## Tillage, Nitrogen Use, and Cover Crop Impacts of Corn and Soybean Returns



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Agricultural & Consumer Economics

COLLEGE OF AGRICULTURAL, CONSUMER & ENVIRONMENTAL SCIENCES

### Laura Gentry

### farmdocdaily

**Gary Schnitkey** 



- 1. What is PCM?
- 2. PCM Data Collection & Reports
- Nitrogen: Applications at Maximum Return to Nitrogen (MRTN) Rates Have Highest Returns
- 4. Tillage & Profitability: Corn & Soybean
- 5. Cover crops: Lessons for New Adopters

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How aware are you of Precision Conservation Management (PCM)?

O Not aware

○ Heard of it, but know little about PCM

O I have studied results from PCM

O I am very familiar with PCM





## What is PCM?

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PRECISION CONSERVATION MANAGEMENT

- Understand how conservation practices impact farm net returns
- Address water quality concerns. Prevent agricultural regulation.
- Position farmers to benefit from positive conservation outcomes

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## **Illinois Nutrient Loss Reduction Strategy**



### **Goal: 45% Reduction** in **Total N & Total P** Losses by **2035 Interim:** 15% Reduction in NO<sub>3</sub>-N & 25% Reduction in Total P by 2025

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Rapid Growth of Companies Setting Science-based Targets Around Sustainability Goals

### **Companies Tackling Supply Chain Emissions**

Food & Tech Companies Showing They Are Serious About Corporate Responsibility

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CORN IL, HIGH SPR 2015-19 AVG VALUES	NO-TILL	STRIP- TILL	1-PASS LIGHT	2-PASS LIGHT	2-PASS MODERATE	2+ TILLAGE PASSES
No. Fields	310	296	710	139	302	46
Yield per acre	209	219	220	224	223	216
GROSS REVENUE	\$750	\$787	\$790	\$804	\$801	\$773
TOTAL DIRECT COSTS*	\$388	\$395	\$382	\$384	\$396	\$422
Field work	\$0	\$20	\$10	\$22	\$26	\$38
Other power costs**	\$96	\$93	\$96	\$93	\$92	\$97
TOTAL POWER COSTS	\$96	\$113	\$106	\$115	\$118	\$135
OVERHEAD COSTS	\$37	\$37	\$37	\$37	\$37	\$37
TOTAL NON-LAND COSTS	\$521	\$544	\$524	\$536	\$550	\$594
OPERATOR & LAND RETURN	\$229	\$243	\$266	\$269	\$250	\$180



Precision Conservation Management

- 16 IL counties
- 10 KY counties
- 330 Farmers in IL
- 300,000+ acres
- 5 years of data
- Farmer enrollment began in 2016

## **PCM Field Staff**



- Staff: Precision Conservation
   Specialists & Data Collection
   Representatives
- Partnership effort: 30+ partners
- NRCS RCPP award
- An intuitively designed web interface



Check us out online: www.PrecisionConservation.ORG

# PCM Data Collection & Reports

## **Data Collection**

- 1. Fields
- 2. Crops
- 3. Systems
  - Conventional
  - Non-GMO
  - Seed Corn/Bean
  - Organic/Transitioning
- 4. Programs

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- Every Pass Across Field
- Inputs; Rates



🖷 Home 🖾 News 🛛 Fields Agronomics - 🖻 Reports 👹 Users 🗯 Switch - 🍋 Glen Salo -





## **PCM Practice Standards**

## 1. Tillage

## 2. Cover Crops

## 3. Nutrient Management



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Economic returns resulting from various nitrogen fertilizer management strategies for corn production in Central Illinois from 2015-19.



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& ENVIRONMENTAL SCIENC	ES	

IS –	CORN IL, 2015-2019 HIGH SPR	>40% FALL	MOSTLY PREPLANT	MOSTLY SIDEDRESS	50% PRE/50 SIDEDRESS	3-WAY SPLIT
13	AVG NUE (lb N/bu grain)	1.01	0.93	0.92	0.91	0.94
	Yield per acre	219	218	220	221	230
	No. Fields	732	492	612	228	52
	<b>GROSS REVENUE</b>	\$789	\$785	\$791	\$793	\$827
	N fertilizer	\$84	\$78	\$76	\$84	\$95
	Other direct costs*	\$320	\$286	\$307	\$311	\$338
	TOTAL DIRECT COSTS	\$404	\$364	\$383	\$395	\$433
	Field work	\$16	\$16	\$16	\$18	\$19
	Other power costs**	\$97	\$89	\$94	\$95	\$93
	TOTAL POWER COSTS	\$113	\$105	\$110	\$113	\$112
	<b>OVERHEAD COSTS</b>	\$37	\$37	\$37	\$37	\$37
	TOTAL NON-LAND COSTS	\$554	\$506	\$529	\$545	\$582
	OPERATOR & LAND RETURN	\$235	\$279	\$261	\$248	\$246

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High Soil Productivity Rating Soils (SPR>136)

## What are we doing to facilitate practice change across the Midwest?

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Weekly Farm Economics: Tillage Passes and Returns on Corn-Soybean Farms in East-Central Illinois

> Agricultural and Consu iversity of Illinois Laura Gentry

ent of Natural Resources and Enviro University of Illinois

Winois." farmdoc daily (9): 53,

number and type of tillage operation

oreover, statistical evidence does it

nonstrated using

Corn

ilcorn.org

6. Overality in number and sype or along operations used 5. As 2019 appears to be a low-income year, reducing b say be more of an option in 2019 since fewer fait tillage

anded citation format: Schnitkey, G. and L. Gentry.

ean Farms in East-Central

osts. This may b

due to wet field cu

Tillage on Illin

ersity of Illinois at Urbana-Champaign, March

Ine oversity in on-taint suage practices is overnonsverie using Management (PCM). Precision Conservation Management (PC Minols Com Growers Association in partnership with over 30 pair

поетчалит раколов акорлоп извед tarm pusness manageme 16-county service area, PCM represents about 200,000 acre

conservation practice adoption using farm business manage to the matching fractice adoption using farm business manage

Table 1 shows the percent of fields falling within varie Table 1 shows the percent of fields failing within various tillinging the number and type of tillingin operations for the over 1,800 field and operation whose your function is to voew? the soil in fuerest, and terrilizer applications are not included in tillinge pr field cultivator, vertical tillage, and disk operations.

March 26, 2019

farmdoc daily (9): 5.

### **The Business Case** for Conservation

A program of the

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Growers Association



Data



farmdocDAILY

Department of Agricultural and Consumer Eco Iniversity of Illinoi

Laura Gentr epartment of Natural Resources and En

Overall returns on Illinois grain farms are projected to be much lower in 2019 to

Overall returns on illinois grain farms are projected to be much lower in 2019 tr in more consumer about managing input costs. Fertilizer, seed, and prediction portion of the total cost dividuality farmitiand in central lilinois. This article wan pre-are costs on high-productivity farmitiand in central lilinois of mitiger applications used to the introgen applications used. Precision Conservation Management (PCM) nitrogen applications used to comparable of preater operator and lend re application. Fields with 40% comparative of preater operator and lend re application. Fields with 40% comparative of preater operator and lend re application. Fields with 40% comparative of total nitrogen application rate and her mostly fail applied nitrogen fields, which is mainly due to the cost of hitrogen average operator and land return below most split applications.

iverage operator and land return below most split applications. Nitrogen timing and application rates can also have important implications Nitrogen timing and application rates can also have important implications for losses from adjorduural fields have boxime a high-profile water quality (issue 2015 illinois Nutrient Loss Reduction Stratign all fields. Nitrate losses from contaminate local dinking water supples, forcing all fields. Nitrate losses from contaminate local dinking water supples, forcing all multicipal water feath her water treatment equipment. Increased nitrate land multicipal water feath the nyoxic zone further downstream in the Guil of Mexico, impairing waters here.

erent Nitrogen Ar

rmalink: https://

University of Illinois November 12, 2019

farmdoc daily (9): 213

mended citation format: Sellars, S., L. Gentry, G. Schnitkey, D. Lattz.

an Application Timing in Illinois." farmdoc daily (9): 213, Depar nomics, University of Illinois at Urbana-Champaign, November

ermalink: https://fr

Weekly Farm Economics: The Economic Advisability of Lowering 2019 Nitrogen Application Rates on Corn

Separtment of Agricultural and Consumer Economics, University of Illinois Urbana-Champe

Gary Schnitke

2015-2019

Data Summary

farmdoc

**The Business Case** 

Cost-Benefit Analysis of Conservation Practices

for Conservation

ent of Agricultural and Consumer Econor University of Illinois

Laura Gentry

University of Illinois

March 19, 2019 farmdoc daily (9): 48 scommended citation format: Schnitkey, G, and L. Gentry, "The Economic Advisability of accommentate cannon rolmat: Schnikkey, G. and L. Gently. The Economic Advisability of Lower Brogen Application Rates on Com." farmdoc daily (9): 48, Department of Agricultural and Consu nomics, University of Illinois at Urbana-Champaign, March 19, 2019.

spring field operations will soon begin, and nitrogen applications on corn will commence. More nitrogen Spring field operations will scoth bagin, and nitrogen applications on corn will commence. More nitrogen will be applied this spring than is price at the scale we weather timited fail applications. University-necommended nitrogen applications is in timitors are between 140 and and of actual nitrogen per arcs for corn-following-objecture fails minor applying above those rates punded of actual nitrogen applications of the scale of the scale

Two economic factors suggest urgency in lowering nitrogen rates this year. First, net incomes on Illinois Twe economic factors suggest urgency in lowering nitrogen rates this year. First, not incomes on Illinois farms could be extramited by low in 2019. Projections indicate average income on grain farms enrolled in Illinois Farm Business First exceptional (see farméc das)(300 per farm if prices maintain in ourrent levies and yeadorm Haspin collecting consistent in Jamary 15, 2019). This average income would be the lowest since prot exceptional (see farméc das) for the service service in higher yields or higher prices could result in higher incomes, it seems more reasonable to expect very low incomes in 2019. Given these low incomes, reducing costs is crucial, particularly if those costs do not increase revenue.

Second, nitrogen fartilizer prices in 2019 have been increasing and will be above levels of the last three years (see Figure 1). On March 14th, the Agricultural Marketing Genrice (AMS) — an agency of the U.S. peramment of Agriculture — reported an average anlydrous more aprice in Minols (4515 the U.S. which is \$97 per ton above the 2016 March average price of \$516 per ton. The 2019 price also is above

Why Consider Lowering Nitrogen Application Rates in 2019?

Department of Natural Resources and Environmental Sciences

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## **Pushing the Data**

**Practice Comparisons** 

**Profitability Analyses** 

**Greenhouse Gas Emissions** 

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Q1

Q2

Q3

How do you expect per acre nitrogen rates used by Illinois farmers to change in the next five year?

- I expect nitrogen rates to decrease
- I expect per acre nitrogen rates to remain the same
- O I expect per acre nitrogen rates to increase
- O I don't know





## Nitrogen: Applications at (Maximum Return to Nitrogen) MRTN Rates Have Highest Returns

## Nitrogen Recommendations



### Table 1. Maximum Return to Nitrogen (MRTN) Rates in Pounds of N Applied, 2019<sup>1,2</sup>

_	Corn-followin	ig-soybeans	Corn-follo	wing-corn
		28%		28%
	Anhydrous	Nitrogen	Anhydrous	Nitrogen
Region of Illinois	Ammonia	Solution	Ammonia	Solution
	lbs./acre	lbs/acre	lbs/acre	lbs/acre
North	157	144	200	186
Central	174	163	200	188
South	180	166	193	180

<sup>1</sup> Taken from the Corn Nitrogen Rate Calculator (http://cnrc.agron.iastate.edu/) on March 18, 2019.

<sup>2</sup> MRTNs determined with a \$3.70 corn price, \$615 anhydrous ammonia price, and a \$280 nitrogen solution price.

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### Nitrogen Applications and Yields, 2015 to 2019



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### Nitrogen Applications and Yields, PCM, By Year





Nitrogen Application (Actual Pounds of N)

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## **Divide Field Observations into Categories**

			Year		
Category	Description	All Years	2016	2019	
Below MRTN		5%	5%	7%	
MRTN	20 lbs +/- MRTN	28%	25%	38%	
Above 1	1 to 20 lbs. above	34%	33%	31%	
Above 2	21 to 40 lbs. above	22%	25%	17%	
Above 3	41 to 60 lbs. above	8%	8%	5%	
Above 4	> 60 lbs. above	3%	4%	2%	

Paper by Sellers, Schnitkey, and Gentry, "Do Illinois Farmer Follow University-Based Nitrogen Recommendations", Select Paper at AAEA

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## Yield by MRTN Nitrogen Categories

	All	Year						
Category	Years	2016	2017	2018	2019			
		Bu per acre						
<b>Below MRTN</b>	-16*	-39*	-3*	-14*	-24*			
MRTN								
Above 1	-1	12	-7*	-1	1			
Above 2	6*	16*	-1	12*	7*			
Above 3	7*	23*	4	10*	9*			
Above 4	18*	44	25*	14*	12			

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## **Returns by MRTN Nitrogen Categories**

	All	Year			
Category	Years	2016	2017	2018	2019
			\$ per acre		
Below MRTN	-16	-100	12	-4	-32*
MRTN					
Above 1	-20*	26	-32*	-28*	-23*
Above 2	<b>-21</b> *	17	-39*	-7	-33*
Above 3	-31*	19	-35*	-32*	-31*
Above 4	-31*	78	0	-54*	-38*

\* Indicates significant different at 5% levels from MRTN category controlling for soil productivity Return is measured by Operator and Land Return

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## **Nitrogen Applications**

Nitrogen applications at MRTN rates (below 200 pounds of N) have statistically higher returns than higher application rates

For 2021, lowering rates will have return/financial implications





## Tillage & Profitability: Corn & Soybean

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## Corn Returns by Tillage Benchmark, 2016 to 2019

Tillage Benchmark	Yield Bu/Acre	Power Costs \$/Acre	Return \$/Acre
No-Till	209	\$96	\$229
Strip-Till	219	\$114	\$243
1-pass Light	220	\$106	\$266
2-Pass Light	224	\$115	\$269
2-Pass Moderate	223	\$118	\$250
2+ Passes	216	\$135	\$180

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### ALL PCM FIELDS 2015-2019

CORN, High SPR	NO-TILL	STRIP TILL		2-PASS LIGHT	2-PASS	2+ TILLAGE
CONN, HIGH SPN	NO-IILL	STRIP TILL	I-PASS LIGITI	2-FA55 LIGITI	MODERATE	PASSES
2015-19 AVG VALUES						
# fields	310	296	710	302	419	46
Yield per acre	209	219	220	224	223	216
Soil Productivity Rating						
GROSS REVENUE	\$750	\$787	\$790	\$804	\$801	\$773
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Other power costs**	\$96	\$93	\$96	\$93	\$92	\$97
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OVERHEAD COSTS	\$37	\$37	\$37	\$37	\$37	\$37
TOTAL NON-LAND COSTS	\$521	\$544	\$524	\$536	\$550	\$594
<b>OPERATOR &amp; LAND RETURN</b>	\$229	\$243	\$266	\$269	\$250	\$180

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### Top 25% Most Profitable Corn, High SPR Tillage, 2015-2019





### Soybean Returns by Tillage Benchmark, 2016 to 2019

Tillage Benchmark	Yield Bu/Acre	Power Costs \$/Acre	Return \$/Acre
No-Till	67	\$72	\$368
1-pass Light	70	\$83	\$387
2-pass Light	69	\$87	\$392
2-Pass Moderate	72	\$84	\$384
2+ Passes	68	\$108	\$357

Return is operator and land return which equals gross revenue minus non-land costs

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## **Tillage & Profitability: Soybean** Top 25% Most Profitable for 2015-2019



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### "Moderate" tillage levels have higher returns than more tillage

Consider when have to make machinery replacement decisions





In four years, how many acres will be in cover crops in Illinois?

- O Less than in 2020
- O About the same in 2020
- $\odot$  I expect cover crops to grow about 10 to 20%
- I expect cover corps to grow by more than 20%





## Cover Crops: Lessons for New Adopters

Need to "experiment" with cover crops

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## Cover Crop Benchmarks (2016 to 2019)

	Soybeans			Corn			
Cover crop	Yield Bu/Acre	Non-land Costs \$/Acre	Return \$/Acre	Yield Bu/Acre	Non-land Costs \$/Acre	Return \$/Acre	
Overwintering	68	\$280	\$344	215	\$553	\$213	
Winter Terminal	68	\$254	\$371	217	\$522	\$258	
No cover crop	69	\$257	\$388	220	\$536	\$255	
Count	253 overwintering 15 winter terminal 1,780 no cover crop fields			49	)7 overwinterir ) winter termin no cover crop	al	

### ECOSYSTEM SERVICES MARKET CONSORTIUM

Growing resilience in agriculture

ecosystemservicesmarket.org

MISSION: To advance ecosystem service markets that incentivize farmers and ranchers to improve soil health systems that benefit society.

Launch a fully functioning national scale ecosystem services market conceived and designed to sell both carbon and water quality and quantity credits for the agriculture sector by 2022.

\$14 Billion Dollar Industry – Annually

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ILLINOIS FARMERS AND PEPSICO PARTNERED TO REDUCE CO2 EMISSIONS BY 8,155 METRIC TONS IN 2 YEARS





Precision Conservation Management

### PCM-Pepsi Partnership providing cost share for cover crop production



PEPSICO PARTNERSHIP WITH Farmers cutting greenhouse gas

May 6, 2020

In a big win for clean air, corn farmers in Illinois and PepsiCo have documented the ability to cut CO2 emissions, a major greenhouse gas contributor, through the adoption of cover crops and other sustainable farming practices. The partnership with PepsiCo and other large corporations across their supply chain is achieving large reductions in carbon emissions.

mdoc

In the first two years of the corn checkoff-funded project, participating farmers have reduced CO2

### Conclusions: Scenario Analysis

**Cover crops are the best single practice for GHG emissions reductions** 

Pairing cover crops with no-till and N rate reductions can reduce emissions by as much as 171%



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## Summary

- 1. MRTN most profitable nitrogen application rates
- 2. Appropriate tillage levels key to profitability
- 3. Cover crops have potential for returns in the future leading to need to experiment



# Illinois Corn Growers Association

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