Cover Crop Use in Semi-Arid Regions

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Lubbock and Vernon

Cover Crops in Semi-Arid Texas

- **Mixed reports on cover crop success in cotton systems within Texas Rolling Plains and Southern High Plains**
- **Introduction of USDA-NRCS Soil Health Initiative and cost share programs for cover crops have sparked interest**
- **Cover crops are promoted to build soil health through diversity and C inputs**
- **Soil moisture use is a major concern**
- **Can a good crop rotation program provide similar or better results than cover crop system?**

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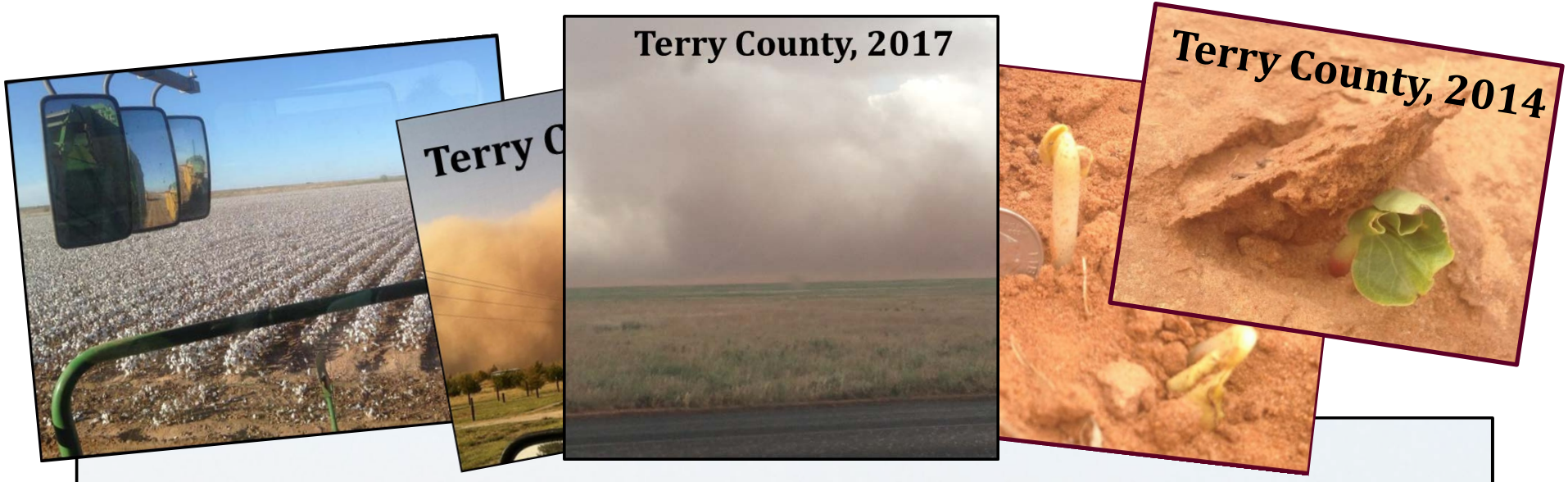

Conservation Practices in Texas' Rolling & High Plains

(crop rotation, cover crops, reduced tillage)

Increases soil organic matter (SOM)
Improves soil structure, reduces crusting
Improves soil water holding capacity
Conserves soil moisture and groundwater
Reduces soil erosion

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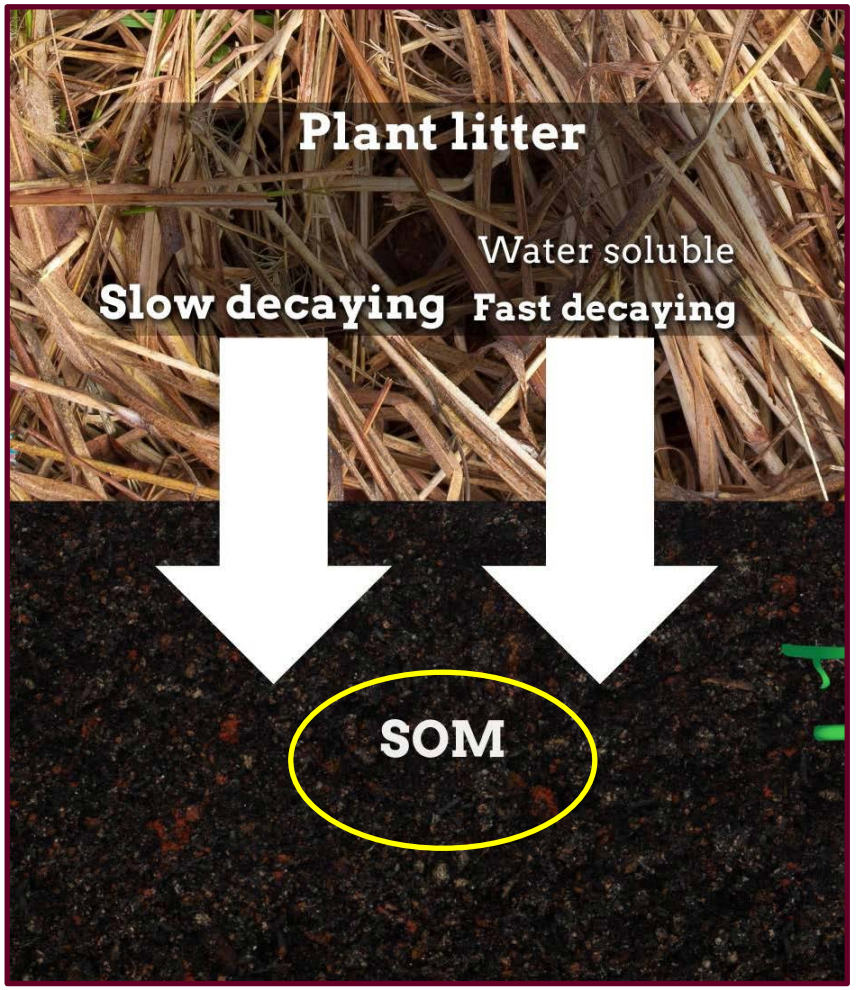
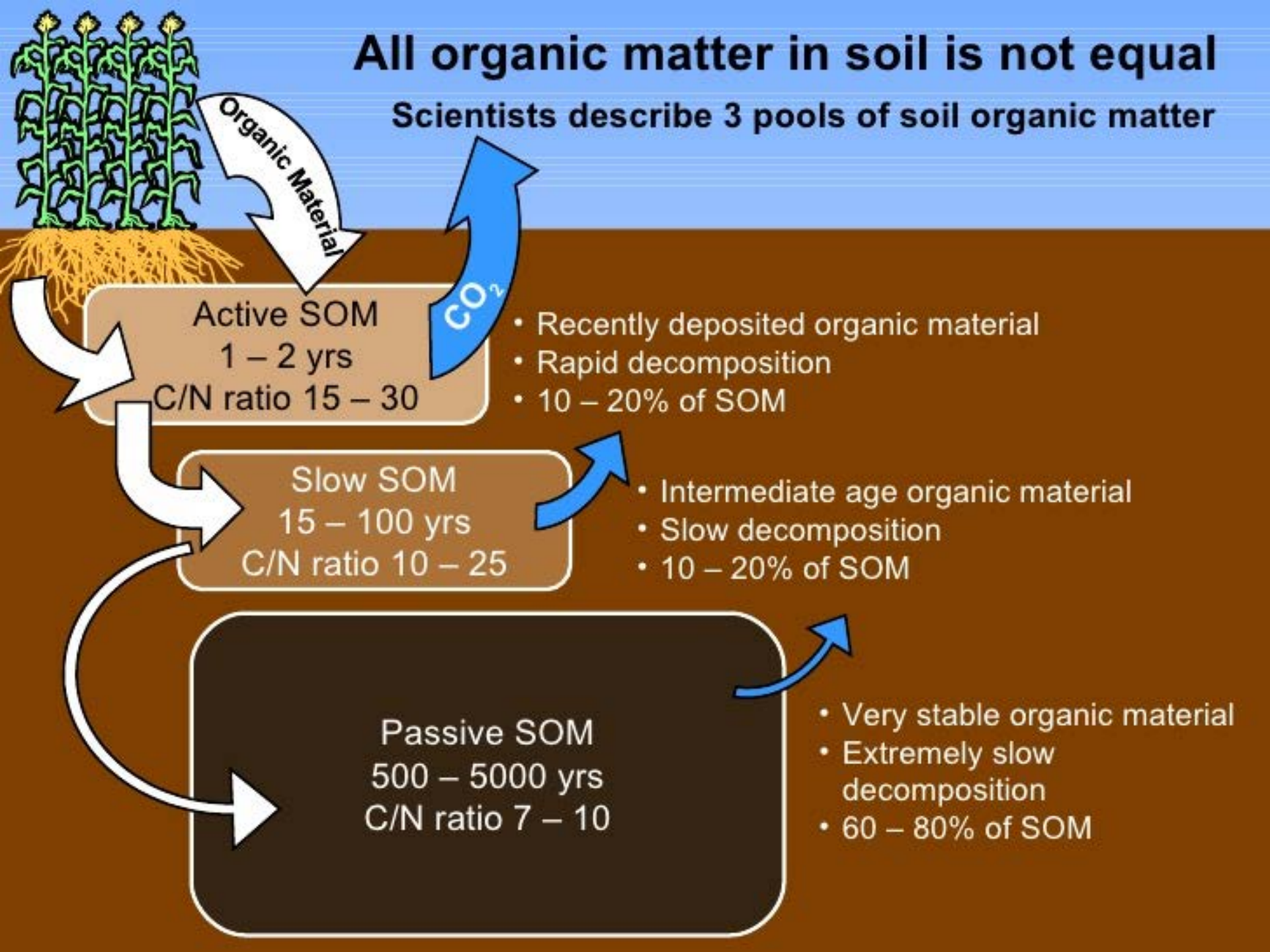
Soil Organic Matter

What is it??



All organic matter in soil is not equal

Scientists describe 3 pools of soil organic matter



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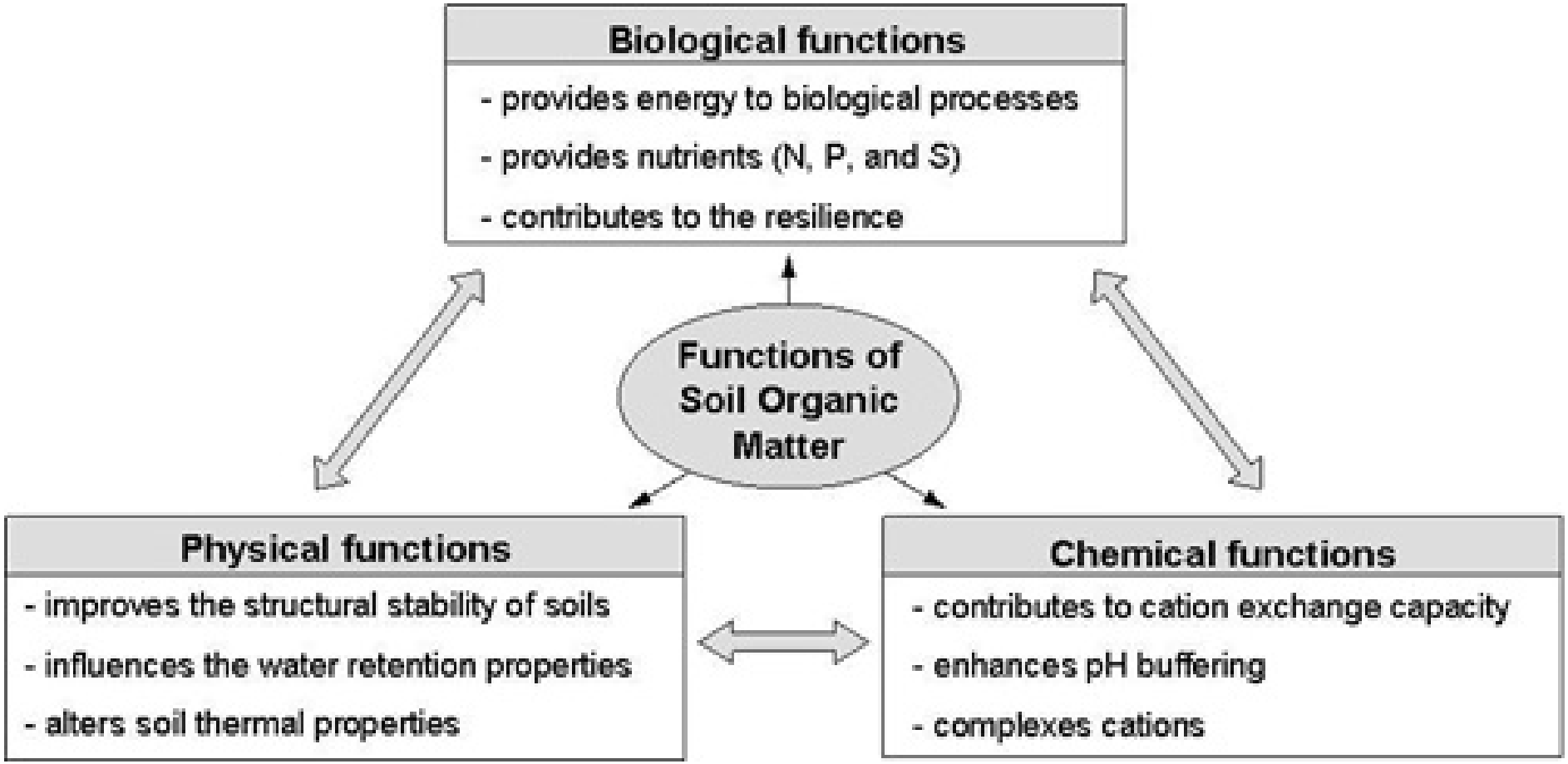
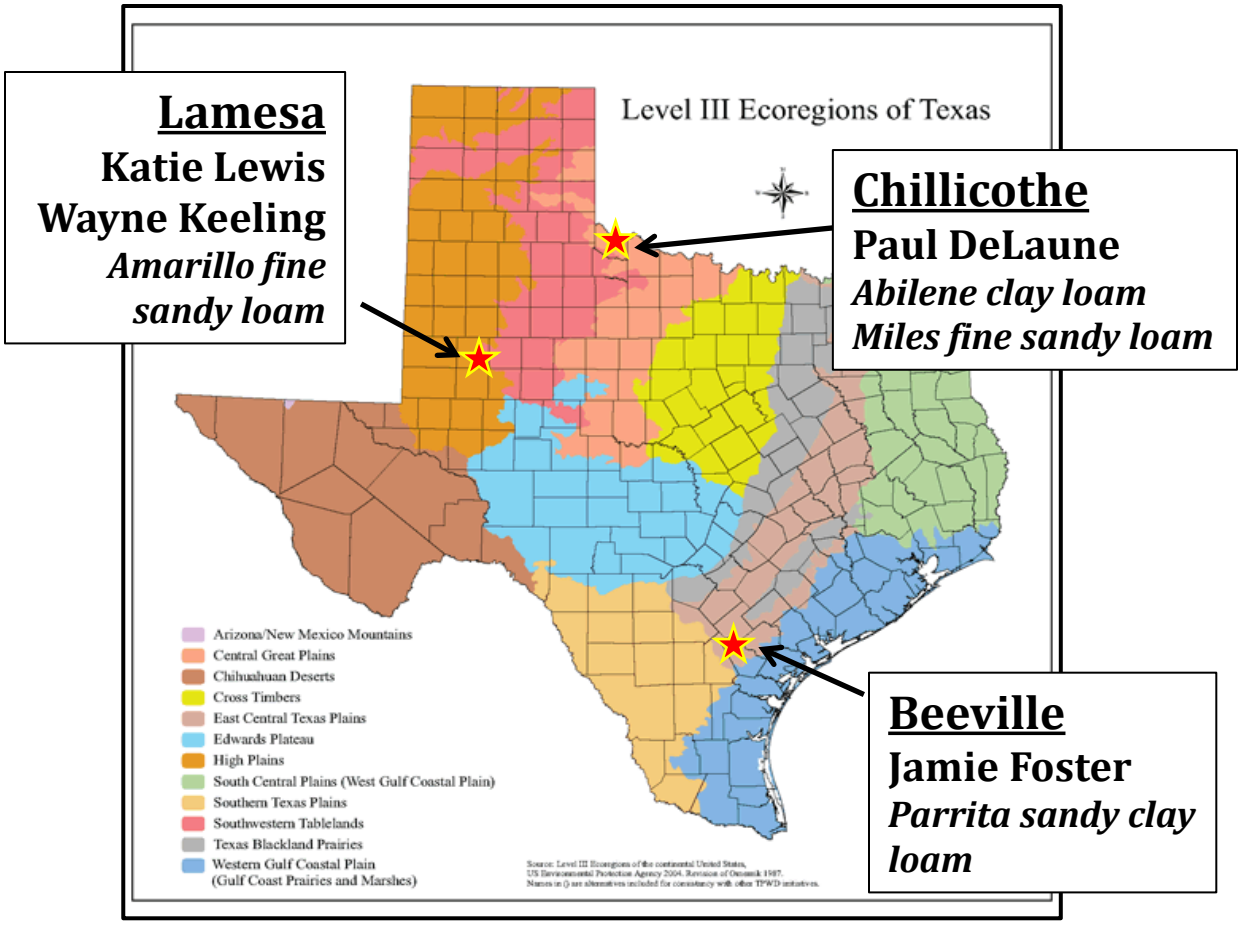
Soil Organic Matter



NRCS-CIG Project (2015 – 2017)

Demonstrate and quantify the impact of conservation tillage and cover cropping on soil carbon, soil health and soil water holding capacity and subsequent yield of deficit-irrigated cotton production.



Lamesa
Katie Lewis
Wayne Keeling
Amarillo fine sandy loam

Chillicothe
Paul DeLaune
Abilene clay loam
Miles fine sandy loam

Beeville
Jamie Foster
Parrita sandy clay loam

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Methods

Tillage and cover crop effects on:

- Soil organic C
- Soil health score
- Soil water storage
- Cotton yield

Treatments

Conventional tillage*

No-till, rye cover*

No-till, mixed cover**

*Since 1998

**No-till since 1998, mixed cover in 2014

Methods

C: conventional tillage, no cover
R: rye cover, no-till
M: mixed cover, no-till

Location
Agricultural Complex for Advanced Research and Extension Systems, Lamesa, TX

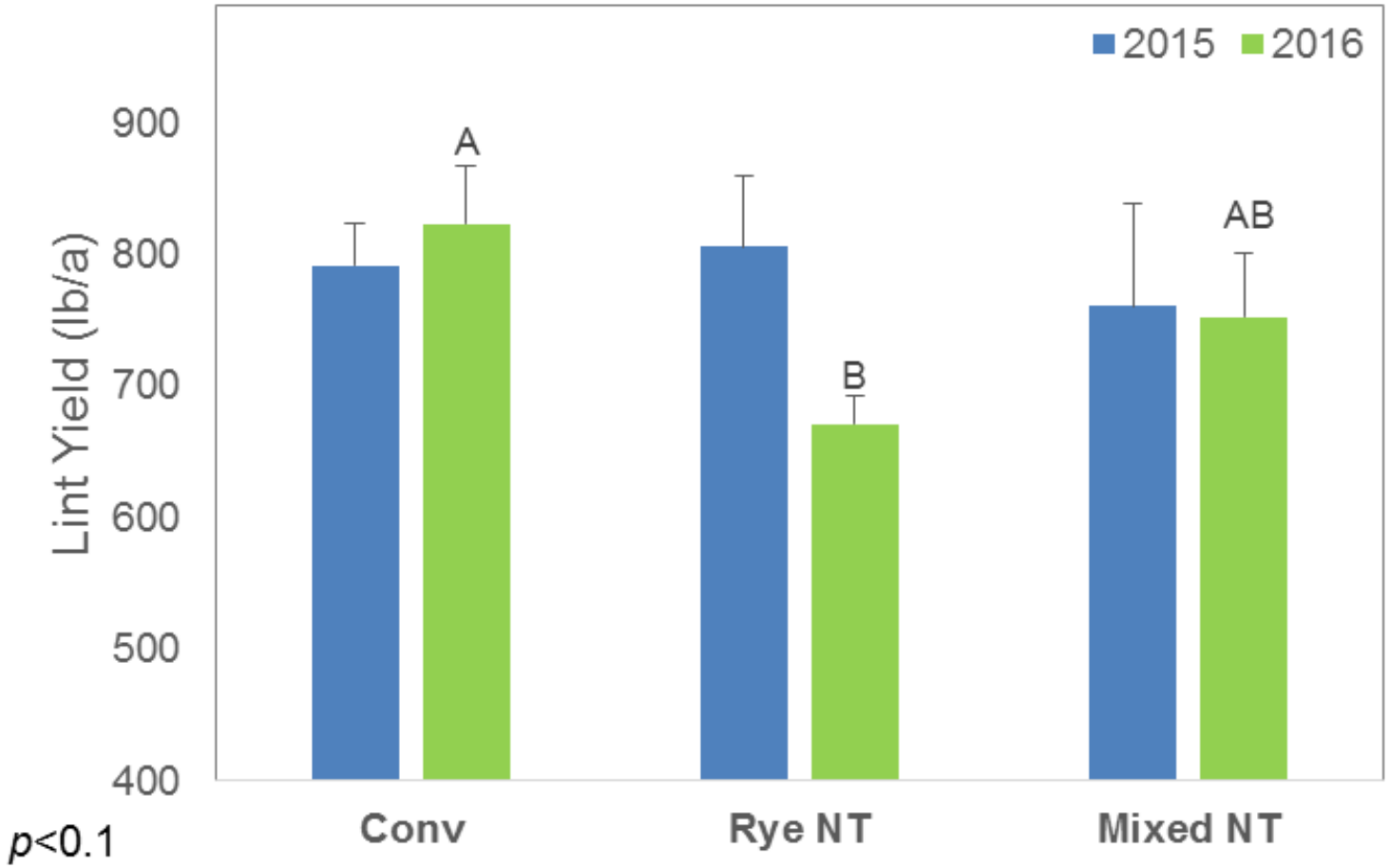
Demonstration Plots
Rye cover crop and no-till initiated in 1998
3 plots per treatment
Plots are 16 rows by 76 m

Deficit Irrigation
Low energy precision application (LEPA)

Cover crop – *30 lb/acre; chemically terminated*
Rye vs Mixed
(50% rye, 33% winter pea, 10% hairy vetch, 7% radish)

Cotton – *DP 1321 B2RF*

Lint Yield
(DP 1321 B2RF)



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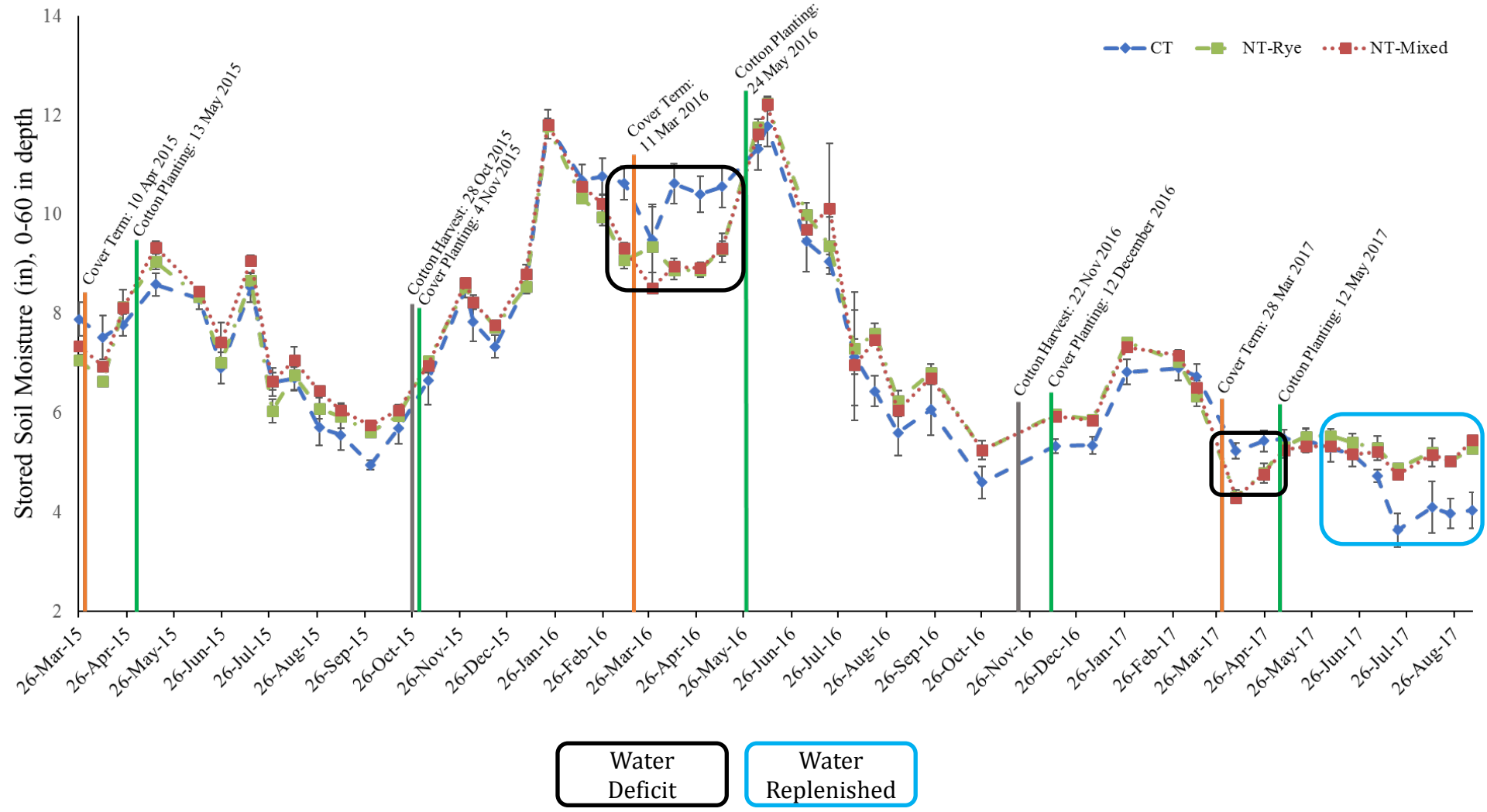
Stored Soil Moisture



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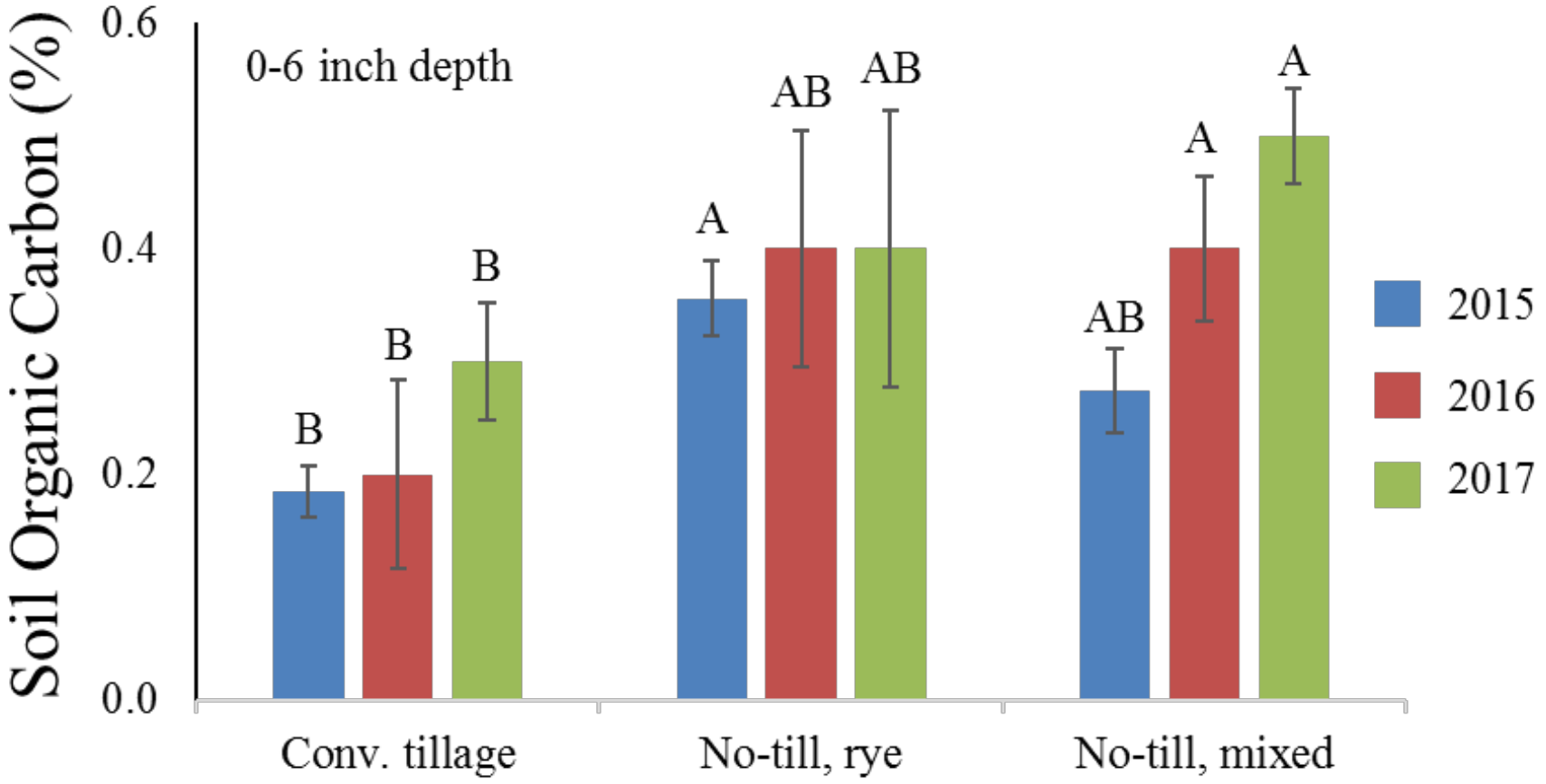
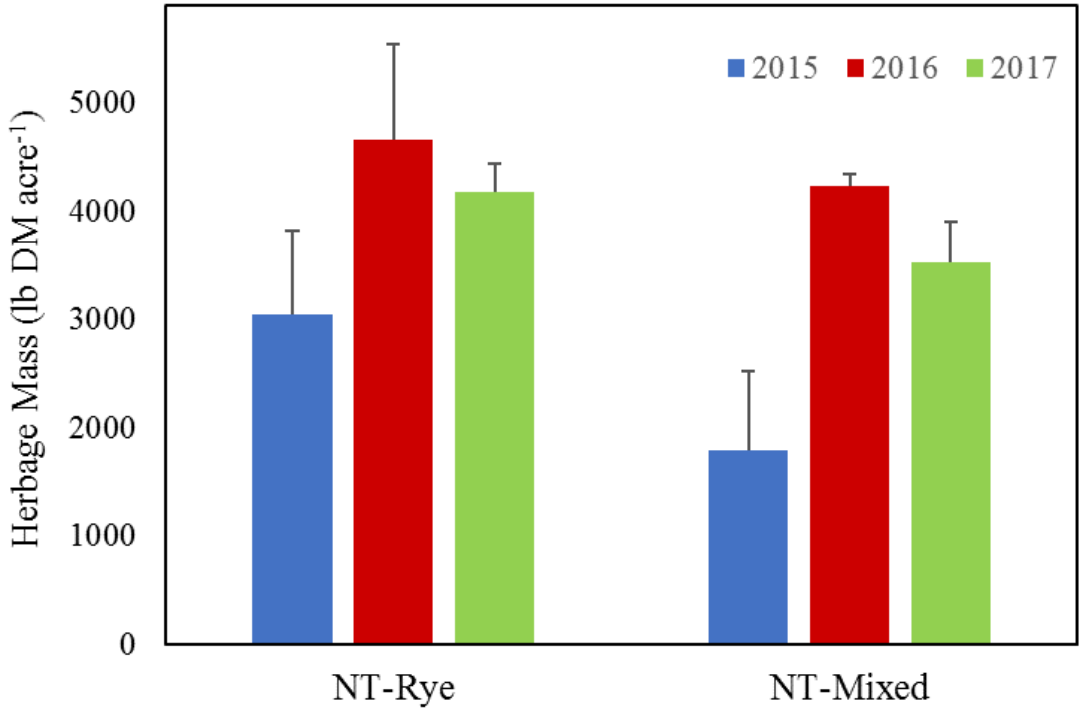
Soil Organic C



Cover Crop Biomass



Rye Cover Mixed Cover

2014 - 2015
Seeded: 2 Dec 2014
Terminated: 26 March 2015

2015 - 2016
Seeded: 4 Nov 2015
Terminated: 10 March 2016

2016 - 2017
Seeded: 12 Dec 2016
Terminated: 28 March 2017

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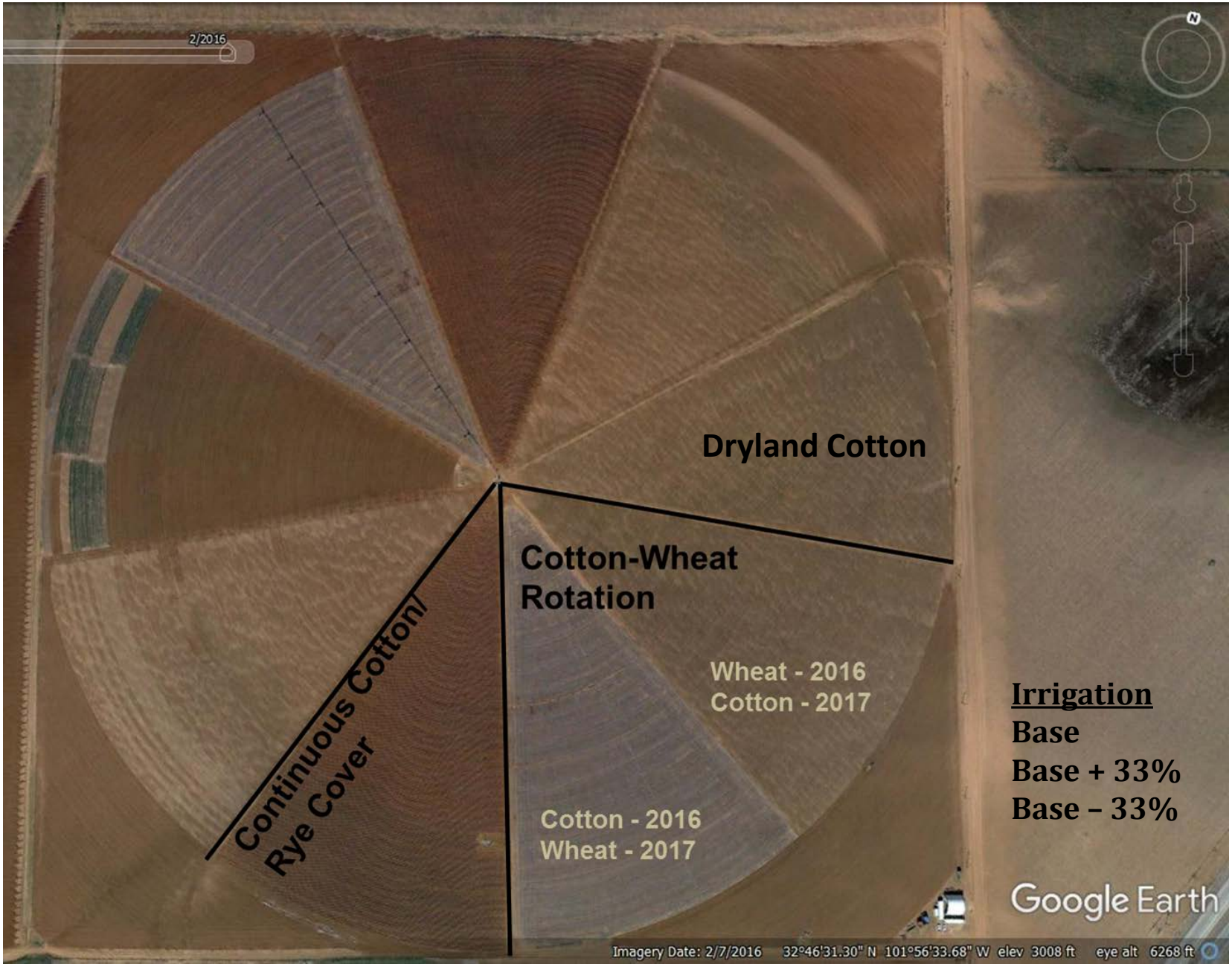
Cover Crop Nitrogen

Year	Cover Crop	Biomass (lb/ac)	N (%)	C:N Ratio	Potential N (lb/ac)
2017	Rye	4,176	2.6	16.7	113
	Mixed	3,529	3.3	13.3	115

	Mineralized N (lb/A)	
% Min	Rye	Mixed
5%	6	6
10%	11	12
20%	23	23
30%	34	35
40%	45	46
50%	57	58

Will N mineralization and availability coincide with cotton demands?

AG-CARES: Rotation vs. Cover



Problem: Not enough water to irrigate the entire 120-acre circle

1) Is a wheat/cotton rotation more profitable than continuous cotton (rye cover)?
2) How does rotation compare to continuous cotton with equal acres of dryland cotton and irrigated cotton?
3) How does irrigation rate effect question 1 and 2?

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2014 – 2015 AG-CARES Continuous Cotton vs Rotation

Cropping System	Irrigation Levels		
	Low	Base	High
	(lbs/A)*		
Wheat – Cotton Rotation	797	881	1176
Continuous Cotton (Rye cover)	580	690	832
% Change with Rotation	+37	+27	+30

*Averaged across 4 varieties

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2016 AG-CARES
Continuous Cotton vs Rotation

Cropping System	Irrigation Levels		
	Low	Base	High
	(lbs/A)*		
Wheat – Cotton Rotation	1104	1227	1351
Continuous Cotton (Rye cover)	674	889	956
% Change with Rotation	+68	+38	+41

*Averaged across 5 varieties

*Completion of 3 years-Economics

Irrigation (LEPA)

Low: 6.6”

Base: 8.1”

High: 9.7”

Summary

- **Long-term continuous cotton w/ cover crop**
  - **Organic C has nearly doubled after 19 yr of rye cover (0.2% to 0.4% OC)**
  - **However, benefits of cover crops to cotton yield have not been consistent – possibly the result of less stored water at planting or N and P immobilization**
- **Crop rotation vs. rye cover**
  - **Cotton/wheat rotation has consistently increased lint yields compared to continuous cotton/rye cover**
    - **Pathogens, water, and N**

Cover Crop Research in the Rolling Plains

- Terminated wheat cover crop in cotton since 2008 – Chillicothe Research Station (no-till, conv-till, strip-till)
- Various cover crop species in dryland cotton systems since 2011 – CRS
- Terminated wheat and mixed species cover crops in pivot irrigated cotton since 2012 – CRS
- Terminated mixed species warm season cover crops in wheat systems since 2013 –Wilbarger County
- Terminated mixed species warm season cover crops in wheat systems (Archer, Baylor, and Clay Co.)
- Terminated mixed species cover crops in bermudagrass since fall 2014 – Cooke and Montague Co.
- Wheat and mixed species in SDI cont. cotton & sorghum/cotton rotation since fall 2014 – CRS
- Single species cover vs. mixed cover vs. double crop in wheat (summer 2015)
- Continuous vs. rotation vs. fallow – with & without cover crops

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How we manage cover crops

- We are not trying to produce an award winning crop.
- We do not seed at “full” seeding rates (not trying to match what we see in a farm magazine).
- We do not fertilize cover crops.
- With the exception of one year under a pivot during exceptional drought, we have not irrigated cover crops.
- We do not apply in-season herbicides to cover crops, only burndown prior to planting and to terminate. We have applied insecticide to summer cover crops.
- Hope to keep management as low as possible.

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Dryland Cotton

- No-Till without a cover
- Conventional Till without a cover (bedded)
- No-till with cover (2011*)
  - *Austrian winter field pea (35 lb/ac)
  - *Crimson clover (20)
  - *Hairy Vetch (20)
  - *Wheat (30)
  - 2012 Mix (40 lb/c: Rye-10, Wheat-10, Turnip-2, Crimson clover-3, Austrian winter field pea-10, and Hairy vetch-5)
  - 2013-2015 Mix (30 lb/ac)
  - No fertilizer
- Chemically terminate in April

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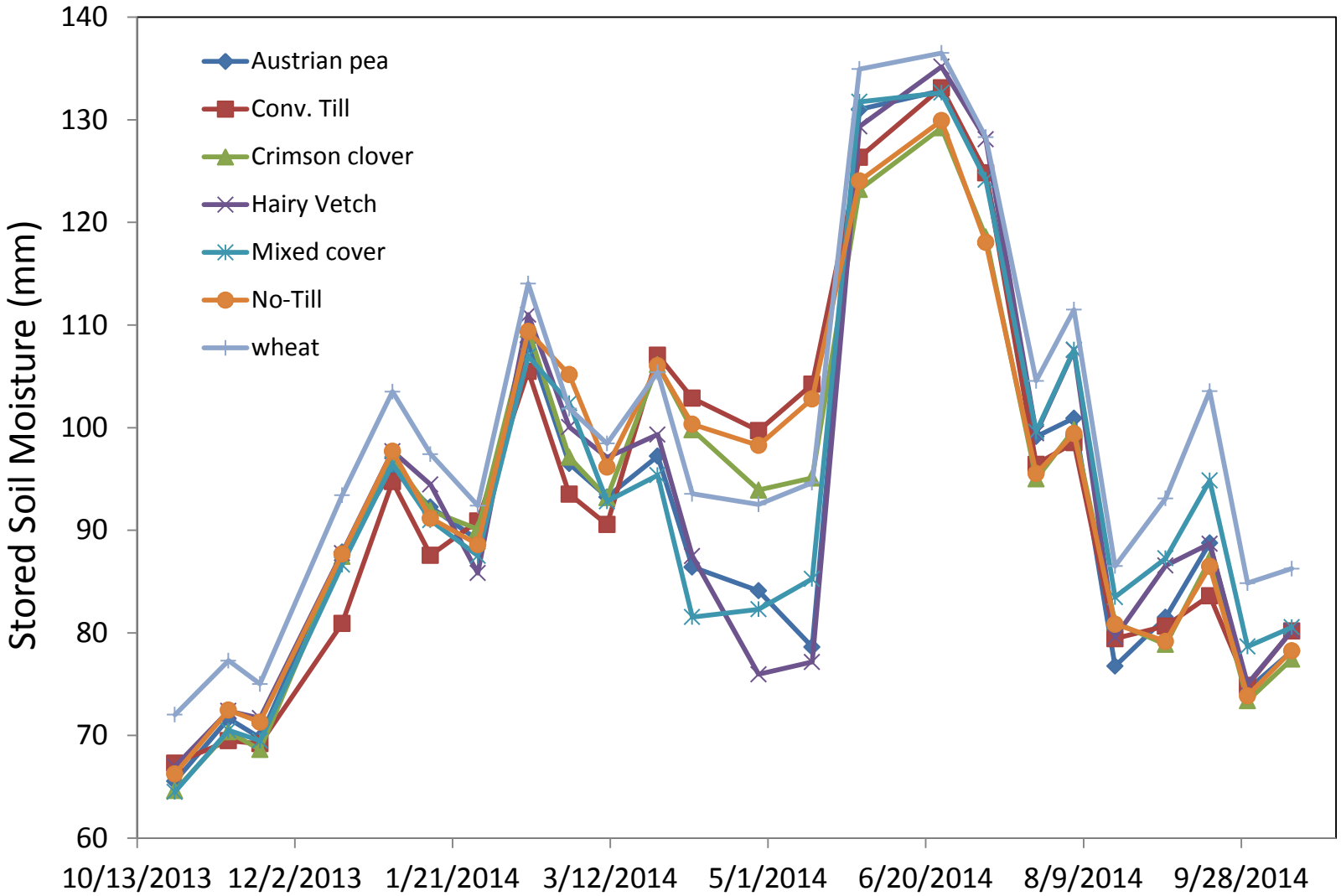
Stored Soil Water in Top 60 cm



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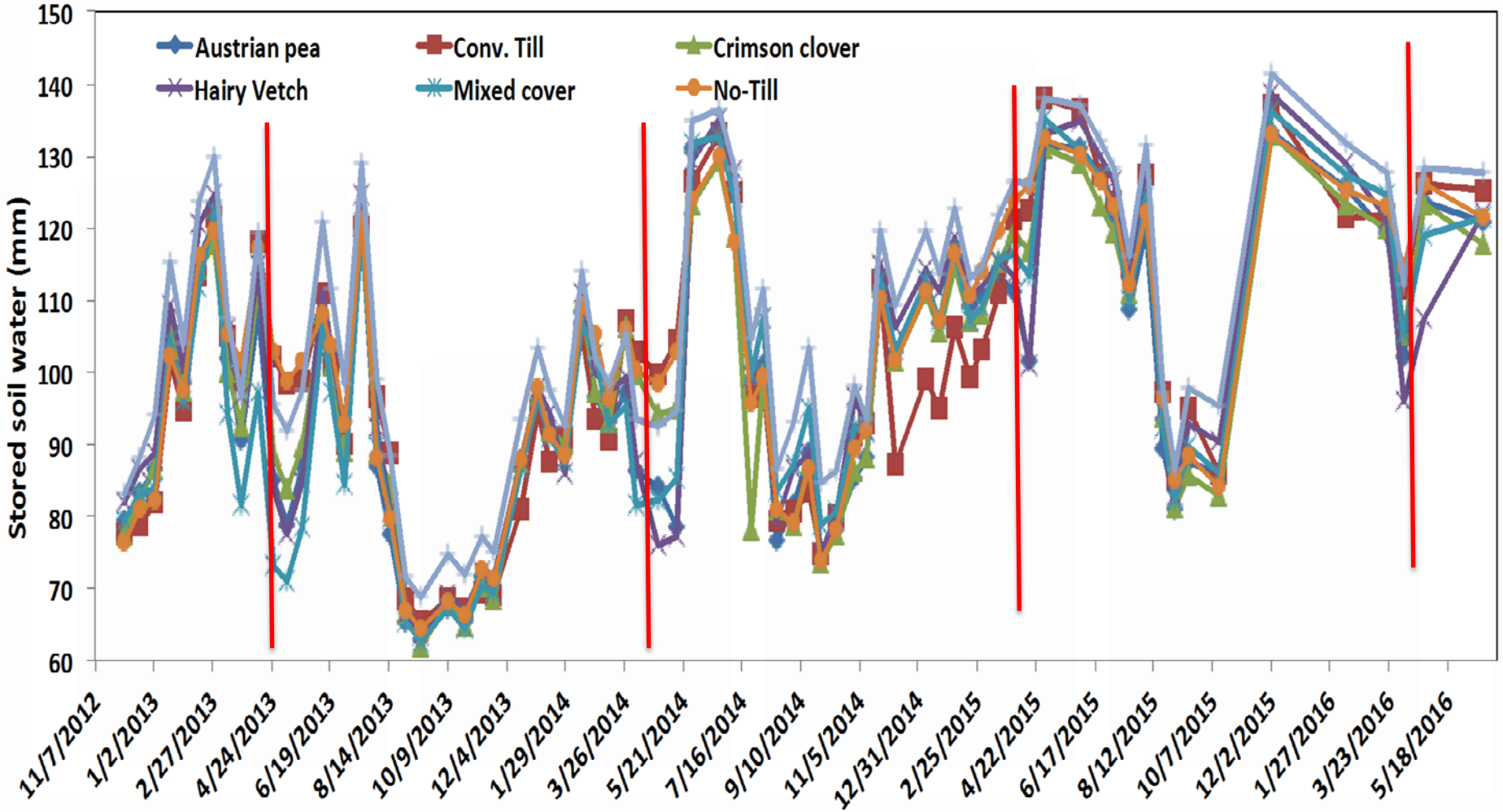
0-60 cm Dryland



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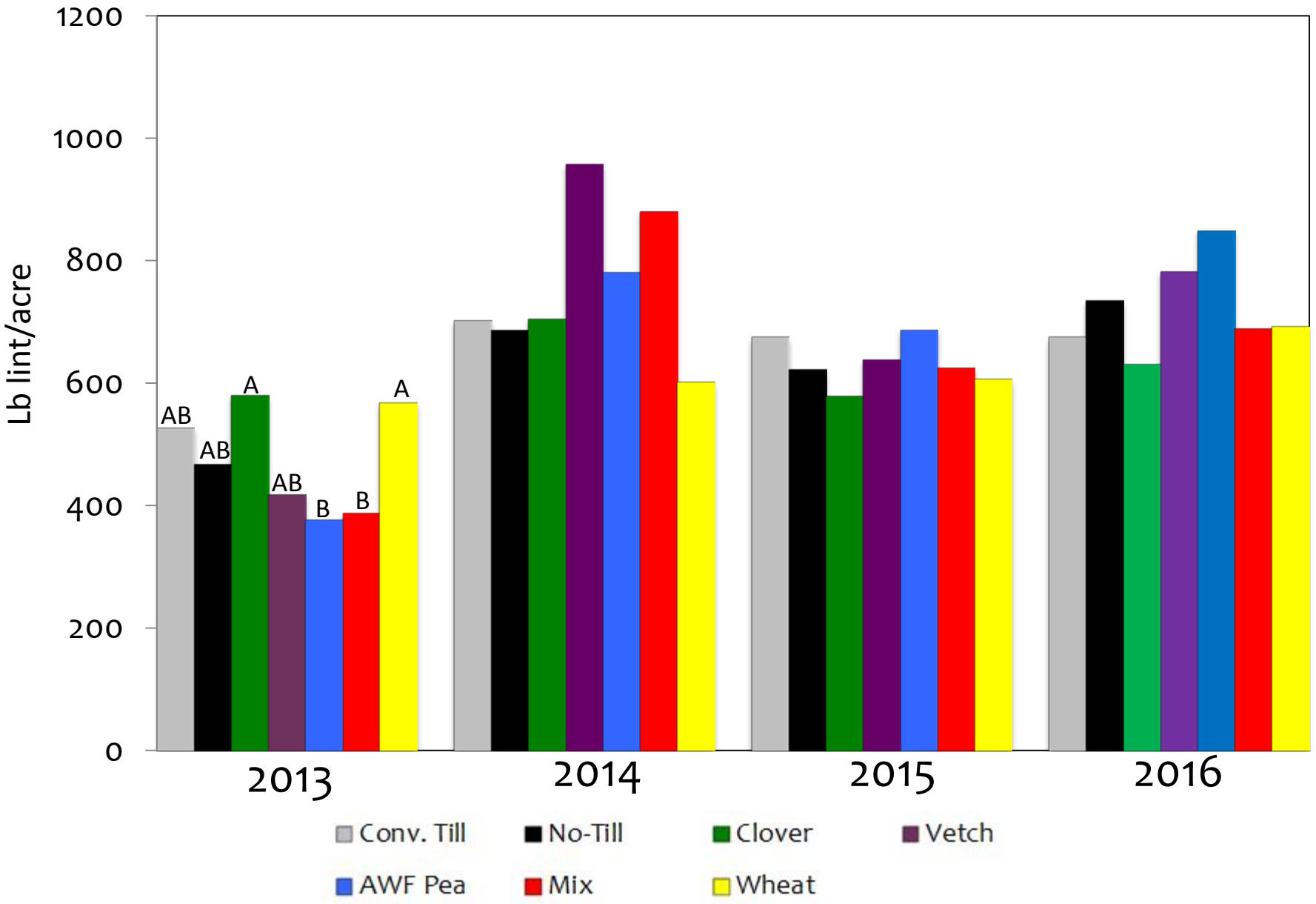
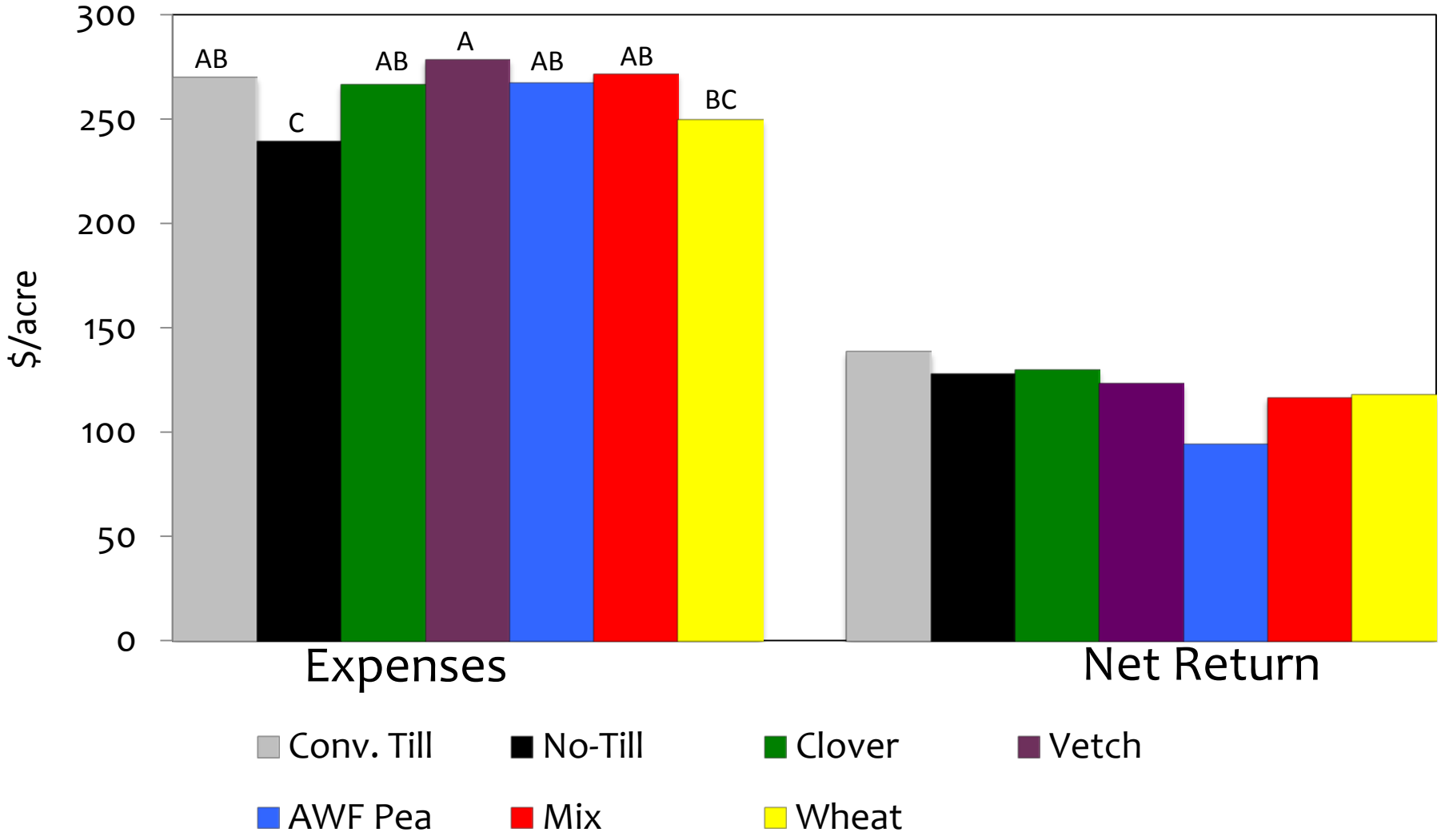
Lint Yield - Dryland



3-Yr Average - Dryland



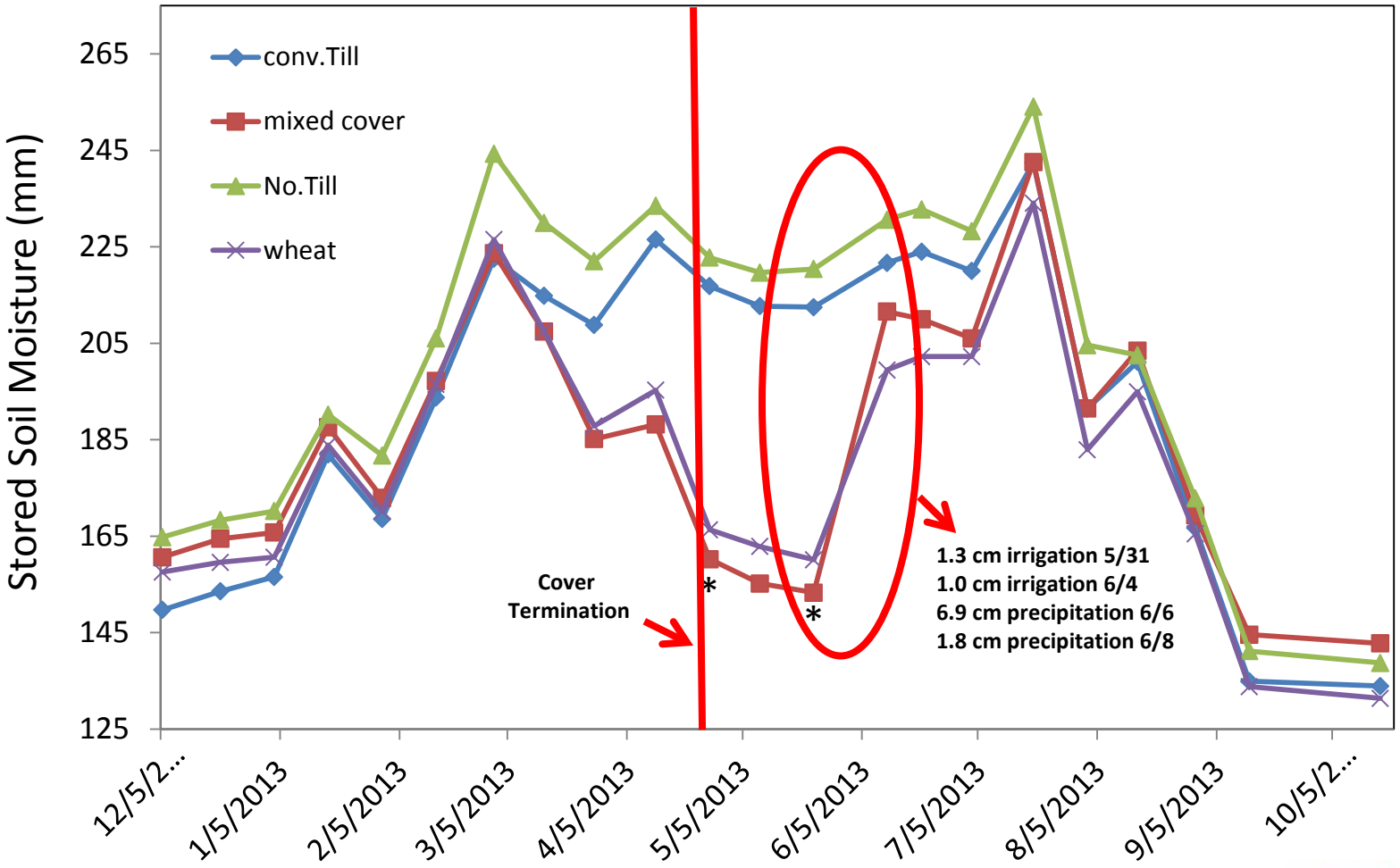
Irrigated Cotton

- No-Till without a cover
- Conventional Till without a cover
- No-till with cover
  - Wheat
  - Mix (40 lb/ac in 2012; 30 lb/ac thereafter)

- 4 Replications per treatment

- LESA Pivot Irrigation, irrigated at
  ≈85% Crop ET Replacement

2013 Stored Soil Water in Top 140 cm



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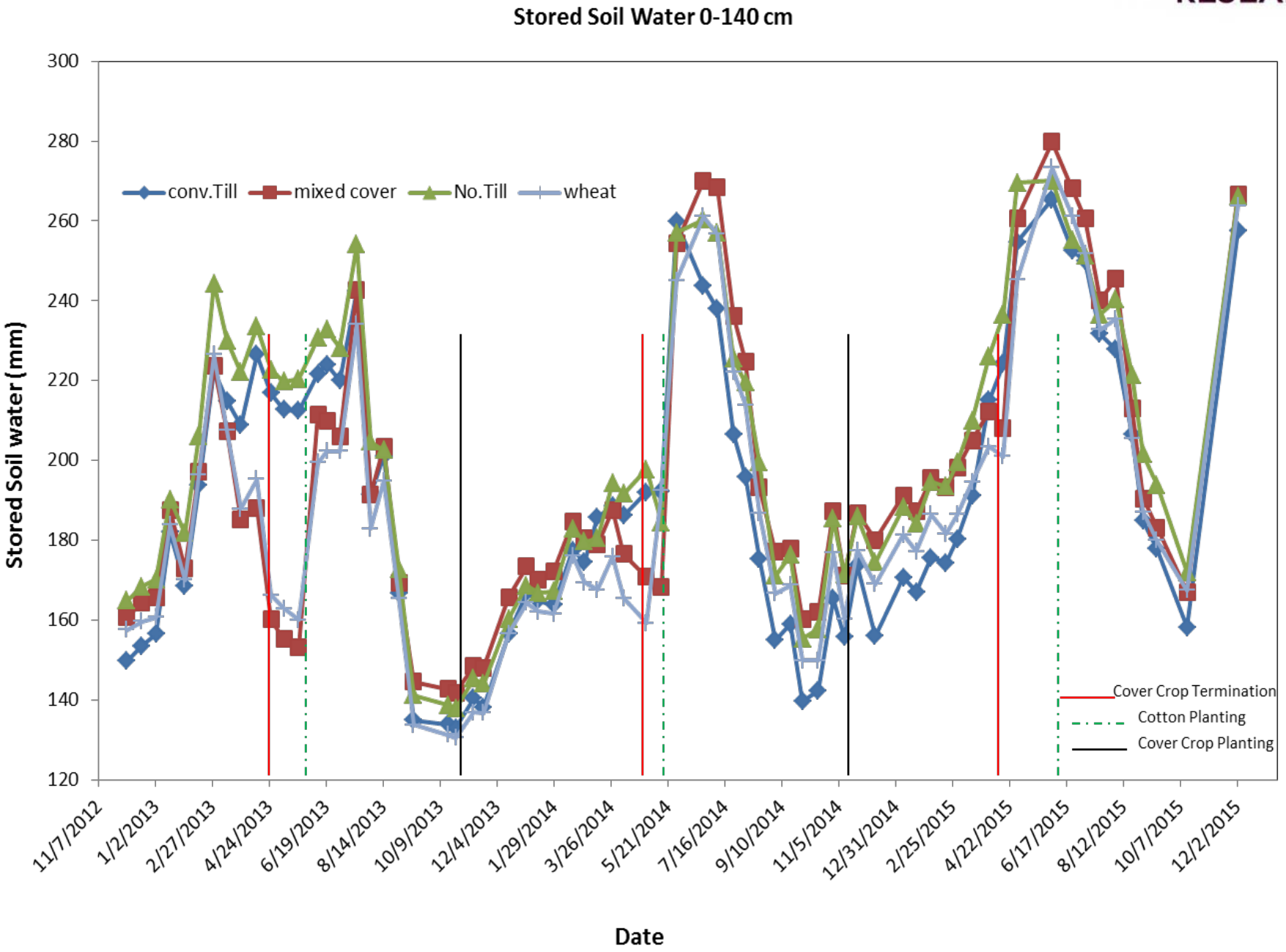
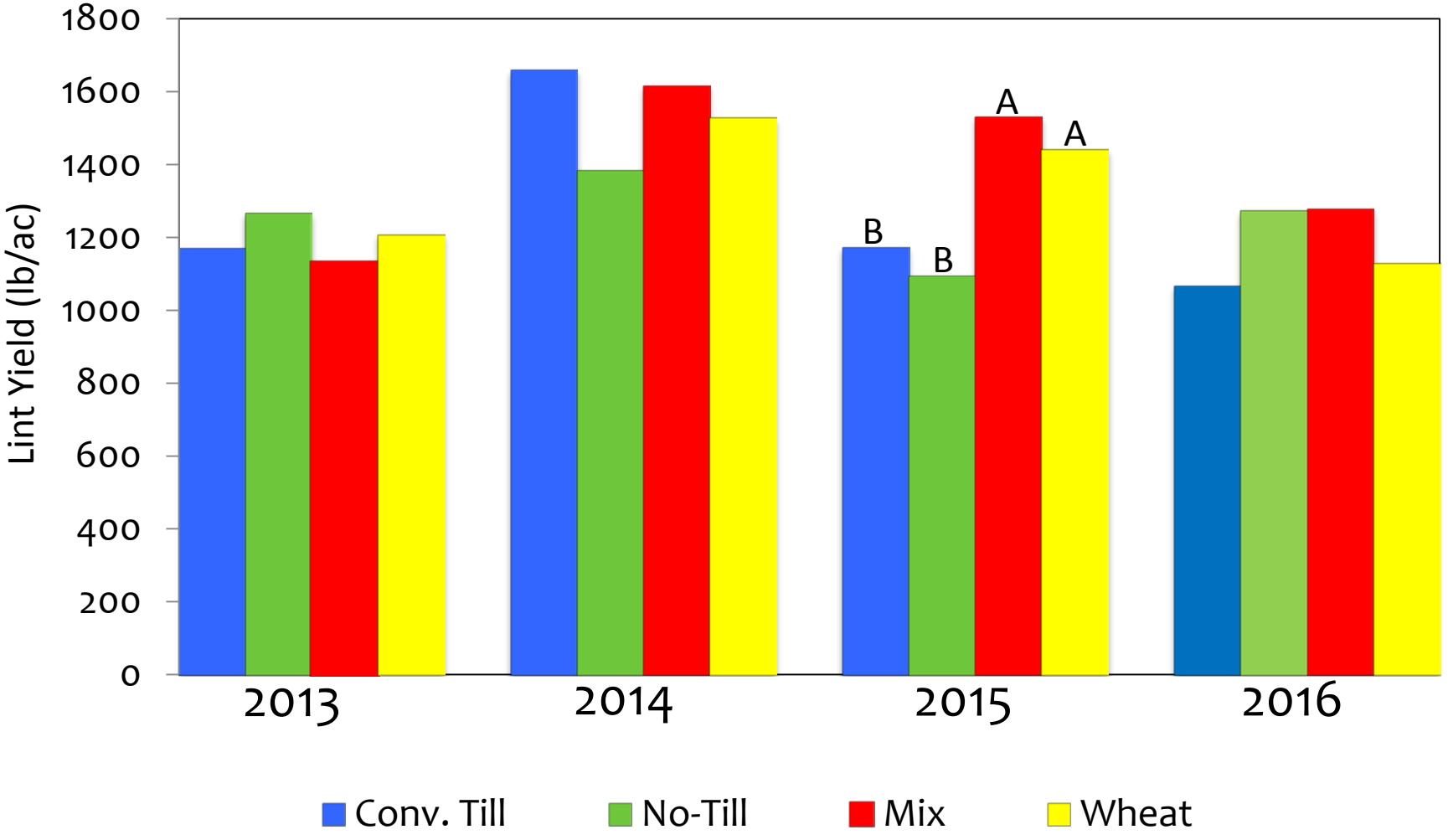
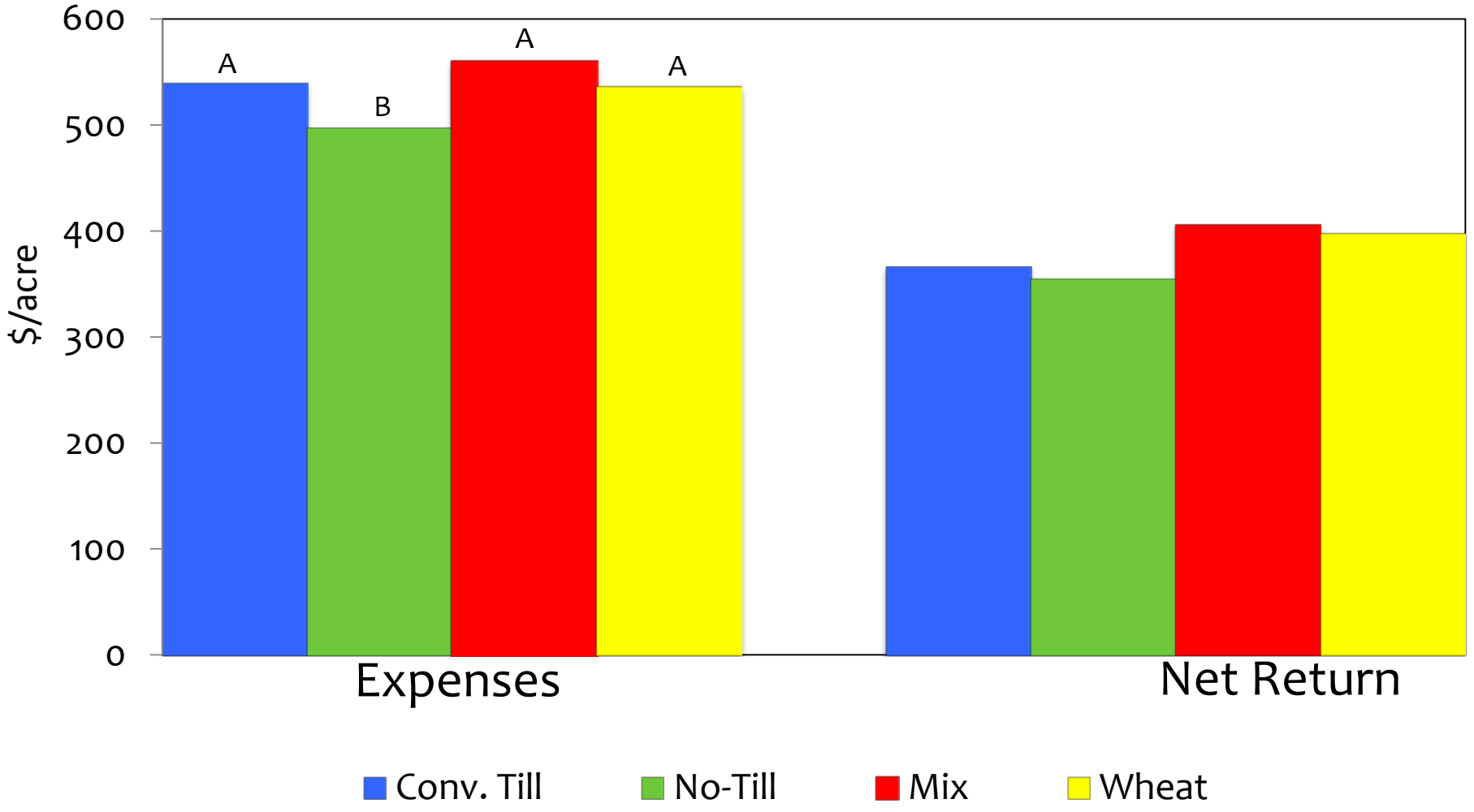

Stored Soil Water 0-140 cm
Stored Soil water (mm)
300
280
260
240
220
200
180
160
140
120
conv.Till
mixed cover
No.Till
wheat
Cover Crop Termination
Cotton Planting
Cover Crop Planting
11/7/2012
1/2/2013
2/27/2013
4/24/2013
6/19/2013
8/14/2013
10/9/2013
12/4/2013
1/29/2014
3/26/2014
5/21/2014
7/16/2014
9/10/2014
11/5/2014
12/31/2014
2/25/2015
4/22/2015
6/17/2015
8/12/2015
10/7/2015
12/2/2015
Date

Lint Yield - Irrigated



3-Yr Average - Irrigated



Chillicothe Research Station

Clay Loam, NT since 2008; Strip-Till since 2011

Conventional Till | No-Till | No-Till with Cover Crop

Wheat and Mixed CC = 30 lb/ac;
Mixed Species: Rye (15), Austrian Winter field pea (10), hairy vetch (3), & radish (2)

Continuous Cotton Systems

	CT	ST	NT	NTC
Depth (cm)	Organic C (ppm)			
0-10	8476	7242	6972	8346
10-20	6472	6155	5743	5872
20-30	6103	6002	5838	5684
30-60	5688	6375	5297	5275
60-90	6516	6848	4534	4404

No-Till Since 2008

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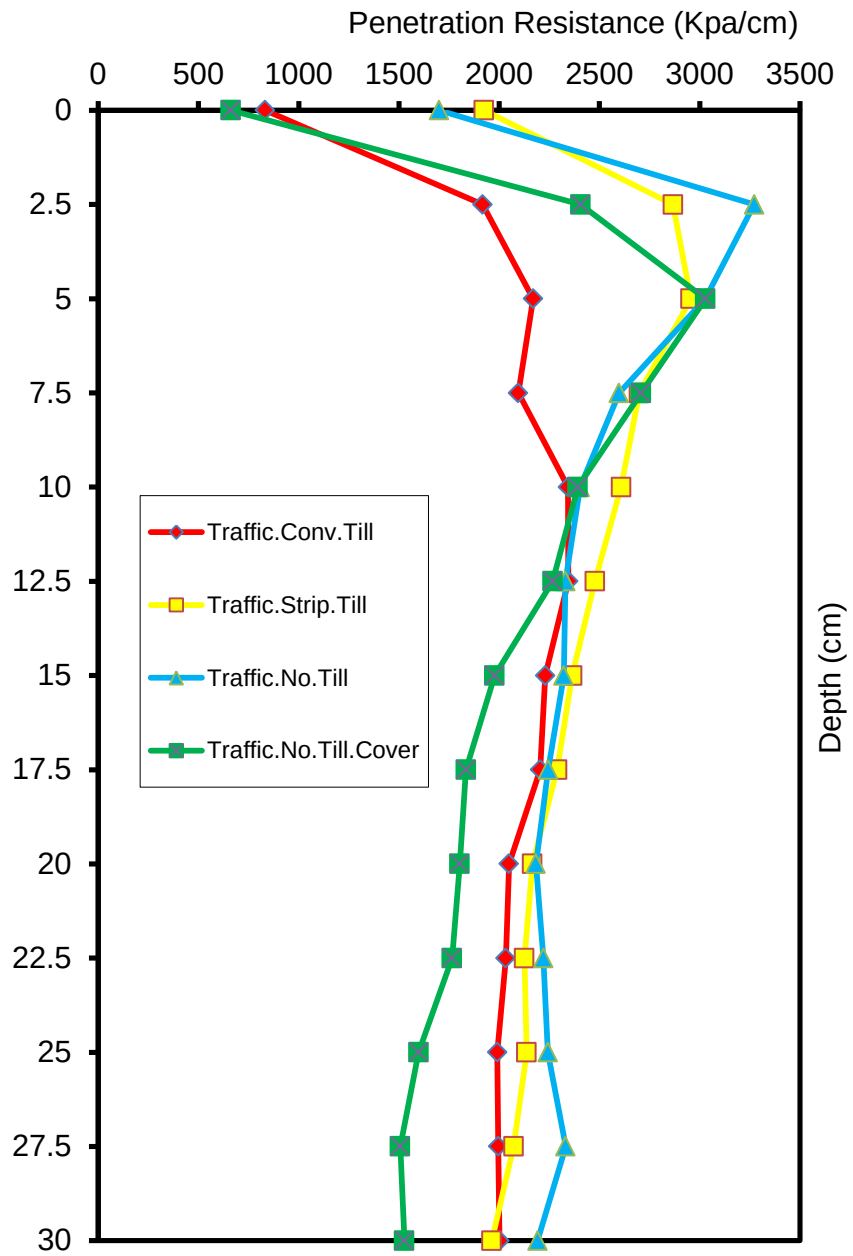
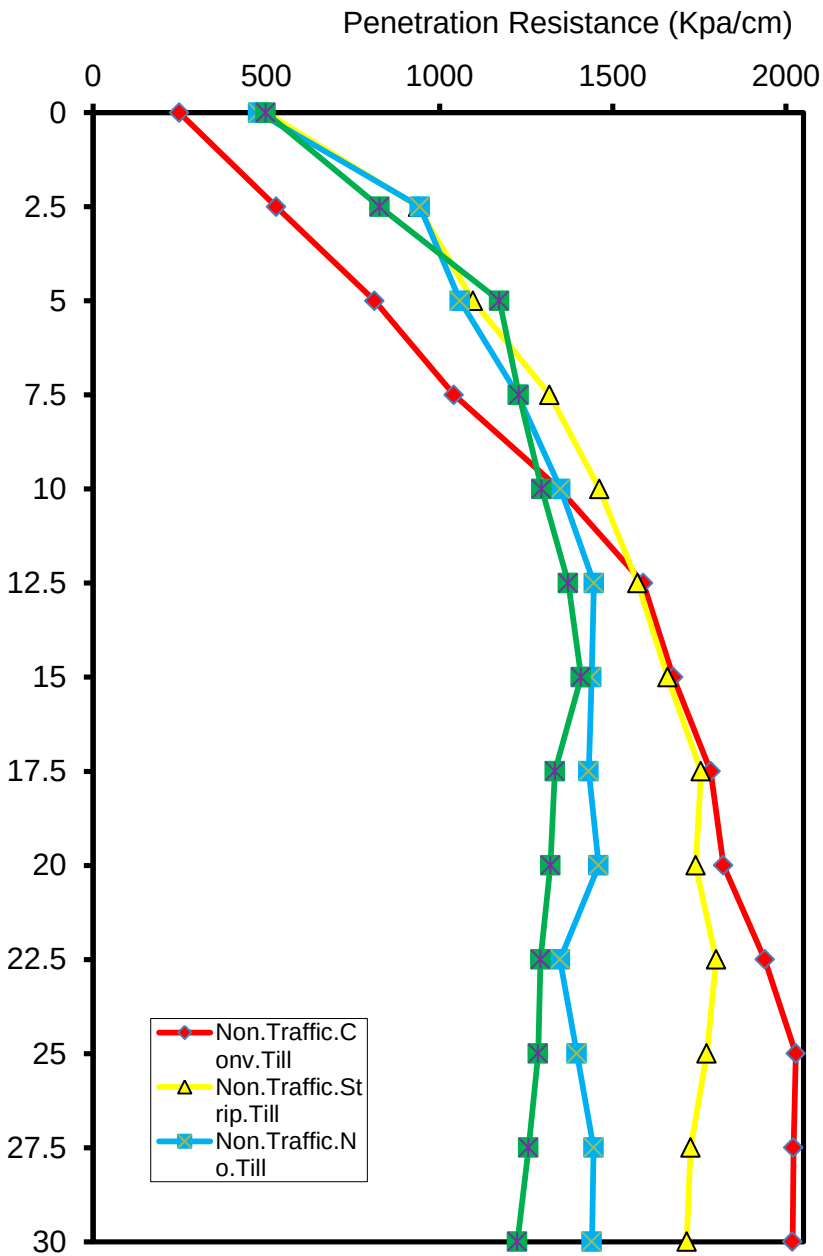
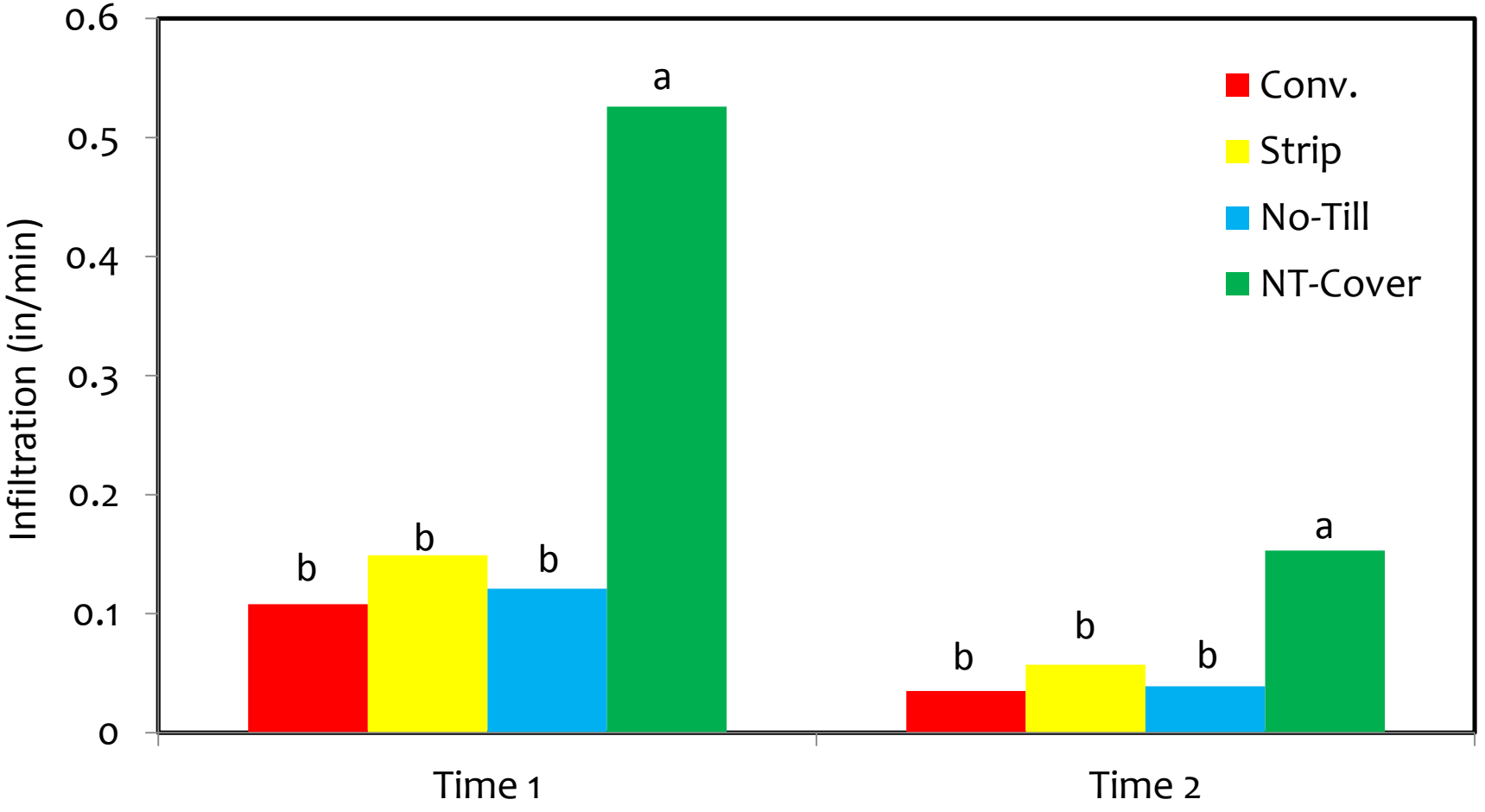
CRS


Penetration Resistance (Kpa/cm)
0
500
1000
1500
2000
2500
3000
3500
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
27.5
30
Depth (cm)
Traffic.Conv.Till
Traffic.Strip.Till
Traffic.No.Till
Traffic.No.Till.Cover


Penetration Resistance (Kpa/cm)
0
500
1000
1500
2000
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
27.5
30
Non.Traffic.Conv.Till
Non.Traffic.Strip.Till
Non.Traffic.No.Till

CRS Infiltration



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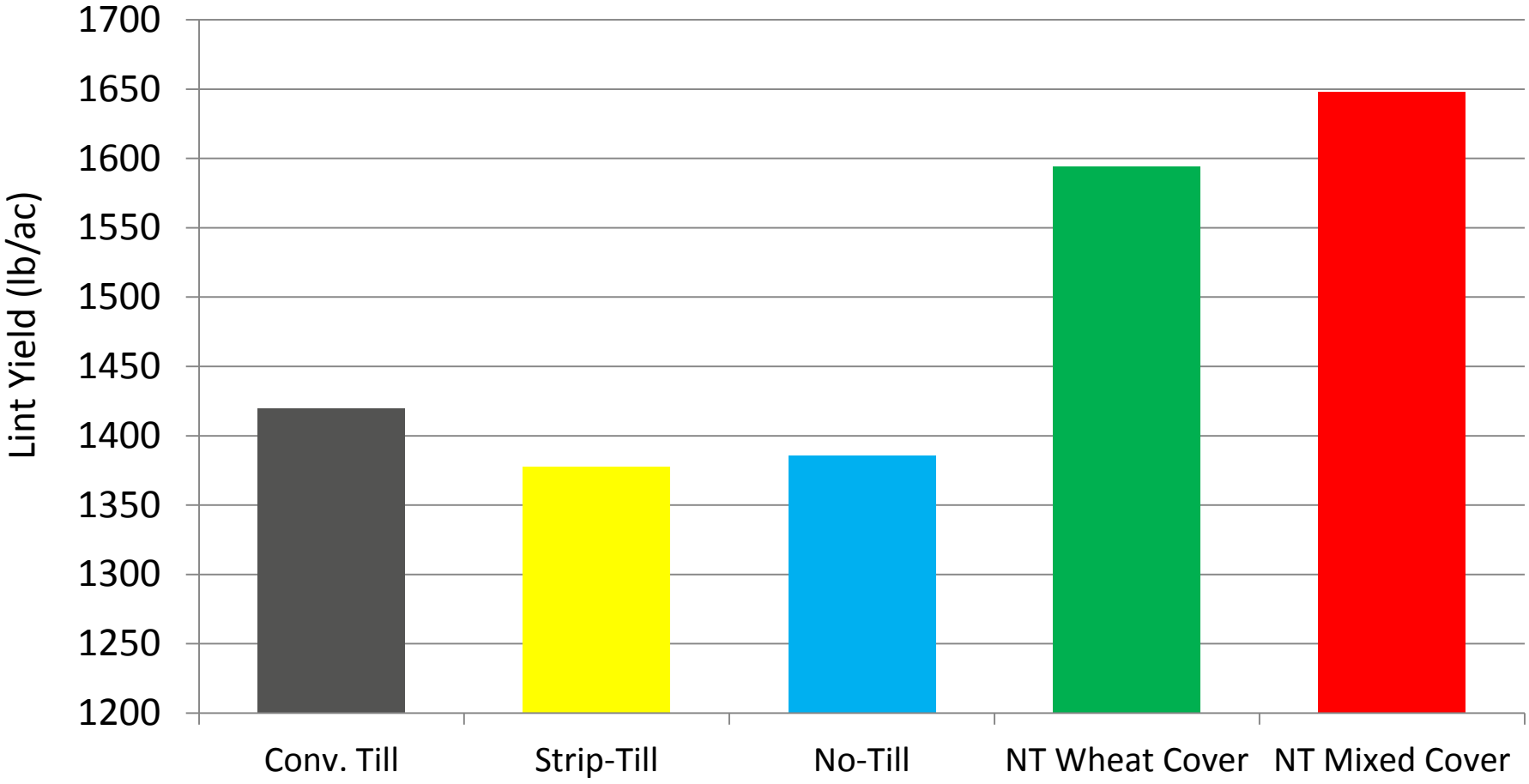
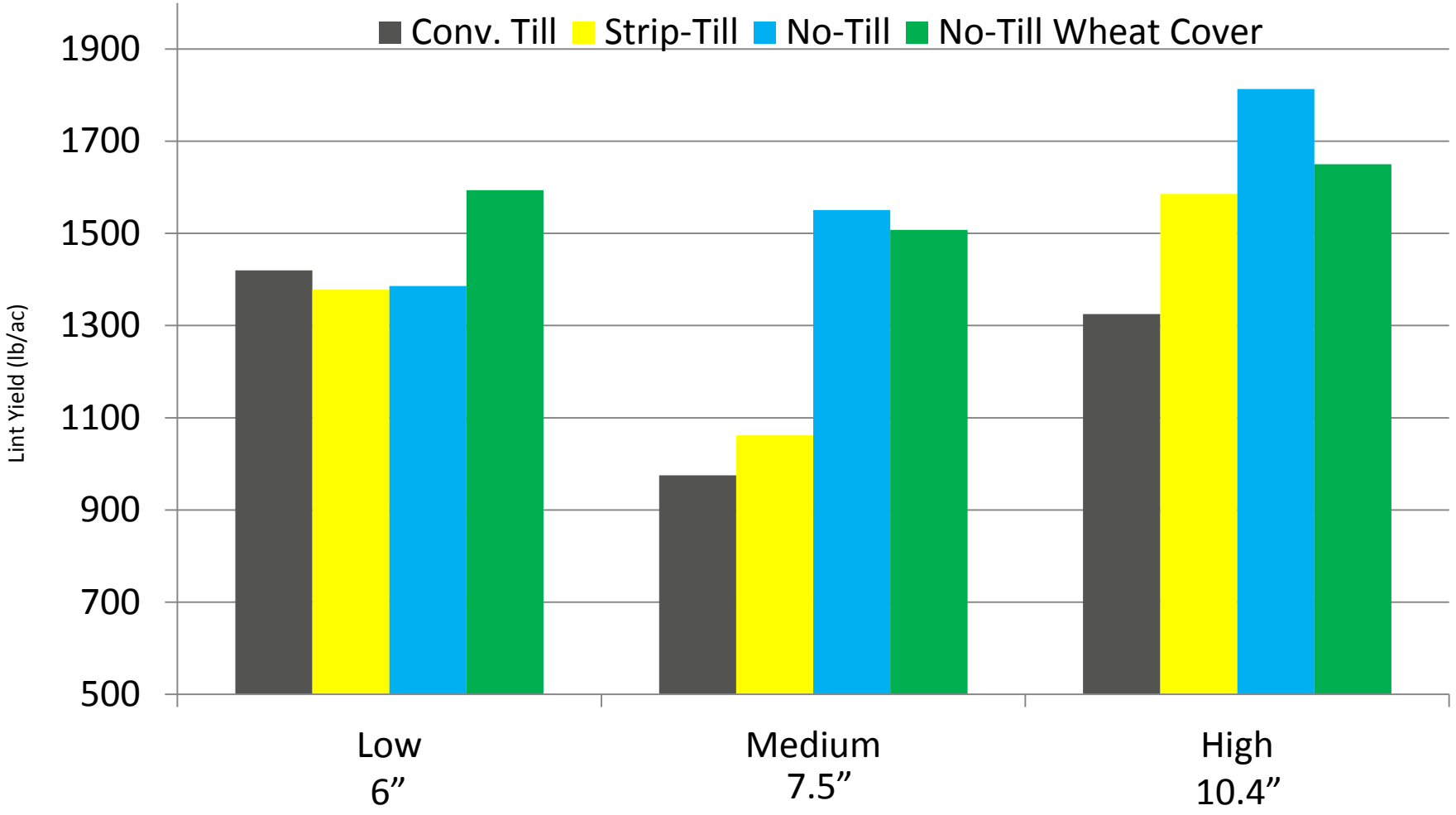
2016 Lint Yield

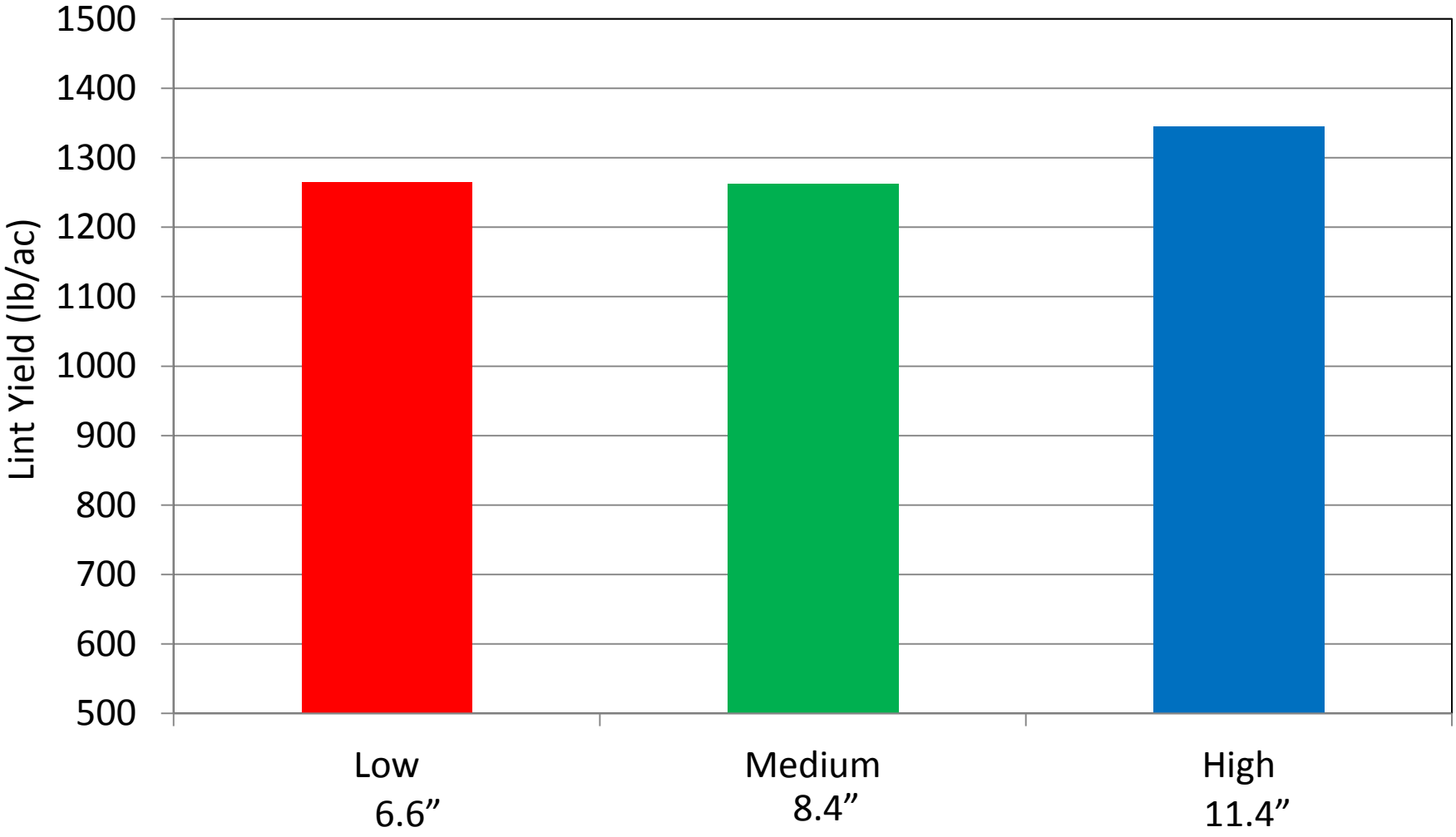


- Does conservation tillage change irrigation strategies?
- Tillage
  - Conventional Tillage
  - Strip-till
  - No-till
  - No-till with wheat cover crop
- Irrigation Management (Subsurface Drip)
  - Initiate irrigation:
    - After stand establishment at 0.2”/day
    - 1st sign of flowering at 0.2”/day
    - 1st sign of flowering at 0.25”/day

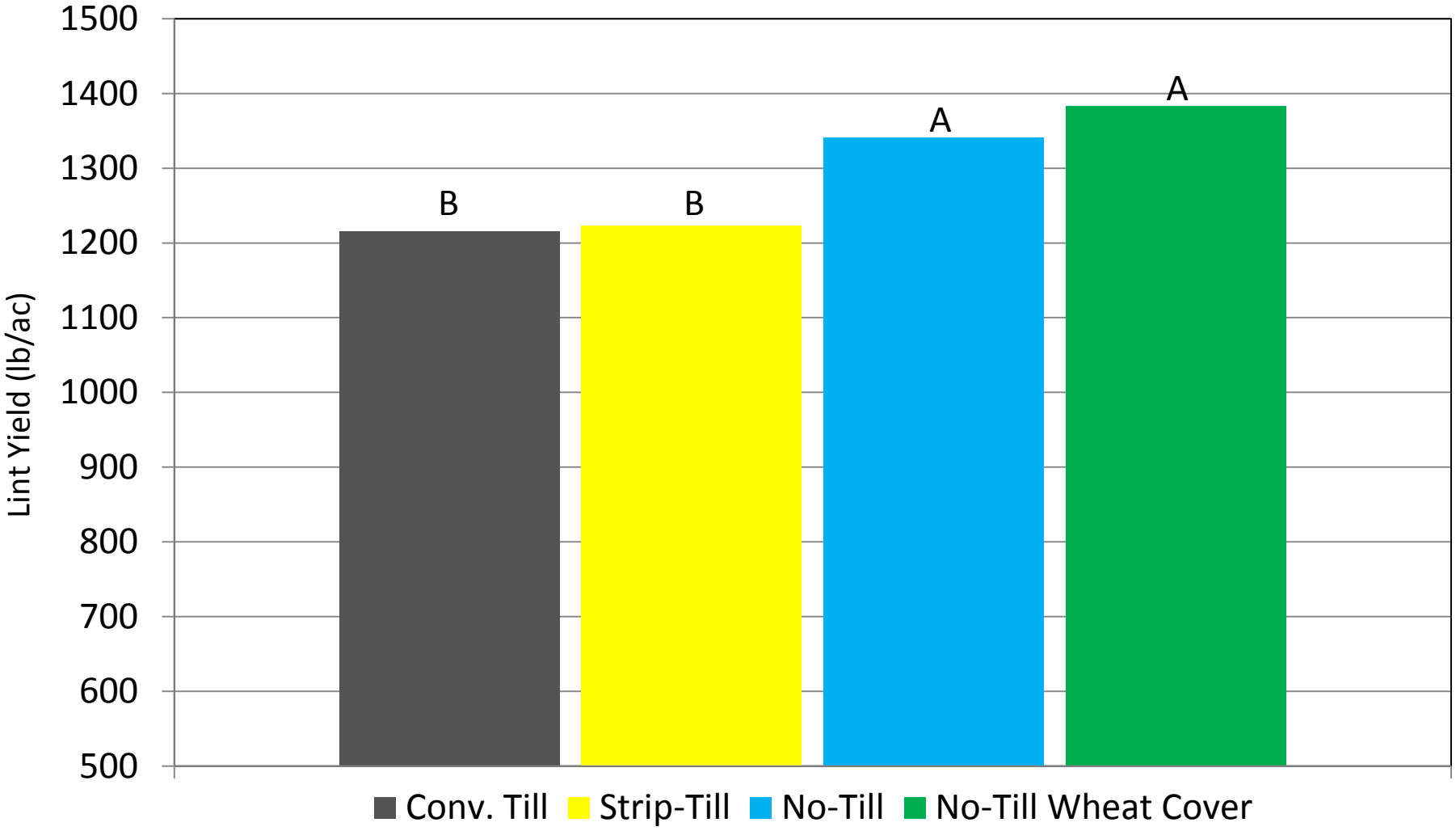
2016 Lint Yield

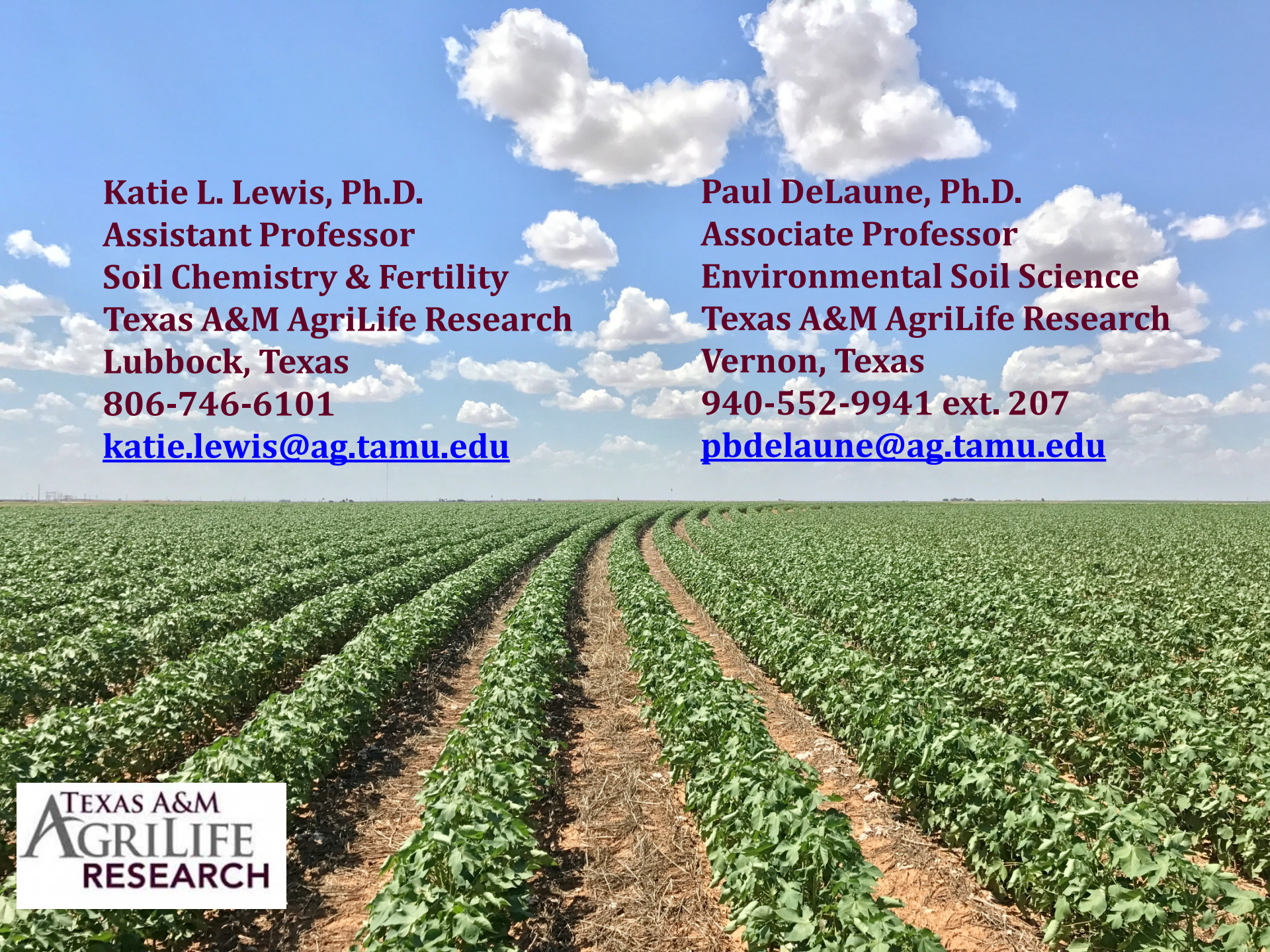


2013-2016 Lint Yield



2013-2016 Average





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