

2017 Industrial 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 (“Farm Bill”; 7 U.S. Code § 5940) authorized state agricultural departments to develop research pilot programs to study the growth, cultivation, or marketing of industrial hemp as an agricultural crop. However, the federal Controlled Substances Act (21 U.S.C. § 801) does not recognize a distinction between the different varieties of *Cannabis sativa*—industrial hemp and marijuana—and considers them both a Schedule 1 controlled substance. The MDA obtained a Schedule 1 Importer Research Registration in January 2016.

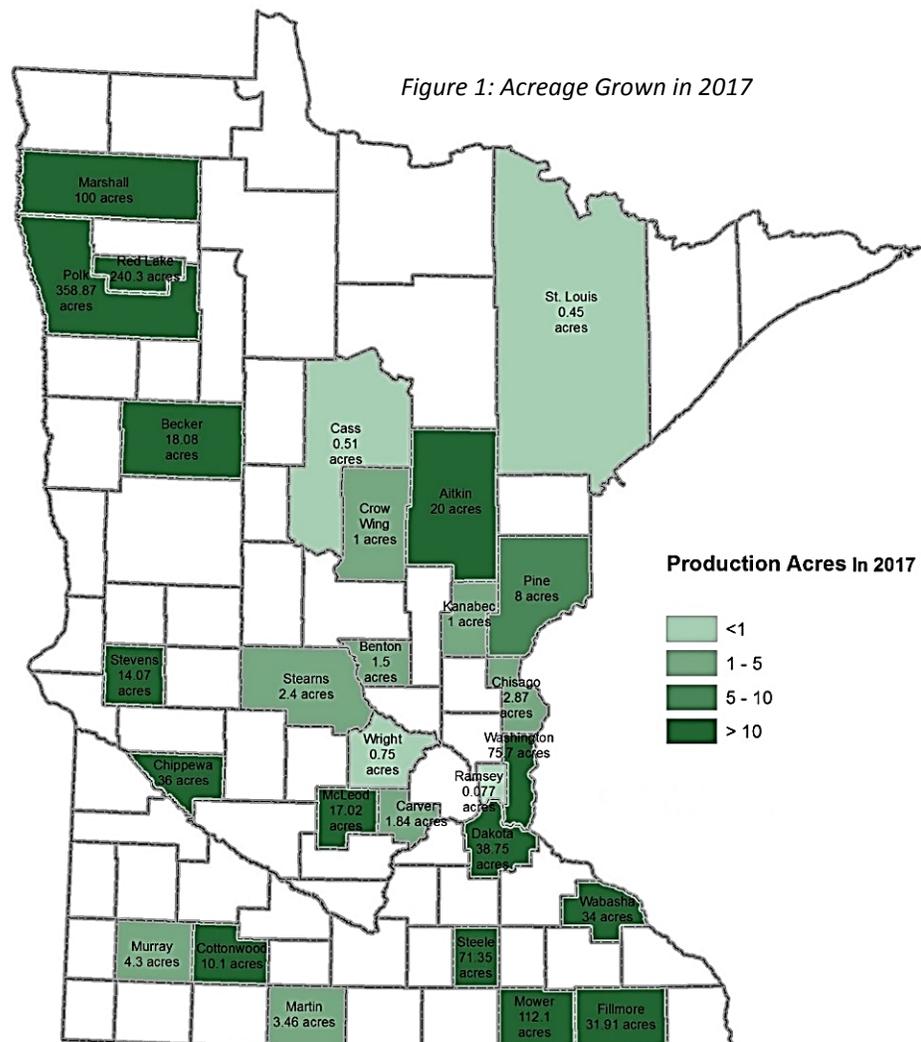
In 2016, the MDA established a pilot program for researchers and farmers to grow industrial hemp in Minnesota. Interested participants applied, registered with the state, and obtained hemp seed through the MDA’s Drug Enforcement Administration (DEA) import permits. There were 7 pilot participants who grew 38 acres of industrial hemp in the first year. To comply with the parameters set up by the 2014 Farm Bill, Minnesota’s pilot growers must report agronomic, processing, and marketing findings at the end of the growing season. Those findings are summarized in this report.

2017 SEASON

The MDA received 47 applications for pilot program participation for the 2017 season. As part of the application process, growers were required to provide Bureau of Criminal Apprehension (BCA) background checks for all persons that would handle seed, a detailed map of the growing site, and stated research goals/deliverables. Of the 47 applications received, 40 went on to become pilot program certificate holders. Of those, 33 were licensed hemp growers, and there were 56 total fields. The MDA also issued pilot program certificates to 2 testing laboratories, 1 hemp seed dealer, 1 researcher, and 3 processors.

The field sizes ranged between small variety trial research plots of 6’ by 10’ and large-scale agricultural tracts of 100- 200+ acres. The average field size was 22 acres.

Industrial hemp seed was ordered by the pilot participant from either Canada or Europe, and imported into Minnesota under the MDA’s import permits. Once the seed went through customs, it was shipped to the MDA



Laboratory Services Building in St. Paul. Pilot growers were required to retrieve their seed orders within 48 hours of delivery to the MDA. The MDA has filed all permits for importation, and chain of custody documentation of transfer to pilot participants, in compliance with DEA protocol. A total of 46,017 pounds of industrial hemp seed was imported for the program in 2017. The pilot participants planted 1,210 acres throughout the state (Figure 1).

REGULATORY COMPLIANCE

Each field was sampled between 60 and 90 days after planting by MDA inspectors. The average date of sampling was 70 days after planting. The MDA collected a total of 110 samples. To take a sample, the inspector randomly selected 30 plants per field, cut the top 2 inches of the plants, and placed all 30 cuttings into an individual paper bag to make a single, homogenized sample. The plant material was then taken to Legend Technical Services Laboratory in St. Paul for cannabinoid analysis using High Performance Liquid Chromatography (HPLC). The MDA looked at delta-9 THC concentration without decarboxylation for regulatory purposes. The average delta-9 THC concentration across all sample was 0.0115%, well below the 0.3% threshold (Table 2).

Table 1: Average Percentage Cannabinoid Concentration for 2017 Hemp Samples

	Delta-9 THC (Tetrahydrocannabinol)	THCA-A (Tetrahydrocannabinolic acid)	CBD (Cannabidiol)	CBDA (Cannabidiolic Acid)
Average Concentration	0.0115%	0.0850%	0.0678%	1.199%

RESEARCH GOALS

Pilot participants were required to state research goals on their applications in accordance with the pilot program’s purpose to expand knowledge of industrial hemp growth, cultivation, and marketing for Minnesota. The pilots cited a range of goals, generally related to agronomic, marketing, and economic viability issues. The following is a summary of the various goals of the pilot producers:

- Gain economic viability from an alternative crop besides corn & soybeans
- Test varieties for seed, grain, fiber, and CBD production
- Expand crop rotation
- Explore food, fiber, and/or CBD markets
- Research and test hemp processing methods to create products such as food, hempseed oil, essential oils, fiber products, CBD extracts, etc.

RESULTS

All pilots were required to provide the requested agronomic, processing, and marketing data by December 15, 2017. Those results are summarized in this section. Out of the 1,210 acres planted, 1,100 acres were harvested. The unharvested acreage were poor stands, attributed variously to extremely heavy rains after planting, improper planting methods, and excessive weed pressure. Growers primarily harvested for the hemp seed or grain.

Four pilot participants harvested only the hemp fiber, or the fiber in addition to the grain.

Planting

The dates of planting ranged between May 17 and July 10. The average date of planting was June 8.

Most growers cultivated, disked, and/or tilled, then dragged or rolled the seedbed before planting. Most growers drilled their seed in 6 or 7 inch rows, with ¼ to ½ inch plant spacing within rows. The average planting depth was ½- 1 inch. Two

growers reported using an air-seeder with the air turned way down. Three people reported broadcasting, then dragging the seed. The average seeding rate was 31 pounds per acre.

Inputs

Fourteen of the growers applied fertilizer to their fields—generally in the form of poultry, hog or cattle manure at a rate of 3- 5 tons per acre. Six growers applied dry nitrogen or other synthetic fertilizer. One field was irrigated.

None of the growers reported applying pesticides. There are no pesticides that are labeled for use on hemp. Seven growers reported that they used glyphosate or other pre-emergence herbicide to kill weeds in the field prior to planting. One grower reported that the hemp was very sensitive to residual herbicides from previous seasons that was still present in the soil and advised growers to check their labels carefully when considering to rotate hemp with other traditional row crops.



Figure 3: Hemp Field in Polk County

Pest Burden

Forty-one percent of the growers reported having little to no weeds in their fields, 17% reported medium weed density, and 42% reported high or extreme weed density. Weeds were suppressed by the dense growth pattern of the hemp plants in fields which had good germination and canopy closure. Fields that had quick seedling establishment, high germination percentages and tight row spacing generally had low weed pressure. Headlands, compacted areas, and water-logged soils tended to have worse weed problems, and weed issues also occurred in fields which had poor hemp stand density.

Two potential insect pests, Japanese beetles and aphids, were commonly reported by growers to be present in their hemp fields throughout the state. However, neither species seemed to do damage to the point of reducing yield. The Japanese beetles were observed to be eating the pollen on the male plants—of which there was such copious amounts that it did not affect pollination of the females.

Sclerotinia sclerotiorum (white mold) was observed in four of the hemp fields. It did not seem to affect yield, but it may become more of an issue over time if the spores build in population, and in high moisture situations—high humidity or irrigated fields.

Beneficial Insects

Honeybees and other pollinating insects were commonly observed in grower's fields. In fact, several growers were interested in planting hemp just to attract and provide food for these pollinators.

Harvest

The average plant height at maturity was 52 inches (4 feet, 4 inches). This reflects a wide range of reports—the shortest mature plants were 1.5 -2' and the tallest between 8- 12'.

Nine out of the 33 growers were not able to harvest their crop for a variety of reasons. The dates of harvest for the other 24 growers ranged from September 30 to November 8. The average date of harvest was Sept. 24th. The average days after planting (DAP) of harvest was 112 days.

Grain was harvested by combine for most of the fields that reached stand maturity. Most growers straight-combined with a draper/flex head. If the head had a floating cutter bar, then it was pinned to a high, non-floating position. One grower swathed their field and then used a pull-type combine afterwards to avoid plugging. Additionally, there were 7 pilots that harvested the grain off their relatively small plots by hand.

In 2016, the average yield for cleaned grain was 1,334 pounds per acre. In 2017, the average grain yield across the 1,100 acres that were harvested was 790 pounds per acre. This reflects a wide variability among yields, ranging from 250 lbs. per acre on the low end, to 2,000 lbs. per acre on the high end. Many factors went into yield variation—including experience of the grower, localized field conditions/weather patterns, and weed density.

Two pilots grew certified seed within the Minnesota Crop Improvement Association's (MCIA) certified seed program. This is permitted under the MDA Pilot Program as long as the grower has written permission from the variety owner and is registered with and supervised by MCIA. The growers reported seed yields between 1,000- 1,250 pounds per acre, but this number does not reflect the final cleaning. The variety produced was X-59.

There were 3 growers that harvested floral material only; it was done in small amounts by hand. One grower cut the plants, hung them upside down in a barn for drying and curing, and then mechanically chopped the material prior to final processing. One pilot reported 50 pounds per acre of floral yield and one reported 500 pounds per acre.

In 2016, one pilot baled the hemp stalks after combining grain; they reported a fiber yield of 1.07 ton per acre. In 2017, four growers harvested just fiber, or fiber in addition to grain. Fiber yields had generally not been calculated at the time of reporting. One pilot did report getting 450 pounds per acre of baled fiber after combining the grain.

Drying, Storage, and Handling Techniques

Growers generally harvested at 20 - 25% moisture and then dried down the grain to 8 - 10% moisture in preparation for long-term storage. They performed field cleaning with grain separators and cleaners, using augurs to move it about. The grain must be put on air immediately- either in aerated bins or by moving/cleaning it frequently until the moisture has fallen to an acceptable level.

Processing Techniques

As of the time of this report, no grower has received money for their harvest or made a finished, sellable product yet. Most of the grain was field-cleaned, dried, and placed in storage on-site. Some has been used for on-farm hog, cattle, or chicken feed. Many of the pilots have used their harvest to conduct research into new product development.

There were three pilots that used their harvested fiber to experiment with making building materials. Two pilots also reported making artwork and/or clothing by hand with their hemp fiber.

The pilots that harvested floral material dried it and chopped it into a fine consistency. At the time of writing, they were in the process of extracting cannabinoids from the floral material.

Costs and Profits

Costs for hemp production were reported between \$170 and \$1,000+ per acre, depending on equipment purchases. The average cost per acre was about \$500. This figure does not include land rent. The cost for seed was about \$120 per acre.

There were no profits reported as of the time of writing since no one had received any money for their harvest. Seven pilots grew hemp grain under contract and reported the contract price was \$0.50 per pound for conventional hemp grain and \$1.08- 1.18 for certified organic. It is unknown what, if any, price the hemp fiber can fetch in the current market.

Research Goals

The stated goals for each pilot producer were generally met. The growers were permitted to submit the MDA report template to fulfill the research requirement of the pilot program. The farmers that experienced stand failures did not meet their goals, but still reported their findings. Of the pilots that filed reports, 15 said they would renew their certificate and grow again in 2018, 5 said they were undecided, and 3 said they would not.

TAKEAWAYS

Finally, we asked the pilot participants for general comments and to comment on their experiences harvesting. Most of the feedback centered on how time-consuming the harvest and cleaning process was. The growers said it took a long time and a lot of tinkering to get their drill and combine calibrated properly. The fiber wrapping was a major issue. If the stalks got too dry, they wrapped and plugged on every possible surface in the combine, on the header, and on cultivation equipment.

Another common theme was the importance of proper nutrients in the soil, especially nitrogen. Planting into well-drained soils was also important. Fields planted into water-logged soils with poor available nitrogen performed worse. Those growers who applied manure or synthetic fertilizers had better-quality hemp and higher yields.

The grain drill seemed to be the best option for planting. Air seeders caused problems for 2 growers—in one case the air pressure was too high, resulting in cracked and ruined seeds. In another case, the air pressure, combined with dry soils, caused the seeds to be planted too deep. The five fields that were planted by broadcasting the seed had relatively poor stands.

Many growers commented that the harvested grain was difficult to clean and dry. Because of the wrapping problems when the crop gets too dry, and also the specter of seed shattering and bird predation, it is better to harvest a little earlier than you would normally think to. Because of that, you end up with high-moisture grain that has to be dried immediately to avoid spoilage. Also there was a lot of green material and weed seeds in the grain, and this made it more difficult to clean and dry down properly. There were 4 growers that had grain get hot and spoil because it did not get on air immediately. This can be a common issue with oilseed crops, so growers that don't have experience with that will need to handle their harvest using different methods.



Figure 4: Combining Hemp Grain

For food-grade products, the existing world market has a strong preference towards certified organic grain. There is already limited opportunity to sell hemp grain in Minnesota, and especially for conventionally raised grain. For the food market, grain purity must be high, in most cases 98% or better. Getting their grain from field-cleaned to a final, food-grade purity has proven to be difficult to achieve for Minnesota hemp farmers.

One grower commented that “the most difficult predicament facing every Minnesota hemp grower is cleaning and processing the seed.” A huge issue for most growers was the lack of places to sell their hemp grain or fiber. The marketing of this crop in the U.S. is still in

its infancy. There is no established hemp processor in Minnesota, as of the time of this writing. Many growers were frustrated by the end of the season when they realized they had nowhere to sell their grain. There are plenty of pilot participants that see much opportunity on the processing, value-added side, but acknowledge it will take time and plenty of money to get an industry established.

UNIVERSITY OF MINNESOTA RESEARCH

Dr. George Weiblen at the University of Minnesota has been doing feral hemp and cannabis genetics research for several years. In 2017, Dr. Weiblen and his team continued the feral hemp research, and also conducted agronomic hemp variety trials for the MDA pilot program. Twelve of the highest-yielding, oilseed varieties from Canada were tested for suitability in Minnesota. These trials occurred at 5 locations—at the U of M’s St. Paul campus; the U of M experiment stations at Rosemount, Crookston, and Morris; and the White Earth Nation in Callaway. MDA will be working with Dr. Weiblen and the University of Minnesota to publish details of this research in the near future.