



*Agriculture Commissioner  
Doug Goehring*

# 2019 HEMP PILOT PROGRAM

*Producer Driven Research*



# North Dakota Department of Agriculture 2019 Hemp Pilot Program

## Introduction

The North Dakota Department of Agriculture (NDDA) created the Hemp Pilot Program to research the growth, cultivation and marketing of industrial hemp in North Dakota. The goal was to increase the understanding of how industrial hemp fits into the current agricultural landscape and investigate how it may contribute to the economy of North Dakota.

## History of Legal Status

Hemp is a variety of the plant species *Cannabis sativa L.* and was considered a Schedule I Controlled Substance under the Controlled Substances Act (CSA, 21 U.S.C. §§801 et seq.; Title 21 C.F.R. Part 1308.11) until recently. Cultivation was highly restricted and only allowable for research purposes authorized under a provision of the Agricultural Act of 2014 (2014 Farm Bill).

On December 20, 2018, the 2018 Farm Bill was signed into law and redefined hemp, removing it from the Controlled Substance Schedule I list. The Farm Bill directed the United States Department of Agriculture (USDA) to establish a national regulatory program for hemp. In accordance with guidance issued by the USDA, NDDA operated the 2019 growing season as another pilot program under the rules of the 2014 Farm Bill.

On October 31, 2019, USDA released the Interim Final Rule (IFR) for hemp. This rule laid out the requirements for state run hemp programs. If any state cannot comply with the rules, or chooses not to comply, then the USDA would oversee hemp production in that state or tribe. The IFR gave states until October 31, 2020, to have a plan approved by the USDA.

## 2019 Hemp Pilot Program

Changes to North Dakota Century Code and federal law drastically changed the hemp landscape for 2019. This was the first year that growers in North Dakota could produce hemp with the intent of extracting cannabinoids. The prospect of a new high value crop led to a doubling of licenses issued for hemp production. NDDA received 90 pilot project proposals; however, due to several factors such as seed cost and seed availability, only 66 growers applied for and received licenses covering 3,958 acres. Most of the acreage was grown for grain production while most of the growers were growing for cannabinoid production.

While they are the same species, the production methods of growing hemp for grain, cannabinoids or fiber can vary dramatically. Due to the differences between grain (Figure 1), cannabinoid (Figure 2) and fiber production, this report will be split into three parts.



Figure 1. Typical Grain Field



Figure 2. Typical Cannabinoid Field

**Grain Production**

Hemp grown for grain production saw an increase in acres from previous years. Growers were no longer required to work through NDDA to import hemp seed and were also able to purchase seed domestically. Growers were able to select the seed supplier and variety of their choice. Table 1 shows the grain varieties selected and the number of acres grown.

Variety	Acres Grown		Change in Acres
	2018	2019	
Altair	0	80	New Variety
Anka	0	52	New Variety
CANDA	314	220	-94
CFX-1	301	754	453
CFX-2	490	167	-323
CRS-1	318	97	-221
JOEY	115	0	None Grown
X-59	925	2480	1555

**Table 1. Variety and acres of grain type crops grown in North Dakota in 2019**

Planting took place from May 26 - July 2, 2019, with the majority being planted during mid-June. Seeding rates ranged from 18 to 35 pounds per acre; planting depth varied from 1/2 to 1 inch deep; and row spacing was reported from 6 to 15 inches. Most growers planted at the following rates: 25 pounds per acre seeding rate, 0.75-inch planting depth, and 7.5-inch row spacing. Growers reported using various makes and models of air seeders and grain drills to plant hemp under both conventional and no-till conditions.

Crops previously grown on hemp fields were wheat, barley, sugar beets, corn, sunflowers, soybeans, peas, potatoes, canola, lentils, durum, alfalfa, perennial grass and summer fallow. Hemp grows best under warmer soil conditions and is typically planted later than other conventional crops. This late planting may allow for an additional flush of weeds, which many growers controlled by applying pre-plant glyphosate.

No significant insect pest pressures were seen at any site in 2019. Cutworm, European Corn Borer, Bertha armyworm, corn borers, Lygus bugs, aphids and grasshoppers on occasion can be a problem. There were beneficial insects such as bees present during flowering at several field locations, as well as lady beetle adults and larva throughout the growing season.

The most prevalent weeds found this year included kochia, Russian thistle, lambs-quarters, Canada thistle, common and giant ragweed, cocklebur, foxtail, and pigweed. Volunteer cash crops such as corn, sunflower, canola, peas, and wheat were also reported. Both wheat and wild buckwheat are problematic as it is difficult to separate out of harvested hemp grain. Wheat contamination also may cause issues with processors who hope to maintain gluten-free facilities or product. Under ideal conditions hemp is very competitive against weeds. It emerges in just 3-4 days in warm moist soils and can quickly shade and outcompete weeds. There were no registered insecticides, herbicides, fungicides or seed treatments for use in hemp crops in 2019. With this being the case, growers were careful to select fields that have not had historic weed problems.

Growers started harvesting hemp September 9, 2019, and it continued through November 20. The 2019 harvest was affected by the same issues that plagued most other crop harvests. Early snowstorms and

constant rains soaked the state over and over during the harvest season. According to the North Dakota State Climate Office, the fall of 2019 was the wettest recorded since recordkeeping began in 1895. Growers reported selecting hemp fields for harvest over other conventional crops due to a lack of federal crop insurance. Growers who were able to harvest hemp reported using rigid, flex and draper heads on varying makes and models of combines. Several growers did cut and bale the hemp for later processing.

Compared to previous years, reported yields were down in 2019. Growers reported yields ranging from 85 lb./ac up to 1150 lb./ac with the average yield around 800 lb./ac. Growers who reported yields on the low end also reported damage from hail and snow.

The grain market remained stable. Growers who were able to prevent spoilage and maintain sanitary conditions in the hemp reported \$0.55/lb. for conventional and \$1.20/lb. for organic.

Crop management is a key consideration in variety performance along with multiple environmental factors. Temperature, fertilizer input, soil type, soil temperature and precipitation, among other growing factors, varied across North Dakota. Grain hemp holds promise as a viable alternative crop for North Dakota growers. Based upon the grower experiences, the crop appears to be well adapted to North Dakota's agricultural conditions. Generally, the field trials lacked significant diseases and other pests. The pilot program growers were comfortable growing the new crop and could plant, maintain and harvest hemp without significant modifications to their current farming equipment and practices.

### **CANNABINOID PRODUCTION**

Changes in the Farm Bill and North Dakota Century Code allowed for growers to grow hemp with the intent of extracting the cannabinoids. Cannabinoid production was dominated by growing for cannabidiol (CBD). Due to this being the only cannabinoid targeted in 2019, this report will focus on CBD production only.

Hemp varieties can be either monoecious or dioecious. Monoecious varieties have both male and female flowers on the same plant, while the dioecious varieties maintain separate male and female plants. Male plants (Figure 3) are taller, light colored and spindly, while the female plants (Figure 4) are bushier and green.





**Figure 4. Female Hemp Plant**

When growing for CBD, one strategy to increase CBD production is to prevent pollination of the female plants. Because of this, CBD growers only select dioecious varieties (Table 2). Most growers opted to scout and remove any male plants. Several growers allowed pollination to occur with the trade-off of less labor inputs but lower CBD output. Growers have several options when it comes to CBD production. They can purchase seeds, seedlings or clones. Some growers opted to purchase feminized seed, which in theory would only produce female plants. Feminized seeds were sold by seed dealers at a premium. Several growers had success with feminized seeds, others did not. The premium price of feminized seed brought fraud into the market with some dealers marketing regular seed as feminized seed leaving the grower with both male and female plants. Seedlings are young plants that were started from a seed in a greenhouse or indoor setting and then transplanted into

outdoor fields. Clones are clippings that produce genetic copies of the mother plant. All three options have their advantages and disadvantages. Growers reported that seed-propagated plants were typically cheaper and easier to plant. But seed-propagated plants had to be carefully watched to prevent pollination and could have germination issues. Growers reported that clones were less likely to have male plants present, but increased cost of clones and lack of tap root led to issues.

Production of CBD and grain/fiber are drastically different agronomic systems. CBD production is typically done on a smaller scale and falls more in line with horticulture. Producing grain/fiber is more of a conventional agriculture-based system. Planting and row spacing on CBD fields varied wildly. Growers spaced rows anywhere from 36 inches to 15 feet. Plant spacing in the rows varied from 18 inches to 60 inches. Many growers utilized plastic weed barrier and drip tape to maintain weeds and irrigate plants. The high cost of seeds caused many growers to hand plant seed and prevent issues caused by machinery, although some growers did use conventional planters to place seed. Growers planting seedlings and clones either hand planted or utilized a Water Wheel Planter (Figure 5) and Plastic Laying Machine (Figure 6).

Variety	
Abacadabra	Cherry Wine Otto
ACDC	EC-11
B-20	Fire Cherry 308
Berry Blossom	Flower #16
Blue-Genius Auto Flower	Juicy Fruit
BOAX	Magic Bullet
Casino Cookie	Stormy Daniels
Cat's Meow	T1
Cherry	Tsunami
Cherry 308	Wife
Cherry Blossom	Yong Sim
Cherry Wine	

**Table 2. Cannabinoid Varieties Grown in 2019**



**Figure 5. Water Wheel Planter**

Photo courtesy of Troy Goltz of Plantology Inc.



**Figure 6. Plastic Laying Machine**

Photo courtesy of Troy Goltz of Plantology Inc.

Weed pressure was low on almost all fields as growers were constantly removing male plants and performing weed control at the same time. Several growers attempted to use cover crops to minimize weed pressure, but growers ran into issues where the cover crops outcompeted the hemp. Utilizing a combination of plastic weed barrier and cover crop (planted in between the plastic weed barrier) appeared to work for one grower.

CBD growers faced some of the same hurdles that grain growers had to deal with. Excessive rains and early snowstorms caused damage to plants and increased labor effort when harvesting. One grower reported using a forage chopper to harvest CBD plants. All other growers reported some variation of hand harvesting. Reciprocating saws, tree loppers and hand saws were all reported as harvest equipment. Most growers hung the plants to dry indoors and hand removed the flower material from the plants.



**Figure 7. Hemp Field Flattened by Snowstorm**

At the writing of this report no growers had reported selling product. CBD biomass prices are considerably less than what they were a year ago. Nationally there is excessive amount of CBD biomass on the market leading to this depression of price. Many growers in North Dakota did not reach the minimum CBD levels that were required by local processors (Table 3).

It is currently unknown if cannabinoid production is feasible in North Dakota. The 2019 growing season was less than ideal and many of the genetics are unproven in the North Dakota climate. The current market conditions only exacerbate the pain growers are feeling.

### **FIBER PRODUCTION**

A sole grower selected a fiber variety for 2019. The grower planted 37 acres of a mix of Anka and USO-31. The grower planted the hemp July 12 at ½ inch deep on 8-inch rows at a rate of 60lbs/ac. This grower planted at a much higher rate compared to grain producers with the intent of the plants producing fiber instead of grain. The field was harvested September 21 with an average plant height of 72 inches. Harvest equipment was typical forage harvesting equipment: a 9-foot sickle mower, wheel rake and round baler. The average yield for the field was 7 tons/ac.



The grower had contracted with a company in Nebraska to take the fiber and at writing of this report the grower has yet to report received price for the bales. The lack of local processing is currently limiting the fiber market in North Dakota. North Dakota State University's State Agricultural Finance Specialist Bryon Parman summed up the main issue facing the fiber market, stating:

"It is an issue with several ag sectors that we see opportunities for expansion for. For instance, we have an abundance of feed in North Dakota, and cash prices for feed is relatively cheap because we have to ship it so far. So why not finish hogs in North Dakota? Well, the political challenges notwithstanding, it would be expensive to ship finished hogs hundreds of miles to be processed since we do not have the large-scale processing here. So, until there is a big increase in processing capacity, there won't be a big hog finishing expansion here.

But there won't be an investment in large pork processing unless companies know there will be a steady supply of hogs to fill the facilities every day. So, you can see the problem here.

The same can be applied to hemp fiber processing."

Currently there is little room for a financial return once a grower harvests, bales and ships hemp fiber. Because of this most growers of grain crops report incorporating fiber back into the soil or burning the fiber.

### **THC Testing**

All registered growers were subject to routine inspection and sampling to verify that the delta-9 THC concentration of the hemp planted within a certified site did not exceed 0.3% on a dry weight basis. In addition to any routine inspection and sampling, NDDA could inspect and take samples from any registered site without notice if there was reason to believe a violation of the program rules was occurring.

NDDA sent notification by phone or email to each pilot grower selected for sampling. Growers of varieties that NDDA deemed low risk were sampled on a random basis, whereas growers who had unknown or high-risk varieties were all sampled.

Growers were required to notify NDDA 30 days prior to planned harvest date. Growers were required to harvest within 14 days of a NDDA sampling. Product could not be processed or leave the grower's property until issuance of a passing report of analysis from the NDDA. If harvest took place outside of the 14-day window, product could not be processed or leave grower's property until a second test was taken and NDDA issued a passing report of analysis.

A minimum of 5 cuttings were taken from each variety present to create a homogeneous representative sample. Additional cuttings could be taken from plants that appeared unique or from larger plantings. Cuttings were taken from the top 3 to 5 inches of female flowers only. This ensured that the plant material contained the highest concentration of THC and created consistency across all samples and for all growers.

Samples were packaged and shipped to Legend Technical Services in St. Paul, MN. Legend Technical Services would dry the samples, grind and homogenize the material to create a composite sample. Legend would then use High Performance Liquid Chromatography (HPLC) to determine the levels of cannabinoids present in the sample. Results were then presented on a Total THC basis (Table 3).

For the first time since the start of the pilot program, NDDA sampled varieties that exceeded the legal THC limit of 0.3%. In all cases of crops produced in excess of 0.3% THC, the hemp was destroyed.

Variety	Samples	Min THC	Max THC	Average THC	Min CBD	Max CBD	Average CBD
Abracadabra	4	0.0810	0.5640*	0.2828	2.5800	5.7100	3.8775
ACDC	1	0.0460	0.0460	0.0460	1.4100	1.4100	1.4100
Altair	2	0.0161	0.0206	0.0184	0.3260	0.7500	0.5380
Anka	2	0.0192	0.0803	0.0498	0.4340	0.5960	0.5150
B-20	5	0.1930	0.3530*	0.2898	5.8200	9.4900	8.1460
Berry Blossom	2	0.3450	0.6330*	0.4890*	0.0185	0.8880	0.4533
Blue-Genius Auto Flower	1	0.1290	0.1290	0.1290	3.2400	3.2400	3.2400
BOAX	2	0.0549	0.4770*	0.2660	1.5500	2.4500	2.0000
Casino Cookie	1	0.0827	0.0827	0.0827	2.3600	2.3600	2.3600
Cat's Meow	7	0.0980	0.1970	0.1388	3.0900	5.9100	4.3525
Cherry	9	0.0628	0.7980*	0.2365	1.6100	5.1400	3.4033
Cherry 308	2	0.1740	0.2450	0.2095	0.8010	7.2500	4.0255
Cherry Blossom	4	0.1610	0.1930	0.1715	4.8700	5.8800	5.4188
Cherry Wine	17	0.0345	0.4800*	0.1506	1.2900	4.1170	2.6451
Cherry Wine Otto	1	0.0779	0.0779	0.0779	2.4500	2.4500	2.4500
EC-11	1	0.0617	0.0617	0.0617	1.7900	1.7900	1.7900
Fire Cherry 308	1	0.0788	0.0788	0.0788	2.5100	2.5100	2.5100
Flower #16	1	0.2010	0.2010	0.2010	5.9700	5.9700	5.9700
Juicy Fruit*	1	0.7200*	0.7200*	0.7200*	0.0173	0.0173	0.0173
Magic Bullet	7	0.0571	0.1850	0.1008	1.6800	5.5700	3.0975
T1	1	0.0573	0.0573	0.0573	1.8500	1.8500	1.8500
Tsunami	1	0.1870	0.1870	0.1870	1.6600	1.6600	1.6600
USO-31	1	0.0038	0.0038	0.0038	0.1290	0.1290	0.1290
Wife	4	0.0691	0.0713	0.0702	2.0900	2.1400	2.1150
X-59	11	0.0057	0.0450	0.0184	0.2280	1.0900	0.5487
Yong Sim	1	0.0599	0.0599	0.0599	1.6300	1.6300	1.6300

**Table 3. 2019 Hemp Varieties Tested by NDDA, THC and CBD are both listed as Total THC and Total CBD**

\*Any fields tested above 0.34% Total THC were destroyed. All Juicy Fruit plants were destroyed.

## **Hemp Processing**

In 2019 NDDA issued 9 new processor licenses and 3 renewal licenses. Healthy Oilseeds LLC, Life Giving Seeds Inc. and Weinlaeder Seed Company were all reissued licenses. Healthy Oilseeds processes cold press oil, protein fiber and hemp hearts. Life Giving Seeds processes protein fiber powder, cold pressed oil and hemp hearts. Weinlaeder Seed Company processes hemp grain and seed. Most of the newly issued licenses were for CBD extraction. None of the CBD extractors processed any hemp material in 2019.

## **Hemp Research at North Dakota State University (NDSU)**

NDSU Research Extension Centers planted hemp again in 2019. Institutions of higher education are exempt from obtaining a hemp license from NDDA. The Extension Centers at Langdon, Carrington and Dickinson planted 13 different varieties of grain type hemp. The average yields across these varieties showed a gradient from north to south and east to west. The average yield for all varieties at Langdon was 1293 lbs./ac, Carrington was at 860 lbs./ac and Dickinson was 697 lbs./ac. More information on hemp research happening at NDSU can be found at [www.ag.ndsu.edu/crops/hemp](http://www.ag.ndsu.edu/crops/hemp).

## **Conclusion**

Hemp continues to hold promise as a viable alternative crop for North Dakota growers. Grain production continues to fit into typical North Dakotan agronomic systems. Fiber production will continue to stall out without local processing to ensure economic viability. Unstable markets and unproven genetics currently make cannabinoid production a risky endeavor for growers. Nonetheless, many growers expressed interest in growing again in 2020.