



# Digging Deep on Growing Grains

## VABF 2022

Farmer William Hale Buyer Ian Gamble Speaker Heather Coiner



This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2019-38640-29878 through the Southern Sustainable Agriculture Research and Education program under subaward number LS20-327. USDA is an equal opportunity employer and service provider.



## **A Modular Curriculum for Growing Food Grain for the Local Market**

### **Thank you to our funders and supporters:**

- Southern SARE (Grant #LS20-327)
- Virginia Tech and Virginia Cooperative Extension (Dr. Wade Thomason and Eric Bendfeldt)
- NRCS (Chris Lawrence)
- And Many Other Member and Partners!







Grain is a  
staple food  
of every  
culture, yet  
how many  
Americans  
know their  
grain farmer?





The image is a close-up, top-down view of a large quantity of corn kernels. The kernels are primarily yellow and white, with some showing signs of wear or discoloration. They are densely packed, filling the entire frame. A semi-transparent grey rectangular box is centered horizontally across the middle of the image, containing the text "We are learning together" in a white, sans-serif font. The text is bold and clearly legible against the grey background.

**We are learning together**



# What are our objectives today?

1. Who is everybody?
2. What is the local grain economy & who are the buyers?
3. What things apply to all grain crops?

**10 min break around 3:30**

4. What about some specific crops?

**Corn, wheat, sorghum, oats**



## 4 pm discussion

**Small  
Groups  
(30 min)**

1. Which crop is a good choice for my farm plan or existing operation?
2. What is the appropriate scale for me?
3. How much is it going to cost?
4. Something else?

**Full Group (20 min)  
&  
Evaluation**





# Who are we?



Sources B. Ferguson



# Who are you?







Pete Sisti, Greater  
Richmond Grains,  
Powhatan, VA



Processor

{  
Miller  
Maltster  
}

Wholesale  
customer

{  
Restaurant  
Mill-Bakery  
Craft brewery  
Oat Milk brewery  
Tortilla maker  
}

Retail  
customer

{  
Home cook  
Home miller / baker  
}



Pete Sisti, Greater  
Richmond Grains,  
Powhatan, VA



Processor

Wholesale  
customer

Retail  
customer

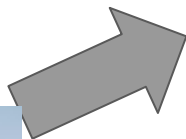
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Miller  
Maltster  
}

{  
Restaurant  
}

Direct  
market

{  
Home cook  
Home miller / baker  
}





Crop (lbs/Bu)	Commodity Price  *USDA AMS for VA 1/11  ** <u>Bin-run</u>	Organic Commodity Price  *USDA AMS for USA 12/15  ** <u>Bin-run</u>	CGA Processor VA Price  *Organic and conventional  ** <u>Cleaned</u>	CGA Processor MD Price  *Organic  ** <u>Bin-run</u>	Wholesale Price  *DC Metro  ** <u>Cleaned</u>	Retail Price  *DC Metro Direct  ** <u>Cleaned</u>
Wheat (60)	\$8.70	\$14.25	\$36-54 (\$60)	\$22.80	\$58.80-\$92.40	\$108-\$480
Corn (56)	\$6.51	\$9.75	\$28-\$84	\$32.50	\$84-\$100.80	\$100.80-\$280
Buckwheat (50)	n/a	n/a	\$26-\$34.40	\$26.00	\$110-\$180	\$200-\$350
Rye (56)	n/a	n/a	\$33.60-\$56	\$32.50	\$60.48-\$112	\$100.80-\$280

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# Who are the CGA buyers?



WADE'S MILL

SEYLOU

BAKERY & MILL

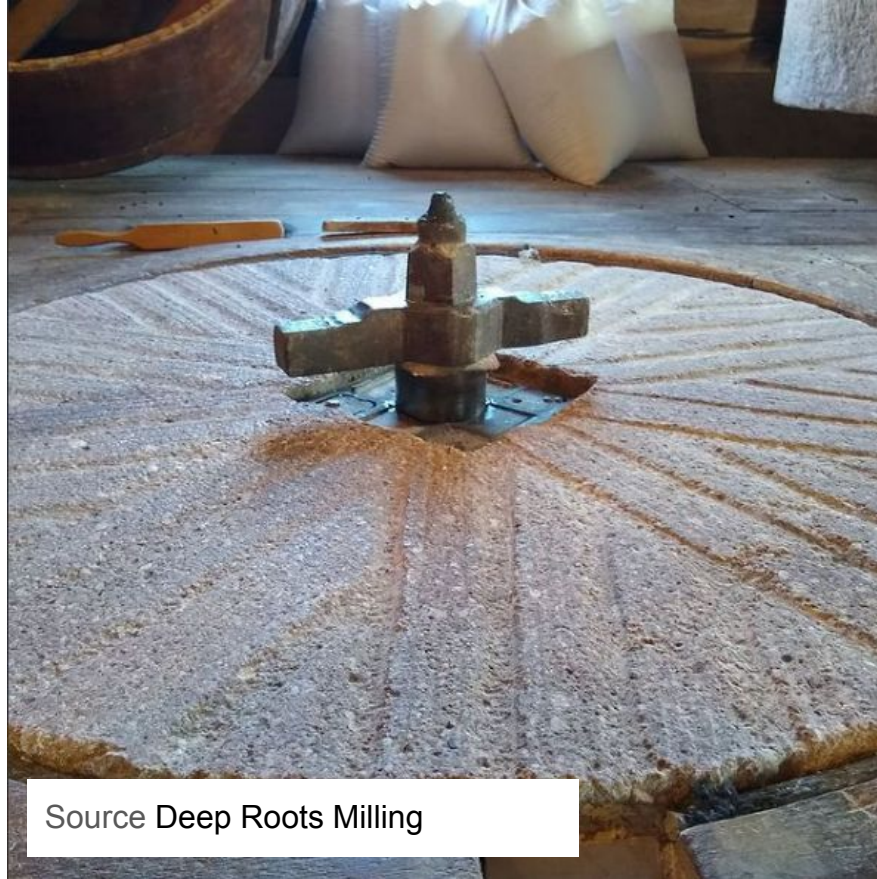




# What do CGA buyers want?

## Growing practices

- No glyphosate
- Minimize other sprays
- Minimize soluble Nitrogen
- Strong soil health practices



Source Deep Roots Milling





[www.4thesoil.org](http://www.4thesoil.org)

Source: A Cooper



**Cover crop**



**Minimize tillage**



**Cover crop**



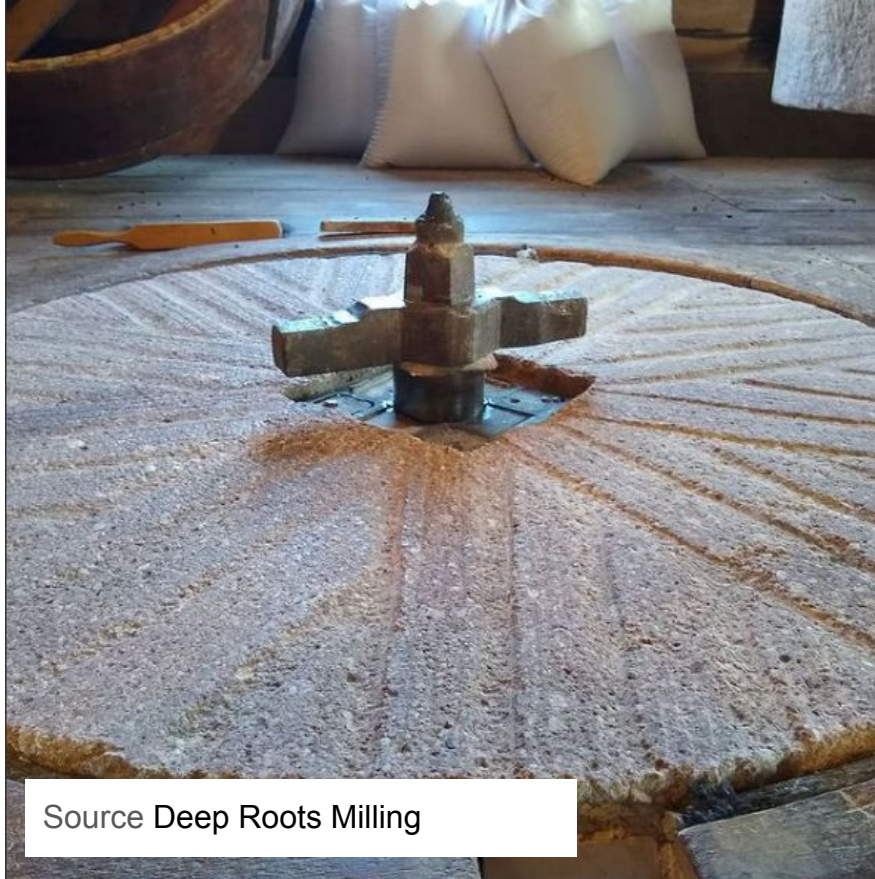
**Vary crops & interseed**



# What do CGA buyers want?

## Growing practices

- No glyphosate
- Minimize other sprays
- Minimize soluble Nitrogen
- Strong soil health practices



Source Deep Roots Milling

## Grain quality

- No stones, dirt, weed seed
- Good test weight
- No insects
- No off odors
- DON < 1 ppm
- Adequate protein
- Adequate falling number
- Varieties with good flavor, milling qualities

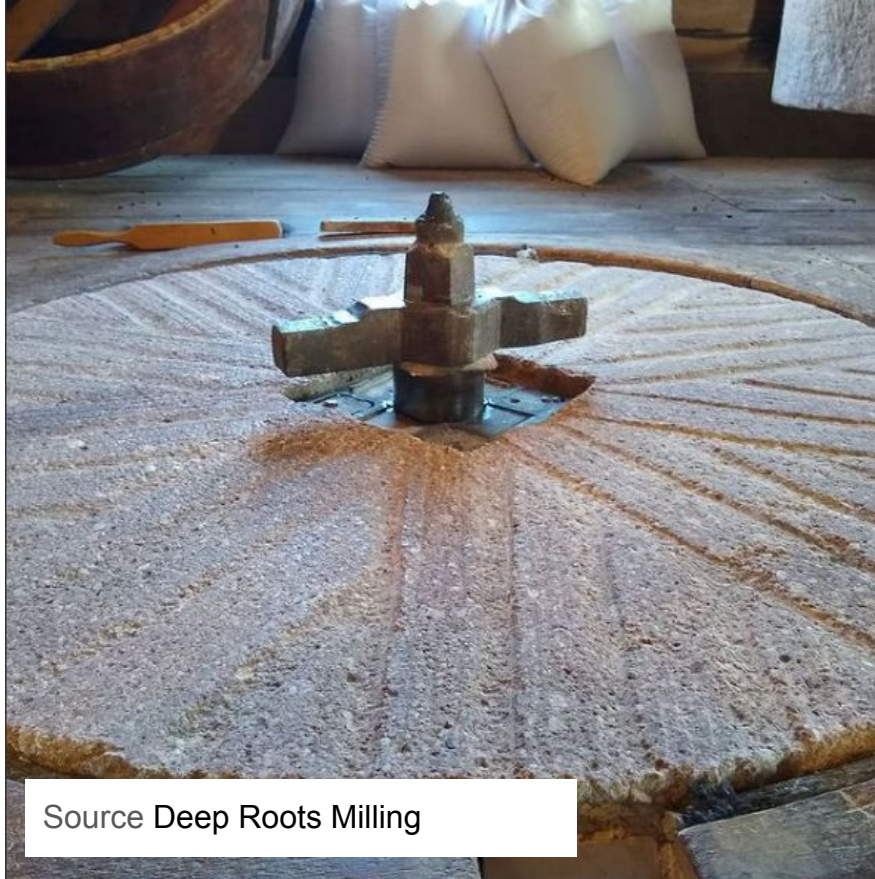




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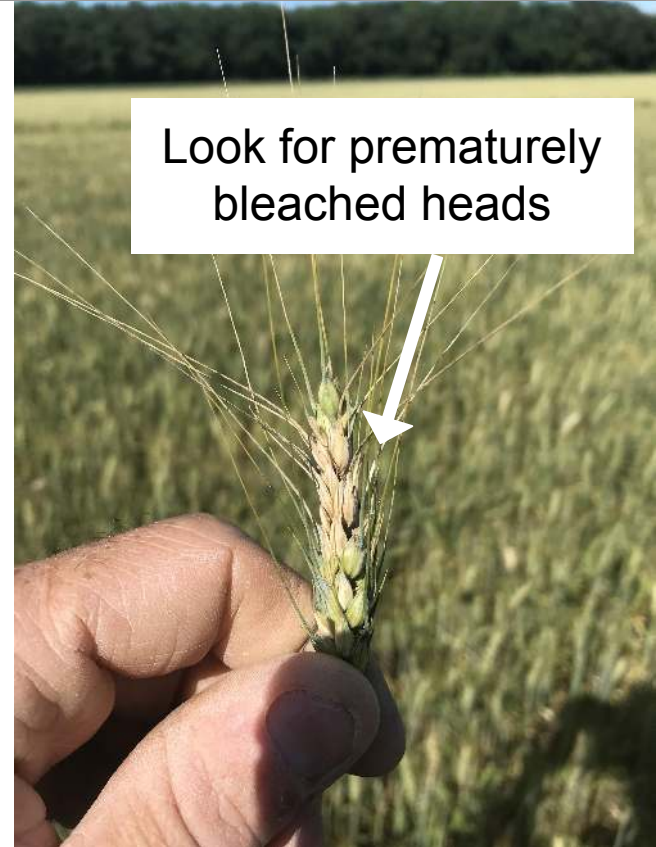




# *Fusarium* Head Blight



- Caused by wet weather when flowering (lasts 7-10 d)
- Leads to DON >1 ppm (vomotoxin)
- Don't plant following corn or other grain
- Some varieties have resistance
- Can be cleaned out but lowers yield

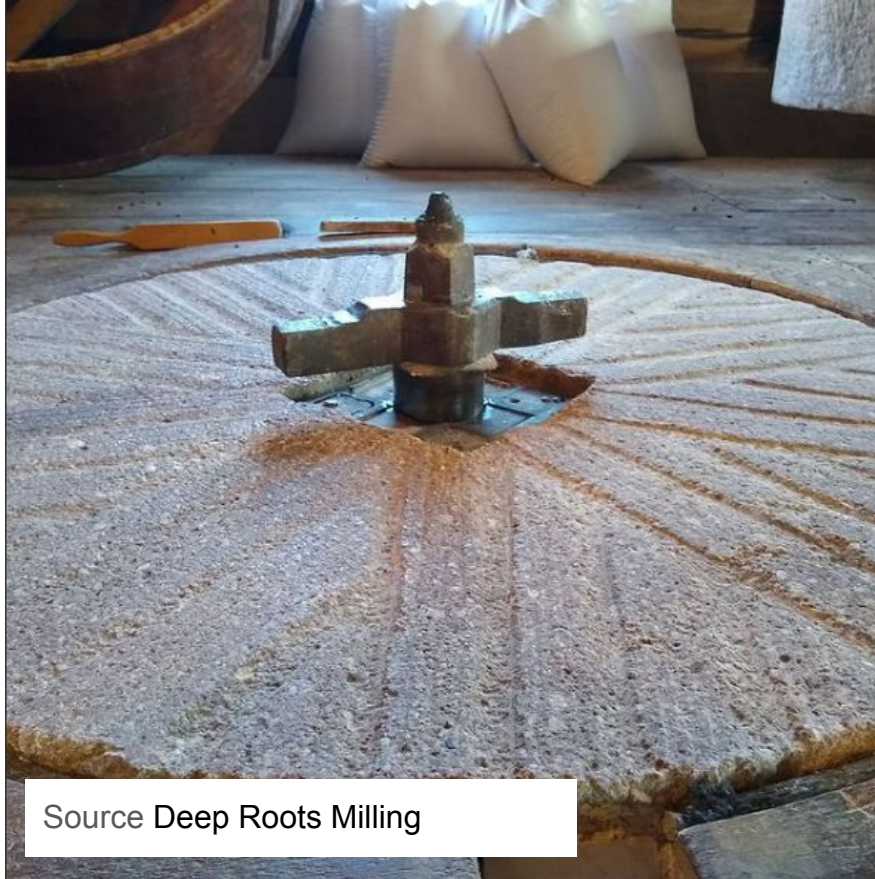


Sources [agcrops.osu.edu](http://agcrops.osu.edu), A. Cooper, Keller (2011)

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## Grain quality

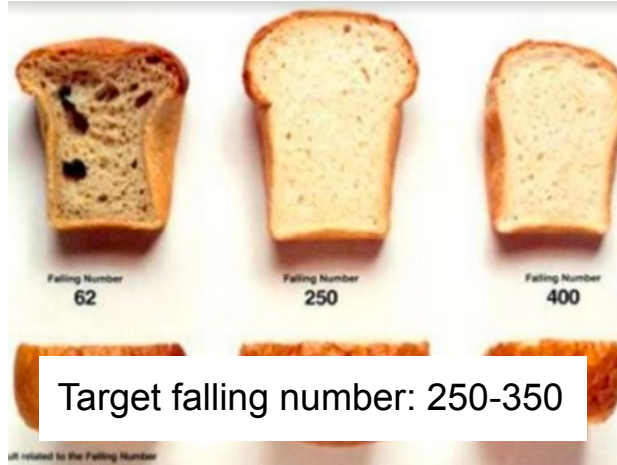
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# Wheat harvest timing: sprouting



- Wet conditions lead to sprouting
- Leads to low falling number
- Grow resistant varieties
- Can be cleaned out?
- Sprouted grain can be used as feed
- Watch the weather



Even if you don't see this, your grain may have sprouted



## Barley

Falling number > 300

Brewers: Needs to sprout properly during malting



Wheatland Spring Brewery

## Rye

Falling number 100 - 250?

Conventional bakers: lower  
Artisanal bakers: higher  
Distillers: ??



Motzi Bread Benne Rye Loaf

# What if my grain doesn't meet the grade?

Sprouted

DON  
too high

Protein / test  
weight too low



Distillers  
Your own farm  
Your neighbors



# How do I find CGA buyers?

Email: [onawa@commongrainalliance.org](mailto:onawa@commongrainalliance.org)



**ONAWA  
DUFRESNE-  
BARGER**



**JILLIAN  
O'DONOHUE**



**LIBBY LYON**



**BENJAMIN  
SHOROFSKY**



[commongrainalliance.org](https://commongrainalliance.org)





Weigh costs and benefits before going for a higher price

Aim high, but make a backup plan

Source CJ Isbell

# Questions?



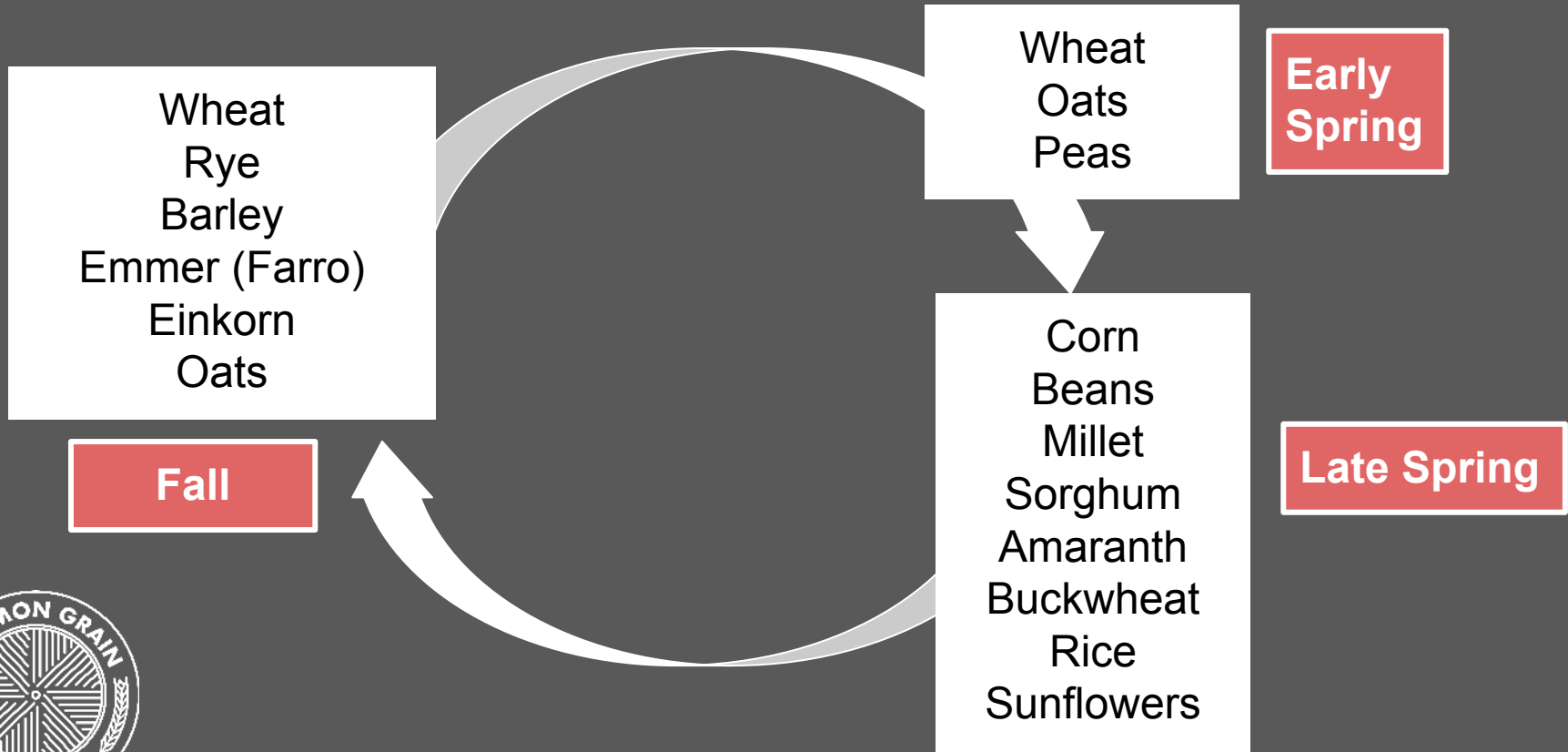


# General Principles

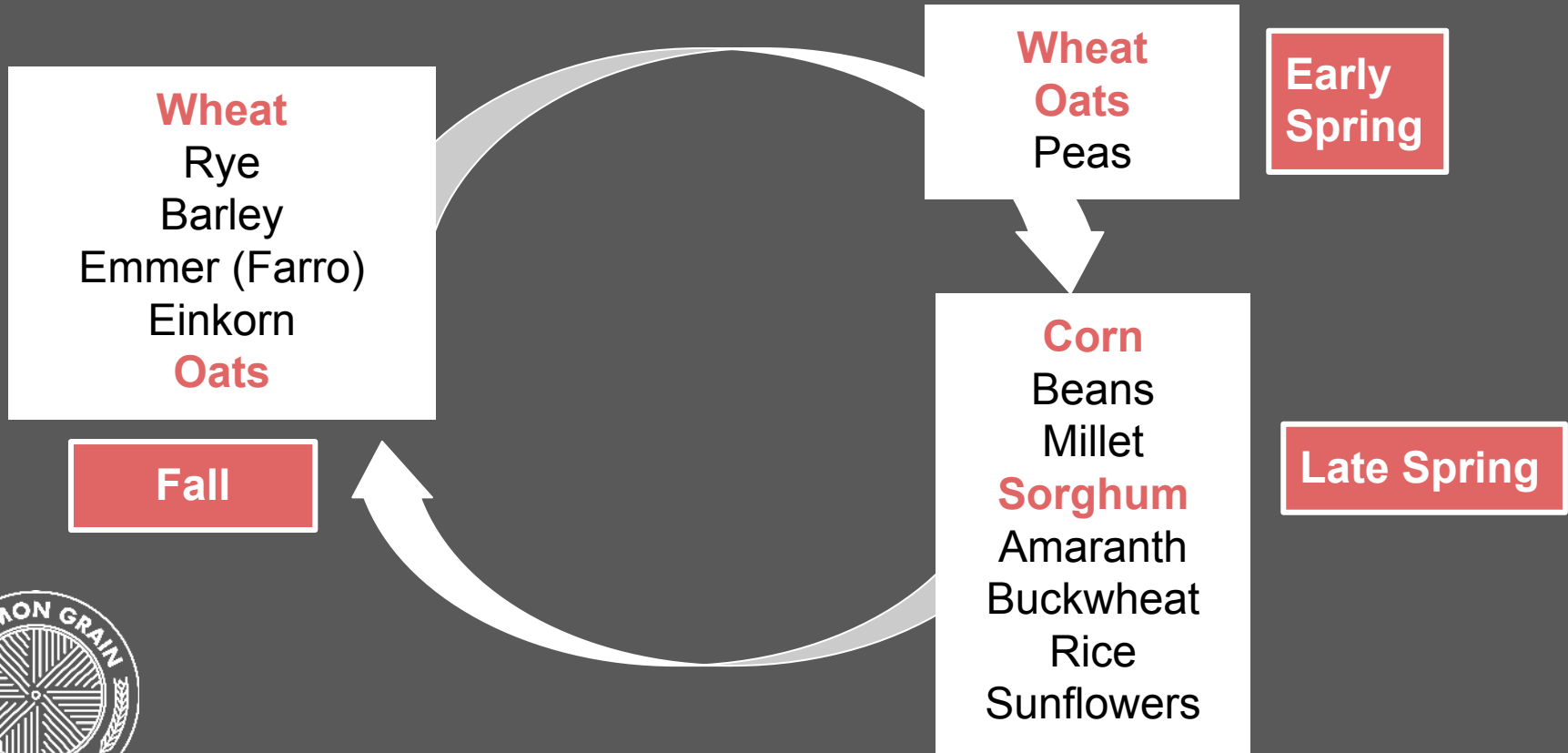




# What crops are we talking about?



# What crops are we talking about?



Garden

Small

Mid

Large

<b>Plot size</b>	< 1 acre	1-10 acres	11-100 acres	> 100 acres
<b>Planting &amp; Cultivating</b>	Hand tools	Small tractor	Bigger tractor	Huge tractor
<b>Harvesting</b>	Hand tools, household supplies	Pull-behind implements or custom	Pull-behind or small combine or custom	Combine
<b>Drying &amp; Storage</b>	Household supplies, grain bags	DIY dryers, grain bags	Batch dryer, bins, augers, grain bags	Same
<b>Cleaning</b>	Buckets, a fan, & a tarp	Custom or antique / small tools	On-farm or custom	Same
<b>Marketing</b>	Home use	Retail	Direct market & Processors	Processors



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# Preparing the soil for planting

## Garden



## Everyone else

### Primary



### Secondary



### Fitting



Sources Lazor (2013), Garden Gate Magazine, Earthway, Johnny's, Farmer's Friend, Tractor shed, Land Pride, Northstar, Machinio, Auction resource

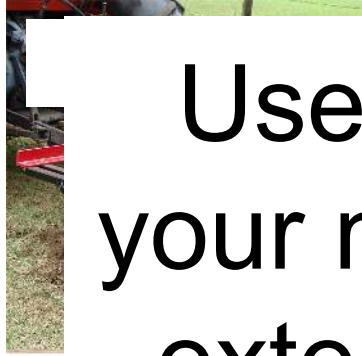
# Preparing the soil for planting

## Garden



## Everyone else

Use what you,  
your neighbors, &  
extension have  
on hand





# Seeding your crop

## Garden



## Everyone else



Sources Lazor (2013), Garden Gate Magazine, Earthway, Johnny's, Farmer's Friend, Tractor shed, Land Pride, Northstar, Machinio, Auction resource

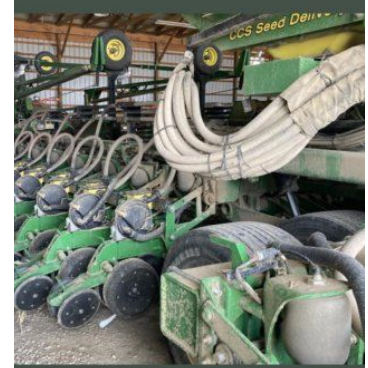
# Seeding your crop

Garden



Match your  
planting gear to  
your cultivation  
gear

se



Sources Lazor (2013), Garden Gate Magazine, Earthway, Johnny's, Farmer's Friend, Tractor shed, Land Pride, Northstar, Machinio, Auction resource

# Drying





# Water content for safe storage



\$500-\$700

Grain	Recommended Moisture for Storage
Corn	13-15%
Soybeans	11-13%
Wheat	12.5-13.5%
Sorghum	11-12%
Oats	11-13%

Tip: warm your grain before measuring



## Batch dryer

Air dried grain is generally better quality, but batch (propane) drying makes sense in the face of factors like:

- wet weather
- lack of time

PERC Propane Drying Calculator:  
<https://propane.com/propane-products/grain-dryers/>



Source A. Cooper

## DIY Mini batch dryer

- Fan taken from a storage bin
- Connected to a perforated drainage pipe
- Run pipe through grain in a bag or bin to air dry
- Easy and cheap for small- and mid-scale



Source A. Cooper





# Storage

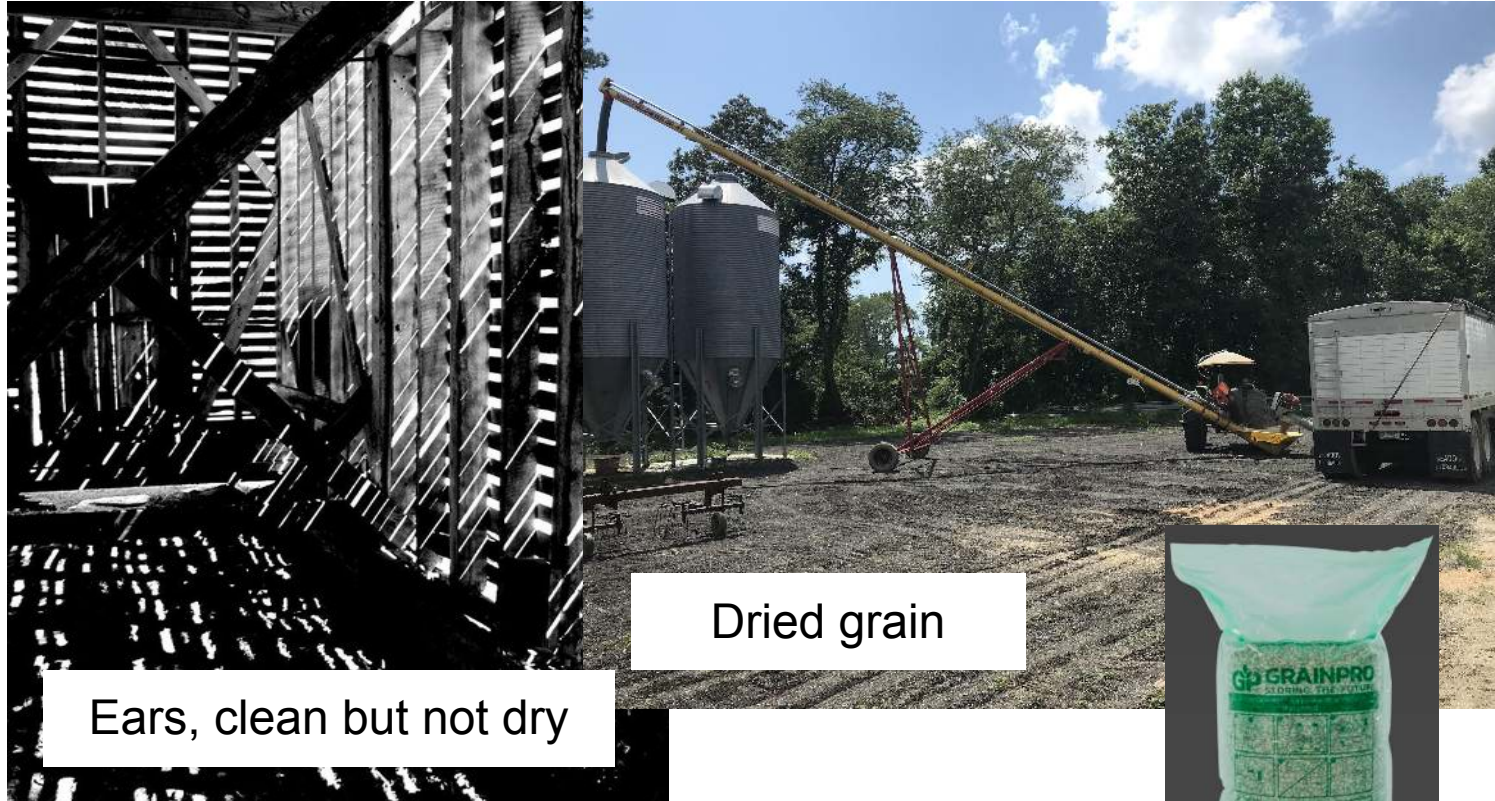
Types

Agronomy

Planting

Cultivation

Harvest



Sources A. Cooper, Lazor 2013, "[Sunshower \(Corn Crib\)](#)" by [David Hoffman '41](#) is licensed under [CC BY-NC-SA 2.0](#)





# Storage

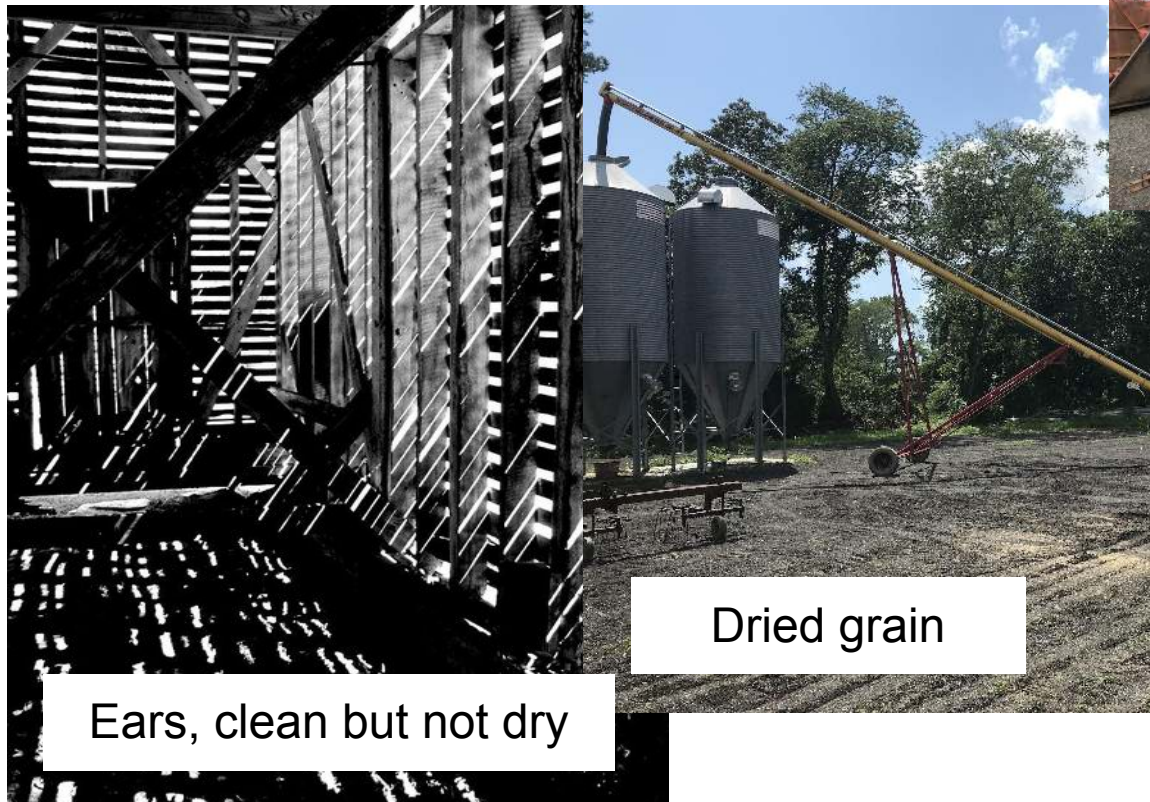
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# Controlling pests using CO<sub>2</sub>



Source A. Cooper, Grainpro.com

Organic post-harvest pest control  
No need for cold storage



# Transporting finished grain



>20,000 lbs

Source A. Cooper, Grainpro.com







The economics of 1-100 acres of grain are tricky, so use what you & your community have on hand

Do your best to air dry your grain, but don't be afraid to use propane to save your crop

Source CJ Isbell



The image shows a close-up, top-down view of a large quantity of corn kernels. The kernels are primarily yellow and white, with some darker, reddish-brown ones interspersed. They are piled together, creating a textured surface. In the center of the image, there is a semi-transparent grey rectangular box containing the text "Questions so far?" in a white, sans-serif font.

Questions so far?



# Breaktime!





# Corn



Source Red Tail Grains

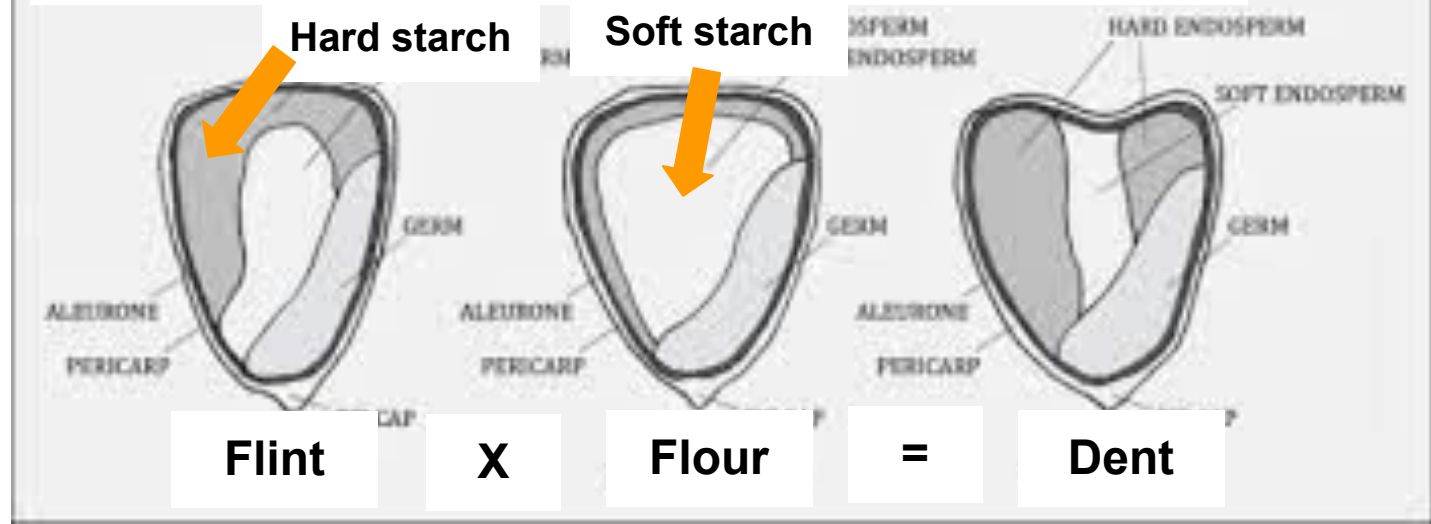




# Types Agronomy

Planting  
Cultivation  
Harvest

Source <https://milesawayfarmwww.com/2016/10/06/learning-about-corn/>

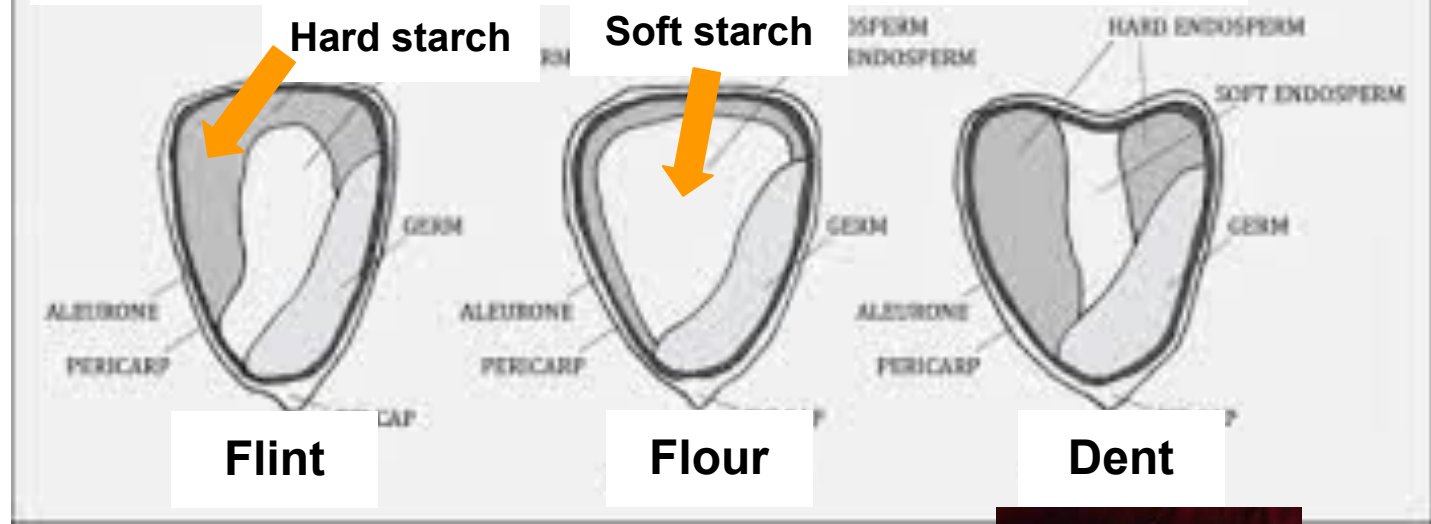


Source Lazor J (2013) The Organic Grain Grower. Chelsea Green Publishing, VT





Source <https://milesawayfarmwww.com/2016/10/06/learning-about-corn/>



**Cateto  
Orange**



**Cherokee  
white**



**Hickory  
King**



**Bloody  
Butcher**

Sources Red Tail Grains, Southern Exposure Seed Exchange

# Types Agronomy

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Cultivation

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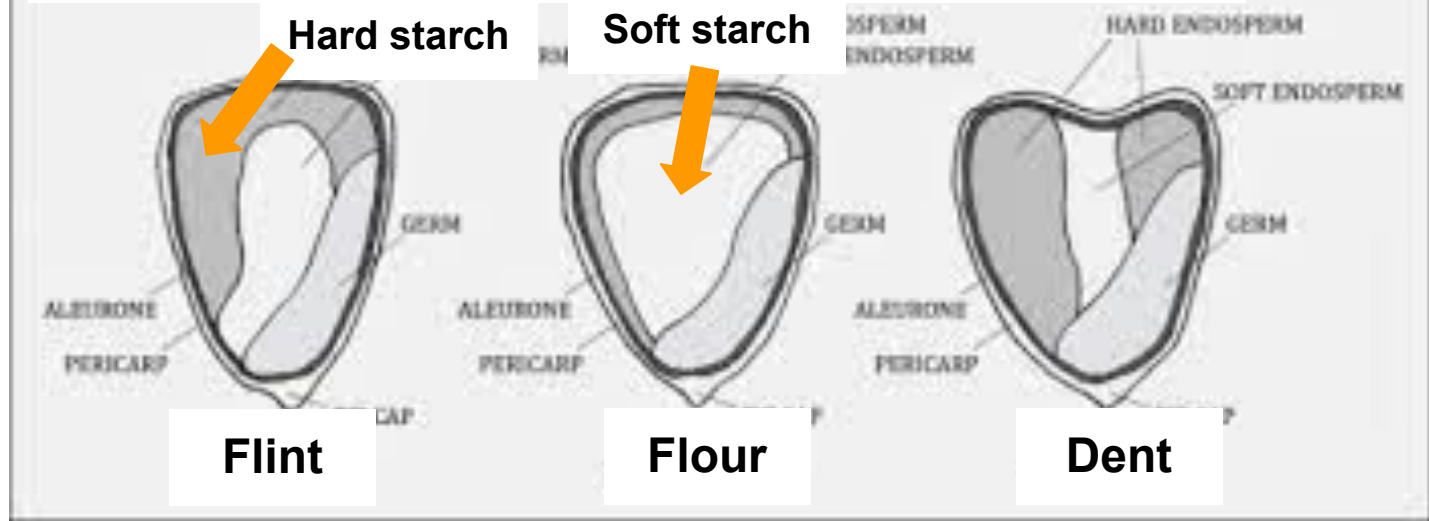
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Sources [allrecipies.com](https://allrecipies.com), [epicurious.com](https://epicurious.com), [simplyrecipes.com](https://simplyrecipes.com)



# Types

## Agronomy

Planting

Cultivation

Harvest



- Indigenous dent corns from Virginia and Appalachia
- Reported yields of 150 bushels / acre before WWII (compared to ~35 bu / ac)
- Superior flour & masa qualities
- BUT flat seeds don't work well with modern planters

Sources Southern Exposure Seed Exchange, Monticello, I. Herzmark





## Types

## Agronomy

Planting

Cultivation

Harvest

- Corn is a heavy feeder
- Planting into a crimped rye-clover cover crop reduces N fertilizer inputs
- Has to compete with summer annuals...
- ...so needs prompt cultivation through 3-4 weeks post-emergence



Sources Valley Conservation Council



# Cover cropping for corn

Winter rye &  
crimson clover

Sources A. Cooper

Roller-crimper







[www.4thesoil.org](http://www.4thesoil.org)

Source: A Cooper



**Cover crop**



**Minimize tillage**



**Cover crop**



**Vary crops & interseed**



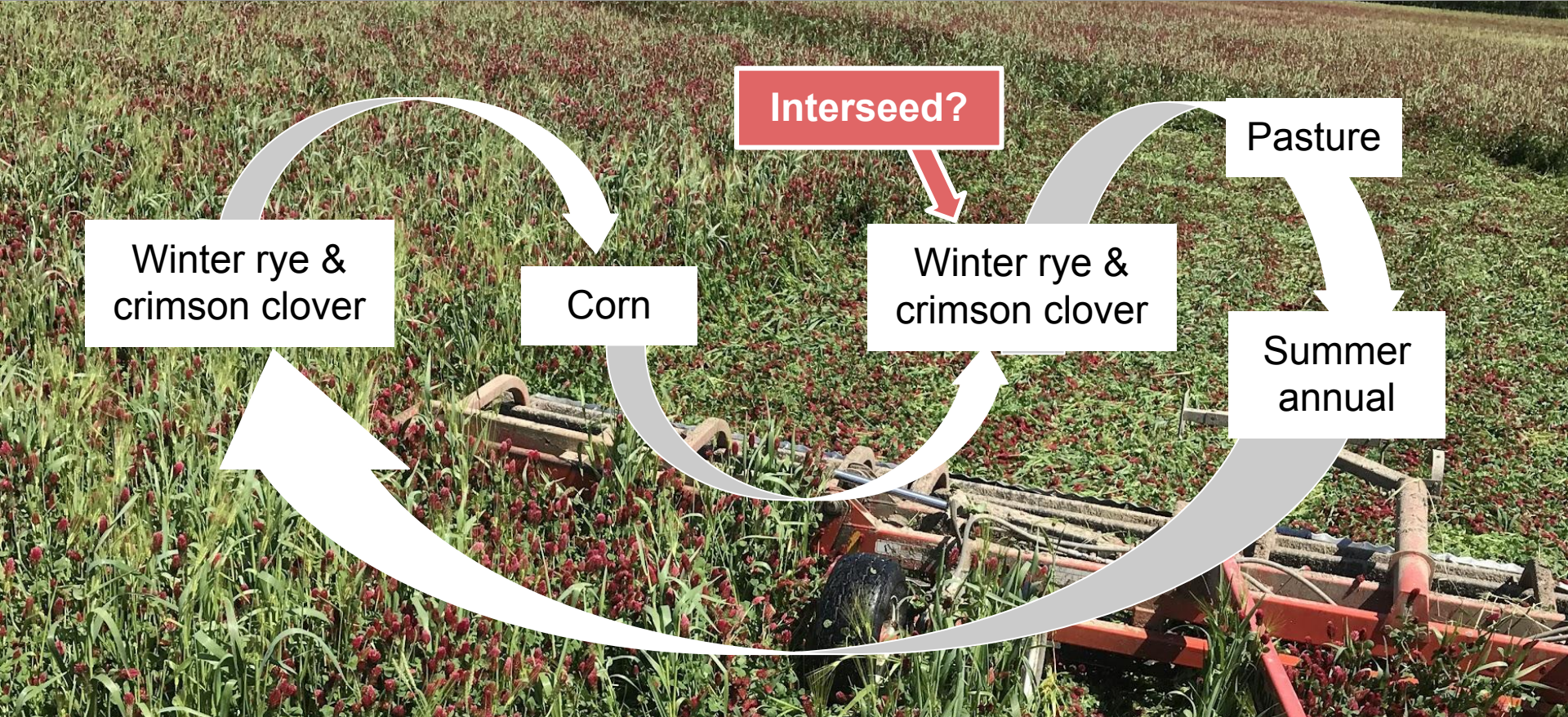
# One-year rotation



Sources A. Cooper



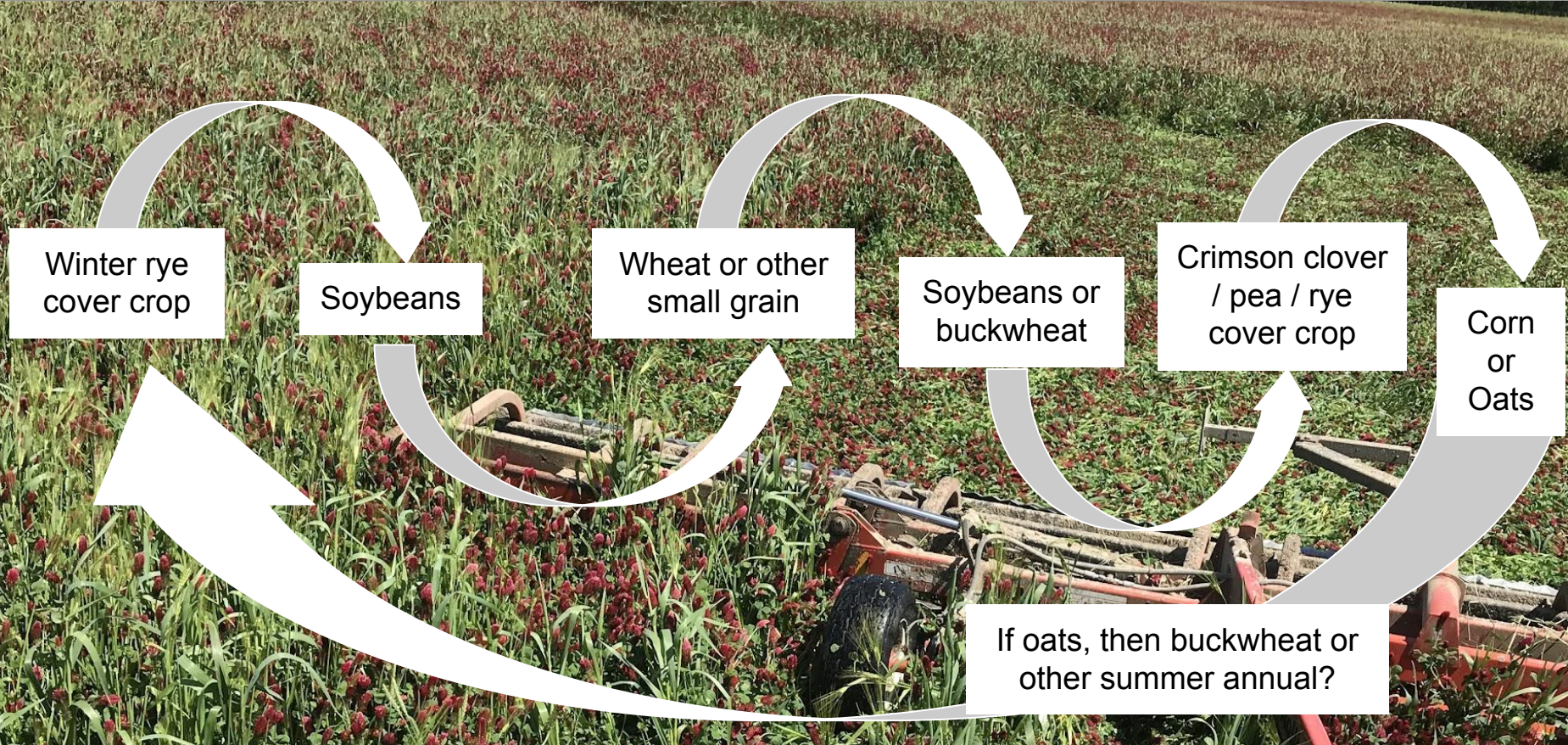
# Two-year rotation



Sources A. Cooper, T.W. Wood & Sons & Henry G. Gilbert, 1899, Logsdon, 2009



# Three-year rotation



Sources A. Cooper, T.W. Wood & Sons & Henry G. Gilbert, 1899, Logsdon, 2009





Timing

Soils > 50°F  
As early as mid-April (BUT...)  
Mid-May allows cover crop to mature

Seeding  
rate

800 seeds per  
per 1000 sq ft  
(5-9 oz)



25,000-35,000  
seeds per acre  
(14-24#)

Spacing

30"

6-8" within rows

Types  
Agronomy

Planting

Cultivation

Harvest

Sources A. Cooper, Alley (2019), Valley Cons. Council, Lazor (2013), Licht (2021), Hancock Seed Co

# Cultivating corn







# Cultivate early

Types

Agronomy

Planting

Cultivation

Harvest



Corn competes poorly with weedy summer annuals

- Flame weed, tine weed, or rotary hoe in the first 10 days after emergence





# Cultivate often in the first month

Types

**Agronomy**

Planting

**Cultivation**

Harvest

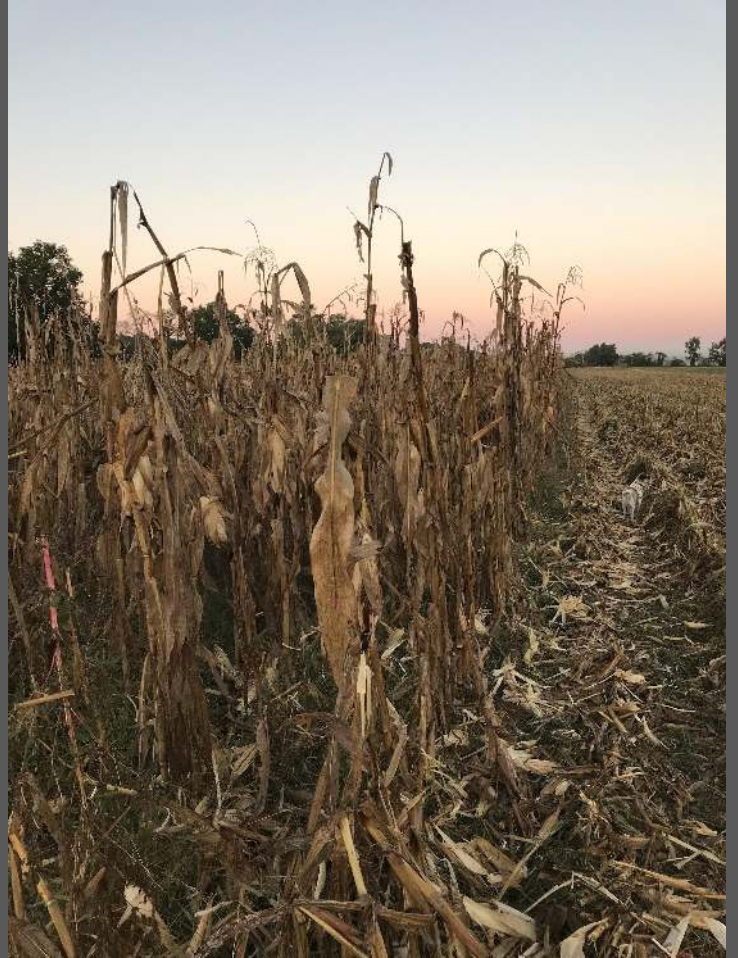


- Buffalo hi-residue cultivator
- Can be used in no-till systems



Sources A. Cooper

# Harvest







## Types

## Agronomy

Planting

Cultivation

Harvest

## Small scale

- Walk row and husk as you go, or cut while green and shock
- Dry ears in covered greenhouse or shed
- Store as ears or shelled (by hand)



Sources Southern Exposure Seed Exchange, 123rf.com, Logsdon 2009, Lazor 2013





## Types

## Agronomy

Planting

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Harvest

## Mid scale

- Harvest as ears (no drying costs!)
- Harvest shelled (good to have some way to dry)
- PTO-driven picker-sheller
- Antique equipment may be set up for 36-40" rows



Sources Lazor 2013, spencer sales, tractor house, Lehman's



Plant corn after an N-fixing cover crop

Cultivate early & often

Ask your neighbors & extension for help

Source C Wade





# Corn Questions?



Source Red Tail Grains







# Wheat

Source Keenbell Farm



# Types Agronomy

Planting  
Cultivation  
Harvest

## CLASSES OF WHEAT

Classified by color and kernel hardness, wheat is divided into six classes.



**Hard  
red  
winter**



**Soft  
red  
winter**



**Hard  
red  
spring**



**Durum**



**Hard  
white**



**Soft  
white**





# Types

## Agronomy

### Planting

### Cultivation

### Harvest

## CLASSES OF WHEAT

Classified by color and kernel hardness, wheat is divided into six classes



**Hard  
red  
winter**

**Soft  
red  
winter**



Hard Red Spring

contains  
perce  
tein,  
an excell  
wheat will  
milling a  
charac



- Redeemer, Nueast, Warthog, Red Fife



Durum



Hard White



Soft White

Low protein but high



and oriental noodles.

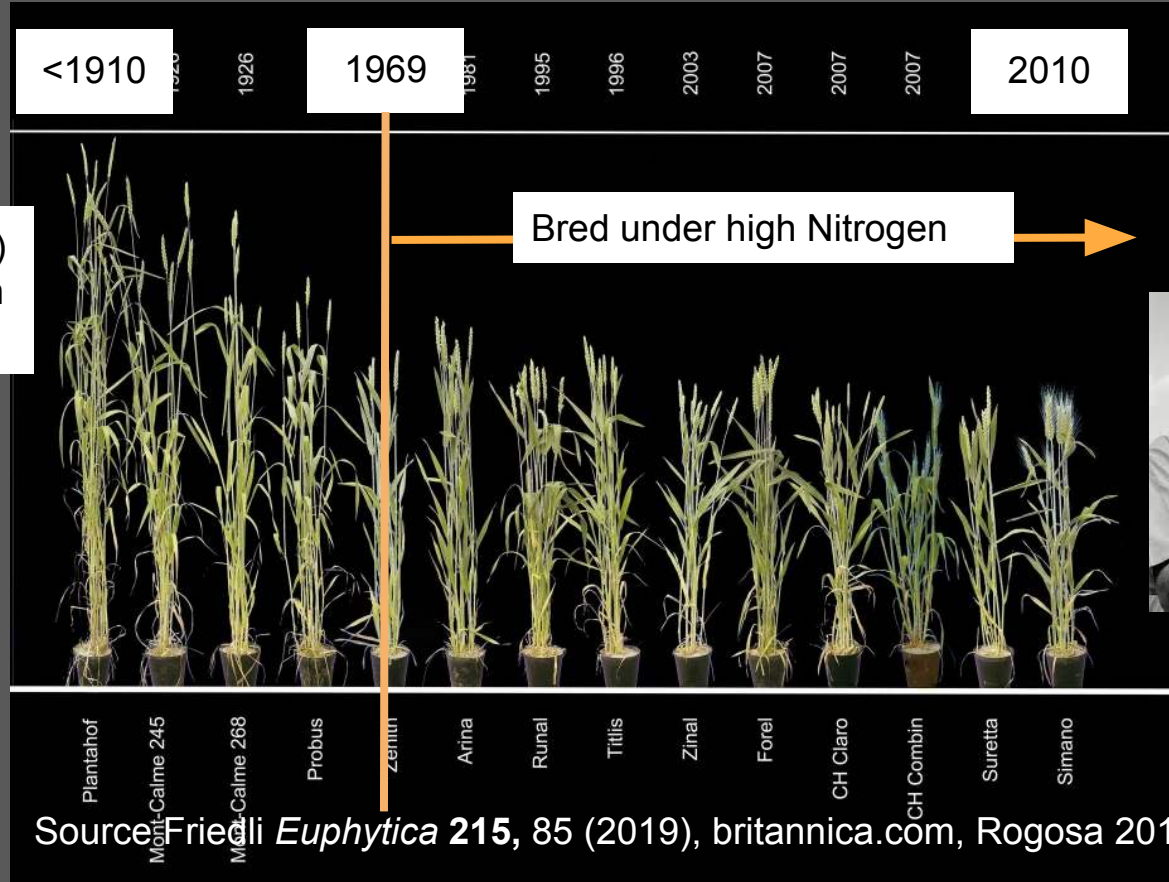


Snack foods.



# “Modern wheat” = bred since 1968

Tend to lodge (fall over) when grown under high Nitrogen



Source: Friedli *Euphytica* **215**, 85 (2019), britannica.com, Rogosa 2016, A. Cooper





# Types

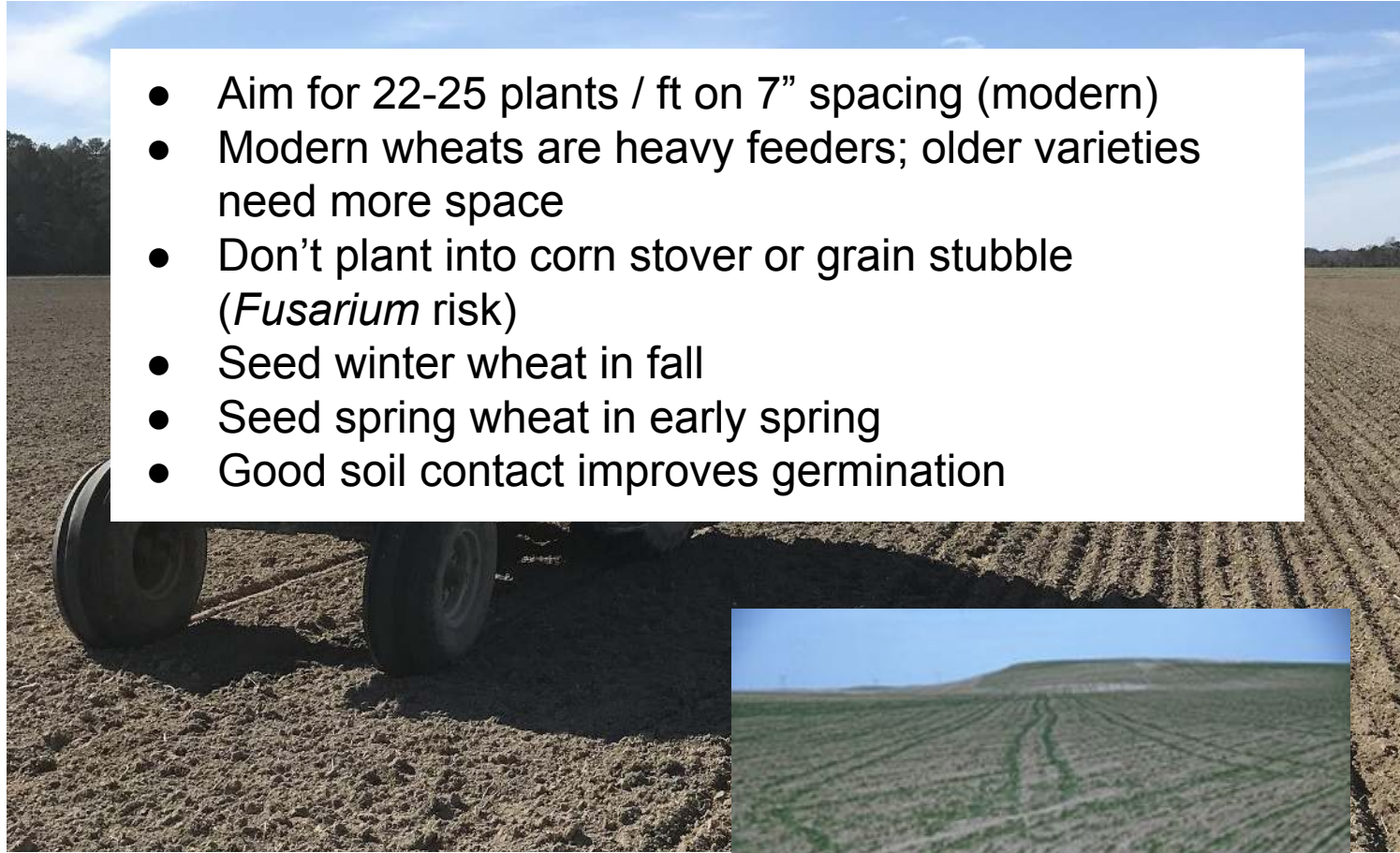
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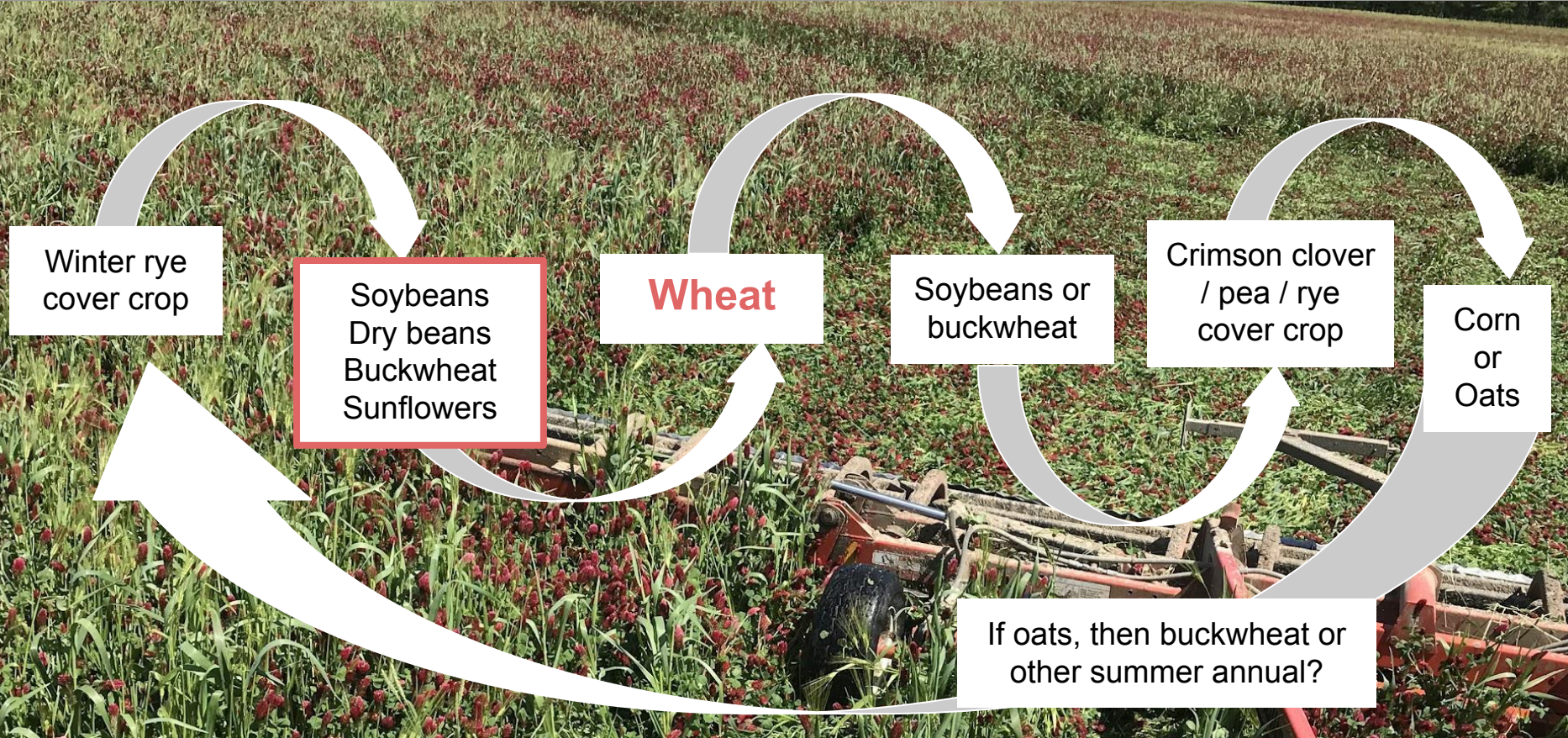
- Aim for 22-25 plants / ft on 7" spacing (modern)
- Modern wheats are heavy feeders; older varieties need more space
- Don't plant into corn stover or grain stubble (*Fusarium* risk)
- Seed winter wheat in fall
- Seed spring wheat in early spring
- Good soil contact improves germination



Sources A. Cooper, Lyon (2004)



# Three-year rotation



Sources A. Cooper, T.W. Wood & Sons & Henry G. Gilbert, 1899, Logsdon, 2009

# Three-year rotation

Winter  
cover

## Small grains enhance the whole-farm picture by

- Lengthening rotations
- Reducing compaction
- Improving nutrient cycling





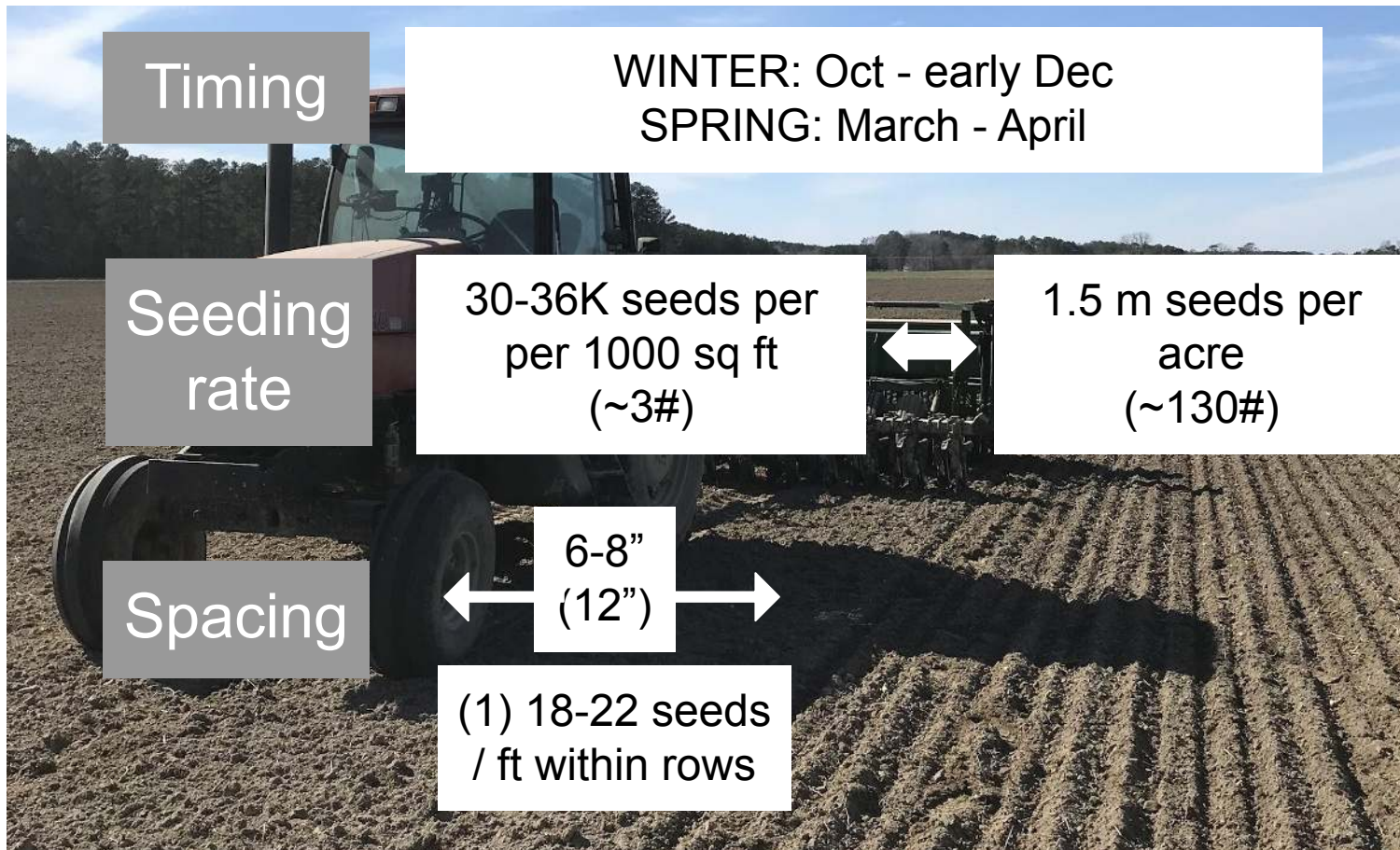
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Cultivation

Harvest



Sources A. Cooper, Thomason (2014), Lyon (2007)

# Cultivating wheat



Source V Hanacek





# Types

## Agronomy

Planting

Cultivation

Harvest



Purple Mountain presents...

# PurpleTools.net

GARDENER, GROWER AND GREEN LIVING SUPPLIES



6" tine weeder

- Cultivation is not strictly necessary
- Winter wheat is already green in the spring
- Spring wheat also gets a head start





Types

Agronomy

Planting

Cultivation

Harvest



Source F Sachs



# Harvesting wheat



Source F Sachs



Types

Agronomy

Planting

Cultivation

Harvest

# Large scale



Sources A Cooper, CJ Isbell





Types

Agronomy

Planting

Cultivation

Harvest

Large scale



Sources A Cooper, CJ Isbell, Ferrari



# Garden scale

Types

**Agronomy**

Planting

Cultivation

**Harvest**

Reap & Bind



Shock



Thresh



Winnow



Sources fromscratchhub, groworganic, dreamstime, ecosnippets





# Small- mid-scale equipment

Types  
Agronomy  
Planting  
Cultivation  
Harvest

Reap & Bind



Shock



Thresh



Winnow



Sources Adaptive Ag, Agriexpo.online, alibaba



Wheat enhances the whole farm

Plant following beans or other non-grain

Ask your neighbors & extension for help



A wide-angle photograph of a golden wheat field. The sun is low on the horizon to the left, creating a strong lens flare and illuminating the scene. A dense line of green trees forms the background against a blue sky with scattered white clouds. The foreground is filled with the detailed texture of the wheat stalks.

# Questions?

Source F Sachs



# Sorghum



Source Kings Agriseeds







## Types

## Agronomy

Planting

Cultivation

Harvest

Source [Aces.edu](https://aces.edu),  
[sorghumcheckoff.com](https://sorghumcheckoff.com), science direct





- Grow like corn
- Fertilize like corn
- Drought tolerant
- Can follow wheat, barley, potatoes
- Avoid following corn
- 90-120 days to maturity
- Feed, food (GF!), biofuel

Source Aces.edu, Farm Progress, sorghumcheckoff.com, science direct

## Types

## Agronomy

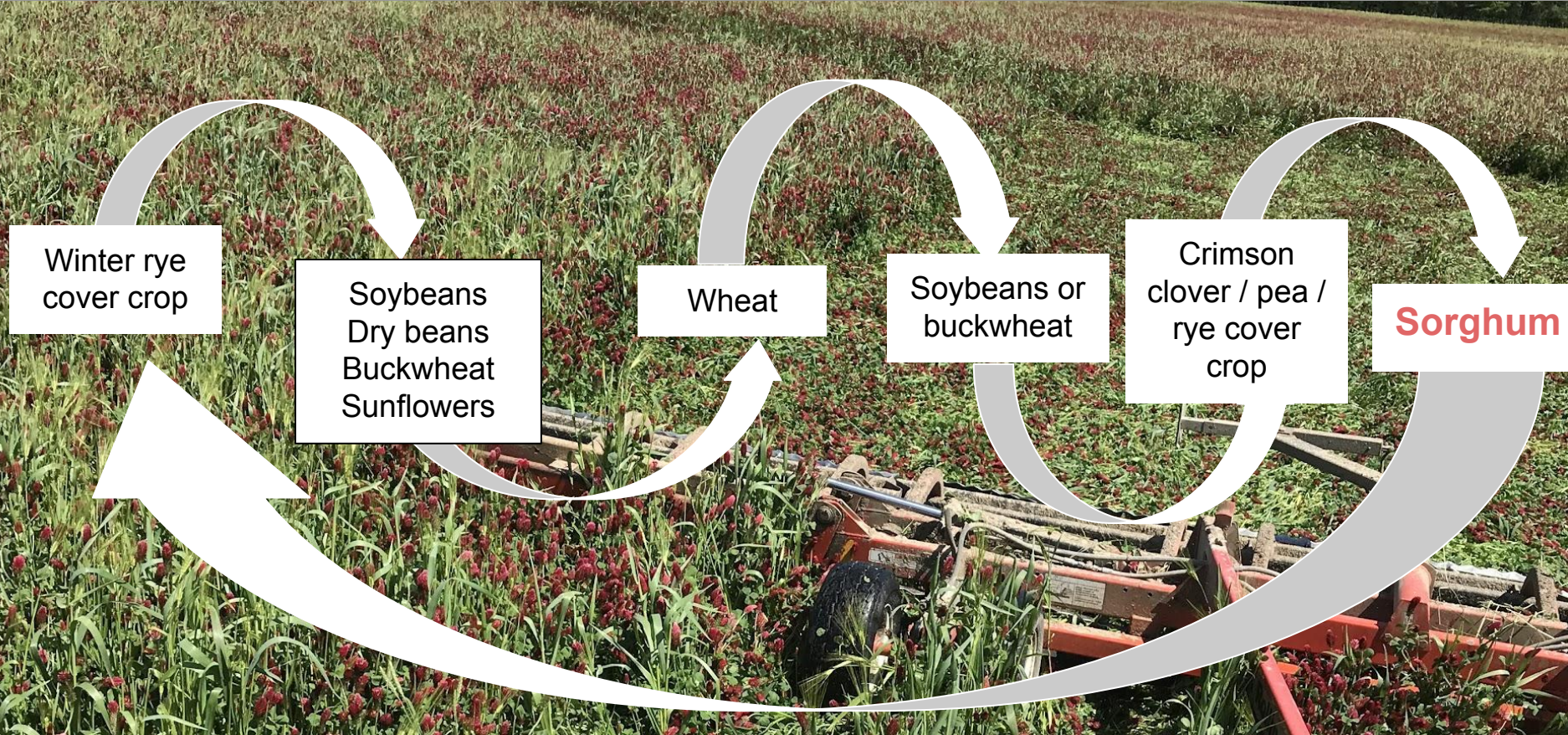
Planting

Cultivation

Harvest



# Three-year rotation



Sources A. Cooper, T.W. Wood & Sons & Henry G. Gilbert, 1899, Logsdon, 2009





Types

Agronomy

Planting

Cultivation

Harvest

Timing

Soils > 60°F  
(May 1) May 10-Jul 1 (Jul 10)

Seeding  
rate

2700 seeds per  
per 1000 sq ft  
(3-4 oz)

115K-120K seeds  
per acre  
(~10#)

Spacing

(7") 15-30" (40")

3-7 seeds / ft  
within rows

Sources sorghumcheckoff, Kingagri seeds





Like corn, cultivate often in the first month

Types

**Agronomy**

Planting

**Cultivation**

Harvest



Sources MS crop situation





# Some harvest tips

Types

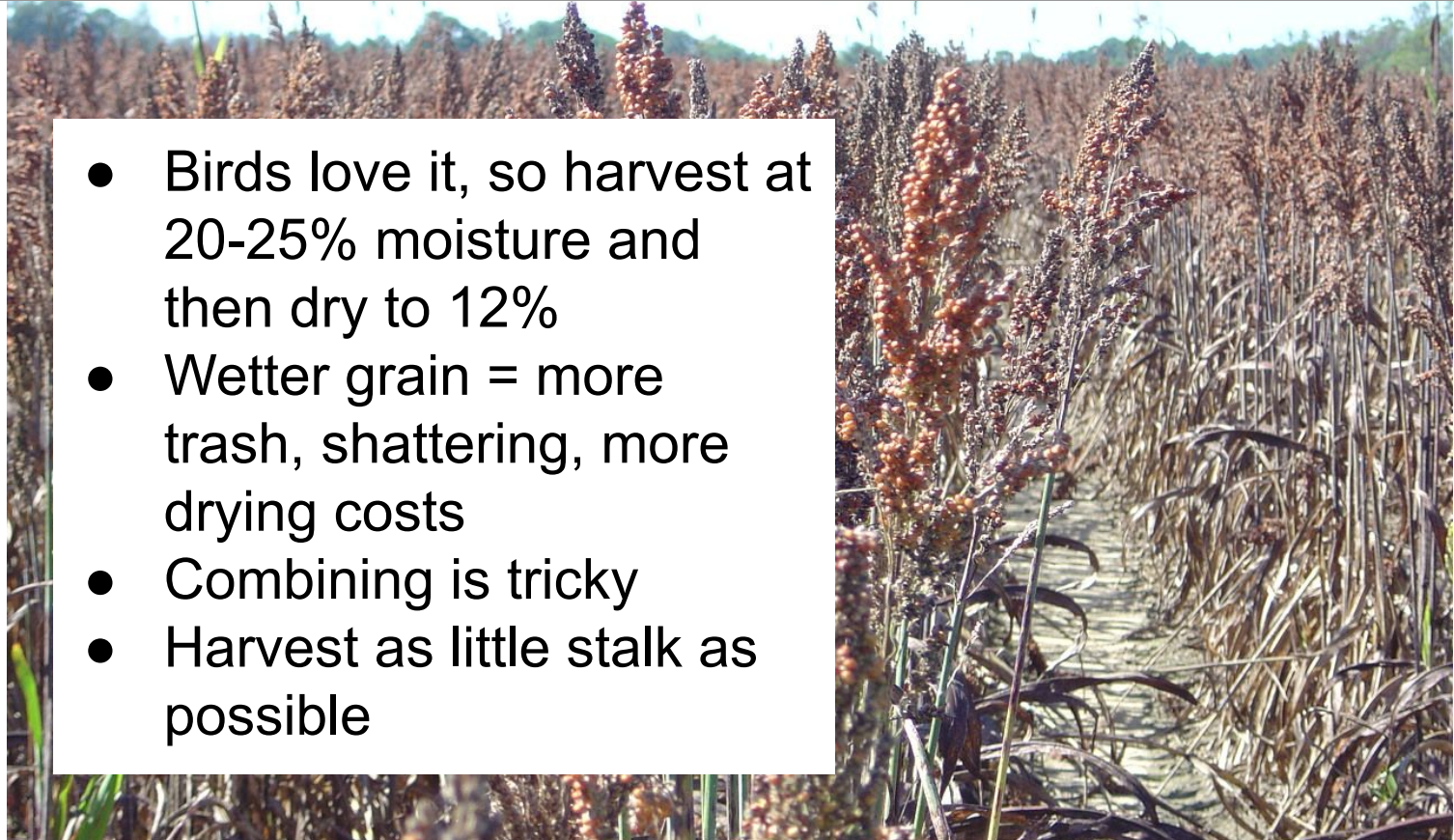
**Agromony**

Planting

Cultivation

**Harvest**

- Birds love it, so harvest at 20-25% moisture and then dry to 12%
- Wetter grain = more trash, shattering, more drying costs
- Combining is tricky
- Harvest as little stalk as possible



Sources UGA Circular 1017, sorghumcheckoff





# Some drying tips

## Types

## Agronomy

Planting

Cultivation

Harvest

- Grains are small and pack tightly, so move grain into dryer within four hours
- Dry at 140°F or below for milling, 110°F for seed
- If using corn dryers fill to  $\frac{2}{3}$  capacity



Sources UGA Circular 1017, sorghumcheckoff



# Oats



Source morningchores







# Types

## Agronomy

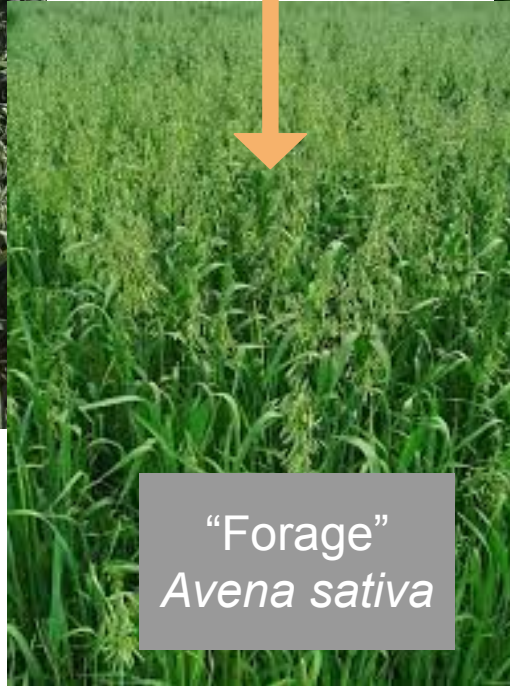
- Planting
- Cultivation
- Harvest



"Hullless"  
*Avena nuda*

Don't need to dehull. "Streaker" is a good variety

Good for cover crops & forage but not grain



"Forage"  
*Avena sativa*



Red vs. white?

"Common"  
*Avena sativa*

Better yields than hullless but need to be dehulled



## Types

## Agronomy

Planting

Cultivation

Harvest

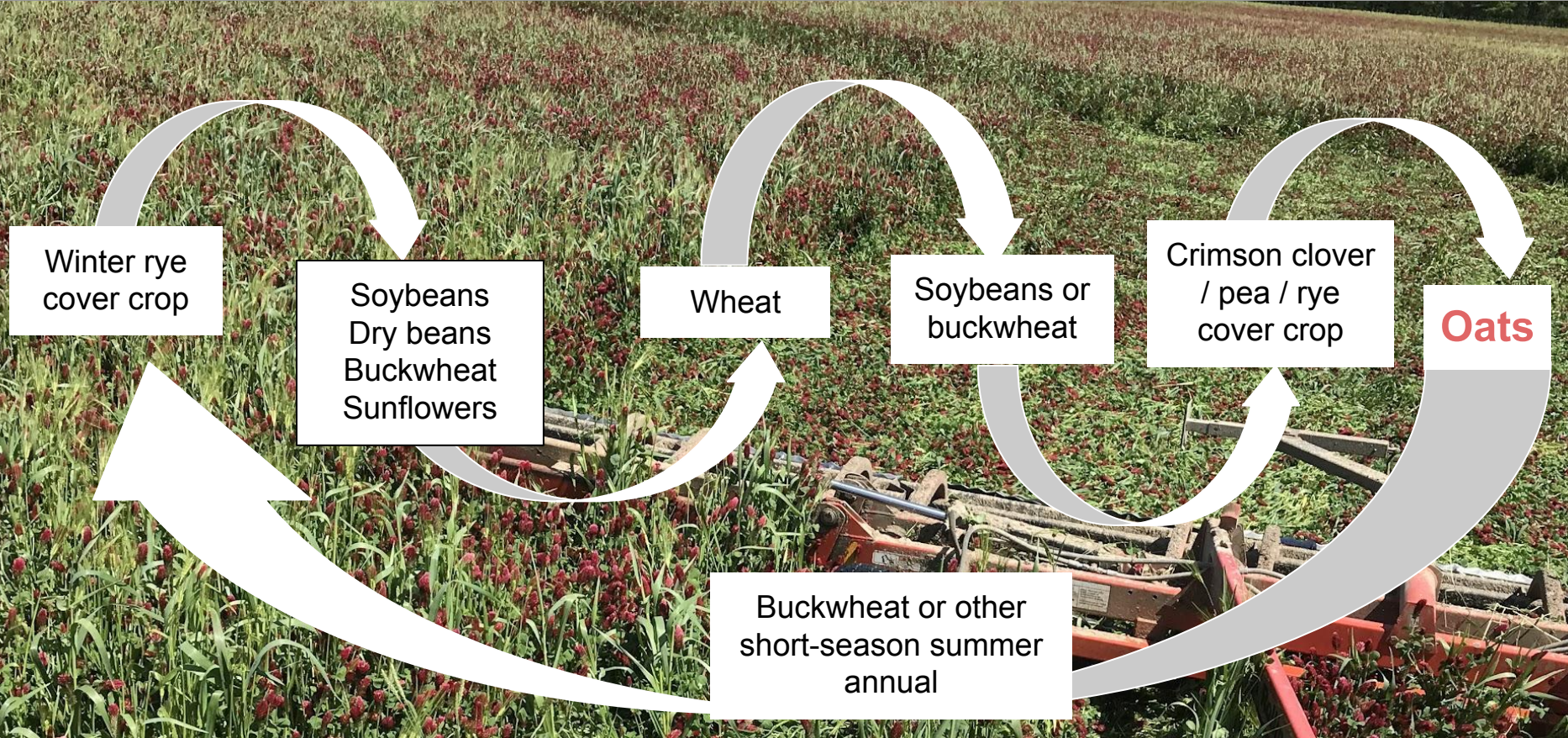


- Grow like wheat
- Cultivate like wheat
- BUT not as heavy a feeder: too much N will cause lodging
- Avoid following grasses like corn or wheat
- 100-120 days to maturity
- If spring planted, prep ground in the fall

Source science direct, amkhaseed



# Three-year rotation



Sources A. Cooper, T.W. Wood & Sons & Henry G. Gilbert, 1899, Logsdon, 2009





# Types

## Agronomy

Planting

Cultivation

Harvest

Timing

SPRING: As early as possible  
FALL: 6-10 wks before frost, but may winter kill

Seeding  
rate

25000 seeds per  
per 1000 sq ft  
(1.5-2#)

112K seeds per  
acre  
(60-90#)

Spacing

7"

8-10 seeds / ft  
within rows

Sources morningchores, Logsdon 2009, Johnnys





# Some harvest tips

Types

**Agromony**

Planting

Cultivation

**Harvest**

- Harvest and thresh like wheat
- Can winnow hullless oats in water and let air dry
- Can feed unthreshed to livestock



Sources Johnny's

# Dehulling

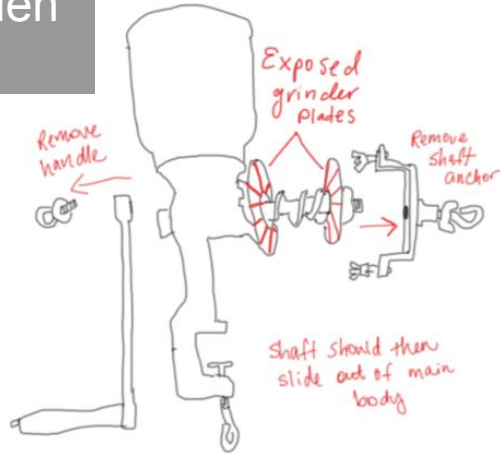
Applies to most oats, barley,  
buckwheat, rice, emmer, spelt,  
einkorn





# Dehulling

Garden



Small-Mid



Build your own, or buy a farmer-built "Trumpet". See final report for SARE grant LNE17-357

Large





Sorghum is like corn, but harder to dry



Oats are like wheat, but fill the spring niche



Figuring out dehulling opens up a lot of crops



Source [sciencedirect](https://www.sciencedirect.com)



# Thank you!

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U.S. DEPARTMENT OF AGRICULTURE



Source F Sachs

# Discussion

**Small  
Groups  
(30 min)**

1. Which crop is a good choice for my farm plan or existing operation?
2. What is the appropriate scale for me?
3. How much is it going to cost?
4. Something else?

**Full Group (20 min)  
&  
Evaluation**





## Equipment & Supplies

Grain pro (DC) – storage bags, solar dryers (202) 921-6700

<https://www.grainpro.com/en>

Purple Tools (MD) – hand tools, small grain processing equipment (301) 891-2488

<https://www.purpletools.net>

Adaptive Ag (ME) – equipment for small- and mid-size plots (207) 214-0620

<https://www.adaptive.ag/>

Your neighbors, the local farm auction, extension office

## Testing

The UVM Cereal Quality Testing Lab (VT) (802) 656-5392

[www.uvm.edu/extension/nwcrops/cereal-grain-testing-lab](http://www.uvm.edu/extension/nwcrops/cereal-grain-testing-lab)

Hartwick College Center for Craft Food and Beverage (NY) (607) 431-4232

<https://www.hartwick.edu/about-us/center-for-craft-food-and-beverage/>

JLA Labs (for corn–GA) (229) 405-6744 <https://www.jlaglobal.com/>

## Seed

Albert Lea Seed (MN) (800) 352-5247 <https://alseed.com/>

Lakeview Organic (NY) (315) 531-1038 <https://lakevieworganicgrain.com/>

Fedco (ME) (207) 426-9900 <https://www.fedcoseeds.com>

NC Foundation Seed Farm (919) 269-5592 <http://www.ncfoundationseeds.org/>

**Keep  
learning**

Follow our new “Growing Grain” blog at  
<https://www.commongrainalliance.org/growing-grain>



# Maintain air flow during storage

Fan purpose	Airflow recommendations
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Natural-air drying of grains and oilseeds
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0.75 to 1.5 cfm/bu
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Aeration of stored grains and oilseeds
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0.05 to 0.5 cfm/bu
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