Hemp Production Growers Meeting

Wednesday June 26th, 5:30-9:00pm
Tolland County Extension Center, Gold Building

5:30-6:00 Registration
6:00-6:30 Light dinner + networking
6:30-6:40 A quick update in CBD hemp research.
   Gerald A. Berkowitz, Professor, UConn PSLA
6:40-7:00 Growing hemp in field: what we know about cultivation practices.
   Shuresh Ghimire, Assistant Extension Educator, UConn Extension
7:00-7:30 Growing hemp in controlled environment.
   Shelley Durocher-Nesta, Grower and Research Laboratory Aid, UConn PSLA
7:30-8:00 Seed sources, dioecy, feminized seed, and pollen drift: Things to consider.
   Jessica Lubell-Brand, Associate Professor, UConn PSLA
8:00-8:10 Regulatory update.
   Carole Briggs and Wayne Kasacek, CT Dept. of Ag
8:10-8:30 Pre-harvest sampling and testing.
   Wayne Nelson, CT Dept. of Ag.
8:30-9:00 Networking and Mini-Trade show
GROWING HEMP IN FIELD: WHAT WE KNOW ABOUT CULTIVATION PRACTICES

Shuresh Ghimire, Assistant Extension Educator, UConn Extension

Photo: Cornell Univ.
Before we start-

Hemp and Marijuana

Both are *Cannabis Sativa* L.

Delta-9 TetraHydroCannabinol (THC) – the psychoactive component of *Cannabis Sativa* L. is how the distinction is made.

Hemp $\leq 0.3\%$ THC  
Marijuana $> 0.3\%$ THC
Grower’s checklist

• Licensing
• Land/soil, water, equipment, infrastructure
• Seeds vs clones
• Testing
• Harvesting, drying, processing
• Selling your crop
Botany

• Dioecious (separate male and female plants)
• Monoecious (male and female flowers in the same plant)
• Photoperiod sensitive (<14 hrs of sunlight - induces flowering)
• Male: taller, die after shedding pollen
Site selection and planting

• Grows best in well-drained sandy loam soils, avoid compacted soils

• Plant after the danger of killing frost or soil temp 50 °F or above

• Seeding depth: ½ to ¾ inch but not deeper than 1 inch

• Ideal temp for growing 60 – 80 °F

• Soil pH: 6.0 – 7.5
Site selection and planting

• Does not tolerate water logging
• Thrives full sun
• Long tap root if friable soil: up to 6 ft deep tap root

Photo: Cornell Hemp - Cornell University

Virginia Dept. of Ag & Consumer Services
# Fertility requirements (lbs/a)

<table>
<thead>
<tr>
<th>Al ppm</th>
<th>&lt;40</th>
<th>41-100</th>
<th>&gt;100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test P</td>
<td>P₂O₅</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-3 lbs/A</td>
<td>80</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>4-7 lbs/A</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>8-13 lbs/A</td>
<td>40</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>14-20 lbs/A</td>
<td>20</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil test K</th>
<th>K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;99 lbs/a</td>
<td>120</td>
</tr>
<tr>
<td>100-169</td>
<td>80</td>
</tr>
<tr>
<td>170-249</td>
<td>40</td>
</tr>
<tr>
<td>250-349</td>
<td>30</td>
</tr>
<tr>
<td>350 - 499</td>
<td>20</td>
</tr>
<tr>
<td>&gt;500</td>
<td>0</td>
</tr>
</tbody>
</table>

Suggestion from UConn soil lab
Seeds/starts

- **CBD:**
  - Feminized seeds
  - CBD clones (female plants)
  - Male and female seed
- **Grain & fiber:** males and female or monoecious seeds
- **Regular seed** (m&f): less expensive, up to 50% males,
- **Feminized seeds:** more expensive, less labor to ID and rouge males
Connecticut Department of Agriculture
Hemp Grower/Processor Application and Licensing

Supporting documents for the application for a license, sample forms and information


Forms
Consent to Grow or Process Hemp on Leased Property [Consent to grow process hemp on private land 5.13.19.pdf](https://www.elicense.ct.gov/Default.aspx)
Grow Site(s), Storage location(s) or Seed Modification Request [Site seed modification request 6.3.19.pdf](https://www.elicense.ct.gov/Default.aspx)
On-Site Manager or Signing Authority Modification Request [On site manager signing authority modification request 6.3.19.pdf](https://www.elicense.ct.gov/Default.aspx)
Sample Legal Description [Sample legal description 5.24.19.pdf](https://www.elicense.ct.gov/Default.aspx)

Guidance and Instruction Documents
Choosing a Laboratory [Choosing a laboratory.pdf](https://www.elicense.ct.gov/Default.aspx)
Due Dates for Reports [Due date overview updated 5.14.19.pdf](https://www.elicense.ct.gov/Default.aspx)
Hemp Sample Chain of Custody Form [Hemp sample chain of custody 5.13.19.pdf](https://www.elicense.ct.gov/Default.aspx)
Sample Hemp Research Plan [Sample hemp research plan.pdf](https://www.elicense.ct.gov/Default.aspx)
Sample Hemp Marketing Plan [Sample hemp marketing plan.pdf](https://www.elicense.ct.gov/Default.aspx)
Sample Legal Description [Sample legal description 5.24.19.pdf](https://www.elicense.ct.gov/Default.aspx)

Seed Sources [Certified seed sources 5.20.19.pdf](https://www.elicense.ct.gov/Default.aspx)
(Note: This is not an exhaustive list nor is it an endorsement of any organization.)

Transporting Hemp or Hemp Samples [Transporting hemp in Connecticut.pdf](https://www.elicense.ct.gov/Default.aspx)
Approved Hemp CBD Varieties

The following high CBD varieties of hemp seed/clones have been approved by DATCP to grow in Wisconsin in 2019. Approval to grow does not guarantee a variety will pass the DATCP pre-harvest regulatory test as THC levels in high CBD hemp varieties are not stable. Growers are responsible for monitoring their crops. Any field/variety that does not pass the required DATCP pre-harvest regulatory test with a delta-9 Total THC concentration of 0.3% or below will be ordered to be destroyed. DATCP calculates Total THC as d9-THC + 0.877*THCa and we round down so 0.399 = 0.3%.

To seek approval of a high-CBD variety not included on this list please send the name of the variety, the name of the supplier, and a lab analysis of the variety (often referred to as a Certificate of Analysis) to DATCPIndustrialHemp@Wisconsin.gov.

A-2
A9 Auto
A11 Auto
Abacus
ACDC Super CBD
Afternoon Delight
Altitude
Apollo
Auto Pilot 1.0
Awesome Blossom
Berry Blast
Berry Blossom
Boax
Boax x Autoflower
Boax x Cherry Wine
Boring 'Ol Hemp Strains 1-4 Boutique
Feminized Strains 1 and 2 Boxwine
Bubblegum
Bubblegum x Otto
Buddha's Hand
Canna Tsu
Cherry Cinco
Cherry Cross
Cherry F
Cherry G
Cherry Hybrid
Cherry Kandy (Nate Moon)
Cherry Pie
Cherry Struck
Cherry Tres
Cherry Uno
Cherry Wine
Cherry Wine 51
Cherry x Abacus
Cherry x ACDC
Cherry x Otto 2 Sweetened Cherub
Coag
Cobbler
Colorado Cherry
Colorado Cherry 5
Colorado Gold
CS2
Deschutes
Mojave Cherry Wine
Mountain Mango
Murphy's Medley
N9 (Jet Fuel)
NEO (GR-NEO5-01-17)
Northern Remedy
Northern Spectrum
Northern Suzy
NBS CBD 1
Oregon Cherry or Original Cherry Otto 1
Otto 2
Otto 2 x AC/DC
Otto 2 x Franklin
Palm
Parkdale Boutique Strains 1, 2 and
Purple Emperor
3 Peacemaker
R23, R24, R25, R26, R27
Red Kross
Relief Now
RN13
Starting seedlings (for CBD)

- Need 3-4 weeks
- Use 50 or 72 cell tray

How many plants/acre?
- 4 ft x 4 ft = 2,722
- 5 ft x 5 ft = 1,742
- 6 ft x 6 ft = 1,210

Cost of planting materials per acre (6 ft. x 6 ft.)
- $1-$2 seed ($1) = $1,210
- $3 to $8 per plant ($3) = $3,630
- $4-8 per clone ($4) = $4,840
Seed rate and spacing for grain & fiber

- Seeding depth: ½ to 1 inch
- Seeding rate for grain: ~30 lb/acre
  for fiber: ~50 lb/acre
- Row spacing: for grain: 8-16”
  for fiber ≤ 8”
- Average grain yield: 600 – 1200 lbs/acre
- Oil content: 30-35%
- Average fiber yield: 3 – 5 ton/acre
UVM 2018: CBD hemp variety trial

• Site: Alburgh, VT
• Spacing: 5 ft x 5 ft
• Planting date: 6 July (seedling started in GH: 14 May)
• Varieties: Boax, Carmagnola selezionata, Otto, Otto x Boax
• Fertilization: preplant (15-June): 100 lbs N per acre; and 9-Aug: 50 lbs N per acre
• Harvest date: 12-Oct and 15-Oct for outdoor plants and 16-Oct for indoor plants

Source: https://www.uvm.edu/extension/nwcrops/research
UVM 2018: CBD hemp variety trial

- Flower buds were removed by hand and by using the EZTrim Debudder (Broomfield, CO).

- Wet bud yield weight and unmarketable bud weight were recorded. The flower buds were then dried at 80°F until dry enough for storage without molding.

Source: https://www.uvm.edu/extension/nwcrops/research
<table>
<thead>
<tr>
<th>Variety</th>
<th>Plant weight (lb/plant)</th>
<th>Plant height (cm)</th>
<th>Unmarketable dry flower yield (lb/plant)</th>
<th>Dry matter flower yield (lb/plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boax</td>
<td>19.6 ab</td>
<td>179</td>
<td>0.007 a</td>
<td>2.25 a</td>
</tr>
<tr>
<td>Carmagnola selezionata</td>
<td>6.87 c</td>
<td>219</td>
<td>0.054 b</td>
<td>0.70 b</td>
</tr>
<tr>
<td>Otto</td>
<td>24.2 a</td>
<td>217</td>
<td>0.003 a</td>
<td>2.22 a</td>
</tr>
<tr>
<td>Otto x boax</td>
<td>16.6 b</td>
<td>168</td>
<td>0.005 a</td>
<td>2.05 a</td>
</tr>
<tr>
<td>p-value</td>
<td>&lt;0.0001</td>
<td>NS</td>
<td>0.0003</td>
<td>0.0004</td>
</tr>
</tbody>
</table>

Source: https://www.uvm.edu/extension/nwcrops/research
# UVM 2018 findings: Outdoor

<table>
<thead>
<tr>
<th>Variety</th>
<th>Plant weight (lb/plant)</th>
<th>Plant height (cm)</th>
<th>unmarketable dry flower yield (lb/plant)</th>
<th>Dry matter flower yield (lb/plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boax</td>
<td>17.1 a</td>
<td>147 b</td>
<td>0.074</td>
<td>2.27 a</td>
</tr>
<tr>
<td>Carmagnola selezionata</td>
<td>5.0 b</td>
<td>192 ab</td>
<td>0.050</td>
<td>0.65 b</td>
</tr>
<tr>
<td>Otto</td>
<td>22.0 a</td>
<td>187 a</td>
<td>0.00</td>
<td>1.69 a</td>
</tr>
<tr>
<td>Otto x boax</td>
<td>18.7 b</td>
<td>153 ab</td>
<td>0.011</td>
<td>2.04 a</td>
</tr>
<tr>
<td>p-value</td>
<td>0.005</td>
<td>0.047</td>
<td>NS</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Source: [https://www.uvm.edu/extension/nwcrops/research](https://www.uvm.edu/extension/nwcrops/research)
UVM 2018 findings

Source: https://www.uvm.edu/extension/nwcrops/research
UVM 2018 plant spacing and planting date trial

- Fertilizers: 100 lbs N, 70 lbs P, 70 lbs K per acre using Kreher’s poultry manure (5-4-3) and Pro-Gro (5-3-4).
- An additional 50 lbs N per acre was added 3 weeks later in the form of sodium nitrate (16-0-0).
- The plants were harvested by hand on 16-Oct by first using a chainsaw to cut down the entire plant.
- The whole plant weight was recorded.

Source: https://www.uvm.edu/extension/nwcrops/research
# UVM 2018 plant spacing and planting date trial

<table>
<thead>
<tr>
<th>Plant spacing (ft x ft)</th>
<th>Dry matter flower yield (lb/plant)</th>
<th>Unmarketable dry matter flower yield (lb/plant)</th>
<th>Dry matter flower yield (lb/acre)</th>
<th>Unmarketable dry matter flower yield (lb/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 1</td>
<td>0.84 c</td>
<td>0.000 a</td>
<td>3669 a</td>
<td>7.1 a</td>
</tr>
<tr>
<td>3 x 3</td>
<td>0.60 b</td>
<td>0.003 a</td>
<td>2894 b</td>
<td>12.4 a</td>
</tr>
<tr>
<td>5 x 5</td>
<td>1.35 a</td>
<td>0.049 b</td>
<td>2354 c</td>
<td>86.6 b</td>
</tr>
<tr>
<td>LSD (0.10)</td>
<td>0.093</td>
<td>0.019</td>
<td>411</td>
<td>35.9</td>
</tr>
</tbody>
</table>

Source: [https://www.uvm.edu/extension/nwcrops/research](https://www.uvm.edu/extension/nwcrops/research)
# UVM 2018 plant spacing and planting date trial

<table>
<thead>
<tr>
<th>Planting dates</th>
<th>Dry matter flower yield (lb/plant)</th>
<th>Unmarketable dry matter flower yield (lb/plant)</th>
<th>Dry matter flower yield (lb/acre)</th>
<th>Unmarketable dry matter flower yield (lb/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-Jun</td>
<td>0.74</td>
<td>0.0151</td>
<td>2920</td>
<td>39</td>
</tr>
<tr>
<td>21-Jun</td>
<td>0.672</td>
<td>0.0223</td>
<td>3243</td>
<td>39</td>
</tr>
<tr>
<td>27-Jun</td>
<td>0.621</td>
<td>0.0149</td>
<td>2755</td>
<td>30</td>
</tr>
<tr>
<td>LSD (0.10)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Source: [https://www.uvm.edu/extension/nwcrops/research](https://www.uvm.edu/extension/nwcrops/research)
# Drying temp affecting CBD content

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Ave actual temp</th>
<th>Ave RH</th>
<th>Harvest moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 °F buds only</td>
<td>79.3</td>
<td>74.7</td>
<td>71.2</td>
</tr>
<tr>
<td>105 °F buds only</td>
<td>86.4</td>
<td>34.6</td>
<td>69.1</td>
</tr>
<tr>
<td>Ambient buds only</td>
<td>59</td>
<td>60.8</td>
<td>NA</td>
</tr>
</tbody>
</table>

UVM 2018

Source: https://www.uvm.edu/extension/nwcrops/research
While the use of higher temperatures results in faster drying rates, producers should consider the potential impact of drying temperature on the quality of their product. In this trial, drying at a higher temperature (above 80°F) resulted in significantly lower total potential CBD concentrations.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Potential CBD</th>
</tr>
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<tbody>
<tr>
<td>80 °F buds only</td>
<td>7.01 ab</td>
</tr>
<tr>
<td>105 °F buds only</td>
<td>5.88 b</td>
</tr>
<tr>
<td>Ambient buds only</td>
<td>7.71 a</td>
</tr>
<tr>
<td>LSD (0.10)</td>
<td>1.29</td>
</tr>
</tbody>
</table>

Source: [https://www.uvm.edu/extension/nwcrops/research](https://www.uvm.edu/extension/nwcrops/research)
Weeds

• Fiber and grain crops should be planted into weed free fields.

• Hemp grows very quickly and reaches one foot tall within 2-4 weeks during warm weather

• Dense planting helps to close canopy and shade weeds quickly

• No pesticides are approved in U.S. for in-season weed management for hemp

Photo: The Oregonian
Diseases

- Powdery mildew
- Botrytis blight
- Mosaic (viral)
- Stem canker (*Phytophthora, Pythium*)
- Vascular wilt (*Fusarium, Verticillium*)
- Root rot (Soil borne pathogens)
- Nematode disease (root-knot, lesions, etc.)

Common Problems of Cannabis Plants

Source: Nevada Dept. of Ag
Diseases

- **Botrytis** (grey mold)
- **Sclerotinia** (white mold)
- **Fusarium root rot**
- **Powdery mildew**
Insects

- European corn borers and aphids
- Japanese beetles
- Tarnished plant bugs
- Mites
- Western black flea beetles

Photo: Whitney Cranshaw, Colorado St. Univ.
Hemp harvest: Grain

- Grain hemp is harvested when shattering begins.
- Seed heads mature from bottom up.
- Only 70-75% of seeds are ripe at this point.
- Grain is between 22-30% moisture.
- Plants are still green at harvesting.
- Conventional combine can be used.
Hemp harvest: Fiber

• Fiber is windrowed between early bloom and seed set and left in the field for ~5 weeks for ‘retting’- a process in which pectineus substances that bind together elemental bast fibers become degraded

• When fibers are ≤ 15% moisture, it is round and square baled
Hemp harvest: CBD

• CBD hemp is harvested at peak flowering
• CBD testing can be used to target harvest
• Weather is critical to yield and quality
• Hand harvesting of whole plants is standard
• Immediate drying at moderate temperature with good ventilation is critical
Industrial Hemp Budgets 2019 - Kentucky

<table>
<thead>
<tr>
<th>CBD Plasticulture Model</th>
<th></th>
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<tbody>
<tr>
<td><strong>Gross Returns Per Acre</strong></td>
<td></td>
</tr>
<tr>
<td>CBD%</td>
<td>6%</td>
</tr>
<tr>
<td>Price Per %</td>
<td>$5.00</td>
</tr>
<tr>
<td>Dry Matter Yield</td>
<td>1,200 lbs</td>
</tr>
<tr>
<td><strong>Total Revenue</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Variable Costs Per Acre</strong></td>
<td></td>
</tr>
<tr>
<td>Transplants</td>
<td>1,500 plants</td>
</tr>
<tr>
<td>Nitrogen (Solid urea 46%)</td>
<td>100 units</td>
</tr>
<tr>
<td>Phosphorous (P2O5)</td>
<td>30 units</td>
</tr>
<tr>
<td>Potassium (K2O)</td>
<td>45 units</td>
</tr>
<tr>
<td>Lime - Delivered and Spread</td>
<td>6.0 ton</td>
</tr>
<tr>
<td>Chemicals (not yet available)</td>
<td>1 acre</td>
</tr>
<tr>
<td>Soil Test</td>
<td>1 field</td>
</tr>
<tr>
<td>Disk Harrow/Plowing</td>
<td>1 acre</td>
</tr>
<tr>
<td>Planting/Setting</td>
<td>1,500 plants</td>
</tr>
<tr>
<td>Black Plastic/Drip Line</td>
<td>1 acre</td>
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<tr>
<td>Irrigation</td>
<td>90 hours</td>
</tr>
<tr>
<td>Requeling Male Plants</td>
<td>0 hours</td>
</tr>
<tr>
<td>Harvest Cost</td>
<td>32.4 hours</td>
</tr>
<tr>
<td>Drying Costs</td>
<td>0 lbs of wet</td>
</tr>
<tr>
<td>Grinding Cost</td>
<td>1 acre</td>
</tr>
<tr>
<td>Total Containers</td>
<td>5 acre</td>
</tr>
<tr>
<td>Transporting Floral Mate</td>
<td>1,200 lb</td>
</tr>
<tr>
<td>Custom Work</td>
<td>1 acre</td>
</tr>
<tr>
<td>Cash Rent</td>
<td>1 acre</td>
</tr>
<tr>
<td>Crop Insurance</td>
<td>1 acre</td>
</tr>
<tr>
<td>Application &amp; License Fee</td>
<td>1 per year</td>
</tr>
<tr>
<td>Lab Test</td>
<td>1 # of test</td>
</tr>
<tr>
<td>Interest on Operating Costs</td>
<td>$40,000 dollars</td>
</tr>
<tr>
<td>Other Variable Costs</td>
<td>1 acre</td>
</tr>
<tr>
<td>Unallocated Labor</td>
<td>1 hours</td>
</tr>
<tr>
<td><strong>Total Variable Costs Per Acre</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Return Above Variable Costs Per Acre</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Break even Yield at $30/lb of CBD</strong></td>
<td>9 /lb per acre to cover variable costs</td>
</tr>
<tr>
<td><strong>Break even Cost at 1200 lbs of CBD</strong></td>
<td>$349.02 /lb to cover variable costs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivity Analysis</th>
<th>Price per % CBD</th>
<th>Total Revenue</th>
<th>Returns Above Variable Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$6</td>
<td>$43,200</td>
<td>$32,729</td>
</tr>
<tr>
<td></td>
<td>$5</td>
<td>$36,000</td>
<td>$25,529</td>
</tr>
<tr>
<td></td>
<td>$4</td>
<td>$28,800</td>
<td>$18,329</td>
</tr>
<tr>
<td></td>
<td>$3</td>
<td>$21,600</td>
<td>$11,129</td>
</tr>
<tr>
<td></td>
<td>$2</td>
<td>$14,400</td>
<td>$3,929</td>
</tr>
<tr>
<td></td>
<td>$1</td>
<td>$7,200</td>
<td>$3,271</td>
</tr>
</tbody>
</table>