC) content of 0.3% by dry weight or less. The Minnesota IHDA provided for the development of a research pilot program administered by the Minnesota Department of Agriculture (MDA). The U.S. Agricultural Act of 2014, section 7606 (“2014 Farm Bill”) authorized state departments of agriculture to develop research pilot programs to study the growth, cultivation, and marketing of industrial hemp as an agricultural crop. Following the passage of the Minnesota IHDA, the MDA established a pilot program for researchers and farmers to grow industrial hemp in Minnesota. The first planting season occurred in 2016.

On December 20, 2018, the Agricultural Improvement Act of 2018 (2018 Farm Bill) became law and added hemp production to the Agricultural Marketing Act of 1946 (7 U.S.C. 1639). Section 12619 of the 2018 Farm Bill also amended the Controlled Substances Act (21 U.S.C. 802) to exclude hemp from the definition of marijuana. The U.S. Department of Agriculture (USDA) now has the authority to regulate hemp and oversee commercial cultivation programs administered by state and tribal governments. The USDA published interim final rules (IFR) for hemp production on October 31, 2019. States that plan to retain regulatory authority over hemp in their jurisdictions must submit a plan for approval to USDA. The USDA is also continuing to receive comments regarding the IFR. Due to the timing of the release of rules and the MDA needing to begin licensing growers for the 2020 season, Minnesota will take advantage of an extension of the 2014 Farm Bill provision and continue to operate a hemp pilot program through October 31, 2020. Unless any changes occur to the IFR, the commercial hemp program will begin in Minnesota on November 1, 2020. All hemp licensees will have to obtain a commercial license when their pilot program licenses expire.

All first-time applicants are required to submit fingerprints to the MDA and pass a criminal history background check. The applicants must register their specific growing and processing locations and pay the annual program fees.



Figure 1. CBD-type hemp field, photo by Kietzer Farms/Journey Organics.

THC Testing

Each field is inspected and sampled within 30 days of harvest. To collect a sample, an MDA inspector randomly selects 30 plants per field, cuts the top two inches of the female flowers, and places all 30 cuttings into a paper bag to make a single, homogenized sample. The plant material is then taken to Legend Technical Services Laboratory in St. Paul for THC analysis using High Performance Liquid Chromatography (HPLC). The 2018 Farm Bill and the recently published IFR specifically requires the MDA to look at delta-9 THC concentration post decarboxylation for regulatory purposes, in which the acid form, THCA, is factored into the calculation. This is done in order to determine the total potential of a plant to produce psychoactive effects. Most of the THC found in the plant is in the acid form, and it converts to delta-9 THC by heat or degradation. Total THC is equal to delta-9 THC + (THCA*0.877) when obtained by an HPLC method. In 2019, the average THC concentration across all samples was 0.24%. The average THC level for cannabidiol (CBD) crops specifically was 0.29%; for fiber crops, 0.22%; and for grain crops, 0.10%.



Figure 2. Female hemp flower, photo by Hemp Acres LLC.

In 2019, the MDA collected 581 samples. Of those, 76 were over 0.3% and thus were failures. That amounted to 13% of the total samples. All the samples that failed were varieties that were bred to be high in CBD. There was a higher percentage of *indoor* CBD hemp crops (19%) that failed than *outdoor* (14%). The average cannabinoid concentrations for all hemp sampled by the MDA in 2016 – 2019 are listed in Table 1.

Table 1. Average Percentage Total Delta-9 THC and CBD For All Minnesota Hemp Samples 2016 – 2019

Sampling Year	Total delta-9 THC (post decarboxylation)	CBD (Cannabidiol)
2016	0.044%	0.008%
2017	0.086%	0.068%
2018	0.156%	0.060%
2019	0.243%	9.26% *

*Not tested by the MDA in 2019, this figure is reported by the growers.

2019 Season

Over the past few years, growers have planted three types of hemp varieties to produce grain, fiber and flower. Flower production is done primarily for extraction of cannabinoids like cannabidiol CBD. The proportion of growers producing hemp for CBD increased dramatically between 2018 and 2019. The statistics shown in Table 2 indicate that the percentage of hemp grown for CBD went from 10% to 74%. The percentage of hemp grown for industrial purposes such as grain and fiber production decreased from 88% to 25%. At the beginning of 2019, the price of CBD biomass and extract was significantly higher than prices for grain or fiber and was the driving factor for growers to increase production of this type of hemp.

Table 2. Minnesota Applicant and Planting Statistics 2016 – 2019

Statistic	2016	2017	2018	2019
Approved Pilot Applicants	7	47	65	505
Licensed Growers	6	33	43	350
Licensed Processors – Processing Only	0	5	8	49
Approved Acreage	N/A	2,258	1,258	15,310
Outdoor Acreage Planted	38	1,202	709	7,353
Indoor Square Footage Planted	0	0	54,618	403,304
Average Field Size (in acres)	5	21.86	15.76	16
Varieties Planted	6	18	31	136
% Acres Planted For Grain	94.7%	99.3%	87.9%	25.2%
% Acres Planted For CBD	0.0%	0.4%	10.1%	74.4%
% Acres Planted For Fiber	5.3%	0.3%	2.0%	0.4%

The average planting date for CBD-type hemp was June 18. The average planting data for grain and fiber-type hemp was May 29. Fields grown for grain or fiber production were seeded with grain drills or broadcast planters. Fields grown for CBD production were either direct seeded or planted with live plants. Many growers started the seeds indoors or purchased clones, and then transplanted into the field either by hand or by using a transplanting implement called a waterwheel. Only 4% of the acreage was planted exclusively by hand, 84% was by machine, and 7% was by a combination of hand and by machine.

CBD-type hemp was planted with wide row spacing—generally one plant in each 4- or 6-square-foot space. That spacing amounted to 1,000 – 2,000 plants per acre. Many growers planted feminized seed or clones to ensure that only female plants were present. Cannabinoid production occurs in the female flower. If males are present, they will pollinate the females, causing cannabinoid production to decrease as energy is funneled into seed production. Because of the threat of pollination, scouting for and pulling males was a significant time and labor requirement in July and August.

The most common pests reported in hemp were aphids and borers, especially the European corn borer and the Eurasian hemp borer. Aphids were well controlled by insect predators such as ladybugs and lacewings. European corn borers and the Eurasian hemp borer were harder for growers to control when they did infest a field. The European corn borer develops in the main stalk and larger stems and causes wilting of major portions of the plant. Eurasian hemp borer damage was not seen until later in the season at harvest time. The damage was observed as suddenly browning and dying flower buds. Hemp borer larvae tunnel through the stem into the developing buds, causing the bud to wilt and die. According to the Colorado State University Hemp Resource Center, wild populations of host plants such as feral hemp, smartweeds, and knotweeds are sources of this pest, and the caterpillar overwinters in stalks, leaves, and seed heads.



Figure 3. Eurasian hemp borer, photo by Nicholas McNeely.

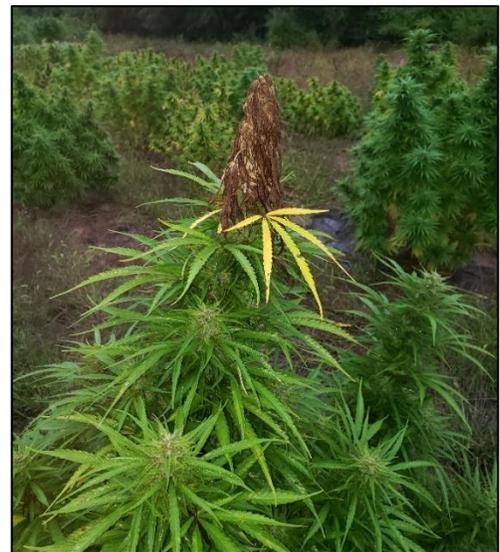


Figure 4. Hemp exhibiting borer damage, photo by Hidden Pine Farms.

It was a very wet year for most areas. Some farmers had issues with washouts and standing water in fields. If the field was flooded within a week or so of planting, then the hemp seed struggled to germinate and grow quickly, and weeds gained an advantage. There were reports of white mold and downy mildew, a result of the wet conditions.

The majority of weed control was done by hand or small machine (hand-pulling, weed whipping, rototilling, garden hoe, and small mower). A small proportion of growers used cover crops and landscape fabric/plastic mulch for weed control. Hemp grown for industrial purposes was planted very densely to foster weed control by hemp canopy closure.

Harvest

Many of the smaller fields (<5 acres) grown for CBD production were harvested by hand, about 15% of the total acreage. Some growers experimented with mechanical harvesting — 46% of the total acreage was harvested by a combination of hand and machine. Harvesting by hand took a significant amount of labor. In the fields that were harvested by hand, the plants were cut at the base, and hung to dry and cure in an indoor storage area. The CBD hemp growers reported yields of 0.5 – 1 pound of dried flower per plant. Average yields for grain, fiber, and flower can be found in Table 3.

Table 3. Average Yields for Hemp Produced in Minnesota 2016 – 2019

Statistic	2016	2017	2018	2019
Average Yield for Grain (lbs/acre)	1,334	790	1,071	706
Average Yield for Fiber (tons/acre)	1.07	0.23	0.56	0.61
Average Yield for CBD Flower (lbs/acre)	N/A	Not tracked	Not tracked	686
Average Yield for CBD Biomass (lbs/acre)	N/A	275	972	1039

Grain-type hemp was harvested by combine. Most growers straight combined with a draper/flex head. Four growers swathed their field and then followed with a pick-up head on a combine.

The MDA did not test for CBD levels when conducting regulatory testing. The growers self-reported the final CBD levels of their harvested crops. The reported CBD levels for the top 20 most commonly planted CBD varieties in Minnesota in 2019 can be found in Table 5 at the end of the report. The average date of harvest for CBD production was 121 days after planting, 92 days for grain production, and 85 days for fiber.

Drying, Storage and Handling Techniques

CBD hemp growers that harvested by hand hung the plants indoors to dry and cure the flowers. Air flow and dehumidifiers were necessary to prevent mold from developing in the flower heads, depending on ambient air humidity. After curing, the flowers were then stripped off the stalks by hand or with a bucking/trimming machine, and the dried biomass was stored in super sacks. CBD hemp growers that machine harvested experimented with silage choppers, combines, and chippers/shredders. The harvested biomass was then dried in full-floor grain bins and on racks with fans and dehumidifiers. At least 10 growers used belt/conveyer dryers to speed up the drying process.



Figure 5. CBD-type hemp plants hanging to dry, photo by Hemp Acres LLC.

Economics

Few growers reported sales as of December 2019. Most growers still had their harvested hemp in storage and were looking for buyers. As a result, data was insufficient to draw concrete conclusions about profits. The cost of hemp production was considerable, especially for first-time, small-scale growers. Costs associated with hemp production in 2019 can be found in Table 4.

Table 4. Average Cost of Hemp Production in Minnesota in 2019

Cost of Production Statistics	Minnesota
Average cost of clones per acre	\$10,958
Average cost of feminized seed per acre	\$7,507
Average cost of non-feminized seed per acre	\$6,086
Average cost of labor per acre	\$3,829
Average total cost of production per acre for fiber-type hemp	\$1,147
Average total cost of production per acre for CBD-type hemp (<3 acres)	\$35,371
Average total cost of production per acre for CBD-type hemp (4 – 10 acres)	\$9,123
Average total cost of production per acre for CBD-type hemp (10+ acres)	\$5,995
Average total cost of production per acre for grain-type hemp	\$502

Market prices for hemp products have dropped dramatically in the last 12 months. In April 2019, bulk CBD flower prices were \$326 per pound, depending on quality and CBD concentration, and has dropped to \$226 per pound. Crude CBD oil was at \$4,600 per kilo and has dropped to \$660. (Figures cited from Hemp Benchmarks® report. Pricing statistics reported by Minnesota growers were spotty but did align with the national figures).

There were 49 actively processing licensees in Minnesota in 2019. Of those, 30 were CBD extractors. Nine extractors used ethanol extraction equipment, 10 used CO₂ extraction, and 11 were “small scale” extractors. The small-scale extractors generally used either rosin presses to process small amounts of hemp flower or kitchen equipment to extract cannabinoids into carrier oils for personal use or testing purposes. The other licensed processors were as follows: five flower packagers, four grain processors, two grain cleaners, three seed packagers/sellers, two equipment manufacturers, and three testing laboratories.

There were three companies outside of Minnesota that contracted farmers for hemp grain. The grain is either dehulled and used as a food ingredient, or it is cold pressed to produce hempseed oil. As of January 2020, the CBD processors in Minnesota are at capacity and not taking in more material for processing. Some farmers indicated that they would look to sell their hemp flower to processors in other states, but it remains unclear if they will be able to, and where. The growers that harvested fiber did not report any sales of harvested material. Without large-scale decortication capabilities in the state, that market has not yet developed.

Conclusion

The fastest growth in hemp production and marketing in the last 18 months had been in the CBD space. Vote Hemp reported that hemp acreage under cultivation across the U.S. increased to 511,442 acres from 78,176 acres in 2018, a 650% increase. Minnesota saw a tenfold increase in acreage in that time. As a result of this huge increase in supply, the price for hemp commodities has dropped significantly. Farmers are looking to cultivate hemp for other, lesser known cannabinoids, such as cannabigerol (CBG) and cannabiol (CBN) in 2020, of which prices remain high.

Despite the price drops, 85% of the 2019 growers and processors reported that they were intending to renew their licenses for 2020. As of the time of this report, the MDA had received 330 applications for the 2020 season.

Table 5. Top 20 Most Planted CBD Varieties in Minnesota in 2019

Variety Name	Acres Planted	Average THC Level	Average CBD Level *
Mahkato	289.4	0.14%	4.96%
Otto II x BaOx	140	0.30%	2.50%
MN Prairie	118.25	0.09%	3.57%
Variety Not Stated (Hemp Depot)	118	0.09%	unknown
T1 (Trump 1)	98.14	0.11%	6.80%
Otto II Stout	91	0.06%	10.00%
T2 (Trump 2)	88.9	0.14%	9.70%
YoungSim 10	84.24	0.30%	6.45%
Emerald Nova	75.5	0.16%	2.00%
Cherry Bubble Gum	75.5	0.16%	4.00%
B-20	60	0.04%	unknown
Buanann	50.5	0.05%	8.00%
Suzy Q	50	0.05%	5.50%
Abbie	50	0.05%	9.00%
Abacus	42.25	0.45%	11.50%
Patriot	37.5	0.07%	3.55%
Midwest Jupiter	21.6	0.16%	7.02%
Oregon Cherry	20.6	0.54%	none went to maturity – too high in THC
Unilateral	20	0.11%	unknown
Socati T2	17	0.08%	6.41%
Wife X Tres	17	0.09%	0.40%

*Not tested by the MDA in 2019, this figure is reported by the growers.