Evaluation of nitrogen application methods, rates, and algorithm on corn under different soil electrical conductivity (EC) zones

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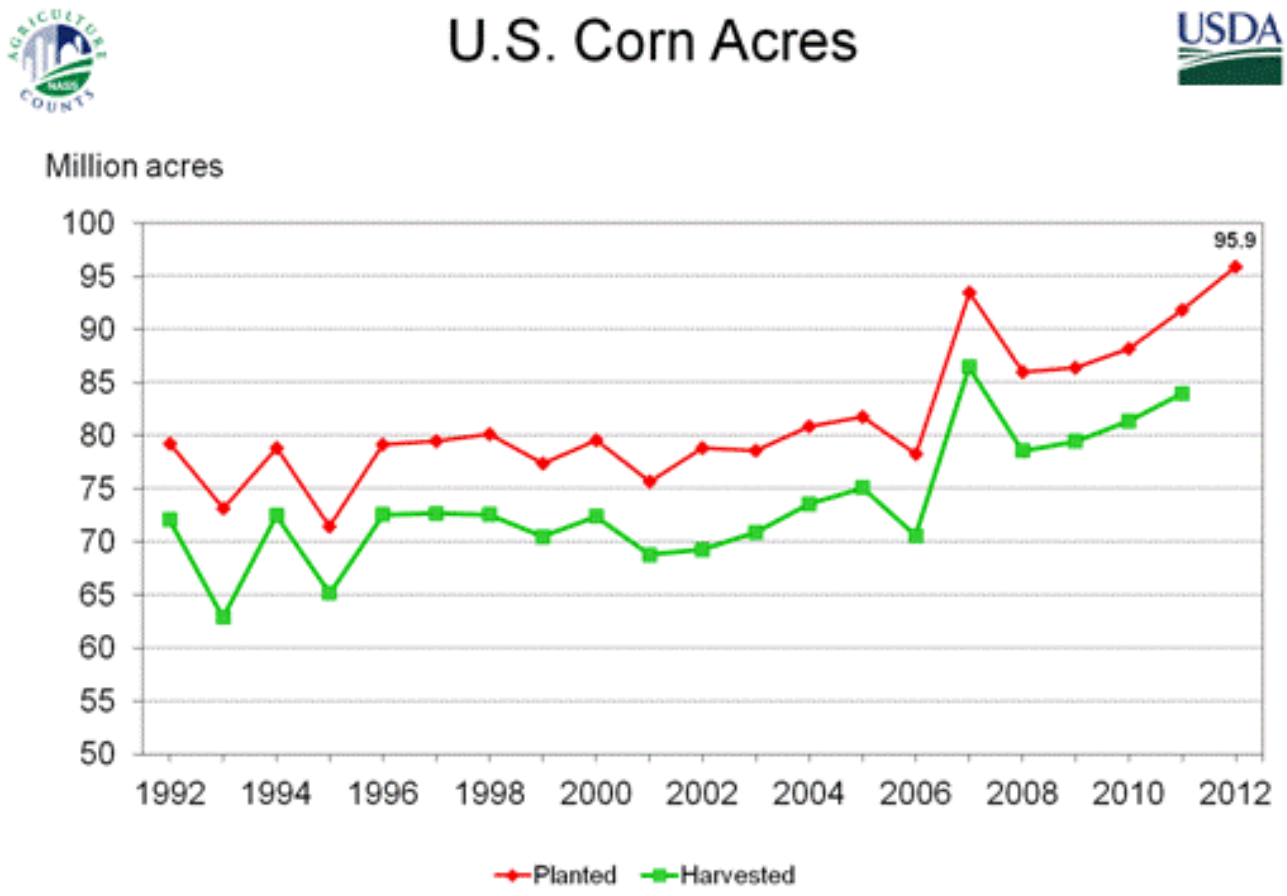
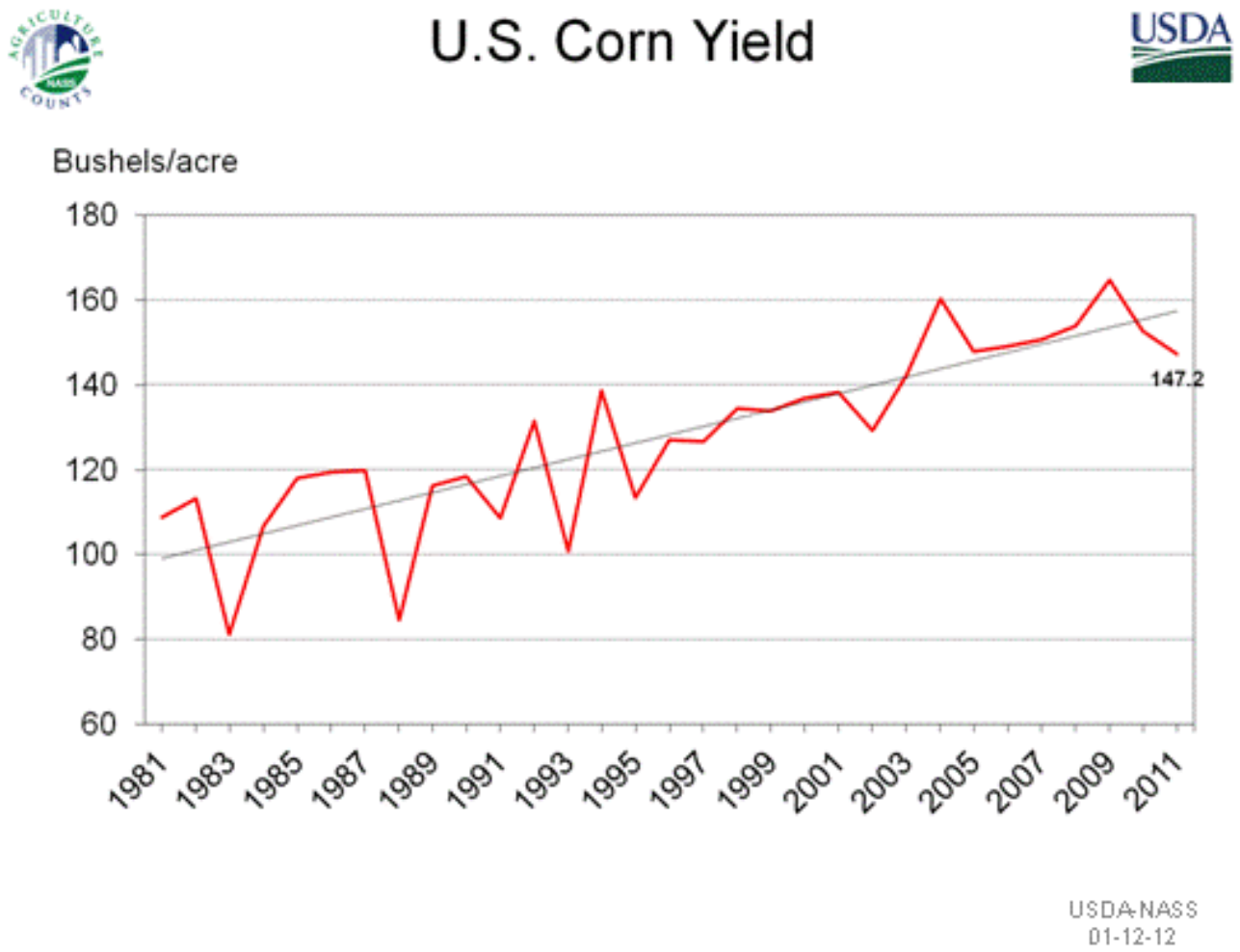
U.S. Corn Acres



U.S. Corn Yield



Corn production in South Carolina

Year	Planted (acres)	Grain yield (Bu/acre)
2006	310,000	110
2007	400,000	97
2008	355,000	65
2009	335,000	111
2010	350,000	91
2011	360,000	65
2012	320,000	122

Objectives

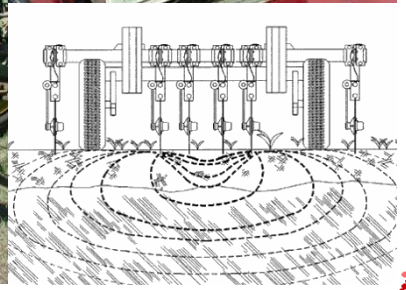
1) Evaluation of nitrogen application method and rate on corn

2) Optimize side-dress N rate for dryland corn under different soil electrical conductivity (EC) zones using optical sensing technology and Clemson algorithm.

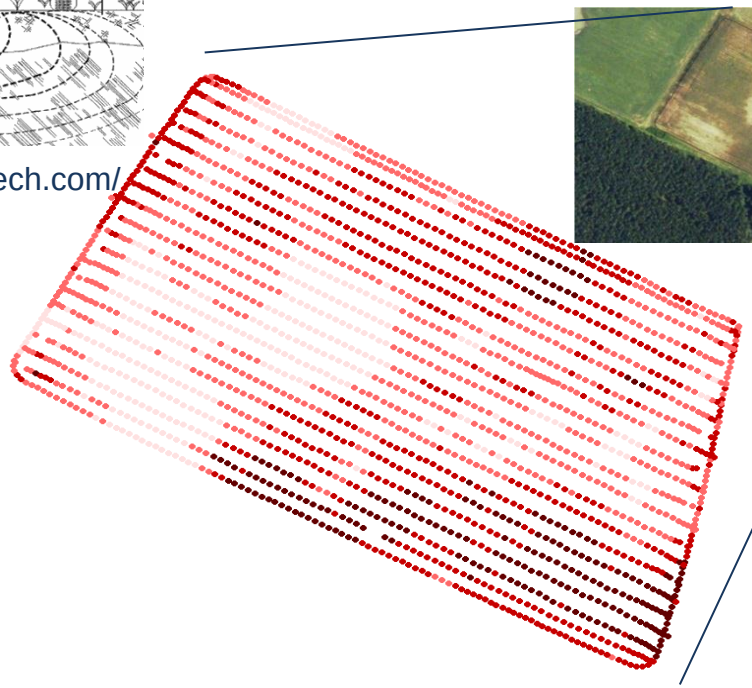
Southern Coastal Plain Soils

- Crop productivity depends on soil texture.
- Mobile nutrients (nitrogen) are utilized differently as soil texture varies.
- Yield potential of the sandy soils is generally very low.

Evaluate field variability using Veris 3100

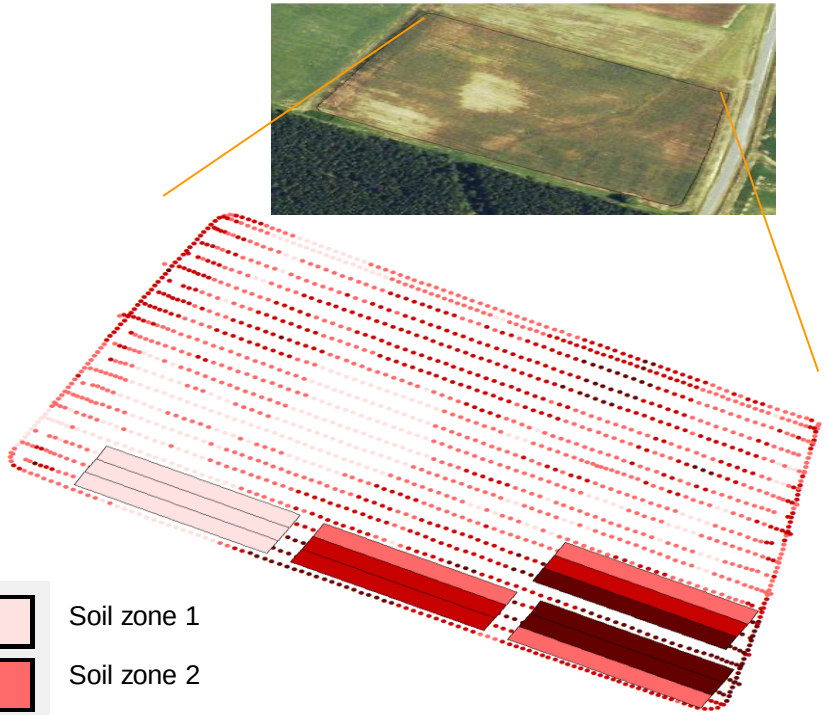


http://www.veristech.com/



Dividing the area into soil electrical conductivity (EC) zones

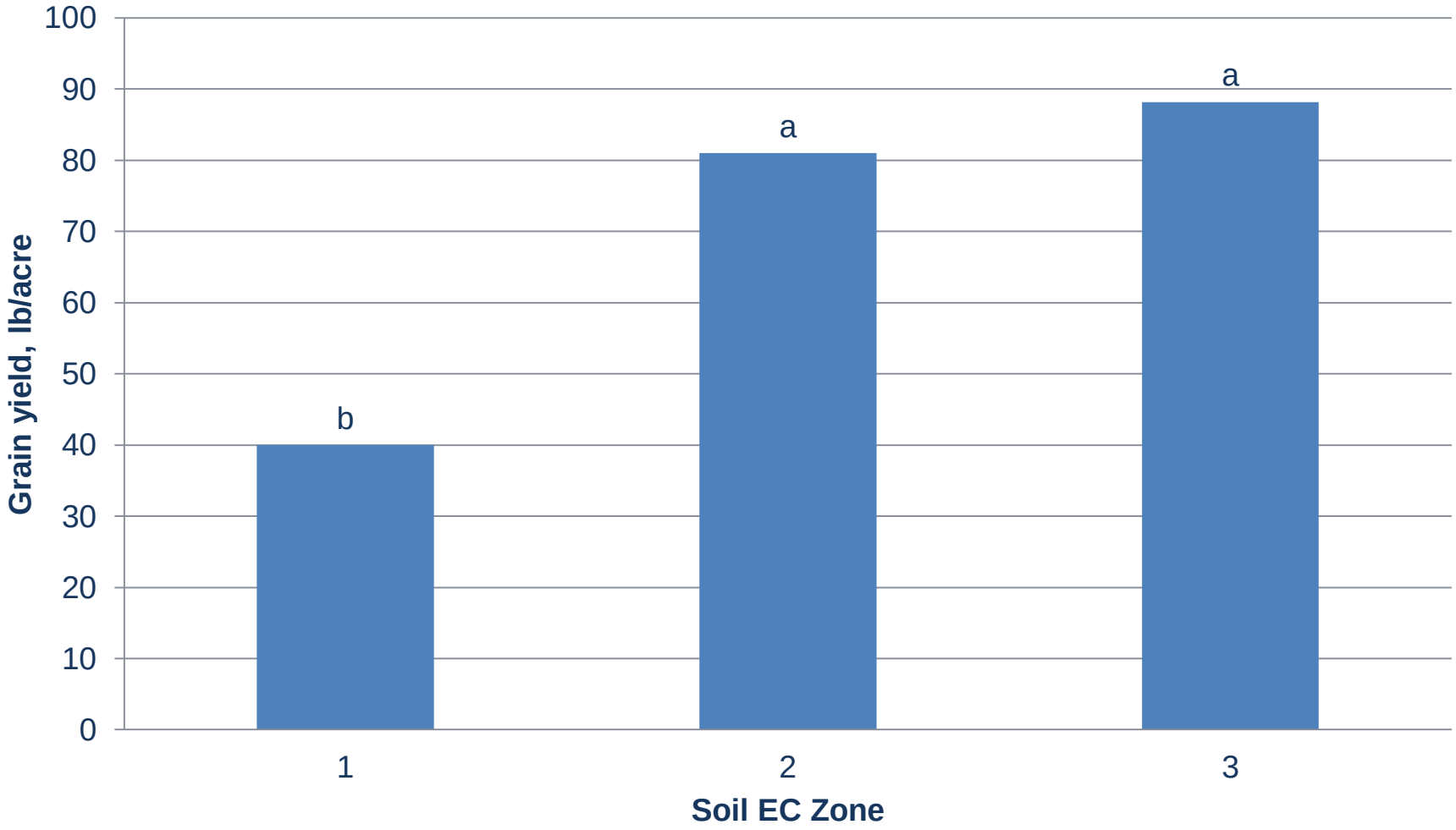
Soil Zones	Soil EC value
1	0.9-3.0
2	3.1-5.9
3	6.0-6.9



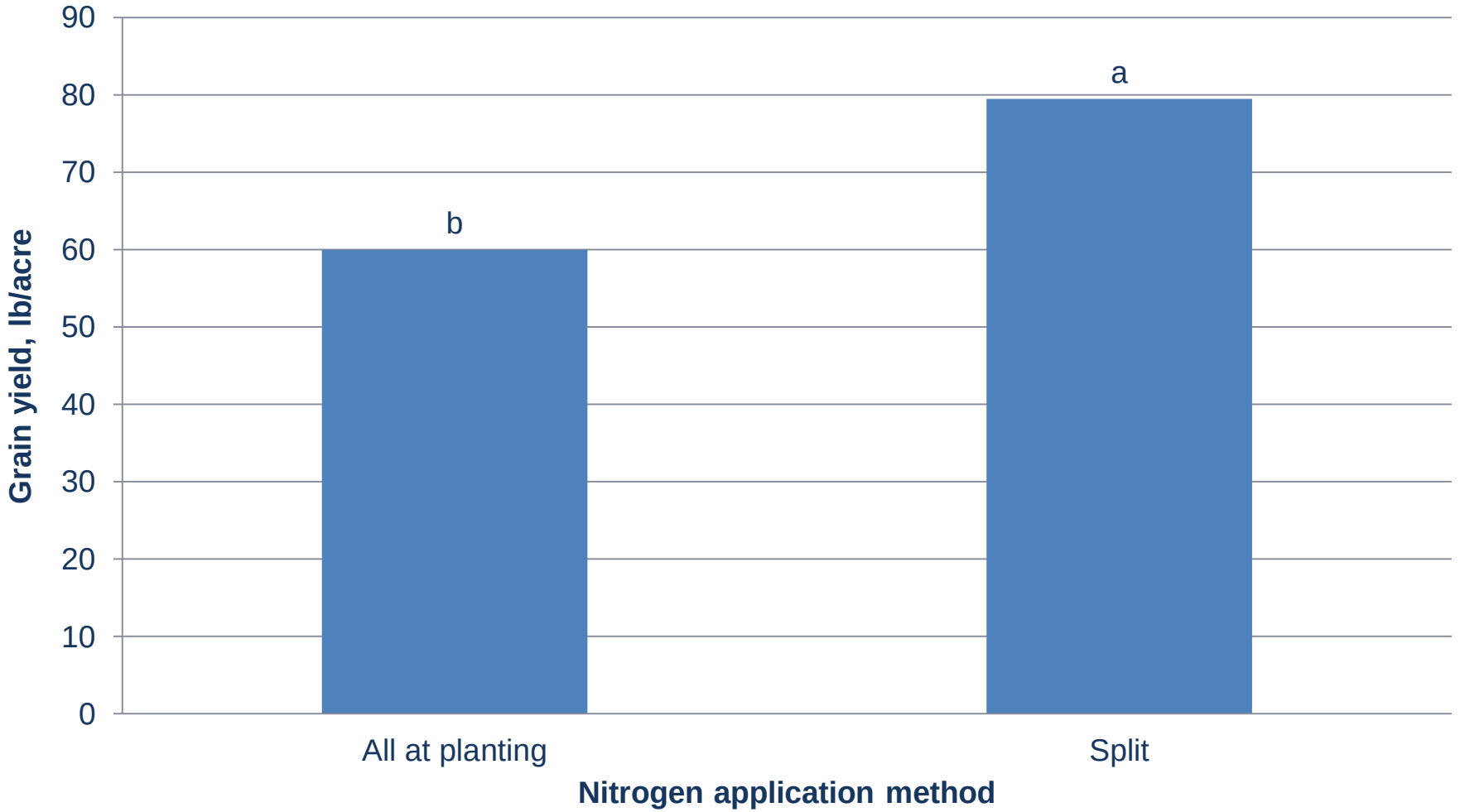
Materials and Methods (Objective 1)

1) Nitrogen application methods
   a) All at planting
   b) Split application
2) N application rates (lb/acre)
   a) 0
   b) 40
   c) 80
   d) 120
   e) 160

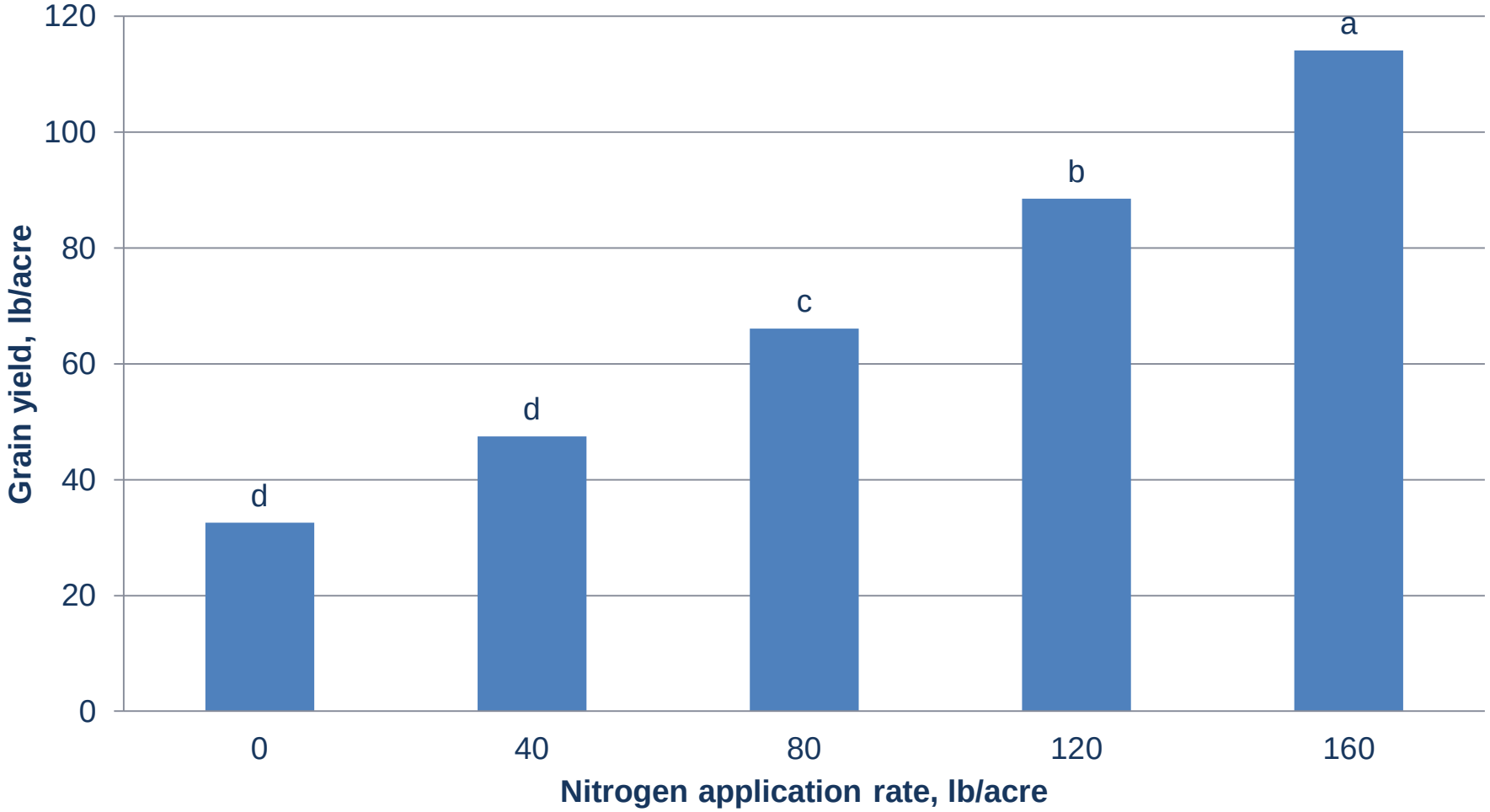
Corn grain yields under different zones



Corn grain yields under application methods



Corn grain yields under application rates

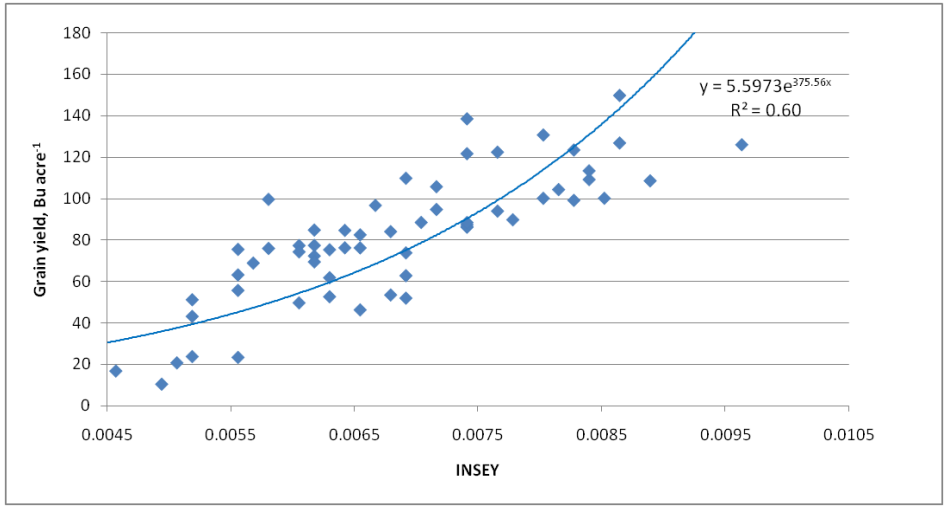


Materials and Methods (Objective 2)

1. Plots received 40 lbs/acre N at planting
2. Side-dress nitrogen application rates based on response index (RI) and developed Clemson algorithm:
   a) Separately for each zone
   b) Averaged across soil zones
   c) 25% below and above the averaged predicted rate across soil zones
   d) Conventional rate

Developing the algorithm for side-dress N application

- Record plant Normalized Difference Vegetation Index (NDVI) using GreenSeeker (Red NDVI)
- Collect grain yields and develop an algorithm for variable N application in corn



INSEY - In Season Estimated Yield = NDVI / number days from planting to sensing (GDD>0). The INSEY index estimates the plant biomass produced per day when growth is possible.

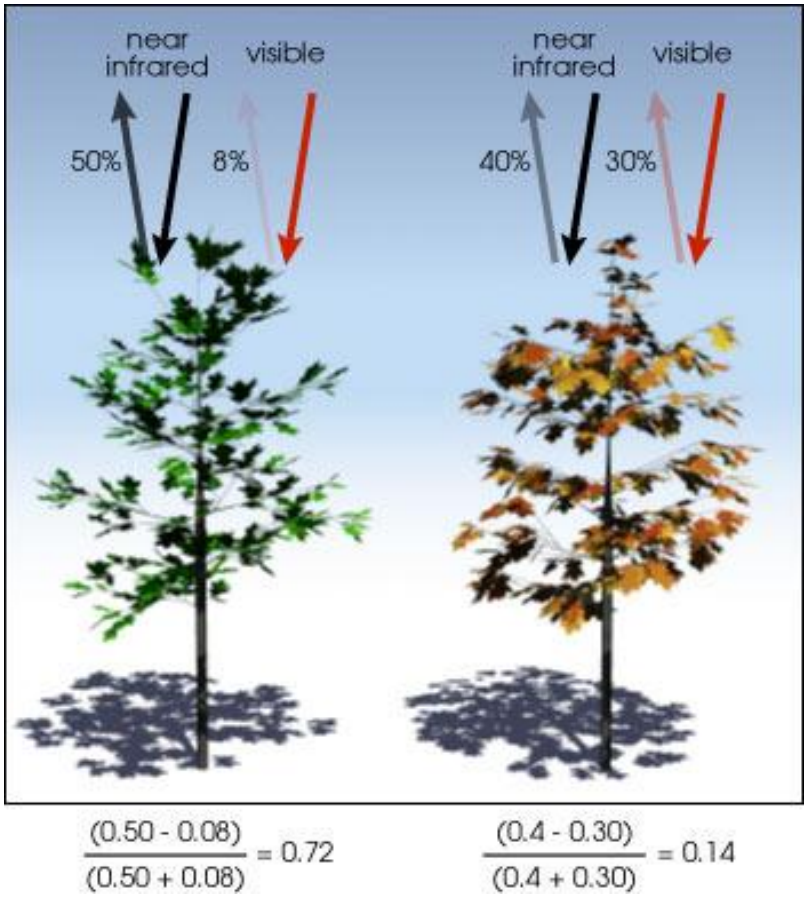
Normalized Difference Vegetation Index (NDVI)

- NDVI = $\frac{\text{NIR - RED}}{\text{NIR + RED}}$
- NIR – WAVELENGTH OF NEAR-INFRARED BAND.
- RED – WAVELENGTH OF RED BAND.

GreenSeeker (Red NDVI) uses

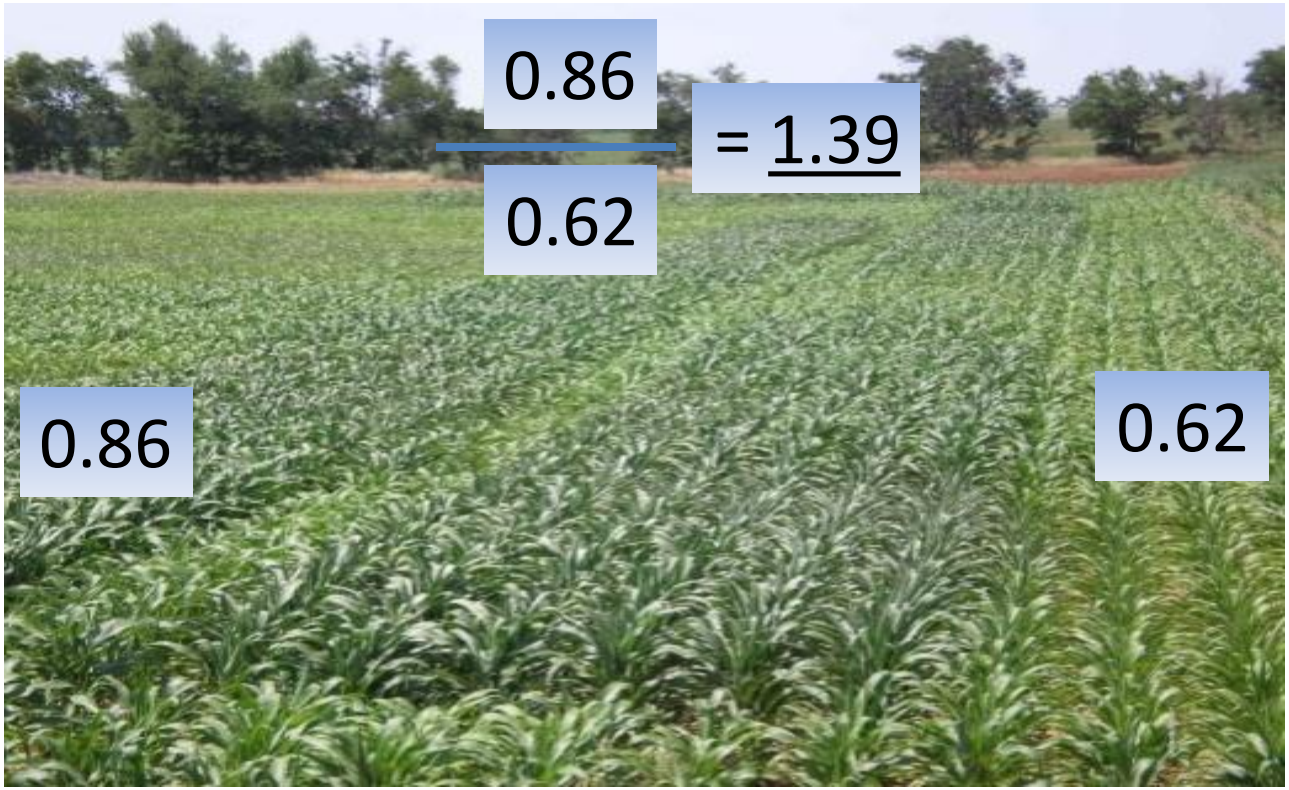
NIR – 770 nm and RED – 660 nm

1 nm = 10^{-9} m



http://earthobservatory.nasa.gov/Features/MeasuringVegetation/measuring_vegetation_2.php

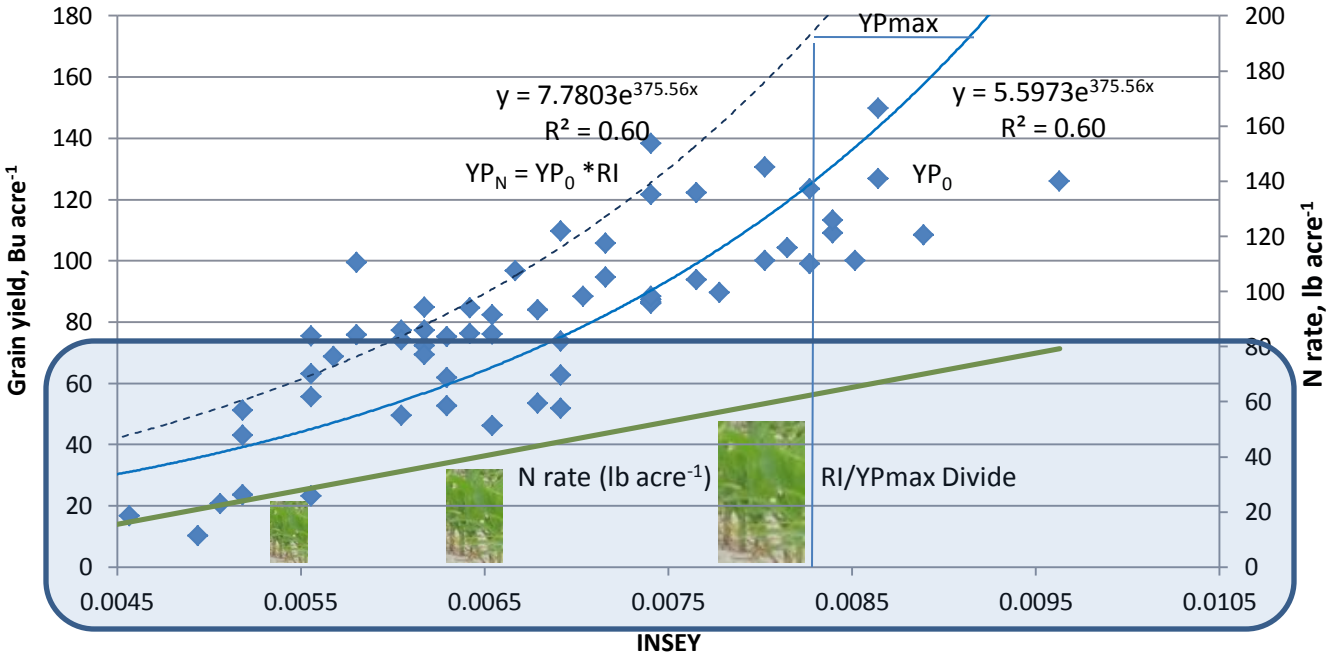
Calculate response index (RI)



http://nue.okstate.edu/

RI = NDVI N Rich strip / NDVI prior to side-dress N

Corn grain potentials with and without nitrogen application



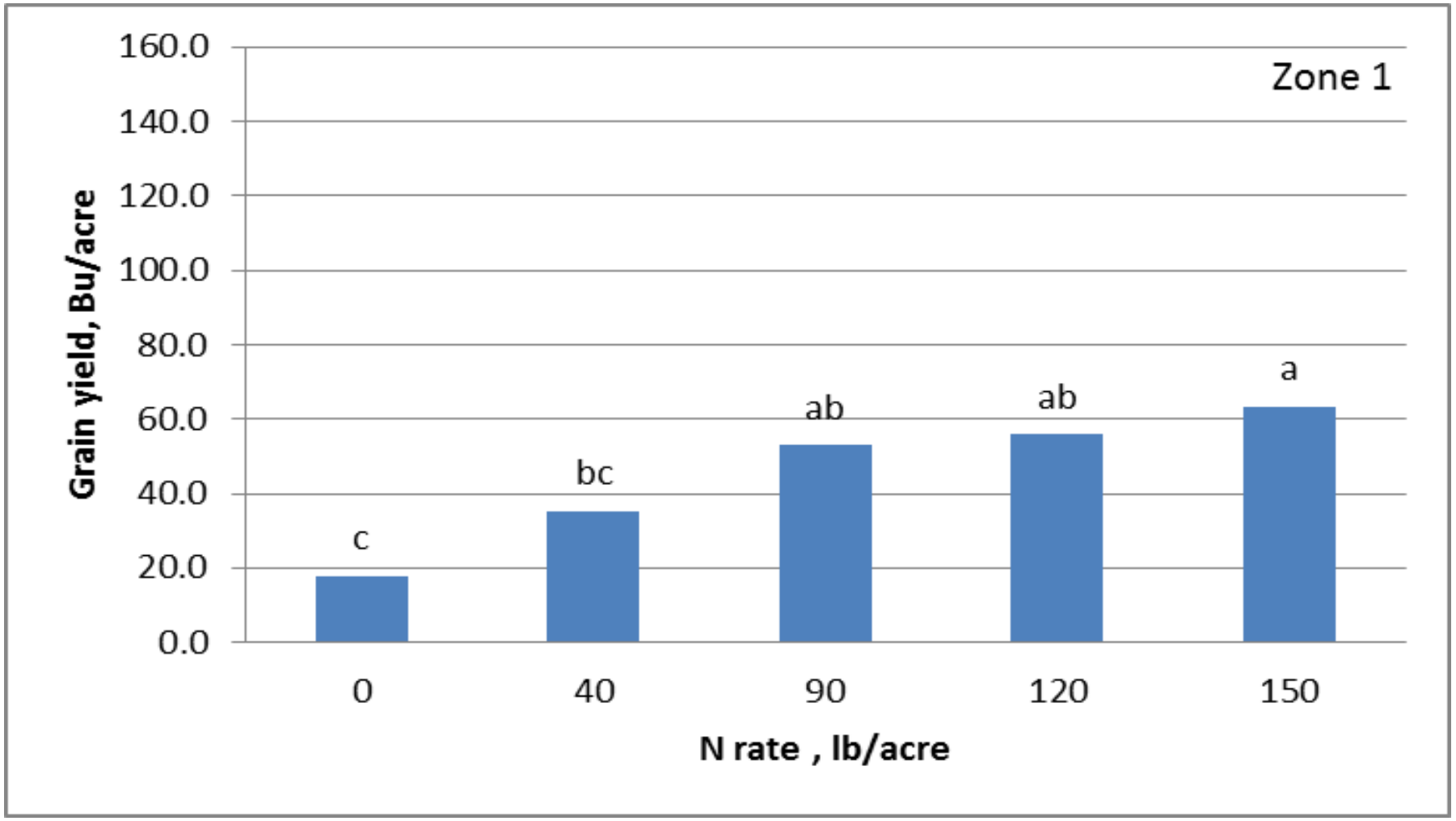
YP_{MAX} - Maximum potential yield (no yield increase expected with additional N)

Side-dress N rate = (YP_N – YP_0) * N in corn grain / N use efficiency

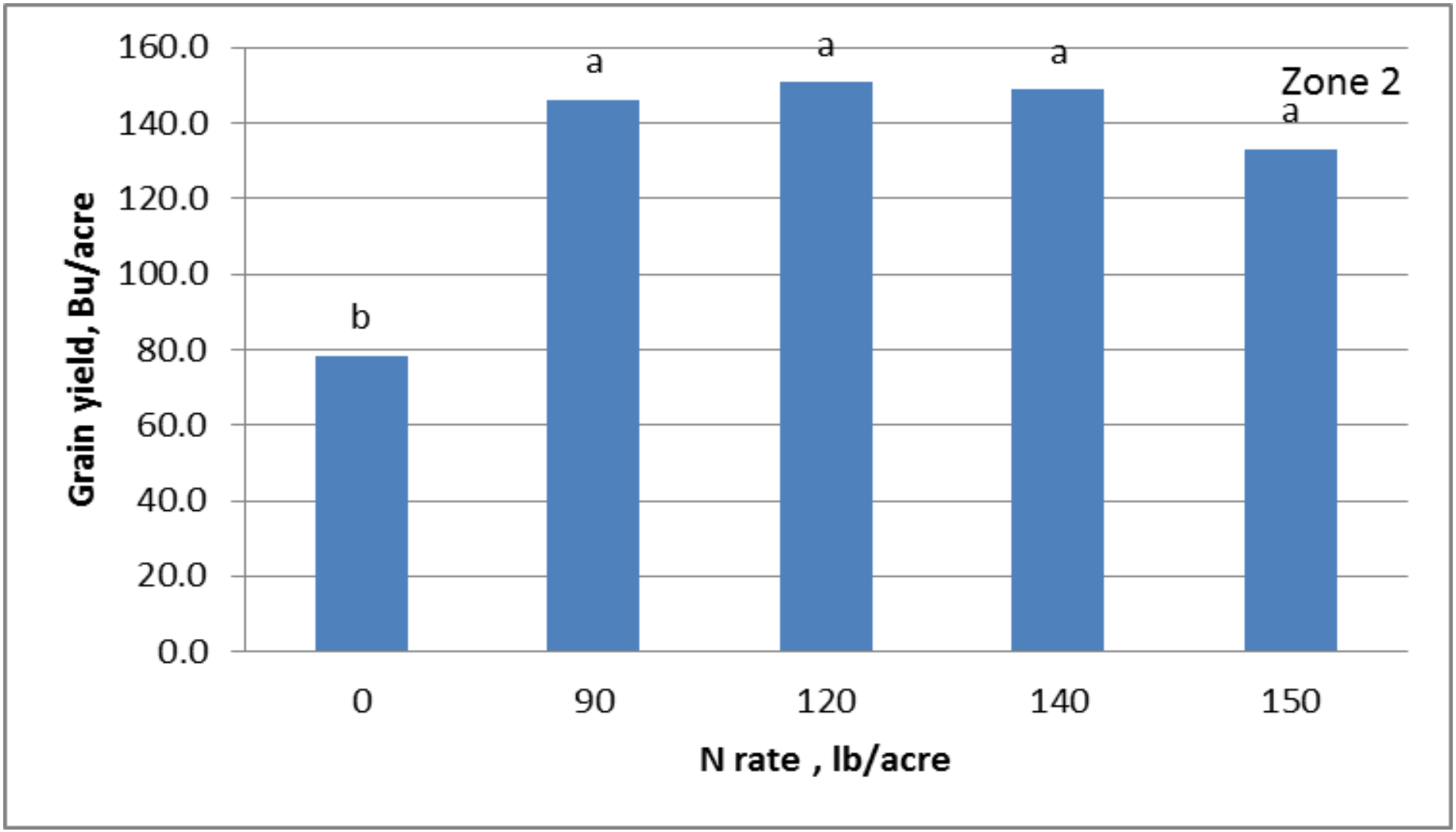
Calculated N rates based on the algorithm and response index (RI)

Method	2012
	——— lb acre^{-1} ———
N Rate for each zone: Zone 1	40
Zone 2	140
Zone 3	140
Average N rate across 3 zones	120
25% above average	150
25% below average	90
Standard N rate rate	120

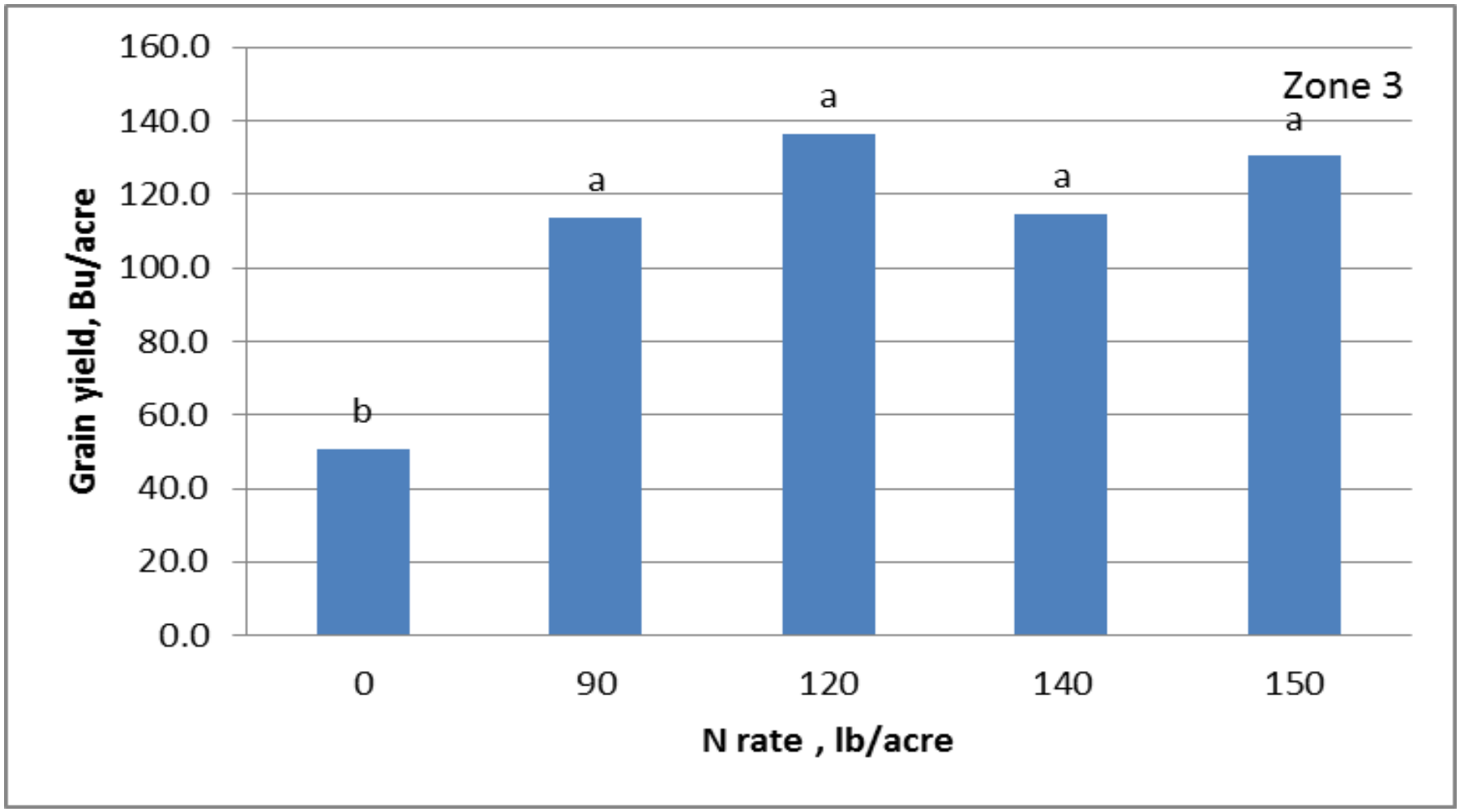
Corn grain yields under zone 1



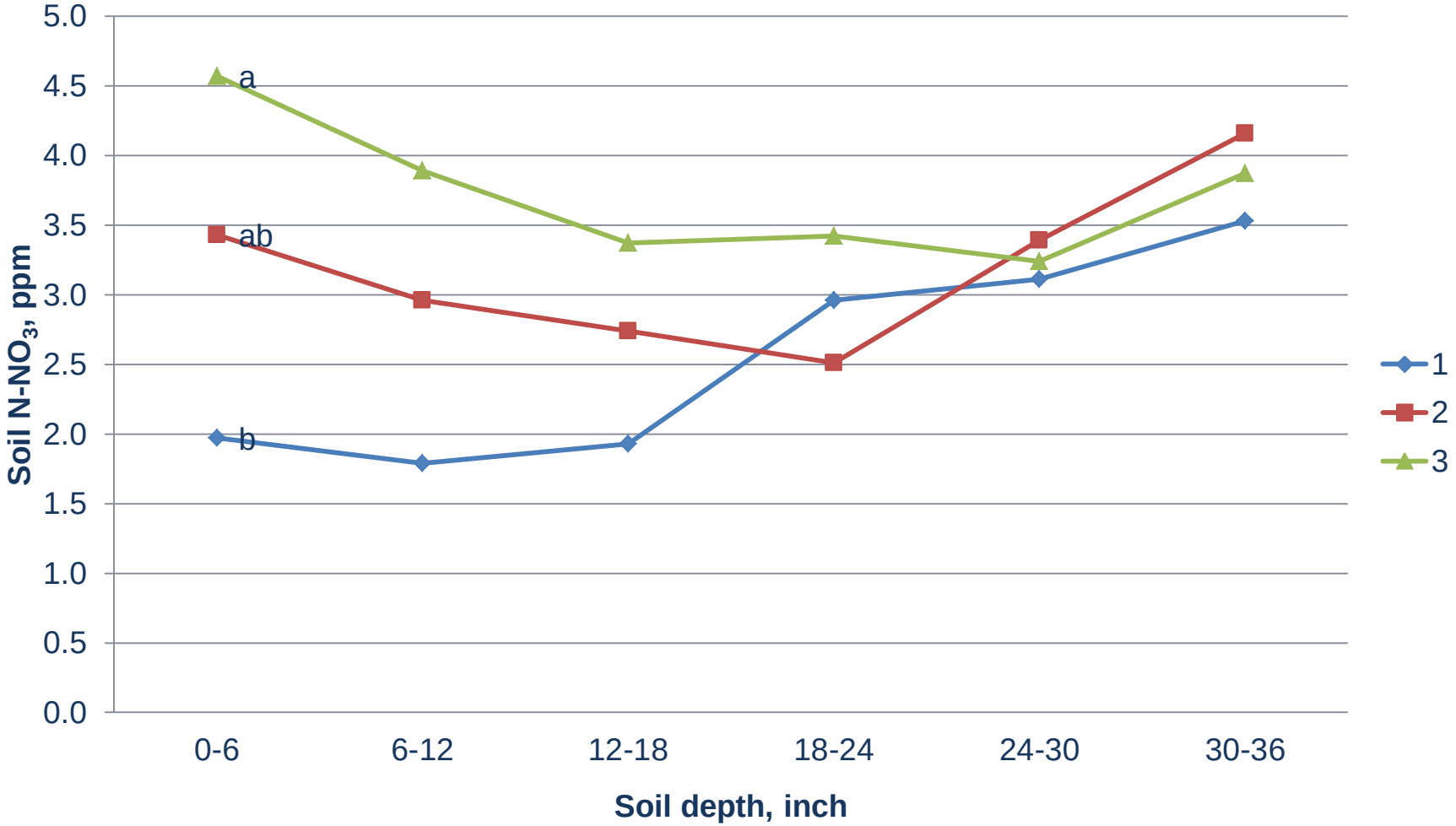
Corn grain yields under zone 2



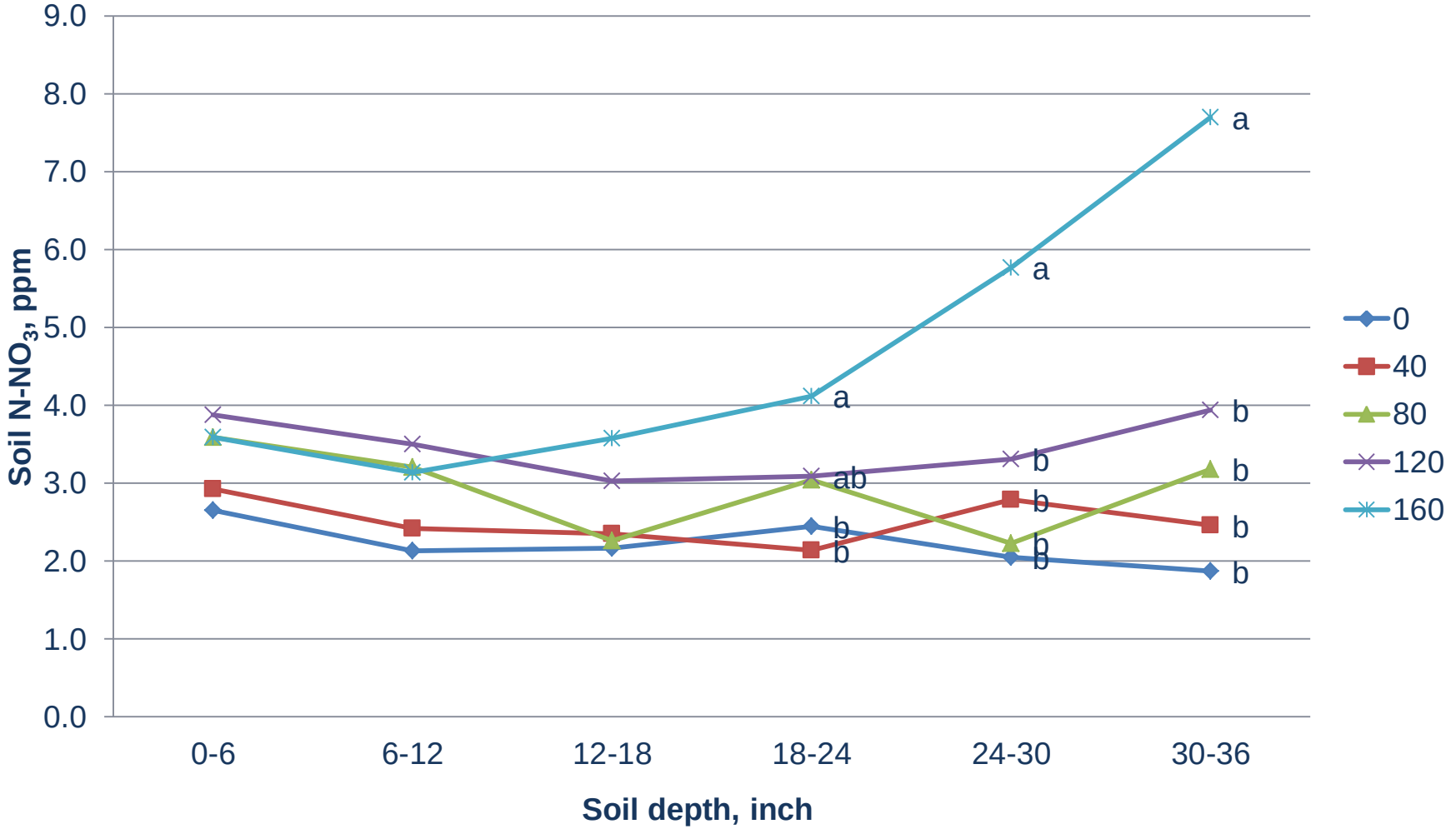
Corn grain yields under zone 3



Soil N-NO_3 movement under different zones



Soil N-NO_3 movement under different N rates



Summary

- ✓ Corn yields were higher from soil zones 2 and 3 than zone 1.
- ✓ Higher yields were obtained from plots with the split N application and greater with highest nitrogen rates.
- ✓ Grain yields from plots with predicted sidedress rate of 90 lb N rate (predicted rate across soil zones and decreased by 25%) were not significantly lower compared to higher N rates for soil zones 1, 2, and 3.
- ✓ Therefore, N rates could be reduced by 30 lb N/acre compared to a fixed rate for all zones.

Summary (cont.)

- ✓ Significantly lower N-NO_3 concentration at 0-6 inch soil depth was observed for soil zone 1 due to higher leaching compared to other zones.
- ✓ Highest N rate contributed to significantly greater N-NO_3 concentration below 18 inches soil depth.
- ✓ Generally, Clemson algorithm can help to optimize nitrogen rates and improve N use efficiency while reducing N-NO_3 leaching in the soil.

Thank you