# **Growing Cannabis**

Production Overview and Environmental Parameters

### **AEE Technical Roundtable**

December 6, 2018

Fred Green
Fred Green Consulting
Princeton, MA



## Personal Background

- Commercial Flower Grower in MA for 40 Years.
- Master's Degree in Horticulture from Cornell.
- Consultant to the Cannabis Industry since 2013.
- 40+ Cannabis Projects in USA, Canada, and Australia.
- Focus on Efficiency in Facility Design and Operations.
  - Labor
  - Energy
  - Space Utilization

### General Cannabis Info

### **Major Cannabinoid Compounds:**

- THC psychoactive compound in marijuana.
- CBD non-psychoactive compound with medicinal properties.
- Terpenes aromatic compounds.

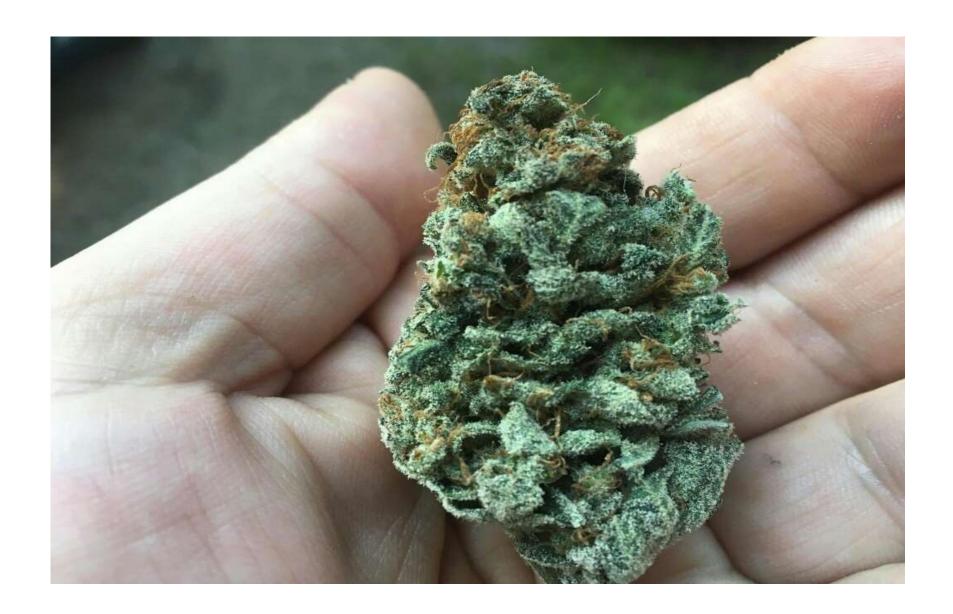
#### **Plants:**

- Only female plants yield usable product.
- Flowering is daylength dependent.
- Flower Buds Contain Majority of Valuable Cannabinoids.
- Oils extracted for MIPs (Marijuana Infused Products).

#### **Demand:**

- Edibles cookies, candies, creams, and lozenges.
- Concentrated oils vaping.
- Dried Flower Buds smoking.
- Current market >60% MIPs and growing.





## Cannabis Production Stages

**Crop Production Time: 12-14 weeks** 

#### Clone

- Period when clippings from 'mother plants' grow roots: 10-14 days
- Bottom heat: +/- 80\*F
- 90% RH

### Veg

- Period when plants grow vegetatively.
- 18 hours light, 6 hours darkness.
- 14-20 days common.

#### **Flower**

- Period when plants produce flower buds.
- 12 hours light, 12 hours darkness.
- 8-10 weeks to harvest, strain dependent.

### **Drying**

- 7-14 days.
- Cool (65\*F), dry (40% RH), dark environment, minimal air movement.
- 10-15% final moisture content.

# Clone



# Veg



### Flower



# Drying



### Cannabis Production Overview

### **Common Production Methodologies**

- Plants grown on benches in plastic nursery pots using drip irrigation.
- Growing media is primarily peat moss or coco fiber (coir).

### OR

 Hydroponic systems with rockwool cubes or clay pebbles on flood tables with recirculating water.

Less Veg time => smaller plants but more crop cycles/year (6) More Veg time => larger plants but fewer cycles (3).



### Cannabis Production Requirements

#### Water

- pH 5.8-6.2
- R/O systems eliminate potential contaminants.
- Volume per irrigation cycle = +/- 1 qt/sq ft of canopy.

### **Nutrients**

- Organic or chemical/salt based fertilizers.
- Fertilizer applications affect product taste and yield.
- Plant nutrient requirements based on science, not myth.

### Light

- PAR: Photosynthetic Active Radiation blue for Veg, red for Flower.
- 'Industry Standard' one light fixture covers 4' x 4' footprint.
- Both spectrum and intensity effect yield and potency.

### Supplemental CO<sub>2</sub>

- +/-1300 ppm improves plant growth and yields.
- Only necessary during 'lights on' period.
- Source must be highly refined.

### **Grow Room Environmental Parameters**

- **Lights On**: 78\*F +/-2\*, RH 50-55% +/- 3%.
- Lights Off: 68\*F +/- 2\*, RH <50% +/- 3%.
- Air Flow: 4 cfm per square foot of floor area.
- Air Velocity: 150-200 fpm.
- Air Changes per Hour: 15-20.
- LED lighting requires warmer production temperatures due to less heat radiated onto leaf surface.

## Questions?

# Thank You!

Fred Green

Princeton, MA

508-395-6321

fredgreen@sprintmail.com

