CLEMSON UNIVERSITY

New Research: Cover Crops in Sandy Soils

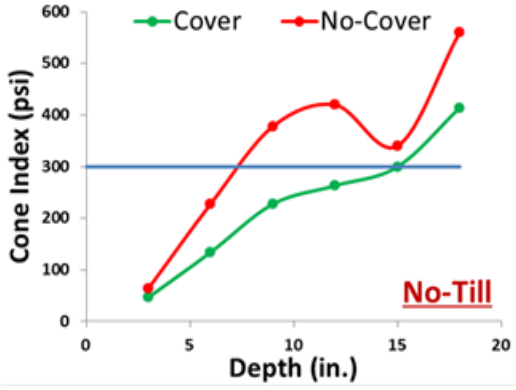
Bhupinder Singh Farmaha
bfarmah@clemson.edu
217-778-5170

Edisto Research and Education Center - Clemson University

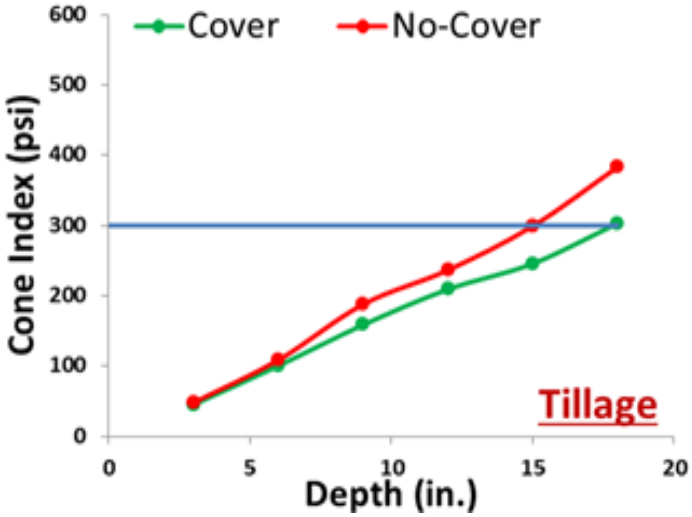
Impact of Covers on Compaction - NT

Effects of Deep-Rooted Cover Crop on Soil Compaction and Crop Productivity

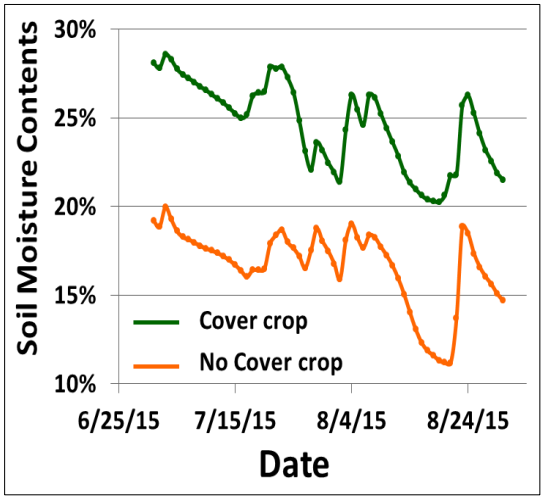
Ahmad Khalilian, Mike Marshall, Jose Payero , Ali Mirzakhani, Phillip Williams



Impact of Covers on Compaction - Till

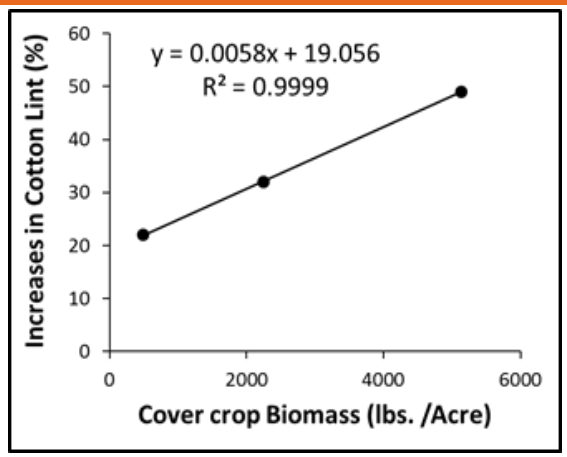


Impact of Covers on Soil Moisture



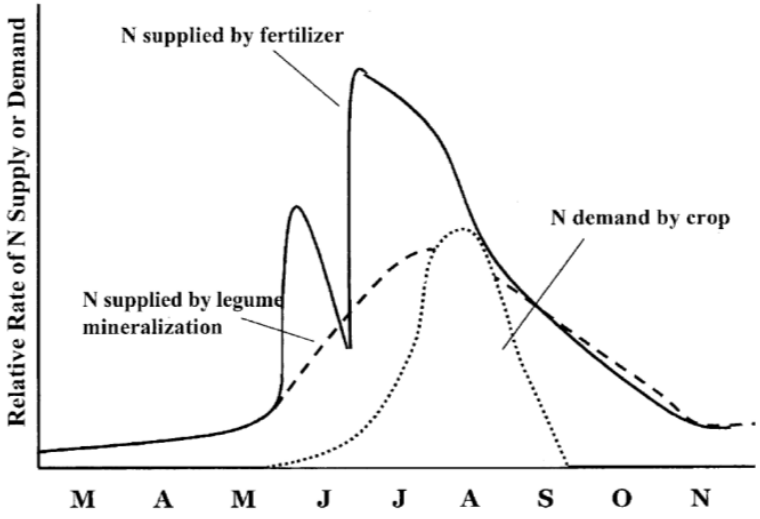
Cover crop increased soil moisture content by about 10 percentage points

Relation Between Cover Crop Biomass and Cotton Lint Yield



There was a strong linear correlation between cover crop biomass and cotton lint yield increase

Cover Crops – N Management



(Crews and Peoples. 2005. Nutrient Cycling in Agroecosystems 72:101-120.)

New Project: 2018-2021

The goal of this project is to diversify cotton-based cropping system with cover crops that reduces fertilizer input costs, increase farm economic profits, and enhance soil health.

Location: Edisto Research Station

Funded by USDA-NRCS

Project Design – Phase 1

- Test fields were selected based on their different yield potential and irrigation regime.
- Planted different mix of cover crops in long strips with a grain drill
- Planted: One field on 20th Nov. and other on 30th Nov. 2018.

Project Design – Phase 1

Treatment	Cover crop species
1.	Cereal rye
2.	Cereal rye + Hairy vetch
3.	Cereal rye + Hairy vetch + Crimson clover + Daikon radishes
4.	No covers

Project Design – Phase 2

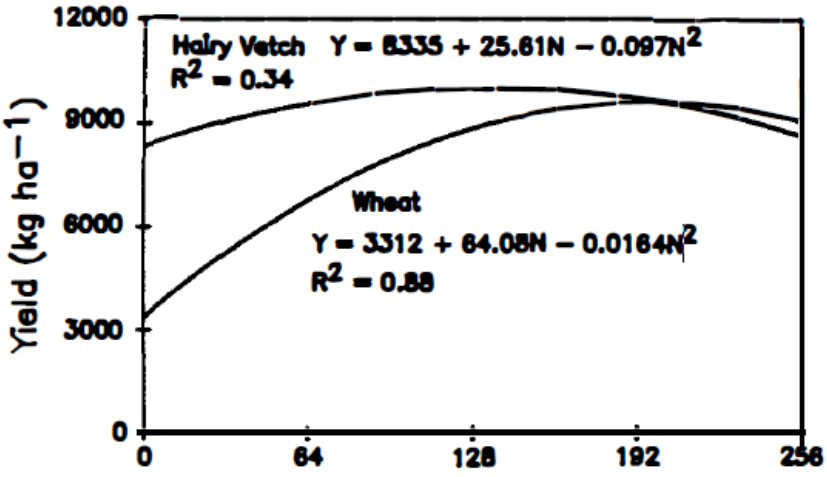
Establish different N and K rate in cotton during 2019 and 2020 growing seasons.

K3		N1		K3		N1	
K2		N2		K2		N2	
K1		N3		K1		N3	
N5		N4		N5		N4	
N4		N5		N4		N5	
N3		K1		N3		K1	
N2		K2		N2		K2	
N1		K3		N1		K3	

Objectives

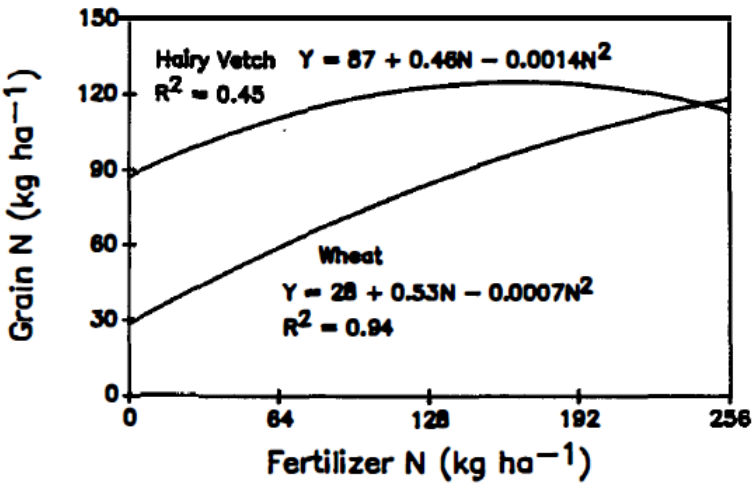
1) Quantify the impact of cover crops *versus* no cover crop and its interaction with soil types in different environments on yield, input use efficiency etc…
2) Quantify temporal changes in soil water content and soil nutrient test levels.
3) Evaluate the economic returns of cover crop farming systems versus no cover crop farming systems.
4) Dissemination of project findings to producers, crop advisors, extension agents, and peer professionals.

Corn Yield as a Function of N rate



Source: McVay et. al., 1989

Grain N as a Function of N rate



Source: McVay et. al., 1989

Rationale

- **Different studies have shown that winter cover crop species like hairy vetch and crimson clover can fix nitrogen which can be taken up by the cash crop planted next. Hairy vetch (*Vicia vilosa* Roth.) can fix 50-100 kg N/ha/crop (Brady and Weil, 2002).**

- **Legume or non-legume CCs can have positive implications in terms of N management for the subsequent row crop.**

Seed Costs

Trt#	Species	Seeding rate (lbs/ac)	Cost/species	Cost/treatment
1.	Cereal rye	75	$22.50	$22.50
2.	Cereal rye	40	$12.00	
	Hairy vetch	5	$10.00	$22.00
3.	Cereal rye	30	$9.00	
	Hairy vetch	3	$6.00	
	Crimson clover	4	$4.80	
	Daikon radishes	3	$4.50	$24.30

Cereal Rye: $15/bag; Hairy Vetch: $100/bag; Crimson clover: $60/bag; Radishes: $75/bag; One Bag = 50 lb

Soil C, Total N, and C:N Ratios At Two Sites

Cover crops	Coastal Plain C	Coastal Plain N	Coastal Plain C:N	Limestone Valley C	Limestone Valley N	Limestone Valley C:N
	g kg⁻¹	g kg⁻¹	kg kg⁻¹	g kg⁻¹	g kg⁻¹	kg kg⁻¹
			0–0.5 m			
Fallow	8.5c*	1.0b	8.5	10.1b	1.3	8.1
Wheat	8.9c	1.1b	8.4	11.8a	1.4	8.9
Crimson clover	10.6a	1.3a	7.8	12.8a	1.5	8.4
Hairy vetch	10.2b	1.3a	7.8	11.8a	1.5	7.8
			0.05–0.10 m			
Fallow	7.2	0.9	7.9	8.7b	1.0	8.6a
Wheat	7.3	1.0	7.7	9.5ab	1.2	8.2ab
Crimson clover	7.7	1.0	7.7	10.3a	1.2	8.3ab
Hairy vetch	7.4	1.0	7.5	9.3b	1.2	7.7b
			0.10–0.20 m			
Fallow	6.8	0.9	7.9	7.9b	1.1	7.5
Wheat	6.6	0.9	7.6	9.3a	1.1	8.5
Crimson clover	7.1	0.9	7.6	10.1a	1.2	8.3
Hairy vetch	6.7	0.9	7.6	7.9b	1.1	7.1
			0.20–0.30 m			
Fallow	4.0	0.5	7.6	4.3b	0.7c	6.5
Wheat	3.7	0.5	7.2	5.7a	0.8b	7.0
Crimson clover	4.1	0.6	7.4	5.7a	0.9a	6.4
Hairy vetch	3.7	0.6	6.7	4.4b	0.7c	6.3

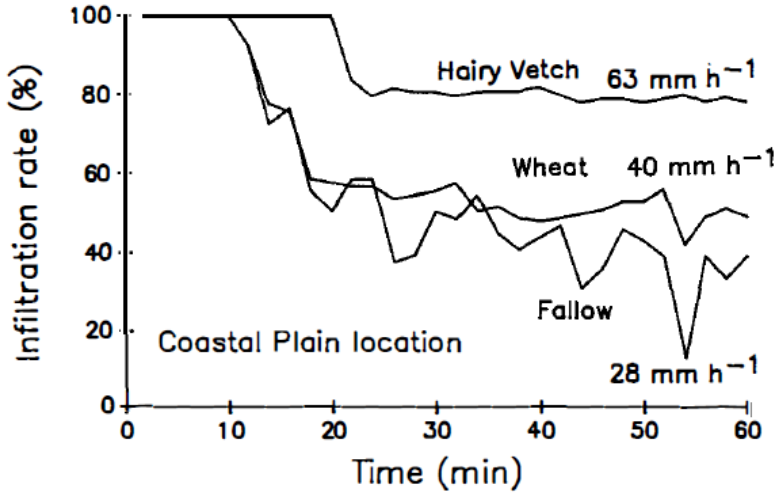
Source: McVay et. al., 1989

Soil C, Total N, and C:N Ratios At Two Sites

Cover crops	Coastal Plain C	Coastal Plain N	Coastal Plain C:N	Limestone Valley C	Limestone Valley N	Limestone Valley C:N
	g kg^{-1}		kg kg^{-1}	g kg^{-1}		kg kg^{-1}
			0–0.5 m			
Fallow	8.5c*	1.0b	8.5	10.1b	1.3	8.1
Wheat	8.9c	1.1b	8.4	11.8a	1.4	8.9
Crimson clover	10.6a	1.3a	7.8	12.8a	1.5	8.4
Hairy vetch	10.2b	1.3a	7.8	11.8a	1.5	7.8
			0.05–0.10 m			
Fallow	7.2	0.9	7.9	8.7b	1.0	8.6a
Wheat	7.3	1.0	7.7	9.5ab	1.2	8.2ab
Crimson clover	7.7	1.0	7.7	10.3a	1.2	8.3ab
Hairy vetch	7.4	1.0	7.5	9.3b	1.2	7.7b
			0.10–0.20 m			
Fallow	6.8	0.9	7.9	7.9b	1.1	7.5
Wheat	6.6	0.9	7.6	9.3a	1.1	8.5
Crimson clover	7.1	0.9	7.6	10.1a	1.2	8.3
Hairy vetch	6.7	0.9	7.6	7.9b	1.1	7.1
			0.20–0.30 m			
Fallow	4.0	0.5	7.6	4.3b	0.7c	6.5
Wheat	3.7	0.5	7.2	5.7a	0.8b	7.0
Crimson clover	4.1	0.6	7.4	5.7a	0.9a	6.4
Hairy vetch	3.7	0.6	6.7	4.4b	0.7c	6.3

Source: McVay et. al., 1989

Infiltration Rate Under Three Scenarios



Source: McVay et. al., 1989

Water-Stable Aggregates

Table 7. Percentage of water-stable aggregates >250 μm in the 0- to 0.025-m depth at the Limestone Valley and Coastal Plain locations.

Cover crop	Stable aggregates	
	Limestone Valley	Coastal Plain
	% by weight	
Crimson clover	55.0	37.9a*
Hairy vetch	58.2	36.7a
Wheat	65.1	32.6ab
Fallow	56.3	28.9b

Source: McVay et. al., 1989

Cumulative Annual NO_3 Load of Drainage Water

Year	Control	Oat	Rye	Average
2006	36.0a	21.6ab	9b	22.2C
2007	66.9a	42.9a	34.6a	48.1A
2008	62.8a	33.3a	36.6a	44.2A
2009	28.9a	17.4a	19a	21.7C
2010	34.9a	24.3a	21.9a	27B
Average	45.9a	27.9a	24.2a	

Source: Kasper et. al., 2012

Recent Pictures From the Trial

Recent Pictures From the Trial

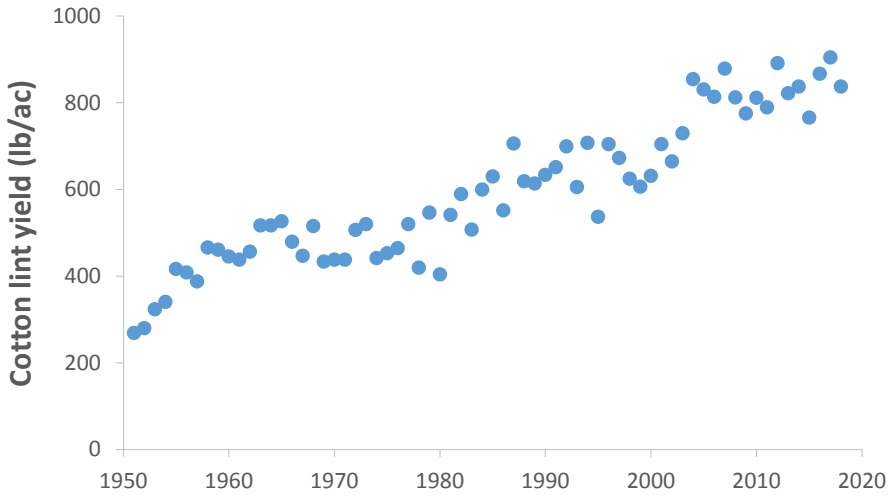
Recent Pictures From the Trial

Recent Pictures From the Trial

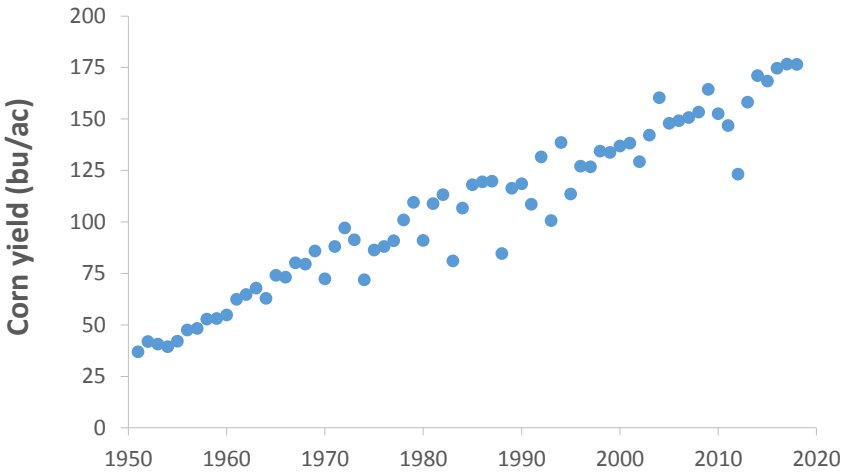
Recent Pictures From the Trial

Recent Pictures From the Trial

Cotton Lint Yields Across Time

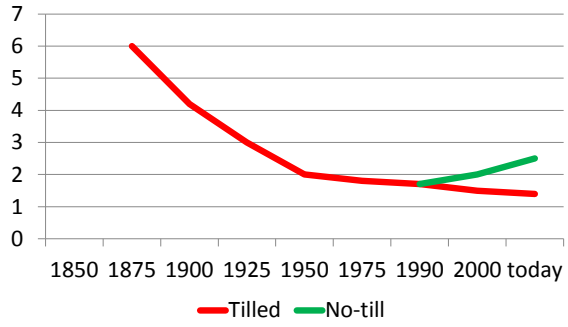


Corn Yields Across Time



Why is Soil Health Important?

Mining Organic Matter Is Not An Option!



Each 1% of O.M. contains:
10,000 lbs. of C
1000 lbs. of N
100 lbs. of P
100 lbs. of S
14,000 gallons of H_2O

Morrow plots, Champaign, IL

Selection of Cover Crops

- What is your cash crop?
- What are your desired benefits?
- What are your growing conditions?
- What is your experience level?

Selection of Cover Crops

What are your desired benefits?

Nitrogen

Crimson clover or hairy vetch

Reducing weed pressure

Rye/black oats, triticale or wheat

-Water conservation

Rye/oats, triticale or wheat

Planting Cover Crops

- Planting dates
- Planting method
- Seeding rates
- Pest control

President Franklin D. Roosevelt……

A nation that destroys its soils destroys itself.

Thanks!!!
Questions?