Midwestern Hemp Database

2020 Research Report

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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 made available through the publicly accessible interface located 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!

Licensed hemp growers must apply in order to determine their eligibility for the program . Chosen program participants will be alerted of their involvement and will receive further instructions. In order to determine your eligibility to participate in this project, please fill out the **online survey here** .
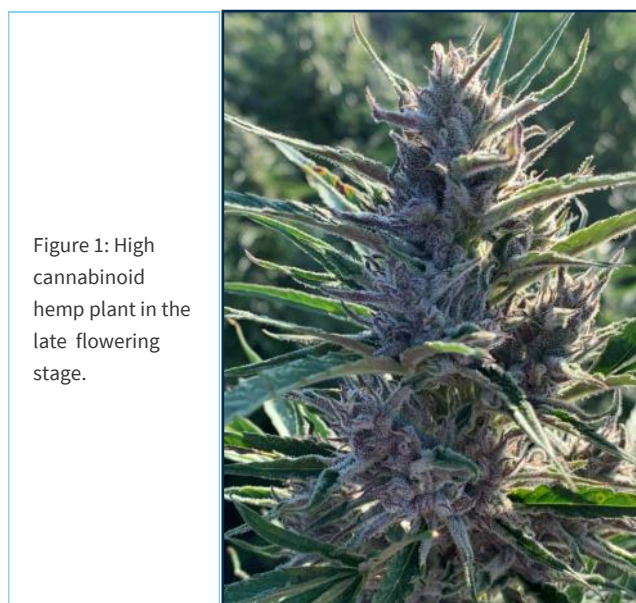

Figure 1: High cannabinoid hemp plant in the late flowering stage.

Why is This Project Important?

Hemp is still a "new" crop to the region, with research regarding best management practices (BMPs) and cultivar performance still in the early stages. Additionally, without the presence of certified hemp seed there is a tremendous amount of variability within and across cultivars and the sources of genetics. Between these two factors, growers are often left without reliable sources of information as they navigate this new industry. This project generates a large amount of data across the region and is uploaded to an interactive, publicly available interface. This tool gives growers have the ability to review agronomic performance and cannabinoid development of select hemp cultivars, genetics providers, and production practices.
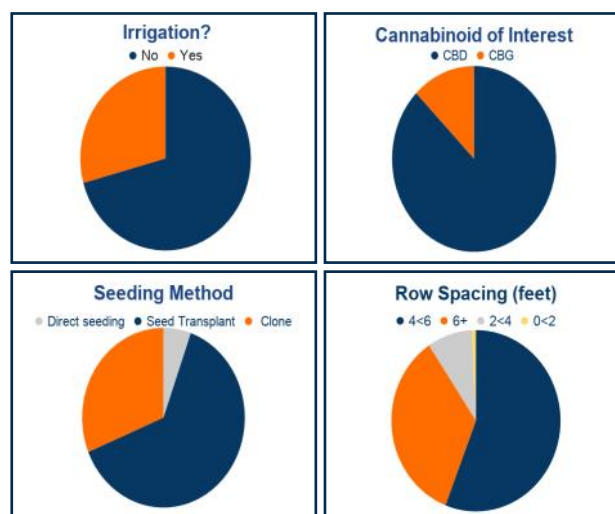

Figure 2: Examples of production system information available on the Midwestern Hemp Database.

What Type of Information is Available?

The database contains information on production practices (planting method, row spacing, irrigation, etc.), agronomic performance indicators (planting date, flowering date, yield, etc.), and results of the cannabinoid profiling for all cultivars entered into the program. In 2020, over 130 grower-cooperators across the Midwest participated in this project, submitting over 750 samples for cannabinoid profiling.

Data collection and sampling protocols have been designed and agreed upon by an 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: go.illinois.edu/HempDatabase

Fore more information
go.illinois.edu/HempDatabase

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Midwestern Hemp Database 2020 Results and Discussion

Production Systems

Hemp production systems are quite variable, with growers utilizing many strategies to successfully (or unsuccessfully) grow industrial hemp. Despite this variation, there are a few trends that have emerged over the last few years with regards to planting and establishment of industrial hemp for cannabinoid production. The following information is shared directly from the MHD results from the 2020 growing season.

Industrial hemp is typically grown on small acreage (<5 acres) and is more akin to specialty crops than traditional row crops. Regional data has shown an increase in number of licensed growers while acreage has decreased indicating a downward shift in average operation size. Farmer ingenuity has led to the implementation of direct seeding strategies, but high cannabinoid hemp is still established primarily via transplants from seed (63%) followed by transplants from clones (31%). Low seedling vigor, poor seed quality, and high seed costs across the industry are likely the cause for these trends. Hemp is considered a high input specialty crop and must often be treated like one for success.

Row spacing and target populations are variable and will depend on the cultivar being grown, production strategies used, and equipment available. In most cases, both row spacing and plant spacing are ~4-6 feet to account for optimal plant growth and ease of production operations (cultivation, harvesting, etc.). Corresponding target populations typically range between 1200-2700 plants per acre, but this can be increased or decreased significantly depending on production needs. It is important to understand how hemp genetics (plant architecture and days to maturity) will also interact with these practices.

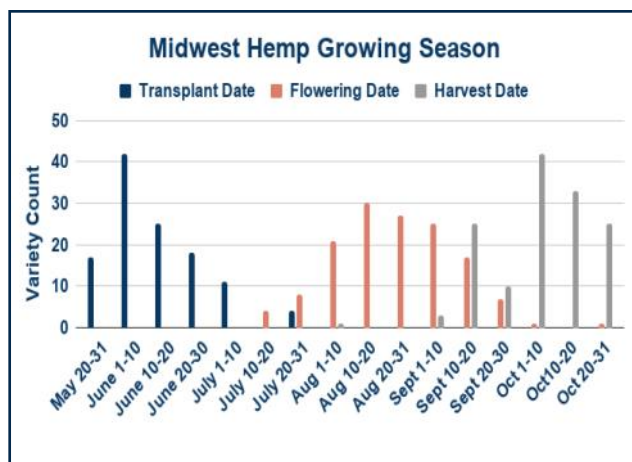Figure 3: A field of high cannabinoid hemp field flowering in late-September 2019.

FIGURE 4: Histogram illustrating various production milestones of high cannabinoid hemp cultivars entered into the MHD.

Hemp Growing Season

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 4). Well-prepared seed beds with good soil tilth will promote uniform growth and development. Hemp does not take well to cold, saturated soils and 65% of all cultivar entries in the MHD were planted into either silt-loam or sandy-loam soils.

Early season weed control is often touted as one of the most limiting factors in hemp production. As there are currently no chemical control options available to hemp, cultural practices will likely be the best tool to combat these early season weeds. Cultural practices such as cover crops, cultivation, plasticulture, and mowing between rows are alternative weed control strategies that will be critical to success. Once hemp is successfully established it is quite a vigorous plant and can outcompete many weeds; however, excessive early season moisture and heavy weed pest pressure can be very challenging to overcome.

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. Production strategies will vary, but growers can use information from the MHD to understand what practices are becoming standard across the region based on their track record of success.
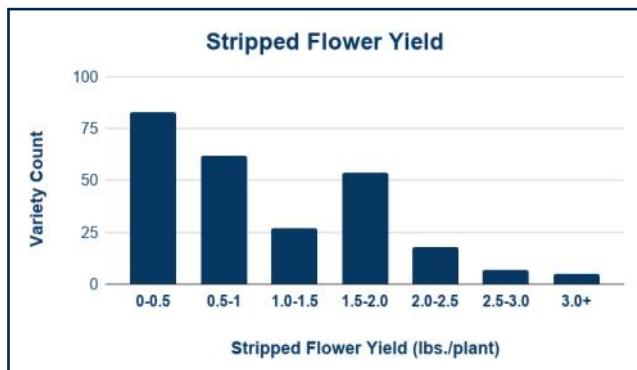
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FIGURE 5 Histogram illustrating stripped floral yield (lbs./plant) for all cultivar entries into the MHD.

FIGURE 6 Histogram illustrating sampling date range for all samples submitted for cannabinoid profiling.

Yield and Growth Characteristics

Average stripped floral yield of all varietal entries in the MHD was ~1.22 lbs./plant. Substantial variation existed across the data set, with 140 (54%) of the cultivar entries resulting in yields less than 1.0 lbs/plant (Figure 5). More stringent cultivar trials may be of better use when making yield comparisons of hemp cultivars, but this will serve as a useful benchmark for the time being. Variations in growth characteristics (photoperiod dependent vs day-neutral), cannabinoid of interest (CBD or CBG dominant cultivars), production practices (row spacing, target populations, etc.). Growing experience has not been taken into account for yield metrics and represent an average taken across the whole data set.

Average plant height at maturity for all hemp cultivars was ~54 inches. Seeing as most hemp cultivars are photo-period dependent, early planting will result in larger plants prior to flower initiation. While larger plants produce greater biomass and subsequent floral production, they are more susceptible to lodging and wind damage. Large plants can also be difficult to work with, whether hand labor/tools or mechanical equipment are used in harvest and processing Growers looking to maximize plant size may want to consider additional reinforcement (trellis, support poles) to protect plants from environmental stresses that reduce quality. The interaction between specific cultivars, the environment, and production practices should be evaluated prior to planting.

Day-neutral (autoflower) cultivars will initiate flowering after a set number of days (~70 days to maturity) compared to photoperiod dependent cultivars whose flowering is determined by day length. There is interest in utilizing day-neutral cultivars to stagger production schedules (planting, testing, harvesting, etc.) but more data is needed in this area. Early flowering may correspond with earlier sampling schedules and harvesting dates. All of these factors and their interactions should be taken into consideration when making cultivar selections.
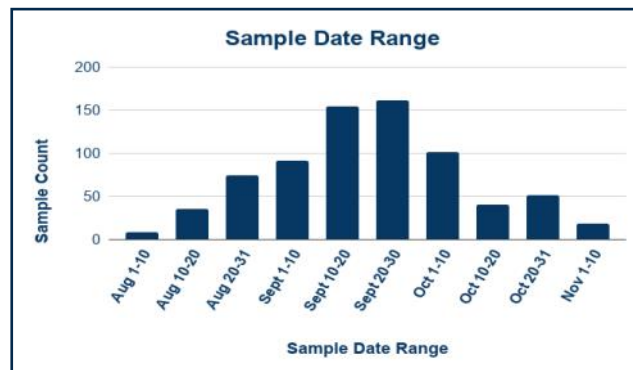
Cannabinoid Sample Timing

Growers are encouraged to test their crop frequently throughout flowering to ensure compliance regarding THC in anticipation of harvest; however, timing 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. Terminal flowering is defined as the period at which clusters of female flowers appear at shoot apices at the top of the plant (main cola). Terminal flowers are distinct from sparse, solitary flowers developing in the axils of the leaves (axial flower). 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.

Of all samples submitted into the MHD, 456 (57%) were submitted between September 14th– October 15th (Figure 6). 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. Compliance with USDA regulations is determined by showing that each hemp lot produces <.3% Total THC (Total THC(%)= Delta 9-THC (%) + (THCA(%)*0.877).

Increases in sample submissions during critical production stages may lead to backlogs and delays in laboratory analysis and reporting. There is currently a great deal of variation across laboratory sample preparation and analytical methods, high performance liquid chromatography (HPLC) and gas chromatography (GC), for example. This disparity between current laboratory procedures makes cannabinoid analyses difficult to compare. As such, submitting samples though an approved, accredited laboratory is recommended to receive the most accurate and useful information for your operation.

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. 152 distinct cultivar*sources representing 752 samples were entered into the MHD in total. Across this data set there was a great deal of 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. The data presented in the following text will only contain information from MHD cultivars which have been categorized as "Good Potential." CBG dominant and CBD dominant cultivars will be evaluated and assessed separately .

CBD-Dominant Cultivars

Criteria for the 21 "Good Potential" CBD dominant cultivars (Table 1) representing 254 samples are as follows:

- Flowering initiated prior to August 30th
- Average stripped floral yield above .5 lbs/plant
- Minimum of 5 distinct samples submitted for each source* cultivar within 35 days of harvest
- Average Total THC for all samples below .39%
- Average Total CBD for all samples above 5%

Preliminary data from the MHD shows that many CBD dominant cultivars exhibit a linear (or curvilinear) relationship between Total CBD (%) and Total THC (%) (Figure 7). Given this presumed relationship, Total CBD (%) is often not able to exceed ~8% without exceeding the regulatory threshold of 0.3% THC. This suggests that cultivars with a stable CBD:THC (~25:1) throughout flowering will help to maximize profitability while maintaining compliance (Figure 8). The reality is most hemp cultivars currently on the market will go "hot" (>.3% THC) if not monitored appropriately, as 25% of the samples tested were above 0.3% total THC regulatory limit.
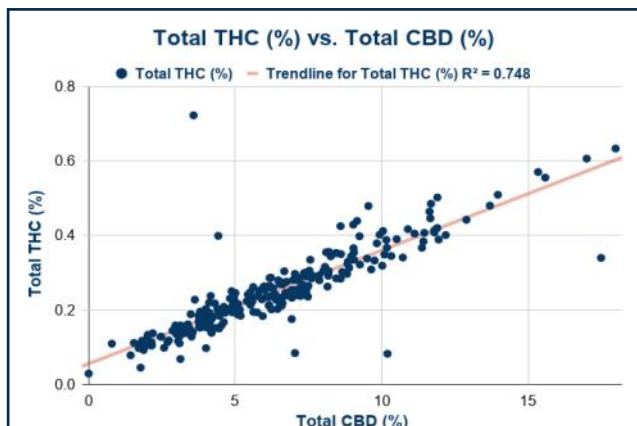

FIGURE 8: Scatter plot comparing CBD:THC for "Good Potential" CBD Dominant cultivar samples entered into the MHD.

FIGURE 7: Scatter plot comparing Total CBD (%) and Total THC (%) for qualifying "Good Potential" CBD dominant cultivars entered into the MHD.
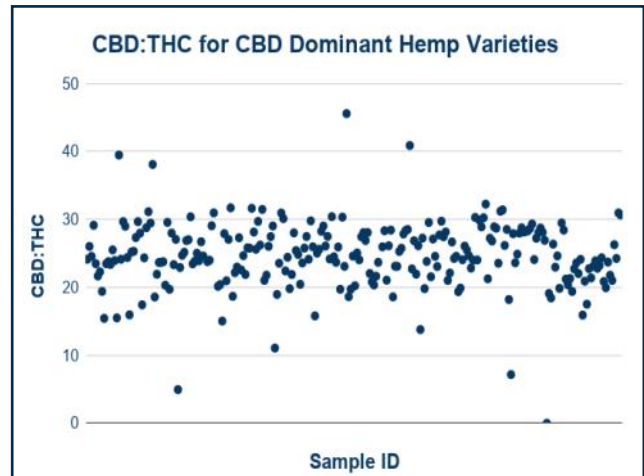
Source	Cultivar	CBD:THC
Beacon Hemp	Early Nueve	22.6
Blue Forest Farms	Queen Dream	27.04
Boring Hemp Co.	The Grand	25.25
Eastern Plains Hemp	Silver Lining	26.19
Front Range Biosciences	Hybrid #5	30.34
Front Range Biosciences	Hybrid #9	27.37
Front Range Biosciences	Anna Lee	31.76
Green Lynx Farms	Ruby #1	22.74
Infinite Tree	BaOx Hybrid	24.07
Davis Hemp Farms	Eighty Eight	25.21
Old Country Hemp	Cherry Blossom	26.54
Old Country Hemp	T1 (Trump)	24.56
Oregon CBD	Suver Haze	26.35
Oregon CBD	Hawaiian Haze	26.22
Phtonyx	Siskiyou Gold	27.71
Phyle Pharms	Cherry Wine	25.08
Seedified	Hempress 3	23.73
Sunrise Genetics	FL58	27.79
Sunrise Genetics	FL71	25.11
Sunrise Genetics	SB1	18.59
United Growers LLC	Cherry x Abacus	25.83

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

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CBG-Dominant Cultivars

Criteria for the 4"Good Potential" CBG dominant cultivars (Table 2) are as follows:

- Flowering initiated prior to August 30th
- Average stripped floral yield above .5 lbs/plant
- Minimum of 5 distinct samples submitted for each source* cultivar within 35 days of harvest
- Average Total THC for all samples below .39%
- Average Total CBG for all samples above 4%

Source	Cultivar	Total CBG (%) Avg
Ag Marvels	Buffalo Soldier	7.2
Kifcure	Buffalo Soldier	4.04
Oregon CBD	White CBG	7.15
Sourced in Nature	Relief CBG	7.81

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

Preliminary data from the MHD shows that many CBG dominant cultivars contain lower amounts of Total THC (%) compared to CBD dominant counterparts. Across the "Good Potential" data set, average Total THC(%) of CBD dominant cultivars was .24 compared to .09 for CBG dominant cultivars.

In addition, CBG dominant cultivars are not exhibiting a quantifiable relationship between Total CBG (%) and Total (THC%) (Figure 9). Thus, growers are not able to accurately or reliably utilize the CBG:THC when making cultivar selections or decisions regarding sampling.
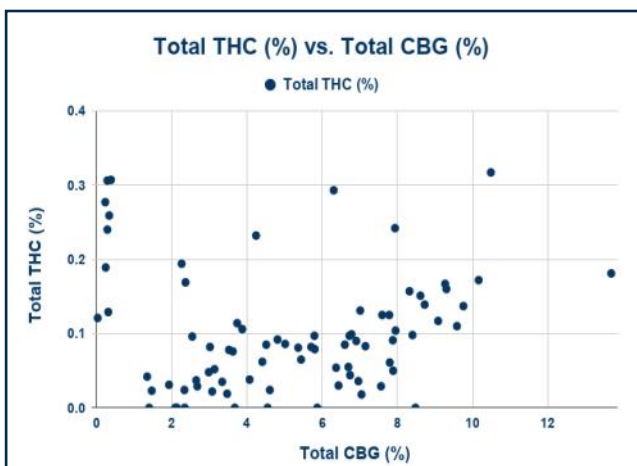

FIGURE 9: Scatter plot comparing Total CBG (%) and Total THC (%) for "Good Potential" CBG Dominant Cultivars.

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. The University of Illinois attempts to maintain the highest accuracy of content in its websites and documentation. Any errors or omissions should be reported for investigation. For questions regarding the Midwestern Hemp Database, please contact Commercial Agriculture Educator Phillip Alberti at palberti@illinois.edu

Additional Resources:

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

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