

NORTHWEST CROPS & SOILS PROGRAM



2021 Hemp Flower Variety Trial



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2021 HEMP FLOWER VARIETY TRIAL

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Hemp is a non-psychoactive variety of *Cannabis sativa* L. The crop is one of historical importance in the U.S. and re-emerging worldwide importance as medical providers and manufacturers seek hemp as a renewable and sustainable resource for a wide variety of consumer and industrial products. Hemp grown for all types of end-use (health supplement, fiber, and seed) contains less than 0.3% tetrahydrocannabinol (THC). Some hemp varieties intended to produce a health supplement contain relatively high concentrations of a compound called cannabidiol (CBD), potentially 10-15%. The compound CBD has purported benefits such as relief from inflammation, pain, anxiety, seizures, spasms, and other conditions. The CBD compound is the most concentrated in the female flower buds of the plant, however, it is also in the leaves and other plant parts as well.

To produce hemp for flower, the plant is generally grown intensively as a specialty crop and the flowers are cultivated for maximum growth. The various cannabinoids and terpenes concentrated in the flower buds are often extracted and incorporated into topical products (salves, lip balm, lotion) and food and is available in pill capsules, powder form, and more, which can be found in the market today. To help farmers succeed, agronomic research on hemp is needed in the United States. The University of Vermont evaluated 27 full season hemp varieties for their growth habit, pest tolerance, flower yields, and flower quality. Please note that there are 3 Autoflower varieties, which are included for comparison with the full-term plants. They are not part of the statistical analysis, which is why they are not part of the full-term hemp cultivar count.

Participants of State Hemp Programs intending to grow are required to follow state and federal regulations regarding hemp production and registration. Growers must register within their intended state for production, and must adhere to most current or active rules and regulations for production within a grower's given state. Regulations are subject to change from year to year with the development and approval of proposed program rules and it is important to note that regulations may vary across state lines and may be impacted by pending federal regulations. Please refer to this https://agriculture.vermont.gov/sites/agriculture/files/documents/PHARM/hemp/Vermont_State_plan_2021_12_1.pdf for a detailed outline of most recent approval from the Agricultural Marketing Service of the USDA of the Vermont Hemp Production Plant. The approved plan supports the Vermont Hemp Rules and governs registration, production, sampling and compliance for hemp cultivation beginning in 2022.

Additional information regarding the Vermont Agency of Agriculture, Food and Markets (VAAFMM) Hemp Program can be found on the VAAFMM website here:

<https://agriculture.vermont.gov/public-health-agricultural-resource-management-division/hemp-program>

MATERIALS AND METHODS

Companies selling hemp seed suitable for the CBD market were solicited to participate in the variety evaluation program. Five companies submitted twenty-seven full season hemp varieties for evaluation in the trial. The varieties were assessed for yield, quality and tolerance to pests at Borderview Research Farm in Alburgh, Vermont. The experimental design was a randomized complete block with 4 replicates. Plots consisted of three plants spaced 5' apart in the row and between rows (Table 1). Treatments consisted of the 27 individual hemp flower varieties (Table 2). In addition, 3 Autoflower varieties are included in this study, but were planted at 2' in row spacing and not included in the statistical analysis.

Fertility amendments were based on soil test results received from the University of Vermont Agricultural and Environmental Testing Laboratory (Burlington, VT). On 6-Apr, all plots were fertilized with 57 lbs N ac⁻¹, 57 lbs P ac⁻¹, 57 lbs K ac⁻¹, using 19-19-19 fertilizer. All entries were transplanted into black plastic mulch with drip tape irrigation.

Table 1. Agronomic information for the hemp variety trial, Alburgh, VT, 2020.

Location	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam, 3-5% slope
Previous crop	Corn
Plant spacing (ft)	5 x 5
Planting date	9-Jun, 16-Jun, 22-Jun
Fertilization	57 lbs N ac ⁻¹ , 57 lbs P ac ⁻¹ , 57 lbs K ac ⁻¹

The plant material received from the companies was comprised of seeds or rooted cuttings. Seed material was planted into deep 50-cell trays containing Fort Light potting mix (Vermont Compost Company, Montpelier, VT) on 12-May and placed in the UVM Greenhouses (Burlington, VT). Greenhouse temperatures were maintained at 70-75° F during the day and 68-72° F at night and received 18 hours of supplemental light at 400 W/m² from 1000W metal halide fixtures. Greenhouse pests, including thrips and fungus gnats, were managed with predatory mites, insects, and nematodes including *Amblyseius cucumeris*, *Orius insidiosus*, *Stratiolaelaps scimitus*, and *Steinernema feltiae*.

Table 2. 2021 Hemp varieties, source, material, and dominant cannabinoid.

Source	Cultivar	Material	Dominant cannabinoid
Blue Forest Farms	Cherry Blonde	Seed	CBD
Blue Forest Farms	Cinderella Story	Seed	CBD
Blue Forest Farms	Queen Dream	Seed	CBD
Davis Farms Oregon	88	Seed	CBD
Davis Farms Oregon	Bhutan Glory	Seed	CBD
Davis Farms Oregon	Painted Lady	Seed	CBD
Davis Farms Oregon	Purple Emperor	Seed	CBD
Davis Farms Oregon	Skipper	Seed	CBD
Meristem Farm	CH	Rooted Cutting	CBD
Meristem Farm	JM	Rooted Cutting	CBD

Meristem Farm	LV	Rooted Cutting	CBD
Meristem Farm	ME	Rooted Cutting	CBD
Meristem Farm	MS	Rooted Cutting	CBD
Meristem Farm	SD	Rooted Cutting	CBD
Northern Roots Nursery	Ceiba's Sister	Seed	CBD
Northern Roots Nursery	Hemp Kush	Seed	CBD
Northern Roots Nursery	R7-EG	Seed	CBD
Northern Roots Nursery	Suzy's Gift	Seed	CBD
Oregon CBD	Forbidden V	Seed	CBDV
Oregon CBD	Hawaiian Haze	Seed	CBD
Oregon CBD	Lifter	Seed	CBD
Oregon CBD	Lifter Seedless	Seed	CBD
Oregon CBD	Pinewalker	Seed	CBD
Oregon CBD	Suver Haze	Seed	CBD
Oregon CBD	Suver Haze Seedless	Seed	CBD
Oregon CBD	White CBG	Seed	CBG‡
Oregon CBD	White CBG Seedless	Seed	CBG
Phylos Bioscience	Alpha Explorer	Seed	CBD -Autoflower
Phylos Bioscience	Alpha Nebula	Seed	CBD -Autoflower
Northern Roots Nursery	NRN Auto	Seed	CBD -Autoflower

‡ CBG, Cannabigerol. CBG varieties were part of the full-term hemp (27 cultivar count) and are part of the stat analysis.

As a result of shipping delays or late entries, some varieties were required to be planted at different dates. Those entries started from seed were planted on 9-Jun and 22-Jun (Blue Forest Farm entries) whereas those received as rooted cuttings were planted on 16-Jun. (Table 3). Irrigation was applied through drip irrigation and the rate modified weekly based on rainfall. Each plot was monitored on a weekly basis for flowering date and variation amongst seedlings were recorded. High variation amongst seedlings generally also meant a range amongst flowering dates. Additionally, plants were harvested as they appeared ready using visual clues including trichome formation/maturity, pistil senescence, and swelling of bracts. Plants matured at different rates with some varieties such as Lifter and White CBG maturing nearly one month before other later maturing varieties.

Table 3. Planting, flowering, and harvest dates for Hemp Flower Variety Trial, Alburgh, VT, 2021.

Variety	Planting week †	Flower week	Harvest week
88	23	31	42
Bhutan Glory	23	34	40
Ceiba's Sister	23	32-34‡	39
CH	24	34	41
Cherry Blonde	25	35	42
Cinderella Story	25	33-35	42+§
Forbidden V	23	35	42
Hawaiian Haze	23	34	40
Hemp Kush	23	32-35	39
JM	24	32	41
Lifter	23	33	39

Lifter Seedless	23	35	40
LV	24	33	41
ME	24	35	43
MS	24	34	41
Painted Lady	23	32-35	40
Pinewalker	23	34	42
Purple Emperor	23	35	41
Queen Dream	25	35	42+
R7-EG	23	31-33	39
SD	24	33	41
Skipper	23	33-35	42
Suver Haze	23	32	39
Suver Haze Seedless	23	33	39
Suzy's Gift	23	33	39
White CBG	23	31	39
White CBG Seedless	23	32	39
Autoflower varieties			
Alpha Explorer	24	27	35
Alpha Nebula	24	27	35
NRN Auto	24	29	35

†..Planting week, harvest week, and flowering week are the weeks of the year in which each respective event occurred

‡ Varieties with a range listed for flowering week exhibited seedling variation in flowering dates so the entire period of flowering is listed.

§ Varieties with a “+” listed next to harvest date could have had an additional 1-2 weeks to fully mature.

Scouting took place weekly from 1-Sep until 17-Sep leading up to harvest. One plant per plot was scouted for disease and insect pests. Three leaves per plant at low, medium, and high locations on each plant were counted for insect populations and feeding damage. Entire plant assessments were made for disease with total number of infected buds or stems counted and severity rated for gray mold (*Botrytis cinerea*), white mold (*Sclerotinia sclerotiorum*), and whole plant disease severity ratings provided for powdery mildew (*Glovinomyces spp.*), and Septoria leaf spot (*Septoria spp.*). Severity was rated on a 0-100 scale for gray mold and white mold, with a rating of 0 being least severe (no apparent infection) and a rating of 100 being most severe. Less severe cases were noted as single flower clusters showing degradation or infection and most severe cases would be indicative of entire stems or colas showing severe disease infection and tissue degradation. Whole plant powdery mildew infections and Septoria leaf spot infections were rated on a visual 0-100 scale indicating the percentage of the entire plant exhibiting infection, 0 having no infection, and 100 having 100% infection throughout the plant, affecting the entirety of the leaf surface.

Prior to harvest, plant height and width were measured from all harvested plants in each plot. From each plot, composite flower samples were taken from harvested floral material and sent to Bia Diagnostic Laboratories (Colchester, VT) to be analyzed for cannabinoids and terpenes.

Plants were harvested by hand using bypass loppers or chainsaw depending on trunk diameter. Each harvested plant was broken down into smaller branched sections and larger “fan” or “sun” leaves were removed by hand, while smaller leaves were left attached since they subtend from the flower bract. Remaining stems were then bucked using the BuckmasterPro Bucker (Maple Ridge, BC, Canada) (Image 1) and remaining leaf material and buds were collected. Wet bud and leaf material was then run through the CenturionPro Gladiator Trimmer (Maple Ridge, BC, Canada) (Image 2). Wet bud weight and unmarketable bud weight were recorded. The flower buds were then dried at 80° F or ambient temperature with airflow until dry enough for storage without molding. A subsample of flower bud from each plot was dried in a small dehydrator and wet weights and dry weights were recorded in order to calculate the percent moisture of the flower buds. The percent moisture at harvest was used to calculate dry matter yields.



Image 1. Triminator BuckMaster Pro (Maple Ridge, BC, Canada).

Autoflower varieties are included for comparison with full season plants in the variety trial. Each was evaluated using similar metrics and received similar field preparation to those grown within the variety trial. Spacing for Autoflower varieties was reduced to 2’ and were similarly planted into irrigated black plastic. Autoflower varieties ‘Alpha Explorer,’ ‘Alpha Nebula,’ and ‘NRN Autoflower’ are included for comparison, but were not included for statistical comparison due to unique growth habit.



Image 2. Centurion Pro Gladiator Trimmer (Maple Ridge, BC, Canada).

Yield data and stand characteristics were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within the trial were treated as random effects, and treatments were treated as fixed. Treatment mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p < 0.10$). Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments is real or whether it might have occurred due to other variations in the field. At the bottom of each table a p-value is presented for each variable that

showed statistical significance ($p\text{-value} \leq 0.10$). In this case, the difference between two treatments within a column is equal to or greater than the least significant difference (LSD) value and you can be sure that for 9 out of 10 times, there is a real difference between the two treatments. In this example, variety 3 is significantly different from variety 1 but not from variety 2. Varieties with an asterisk are statistically similar to the top performer in bold. The difference between variety 3 and variety 2 is equal to 1.5, which is less than the LSD value of 2.0. This means that these varieties did not differ in yield. The difference between variety 3 and variety 1 is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these varieties were significantly different from one another.

Treatment	Yield
Variety 1	6.0
Variety 2	7.5*
Variety 3	9.0
LSD ($p\text{-value} \leq 0.10$)	2.0

RESULTS

Seasonal precipitation and temperature were recorded with a Davis Instrument Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT (Table 4). The growing season initially saw hot periods especially through plant establishment. July was unusually cool with an average temperature of 68.1, over 4 degrees cooler than normal. Dry conditions persisted across the entire growing season resulting in below average precipitation for the season. Average temperatures during the growing period were 5.97 degrees higher than the 30-year average for the season with a 4.69% higher growing degree day accumulation for the year.

Table 4. Seasonal weather data collected in Alburgh, VT, 2021.

Alburgh, VT	June	July	August	Sept	Oct
Average temperature (°F)	70.3	68.1	74.0	62.8	54.4
Departure from normal	2.81	-4.31	3.25	0.14	4.07
Precipitation (inches)	3.06	2.92	2.29	4.09	6.23
Departure from normal	-1.20	-1.14	-1.25	0.42	2.40
Growing Degree Days (50-86°F)	597	561	727	394	217
Departure from normal	73	-134	85	7	79

Historical averages are for 30 years of data provided by the NOAA (1991-2020) for Burlington, VT.

Cultivars were scouted from 17-Sep through 1-Oct for pest pressure and abiotic injury (Table 5). Few insect pests were observed on hemp plants within the trial with aphids being the primary pest observed during the scouting period. Additionally, low levels of potato leaf hopper and flea beetles were observed during the scouting period and throughout the season. Significant differences amongst varieties were observed for aphids, potato leaf hoppers, and leaf damage as a result of flea beetles. Highest observed values were seen in JM at 8.20 aphids leaf⁻¹ whereas lowest observed values were seen on Forbidden V at 0.80 aphids leaf⁻¹. Similarly, low values were observed for aphids in all other varieties except for Bhutan Glory and JM. Potato leafhoppers were similarly low in populations throughout the trial with highest observed in Bhutan Glory at 1.75 PLH leaf⁻¹. While flea beetle populations were not recorded per leaf due to insect movement, the impacts of chewing damage were recorded for observed leaves. Highest percentages of affected leaves were observed in White CBG Seedless at 3.13% chew damage and was statistically similar to Pinewalker and Skipper, whereas all other varieties saw significantly lower chew damage with lowest observed damage seen in MS and Suver Haze at 0.250% affected leaf area. Overall insect pests did not seem to be highly impactful on hemp varieties within the trial. Akin to past years, large amounts of predatory insects were also observed on plants including green lacewings and various species of lady beetles however these populations were not quantified.

Four main diseases were observed including Septoria leaf spot, powdery mildew, gray mold, and white mold. Within this trial, the greatest severity of Septoria leaf spot was observed in White CBG with least affected plants seen for Forbidden V variety. The CBDv varieties showed little to no disease damage or incidence. Most susceptible cultivars for powdery mildew included White CBG and White CBG Seedless at 67.5 and 55.0% respectively. Botrytis was largely not observed during the scouting period with greater

impacts observed throughout the harvest period as plants matured and experienced physical damage leading up to harvest. These impacts are recorded through the unmarketable flower metric collected at harvest.

Table 5. Disease and arthropod pest incidence and severity on hemp varieties, Alburgh, VT, 2021.

Variety	Aphids # leaf ⁻¹	Potato Leaf Hopper # leaf ⁻¹	Chewing damage %	Septoria leaf spot %	Powdery mildew %	White mold incidence # infected stems plant ⁻¹	White mold severity 0-100 [†]	Botrytis Incidence # infected stems plant ⁻¹	Botrytis severity 0-100
88	2.9*‡	0.25*	0.438*	6.50*	17.5*	0.750*	5.00*	0.00	0.00
Bhutan Glory	7.90	1.75	1.69*	10.5*	12.5*	0.00	0.00	0.00	0.00
CH	2.5*	0.00	1.13*	4.25*	27.5	0.500*	2.50*	0.00	0.00
Ceibas Sister	2.8*	0.00	0.313*	25.3	32.5	2.00	2.50*	0.00	0.00
Cherry Blonde	2.1*	0.00	1.38*	10.5*	25.0	0.250*	2.50*	0.00	0.00
Cinderella Story	2.8*	0.00	2.38*	20.3	15.0*	0.250*	5.00*	0.00	0.00
Forbidden V	0.80	0.00	0.813*	0.750	10.0*	0.00	0.00	0.00	0.00
Hawaiian Haze	1.7*	0.00	2.06*	40.3	22.5	0.00	0.00	0.00	0.00
Hemp Kush	3.9*	0.00	0.750*	36.3	32.5	1.50	5.00*	0.00	0.00
JM	8.20	0.00	1.63*	22.8	17.5*	0.00	0.00	0.00	0.00
LV	2.4*	0.25*	2.13*	1.00*	12.5*	0.250*	2.50*	0.00	0.00
Lifter	3.8*	0.00	1.81*	75.0	32.5	2.25	20.0	0.25	2.50
Lifter Seedless	1.5*	0.00	1.38*	9.00*	27.5	0.750	10.0	0.00	0.00
ME	2.6*	0.00	1.38*	1.00*	12.5*	0.250*	2.50*	0.00	0.00
MS	4.0*	0.00	0.250	2.00*	15.0*	0.500*	5.00*	0.00	0.00
Painted Lady	3.7*	0.00	0.313*	3.25*	22.5	1.50	10.0	0.00	0.00
Pinewalker	3.9*	0.00	2.81	1.00*	10.0	0.00	0.00	0.00	0.00
Purple Emperor	2.6*	0.00	0.625*	8.25*	12.5*	0.00	0.00	0.00	0.00
Queen Dream	3.3*	0.00	1.69*	20.0	27.5	0.250*	2.50*	0.00	0.00
R7-EG	5.3*	0.00	1.69*	51.3	32.5	2.25	7.50*	0.00	0.00
SD	2.5*	0.00	2.19*	13.0*	17.5*	0.500*	5.00*	0.00	0.00
Skipper	2.3*	0.00	2.69	5.25*	17.5*	0.500*	5.00*	0.00	0.00
Suver Haze	2.4*	0.00	0.250	68.8	27.5	1.00*	7.50*	0.00	0.00
Suver Haze Seedless	4.3*	0.00	1.00*	23.8	20.0*	1.00*	7.50*	0.00	0.00
Suzys Gift	4.3*	0.25*	1.00*	45.3	32.5	2.50	7.50*	0.00	0.00
White CBG	3.3*	0.00	1.81*	75.0	67.5	2.00	10.0	0.00	0.00
White CBG Seedless	1.6*	0.00	3.13	25.0	55.0	3.25	17.5	0.00	0.00
LSD (0.10) §	3.64	0.816	2.22	17.4	14.9	1.29	8.5	0.113	1.13
Trial Mean	3.30	0.093	1.43	22.4	24.3	0.889	5.28	0.009	0.093

†Rating on a 0 to 100 scale; where 0 = no disease and 100= severe.

‡Treatments with an asterisk (*) are not significantly different from the top performer in **bold**.

§ LSD – Least significant difference at p=0.10.

Within the variety trial, Lifter Seedless was the tallest at 183 cm and was statistically similar in height to 88, Bhutan Glory, Cinderella Story, Lifter, Painted Lady, Pinewalker, Queen Dream, and Suzy's Gift (Table 6). Widest plants included the top performer R7-EG at 174 cm amongst statistically similar 88, Bhutan glory, Ceiba's Sister, Cinderella Story, Hawaiian Haze, Hemp Kush, Lifter, Lifter Seedless, Painted Lady, Pinewalker, Purple Emperor, Skipper, Suver Haze Seedless, Suzy's Gift, and White CBG Seedless.

Majority of these plants with widest growth habit also experienced some of the greatest amounts of lodging as plants matured towards the end of the growing season, with the exception of Ceiba's Sister, Hemp Kush, Suver Haze Seedless, and Suzy's Gift, which experienced little to no lodging despite more sprawling growth habits. Other plants with notably low lodging values included many of the smaller plants. Hawaiian Haze had the highest whole plant biomass with plants reaching 23.6 lbs plant⁻¹ whereas smallest observed plants were seen in variety CH at 5.6 lbs plant⁻¹ with a trial average of 16.3 lbs plant⁻¹. For each of the measured metrics, Autoflower varieties 'Alpha Explorer,' 'Alpha Nebula,' and 'NRN Autoflower' are included for comparison. Autoflower plants were generally much smaller while compared to full term plants ranging from 42 cm to 62 cm plant widths, having the potential to be planted at a greater density. Given growth habits of these plants and maturation time, and finishing a month or more ahead of other full term plants, plants experienced no lodging.

Table 6. Hemp whole plant weight, height, and width, Alburgh, VT, 2021.

Variety	Height	Width	Lodging
	cm	cm	1-5 [†]
88	180*‡	157*	4.25
Bhutan Glory	169*	151*	2.75
CH	82.0	85.0	1.25*
Ceibas Sister	154	152*	1.00
Cherry Blonde	149	134	1.5*
Cinderella Story	163*	161*	2.50
Forbidden V	154	141*	1.75*
Hawaiian Haze	147	168*	1.50*
Hemp Kush	136	145*	1.00
JM	122	134	1.50*
LV	96.0	89.0	1.25*
Lifter	157*	153*	1.75*
Lifter Seedless	183	163*	1.75*
ME	152	128	1.00
MS	91.0	97.0	1.50*
Painted Lady	182*	167*	2.75
Pinewalker	165*	173*	2.00
Purple Emperor	142	147*	2.50
Queen Dream	162*	144*	3.50
R7-EG	148	174	1.50*
SD	131	131	1.00
Skipper	151	161*	2.50
Suver Haze	154	135	1.25*
Suver Haze Seedless	144	161*	1.00
Suzys Gift	156*	157*	1.00
White CBG	119	125	1.50*
White CBG Seedless	147	168*	1.25*
LSD (0.10) §	28.0	36.2	0.804
Trial Mean	146	144	1.78
Autoflower varieties[‡]			
Alpha Explorer	80.0	62.0	1.00

Alpha Nebula	77.0	59.0	1.00
NRN Auto	40.0	42.0	1.00

‡Treatments with an asterisk (*) are not significantly different from the top performer in **bold**.

§LSD – Least significant difference at p=0.10.

†Lodging was rated on a 1 to 5 scale where 1= no lodging and 5 = Severe breaking of branches and fallen plant.

¥Autoflower varieties were not statistically analyzed with the full season varieties and are shown for comparison.

Total bud weight, leaf weight, and stem weight were measured at harvest to further evaluate growth characteristics of each variety (Table 7). Painted Lady had the highest overall stem weight within the trial at 7.70 lbs plant⁻¹ whereas SD had the highest overall percentage of stem material at 41.7%. Top performers for overall flower weight included Hawaiaan Haze at 9.02 lbs plant⁻¹ and was statistically similar to Ceiba's Sister, Lifter, Lifter Seedless. While these varieties were top performers for total flower weight, White CBG had the highest percentage of floral material at 48.5% alongside Hemp Kush, JM, and Suver Haze with comparable values. Similarly, these varieties also had the highest ratio of flower to stem material in addition to CH, Hawaiian Haze, and Purple Emperor.

The amount of total leaf or stem material can also greatly affect how long it takes to harvest the crop, especially if much of the harvest is by hand. A few documented harvest times in 2019 and 2020 showed a great range in total hours to harvest by hand. From 2019, VT Cherry was one of the smallest varieties which took approximately 45 minutes per plant to break down plants, remove fan leaves, and buck flowers from stems. In 2020, some smaller varieties with very little leaf material, such as Panakeia, took approximately 15 minutes to process plants. This variety had one of the lowest overall plant weights with the highest bud:stem ratio and was one of the last varieties to be planted, this certainly contributed to its small size. Comparable hemp varieties this year included a number of those with highest flower to stem ratios such as White CBG, JM, and Hemp Kush to name a few. Growth habits varied greatly within the trial and each of these factors can greatly impact harvest time for individual plants. Some other larger, later harvested varieties may require additional time to trim and harvest by hand. Amount of time required to harvest plants will vary drastically depending not only on selected cultivars but also desired end-product and intricacy of trimming, however all are important factors to take into consideration when selecting a variety. Each Autoflower variety had substantially larger proportions of flower material when compared to full term cultivars, yet plants as a whole were also much smaller compared to most full-term cultivars in this case.

Table 7. Wet hemp plant harvest growth metrics, Alburgh, VT, 2021.

Variety	Whole plant weight	Stem weight	Stem weight	Flower weight	Flower weight	Leaf weight	Leaf weight	Flower:Stem	Leaf:Stem
	lbs plant ⁻¹	lbs plant ⁻¹	%	lbs plant ⁻¹	%	lbs plant ⁻¹	%		
88	17.2	6.01*	34.1	5.62	32.8	5.53	33.1*	0.973	0.990
Bhutan Glory	17.7*‡	5.28	30.3	6.26	34.7	6.12	35.0*	1.16	1.16
CH	5.60	1.97	29.3	2.07	38.9	1.56	31.8	1.54*	1.25
Ceibas Sister	19.2*	6.02*	31.5	7.33*	38.4	5.80	30.2	1.22	0.970
Cherry Blonde	20.0*	5.65*	27.9	6.77	36.1	7.58*	36.1*	1.33	1.30
Cinderella Story	12.9	4.10	32.0	5.14	40.1	3.61	27.9	1.26	0.890
Forbidden V	21.3*	7.64*	35.9*	5.98	27.8	7.64*	36.3*	0.777	1.01
Hawaiian Haze	23.6	5.64*	24.0	9.02	38.1	8.89	37.9*	1.60*	1.59*
Hemp Kush	14.5	3.69	25.2	6.45	44.5*	4.36	30.3	1.77*	1.21
JM	10.4	2.81	27.1	4.87	47.5*	2.72	25.4	1.75*	0.940
LV	9.60	2.83	29.3	3.40	39.8	3.37	30.8	1.54*	1.10
Lifter	18.8*	5.79*	31.2	6.97*	37.5	5.99	31.3	1.22	1.03
Lifter Seedless	20.4*	6.16*	29.5	7.68*	38.0	6.51	32.5	1.31	1.12
ME	20.7*	6.72*	32.7	6.42	30.3	7.56*	37.0*	0.933	1.14
MS	7.30	2.46	29.8	2.58	39.5	2.26	30.7	1.43	1.08
Painted Lady	21.0*	7.70	36.9*	5.83	27.6	7.42	35.5*	0.752	0.970
Pinewalker	19.9*	6.77*	33.7	5.37	27.4	7.77*	38.8*	0.829	1.16
Purple Emperor	11.4	3.05	24.1	3.82	35.2	4.54	40.7	1.53*	1.82
Queen Dream	16.3	5.88*	36.2*	5.05	30.4	5.33	33.3*	0.849	0.950
R7-EG	18.4*	5.79*	31.3	5.55	30.1	7.06*	38.6*	0.991	1.25
SD	11.2	4.53	41.7	3.66	33.4	2.97	24.9	0.82	0.680
Skipper	19.8*	7.37*	35.0	5.61	32.1	6.77*	33.0*	1.00	0.980
Suver Haze	15.1	4.03	26.6	6.19	41.2*	4.88	32.2	1.56*	1.22
Suver Haze Seedless	16.6	5.27	31.7	5.14	31.1	6.15	37.2*	1.09	1.22
Suzys Gift	21.8*	6.85*	31.0	6.46	30.0	8.44*	39.0*	1.00	1.29
White CBG	13.0	3.48	25.9	6.14	48.5	3.38	25.6	1.94	1.00
White CBG Seedless	16.9	5.78*	35.0	5.90	36.6	5.18	28.5	1.04	0.880
LSD (p=0.10) [§]	5.98	2.25	6.22	2.06	7.63	2.32	8.02	0.468	0.380
Trial Mean	16.3	5.16	31.1	5.60	35.8	5.53	33.1	1.23	1.12
Autoflower varieties[¥]									
Alpha Explorer	2.48	0.41	16.5	1.79	72.0	0.28	11.5	4.36	0.695
Alpha Nebula	1.80	0.28	15.6	1.23	68.2	0.29	16.2	4.36	1.03
NRN Auto	0.904	0.10	11.5	0.575	63.7	0.22	24.8	5.53	2.15

†Proportion of the whole plant biomass made up of stem, leaves, or flower material at harvest.

‡Treatments with an asterisk (*) are not significantly different from the top performer in **bold**.

§LSD – Least significant difference at p=0.10.

¥Autoflower varieties were not statistically analyzed with the full season varieties and are shown for comparison.

At harvest, a composite subsample of flower material was collected from each plot and dried down to determine flower dry matter and calculate dry matter flower yields (Table 8, Figure 1). R7-EG had the highest harvest dry matter (22.7%) alongside 88, Bhutan Glory, CH, Ceiba's Sister, Forbidden V, Hemp Kush, JM, MS, Painted Lady, Pinewalker, Purple Emperor, and SD. Unmarketable flower included any flower that had suffered from disease, rot, soil contamination, or otherwise damaged flower material. CH, Lifter, R7-EG, and White CBG Seedless all had no recorded unmarketable flower material within the trial whereas Painted Lady, Hawaiian Haze and Lifter Seedless had the greatest amounts of unmarketable flower material ranging from 0.312 and .285 lbs plant⁻¹. Hawaiian Haze had the highest overall dry matter flower yield at 2652 lbs ac⁻¹ and was statistically similar to 88, Bhutan Glory, Ceiba's' Sister, Cherry Blonde, Forbidden V, Hemp Kush, JM, Lifter, Lifter Seedless, ME, Painted Lady, Pinewalker, R7-EG, and Suzy's Gift. Lowest observed yields were seen in CH at 740 lbs ac⁻¹ with an overall trial mean of 1869 lbs ac⁻¹. Dry matter yields on a per acre basis for Autoflower varieties Alpha Explorer and Alpha Nebula were above those of full term plants, however yield calculations are based on 2' x 2' plant spacing. Higher plant density in this case would compensate for lower per plant yields, however seed costs as well as potential for disease may be significantly higher.

Table 8. Hemp flower yield, Alburgh, VT, 2021.

Variety	Flower dry matter	Unmarketable flower	Dry matter flower yield [†]	Dry matter flower yield	Yield at 8% moisture
	%	lbs plant ⁻¹	lbs plant ⁻¹	lbs ac ⁻¹	lbs ac ⁻¹
88	21.2*‡	0.015*	1.19*	2072*	2252*
Bhutan Glory	21.4*	0.017*	1.39*	2425*	2636*
CH	20.8*	0.000	0.430	740	805
Ceibas Sister	20.7*	0.008*	1.52*	2648*	2878*
Cherry Blonde	18.8	0.013*	1.27*	2216*	2409*
Cinderella Story	18.0	0.002*	0.940	1645	1788
Forbidden V	21.7*	0.002*	1.31*	2288*	2487*
Hawaiian Haze	17.0	0.288	1.52	2652	2882
Hemp Kush	21.7*	0.019*	1.40*	2432*	2643*
JM	22.6*	0.005*	1.11*	1929*	2096*
LV	18.4	0.028*	0.60	1050	1141
Lifter	17.1	0.000	1.20*	2085*	2266*
Lifter Seedless	16.4	0.285	1.19*	2074*	2255*
ME	20.0	0.010*	1.22*	2120*	2305*
MS	20.7*	0.018*	0.530	917	997
Painted Lady	21.6*	0.312	1.26*	2188*	2378*
Pinewalker	21.3*	0.017*	1.13*	1972*	2144*
Purple Emperor	20.4*	0.044*	0.770	1346	1463
Queen Dream	19.4	0.006*	0.960	1672	1817
R7-EG	22.7	0.000	1.28*	2229*	2423*
SD	20.1*	0.007*	0.740	1281	1392
Skipper	19.1	0.013*	1.06	1854	2015
Suver Haze	17.1	0.009*	1.06	1849	2010
Suver Haze Seedless	15.7	0.009*	0.810	1406	1529

Suzys Gift	18.7	0.004*	1.20*	2099*	2281*
White CBG	16.3	0.032*	1.01	1753	1905
White CBG Seedless	14.7	0.000	0.870	1512	1644
LSD (p=0.10) [§]	2.67	0.151	0.419	730.6	794.1
Trial Mean	19.4	0.043	1.07	1869	2031
Autoflower varieties[‡]					
Alpha Explorer	20.6	0.000	0.368	4012	4333
Alpha Nebula	21.3	0.000	0.261	2843	3071
NRN Autoflower	20.1	0.000	0.116	1261	1362

† Dry matter yield is reported at 0% moisture.

‡ Treatments with an asterisk (*) are not significantly different from the top performer in **bold**.

§ LSD – Least significant difference at p=0.10.

‡ Autoflower varieties were not statistically analyzed with the full season varieties and are shown for comparison.

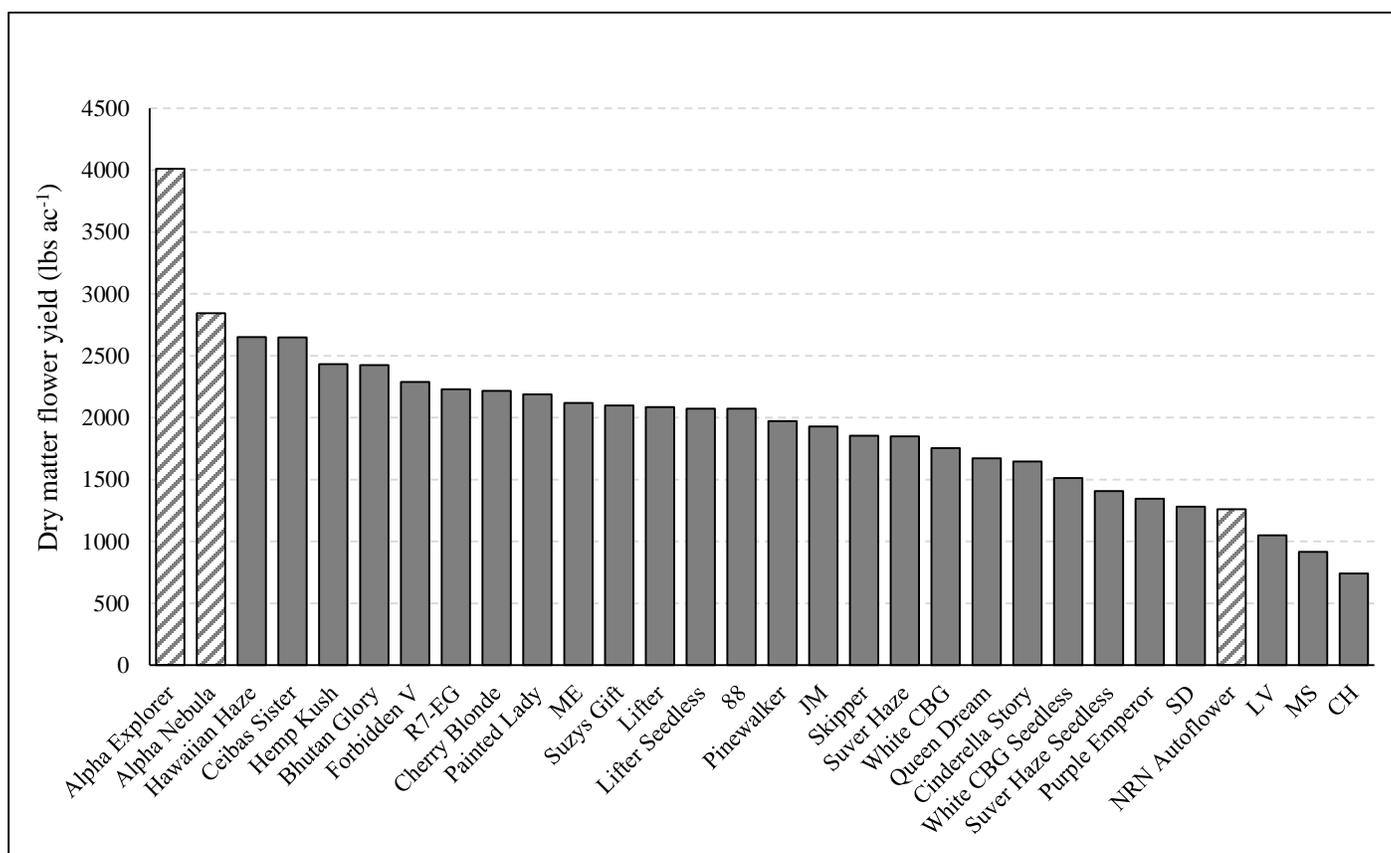


Figure 1. Dry matter flower yield of hemp varieties for the flower market, 2021.

Autoflower varieties are included and are denoted by striped, gray bars.

Each cultivar within the trial was also analyzed for cannabinoid content and terpenes (Table 9, Figure 2). Results for cannabinoids are on a dry matter basis (0% moisture). These results represent three replications of the study. Autoflower varieties are included with these results for comparison. Peak, dominant cannabinoid concentration for each variety ranged from 7.8% to 17.0%. Within the study, Suver Haze had the highest total concentrations of CBD at 17.0%, whereas White CBG Seedless had the highest total CBG

at 10.6%. Each variety within the trial would be compliant with 2021 Vermont State regulations for THC limits for both total THC and D9-THC with lowest observed values seen in both CBG varieties as well as those varieties with lower total CBD such as Painted Lady, Skipper, LV, Purple Emperor, 88, Forbidden V, Bhutan Glory, and Pinewalker which were all below a 0.3% total THC concentration. Highest total THC was seen in Suver Haze at 0.600% followed closely by Hemp Kush, Ceiba's Sister, Cherry Blonde, Lifter, and Lifter Seedless. Some varieties within this trial may not be compliant with other state regulations and limits for THC. It is important to consult individual state regulations and recognize that varieties may perform differently in other growing regions. Additionally, it is important to acknowledge that while these were compliant under 2021 growing regulations in Vermont, these regulations are subject to change in upcoming years.

Table 9. Hemp flower major cannabinoid analysis, Alburgh, VT, 2021.

Variety	CBDVa	CBDV	CBDa	CBGa	CBG	CBD	THCa	Total THC‡	Total CBD†	Total Cannabinoids	THC : CBD
	%	%	%	%	%	%	%	%	%	%	
88	0.057	0.007	9.26	0.097	0.067	0.130	0.290	0.253	8.30	10.0	32.6*§
Bhutan Glory	0.053	0.000	8.93	0.137	0.017	0.083	0.267	0.237	7.90	9.53	33.4
CH	0.043	0.013	15.8	0.100	0.057	0.213	0.553	0.483	14.1	16.9	29.0
Ceibas Sister	0.100	0.023	17.4*†	0.147	0.070	0.133	0.620*	0.547*	15.4*	18.6*	28.2
Cherry Blonde	0.150	0.023	18.5*	0.160	0.057	0.130	0.620*	0.543*	16.3*	19.7*	30.0
Cinderella Story	0.217	0.007	14.7	0.110	0.037	0.127	0.487	0.427	13.0	15.8	30.5
Forbidden V	4.18	0.047*	9.00	0.110	0.070	0.077	0.313	0.273	8.00	13.8	29.0
Hawaiian Haze	0.077	0.010	14.7	0.183	0.033	0.180*	0.523	0.453	13.0	15.8	28.7
Hemp Kush	0.283	0.010	17.9*	0.223	0.140*	0.120	0.653*	0.573*	15.8*	19.4*	27.6
JM	0.067	0.020	13.0	0.090	0.030	0.210*	0.423	0.370	11.6	13.9	31.2*
LV	0.023	0.010	9.81	0.057	0.027	0.137	0.307	0.270	8.70	10.4	32.3*
Lifter	0.087	0.030*	16.7*	0.157	0.037	0.140	0.610*	0.530*	14.8*	17.8*	23.8
Lifter Seedless	0.080	0.043*	17.8*	0.160	0.030	0.140	0.617*	0.537*	15.7*	18.9*	29.2
ME	0.020	0.000	12.6	0.060	0.050	0.123	0.407	0.357	11.2	13.3	31.2*
MS	0.040	0.007	14.9	0.063	0.050	0.143	0.333	0.457	13.2	15.8	28.9
Painted Lady	0.133	0.000	10.7	0.097	0.040	0.093	0.327	0.287	9.50	11.5	33.2*
Pinewalker	5.21	0.053	8.77	0.187	0.057	0.080	0.307	0.267	7.80	14.7	28.8
Purple Emperor	0.033	0.000	9.64	0.100	0.040	0.137	0.310	0.273	8.60	10.3	31.6*
Queen Dream	0.130	0.030*	12.8	0.117	0.023	0.113	0.403	0.350	11.3	13.6	32.1*
R7-EG	0.240	0.017	15.8	0.273	0.070	0.103	0.563*	0.497	14.0	17.2	28.5
SD	0.237	0.020	14.6	0.150	0.057	0.180*	0.500	0.440	13.0	15.9	29.8
Skipper	0.047	0.000	10.0	0.097	0.020	0.093	0.313	0.270	8.8	10.6	32.4*
Suver Haze	0.073	0.043*	19.2	0.160	0.053	0.167*	0.683	0.600	17.0	20.5	28.4
Suver Haze Seedless	0.120	0.010	15.9	0.173	0.043	0.117	0.580	0.507	14.1	17.1	27.7
Suzys Gift	0.050	0.017	11.2	0.250	0.053	0.070	0.403	0.353	9.90	12.1	28.5
White CBG	0.000	0.010	0.00	11.3	0.143	0.013	0.170	0.153	0.00	11.7	.
White CBG Seedless	0.000	0.013	0.00	11.9	0.123*	0.000	0.100	0.117	0.00	12.2	.
LSD (p=0.10) ¥	0.171	0.028	2.63	0.521	0.031	0.049	0.128	0.086	2.30	2.90	2.35
Trial Mean	0.435	0.017	12.6	0.990	0.055	0.120	0.433	0.386	11.1	14.7	29.9
Autoflower variety[€]											
Alpha Explorer	0.00	0.017	6.68	0.334	0.164	3.13	0.271	0.350	9.00	10.9	25.8

Alpha Nebula	0.00	0.017	8.33	0.449	0.184	3.20	0.335	0.413	10.5	12.8	25.4
NRN Autoflower	0.00	0.012	5.26	0.380	0.169	2.19	0.193	0.259	6.81	8.40	26.6

† Total potential CBD = (0.877 x CBDA) + CBD.

‡ Total potential THC = (0.877 x THCA) + Δ-9 THC.

§ Treatments with an asterisk (*) are not significantly different from the top performer in **bold**.

¥ LSD – Least significant difference at p=0.10.

€ Autoflower varieties were not statistically analyzed with the full season varieties and are shown for comparison.

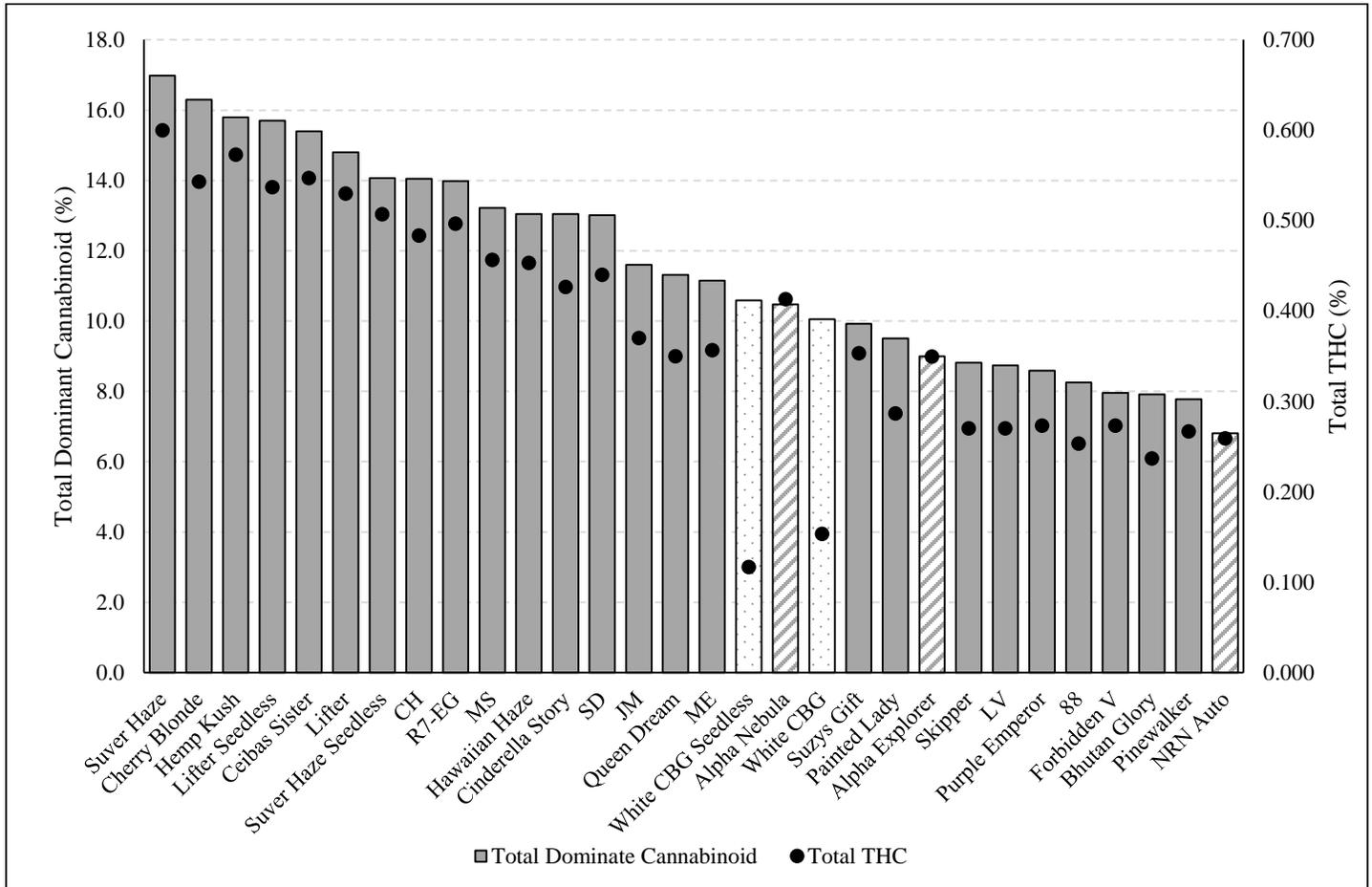


Figure 2. Dominate hemp flower cannabinoid concentrations, 2021.

CBG varieties are denoted by dotted white bars, whereas Autoflower varieties are denoted by striped bars for comparison with other CBD dominate varieties.

The cannabis plant contains a wide array of non-cannabinoids that contribute to aromatic profiles and may potentially have similar health benefits to some cannabinoids. Terpenes make up one group of many types of compounds found in hemp. Terpene profiles were determined in three replicates for each variety (Table 10). Results are included for 17 analyzed, unique terpenes, which have distinct chemical compositions and associated aromas that contribute to individual plant characteristics. Some terpenes may have medicinal uses as anti-irritants, anti-inflammatories, anti-microbials, or pain relievers, however the medicinal effects of many known compounds remain to be unseen. As highly volatile compounds, many of these terpenes can be subject to high levels of loss as a result of various harvest, drying, processing, or storage methods. Each of these factors should be carefully considered when evaluating and determining your growing practices, as well as desired end-product.

Table 10. Total flower bud terpene profiles, Alburgh, VT, 2021.

Variety	Total terpenes mg/g	α -Pinene mg/g	Camphene mg/g	β -Myrcene mg/g	β -Pinene mg/g	3-Carene mg/g	Limonene mg/g	Ocimene mg/g	Eucalyptol mg/g
88	19.5	0.313	0.000	8.32	0.393	0.000	1.30	0.055	0.000
Bhutan Glory	15.1	1.18	0.014	6.58	0.823	0.000	0.716	0.033	0.000
CH	33.7*†	0.457	0.039	9.81	0.713	0.000	2.59	0.062	0.208
Ceibas Sister	36.9*	2.55	0.101	9.40	1.97*	0.000	3.84	0.157	0.060
Cherry Blonde	28.3*	2.14	0.234	14.0*	1.61	0.000	2.50	0.120	0.048
Cinderella Story	35.5*	4.46	0.056	15.9	2.90	0.000	2.57	0.210	0.079
Forbidden V	37.1	1.60	0.038	11.9*	1.06	0.058*	2.54	2.93	0.000
Hawaiian Haze	20.4	1.17	0.000	10.7	0.915	0.000	1.39	0.088	0.048
Hemp Kush	24.9	0.713	0.094	6.20	0.884	0.000	3.65*	0.090	0.050
JM	16.0	0.478	0.000	8.84	0.481	0.000	1.31	0.063	0.322
LV	20.7	3.18*	0.027	9.80	1.90	0.000	1.44	0.127	0.607
Lifter	25.5	1.72	0.033	9.88	1.22	0.014	1.71	0.093	0.015
Lifter Seedless	24.7	1.18	0.000	12.3*	0.856	0.016	1.60	0.094	0.000
ME	26.3	0.380	0.000	12.8*	0.659	0.000	2.39	0.054	0.199
MS	36.7*	0.465	0.036	11.1	0.687	0.000	2.48	0.077	0.180
Painted Lady	16.8	1.33	0.014	7.67	0.877	0.000	1.08	0.052	0.000
Pinewalker	32.4*	2.36	0.054	10.5	1.13	0.064	2.11	4.51	0.000
Purple Emperor	18.4	1.24	0.000	9.43	0.710	0.000	1.22	0.066	0.000
Queen Dream	25.4	1.81	0.017	10.7	1.29	0.000	1.59	0.093	0.000
R7-EG	25.9	3.52*	0.058	8.34	1.90	0.000	1.81	0.125	0.000
SD	31.7*	3.35*	0.057	14.9*	2.24*	0.000	2.50	0.201	0.142
Skipper	21.6	1.27	0.000	9.90	0.914	0.000	1.45	0.074	0.000
Suver Haze	31.8*	2.29	0.023	13.3*	1.53	0.033	1.80	0.121	0.000
Suver Haze Seedless	27.3	2.05	0.000	9.98	1.29	0.000	1.30	0.094	0.097
Suzys Gift	26.4	1.69	0.000	7.05	1.20	0.053*	1.57	0.298	0.022
White CBG	11.3	0.163	0.000	1.64	0.124	0.000	0.36	0.000	0.000
White CBG Seedless	14.6	0.209	0.000	2.34	0.187	0.000	0.66	0.000	0.000
LSD (p=0.10)	9.24	1.68	0.099	4.73	0.978	0.025	0.946	0.748	0.068
Trial Mean	25.4	1.60	0.033	9.75	1.13	0.009	1.832	0.366	0.077

†Treatments with an asterisk are not significantly different from the top performer in **bold**.

‡LSD – Least significant difference at p=0.10.

Table 10 continued. Total flower bud terpene profiles, Alburgh, VT, 2021.

Variety	Y-Terpinene mg/g	Terpinolene mg/g	Linalool mg/g	Caryophyllene mg/g	α -Humulene mg/g	Cis-Nerolidol mg/g	Guaiol mg/g	Caryophyllene Oxide mg/g	α -Bisabolol mg/g
88	0.000	0.000	0.086	5.75	1.96	0.000	0.719*	0.433	0.210
Bhutan Glory	0.054*†	0.100	0.067	3.48	1.24	0.000	0.417*	0.184	0.177
CH	0.016	0.051	0.110	13.6*	4.94*	0.000	0.000	0.483	0.613
Ceibas Sister	0.000	0.596	1.57	11.5	4.19	0.088	0.467*	0.226	0.237
Cherry Blonde	0.000	0.000	0.254	4.51	1.99	0.000	0.470*	0.163	0.419
Cinderella Story	0.000	0.042	0.378	5.59	2.23	0.000	0.330	0.235	0.581
Forbidden V	0.000	0.017	0.967	10.5	4.25	0.309	0.325	0.275	0.342
Hawaiian Haze	0.000	0.000	0.447	3.41	1.10	0.136	0.618*	0.149	0.222
Hemp Kush	0.000	0.572	0.638	7.88	2.74	0.225*	0.480*	0.184	0.426
JM	0.044*	0.000	0.030	2.92	1.23	0.000	0.000	0.182	0.080
LV	0.070*	0.032	0.015	1.71	0.89	0.000	0.000	0.104	0.812
Lifter	0.000	0.130	0.932	6.34	2.57	0.070	0.162	0.246	0.410
Lifter Seedless	0.000	0.000	1.16*	4.60	1.87	0.071	0.429*	0.236	0.231
ME	0.000	0.000	0.053	6.22	2.86	0.000	0.000	0.213	0.463
MS	0.000	0.088	0.071	14.8	5.50	0.000	0.000	0.622	0.629
Painted Lady	0.000	0.000	0.000	4.08	1.28	0.031	0.235	0.155	0.019
Pinewalker	0.000	0.000	0.647	6.99	2.89	0.208*	0.305	0.249	0.429
Purple Emperor	0.000	0.000	0.195	3.40	1.16	0.000	0.640*	0.188	0.129
Queen Dream	0.000	0.024	0.020	6.30	2.50	0.000	0.238	0.288	0.485
R7-EG	0.000	0.269	0.378	5.95	2.24	0.168*	0.369*	0.171	0.571
SD	0.000	0.066	0.000	5.24	1.77	0.000	0.552*	0.172	0.597
Skipper	0.000	0.016	0.131	5.31	1.77	0.000	0.409*	0.274	0.066
Suver Haze	0.000	0.030	1.17*	6.55	2.21	0.073	0.515*	0.289	0.250
Suver Haze Seedless	0.000	0.020	1.56*	7.05	2.94	0.073	0.240	0.207	0.356
Suzys Gift	0.075	2.27	0.344	7.33	2.97	0.209*	0.523*	0.162	0.531
White CBG	0.000	0.000	0.561	5.29	1.52	0.000	0.726	0.182	0.699
White CBG Seedless	0.000	0.000	0.506	7.23	1.99	0.000	0.650*	0.165	0.616
LSD (p=0.10)‡	0.032	0.558	0.416	3.20	1.22	0.148	0.393	0.238	0.371
Trial Mean	0.010	0.160	0.455	6.43	2.40	0.062	0.364	0.422	0.393

†Treatments with an asterisk are not significantly different from the top performer in **bold**.

‡LSD – Least significant difference at p=0.10.

DISCUSSION

Many of the varieties within the trial appeared to perform well in our Northeast climate, however others appeared as if they would have benefit from additional time in the field as they did not reach full maturity. Varieties including Cinderella Story and Queen Dream could have benefited from an additional week of growth and higher yields could potentially have been obtained through maturation. Additionally, there were some stark differences in growth habits and quality across the board. A number of varieties such as CH, LV, and MS had smaller plants and could potentially be planted at higher densities to increase yield per acre. Conversely plants with more sprawling growth habits, such as those observed in 88, would likely benefit from greater plant spacing to improve airflow between plants. Various growth characteristics, such as sprawling versus upright growth habits, can be especially important when looking at the potential for high disease pressure. Some disease issues could potentially be mitigated by cultural practices such as adequate plant spacing and selecting varieties with disease tolerance or resistance. Additionally, autoflower varieties may be good options for early harvest and diversification. As in past years, these varieties matured over a month ahead of earlier maturing full term varieties and could be worked into a production system to spread out harvest labor requirements while bringing in a marketable crop at an earlier date.

In the past two years of variety trial evaluation, insect damage has been largely non-impactful in the weeks leading up to harvest. While aphids appear to be present on plants, damage in our area is not noticeable though higher populations may have the potential to impact flower quality, especially in the smokable flower market. During severe years with high populations of leaf hoppers, greater damage to leaves in the form of hopper burn may also be noticed in crops, however other preferred crops may draw insects away from hemp. With continued growth of the hemp industry and often lack of crop rotation in fields, disease impacts may prove to be more detrimental moving forward. In the past two years of our studies under similar weather conditions, Septoria leaf spot and powdery mildew have become more noticeable in our trials. From this trial, it appeared as if the two CBDv varieties, Forbidden V and Pinewalker, had much greater disease tolerance, whereas the two CBG varieties were most susceptible to powdery mildew and Septoria leaf spot. Previous years also yielded similar results in which many of the CBG varieties were more adversely impacted by powdery mildew.

While varieties were able to be harvested in a timely matter, weather constraints in the region forces all varieties to be harvested due to cold temperatures in late October. In our region many areas have the potential to experience a killing frost by mid-September. While many varieties have shown some resistance to frost throughout the past few years, earlier maturing varieties may be more beneficial to reduce the potential for crop loss. Varieties such as Hemp Kush, Lifter Seedless, Suver Haze, and Cherry Blonde stood out for their higher yields, cannabinoid contents, and earlier maturation finishing 3 weeks prior to some of the latest maturing varieties. Within this trial, all cultivars tested were compliant in accordance with Vermont State Regulations for THC limits in 2021, having a D9-THC below 0.3% and total potential THC below 1.0%.

Highest values of total potential CBD were seen in Suver Haze, Lifter Seedless, Hemp Kush, and Cherry Blonde to name a few, however these may not be compliant depending on your state when looking at total potential THC values. As regulations may differ from state to state, it is important to refer to your own state specific regulations to ensure you are selecting compliant cultivars for your area and remain up to date on

current regulations. Lower total potential CBD cultivars also appeared to produce lower total THC and may be safer options to produce a compliant crop. Similarly, CBG varieties tested within this study were among the lowest values for total THC and may serve as a good alternative depending on market and desired product. Terpene profiles and concentrations of hemp may also become increasingly important as new markets are developed for the crops. While many of these compounds contribute to the vast array of aromatics and can exhibit distinct aroma profiles across cultivars, many of these compounds may also be important for their purported health benefits and synergistic effects with other compounds when consumed in hemp and hemp related products. The twenty-seven varieties within our research trial, and building on past year's variety trials, only begins to scratch the surface of the multitude of hemp cultivars that are now commercially available. With such wide scale variations in growth habits, yield, and quality of various cultivars, it will be increasingly important to continue research and evaluation of those available cultivars to provide region specific information to optimize farmer yields within the Northeast.

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