NORTHWEST CROPS & SOILS PROGRAM

2019 Industrial Grain Hemp Variety Trial

Dr. Heather Darby, UVM Extension Agronomist
Rory Malone, John Bruce, Ivy Luke, and Sara Ziegler
UVM Extension Crops and Soils Technicians
(802) 524-6501

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THE UNIVERSITY OF VERMONT EXTENSION

2019 INDUSTRIAL GRAIN HEMP VARIETY TRIAL

Dr. Heather Darby, University of Vermont Extension
heather.darby[at]uvm.edu

Hemp is a non-psychoactive variety of *cannabis sativa L*. The crop is one of historical importance in the U.S. and reemerging in worldwide importance as manufacturers seek hemp as a renewable and sustainable resource for a wide variety of consumer and industrial products. The crop produces a valuable oilseed, rich in Omega-3, and other essential fatty acids that are often absent in western diets. When the oil is extracted from the seed, what remains is a marketable meal co-product, which is used for human and animal consumption. The fiber has high tensile strength and can be used to create cloth, rope, building materials, and even a form of plastic. For twenty years, U.S. entrepreneurs have been importing hemp from China, Eastern Europe, and Canada. Today, industrial hemp is re-emerging as a locally grown product in the U.S. To help farmers succeed, agronomic research on hemp is needed, as much of the historical production knowledge for the region has been lost. In this trial, hemp grain varieties were evaluated to determine best cultivars for the region.

MATERIALS AND METHODS

The trial was initiated at Borderview Research Farm in Alburgh, Vermont (Table 1) to evaluate the impact variety has on hemp grain yield. The experimental design was a randomized complete block with four replications. On 25-Apr, prior to planting, 57 lbs ac^{-1} of nitrogen (N), 57 lbs ac^{-1} of phosphorus (P), and 57 lbs ac^{-1} of potassium (K) was applied to the tract of land where the trial was later initiated. Twelve grain and dual-purpose hemp varieties (Table 2) were planted into 5 x 20' plots at a rate of 125 live seeds m^{-2} on 7-Jun with a Great Plains NT60 Cone Seeder. There were 5' buffers between replicates. The soil type was Covington silty clay loam with 0-3% slopes.

Table 1. Agronomic information for the industrial hemp grain variety trial, Alburgh, VT, 2019.

Location	**Borderview Research Farm Alburgh, VT**
Soil type	Covington silty clay loam, 0-3% slopes
Previous crop	Corn
Plot size (ft)	5 x 20
Planting date	7-Jun
Row spacing	7"
Replicates	4
Planting equipment	Great Plains NT60 Cone Seeder
Seeding rate (live seeds m^{-2})	125
Harvest date	6-Sep

Seed was sourced from three seed companies (Table 3). On 6-Sep, the plots were harvested with an Almaco (Nevada, IA) SPC50 small plot combine. Yield, test weight, and moisture meter were determined at harvest with a Berckes Test Weight Scale, which weighs a known volume of grain. Harvest moisture was measured using an OHaus (Parsippany, New Jersey) MB 23 moisture analyzer. Oil was extruded

from the seeds with an AgOil M70 oil press (Mondovi, WI) on 26-Nov and 27-Nov, and the amount of oil captured was weighed to determine oil content.

Table 2. Hemp grain varieties evaluated in the hemp trial, Alburgh, VT, 2019.

Variety	Seed company	Days to maturity
CFX-1	Hemp Genetics International	100-110
CFX-2	Hemp Genetics International	100-110
CRS-1	Hemp Genetics International	100-110
Grandi	Hemp Genetics International	100-110
Katani	Hemp Genetics International	100-110
Picolo	Hemp Genetics International	100-110
Canda	Parkland Industrial Hemp Growers	100-120
Joey	Parkland Industrial Hemp Growers	110-120
Altair	UniSeeds	100
Anka	UniSeeds	110
Ferimon	UniSeeds	129-134
USO-31	UniSeeds	122-127

Table 3. Participating seed companies and contact information.

Hemp Genetics International	Parkland Industrial Hemp Growers	UniSeeds
Jeff Kostuik Saskatoon, Saskatchewan (204) 821-0522 Jeff.kostuik@hempgenetics.com	Clare Dutchysen Dauphin, Manitoba (204) 629-4367 info@pihg.net	Keenan and Cobden, Ontario (613) 646-9737 orders@uniseeds.ca

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 varieties is real or whether it might have occurred due to other variations in the field. Data were analyzed using the Mixed Procedure of SAS (SAS Institute, 2008). Replications within trials were treated as random effects, and varieties were treated as fixed. Varieties were considered different at the 0.10 level of significance. Variety mean pairwise comparisons were made using the Tukey-Kramer adjustment, also at the 0.10 level of significance. At the bottom of each table, a level of significance is presented for each variable (i.e. yield). Varieties that differed at a level of significance >0.10 were reported as being not significantly different. Varieties that were not significantly different in performance than a performer in a particular column are indicated by sharing the same letter. In the example to the right, variety C is significantly different from variety A but not from variety B. This means that these varieties did not differ in yield. The bolded mean represents the top performer. The level of significance refers to whether the variety was statistically significant overall, while the letters are drawn from the Tukey-Kramer means comparison.

Treatment	Yield
A	6.0[b]
B	7.5[ab]
C	**9.0[a]**
Level of significance	<0.10

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 4). A cool and wet spring led to a cool June, which was 1.46° F cooler than average and accumulated 44 fewer Growing Degree Days (GDDs) than normal. The average July temperature was 2.87° F higher than the 30-year normal, while precipitation was below the normal in June and August. Temperatures were less than one degree below normal during August and September. The hotter than average July resulted in 88 more GDDs than average during that month. From June to August, 4221 GDDs were accumulated, 12 GDDS above the 30-year normal.

Table 4. Seasonal weather data collected in Alburgh, VT, 2019.

Alburgh, VT	June	July	August	September
Average temperature (°F)	64.3	73.5	68.3	60.0
Departure from normal	-1.46	2.87	-0.51	-0.62
Precipitation (inches)	3.06	2.34	3.50	3.87
Departure from normal	-0.63	-1.81	-0.41	0.23
Growing Degree Days (32-95°F)	970	1286	1125	840
Departure from normal	-44	88	-14	-18

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 (1981-2010) from Burlington, VT.

Harvest and oil content data are displayed in Table 5. Many plots were not harvested due to high weed density. During hemp grain harvest, combining may be difficult due to weeds, fiber wrapping on the combine, or seed shattering. There were no harvest data collected for Katani, Grandi, and Picolo. No plots of Katani were harvestable, and Grandi and Picolo only had one harvestable replicate. These varieties are grain specific types and tend be much shorter in stature. This short stature provides very little competition against weeds. Taller varieties performed better in this trial likely because they were better able to grow above weeds. In the plots that were harvested, some yields did not have enough seed to determine test weight. Seed moistures were very dry at harvest, with the majority of varieties at less than 10% moisture. Harvest moisture did not vary statistically by variety.

Yields ranged from 509 lbs ac^{-1} to 1109 lbs ac^{-1} on a dry matter basis, and from 566 lbs ac^{-1} to 1232 lbs ac^{-1} at 10% moisture. Ferimon was the top performer, and was significantly greater than CFX2 and CRS-1, the lowest performers, but was statistically similar to all other varieties. Test weight and seed oil content did not differ significantly by variety. CRS-1 was the top performer in test weight at 40.6 lbs bu^{-1}, however, this was still below the industry average of 44 lbs bu^{-1}. CFX1, CFX2, and Joey did not have yields large enough from multiple replicates in order to compare test weights. CFX2 had the highest oil content, 28.7%, while Anka had the lowest at 18.2% oil content.

Table 5. The impact of variety on harvest metrics of industrial grain hemp, Alburgh, VT, 2019.

Variety	Seed moisture @ harvest	Dry matter yield	Yield @ 10% moisture	Test weight	Seed oil content
	%	lbs ac^{-1}	lbs ac^{-1}	lbs bu^{-1}	%
Altair	11.3	1054[a]	1171[a]	39.5	21.5
Anka	9.95	933[ab]	1036[ab]	38.8	18.2
CFX1	13.0	978[ab]	1087[ab]	-	**28.7**
CFX2	**8.45**	509[b]	566[b]	-	22.8
CRS-1	9.18	524[b]	583[b]	**40.6**	20.9
Canda	8.90	872[ab]	969[ab]	42	20.4
Ferimon	9.85	**1109[a]**	**1232[a]**	38.3	24.4
Joey	10.4	739[ab]	821[ab]	-	19.7
USO31	9.43	831[ab]	923[ab]	35.5	22.8
P-value (0.10)	NS	0.0223	0.0223	NS	NS
Trial mean	10.1	839	932	39.1	22.2

ŧ Within a column treatments marked with the same letter were statistically similar (p=0.10). Top performers are in **bold.**
NS – There was no statistical difference between treatments in a particular column (p=0.10).

DISCUSSION

All hemp varieties reached full plant maturity. This year's varieties were harvested at a lower than ideal moisture content. Grain hemp should be combined at a seed moisture range of 10-20% and then dried down to less than 10% for storage. Harvesting seed that is too dry increases risk of yield loss from shattering and bird damage, and can reduce the quality of the grain. Harvesting plants at moistures near 20% also helps prevent dry hemp fibers from getting wrapped in the combine. Harvesting at low moisture contents, when most of the varieties were below 10% moisture, along with below average precipitation June through August, may have resulted in none of the varieties meeting the industry standard for test weight of 44 lbs bu^{-1}. Yields averaged 932 lbs ac^{-1} at 10% moisture, which was higher than the 2018 trial yield of 883 lbs ac^{-1}, and in the median range compared to average yields from Canada of 500-1200 lbs ac^{-1}. Stand establishment overall was poor and in many cases led to high weed densities in the plots. Weeds control in hemp starts with first obtaining an adequate emergence rate. This year the cool June may have led to poor conditions for hemp germination and establishment. In many cases, weed populations completely overcame the trial plots. Varieties that had taller growth habits tended to yield much higher than those varieties specifically aimed towards grain production (i.e. Grandi and Katani). It is important to remember that these data represent only one year of research, and in only one location. Additional research needs to be conducted to evaluate varieties under more growing conditions.

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