How to Increase Cannabinoids and Terpenoids in Cannabis Through Horticultural Management

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**Cannabis sativa** L.

- Annual, herbaceous species
- Dioecious (male and female plants)
- Cannabinoids – secondary metabolites
  - Trichomes on female flowers
  - Over 100 identified [1–3]
  - Unique physiological effects on animals
  - Decarboxylation (e.g. THCA vs. THC)
- Terpenoids = flavours and aromas
Introduction to Drought Stress

• Intermittent drought = high levels of essential oils [4]


• Drought generally reduces growth [7–9]
Research Objectives

Evaluate the effects of drought stress timing and frequency on cannabinoid and terpenoid content in cannabis.

Two trials:

- Drought applied once during the flowering stage
- Drought timing and intermittent drought
# Methods: Drought Stress

## Drought Stress Trial

- **Treatment**: Drought + well-watered control
- **Drought timing**: Week 7
- **Drought threshold**: Mid-day plant water potential (WP) between -1.4 and -1.5 MPa
- **Experimental design**: Completely randomized
- **Replication**: 4 for drought treatment and control
- **Pot volume**: 11 L
- **Measurements**: Only cannabinoids

## Drought Stress Timing Trial

- **Treatments**: Six + well-watered control
- **Drought timing**: Weeks 4, 5, 6, and 7 + two intermittent treatments
- **Drought threshold**: Leaf angle increase of ≈50%
- **Experimental design**: Completely randomized
- **Replication**: 7 for each drought treatment and the control
- **Pot volume**: 6 L
- **Measurements**: Cannabinoids and terpenoids
Drought Indicators

Location for leaf angle measurement to indicate degree of wilting in cannabis.
Results: Drought Stress

Net leaf photosynthetic rate after drought stress and subsequent fertigation at seven weeks into the flowering stage.
Results: Drought Stress

Drought Stress Trial

- No difference in floral dry weight (yield) between drought and control
- Drought *Increased*:
  - THCA concentration by 12%
  - CBDA concentration by 13%
  - THCA yield by 43%
  - CBDA yield by 47%
  - THC yield by 50%
  - CBD yield by 67%

Drought Stress Timing Trial

- No differences in yield or cannabinoid content among treatments
- Intermittent stress did not increase secondary metabolites or yield

Early stress treatments:
- Linalool yield 49% higher than the control
- Cis-ocimene exclusively in these treatments

Later stress treatments:
- Alpha-bisabolol yield 36% higher than the control
- Trans-ocimene detected only in these treatments and in the control
Disagreement in Cannabinoid Results

• Drought increased cannabinoid content in the first drought trial but NOT in the second
• Same variety and similar environmental conditions
• Different pot size
• Larger pot = slower onset of drought AND longer period of stress

Pot size matters!
### Summary: Drought Stress

#### Drought Stress

- Controlled drought stress can increase:
  - Concentration of THCA and CBDA
  - Yield of THCA, CBDA, THC, and CBD
- No reduction in floral dry weight irrespective of decreased photosynthetic rate

#### Drought Stress Timing

- Controlled drought timing can influence the concentration and/or yield of specific terpenoids in cannabis
- Pot size may influence rate of stress and cannabinoid content
- Importance of terpenoids?
Looking Forward

• Horticultural research on cannabis in its infancy
• This research helps growers, consumers, and regulators
• Legalization in Canada
Acknowledgements

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References


