



# 2019 UT Hemp Variety Trial: Diseases, Insects, & Yields

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# High Demands for Joint Effort: Diseases in Tennessee Hemp

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## Hemp Diseases

Hemp Variety Trial Showcase  
Hemp Inservice Training



# High Expectations



# Cultivated *Cannabis*

- *Cannabis sativa* L.
- Involves primarily two sub-species that freely interbreed:
  - *C. sativa* subsp. *sativa*
  - *C. sativa* subsp. *indica*
- Hybrids
  - Sativa or indica dominant
  - Balanced



Sativa



Indica



Hybrid





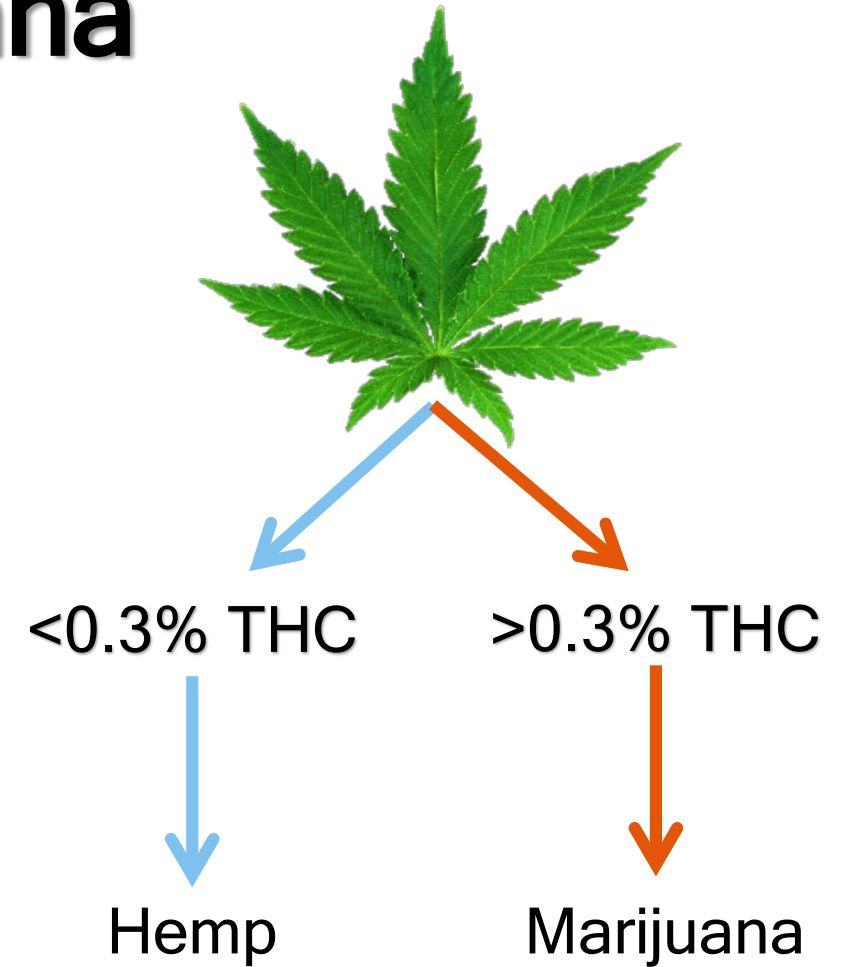
# Hemp vs. Marijuana

## Hemp

- 0.3% or less of delta-9-tetrahydrocannabinol ( $\Delta^9$ THC)
- Cultivated for seed, fiber, or flower
- Non-psychoactive extract

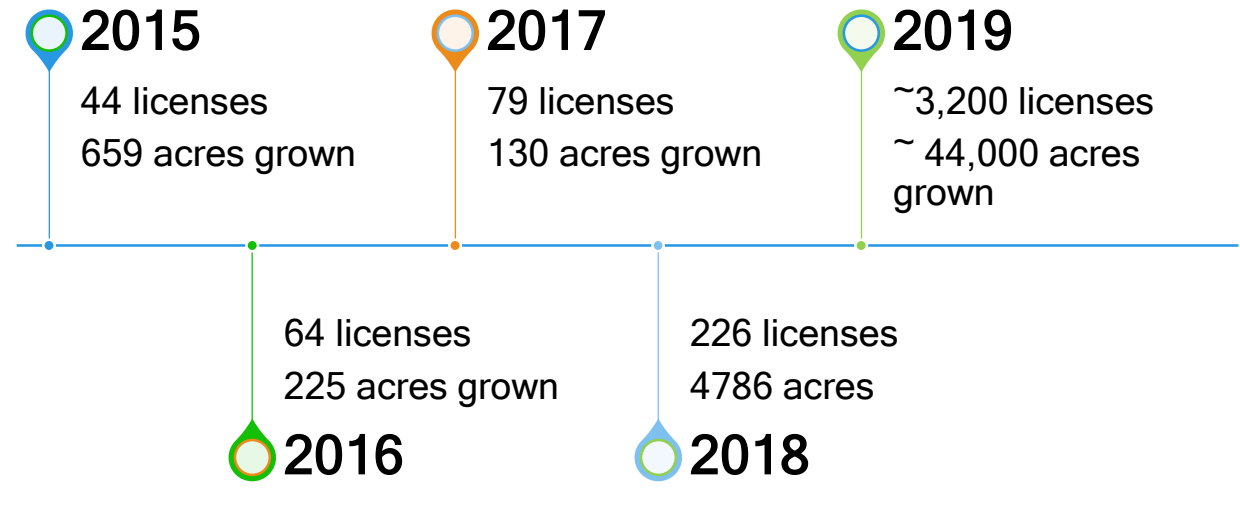
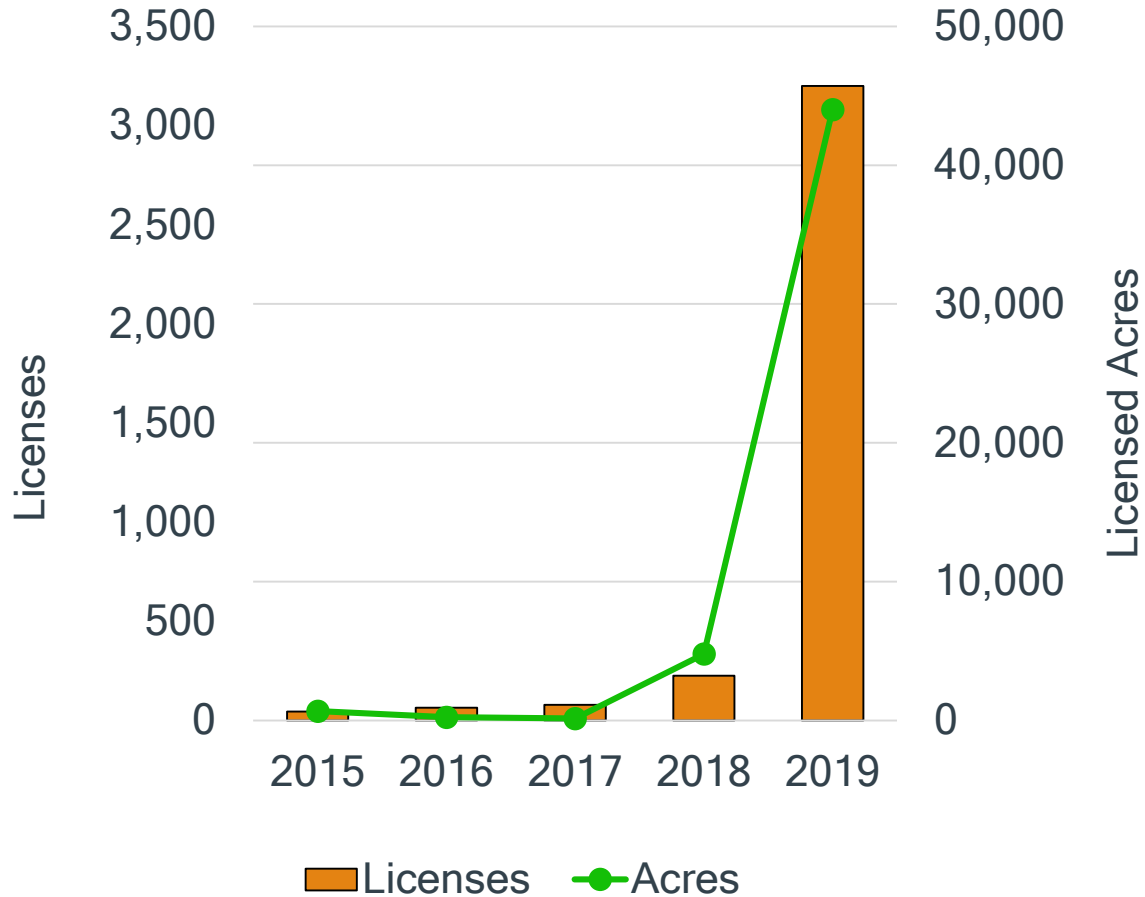
## Marijuana

- Contains greater than 0.3%  $\Delta^9$ THC
- Cultivated for medicinal or recreational use





# Hemp Production in Tennessee



(The number of licenses and acres grown in Tennessee since the first year of Tennessee Industrial Hemp Pilot Program with the Tennessee Department of Agriculture in 2015.)

Source: Tennessee Department of Agriculture



# The Plant Disease Triangle

For a plant disease to occur, three factors must be present and conductive:

## 1. Susceptible host ✓

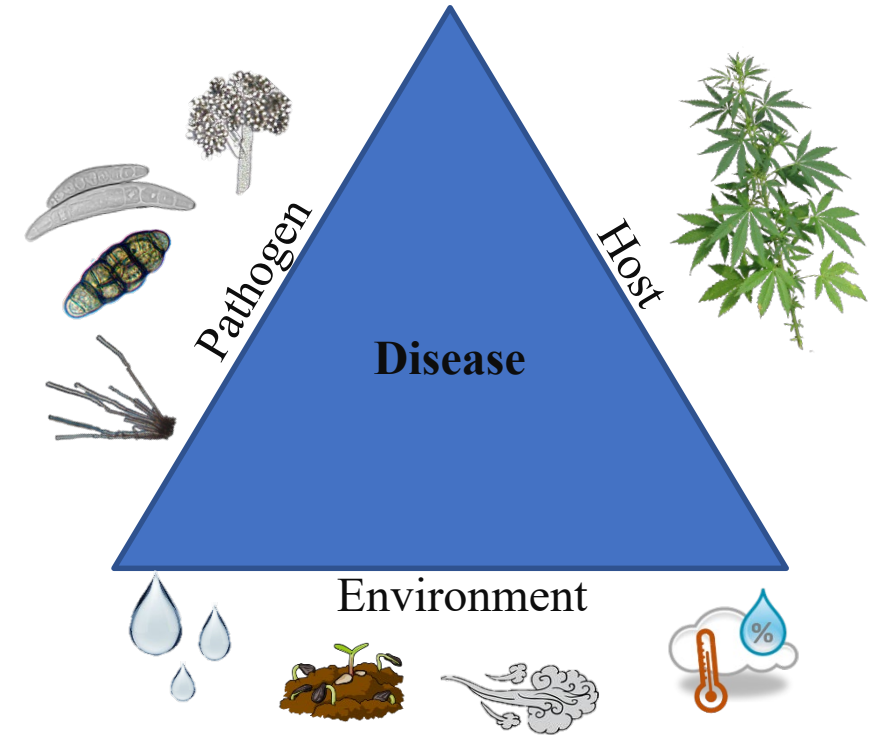
- Crop
- Cultivar
- Crop Stage

## 2. Pathogenic and Virulent pathogen ✓

- Fungi
- Bacteria
- Virus
- Nematode

## 3. Favorable environment

- Temperature (air and soil)
- Soil Physical and Chemical Properties
- Moisture (Rainfall, Irrigation)
- Relative Humidity





# Resources

## Hemp Diseases and Pests

Management and Biological control

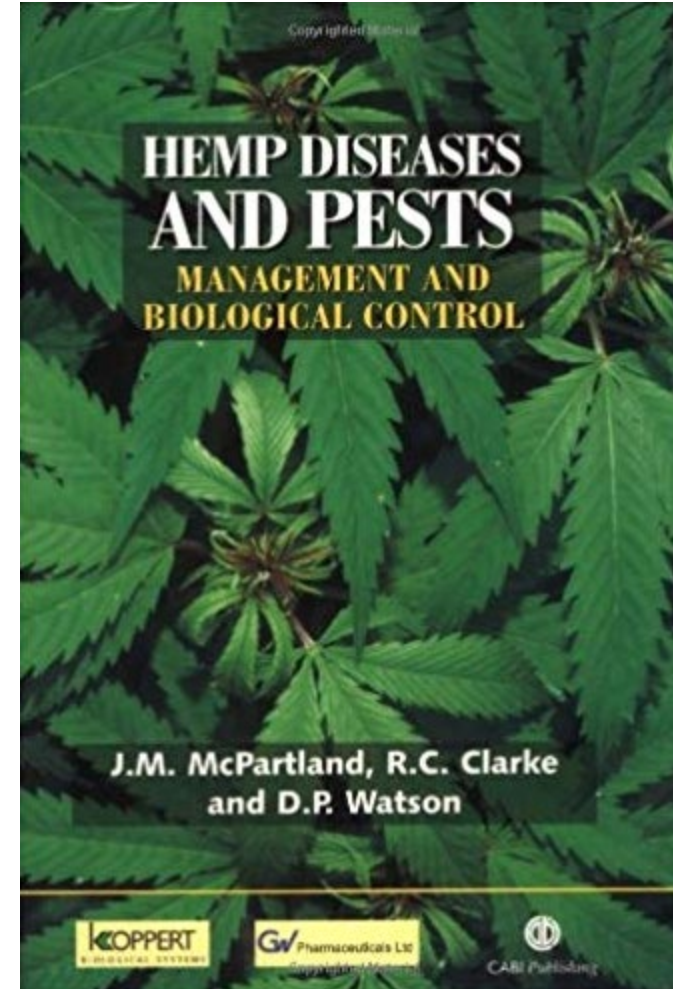
McPartland, J.M., Clarke, R.C., & Watson, D.P.

Cranshaw, W. et al. **Developing Insect Pest Management Systems for Hemp in the United States: A Work in Progress**, Journal of Integrated Pest Management, Volume 10, Issue 1, 2019, 26, <https://doi.org/10.1093/jipm/pmz023>

Specialty crops pathology lab, Knoxville, Dr. Zach Hansen

WEST TN REC, Jackson, Dr. Heather Kelly

Soil, Plant and Pest Center, Nashville





# The Many Diseases of Hemp

## Root, Crown and Stem

Seed & Seedling Disease\*

Root Rots\*

Fusarium Wilt, Crown Rot and Stem Canker\*

Hemp Canker

Cotton Root Rot

Verticillium Wilt

Dieback\*

Southern Blight\*

## Foliar

Leaf Spot Complex\*

Rust\*

*Chaetomium globosum*\*

Black Dot\*

Powdery Mildew\*

Bacterial Leaf Spot\*

Viral Diseases\*

## Nematodes

Root-Knot Nematode

## Storage Fungi

*Aspergillus* sp.\*

*Penicillium* sp.

*Rhizopus* sp.\*

*Mucor* sp.

Black Mildew\*

*Alternaria* sp.\*

## Flower/Bud

Botrytis Bud Rot\*

Fusarium Bud Rot\*

# Risk of Yield Loss from Disease

## High

- Seed and Seedling Diseases
- Bud Rots
- Southern Blight\*
- Postharvest Diseases

## Moderate

- Root Rots
- Wilts
- Cankers
- Leaf Spots\*

## Low

- Mildews

## Unknown

- Rusts\*
- Disease that have not been observed in Tennessee yet



# Southern Blight

Pathogen: *Sclerotium rolfsii* (syn. *Athelia rolfsii*)





# Rust

Pathogen: *Uredo kriegerinia*

- First observation in Tennessee in August 2019
- Symptoms and Signs:
  - Initially on lower leaves appearing as reddish-orange lesion with a chlorotic on upper leaf surface
  - On lower leaf surface, a cluster of brightly colored orange spores are apparent
- Impact on yield is unknown at this point





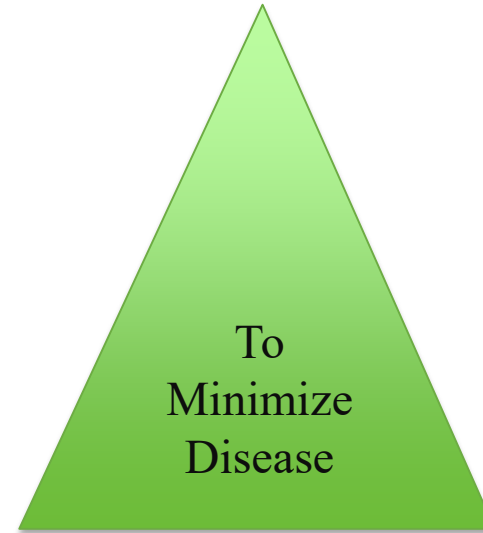
# Leaf Spot Complex

- **Pathogens** include several fungal genera:
  - *Cercospora*, *Bipolaris*, *Septoria*, *Exserohilum*, *Stemphylium*, *Curvularia*, *Colletotrichum* and *Alternaria*



# IPM Practices Applied

**Pathogen**  
Crop Rotation  
Pathogen-free seed or  
transplants  
Control volunteers  
Maintain weed control



**Host**  
Crop selection  
Adapted cultivars (maturity)  
High quality seeds or  
transplants

Tillage  
Reduced Tillage  
No-Till

**Environment**  
Proper Soil Fertility  
Planting Date

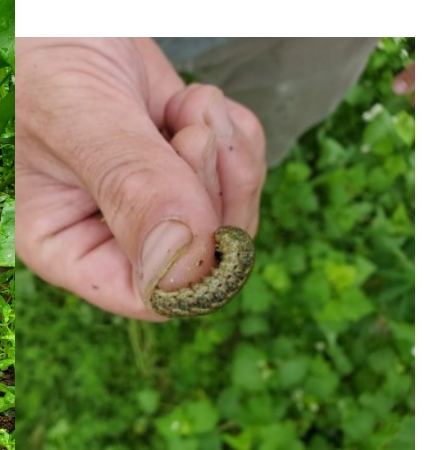
Stand Density  
Seeding Rate  
Row Spacing



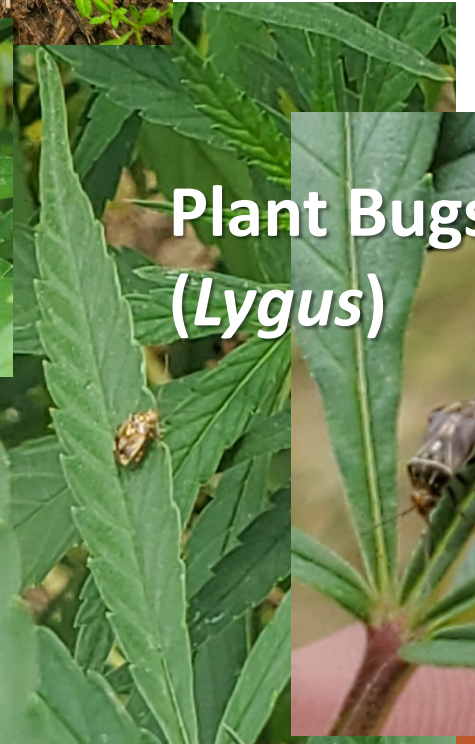
# Insects

Developing Insect Pest  
Management Systems for Hemp  
in the U.S.: A Work in Progress

[https://academic.oup.com/jipm/  
article/10/1/26/5555744](https://academic.oup.com/jipm/article/10/1/26/5555744)



\*Possibly spray  
ground before  
planting for cutworm



Also in TN Hemp:  
- Aphids  
- Mites





## Corn Earworm (*Helicoverpa zea*)

- Other common names: cotton bollworm or tomato fruitworm
- Overwinters as pupae in soil (~2-4 in.)
- Adult moths begin to emerge in early May
- Each female may lay **450-3,000 eggs**, hatch in 2-5 days (2-3 days in summer)
- Larvae develop through 5-6 instars, starting at ~1/16 in. up to 1 ¾ in., **feeding for 2-3 weeks**
- Larvae drop to ground and pupate in soil, 2-3 weeks pass before a new generation of moths emerge (at least **3 generations** occur in year in TN)



# Corn Earworm (*Helicoverpa zea*)

- Peak CEW last week July through September
- Severe damage to buds

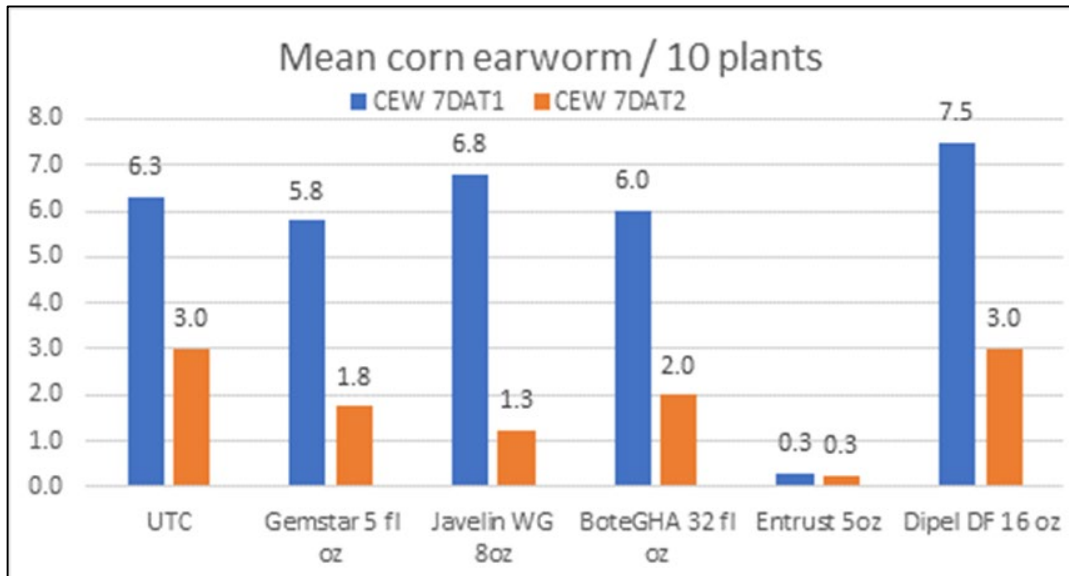






# Managing insect (corn earworm)

- Pheromone traps – only catch male moths (good for monitoring flights)
- Bt (Dipel, etc.) – very ineffective ...



- **Gemstar (5 fl oz/A)** – which is a nuclear polyhedrosis virus that is specific to the corn earworm species.
- **Javelin WG (8 oz/A)** – *Bacillus thuringiensis* (Bt) strain *kurstaki*
- **BoteGHA (32 fl oz/A)** – *Beauveria bassiana* – entomopathogenic fungi
- **Entrust (5 oz/A)** – Spinosad derived from soil microbes  
(NOT LABELED FOR USE IN HEMP)
- **Dipel DF (16 oz/A)** – Bt *kurstaki* different formulation
- Nuclear polyhedrosis virus-NPV (Heligen, Gemstar, etc.) – takes time for virus to spread and kill, may self sustain

# Trap Crops – possibility for managing insect (corn earworm)

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**VIP Corn Trait** (Trecepta, Optimum Leptra, Agrisure Viptera) – new trait that will kill CEW that feed on it

**Sorghum** – spray with Prevathon, Besiege, etc. (chorantraniliprole)

- ✓ Timing trap crop to bloom during hemp critical growth stage (budding)
  - Corn and sorghum – 2 to 3 weeks of attracting CEW
  - Multiple planting dates - June to July
  - Treating sorghum – once at mid-late bloom (with products above)
- ✓ Area of trap crop - ? Probably 5-10% of hemp acreage



# Weed Control





# 2019 UT Variety Trials

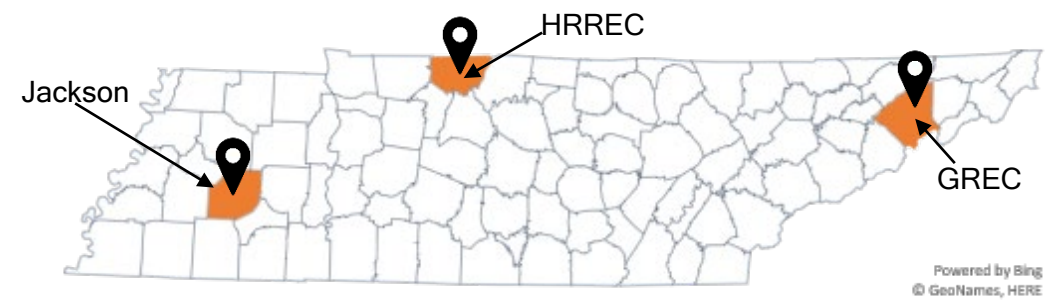
**Objective:** Evaluate varietal response to leaf spot of hemp for CBD production in Tennessee

**Data collected** (per plot = 10 plants/plot):

- Leaf spot incidence and severity
- Leaf spot index (Incidence\*Severity/100)
- Plant maturity
- Additional data from Jackson location:
  - Plant height
  - Number of branches
  - Yield
  - Cannabinoid results
  - Jackson harvest from Sept. - Nov.

**Data Analysis:**

- Used lmer function in R ver 3.5.1 with cultivar as fixed effect and replicate as random effect
- Means were separated using the Tukey's HSD test with  $P=0.05$



	Jackson <sup>1</sup>	HRREC <sup>2</sup>	GREC <sup>3</sup>
Number of Varieties	14	18	25
Experimental Design	RCBD	RCBD	RCBD
Replications	6	4	4
Plant Spacing	4.0-4.5 ft x 6 ft	6 ft	6 ft
Planting Date	17 to 19-Jun	17-Jun	28-Jun
Fertility	196-148-112	240-96-312	240-96-312
Disease Rating	14 to 19-Sept	7-Oct	2-Oct

<sup>1</sup>On-farm location in Jackson, TN (Madison County)

<sup>2</sup>Highland Rim Research and Education Center, Springfield, TN (Robertson County)

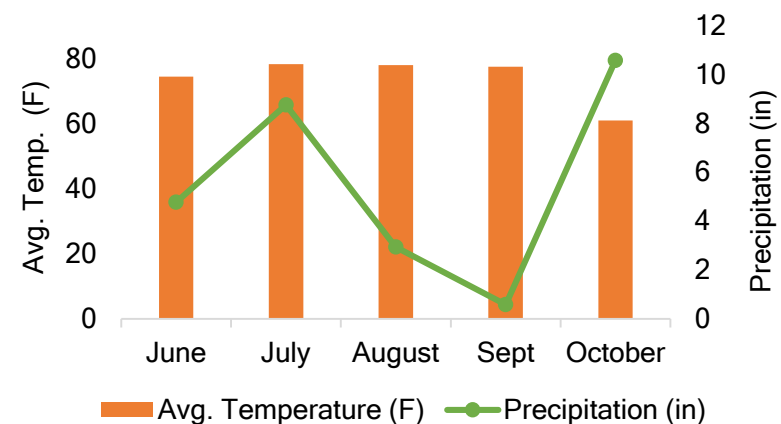
<sup>3</sup>Greeneville Research and Education Center, Greeneville, TN (Greene County)

# Field Conditions in 2019

## Jackson

Soil Type: Feliciana Silt Loam

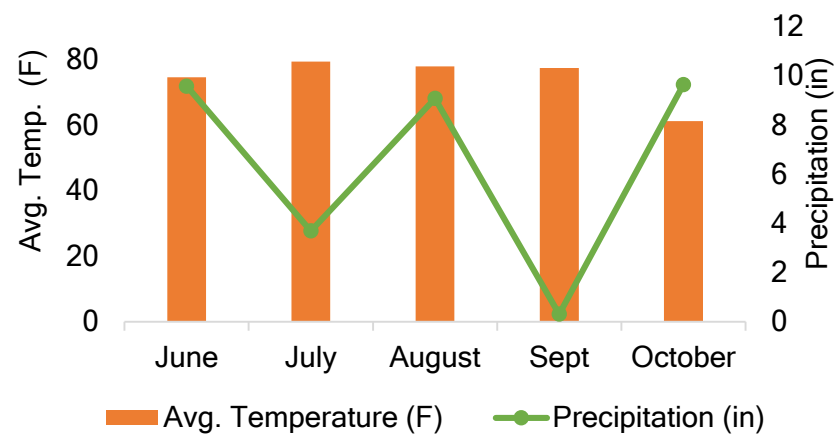
Soil Drainage: Well-drained



## HRREC

Soil Type: Baxter Cherry Silty Clay Loam

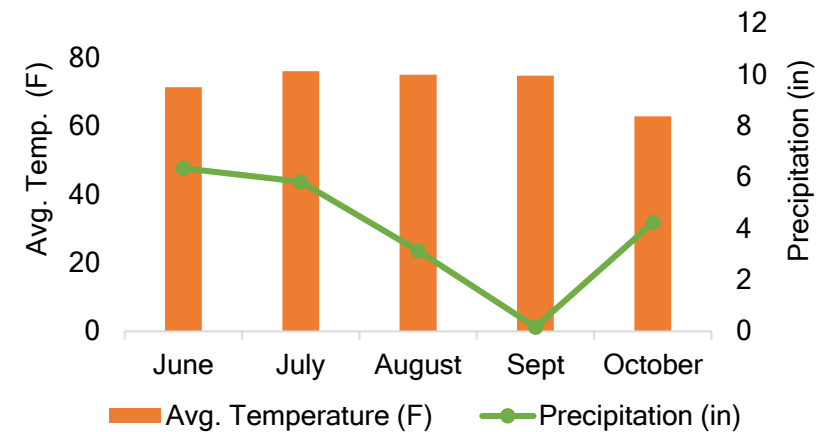
Soil Drainage: Well-drained



## GREC

Soil Type: Ooltewah Silty Loam

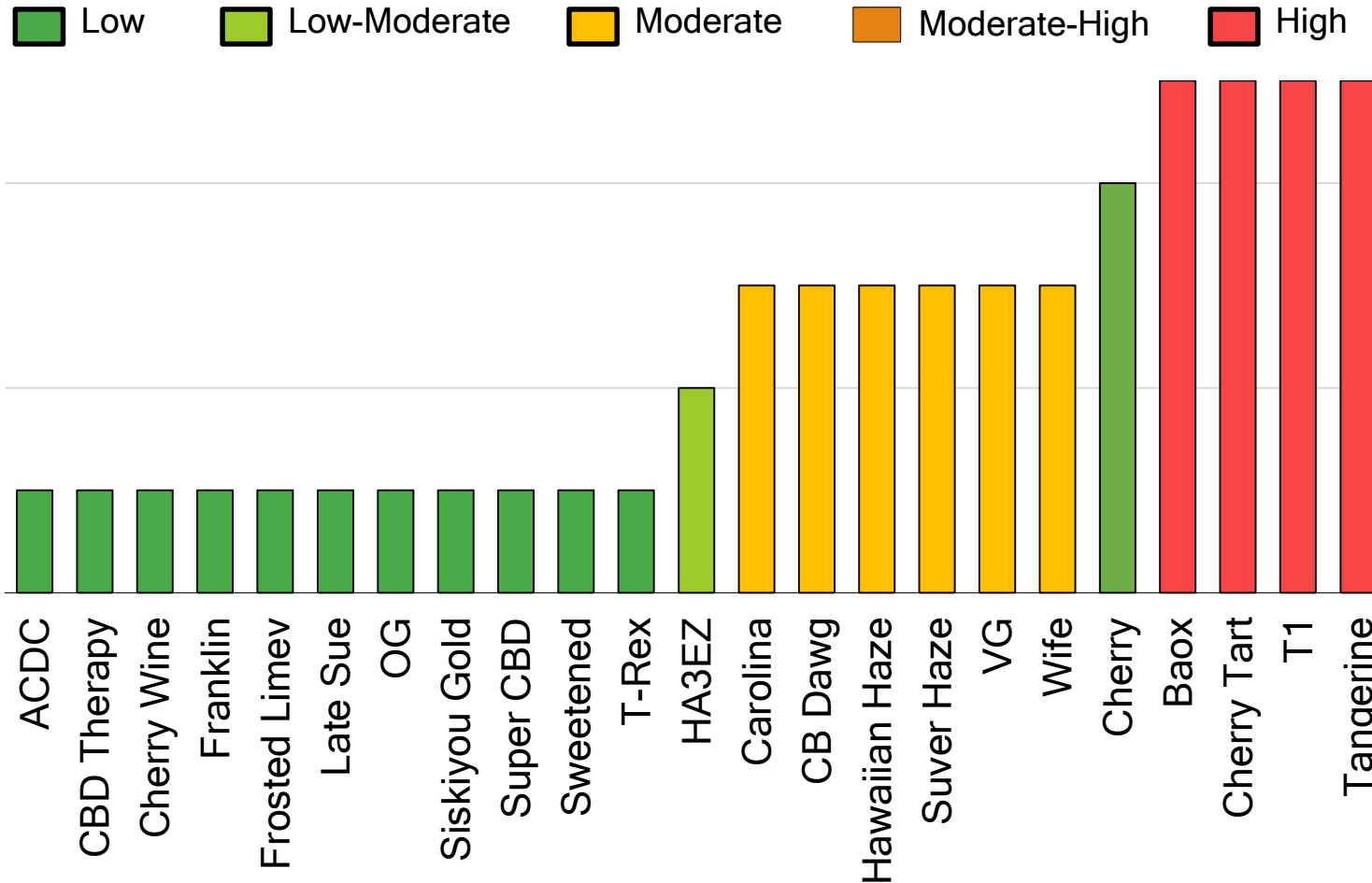
Soil Drainage: Mod. well-drained



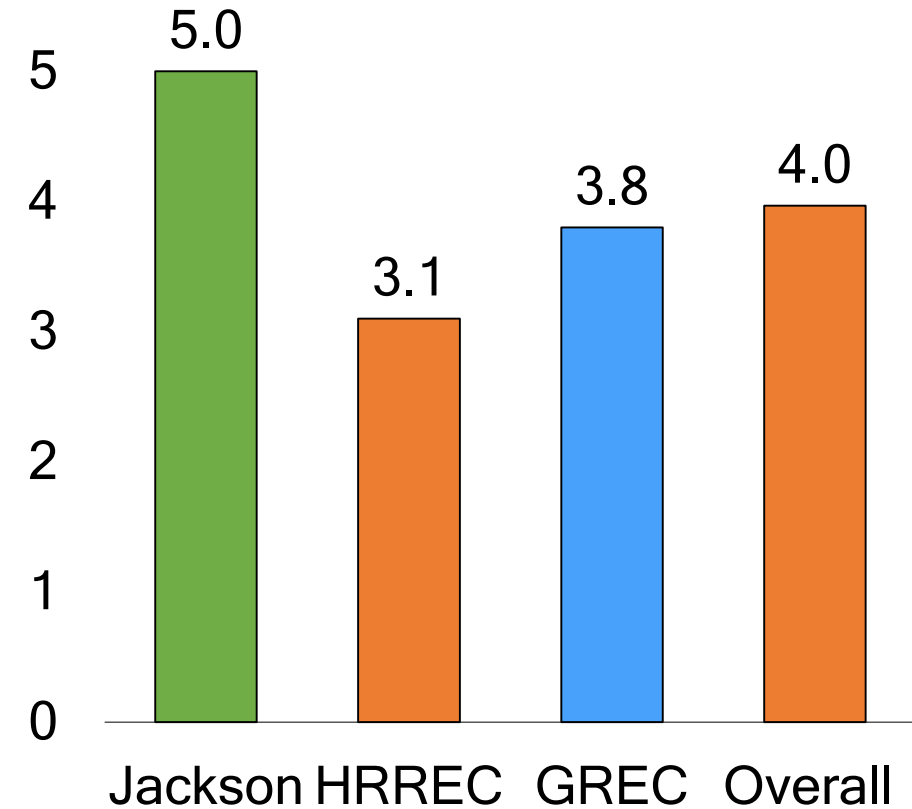


# Disease Susceptibility and Index

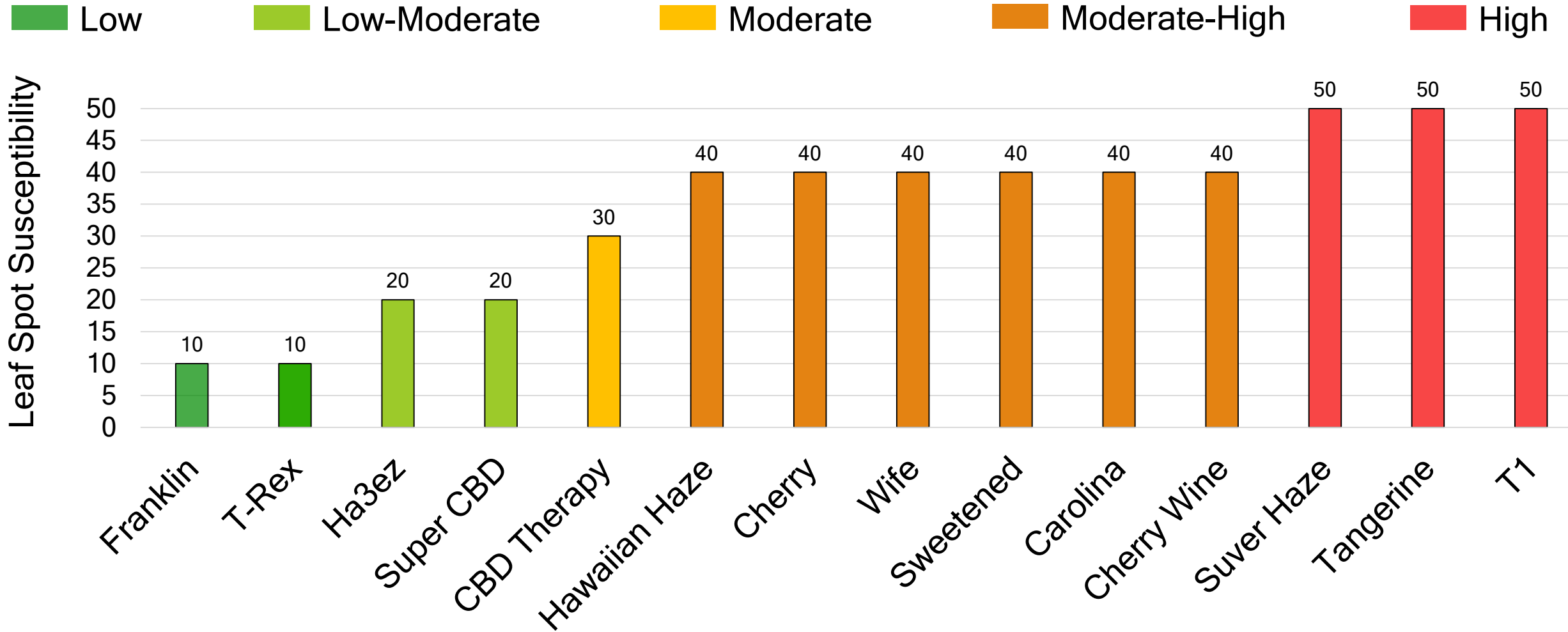
## Susceptibility Across Locations



## Average Disease Index per Location



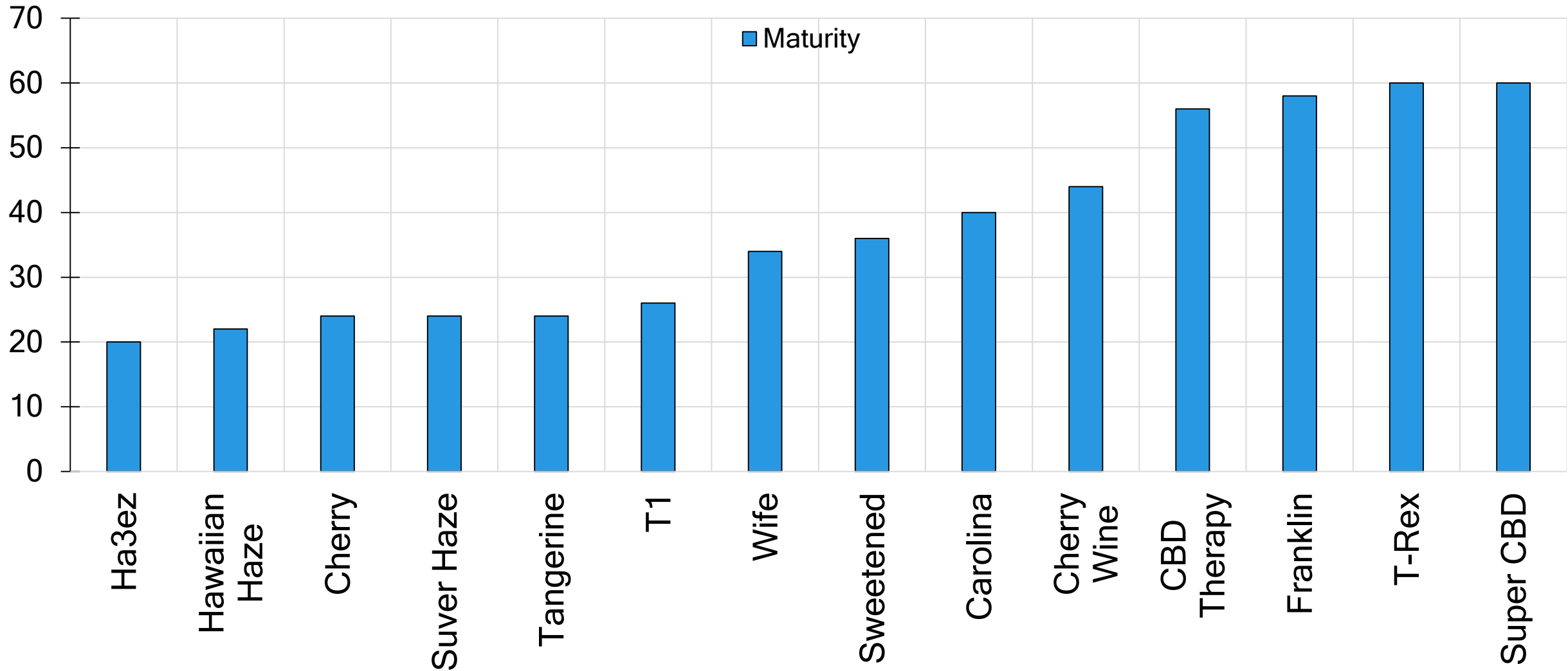
# Jackson





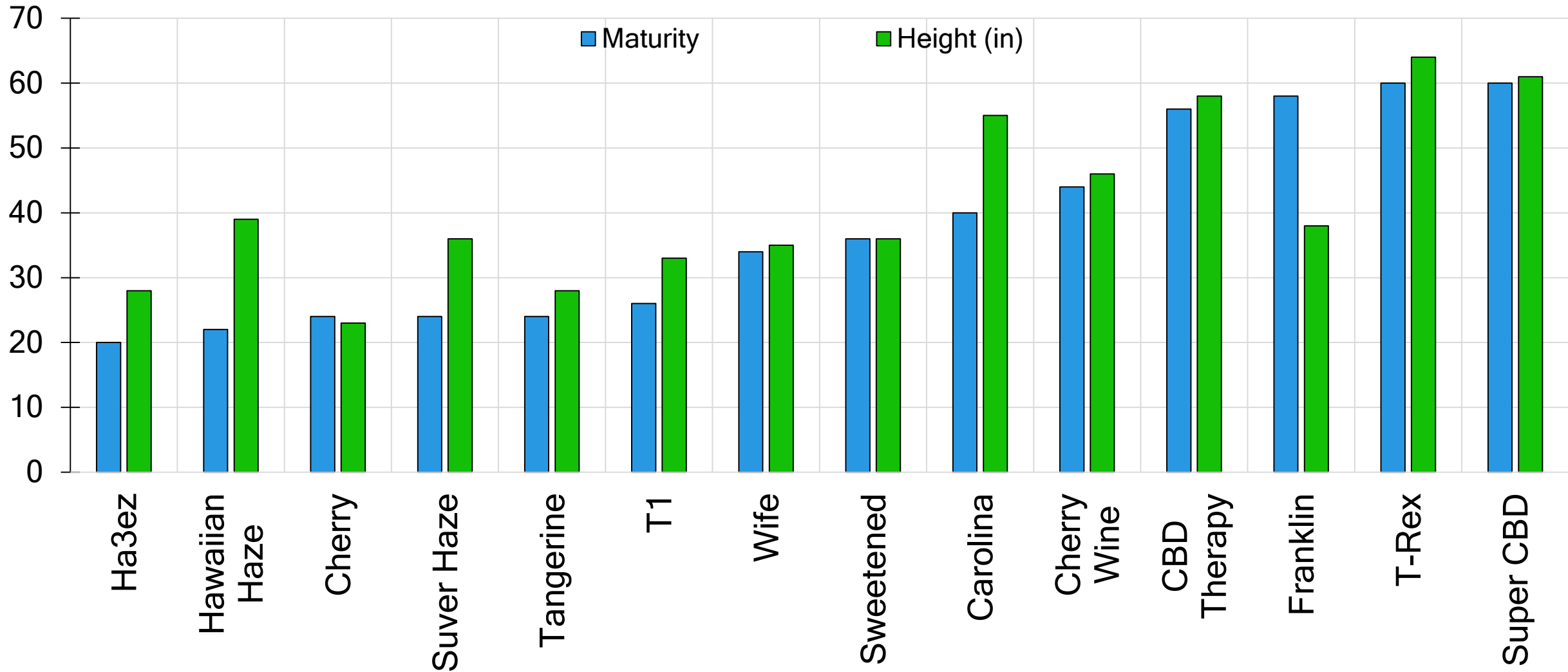
# Jackson Location

Maturity (scale converted to 20-60 range), height, and number of branches similar trend



# Jackson Location

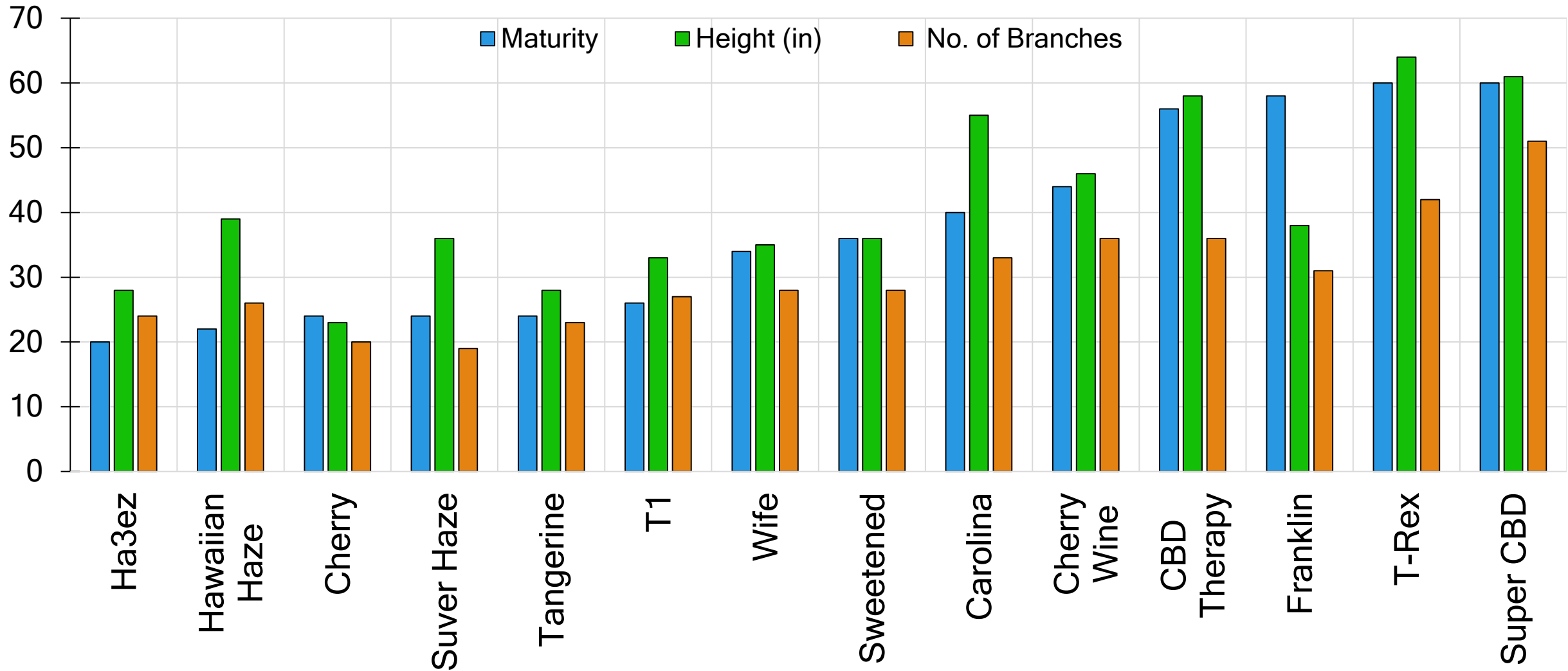
Maturity (scale converted to 20-60 range), height, and number of branches similar trend





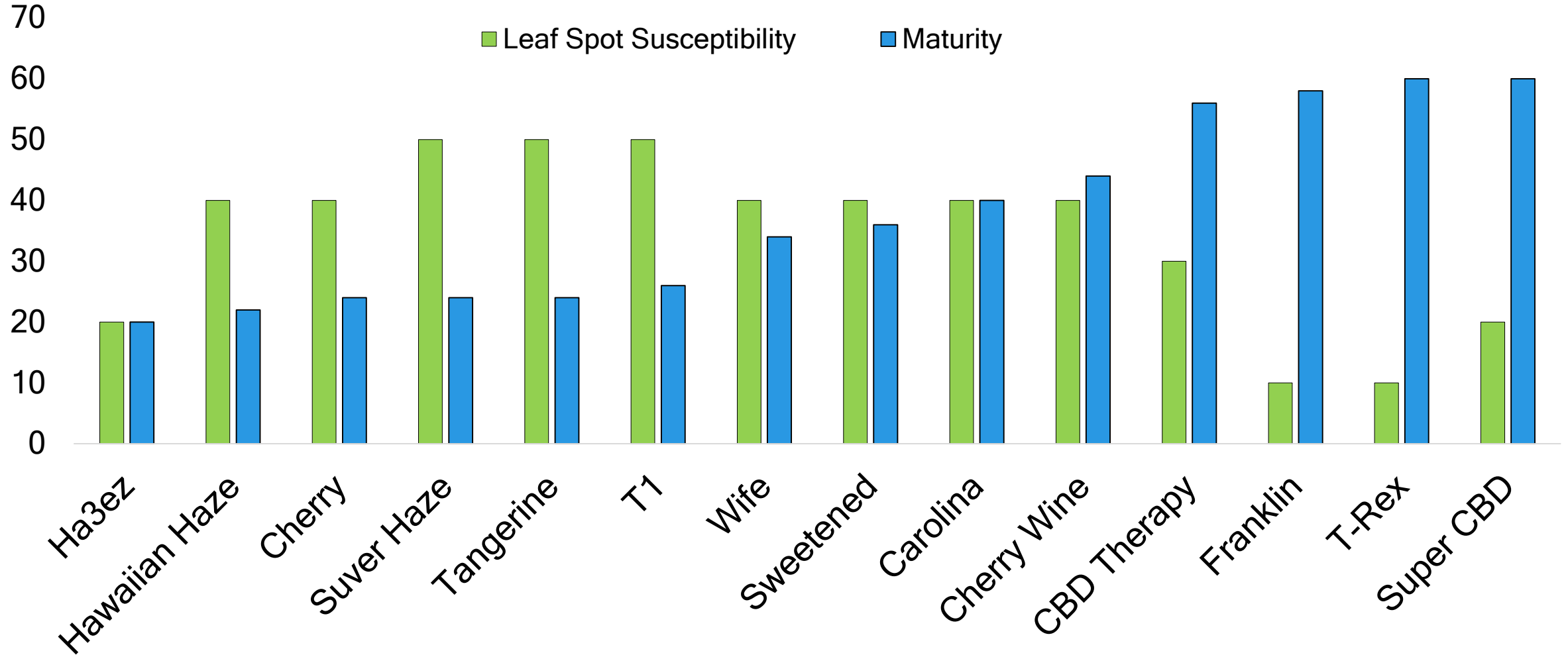
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# Jackson Location

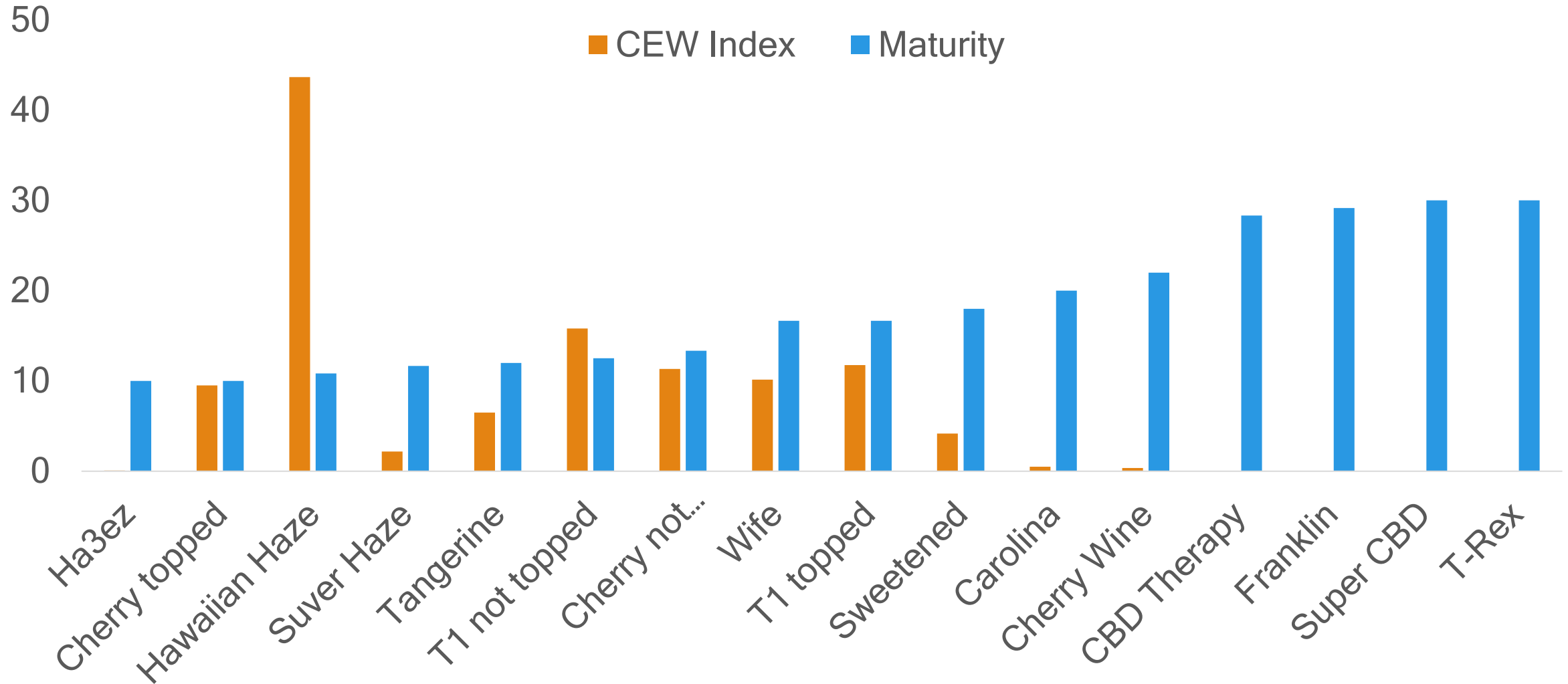
Later maturing varieties seemed to be less susceptible



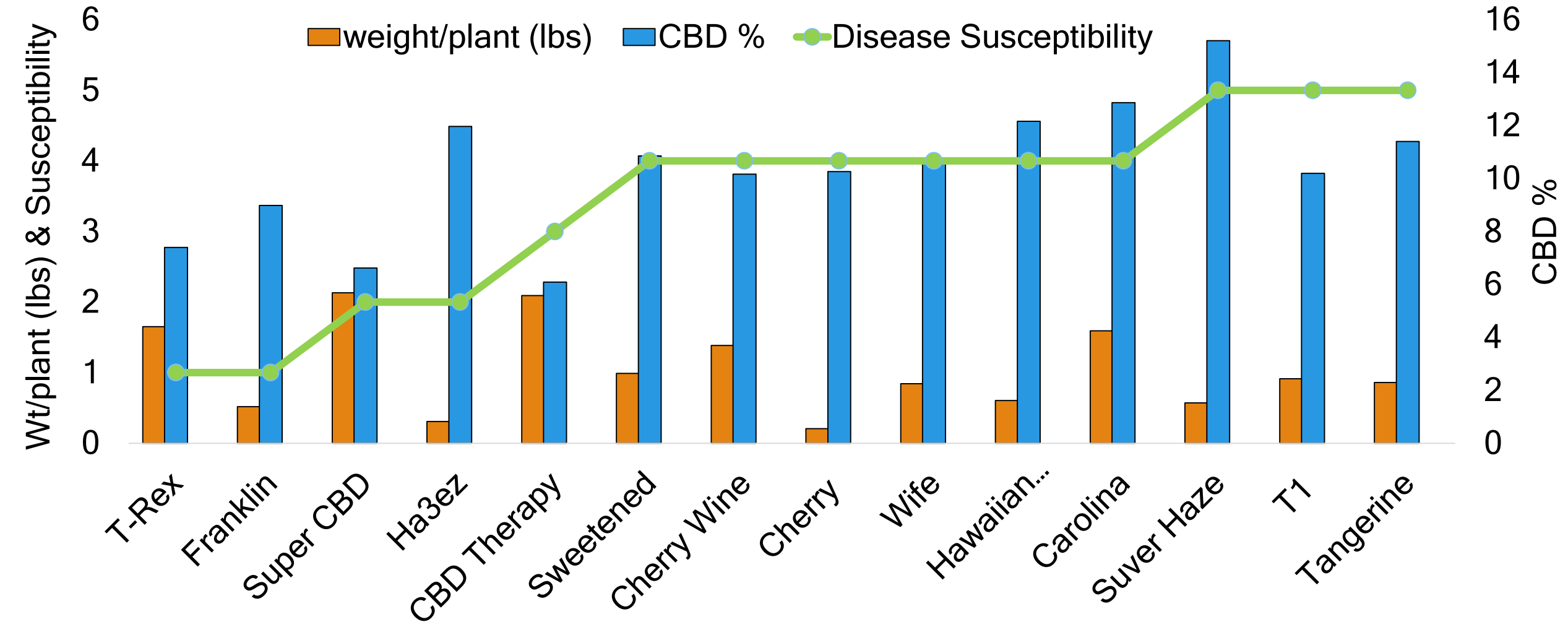


# Jackson Location

Later maturing varieties had less CEW injury  
(this trend will differ by location and year)

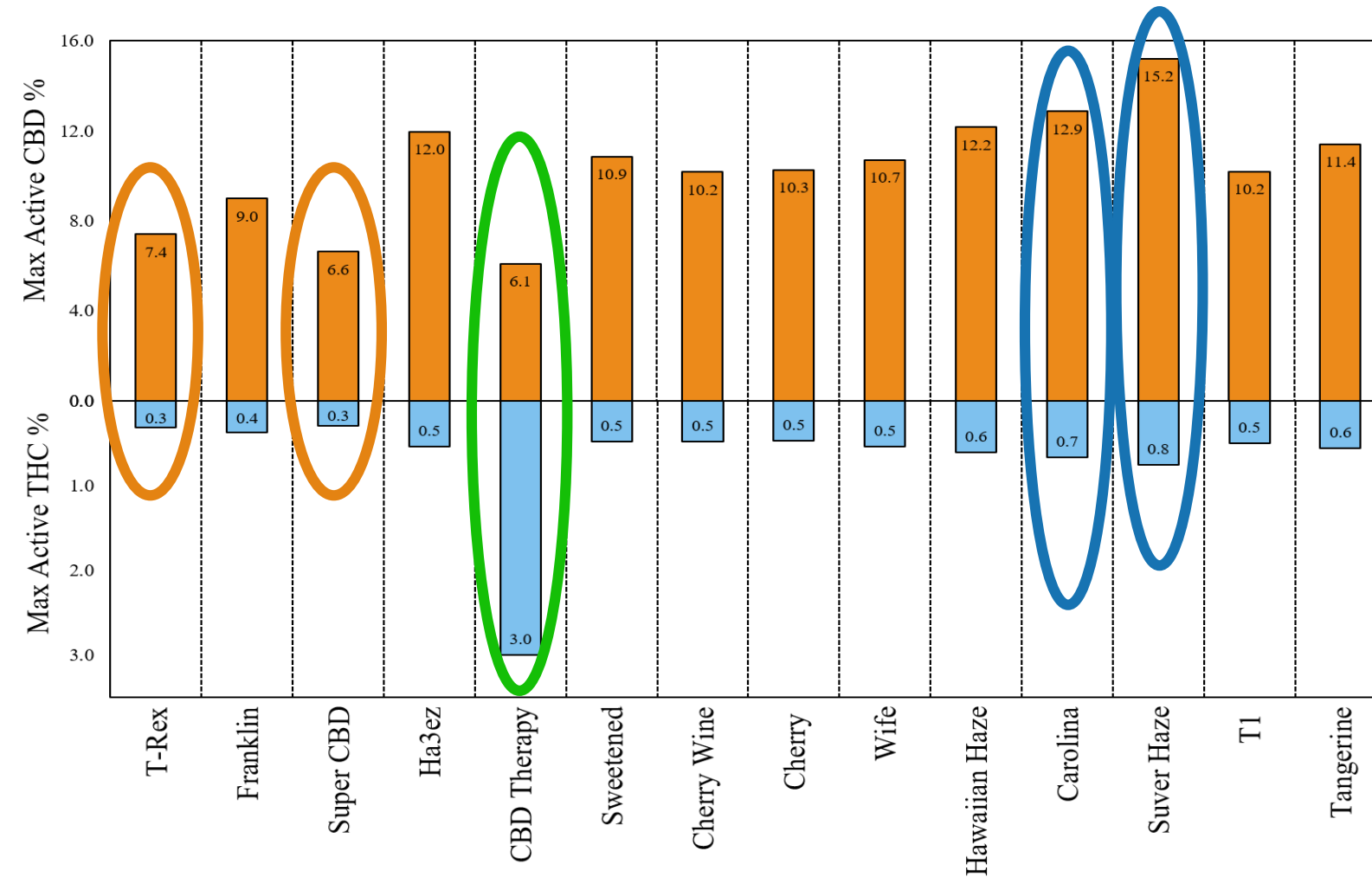


# Jackson Yield and Cannabinoid Data





# Cannabinoid Results from Jackson Location



Variety	Δ9-THC %	Max Active THC %	Max Active CBD %
Tangerine	0.06	0.6	11.4
T1	0.06	0.5	10.2
Suver Haze	0.11	0.8	15.2
Carolina	0.05	0.7	12.9
Hawaiian Haze	0.08	0.6	12.2
Wife	0.08	0.5	10.7
Cherry	0.11	0.5	10.3
Cherry Wine	0.04	0.5	10.2
Sweetened	0.04	0.5	10.9
CBD Therapy	0.12	3.0	6.1
Ha3ez	0.18	0.5	12.0
Super CBD	0.01	0.3	6.6
Franklin	0.01	0.4	9.0
T-Rex	0.01	0.3	7.4

# Thank you for your attention!

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