# Quantifying the nitrogen budget

Irrigated potato and vegetable production in Central Wisconsin

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United States Department of Agriculture NRCS Natural Resources Conservation Service

# Objective:

Scaling up improvements at small plots to field scale

# Enviromentally Smart Nitrogen

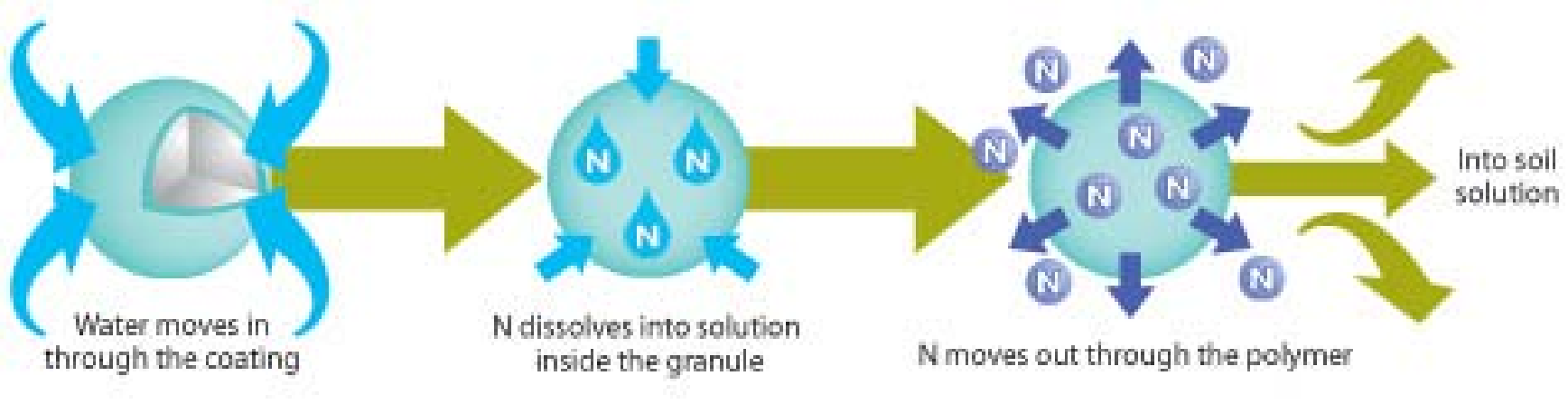


Image from smartnitrogen.com 2.21.2013

# Outline

- **Setting the stage for adoption of slow release N**
  - **Extension: PCU works most of the time**
  - **Federal money is available**
  - **Growers say ‘meh’**

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- **Setting the stage for adoption of slow release N**
  - **Small plot success**
  - **NRCS programs to aid adoption**
  - **Barriers to adoption**

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- Setting the stage for adoption of slow release N
  - Small plot success
  - EQUIP: NRCS programs to aid adoption
  - Barriers to adoption
- **Year One demonstration pivots**
  - **Methods**
  - **Year one PCU field demonstration**
    - **Sweet corn**
    - **Field corn**
    - **Potato**

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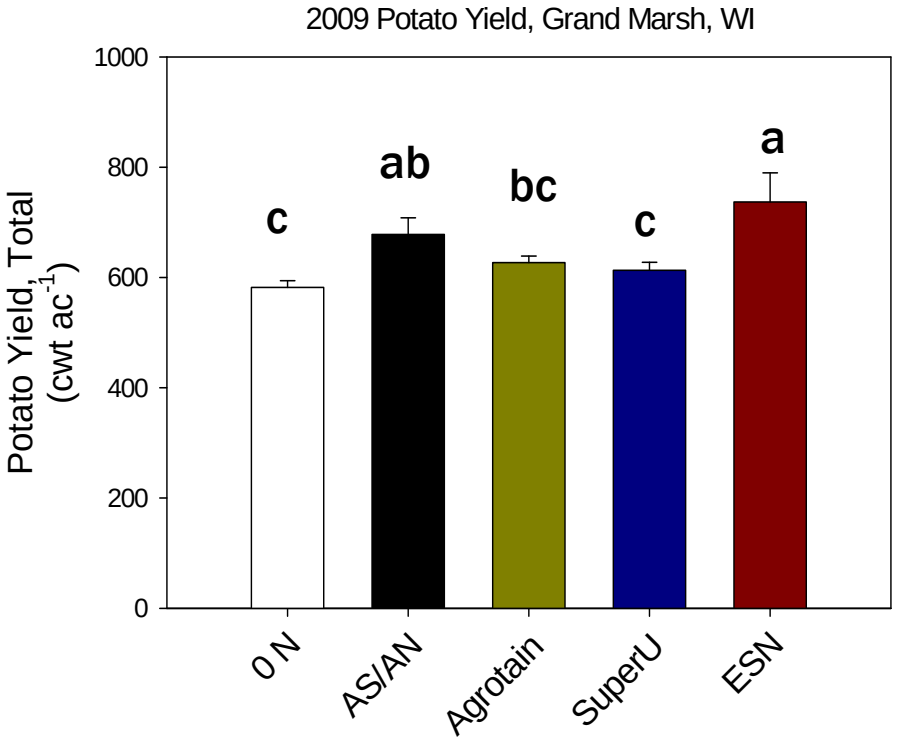
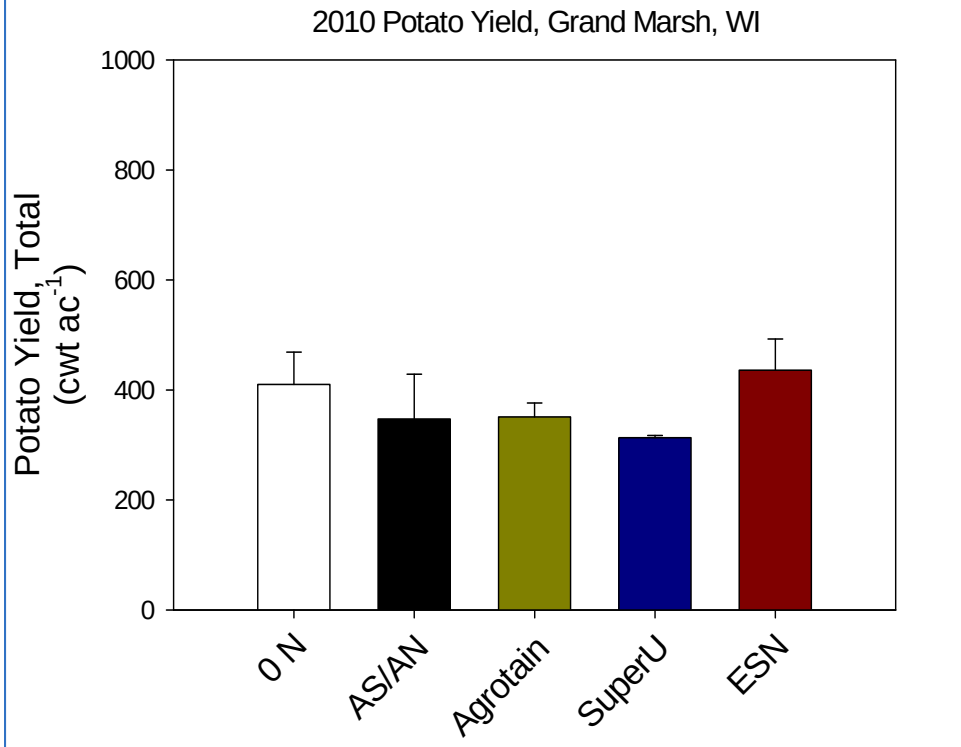
  - Small plot success
  - EQUIP: NRCS programs to aid adoption
  - Barriers to adoption
- Year One demonstration pivots
  - Methods
  - Year one PCU field demonstration
    - Sweet corn
    - Field corn
    - Potato
- **ESN release curve 2012**
- **Conclusion + improvements for year two**

# Small plot evaluation

- Potato
  - 2009 -2010 – on farm
  - 2010 – research station, two experiments
- Sweet corn
  - 2011 – 2012
- Field Corn
  - 2003-2005

# YIELDS

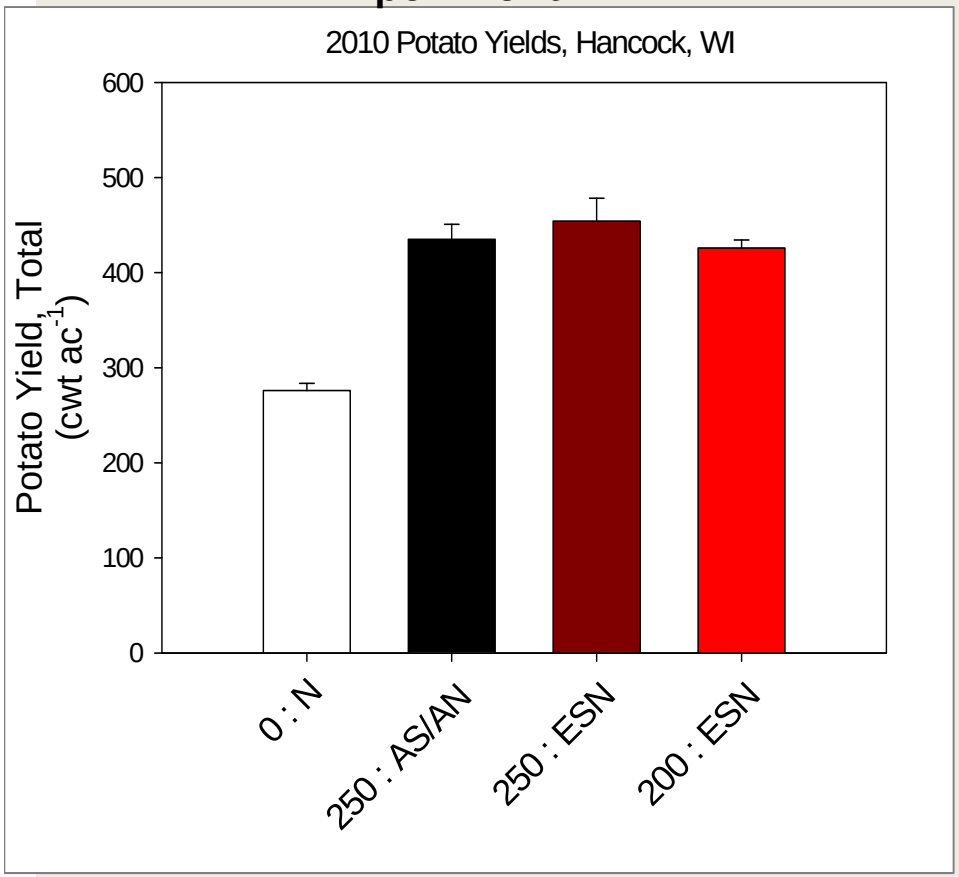


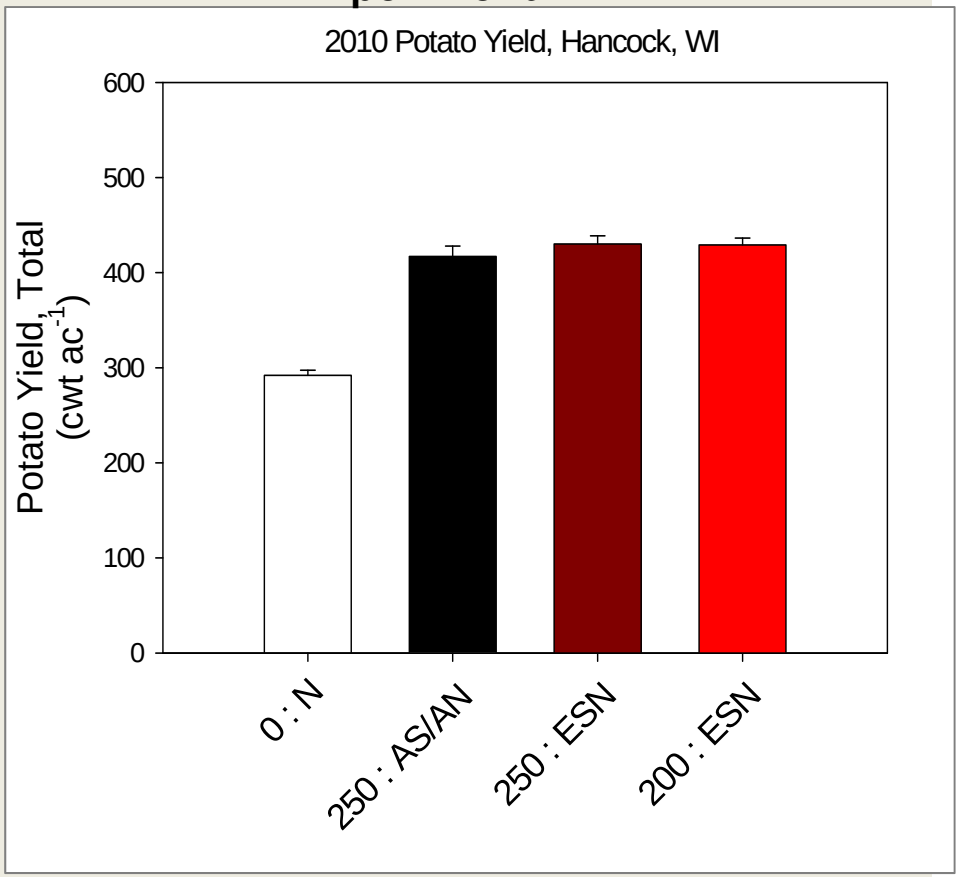

*All plots were fertigated to a total of 300 lb $ac^{-1}$ of N in 2009 and 500 lb $ac^{-1}$ of N in 2010.

# 2010 YIELDS

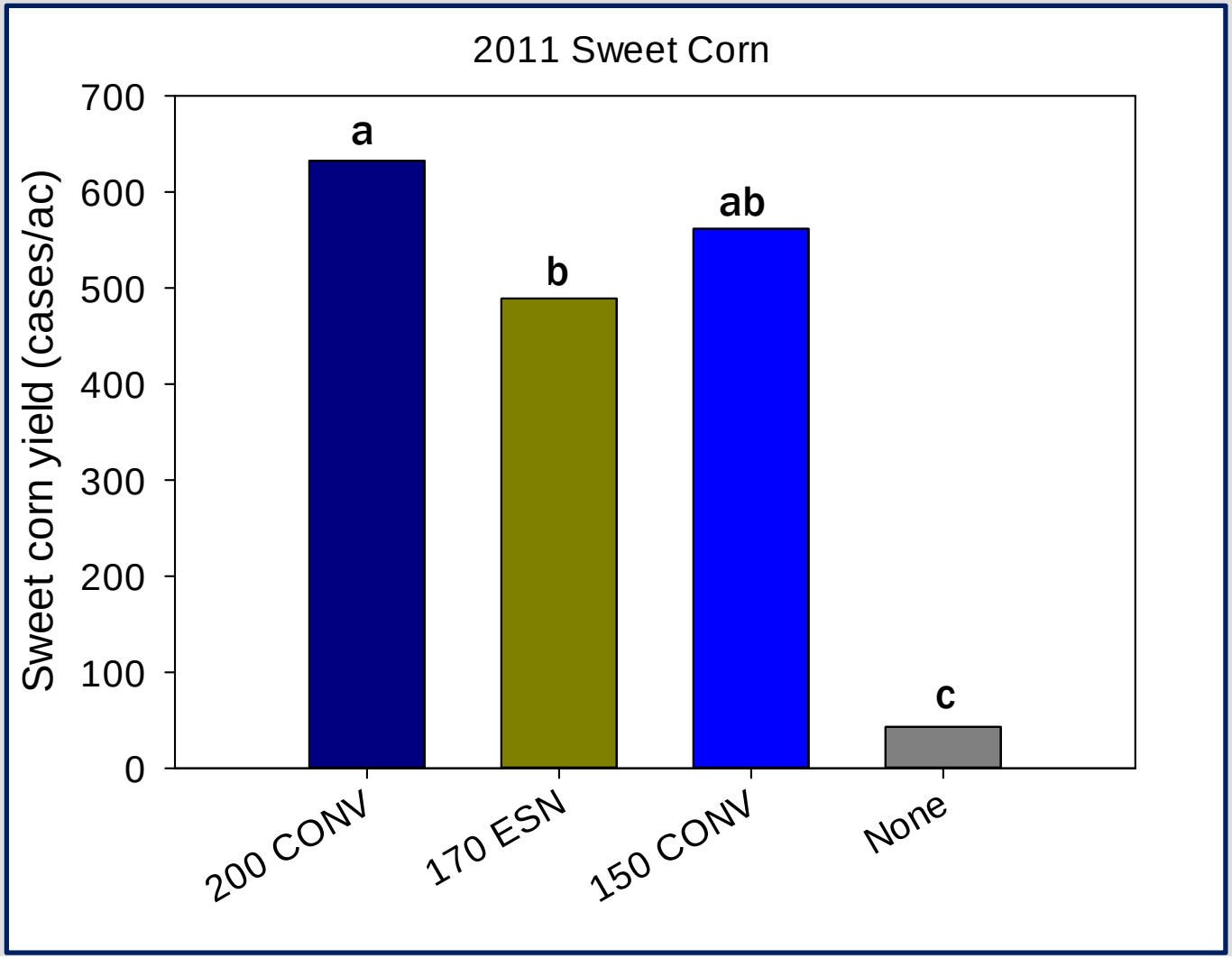
## Experiment #1



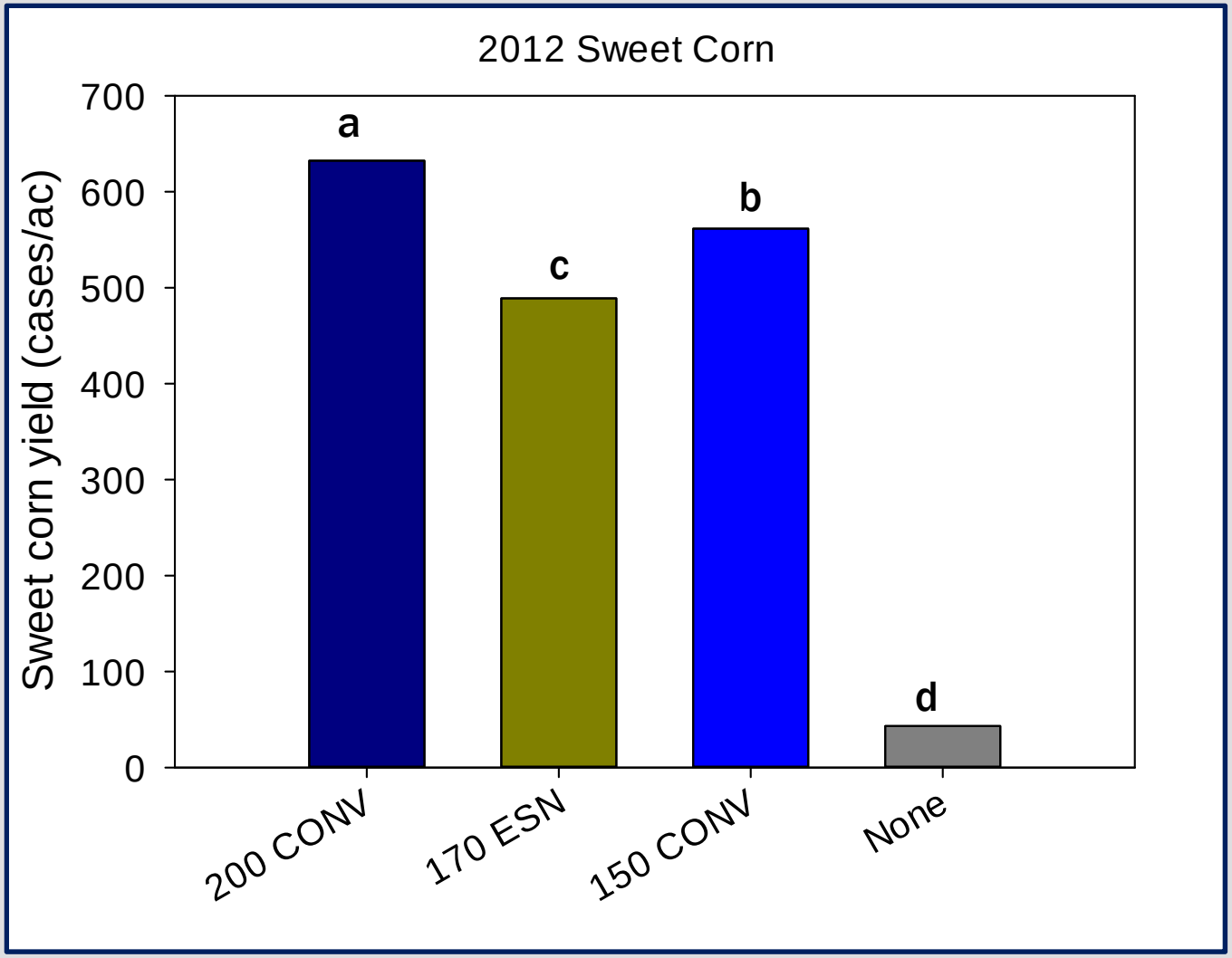

## Experiment #2

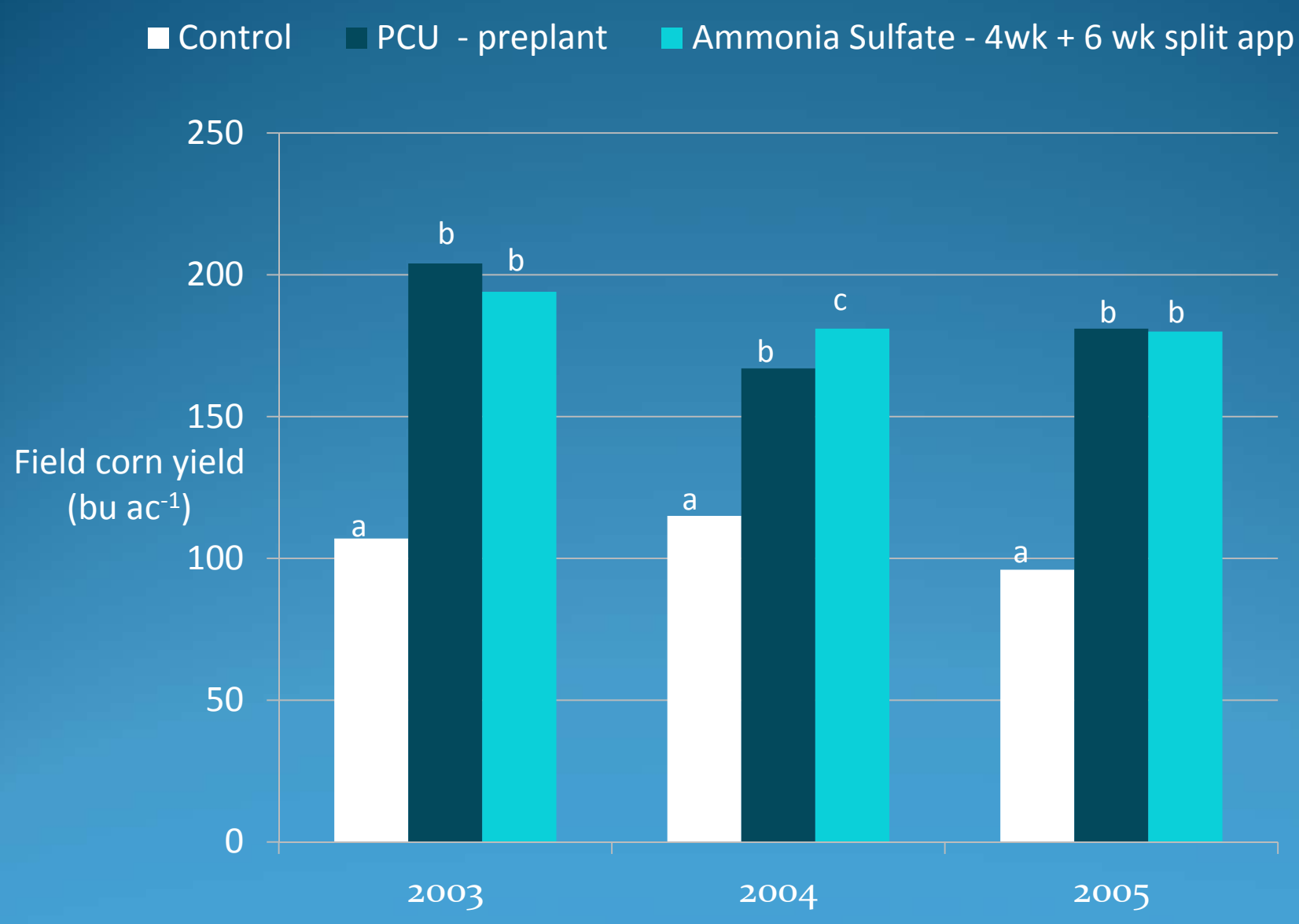


# 2011 YIELD


2011 Sweet Corn
Sweet corn yield (cases/ac)
700
600
500
400
300
200
100
0
a
b
ab
c
200 CONV
170 ESN
150 CONV
None

# 2012 YIELD


2012 Sweet Corn
Sweet corn yield (cases/ac)
700
600
500
400
300
200
100
0
a
b
c
d
200 CONV
170 ESN
150 CONV
None


Control
PCU - preplant
Ammonia Sulfate - 4wk + 6 wk split app
250
200
150
100
50
0
Field corn yield (bu ac-1)
a
b
b
a
b
c
a
b
b
2003
2004
2005

# Small plot summary

- ESN applied at same rates as conventional results in similar yields
  - Except in sweet corn*
- ESN applied at reduced rate has similar yields as full rate conventional
  - Most of the time

# EQIP: Environmental Quality Inceptives Program

- For conservation practices that protect soil and water quality.
- Agricultural producers on agricultural land are eligible.
- Ag producers may be eligible for up to $300,000 for the life of Farm Bill.

# CSP: Conservation Stewardship Program

- CSP offers participants two possible types of payments:
  - Annual payment for installing and adopting additional activities, and improving, maintaining, and managing existing activities
  - Supplemental payment for the adoption of resource-conserving crop rotations

# Barriers to adoption

- Yield concerns
- Practical management – how is the practice used
- Issues with scaling up
  - Damaged pells
  - Weather
  - Producers make decisions in real time (they change thier mind)
- Evaluation at scale

# Methods

- Growers determined treatments
- Researchers
  - Collect cover biomass prior to burn down/ plow down
  - Soil sampled at planting
  - In-season tissue samples
  - Whole plant samples hand harvest
  - Soils samples immediately following harvest

- Soil + plants samples will determine N-loss in season and NUE

# Methods

- **Growers determined treatments**
- Researchers
  - Collect cover biomass prior to burn down/ plow down
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- Soil + plants samples will determine N-loss in season and NUE

## Sweet corn applied nitrogen and yield

| Treatment | Preplant | Starter | Sidedress | Fertigation | Total N applied | Yield | |
|---|---|---|---|---|---|---|---|
| | (ESN) | | | | | mean | S.E. |
| | ---------- | | lbs N $ac^{-1}$ | ---------- | | tons $ac^{-1}$ | |
| ESN | 88 | 14 | 95 | 0 | 198 | 8.2 | 0.2 |
| CTL | 0 | 14 | 96 | 70 | 180 | 8.8 | 0.5 |

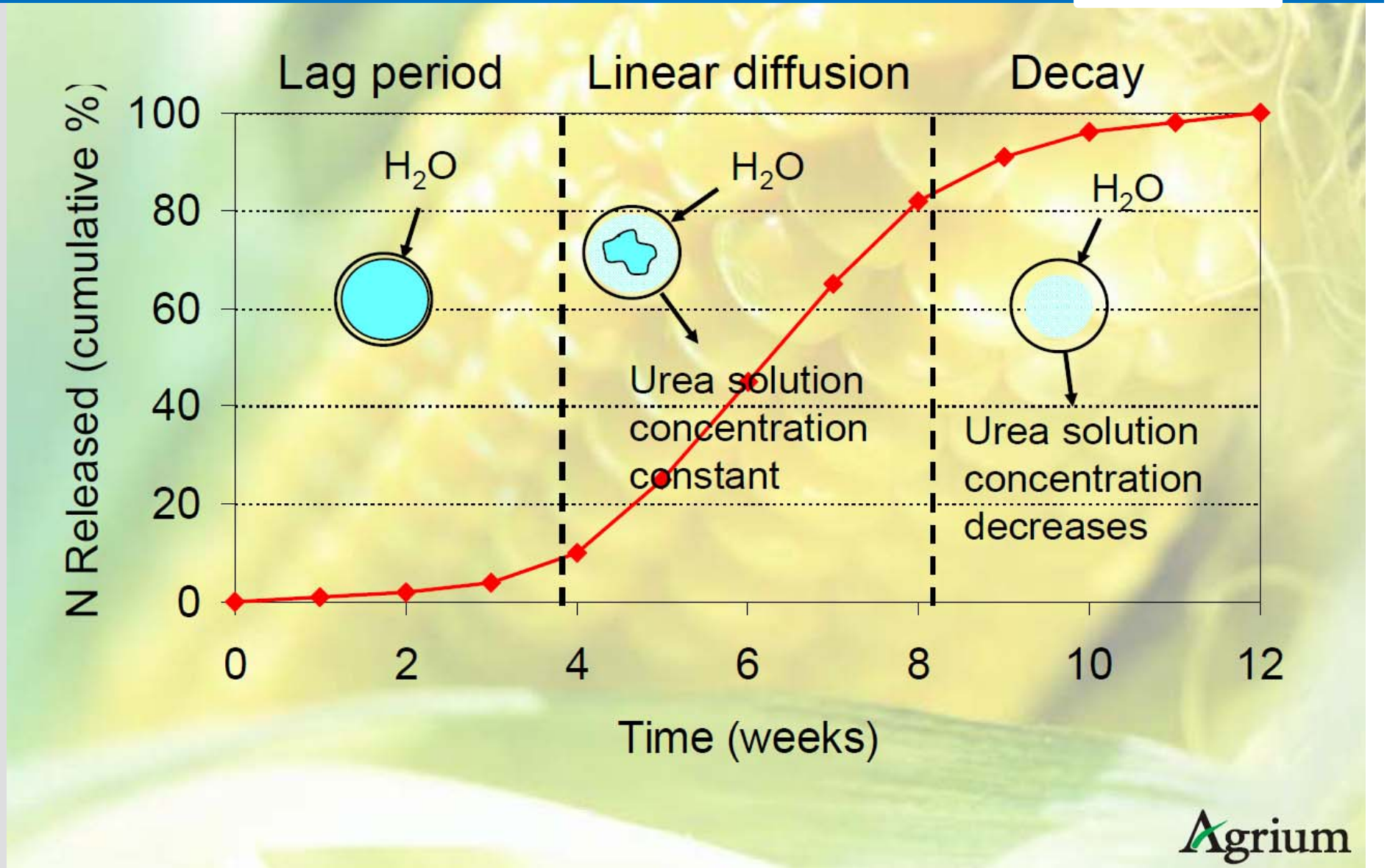
## Russet Burbank applied nitrogen and yield:

| Treatment | starter | UAN | Urea+ESN | Fertigation | AS | Total N applied | Yield | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | mean | S.E. |
| | | ---------- | lbs N $ac^{-1}$ | ---------- | | | -- cwt $ac^{-1}$ -- | |
| ESN | 21 | 77 | 46+132 | 0 | 0 | 275 | 397 | 29 |
| CTL | 21 | 77 | 0 | 88 | 21 | 206 | 441 | 28 |

Grower used petiole nitrate content to guide N-applications to control

## Field corn applied nitrogen

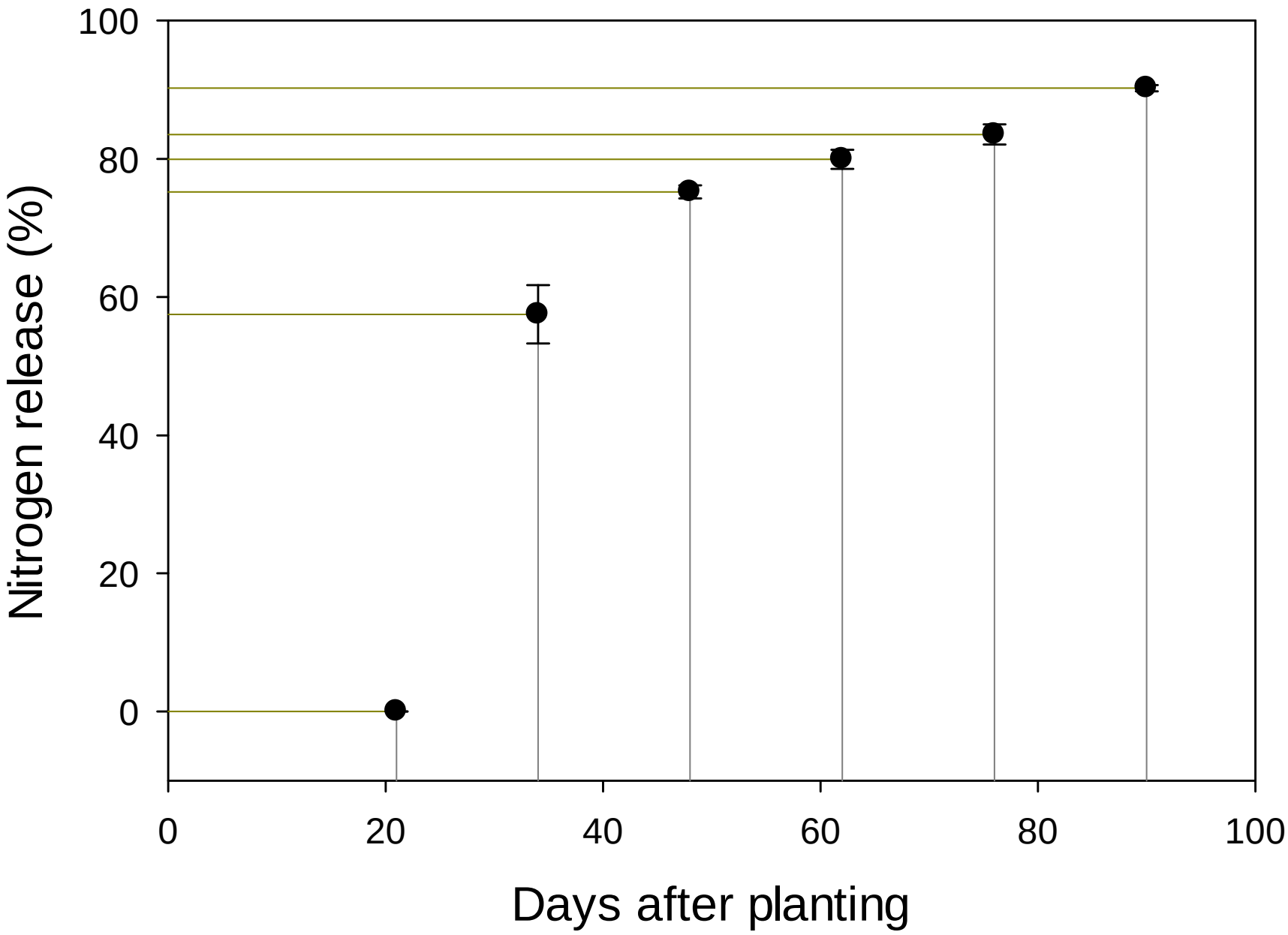
| Treatment | starter | sidedress | ESN | Fertigation | Total N applied | Yield | |
|---|---|---|---|---|---|---|---|
| | | | | | | mean | S.E. |
| | ---------- | ---------- | lbs N $ac^{-1}$ | ---------- | ---------- | Bu $ac^{-1}$ | |
| ESN | 21 | 120 | 110 | 0 | 251 | 242 | 13 |
| CTL | 21 | 113 | 0 | 64 | 198 | 296 | 22 |

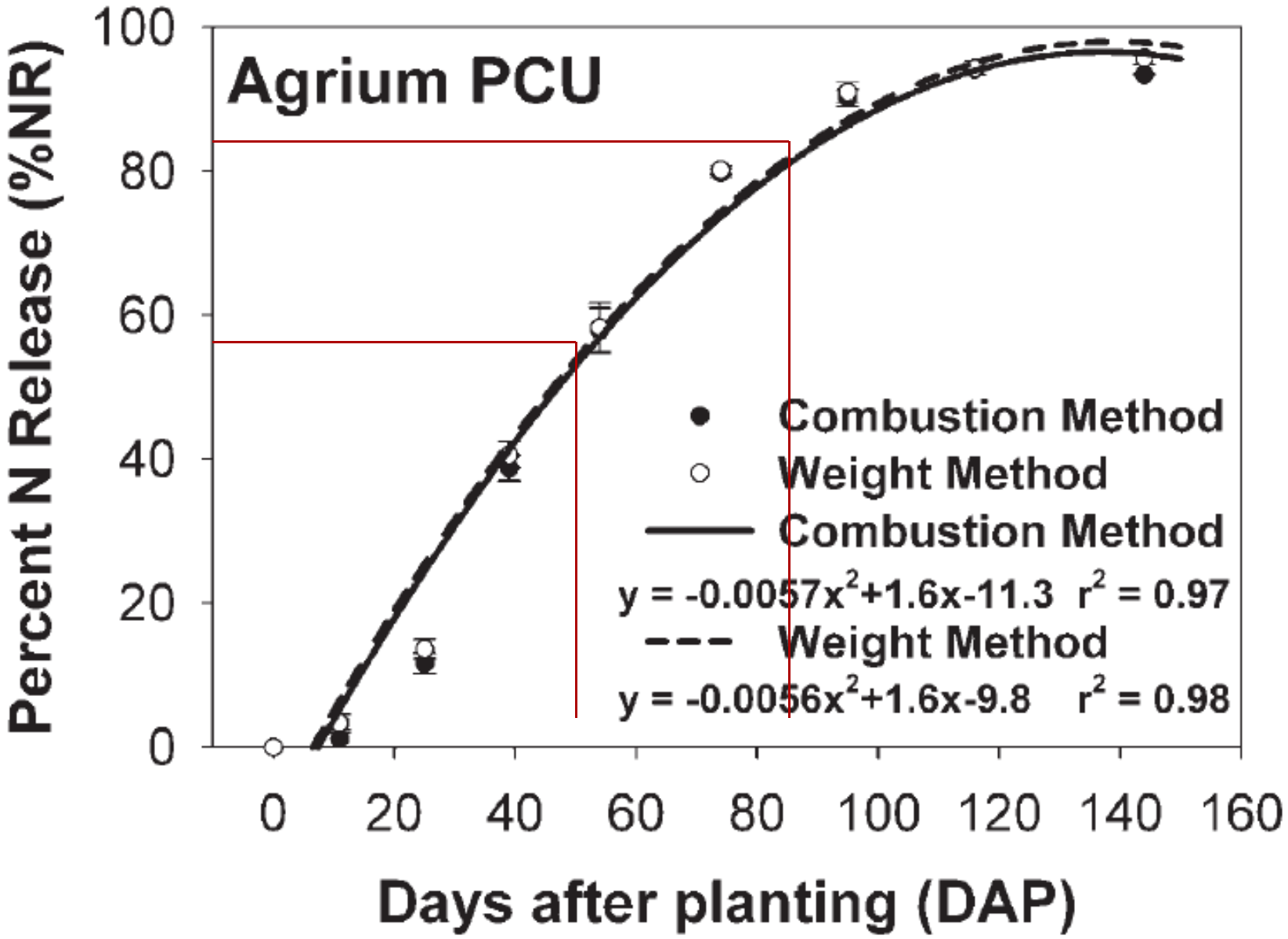

Lag period
Linear diffusion
Decay
N Released (cumulative %)
100
80
60
40
20
0
$H_2O$
$H_2O$
$H_2O$
Urea solution concentration constant
Urea solution concentration decreases
0
2
4
6
8
10
12
Time (weeks)

Agrium

# NITROGEN RELEASE FROM ESN COATINGS

- We buried a known amount of ESN in a mesh bag.
- Eight bags per plot, four reps
  - 250 ESN (no extra N)
- Weighted the remaining ESN
- The weight of the polymer is known


100
80
60
40
20
0
Nitrogen release (%)
0
20
40
60
80
100
Days after planting


Agrium PCU
Percent N Release (%NR)
100
80
60
40
20
0
0
20
40
60
80
100
120
140
160
Days after planting (DAP)
Combustion Method
Weight Method
Combustion Method
y = -0.0057x²+1.6x-11.3 r² = 0.97
Weight Method
y = -0.0056x²+1.6x-9.8 r² = 0.98

# Conclusions

- Use **strong caution before drawing conclusions** from one year worth of data
- ESN – no advantage on dry year: no leaching
- Field trails can be improved
  - Nitrogen contributed from irrigation water
  - More fields sites using ESN

# Future questions:

- ESN specific questions
  - 2012 release curve: abnormal or typical?
    - Damaged pells or environmental?
  - Use both ESN and conventional sources?
  - Application
    - Preplant or Sidedress
    - Preplant and sidedress

# Questions?

# N Source & timing effects on corn grain yield at Hancock, WI, 2003-2005

| N source | N timing | Year* 2003 | 2004 | 2005 |
|---|---|---|---|---|
| | | --- grain yield, bu/acre --- | | |
| Control | -- | 107 | 115 | 96 |
| PCU (ESN) | PP | 204NS | 167c | 186ab |
| | PP+4 wk | 205 | 180b | 189a |
| Am. Sulf. | PP | 196 | 132e | 175b |
| | PP+DCD | 202 | 136e | 183ab |
| | 4wk & 6 wk | 194 | 181b | 180ab |

* Yields shown are means of 150 and 200 lb N/acre rates.