Evaluation of Nitrogen Source and Rate on Tuber Yield and Quality in Old and New Potato Fields

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NPPGA Research Reporting Conference
February 18, 2014
Grand Forks, ND

Nitrogen Management

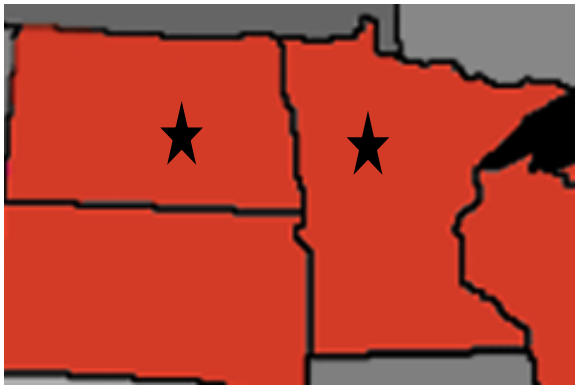
- Nitrate leaching losses continue to be a concern associated with production of irrigated potato in Minnesota and North Dakota

- Use of coated urea products such as ESN (44-0-0) or Duration (43-0-0) provides some insurance against losses during the season
  - Cost concerns
  - How do coated products compare with other N sources?
  - Most research is based on small plots at experiment stations

Overall Objectives

- Evaluate the effects of ESN rates and a blend of ESN and Duration on Russet Burbank yield and quality in on-farm settings (ESN obtained from airboom)
  - Comparisons with uncoated urea, and ammonium sulfate on yield and quality
- Compare potato N response in a field without a previous history of potato to response in a field with a long potato history

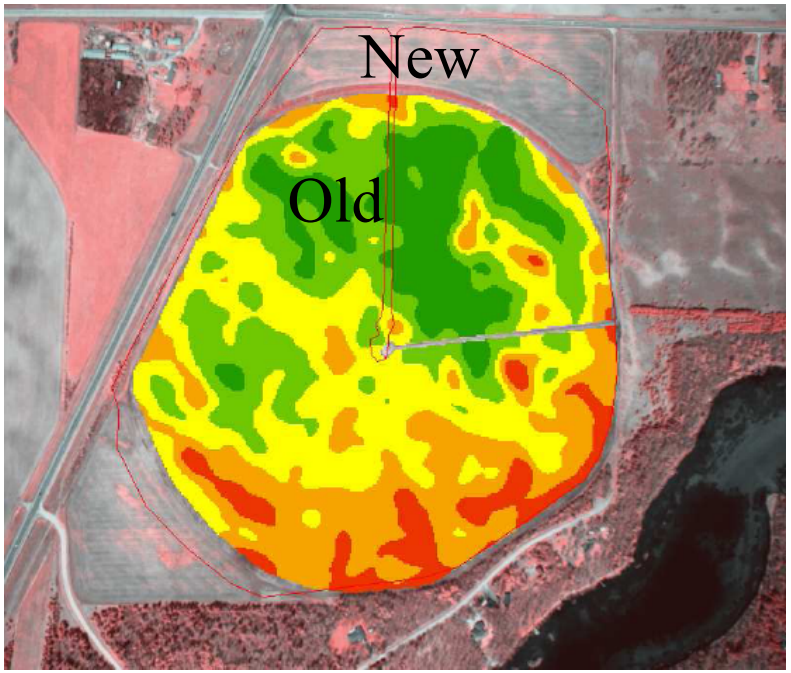
On-farm Studies Conducted in 2013



- Park Rapids
  - ESN rate; urea; Duration/ESN blend; ammonium sulfate
  - “Old” field vs. “New” field effects
- Dawson
  - ESN rate; urea; Duration/ESN blend; ammonium sulfate

Park Rapids - 2013

- Two fields – “Old” and “New”
- Old field was fumigated
- Nine N treatments
- 4 Replications
- 6, 40’ rows,
- Planted – May 11
- Sidedress N – May 28
- Harvest – September 17



2012 – NIR Aerial

Soil Test Results

New Field

- pH: 6.1
- OM: 1.7%
- Texture: Loamy sand
- P: 120 ppm
- K: 162 ppm

Old Field

- pH: 5.9
- OM: 0.7%
- Texture: Sand
- P: 115 ppm
- K: 125 ppm

Nine Nitrogen Treatments

Total N rate	Emergence N rate	N Source at Emergence
--------- lb N/A ---------		
105	0	----
185	80	ESN
225	120	ESN
265	180	ESN
305	200	ESN
345	240	ESN
225	120	Urea
225	120	AMS
225	60+60	ESN/Dur

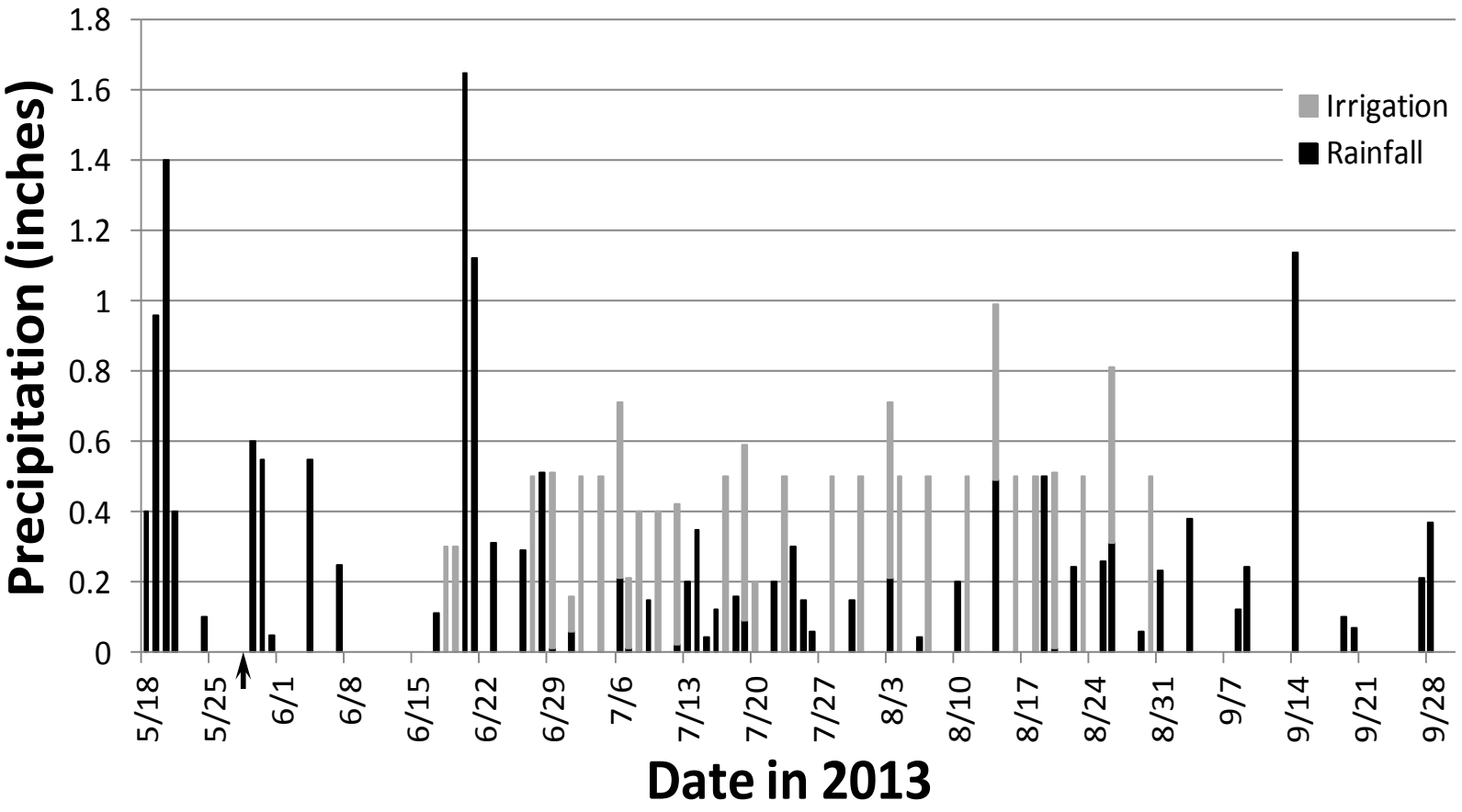
Preplant - 100 lb/A AMS
(May8) 60 lb/A Urea
525 lb/A 5-8-13

Planting - 18.8 gal 10-34-0/A

July 1 - 4.7 gal ATS/A
3.2 gal 32%/A
July 7 - 4.8 gal ATS/A
3.2 gal 32%/A

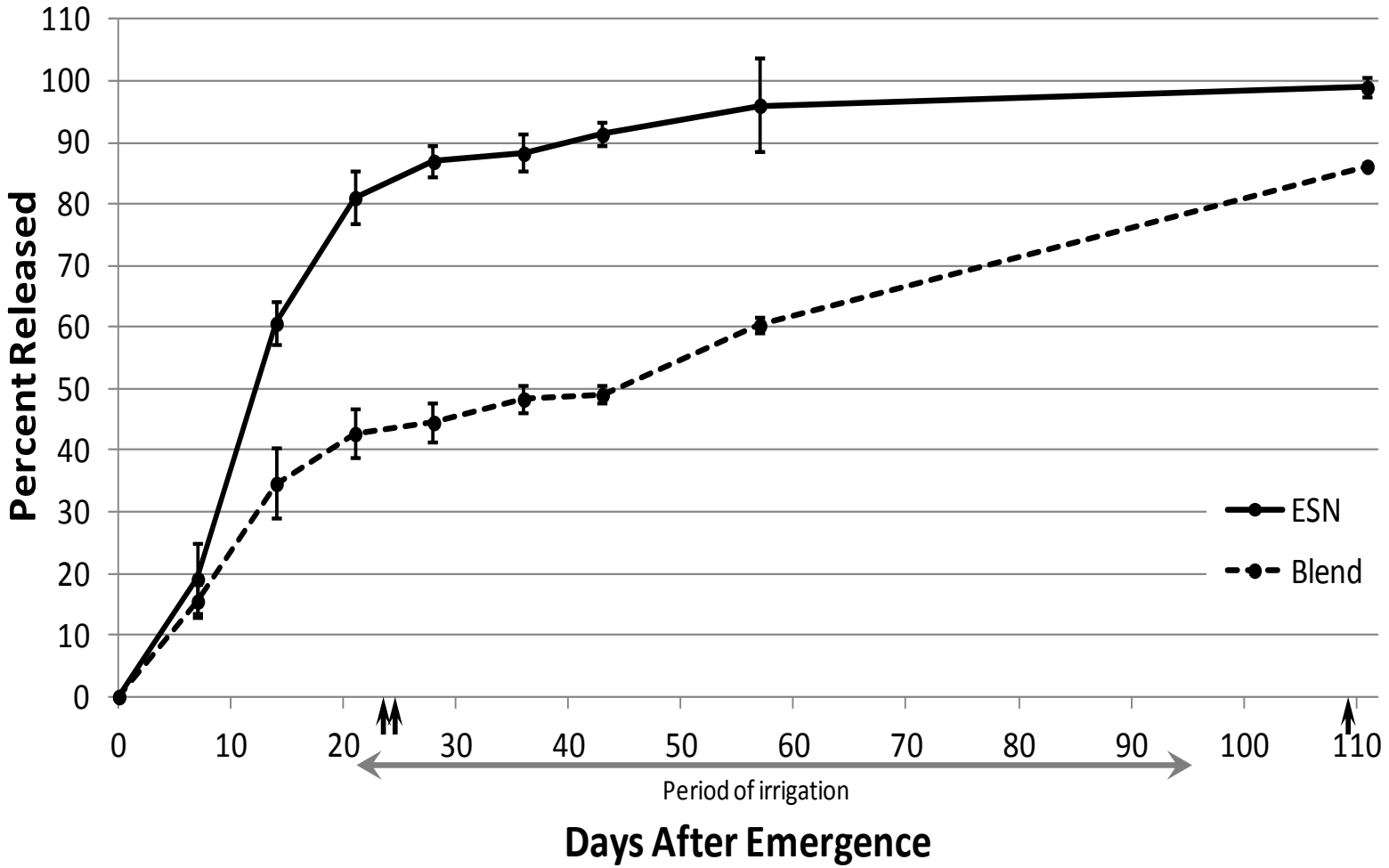
Total soluble N: 105 lb/A

Rainfall and Irrigation at Park Rapids – Lepp Field

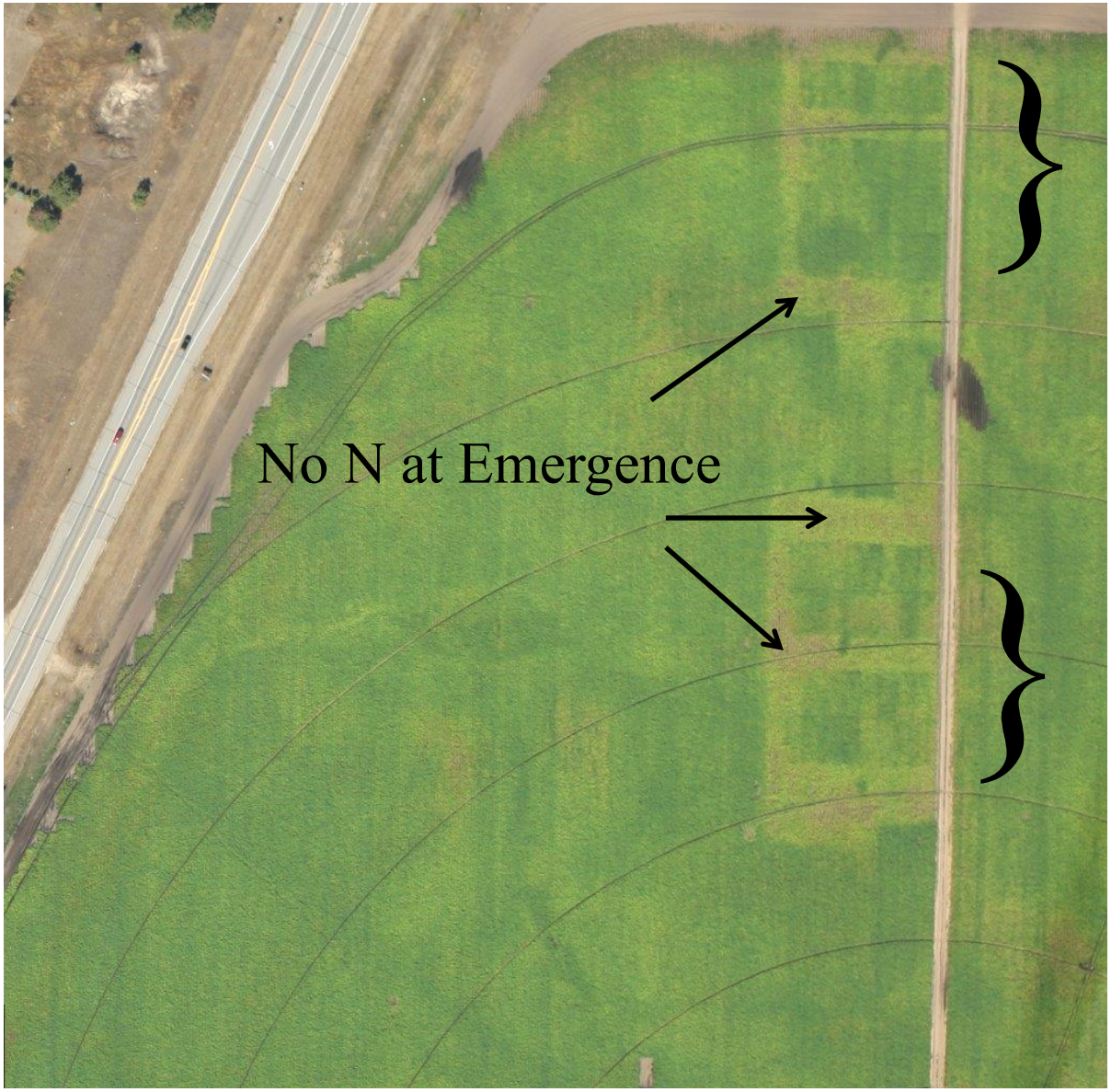


N Release from ESN & ESN/Dur. Blend

-- 2013 --



Mid-season
Aerial Photo


No N at Emergence
"New" Field Plots
"Old" Field Plots

Statistical Analysis - Yield

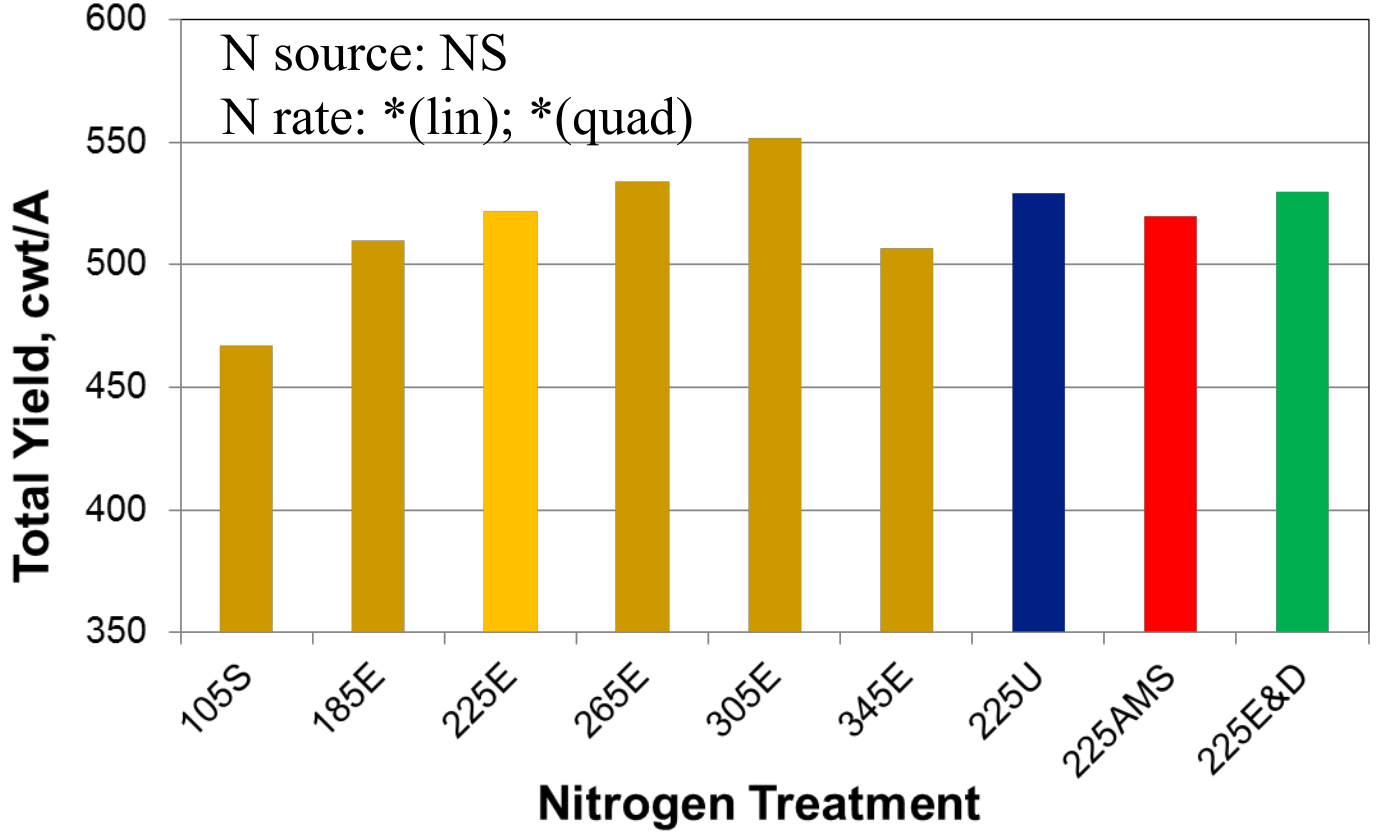
-- Park Rapids 2013 --

Source of Variation	Total Yield	Marketable Yield	% > 6
N Treatment	NS	*	**
N rate	*	**	**
N source	NS	NS	NS
Field	++	NS	**
Field x N Trt	NS	NS	NS

**,*,++ = significant at 1%, 5%, and 10%, respectively

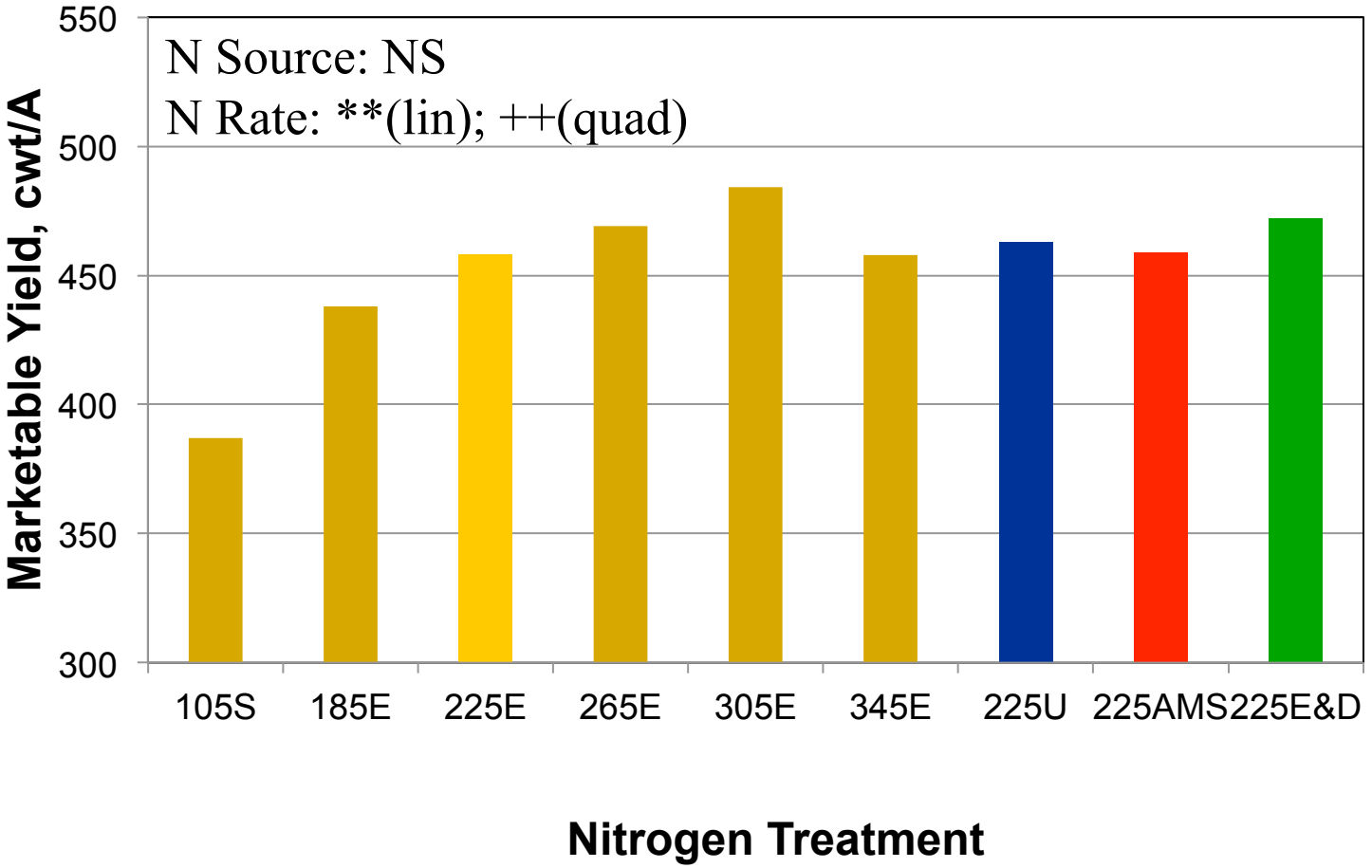
Total Yield – Park Rapids 2013

% > 6 oz: 37 45 52 54 54 61 49 50 54



Field average total yield at 286 lb N/A, 432 cwt/A; % > 6 oz, 43

Marketable Yield – Park Rapids, 2013



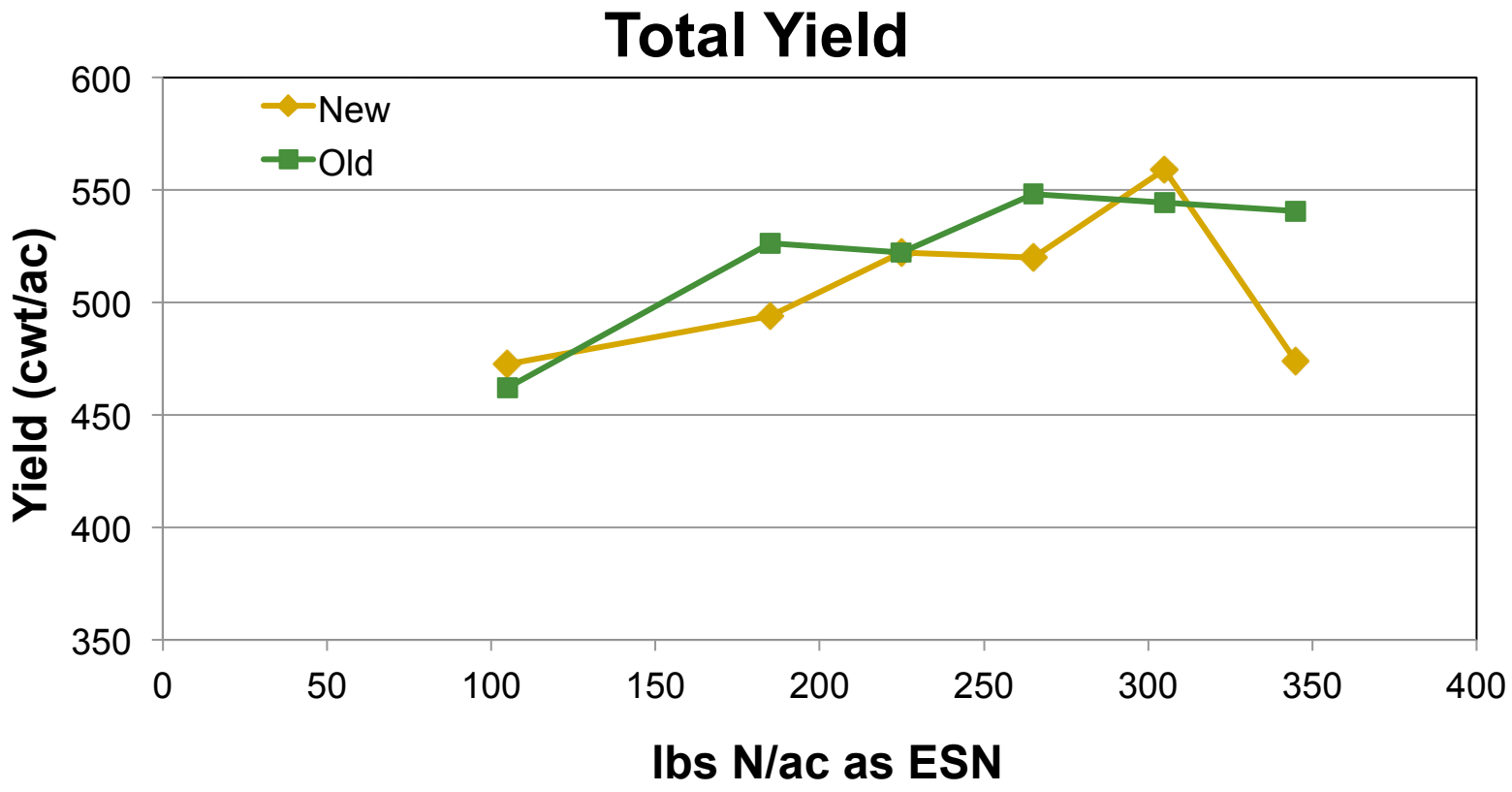
Field average marketable yield at 286 lb N/A, 341 cwt/A

Economic Analysis – Marketable Yield

lb N/A N rate	Nitrogen Source	Market Yield, cwt/A	gain or loss over 105 control	gain or loss over 105 control
105		387	$0.0	$0.0
185	ESN	438	$251.6	$302.6
225	ESN	458	$344.4	$415.4
265	ESN	469	$383.2	$465.2
305	ESN	484	$446.0	$543.0
345	ESN	458	$262.8	$333.8
225	Urea	463	$394.8	$470.8
225	AMS	459	$318.0	$390.0
225	ESN / Duration	472	$416.4	$501.4
			$6/cwt	$7/cwt

2013 N Prices:
Urea – $0.51/lb N
AMS - $0.95/lb N
ESN - $0.68/lb N
ESN/Dur Blend – $0.79/lb N

N Rate by Field Interaction (NS)



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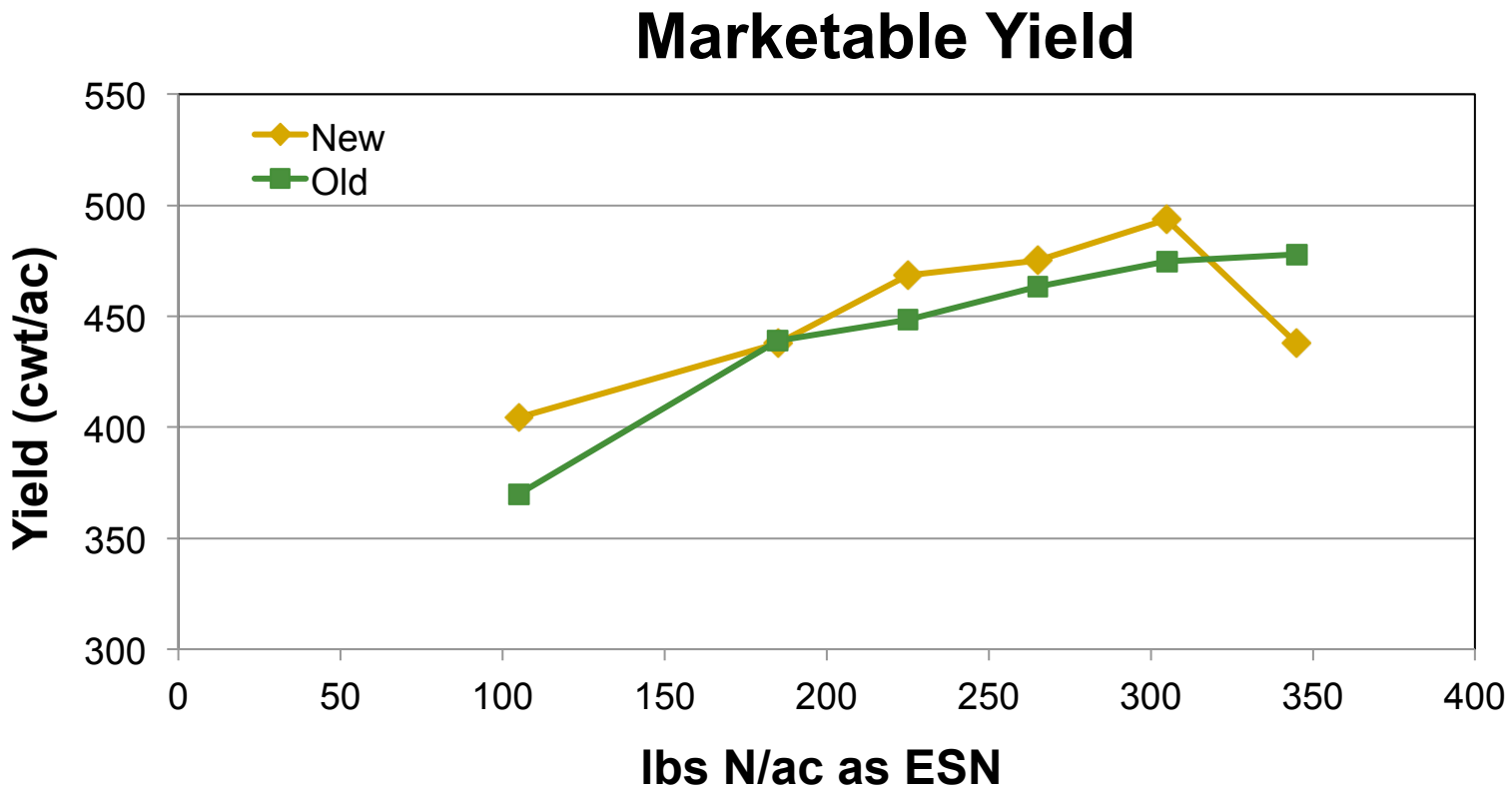

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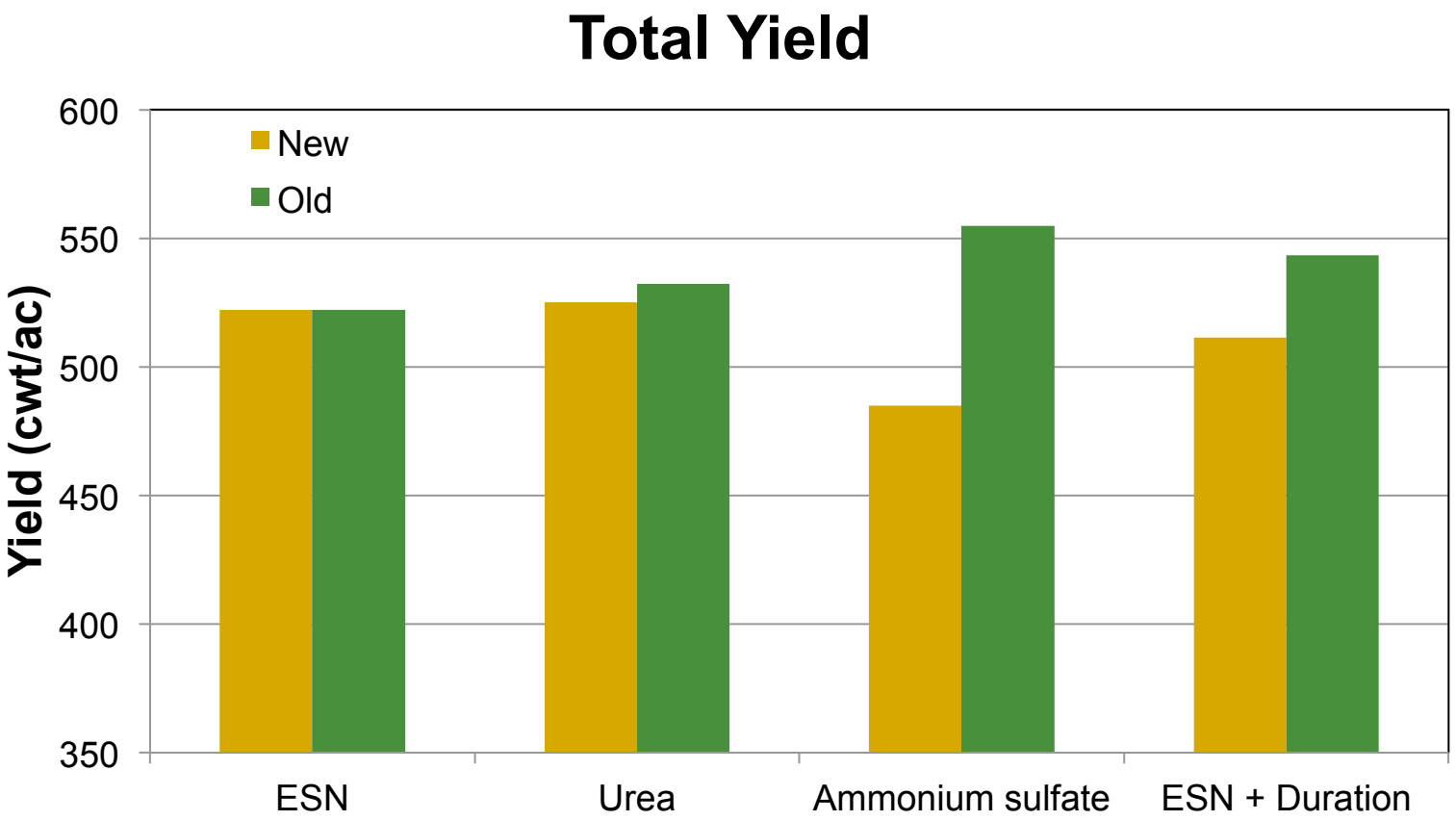

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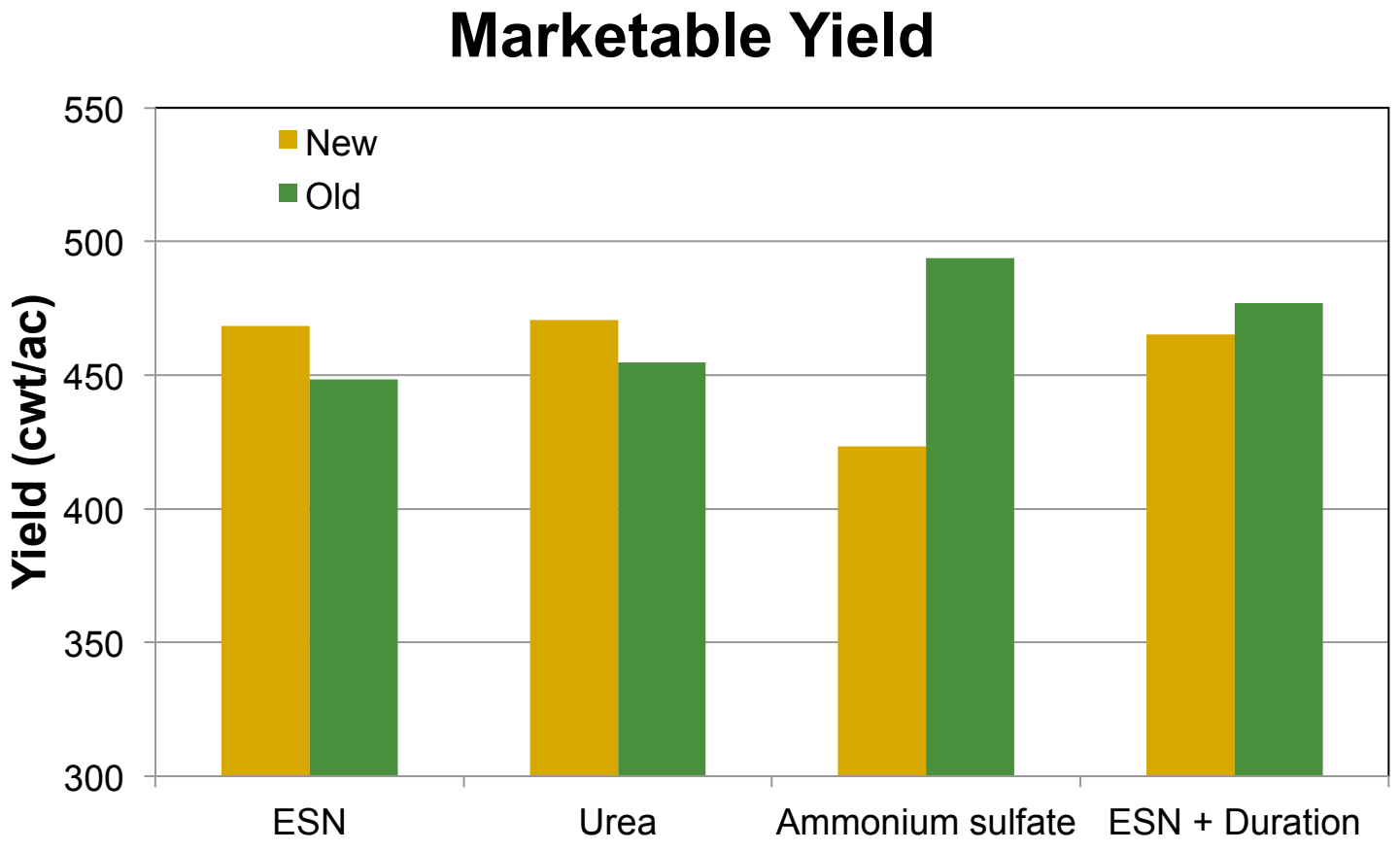


Old Field vs. New Field

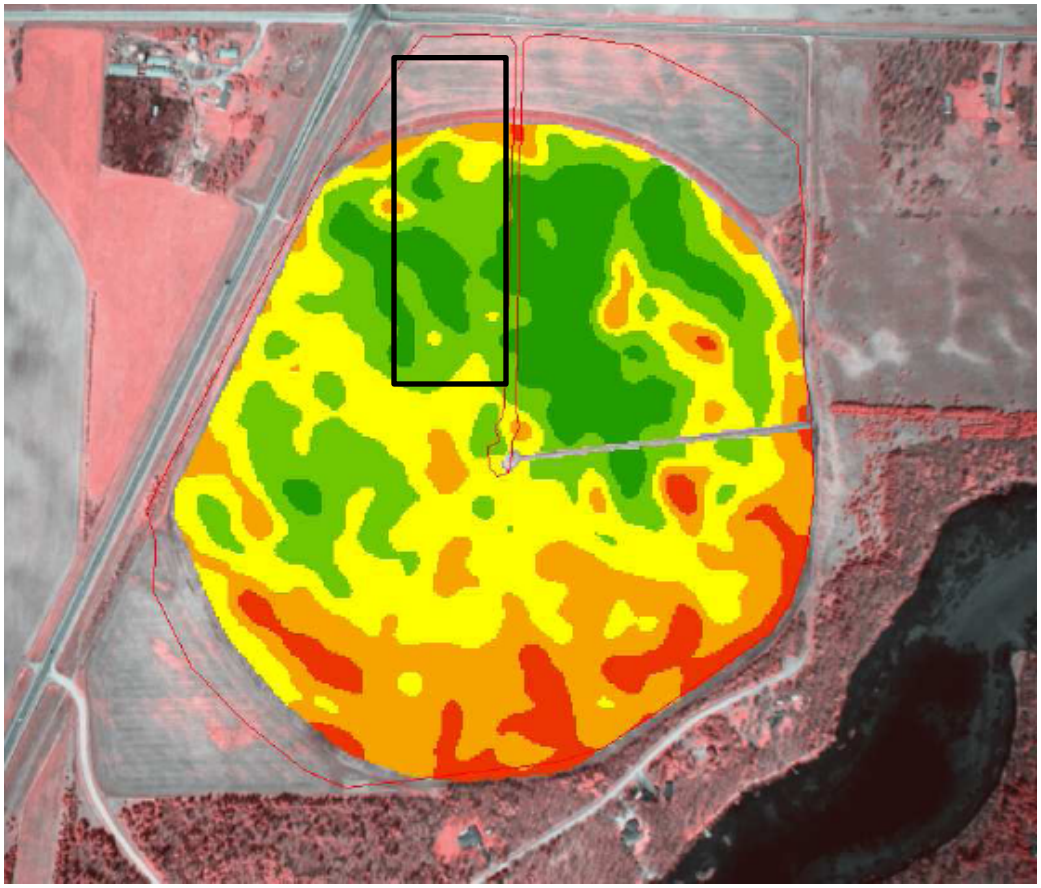
Field	Total Yield	Marketable Yield	% > 6oz
	--------- cwt/A ---------		
Old	530	453	45
New	507	455	56
Significance	++	NS	**

**,*,++ = significant at 1%, 5%, and 10%, respectively

Field average % > 6 oz at 286 lb N/A, 43%
Field average total yield at 286 lb N/A, 432 cwt/A
Field average marketable yield at 286 lb N/A, 341 cwt/A

Why Did Bulk Field Have a Lower Yield?

- Plot area was in better ground (green)
- Bulk of field in poorer soil?



Park Rapids Summary

- N source effect was not significant for yield
- N rate effect was significant in old and new fields – optimal rate was between 260 and 300 lb N/A
- Total tuber yield was not affected by field, but tuber size was larger in the new field
- Higher set and higher incidence of Vert. in the old field

Dawson Study - 2013

- Eight N treatments
- 4 Replications
- Planted – May 18
- Emergence – June 13
- Harvest – October 1
- Soil test:
  - OM – 1.6
  - **pH – 8.1**

Eight Nitrogen Treatments

Total N rate	Emergence N rate	N Source at Emergence
---------- lb N/A ----------		
164	0	ESN
224	60	ESN
284	120	ESN
344	180	ESN
404	240	ESN
284	120	Urea
284	120	AMS
284	120	ESN&Dur

Preplant: 21-0-0-24: 60 lbN/A

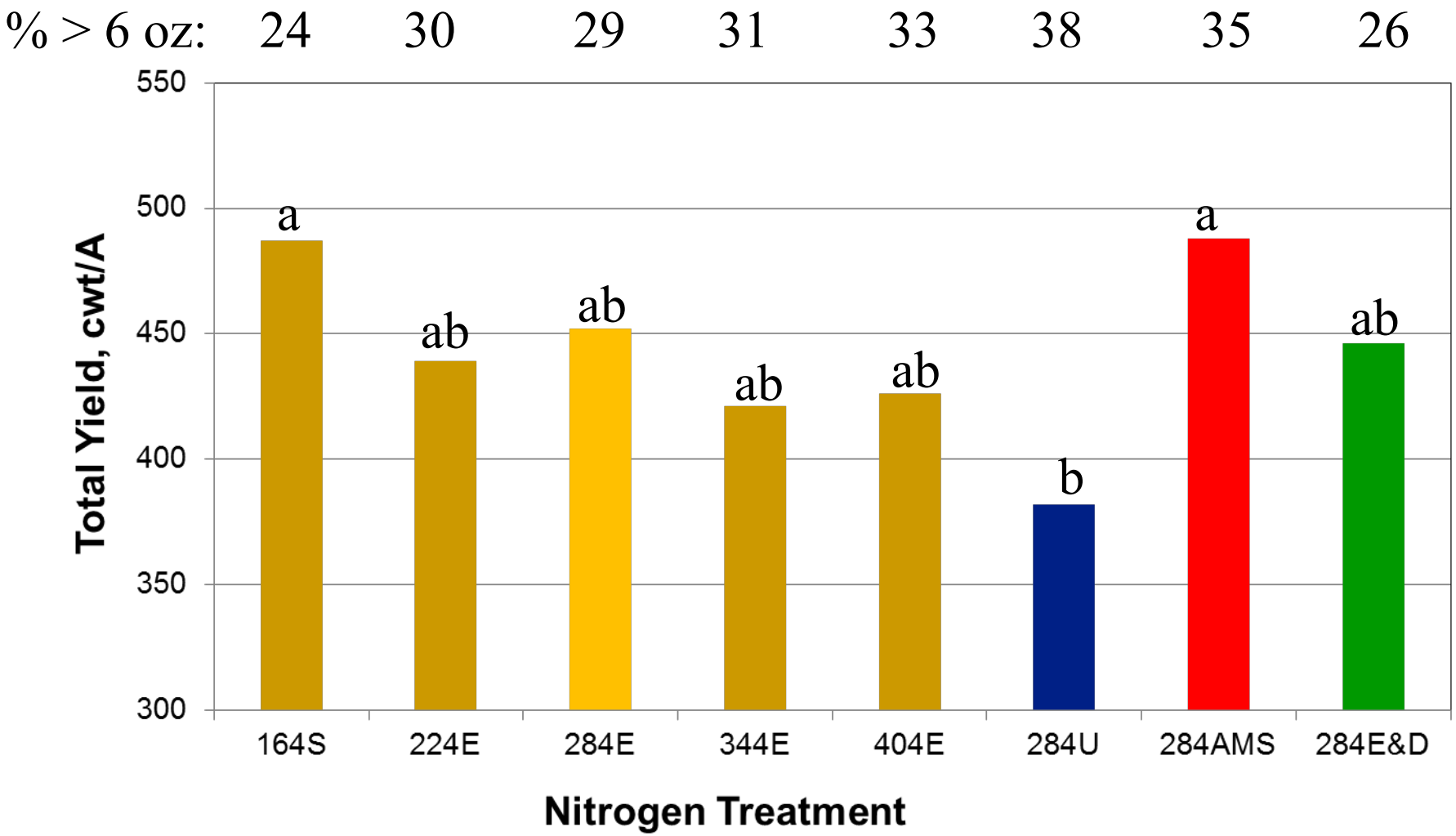
Planting - 10-34-0: 37 lb N/A

Sidedress – 28-0-0: 30 lb N/A

Fertigation – 28-0-0 38 lb N/A

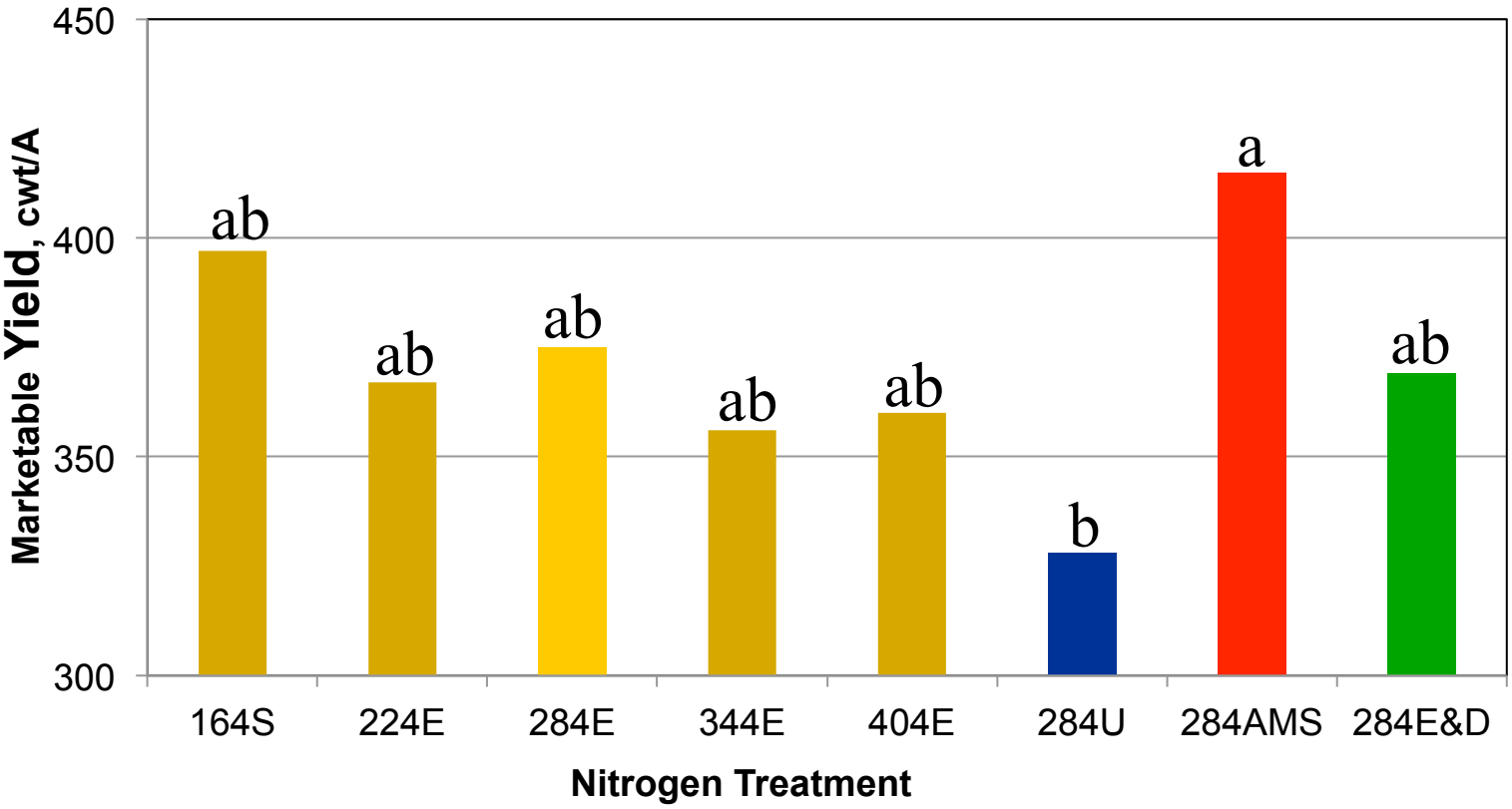
Total soluble N: 164 lb/A

Total Yield



Field total yield with 328 lb N/A – 487 cwt/A; % > 6 oz = 54

Marketable Yield



Economic Analysis – Marketable Yield

lb N/A N rate	Nitrogen Source	Market Yield, cwt/ A	gain or loss over 164 control	gain or loss over 164 control
164		397	$0.0	$0.0
224	ESN	367	-$220.8	-$250.8
284	ESN	375	-$213.6	-$235.6
344	ESN	356	-$368.4	-$409.4
404	ESN	360	-$385.2	-$422.2
284	Urea	328	-$475.2	-$544.2
284	AMS	415	-$6.0	$12.0
284	ESN / Dur	369	-$262.8	-$290.8
			$6/cwt	$7/cwt

2013 N Prices:

Urea – $0.51/lb N

AMS - $0.95/lb N

ESN - $0.68/lb N

ESN/Dur Blend – $0.79/lb N

Dawson Summary

- Urea as the N source significantly reduced yield compared to other N sources and no added N
  - Possibly due to high soil pH
- Ammonium sulfate resulted in numerically highest yields, but statistically yields were similar to ESN and no added N
- Poor tuber size and lack of N response are difficult to explain

Take Home Messages

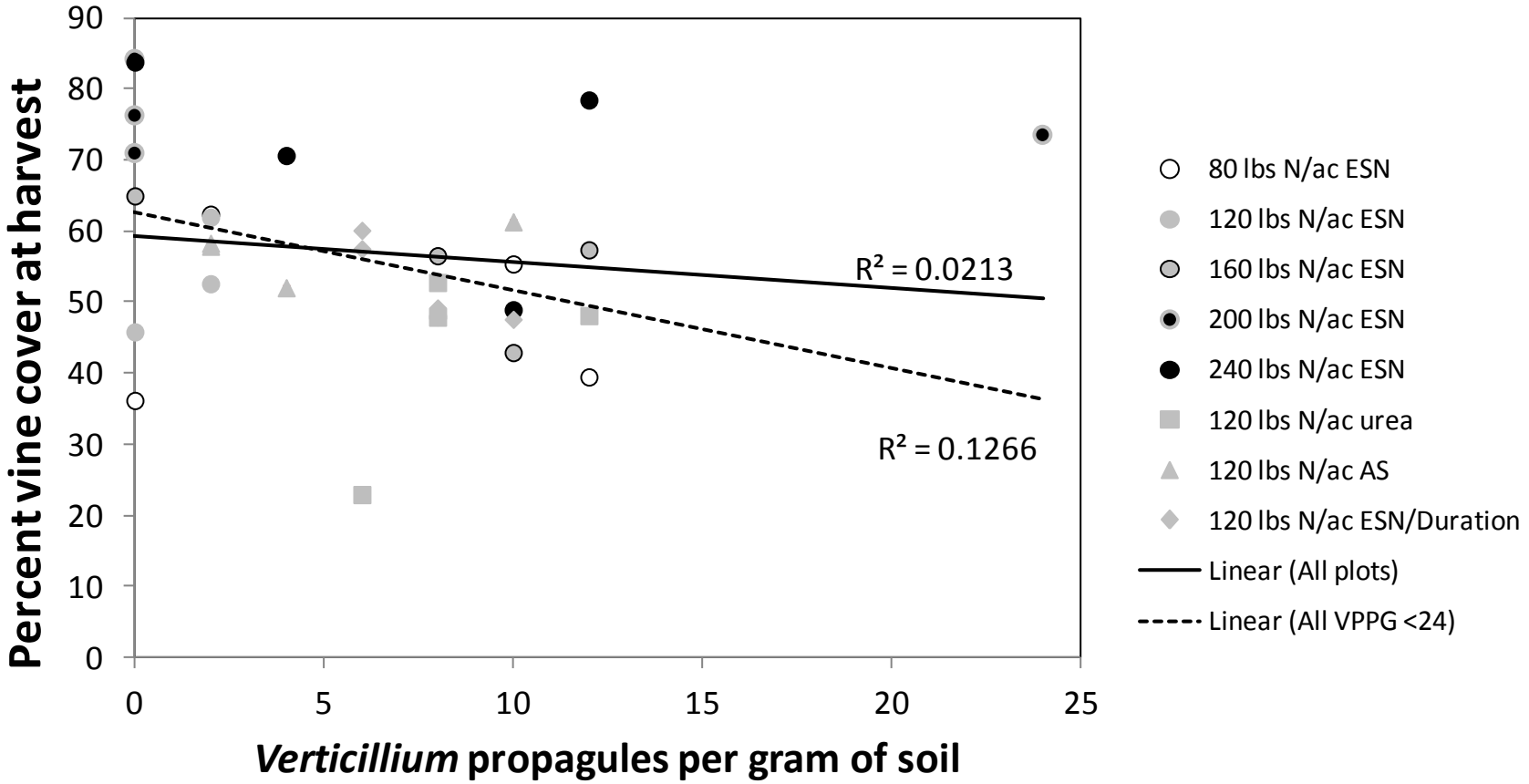
- In 2013, rate of N was more important than source of N at the Park Rapids site
- Urea as a main N source on high pH (~8.0) soils should be avoided – Dawson site
- Field history affected tuber set
  - Lower set in fields without potato history (less disease)
  - Higher set in older potato fields (more disease)
    - Reasons for this are not clear

Questions???

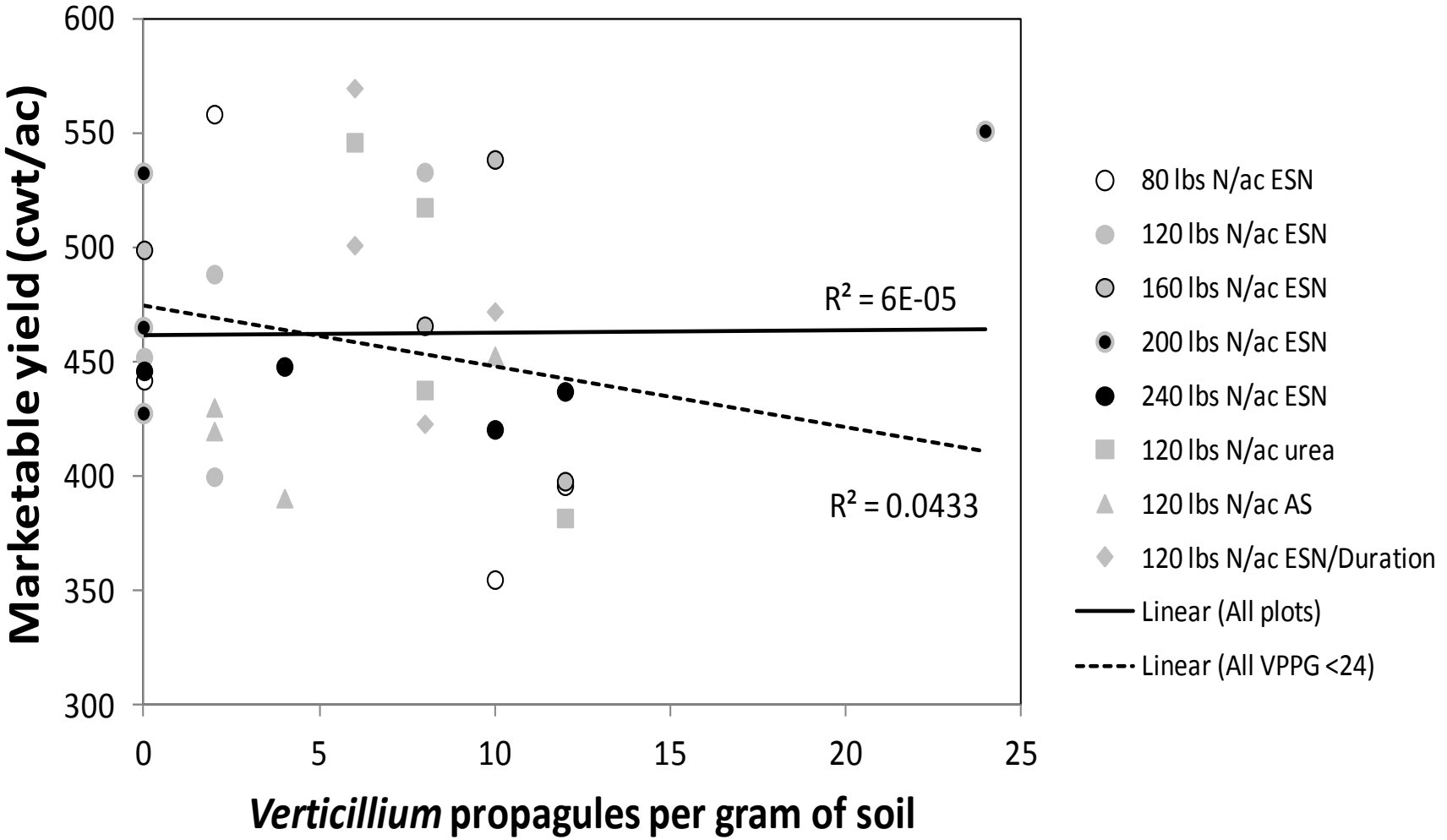
Verticillium

- Old Field
  - 25 of 32 plots positive for vert
  - 15 plots 8 or greater VPPG
  - Range: 0 to 24 VPPG
  - Average: 6.2 VPPG
- New Field
  - 2 of 32 plots positive for vert
  - 2 or less VPPG

Vert. and Vine cover at Harvest

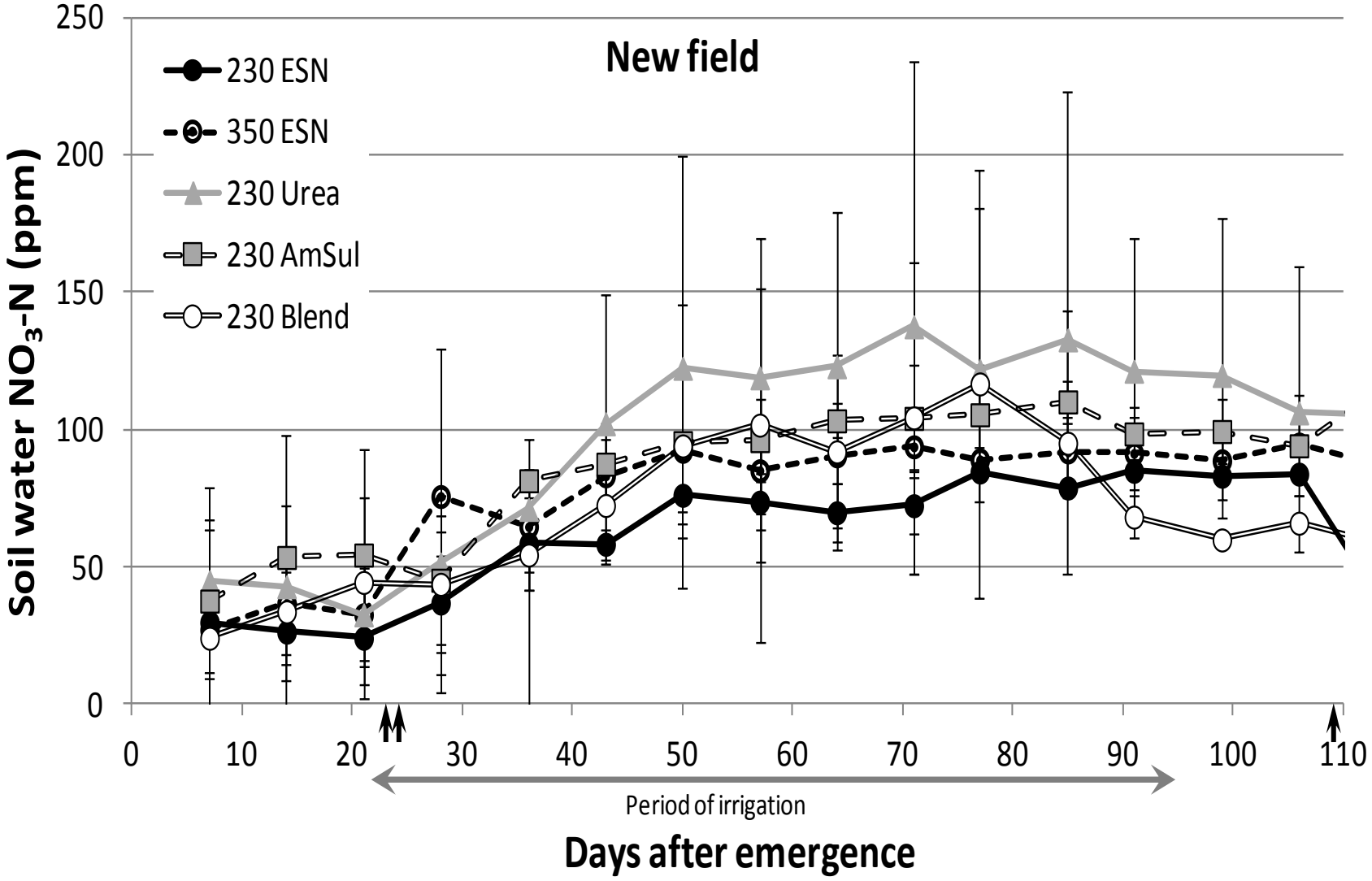


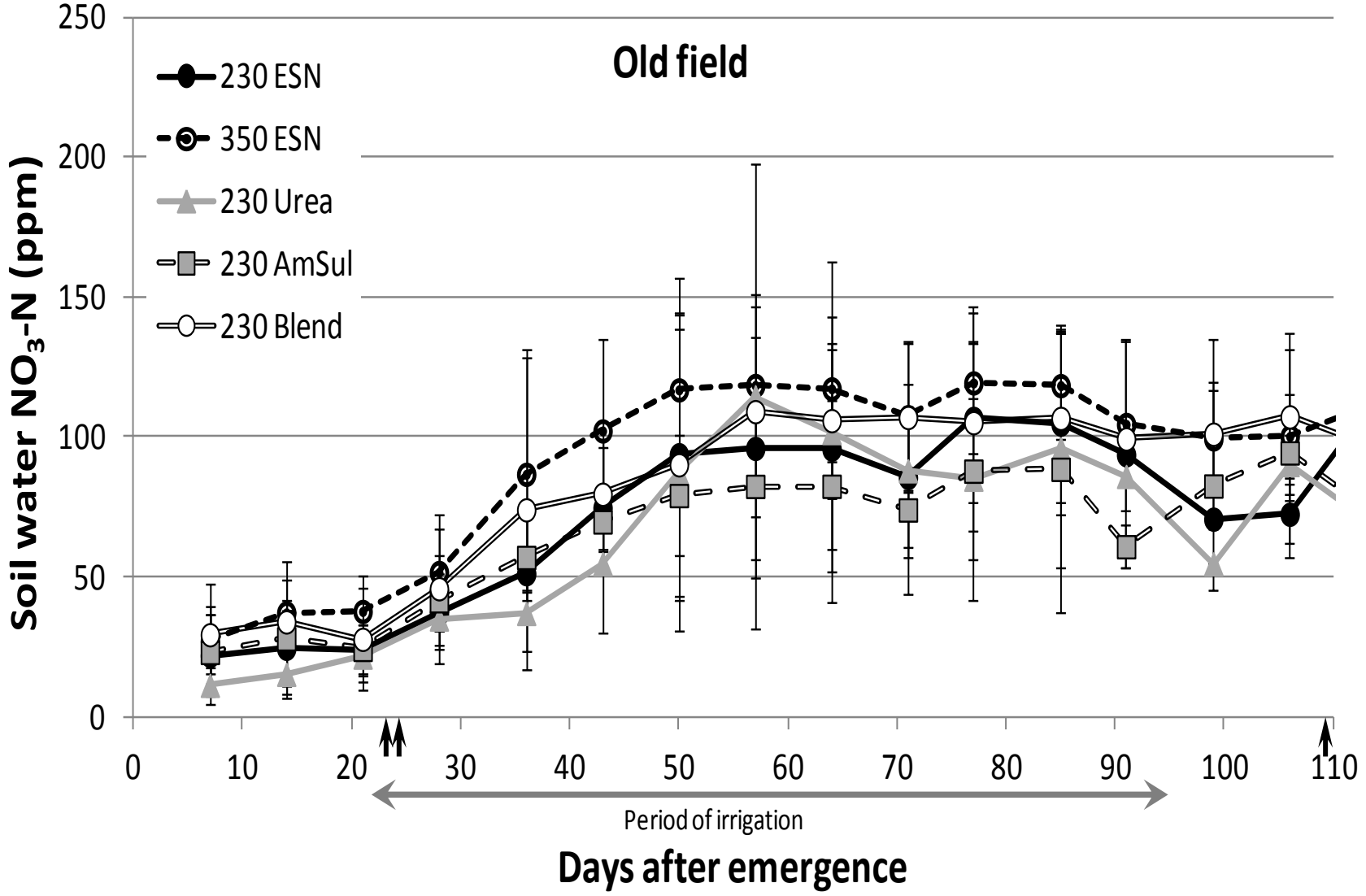
Vert. and Marketable Yield



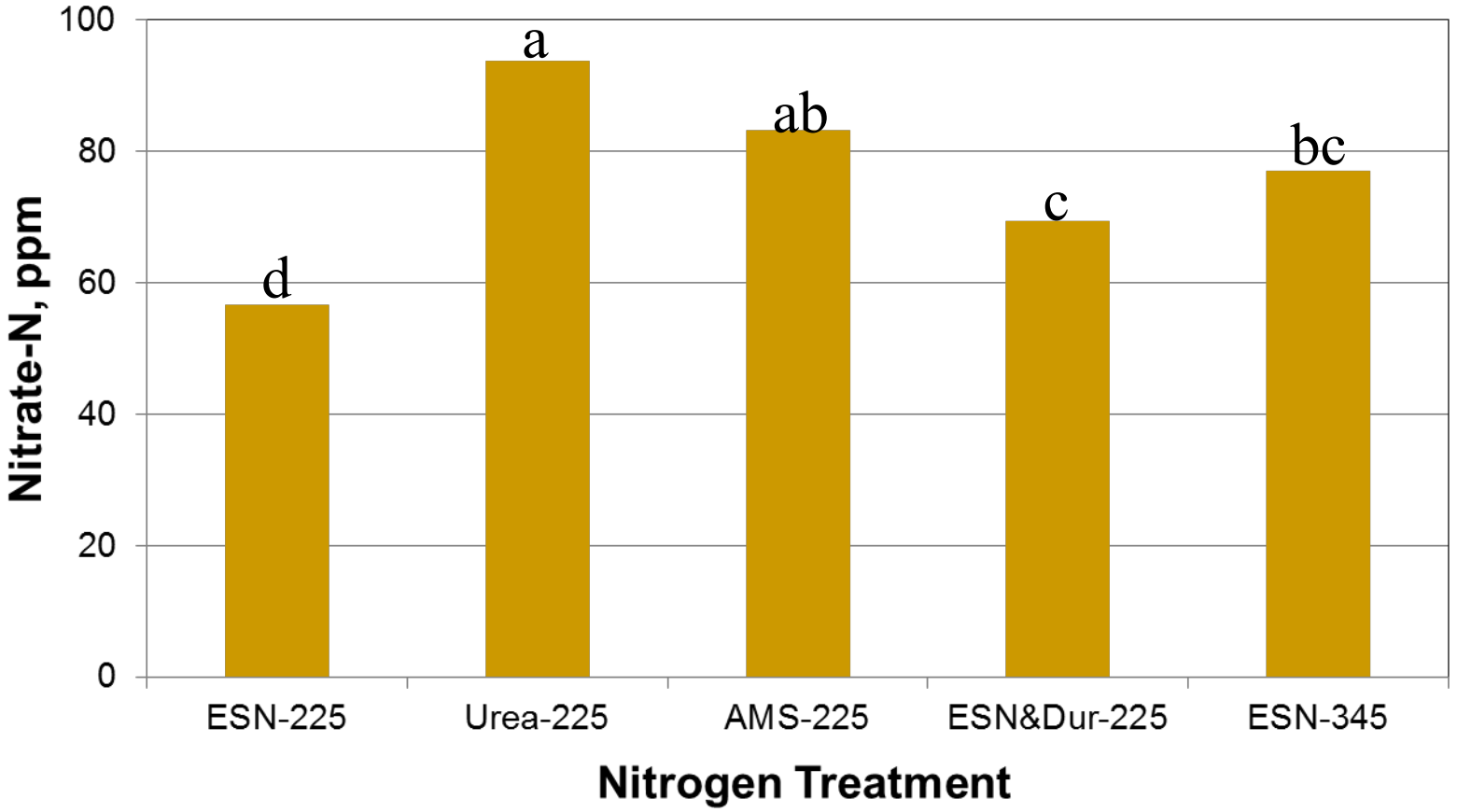
Nitrate Leaching

- On any given date, nitrate-N concentrations were not affected by N treatment
- When averaged over all dates, concentrations were affected by treatment but the response was not consistent between fields


New field
230 ESN
350 ESN
230 Urea
230 AmSul
230 Blend
Soil water NO3-N (ppm)
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
110
Period of irrigation
Days after emergence


Old field
230 ESN
350 ESN
230 Urea
230 AmSul
230 Blend
Soil water NO_3-N (ppm)
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
110
Period of irrigation
Days after emergence

New Field – Nitrate-N Concentrations



Old Field Nitrate-N Concentrations