Wisconsin Emerging Crops Accelerator

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2022 Research Report: Cultivar Check Program

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Introduction

Legalization of hemp in the U.S. has provided a unique opportunity to build an entirely new agriculture sector. Despite overwhelming interest in hemp, there is still substantial uncertainty regarding agronomic best practices, including basic information such as what cultivars should be grown for various products or markets. Without federal seed certification standards in place, substantial variation between and within cultivars has been observed in hemp. Unfortunately, current regulatory, production, and market risks associated with hemp have made establishment of this new industry challenging. This is particularly true for high cannabinoid hemp grown for CBD, CBG, etc.

To address these issues, The Midwestern Hemp Research Collaborative (MHRC), a joint effort of land grant universities, non-profits, private laboratories and growers was formed. The MHRC formed in 2020 to conduct collaborative hemp research and outreach, establishing the Midwestern Hemp Database (MHD) with over 200 growers contributing data. The MHD has become the largest public repository for hemp cultivar performance data from three sources (Table 1):

1. MHRC Replicated Trials
   - Replicated cultivar trials conducted at university research stations
2. Commercial Growers
   - Partnership with grower cooperators sharing data and samples to receive discounted cannabinoid analysis
3. Cultivar Check Program
   - A series of participatory on-farm trials engaging growers across the Midwest with elite genetics

The following report will discuss results from the Cultivar Check Program across the 2021 and 2022 growing seasons.

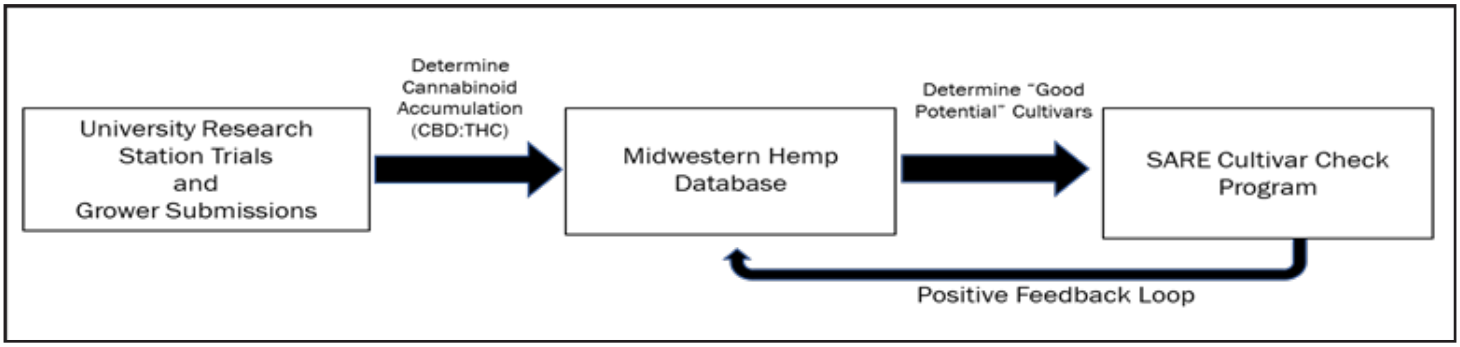

Figure 1. Logic model for Midwestern Hemp Database and Cultivar Check Program.

Cultivar Check Program Overview

Established via a Sustainable Agriculture Research and Education (SARE) Partnership Grant in 2021, the Cultivar Check Program operates as a series of participatory on-farm trials using an extensive grower-cooperator network across the Midwest. The main objective of these cultivar trials was to obtain data on how high cannabinoid hemp cultivars perform in different Midwestern locations. Utilizing findings from university trials and the MHD, criteria were established to identify a list of cultivars categorized as "good potential" (go.illinois.edu/HempDatabase). Criteria for the "good potential" CBD dominant cultivars included expected flowering dates and cannabinoid production for both THC (compliance) and CBD/CBG (profit potential). Cultivars that achieve "good potential" status are included in the Cultivar Check Program for further evaluation. This project has increased from 14 total grower-cooperators (2021) to 32 (2022); similarly, the total number of cultivars evaluated increased from 8 (2021) to 20 (2022). A complete list of the cultivars evaluated, the source of seed, years in the program, and number of sites evaluated can be found in Table 2.

Across the 2021 and 2022 growing seasons, 32 grower-cooperators evaluated 20 different hemp cultivars for agronomic performance and cannabinoid development throughout USDA Hardiness Zones 5 and 6 (Figure 2). As a result, the information synthesized from these trials marks a significant increase in regional hemp knowledge and is an important step toward successful adaptation of hemp as a viable option for Midwestern farmers.

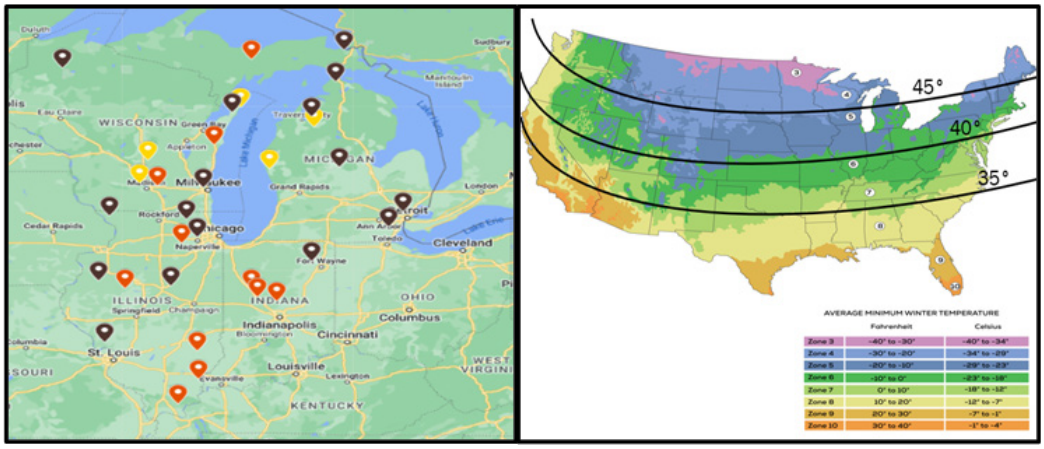

Figure. 2. Map showing geographic location of sites for MHD Cultivar Check Program during the 2021 growing season (Left); Black represents sites from both 2021 and 2022, red represents sites from 2022 only, and yellow represents sites from 2021 only. Map showing Hardiness Zones (USDA) overlaid with approximate latitudes (Right).

Materials and Methods

Licensed hemp growers across the Midwest were recruited to participate in the Cultivar Check Program. Growers represent four states (Michigan, Illinois, Indiana, and Wisconsin) and four Hardiness Zones (5a, 5b, 6a, and 6b). Each grower received a subset of four to five "good potential" cultivars in a predetermined trial design consisting of a combination of CBD Dominant (Chemotype 3) and CBG Dominant (Chemotype 4) cultivars.

Each grower received 20-25 feminized seeds per cultivar per location depending on availability. Seedlings were established in late April or early May in indoor/greenhouse settings. Seedlings were allowed to develop in a greenhouse/hoop house for 4-5 weeks prior to a "hardening-off" period. For the hardening-off period, seedlings were placed outdoors intermittently for 5-7 days to get accustomed to outdoor conditions. Following a 1 week hardening-off period ~15 healthy, representative seedlings per cultivar were transplanted into the field with a target of mid-June.

Growers were responsible for submitting various management, performance and economic data via an online survey using the SeedLinked® platform. Several traits were rated on a scale from 1 to 5 using a semi-quantitative guide to help cooperators make their ratings. A complete list of agronomic data collection and cannabinoid sampling protocols can be found here, which includes:

Seed Start and Transplant Date
- The dates at which the plants have been started in the greenhouse/indoor environment and transplanted into the field, respectively.

50% Flowering Date
- The date at which half of the plants of a given cultivar have visibly initiated terminal flowering. A plant has reached terminal flowering when it shows extruding stigma at its apical (top) inflorescence (Figure 3).

Germination
- A visual rating of germinative capacity and speed of plant growth within a cultivar (1- poor, 5= excellent)

Uniformity
- A visual rating of the overall uniformity of plants within a cultivar (1- not uniform, 5= very uniform)

Overall Performance
- A visual rating of the overall performance of plants within a cultivar (1- poor, 5= excellent)

In addition to agronomic performance data, growers were required to submit floral samples for cannabinoid analysis at three time points: 3 weeks, 5 weeks, and 7 weeks (~21 days, 35 days, and 49 days, respectively) after flowering initiation (Figure 2).

Figure. 3. A plant which has reached terminal flowering, extruding stigma at the top inflorescence (Left, Photo Credit: Shelby Ellison). This figure illustrates proper sampling locations taken from hemp inflorescence located on the top 1/3 of the plant (Right, Photo Credit: USDA Hemp Sampling Guide).

Before submitting flower samples, growers submitted pictures of plants to establish flowering dates. Flowering was confirmed by one of the project collaborators and a sampling schedule was developed. For sampling, growers followed the USDA sampling guidelines, collecting 5-8 inches of floral tissue from the top third of 5 plants for each cultivar at each sampling time point. The 5 flowers were placed into one bag to generate one composite sample per cultivar at each time point.

Floral material was sent to Rock River Laboratories (Watertown, WI) for analysis of cannabinoid potency using high-performance liquid chromatography (HPLC). Flower samples were collected at three, five, and seven weeks after the cultivar reached 50% flowering. Total THC = Δ9 THC + (THCA*0.877), Total CBD = CBD + (CBDA*0.877), Total CBG = CBG + (CBGA*0.878). Cannabinoid data was not subject to statistical analysis.

Statistical Analysis of Data

The tables (1 and 2) on the following pages have been prepared with the entries listed by maturity group followed by alphabetical order. Cannabinoid development data were analyzed in R with the program agricolae, with mean separation performed using the Fisher's Protected LSD (Least Significant Difference) test. Each trial location was grouped into its corresponding hardiness zone (5a, 5b, 6a, and 6b). Cultivars were evaluated separately with all analyses using a mixed model with treatment (Location/Hardiness Zone) as a fixed effect and replication (sampling period) as a random effect with an alpha level of 0.05 to determine significance. Cultivars that were within the range of the value listed for LSD were not significantly different from each other at a five percent level of probability. Qualitative traits (germination, uniformity, vigor, disease resistance, and overall performance) are all presented as averages across all locations for that cultivar.

Results and Discussion

Agronomic Performance

A cultivar reached 50% flowering when half of the plants showed extruding stigma located at the terminal inflorescence or apical bud/cola (Figure 3). Flowering data are presented as the Julian Calendar Date at which a cultivar was deemed to be flowering. Most high cannabinoid hemp grown in the Midwest will begin to flower mid-August to early September, continuing reproductive growth until harvest in late September/early October (Source: MHD). Importantly, significant variation in flowering windows are observed for some cultivars, while others flower more uniformly, suggesting varying degrees of genetic uniformity within seed lots.

Results of the ANOVA show that flowering date was significantly impacted by cultivar and environment/ hardiness zone ($P > 0.05$) but no interactions were significant. Across all cultivars, the mean 50% flowering date at the midpoint of hardiness zones 5b/6a was day 231 or August 19th. (Table 2). Cultivars were subsequently grouped into maturity groups based on mean expected flowering day:

- Julian Calendar Date <231 or August 8th-August 20th (Early Maturing)
- Julian Calendar Date >231 or August 20th (Late Maturing)

Traditionally, photoperiodic flowering response due to geographic location has been discussed in terms of differences in latitude. For the purposes of this study, hardiness zones will be used to reflect geographic location but will correspond to the following approximate latitudes:

- Hardiness Zone 5a (~42- 45°)
- Hardiness Zone 5b (~39- 42°)
- Hardiness Zone 6a (~38-39°)
- Hardiness Zone 6b (~37-38°)

Maturity Group	Source	Cultivar	Cannabinoid of Interest	# Site Years	Average Flowering Julian Date	Average Flowering Day	Germination	Uniformity	Average Overall Rating
Early Flowering	Oregon CBD	White CBG	CBG	13	222.3e	August 10th	3.6	4.2	4.2
	Beacon Hemp	Early Nueve	CBD	12	222.7e	August 11th	4.4	3.4	2.8
	Oregon CBD	Suver Haze	CBD	14	224.1e	August 12th	3.6	4.3	4.4
	Oregon CBD	StemCell CBG	CBG	7	224.6de	August 13th	3.6	3.1	4.0
	KifCure	Buffalo Soldier	CBG	6	226.0cde	August 15th	4.4	3.5	3.0
	Front Range Biosciences	Hybrid 5	CBD	9	226.1cde	August 15th	4.1	3.5	2.2
	Oregon CBD	Hawiian Haze	CBD	9	226.3cde	August 15th	3.9	4.3	4.5
	Oregon CBD	Lifter	CBD	7	228.3bcde	August 17th	3.0	4.0	4.2
	Cheyenne Mountain Seed Co.	Quick Kush	CBD	5	230.8bcde	August 20th	4.4	3.0	4.0
	Eastern Plains Hemp	Silver Lining	CBD	7	231.1bcde	August 22nd	4.0	4.7	3.6
Late Flowering	Blue Forest Farms	Cherry Blossom	CBD	9	235.2abcde	August 23rd	3.9	4.1	4.4
	Arrowhead Seed Co.	BaOx Hybrid	CBD	10	236.2abcde	August 24th	4.6	4.0	3.0
	Trilogene Seed Co.	Super Wife	CBD	4	236.3abcde	August 24th	4.0	-	-
	Arrowhead Seed Co.	Abacus	CBD	6	236.7abcd	August 25th	3.2	3.3	4.6
	Arrowhead Seed Co.	Florence	CBD	12	239.6abc	August 28th	4.0	3.4	3.4
	Blue Forest Farms	Queen Dream	CBD	10	239.8ab	August 28th	4.8	4.8	4.2
	Trilogene Seed Co.	Ultra Woman	CBD	4	240.7abc	August 29th	5.0	-	-
	Cheyenne Mountain Seed Co.	Cherry Wine	CBD	8	244.4ab	September 1st	3.1	3.4	3.8
	Arrowhead Seed Co.	Boxwine	CBD	3	245.0ab	September 2nd	4.0	-	3.0
	Cheyenne Mountain Seed Co.	Mountain Mango	CBD	7	246.2a	September 3rd	3.1	2.7	3.0

Table 1. Average flowering day number, Average flowering day, Germination, Uniformity, Disease Resistance, and Overall Grower Ratings for cultivars entered into the Cultivar Check Program.

Across hardiness zones 5a (~37°) to 6b (~45°), average flowering date differed by ~7.9 days (Figure 4); this means that on average, cultivars experienced flowering initiation ~8 days later at the northern edge of hardiness zone 5a than they did in the southern edge of hardiness zone 6b. Growers may utilize this data to estimate approximate flowering dates based on their location relative to the average expected flowering dates observed. A similar delay in flowering date as hardiness zone decreases has also been observed when comparing the same cultivars evaluated in university station trials at Michigan, Wisconsin, and Illinois (DeDecker et al., 2021, Ellison et al., 2021, Shekinah 2020, Shekinah 2021, and Alberti et al., 2021).

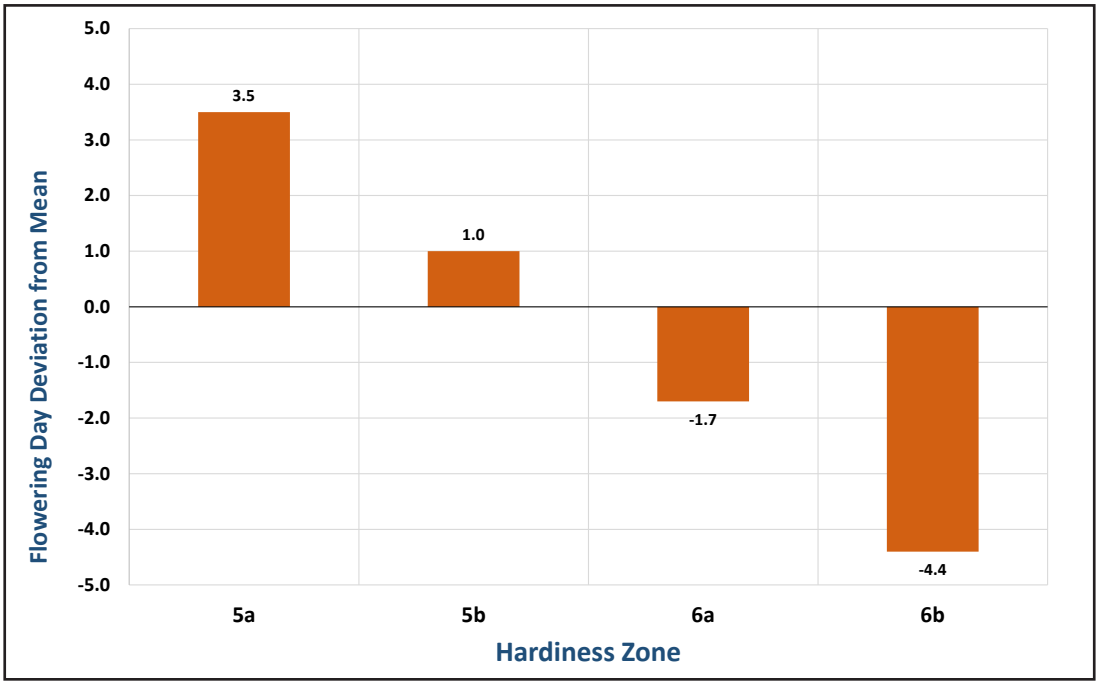

Figure 4. Table showing expected flowering dates across hardiness zones for select cultivars entered into the Cultivar Check Program. Cultivars must have been grown in each of the hardiness zones (5a, 5b, 6a, and 6b) to be evaluated. There is no significant difference between cultivars sharing the same letter assignment.

Agronomic performance ratings (germination, uniformity, overall performance etc.) are given as averages across all environments for each cultivar. These ratings will not be analyzed for statistical significance given the subjective nature of the qualitative ratings and are meant to guide future research trials and cultivar selections only. In the same way, yield metrics across locations have historically been quite variable due to variance between and within cultivars and differences in grower-cooperator skill; for this reason, university station trials may be more useful/accurate sources of information for yield metrics and will not be discussed here (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 on a dry weight basis (12% moisture) (Alberti 2021).

Cannabinoid Development

CBD Dominant Cultivars

Total THC and Total CBD were impacted by cultivar, sampling period, and location ($P < 0.05$). Cannabinoid data is presented in terms of averages across all locations at each time point. THC and CBD generally increased from week three to week five, with cultivars exhibiting varying optimal harvest intervals for both compliance (THC) and profit potential (CBD) across weeks 5-7 (Figure 5 and Table 3). This suggests that growers will want to consider both CBD and THC production when making harvest decisions.

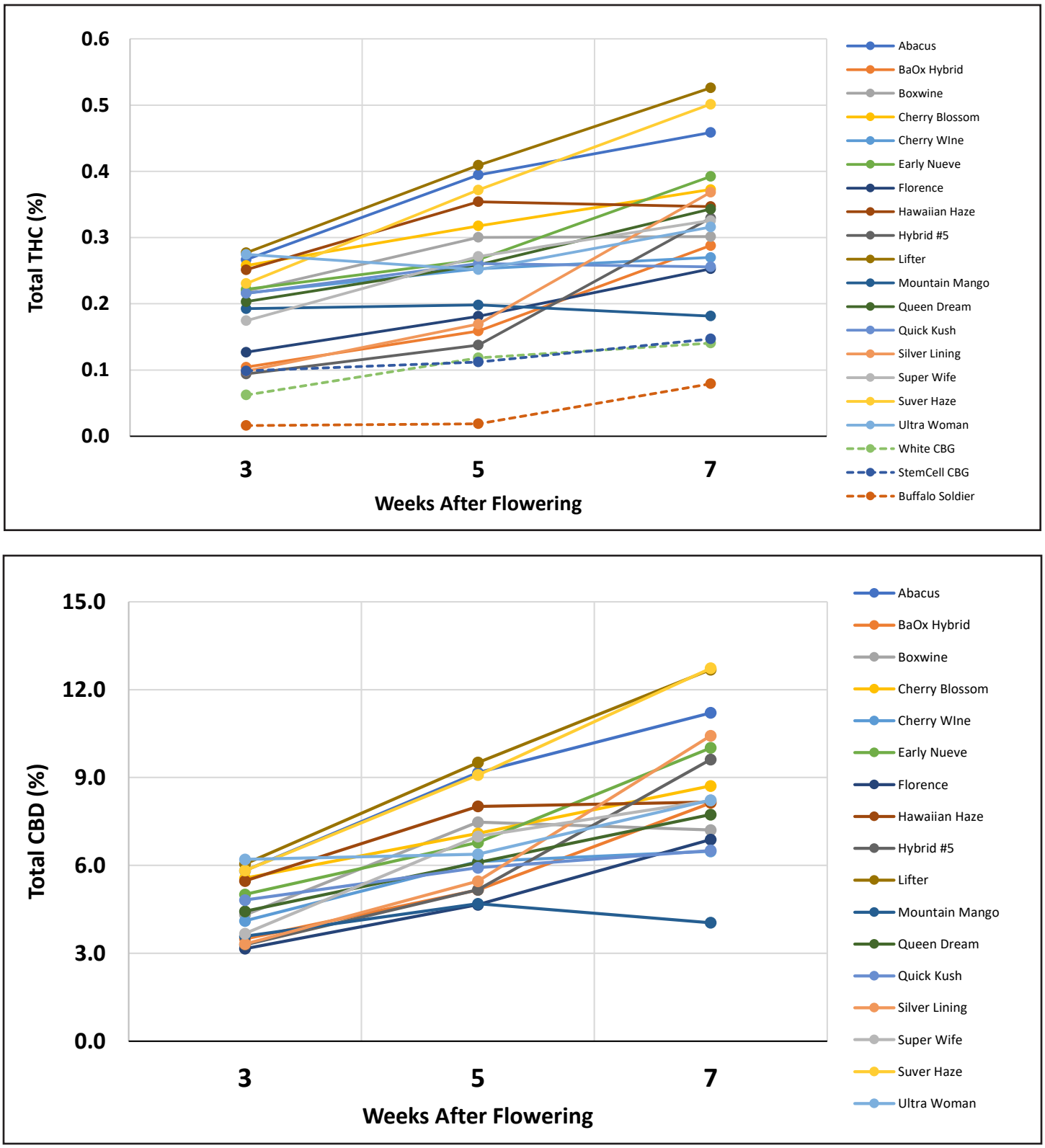

Figure 5. Total THC (%) and Total CBD (%) accumulation at 3, 5, and 7 weeks after flowering from cultivars entered into the Cultivar Check Program. Total THC (%) is presented in terms of averages across all locations at each time point. Solid lines represent CBD dominant cultivars while dotted lines signify CBG-dominant cultivars.

The reality is many CBD dominant hemp cultivars currently on the market will go "hot" (Total THC >0.3%) if not monitored appropriately during flowering. To illustrate, 11 (65%) of the cultivars in the check program exceeded the regulatory limit at some point during the flowering period (Figure 5). Even with increased caution from farmers 29% of the 2,000 samples submitted into the MHD were above 0.3% Total THC regulatory limit across the 2020-2022 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. This data would suggest that the optimal sampling date for many cultivars will likely be 5 to 7 weeks (35 to 49 days) after flowering initiation to remain compliant. Data from the 2021 and 2022 growing seasons has been utilized to develop estimated compliant harvest schedules based on 95% confidence intervals (Table 3).

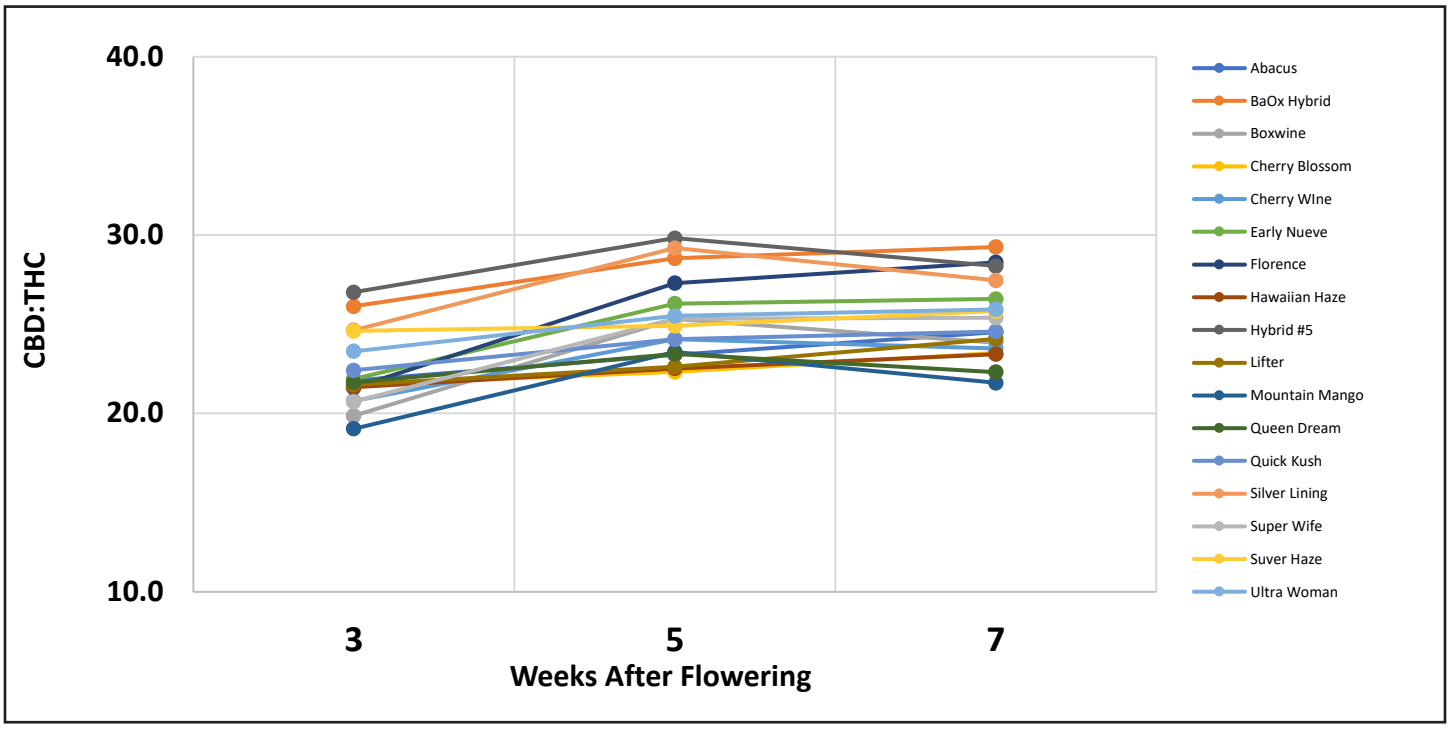

Figure 6. CBD:THC at 3, 5, and 7 weeks after flowering for the CBD dominant cultivars entered into the Cultivar Check Program. CBD:THC is presented in terms of averages across all locations at each time point.

CBD:THC is impacted by cultivar, sampling period, environment, and cultivar by environment interactions ($P< 0.05$). As such, cultivars were evaluated individually and CBD:THC is presented in terms of averages across all locations at each time point. CBD:THC of many of the hemp cultivars were unaffected by sample timing, remaining consistent throughout flowering (Figure 6 and Table 3). Similarly, CBD:THC of many of the hemp cultivars was unaffected by grower location, remaining consistent across environments (Figure 6 and Table 3). This supports previous work by researchers from Cornell University showing that CBD:THC remains stable throughout flowering for uniform cultivars (Campbell et al., 2019 and Toth et al., 2021).

The MHD has demonstrated that most CBD dominant cultivars exhibit a linear (or curvilinear) relationship between Total CBD (%) and Total THC (%) (Alberti 2021). Given this relationship, Total CBD (%) infrequently exceeds ~8% without exceeding the regulatory threshold of 0.3% Total THC. Considering that CBD:THC is mostly stable across flowering periods and environments, cultivars with a stable CBD:THC (>25:1) throughout flowering will help to maximize profitability while maintaining compliance.

It should be noted that some cultivars are more impacted by environment or genotype* environment interactions; as such, heterogeneity across and within cultivars can make agronomic performance and cannabinoid development less predictable and difficult to evaluate. Due to the non-uniformity of the flowering process, unstable/non-uniform 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. For this reason, growers may want to consider uniformity of growth and development of plants within a cultivar when making selections to avoid issues in the field for compliance and harvest.

CBG Dominant Cultivars

For each cultivar, cannabinoid development was impacted by sampling period and location/environment ($P < 0.05$). As such, cannabinoid data is presented in the following manner for each cultivar: Total THC (%) and Total CBG (%) are presented in terms of averages across all locations at each time point. THC and CBG increased over time, with cultivars exhibiting varying optimal harvest intervals for both compliance (THC) and profit potential (CBG) (Figure 5, Figure 7, and Table 2). None of the three CBG dominant cultivars exceeded the THC threshold for compliant hemp by the week 7 sampling period. Similarly, across the entire MHD data set, average Total THC (%) of CBD dominant cultivars was 0.258 compared to 0.075 for CBG dominant cultivars (Source: MHD). CBG dominant cultivars may provide an alternative cropping option for those looking to reduce risk of non-compliance compared to production of CBD dominant cultivars.

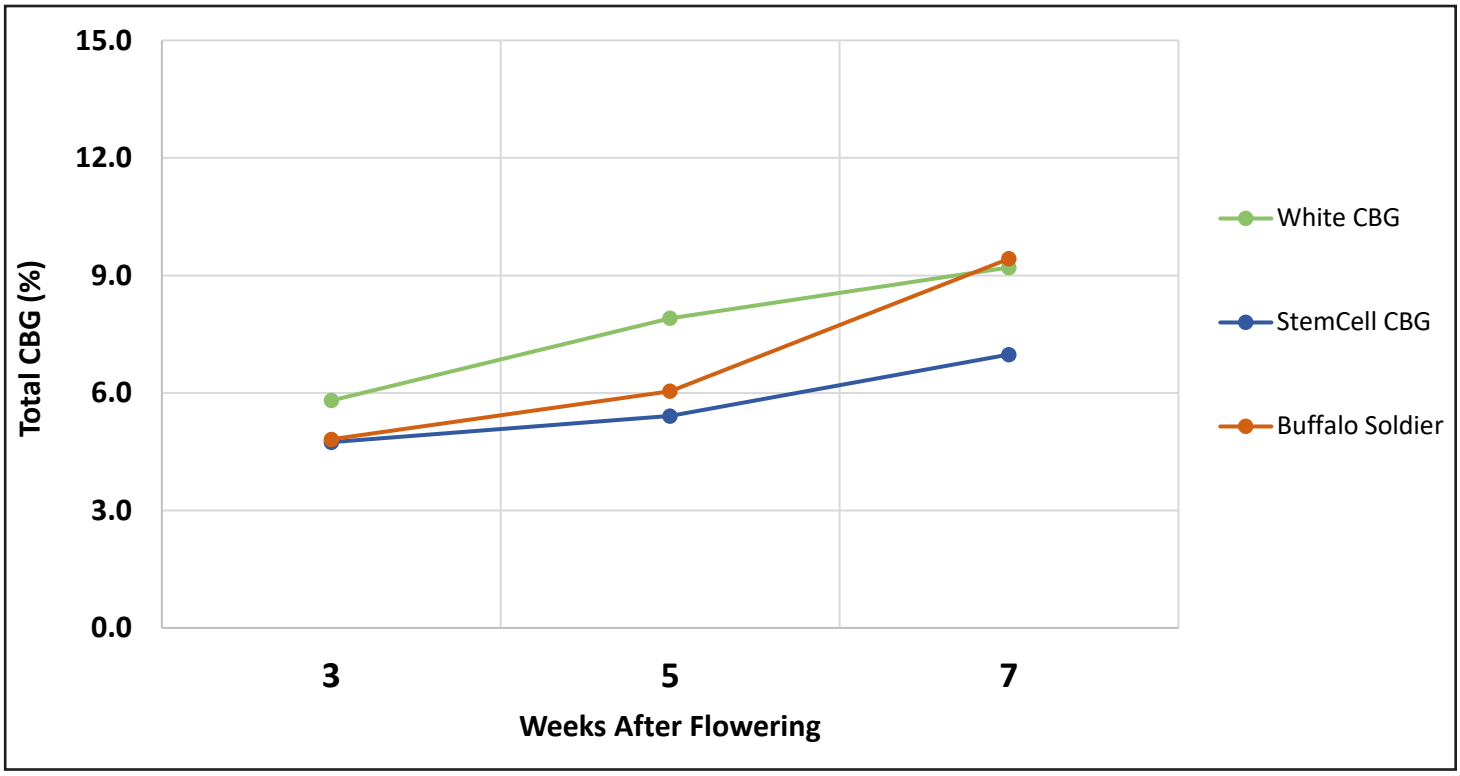

Figure 7. Total CBG (%) accumulation at 3, 5, and 7 weeks after flowering from CBG dominant cultivars evaluated via the Cultivar Check Program. Total CBG (%) is presented in terms of averages across all locations at each time point.

Recommendations

Growers will want to consider the following factors when making variety selections in their region:
- Seed Quality (Germination, Uniformity, etc.)
- Maturity Group (Photoperiod)
- Agronomic Performance (Yield and Quality)
- Cannabinoid Development (Compliance Potential)

Currently, seed certification standards in the hemp industry are still being developed. Growers are encouraged to develop relationships with seed providers and to look to university published resources to guide their selections. Seed providers should provide seed testing data (germination, dormancy, noxious weed presence, etc.) but growers may also wish to look to local seed certifying agencies (such as crop improvement centers of departments of agriculture) to find cultivars which have either been certified or are in the process of doing so. The Association of Seed Certifying Agencies (AOSCA) provides an updated list of cultivars eligible for certification, which can be found here: Hemp.VarietiesOrigin_Updated_18Jul2022.pdf (aosca.org). It should be stated these lists may not be complete/ updated but should provide a good place to start.

Growers will want to consider the hardiness zone and maturity group, as well as their potential interactions, when making variety selections. For example, growers in northern latitudes may want to plant earlier maturing cultivars to maximize the shorter growing season compared to their southern counterparts. In a similar fashion, growers may wish to grow cultivars of varying maturity groups to diversify and stagger field operations.

Importantly, cultivars with a history of compliance may not be suited to a region while some cultivars with a history of high performance may not be reliably compliant.To better understand cultivar agronomic performance in a similar region, growers are encouraged to access local university cultivar trials for the most accurate regional information (see Additional Information). Similarly, growers are encouraged to access the Midwestern Hemp Database and Cultivar Check Program Reports for the best information available regarding compliance potential of evaluated cultivars. Using the information from both of these sources will allow growers to combine agronomic performance and cannabinoid development to make the best decision.

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 state, federal, or tribal regulations is determined by showing that each hemp lot produces Total THC <0.3%. Under the current final rule, no more than 30 days prior to the anticipated harvest of cannabis plants, a "sampling agent" must collect samples for compliance testing. If producers do not harvest within 30 days of sampling, the plant will likely have a higher THC level at harvest than the sample that is being tested, and must subsequently be re-tested prior to harvest. Growers will want to consider their cultivar's cannabinoid development throughout flowering in conjunction with this 30-day window from sampling to harvest to maximize profitability while maintaining compliance.

For example, if growing cultivars with a history of becoming non compliant through 5 weeks (35 days) of flowering (Table 2), growers may want to consider submitting a pre-harvest report and scheduling a compliant test immediately following flower initiation. Conversely, cultivars with a history of staying compliant through 7 weeks post-flowering may be able to delay in scheduling their pre-harvest report and subsequent compliant test for a few weeks following flowering.

Importantly, there is currently a great deal of variation across sampling and laboratory sample preparation and analytical methods. This disparity between current field and laboratory procedures makes cannabinoid analysis difficult to compare. As such, using USDA/state approved sampling methods and submitting samples to an approved, accredited laboratory is recommended.

Maturity Group	Origin	Cultivar	Cannabinoid of Interest	Years in Program	Week Post Flowering	CBD:THC	Total CBD (%) Avg.	Total CBG (%) Avg.	Total THC (%) Avg.	# of Samples <0.3% THC	# of Samples Total	Total THC (%) LCL @ 95%	Total THC (%) UCL @ 95%
Early	KifCure	Buffalo Soldier	CBG	2021	3	2.97	0.07	4.82a	0.02a	14	14	0.00	0.00
					5	0.55	0.01	6.05a	0.02a	14	14	0.00	0.04
					7	0.13	0.01	9.43b	0.08b	11	11	0.05	0.11
	Beacon Hemp	Early Nueve*°	CBD	2021/2022	3	21.94	5.01b	0.24b	0.22b	18	19	0.17	0.27
					5	26.15	6.78b	0.28b	0.27b	13	18	0.21	0.32
					7	26.41	10.01a	0.37a	0.39a	5	16	0.34	0.45
	Oregon CBD	Hawaiian Haze	CBD	2022	3	21.47b	5.47b	0.33	0.25b	10	13	0.20	0.30
					5	22.51a	8.02a	0.43	0.35a	3	12	0.30	0.41
					7	23.32a	8.16a	0.40	0.35a	7	12	0.29	0.40
	Front Range Biosciences	Hybrid #5*°	CBD	2021	3	26.79	3.29c	0.04b	0.09b	17	18	0.01	0.15
					5	29.82	5.17b	0.05b	0.14b	16	16	0.08	0.19
					7	28.26	9.62a	0.15a	0.33a	8	16	0.27	0.38
	Oregon CBD	Lifter	CBD	2022	3	21.62b	6.05c	0.37b	0.28c	8	10	0.21	0.35
					5	22.61b	9.51b	0.42b	0.41b	2	10	0.34	0.48
					7	24.18a	12.69a	0.54a	0.53a	0	8	0.45	0.61
	Cheyenne Mountain Seed Co.	Quick Kush°	CBD	2022	3	22.42	4.82	0.32	0.22	7	8	0.18	0.25
					5	24.16	5.92	0.52	0.26	4	7	0.23	0.30
					7	24.59	6.51	0.29	0.26	4	6	0.22	0.29
	Eastern Plains Hemp	Silver Lining*°	CBD	2021	3	24.66	3.32c	0.10b	0.10c	13	13	0.05	0.15
					5	29.27	5.46b	0.11b	0.17b	11	12	0.12	0.22
					7	27.46	10.43a	0.25a	0.37a	3	12	0.32	0.42
	Oregon CBD	StemCell CBG	CBG	2022	3	1.14	0.09	4.74b	0.10b	12	12	0.08	0.12
					5	1.22	0.16	5.41b	0.11b	12	12	0.09	0.13
					7	1.20	0.15	6.98a	0.15a	9	10	0.12	0.17
	Oregon CBD	Suver Haze*°	CBD	2021/2022	3	24.62	5.83c	0.27	0.23c	18	22	0.18	0.28
					5	24.91	9.08b	0.83	0.37b	8	22	0.32	0.42
					7	25.74	12.73a	0.35	0.50a	2	17	0.44	0.56
	Oregon CBD	White CBG	CBG	2021/2022	3	2.03	0.14	5.81b	0.06b	17	17	0.03	0.09
					5	1.49	0.35	7.91a	0.12a	18	18	0.09	0.15
					7	0.40	0.05	9.21a	0.14a	18	18	0.11	0.17
Late	Arrowhead Seed Co.	Abacus*	CBD	2022	3	21.85b	5.82c	0.36b	0.27b	8	9	0.20	0.33
					5	23.28ab	9.16b	0.55a	0.39a	1	8	0.33	0.46
					7	24.56a	11.21a	0.52a	0.46a	0	5	0.37	0.54
	Arrowhead Seed Co.	BaOX Hybrid*°	CBD	2021/2022	3	26.00	3.49c	0.19b	0.10b	17	17	0.06	0.15
					5	28.70	5.16b	0.18b	0.16b	12	12	1.06	0.21
					7	29.33	8.13a	0.32a	0.29a	10	15	0.24	0.34
	Arrowhead Seed Co.	Boxwine°	CBD	2022	3	19.87	4.31b	0.39	0.22ab	8	8	0.17	0.27
					5	25.30	7.48a	0.51	0.30a	3	5	0.24	0.36
					7	23.97	7.21a	0.51	0.30a	1	2	0.20	0.40
	Blue Forest Farms	Cherry Blossom*°	CBD	2022	3	21.61	5.56c	0.34b	0.26b	7	10	0.22	0.30
					5	22.33	7.09b	0.47a	0.32a	6	10	0.28	0.36
					7	23.40	8.71a	0.48a	0.37a	4	10	0.33	0.41
	Cheyenne Mountain Seed Co.	Cherry Wine°	CBD	2022	3	20.70	4.11b	0.33b	0.22b	12	13	0.19	0.24
					5	24.16	6.13a	0.42a	0.25a	11	12	0.23	0.28
					7	23.63	6.48a	0.36b	0.27a	7	9	0.24	0.30
	Arrowhead Seed Co.	Florence°	CBD	2021/2022	3	21.44	3.16c	0.39	0.13c	19	19	0.10	0.16
					5	27.30	4.66b	0.29	0.18b	19	21	0.15	0.21
					7	28.47	6.88a	0.32	0.25a	15	19	0.22	0.28
	Cheyenne Mountain Seed Co.	Mountain Mango*°	CBD	2022	3	19.14	3.58	0.28	0.19	6	7	0.16	0.22
					5	23.45	4.69	0.27	0.20	9	10	0.17	0.22
					7	21.71	4.04	0.21	0.18	5	5	0.14	0.22
	Blue Forest Farms	Queen Dream*°	CBD	2022	3	21.74	4.43c	0.3b	0.2c	13	13	0.17	0.24
					5	23.34	6.10b	0.39a	0.26b	8	11	0.22	0.30
					7	22.31	7.74a	0.4a	0.34a	4	10	0.30	0.38
	Trilogene Seed Co.	Super Wife°	CBD	2022	3	20.66	3.67b	0.34	0.17b	7	7	0.22	0.32
					5	25.31	6.99a	0.56	0.27a	3	4	0.20	0.31
					7	25.36	8.22a	0.56	0.33a	1	3	0.24	0.39
	Trilogene Seed Co.	Ultra Woman°	CBD	2022	3	23.48	6.21	0.49	0.27	5	7	0.22	0.32
					5	25.47	6.38	0.43	0.25	5	6	0.20	0.31
					7	25.83	8.23	0.56	0.32	2	3	0.24	0.39

Table 2. Table showing cannabinoid concentrations (Total THC (%), Total CBD (%), and Total CBG (%)) over time from cultivars entered into the MHD Cultivar Check Program. Colors used to indicate Total THC(%) compliance for various harvest windows using a 95% confidence interval include Red (non-compliance prior to week 3), Yellow (compliance through week 3), Orange (compliance through week 5), and Green (compliance through week 7). There is no significant difference between cultivars sharing the same letter assignment. In cases where letters are missing, the values are not significantly different.
*CBD:THC is considered stable across environments when P>0.05
°CBD:THC is considered stable across flowering periods when P>0.05

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