How can I cover my fields without losing my shirt growing corn?

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Soybean stubble will not hold soils in place…even in no-till.

We need a cover crop to protect soils.

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Cover Crops can help reduce erosion.

Image: Joseph Sisk

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Cereal rye

7 inches of shoot growth; about 18 inches of roots.

Images:
Joseph Sisk
February 2016

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Rye Cover Crop

4 inches of shoot growth; at least 29 inches of roots

March 2019, Bluegrass Maury Silt Loam

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Why a Cover Crop?

1. Prevent Erosion
2. Prevent Erosion
3. Prevent Erosion

Capture nutrients
Cycle nutrients
Build soil structure
Hold carbon

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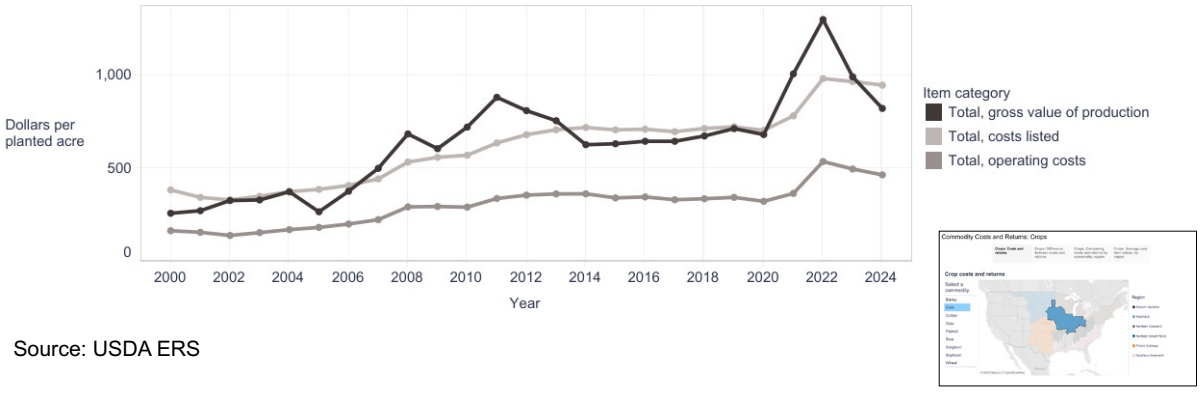
The Economy Hurts Right Now

Heartland: Corn trends from 2000 to 2024
For region-specific results, select from the map above



Source: USDA ERS

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Cover Crop Termination

- Terminate 2 to 5 weeks before planting corn
- Glyphosate, higher rates
- Full adjuvants on the label
- Avoid UAN as a carrier
- Avoid tank mixes that could antagonize glyphosate activity

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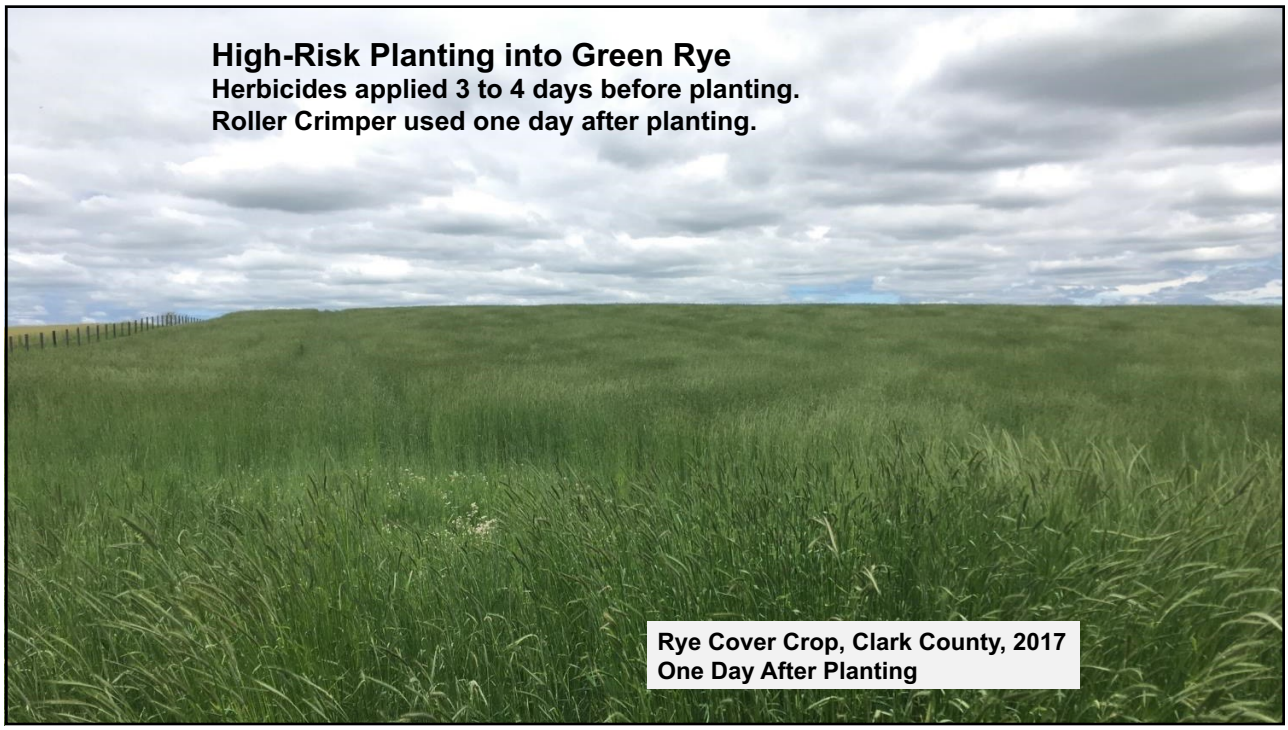
High-Risk Planting into Green Rye
Herbicides applied 3 to 4 days before planting.
Roller Crimper used one day after planting.
Rye Cover Crop, Clark County, 2017
One Day After Planting

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High-Risk Planting into Green Rye
Herbicides applied 3 to 4 days before planting.
Roller Crimper used one day after planting.
Rye Cover Crop, Clark County, 2017
18 Days After Planting

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Cover Crops

- **Will compete with corn…even after the cover crop is dead.**
- **Will hold soils together…even after the cover crop is dead.**

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Strip Till Corn & Rye Cover Crop, Planting 4/11/2023, Christian County, KY

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Strip Till: Early Termination of Cover Crop

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Strip-Till in Kentucky

Photo by: Micah Lester, Lester Family Farms, Gracey, Kentucky, USA

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Strip-Till Corn, Cover Crop
Gracey, KY USA

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Strip-Till Corn, Cover Crop
Gracey, KY USA

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Photos by Dr. Dan Quinn

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Where we think we are headed…

Terminate small grain cover crop 4 to 5 weeks before planting corn …

OR… before it produces 2,000 lb of biomass

… whichever comes first.

Still working on studies and data to support this opinion.

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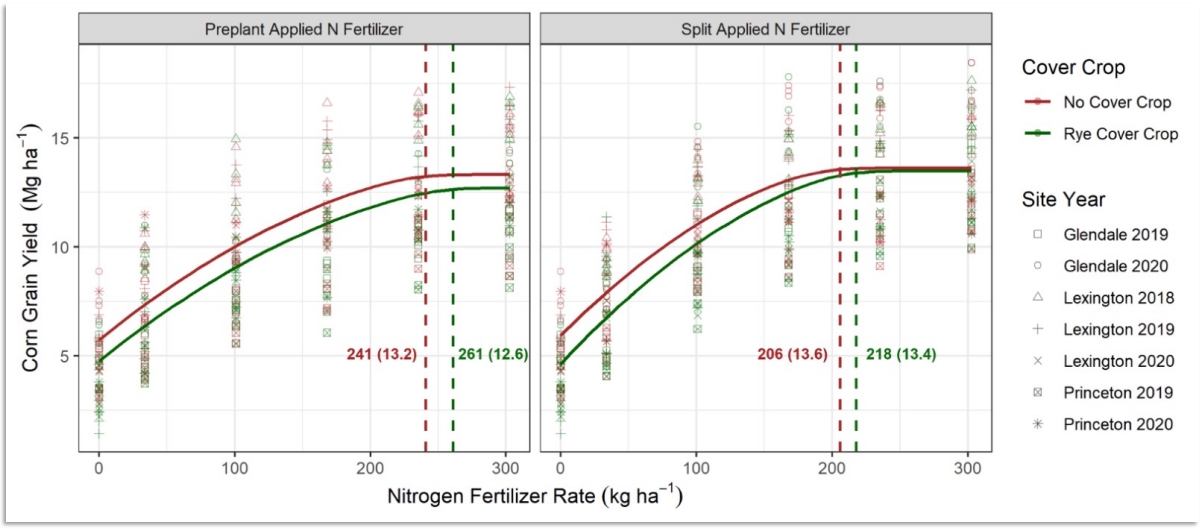

D.J. Quinn, H.J. Poffenbarger, F. E. Miguez, and C. D. Lee. 2023. Corn optimum nitrogen fertilizer rate and application timing when following a rye cover crop. Field Crops Research. 291. 108794. https://doi.org/10.1016/j.fcr.2022.108794.

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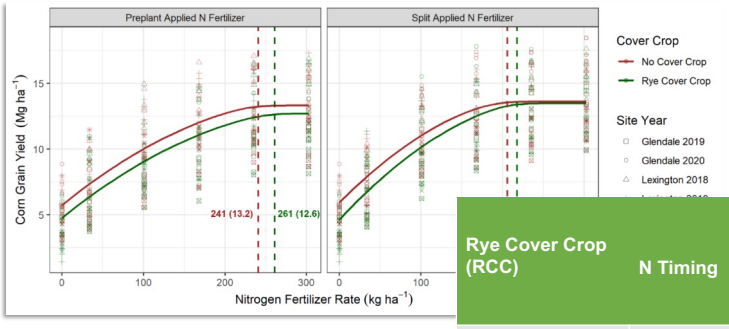

Rye Cover Crop (RCC)	N Timing	Agronomic Optimum N Rate (AONR) lb N/acre	Economic Optimum N Rate (EONR) lb N/acre
No	Preplant	215 a	209 a
No	Split	183 a	183 a
Yes	Preplant	232 a	216 a
Yes	Split	194 a	191 a
Average		206	200

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D.J. Quinn, H.J. Poffenbarger, F. E. Miguez, and C. D. Lee. 2023. Corn optimum nitrogen fertilizer rate and application timing when following a rye cover crop. Field Crops Research. 291. 108794. https://doi.org/10.1016/j.fcr.2022.108794.

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Will other cereals work better than rye?

Wheat and Barley

- Should have less biomass…maybe less of a nitrogen penalty than rye.
- Easy to plant like rye.
- Easy to get good seed quality.
- Easy to find.
- Less expensive than some other species.

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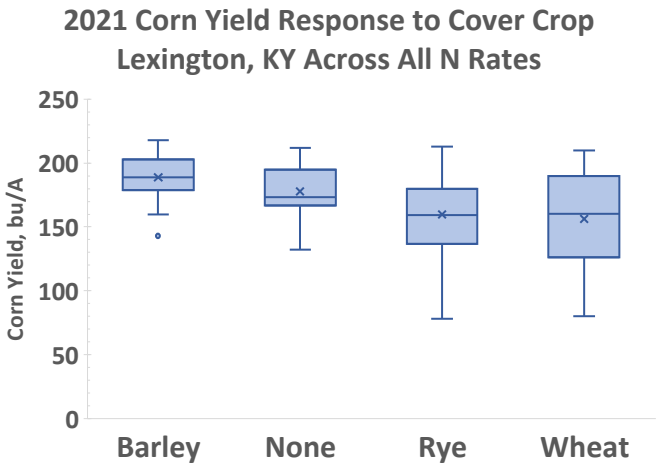
2021 Corn Yields Following Barley were Higher than when following Other Covers

ALL N RATES
30
100
200
300
lb N/A



2021 Cover Crop Yield	lb/A
Rye	1,114 a
Barley	653 b
Wheat	413 c
LSD (0.10)	2.52

Planted 11/13/2020
Terminated 4/16/2021

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2022 and 2023 Corn Cover Crop Trials
Rye, Wheat and Barley Cover Crops

Sampling Biomass

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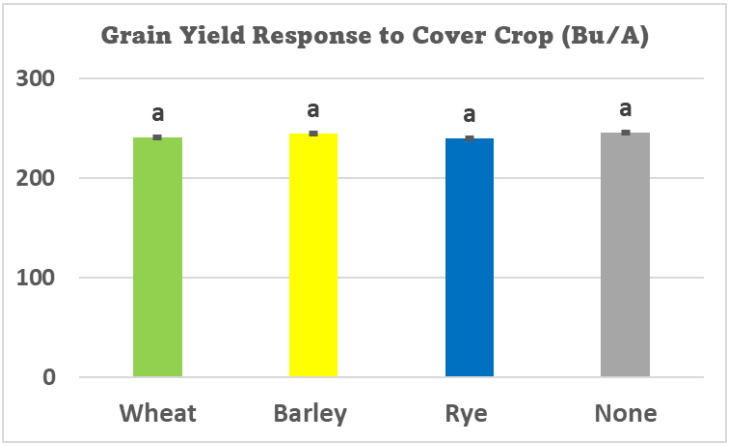
Corn Yield 2022 Lexington

- **Low biomass from cover crops did not affect corn yield.**



R. Nalley. MS thesis research. Preliminary Analysis.

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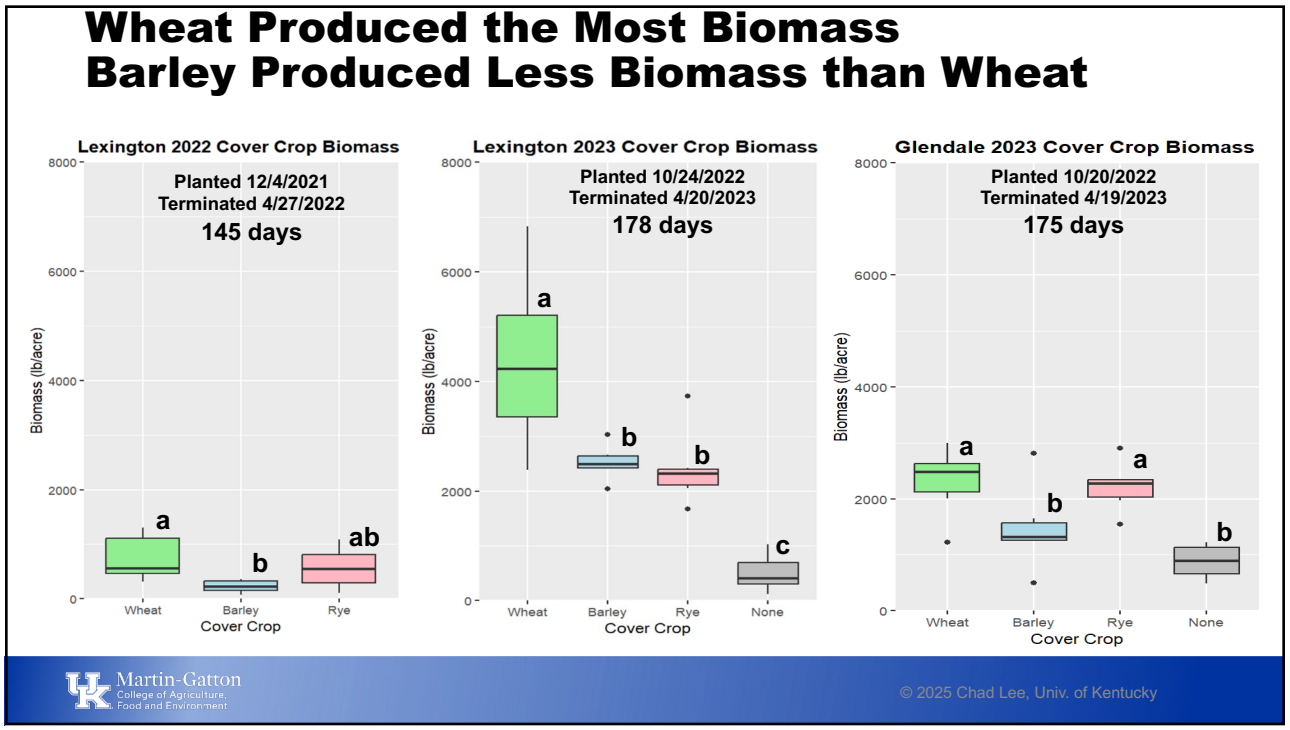
Wheat Produced the Most Biomass
Barley Produced Less Biomass than Wheat
Lexington 2022 Cover Crop Biomass
Planted 12/4/2021
Terminated 4/27/2022
145 days
Biomass (lb/acre)
Wheat
Barley
Rye
Cover Crop
a
b
ab
Lexington 2023 Cover Crop Biomass
Planted 10/24/2022
Terminated 4/20/2023
178 days
None
c
Glendale 2023 Cover Crop Biomass
Planted 10/20/2022
Terminated 4/19/2023
175 days
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2023 Cover Crops, Lexington, KY
Residue from Cover Crops Allowed for Slug Feeding on Corn
This study was destroyed and replanted.
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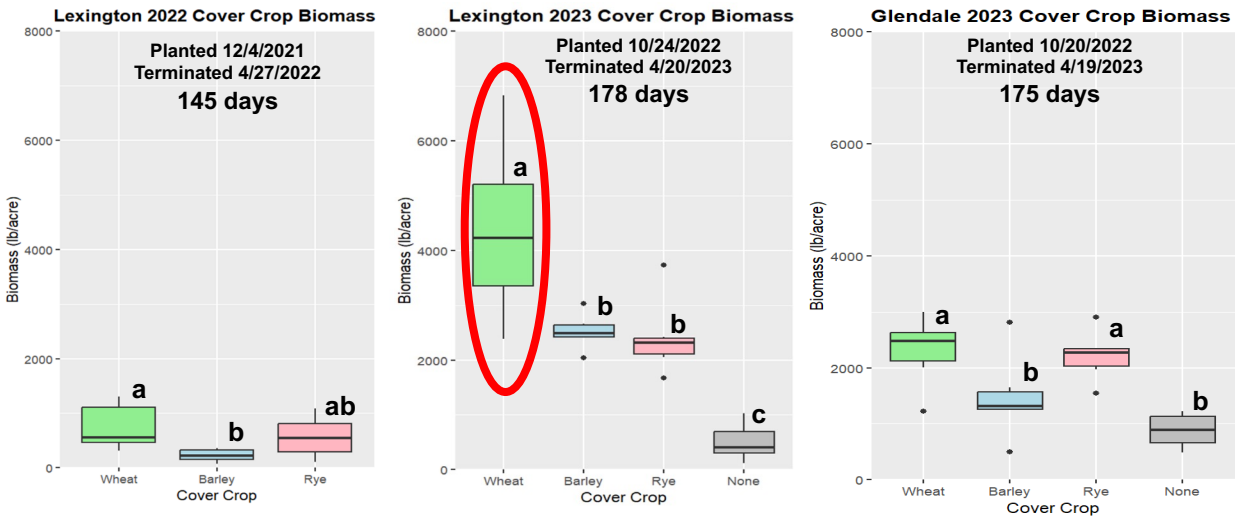
Wheat Produced the Most Biomass



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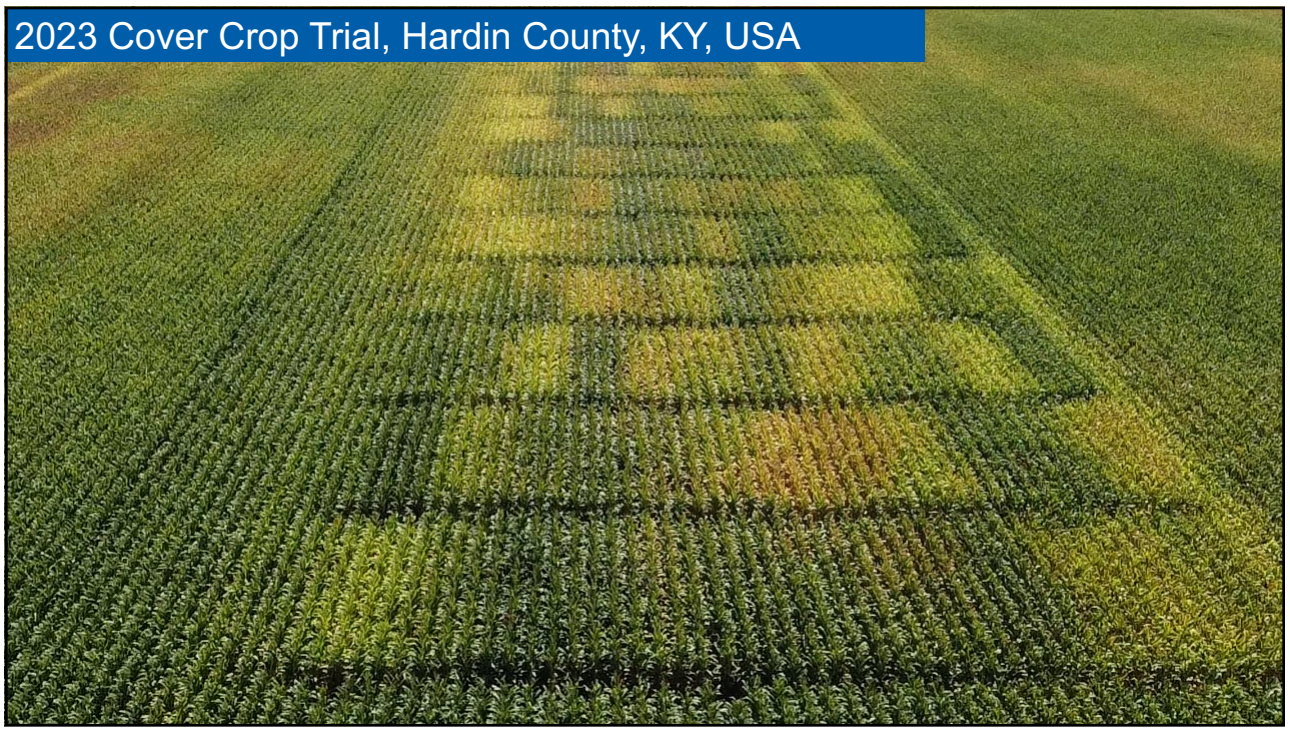

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Measuring N Content in the Season

SPAD

- SPAD measures amount of green color in the leaves.
- Other studies have linked those reading to Nitrogen content estimates.

Leaf Samples

- Ear leaves taken at R1, dried, ground and then analyzed for N content.

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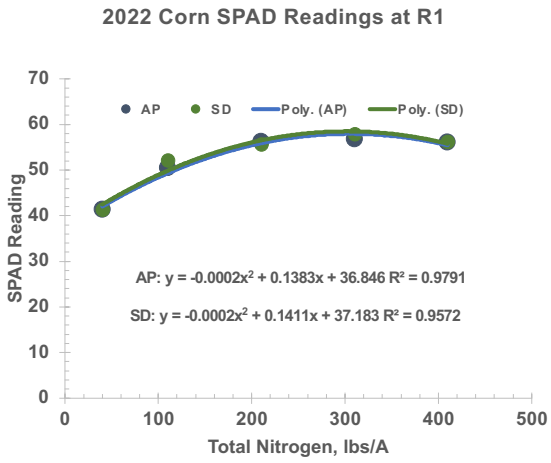
SPAD readings for each N rate were similar w/ and w/o cover crops

LOW cover crop biomass in Spring 2022 was from the December 2021 planting date.

Cover Crop	Biomass at Burndown lb/acre
Barley	227
Rye	562
Wheat	775
P value	0.0523



R. Nalley. MS thesis research. Preliminary Analysis.

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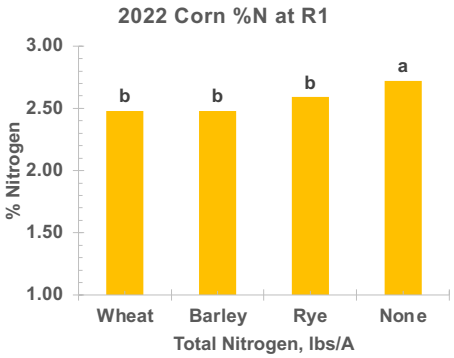
Nitrogen Concentration at R1 was Higher Following No Cover Crop, 2022

Low cover crop biomass in Spring 2022 was from the December 2021 planting date.

Cover Crop	Biomass at Burndown lb/acre
Barley	227
Rye	562
Wheat	775
P value	0.0523



R. Nalley. MS thesis research. Preliminary Analysis.

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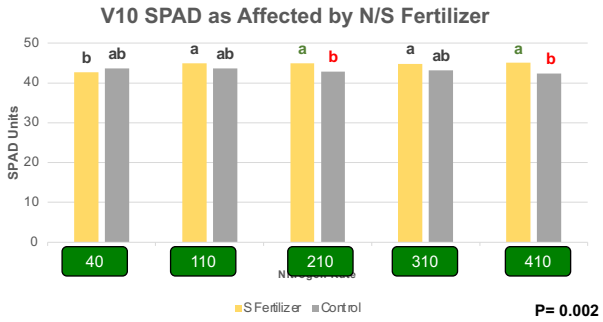
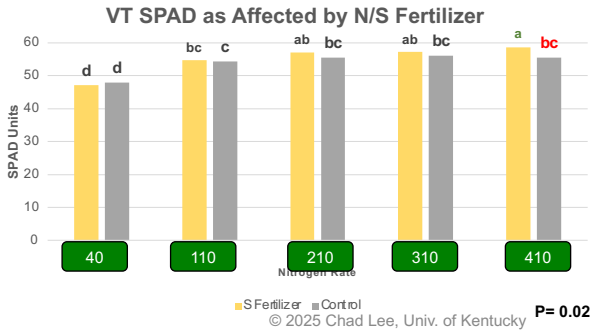
2023 Sulfur Interaction

- Significant S interaction with higher N rates at V10 and VT growth stages
- No impact on yield.





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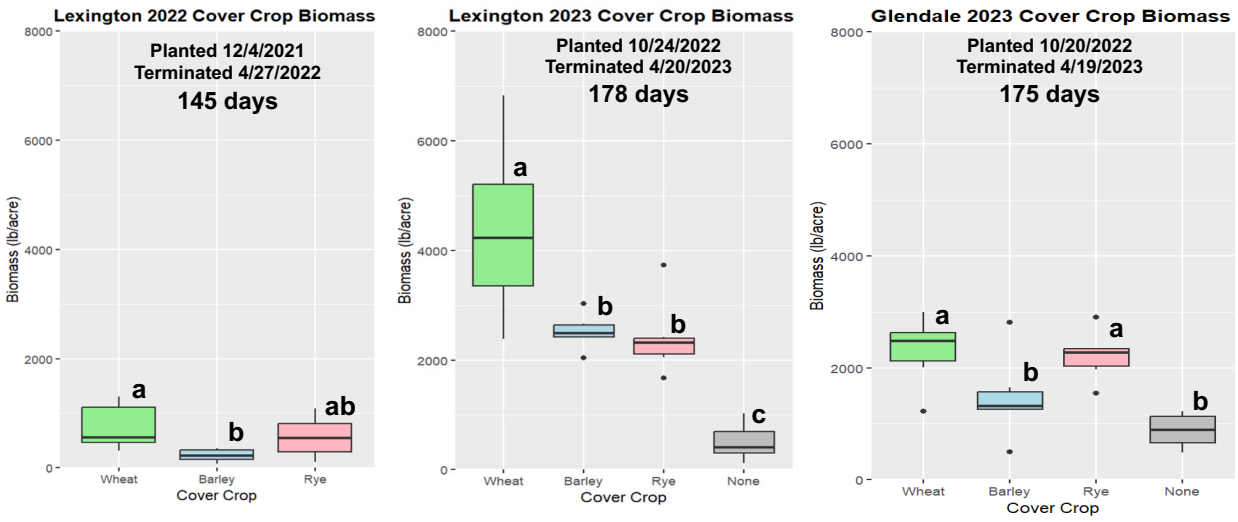
Barley prevented soil erosion and produced the lowest biomass



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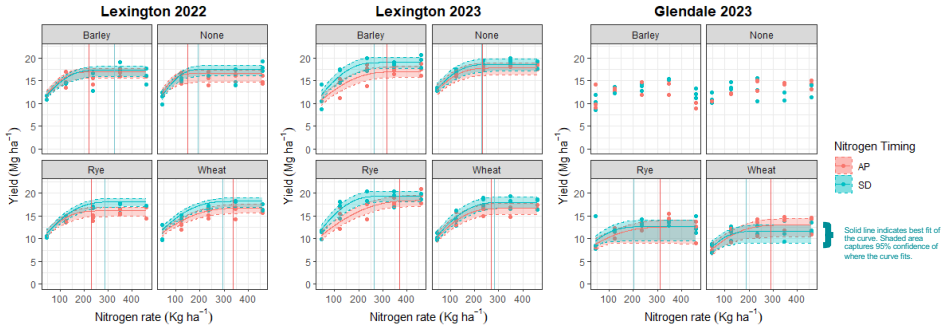
Corn Needed High N Rates in Most Comparisons from 2022 and 2023

Between 200 to 300 lb N/acre in many cases.



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20 Mg ha^{-1} = 239 bushels/acre
15 Mg ha^{-1} = 219 bushels/acre
10 Mg ha^{-1} = 159 bushels/acre

AP = at planting
SD = sidedress

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Sometimes Sidedressing Makes a Huge Difference

Sometimes it does not.

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Sidedress Reduced N Needed at Lexington 2023

Corn Replanted 1 month after 1st planting. All N applied at planting was applied at 1st planting.

Lexington, 2023		
Timing	AONR, lb N/acre needed to maximize yield	Yield at AONR, bu/acre
At Planting	301	278
Sidedress	212	293
Difference	-89	15

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At Planting: All Nitrogen applied at 1st planting
Sidedress: 40 lb N/A (32%UAN) applied at 1st planting. Remainder (Urea) applied at V3 growth stage.

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Lexington 2023

Corn Replanted 1 month after 1st planting. All N applied at planting was applied at 1st planting.

Lexington 2023: Yields ranged from 266 to 300 bu/A

Cover Crop	AT PLANTING AONR, lb N/A	SIDEDRESS AONR, lb N/A	Difference
Wheat	267	244	23
Barley	305	204	101
Rye	417	200	217
None	217	199	18
Averages	301	212	89

At Planting: All Nitrogen applied at 1st planting
Sidedress: 40 lb N/A (32%UAN) applied at 1st planting. Remainder (Urea) applied at V3 growth stage.

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Cover Crop (rye, wheat and barley) competed with corn for Nitrogen (even after the cover crop was dead)

Environment	Average AONR, lb N/A	No Cover Crop AONR, lb N/A
LEX22	285	191
LEX23	313	232
GLN23	159	40

- **LEX22 and LEX23: Cover Crops required an average of 88 lb N/acre more**
- **Lower N needed at Sidedress Timing in 6 of the 10 comparisons.**

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AONR:
Agronomic Optimum Nitrogen Rate
The lowest N rate needed to maximize yield.

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Adding a Legume…

- Barley and Barley + Austrian Winter Pea
- AWP might make the cover crop less competitive
- Included an earlier termination timing
- We need cover crops to prevent erosion.
- They cannot compete with the corn if farmers will continue to use them.

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Treatments	
Cover Crop	Barley Barley+ Austrian Winter Pea (Mix) Fallow Control
Termination	5 weeks before planting (Early) 2 weeks before planting (Standard)
Nitrogen Rate	40 lb N/acre (lb/ac) 170 lb N/ac 215 lb N/ac 260 lb N/ac 349 lb N/ac

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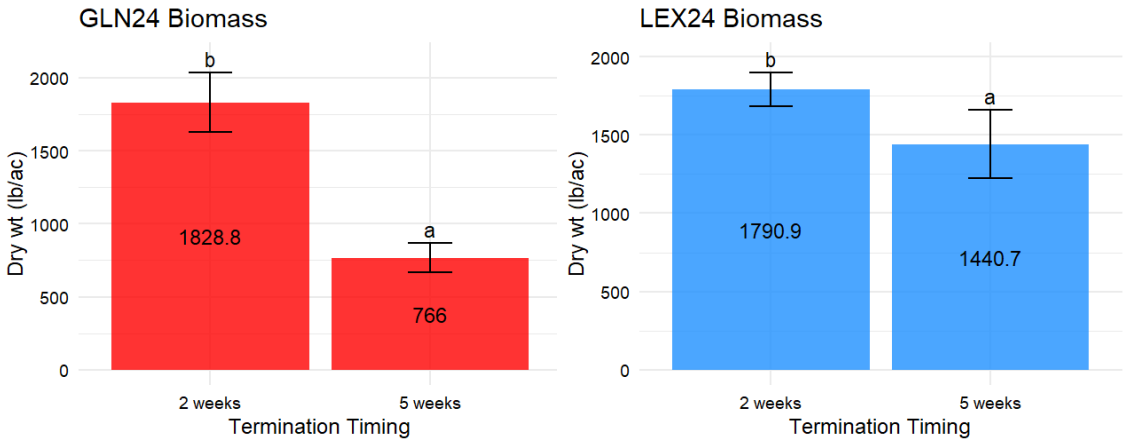
Earlier Termination Results in Lower Biomass



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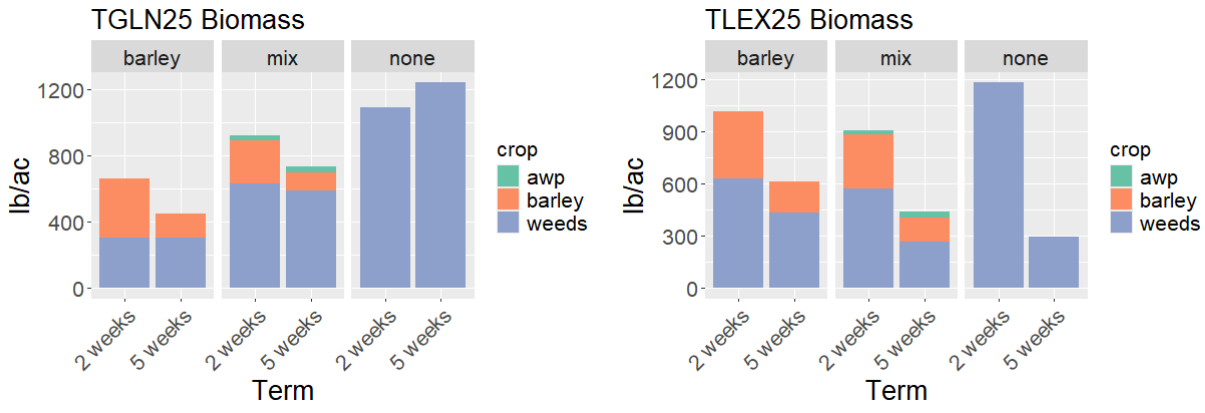
Terminations are too early to get any benefit from Austrian Winter Pea
Erosion visible with weeds alone.



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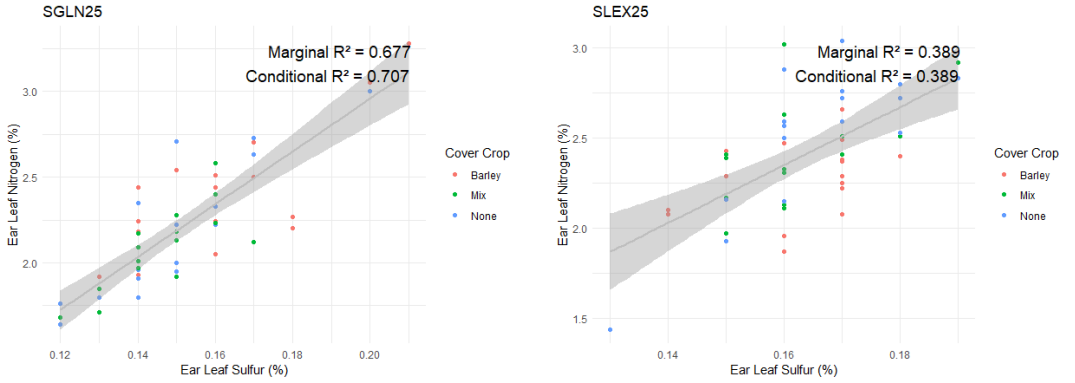
N and S are loosely correlated in the ear leaves



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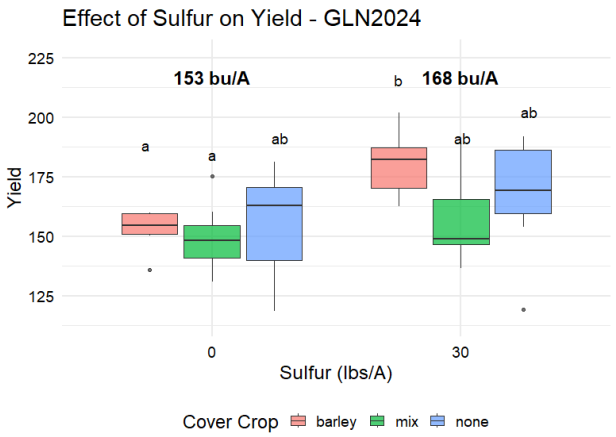
Sulfur in corn following cover crops increased yields in 1 of 4 environments.

- Corn yields increased in 1 of 4 environments
- No differences in yield in other 3 environments
- Note: 30 lb S/acre is a high rate of sulfur



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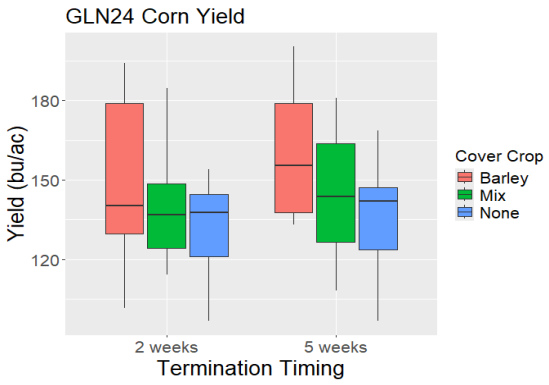
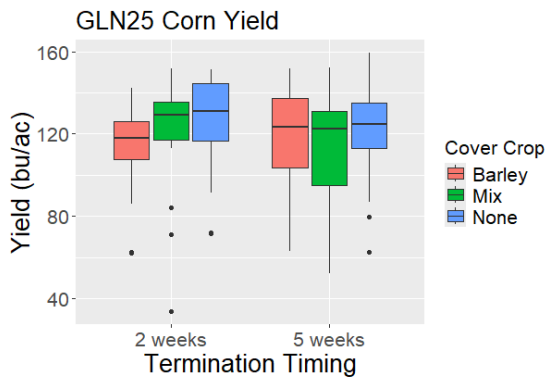
2024: Corn following barley was best
2025: no differences



1828 lb biomass

766 lb biomass



Less than 1,000 lb biomass for both timings

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Keeping soils covered and keeping your shirt

1. Stick with a cereal: wheat, barley or rye
2. Terminate 2 to 5 weeks before planting
3. Sidedress most of the N to avoid competition
4. Maybe add Sulfur is cover crop biomass is high
5. Possibly keep biomass below 1,000 lb/acre or less

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Thank you!

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Killing the Cover Crop

AGR-6 "Burndown" Options for Corn

Glyphosate formulation[1]	Annuals <6" tall	Annuals >6" tall
3 lb Glyphosate formulations *Numerous products* (3 lb ae/gal)	1.5 to 2 pt/A (24 to 32 fl oz/A) (0.56 to 0.75 lb ae/A)	2 to 3 pt/A (32 to 48 fl oz/A) (0.75 to 1.13 lb ae/A)
Buccaneer 5 (3.75 lb ae/gal)	1.2 to 1.75 pt/A (19 to 28 oz/A) (0.56 to 0.82 lb ae/A)	1.75 to 2.5 pt/A (28 to 40 oz/A) (0.82 to 1.17 lb ae/A)
Duramax Durango DMA (4 lb ae/gal)	1.13 to 1.5 pt/A (18 to 24 fl oz/A) (0.56 to 0.75 lb ae/A)	1.5 to 2.25 pt/A (24 to 36 fl oz/A) (0.75 to 1.13 lb ae/A)
Roundup PowerMAX Roundup Weather MAX (4.5 lb ae/gal)	1 to 1.4 pt/A (16 to 22 fl oz/A) (0.56 to 0.77 lb ae/A)	1.4 to 2 pt/A (22 to 32 fl oz/A) (0.77 to 1.13 lb ae/A)
Roundup PowerMAX 3 (4.8 lb ae/gal)	0.94 to 1.25 pt/A (15 to 20 fl oz/A) (0.56 to 0.75 lb ae/A)	1.25 – 1.88 pt/A (20 to 30 fl oz/A) (0.75 to 1.13 lb ae/A)
[1] **See page 20 for a detailed list of glyphosate products**		

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