2021 Research Report

Cultivar Check Program

What is the Cultivar Check Program?

Since 2019, substantial variation across performance metrics has been observed in hemp throughout the Midwest. As such, using findings from the Midwestern Hemp Database (MHD) in 2020, criteria were used to determine a list of cultivars which were categorized as "Good Potential" (go.illinois.edu/MHDReport). These cultivars would be used as a baseline for growers to consider and for researchers to study further. Criteria for the "Good Potential" CBD dominant cultivars include, but are not limited to, these parameters:

- Flowering initiated prior to August 30th
- Average Total THC for all samples below 0.39%
- Average Total CBD for all samples above 5%

In 2021, a group of 14 grower-cooperators (Figure 1) across the Midwest participated in a semi-replicated variety trial using selected "Good Potential" cultivars (Table 1). Each grower received five to six cultivars (four to five CBD Dominant and one CBG Dominant) which were sampled for cannabinoid determination at three time points: 3 weeks, 5 weeks, and 7 weeks after flowering initiation. Via funding from the Sustainable Agriculture Research and Education (SARE) Partnership Grant, floral samples were sent to Rock River Laboratory Inc. for cannabinoid determination; sub-samples of prepared tissue were subsequently sent to ACT Labs for secondary analysis. Growers also collected select agronomic data and other performance metrics.

Most high cannabinoid hemp grown in the Midwest will begin to flower during mid-August to early September, continuing reproductive growth until harvest in early October (Figure 2). Average harvest date for full season varieties in the Midwest is 45 days after flowering (Alberti 2021). Varieties/cultivars in the Cultivar Check Program were harvested at 7 weeks (~49 days) after flowering was initiated.

Source	Cultivar	CBD/CBG	Sites	Sample Submissions
Beacon Hemp	Early Nueve	CBD	5	15
Company X	Hybrid X	CBD	7	21
Eastern Plains Hemp	Silver Lining	CBD	7	21
Arrowhead Seed Co.	Florence	CBD	6	18
Arrowhead Seed Co.	BaOx Hybrid	CBD	7	21
Oregon CBD	Suver Haze	CBD	6	18
Oregon CBD	White CBG	CBG	5	15
KifCure	Buffalo Soldier	CBG	7	21

Table 1. Table showing the high cannabinoid hemp cultivars utilized in the MHD Cultivar Check Program during the 2021 growing season.

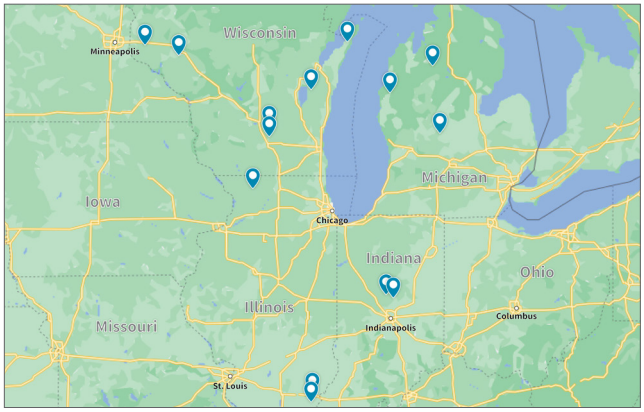

Fig. 1. Map showing geographic location of sites for MHD Cultivar Check Program during the 2021 growing season (Google Maps).

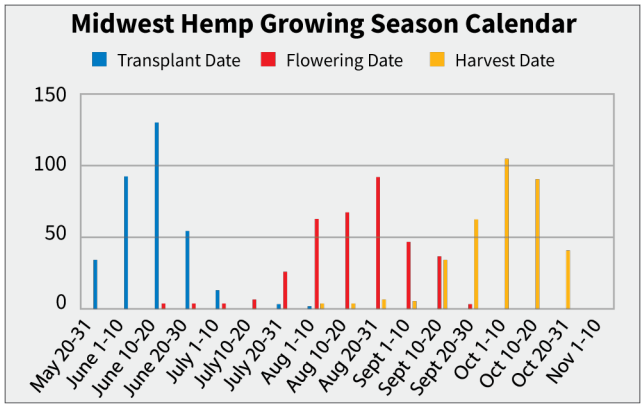

Fig. 2. Histogram illustrating various production milestones of high cannabinoid hemp in 2020 and 2021 (Source: MHD).

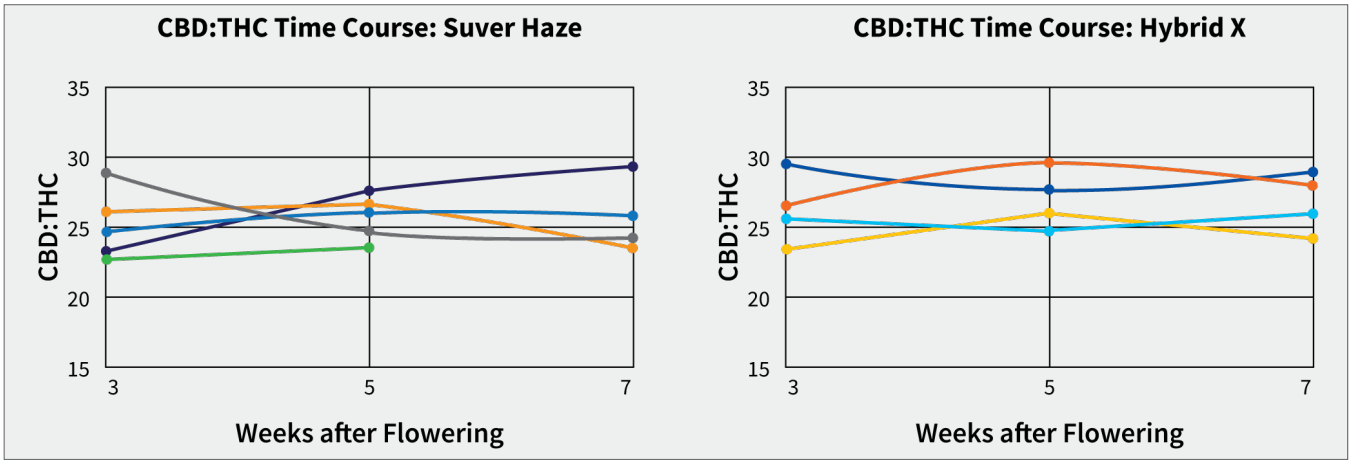

Fig. 3. The CBD:THC ratio across flowering periods for representative varieties (Suver Haze and Hybrid X. Different colored lines represent various sites/locations.

Results and Discussion

Certain agronomic traits were evaluated including: flowering date, biomass yield, floral yield, and plant height. Agronomic data and other performance metrics were collected and entered in using SeedLinked. Yield components across and within varieties were extremely variable across locations; for this reason, university station trials may be more useful/accurate sources of information for those performance metrics (Ellison et al., 2021 and DeDecker et al., 2021). Anecdotally, across two years of agronomic data collection via the MHD, floral yields averaged 1.1 lb. per plant (Alberti 2021).

CBD Dominant Cultivars

Data from the Cultivar Check Program illustrate that CBD:THC of the chosen hemp varieties were relatively unaffected by sample timing, remaining consistent throughout flowering; a figure illustrating this relationship for "Suver Haze" and "Hybrid X" can be seen in Figure 3. This suggests that CBD:THC ratios are consistent throughout the flowering period at each location. This supports previous literature done by researchers from Cornell University showing stable CBD:THC throughout flowering (Toth et al., 2021).

In addition, CBD:THC of stable cultivars only appear to be impacted by environmental factors on a limited basis (Figure 3); This also supports prior literature from various research studies (Campbell et al., 2019 and Toth et al., 2021). This information is especially important for growers looking to utilize CBD:THC to make variety/cultivar selections and aid in harvest timing. Considering this information, CBD:THC ratios may be the most useful and accurate indicator of compliant, profitable hemp.

It should be noted that some genetic sources are less impacted by environment or genotype* environment interactions; as such, heterogeneity across and within varieties can make agronomic performance and cannabinoid development less predictable. Due to the non-uniformity of the flowering process, unstable cultivars could reach maturity at different points in the growing season, which could have adverse impacts on testing and harvesting strategies at the field level.

As cannabinoids do not begin to develop rapidly until flowering has been initiated, growers are encouraged to delay sampling until after terminal flowering to eliminate unnecessary testing costs. Compliance with USDA regulations is determined by showing that each hemp lot produces Total THC <.3%. However, there is currently a great deal of variation across laboratory sample preparation and analytical methods. This disparity between current laboratory procedures makes cannabinoid analyses difficult to compare. As such, submitting samples though an approved, accredited laboratory is recommended.

This is a reminder that these varieties were chosen due to their track record and "Good Potential" status (Alberti 2021). Data is presented in the following manner: cannabinoid data (Total THC (%), Total CBD (%), and Total CBG (%)) are presented

Variety/Cultivar	Flowering Date Range	Weeks After Flowering	# of Samples	Total THC (%)	Total CBD (%)	Total CBG (%)	CBD: THC Avg.
BaOX Hybrid	Late August/Early September	3	14	0.09	3.56	0.14	34.5
		5	14	0.15	5.28	0.11	
		7	14	0.31	8.88	0.26	
Buffalo Soldier	Early-Mid August	3	14	0.02	0.07	4.81	1.57
		5	14	0.02	0.01	6.04	
		7	14	0.08	0.01	9.52	
Early Nueve	Mid August	3	10	0.19	5.18	0.07	27.4
		5	10	0.26	7.49	0.13	
		7	10	0.41	10.98	0.25	
Florence	Mid-Late August	3	12	0.04	2.30	0.23	34
		5	12	0.13	4.69	0.12	
		7	12	0.24	7.85	0.15	
Hybrid X	Mid-Late August	3	14	0.09	3.45	0.04	35.1
		5	14	0.13	5.10	0.05	
		7	14	0.33	9.56	0.15	
Silver Lining	Mid-Late August	3	14	0.10	3.32	0.10	31.7
		5	14	0.17	5.50	0.11	
		7	14	0.42	11.50	0.27	
Suver Haze	Mid August	3	12	0.20	5.74	0.19	27.5
		5	12	0.35	9.87	0.19	
		7	12	0.51	13.42	0.30	
White CBG	Mid August	3	10	0.03	0.18	6.46	2.5
		5	10	0.07	0.01	9.65	
		7	10	0.11	0.02	11.03	

Table 2. Table showing cannabinoid concentrations (Total THC (%), Total CBD (%), and Total CBG (%)) over time from cultivars entered into the MHD Cultivar Check Program during the 2021 growing season.

in terms of averages across all locations at each time point for each variety. This decision was made due to this study and others illustrating stability of CBD:THC throughout flowering and across environmental conditions for stable cultivars. In addition, the data used at each time point in the following tables and figures includes taking averages of the primary and secondary analysis. Results of proficiency testing among partnering laboratories gave us the confidence to average primary and secondary analysis to get a more representative sample.

Both Total THC (%) and Total CBD (%) increased steadily throughout the flowering period (Table 2 and Figure 4). Across all variety entries during the week 5 sampling period, the average value for Total THC was 0.20% ; by week 7, the average values for Total THC increased to 0.37%. Of the six stable, CBD dominant cultivars grown via the Cultivar Check Program, five (83%) exceeded the threshold for compliant hemp by the week 7 sampling period. This data would suggest that optimal harvest for these cultivars will likely be 5 to 6 weeks (35 to 42 days) after flowering initiation to remain compliant.

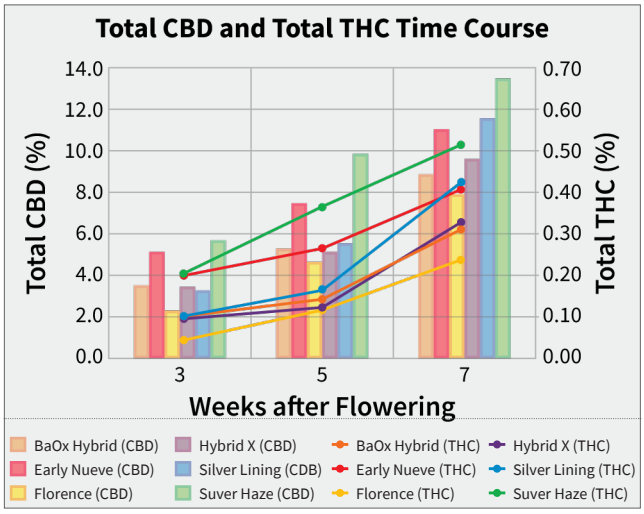

Fig. 4. Combination chart showing Total CBD (%) and Total THC (%) accumulation from CBD-Dominant cultivars entered into the MHD Cultivar Check Program.

This trial shows that many CBD dominant cultivars exhibit a linear (or curvilinear) relationship between Total CBD (%) and Total THC (%) (Figure 5). Given this relationship, Total CBD (%) infrequently exceeds ~8% without exceeding the regulatory threshold of 0.3% THC. This relationship suggests that cultivars with a stable CBD:THC (~25:1 to 30:1) throughout flowering will help to maximize profitability while maintaining compliance. This data is supported by results found via the MHD (Alberti 2021) and Cornell University (Toth et al., 2021).

The reality is most hemp cultivars currently on the market will go "hot" (Total THC >0.3%) if not monitored appropriately during flowering. To illustrate, 29% of the samples tested were above 0.3% Total THC regulatory limit across the results from the MHD over the 2020 and 2021 growing seasons (Alberti 2021). Growers are encouraged to test their crop frequently during later stages of flowering to maximize production of cannabinoids while maintaining compliance.

CBG Dominant Cultivars

Data from the MHD supports these findings as CBG dominant cultivars are not exhibiting a clear quantifiable relationship between Total CBG (%) and Total (THC%). Importantly, many CBG dominant cultivars contain lower amounts of Total THC (%) compared to CBD dominant counterparts. Across the MHD data set, average Total THC(%) of CBD dominant cultivars was 0.258 (1181 entries) compared to 0.075 for CBG dominant cultivars (200 entries) (Alberti 2021). Data suggests that CBG:THC are not stable with fluctuations occurring throughout the flowering period (Figure 5). The highest CBG:THC occur during the earliest stages of flowering before decreasing significantly as flowering progresses (Figure 5). Thus, utilization of CBG:THC an unreliable metric for evaluating performance throughout the growing season.

References

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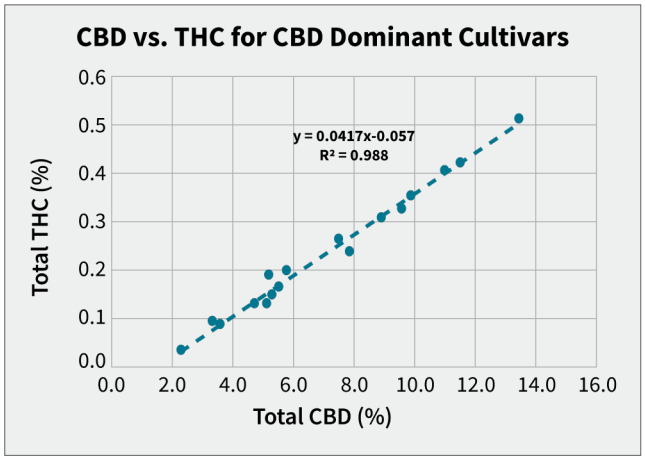

Fig. 5. Scatter plot showing relationship between Total CBD (%) Total THC (%) for all CBD dominant cultivars in the Cultivar Check Program during the 2021 growing season. Data from values presented in Table 2.

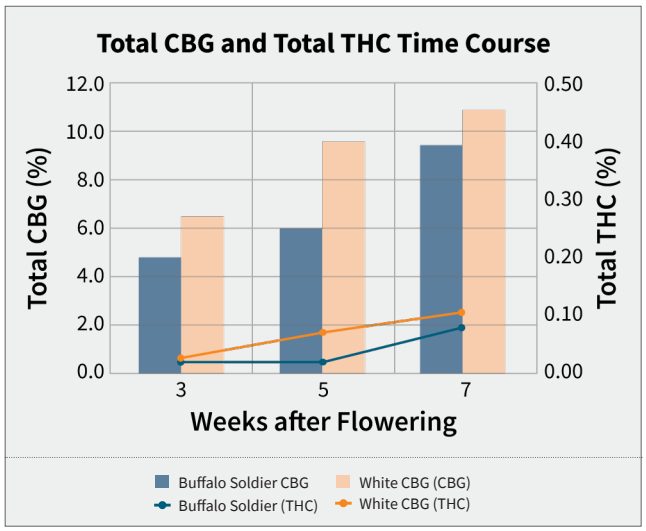

Fig. 6. Combination chart showing Total CBG (%) and Total THC (%) accumulation from CBG-Dominant cultivars entered into the MHD Cultivar Check Program.

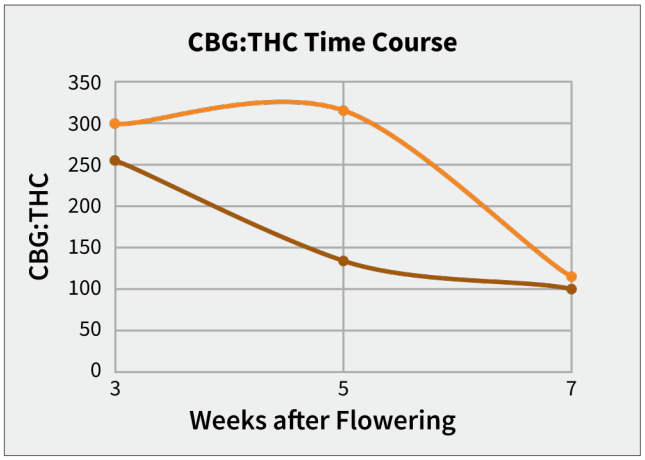

Fig. 7. Figure showing CBG:THC throughout the flowering period for CBG Dominant cultivars entered into the MHD Cultivar Check Program during the 2021 growing season.

Additional Resources

- University of Illinois Hemp Production
- University of Wisconsin-Madison Trials
- Michigan State University Specialty Crops
- Purdue University Hemp Project

Important Disclosure

This is not an endorsement or promotion of these cultivars or seed companies. This resource is intended as a baseline for growers as we gather more information about cultivar performance. Growers are encouraged to think about how this information may help them in their production endeavors, and what characteristics are desirable for complaint and profitable hemp crops.

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For More Information

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