

# Preliminary Results and Lessons Learned Initiating Hemp Research at NMSU

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Specialty Crops Workshop

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# What is Hemp?

- Hemp is defined by the USDA as *Cannabis sativa* L. containing  $\leq 0.3\%$  total tetrahydrocannabinol (THC)
- U.S. re-legalized crop in 2018, following nearly 70 years of prohibition

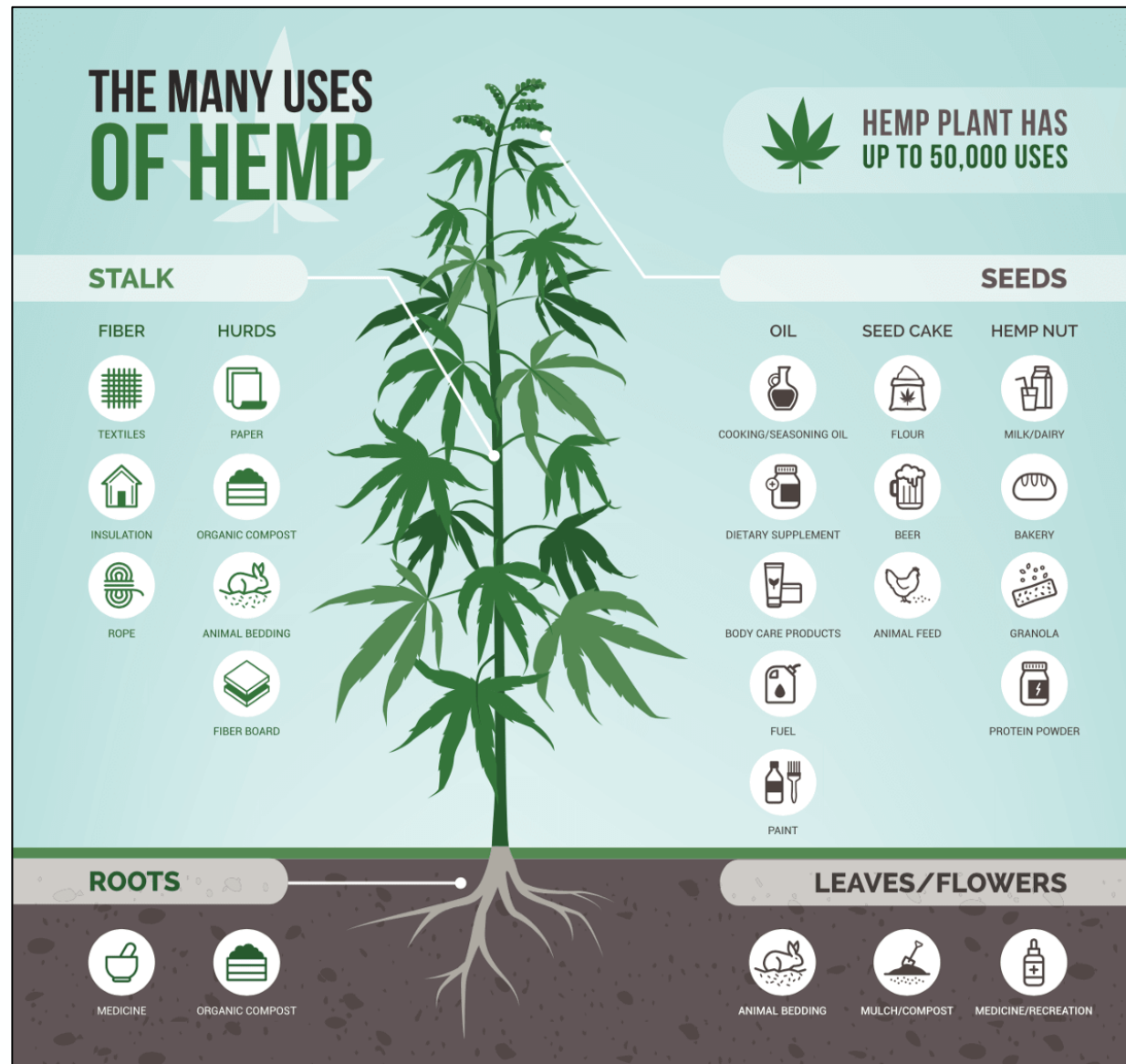


Image from Bloodhound Hemp Farms, 2020

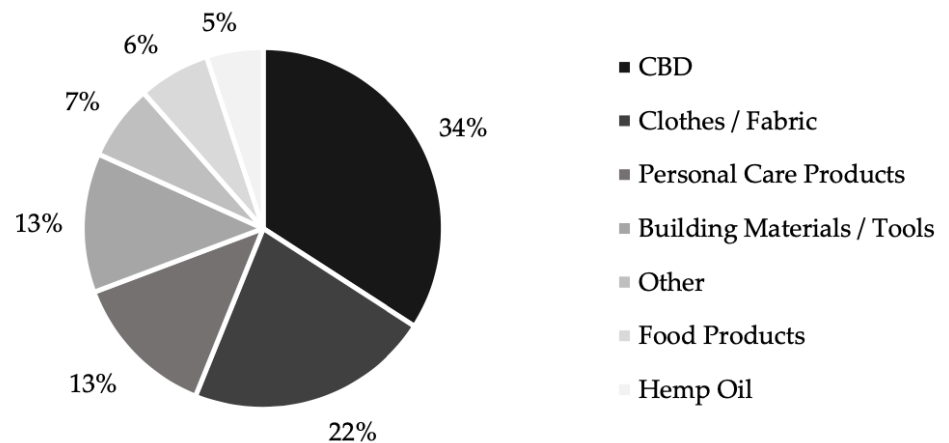
# Types of Industrial Hemp

- Types of hemp:
  - Flower (high-cannabinoid or essential oil)
  - Fiber
  - Grain
- US market *initially* dominated by cannabidiol (CBD) products – this is changing!



*Different hemp types: (left) CBD-type; (right) industrial-types*

***Hemp Products Purchased by U.S. Consumers (Kodilinsky et al., 2019)***

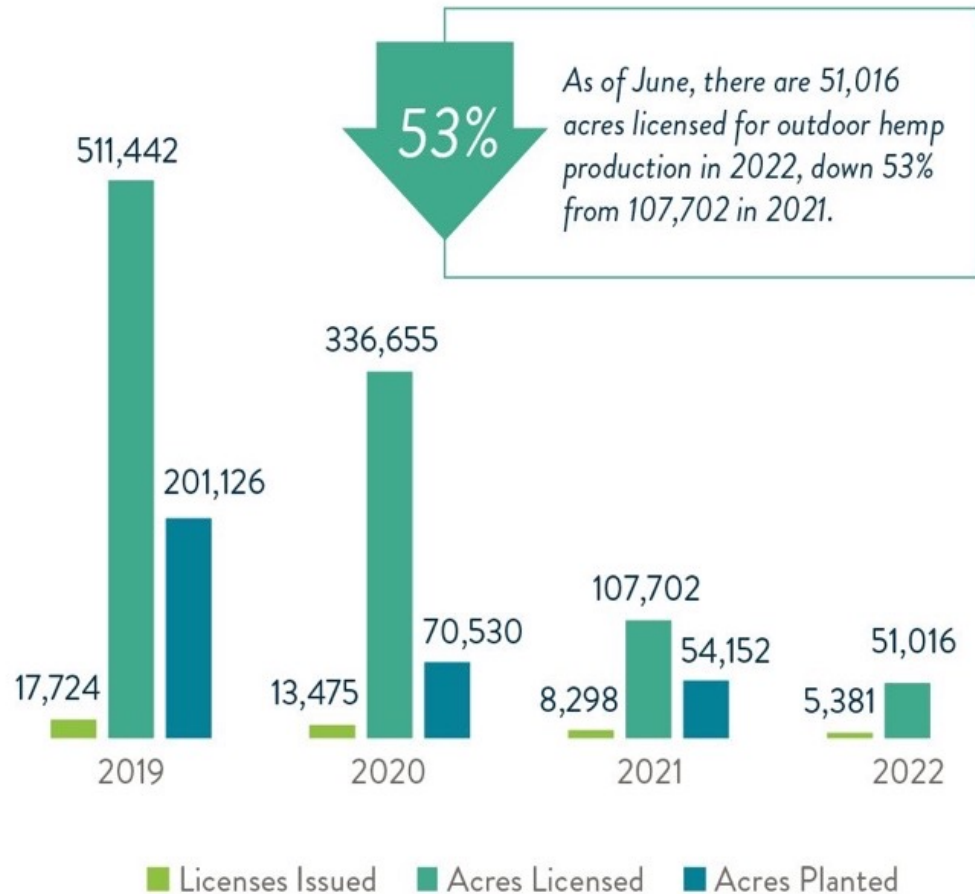




# Current State of Hemp in NM

- Decrease in hemp licenses issued in NM mirrors nationwide 53% drop in outdoor production
- NM recreational *Cannabis* sales went live April 1, 2022

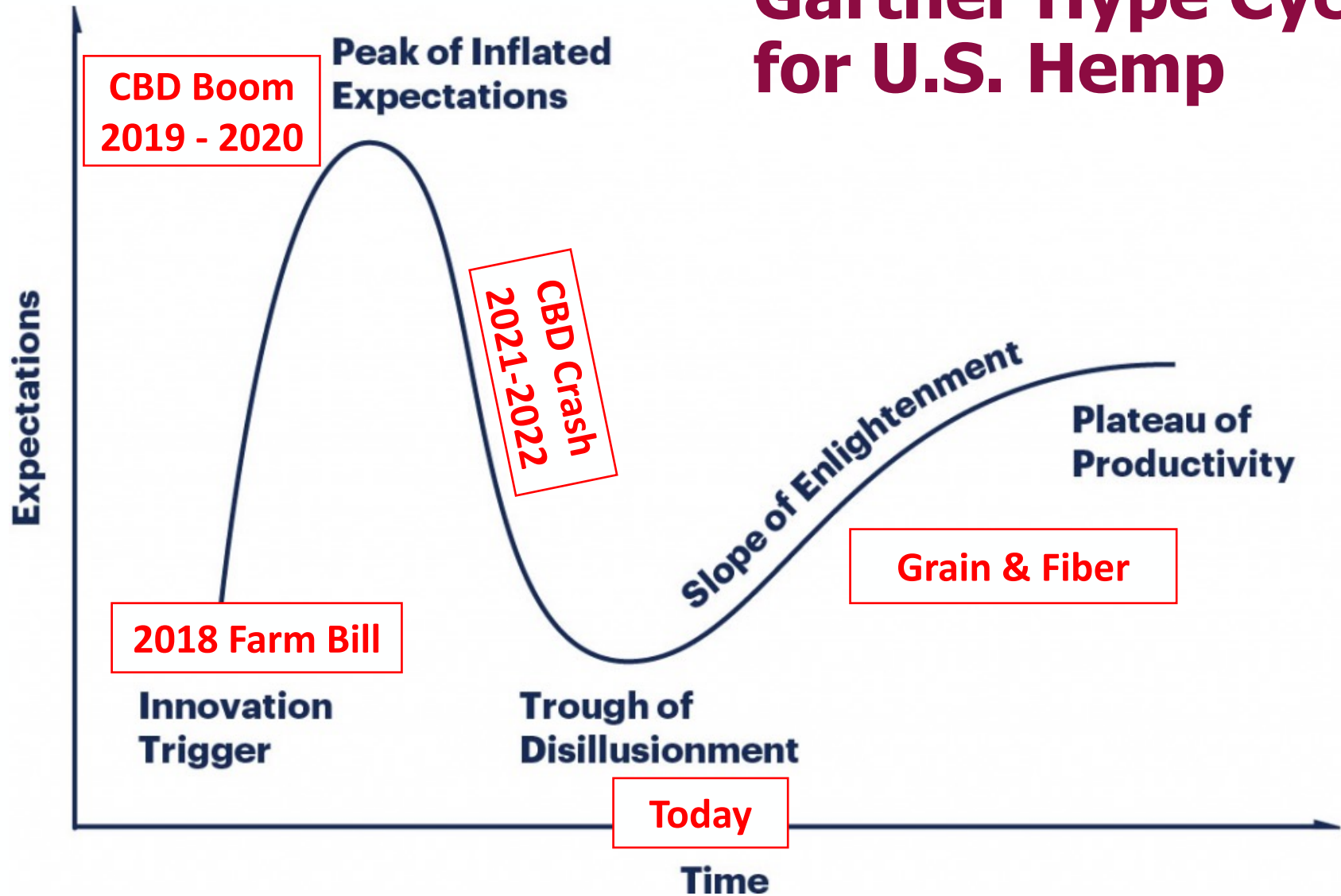
2019-2022 U.S. Hemp Acreage



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Singular, E. (2022). Midterm Review: A 2022 U.S. Hemp Production Outlook. New Frontier Data. <https://newfrontierdata.com/cannabis-insights/midterm-review-a-2022-u-s-hemp-production-outlook/>

# Gartner Hype Cycle for U.S. Hemp



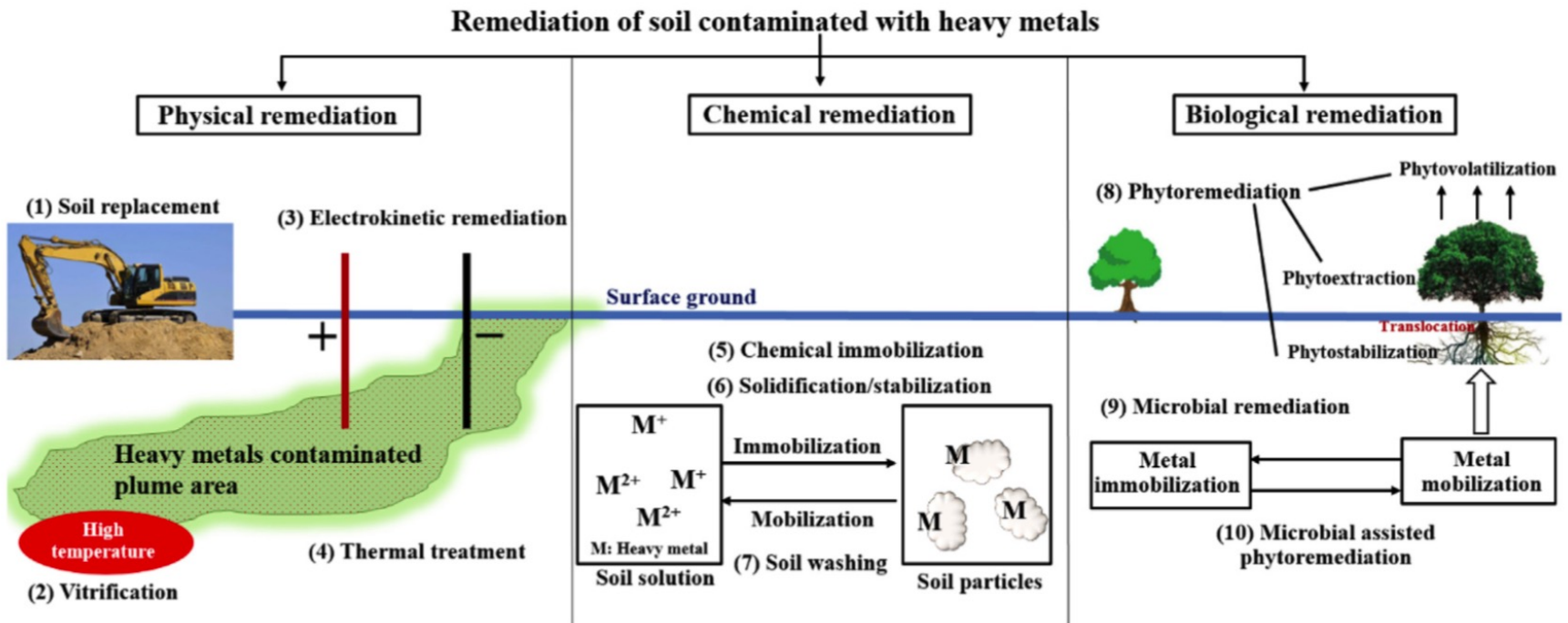
# Overview: Hemp Research at NMSU

- Phytoremediation trial (2019-2020)
- NMSU initial variety trial (2019-2020)
  - Farmington
- Expanded variety trials (2021-2022)
  - Leyendecker, Los Lunas, Alcalde



# Soil Remediation

- Traditional methods have high environmental impacts
- Interest in improving sustainable biological practices



# Phytoremediation Technologies

- Issues with large-scale implementation
- High cost without product potential

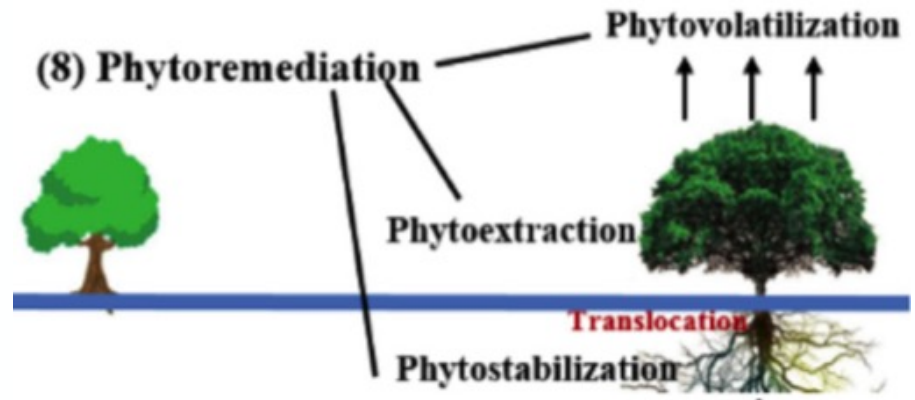


Table 1: Comparison between phytoremediation technologies

Technology	Action on Contaminants	Main Type of Contaminants	Vegetation
Phytostabilization	Retained <i>in situ</i>	Organics and metals	Cover maintained
Phytodegradation	Attenuated <i>in situ</i>	Organics	Cover maintained
Phytovolatilization	Removed	Organics and metals	Cover maintained
Phytoextraction	Removed	Metals	Harvested repeatedly



# Hemp as a Phytoremediator

Compound	Literature
Cadmium (Cd)	Citterio et al., 2003; Di Candilo et al., 2004; Linger et al., 2002; Meers et al., 2005
Cesium (Cs)	Szekely, et al., 1994
Chromium (Cr)	Citterio et al., 2003
Copper (Cu)	Meers et al., 2005
Lead (Pb)	Di Candilo et al., 2004; Linger et al., 2002; Meers et al., 2005
Nickle (Ni)	Citterio et al., 2003; Linger et al., 2002; Meers et al., 2005
Radium (Ra)	Soudek et al. 2006
Selenium (Se)	Stonehouse et al., 2020
Strontium (Sr)	Hoseini et al., 2012
Thallium (Tl)	Di Candilo et al., 2004
Zinc (Zn)	Meers et al., 2005; Shi and Cai, 2010



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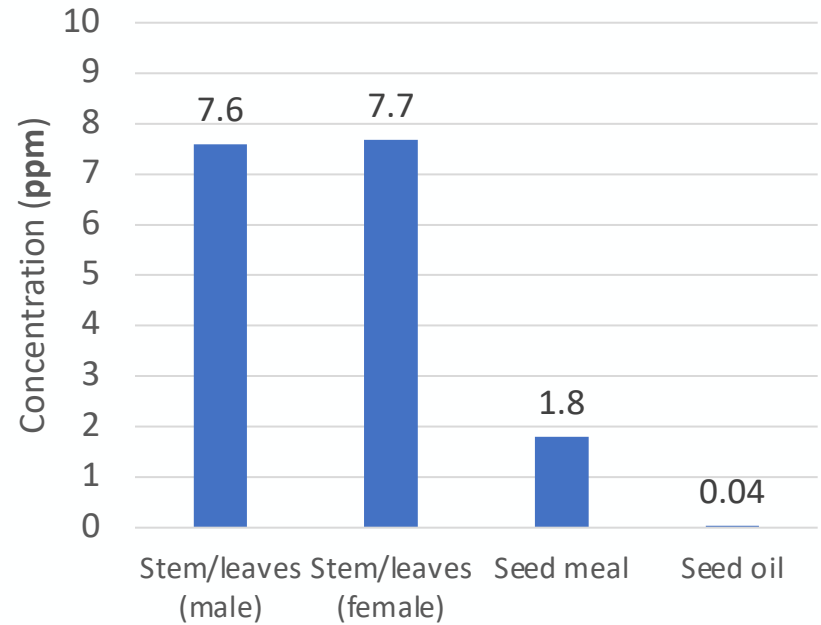
Rheay, H.T., Omandi, E.C., and Brewer, C.E. (2020). Potential of hemp (*Cannabis sativa* L.) for paired phytoremediation and bioenergy production. *GCB Bioenergy*, 13(4), 525-536.  
<https://doi.org/10.1111/gcbb.12782>

# Phytoremediation of Radionuclides

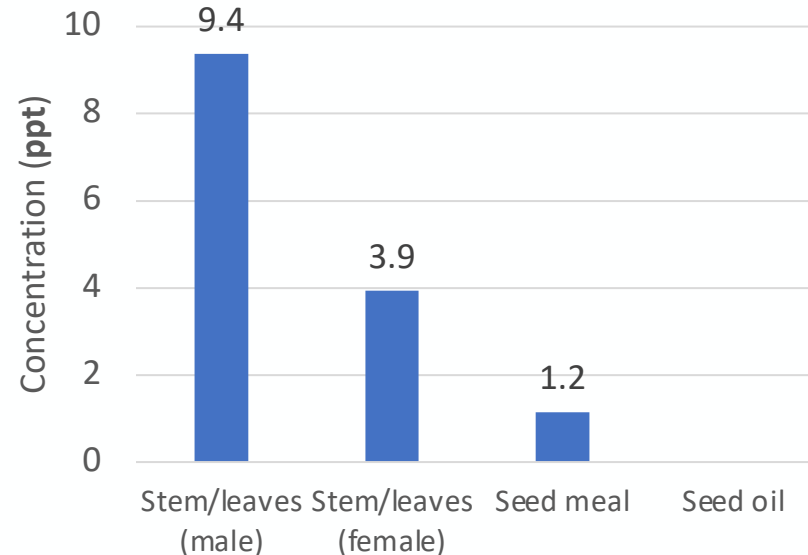
- 100+ years of production to reduce soil contamination to safe levels
- Low concentration of contaminants in oil increase the potential for use in non-food, fuel/material applications



### Uranium in Hemp Biomass

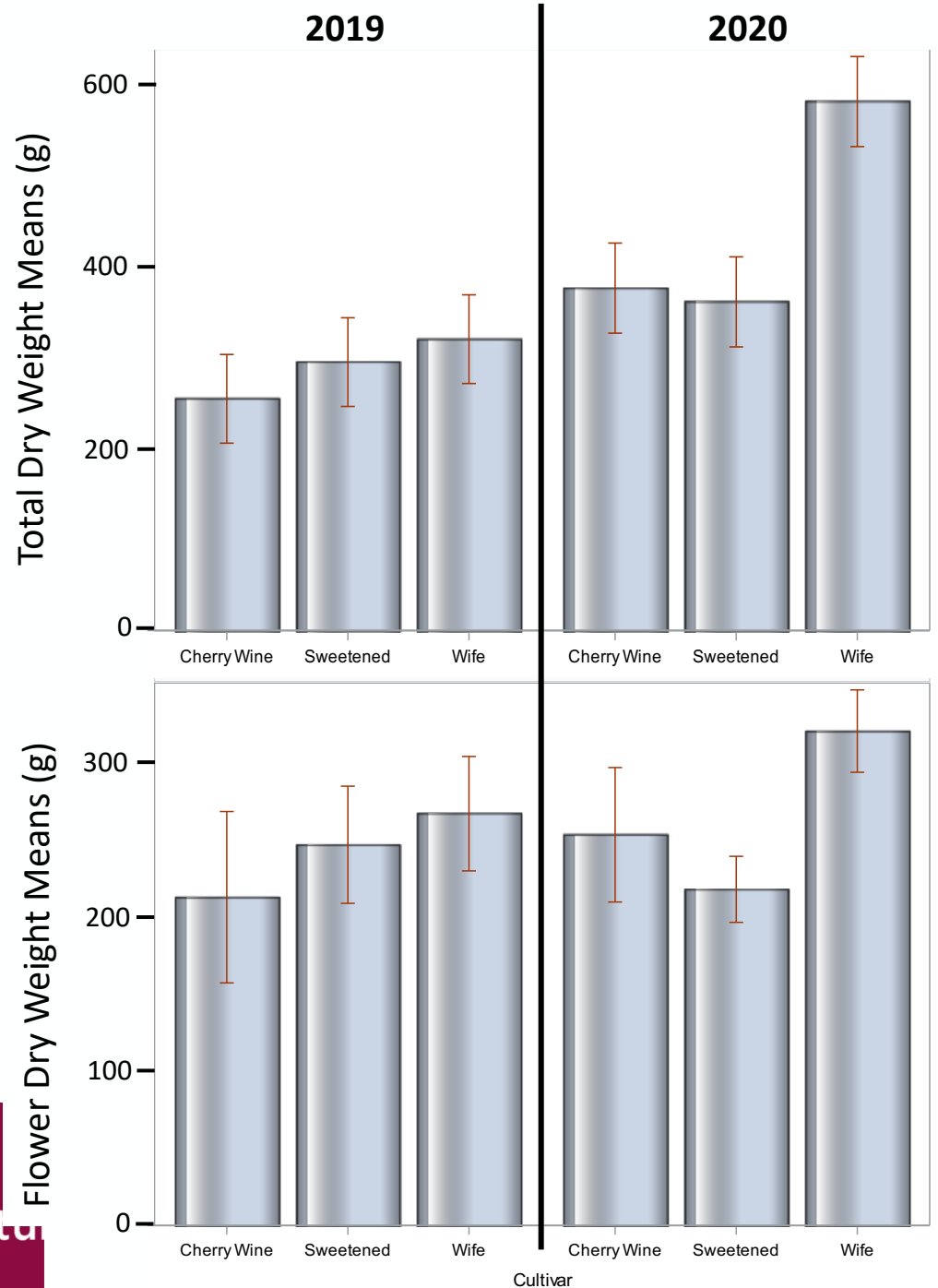


### Radium-226 in Hemp Biomass



# 2019-2020 Farmington Harvest Data

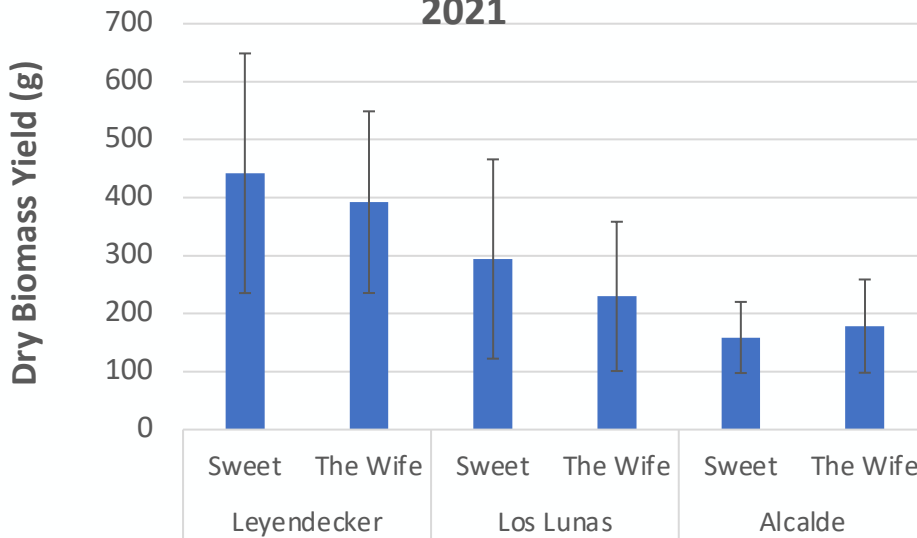
- 2019: over-head sprinkler + hand fertilization; planted mid-July
- 2020: drip irrigation + fertigation; planted mid-June



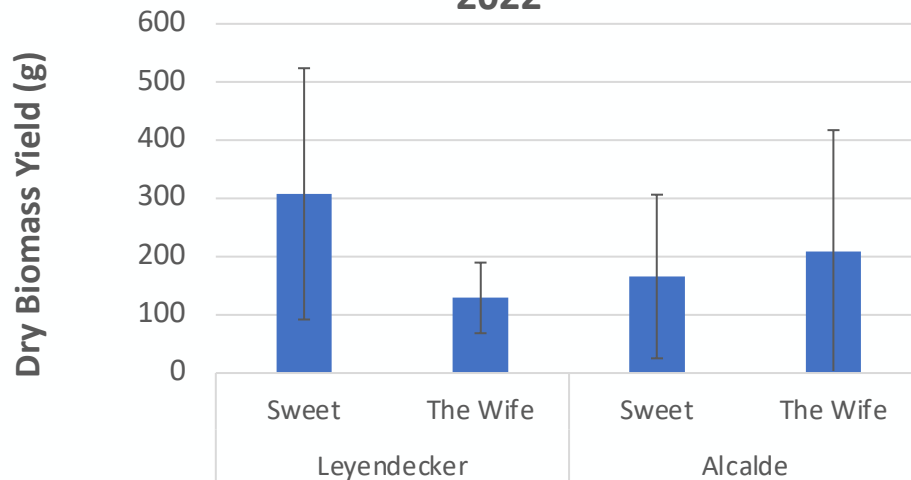
# 2021-2022 Variety Trials

- Yields are poor compared to indoor potential
- 30-70% of total crop weight was fiber across all sites/varieties

Flower + Leaf, Average Dry Biomass Yield,  
2021



Flower + Leaf, Average Dry Biomass Yield,  
2022





# Photoperiod Response

- 6 of 7 varieties exhibited early reproductive behavior
- MS-77 grew normally

Growth Stages Key		Sowing
		Vegetative Growth
		Reproductive Growth / Maturation
		Harvest

A. Anka (2021)							
Site	Days in Season	April	May	June	July	August	September
Expected	92-113			~75 days			
Leyendecker	111			25			
Alcalde	75				30		

B. Altair (2021)							
Site	Days in Season	April	May	June	July	August	September
Expected	92-113			~ 75 days			
Leyendecker	111			25			
Alcalde	75				30		

C. Earlina (2021)							
Site	Days in Season	April	May	June	July	August	September
Expected	115-120			~ 75 days			
Leyendecker	111			13			
Alcalde	75				22		

D. MS77 (2021)							
Site	Days in Season	April	May	June	July	August	September
Expected		Data not available					
Leyendecker	111				N/A <sup>1</sup>		
Alcalde	75				N/A <sup>1</sup>		

E. Orion 33 (2022)							
Site	Days in Season	April	May	June	July	August	September
Expected	138-143			~ 100 days			
Leyendecker	148		44				
Los Lunas	140			50			
Alcalde	138			55			

F. Felina 32 (2022)							
Site	Days in Season	April	May	June	July	August	September
Expected	133-138			~ 100 days			
Leyendecker	148		44				
Los Lunas	140			50			
Alcalde	138			55			

G. Futura 83 (2022)							
Site	Days in Season	April	May	June	July	August	September
Expected	112-117			~ 100 days			
Leyendecker	148		55				

<sup>1</sup> Plot was harvested before ½ of the plants exhibited flowering; although pollination was observed



# NMDA Supervised Destruction

- Plants at Los Lunas tested “hot” (above the legal THC limit)
- Huge variation in sampling and testing methods






# Observations & Lessons Learned

- Logistical issues with licensing and material quality
- Early flowering in grain/fiber
- Pests and disease
- Lack of best practices/standards



# Looking Ahead: Need for More Fiber/Grain Research in NM


 Hemp Grower

## Researchers Earn USDA Grant to Study Hemp in Cattle Feed

The \$200,000 grant will help the researchers determine the concentrations of cannabinoids in livestock after they've eaten hemp feed.

**BUSINESS**


## Feds Fund Research Into Hemp Fiber Insulation As Environmentally Friendly Alternative

 apg-wi.com

## Hempcrete may be a more viable option for tribe than CBD oils

## USDA Awards \$21 Million for Two Hemp Research Projects

The projects were selected as part of the first pool of grant recipients under the organizations Partnerships for Climate-Smart Commodity Program.

 Hemp Industry Daily

## USDA creating hemp germplasm collection, funding lab to ...

A new \$66 million Agricultural Research Service lab where scientists will study hemp farming, fiber, and plant breeding. Developing software ...

NIFA Joins Other USDA Agencies to Establish, Expand Industrial Hemp in the U.S.

**NM**  
STATE

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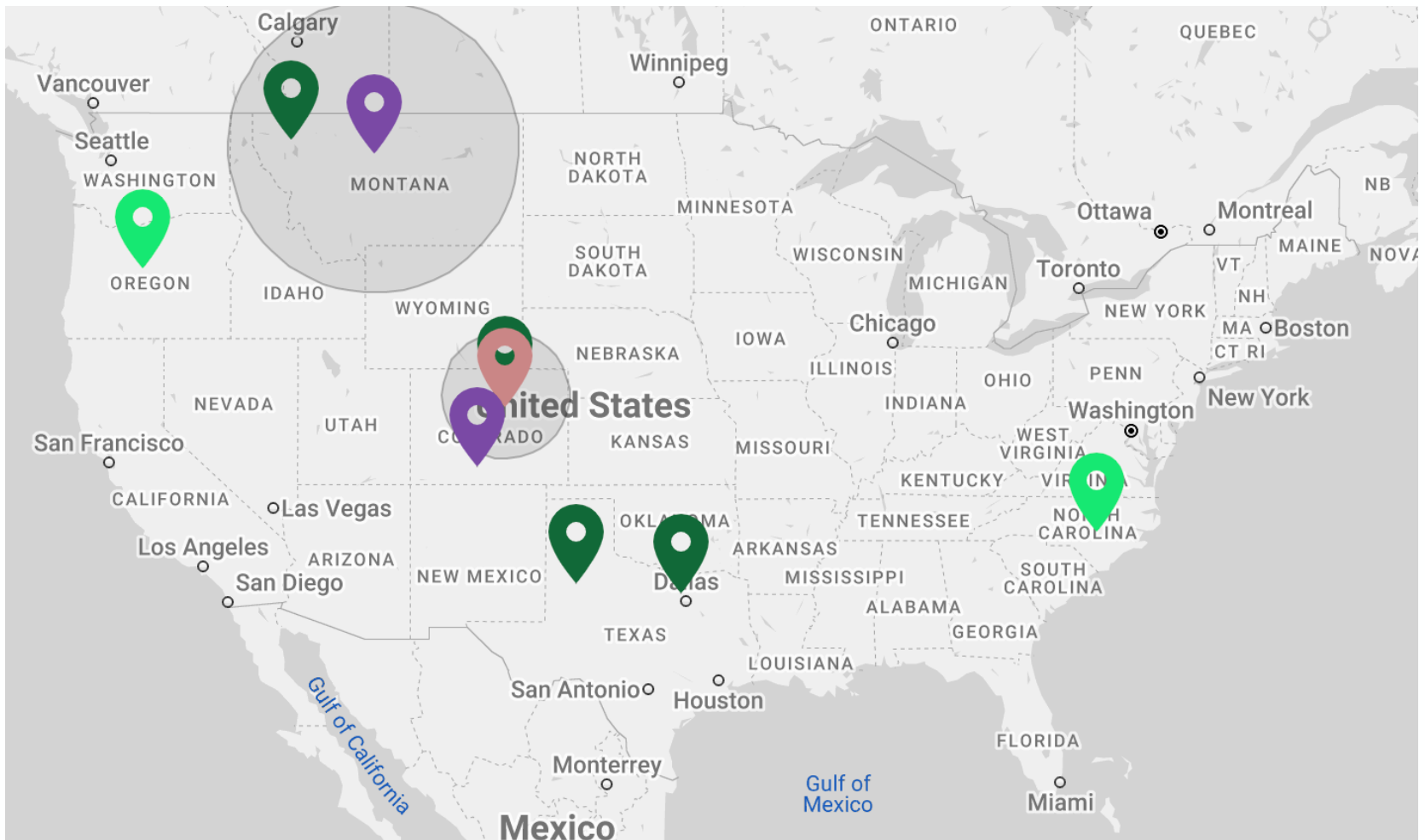


# Major Roadblocks & Challenges to Grain/Fiber Hemp in NM

- **Manufacturing Infrastructure**
- **Pollen Drift**
- **Photoperiod Response**
- **Total THC Limits**



# Hemp Fiber - Decorticators

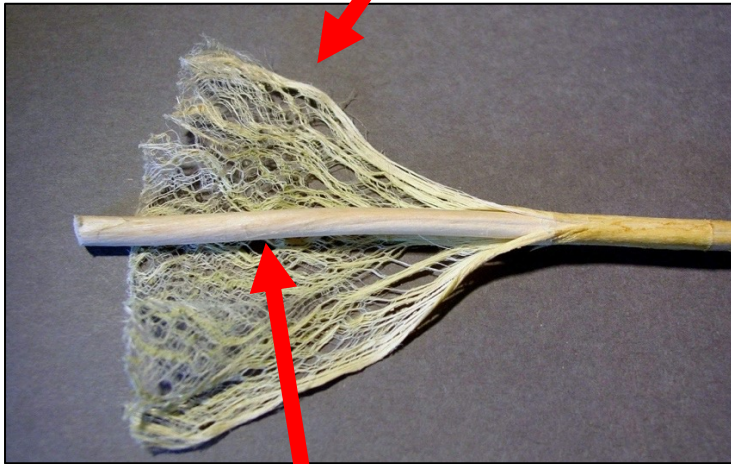


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North American Hemp Fiber and Hurd Supply Chain.  
Interactive Map. (2023). <https://thehia.org/hemp-fiber-and-hurd-map/>

# Hemp Fiber – Building Materials

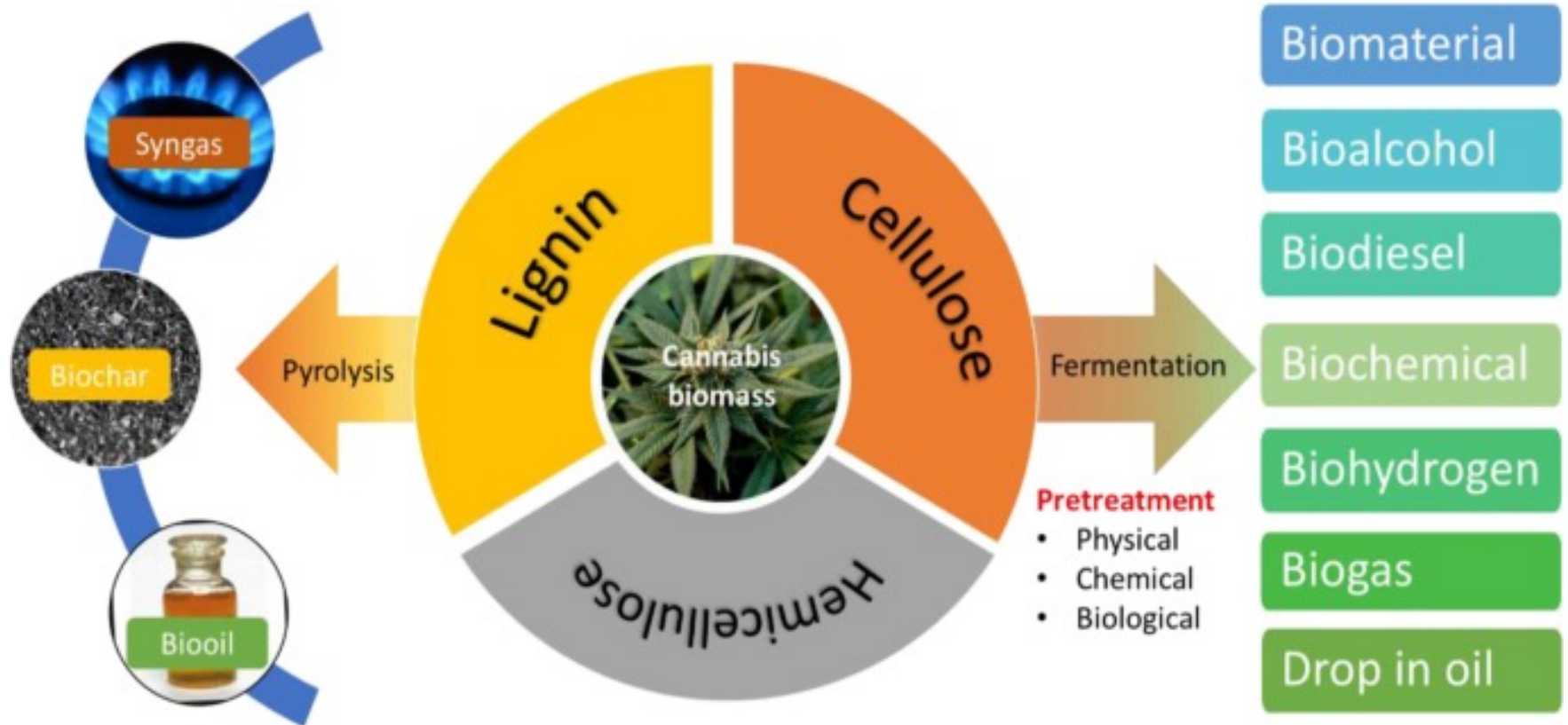
Bast: strong,  
high-value fibers



Hurd: abundant,  
woody fiber



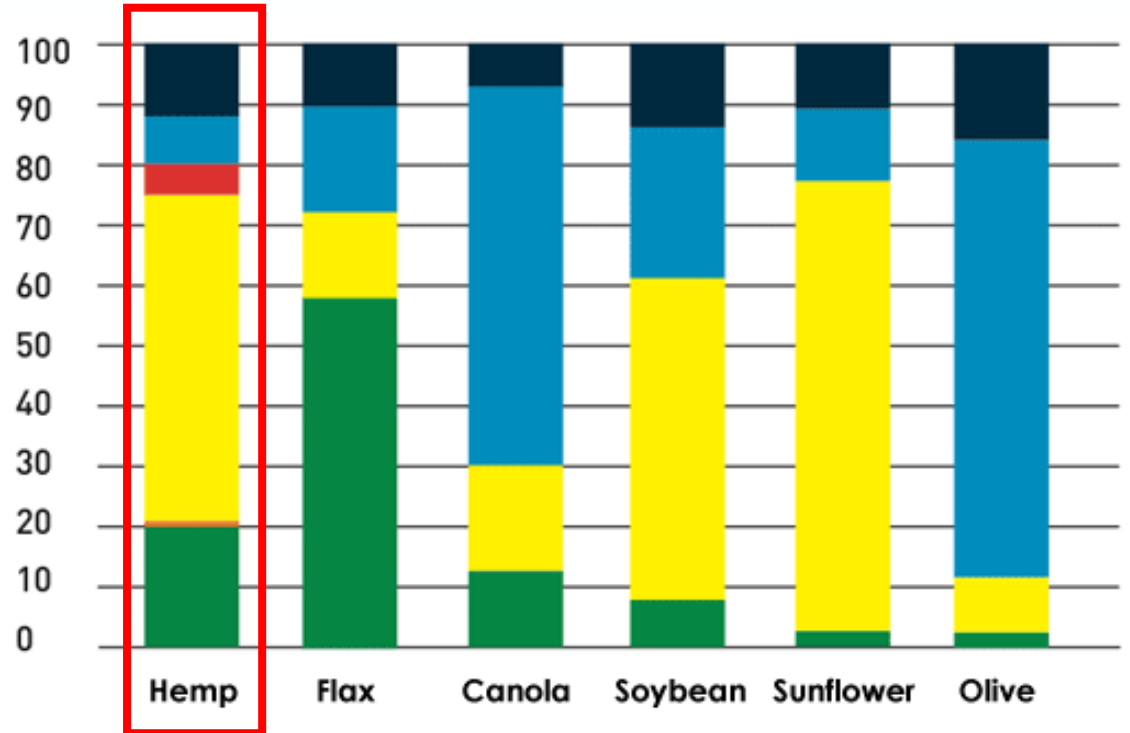
# Hemp Fiber – Greater Potential





# Hemp Grain

- 20-30% seed oil
- 25-30% protein
- 25-30% fiber
- 20-30% carbohydrates
- *NO CANNABINOIDS*



■ Alpha-Linolenic Acid (ALA, 18:3, omega-3)  
■ Linoleic Acid (LA, 18:2, omega-6)  
■ Oleic Acid (18:1, omega-9)

■ Stearidonic Acid (SDA, 18:4, omega-3)  
■ Gamma-Linolenic Acid (GLA, 18:3, omega-6)  
■ Saturated Fatty Acids

# Hemp Grain



Hemp 101. (2019). Kentucky Hempsters. <https://www.kyhempsters.com/hemp101>



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# Hemp's Future at NMSU

- No trials in 2023
  - No ongoing trials at NMSU to continue variety trials
  - Production for CBD should be shifted indoors; focus on outdoor industrial production as an agronomic crop
- Fiber characterization and bio-based chemical processing (ongoing)
- Phytoremediation project – ?
- ***Product research by other NMSU groups (food science, biochemistry) must be supported by cultivation to create a viable state industry***





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# Additional Acknowledgements

- Collaborators Barbara Hunter, April Ulery, and Frank Ramos
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# Questions?

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