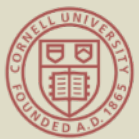




Growing Hemp in NYS

Kitty O'Neil, PhD, CCA

Hemp Update @ Miner Institute, 18 December 2019

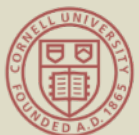
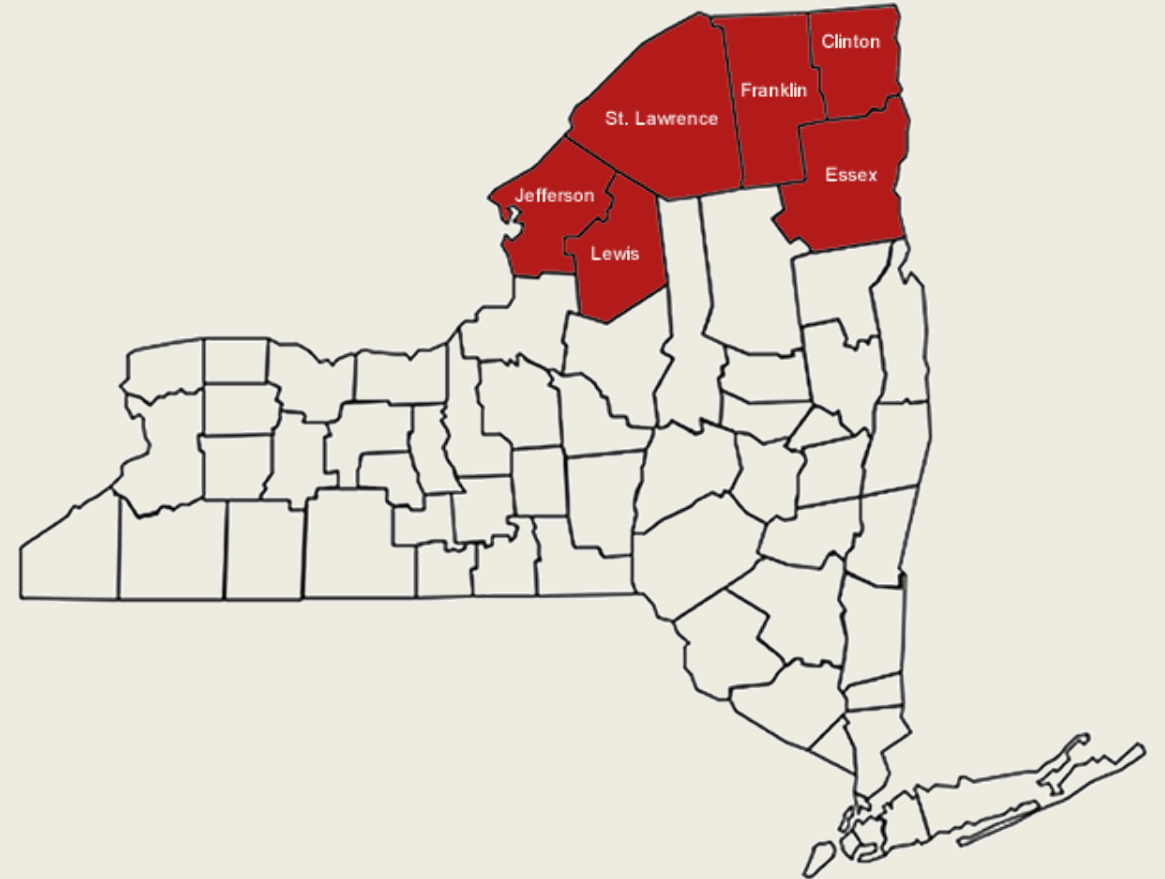


Cornell Cooperative Extension

North Country Regional Ag Team

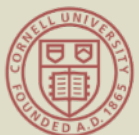
Overview

- CCE Regional Field Crops and Soils specialist
- Area is NNY
- Corn, alfalfa-grass, soybeans
... and hemp
- Cornell Hemp Team
- Climate Smart Farming Team



Overview

- Brief history of hemp in NYS, US
- Hemp, the plant
- Hemp cultivation in NNY
 - soils
 - management
 - pests and pathogens
 - different types
 - machinery requirements
- Cornell agronomic research resources
- NYS hemp regulations update

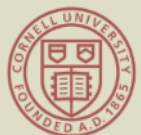


History of hemp cultivation in US

- Hemp was widely planted in the colonies in the 1700's
- Thomas Jefferson bred hemp varieties
- Hemp production boomed during WW II
- By mid-1950's hemp was replaced by synthetic fibers and hemp farming declined
- Hemp was banned in 1970 by the Controlled Substance Act – treating it like marijuana, Schedule I



Kentucky Digital Library



History of hemp cultivation in US, cont'd

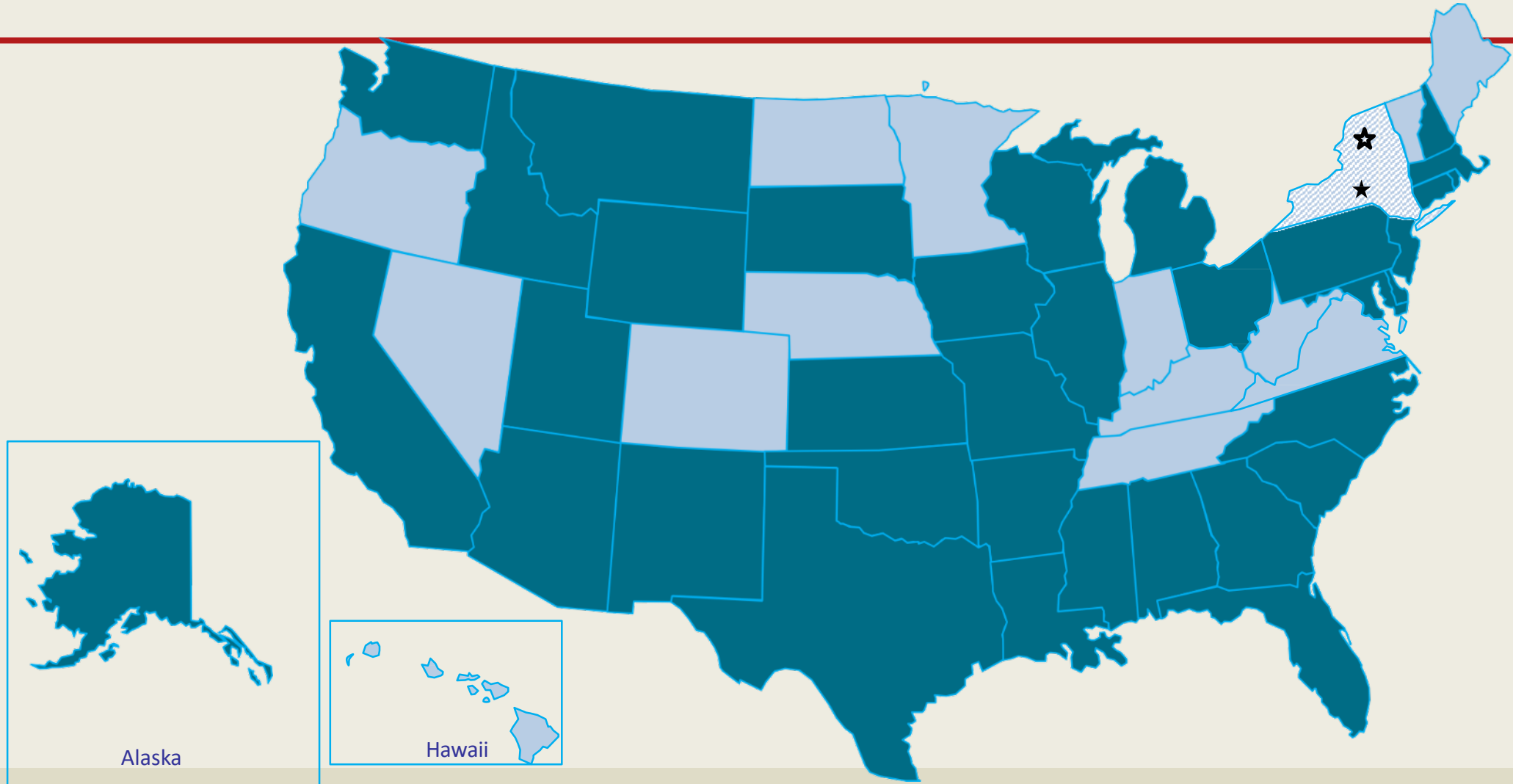
- 2014 Farm Bill allowed Pilot Research Programs if approved by each state
- NYS permitted hemp in 2016
- 2018 Farm bill legalized the production of hemp as an agricultural commodity, no longer listed as controlled substance. CBD handled like a pharmaceutical.
- Waiting for USDA guidance before changing NYS law further...



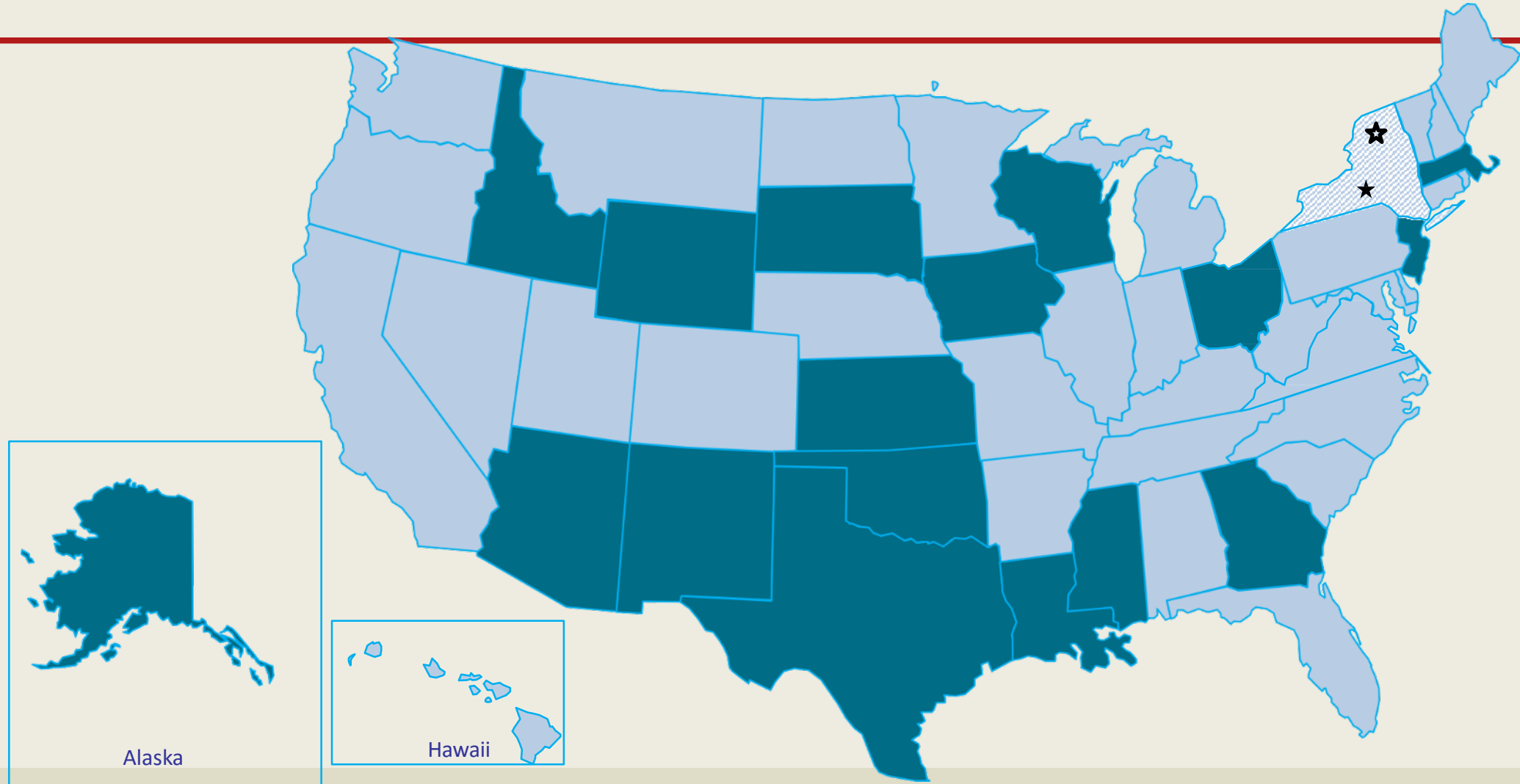
Kentucky Digital Library



15 States with Hemp Research Programs in 2016

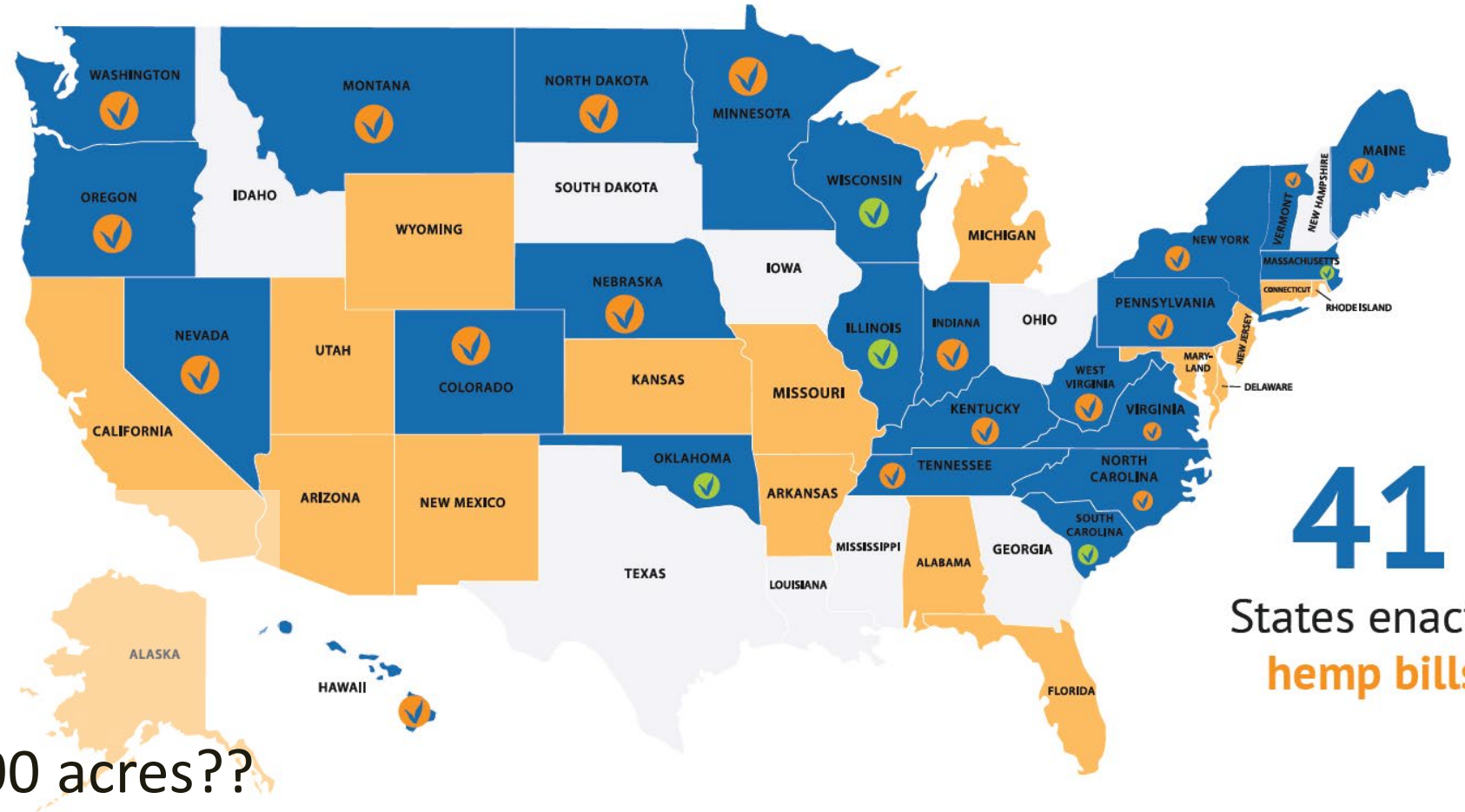


33 States with Hemp Research Programs in 2017



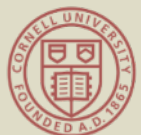
Current US hemp cultivation

2016: 9,770 acres
2017: 25,713 acres
2018: 78,176 acres
2019: 250,000-300,000 acres??



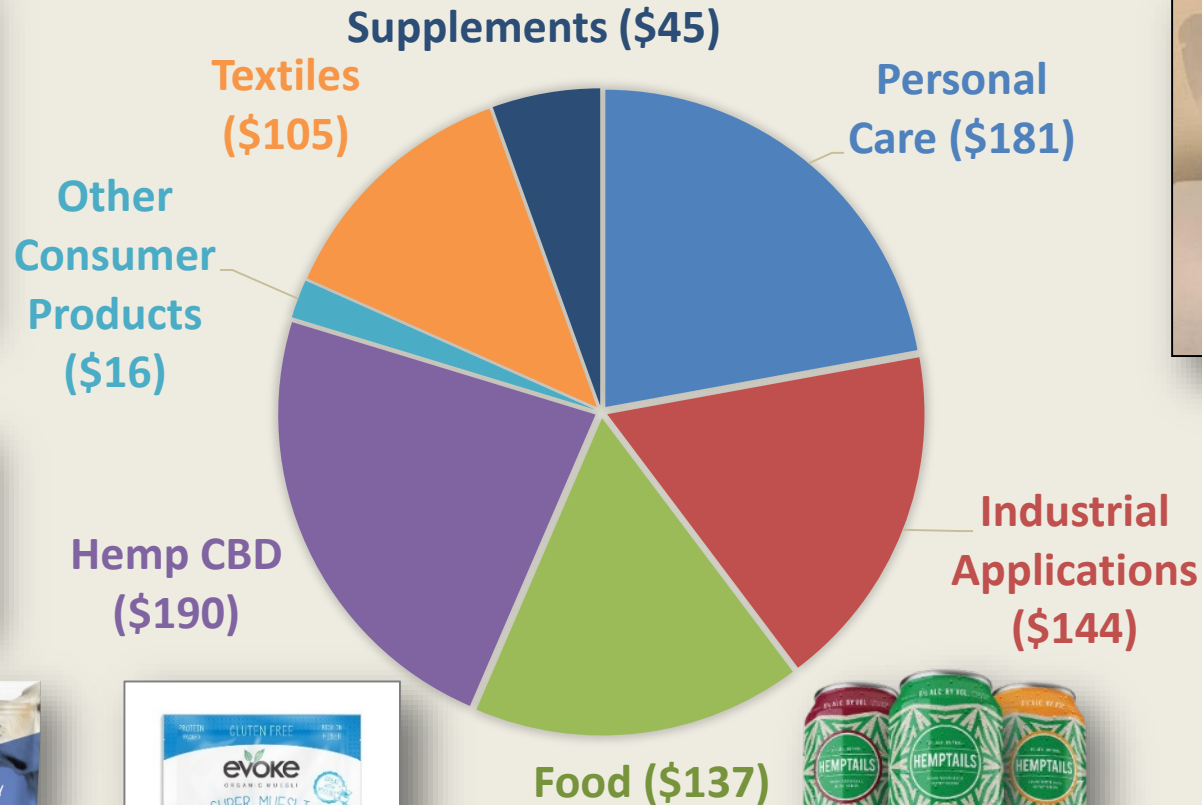
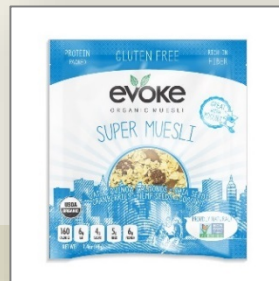
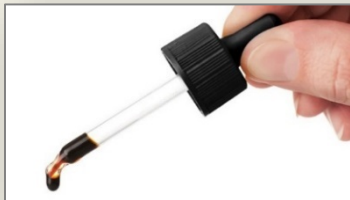
41

States enacted
hemp bills

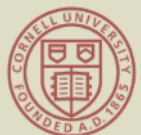


2017 Estimated hemp market in US = \$820 M

MILLIONS, US\$

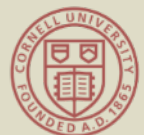
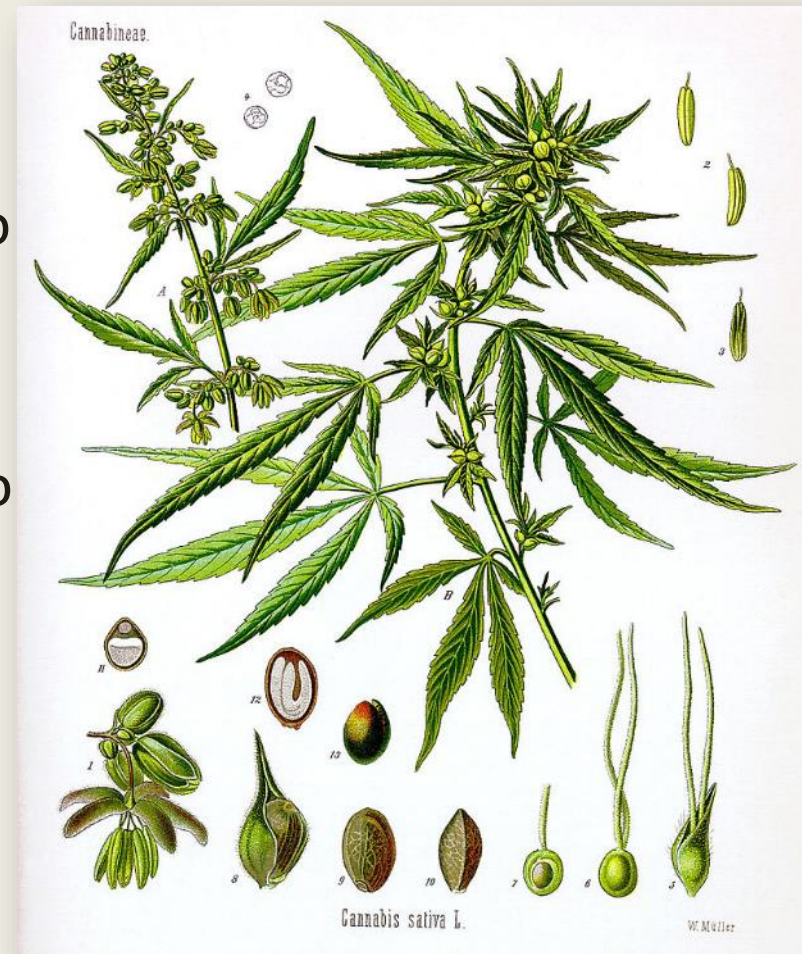


\$2 B by 2020??
\$20 B by 2022??



Cannabis sativa, L.

- Family *Cannabaceae* – includes hemp, hops, ornamental trees
- Annual herbaceous flowering plant indigenous to eastern Asia, now worldwide.
- All of recorded human history
- Source of industrial fiber, seed oil, food, recreation religious and spiritual purposes and medicine
- Plants and plant parts are grown and harvested differently, depending on the purpose of its use.
- Wild types are found in NNY.



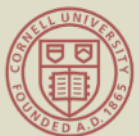
Both hemp and marijuana are *Cannabis sativa*, L.



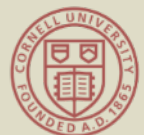
Industrial hemp: $\leq 0.3\%$ $\Delta 9$ -THC
Field crop for grain, fiber, CBD



Marijuana: $> 0.3\%$ $\Delta 9$ -THC
Female plants grown for flower

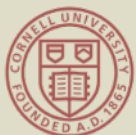


Dioecious, Monoecious, or Female



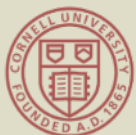
Dioecious v. Monoecious Hemp

- Hemp is typically dioecious, meaning plants are either male or female.
- Differences between male and female plants in growth rate and development are significant (Van der Werf and Van den Berg, 1995).
- Male plants generally flower and senesce without developing grain.
 - To minimize the impact of this on production, many cultivars have been bred to be monoecious, yielding plants that are mostly females (a small percentage of males plants are included for pollination), to yield more grain and fiber.



Dioecious v. Monoecious Hemp

- Hemp is typically dioecious, meaning plants are either male or female.
- Female flowers produce seed
 - Seed set is indeterminate - seeds continue to develop and mature over an extended period of time – resulting in both mature and immature seeds on the same seed head at time of grain harvest.



Current Production in NY

- Grain
- Oilseed
- Fiber
- CBD Oils
- Micro-greens



Current Production in NY

- Planting methods
- Pest management / control
- Harvest methods

- All dependent upon hemp type and market requirements



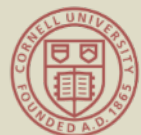
Site Selection, Planting, Fertility and Management

- Hemp prefers semi-humid conditions and temperatures of 60-80 °F.
- Loamy, well-drained soils are ideal. Avoid compact soils. pH 6.0 to 7.5.
- High fertility, high organic matter soils are ideal. Hemp is similar to corn and wheat in its nutrient requirements.
- Place seed at ¾ to 1” depth.
- Seeding rate is variety and type specific, 25 to 80 lb/acre
 - Higher populations for fiber than grain



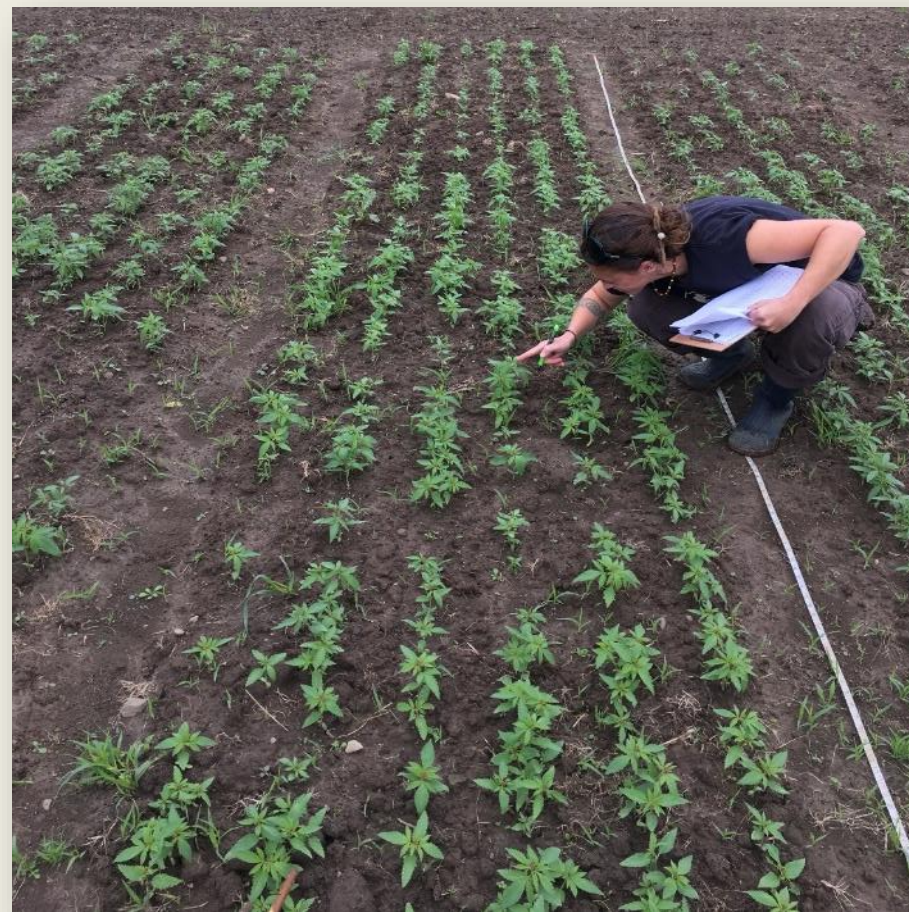
Site Selection, Planting, Fertility and Management, cont'd

- Plant grain and fiber varieties in closely spaced rows for good weed competition. Grain drill.
- CBD crops are planted at 4' spacing. 1500-4000 plants per acre.
- Anecdotal information cites plant growth of up to 4 inches per day which can help hemp outcompete weeds. Research measurements cite up to 12 inches of growth in a week. Heights of 6-8 feet are much more common.
- Grain and fiber hemp crops can grow quickly enough to suppress weeds, but it doesn't always.



Cannabis sativa, L. is day-length sensitive.

- Hemp is a short day plant, flowers when the day length becomes less than critical length
- Complicated – depends on sex, other environmental conditions too
- Varies among varieties
- Autoflowering strains are not day length sensitive



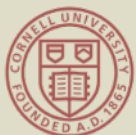
Cannabis sativa, L. is wind-pollinated.

- Monoecious strains (male and female flowers on the same plant) are 30-40% self-pollinated.
- Dioecious types are pollinated by nearby male plants.
- Cross-pollination over distance is possible.
- Pollination of CBD all-female hemp plants is a major concern, because CBD production drops 2- to 3-fold upon pollination.



“Unique features” make hemp a learning opportunity.

- Response to day length
- Monoecious v. dioecious v. all female
 - Pollination concerns
- Different strains for different purposes
 - Oilseed, fiber or dual-purpose varieties
 - CBD varieties
- Different cultivation strategies
- Well suited to either organic or conventional methods



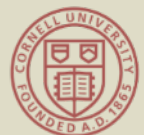
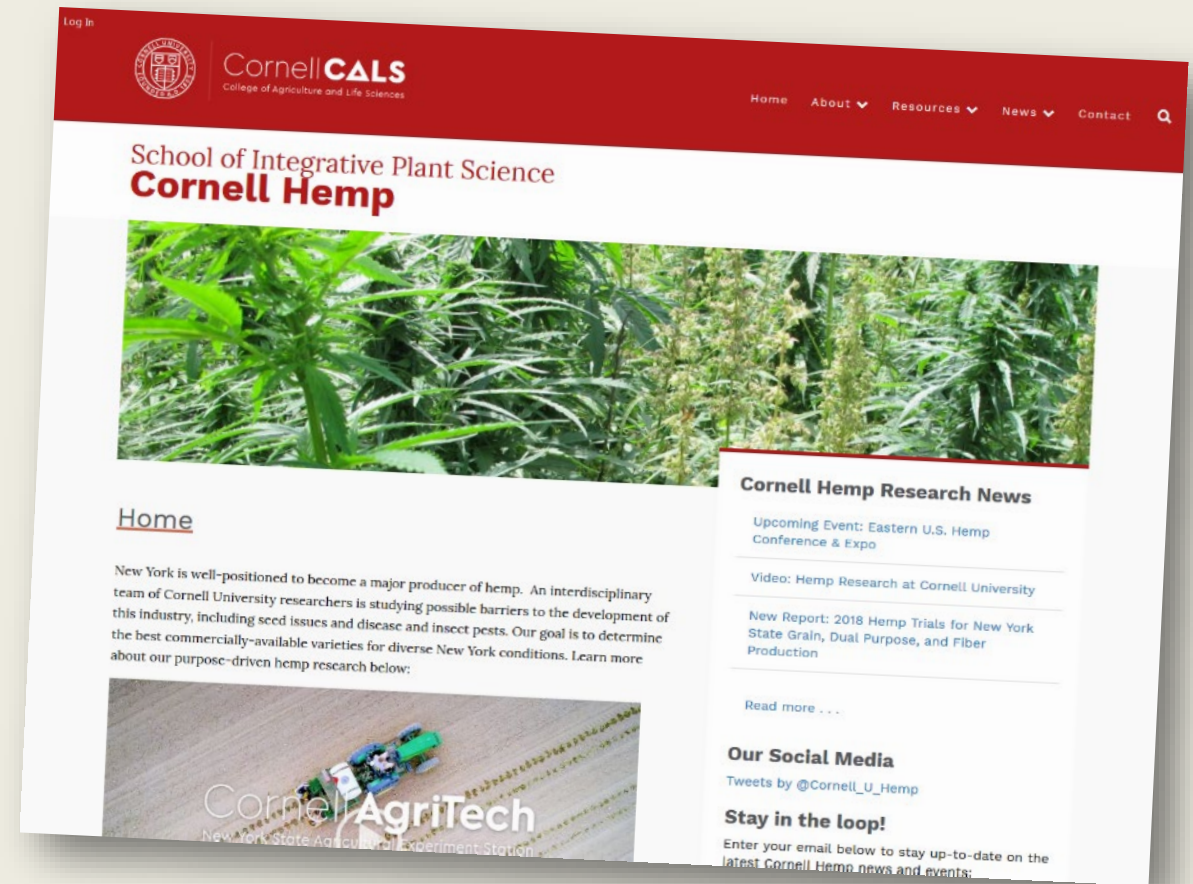
Field crop or horticultural crop?



Research Results @ hemp.cals.cornell.edu

- Cultivar comparisons
- Studying pollen travel distance
- Hemp seed coatings
- Insect pests and pathogens of hemp
- Economic analyses
- Supply chain analyses

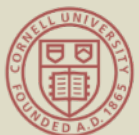
- Establish certified seed production in NYS
- Initiate breeding program for NY cultivars
- Release cultivars adapted to New York
- Develop transformation and CRISPR system



Evaluating hemp cultivars in NY



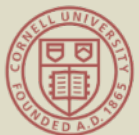
- Stand density
- Flowering date
- Flower sex
- Plant height
- Diseases and insects
- Weed pressure
- Biomass yield
- Grain yield
- Fiber yield
- Quality components

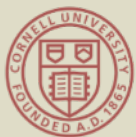


Ithaca - Plots at three weeks (6/30/17)

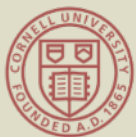


Ithaca - Plots at seven weeks (7/26/17)





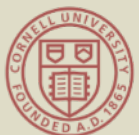
Cornell



Corn

Integrated Pest Management

- Many pests like hemp
 - Weeds
 - Insects
 - Fungi
 - Bacteria
 - Other
 - Some limit yield and quality, some do not.



Insects

Leaf Feeders:

- Grasshoppers
- Japanese Beetles
- Armyworm

Stalk borers:

- ECB



Weed Control

- Start Clean
 - A field should have a couple of years in a weed smothering crop before planting hemp
- Tillage
- Early planting
- Dense, vigorous stand
 - As tight row spacing as possible
- A minimum three year rotation is wise



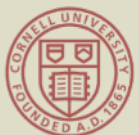
Hemp Diseases



Sclerotinia white mold

- Prevalent in many locations
- Problem with rotations including legumes and other dicots

G.C. Bergstrom, J. Starr, K. Myers, and J.A. Cummings, Plant Pathology and Plant Microbe Biology Section, School of Integrative Plant Science



Hemp Diseases



Botrytis
gray
mold

G.C. Bergstrom, J. Starr, K. Myers, and J.A. Cummings, Plant Pathology and Plant Microbe Biology Section, School of Integrative Plant Science

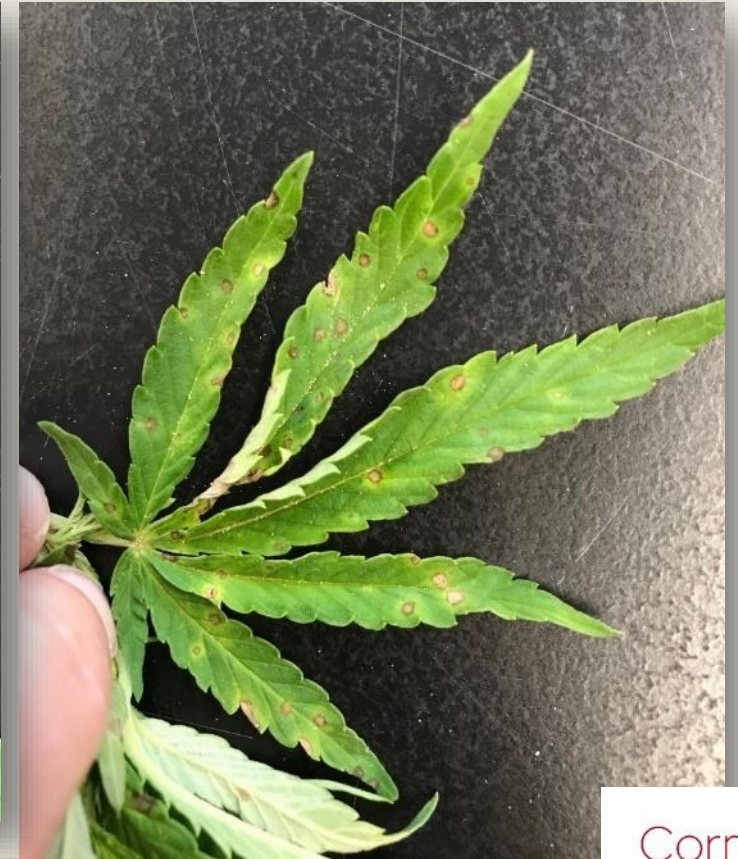


Cornell Cooperative Extension | North Country Regional Ag Team

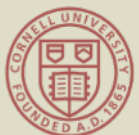


Hemp Diseases

Bipolaris leaf spot (novel *Bipolaris* species on hemp)
Increase in prevalence and severity since 2018



G.C. Bergstrom, J. Starr, K. Myers, and J.A. Cummings, Plant Pathology and
Plant Microbe Biology Section, School of Integrative Plant Science



Cornell Cooperative Extension | North Country Regional Ag Team

Cornell
CALS
College of Agriculture
and Life Sciences

Hemp Diseases



Fusarium bud blight
Several *Fusarium* species
Mycotoxin contamination
documented

G.C. Bergstrom, J. Starr, K. Myers, and J.A. Cummings, Plant Pathology and Plant Microbe Biology Section, School of Integrative Plant Science



Cornell Cooperative Extension

North Country Regional Ag Team

Cornell
CALS
College of Agriculture
and Life Sciences

Hemp Diseases



Hemp Rust

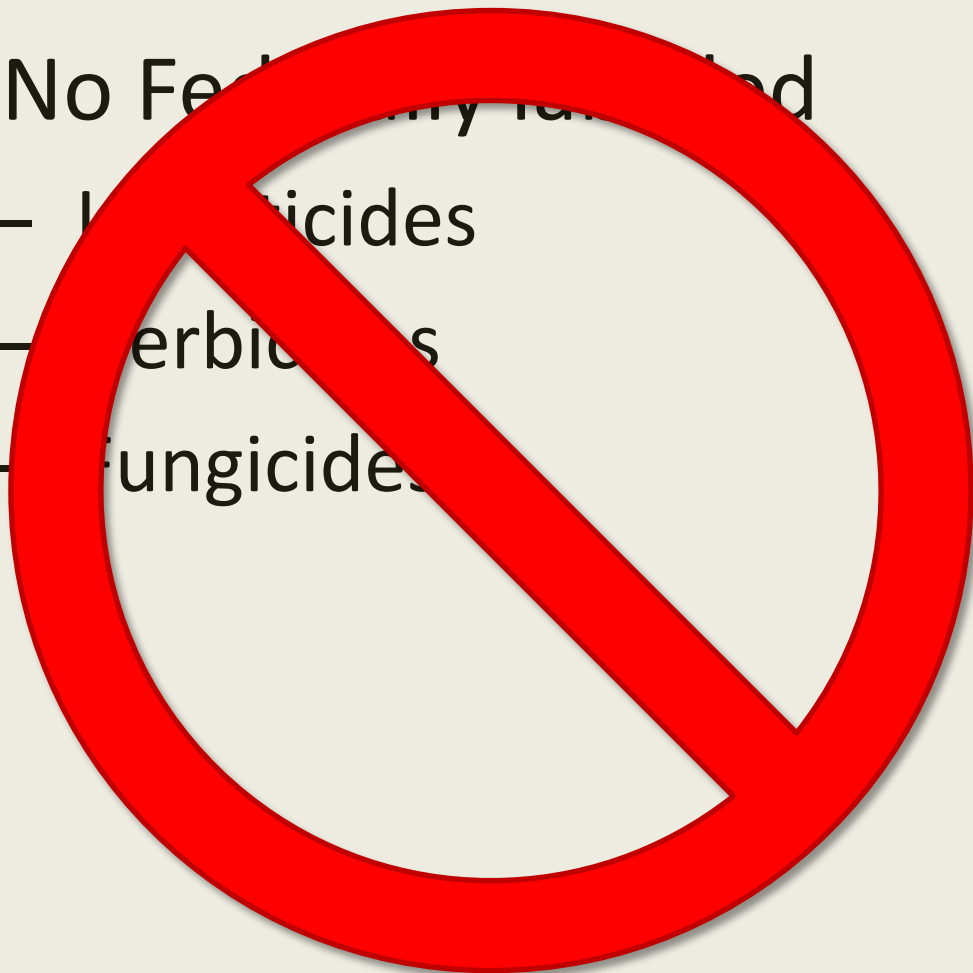
First diagnosed in NYS in 2019

Uredo kriegneriana
likely, but not
previously diagnosed in
US. No DNA specimen
to compare with yet.



Integrated Pest Management

- No Feeding any...
 - Insecticides
 - Herbicides
 - Fungicides





Advanced Search...

Ingredients

PC Code:

Active Ingredient:

Has All Has Any

Use/Type

Pesticide Use:

Pesticide Type:

Other

Pests:

Signal Words:

Restriction:

Unrestricted Products Only
 Restricted Products Only
 Reduced Risk
 Biopesticide

Sites:

Formulation:

Registration On or After:

Nassau/Suffolk County Use Allowed:

Authorization Type:

Registration Status:

"Zee" Reason:

Search Reset

Showing 1 - 20 out of 53 Products

ACTINOVATE AG More

EPA Reg. No. 73314-1, Registrant NOVOZYMES BIOAG INC

Restrictions None LI Use Yes
 Status REGISTERED Type FUNGICIDE

ACTINOVATE SP More

EPA Reg. No. 524-641, Registrant MONSANTO COMPANY

Restrictions None LI Use Yes
 Status REGISTERED Type FUNGICIDE

AGREE WG More

EPA Reg. No. 70051-47, Registrant CERTIS USA LLC

Restrictions None LI Use Yes
 Status REGISTERED Type INSECTICIDE

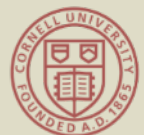
ALUDE FUNGICIDE More

EPA Reg. No. 55146-83, Registrant MUEARM AMERICAS INC - AGT DIVISION



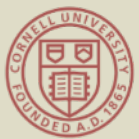
Integrated Pest Management

- 53 Pesticides now labelled in NYS
 - Fungicides
 - Insecticides
 - Miticides
 - Nematicides
 - Algaecide
 - Growth regulators
 - Antimicrobial
 - Disinfectant / Sanitizer
 - Rodenticide
 - **ALL UNRESTRICTED**
 - **NO HERBICIDES**

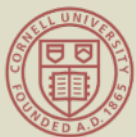


Harvesting Hemp

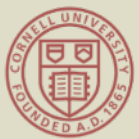




Corn



Corn



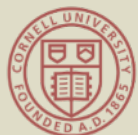
Cornell





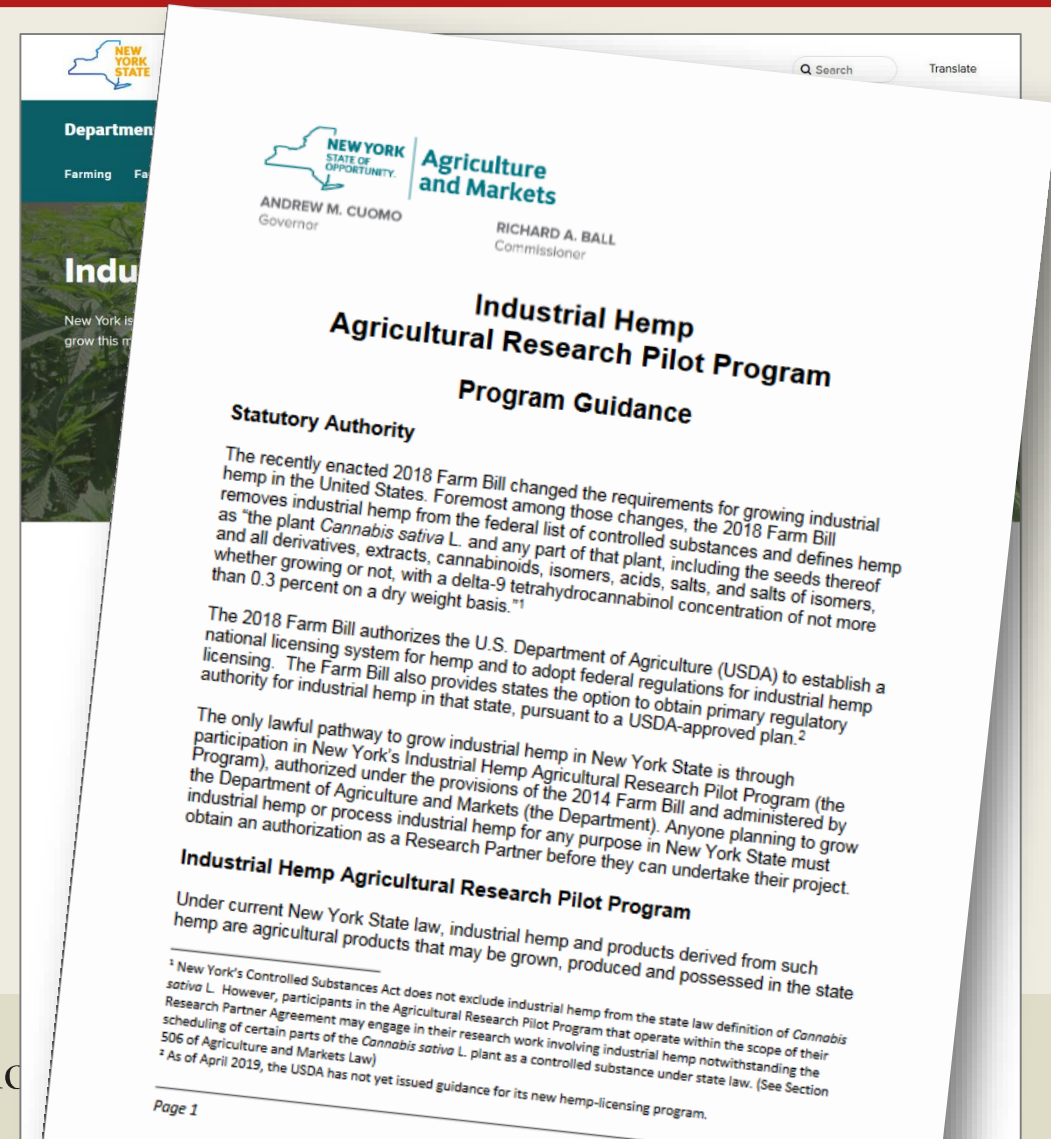
Cornell CALS Hemp Research and Extension Team

- Christine Smart – Project leader; microbiome
- Don Viands – Breeding; Cultivar trials
- Larry Smart – Breeding/genomics; Trials
- Alan Taylor – Seed science
- Gary Bergstrom – Plant pathology
- Elson Shields – Entomology - pests
- Heather Grab – Entomology - pollinators
- Dan Buckley - Microbiome
- Neil Mattson – Greenhouse cultivation
- Joss Rose – Metabolites (THC; CBD)
- Matthew Willmann – Tissue culture
- 10 Cooperative Extension Specialists & Educators



License Requirement in NYS

- Permit required to grow or process hemp in NYS
- NYS Ag & Markets, [Plant Industry Division](#)
- ‘Research Partner’ Application
 - Detailed map, plan of type, intent, marketing
 - Seed acquisition plan
 - Overview of experience
 - \$500
 - Application process opens & closes frequently
- Review by PI Division
- Disqualifying factors list



License Requirements in NY

- Permitted as ‘Research Partner’
- Research Partner Agreement defines obligations
 - Permit limited to what was proposed in application
 - Must agree to inspections, annual reporting, sampling, testing for Δ 9-THC, ...
 - Quarantine, seizure, suspension, termination

DEPARTMENT-CONDUCTED RESEARCH PARTNER AGREEMENT INDUSTRIAL HEMP GROWERS

This Department-Conducted Research Partner Agreement for Industrial Hemp Growers (“Research Agreement”), dated _____ between the State of New York, acting by and through the New York State Department of Agriculture and Markets, or another agency, department or authority of New York State subsequently designated by the State (the “Department”) and _____ (the “Research Partner”).

WHEREAS, pursuant to Title 7 U.S.C. § 5940 and New York State Agriculture and Markets Law § 505, et seq., the Commissioner of the New York State Department of Agriculture and Markets has been granted the authority to approve sites for the study of the growth and cultivation, sale, distribution, transportation and processing of hemp and products derived from such hemp as part of an agricultural pilot program conducted by the Department; and

WHEREAS, the Department has decided to undertake an agricultural research pilot program with respect to industrial hemp as provided for in 7 U.S.C. § 5940 (the “Research Pilot Program”); and

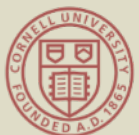
WHEREAS, pursuant to Agriculture and Markets Law § 506, et seq., the Department has the authority to partner with individuals, businesses and institutions of higher education in connection with its Research Pilot Program;

WHEREAS, the Research Partner has submitted an application to engage in research with respect to growth and cultivation of industrial hemp;

NOW THEREFORE, in consideration of the mutual covenants, terms and conditions set forth herein, the parties do hereby agree as follows:

SCOPE OF RESEARCH

1. The Research Partner shall act as a researcher in connection with the Research Pilot Program.
2. The Research Partner’s authority to study industrial hemp in the manner set forth on its “Application to become a Research Partner in the Department’s Industrial Hemp Research Pilot Program” (attached as Exhibit 1, and herein referred to as the “Scope of Work”) shall commence upon the execution of this agreement by both parties and shall continue unless suspended or terminated, as set forth below.
3. The Research Partner’s authority to research industrial hemp is limited to the research set forth in the Scope of Work and the Research Partner shall strictly adhere to the Scope of Work, except as otherwise authorized pursuant to

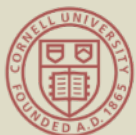


Establishment of a Domestic Hemp Production Program – USDA Interim Final Rule

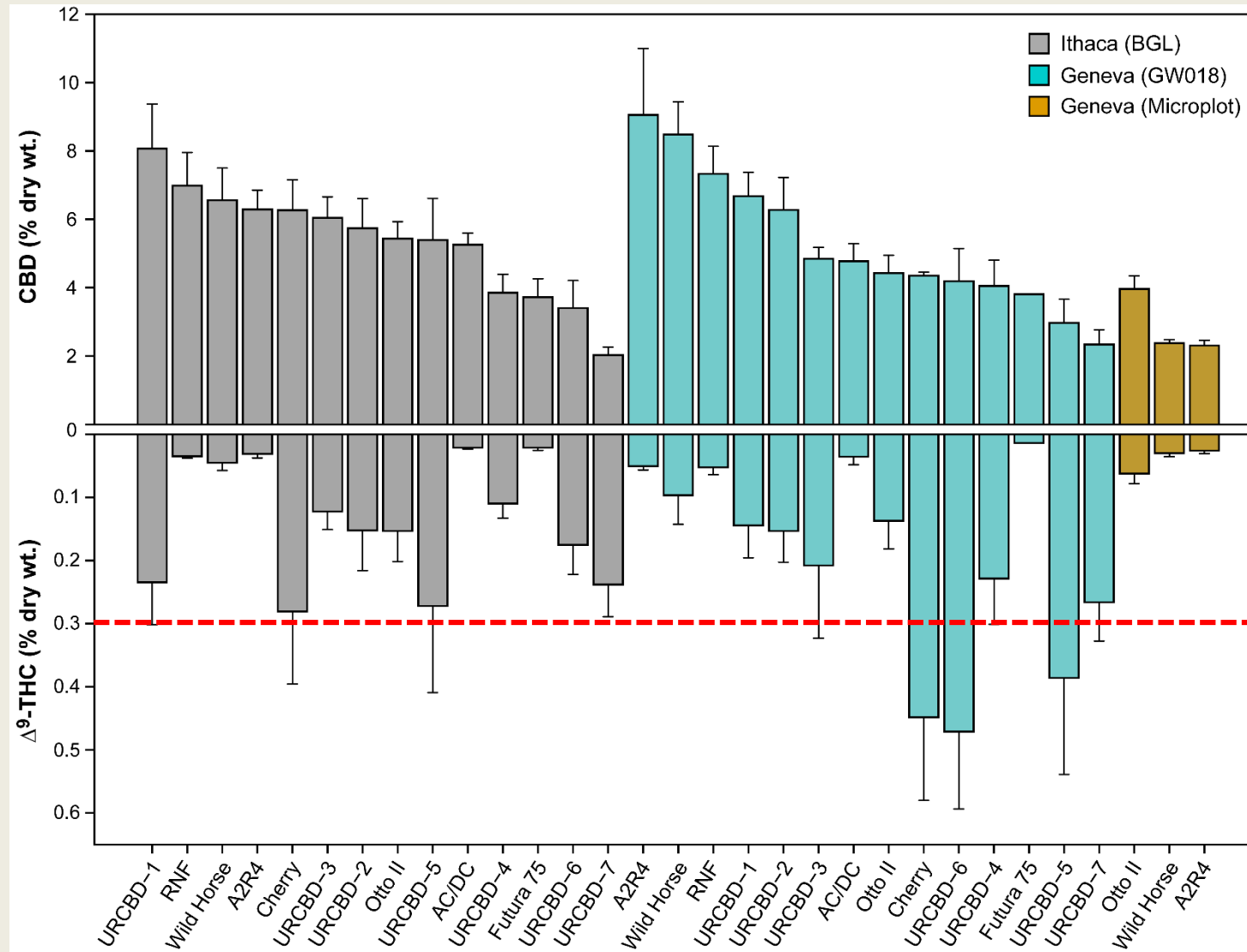
- Licensing requirements;
- Maintaining information on the land on which hemp is produced;
- Procedures for testing the THC concentration levels for hemp;
- Procedures for disposing of non-compliant plants;
- Compliance provisions; and
- Procedures for handling violations.

Establishment of a Domestic Hemp Production Program- USDA Interim Final Rule - Guidelines for Sampling

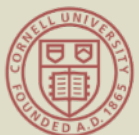
- **Background checks** for main staff
- Collection of the minimum number of plant specimens
- Cuttings from each “lot” of hemp crop acreage are sampled
- An **authorized representative** determines protocol and samples
- The **total $\Delta 9$ -THC and $\Delta 9$ -THC-A** concentrations shall be determined and reported
- Labs approved for THC testing must be registered with DEA to handle controlled substances under the Controlled Substances Act (CSA), 21 CFR part 1301.13



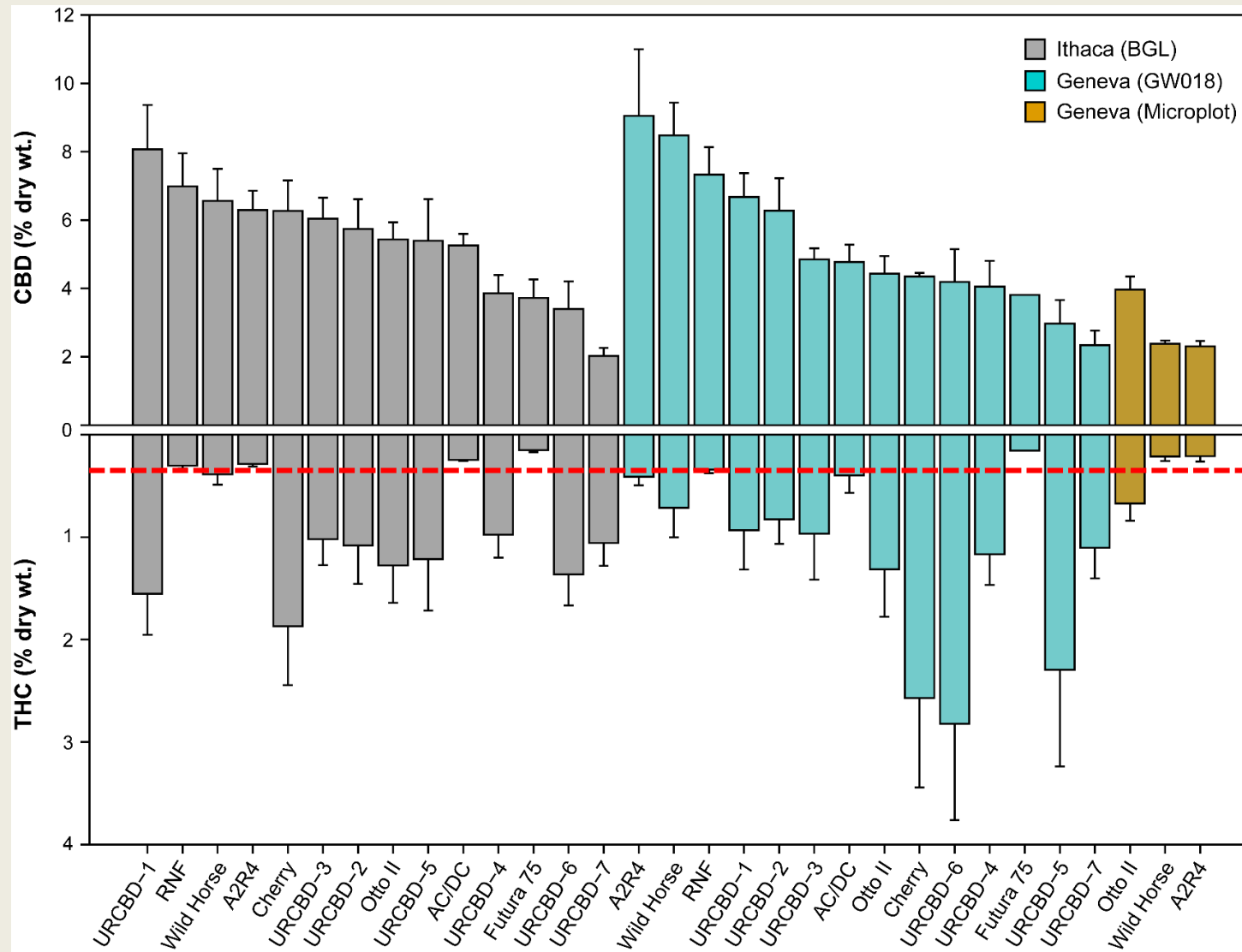
CBD Cultivar Trial Cannabinoid Analysis



11% 'hot'



CBD Cultivar Trial Cannabinoid Analysis



75% 'hot'



Establishment of a Domestic Hemp Production Program – USDA Interim Final Rule

**NYS MAY OR
MAY NOT
ADOPT THIS
USDA FINAL
RULE**

Permitted Growers and Processors = 617

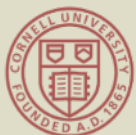
- As of Jan 21, 2020:
 - Grower-Processors = 19
 - Processors = 99
 - Growers = 499
- At present, applications are being accepted
- Expect regulations, regulatory process to change based on USDA guidance... soon?

Number of Authorized Growers 459

Growing

Authorization	Business Name	Contact	Email	City	County
HEMP-G-000005	21st Century Hemp LLC	Ira Fair	ifair@centuryhemp21.com		
HEMP-G-000006	JD Pinnacle Holdings dba JD Farms	Dan Dolgin	daniel.dolgin@gmail.com	Scottsville	Monroe
HEMP-G-000007	Plant Science Laboratories	Mike Barnhart	mike@plantsciencelabs.com	Eaton	Madison
HEMP-G-000011	Farm Fresh First	Thomas Facer	tfacer@farmfreshfirst.com	Buffalo	Erie
HEMP-G-000012	Weiss Farms	Anthony Weiss	tonyweissrr@gmail.com	Oakfield	Genesee
HEMP-G-000015	Agricultural Development Services LLC	Christine Wildman	cwildman@agrinetix.com	Eden	Erie
HEMP-G-000016	Edgewood Farms	Clayton Phelps	ccp140@vt.edu	Henrietta	Monroe
HEMP-G-000017	Harvest Queen Farms	Alex Kocot	kocot4@warwick.net	Groveland	Livingston
HEMP-G-000020	Valley View	Jeffrey Reichle	valleyview.jeff@gmail.com	Warwick	Orange
HEMP-G-000020	Gene Reed Dairy Farm	Gene Reed	ramsdennrich@aol.com	Walden	Orange
HEMP-G-000021	DuMond Ag LLC	Todd DuMond	todd@dumondfarms.com	New Woodstock	Madison
HEMP-G-000022	22nd Century Group Inc.	Henrey Sicignano III	prushton@xxicentury.com	Union Springs	Cayuga
HEMP-G-000024	Liburdi Industries Inc.	Francesco Liburdi	fliburdi@liburdii.com	Buffalo	Erie
HEMP-G-000026	Agbotic	John Gaus	gaus@agbotic.com	Binghamton	Broome
HEMP-G-000027	Projics	Stephen Cowart	stephen@stephencowart.com	Sackets Harbor	Jefferson
HEMP-G-000028	Farm In Peace	Christopher Jeanniton	christopherjeanniton@gmail.com	Greenwich	Washington
HEMP-G-000034	Steuben Foods	Tyson Prince	tprince@steubenfoods.com	Collins	Erie
HEMP-G-000035	Nightshade Farm	Phillip Spinelli	nightshadefarm@gmail.com	Elma	Erie
HEMP-G-000037	Edmond Shabo	Milad Shabo	miladshabo@aol.com	Medusa	Albany
HEMP-G-000038	BARR Scientific LLC	Christopher Becker	becker89@ottcmail.com	DeRuyter	Madison
HEMP-G-000042	WhatCannaDo	Aidan Woishnis	contact@whatcannado.com	Romulus	Seneca
HEMP-G-000043	WhatCannaDo Affiliated Grower - Keith Klingman	Aiden Woishnis	aiden@whatcannado.com	Gilbertsville	Otsego
HEMP-G-000044	Pleasant View Harvest LLC	Ervin Raboy	pvrllc@gmail.com	Gilbertsville	Otsego
HEMP-G-000045	Scotch Valley Ranch	John Houshmand	scotchvalleyranch@gmail.com	Brewster	Putnam
HEMP-G-000048	For the Birds Farm	Clarissa Farrell	lissa.farrell@gmail.com	Hobart	Delaware
HEMP-G-000051	High Peaks Solar LLC	Kevin Bailey	kbailey@highpeaksolar.com	Trumansburg	Tompkins
HEMP-G-000058	Chessworth Farms	Laura Swatsworth	Laura.Swatsworth@gmail.com	Wyantskill	Rensselaer
HEMP-G-000059	Meadeville Farm	Ann Marie Helzmann	ann@meadevillefarm.com	Watertown	Jefferson
HEMP-G-000064	Coryell Farms	Esther Woods	e_woods32667@yahoo.com	Seneca Falls	Seneca
HEMP-G-000066	Lisa & Brandon Kapoor	Lisa & Brandon Kapoor	lisamaye35@yahoo.com	Nichols	Tioga
				Argyle	Washington

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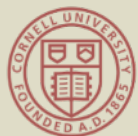
Challenges in Hemp Production in NYS

- Immature, developing industry
 - Production methods
 - Markets
 - Quality control
 - Cart vs horse? – need balance
- Highly competitive
- Risks to growers, contracts essential
- More quality control is needed at consumer end
- Changing landscape at present



Challenges in Hemp Production in NYS

- Be CAUTIOUS
- Invest only what you can afford to lose
- Informal discussion at recent SUNY Morrisville Hemp Conference
 - *~85% of growers in one discussion group still haven't sold their 2019 biomass*
 - Hadn't found a processor
 - Broken contract with buyer
 - Waiting out low prices



Questions?



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