NORTHWEST CROPS & SOILS PROGRAM

2017 Industrial Cannabidiol Hemp Report

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UNIVERSITY OF VERMONT EXTENSION
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2017 INDUSTRIAL CANNABIDIOL HEMP REPORT

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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). Hemp varieties intended to produce a health supplement contain relatively high concentrations of a compound called cannabidiol (CBD), potentially 8-10%. CBD has purported benefits such as relief from inflammation, pain, anxiety, seizures, spasms, and other conditions. The CBD is the most concentrated in the female flowers of the plant. To grow hemp for CBD production, the crop is generally grown intensively as a specialty crop and the flowers are cultivated for maximum growth. There is also potential to grow industrial hemp as a row crop for seed and/or fiber and extract CBD from other plant parts, as well. The CBD oil is 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. Industrial hemp is poised to be a "new" cash crop and market opportunity for Vermont farms that is versatile and suitable as a rotation crop with other specialty crops, small grains, and grasses.

To help farmers succeed, agronomic research on hemp is needed. We evaluated hemp CBD varieties, growing conditions (under hoop house and outdoors), and planting stock (seed or clonal propagation) to determine best management practices for hemp grown for CBD production in this region.

MATERIALS AND METHODS

Table 1. Agronomic information for the CBD hemp trial 2017, Alburgh, VT.

Location	**Borderview Research Farm Alburgh, VT**
Soil type	Benson rocky silt loam, 8-15% slope
Previous crop	Winter squash
Plant spacing (m)	6.5 x 8.0
Planting date, variety – plant stock, location	16-Jun, Boax – clonally propagated transplants, hoop house 26-Jun, Otto – clonally propagated transplants, hoop house 30-Jun, Otto – seedlings started from seed, outdoors
Harvest date	6-18 Oct

The CBD hemp was grown at Borderview Research Farm in Alburgh, Vermont (Table 1) to evaluate the impact of variety, growing conditions (hoop house and outdoors), and starting stock (seed or clonally propagated transplants) on flower yield and CBD oil yields in hemp. Female plants of the CBD variety, Boax, were planted on 16-Jun from clonally propagated transplants, under a hoop house and into black

plastic mulch (Image 1). The clonally propagated female plants of the variety Otto, were planted on 26-Jun into black plastic mulch under a hoop house (Image 1).

Image 1. CBD hemp grown under hoop house, Alburgh, VT, 2017.

Male and female seedlings of the variety Otto, propagated from non-feminized seed, were planted into black plastic outdoors on 30-Jun. Four seedlings were planted at each plant spacing, in order to improve the probability of having one female plant per plant spacing. Male plants were culled on 4-Sep when male flowers could be identified. All plants were covered with lightweight grade Agribon row cover until 17-Jul, when they had grown too large for the row cover to fit. Plants were given extra support from a polypropylene trellis net by Trellinet. The plants were harvested by hand by first using a chainsaw to cut down the entire plant. Then the plant was broken down into smaller branched sections and flower buds were removed by hand. Larger "fan" or "sun" leaves were removed, while smaller leaves were left attached since they subtend from the flower bract. Flower bud harvest was labor intensive with smaller plants taking 5 hours and larger plants taking 12 hours to process. Flower buds were dried at 80° F for 18-36 hours, depending on the load size in the dryer, until the stems of the flower buds easily snapped. Flower buds were sent to the Phytoscience Institute (Waterbury, VT) for analysis of the CBD concentration. CBD was analyzed using high performance supercritical fluid chromatography with a photodiode array detector and ChromScope software was used for data acquisition.

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 2. Seasonal weather data collected in Alburgh, VT, 2017.

Alburgh, VT	June	July	August	September	October
Average temperature (°F)	65.4	68.7	67.7	64.4	57.4
Departure from normal	-0.39	-1.90	-1.07	3.76	9.20
Precipitation (inches)	5.60	4.90	5.50	1.80	3.30

Departure from normal	1.95	0.73	1.63	-1.80	-0.31
Growing Degree Days (base 50°F)	468	580	553	447	287
Departure from normal	-7	-60	-28	129	175

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger. Alburgh precipitation data from August-October was provided by the NOAA data for Highgate, VT. Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

Throughout the growing season, temperature and precipitation fluctuated away from the 30-year historical averages. June-August was wetter than normal, receiving 4.31 more inches of precipitation as compared to historical averages (Table 2). Temperatures in June-August were cooler than normal by an average of 1.12° F per month. September and October were unseasonably warm and dry, averaging 6.48° F warmer and 1.06 fewer inches of precipitation. Overall, there were an accumulated 2335 Growing Degree Days (GDDs) this season, approximately 209 more than the historical average, however, much of this heat gain came at the end of the season.

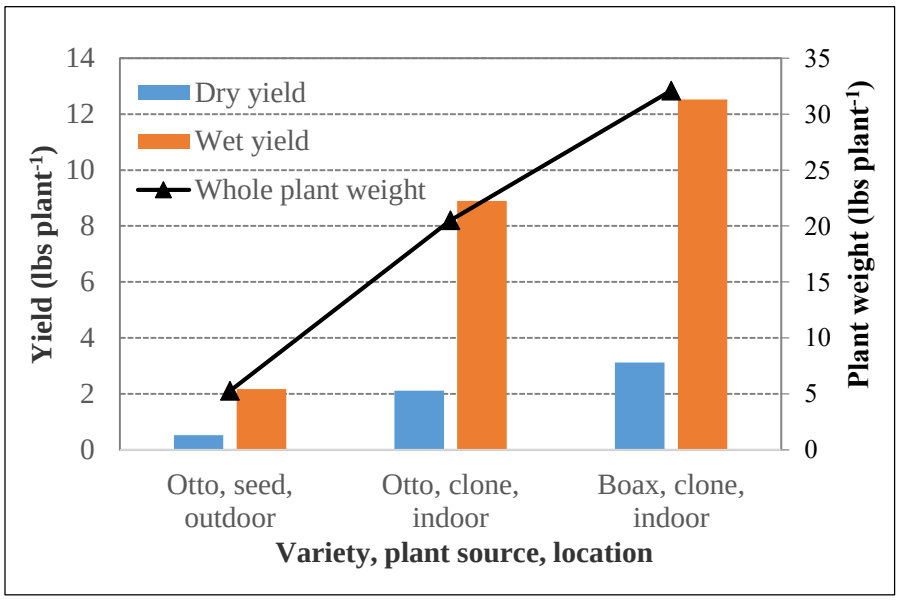

Figure 1. Average yields of Boax and Otto, Alburgh, VT, 2017.

The Boax plants, grown from clonally propagated transplants under hoop house, had the highest dry flower yield at 3.12 lbs plant^{-1} and the largest plants, with wet weights having an average of 32.1 lbs plant^{-1} (Figure 1). This was unsurprising, considering that the Boax transplants were the best established at the time of planting and growing under the hoop house was especially helpful this season, with the spring having been unseasonably cool and wet. The Otto, grown from seed, yielded the least and were the smallest plants; this was likely due to less favorable, outdoor growing conditions. Since the Otto seedlings were grown with four plants per plant spacing, the increased competition for sunlight, nutrients, and water, may have also stunted yields for the Otto grown from seed, outdoors.

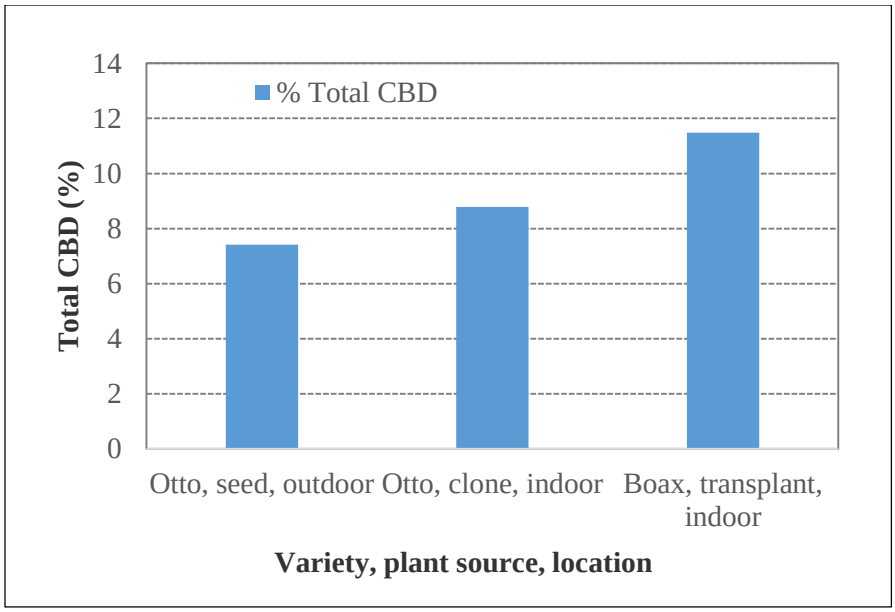

Figure 2. Average cannabidiol (CBD) concentration of Boax and Otto, Alburgh, VT, 2017.

Boax again performed well compared to Otto for the total CBD content, at 11.5% (Figure 2). Interestingly, the difference in CBD content was much smaller between Otto grown from seed, outdoor (7.42%) and the Otto grown from clone, indoor (8.79%), as compared with CBD content between varieties.

Insect pests did not seem to affect yields and primarily consisted of fruit flies, Japanese beetles, tarnished plant bugs, and mites. The mites had appeared within the first 3 weeks after planting and were treated with neem oil. The fungal disease *Sclerotinia sclerotiorum* was present on the plants, yet overall was minimal and did not seem to affect yields. More evaluation is needed in order to better understand ideal conditions, plant stock, and varieties for yield and quality.

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