

# NORTHWEST CROPS & SOILS PROGRAM



## 2023 Industrial Hemp Fiber Harvest Date Trial



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**2023 INDUSTRIAL HEMP FIBER HARVEST DATE TRIAL**  
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Hemp is a non-psychoactive variety of *cannabis sativa L.* The crop is one of historical importance in the U.S. and is reemerging in worldwide importance as manufacturers seek hemp as a renewable and sustainable resource for a wide variety of consumer and industrial products. The fiber has high tensile strength and can be used to create a variety of goods. Hemp stalks contain two types of fiber: bast and hurd. The bast fibers are the long fibers found in the bark layer of the hemp stalk and are best suited for textiles, nonwoven textiles, rope, insulation, bio-composites for vehicles, or paper. The hurd fiber comprises the woody core of the stem and is suited for building materials, such as hempcrete and particle boards, bedding materials, and absorbents.

For decades, U.S. entrepreneurs have been importing hemp fiber from China, and Eastern Europe. Industrial hemp is poised to be a “new” cash crop and market opportunity for Vermont farms. It is also versatile and suitable for rotation with other small grains and grasses. To help farmers succeed, agronomic research on hemp is needed, as much of the historical production knowledge for the region has been lost. Research needs to be conducted to determine best cropping practices for the region. In this trial, we evaluated the impact of three harvest timings on hemp fiber yield and quality.

## MATERIALS AND METHODS

**Table 1. Agronomic information for the industrial hemp fiber variety trial 2023, Alburgh, VT.**

Location	Borderview Research Farm Alburgh, VT
<b>Soil type</b>	Benson rocky silt loam over shaly limestone, 3-8% slope
<b>Previous crop</b>	Spring Grains
<b>Plot size (ft)</b>	5 x 20
<b>Variety, Source</b>	Futura 83, KonopiUS Seeds
<b>Seed Contact</b>	Robin Destiche (robin@konopius.com)
<b>Planting date</b>	25-May 2023
<b>Row spacing</b>	7"
<b>Planting equipment</b>	Great Plains NT60 Cone Seeder
<b>Seeding rate (live seeds m<sup>-2</sup>)</b>	450
<b>Harvest Dates (HD)</b>	HD 1: 7-Aug 2023 HD 2: 14-Aug 2023 HD 4: 28 Aug 2023

A trial was conducted at the Borderview Research Farm in Alburgh, Vermont (Table 1) to evaluate the impact of harvest timing on fiber yield and quality. The experimental design was a randomized complete block with four replications. The variety used for testing was Futura 83 (Konopius Seeds). Seeds were sown on 25-May into 5' x 20' plots. The target population for each plot was 1,821,087 live seeds ac<sup>-1</sup>. Four harvest

dates were originally trialed in this experiment, though data from HD3 on 21-Aug was lost. Thus, this report reflects results across three harvest timings: 7-Aug, 14-Aug, and 28-Aug; or 74, 81, and 95 days from planting, respectively.

On 8-May approximately 2.5 weeks prior to planting, the trial field received 300 lbs ac<sup>-1</sup> 19-19-19. Fertility amendments were based on soil test results. On 25-May, plots were seeded with a Great Plains NT60 cone seeder, and on 1-Jun plant emergence populations were recorded by counting the number of plants in a foot-long section of the row, three times per plot. Upon each harvest date, wet weight harvest yields were calculated by sampling the hemp biomass within a 0.25 m<sup>2</sup> quadrat from corresponding plots. Harvest moisture was calculated by taking a subsample of hemp biomass and drying it at 105° F until it reached a stable weight. Heights and stem diameters were recorded from five randomly selected plants within each plot before they were run through a custom-built decorticator (Image 1). While the stalks were still fresh, they were weighed and decorticated to separate the bast and hurd fibers. As the stalks passed between the two moving gears, hurd fiber broke away and dropped to a bucket placed underneath. The bast and hurd were weighed to determine ratios and differences.



**Image 1. Custom built decorticator, Alburgh, VT, 2017.**

The harvest timing trial data were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and seed rate treatments were treated as fixed. Mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ( $p < 0.10$ ).

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments is real or whether it might have occurred due to other variations in the field. At the bottom of each table an LSD value is presented for each variable (i.e., yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown, except where analyzed by pairwise comparison (t-test). Where the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9 out of 10 times, there is a real difference between the two treatments. Treatments that were not significantly lower in performance than the top-performing treatment in a particular column are indicated with an asterisk. In this example, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these hybrids did

Treatment	Yield
A	6.0
B	7.5*
C	<b>9.0</b>
LSD	2.0



not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these hybrids were significantly different from one another. The asterisk indicates that hybrid B was not significantly lower than the top yielding hybrid C, indicated in bold.

## RESULTS

Seasonal precipitation and temperature were recorded with a Davis Instrument Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT (Table 2). June exhibited cloudy weather with relatively standard rainfall. July's rainfall saw a staggering departure from normal with 10.8 inches of precipitation, 6.74 inches more than the 30 year average. Much of Vermont experienced persistent rain in tandem with hazy conditions caused by Canadian wildfire smoke over the course of July and August. Despite the heavy rainfall, the well-saturated research farm did not experience the heavy flooding that wrought havoc on many other farms in the state. Overall, from May to September there were 23.4 inches of rain and 2038 Growing Degree Days (GDDs) accumulated, which was 124 GDDs below normal.

**Table 2. Seasonal weather data collected in Alburgh, VT, 2023.**

Alburgh, VT	May	June	July	August
Average temperature (°F)	57.1	65.7	72.2	67.0
Departure from normal	-1.28	-1.76	-0.24	-3.73
Precipitation (inches)	1.98	4.40	10.8	6.27
Departure from normal	-1.78	0.14	6.69	2.73
Growing Degree Days (Base 50°F)	303	483	712	540
Departure from normal	1.00	-41.0	17.0	-101

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger. Alburgh precipitation data from August-October was provided by the NOAA data for Highgate, VT. Historical averages are for 30 years of NOAA data (1991-2020) from Burlington, VT.

**Table 3. The impact of harvest timing on plant characteristics and harvest yield of fiber hemp, Alburgh, VT, 2023.**

Harvest Date	Plant height cm	Stem diameter mm	Dry matter yield lbs ac <sup>-1</sup>	Dry matter yield Tons ac <sup>-1</sup>	Harvest population plants ac <sup>-1</sup>	Harvest population plants ft <sup>-2</sup>	Bast fiber %	Hurd fiber %
<b>HD1 7-Aug</b> (Day 74)	198	7.78* <sup>†</sup>	18,370	9.19	<b>1,011,714</b>	<b>23.2</b>	<b>38.6</b>	61.4
<b>HD2 14-Aug</b> (Day 81)	190	6.23	18,541	9.27	833,652*	19.1*	22.5	<b>77.5</b>
<b>HD4 28-Aug</b> (Day 95)	216	<b>8.20</b>	22,132	11.1	530,138	12.2	25.6	74.4
<b>LSD (p=0.10) ‡</b>	NS§	<b>1.45</b>	NS	NS	<b>211,495</b>	<b>4.86</b>	<b>3.05</b>	<b>3.05</b>
<b>Trial Mean</b>	<b>202</b>	<b>7.40</b>	<b>19,681</b>	<b>9.84</b>	<b>791,834</b>	<b>18.2</b>	<b>28.9</b>	<b>71.1</b>

<sup>†</sup>Treatments marked with an asterisk did not perform statistically different than the top performing treatment shown in **bold** (p=0.10).

<sup>‡</sup>LSD; least significant at the p=0.10 level.

<sup>§</sup>NS – There was no statistical difference between treatments in a particular column (p=0.10).

The trial results by fiber hemp harvest date are summarized in Table 3. Our goal with this experiment was to observe the impact of harvest timing on plant characteristics and yield. The trial showed no statistically significant difference in plant heights or yield across the three harvest timings (Table 3). However, harvest date did appear to have an impact on stem diameter, with the thickest stems, averaging 8.2 mm, coming from HD4 on 28-Aug. Perhaps the most noteworthy data collected in this trial is that of bast to hurd ratio. The first harvest timing, which occurred 74 days from planting, yielded the highest percentage of bast fiber at 38.6% of the stalk. Neither of the following harvest dates yielded a statistically similar result. This data is aligned with the widespread belief that bast fiber quality and quantity can be expected to diminish with the onset of flowers and seeds. Given that the highest bast fiber percentage was observed in HD1 and the thickest stems were observed in HD4, it is likely that the hemp stalks are getting woodier as the plants transition from the vegetative stage to flowering. HD1 also saw the highest populations of plants at 1,011,714 plants  $\text{ac}^{-1}$ , with HD2 yielding a statistically similar result of 833,652 plants  $\text{ac}^{-1}$ . It is possible that the reduced population of plants in HD4 was the result of “self-thinning” or a die-off of smaller plants under the canopy by the time of harvest.

## DISCUSSION

In the 2023 growing season, the UVM extension Northwest Crops and Soils Program initiated a fiber hemp harvest date trial to evaluate the impact of harvest timing on fiber quality and plant characteristics. This trial marked our first look at the impacts of harvest timing on fiber hemp. The trial intended to capture data across four harvest timings, but data from the third harvest timing on 21-Aug was lost. The growing season was wet, with 7.78 inches of rain above average, and also cool, with 124 less accumulated Growing Degree Days than normal. May, June, July, and August were all cooler than normal, and the combination of cool and dry conditions towards the end of May might have affected establishment, as seeds did not see rain for twelve days after planting. July saw 6.69 inches of rain above the 30-year average, which saturated the soil for much of the growing season.

In our trial, harvesting fiber hemp variety Futura 83 at 74, 81, and 95 days from planting did not produce statistically significant differences in heights or dry matter yields. It did however, see a statistically significant difference in population counts, stem diameters, and bast to hurd ratio. On average, plants appeared to get thicker and woodier from first harvest date to last, which insinuates a general reduction in textile-grade bast fiber as the plants mature. Biomass yields were consistently high across all harvest timings, and did increase from first to last harvest date, though no statistically significant difference was observed. According to the National Hemp Report issued by the USDA in early 2023, the average yield for 2022 fiber hemp was estimated at 3070 lbs  $\text{ac}^{-1}$ . In our trial, the average dry matter yield across all harvest dates was 19,681 lbs  $\text{ac}^{-1}$  (Table 3). This was 1.62 tons greater than our 2023 fiber hemp variety trial average dry matter yield of 16,438 lbs  $\text{ac}^{-1}$ , confirming that Futura 83 is an above average producer in our region.

Hemp plants grown exclusively for fiber are usually cut around the time of flowering before seeds have set. This window typically spans 80-100 days. Plants will largely still be green and less mature than those harvested for grain or dual production. Harvest timing will depend greatly on intended end-use for the crop. Whether growing primarily for bast or hurd production, each can be a lucrative byproduct of the other, and turning the highest profit will hinge on finding markets for both.

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