

# Perennial Grains at Cornell

## Learning from and with farmers

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Sustainable Cropping Systems Lab  
Cornell University

2<sup>nd</sup> Annual Kernza Conference, Green Lands Blue Waters, July 2017



# July 2016: Kansas Kernza Conference





# Topics

- Planted 3 on-farm trials
- Tiny update on the Culman experiment
  - Yields in 2016
  - Got our first fall cut in 2016
- Farmer perennial grains survey
- Ergot
- Eugene's intercropping work



# Questions for the group

- How do grain heads develop? At what rate? Evenness across field? Difference by age of plants?
- What do people use to store seed? How long does it last? Difference in storage for re-planting vs. food use?
- What are the trade-offs with spring seeding vs. fall seeding?
- Has anyone tried a nurse crop with Kernza?
- Forage quality numbers to trust? Which method is best? Not NIR...?
- Have other people had ergot in their stands?
- Combine settings: cylinder to concave clearances, cylinder speed, any chaffer or sieve to put in there, air level?



The background of the slide is a close-up, slightly out-of-focus image of tall, dry grass. The grass blades are thin and light brown/tan in color, creating a dense, textured pattern across the entire frame. The lighting is soft, highlighting the individual blades and their natural curves.

New on-farm trials



# On-Farm Fall 2016 Plantings

- 3 organic grain farmers in Fingerlakes area
  - Klaas Martens, Lakeview Organic Grain
  - John Myer, Myer Farm and Distillery
  - Thor Oechsner, Farmer Ground Flour
- ACE1 Perennial Rye and Kernza planted
  - Under an acre for each crop
- Farmer-driven research questions
  - Swathing vs. Direct Combining (Thor)
  - Influence of fertility application (John)
  - Kernza Seeding rate (25 vs. 15 lb/ac, Klaas)





# On-Farm Seeding

| Farm Info |                             |               | Kernza                           |  |                                    | ACE1 Perennial Rye          |                      |               |
|-----------|-----------------------------|---------------|----------------------------------|--|------------------------------------|-----------------------------|----------------------|---------------|
| Farm      | Equipment                   | Planting Date | Actual seeding rate (lb/ac)      | Area covered   | Drill Setting                      | Actual seeding rate (lb/ac) | Area covered (ft)    | Drill Setting |
| Thor      | 10-foot IH5300 grain drill  | 9-9-16        | 23                               | 400x80ft<br>0.73 acre  | 12                                 | 95                          | 400x60<br>0.55 acre  | 12            |
| Klaas     | Amazone Airstar Prafi       | 9-21-16       | Targeted<br>15 lb/ac<br>25 lb/ac | 290x60ft<br>(low rate)<br>290x60<br>(high rate)<br>aka 0.40<br>acre each | 0 (15<br>lb/ac)<br>8 (25<br>lb/ac) | 50                          | 120x290<br>0.80 acre | 6             |
| John      | Case III 5400 No-till Drill | 9-15-16       | 14                               | 75x600ft<br>1 acre   | 12                                 | 51                          | 60x600<br>0.83 acre  | 12            |

## Planting Notes

**Thor:** half inch rain the day before, but field had previously been “talcum powder” dry.

**Martens:** drill is not accurate under 40 lb/ac rate. Field was rolled after planting. Klaas only field site to plant 2015 Archarya ACE1 lot.

**Myer:** fairly dry planting conditions.



# Planting



John's



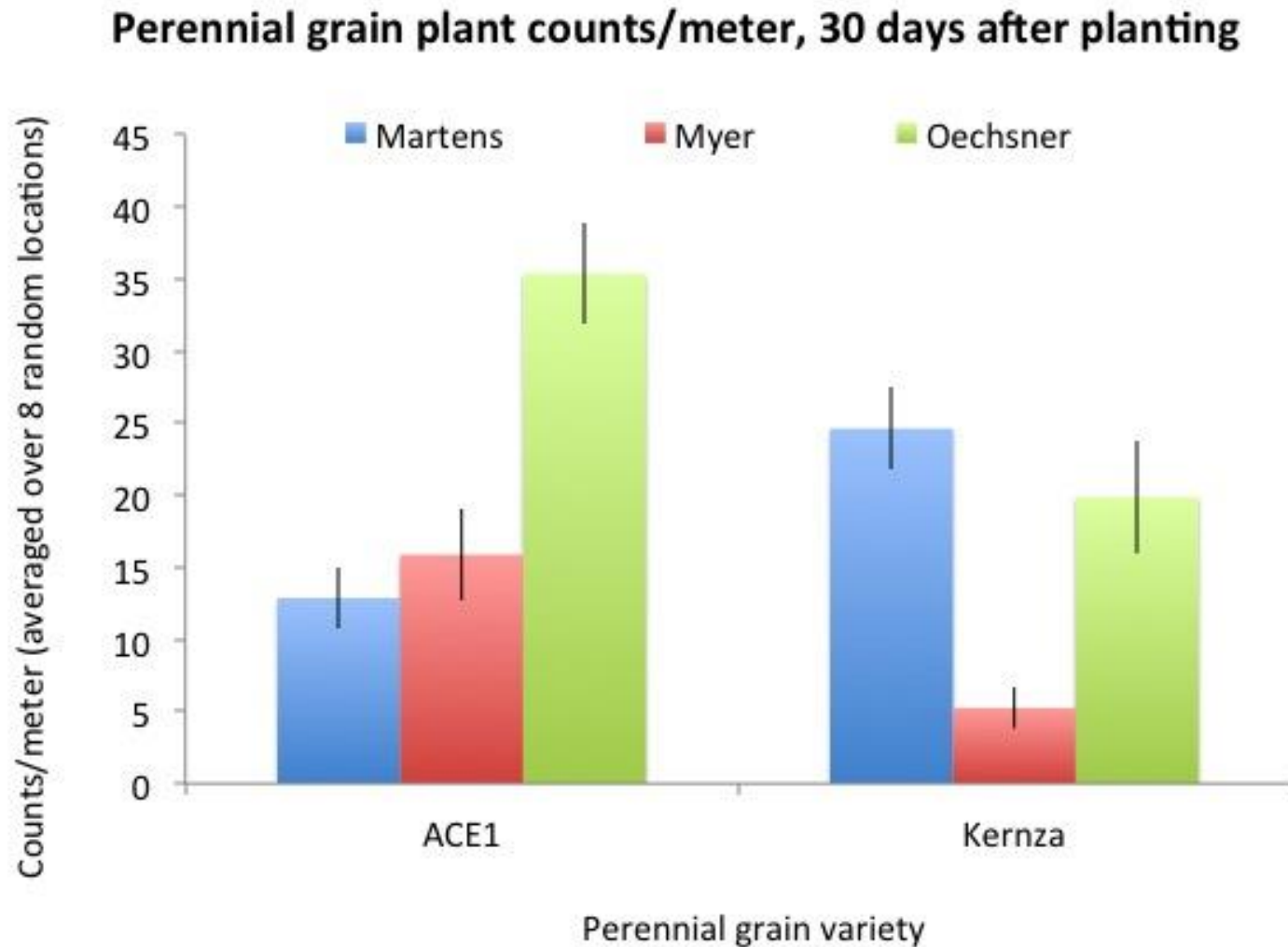
Thor's (very rocky)



Klaas'



# Establishment (30-days after planting)





# Thor's, 1 month after planting



Kernza



ACE1 Rye



# Myer's, 41 days after planting



Kernza



ACE1 Rye



# Marten's, 35 days after planting



Kernza



ACE1 (2015 seedlot) Rye  
It was hard to tell grass weeds from rye



# Farmers' Impressions fall 2016

Early thoughts about perennial grains on their farms

- Thor:

- Heard about Kernza years ago and excited about trialing it. Skeptical of the “pathetic” looking Kernza in the fall. Is interested to see how Kernza does on “poor” fields.

- John:

- Also really interested and curious. So far pretty quiet about the process. Interested in distilling ACE1 rye.

- Klaas:

- Compares Kernza to emmer and cheatgrass. Concerned about small seed size. Thinks that forage will be important for Kernza success.



# Klaas, 4-21-17

Rye →



Kernza left, Rye right



Kernza →





# John, 4-21-17



Kernza row

Kernza →



Rye →





# Thor, 5-2-17

Kernza



ACE1 Perennial Rye



Rye  
tillering →





# John – great rye, poor Kernza



Rye

April 21

Kernza



June 10



# Thor – Kernza was mostly field pennycress



Kernza, May 2



Kernza, June 8



Thor –ACE1 rye looks great



June 8



# What happened with the Kernza?

- Wrong planting depth? (0.5 in)
  - Very dry at time of planting
  - Needed better weed control?
- 
- What can we learn for next time?



The background of the slide is a close-up, slightly blurred image of tall, dry grass. The grass blades are thin and light-colored, with some yellow and brown tones, suggesting a natural, outdoor setting. The text is centered over this background.

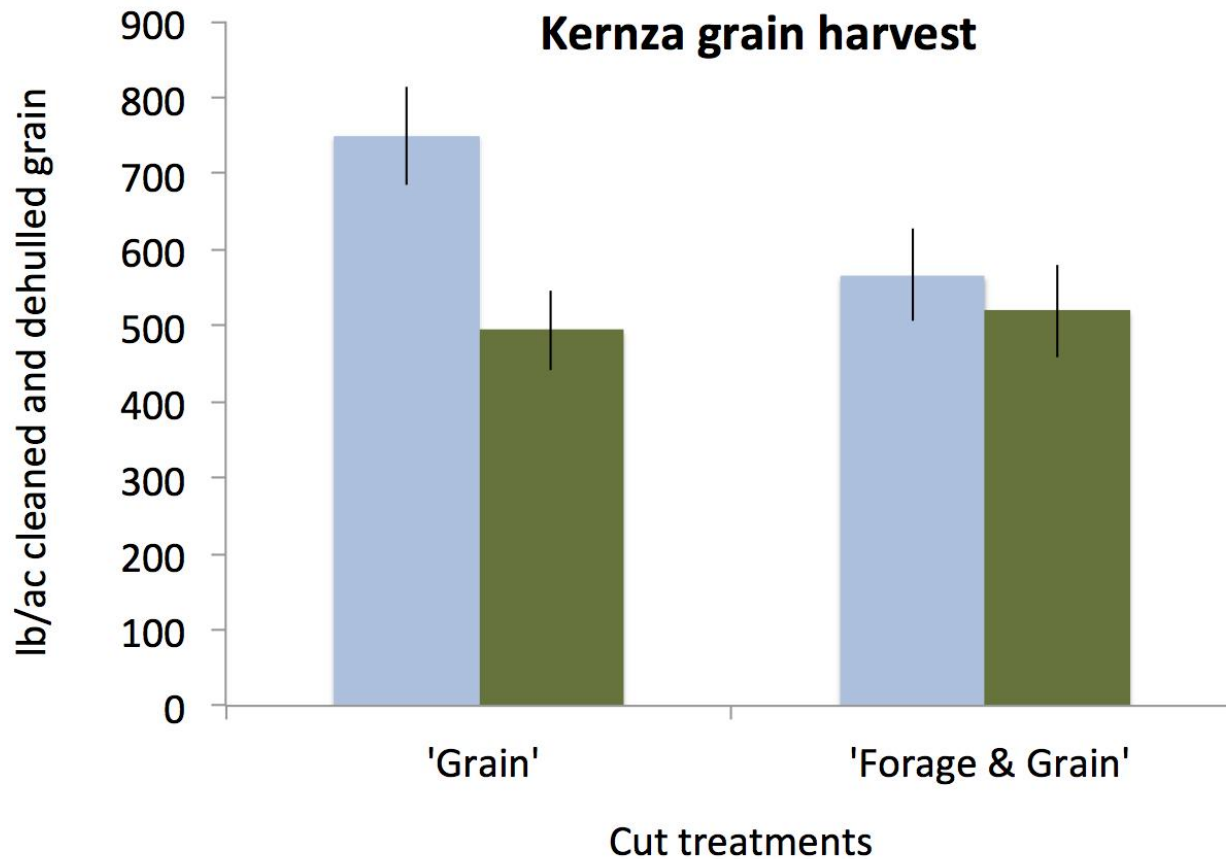
# A moment for a Culman study update



# Culman study

776 lb forage/ac

555 lb forage/ac.



Kernza growth stage ranged from V0 to V2 at the fall clip, 10-18-16 (Moore, 1991)

Fall forage was only harvested in 2016, because in 2015 the plants did not mature sufficiently past summer harvest to safely cut for fall forage.



# Culman study

planted August 2014 (snapshots June 28 2017)



Control, N80, Block 1



Summer, N120, Block 1





Lodging (for the first time in the experiment)





# Perennial Grains Survey

Conducted spring 2016



# Survey on perennial grains

 Cornell University

 **isaralyon**  
Une école d'ingénieurs au cœur de la vie

English ▾

**Please rank the top 3 potential issues that might prevent you from growing perennial grains on your farm.**  
*Type in a number from 1 to 3 in the box to the left (use "1" to indicate the most important reason)*

High cost of seed

Increased pest problems (weeds, diseases, insects)

Limited life span

Low grain yield

Lack of market where you can sell your crop

Low profitability

Other, please define:

<< >>

- Farmers & Processors
- Gauge interest and current knowledge
- France and USA
- Christophe David
- To inform research and market goals
- 407 farmer responses
- **Be aware of survey bias**



# Some example questions for farmers

- Farm size, organic vs. conventional, crops produced...
- What top 2 soil issues are you most concerned about?
- Given the potential challenges associated with perennial grain production, what would be your top 3 concerns?
- What level of interest do you have in growing perennial grains? (“definitely not interested” – “very interested”)



# Farm Types Represented

**Table 1.** Proportions of respondents by farm type, farm size, and production type.

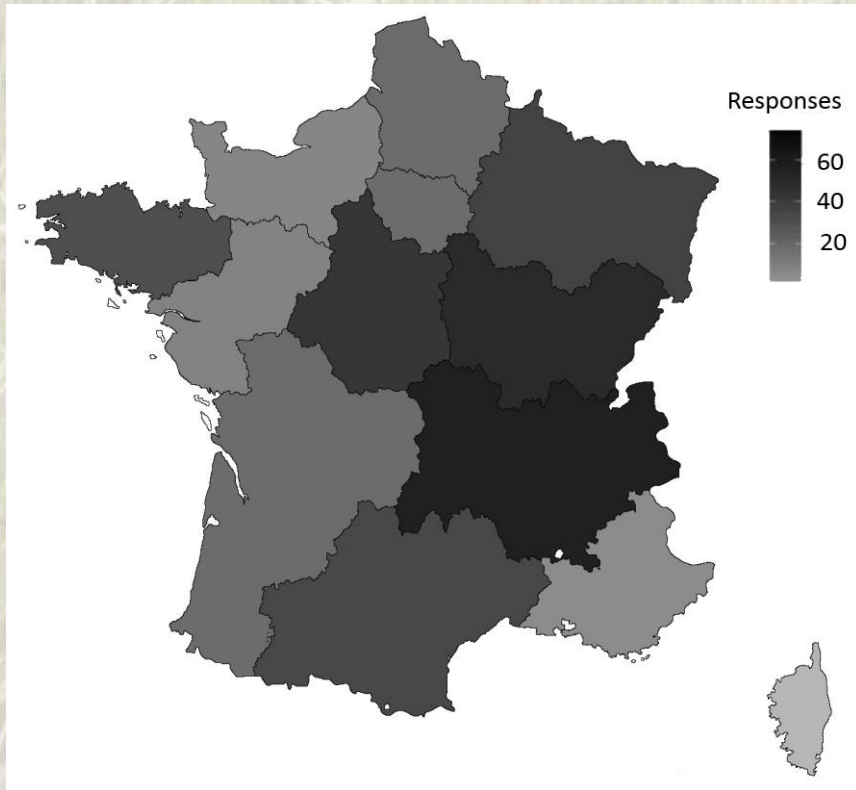
|        | Farm Type     |                | Farm Size           |                     |                    | Production type |                |                |                |
|--------|---------------|----------------|---------------------|---------------------|--------------------|-----------------|----------------|----------------|----------------|
|        | Conventional  | Organic        | Range of farm sizes |                     |                    | Livestock       | Forage crops   | Perennials     | Ancient grains |
|        |               |                | Small <sup>1</sup>  | Medium <sup>1</sup> | Large <sup>1</sup> |                 |                |                |                |
| USA    | 23%<br>(n=20) | 69%<br>(n=61)  | 44%<br>(n=39)       | 10%<br>(n=9)        | 41%<br>(n=36)      | 48%<br>(n=39)   | 57%<br>(n=46)  | 58%<br>(n=47)  | 36%<br>(n=29)  |
| France | 21%<br>(n=68) | 63%<br>(n=202) | 50%<br>(n=159)      | 32%<br>(n=101)      | 17%<br>(n=53)      | 39%<br>(n=119)  | 61%<br>(n=186) | 50%<br>(n=153) | 58%<br>(n=177) |

<sup>1</sup>Small: under 100 ha; Medium: 100 to 200 ha; Large: above 200 ha

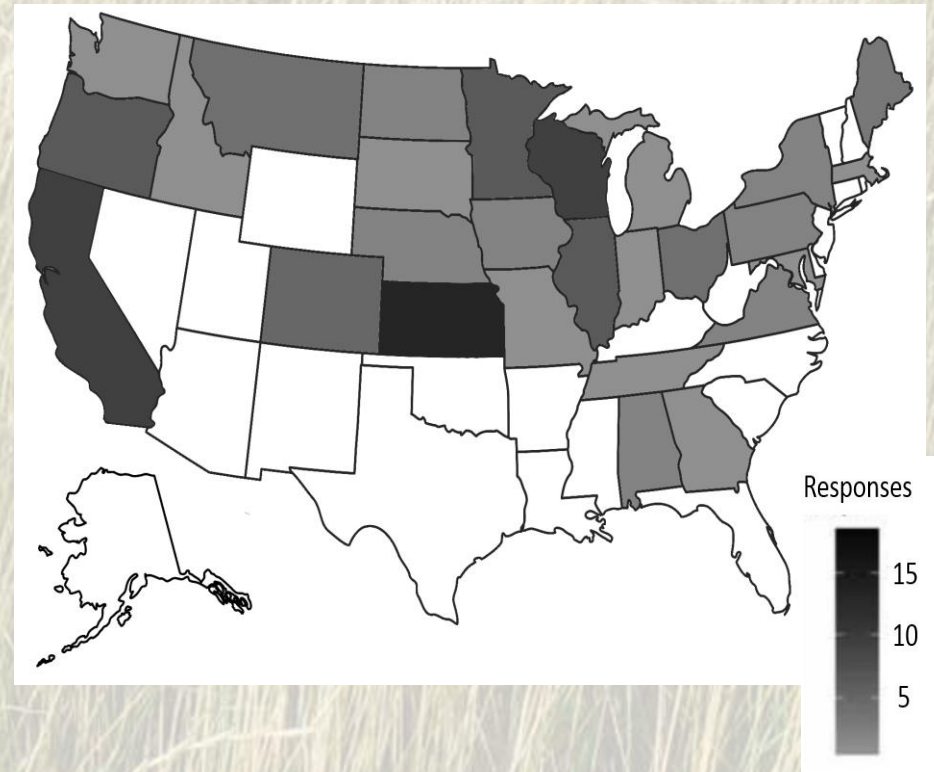
(Could choose multiple production types)



# Farmer survey responses



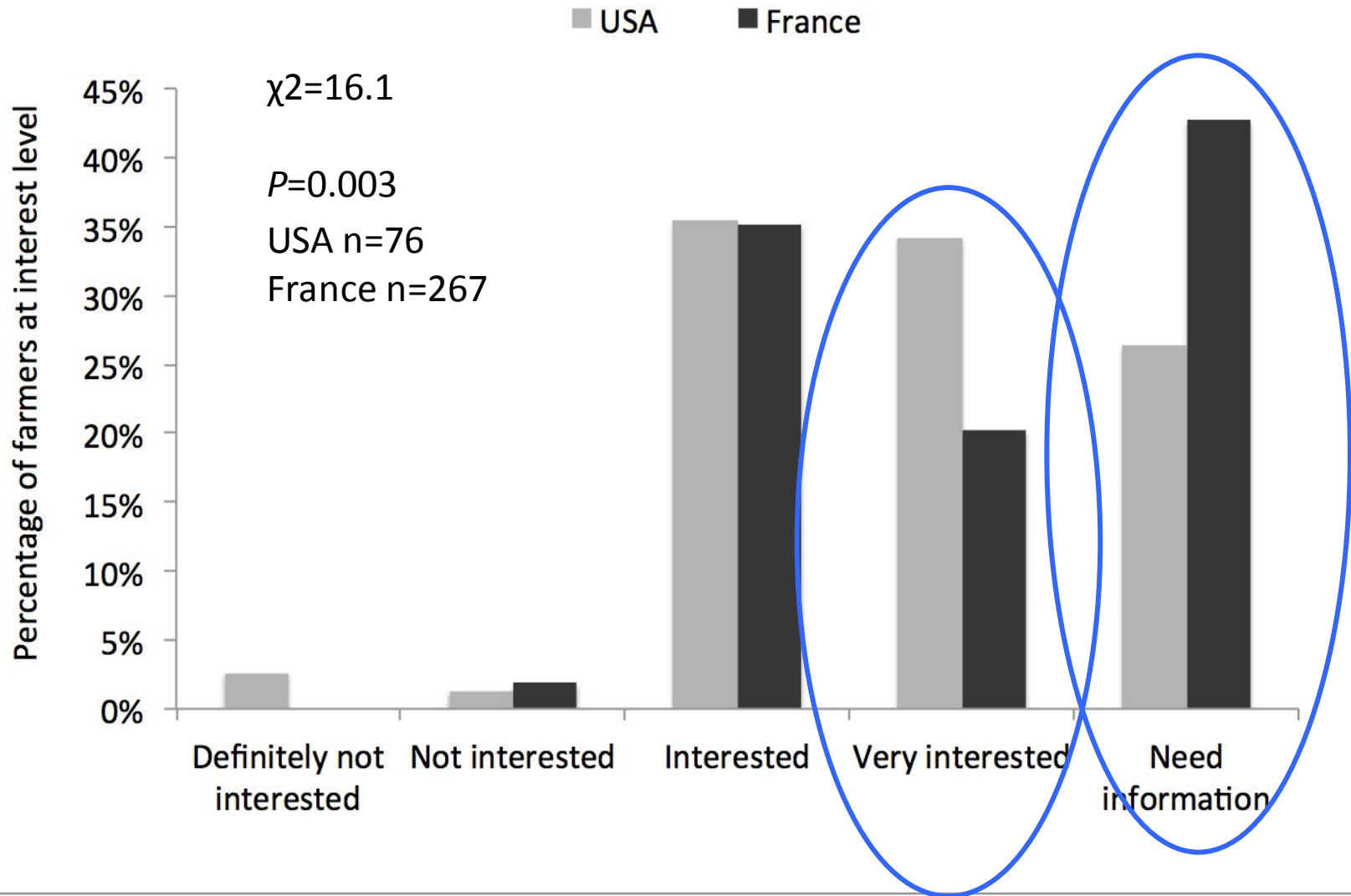
319 French farmers



88 USA farmers

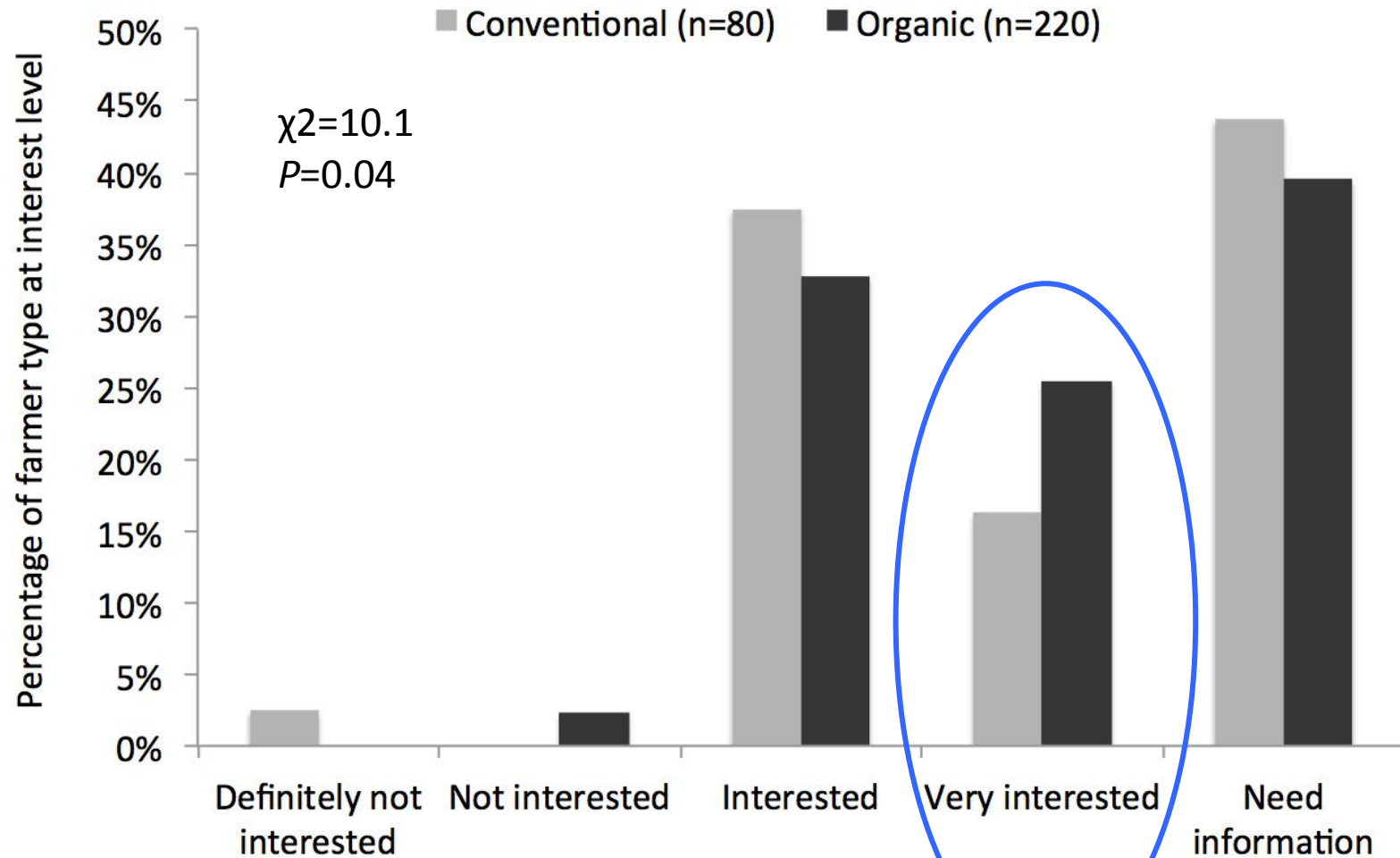


## Farmer interest in perennial grains by country



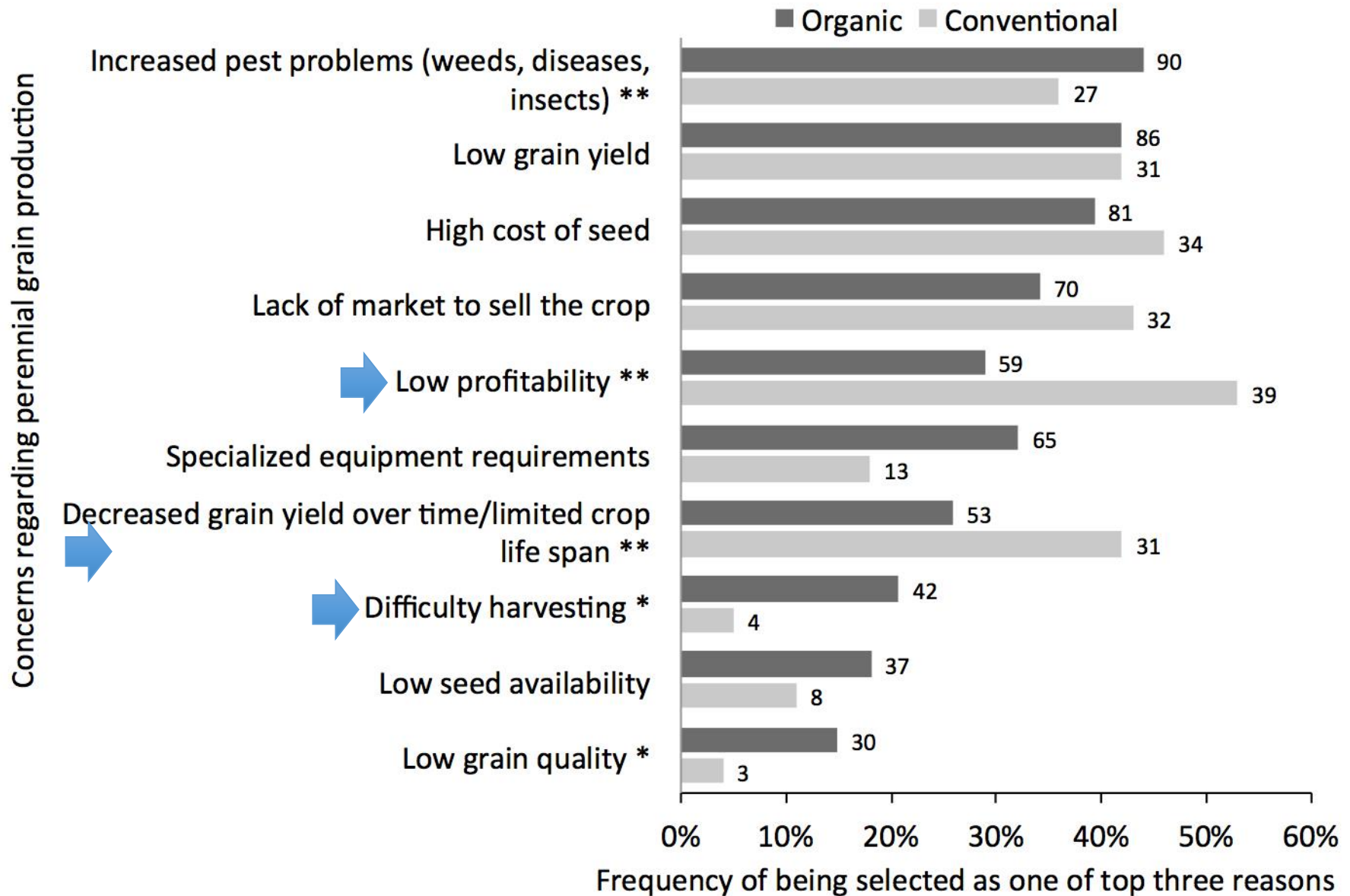


## Farmer interest in perennial grains by farmer type



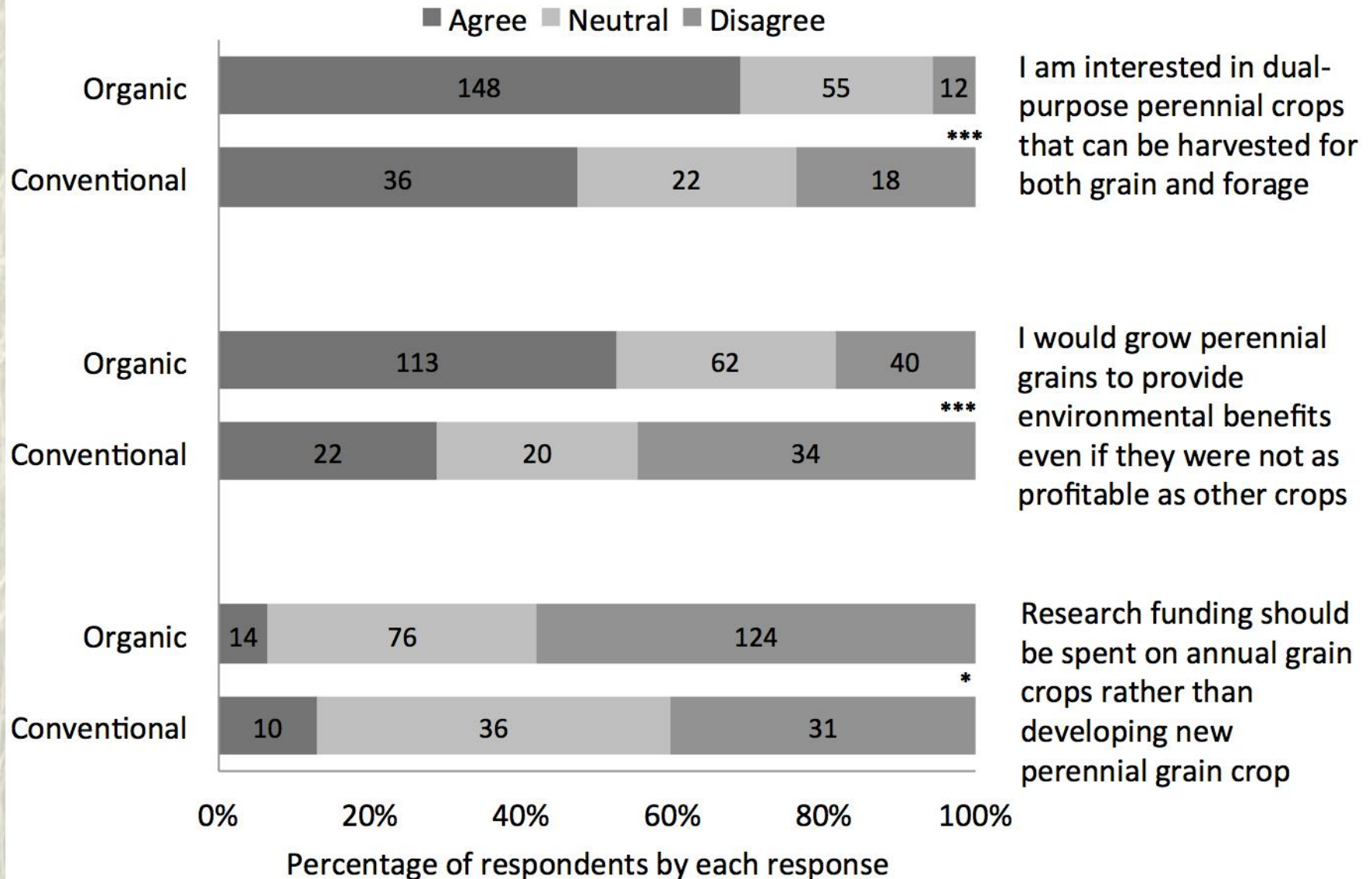


# Farmers' potential concerns about perennial grains





# Farmer agreement with 3 statements on perennial grains





# Important points from survey

- Farmer interest in dual-purpose crop
  - Likely very important for adoption/economics
- Top motivations:
  - Economic profitability
  - Reduce input use
  - Soil health improvement
- Conventional farmers interested in economics of perennial grains; organic farmers interested in environmental benefits





Ergot



# Ergot (*Claviceps purpurea*)

- A fungus, makes “sclerotia” in place of a grain head
  - In Kernza the hull can’t form
  - Transmitted by coming in on seed, blowing in from neighboring field
  - Contains toxic alkaloids
- 0.1% in 30 gram sample is FDA allowance
- Wheat is considered “ergoty” if it contains 0.05% (USDA Grain Inspection Handbook)
- Swiss chemist A. Hoffman wanted to make medicine out of ergot in 1938, found lysergic acid. LSD is purely synthetic but based off ergot compound.





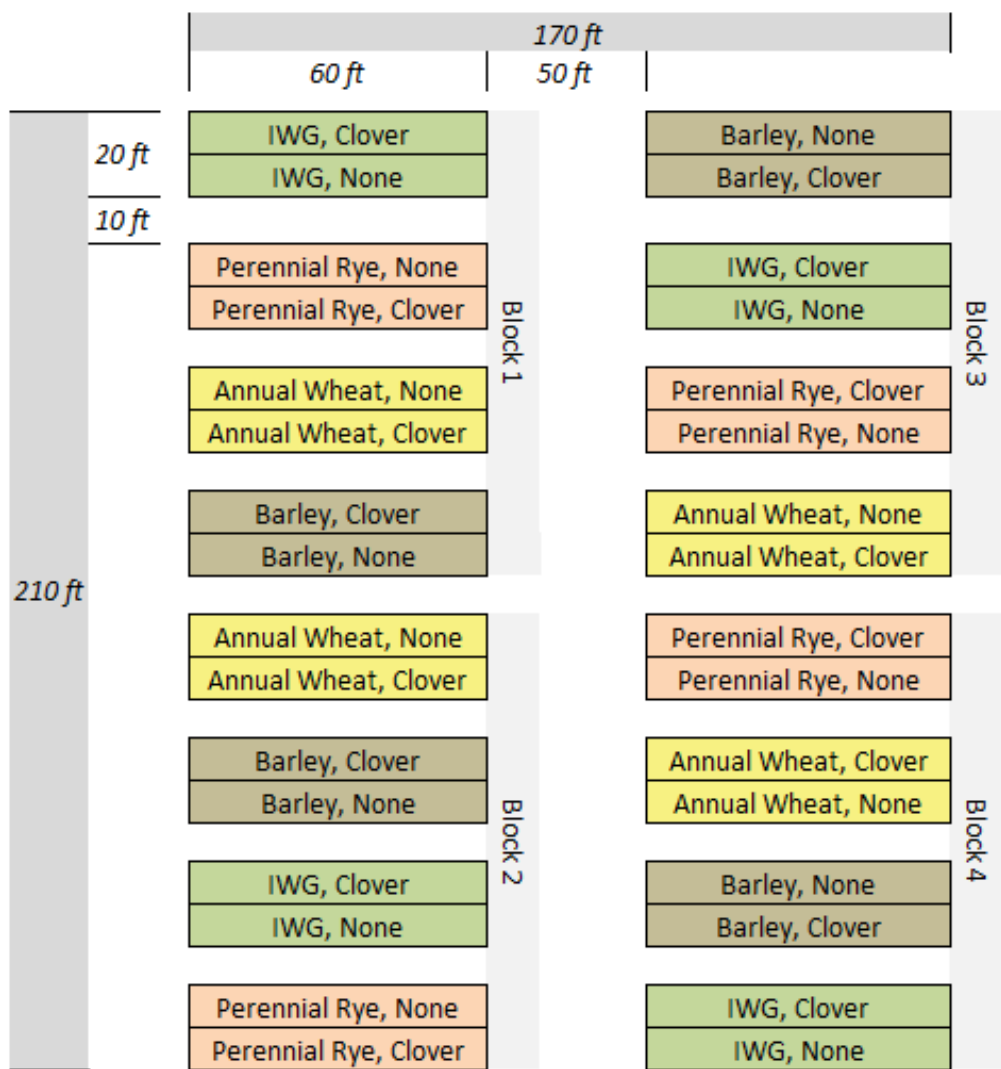
- Ergot incidence worse in wet year
- Cleaning it out?
  - Gravity table, color sorter, floating
- Baking does not break down toxin
- Ergoty grain can be used for distilling, but byproduct should not be fed to cattle.
- Controlling ergot?
  - Rotation (hard with perennials)
  - Ergot incidence worse in wet year
  - Mow field edges because grasses there could host it
  - Use an ergot-free seed source (that's a way it comes in)
  - Don't harvest edge of field (Lee)



# PhD Candidate Eugene Law



# Intercropping in Perennials and Annuals



Comparing Kernza, perennial rye, winter wheat, and winter barley over three growing seasons

Planted September 2016, medium red clover interseeded March 2017

Data Being Collected:

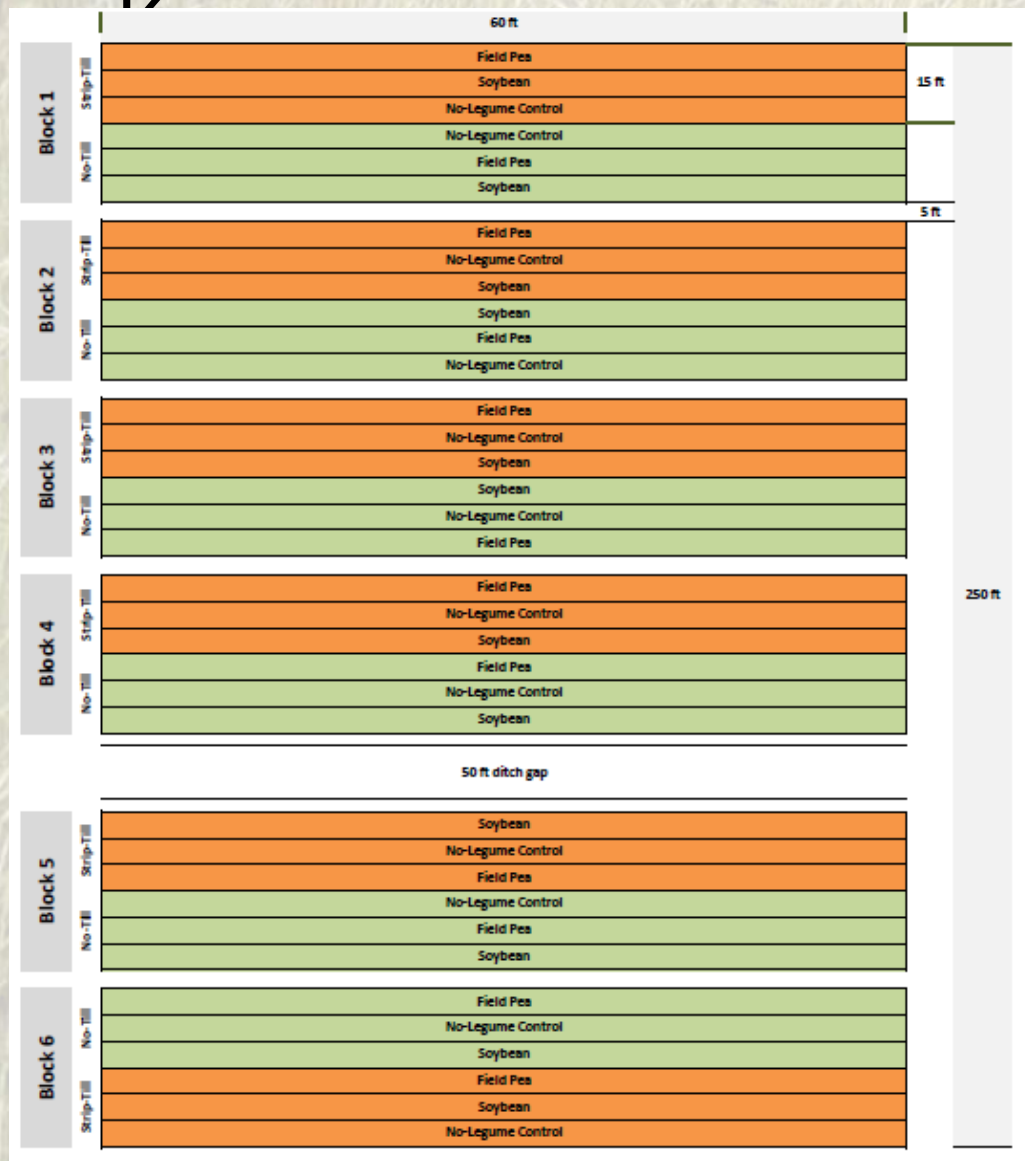
- Grain yield
- Aboveground biomass / potential forage yield
- Weed, disease, and insect problems
- Soil health and erosivity
- Energy, labor, and material usage







# Grain Legume Intercropping in



Food-grade soybean and field pea intercropped with 4-year-old Kernza

Questions:

- Does strip tillage stimulate Kernza growth or reproduction?
- Is there complementarity between Kernza and grain legumes as intercrops?
- How do strip tillage and intercropping affect pests?
- Does intercropping affect overall cropping system productivity/profitability?







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