



**2021 UW Madison - Wisconsin Hemp Cultivar Trial
Grain and Fiber Production**

Shelby Ellison¹, Jackie Slivicke¹, Logan Gartman¹, Tylor Savage¹, and Jerry Clark²

¹Department of Horticulture, University of Wisconsin, Madison

²University of Wisconsin, Madison, Division of Extension

Introduction

Hemp has been legal to grow in Wisconsin since 2018, however, there is still substantial uncertainty regarding agronomic practices and markets, including such basic information as what varieties should be grown. To address this lack of information a replicated grain and fiber trial was conducted in the summer of 2021 in Chippewa Falls, Wisconsin to obtain data on how fiber and grain hemp cultivars perform in Wisconsin. Farmers can use this data to help choose the best cultivars to plant, and breeders to decide on key traits in need of improvement. A total of 20 different hemp cultivars were evaluated for plant height, stem diameter, straw yield, and grain yield. The information synthesized from this trial will help refine and expand the existing knowledge base and increase the successful adaptation of hemp as a viable option for Wisconsin farmers.



Hemp producers and processors are required to follow state and federal regulations regarding hemp production and registration. Growers must register within their intended state for production and must adhere to most current or active rules and regulations. Regulations are subject to change from year to year with the development and approval of proposed program rules. It is important to note that these regulations may vary across state lines and may be impacted by pending federal regulations. In 2021, hemp production was licensed under the WI Department of Agriculture Trade and Consumer Protection (https://datcp.wi.gov/Pages/Programs_Services/Hemp.aspx). In 2022, hemp production is licensed under the U.S Domestic Hemp Production Program. Please see (<https://www.ams.usda.gov/rules-regulations/hemp>) for current rules and regulations regarding hemp production in Wisconsin.

2021 Growing season, location, design and materials.**Table 1. Location and management information.**

| | |
|--------------------------|--|
| Location | Chippewa Falls, Wisconsin |
| Latitude Of Field | 44.950666 |
| Longitude Of Field | -91.349112 |
| Planting Date | June 16th, 2021 |
| Date Of Emergence | June 23rd, 2021 |
| Harvest Date(S) | September 1st, 2021 |
| Seeding Rate (Seeds/Ft2) | 15.6 |
| Experimental Design | RCBD |
| Number Of Entries | 20 |
| Number Of Replications | 4 |
| Plot Size (Ft2) | 40 |
| Harvested Area (Ft2) | 10.76 |
| Tillage Regime | 2 passes field cultivator and cultipacker |
| Irrigation (Yes Or No) | No |
| Total Rainfall | 11.25 inches |
| Other Observations | Wind and minor lodging on August 11th |

**Table 2. Trait collection methodology.**

| Trait | Standard Units | Method |
|-------------------|----------------|--|
| Grain Yield | grams | Total for harvested area. Dry to near constant moisture or correct for harvest moisture. |
| | lbs./A | Conversion to Pounds/Acre |
| Total Straw Yield | grams | Total for harvested area. Dry to near constant moisture or correct for harvest moisture. |
| | lbs./A | Conversion to Pounds/Acre |
| Plant Height | inches | 5 measurements per plot, averaged. |
| Stem Diameter | millimeters | 5 measurements per plot, averaged. Measure just above point of stem cutoff. |

Table 3. Source of seed for the cultivars used in the trial.

| Cultivar | Source |
|-----------------|-----------------------------|
| Altair | UniSeeds |
| Amaze Auto | MASA Ag LLC |
| Anka | UniSeeds |
| Bialobrzeskie | International Hemp |
| Cfx-1 | Hemp Genetics International |
| Cfx-2 | Hemp Genetics International |
| Fibror 79 | Hempoint |
| Futura 83 | Hempoint |
| Grandi | Hemp Genetics International |
| H-51 | Roher Seed |
| Henola | International Hemp |
| Hlesia | Roher Seed |
| Hliana | Roher Seed |
| Katani | Hemp Genetics International |
| Lara | Omni Trade Inc |
| Piccolo | Hemp Genetics International |
| Santhica 70 | Hempoint |
| Vega | UniSeeds |
| Wi-M-H-19-00112 | Wisconsin Feral Hemp |
| X-59 | IND Hemp |



Cannabinoid Composition

Approximately three inches of floral tissue was collected from the top third of 15 plants for each cultivar. Floral material was sent to Rock River Laboratory (Watertown, WI) for analysis of cannabinoid potency using high-performance liquid chromatography (HPLC). Flower samples were collected at harvest. Total THC = Δ^9 THC + (THCA*0.877) and Total CBD = CBD + (CBDA*0.877).

Statistical Analysis of Data

The tables on the following pages have been prepared with the entries listed in alphabetical order. Height, flowering, and yield data were analyzed in R with the program agricolae, with mean separation performed using the Fisher's Protected LSD (Least Significant Difference) test. All analyses used a mixed model with treatment as a fixed effect and replicates as a random effect with an alpha level of 0.05 to determine significance.

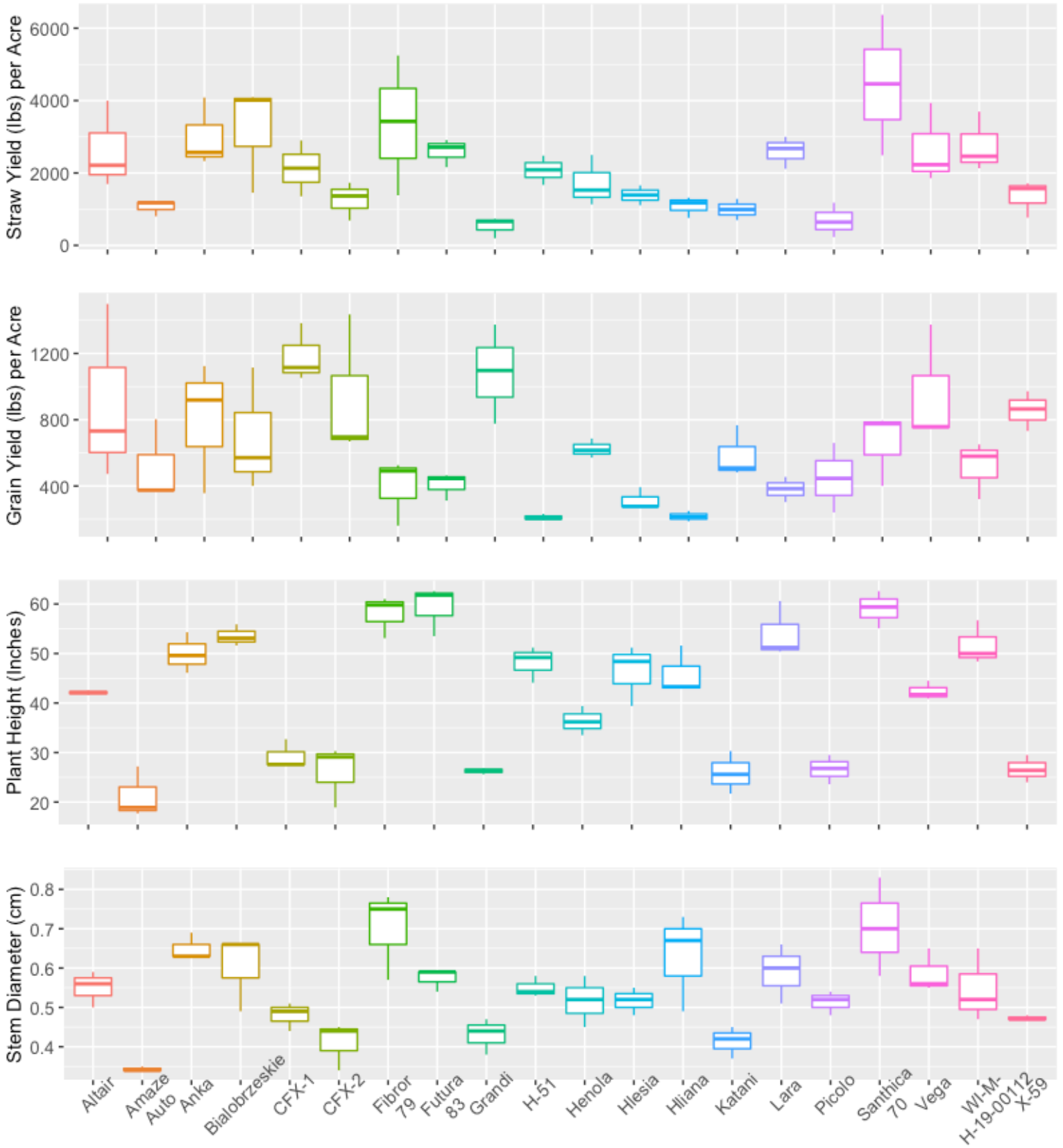
Table 4. Grain yield, straw yield, plant height and stem diameter for grain and fiber cultivars. There is no significant difference between cultivars sharing the same letter assignment.

| Cultivar | Grain Yield (lb/a) | Dry Straw Yield (lb/a) | Plant Height (in) | Stem Diameter (cm) |
|-----------------|--------------------|------------------------|---------------------|---------------------|
| Altair | 901 ^{abc} | 2635 ^{a-e} | 42.1 ^{de} | 0.55 ^{a-e} |
| Amaze Auto | 518 ^{abc} | 1059 ^{b-e} | 21.3 ^g | 0.34 ^e |
| Anka | 800 ^{abc} | 2995 ^{a-d} | 50.0 ^{a-d} | 0.65 ^{ab} |
| Bialobrzeskie | 696 ^{abc} | 3188 ^{abc} | 53.5 ^{abc} | 0.60 ^{a-d} |
| Cfx-1 | 1184 ^a | 2129 ^{a-e} | 29.3 ^{fg} | 0.48 ^{b-e} |
| Cfx-2 | 934 ^{abc} | 1261 ^{b-e} | 26.1 ^{fg} | 0.41 ^{de} |
| Fibror 79 | 393 ^{abc} | 3352 ^{ab} | 57.9 ^a | 0.70 ^a |
| Futura 83 | 407 ^{abc} | 2593 ^{a-e} | 59.3 ^a | 0.57 ^{a-d} |
| Grandi | 1082 ^{ab} | 529 ^e | 26.3 ^{fg} | 0.43 ^{cde} |
| H-51 | 211 ^c | 2079 ^{b-e} | 48.2 ^{a-d} | 0.55 ^{a-e} |
| Henola | 625 ^{abc} | 1719 ^{b-e} | 36.4 ^{ef} | 0.52 ^{a-e} |
| Hlesiia | 316 ^{bc} | 1386 ^{b-e} | 46.3 ^{b-e} | 0.52 ^{a-e} |
| Hliana | 217 ^c | 1085 ^{b-e} | 45.9 ^{b-e} | 0.63 ^{abc} |
| Katani | 586 ^{abc} | 990 ^{cde} | 25.9 ^{fg} | 0.41 ^{de} |
| Lara | 381 ^{abc} | 2596 ^{a-e} | 54.1 ^{ab} | 0.59 ^{a-d} |
| Piccolo | 449 ^{abc} | 684 ^{de} | 26.6 ^{fg} | 0.51 ^{a-e} |
| Santhica 70 | 657 ^{abc} | 4440 ^a | 59.1 ^a | 0.70 ^a |
| Vega | 960 ^{abc} | 2674 ^{a-e} | 42.4 ^{cde} | 0.59 ^{a-d} |
| Wi-M-H-19-00112 | 517 ^{abc} | 2763 ^{a-e} | 51.7 ^{a-d} | 0.55 ^{a-e} |
| X-59 | 856 ^{abc} | 1350 ^{b-e} | 26.6 ^{fg} | 0.47 ^{b-e} |
| Mean | 634 | 2075 | 41.5 | 0.53 |

Table 5. CBD and THC composition at harvest.

| Variety | CBD (%) | THC% |
|-----------------|---------|-----------------------|
| Altair | 0.5 | Below Detection Limit |
| Amaze Auto | 0.4 | Below Detection Limit |
| Anka | 0.4 | Below Detection Limit |
| Bialobrzeskie | 1.0 | 0.02 |
| Cfx-1 | 0.4 | Below Detection Limit |
| Cfx-2 | 0.3 | Below Detection Limit |
| Fibror 79 | 1.0 | 0.03 |
| Futura 83 | 1.6 | 0.02 |
| Grandi | 0.5 | Below Detection Limit |
| H-51 | 0.0 | Below Detection Limit |
| Henola | 0.0 | Below Detection Limit |
| Hlesiia | 0.0 | Below Detection Limit |
| Hliana | 0.0 | Below Detection Limit |
| Katani | 0.2 | Below Detection Limit |
| Lara | 0.0 | Below Detection Limit |
| Piccolo | 0.7 | 0.01 |
| Santhica 70 | 0.0 | Below Detection Limit |
| Vega | 0.3 | Below Detection Limit |
| Wi-M-H-19-00112 | 1.1 | 0.01 |
| X-59 | 0.5 | Below Detection Limit |

Figure 1. Boxplots of straw, grain, height, and stem diameter traits across the 20 grain and fiber hemp cultivars. The box represents the middle 50% of the data. The bottom line represents the bottom quartile (25%) and the top line represents the top quartile (25%). The median is represented by a vertical bar in the center of the box.



Acknowledgments

This research was funded by the UW-Madison Division of Extension with support from participating seed companies.

We gratefully acknowledge the physical, emotional, and intellectual assistance of the following individuals in conducting this trial: Dan Heider, Richard Rittmeyer, Sean Kim, Autumn Brown, Grace Connelly, Dustin Sawyer, Scott Fleming, Bill Halfman, Kaitlyn Davis, Carl Duley, Ashley Olson, Esther Shekinah, James DeDecker, Phillip Alberti, and Marguerite Bolt.

Questions about this project can be directed to:

Shelby Ellison

Department of Horticulture

1575 Linden Dr.

Madison, WI 53706

Email: slrepinski@wisc.edu

Website: <https://fyi.extension.wisc.edu/hemp/>



An EEO/AA employer, University of Wisconsin-Madison Division of Extension provides equal opportunities in employment and programming, including Title VI, Title IX, the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act requirements.