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# Integrating no-till and cover crop mixtures for sustainable early sweet corn production

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# Introduction

- Forage radish cover crops
  (Raphanus sativus L. var. longipinnatus)
  in vegetable production
- Sweet corn in New England
  - 12,000 acres in 2015
  - Production of $40 million[1]
- No-till production is feasible and under-utilized
- Cover crops improve no-till sweet corn success[2]



[1] USDA NASS, 2015

[2] Mohler, 1991; Carrera et al., 2004

# Benefits of forage radish

Fall:

- ✓ Deep nitrogen scavenging
- ✓ Weed suppression
- ✓ Quick soil cover

* WINTER-KILLED *

Spring:

- ✓ Low residue management
- ✓ Increased water infiltration
- ✓ Rapid decomposition
- ✓ Nutrient recycling
- ✓ Window of weed suppression

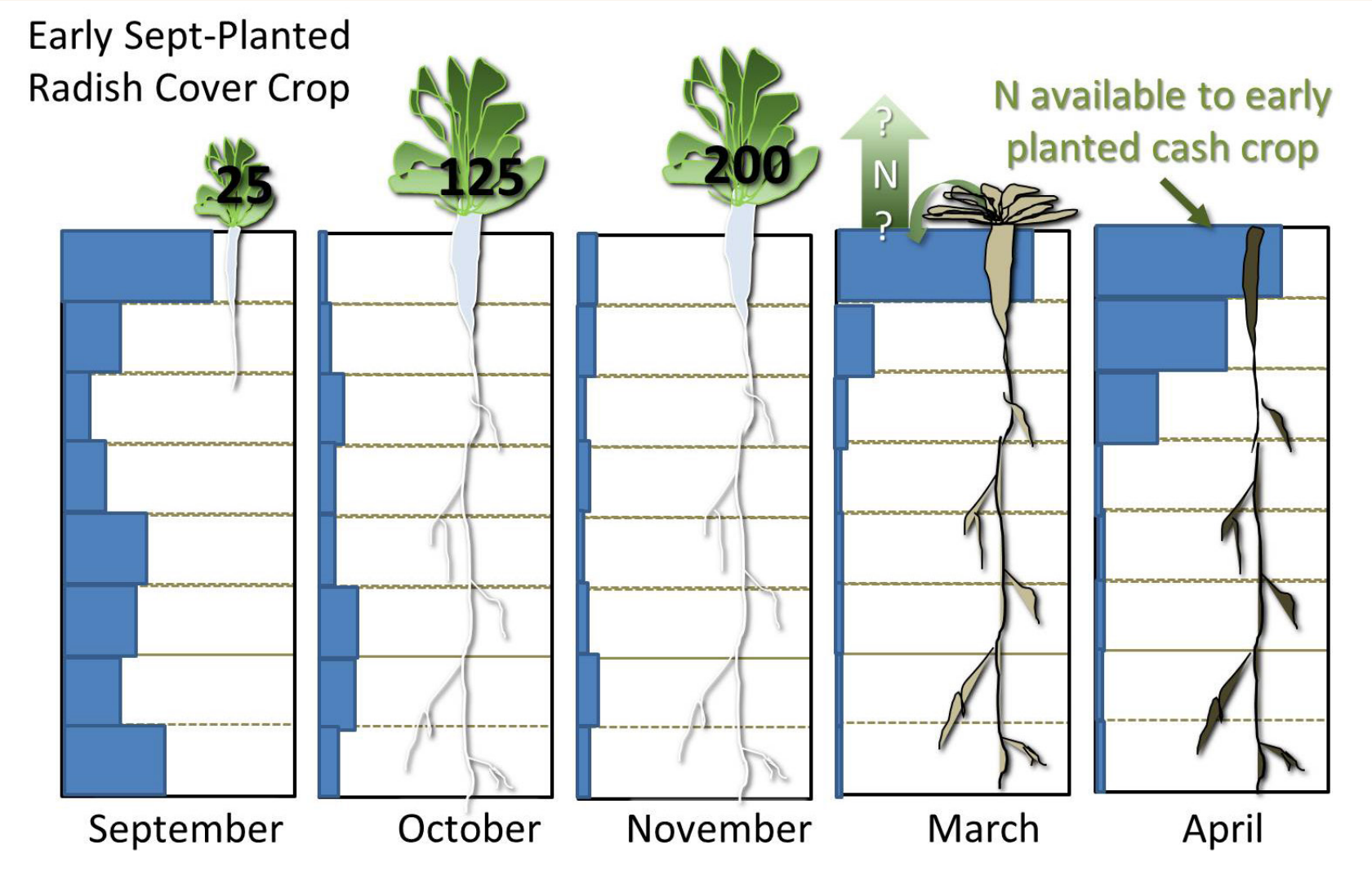



*Image courtesy of Dr. Ray Weil*

# Limitations of forage radish

- ✗ Short planting window in northern NE
  - *Late August to early September*
- ✗ Low biomass production
- ✗ No N fixation
- ✗ Rapid spring decomposition
- ✗ Low C:N ratio
- ✗ Duration of spring weed suppression

*Spring residue of forage radish*

# Experimental Questions

- How can we utilize FR to benefit sustainable crop production?
- Can we improve performance of FR in northern climates by using it in a cover crop mixture?
- Will winter-killed cover crop mixtures allow for early spring planting?
- Can cover crop mixtures benefit no-till sweet corn?
  - Reduced fertilizer?
  - Weed suppression?

# Experimental Questions

**What we know…**

- Multi-species cover crops can be more productive than monocultures (Finney et al., 2016; Sainju et al., 2005)
- Fall-planted forage radish can provide successful weed suppression and nitrogen scavenging (Lawley et al., 2011; Lawley et al., 2012; Lounsbury and Weil, 2015)
- No-till sweet corn can benefit from cover crops (Mohler, 1991; Carrera et al., 2004)
- Cover crops may not provide N to succeeding sweet corn (O'Reilly et al., 2012)

# Experimental Questions

**What we <u>don't</u> know…**

- Will these cover crops provide N to succeeding sweet corn? They may not. (O'Reilly et al., 2012)
- How does the timing of CC-recovered N synchronize with demands of sweet corn? (Lawson et al., 2012)
- Are forage radish cover crops providing weed control to sweet corn in season? (Kruidhof et al., 2008)

# Hypotheses

1. CC mixtures will produce more biomass than FR alone or control

2. CC mixtures will not reduce spring soil temperatures

3. Mixtures C:N ratio will adjust decomposition rate

4. Sweet corn yield will be higher following CC mixtures
5. Weed HYPOTHESIS!!!

# Materials and Methods

## 4 cover crop treatments

Forage radish

Oat +FR

Pea +Oat +FR

Local Weeds (control)

## 3 N fertilizer treatments:

0 fertilizer, 25 lbs N/ac, 50 lbs N/ac

# Cover crop costs

| Cover crop species | Seeding rate: drilled (lbs/ac) | Seed price ($/lb) | Seed cost ($/ac) |
|---|---|---|---|
| Forage radish (FR) | 7 | $3.00 | $21 |
| Oat/FR (OFR) | 50/3 | $0.40/ $3.00 | $29 |
| Pea/Oat/FR (POFR) | 45/30/2 | $1.20/ $0.40/ $3.00 | $72 |

# Experimental Design

- UMass Amherst Research and Education Farm

  Hadley loam soil
- Drilled CC seed late August 2014, repeated in 2015
- Randomized complete block design with split plots
- 4 replications
- Sweet corn drill seeded first week of May, approximately 30,000 seeds/ac

# Methods

**Fall planted cover crops**
- FR
- OFR
- POFR
- Control: LW

**Sweet Corn**
- Herbicide applied
- var. 'Trinity'
- Planted at 60 °F soil temp

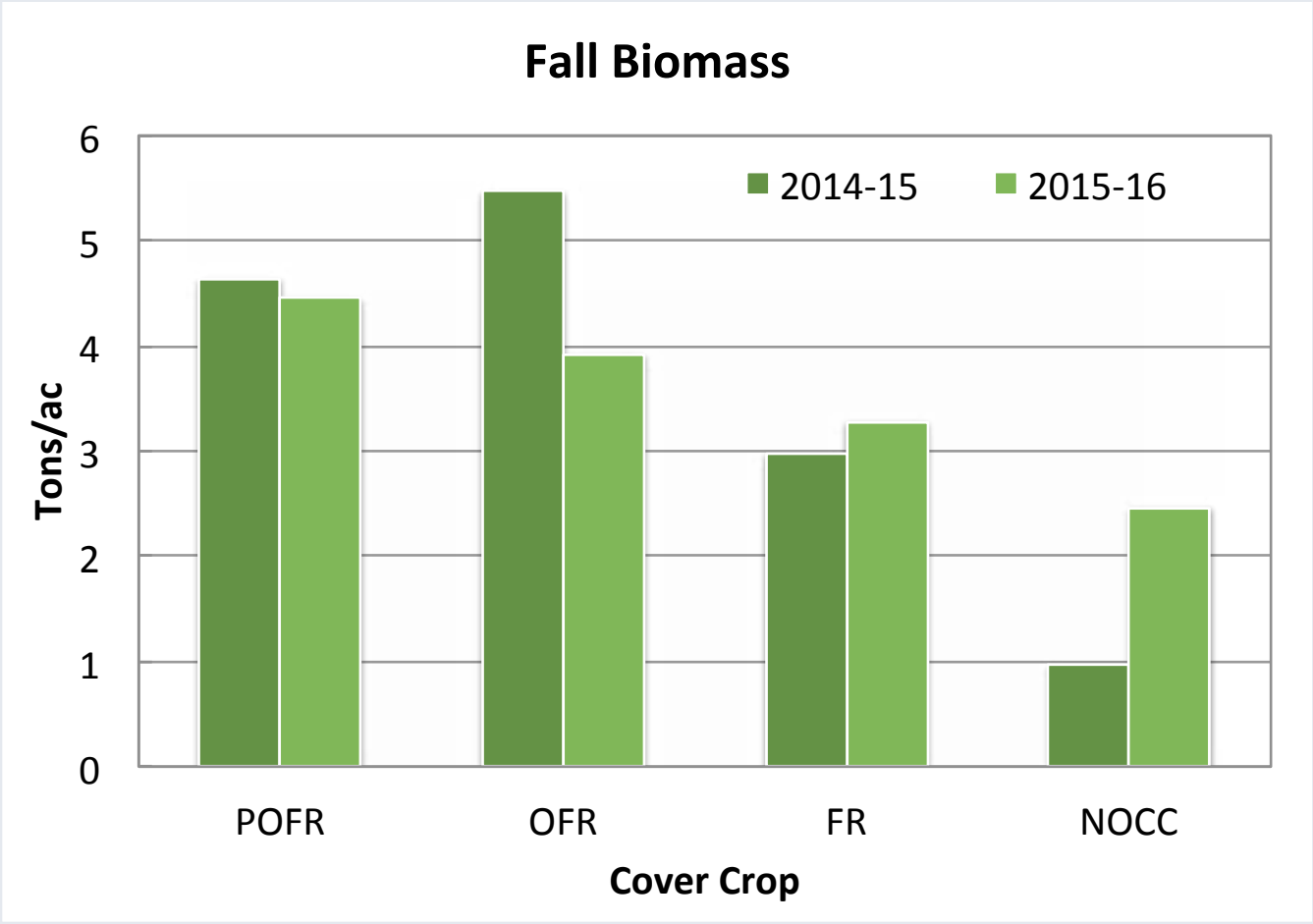
**N Fertilizer**
- 0 N fertilizer
- 25 lbs N/ac @ sidedress
- 50 lbs N/ac split application (half @planting half @sidedress)

# Measurements

Evaluate the feasibility of integrating no-till sweet corn production with FR-based cover crop mixtures.

| Fall cover crops | Spring soils | Sweet corn |
|---|---|---|
| • cover crop biomass<br>• C:N ratio<br>• fall weed biomass | • soil temperatures<br>• soil nitrate<br>• spring weed biomass<br>• respiration | • leaf N at V5<br>• yield<br>• tip fill<br>• ear length<br>• CSNT |

# Results: fall cover crop biomass

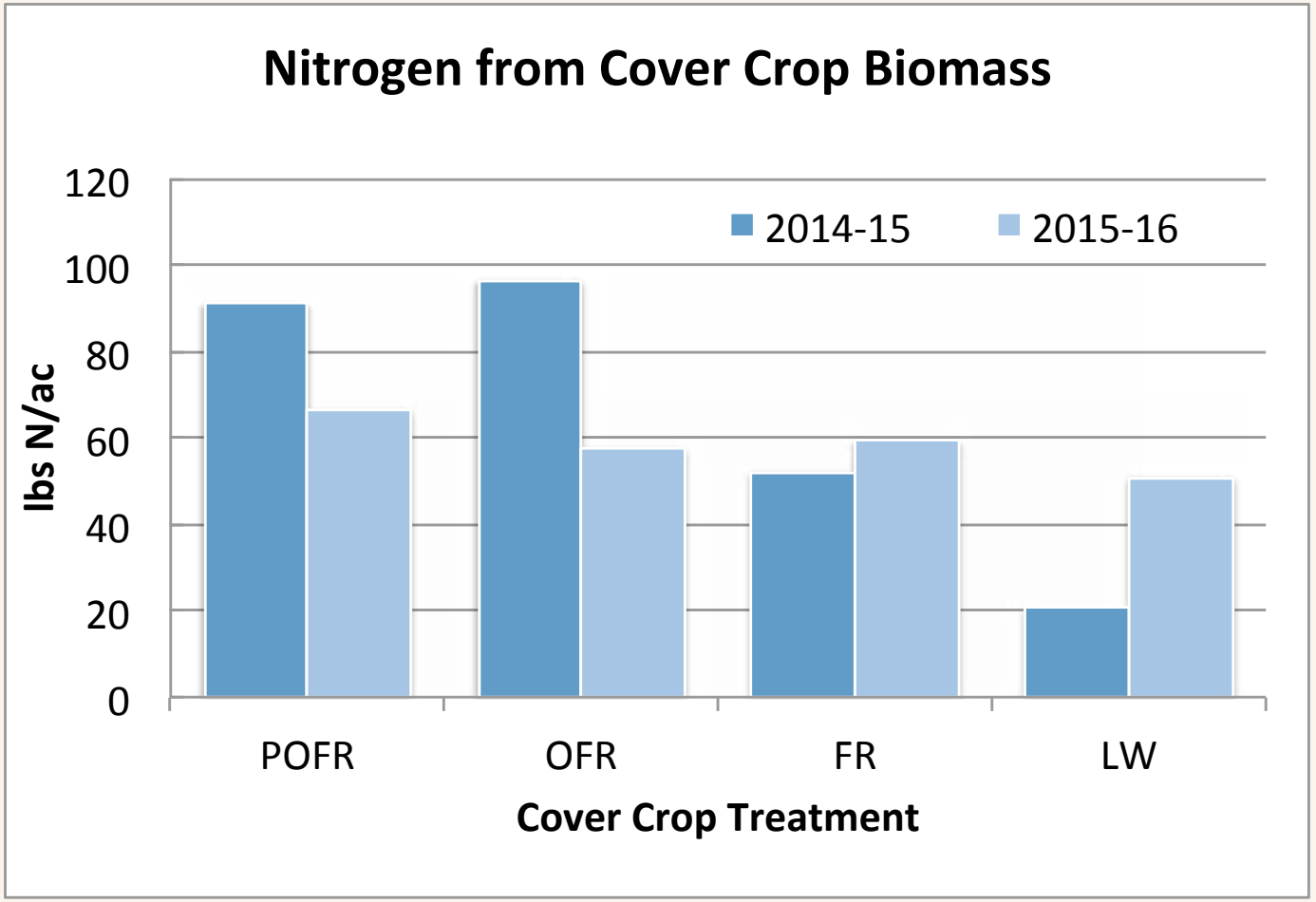


# Results: C:N ratios

| | POFR | OFR | FR | LW |
|---|---|---|---|---|
| *2014-15* | **22:1** | **25:1** | **24:1** | **18:1** |
| *2015-16* | **22:1** | **21:1** | **20:1** | **17:1** |

Highly significant differences only in 2015-16.

# Results: Recycling N




Significant differences only in 2014-15.

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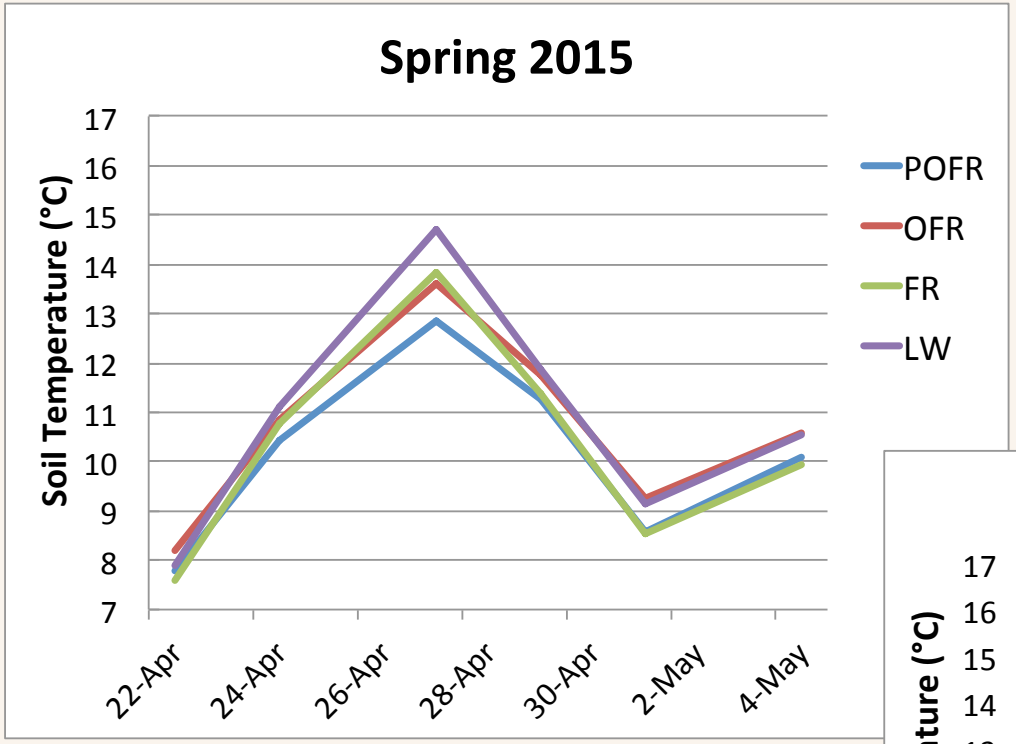
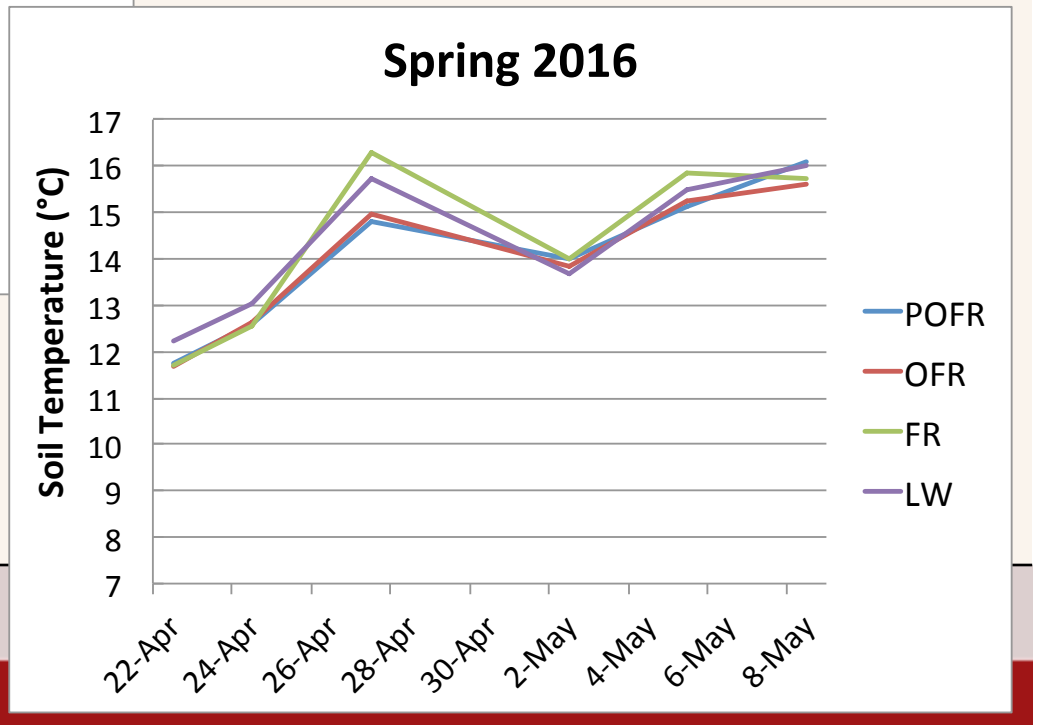
# Results: Spring soil temperature




Significant differences by CC treatment only in 2014-15.

Highly significant interaction between date & CC both years.

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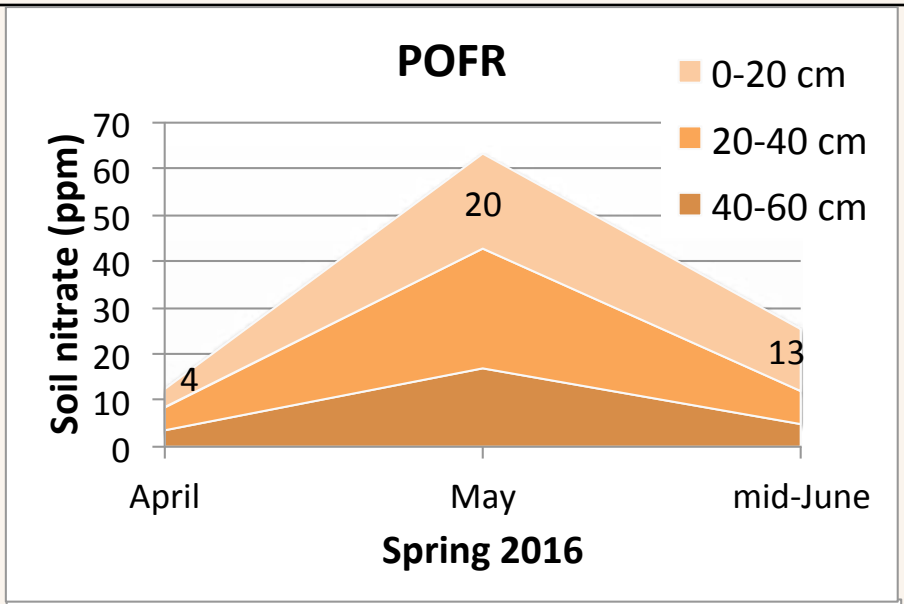
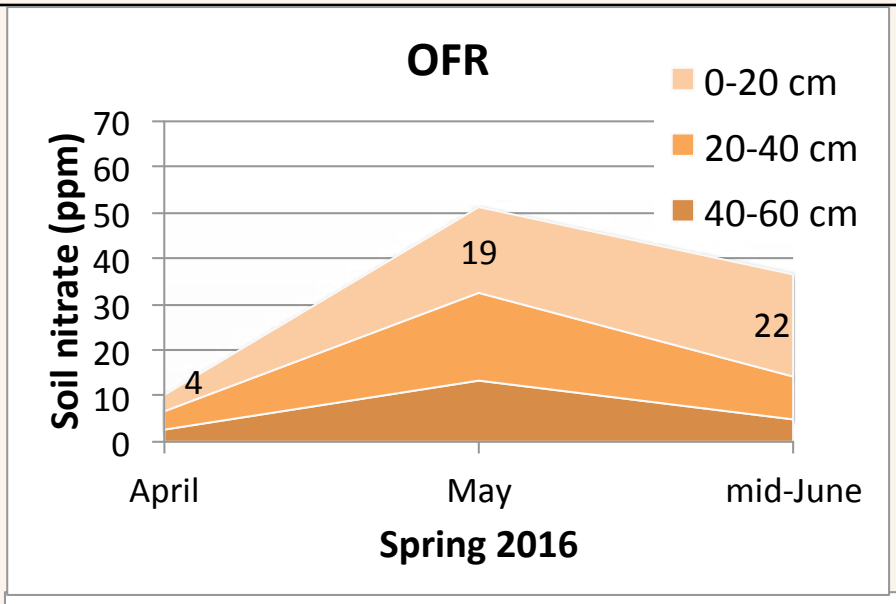
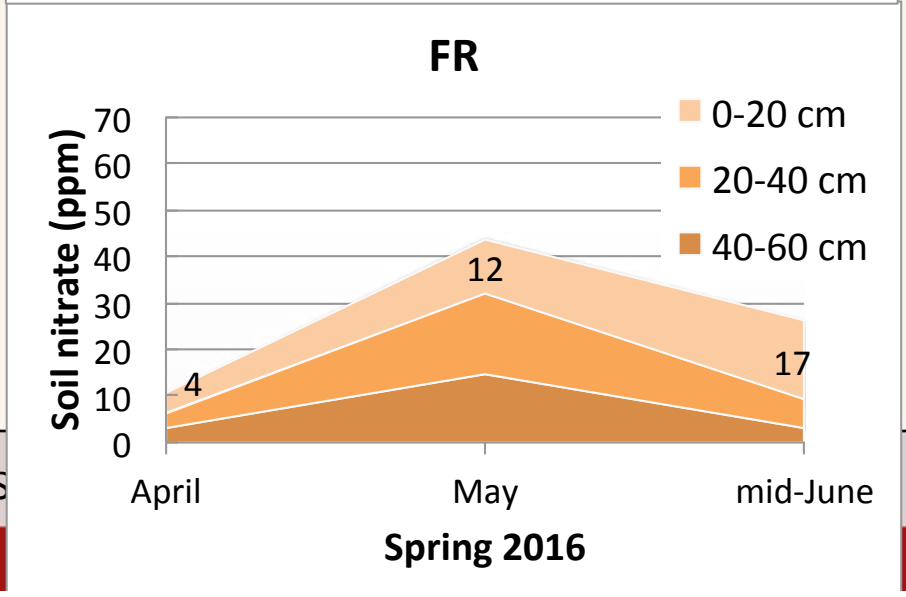
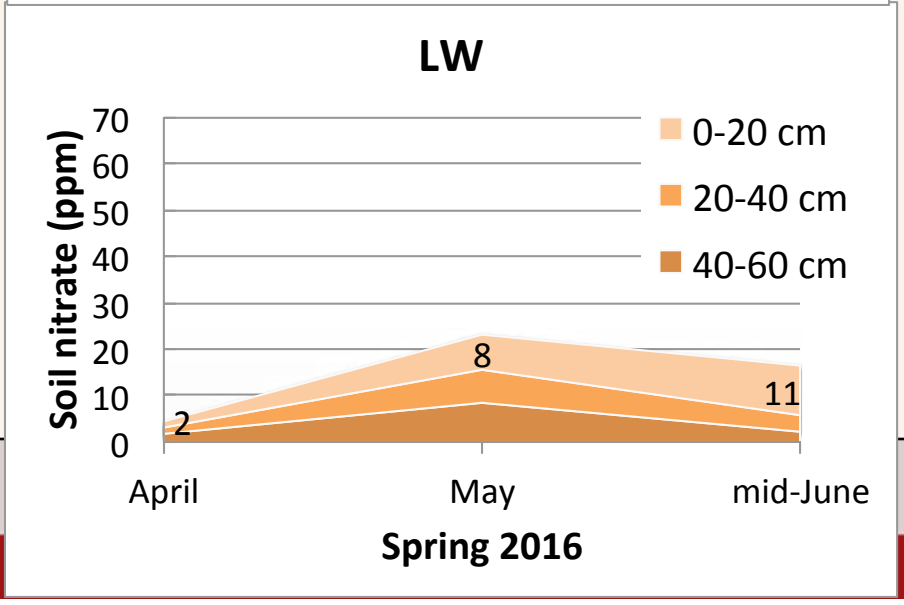
# Results: Spring Soil Nitrate

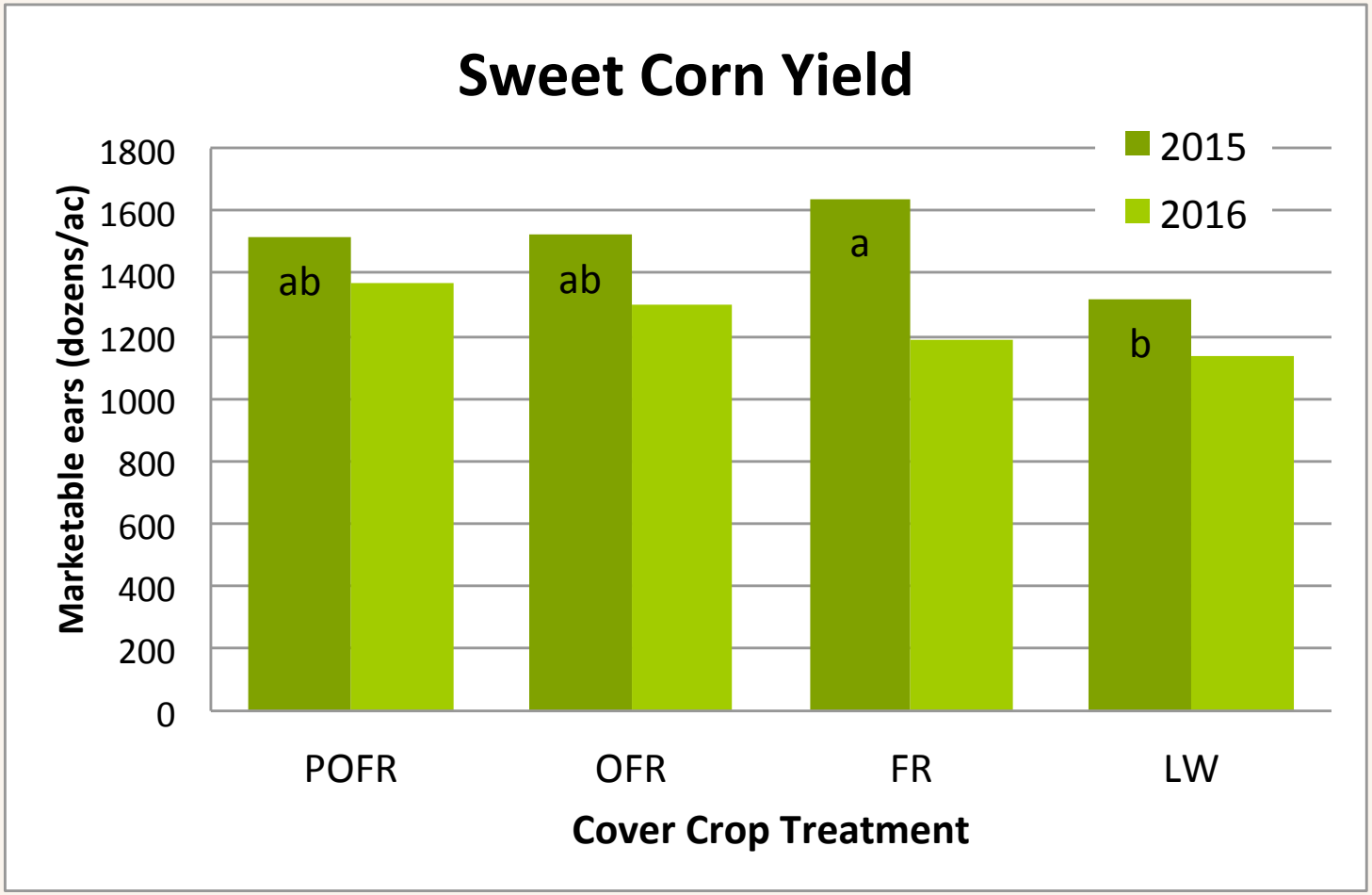


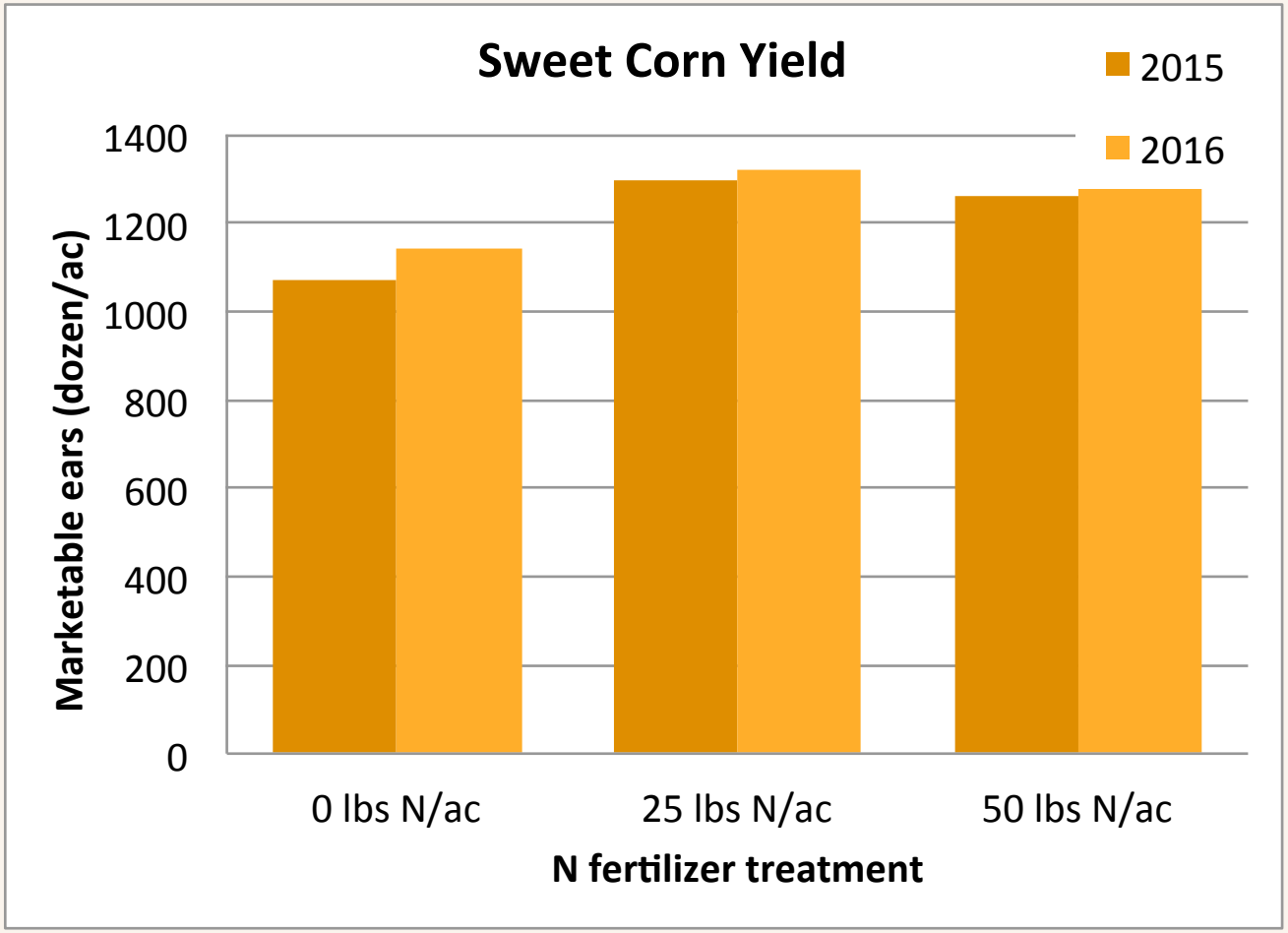



# Results: Sweet corn yield affected by cover crop




Highly significant differences by CC treatment only in 2015.

# Results: yield influenced by N fertilizer treatment

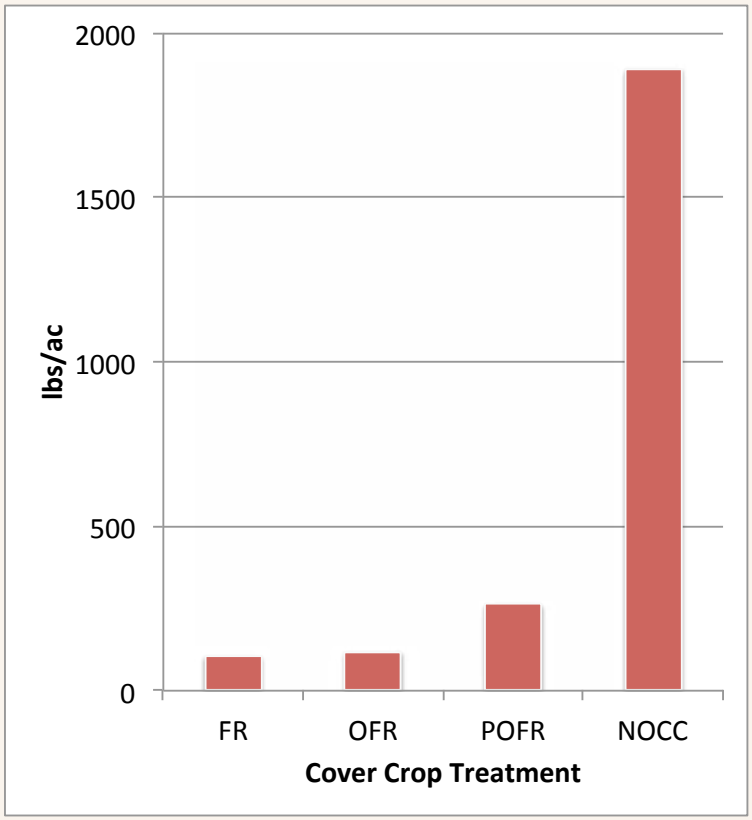



Significant differences by CC treatment only in 2016.

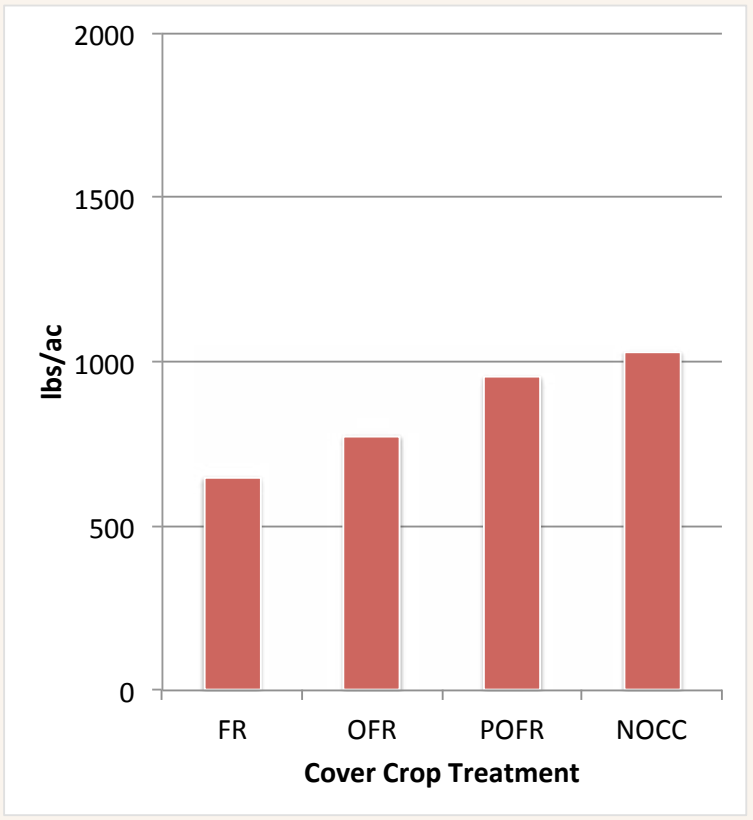
- Set up weed experiment w/ map

# Results: Weed Biomass

## April 2016: pre-plant

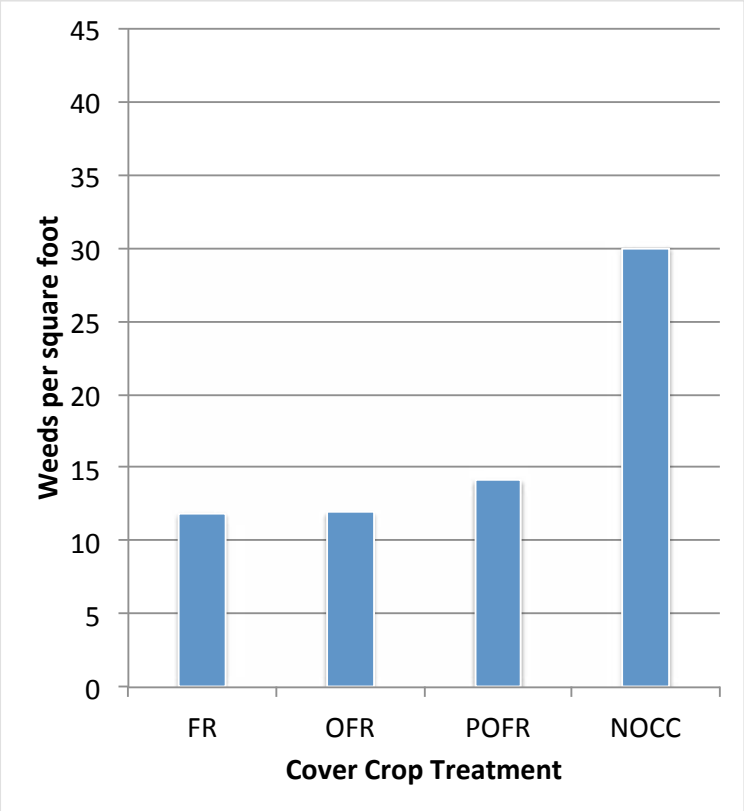



## June 2016: V5 stage

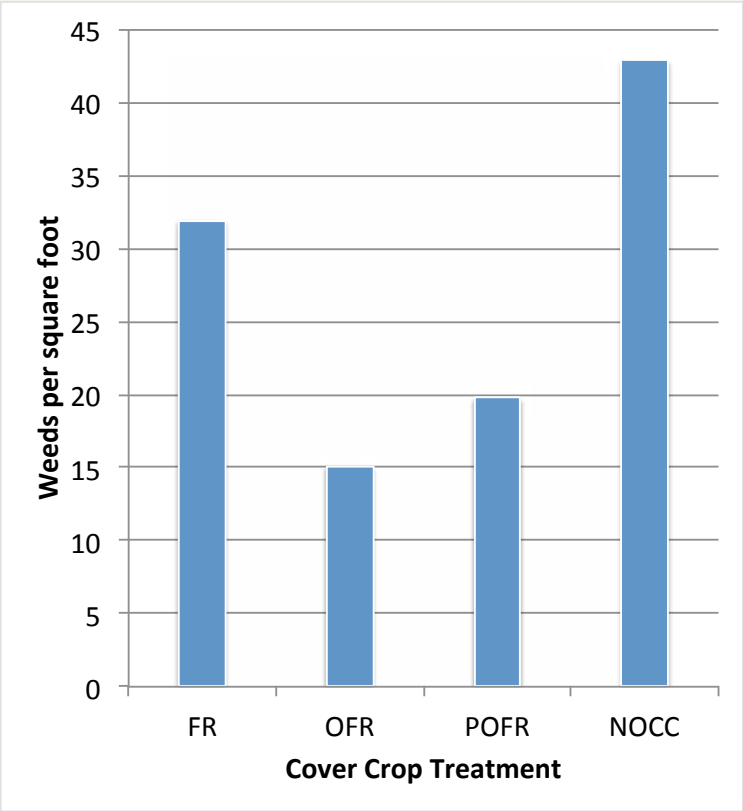


# Results: Weed Population

## April 2016: pre-plant




## June 2016: V5 stage



# Summary

- Strong influence of weather in non-irrigated sweet corn
- Mixtures produced more aboveground biomass than FR or LW
  - Therefore more recycled N to subsequent crop
- Soil temperatures were not significantly different at corn seeding
- In first year, CC had significant effect on yield
- In second year, N fertilizer had significant effect on yield
- Quality was not effected by CC treatment or N fertilizer



- In this production system, N fertilizer may be reduced

# Conclusions

- Feasibility of no-till sweet corn
- Cover crop mixture cost per acre should be considered
  - POFR $73 versus OFR $29
- 25 lbs N/ac fertilizer at sidedress was more efficient than 50 lbs N/ac split application
- Weed suppression by CC in-season was insufficient

# Acknowledgments

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