Innovative Traits and New Technologies for Forage Plants

A Noble Approach

Mike Trammell, Plant Breeder

THE SAMUEL ROBERTS NOBLE FOUNDATION

Talk Outline

- ❑ At a Glance – The History of the Noble Foundation.
- ❑ Noble Foundation Divisions.
- ❑ The 'breeding pipeline'.
- ❑ Innovative traits and new technologies for forage plants.

a. recent cultivar releases.

b. current breeding projects.

c. FORAGE365. A Noble approach to research, development and delivering outcomes.

- ❑ Conclusion

History and mission of the Noble Foundation

Lloyd Noble

founder of the Samuel Roberts Noble Foundation.

Ardmore, OK


1937

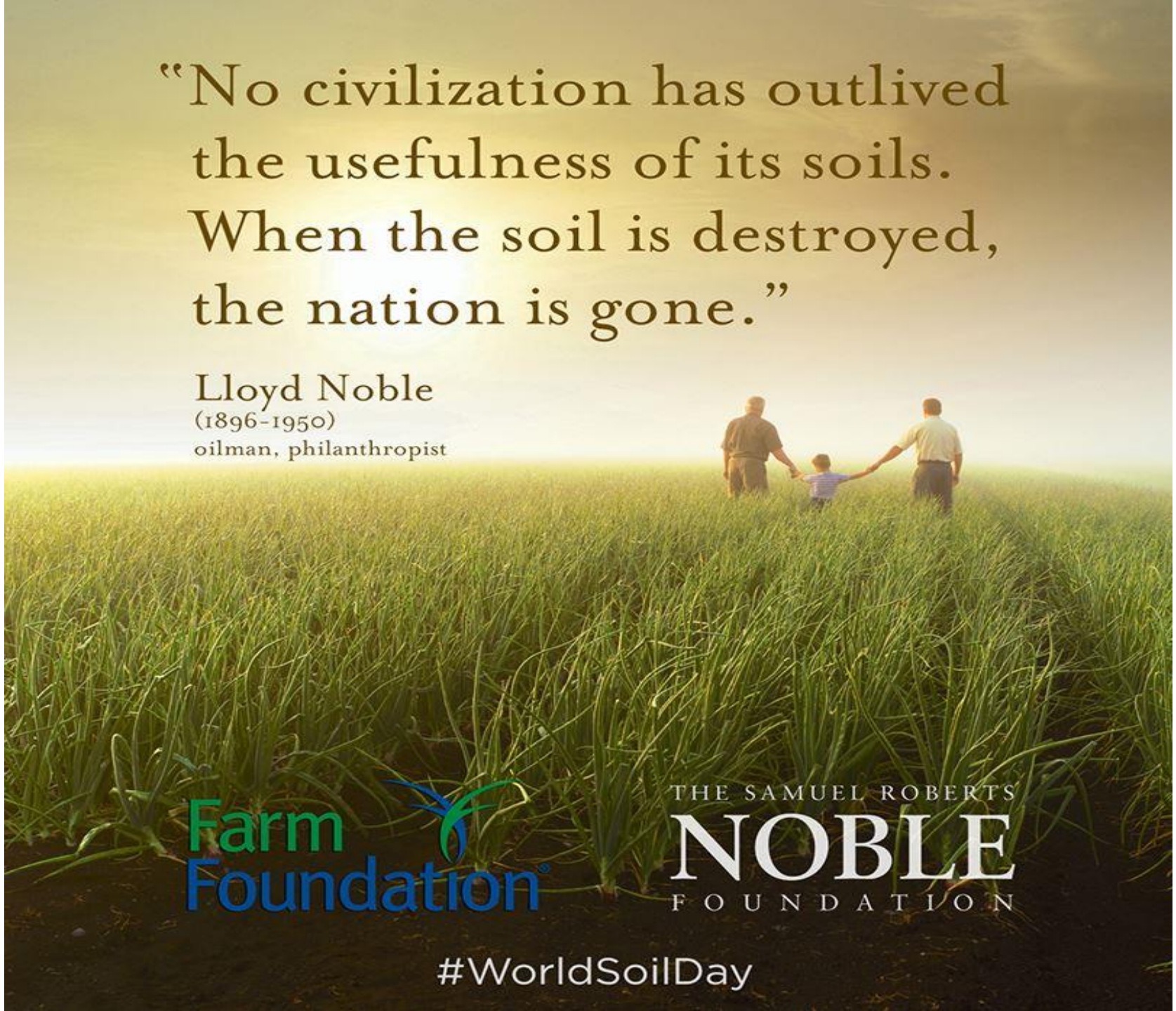
Lloyd Noble establishes the Samuel Roberts Noble Foundation in 1945.

At a Glance…….. *Today*

- Is the largest private foundation in Oklahoma and is in the top 44 in the United States (based on asset size).
- Employs more than 350 individuals, including more than 90 Ph.D. scientists, agricultural consultants and research associates.
- Houses 21 primary research laboratories focused on plant research.
- 500,000-square-foot central campus having research, program, infrastructure and administrative space.
- Operates more than 12,000 acres of farms in southern Oklahoma for research and demonstration projects.

Mission Statement

The purpose of the Samuel Roberts Noble Foundation is to advance agricultural science and practice by conducting field and laboratory research and providing consultation to farmers, ranchers and land managers in the southern Great Plains.


"No civilization has outlived the usefulness of its soils. When the soil is destroyed, the nation is gone."
Lloyd Noble
(1896-1950)
oilman, philanthropist
Farm Foundation
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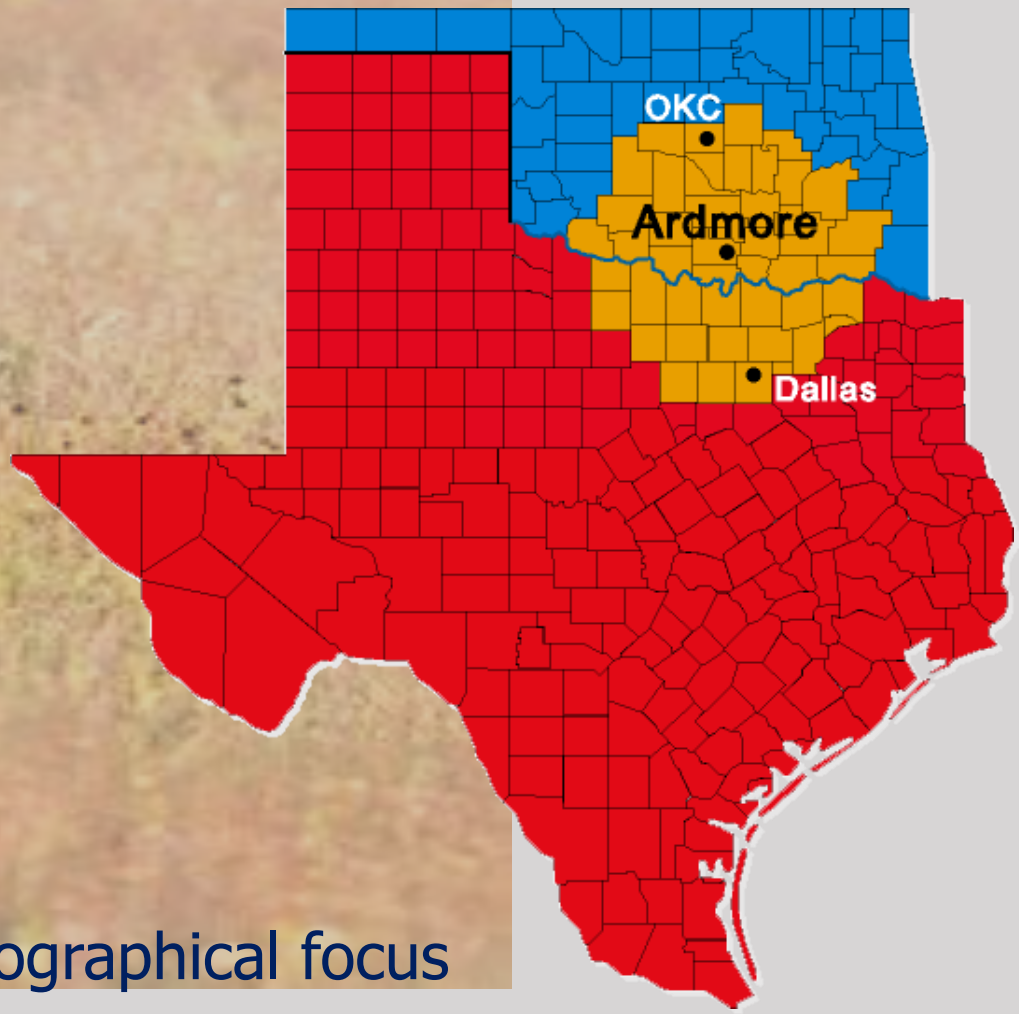
#WorldSoilDay

Noble Foundation Divisions

Agricultural Division



Geographical focus

Noble Foundation consultants work with farmers, ranchers and land stewards to improve their operational profitability and personal quality of life.


273


RISK
AHEAD

Plant Biology Division

The plant biology division conducts basic biochemical, genetic and genomic plant research for the purpose of improving crop productivity and value.

Forage Improvement Division

The forage improvement division translates basic plant science research into tangible plant varieties.

The Samuel Roberts Noble Foundation

Laboratory to Field Pipeline

Plant Biology

Cutting-edge Plant Science

Forage Improvement

Cultivar Development

Agricultural

Field & Producer Application

Forage Improvement Division

'breeding pipeline'

Cultivar Development

Mike Trammell
Plant Breeding

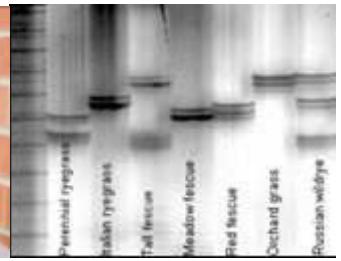
Agronomy

Twain Butler
Management systems

Legumes Markers

Maria Monteros
Al tolerance
Drought tolerance
Abiotic stresses

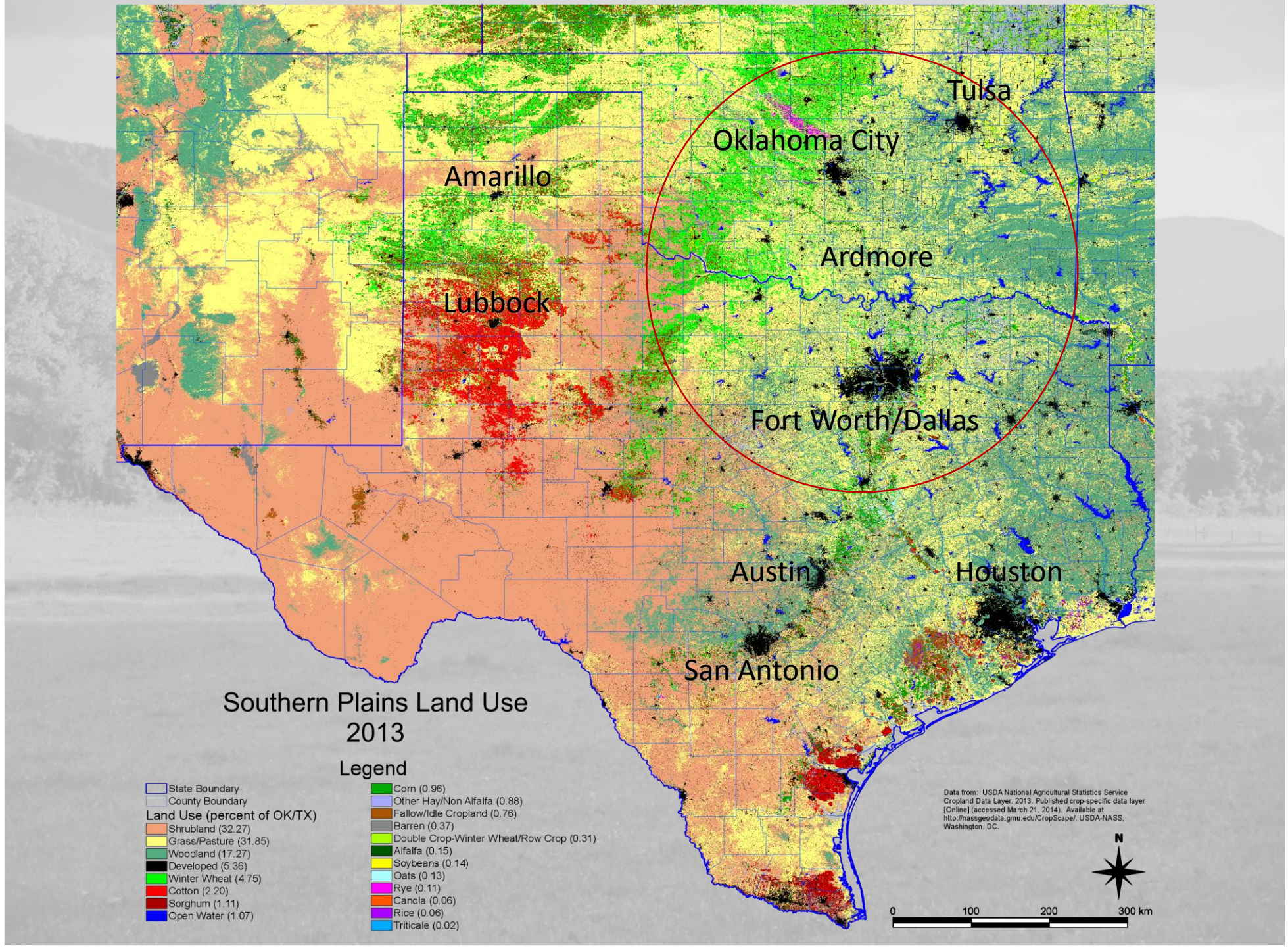
Markers



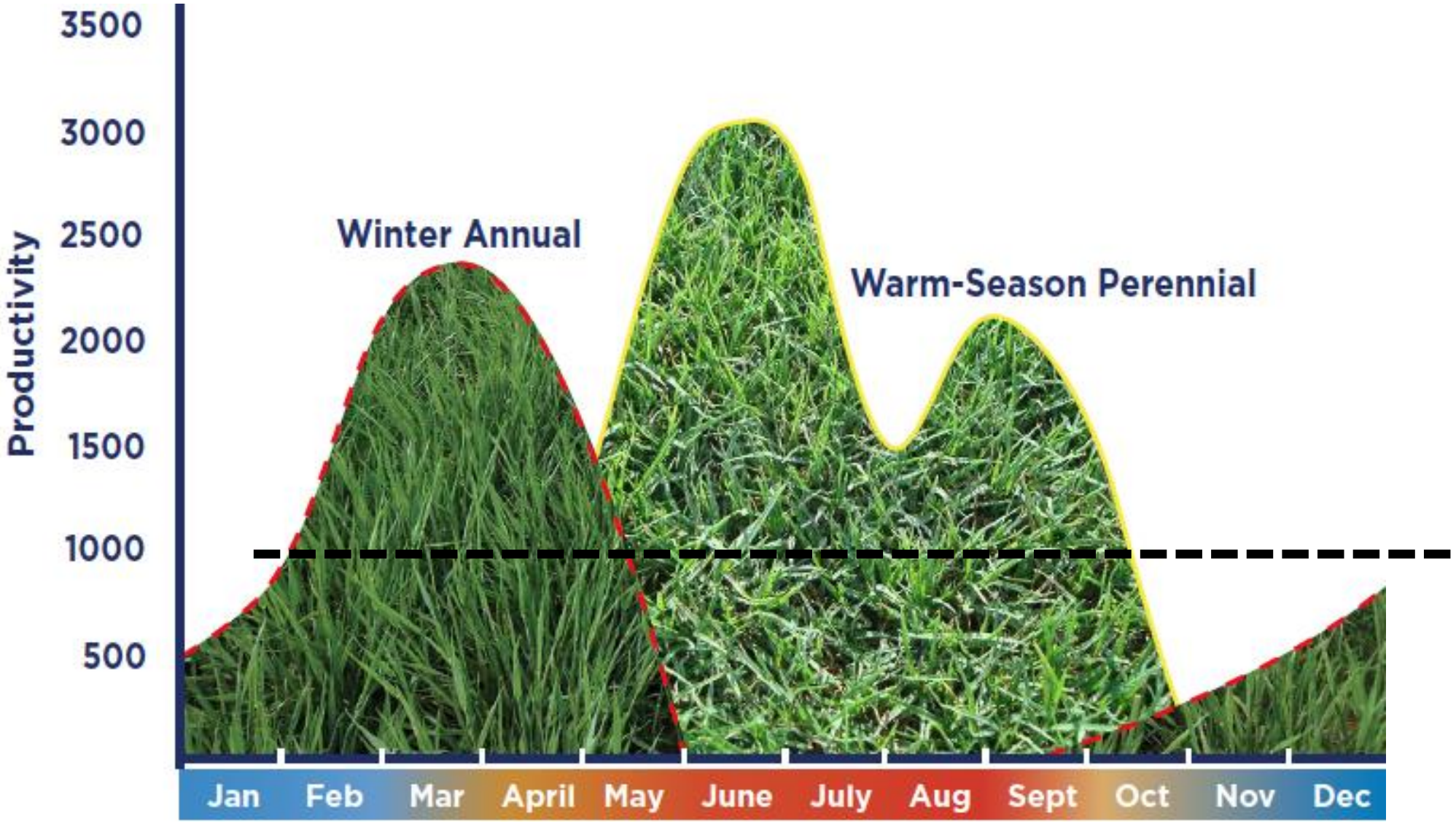
Malay Saha
Drought tolerance
Stem rust resistance
Summer dormancy

Endophytes

Carolyn Young
Epichloë species for grass improvement
Mammalian-friendly endophytes
Endophytes for target cool season grasses


Tulsa
Oklahoma City
Amarillo
Ardmore
Lubbock
Fort Worth/Dallas
Austin
Houston
San Antonio
Southern Plains Land Use
2013
Legend
State Boundary
County Boundary
Land Use (percent of OK/TX)
Shrubland (32.27)
Grass/Pasture (31.85)
Woodland (17.27)
Developed (5.36)
Winter Wheat (4.75)
Cotton (2.20)
Sorghum (1.11)
Open Water (1.07)
Corn (0.96)
Other Hay/Non Alfalfa (0.88)
Fallow/Idle Cropland (0.76)
Barren (0.37)
Double Crop-Winter Wheat/Row Crop (0.31)
Alfalfa (0.15)
Soybeans (0.14)
Oats (0.13)
Rye (0.11)
Canola (0.06)
Rice (0.06)
Triticale (0.02)
Data from: USDA National Agricultural Statistics Service Cropland Data Layer. 2013. Published crop-specific data layer [Online] (accessed March 21, 2014). Available at http://nassgeodata.gmu.edu/CropScape/. USDA-NASS, Washington, DC.
N
0
100
200
300 km

Current Forage Production System



Oklahoma Pastures

Summer

Winter


Beef cattle is the #1 most valuable agricultural commodity in Oklahoma
113
AG DAY
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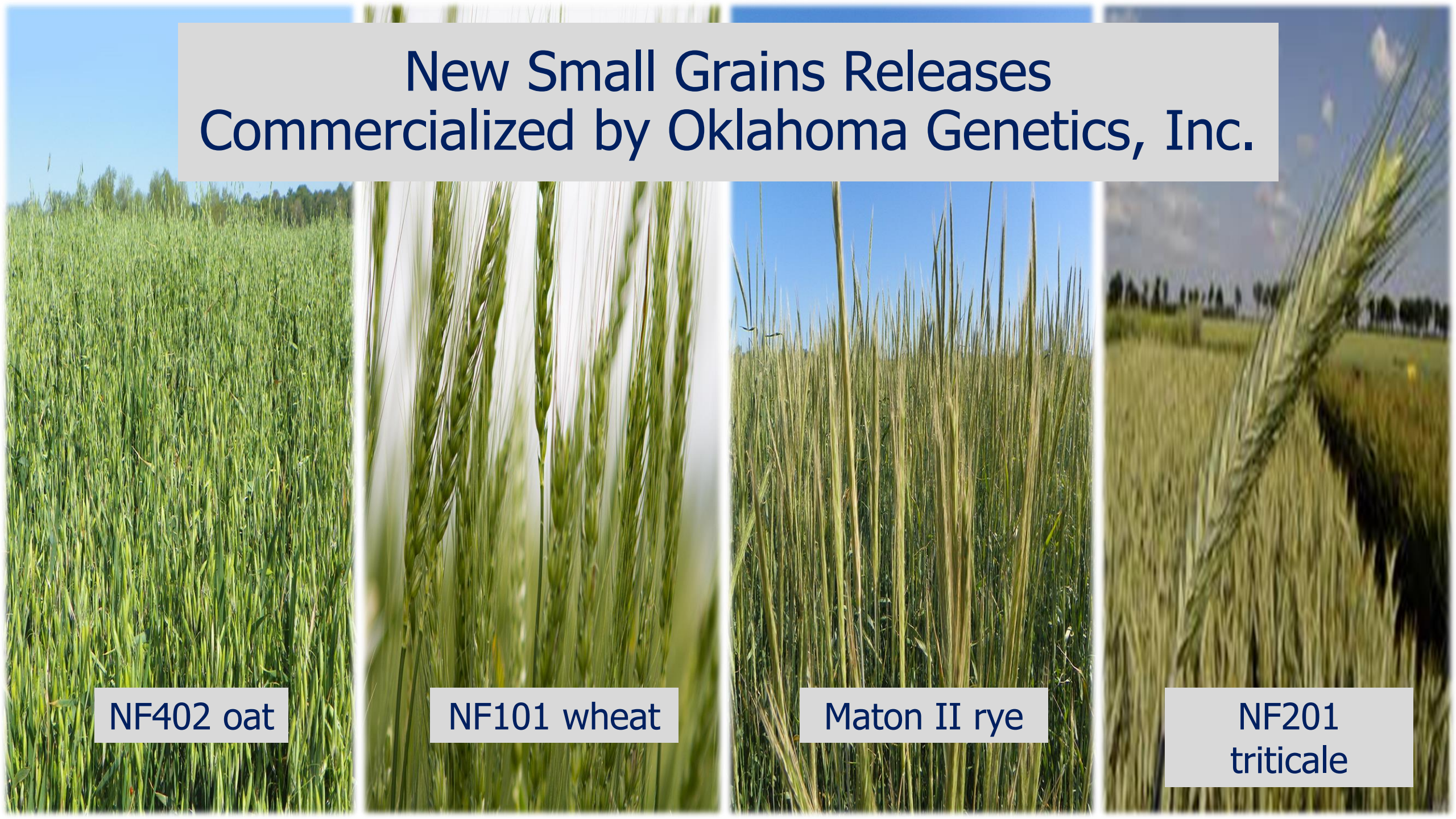
Winter feeding costs account for as much as 60% of total yearly cow maintenance cost

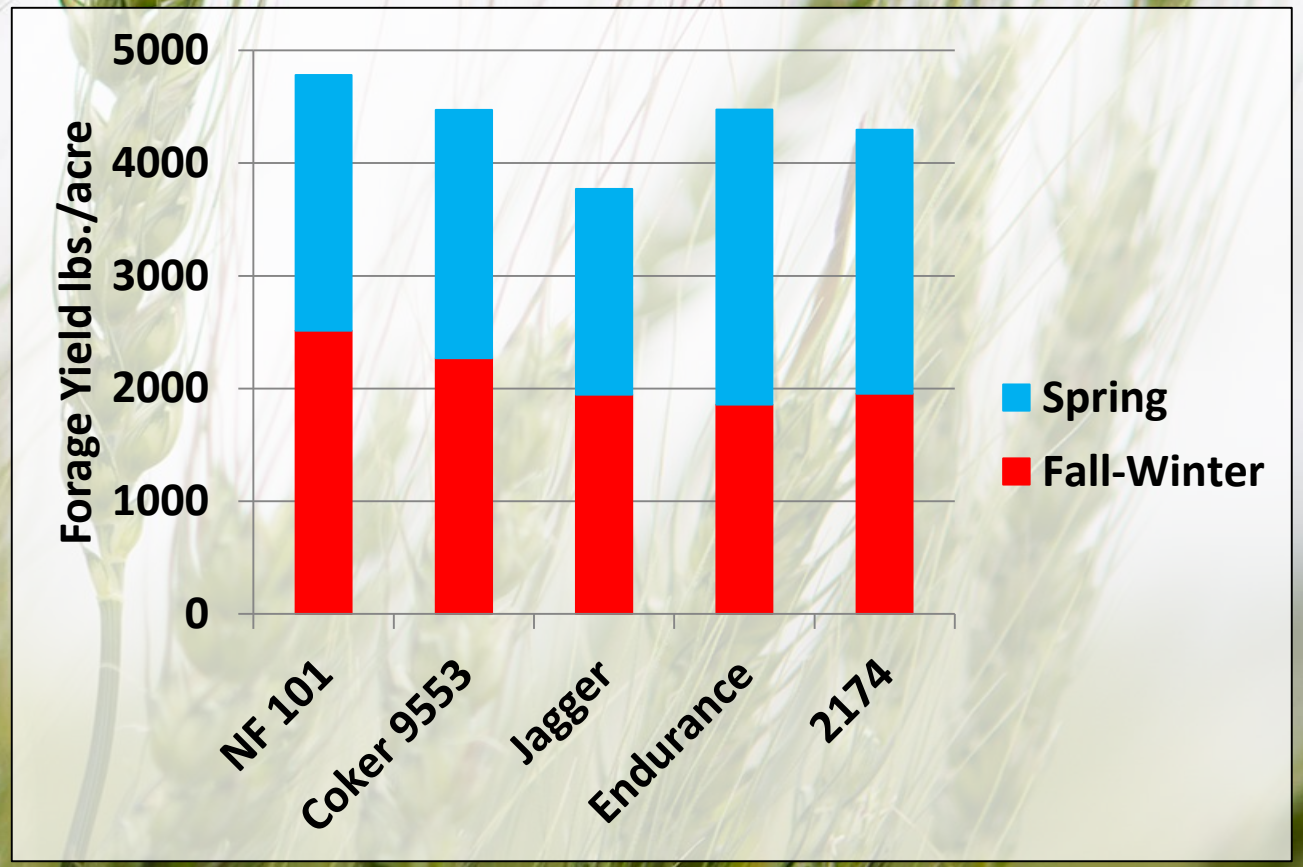
Innovative Traits and New Technologies

Recent cultivar releases and current breeding projects

New Small Grains Releases Commercialized by Oklahoma Genetics, Inc.

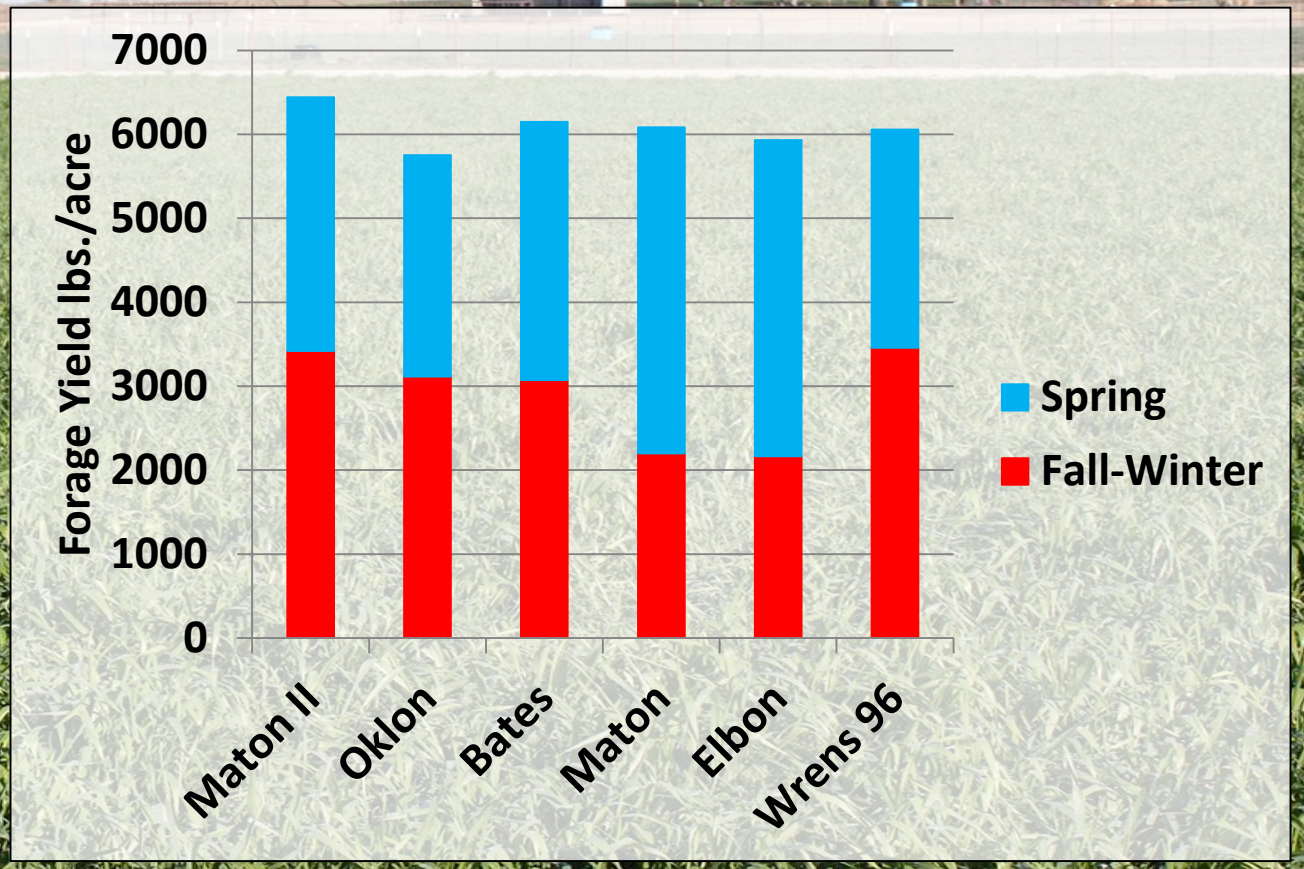


NF101 forage wheat



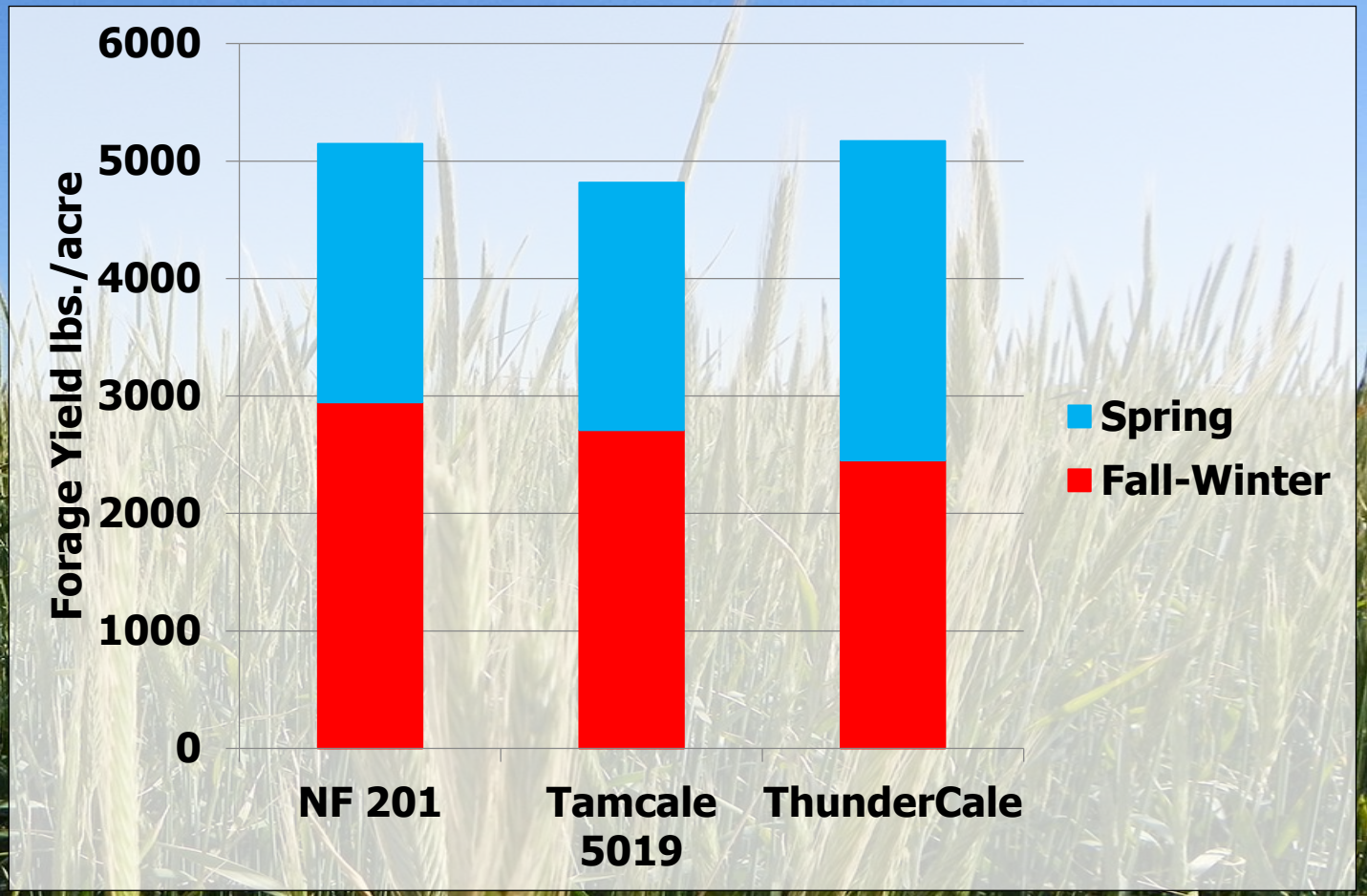
Seasonal yield of NF 101 forage wheat compared to other wheat cultivars in southern Oklahoma. Yields are averaged across seven years (2004-11) and two locations (Ardmore and Burneyville, OK).

Maton II rye



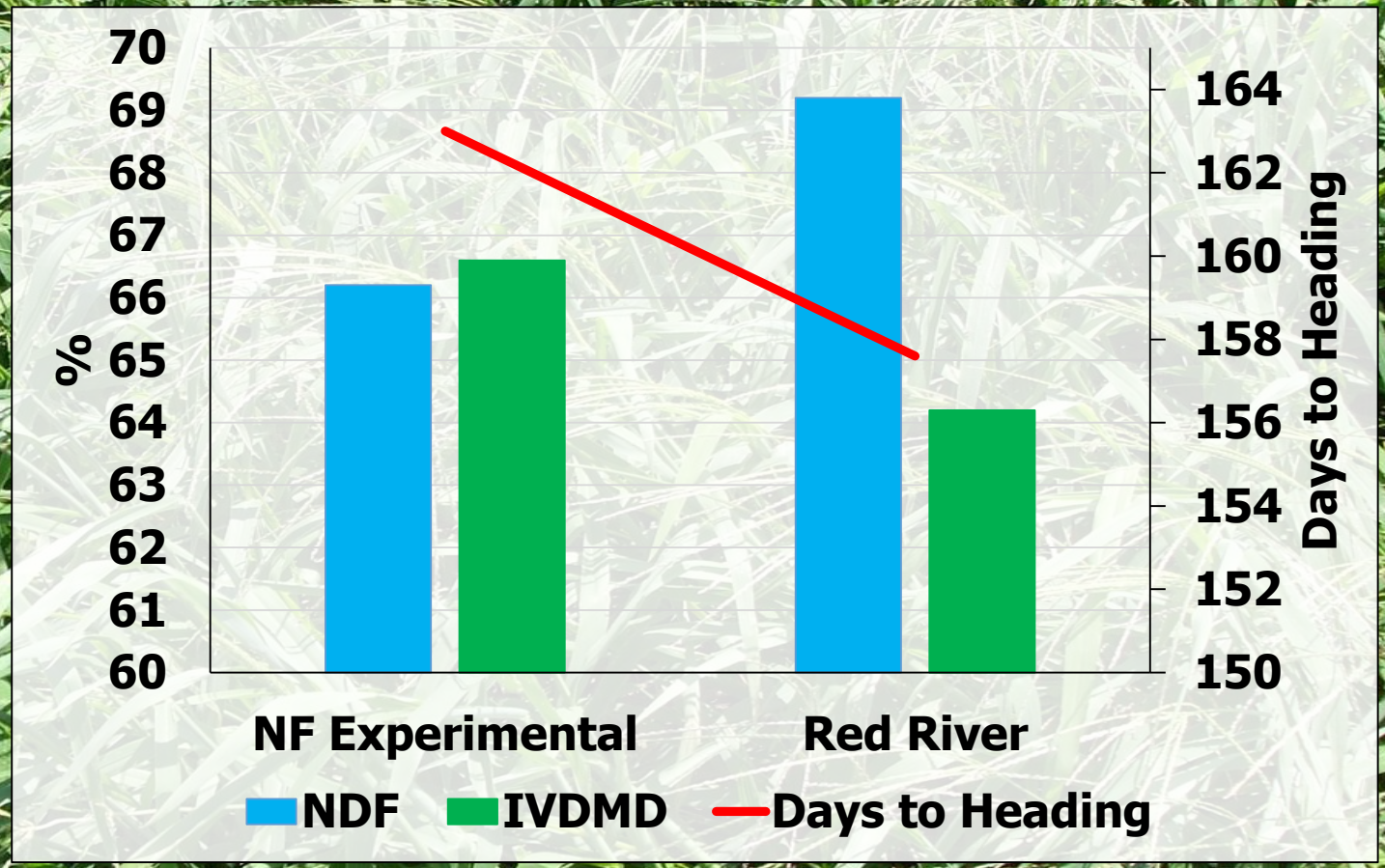
Seasonal yield of Maton II forage rye compared to other rye cultivars in southern Oklahoma. Yields are averaged across seven years (2004-11) and two locations (Ardmore and Burneyville, OK).

NF201 forage triticale



Seasonal yield of NF 201 forage triticale compared to other triticale cultivars in southern Oklahoma. Yields are averaged across seven years (2004-11) and two locations (Ardmore and Burneyville, OK).

Crabgrass

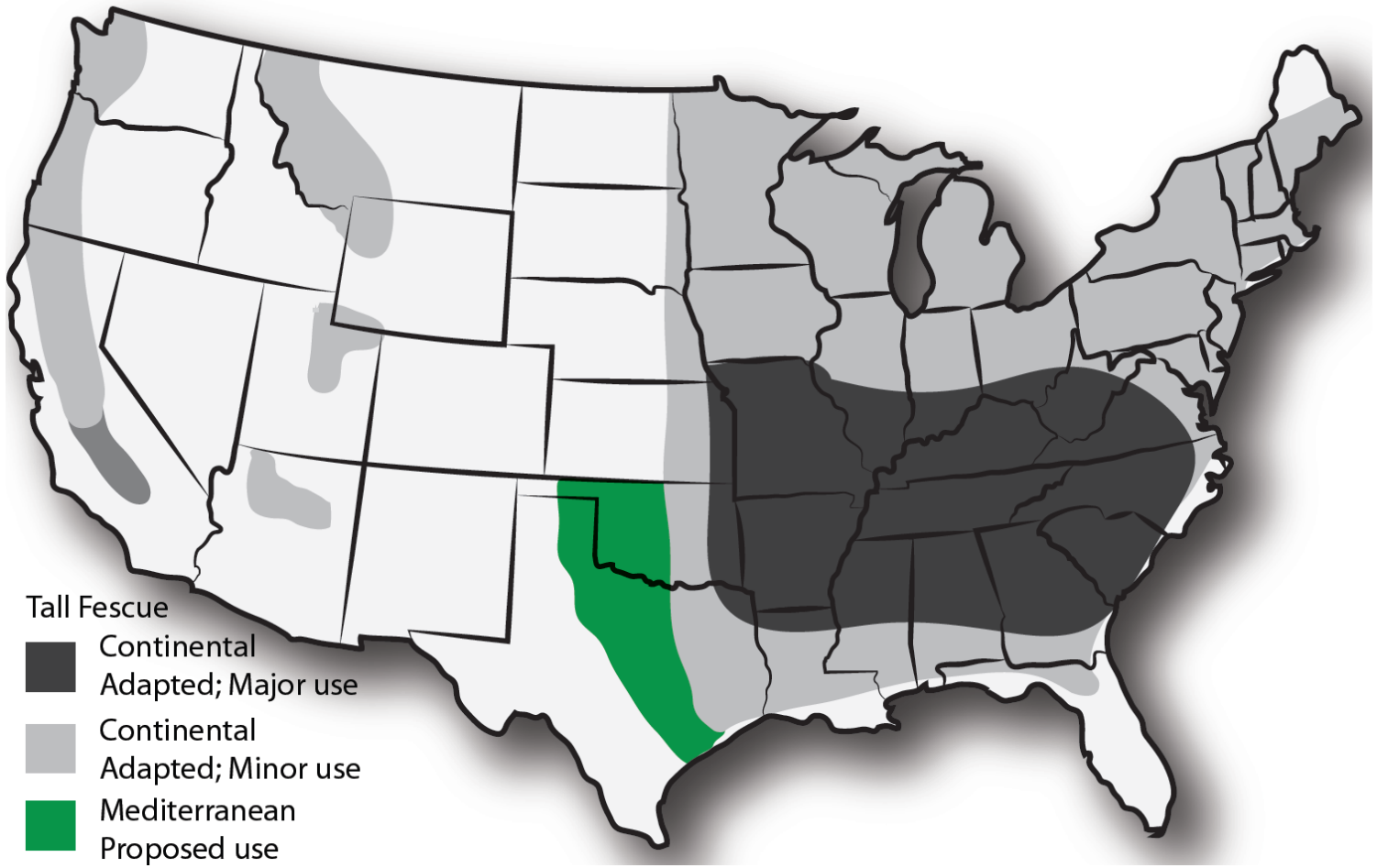


Percent NDF and IVDMD of crabgrass plots harvested during the summer of 2014. Data is the average across two sites (Ardmore, OK and Vashti, TX) and two cuttings.

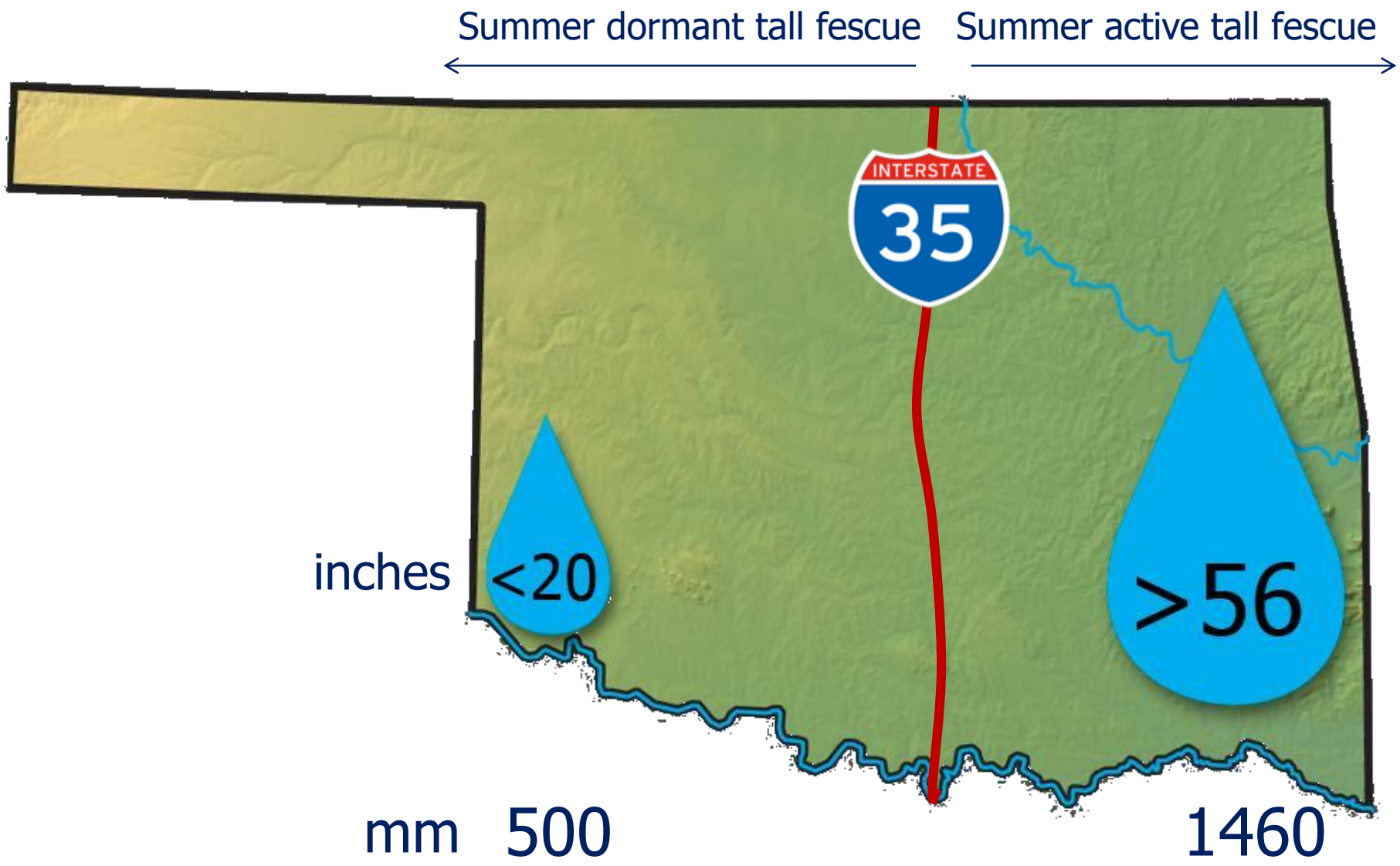
New Tall Wheatgrass Cultivar Release
NFTW 6020

Improved fall yield

Tall Fescue for Oklahoma



Rainfall across OK



Summer dormant tall fescue

Endophyte free tall fescue.

New Tall Fescue Cultivar Release NF97TF1

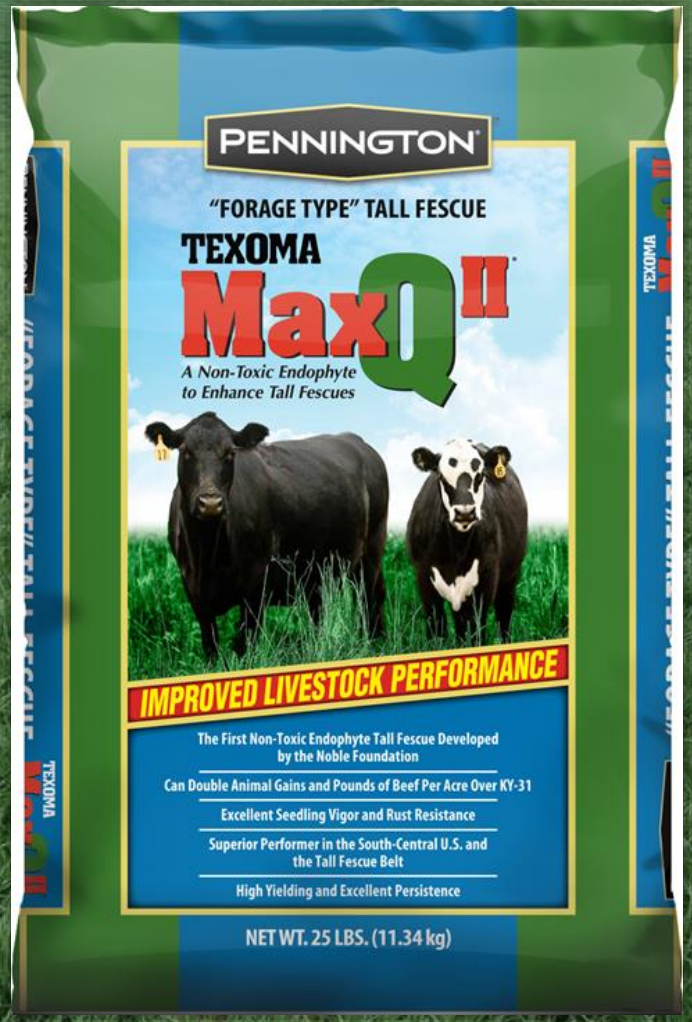
– a continental type tall fescue with broad adaptation and higher overall crude protein content than Texoma MaxQ II. Excellent yields. Could be commercialized immediately.

Texoma MaxQ II Tall Fescue

Continental tall fescue release from Noble Foundation

Can double animal gains and pounds of beef per acre over toxic KY-31

Non-toxic endophyte



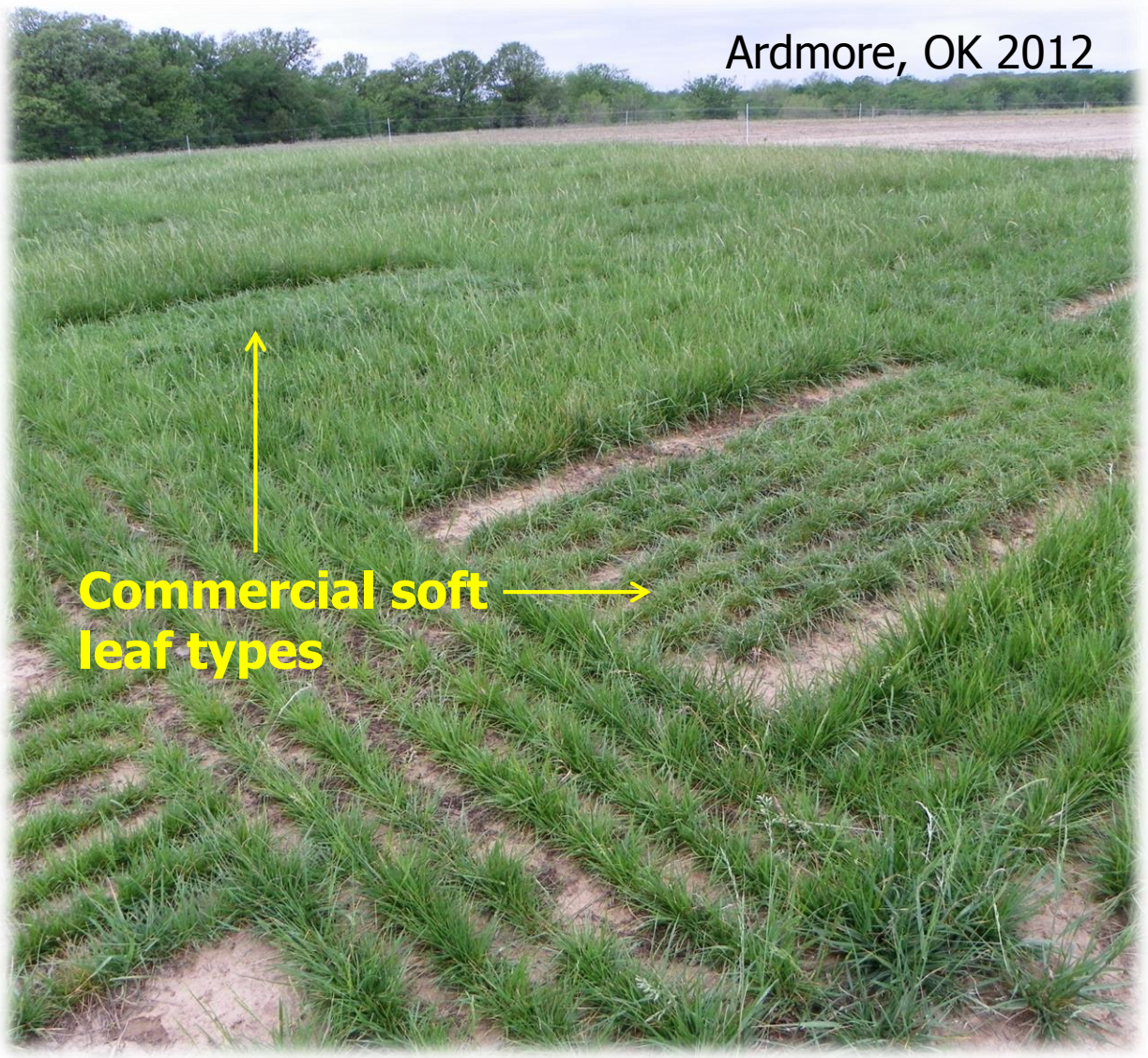
Objectives of soft leaf tall fescue breeding program-

- Improve nutritive value, while maintaining persistence and forage yield.

- We chose to evaluate the nutritive value, yield and persistence of hybrids between persistent cultivars and soft leaf germplasm.

  Traditionally, forage grasses have been defined by two traits: yield and persistence. Tall fescue has lower forage nutritive value than ideal for many livestock enterprises.

A good example of selection after 24 hrs. of grazing



Soft Leaf Advantages

- ❑ Palatable
- ❑ Increased Intake
- ❑ Late Heading
- ❑ Higher ADG
- ❑ Increased Milk Production

Development of hybrids-

- Texoma MaxQ II hybridized with various soft leaf tall fescue populations (Texoma MaxQ II x soft leaf tall fescue).
- A total of 10 soft leaf populations were developed and are currently under evaluation.

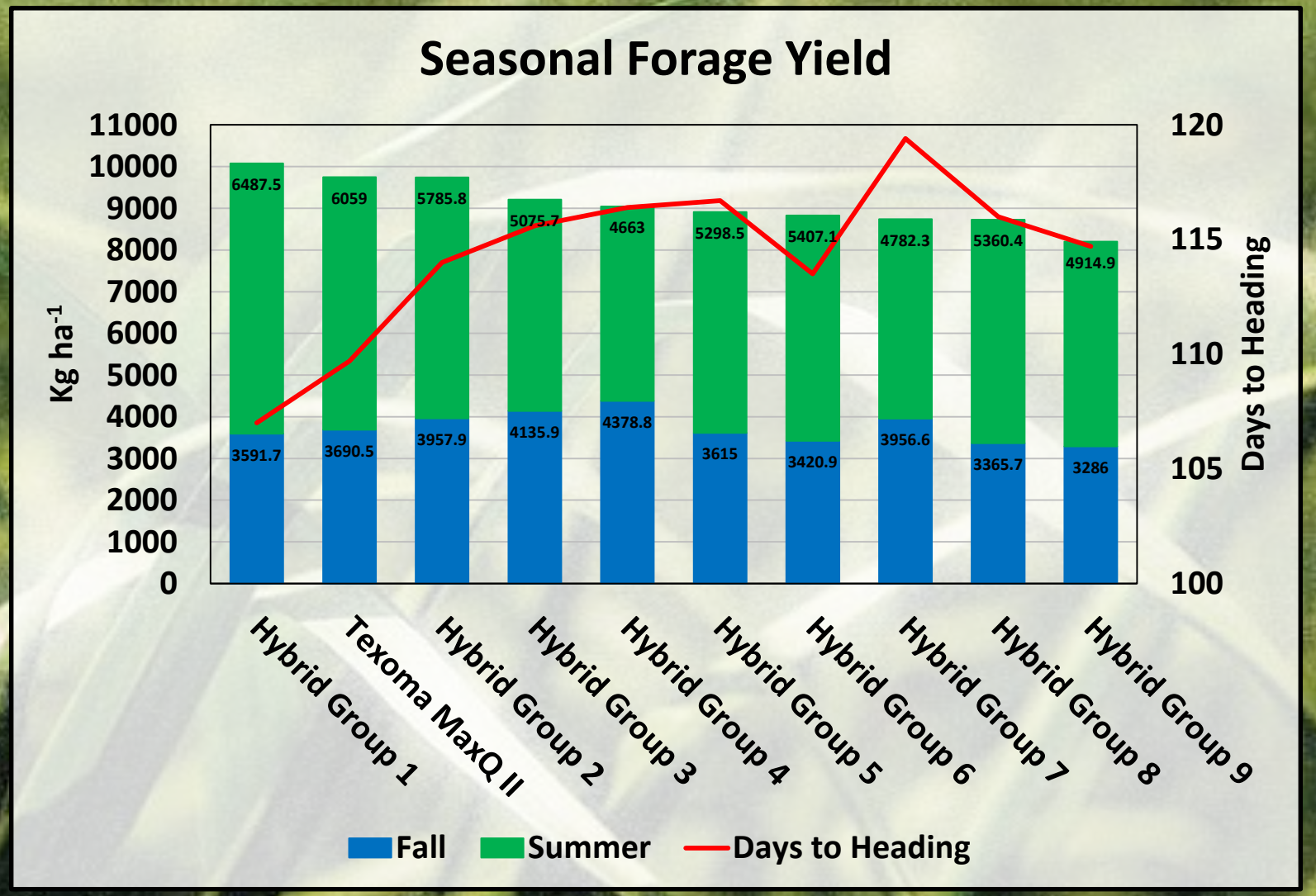


Figure 1. Seasonal forage yield and day of heading of tall fescue soft leaf hybrid populations and Texoma MaxQ II during the fall and summer 2014 growing season. Fall harvest LSD (0.05) = 797 kg ha^{-1}. Spring harvest LSD (0.05) = 656 kg ha^{-1}.

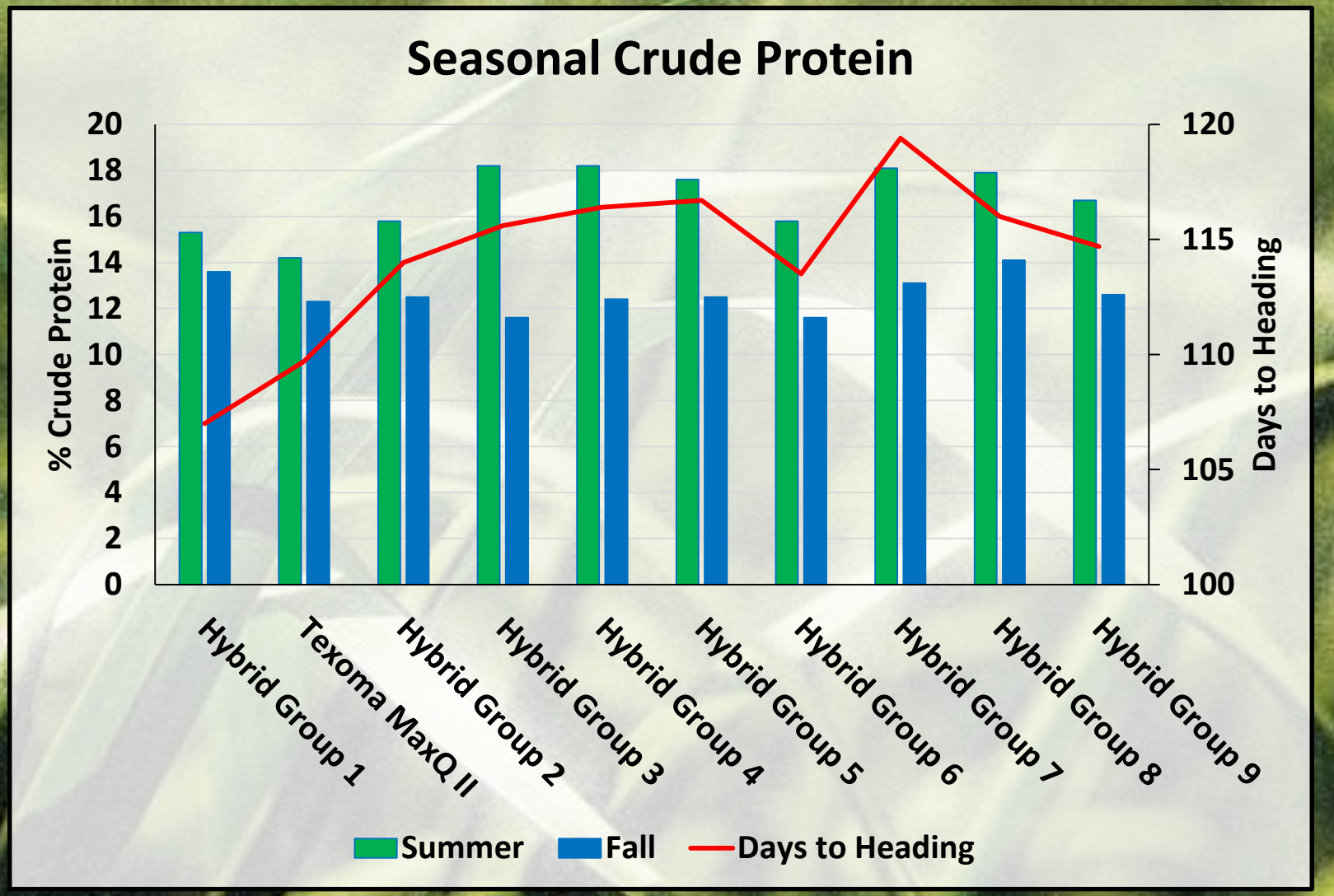


Figure 2. Seasonal crude protein content and day of heading of tall fescue soft leaf hybrid populations and Texoma MaxQ II during the fall and summer 2014 growing season. Fall harvest LSD (0.05) = 1.8 kg ha^{-1}. Spring harvest LSD (0.05) = 2.7 kg ha^{-1}.

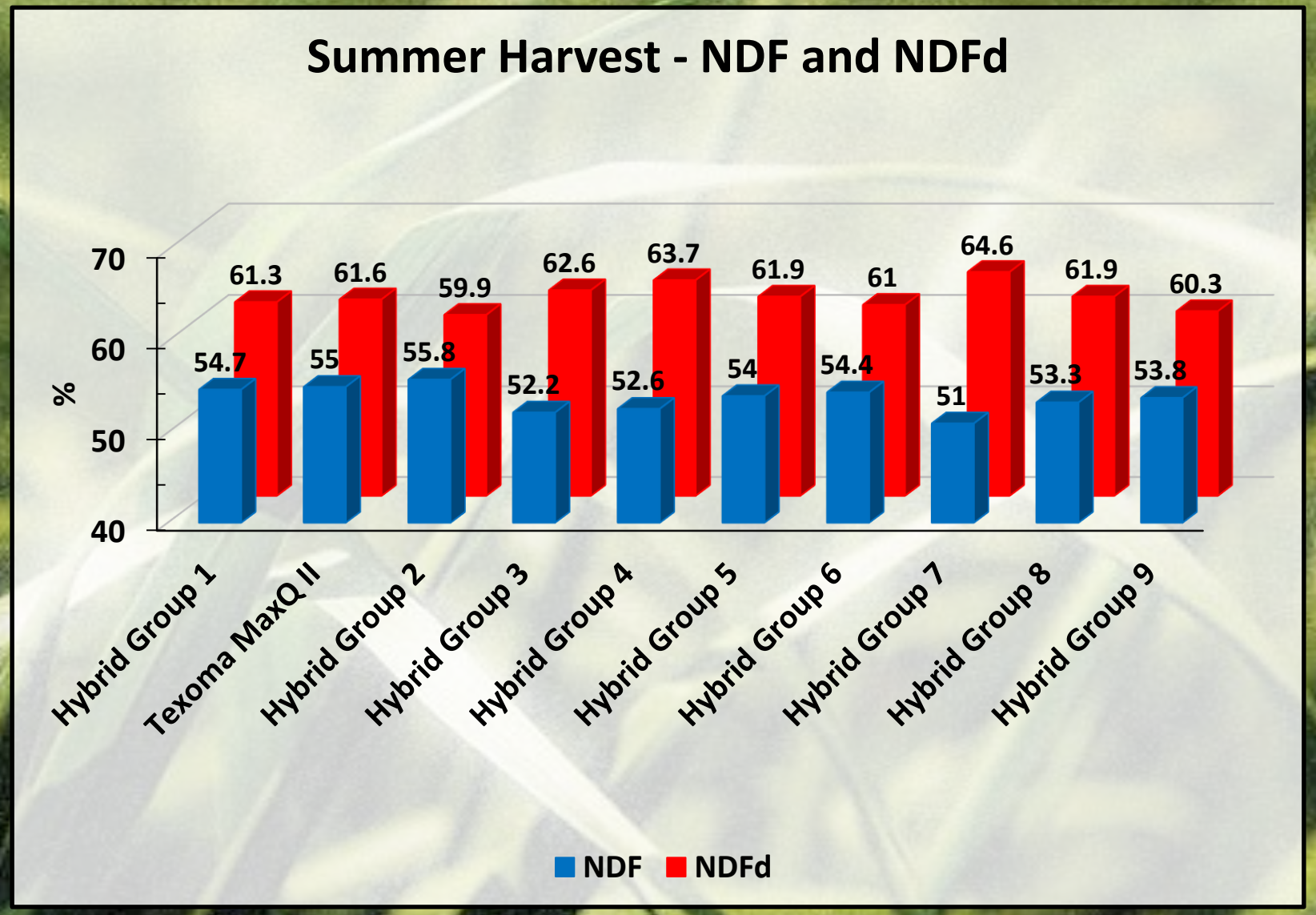


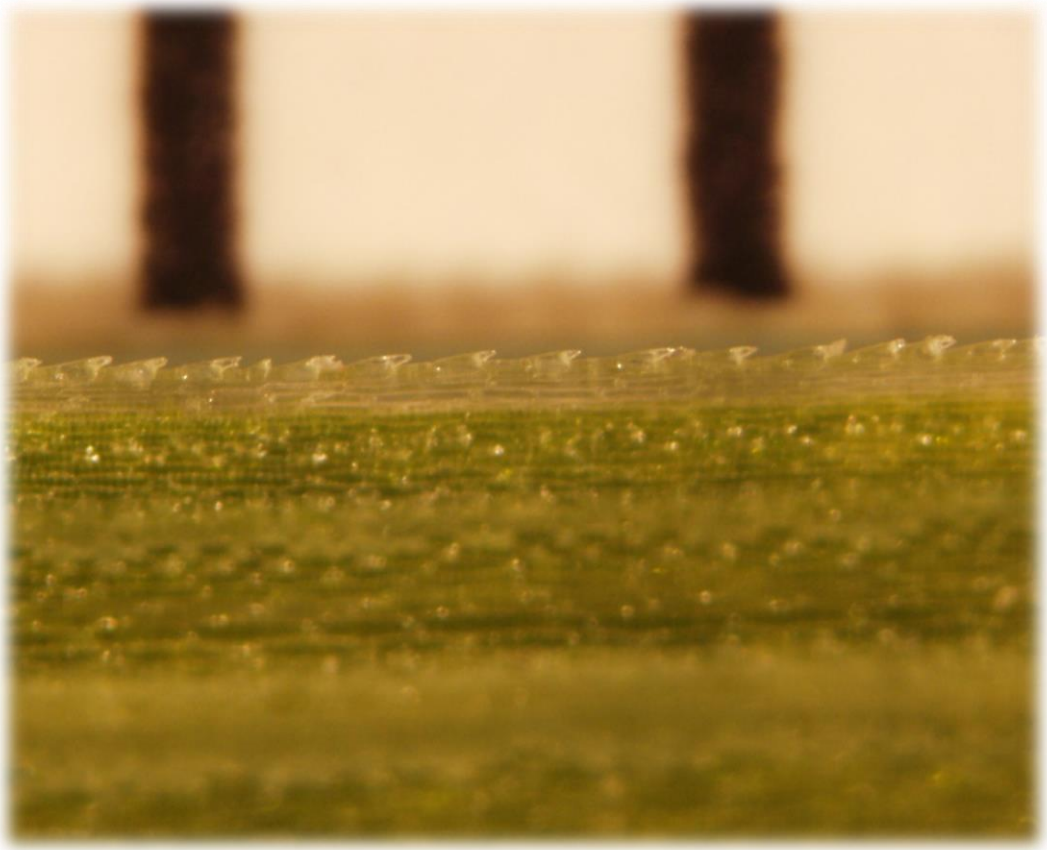
Figure 3. Percent NDF and NDFd of tall fescue soft leaf hybrid populations and Texoma MaxQ II during the summer 2014 growing season.

Reliable phenotyping for softness

Which one is softer?

Reliable phenotyping for softness – leaf morphology

Soft leaf Continental tall fescue



Continental tall fescue

Reliable phenotyping for softness – WSC

- Phenotyping softness is very difficult
- Soluble solids in leaves could be an indicator of softness which can be measured through Degree Brix

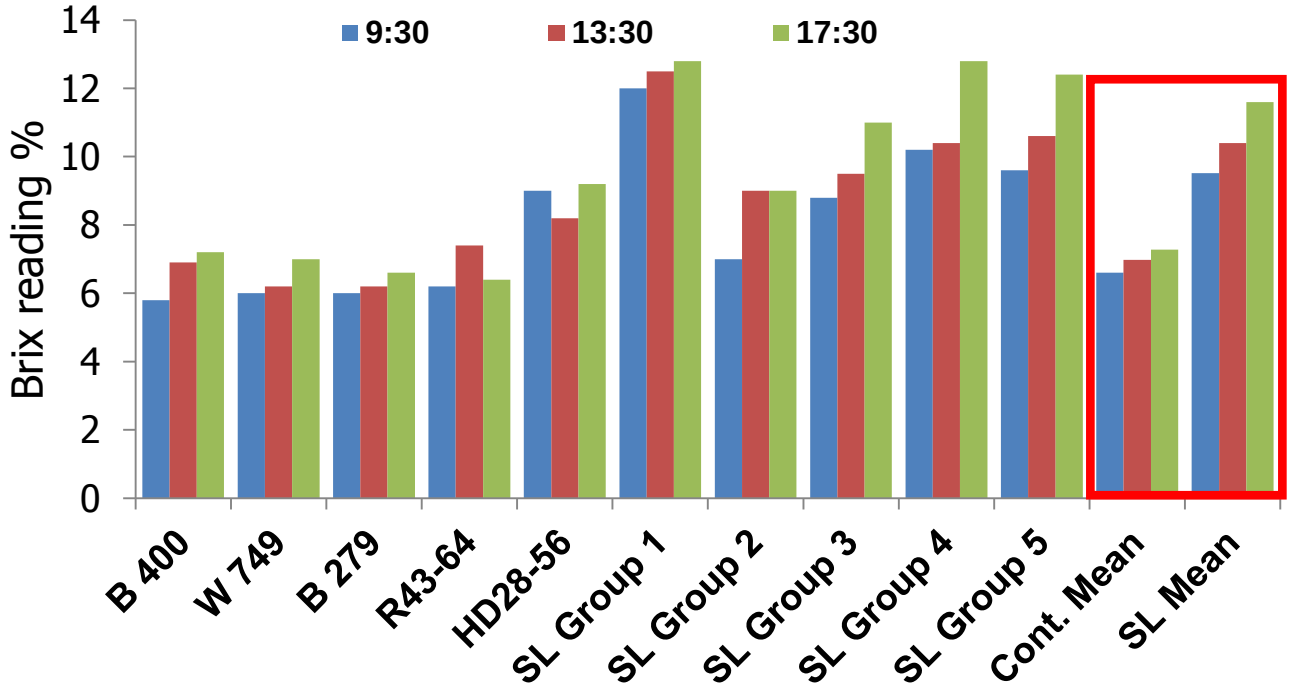
Measuring Degree Brix

- One degree Brix is 1 g of sucrose in 100 g of solution
- Measures the concentration of sugar from 0 to 32-Percent Brix
- Max resolution 0.2-Percent Brix
- Automatic temperature compensation
- Only requires 2 or 3 drops of solution
- Simple, repeatable measurements

Portable Automatic Temp. Compensation Sucrose Refractometer

Soft leaf tall fescue – WSC

- Collected soft leaf tall fescue germplasm mainly from Europe
- Crosses were made between Texoma and soft leaf genotypes



Distinct Brix reading between Continental and soft leaf Continental

Grazing preference – sensor technology

A Noble approach to research, development and delivering outcomes

FORAGE365

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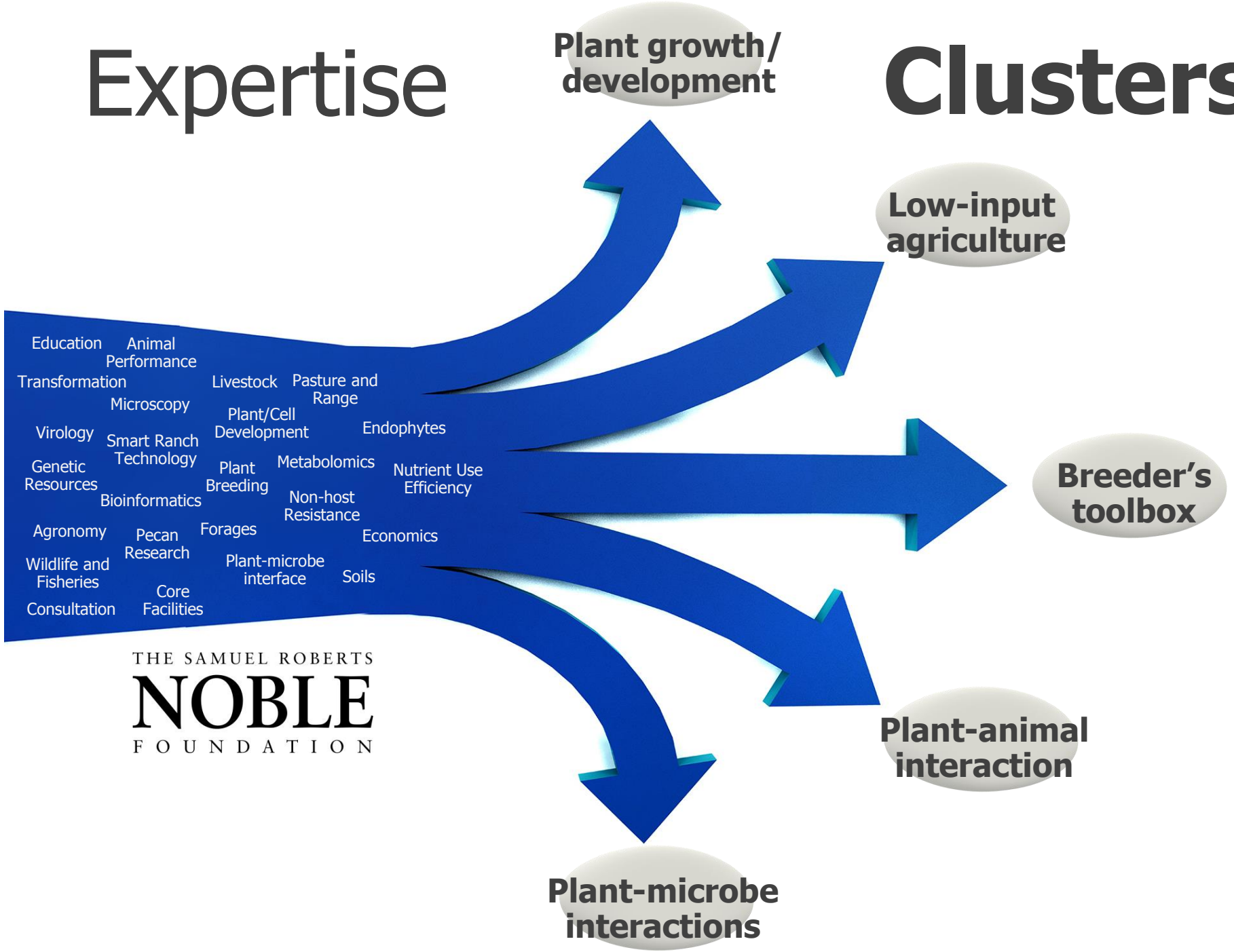
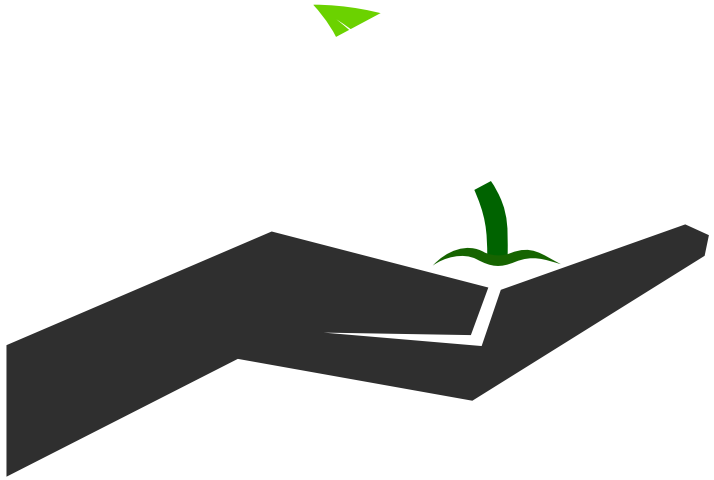
Expertise

Clusters



Clusters

Plant growth and development



Clusters

Plant-microbe interaction

Clusters

Low-input agriculture

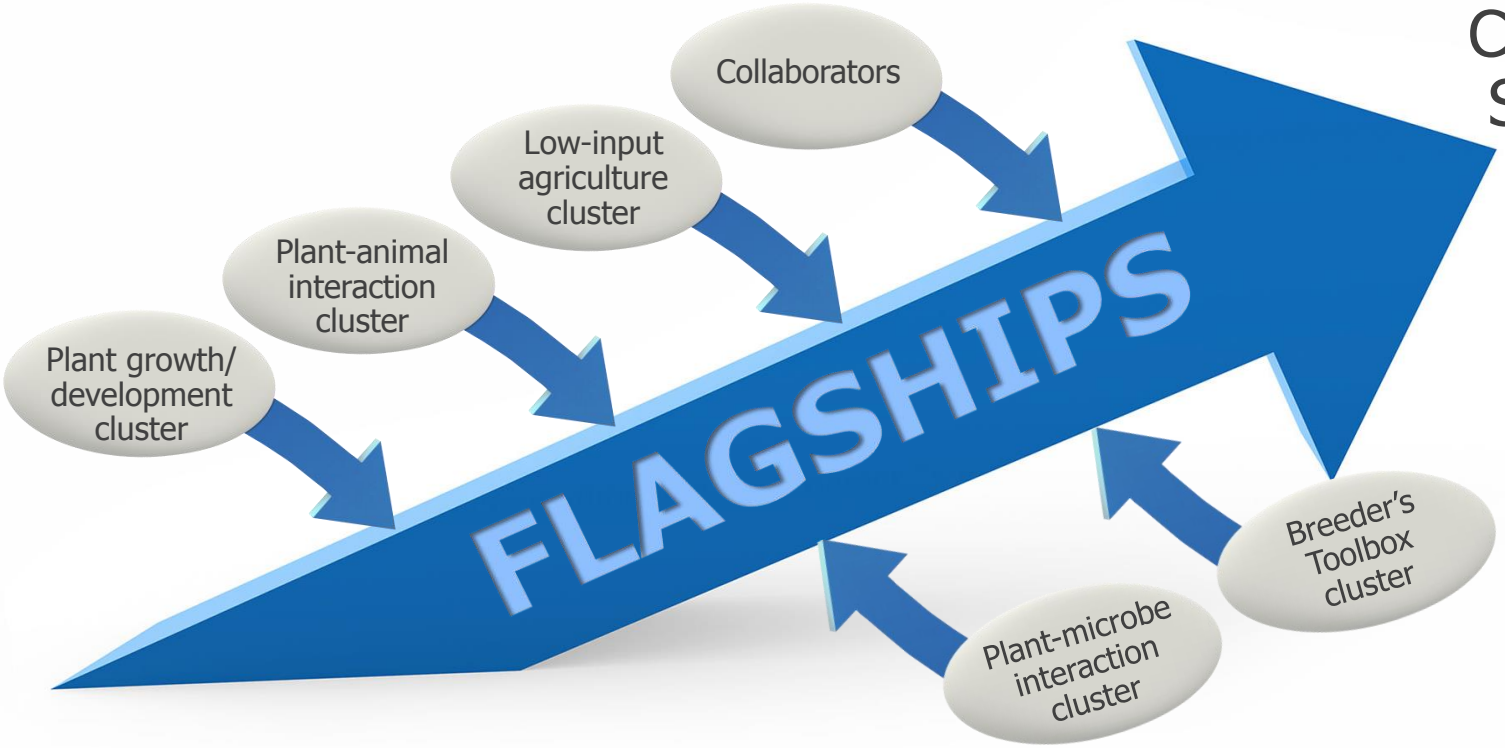
Clusters

Breeders toolbox

Defining and solving gaps and grand challenges

Outcomes for:

Producers
Consumers
Society
Environment



Benefits to the Southern Great Plains, the United States, world agriculture.

Year-round Grazing for the Southern Great Plains

FORAGE365

Year-round grazing for forage-based beef production is a strategic objective of the Noble Foundation. FORAGE 365 is a research initiative that focuses on advancing four pillar species to better achieve year-round grazing in the Southern Great Plains.

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FORAGE365

Current situation

For many grazing operations:

- Limited grazing from late fall through early spring.
- Hay is used to fill grazing voids.

FORAGE365

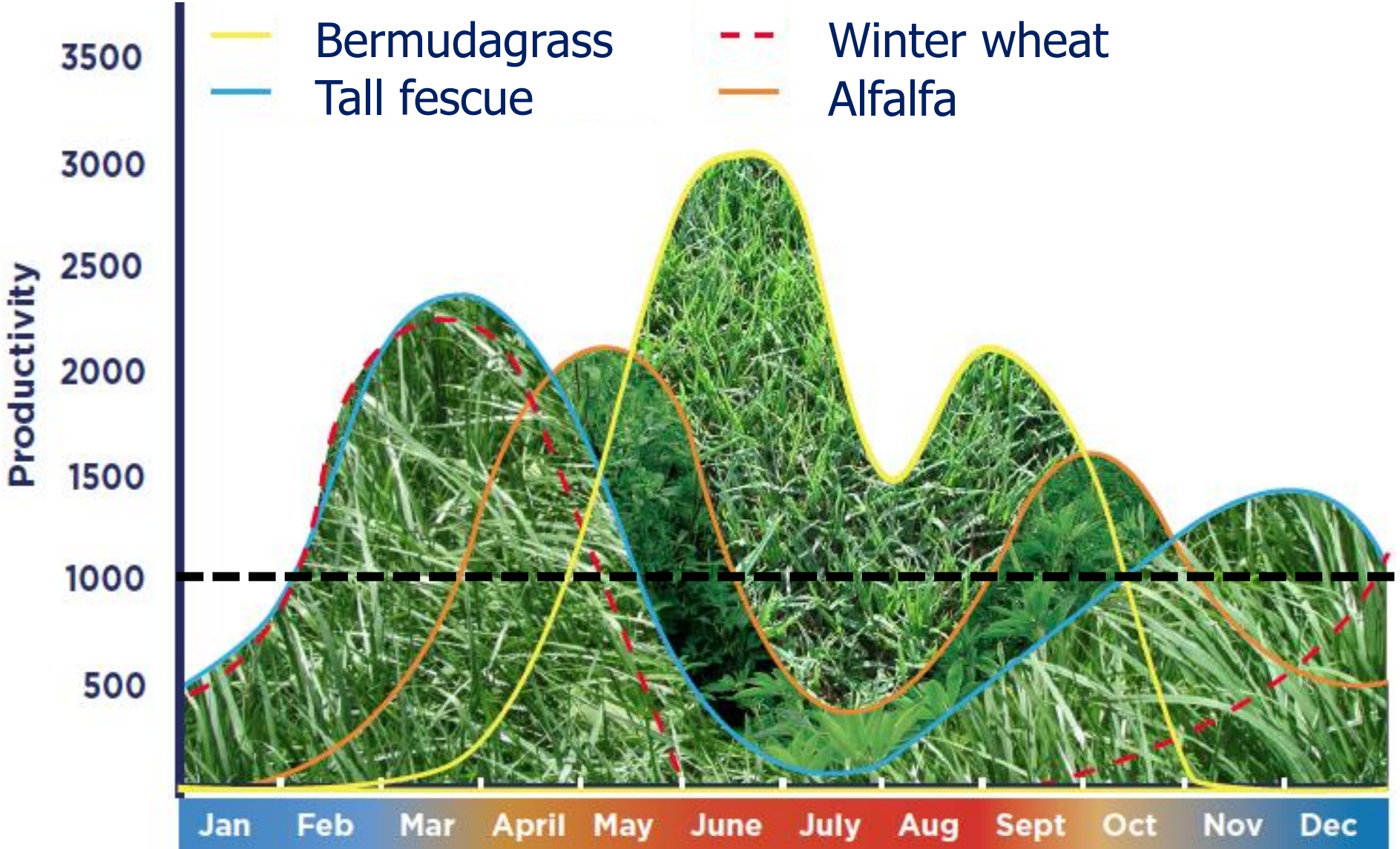
Objectives

Establish sustainable year-round forage systems for the southern Great Plains.

Improve forage productivity, production profitability and soil and water quality and sustainability.

FORAGE365: Pillar Species

Forage 365 System



Alfalfa
Improvements Needed

- Persistence/drought tolerance.
- Phosphorus use efficiency.
- Cotton Root Rot control.
- Genomic resources for breeders.
- Management systems.

Winter Wheat
Improvements Needed

- Nutrient and resource acquisition.
- Phosphorus and nitrogen use efficiency.
- Management systems.

Tall Fescue
Improvements Needed

- Summer dormancy.
- Persistence/drought tolerance.
- Resource acquisition.
- Management systems.

Bermudagrass
Improvements Needed

- Nutrient acquisition.
- Nitrogen use efficiency.
- Management systems.

Benefits

More effective R&D, including greater impact on agriculture – producers, consumers, society and environment.

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