Retrieved from:
http://sealytractor.com/photos.php
This is not an endorsement of any Ag equipment company

FLUID NITROGEN/SULFUR FORMULATIONS TO MITIGATE SULFUR DEFICIENCIES AND MAXIMIZE COTTON YIELDS IN THE UPPER SOUTHEAST COASTAL PLAIN

William "Hunter" Frame
Field Crops Agronomist/ Associate Professor
Virginia Tech
Tidewater Agricultural Research and Extension Center
Suffolk, VA

Febraury 19, 2019
2019 Fluid Fertilizer Forum
Scottsdale, AZ

JUSTIFICATION

- Sulfur is an essential plant nutrient, though required in smaller quantities than N, P and K.
  - Used to create proteins which regulated photosynthesis and N metabolism.
- Sulfur is mobile in soil systems and is taken up by plants as sulfate, SO_4^{2-}, thus making it prone to leaching like nitrate (NO_3^-).
- Sulfur in immobile in plants, therefore remobilization of S will not occur and deficiencies will be observed in the upper portion of the canopy
- The Clean Air Act has resulted in cleaner air with lower S deposition and more common S deficiencies occurring in cotton

NITROGEN AND SULFUR DEFICIENCY IN COTTON

OBJECTIVES

- Evaluate granular and fluid N sources with varying S application rates on in-season NDVI measurements, petiole and leaf S status during the first week of bloom, and lint yield of cotton in the upper southeast coastal plain.

- Determine the effect of high N:S ratios in side-dress fluid N sources at varying N application rates on NDVI, petiole and leaf N:S ratios, and lint yield in the upper southeast coastal plain.

MATERIALS AND METHODS

- Three locations during 2016 and 2017
- Randomized complete block design with 17 treatments and 4 replications
- Compared granular and fluid side-dress sources
  - Urea + ammonium sulfate (AMS)
  - UAN32 + ammonium thiosulfate (12-0-0-26S)
    - 24-0-0-3S
    - 24-0-0-6S
    - 24-0-0-9S
- NDVI measured from a week after fertilizer application for five weeks (data not shown)
- Petiole and leaf tissue samples were collected from each plot during the first week of bloom
- Yield was measured from the center two rows of the four row plot
- PROC GLIMMIX was used for ANOVA with an alpha = 0.05.
  - Treatment design was
    - 2 S Sources x 4 S rates
    - 4 Fluid Formulations x 3 N rates

NITROGEN AND SULFUR TREATMENTS

Trt	N-S Formulations	Total N	Side-dress N	Sulfur	Total N:S	Fluid Fertilizer N:S
		---------- lbs acre^{-1} ----------				
1	No Applied N or S Control	-	-	-	-	-
2‡	Urea	100	80	0	100:0	-
3‡	Urea + AMS†	100	80	10	10:1	-
4‡	Urea + AMS	100	80	20	5:1	-
5‡	Urea + AMS	100	80	30	3:1	-
6	32-0-0	60	40	0	60:0	32:0
7‡	32-0-0	100	80	0	100:0	32:0
8	32-0-0	140	120	0	140:0	32:0
9	24-0-0-3S	60	40	5	12:1	8:1
10‡	24-0-0-3S	100	80	10	10:1	8:1
11	24-0-0-3S	140	120	15	9.33:1	8:1
12	24-0-0-6S	60	40	10	6:1	4:1
13‡	24-0-0-6S	100	80	20	5:1	4:1
14	24-0-0-6S	140	120	30	4.67:1	4:1
15	24-0-0-9S	60	40	15	4:1	2.66:1
16‡	24-0-0-9S	100	80	30	3:1	2.66:1
17	24-0-0-9S	140	120	45	3.11:1	2.66:1

†AMS = granular ammonium sulfate (21-0-0-24S)

‡ Treatments to be compared to evaluate sulfur application rates and granular vs fluid N-S sources.

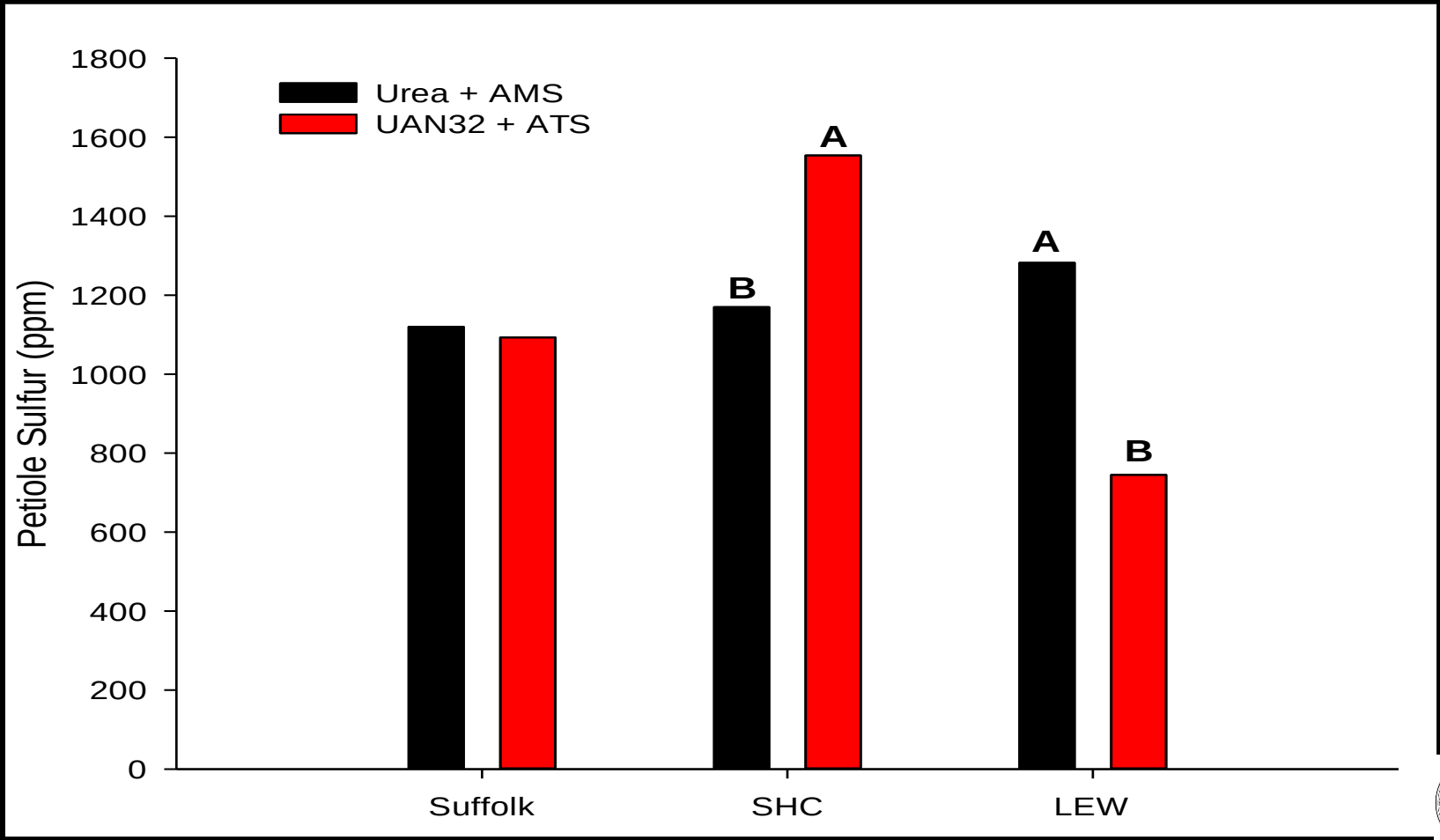
RESULTS

GRANULAR N/S FORMULATIONS

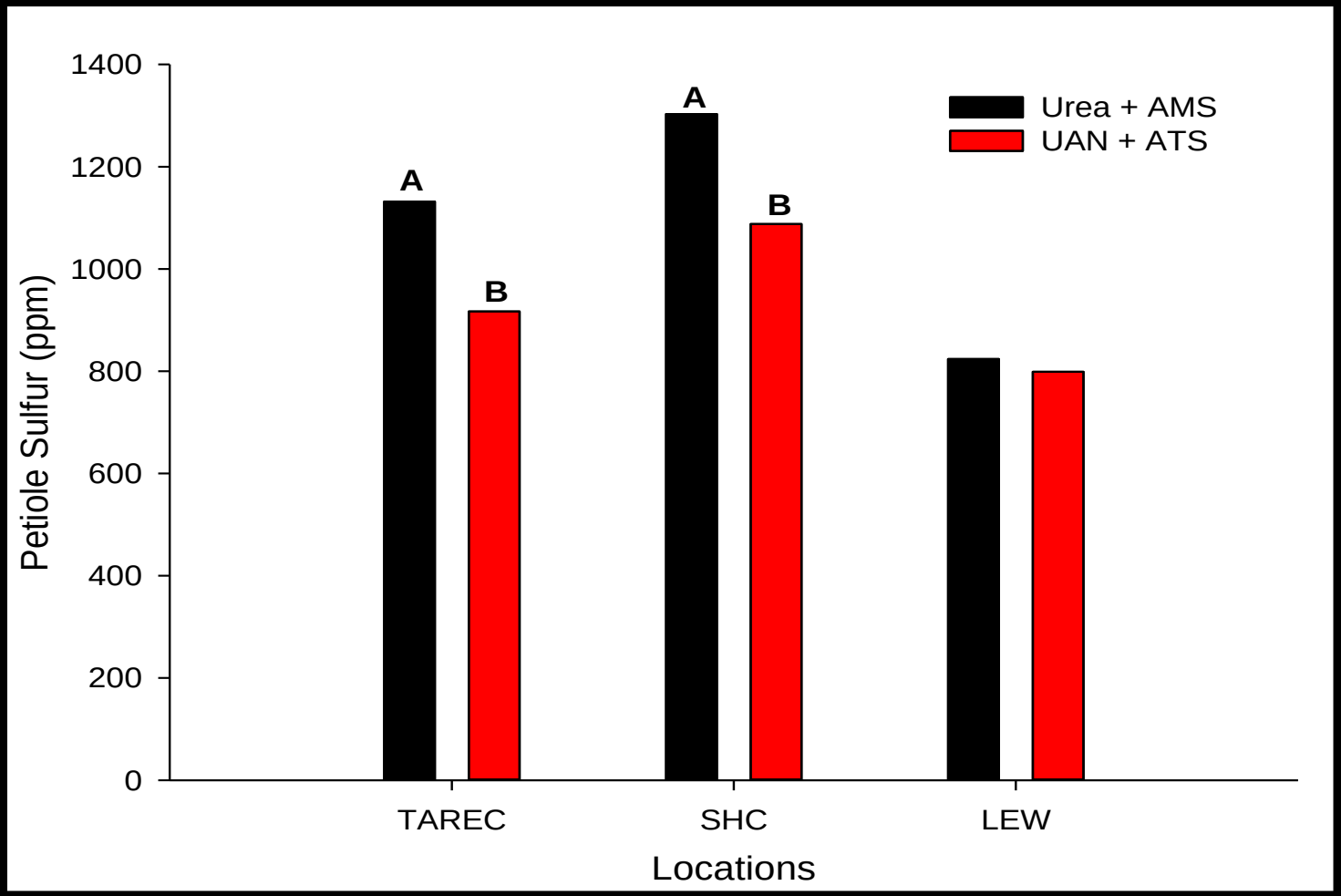
VERSUS

FLUID N/S FORMULATIONS

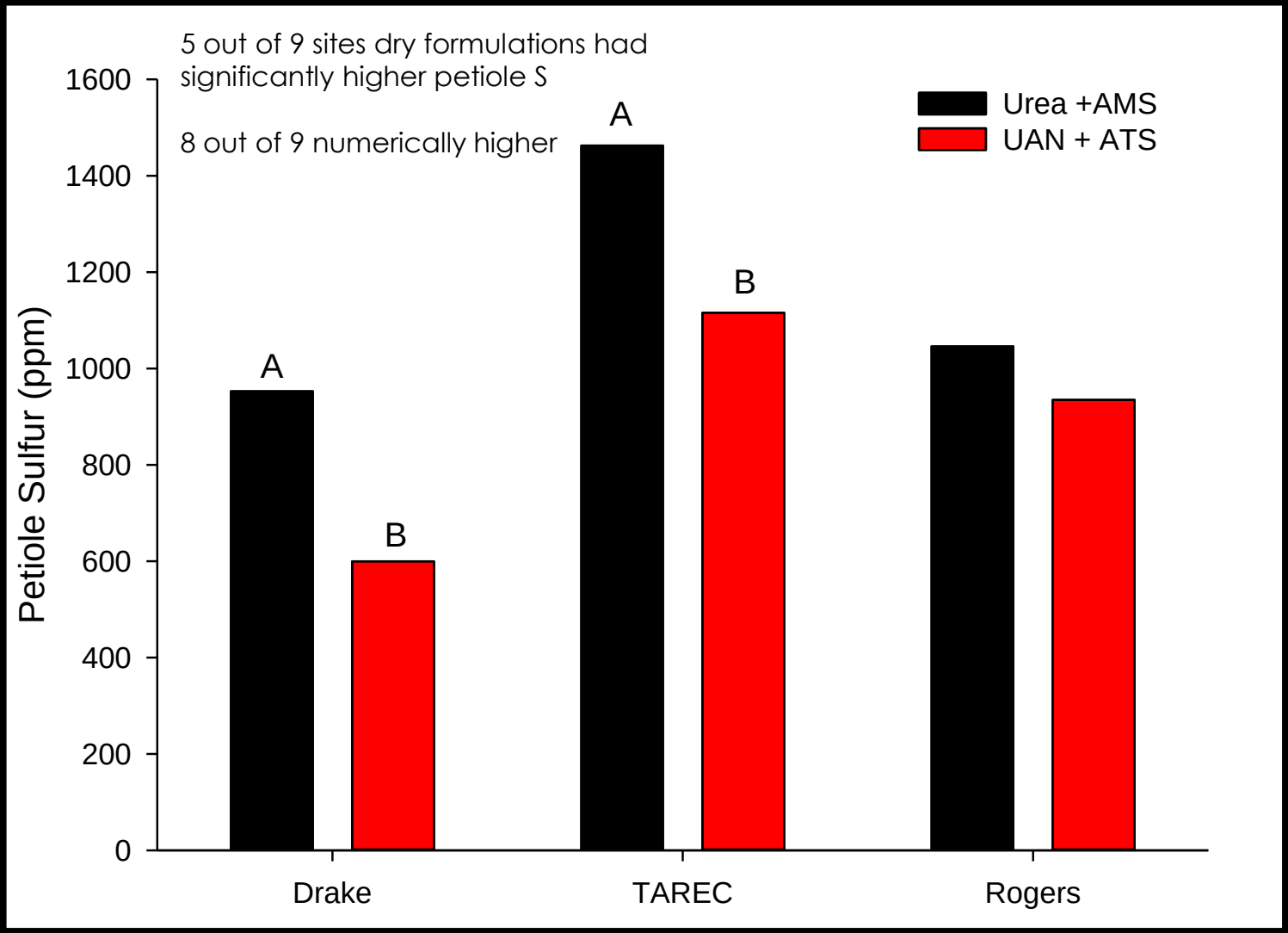
PETIOLE S CONCENTRATION AND FERTILIZER SOURCE IN 2016



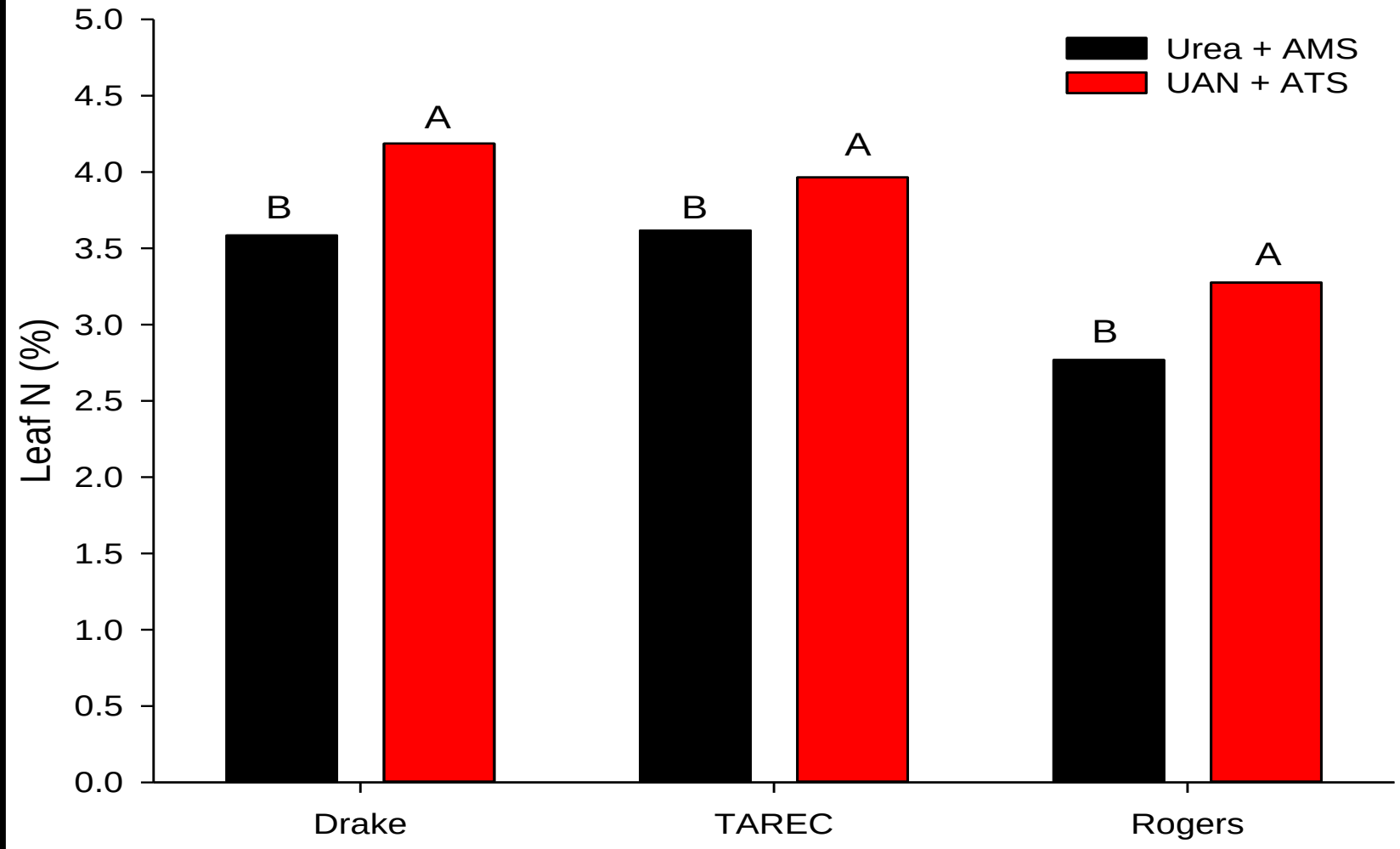
PETIOLE S CONCENTRATION AND FERTILIZER SOURCE IN 2017



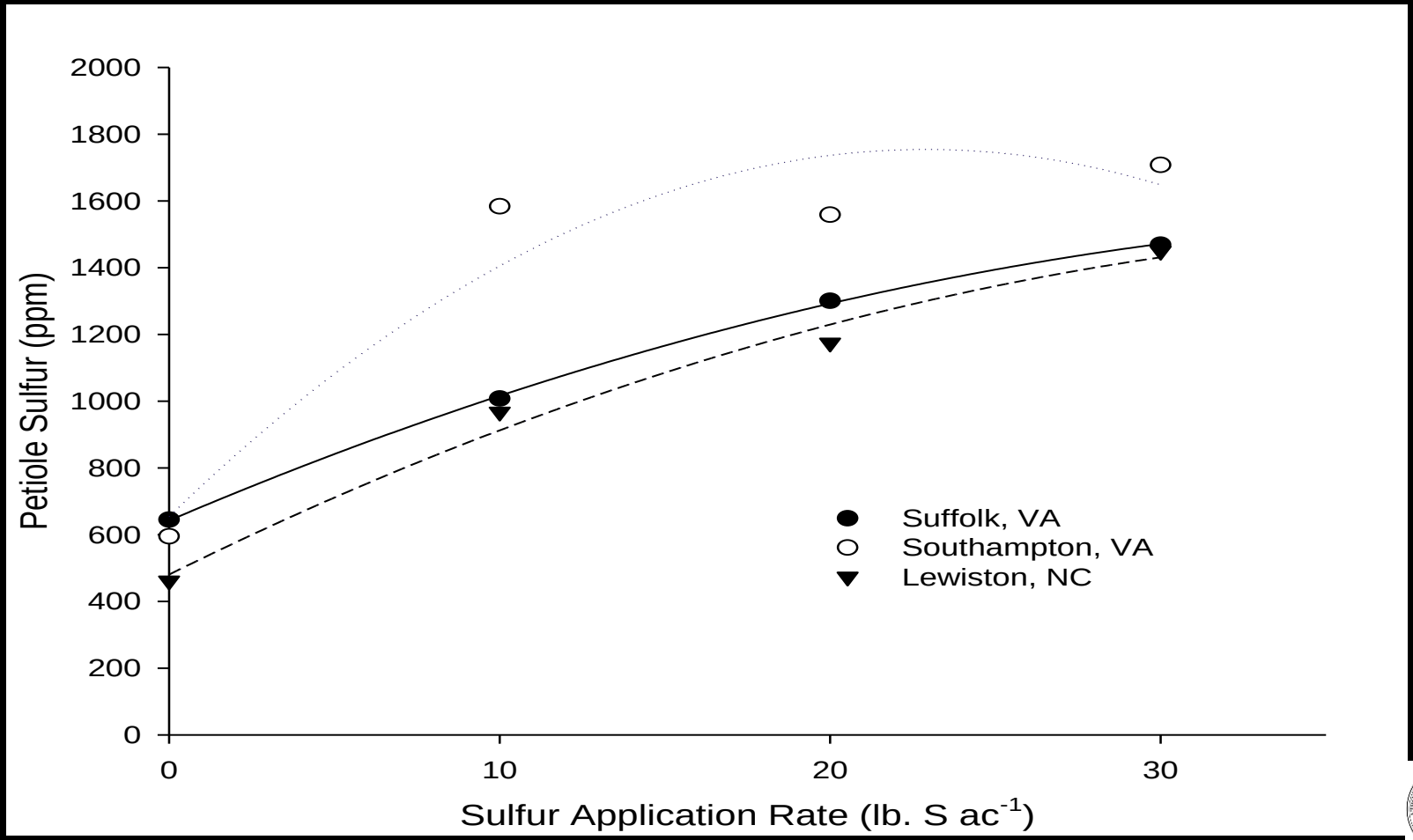
PETIOLE S CONCENTRATION AND FERTILIZER SOURCE IN 2018



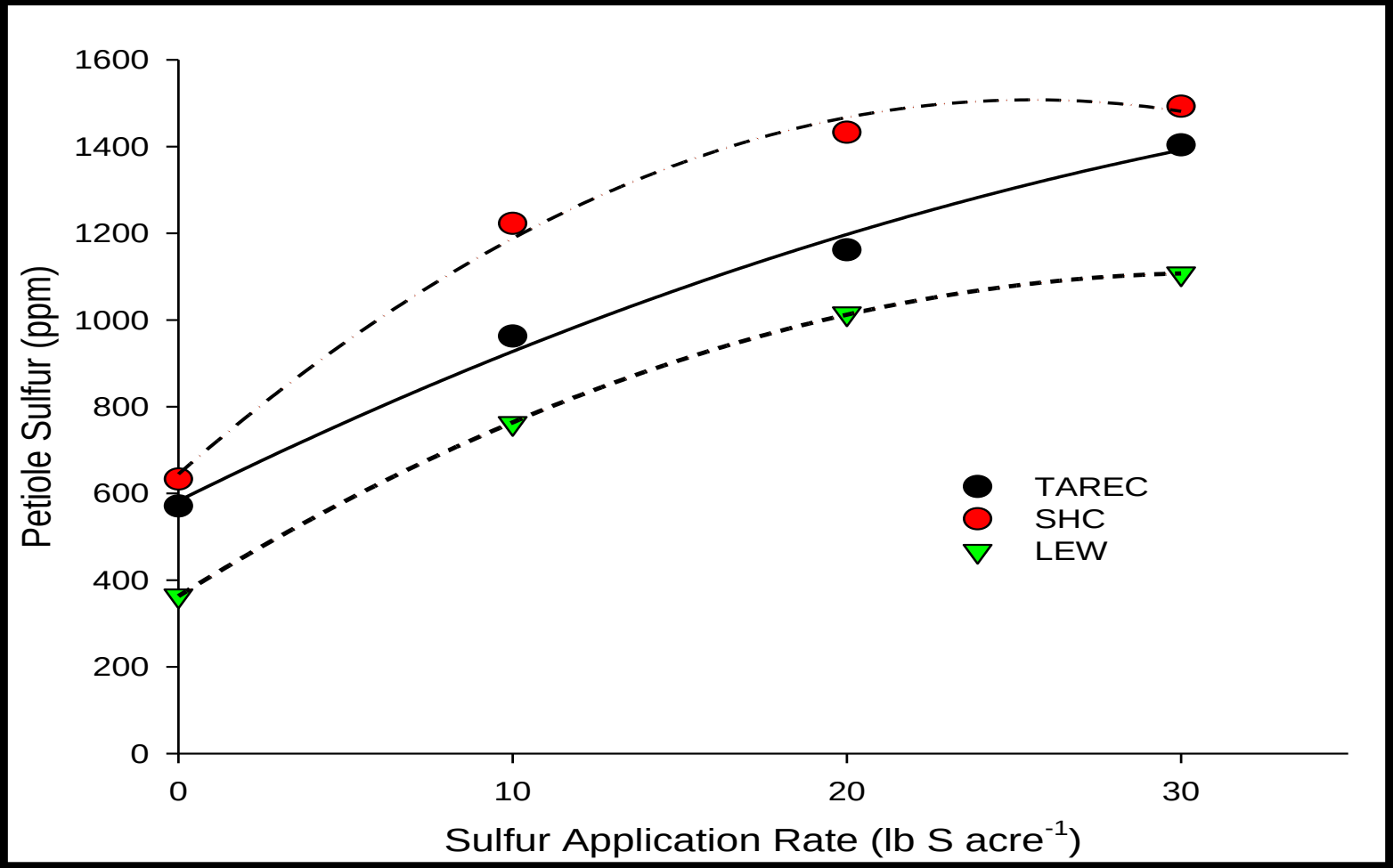
LEAF N AND N/S FORMULATION IN 2018



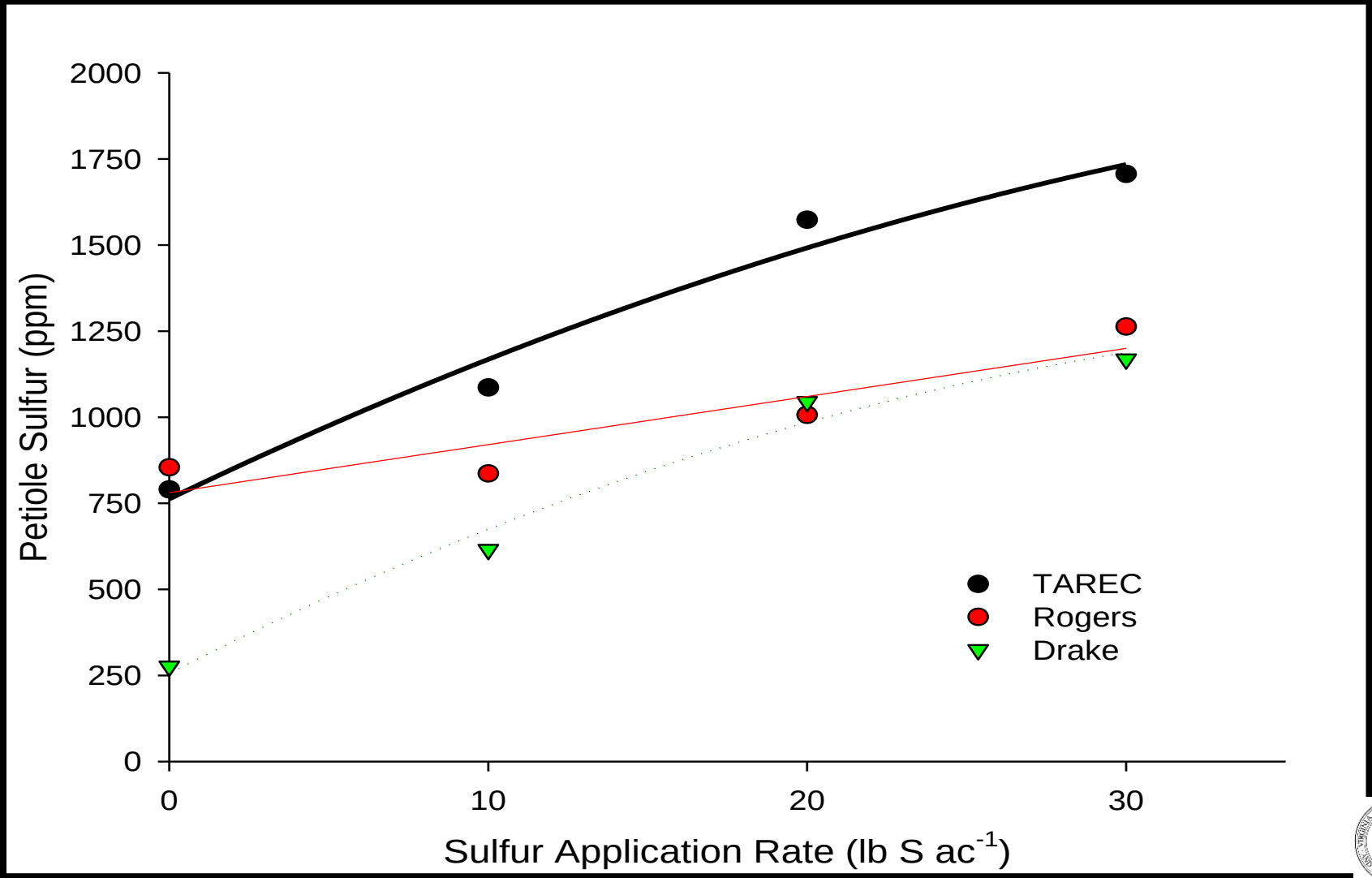
PETIOLE S DURING 1ST WEEK OF BLOOM IN 2016



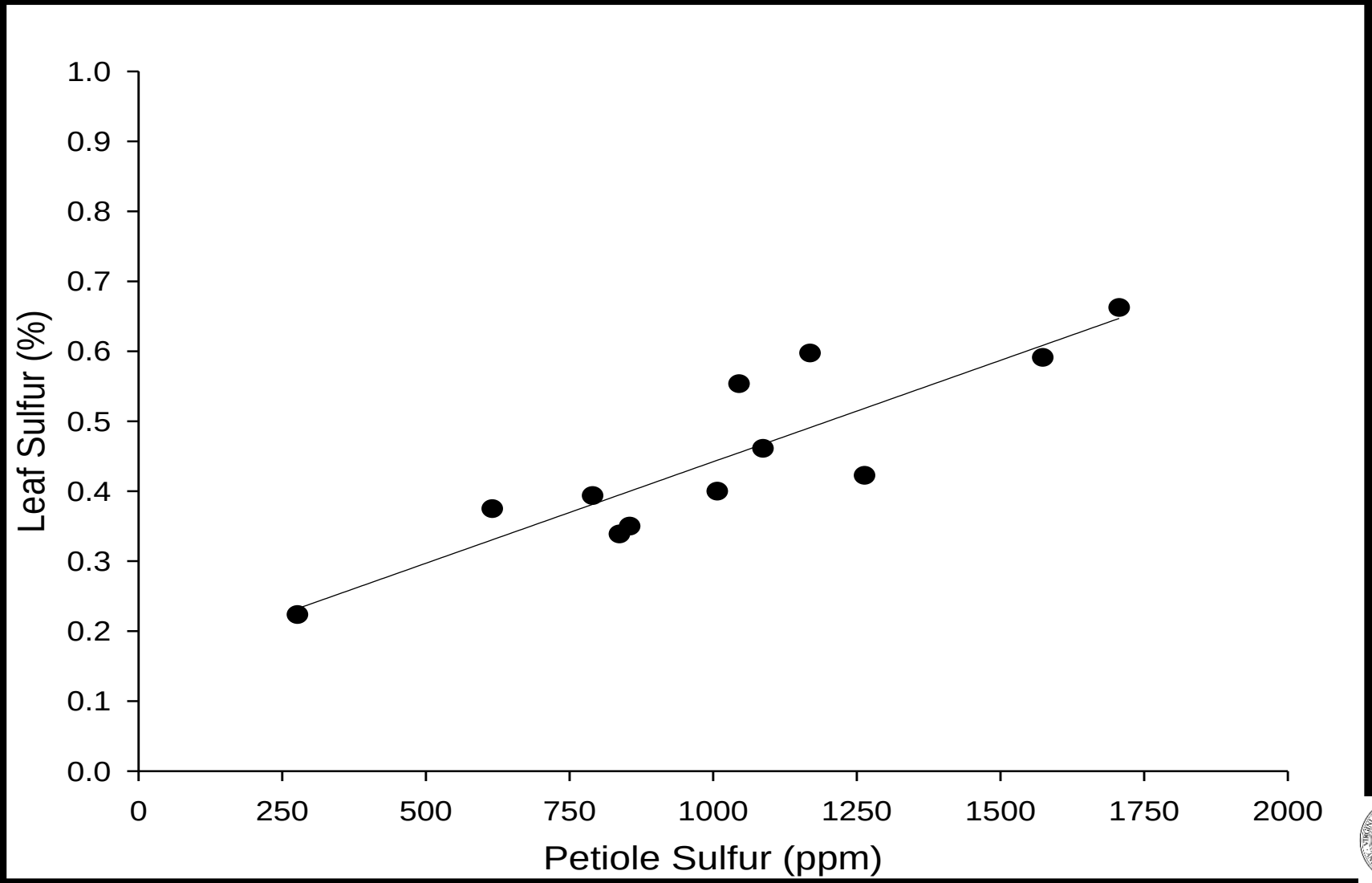
PETIOLE S DURING 1ST WEEK OF BLOOM IN 2017



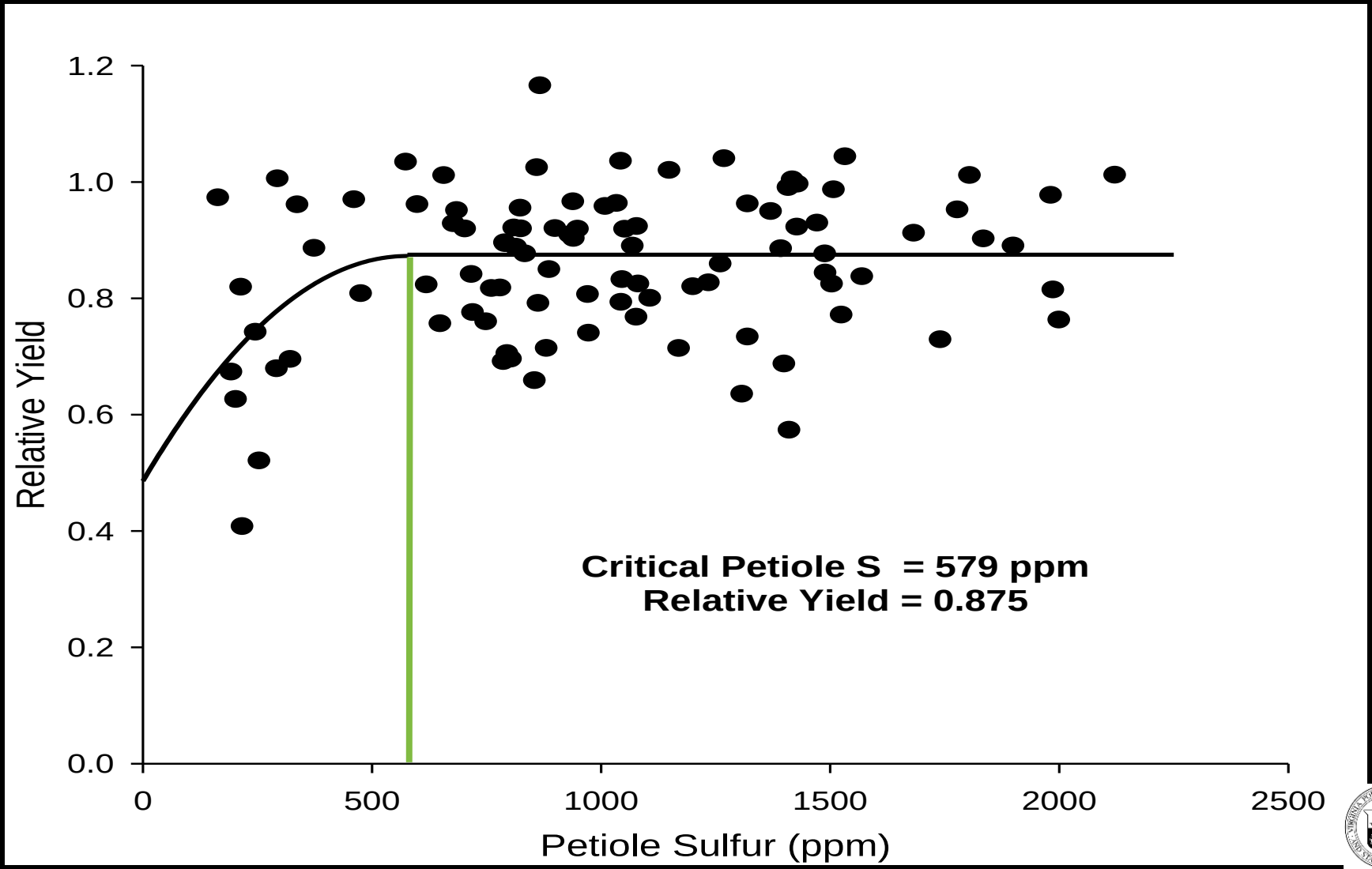
LEAF S DURING 1ST WEEK OF BLOOM IN 2018



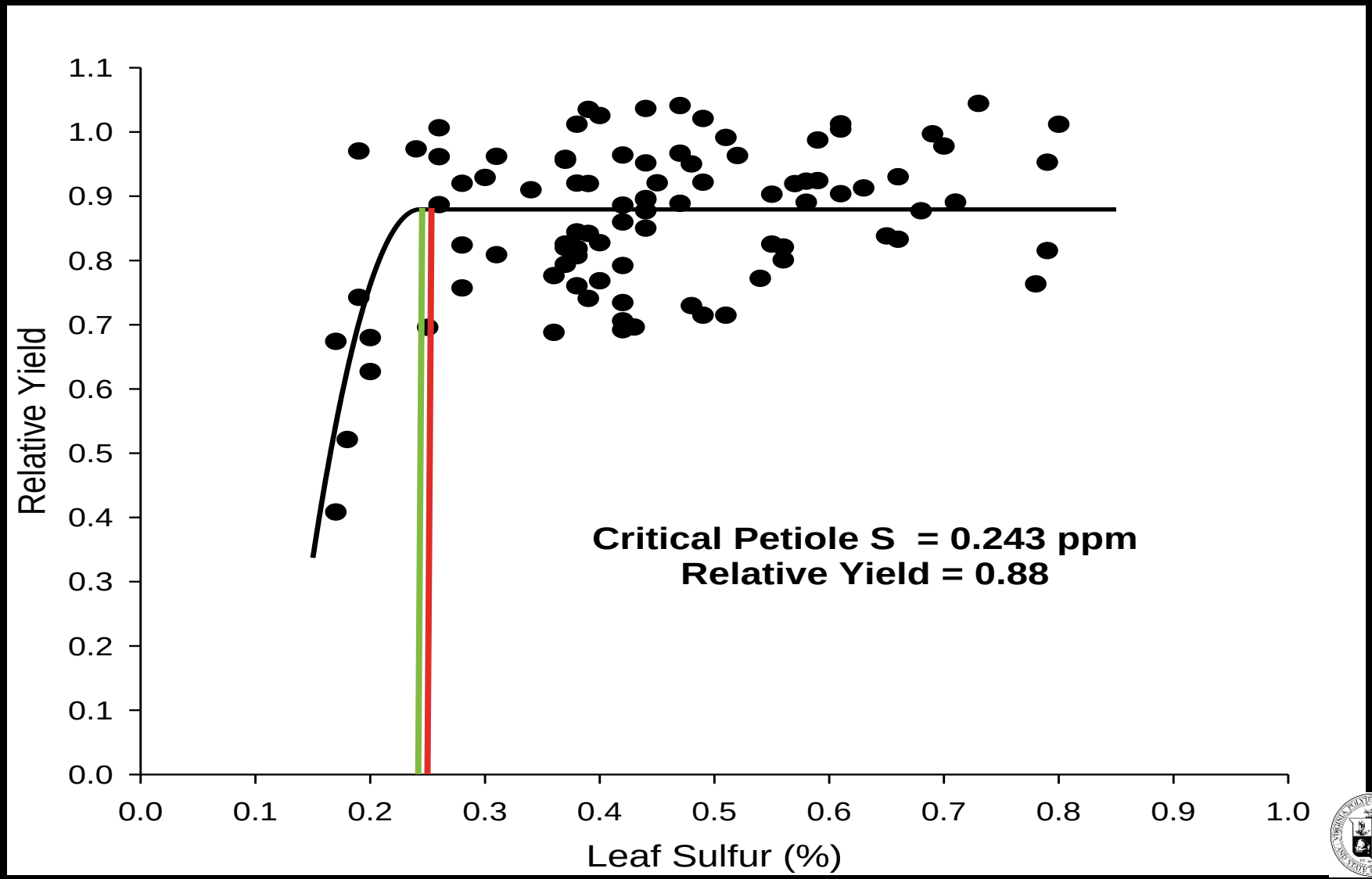
PETIOLE SULFUR VS. LEAF SULFUR



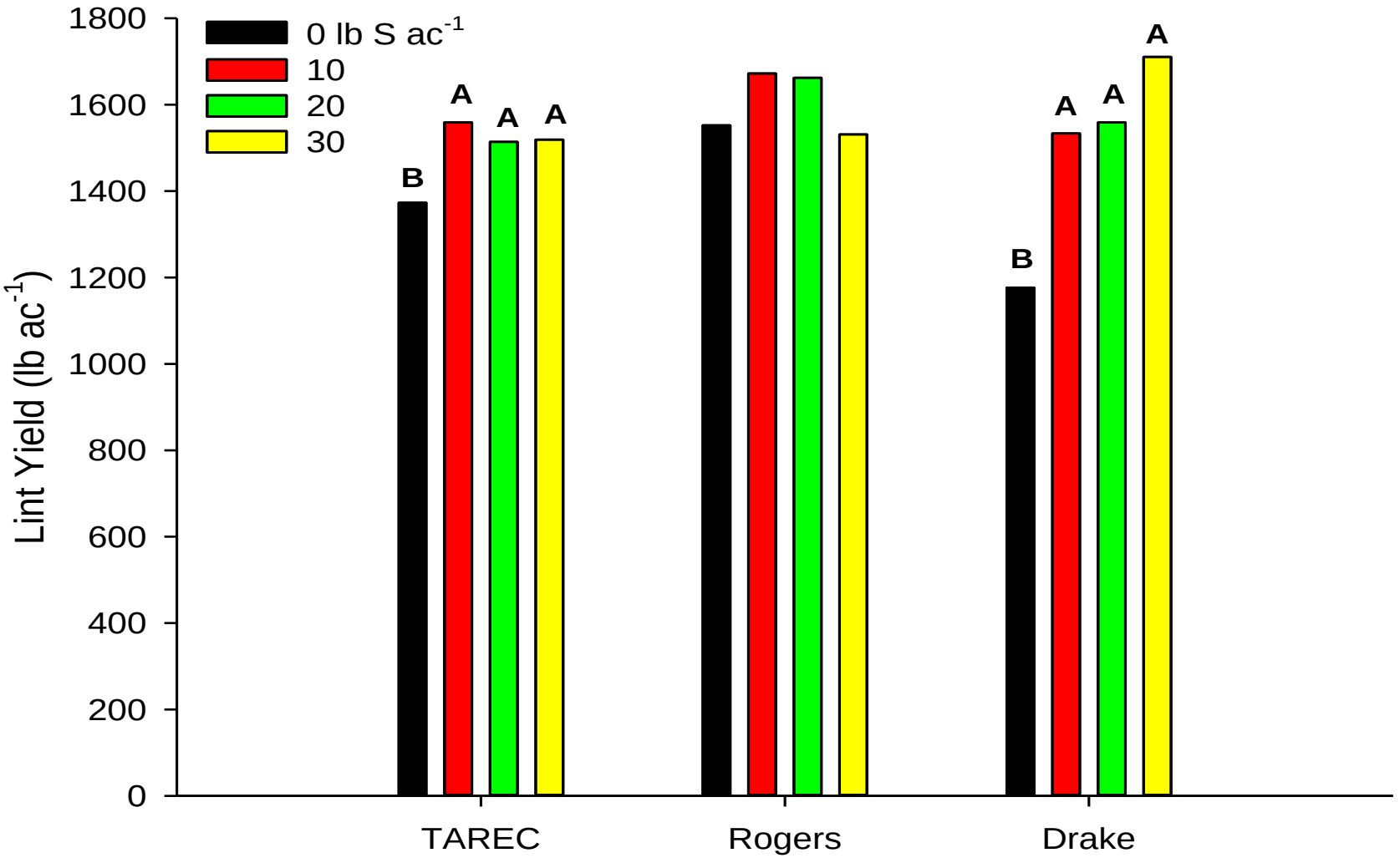
CRITICAL PETIOLE S CONCENTRATION FROM 2018



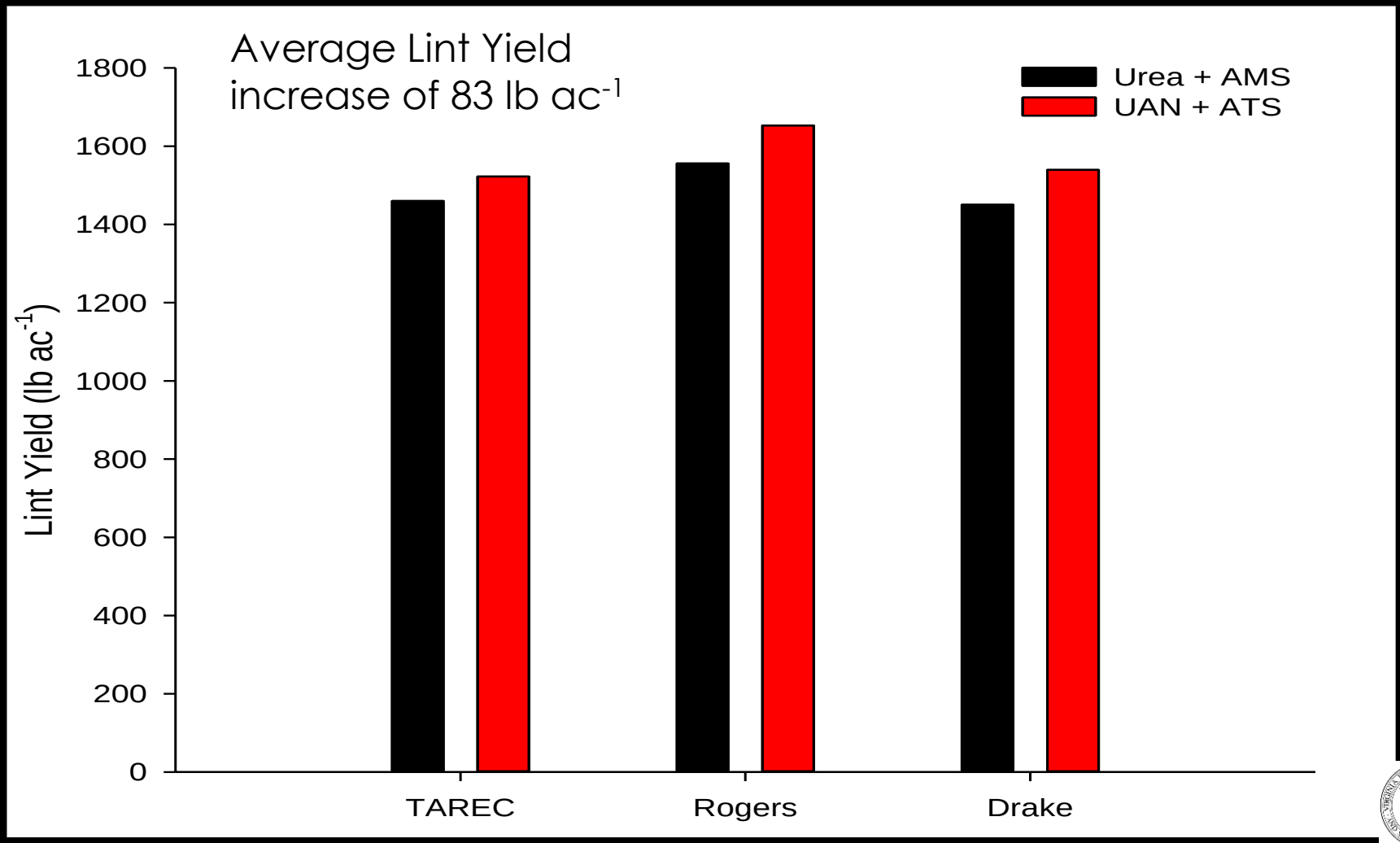
CRITICAL LEAF S CONCENTRATION FROM 2018



YIELD AND SULFUR APPLICATION RATE @ 100 LB N AC^{-1}



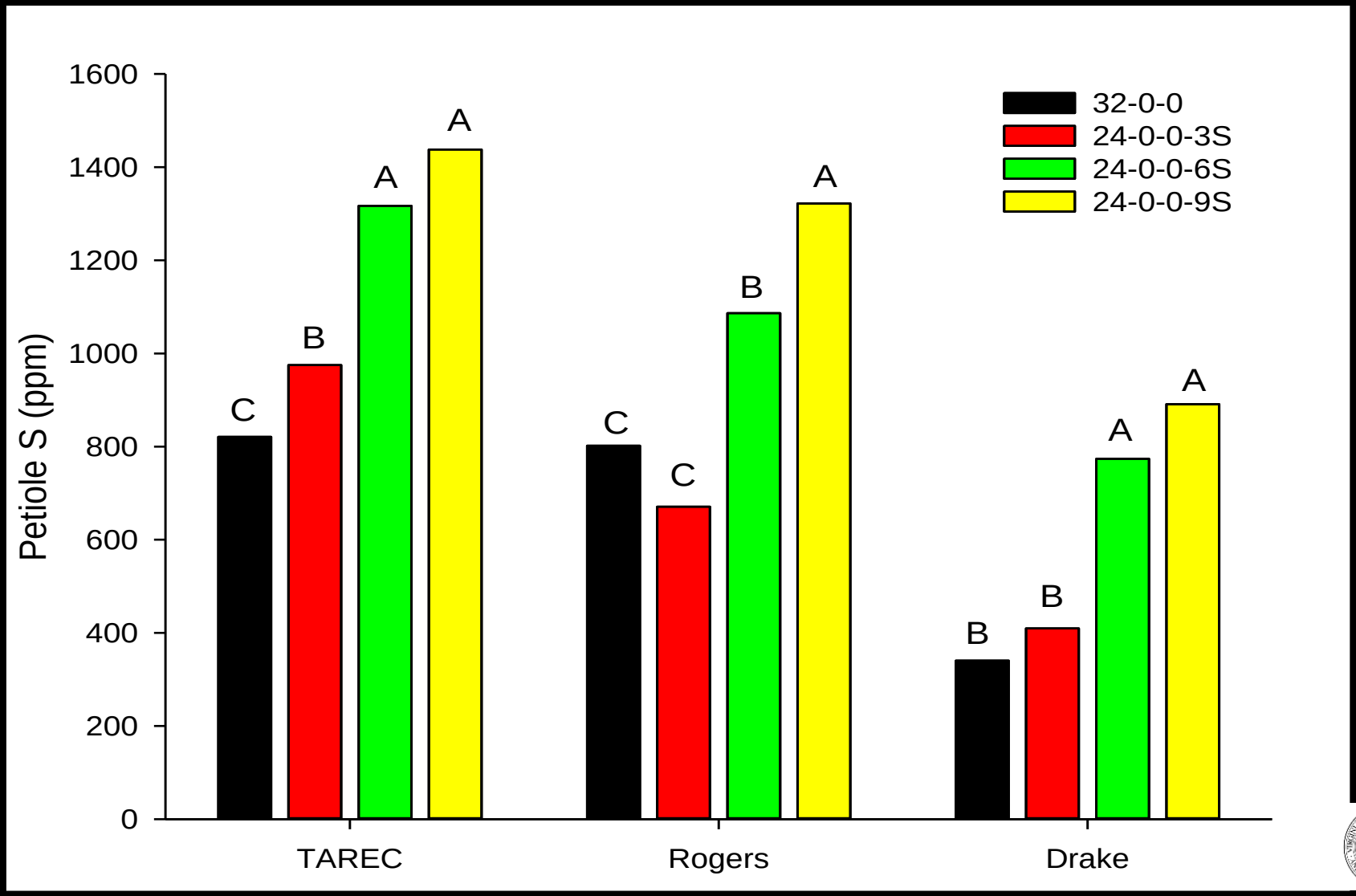
N/S FORMULATION AND LINT YIELD IN 2018



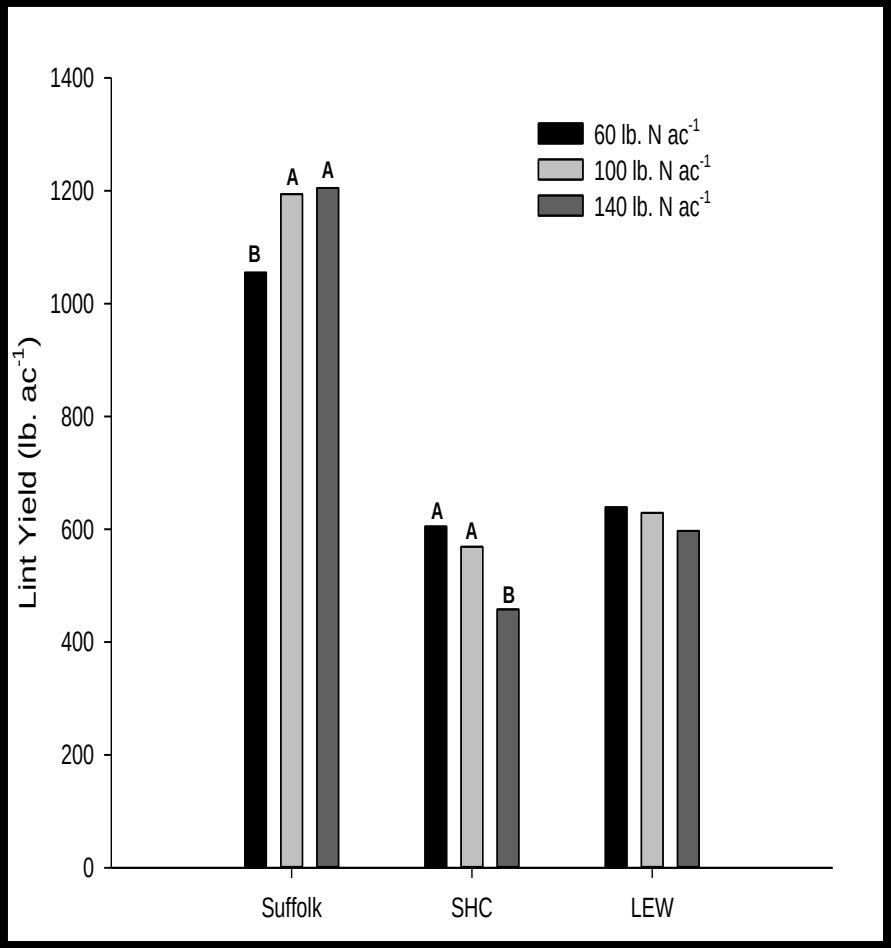
RESULTS

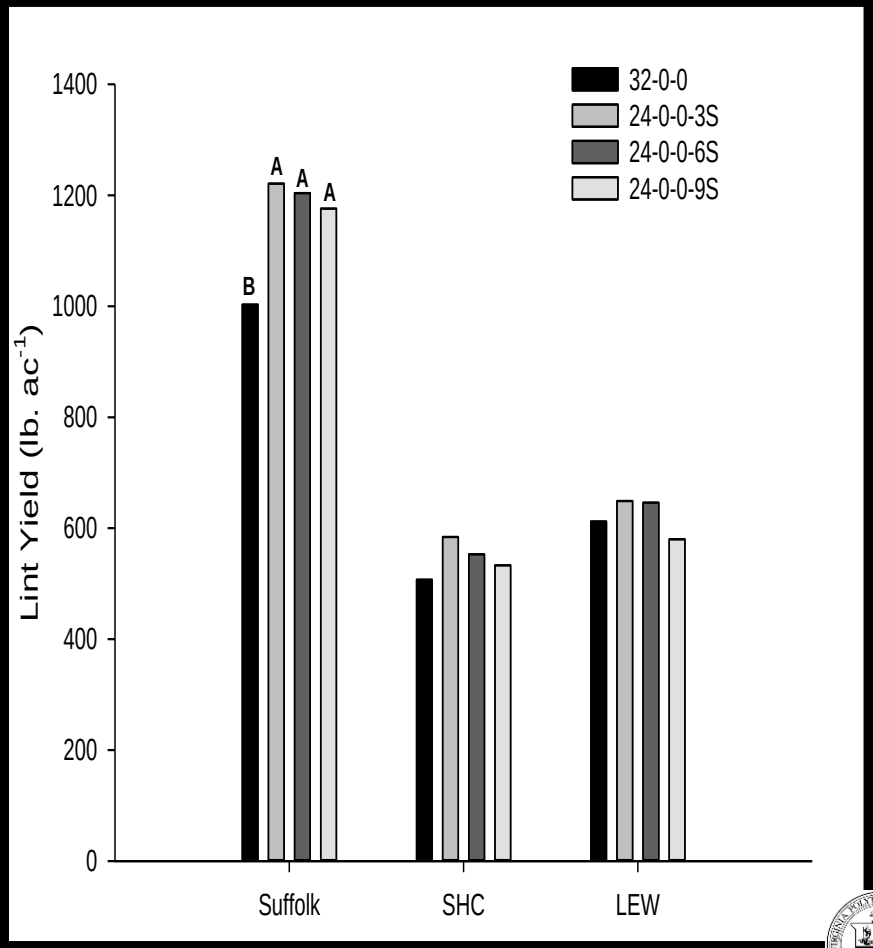
FLUID N/S FORMULATIONS AND VARYING NITROGEN RATES

PETIOLE SULFUR FOR FLUID N/S FORMULATIONS

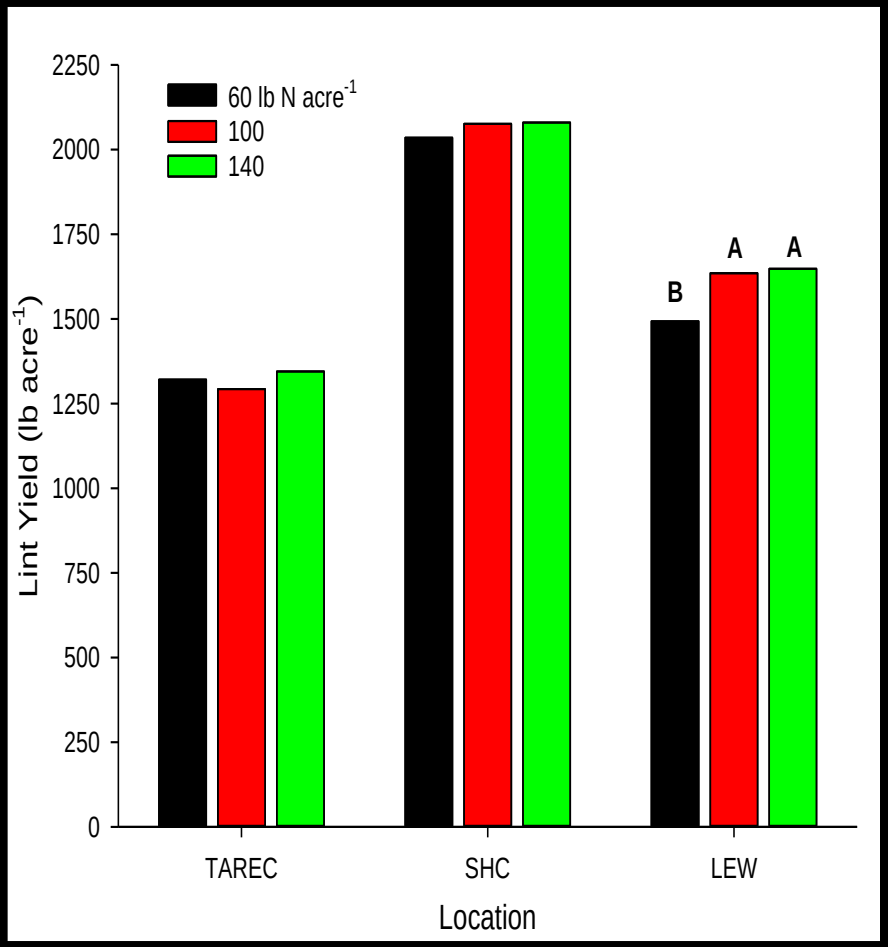


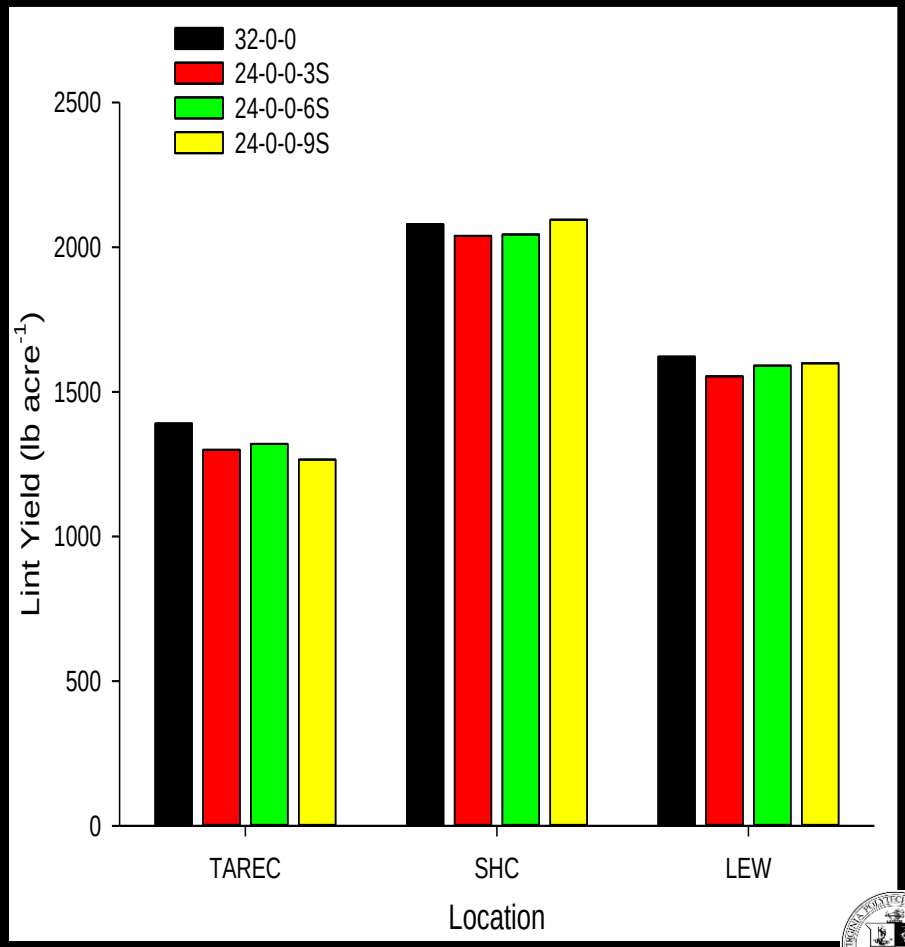
FLUID N/S FORMULATIONS AND LINT YIELD IN 2016



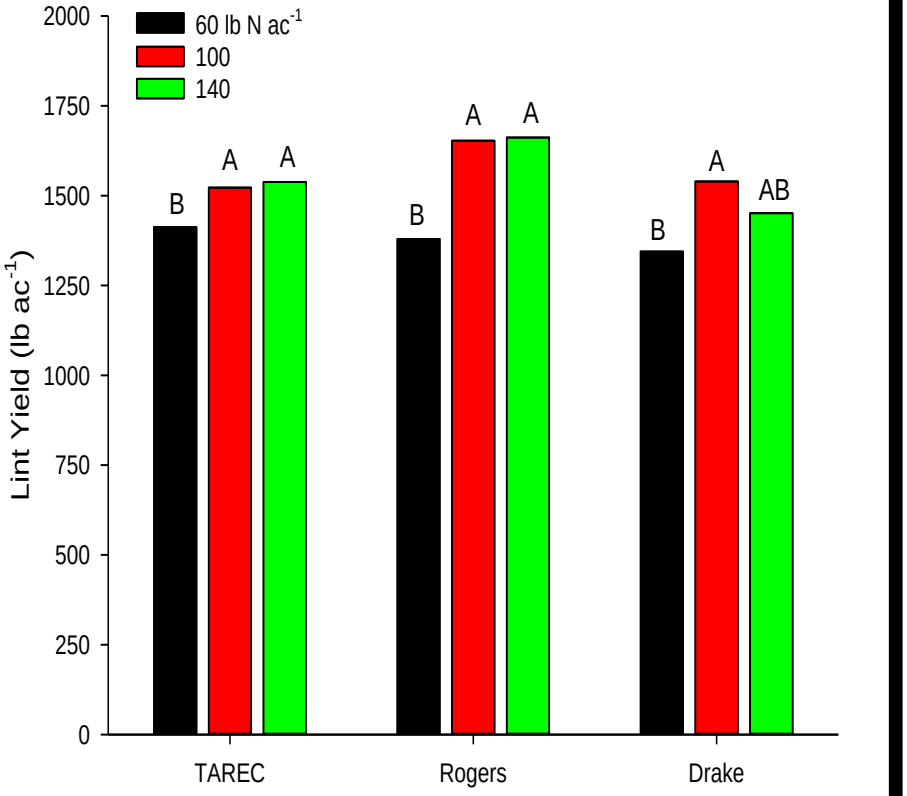


FLUID N/S FORMULATIONS AND LINT YIELD IN 2017

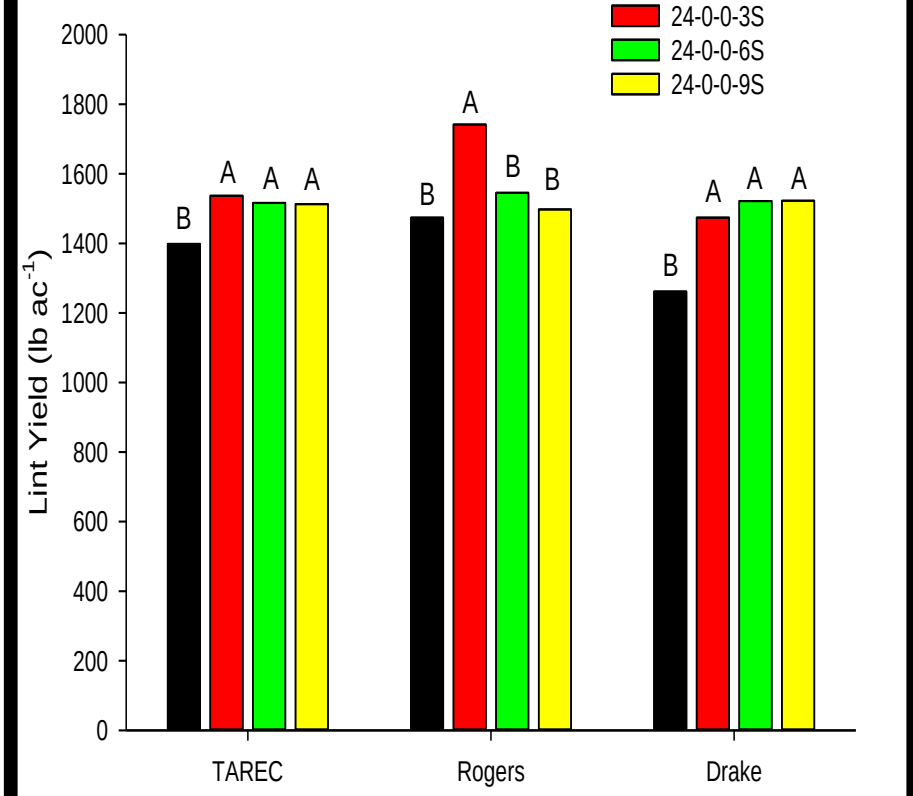




FLUID N/S FORMULATIONS AND LINT YIELD IN 2018

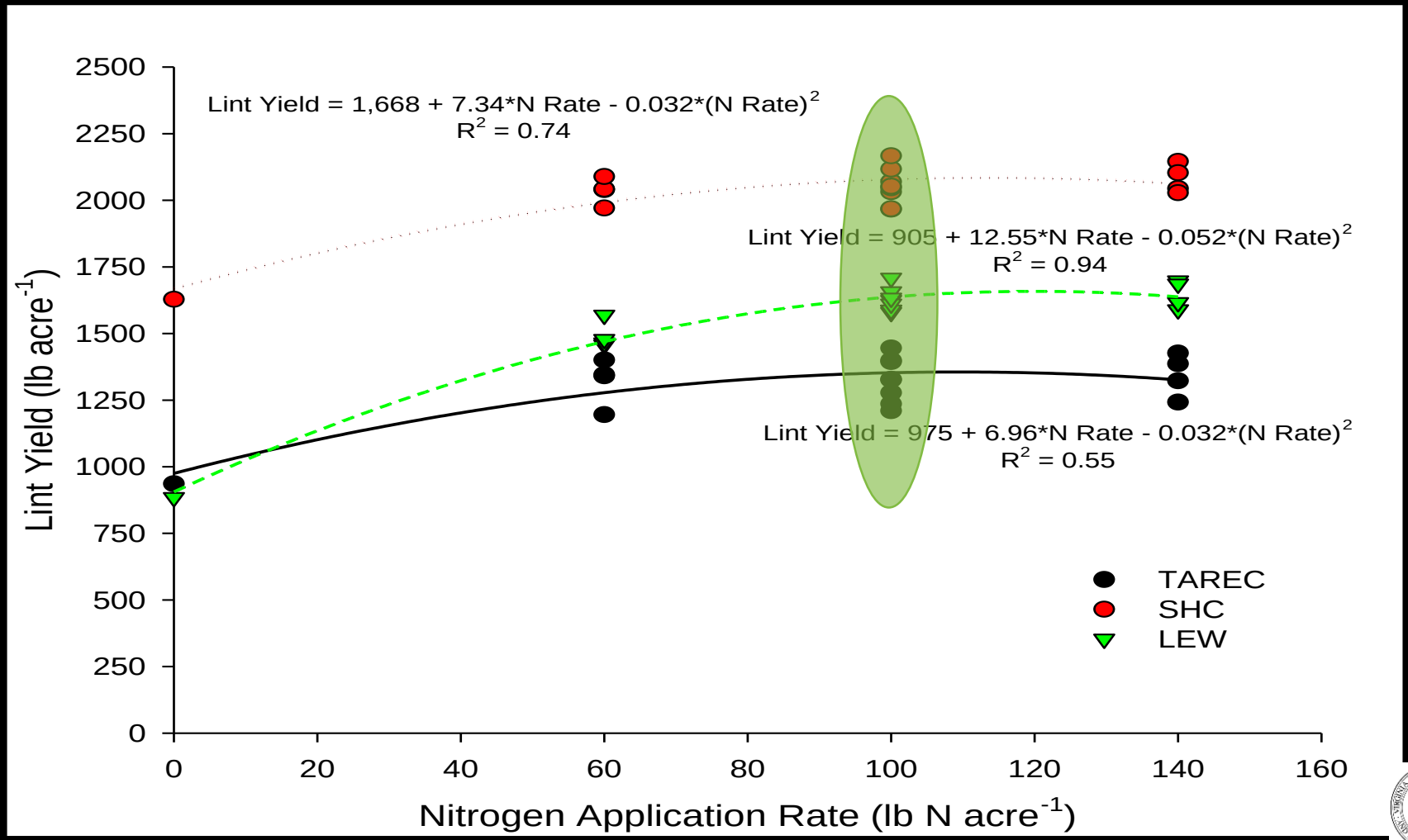


Average lint yield increase of **193 lb ac^{-1}** from 60 to 100 lb N ac^{-1}



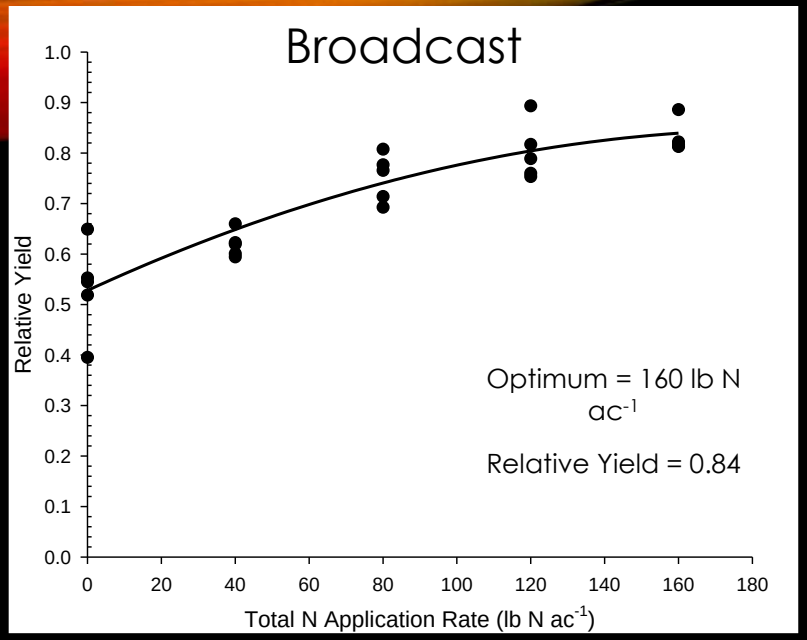
Average lint yield increase of **207 lb ac^{-1}** from UAN 32 to 24-0-0-3S

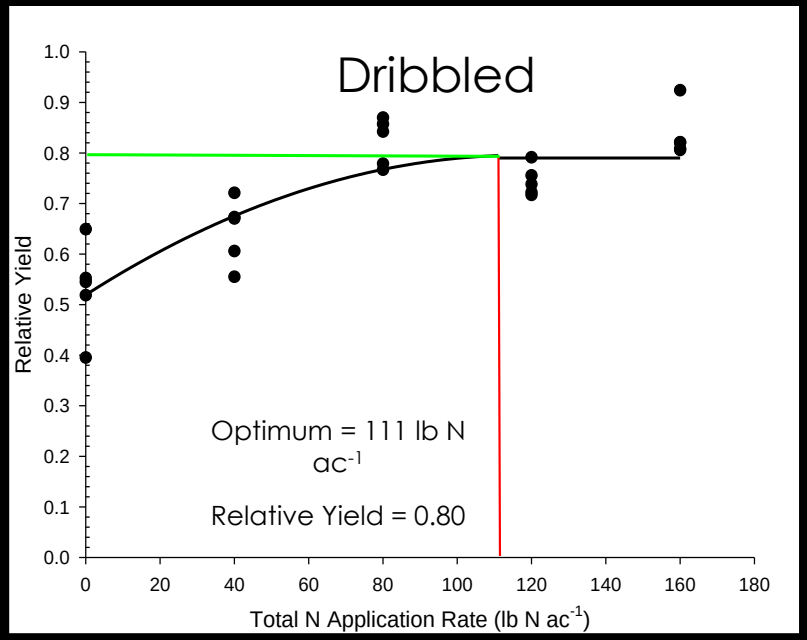
NITROGEN RATE AND LINT YIELD AT ALL LOCATIONS IN 2017

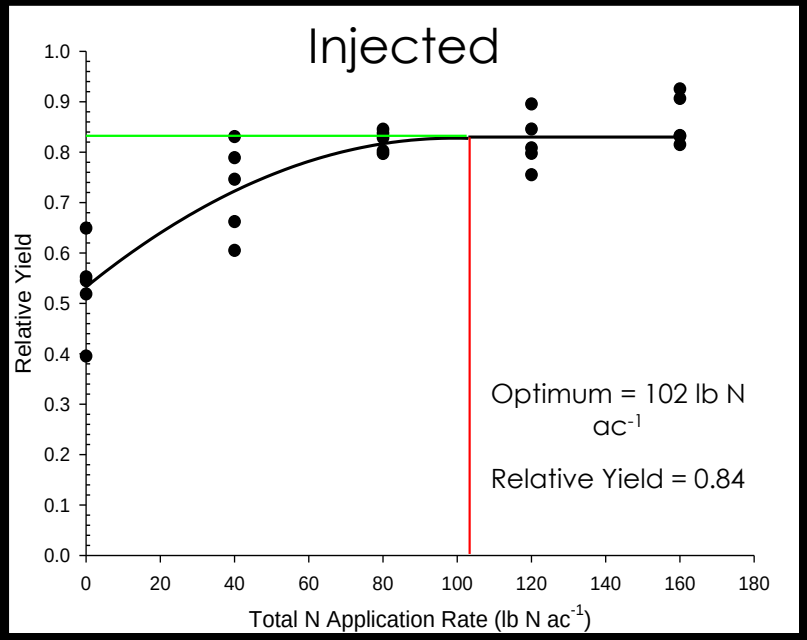


NITROGEN SOURCE/PLACEMENT IMPACT ON COTTON LINT YIELDS

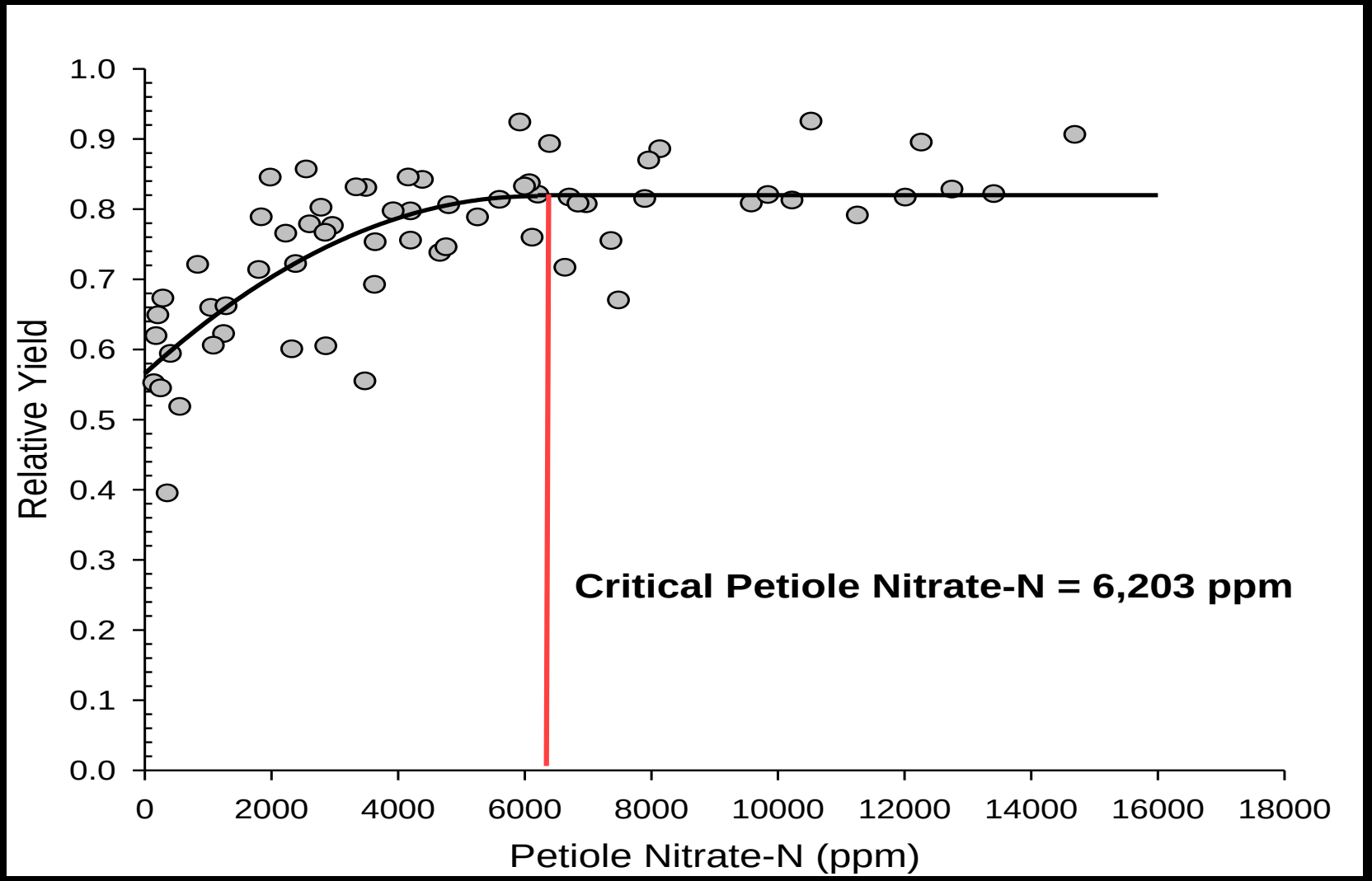
2016-2018


Broadcast
Relative Yield
Total N Application Rate (lb N ac-1)
Optimum = 160 lb N ac-1
Relative Yield = 0.84


Dribbled
Relative Yield
Total N Application Rate (lb N ac-1)
Optimum = 111 lb N ac-1
Relative Yield = 0.80


Injected
Relative Yield
Total N Application Rate (lb N ac-1)
Optimum = 102 lb N ac-1
Relative Yield = 0.84

CRITICAL PETIOLE NITRATE-N 1ST WEEK OF BLOOM



SUMMARY

- **Environment plays a critical role in response to N/S fertilization in the coastal plain**
- Petiole nitrate-N, petiole sulfur, leaf nitrogen, and leaf sulfur concentrations increased with increasing application rates.
- Critical petiole and leaf S concentrations in 2018 were
  - Petiole S = 527 ppm
  - Leaf S = 0.24% (Very close to current critical thresholds)
  - 2018 was the most responsive year to S fertilization of the study
- At all locations 24-0-03S increased lint yields above 32-0-0 when averaged over nitrogen rates in 2016 and 2018.
  - Sulfur response was not observed among formulations in 2017
- Nitrogen application rate seems to be the best predictor of lint yield over both years of the study when environmental conditions support average to high yields.
  - However, when sulfur is limiting yields responses can be large!
  - At 100 lb N per acre the optimum S application rate was 10 lb S per acre in 2018
  - There seems to be a greater efficiency in cotton when fluid N/S fertilizers are used compared to a urea/AMS bulk blend.

ACKNOWLEDGEMENTS

- Fluid Fertilizer Foundation funded the project
- Tessenderlo Kerley donated all Ammonium Thiosulfate
- Water's Agricultural Laboratory
- Tidewater AREC faculty and staff
  - David Horton
  - Gail White
- Lewis Everett, Southampton Cooperator
- NC Peanut Belt Research Station Staff