Cover Crops: Agronomic, Economic, and Environmental Considerations

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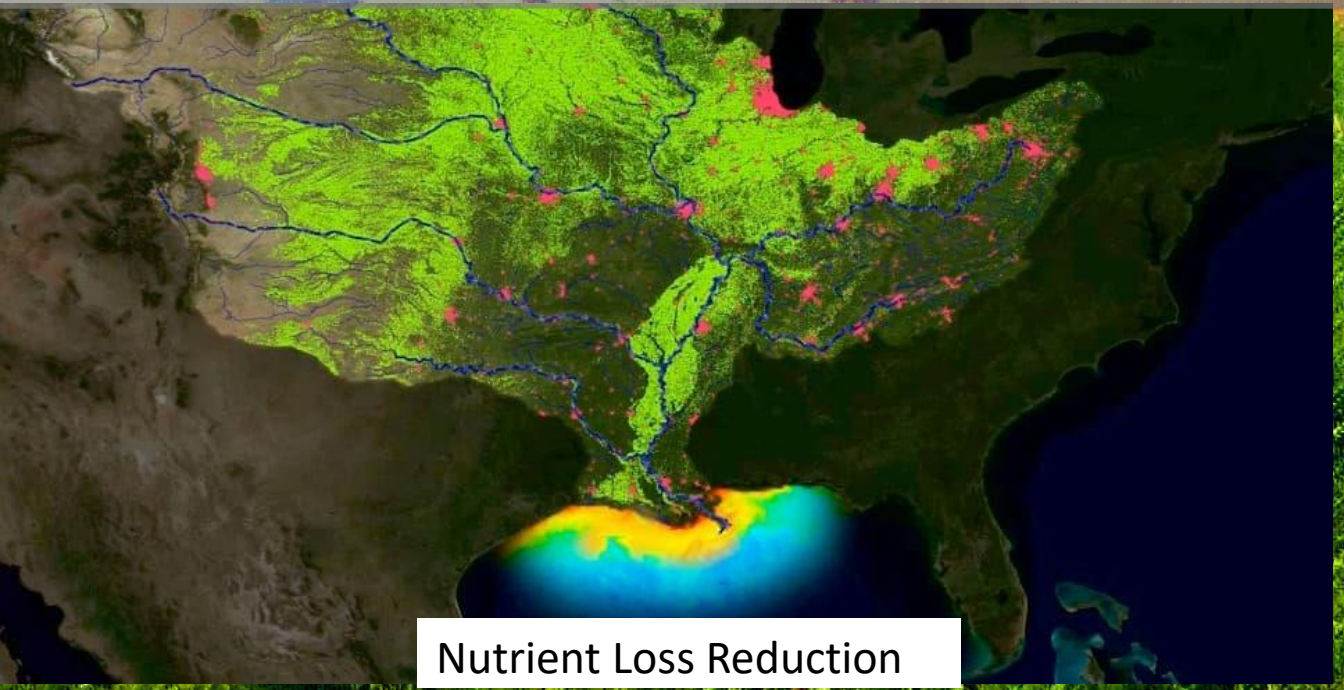
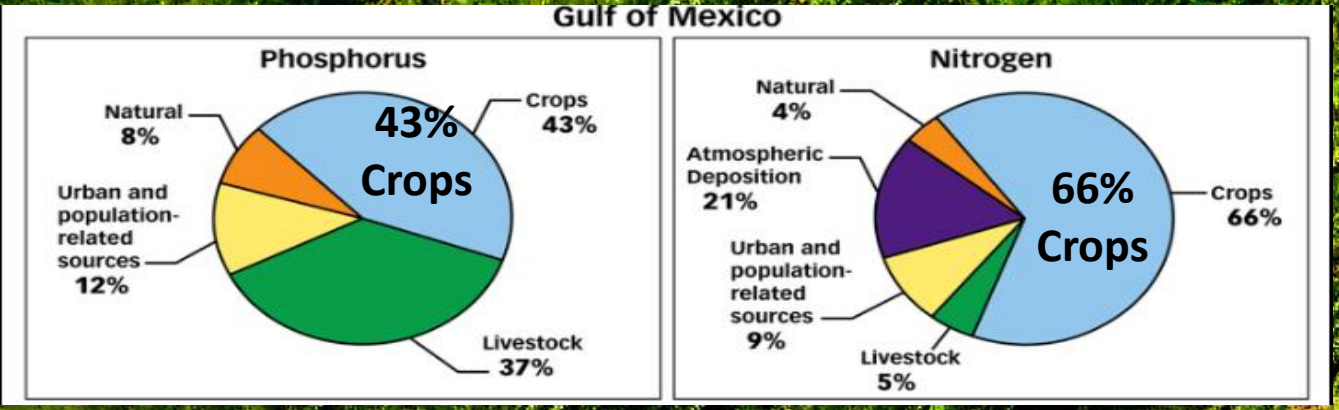
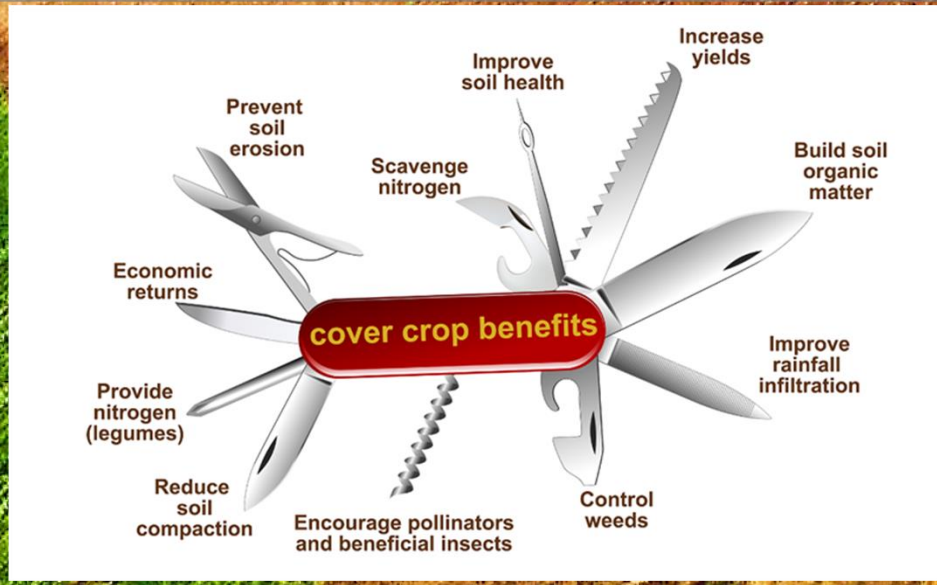
Re-emergence of Cover Crop Adoption

Nationally: 133% increase in cover crop acres nationally since 2011 in the U.S.

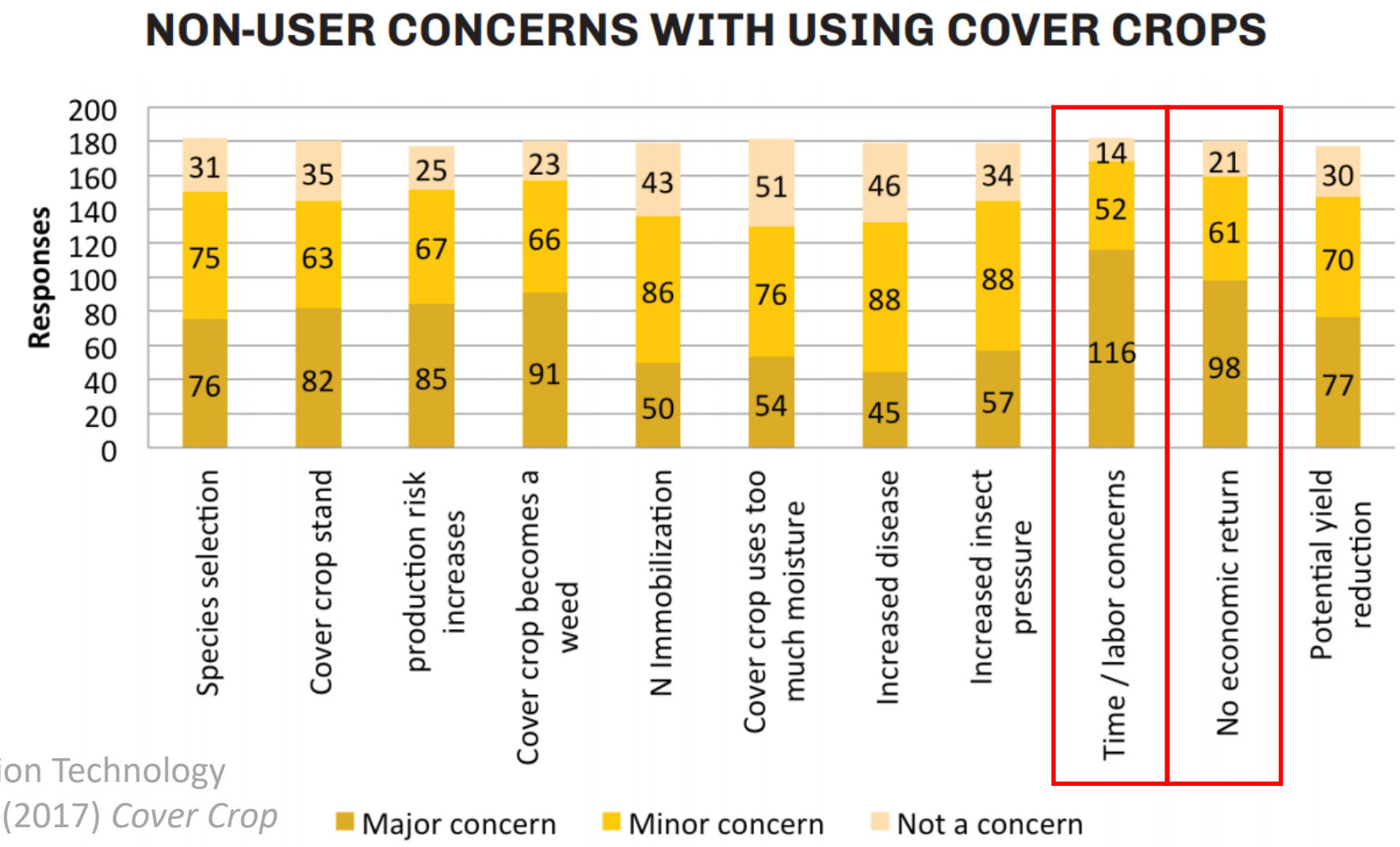


Nutrient Loss Reduction





Introduction: Why do we not cover crop?



Source: Conservation Technology Innovation Center (2017) *Cover Crop Survey*

Indirect costs/benefits:

don't directly accrue to the farmer/difficult to monetize

- Increased soil organic matter
- Reduced nitrate leaching

Direct costs/benefits:

directly accrue to the farmer

- Cover crop establishment and termination
- Cash crop yield impacts

Extra insecticide

Extra nitrogen

More management

Higher cash crop seed and planting costs

More soil testing

Extra herbicide

Reduced tillage

Savings on repairs due to soil erosion

Savings on land rent

Lower cash crop planting population

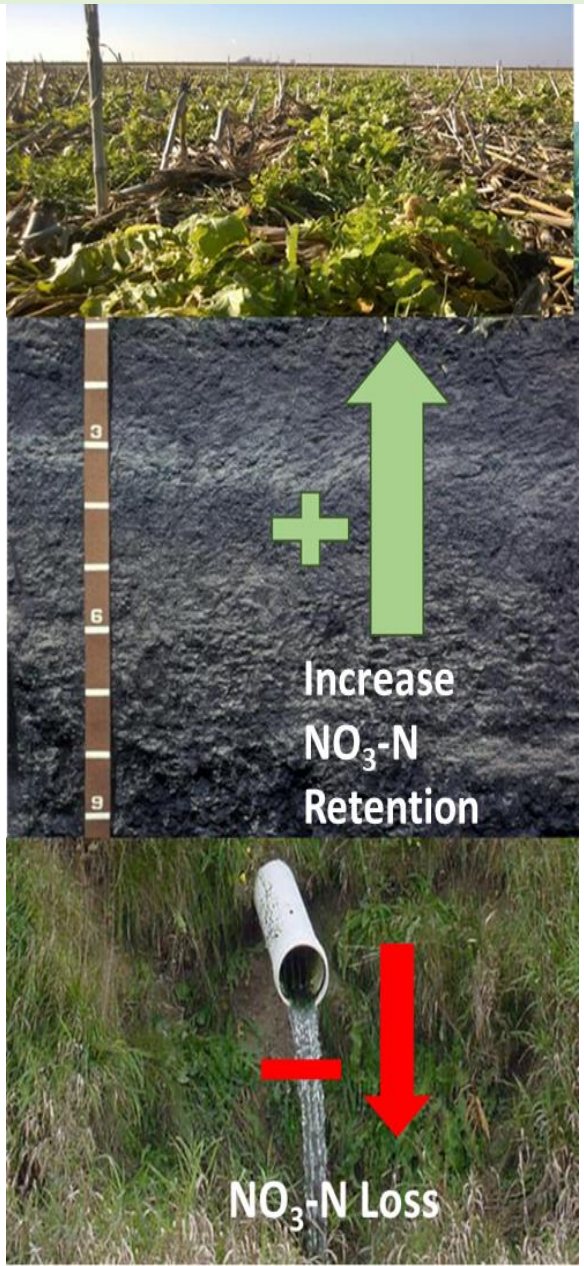
Cost share

Rented more acres

Replacing wheat by corn/soybeans

Source: Plastina et al. (2018) *Journal of the American Society of Farm Managers and Rural Appraisers*

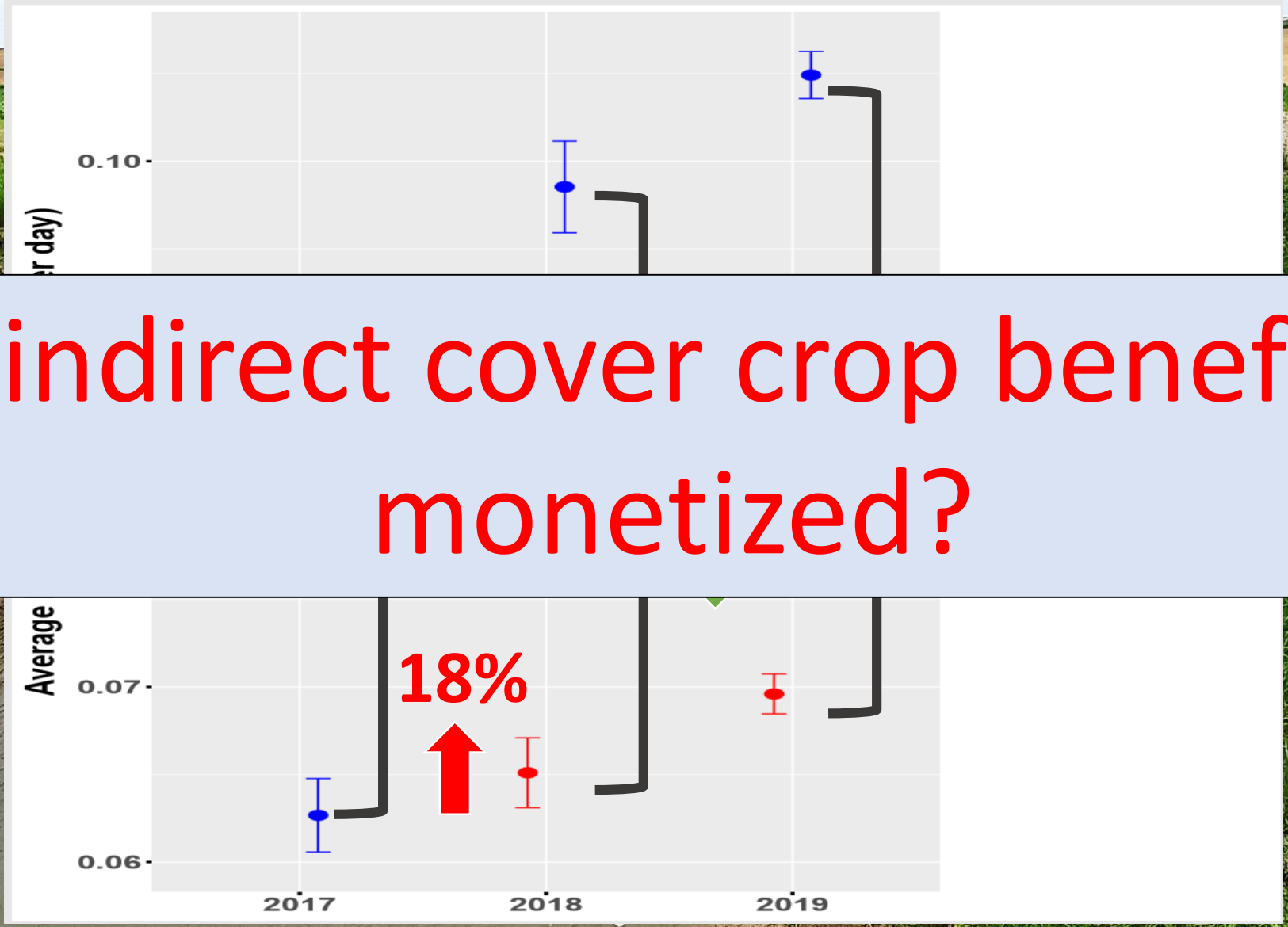
Cover Crops Reduces Nitrate Loading Down Stream



- Interseeded Cereal Rye/Radish Mix *(Mid Sept.)*
- Average cover crop biomass: *1,200 lbs. ac^{-1}*
- Average shoot N uptake was *59 lbs/A*
- Terminated *2 weeks* before planting

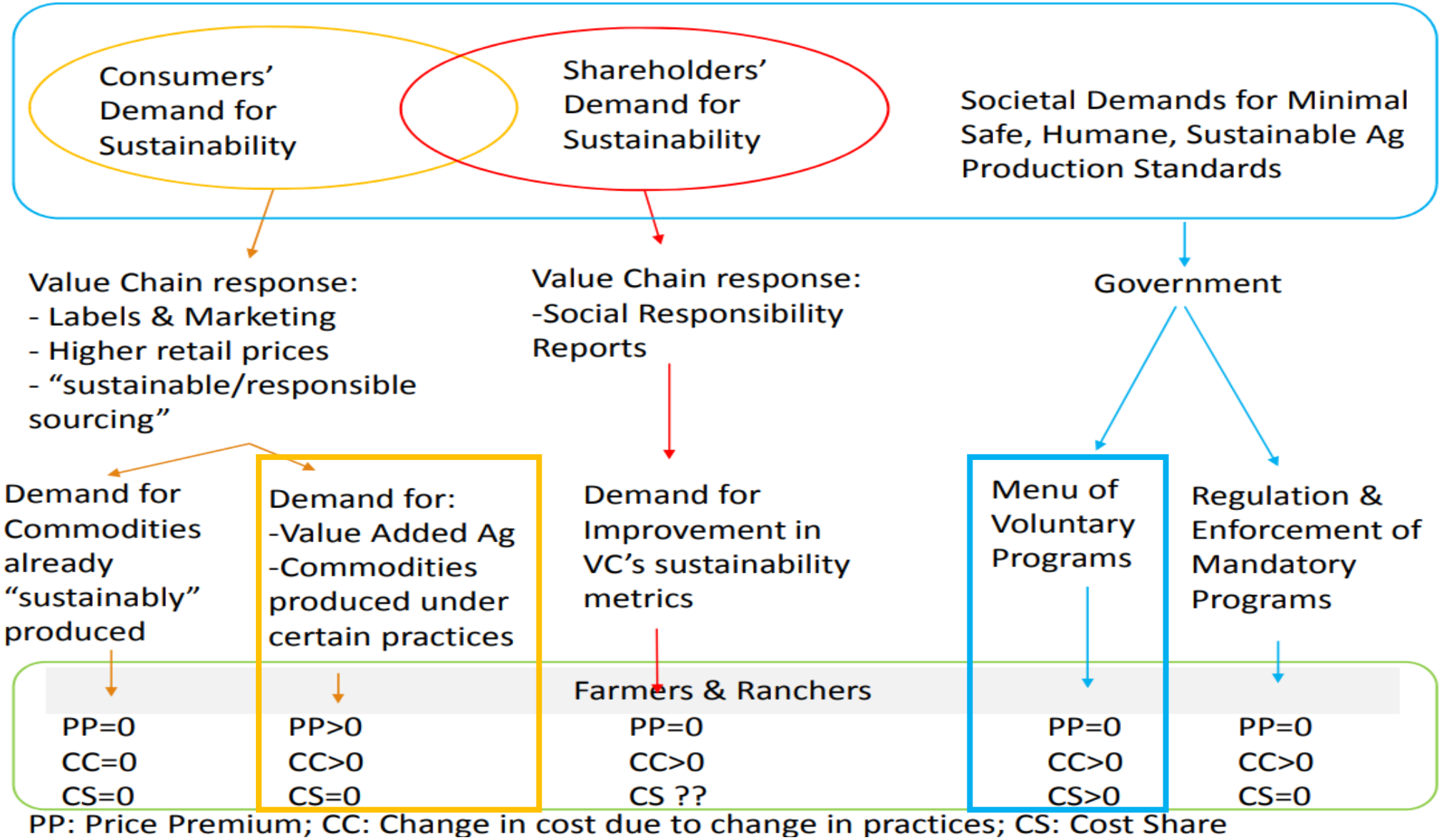
Ruffatti et al. (2018) Agricultural Water Management 211:81-88.

Watershed Impact of Mass Cover Crop Adoption



Can indirect cover crop benefits be monetized?

It depends…



PP: Price Premium; CC: Change in cost due to change in practices; CS: Cost Share

Source: Plastina and Massey (2019) https://www2.econ.iastate.edu/faculty/plastina/presentations/Plastina-190722.pdf

What are the Direct Budget line Considerations?

What does research say about these?

establishment

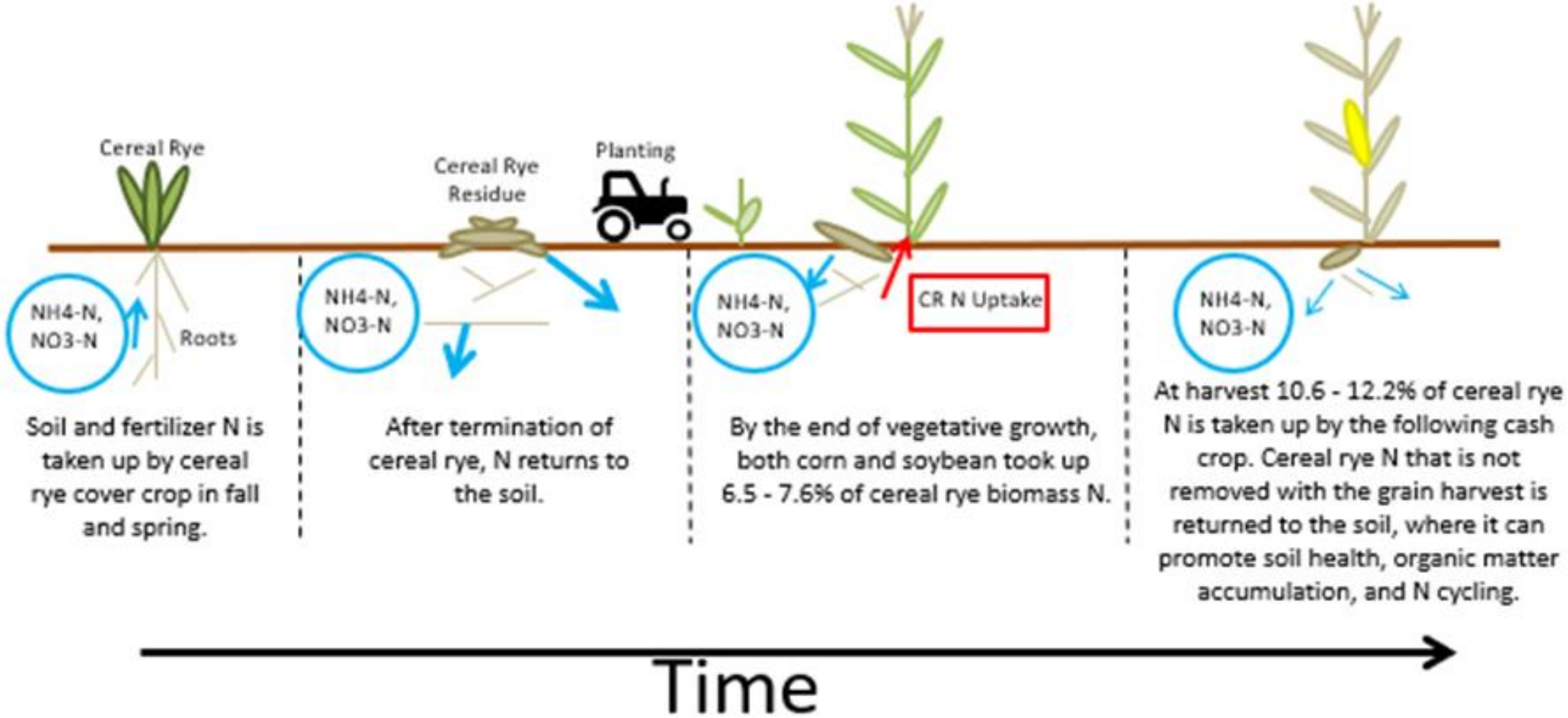
- Cover crop termination

- **Increased revenue**
  - Increased cash crop yield
  - Cost-share payments

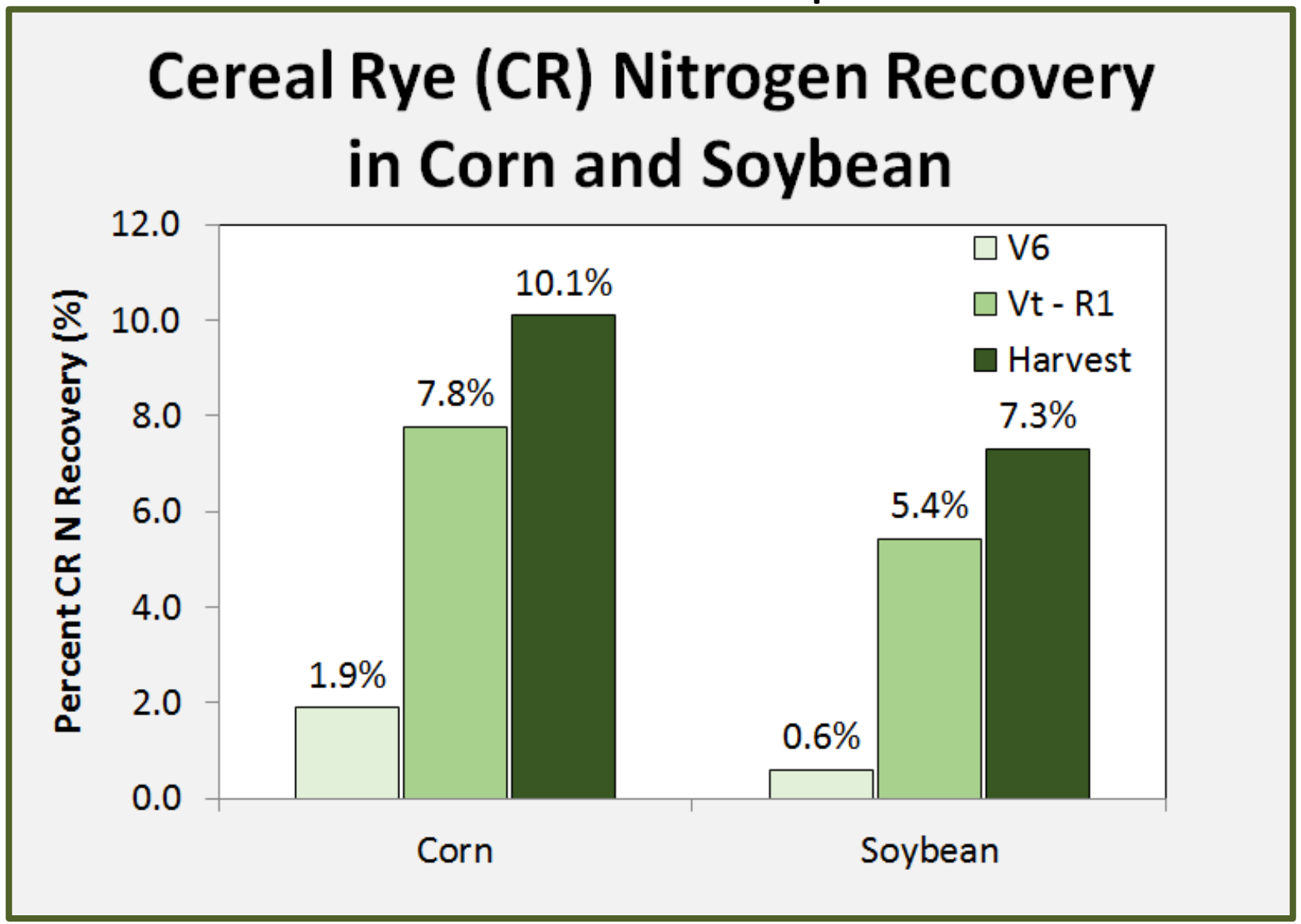
- **Decreased costs**
  - Reduced nitrogen Fertilizer needs

- **Decreased revenue**
  - Decreased cash crop yield

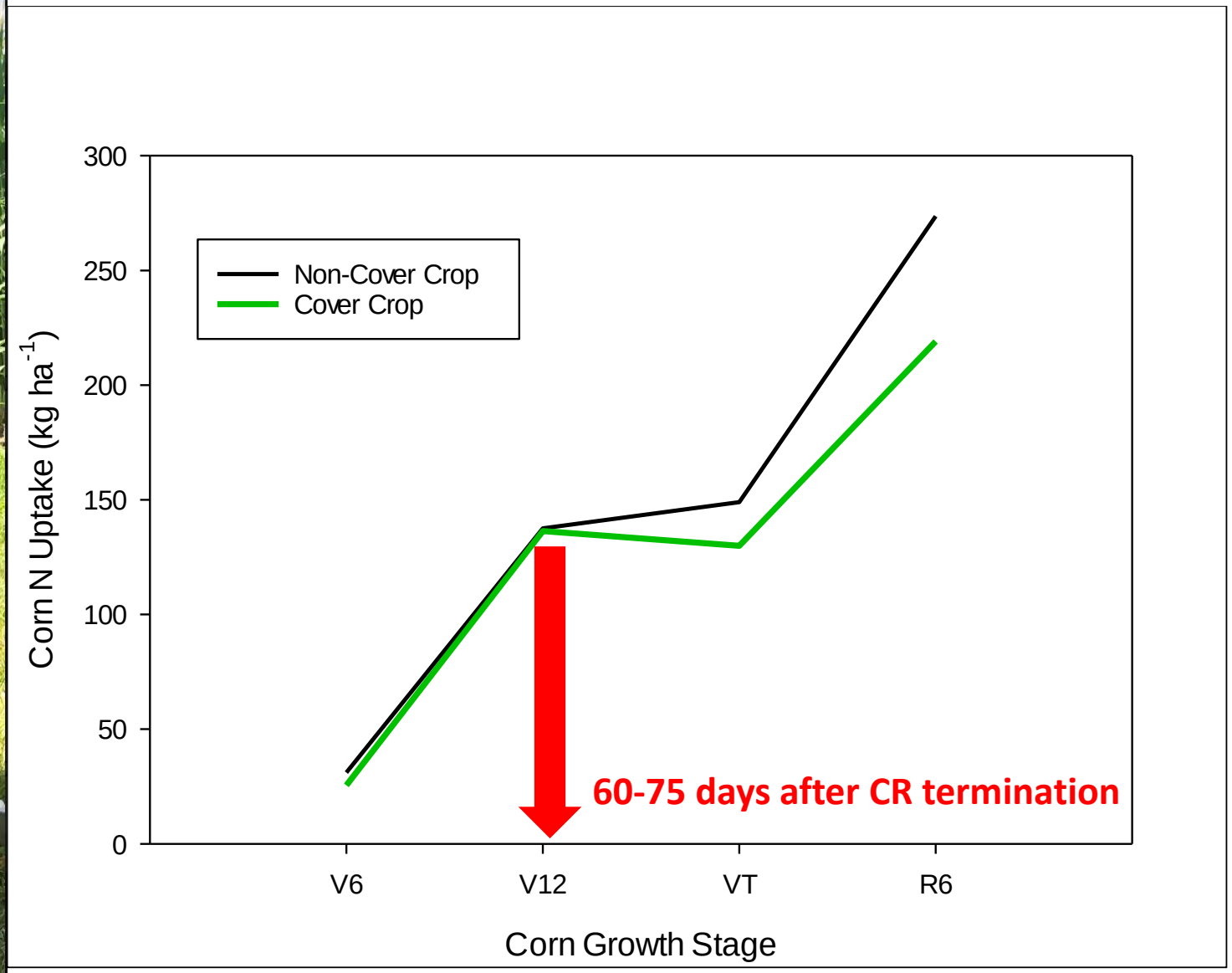
Cereal Residue Nitrogen Tracking N Study



Utility of Cereal Rye Residue N by Subsequent Corn Crop

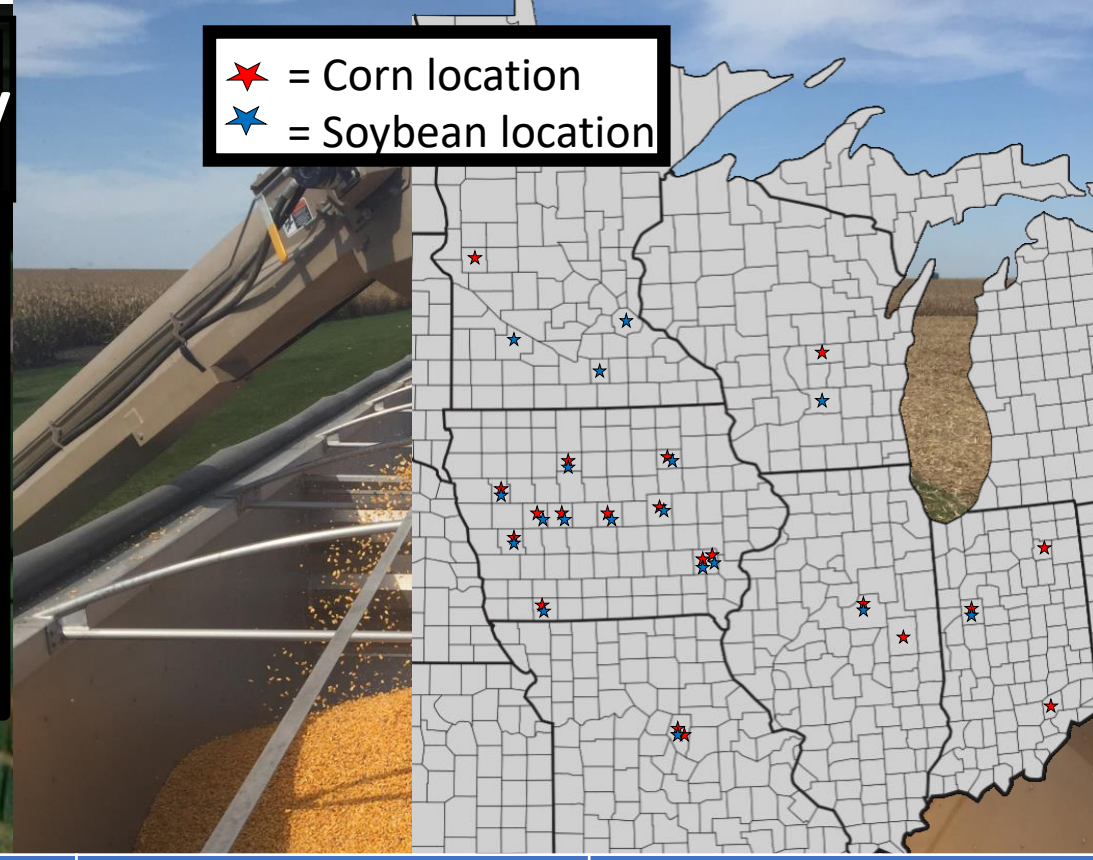


Cereal Rye Impact on Corn N Uptake



Regional CR-Cash Crop Yield Study

- 773 Total **Paired** Observations from **24** different Experimental Sites
  - **430** Corn **Paired** observations from 20 Experimental sites
  - **343** Soybean **Paired** observations from 18 Experimental Sites



Crop	Treatment	Yield Mg ha^{-1} (SE)	Average Δ Yield Control – Cereal Rye	P-value
Corn N= 430 pairs	Control	9.6 (0.183)	6% (10 bu/A)	<0.00001
	Cereal Rye	9.0 (0.162)		
Soybean N= 343 pairs	**Control**	**3.1 (0.049)**	**6% (3 bu/A)**	**<0.00001**
	Cereal Rye	**2.9 (0.035)**		

Cover Crop Budget: Putting it all together

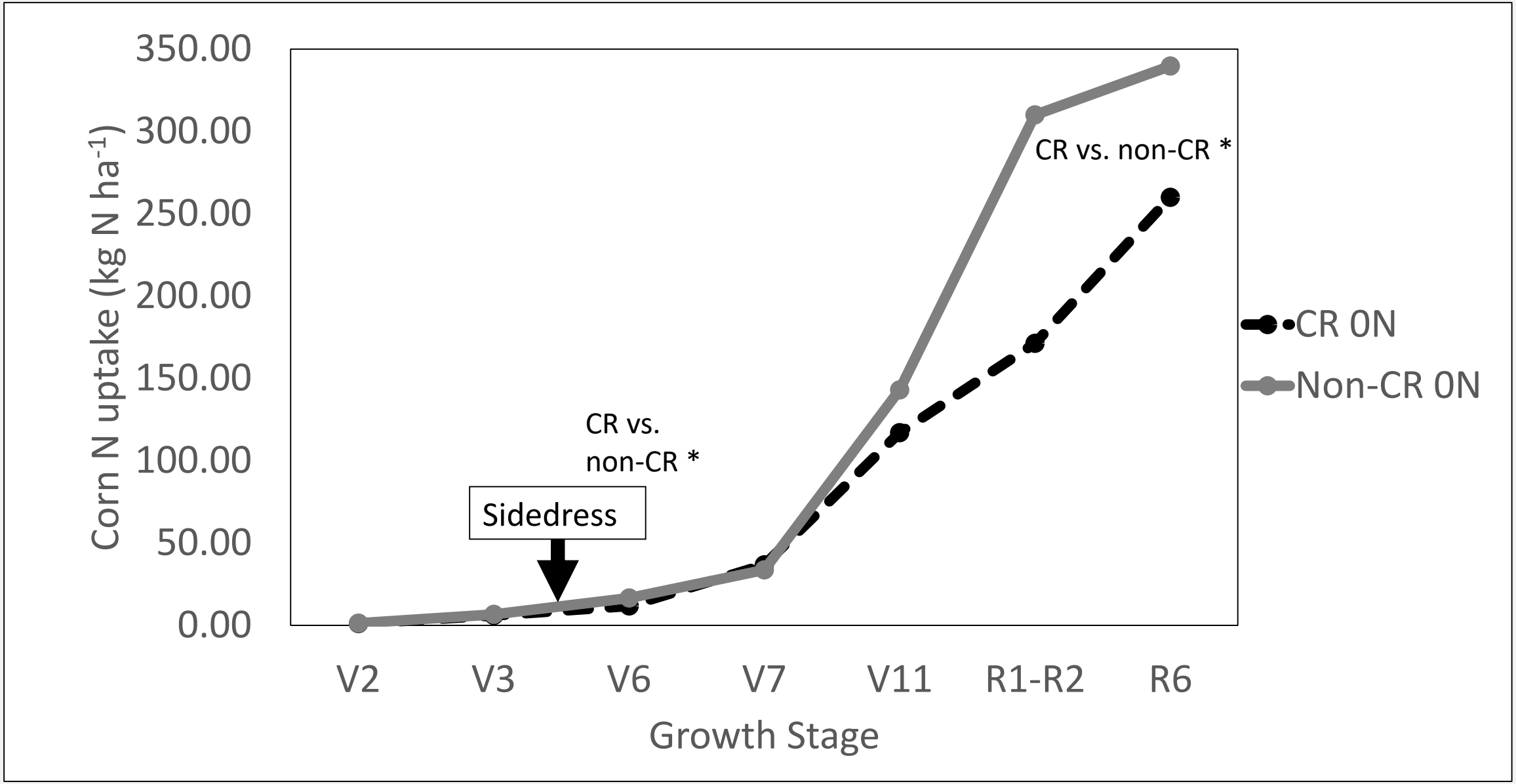
Changes in revenue	Corn	Corn + EQIP Payment
Yield change	-10 bu/ac @4.00/bu -$40/ac	-10 bu/ac @$4.00/bu -$40/ac
EQIP Payment		+$50/ac
Changes in costs		
Establishment costs	-$30/ac	-$30/ac
Termination costs	-$5/ac	-$5/ac
Net change in profit	**-$75/ac**	**-$25/ac**
Breakeven yield change	**+9 bu/ac**	**-4 bu/ac**

Cover Crop Budget: Putting it all together

Changes in revenue	Soybean	Soybean + EQIP Payment
Yield change	-3 bu/ac @9.50/bu -$29/ac	-3 bu/ac @$9.50/bu -$29/ac
EQIP Payment		+$50/ac
Changes in costs		
Establishment costs	-$30/ac	-$30/ac
Termination costs	-$5/ac	-$5/ac
Net change in profit	-$64/ac	-$14/ac
Breakeven yield change	+4 bu/ac	-2 bu/ac

Is that the end of the story?

Adaptive Nitrogen Fertilizer Management: **Starter at Planting**



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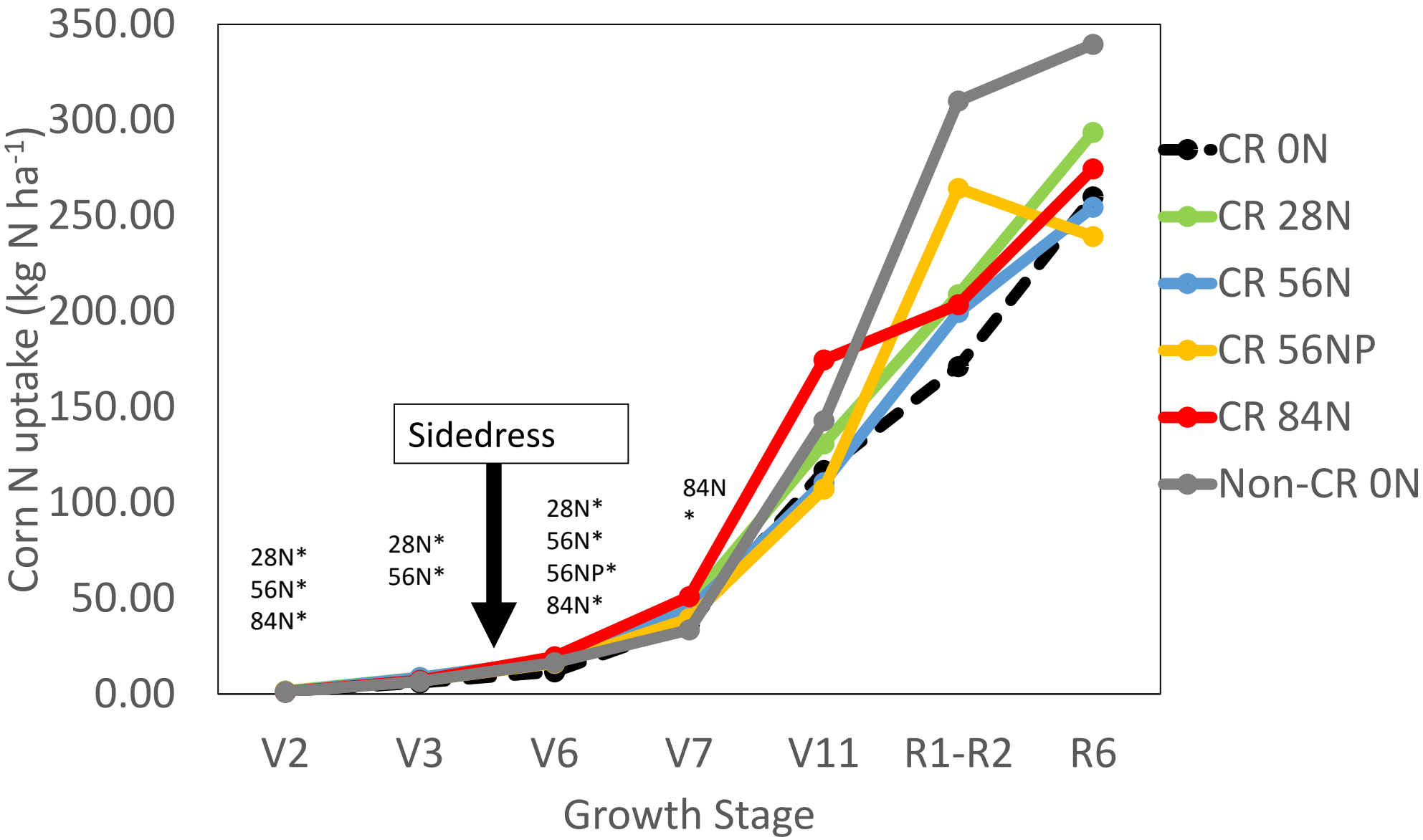
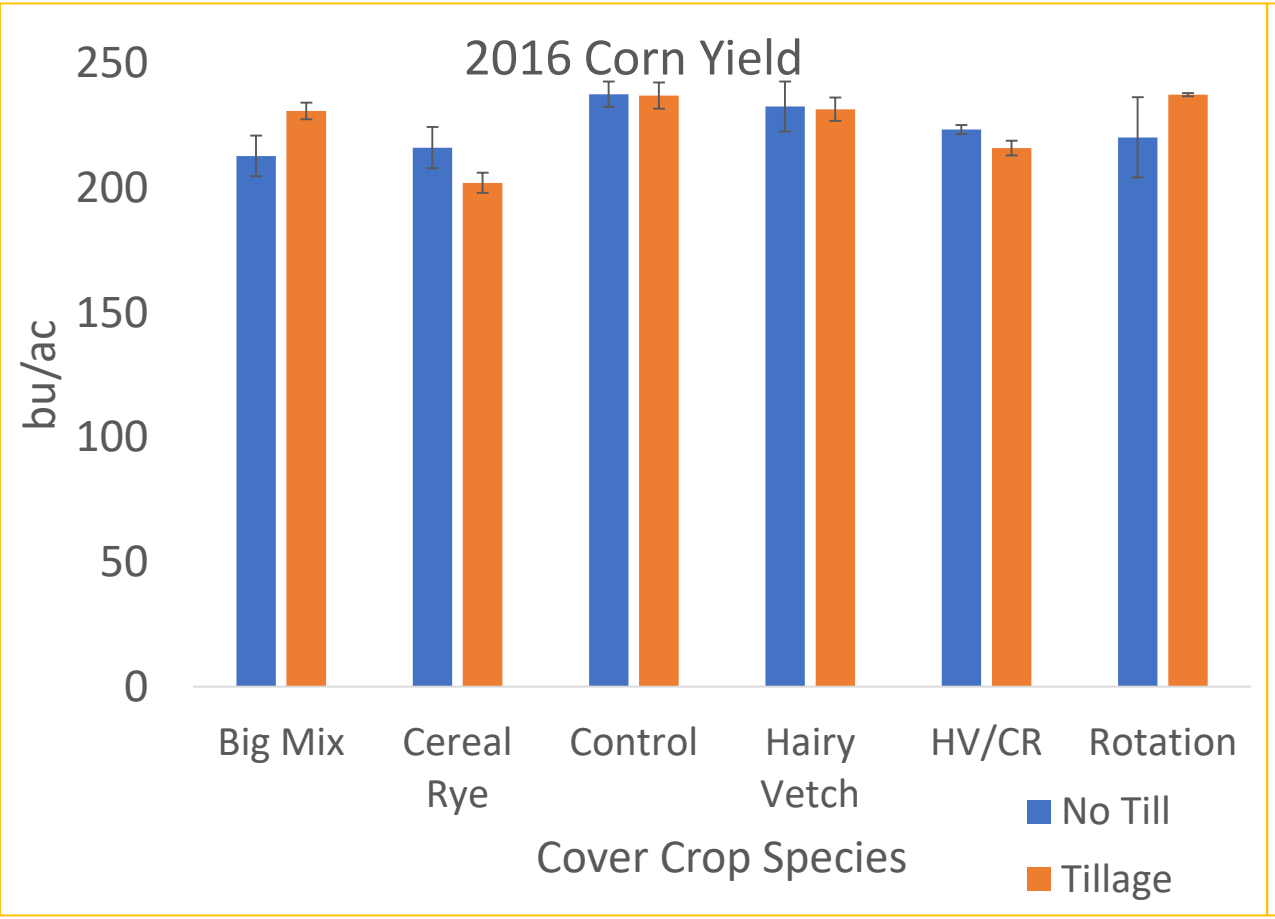
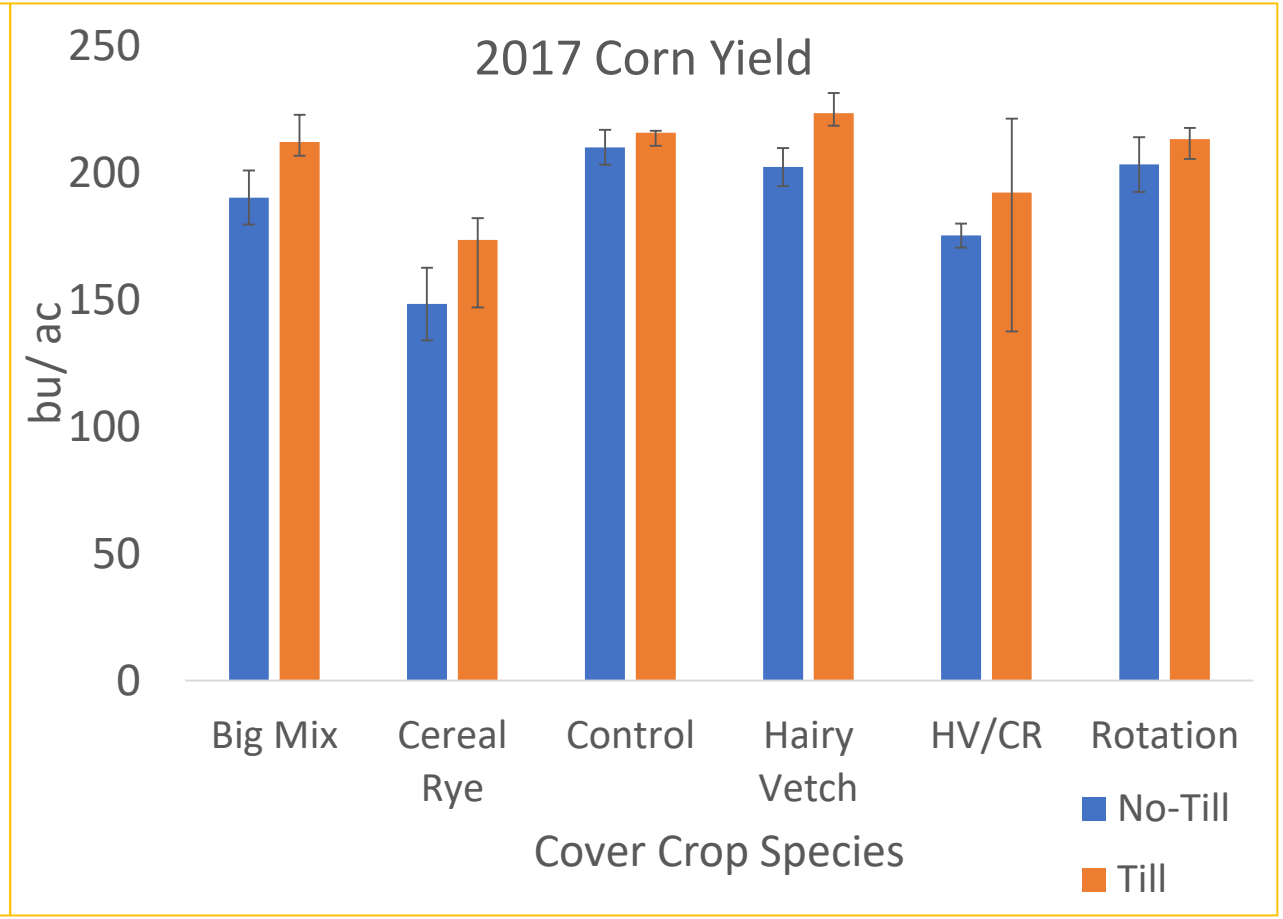


Yield Summary

- **At 2 of 3 sites, adding 56 kg N ha^{-1} (50 lbs/A) resulted in equal or greater corn yield relative to the non-CR and starter N control.**
- **Within CR treatments, at 3 of 3 sites, adding 28-56 kg N ha-1 starter resulted in greater yield (1.3-13.4% greater).**





Lower Inclusion of Cereal Rye Results in Less Reduction of Corn Yield

Takeaways

1. Its complicated!
2. Cover crops offer a number of environmental services
   - However, these indirect benefits are often difficult for the producer to monetize
3. Direct, short-run economic returns to a cereal rye cover crop are generally negative
   - Even when including EQIP cost-share payments
   - Negative and uncertain yield impacts are primary contributor – especially for corn
4. Improvements of corn yield following cover crop adoption
   - Adaptive nitrogen management for corn following cereal rye (Starter Nitrogen at Planting)
   - Cover crop selection: reducing the inclusion rate of cereal rye prior to a corn crop