Hemp 101

April 8, 2020

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Hemp Biology

EA/EO

Cannabis sativa Biology

- Hemp is dioecious, plants can be male or female
  - Think asparagus
- Specially bred hybrids can be mostly monoecious plants
  - Think corn
- Hemp grown for cannabinoids are typically all female
  - so-called “all-female” can also produce some hermaphrodites

Cannabis sativa Biology

- Hemp is wind pollinated
  - Think corn, wheat
- Photoperiod dependent
  - Decrease in daylength triggers flowering, think soybeans

Cannabis sativa Biology

- Cannabis plants produce secondary plant compounds
  - Cannabinoids
  - Terpenes
  - Flavonoids
- Synthesized in hairs on outside of plant
  - Glandular trichomes
  - On flowers, leaves, stems

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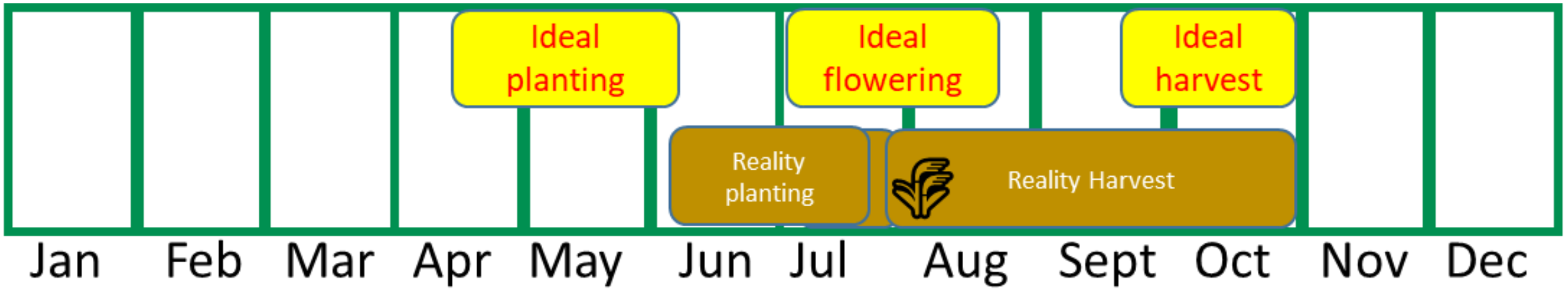
Production Basics

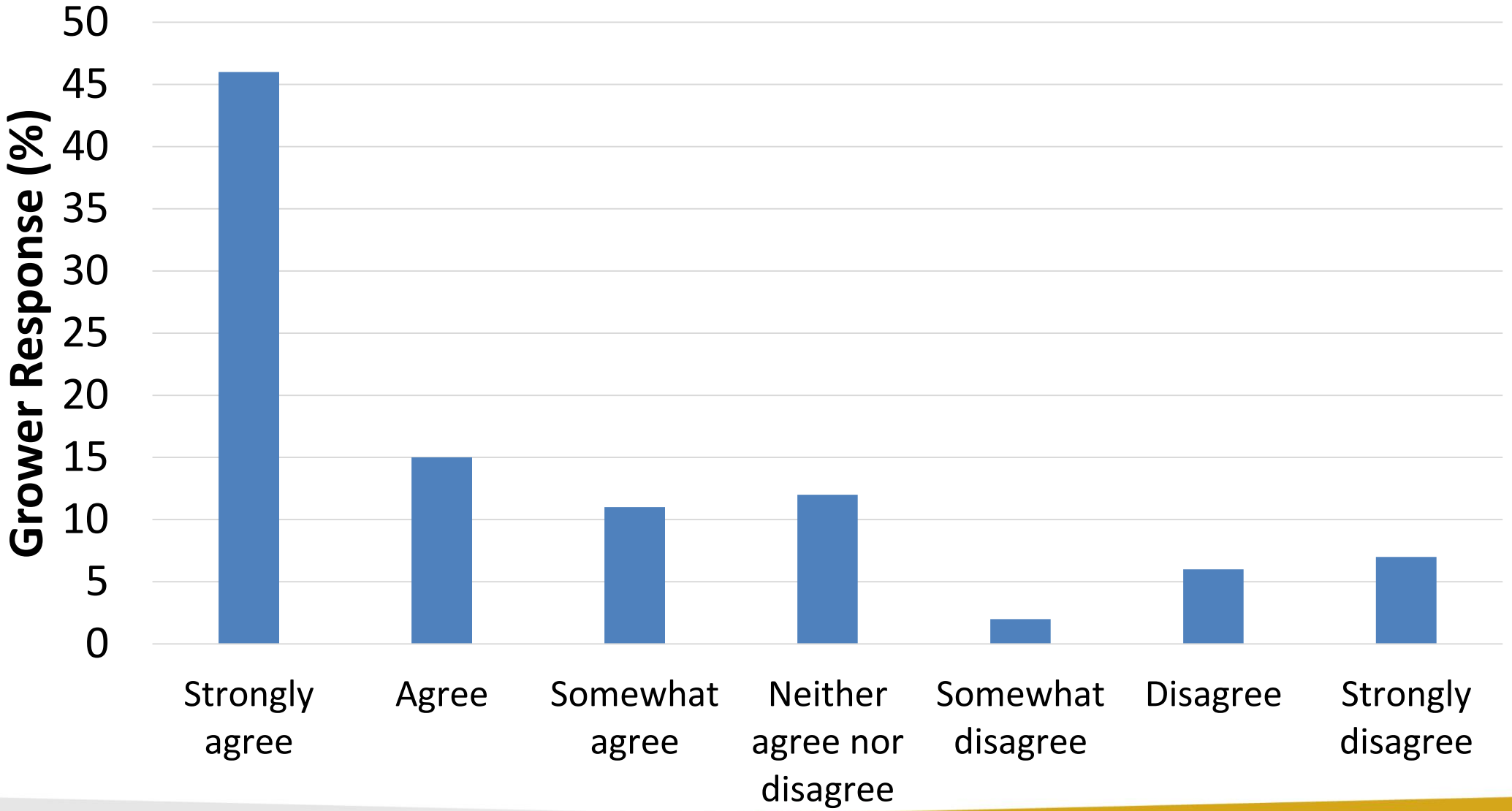
EA/EO

Planting and Harvest Windows

- No clearly defined planting window yet (different for each type of hemp)
- 72% of hemp was planted in June and July
- 68% of hemp was harvested in September and October



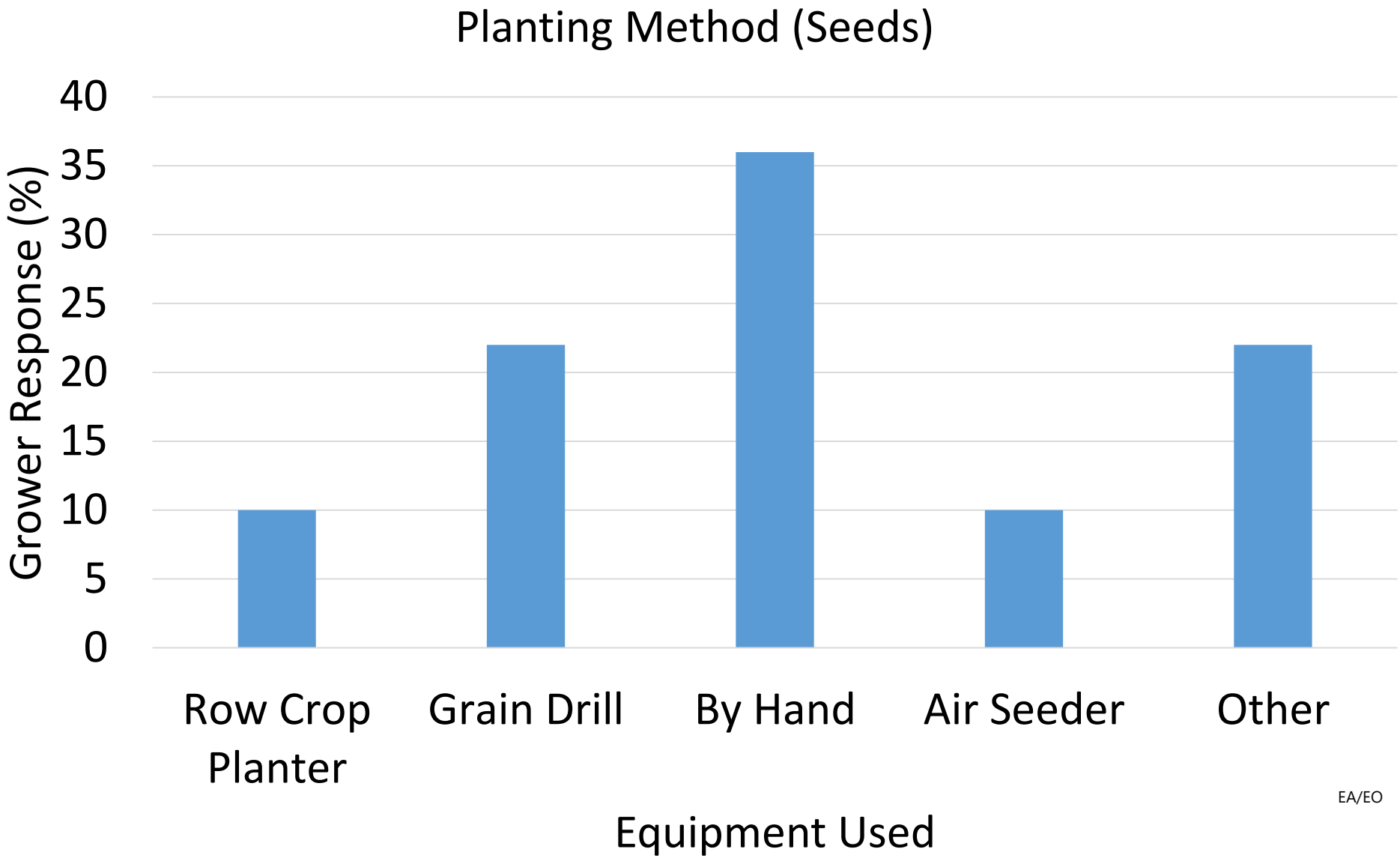
Planting Issues Due to Weather

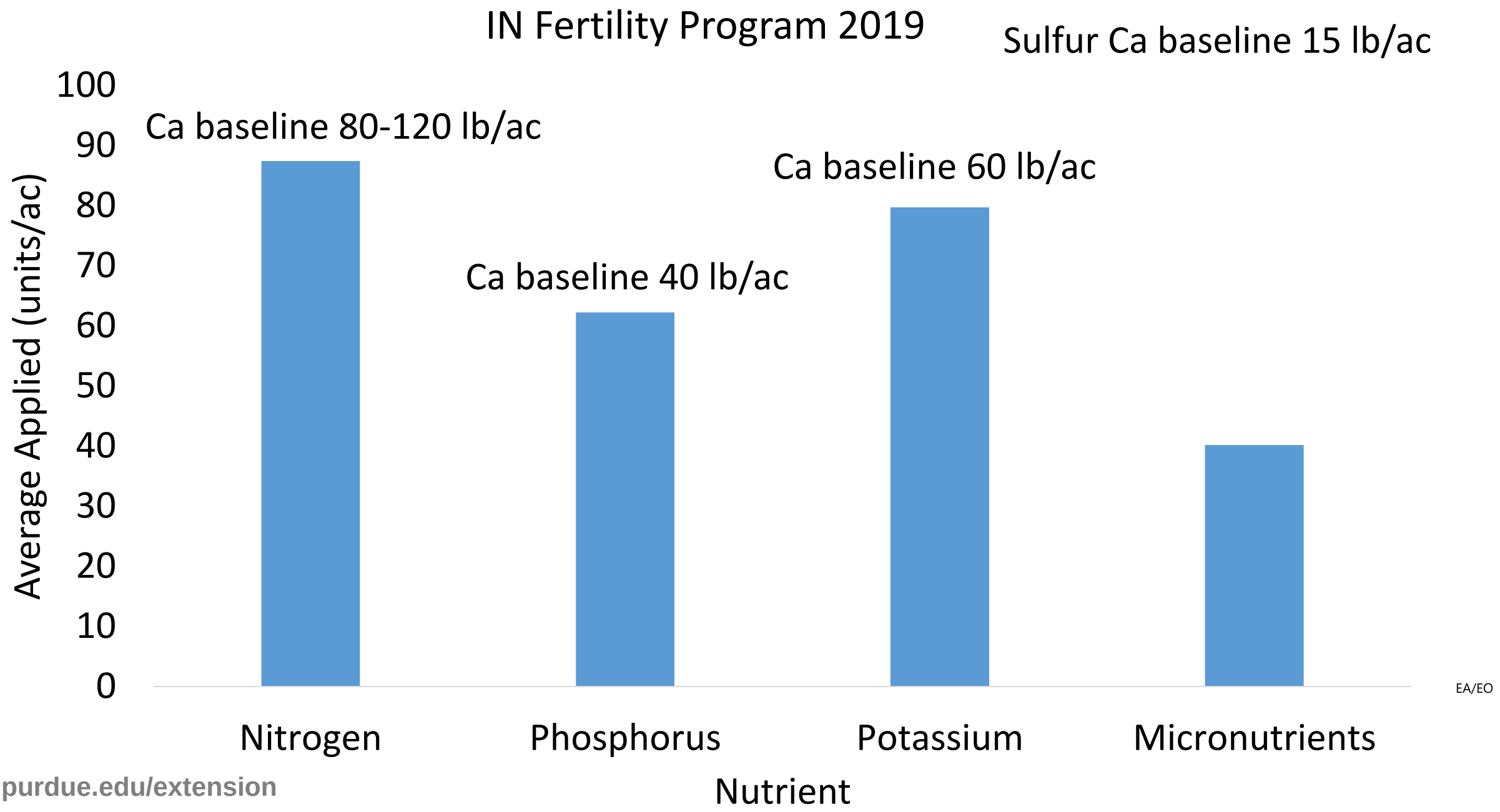


Site Selection

- Hemp does not like wet feet
- Avoid clay dominant soils or compacted soils
- Choose fertile field sites
- Choose sites that do not have a history of soil pathogens (ie white mold)

- Other-Brillion seeder, broadcast, fertilizer spreader
- Transplants-mostly by hand, some mechanical




IN Fertility Program 2019
Sulfur Ca baseline 15 lb/ac
Ca baseline 80-120 lb/ac
Ca baseline 40 lb/ac
Ca baseline 60 lb/ac
Average Applied (units/ac)
100
90
80
70
60
50
40
30
20
10
0
Nitrogen
Phosphorus
Potassium
Micronutrients
Nutrient
EA/EO

Producing for Grain/Seed

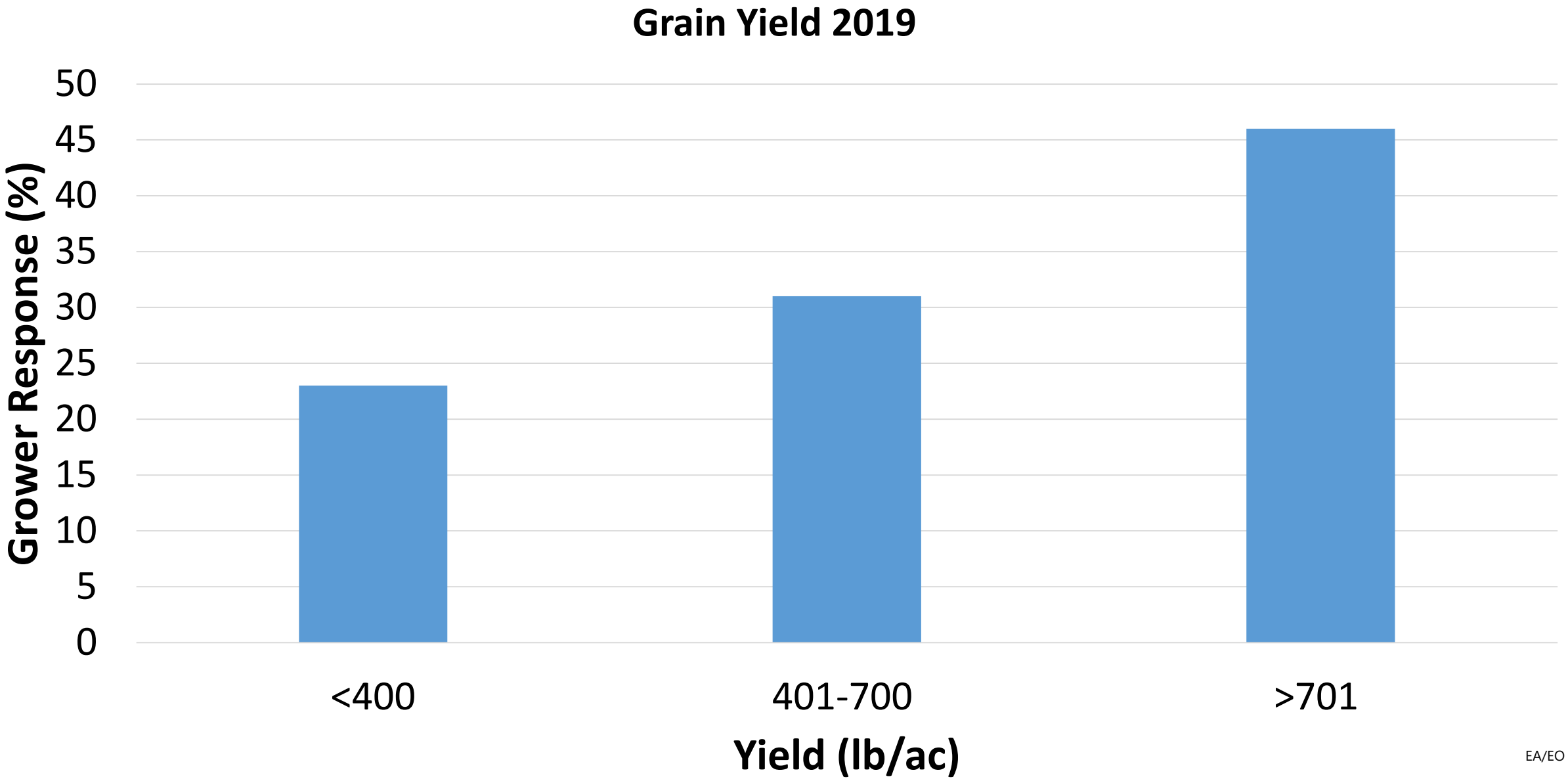
- Seed at 20-40 lb/ac
- Grain drill, Brillion seeder, corn planter were common methods in 2019
- Depth target of ¼ - ¾ inch (deeper plantings may be tolerated in sandy soil)
- Plant after a rain, not before

Producing for Grain/Seed

- $.40-1.23 per pound (2011)
- $.55-1.25 per pound (2019)

- Cost of production estimates UKY $395/ac

- Seeds are 30-40% oil


Grain Yield 2019
Grower Response (%)
50
45
40
35
30
25
20
15
10
5
0
<400
401-700
>701
Yield (lb/ac)
EA/EO

Producing for Fiber

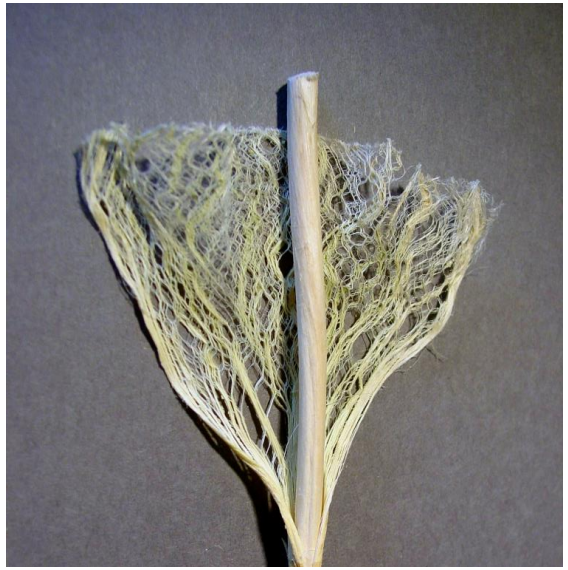
- Seed at 50-70 lb/ac
- Grain drill or broadcast were common methods in 2019
- Depth target of ¼ - ¾ inch (deeper plantings may be tolerated)
- Plant after a rain, not before

Wiki

http://www.frankferrisco.com/hemp_casting/hemp_casting_fiber.html

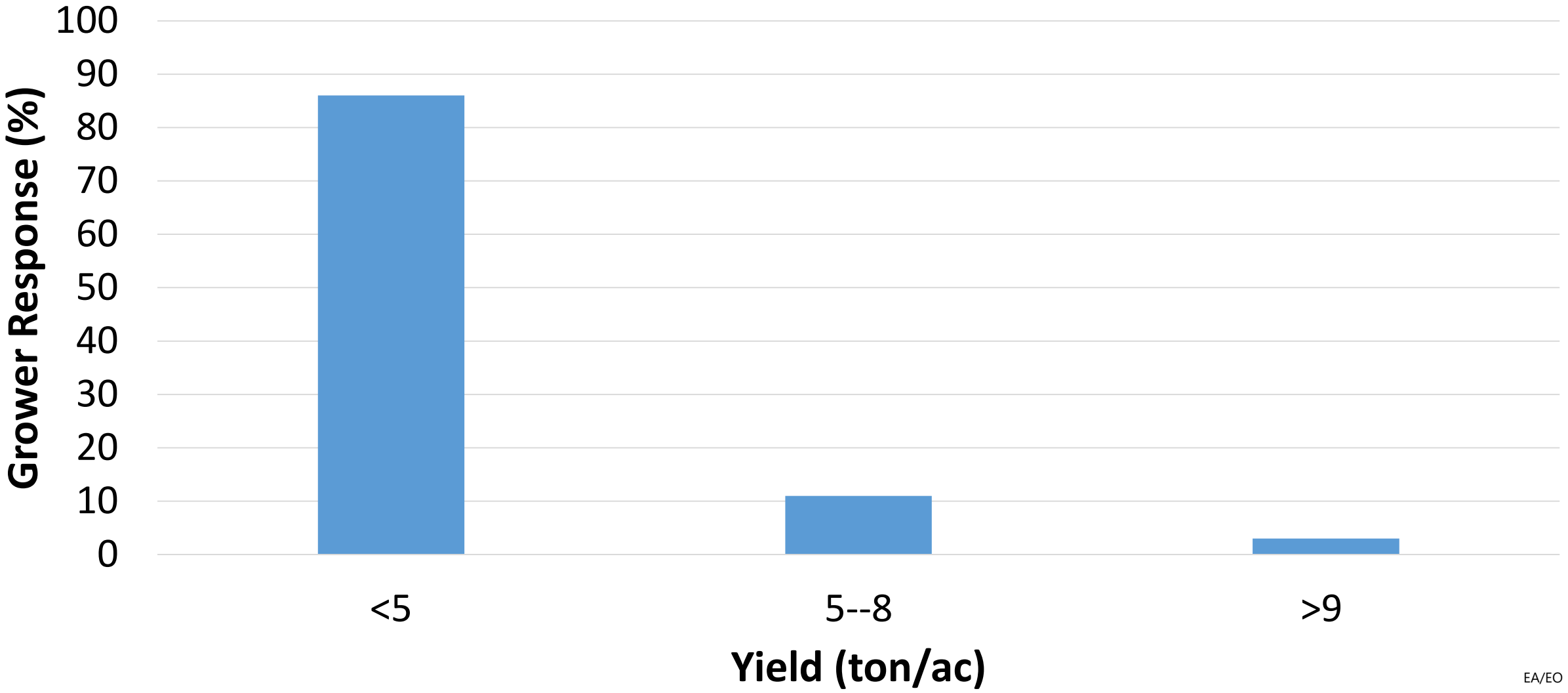
Producing for Fiber

- $0.08 per lb dry stalk or $160 per ton
- Cost of production estimates UKY $486/ac
- 5,300 lb stalk=1,300 lb of fiber
- Decortication process for fiber



Wiki

Fiber Stalk Biomass Yield 2019



EA/EO

Hemp as Fiber

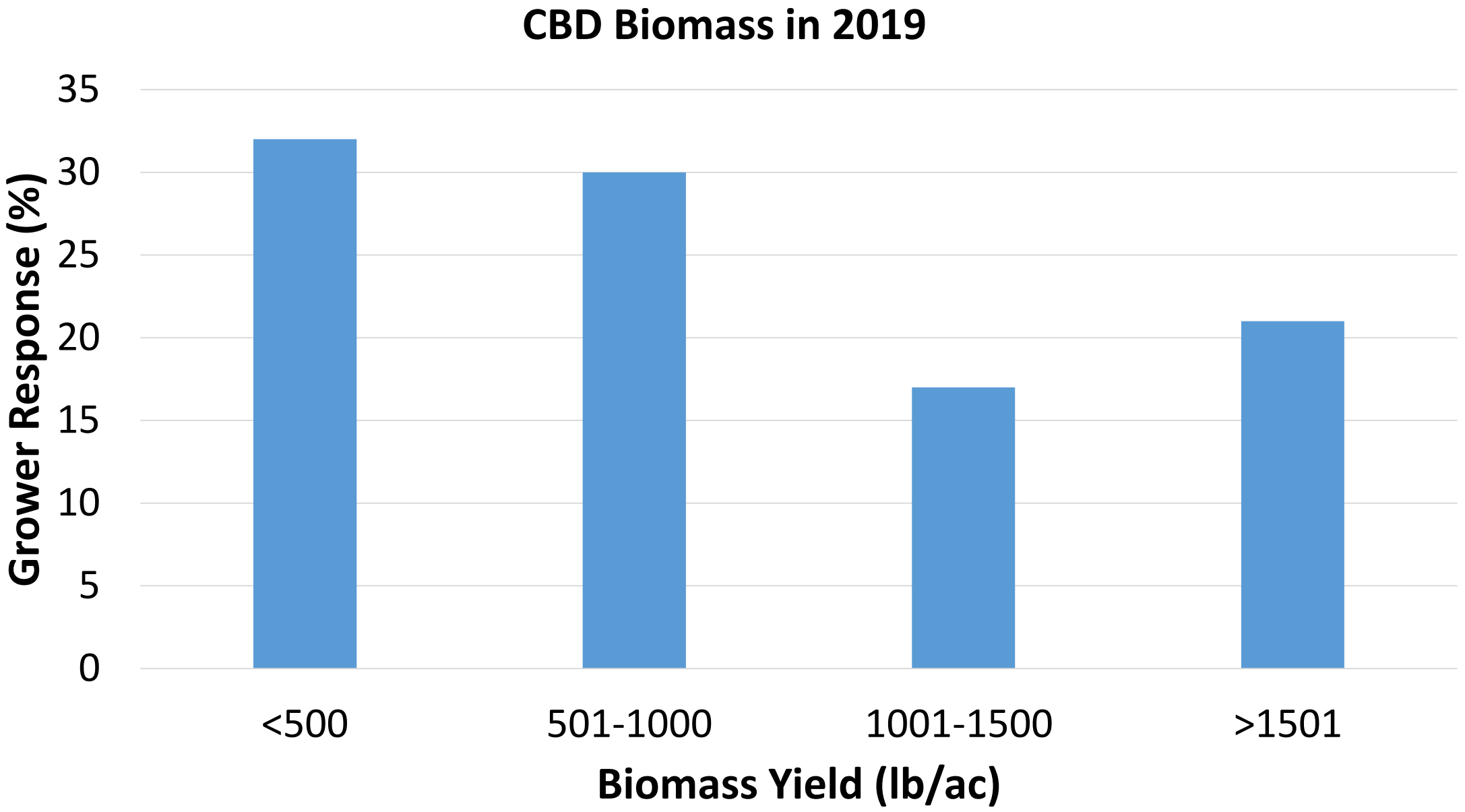
- Outer fiber (bast) 25-30% stalk
- Retting (dew, chemical, water) digest plant tissue except bast
- Compared to other bast fibres (e.g., flax, kenaf, jute or ramie), hemp has excellent;
  - length
  - strength
  - durability
  - absorbency
  - anti-mildew and anti-microbial properties

EA/EO

Producing for Cannabinoids

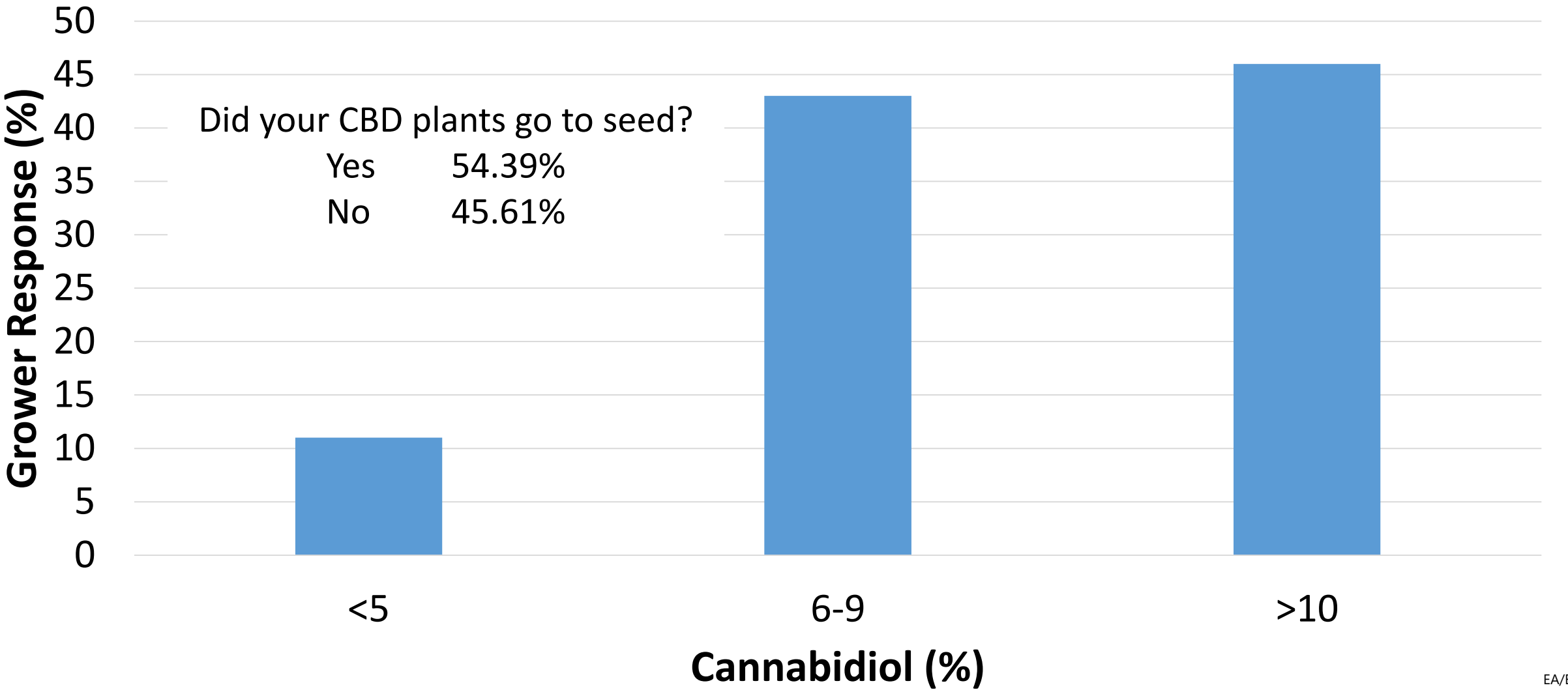
- Planting 1500-2500 plants/ac (or even higher)
- Transplanted seedlings or clones using water wheel/tobacco setter or by hand in 2019
- Raised beds, plasticulture, drip irrigation


FAST & EFFICIENT
PATENT PENDING


CBD Biomass in 2019
Grower Response (%)
35
30
25
20
15
10
5
0
<500
501-1000
1001-1500
>1501
Biomass Yield (lb/ac)

EA/EO

Average Cannabidiol (CBD) Content Crop Wide



EA/EO

Producing for Cannabinoids

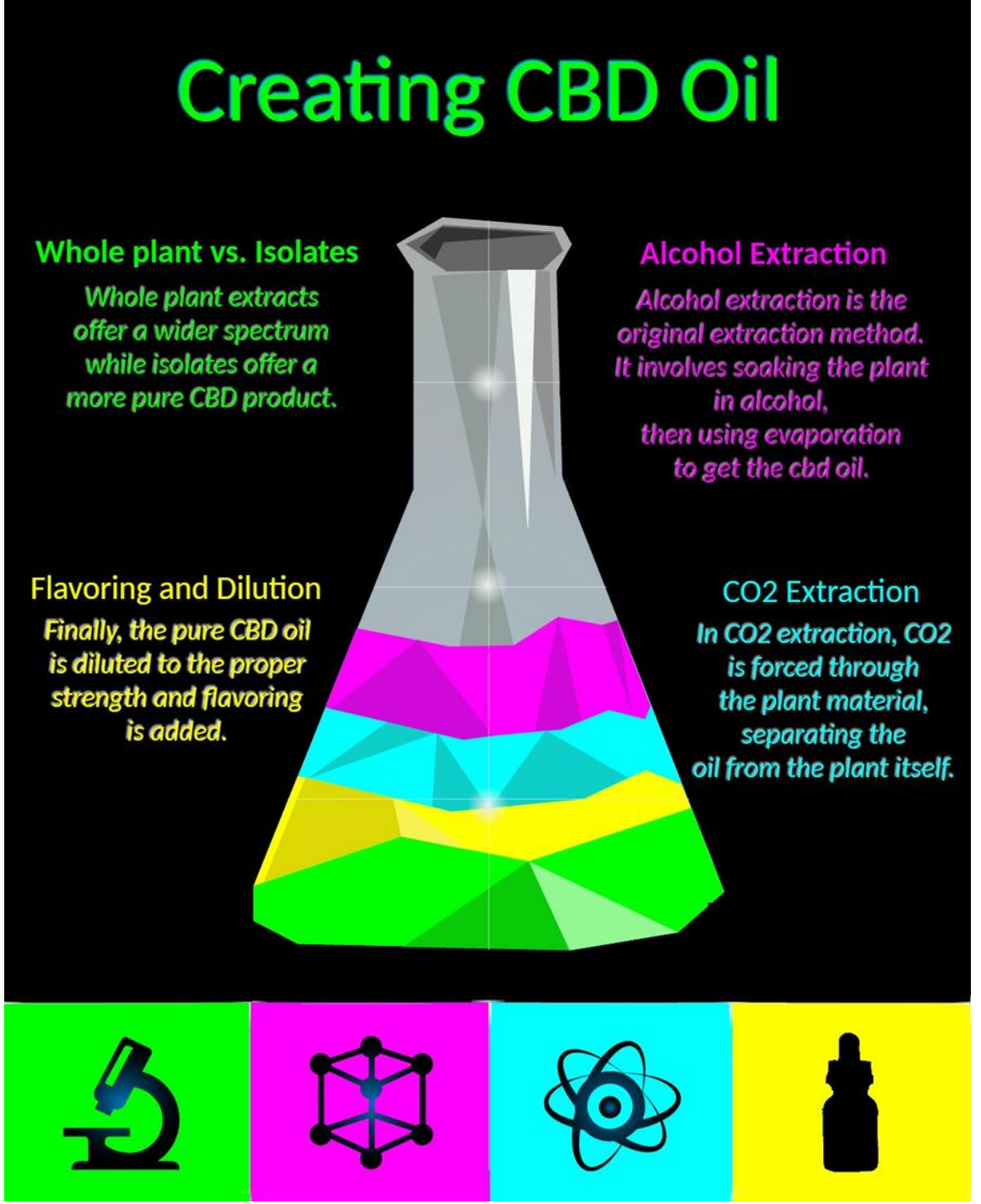
- Example of price breakdown:
  - Average yield of one pound of floral material
  - Price/percentage/lb
- $1.00/percentage/lb @ 10% CBD makes that plant worth $10
  - At 1,500 plants/ac you have $15,000
- Cost of production UKY & UT $1,522-15,700/ac
- Price for CBD has decreased since spring

Harvesting, Drying, and Processing

- Hand Harvest
- Hang dry or mechanical dryer in Kokomo
- Several processors in Indiana and neighboring states
- Craft flower/smokable market?

EA/EO

- CBD oil is made from Cannabis plants
- Plant buds and leaves are collected, and CBD is extracted
- Different solvents are used to extract dissolved CBD, along with oils and waxes
  - Alcohol (or some other solvent)
  - Supercritical CO_2
  - Novel techniques?
- Ethanol is further used to refine the oil and separate CBD from other oils and waxes
- HPLC is used to analyze the CBD oil to determine concentration



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Pests, Pathogens, Weeds

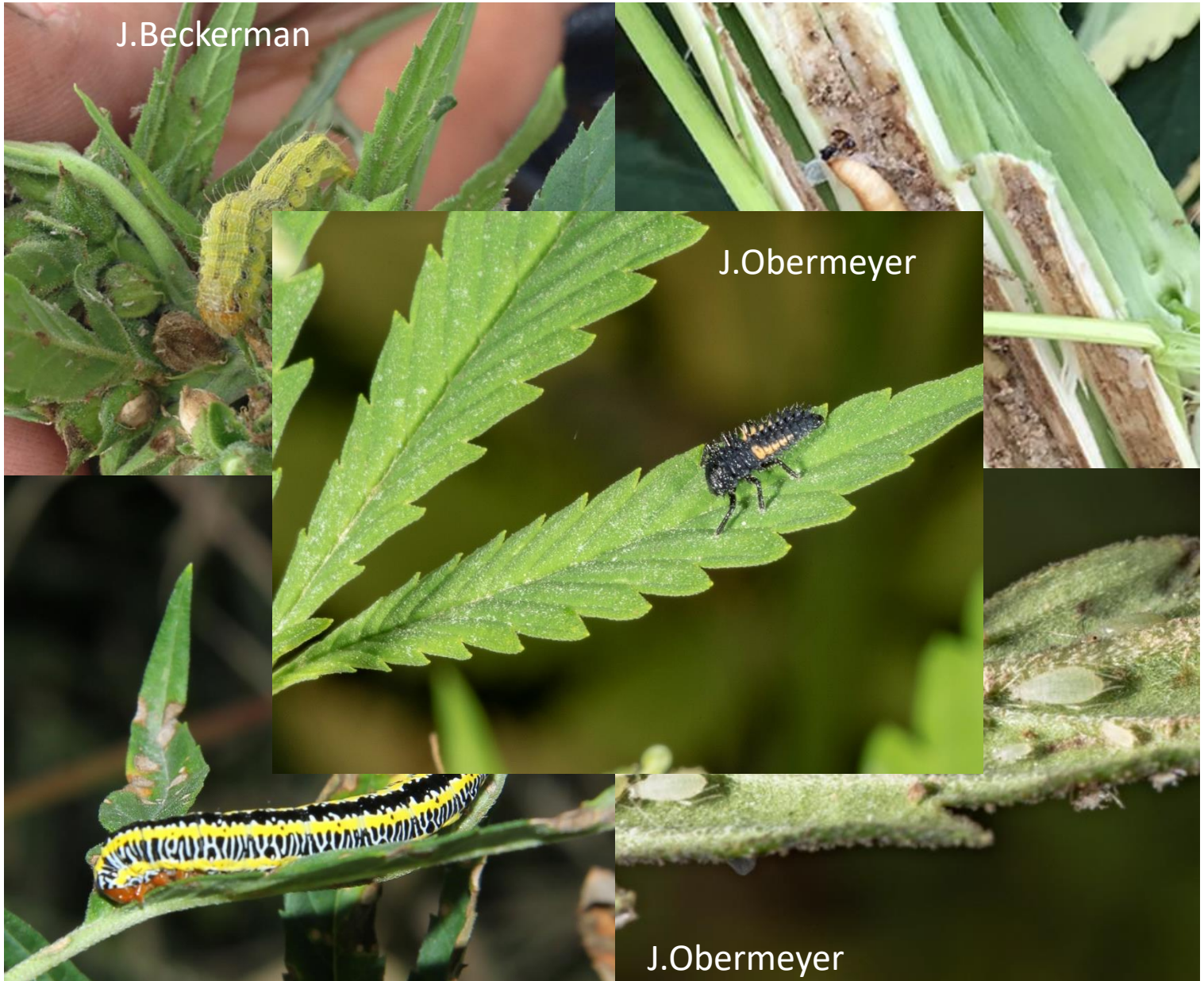
Pests and Pesticides

- Pathogens, insects, weeds
  - Some pathogens and insects were observed for the first time
- EPA Section 3, 24 (c), and 25(b) products
  - OISC has their own list specific to Indiana

Sec. 3, EPA registered, products acceptable for use on hemp and registered in Indiana			
OISC Product ID	**Company Name**	**Product Name**	**EPA Reg Number**
2019085216	MARRONE BIO INNOVATIONS	REGALIA BIOFUNGICIDE	84059-3
2018083267	MARRONE BIO INNOVATIONS	REGALIA CG BIOFUNGICIDE	84059-3
2018083084	MARRONE BIO INNOVATIONS	STARGUS BIOFUNGICIDE	84059-28
2016080206	GENERAL HYDROPONICS	GENERAL HYDROPONICS PREVASYN INSECT REPELLANT/INSECTICIDE	91865-1
2019084738	GENERAL HYDROPONICS	GENERAL HYDROPONICS PREVASYN INSECT REPELLANT / INSECTICIDE 2	91865-1
2016080207	GENERAL HYDROPONICS	GENERAL HYDROPONICS EXILE INSECTICIDE/FUNGICIDE/MITICIDE	91865-2
2019085092	GENERAL HYDROPONICS	GENERAL HYDROPONICS DEFGUARD BIOFUNGICIDE/BACTERICIDE1	91865-3
2016080208	GENERAL HYDROPONICS	GENERAL HYDROPONICS DEFGUARD BIOFUNGICIDE/BACTERICIDE	91865-3
2017080722	GENERAL HYDROPONICS	AZAMAX BOTANICAL INSECTICIDE/MITICIDE/NEMATICIDE1	91865-4
24(c) Special Local Need Registrations for use on hemp			
OISC Product ID	**Company Name**	**Product Name**	**IN SLN Number**
2020085540	CERTIS USA LLC	GEMSTAR LC (EPA REG. NO. 70051-45)	IN-200005
2020085539	CERTIS USA LLC	AGREE WG (EPA REG. NO. 70051-47)	IN-200006
2020085536	MARRONE BIO INNOVATIONS	GRANDEVO WDG (EPA REG. NO. 84059-27)	IN-200007
2020085535	MARRONE BIO INNOVATIONS	GRANDEVO CG (EPA REG. NO. 84059-27)	IN-200008
2020085538	MARRONE BIO INNOVATIONS	VENERATE XC (EPA REG. NO. 84059-14)	IN-200009
202008537	MARRONE BIO INNOVATIONS	VENERATE CG (EPA REG. NO. 84059-14)	IN-200010

Commonly Observed Insects

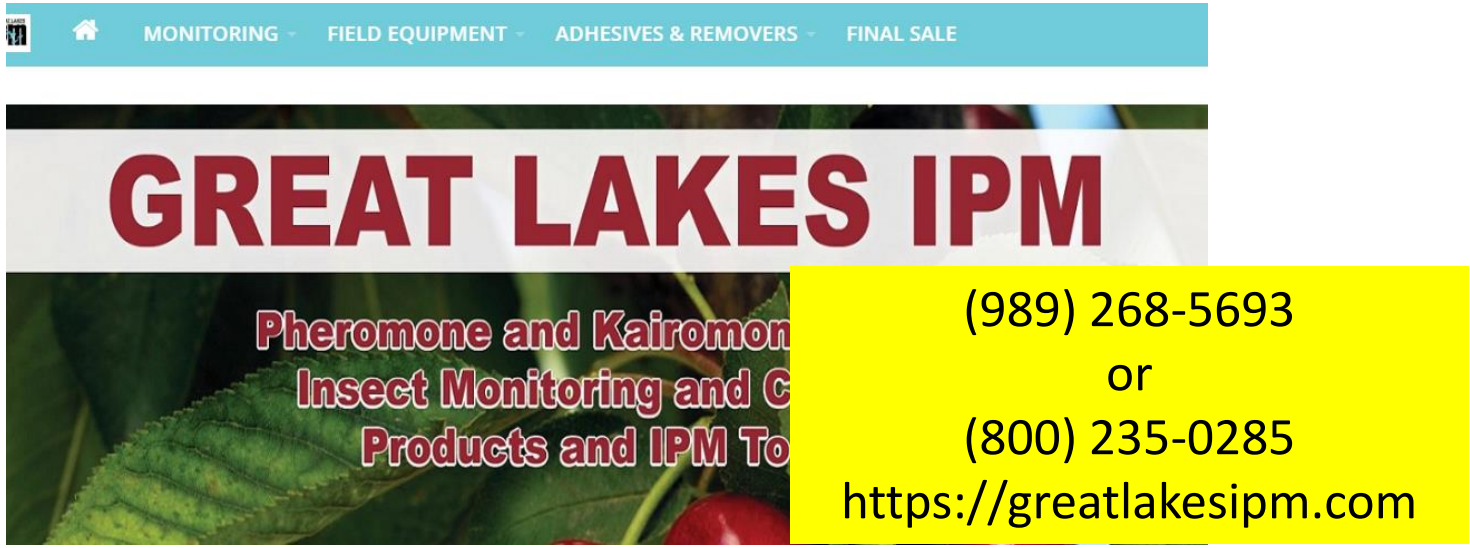
- Flowers/seed heads-Corn earworm
- Stalks-European corn borer
- Leaves-Caterpillars (multiple species)
- Fluid suckers-Cannabis aphids
- Beneficial insects-Lady beetles



Corn earworm (*Helicoverpa zea*)

Trapping Supplies and Trapping Network

- Great Lakes IPM, Vestaburg, Michigan
- Scentry ‘heliothis’ trap and specific pheromone lures
- use the Iowa/IA strain lure to trap for ECB in Michigan
- Purdue CEW trapping network
  https://extension.entm.purdue.edu/cornearworm/index.html

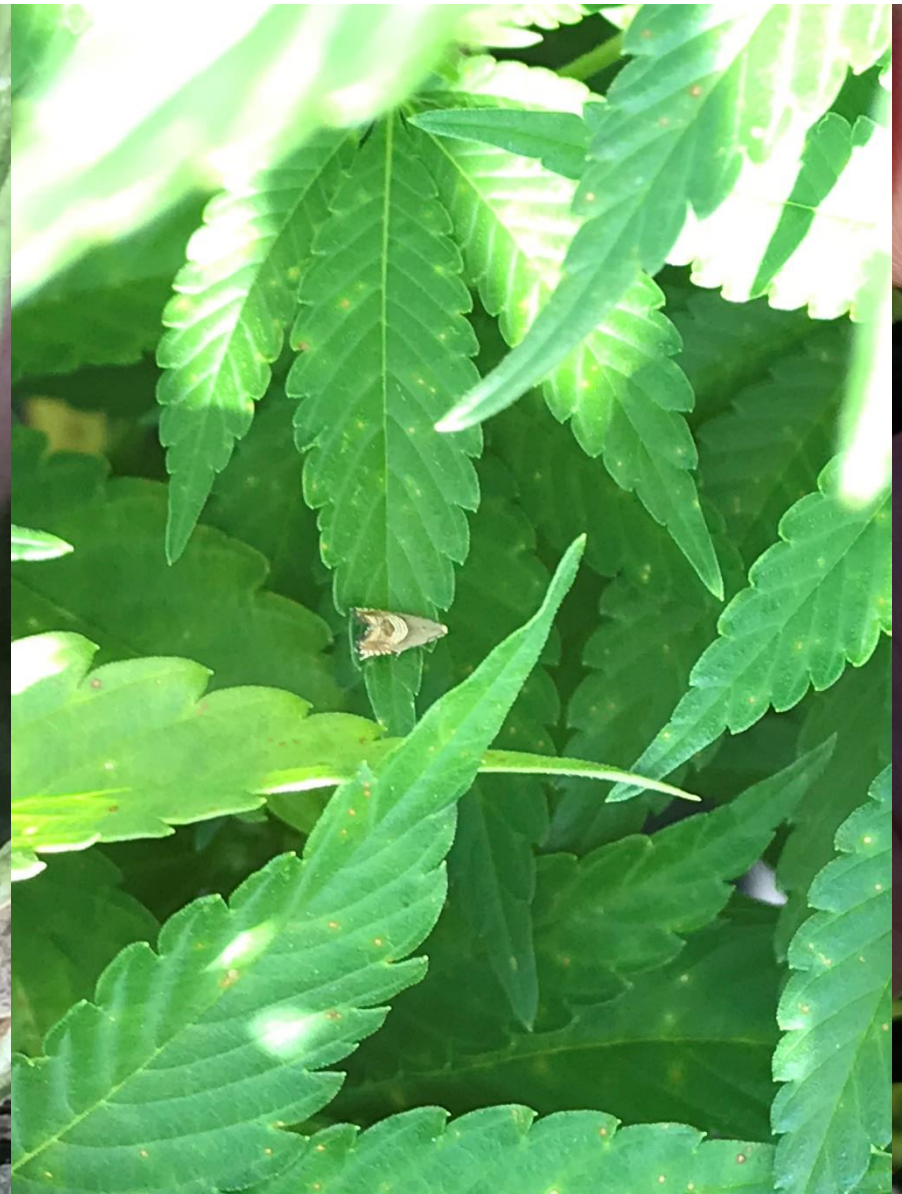


(989) 268-5693
or
(800) 235-0285
https://greatlakesipm.com

Pheromone Trapping for CEW

- Provides information on timing & intensity of moth flight
- Specific pheromone lure attracts males which are captured and counted at least weekly

Eurasian hemp borer (*Grapholita delineana*)



Alternative Hosts, Monitoring, and Management

- Hops, Japanese knotweed, feral hemp
- No lures developed
- Life history murky
- Remove plant debris, good sanitary practices

Photos: Turtle Creek Farms, WI

Potato leafhopper (*Empoasca fabae*)

Monitoring and Management

- Note other nearby crops- choose field sites wisely
- Look for nymphs and adults- use a sweep net
- Look for scorching
- Cultivar selection may be future option
    - Observed a very susceptible cultivar- Midwestern Strain

Cannabis aphid (*Phorodon cannabis*)

Monitoring and Management

- Look for aphids on underside of leaves, honeydew, cast skins
- Eggs overwinter in field, remove debris, till
- Remove early season volunteers (grain/seed producers)
- Many natural enemies found outdoors

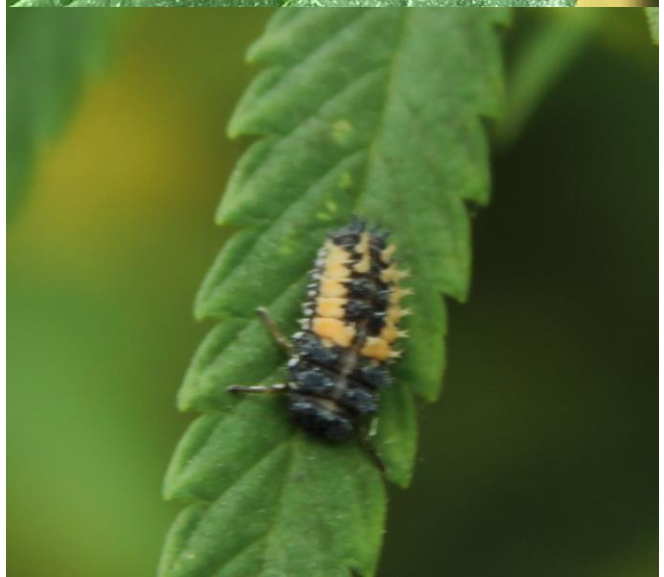
Beneficial Insects

Aphid mummies are brownish yellow and bloated. Mummies are caused by parasitic insects. This is a parasitic wasp that emerged from a cannabis aphid mummy.

Whitney Cranshaw

Beneficial Insects

Lady beetle larvae and adults can be found on hemp feeding on small insects. Multiple species have been observed in Indiana.



Praying mantis seem to be more common in CBD hemp.

Lacewing larvae and adults can be found on hemp plants. They feed on soft bodied insects.

Commonly Observed Diseases

- Root-unknown, Pythium
- Foliar -Cercospera
- Stem/crown-Bud rot (Botrytis)

Pythium Management

- In an agronomic setting
  - Tiling
  - Plant on fields that have good drainage
  - Avoid areas that were previously planted in beans or sunflower

Sclerotinia management

- Avoid planting close to or in rotation with soybean, sunflower, legumes or rye

- Sclerotia numbers begin to decline if left undisturbed
  - viability is maintained if sclerotia are buried 8 to10 inches in the soil
  - Greater tillage also promotes earlier canopy development, thus increasing the risk of white mold
  -
- Weed control is critical as many broadleaf weeds are hosts of the white mold pathogen

Diagnosis is essential: PM versus pollen

Powdery Mildew Management

- Use resistant cultivars when available and when identified
- Plant in non-shaded areas
- Space plants providing enough aeration and growing room
- Prune and thin out branches
- Monitor for signs of infection
- Remove infected leaves
- Provide enough moisture, always watering in the morning or late afternoon

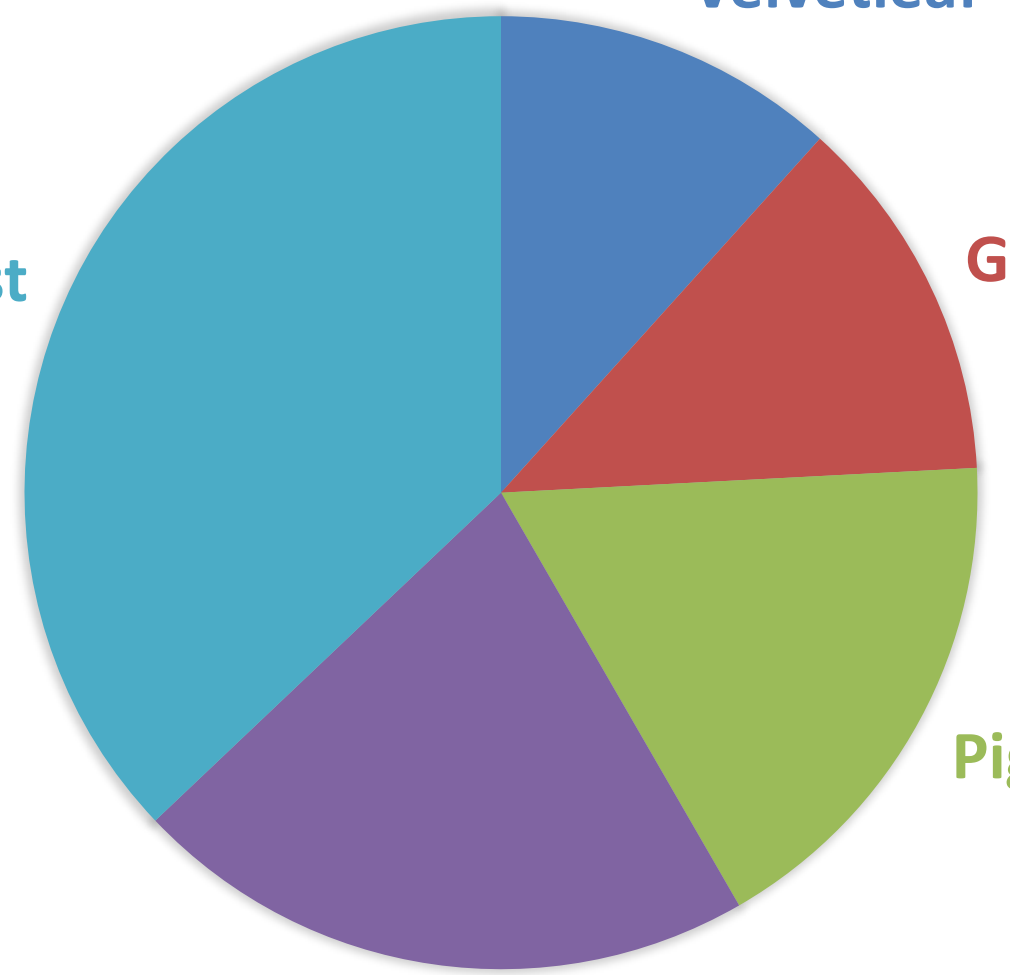
Botrytis

UKY

Botrytis Management

- Promote rapid drying of plants, space to allow good air circulation
- Avoid overhead watering or misting plants especially if Botrytis blight has been troublesome in the past
  - Do not scout when plants are wet with dew or rain since this could spread fungal spores during conditions which favor infection
- While inspecting plants carry a paper bag for sanitation
  - Remove faded or blighted leaves or entire plant if infected at the base
    - Fungus can overwinter as tiny, black sclerotia embedded in dead plant tissue

MAIN WEED ISSUES



Other, please list

Johnson grass
Purslane
Water hemp
Morning glory
Cocklebur

Weed Issues

- Slow growth phase of hemp
  - Hemp is not competitive in first 3-4 weeks
- Weed control is challenging
  - No herbicides labeled for use in hemp
- Growers struggled with weed control
  - Used hand labor to remove weeds

./EO

Additional Resources

- https://purduehemp.org/
- https://www.oisc.purdue.edu/hemp/index.html
- https://www.ams.usda.gov/rules-regulations/hemp
- https://hemp.ca.uky.edu/
- https://fyi.extension.wisc.edu/hemp/
- https://www.canr.msu.edu/hemp/

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Thank you!