



# Choosing Your Cannabinoid: A Primer on the Pathway, Underlying Genetics and Considerations When Choosing What to Grow

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Innovation Series | July 23, 2020

# Arcadia brings modern agriculture expertise to GoodHemp



18+ years experience improving crops and their seed performance



Bringing deep understanding of other crops to hemp



Only publicly traded company in hemp genetics



Most experienced team in hemp genetics

- More PhDs, more geneticists
- Importantly, more practical field agronomists who have grown this crop previously







# Choosing Your Cannabinoid: A Primer on the Pathway, Underlying Genetics and Considerations When Choosing What to Grow

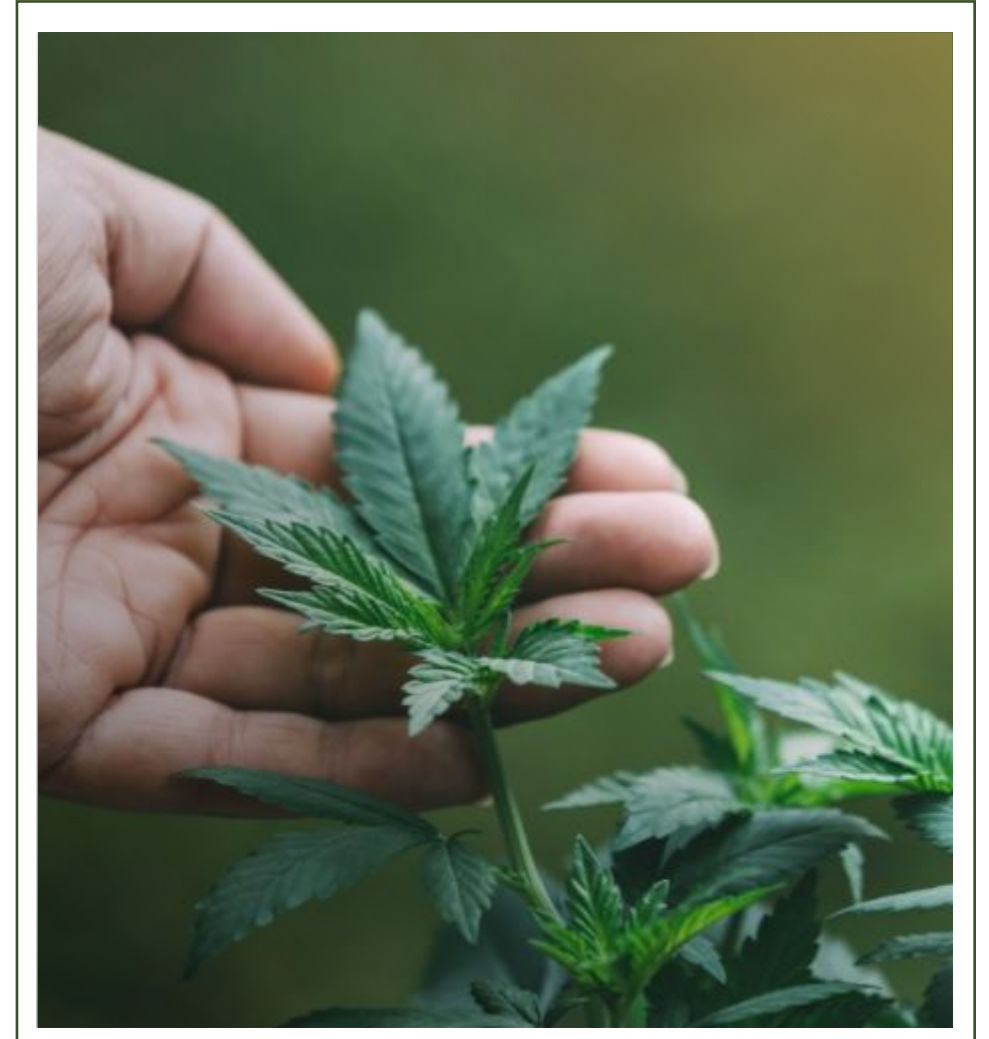
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# Brief overview of discussion topics

- ▶ What are cannabinoids?
- ▶ What cannabinoids are produced by cannabis?
- ▶ What cannabinoids are specific to 'Hemp'?
- ▶ What are the health benefits of the cannabinoids produced in hemp?
- ▶ Considerations when choosing the type of hemp you will grow.
- ▶ Compliance issues related to cannabinoid choice.





# What are cannabinoids?



Cannabinoids are part of plant secondary metabolism

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Plant secondary metabolites are involved in specialized functions not directly related to normal plant growth and development

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Terpenes, the chemicals that give cannabis and hemp its characteristic smell, are also important secondary metabolites



# What are the major and minor cannabinoids found in cannabis?



The major cannabinoids found in cannabis include THC, CBD and CBG



The majority of the cannabinoids produced by a cannabis plant are found in the trichomes associated with the female flowers



There are also minor cannabinoids that make up a smaller proportion of the total cannabinoid content





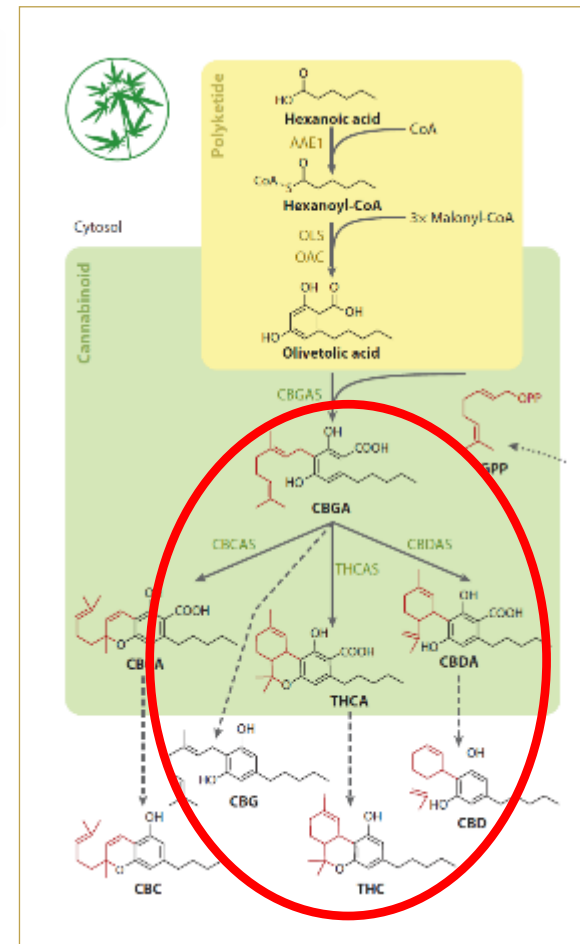
# Major cannabinoids – Hemp vs. marijuana alleles of CBD and THC synthesis genes determine chemotype

Chemotypes are **chemical phenotypes**

- ▶ The 4 chemotypes result from different combinations of genes involved in the cannabinoid synthesis pathway and cannabinoid production structures
- ▶ CBGA is the precursor of both THC & CBD
- ▶ Type I: THC>>CBD due to inactive CBDAS gene
- ▶ Type II: THC~CBD both are functional genes
- ▶ Type III: CBD>>THC due to inactive THCAS gene
- ▶ Type IV: CBG builds up because all are inactive



**Hemp growers must grow Type III or IV – otherwise not compliant!**



# Major cannabinoid accumulation levels



Germplasm currently available provides for varieties with the following ratios of flower cannabinoids

- Marijuana (type I) has ratios of THC/CBD of >30:1
- CBD Hemp (type III) has ratios of CBD/THC of ~25:1
- CBG Hemp (type IV) has ratios of CBG/THC of ~100:1



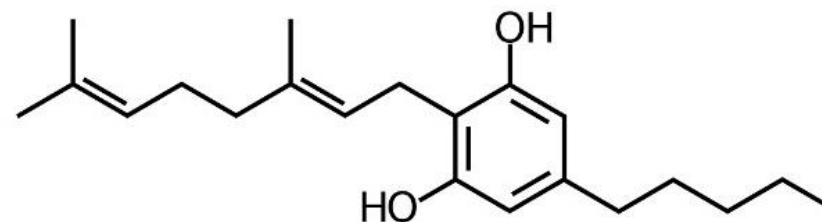
For Hemp the ratio between CBD or CBG and THC is critical. The greater this ratio the more of your desired cannabinoid can be produced before potential compliance issues related to THC content.



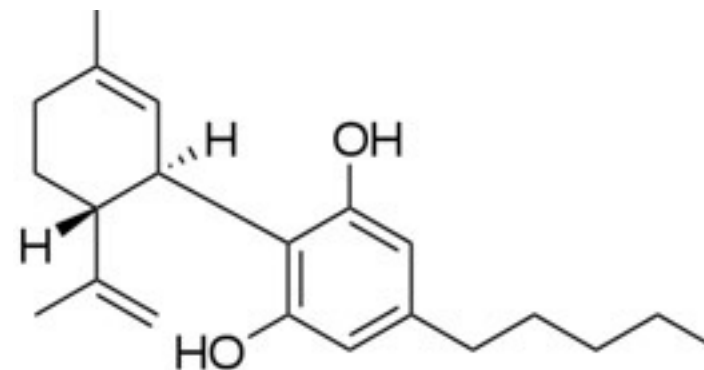
Reducing the amount of THC to improve these ratios is an active part of our breeding activities



CBG



CBD





# Value of analytical analysis



We have the internal capability to sample and analyze our varieties for chemotype



This enables us to ensure we are starting our breeding program with only type III plants



All plants used to produce our Developmental Varieties were screened for chemotype before seed production



# Pictures of hemp

**High CBG Hemp**



**High CBD Hemp**





# Minor cannabinoid accumulation levels



We generally see these minor cannabinoids accumulate to the following levels in individual plants in our breeding material:

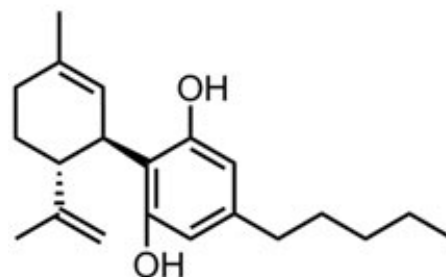
- CBC – undetectable up to 4% dry weight
- CBDV – undetectable up to 2% dry weight
- THCV – found primarily in type I and II plants
- CBN – product of THC degradation



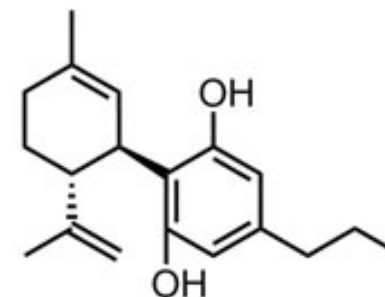
Our technology platform ArcaTech will allow us to perturb this complex pathway to better understand and manipulate cannabinoid levels.



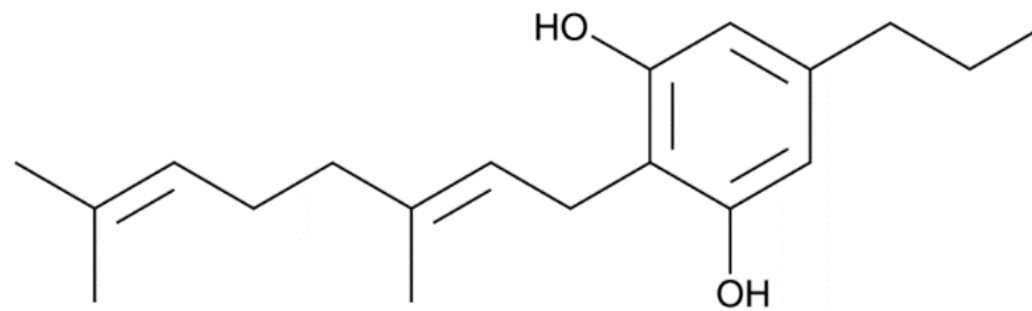
CBD



CBDV



CBGV



# Health benefits



CBD comes in many forms for consumption



There is a significant amount of ongoing research looking at the potential health benefits of various cannabis derived products



One CBD prescription drug on the market now in the USA

- Epidiolex is the first FDA-approved drug made with cannabidiol (CBD)





# Health benefits of CBD



CBD is the subject of many ongoing clinical trials to test its effectiveness against a broad range of health conditions



CBD has been granted Orphan drug designation for a number of lesser known conditions



CBD is the subject of Phase 2 or 3 human clinical trials for the following conditions:

- Anxiety
- Drug-resistant epilepsy
- Fatty liver
- Infantile spasms
- Opiate addiction
- Pain
- Parkinson disease
- Posttraumatic stress disorder
- Solid tumor
- Ulcerative colitis



# Health benefits of CBG



Varieties of cannabis producing relatively large amounts of CBG only became available recently.



Most studies have involved mice or similar non-human models to study CBG's benefits versus various conditions



It has shown some potential benefits in animal models for the following conditions:

- Inflammatory bowel disease
- Glaucoma
- Bladder dysfunctions
- Huntington's disease
- Bacterial infections
- Cancer



As available quantities of CBG increase, clinical trials of CBG will explore its potential health benefits in greater detail



# Growing considerations

There are more high CBD varieties currently on the market to choose from

- Some variation in resistances to pests and abiotic stress in different varieties giving choices for your particular needs.
- Suitable varieties available for many growing regions – still room for improvement.
- Offer greater variability in terpene profiles.

There are fewer high CBG varieties currently available

- Reported to be more susceptible to disease and insects.
- Available varieties may be very poorly adapted to some growing regions.
- Less variability in terpene profiles





# Additional considerations

## Extraction

- Both CBD and CBG can be extracted on the same equipment with some minor modifications depending on the specific extraction technology.
- If looking to isolate a particular cannabinoid, the starting material should be far in excess for that cannabinoid to make the extraction cost effective.
- Contact extractors directly with questions regarding extraction of CBD or CBG

## Market for CBD and CBG

- How will you sell it – do you have a buyer – are you aware of buyers in your area?
- There is a larger and more established market for CBD vs CBG
- Many growers are growing CBG this year due to its high compliance, but that may lead to a flooded market and low prices



# Compliance considerations



Hemp is defined as cannabis with <0.3% total THC in the 2018 Farm Bill with no regard to other cannabinoids.



Follow your states rules regarding approved varieties



State compliance testing is the same regardless of whether you are producing CBD or CBG







# THANK YOU

Please register and join for our next session:  
**Recognizing Male Hemp Plants in the Field:  
Improving quality of product**

Thursday, August 6th, 11 am Pacific time | 2 pm Eastern time

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