2021 Research Report

Midwestern Hemp Database

What is the Midwestern Hemp Database?

The Midwestern Hemp Database (MHD) is a large scale collaboration between land grant institutions, private laboratories, non-profit organizations, and grower-cooperators in the Midwest. The goal of this project is to provide regional insight into agronomic performance and cannabinoid development of hemp cultivars grown for cannabinoid production. The data generated from this project is available to the public at go.illinois.edu/HempDatabase.

The MHD leverages grower-collaborator networks to provide data on adopted production strategies and cultivar performance in exchange for discounted cannabinoid profiling ($35 per sample). While these tests do not replace compliance testing through state or federal agencies, it does give growers a chance to participate in research that is beneficial for both themselves and others!

In order to determine your eligibility to participate in this project, please fill out the online survey here.

What Type of Information is Available?

The database contains information on agronomic performance indicators (planting date, flowering date, yield, etc.), and results of the cannabinoid profiling for all cultivars entered into the program. In 2020 and 2021, more than 180 grower-cooperators across the Midwest participated in this project, submitting 1,381 samples for cannabinoid profiling.

Data collection and sampling protocols have been designed and agreed upon by a team of Midwestern researchers using the USDA rules as a guide. All project information including project applications, updates, and data collection protocols are available at the MHD webpage.

Data entered into the Midwestern Hemp Database comes from multiple sources including:

- Grower Submitted Variety Entries
- Cultivar Check Program
- University Research Station Variety Trials

2020-21 Midwestern Hemp Database Results and Discussion

Transplanting of hemp into the field peaks in mid-June but extends into early July. Seedlings/clones are usually established in greenhouse/nurseries for several weeks prior to transplanting into the field (Figure 1). Most high cannabinoid hemp grown in the Midwest will begin to flower during the month of August, continuing reproductive growth until harvest in early October. High cannabinoid hemp is traditionally hand harvested for premium floral material, but mechanical methods designed to harvest biomass are also being developed and utilized with varying degrees of success.

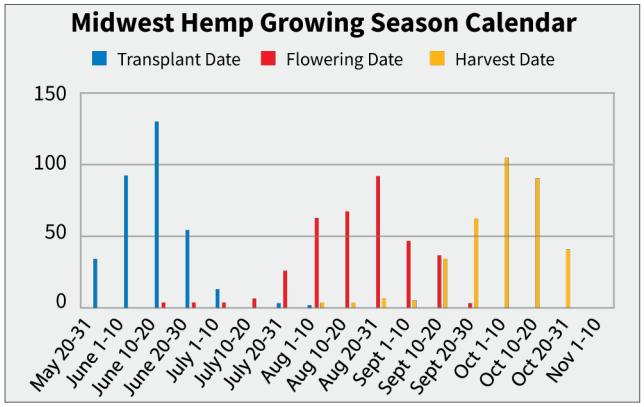

Fig. 2. Histogram illustrating various production milestones of high cannabinoid hemp in 2020 and 2021 (Source: MHD).

Yield and Growth Characteristics

Yield components across and within varieties were extremely variable across locations; grower experience/skill and weather play a tremendous role in production. 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).

Importantly, growth characteristics (photoperiod dependent vs day-neutral), and production practices (transplant date, row spacing, populations, etc.) can impact development and yield. While larger plants produce greater biomass and subsequent floral production, they are more susceptible to lodging and wind damage (Darby et al., 2019). Growers may want to consider additional reinforcement (trellis, support poles) to protect plants from environmental stresses that reduce quality. The interaction between cultivar, environment, and production practices should be evaluated prior to planting.

Cannabinoid Sampling

Growers are encouraged to test their crop frequently throughout flowering to ensure compliance regarding Total THC in anticipation of harvest; however, timing and location of sampling is of critical importance. As cannabinoids do not begin to develop rapidly until flowering has been initiated, growers are encouraged to delay sampling until after terminal flowering. The goal of this will be to eliminate unnecessary production costs and/or testing. Sampling for cannabinoids in the Midwest will typically begin in August as flowering begins, increasing in frequency as harvest draws near. Additionally, research has shown that cannabinoid concentrations are greatest in the top portions of the plant, where sampling for compliance testing will occur (Lowman et al., 2019); growers are encouraged to sample plants in a similar manner to promote accurate harvest timing decisions.

Of all samples submitted into the MHD, 636 (53%) were submitted during the month of September. This increase in sample submission corresponds with peak flowering/harvest time in our region. This information suggests there will be a tight peak window during which samples will be collected in anticipation of harvest; sampling requests and sample submissions increase in frequency as growers attempt to maximize production of cannabinoids while maintaining compliance. Increases in sample submissions during critical production stages may lead to backlogs and delays in laboratory analysis and reporting.

Cannabinoid Production

During the flowering period, hemp begins to accumulate cannabinoids in the floral material. Cannabinoids like CBD and CBG determine profit potential while THC determines compliance. 159 distinct cultivars/varieties representing 1,381 samples were entered into the MHD in total. Across this data set there was variation across performance metrics. For these reasons, a list of criteria were used to “clean” this data set to provide the most useful information to growers. CBG dominant and CBD dominant cultivars were evaluated and assessed separately .

Data from the MHD Cultivar Check Program showed that of the six stable cultivars grown via the Cultivar Check Program, 83% exceeded the threshold for compliant hemp by week 7. Optimal harvest for many CBD dominant cultivars will likely be 5 to 6 weeks (35 to 42 days) after flowering initiation to remain compliant (Alberti 2022).

Data from the MHD shows that many CBD dominant cultivars exhibit a linear (or curvilinear) relationship between Total CBD (%) and Total THC (%) (Figure 2). Given this presumed relationship, Total CBD (%) is often not able to exceed ~8% without exceeding the regulatory threshold of 0.3% THC. Cultivars with a stable CBD:THC (Between 25:1 and 35:1) throughout flowering will help to maximize profitability while maintaining compliance (Figure 3). Currently, many hemp cultivars on the market will go “hot” (>0.3% THC) if not monitored appropriately, as 29% of the samples entered into the MHD were above the regulatory limit.

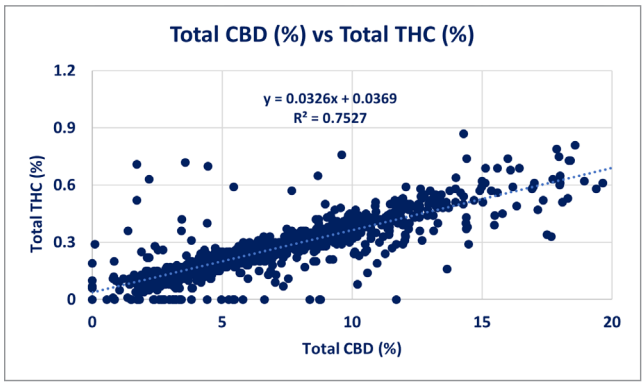

FIG 2: Relationship between Total CBD and Total THC for all CBD dominant cultivars entered into the MHD.

CBD:THC of stable cultivars only appears to be impacted by sample timing on a limited basis (Campbell et al., 2019, Toth et al., 2021). Additionally, CBD: THC has been shown to not be impacted (Toth et al., 2021) or only moderately impacted by environmental factors (Alberti 2022). This information is especially important for growers looking to utilize CBD:THC to make cultivar selections and sampling/harvest decisions. In all, 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 sampling strategies and test results.

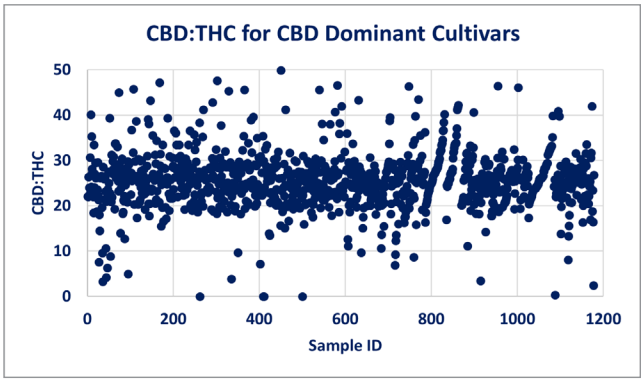

FIG 3: Scatter plot comparing CBD:THC for CBD Dominant cultivar samples entered into the MHD.

Good Potential Cultivars

Across the MHD data set there exists variation across performance metrics and analytical methods. As such, criteria were used to determine a list of cultivars which were categorized as "Good Potential" (go.illinois.edu/MHDReport) in 2020. Cultivars which achieve "good potential" status are included in the Cultivar Check Program which evaluates hemp cultivars using grower-cooperators across the region (Alberti 2022).

An updated list of criteria, and cultivars fitting those criteria, are listed below. This list, and its criteria, will continue to be updated as data becomes available. More data including maximum, minimums, and averages for various cannabinoids can be found at the MHD website.

CBD-Dominant Cultivars

Criteria for the 13 "Good Potential" CBD dominant cultivars (Table 1) are as follows:

- Flowering initiated before August 31
- Minimum of 15 distinct samples submitted for each source* cultivar
- Average Total THC for all samples below .39%
- Average Total CBD for all samples above 5%
- CBD:THC > 25

Cultivar	Record Count	Total CBD (%) Avg.	Total THC (%) Avg.	CBD:THC
Cherry Wine	84	5.69	0.229	27.0
Hybrid #5	71	6.25	0.198	30.6
Suver Haze	59	10.18	0.374	27.1
BaOX Hybrid	52	7.01	.224	31.3
Silver Lining	50	8.29	0.289	27.7
Florence	42	6.33	0.187	33.6
Early Nueve	41	8.20	0.299	27.7
Cherry Blossom	23	6.14	0.223	26.8
Lifter	21	10.42	0.396	25.9
T1 (Trump)	18	5.55	0.225	24.2
Queen Dream	16	7.24	0.257	28.0
Hawaiian Haze	16	8.53	0.334	25.6
Hot Blonde	15	7.04	0.218	29.6

Table 1. Table showing the "Good Potential" CBD Dominant cultivars entered into the MHD.

CBG-Dominant Cultivars

Criteria for the four "Good Potential" CBG dominant cultivars (Table 2) were as follows:

- Minimum of 15 distinct samples submitted for each source* cultivar
- Average Total THC for all samples below 0.3%
- Average Total CBG for all samples above 5%

Preliminary data from the MHD shows that 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 (1,181 entries) compared to 0.075 for CBG dominant cultivars (200 entries).

In addition, CBG dominant cultivars are not exhibiting a quantifiable relationship between Total CBG (%) and Total (THC%) (Figure 4); nor are they exhibiting stable CBG:THC ratios throughout flowering (Alberti 2022). Thus, growers are not able to accurately or reliably utilize the CBG:THC when making cultivar selections or decisions regarding sample timing.

Cultivar	Record Count	Total CBG (%) Avg.	Total THC (%) Avg.
Buffalo Soldier	58	6.39	.06
White CBG	58	8.09	.08
Panakeia	17	6.37	.01
Matterhorn CBG	17	5.66	.06

Table 2. Table showing the "Good Potential" CBG Dominant cultivars entered into the MHD.

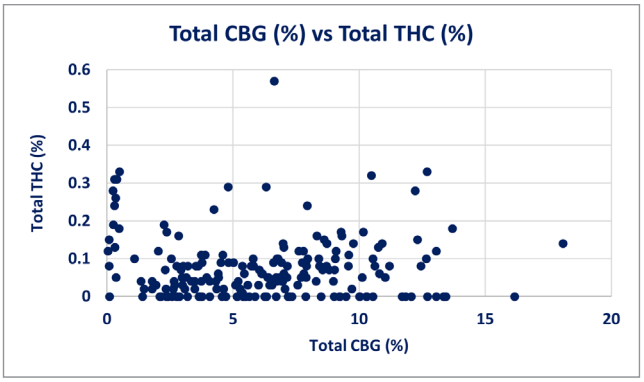

FIG 4: Scatter plot comparing Total CBG (%) and Total THC (%) for CBG Dominant Cultivars in the MHD.

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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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