



Hemp Cultivar Trial – Wisconsin, 2021

Michael Fields Agricultural Institute
East Troy, Wisconsin



Introduction

Michael Fields Agricultural Institute (MFAI) has been working with the CBD hemp crop since Wisconsin's pilot program launched in 2018. Our efforts to provide information to growers on this relatively new crop continued into 2021 when we undertook a cultivar trial in coordination with University of Wisconsin – Madison, Michigan State University, University of Illinois and Purdue University. The main objective was to evaluate different cultivars that would best suit the Midwest region as well as generating information on agronomic practices for a successful crop. MFAI works in the certified organic space and the information generated can help farmers make decisions on the choice of hemp cultivars for their farm. MFAI evaluated 13 cultivars, of which 10 are photo period sensitive and 3 are day-neutral cultivars.

In 2021 a Wisconsin grower or processor license had to be obtained from Department of Agriculture, Trade and Consumer Protection (DATCP) for cultivation. This license was valid for one year and had to be renewed every year (now changed with USDA rules). Hemp cultivation is guided by state and federal rules and regulations and a grower/processor is expected to always adhere to the changing rules and regulations.



Experimental Site

Our cultivar trial was conducted at the research grounds of MFAI, East Troy, Wisconsin (42.782077, -88.423920). The soil type was Warsaw Silt Loam. Before transplanting hemp plants, a Dutch white clover cover crop was sown which did not establish because of the warm weather in the spring of 2021.

In the trial, a total of 13 cultivars were tested in a Randomized Block Design with three replications. All the transplants were raised from seeds. There were 10 photoperiod cultivars and 3 day-neutral (a.k.a. auto-flowering) varieties. Each replication had 5 plants with a total of 15 plants for each photoperiod cultivar. The day-neutral cultivars had 12 plants per replication (planted at 1'x1' spacing) and a total of 36 plants per cultivar. Feminized seeds for the photoperiod sensitive cultivars were planted on May 10th and after hardening off, transplanted on June 7th, 2021. Feminized day-neutral cultivars were planted on May 24th and transplanted on June 7th, 2021, as well. Spacing for the photoperiod sensitive cultivars was 4 ft between rows and 4 ft between plants to enable intercultural operations, while the day-neutral cultivars were at 1 ft x 1 ft spacing. Irrigation was provided three times, when needed most. Composted chicken manure was added before planting. Fertility was supplemented with AgroThrive LF 2.5-2.5-1.5 fish emulsion applied in the irrigation water at a rate of 2 oz. per gallon, once during the peak season. The weeds were cut back twice during the season by mowing close to the ground to keep off competition.

Weather Data

The recorded weather data for East Troy, Wisconsin during the cropping season is thus: an average maximum temperature of 84.8 °F was recorded in August and a minimum temperature of 54.6 °F recorded in October. Highest rainfall of 3.40 inches was recorded in August, with a cropping season total of 8.85 inches.

Table 1: Average monthly weather data for East Troy, Wisconsin in 2021

	Jun.	Jul.	Aug.	Sept.	Oct.
Max Average Temp (°F)	81.4	80.8	84.8	80.5	67.8
Average Temp (°F)	71.0	70.9	73.9	68.5	61.2
Min average Temp (°F)	60.6	61.4	63.0	55.6	54.6
Total Precipitation (in)	2.25	0.90	3.40	1.00	1.30

(Temperature data retrieved from National Weather Service, NOAA, 2021, Milwaukee

* Data collected at MFAI field site at East Troy, Wisconsin, 2021)

Trait Evaluation

Plant Height

Plant height was measured from the base of the plant to the tip of the tallest inflorescence at 30 and 60 days after planting and at harvest. The data was collected from 5 plants for each replication both in photoperiod sensitive cultivars and the day-neutral cultivars.

Flowering Time

The plots were scouted every week and flowering data was recorded once the plants showed indication of flowering. All five plants in a plot were rated for flowering. A plant was considered to be flowering when clusters of female flowers were observed at the shoot apices (terminal flowering – Fig. 1). Flowering data is presented as the average number of days after transplanting that the terminal flowering occurred in 50% of the plants. Significant flowering intervals were observed for some cultivars, while others flowered consistently across individual plants/plots within a cultivar.

Flowering data is presented as number of days after transplanting for the cultivars.



Fig. 1 - Flower initiation with a yellow arrow pointing at the extruding stigmas.

Cannabinoid Composition

Flower samples were collected at three, five and seven weeks after the cultivar reached 50% flowering for testing of cannabinoids and Total THC. Approximately 3 inches of floral tissue was collected from the side branches of the plants at 3rd and 5th week, while the top third of 15 plants were collected at 7th week for each cultivar. Floral material was sent to Rock River Laboratory (Watertown, WI) for analysis of cannabinoid potency using high-performance liquid chromatography (HPLC). All cultivars tested were CBD cultivars. The CBD, THC and CBD: THC ratio were recorded at the 3, 5 and 7th week for cultivars.

Whole Plant Biomass and Dry Matter Yield

Seven weeks after achieving 50% flowering, the plants were cut at the base by hand. Three plants were harvested in each replication, for a total of nine plants for a cultivar, and the wet weight was recorded. The whole plants were air dried in a barn with air circulation for approximately 5 weeks. Once dried, the whole plant dry weight was recorded. They were then stripped to remove the flowers/bud and the leaf matter from the stem, which was bagged and weighed separately to give the floral yield for the cultivar.

Statistical Analysis of Data

The entries in the table of results have been entered as planted in the field, for ease of observation, and

does not indicate a hierarchy of value. The data were analyzed using the DMRT with a significance level of 0.05. Cultivars that are within the range of the value listed for LSD are not significantly different from each other at the five percent level of probability.

Results

Significant differences in flowering date, plant height, whole plant dry weight yield, stripped biomass yield, and cannabinoid composition were found for photoperiod sensitive cultivars (Table 3 & 5). The day-neutral (auto) cultivars (Table 2 & 4) were not subjected to statistical analysis.

Table 2: Planting date, average days to flowering, 50% flowering and harvest date for day- neutral cultivars

Cultivar	Source	Planting Date	Av. days to flowering	50% Flowering	Harvest Date
Dr. Chuck	Kayagene	06/07/2021	20	06/24/2021	08/10/2021
118 Early Harvest	7-Mile Farms LLC	06/07/2021	20	06/24/2021	08/10/2021
Auto Blunami	Beacon Hemp	06/07/2021	16.5	06/29/2021	08/17/2021

Table 3: Plant height, dry whole plant weight, stripped biomass, and cannabinoid composition (7th week) for day-neutral cultivars.

Cultivar	Plant height (cm)	Dry whole Plant weight (lbs/ac)	Stripped Biomass (lbs/ac)	CBD (%)	THC (%)	CBD:THC ratio
Dr. Chuck	56.5a	2251	1924	7.2	0.35	20.2
118 Early Harvest	36.47b	2142	1851	6.1	0.26	20.9
Auto Blunami	56.0a	4066	3485	6.0	0.27	22.1
Mean	49.6	2820	2420			
LSD (p=0.05)	16.1	NS	NS			

Table 4: Date of flowering, 50% flowering, duration of flowering and harvest date for photo-period sensitive cultivars

Cultivar	Source	Date of first flowering	50% Flowering	Duration of Flowering (days)	Harvest Date
Umpqua	Arcadia	07/13/2021	07/20/2021	49	09/10/2021
Bubbatonic	Kayagene	08/03/2021	08/10/2021	7	10/03/2021

Early Remedy	Beacon Hemp	08/03/2021	08/10/2021	14	09/30/2021
Early Neuve	Beacon Hemp	07/13/2021	08/03/2021	29	09/24/2021
Early Cherry	Beacon Hemp	08/03/2021	08/10/2021	21	09/30/2021
Santiam	Arcadia	08/10/2021	08/24/2021	28	10/16/2021
Ultra-Woman	Trilogene	08/10/2021	08/31/2021	28	10/19/2021
Rogue	Arcadia	08/24/2021	8/31/2021	7	10/16/2021
Super Wife	Trilogene	08/10/2021	8/31/2021	35	10/19/2021
IHG 85 (71x71)	Industrial Hemp Genetics LLC	08/24/2021	8/31/2021	7	10/19/2021

Table 5: Plant height, wet and dry whole plant weight, and stripped biomass yield for photo-period sensitive cultivars.

Cultivar	Plant Height at harvest (cm)	Wet Whole Plant Weight (lbs/plant)	Dry Whole Plant Weight (lbs/plant)	Stripped Biomass (lbs/plant)
Umpqua	153.13bc	4.83	1.68bc	0.98b
Bubbatonic	196.47a	8.21	2.34ab	1.40ab
Early Remedy	129.33c	6.61	2.07abc	1.30ab
Early Neuve	137.13c	5.99	1.87abc	1.32ab
Early Cherry	128.40c	4.97	1.40cd	1.00b
Santiam	153.53c	6.45	1.93abc	1.01b
Ultra-Woman	165.60abc	6.71	2.01abc	1.17ab
Rogue	163.00abc	6.96	2.64a	1.52a
Super Wife	180.40ab	7.92	2.39ab	1.54a
IHG85 (71x71)	76.57d	2.29	0.70d	0.43c
Mean	148.36	6.09	1.90	1.17
LSD (p=0.05)	49.88	NS	0.99	0.56



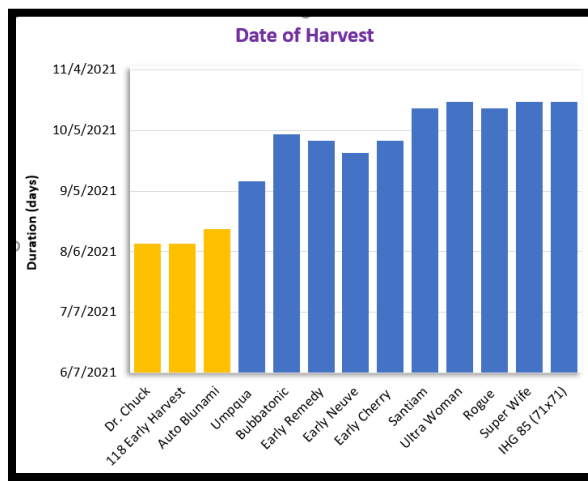
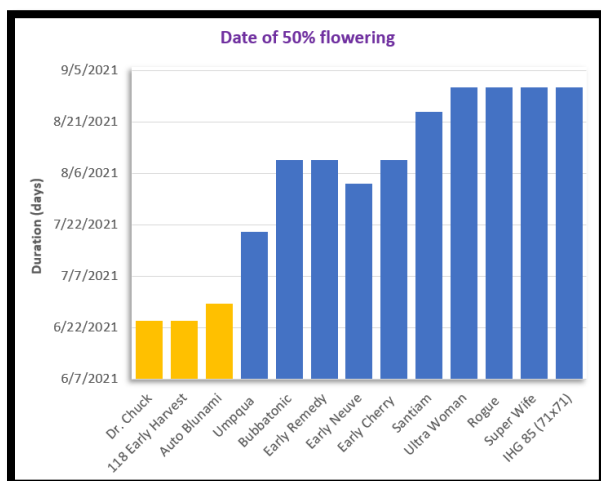


Fig. 2. 50% flowering date in field grown cultivars Fig. 3. Harvest date in field grown cultivars

Though white clover was sown as cover crop in April, it did not establish well due to the prevalent dry weather. While clover started to establish and grow well during the early fall when the seasonal temperature got cooler, the hemp plants did not benefit from the white clover planted as a cover crop during the 2021 season.

All plants in cultivar “Rogue” were uniformly flowering at the same time. The flowering duration (the time duration between the first plant to flower and the last plant to flower) was a smaller window in Rogue (7 days). Even though Super Wife had a drawn-out flowering duration (35 days), it still yielded on par with Rogue. The 15 plants in Umpqua took 49 days to flower (meaning the last plant flowered 49 days after the first one). Consequently, the crop maturity at harvest was not uniform. Lodging was a problem in some cultivars that had late maturity.

The Midwestern Database uses certain criteria for determining the cultivars as ‘good potential’ ones in our region: i) Flowering initiated before Aug 30th; ii) Total THC below 0.39% iii) average CBD:THC ratio of above 25:1

The day-neutral cultivars were planted at 1 ft x 1 ft spacing and the dry biomass produced was calculated at an acre basis.

The highest yields were recorded with Auto Blunami (stripped biomass yield of 3485 lb/ac). The other two cultivars Dr. Chuck and 118 Early Harvest recorded - 1924 and 2420 lbs/ac. The CBD values were around 6.0 to 7.2%.

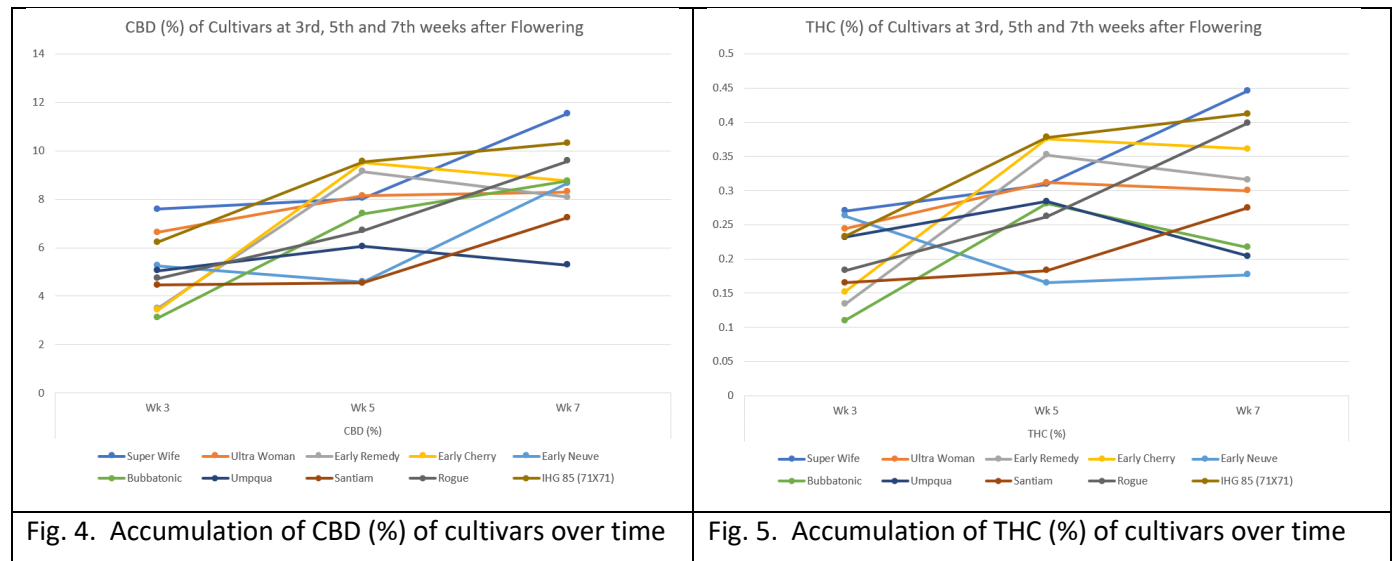


Rogue (1.52 lbs/plant) and Super wife (1.54 lbs/plant) recorded the highest stripped biomass yield after harvest at 7th week which was statistically superior from the rest of the cultivars grown. On par yields were recorded with Bubbatonic, Early Neuve, Early Remedy, and Ultra women.

Table 6: Cannabinoid composition (5th and 7th week) for photo-period sensitive cultivars.

Cultivar	5 th Week			7 th Week		
	CBD (%)	THC (%)	CBD: THC Ratio	CBD (%)	THC (%)	CBD: THC Ratio
Umpqua	6.06	0.28	21.3	5.3	0.20	26.0
Bubbatonic	7.40	0.28	26.4	8.8	0.22	25.9
Early Remedy	9.14	0.35	26.0	8.1	0.32	25.6
Early Neuve	4.59	0.17	27.9	8.7	0.18	49.1
Early Cherry	9.51	0.38	25.3	8.8	0.36	24.2
Santiam	4.54	0.18	24.8	7.2	0.28	26.3
Ultra-Woman	8.15	0.31	26.2	8.3	0.30	27.8
Rogue	6.71	0.26	25.6	9.6	0.40	24.0
Super Wife	8.04	0.31	26.1	12.0	0.45	25.9
IHG85 (71x71)	9.56	0.38	25.3	10.0	0.41	27.8

All cultivars tested remained below 0.39% for Total THC at week 5 after 50% flowering, but 5 cultivars were above 0.30% (Table 6). Most cultivars continue to accumulate cannabinoids (CBD, THC) until harvest (Table 3 & 6). The ratio of CBD to THC ranged between 24:1 to 28:1 (Table 3 & 6) except in one instance.



Recommendations:

The Midwest Hemp Database project uses the following criteria to identify CBD hemp cultivars with “good potential” in our region:

- Flowering initiated prior to August 30th
- Total THC below 0.39%
- Total CBD above 5%
- Average CBD:THC ratio above 25:1

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Important Disclaimer:

This is neither an endorsement nor a promotion of these cultivars or seed companies. This resource is intended to increase the knowledge on cultivar performance and to provide additional information to growers in their production endeavors. Performance of these cultivars may not be similar in another field and varies with the resources available and the prevalent weather conditions.

Contact Information:

Dr. Esther S Durairaj
Research Agronomist
www.michaelfields.org
eshekinah@michaelfields.org

MICHAEL FIELDS
AGRICULTURAL INSTITUTE

