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UNIVERSITY OF GEORGIA EXTENSION

Ivey's OUTDOOR & FARM SUPPLY

WAX

Georgia Beef BEEF Commission

Georgia Forages Conference - 2018

GA Cattlemen's Convention | Perry, GA | 4-5-18

AGENDA

Thursday, April 5, 2018:

8:30 **Registration opens**

9:00 **Welcome and introductions**
Dr. Dennis Hancock, Prof. & State Forage Ext. Specialist, UGA
Will Bentley, Exec. VP, Georgia Cattlemen's Association

9:15 **Balancing calf performance while maximizing profit per acre**
Dr. Dennis Hancock, Prof. & State Forage Ext. Specialist, UGA

9:45 **Management strategies for intensive, sustainable beef cattle production on bermudagrass**
Dr. Monte Rouquette, Regents Professor, Texas A&M University

10:30 **Break**
Visit sponsors

AGRI-KING KEY TO PROFIT Technology Driven Nutrition

SILO-KING FORAGE & GRAIN TREATMENT

10:45 **Management strategies for intensive, sustainable beef cattle production on tall fescue and winter annuals**
Dr. Paul Beck, Professor, University of Arkansas

11:30 **Long-term impacts of fertilization and stocking rate decisions on soil fertility**
Dr. Monte Rouquette, Regents Professor, Texas A&M University

12:00 **Lunch Break (Visit Display Area)**
Lunch sponsored by:

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Lunch Program

Updates on products from program sponsor:

Boehringer Ingelheim

12:45 **Interseeding alfalfa into bermudagrass to reduce N costs, increase yields, and decrease supplementation needs***
Taylor Hendricks, UGA Doctoral Student

1:00 **Benefits and limitations to replacing commercial N with legumes in bermudagrass-based pastures**
Dr. Paul Beck, Professor, University of Arkansas

1:30 **Benefits and limitations to replacing commercial N with legumes in cool season grass-based pastures**
Dr. Dennis Hancock, Prof. & State Forage Ext. Specialist, UGA

2:00 **Dismiss**

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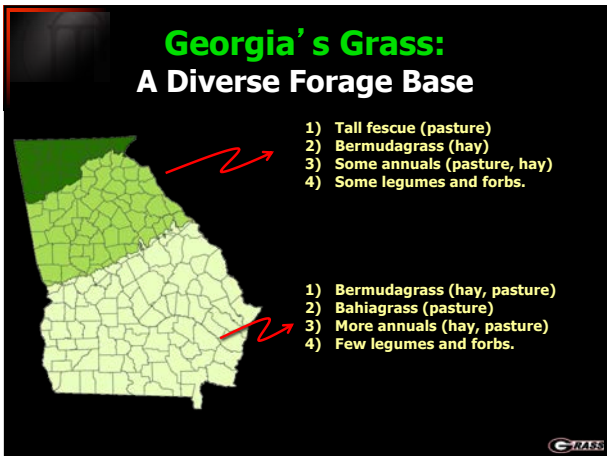
Georgia Beef BEEF Commission

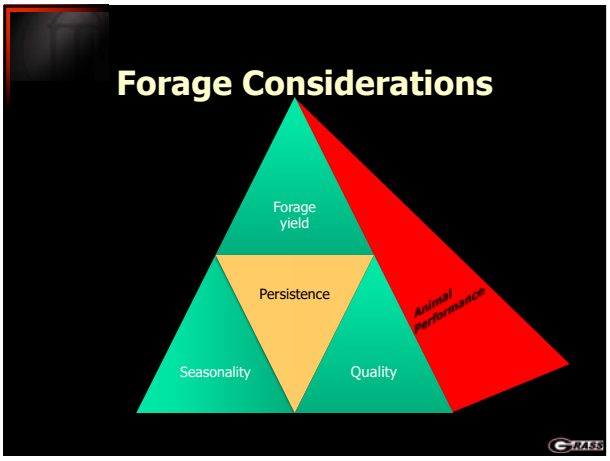
Section 1

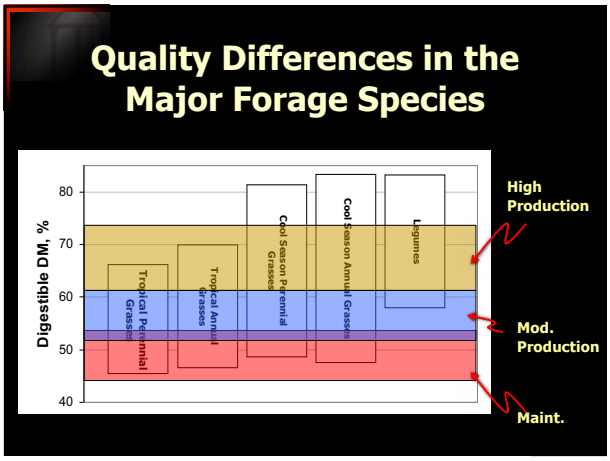
Balancing calf performance while maximizing profit/acre

Georgia Forages Conference

Balancing calf performance while maximizing profit per acre

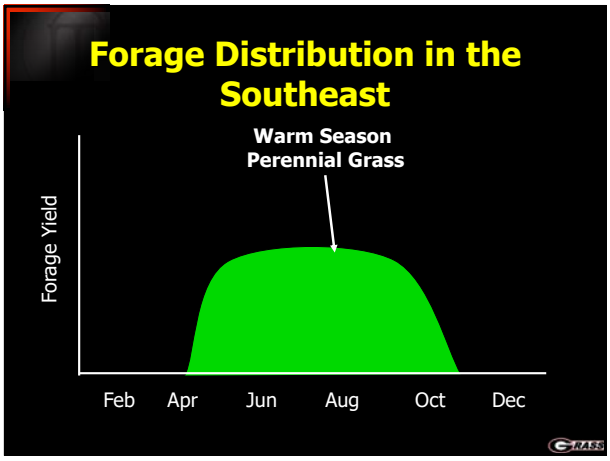






Forage Yield of Selected Forages in Georgia

Forage Crop	Typical Yield
	(lbs DM/acre)
Tall fescue	7,000-10,000
Alfalfa	10,000-14,000
Ann. ryegrass	8,000-14,000
Small grains	5,000-8,000
Bermudagrass, Common	7,000-10,000
Bermudagrass, Coastal	12,000-15,000
Bermudagrass, Tifton 85	**14,000-22,000**
Bahiagrass	10,000-16,000
Sorghum x Sudangrass	9,000-20,000
Pearl Millet	8,000-13,000



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Professor and Forage Extension Specialist

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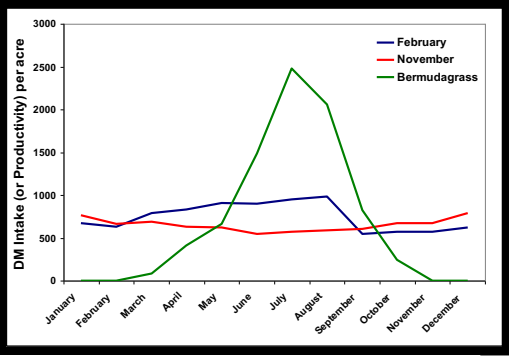
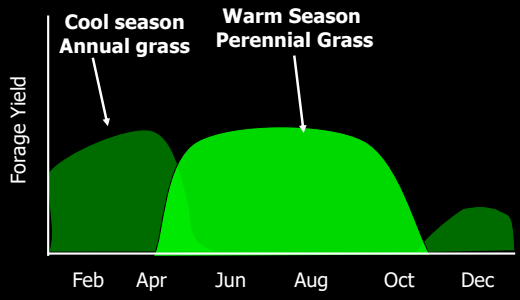
Balancing calf performance while maximizing profit per acre

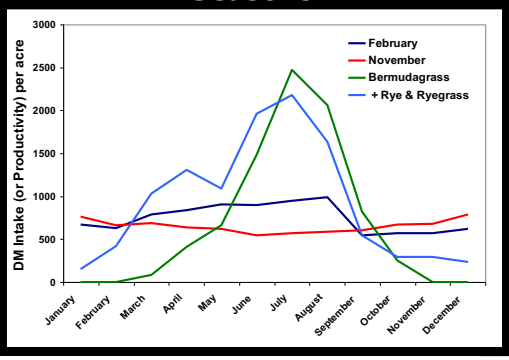
Forage Production Relative to Spring or Fall Calving Seasons



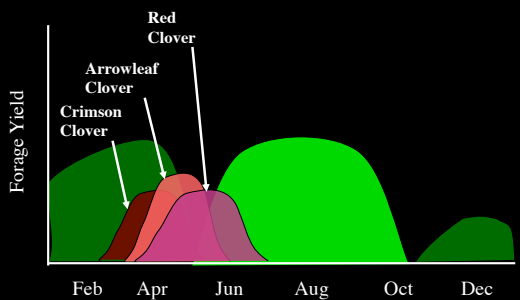
Forage Distribution in the Southeast



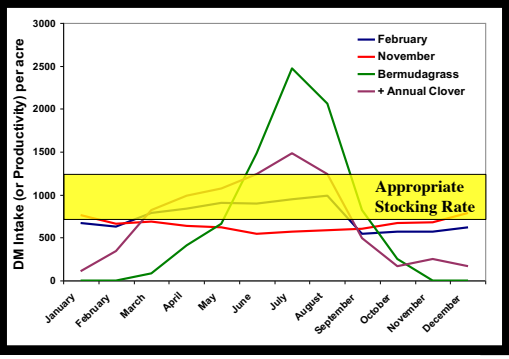
Potential Forage Production Relative to Spring or Fall Calving Seasons



Where do legumes fit?



Potential of "Low N-Put" Forage Production Relative to Spring or Fall Calving Seasons



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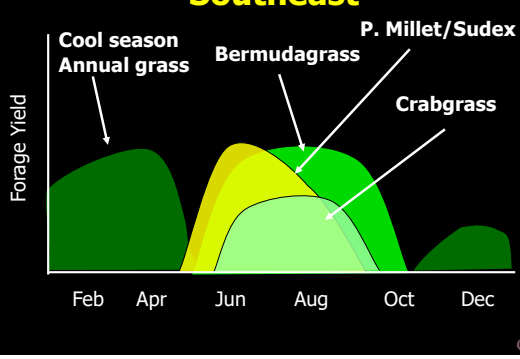

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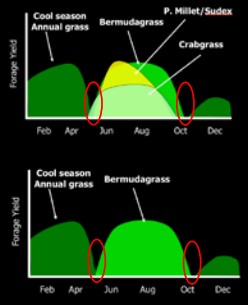
Dual Forage System

- Using both in some proportion:
  - 50%:50% (mgmt.-intensive)
  - 60%:40%
  - 75%:25%
  - 90%:10%
  - 100%:0% (least intensive)
- Eases the transitional periods
- Proportion (ratio) depends upon timing of animal needs and profitability.



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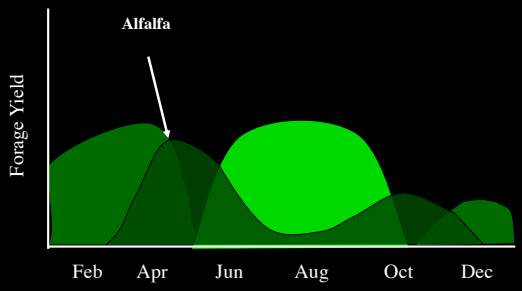

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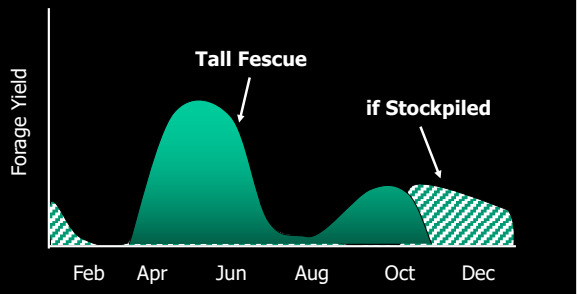

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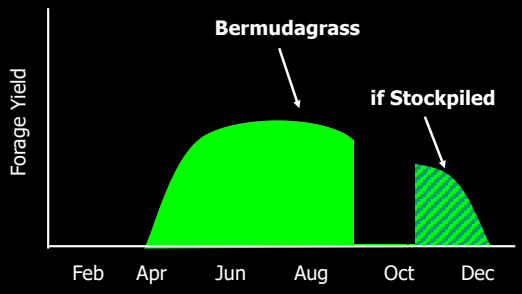
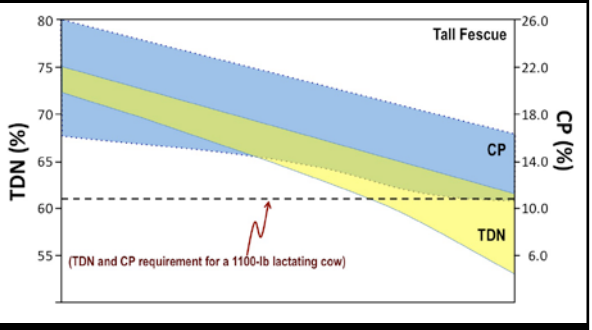


Forage Quality of Stockpile



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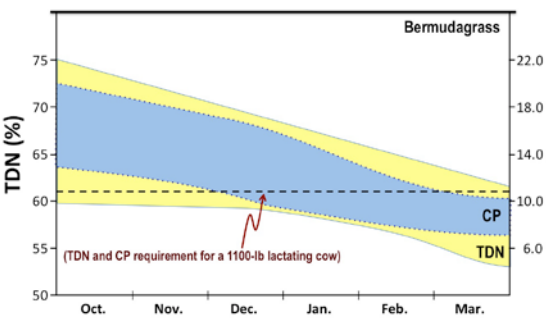

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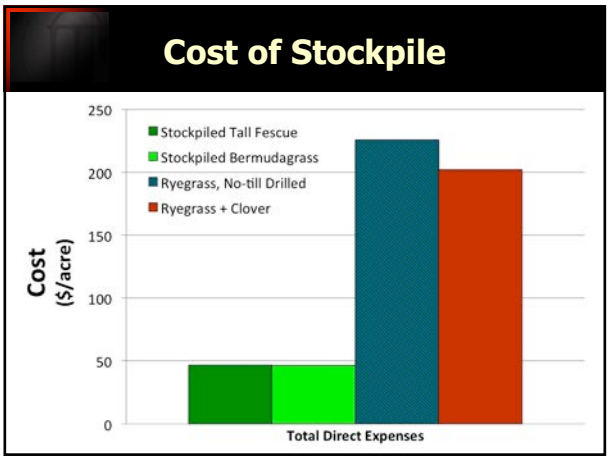

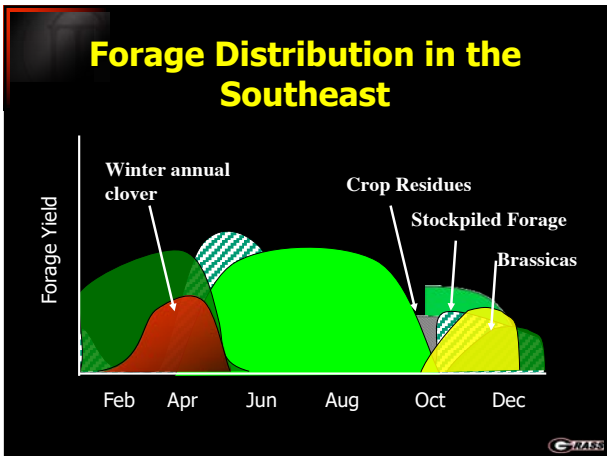

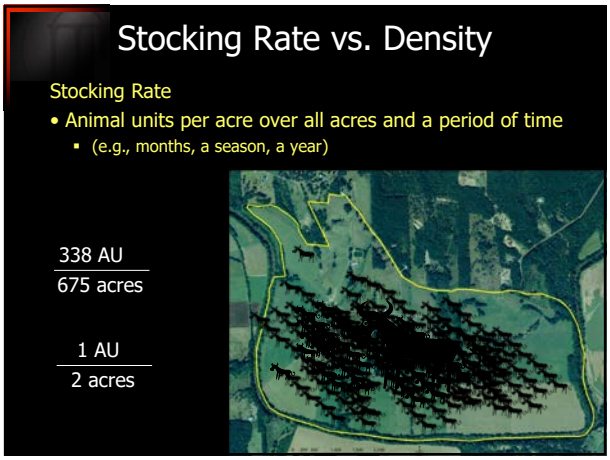

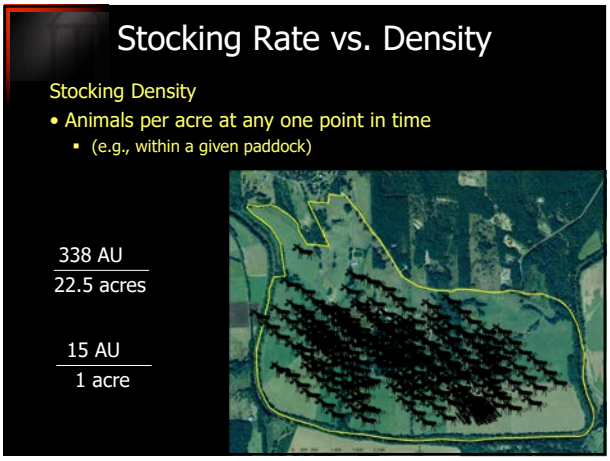

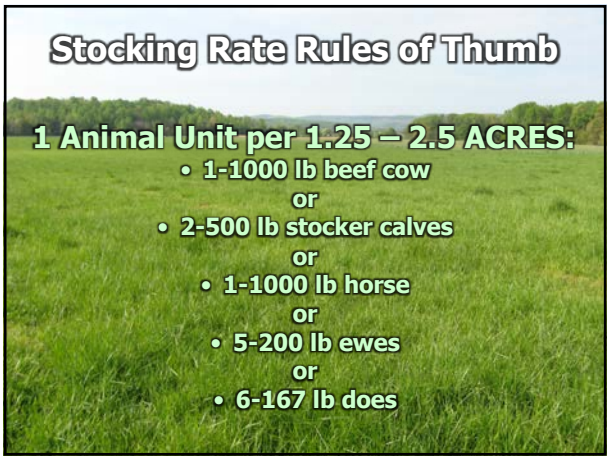

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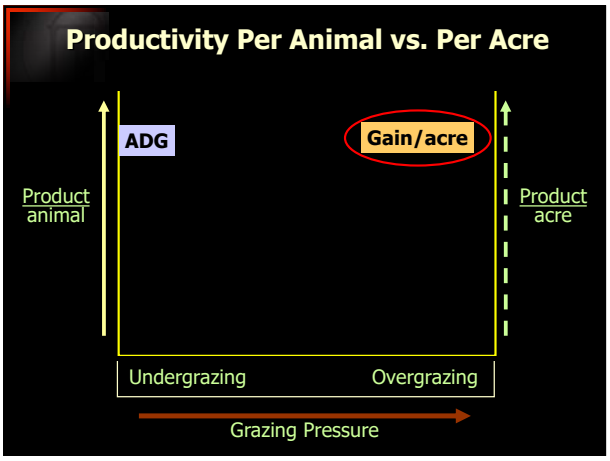

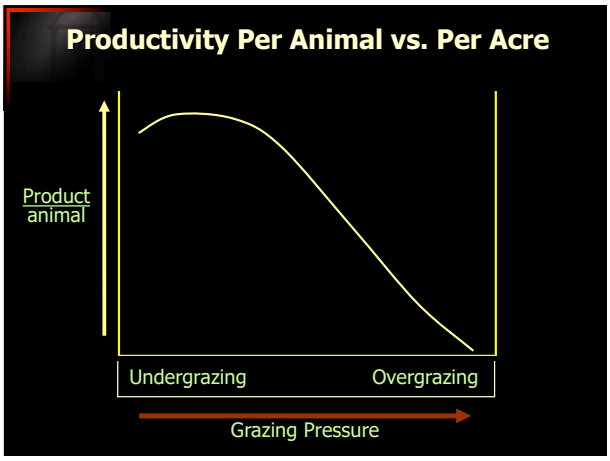

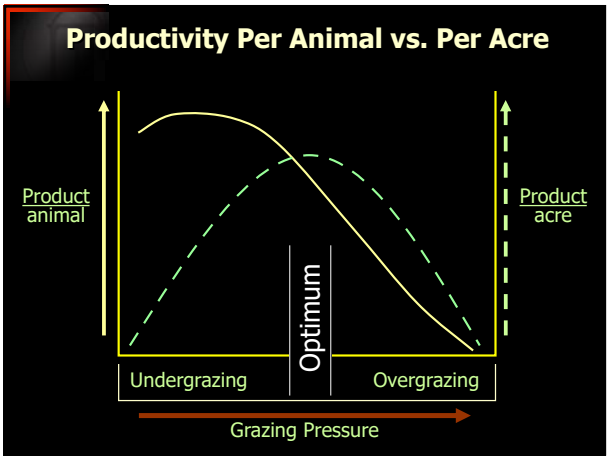

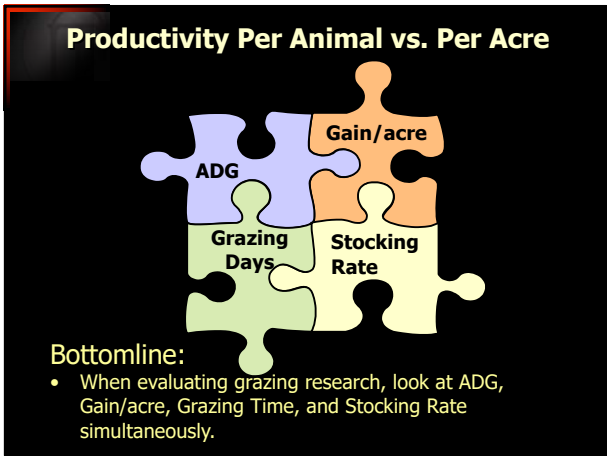

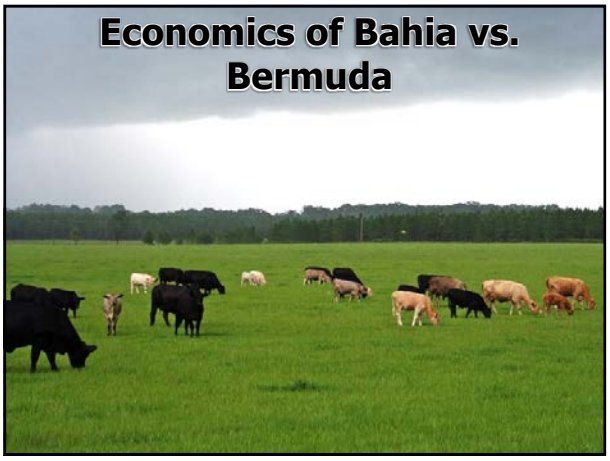

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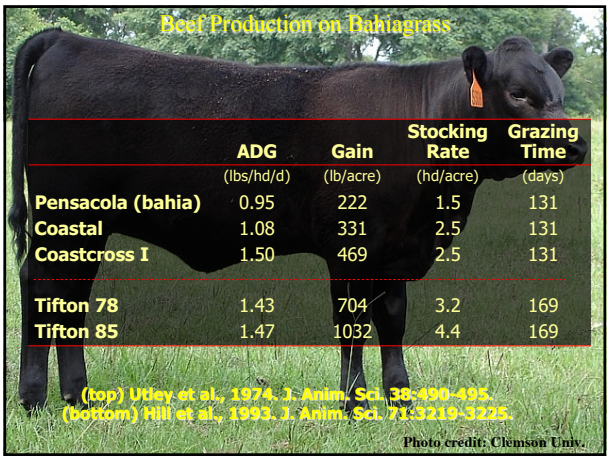

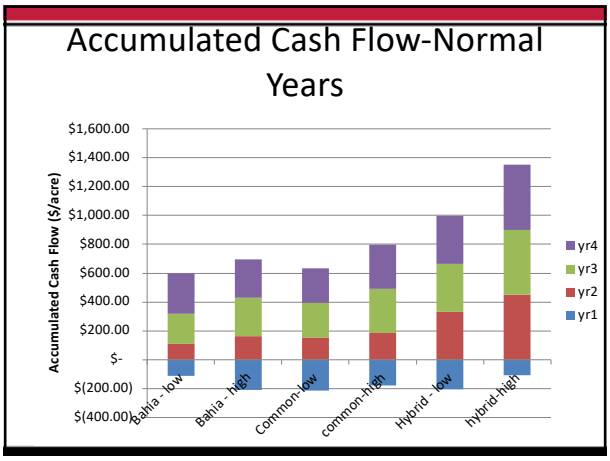

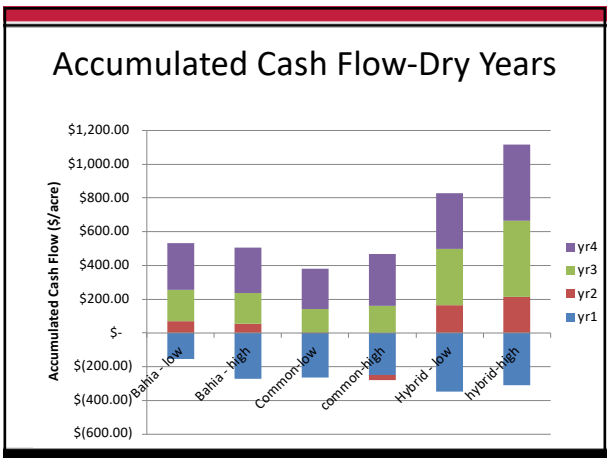

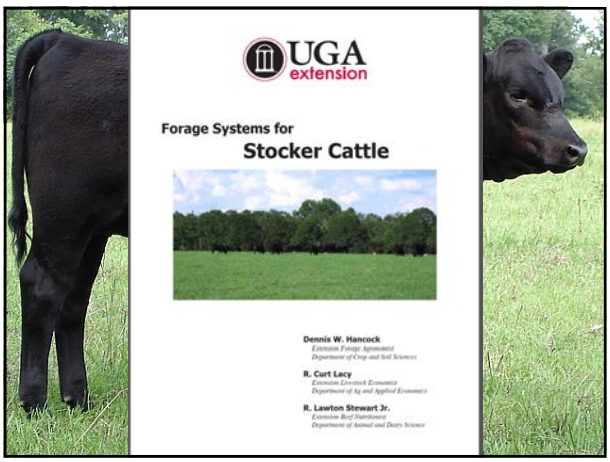

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Section 2

Management strategies for intensive, sustainable beef cattle production on bermudagrass

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Management strategies for intensive, sustainable beef cattle production on bermudagrass

Management Strategies for Intensive, Sustainable Beef Cattle Production on Bermudagrass Pastures

Monte Rouquette, Jr. PAS
TAMU Regents Fellow and Professor
Texas A&M AgriLife Research
Overton, TX

2018 Georgia Forages Conference
Georgia Cattlemen's Convention

Bermudagrass Pastures and Cow-Calf Performance

MARCH MADNESS !!

Basketball Tournaments
and
Pasture Management

March Madness Management Checklist

- **Warm-season perennial grass pastures/hay**
  - **Weed control and herbicides**
  - **Fertilization requirements; Soil Test**
  - **Drought-Freeze damage assessment**
  - **New plantings; site preparation; cultivar selection; timing**

March Madness Management Checklist

- **Cool-season annual grasses/legumes**
  - **Increased forage DM; adjust stocking rates**
  - **Fertilization requirements to extend production**
  - **Breeding-weaning projections**
  - **Reseeding clovers-ryegrass;hay options**

Intensive Production

- Multiple Definitions for Management Strategies
- Multiple Approaches and Objectives
- Overall Emphases–
  - –Enhance/Increase Production
  - –Increased Stocking Rate and/or Pasture Utilization
  - –Economic Decisions & Net Returns Per Animal/Acre
  - –Sweat and Stress?

SUSTAINABLE

The US Roundtable for Sustainable Beef

- Multil-Stakeholder Initiative developed to support sustainability of the United States Beef Value Chain (USRSB-2016).
- The USRSB works in collaboration with the Global Roundtable for Sustainable Beef to meet Beef Value Goals (GRSB-2016).

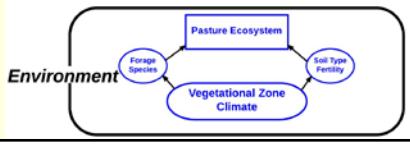
GLOBAL ROUNDTABLE for SUSTAINABLE BEEF, 2016

"Sustainable Beef"

- Socially Responsible
- Environmentally Sound
- Economically Viable Product

Priortizes: a) Natural Resources,
b) Efficiency & Innovation,
c) People & Community,
d)Animal Health & Welfare, and e) Food.

Management Strategies for SUSTAINABLE Pastures & Beef



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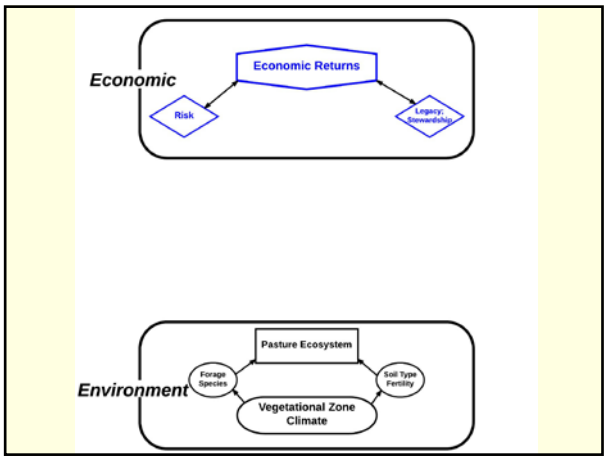

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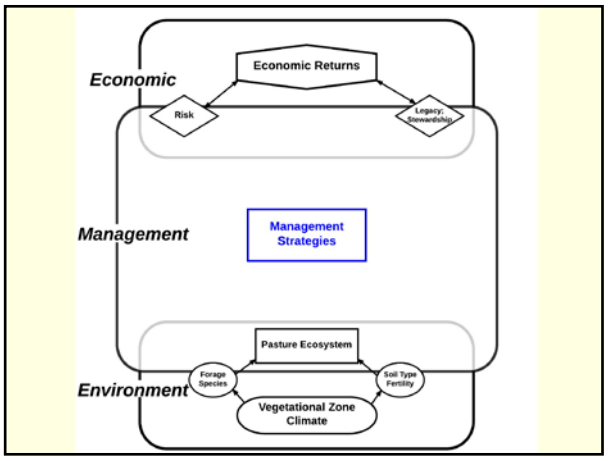

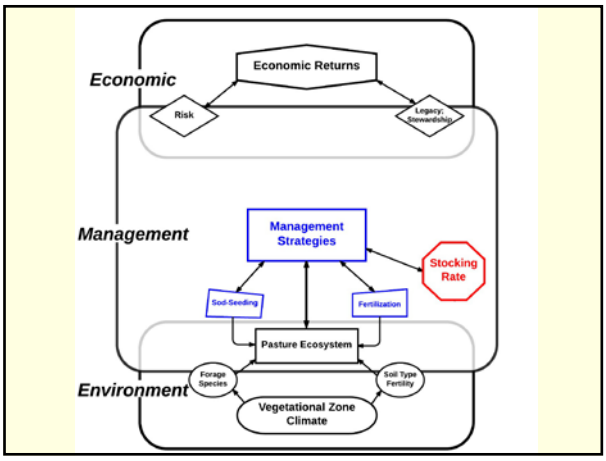

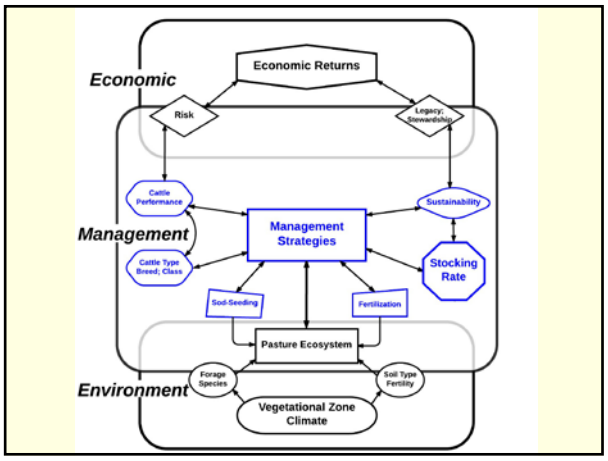

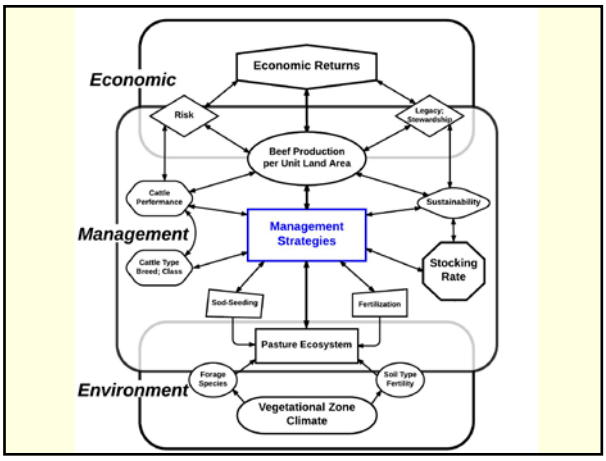

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Management of Pastures

- Constant realignment and integration of Cause-Effect Actions… Coupled with…
- Decision-based, Heuristic Inputs…that…
  - Influence Forage Growth,
  - Utilization Regimens;
  - Stocking Strategies
- That Affects…
  - Pasture-Animal Production
  - Sustainability of Forages & Pastures
  - Economic Rewards

Factors Influencing Strategies for Management

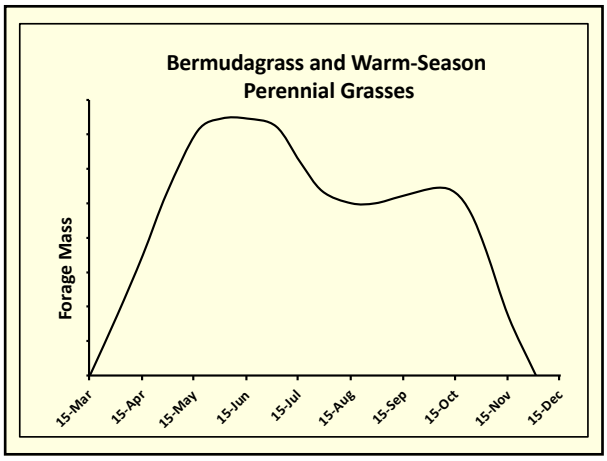
- Enhance Efficiencies
  - Economical - Costs, Returns, Profit
  - Biological - Optimize, Maximize
- Reality vs Perceptions for Plan of Action
- Implementation ➡ Results
- Recover, Re-adjust, New Implementation
- Keep Records…Don't Forget!!

Grazing Management Strategies for Bermudagrass Pastures

Forage Calendar

JAN	FEB	MAR
APR	MAY	JUN
JUL	AUG	SEP
OCT	NOV	DEC

Warm Season Perennial Grasses



Stocking Strategy

- Approach to Forage Utilization via
- Stocking Rates
- Stocking Methods

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Factors that Influence, Define, & Refine Stocking Strategies

- Stocking Methods
  - –Continuous
  - –Rotational
- Flexible / Adaptive Stocking
- Economic Goals & Objectives and Risk-Aversion Awareness

Stocking Strategies – Decision Indicators

- Databases; Comparative Information
- Visual Assessments
  - – Pasture Height
  - – Patch Grazing/Refusals
- Expectations of Forage Growth/Production
  - – Weather; Season(s)
  - – Soil Fertility; Fertilization
  - – Nutritive Value
- **Art & Application**

Prerequisites for the Art of Stocking Strategies

- Knowledge and expertise with forage species growth and regrowth attributes
- Experience with animals and animal husbandry
- Intuitive application of decisions for input-outputs
- Knowledge of current, forecast, and strategic weather conditions in specific vegetational zone

Prerequisites for the Art of Stocking Strategies

- Ability to assume and take risks associated with stocking intensity outcomes
- Constant awareness of impact on sustainability of vegetation and land resources
- Have an alternative site or escape-route for animals in event of extreme, unfavorable climatic conditions

Grazing Management Strategies

- Be Prepared for Forage Growth x Climatic Conditions…Rainfall
- Take advantage of Dynamic Forage Growth Rate created by Soil Fertility, Fertilization, Rainfall; Temperature; Season of Year
- Use Flexible Stocking Strategies

…. Nothing is Fixed!!

Management Strategies

- Match Forage DM & Nutritive Value with Cow-Calf Requirements
- WSPG + Overseeded Small Grain, Ryegrass, Clover
- Standing Hay; Deferred Forage
- Hay; Supplementation
- Calving Season(s)
- Breeding Season(s)
- Pregnancy Rate
- Weaning Date(s); Weaning Weight

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Management Strategies

- Stocking Rate – Forage Utilization
  - Cow-Calf
  - Dry Cow
  - Stocker
- Body Weight & BCS; Maintain – Gain – Lose
- Cull – Replacements
- Sale – Merchandize
- Cash Flow

Top Five Rationales Used For Culling Cattle

STOCKING RATE & GRAZING INTENSITY

Stocking Rate

is More Important Than

Stocking Method

Proper Stocking Rate

- What is it?
- What's the duration?
- How to know?
  - ♦ Visual, Subjective?
  - ♦ Measurement, Quantitative?

Take a Look at Pastures!!!

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STOCKING

RATE

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Regents Professor
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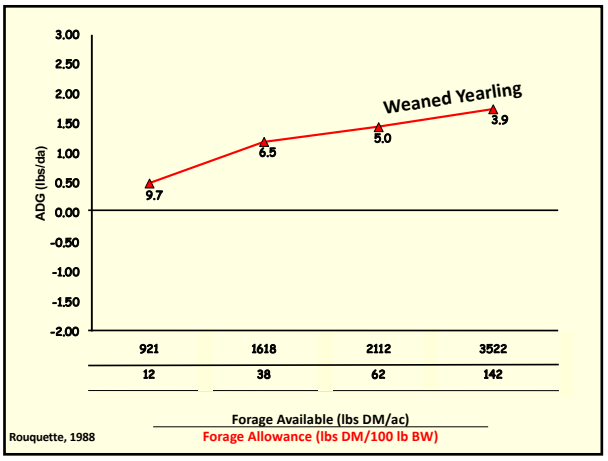
. . . it depends

Stocking Rates are . . .

- Site Specific ; ZIP-CODE
- Controlled by Management

  Decisions & Strategies !!



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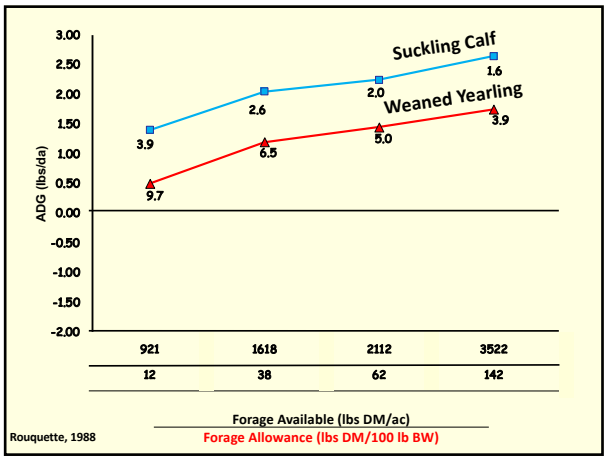

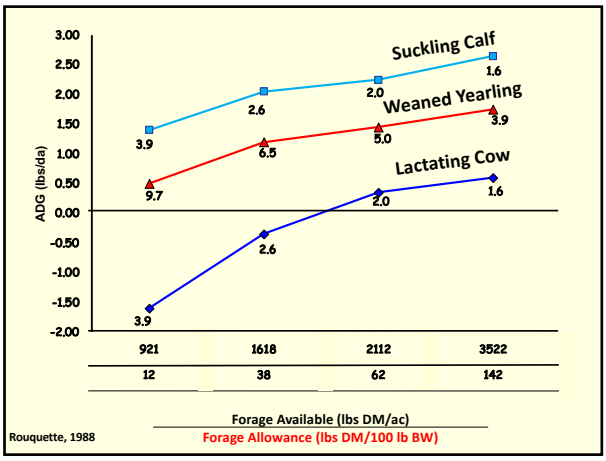

Stocking Rate & Forage Availability: Performance of Cow-Calf vs Dry Cow

Stk Rate	Forage Avail	Calf ADG	Lactating Cow			Dry Cow		
	lbs/ac	lbs/da	ADG	BCS		ADG	BCS	
				Init	Final		Init	Final
LOW	3275	2.30	0.20	5.0	5.0	N/A	N/A	N/A
HIGH	1400	1.12	- 1.66	5.0	4.3	- 0.30	6.7	6.6

Cow-Calf Operations

and/or

Stocker Programs

Stocking Strategies to Enhance Stocker Gain from Bermudagrass Pastures

- **Animal Genotype-Class**
  - Age
  - Weight
  - Body Condition
  - Brahman-influence
- **Forage Cultivar Selection**
  - Tifton 85 has highest nutritive value and ADG
- **Stocking Rate**
  - With "ceiling ADG" of ≤ 1 lb/da… increase Stocking Rate to Optimum Gain/ac

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Tifton 85 Bermudagrass

Pasture – Animal Niche

- Opportunities
- Challenges
- Successes

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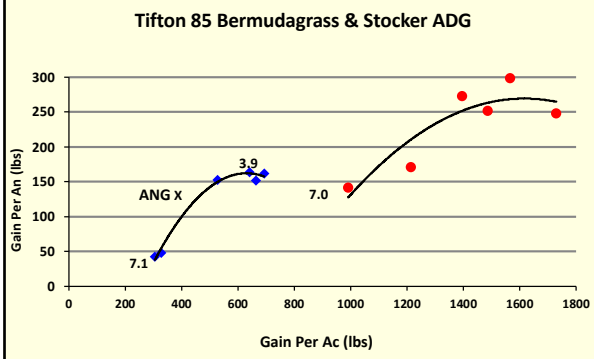
Grazing Management Strategies



Nitrogen Drives Grass Production

Nitrogen Fertilization Scenarios for Tifton 85 Bermudagrass

- **Fertilization Rate with Soil Test**
  - 150 to 200 lbs N/ac
  - N Costs ≈ $0.50 to $0.60/lb N
  - Cost/ac = $83 to $110
  - Gain/ac = 500 to 1500 lbs/ac

Nitrogen Fertilizer Cost per Pound Gain

Stocker Gain	$100/ac Cost	$150/ac Cost
lbs Gain/ac	Cost/lb Gain	Cost/lb Gain
500	0.20	0.30
750	0.13	0.20
1000	0.10	0.15
1250	0.08	0.12
1500	0.07	0.10

* N cost @ $0.55/lb N.

Where are we headed?

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Good news…..

Bad news…..

Good News

- Warm-season perennial grasses are the base-pasture grass in Southern US, and produce highest total Forage DM/ac.

Bad News

- Warm-season perennial grasses are in the Category of Lowest Nutritive Value of all Forages.

Stocking Strategy

- Approach to Forage Utilization via
- Stocking Rates
- Stocking Methods

Grazing Management & Stocking Methods

- Continuous Stocking
- Rotational Stocking

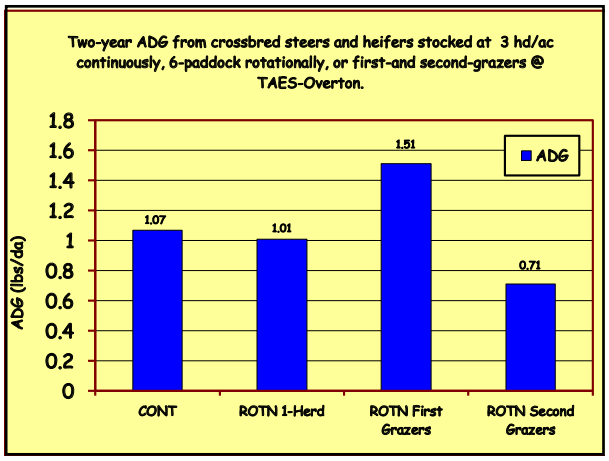
PERCEPTIONS VS REALITY OF ADVANTAGES FOR ROTATIONALLY STOCKED PASTURE SYSTEMS

Movement Schedule

- BG leaf growth – 21-day optimum
- Residence time – 1 day to 7 days
- Depends on
  1. Stubble height of grazed pasture
  2. Deferment period or age of new pasture

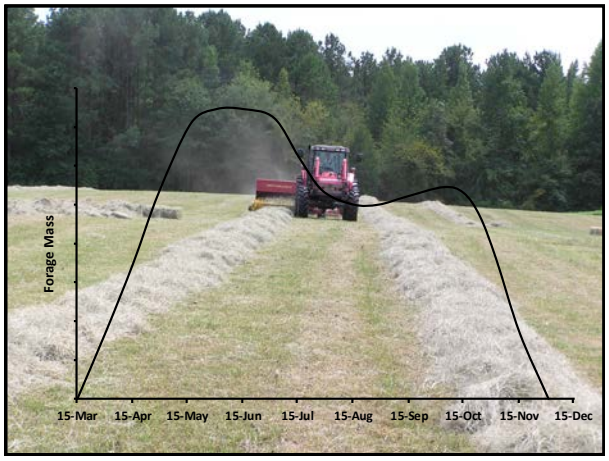
Rotational Stocking Considerations for Bermudagrass

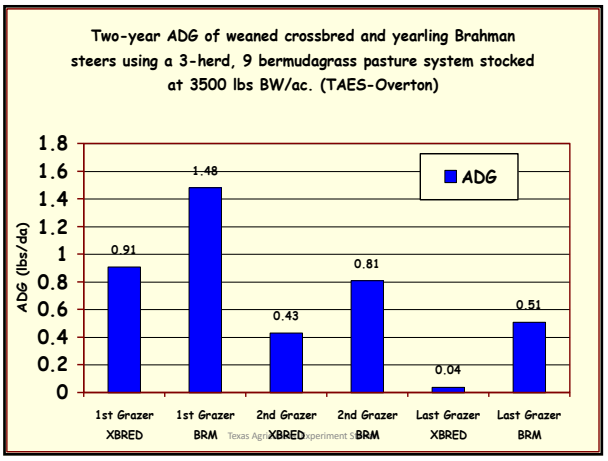
- At the same SR, no Animal Gain advantage from Rotational Stocked *vs* Continuous Stocked pastures
  - ❖Why??
  - ❖Forced consumption of forage in lower strata of pasture=lower nutritive value.



Rotational Stocking Considerations for Bermudagrass

- How to optimize performance
  - —Graze only top 1/3 to 1/2 of forage, then move to new pastures
  - —Multiple herds
  - —Harvest excess for hay





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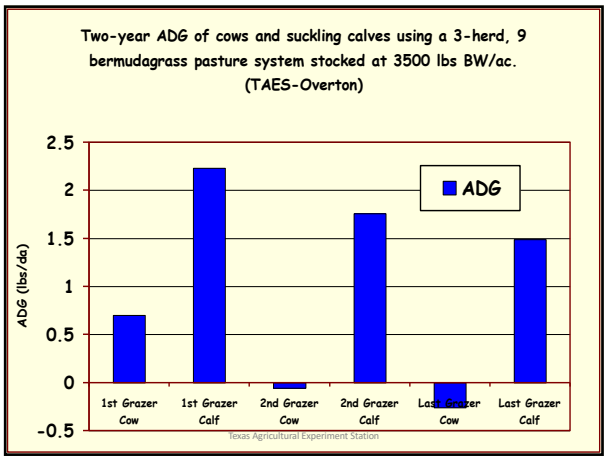

Stocking Strategies to Optimize Forage Use and Animal Performance

- **Flexible Management**
  - –Rotate cattle/pastures with forage-performance TARGET
  - –First-Last Grazers
  - –Creep Grazing

Stocking Rate
is More Important Than
Stocking Method

WHY is there a departure-disconnect from Research-based Information to Application Recommendations for Stakeholders?

Rotational Stocking or Not ?

- **Pasture Research shows limited to no advantages for use of Rotational Stocking**
- **State Extension Bulletins and Popular Press encourages Rotational Stocking**

Why do stakeholders provide repeated positive testimonials regarding rotational stocking?

- **No comparison between continuous vs rotational stocking**
- **Managers more comfortable with forage mass conditions and control by combining grazing and haying-baleage-silage**
- **Rotational stocking regimens mandate regular assessment- inspection of forage-animal conditions**

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Why do stakeholders provide repeated positive testimonials regarding rotational stocking?

- Rotational stocking is better fit for adapting to pastoral and animal husbandry management skills.
- Managers perceive that rotational stocking provides added value to soil-plant interface and enhanced animal performance
- Managers are smarter than Grazing Researchers !!

Rotational Grazing "Rules"

Overstocking wrecks the system...

GAME OVER !!!

Management Strategies for Intensive-Sustainable Bermudagrass Pastures in Southeastern US

- Bermudagrass Cultivar(s); Mass & Quality
- Fertilization Regimens
- Use of Small Grains, Ryegrass, and/or Clovers
- Utilization-Stocking Rates; Gain/an; Gain/ac
- Ecosystem Sustainability & Resource Stewardship
- Calving Season(s) & Hay-Supplement
- Integrated Stockers with Cow-Calf; G x E
- Flexible Implementation Strategies & Economy of Production; Merchandizing Livestock

Basketball Players and Pasture Managers

- Remember the game plan !!
- Forget the missed shot !!
- You can't score if you don't shoot !!
- Don't foul out !! You can't win if you aren't in the game...!!
- Game's not over 'til the buzzer sounds.. Be persistent !

Animal Management Strategies to Offset High Input Costs

- Cull Cows
  - *Efficiency *Productivity *GxE
  - *Age *Disposition
- Alter Calving Season
- Weaning Percent, Weight
- Sale Weight
- Marketing Strategies

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God Bless America

Section 3

Management strategies for intensive, sustainable beef cattle production on tall fescue and winter annuals

Georgia Forages Conference

Management strategies for intensive, sustainable beef cattle production on tall fescue and winter annuals

Management strategies for intensive, sustainable beef cattle production on tall fescue and winter annuals

Paul Beck

University of Arkansas SWREC

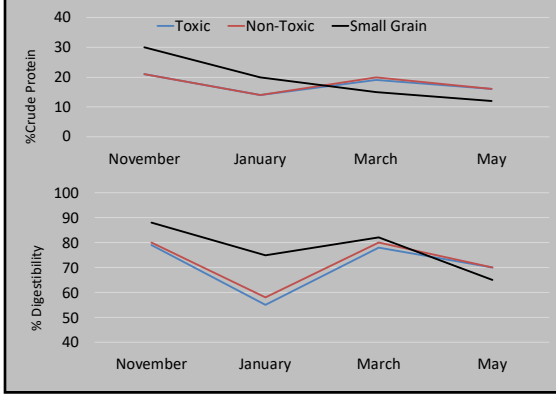
Department of Animal Science

DIVISION OF AGRICULTURE RESEARCH & EXTENSION University of Arkansas System

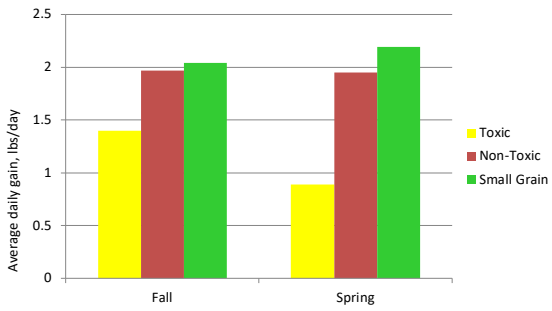
Economic Costs of Fescue Toxicosis

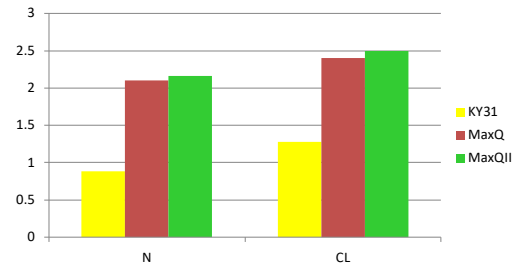
- Greatest economic loss in Cow Calf Industry
  - Reduce calf weaning percentage by 16% = $354 million cost to the industry
  - Weaning Weights reduced by 50 lbs = $255 million cost
- Stocker losses are commonly result of reduce ADG and animal quality
  - Fall ~0.5 lb/day
  - Spring ~ 1.0 lb/d
  - Calf value reduced by $5/cwt
  - Total reduction $140/calf

Forage Quality



Average Daily Gain





Spring Average Daily Gain

Seedhead Suppression

- Mefluidide researched in the 1990's
- Decreased forage growth by 50%
  - Increased CP by 32%
  - Increased digestibility by 18%
- Steers grazing treated pastures
  - Increased DM intake 47%
  - Increased digestibility 17%
  - Increased gain by 25%
- Mefluidide did not get FDA approval for use in pastures or hay fields

Turner et al., 1990, Missouri

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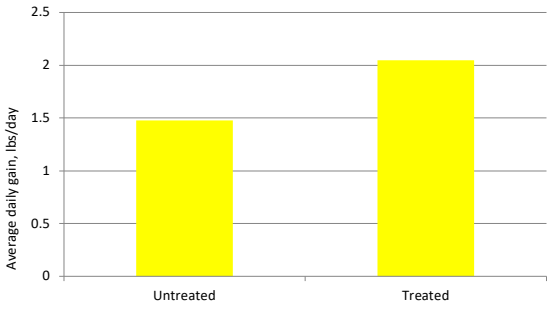
Management strategies for intensive, sustainable beef cattle production on tall fescue and winter annuals

Plant Responses to Chaparral Suppression of Tall Fescue Seedheads

- Chaparral applied late March or early April.
  - 89% infected tall fescue
  - 2 to 3 week period of yellowing and growth lag
  - 15 fold reduction in reproductive tiller density
    - 6 tillers/sq yd vs 90 tillers/sq yd
- Forage mass of untreated 15% greater than treated
  - 3,541 lb/acre vs 3,065 lb/acre
  - CP of Treated was greater 14.5% vs 12.1%
  - Digestibility of Treated was greater 78 vs 67%

Animal Responses to Chaparral Suppression of Tall Fescue Seedheads



Non-Toxic Endophyte Infected Tall Fescue for Beef Cows

Interseeding

- Timing: after warm-season grass goes dormant
  - 1 week of nights < 60° F
- Early planting – September 15 to October 1
  - May need glyphosate application to stop bermudagrass growth
- Ideal planting – October 1 – October 20
- Get seeds in ground
  - No-till drill
  - Disk, broadcast, drag
- Planting: 100 to 120 lb small grain + 20 lb Ryegrass
  - Rye
  - Wheat
  - Oats
- Fertilizer: P & K to test, 50 lb N in fall and spring

Interseeding Small Grains

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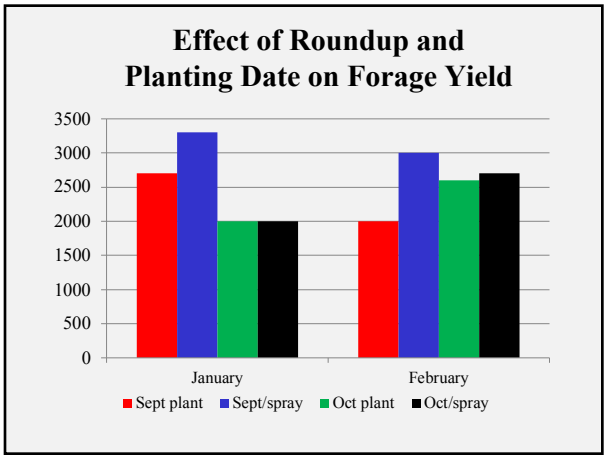

Effect of Planting Date

	September w/ Roundup	October w/o Roundup
On test BW	601	599
Off test BW	851	779
ADG	2.4	1.9
Total gain	266	163

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Conventional Tillage

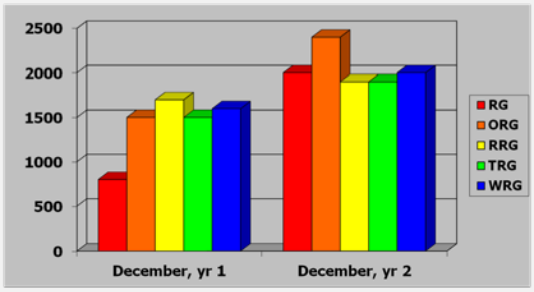
No-Till

Tillage Comparison in Wet Conditions

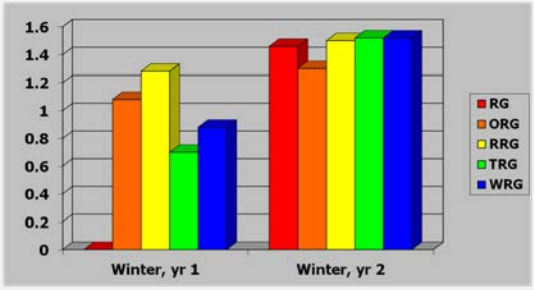
Species Comparisons

- Wheat, Rye, and Oats were planted with ryegrass
- SWREC
- Interseeded into bermudagrass sod October 15-20 at 2 bu small grain and 20 lb ryegrass/acre

Effect of species interseeded into grass sod on fall forage yield



Effect of species interseeded into grass sod



Winter Stocker Steer ADG

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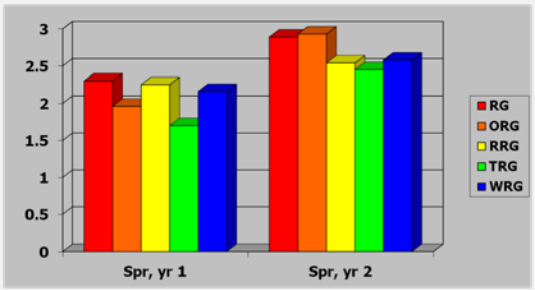
Effect of species interseeded into grass sod

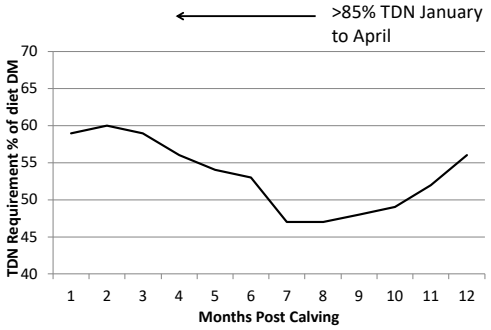


Spring Stocker Steer ADG

Cow Pastures

- Pastures planted November 1-10
  - Oat/ryegrass
  - Rye/ryegrass
  - Ryegrass alone
- 10 acres planted for each group of 7 cows
  - 1.4 acres per cow
- Pastures grazed starting January 15

Annual Cow Nutrient Requirements



Cow Grazing January

Cows Grazing in February

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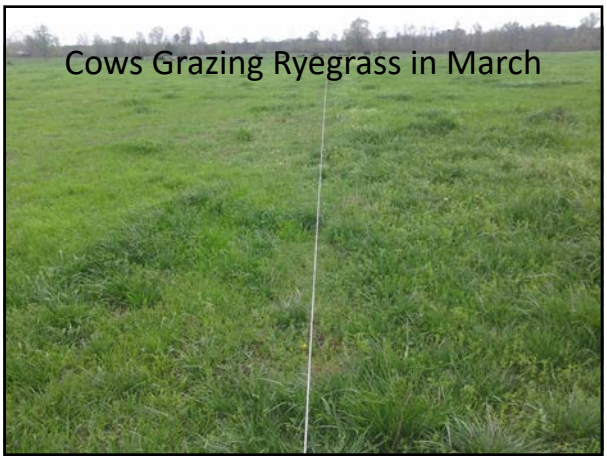


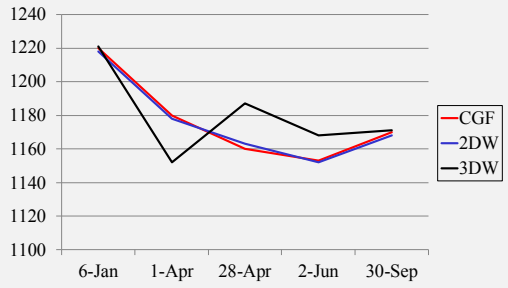
Cow Performance on Winter Annuals

- With winter annual pasture and limited hay
  - Hay intake will decrease to < 10 lb/d
  - A cow in early lactation will gain 2.75 lbs per day
    - Gain a BCS in 30 days
    - Cows in BCS 4 will have BCS 6 by April
  - No better or cheaper way to add condition to thin cows.

Limit-Grazing Interseeded Bermudagrass

- **Bermudagrass was interseeded with wheat, rye, & ryegrass.**
- **Base forage of bermudagrass pasture with *ad libitum* Bermuda/dallisgrass hay:**
  - **Graze pasture 2 d/wk (0.2 acre/cow)**
  - **Graze pasture 3 d/wk (0.3 acre/cow)**
- **Control cows had bermuda/dallisgrass hay plus a corn gluten feed (CGF; 21% CP) supplement fed at 2.0 lb/cow/d**
- **Grazed winter pasture beginning in January 6 (Feb./Mar. calving)**

Cow BW



Cow Performance

	CGF	2DW	3DW
Hay intake	25	22	22
Hay reduction	-	14%	14%

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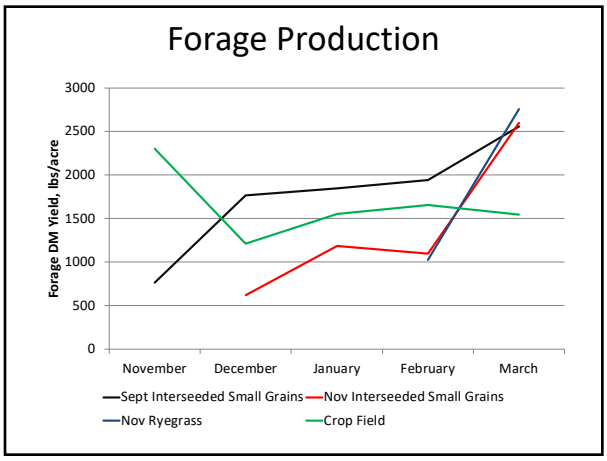
Management strategies for intensive, sustainable beef cattle production on tall fescue and winter annuals



Summary

- Cool season annual grasses and tall fescue can provide excellent animal performance during the winter and spring if:
  1. Adequate forage production is allowed to occur by allowing it to accumulate before stocking
  2. Stocking rate and grazing management are utilized to maintain adequate forage levels.
- Forage production can be maintained at levels that promote maximum performance through targeted supplementation and stocking rate adjustments.

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Section 4

Long-term impacts of fertilization and stocking rate decisions on soil fertility

Long-term Impacts of Fertilization and Stocking Rate Decisions on Soil Fertility

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TAMUS Regents Fellow & Professor
Texas A&M AgriLife Research
Overton, TX

2018 Georgia Forages Conference
Georgia Cattlemen's Convention

GLOBAL ROUNDTABLE for SUSTAINABLE BEEF, 2016

"Sustainable Beef"

- Socially Responsible
- Environmentally Sound
- Economically Viable

SUSTAINABLE

Long-Term Stocking of Bermudagrass Pastures and Nutrient Cycling

- Cow-Calf Stocking on COM and COS in 1968
- Complete Fertilizer through 1984
- From 1985 to present
  - Three Stocking Rates; Forage Mass
  - N Fertilizer + Ryegrass
  - No N Fertilizer + Clover + K and/or P
- Soil Nutrient Status; Soil Depth
- Forage Persistence
- Cow-Calf Gain/An & Gain/Ac

Most Important Management Strategies Affecting Ryegrass or Clover Establishment & Growth

- Soil pH & Other Nutrients
- Variety Selected for Environment
- Soil x Clover Adaptation
  - Sandy, Upland, Well-drained = Crimson
  - Transition Soil/Site = Arrowleaf, Ball, Red
  - Bottomland = White

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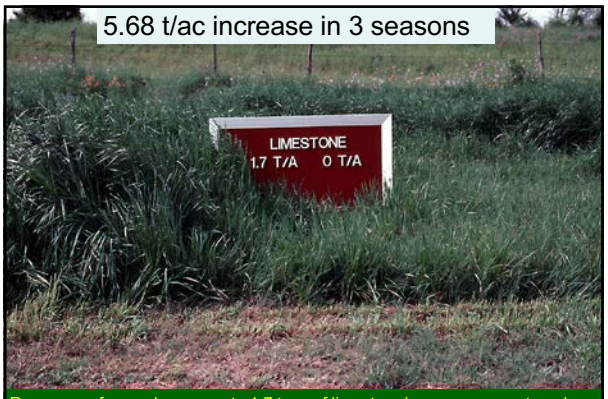

Response of annual ryegrass to 1.7 tons of limestone/acre on a very strongly acid Lilbert loamy fine sand (pH_w 4.5) compared to zero limestone on the Coastal Plain of the East Texas Timberlands.

Long-Term Stocking Rates and Fertility Regimens Affects Forage Species Diversity and Sustainability of Bermudagrass Pastures

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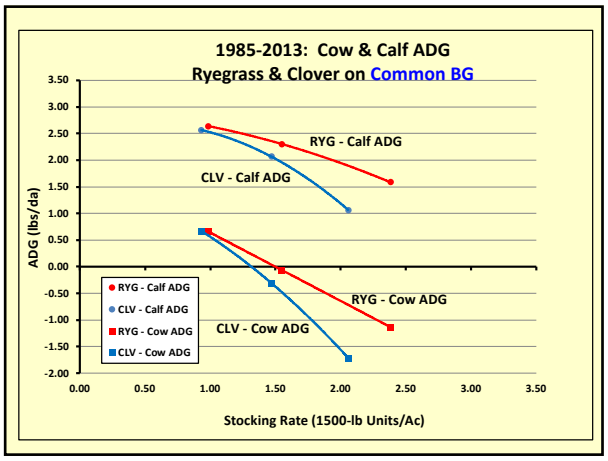

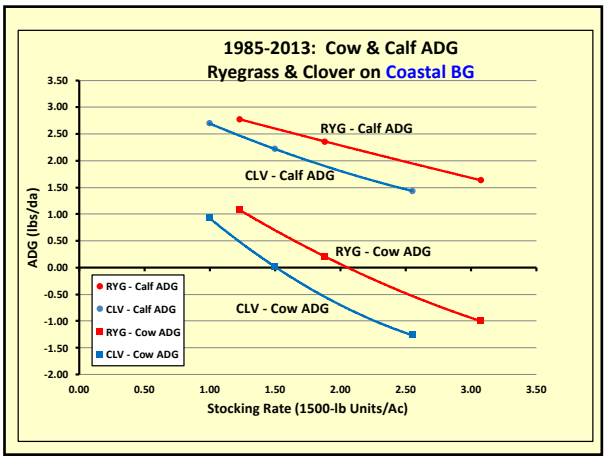

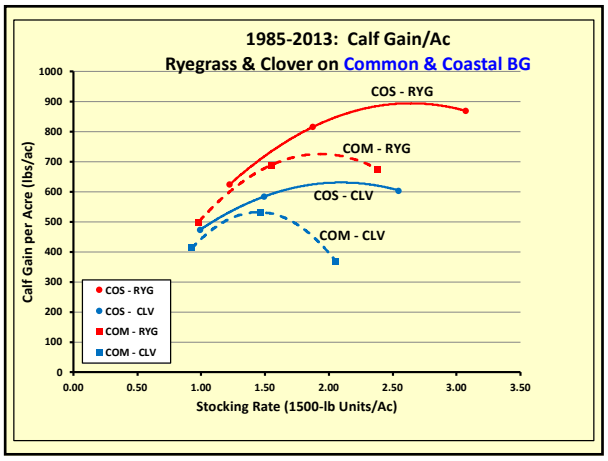

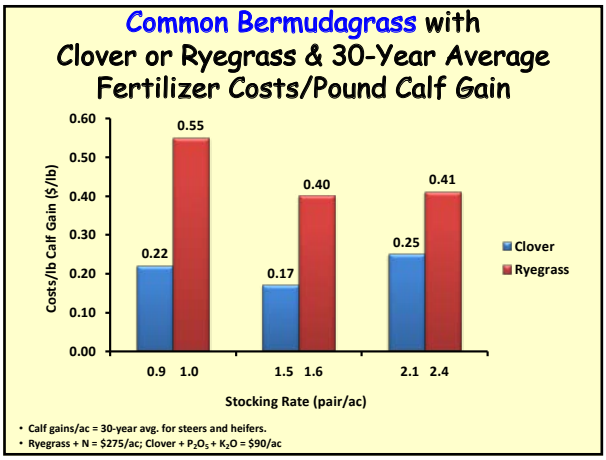

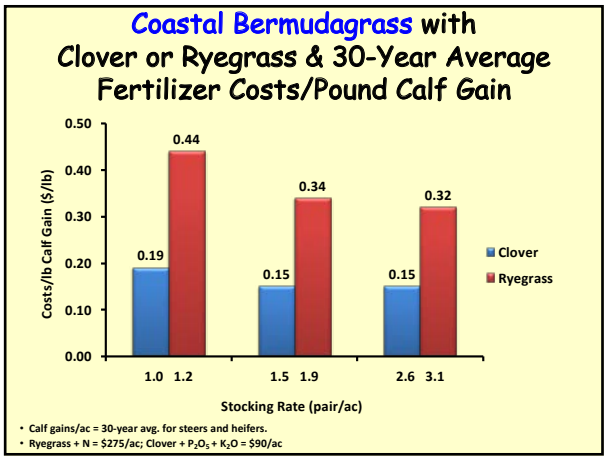

Impact of Long-Term Stocking Rates & Fertility Regimens on Stand-Maintenance, Genetic Diversity, & Sustainability of Bermudagrass Pastures

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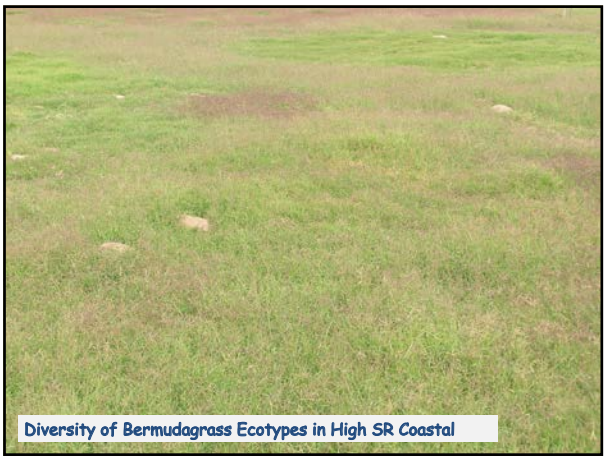
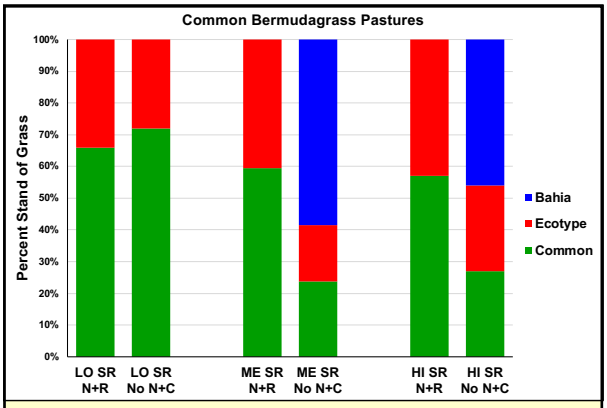
Soil Organic C and N in Pastures

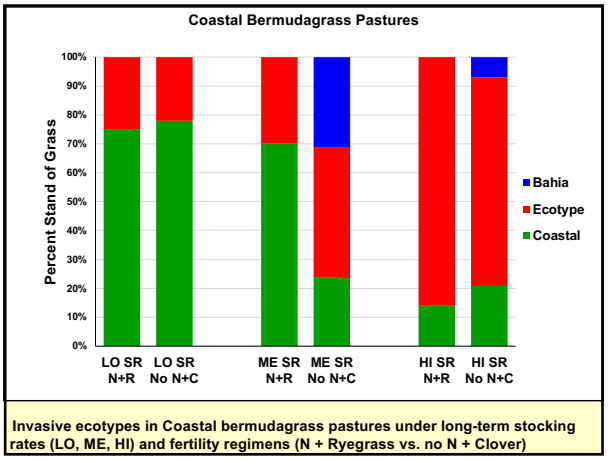
- Increase in SOC and SON 32 yrs after establishment of bermudagrass
- Grazing Strategies affected C & N Sequestration
  - Low Stocking Rate > High Stocking Rate
  - N + Ryegrass > no N + Clover

Hons, TAMU; Wright, Post doc, TAMU; Haby, Overton; Smith, Overton


Diversity of Bermudagrass Ecotypes in High SR Coastal



Invasive ecotypes in Common bermudagrass pastures under long-term stocking rates (LO, ME, HI) and fertility regimens (N + Ryegrass vs. no N + Clover)



Invasive ecotypes in Coastal bermudagrass pastures under long-term stocking rates (LO, ME, HI) and fertility regimens (N + Ryegrass vs. no N + Clover)

Implications from Long-Term Stocking of Bermudagrasses & Fertilization

- Prolonged, high STK under continuous stocking can cause substantial loss of COS and COM.
- Invasive bermudagrass ecotypes allowed for maintenance of bermudagrass in pastures.
- Reduced stocking rate on non-N pastures.
- Pastures without N-fertilization for > 30 years.
  - * High STK allowed invasion of ECOT & Bahiagrass.
  - * Low STK; 1.0 for Coastal & 0.8 for Common - allowed for persistence of 75-80% of each originally-established bermudagrass.

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Good news.....

Bad news.....

Nitrogen Drives Grass Production

Poultry litter and other manures provide N, P, K other plant nutrients, and organic matter.

Forage Legumes as Nitrogen Source for Pastures

- Nitrogen is the first-most limiting nutrient for grass pastures on most Southeastern US soils.
- Forage legumes fix atmospheric N through symbiosis with Rhizobium bacteria.
- Arrowleaf or Crimson Clover overseeded on grass pastures can fix 80 to 100 lbs N/acre/year.
- N-Fixation occurs in the leaves and stems of clover.
- N-Transfer to grass is accomplished through grazing and recycling of nutrients from animal excreta.

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Nutrient Cycling

Effectiveness of Nutrient Cycling on Pastures

- Stocking Rate
- Stocking Method
- Forage Nutritive Value

Nutrient Cycling on Pastures

Plant nutrients, N, P, K, etc., taken up by plant and returned to the soil for use again.

A use-return-reuse process.

Very Small Amount of plant food nutrient removed from pasture system by animal

Sources & Pathways of Nutrient Cycling

- Leaf-stem loss; accumulated as litter
- Root decay
- Animal excreta

Nutrients in Excreta

- Function of diet
- Fecal N ≈ constant/unit DM intake
- N in urine is diet-dependent
- P in feces and urine
- K primarily in urine; 25% in feces

Management Strategies and Costs

Fertilizer Management Strategies

- Eliminate ALL fertilizer use
- Reduce fertilizer to "minimum" applications
- Continue fertilizer applications as in the past…or increase rate

Management Options When Eliminating ALL Fertilizer

- Take soil test
- Overseed clovers for N-fixation … IF… soil status (pH, P) is acceptable
- Reduce stocking rate – Cull
- Lease additional pasture
- Purchase hay based on quality and weight
- Use herbicides; broad-leafed weeds, woody-species

Management Options Using Minimum Fertilizer Applications

- Take soil test
- Apply lime for clovers
- Overseed with clovers and/or ryegrass
- Strategic N application
  - Best "Bang for the Buck" 50-100 lb/ac Nitrogen in 1-2 applications
- Purchase hay based on quality and weight
- Evaluate stocking rate – cull
- Use herbicides

Management Options When Fertilizing as Usual or Increased Rate

- Take soil test
- Apply lime for clovers
- Overseed with clovers, ryegrass, small grains
- Strategic N applications
- Evaluate animal performance – cull/buy
- Increase weaning weights / rates
- Consider stocker-replacement heifers
- Increase Bermudagrass DM & Sell Hay
- Use herbicides

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Is the Strategy to Reduce Fertilization Rate…OR… to be More Efficient with Utilization??

- Application of "proper" nutrients
- Utilization of pasture/hay
- Opportunities for Nutrient Cycling

For Bermudagrass Pastures

- Fertilizer Costs may NOT be the Number 1 problem….
- Matching Animal Requirements and Forage Quality may be the most Costly Problem…

  Management Strategy

Bermudagrass for Pasture & Hay

- Pasture fertilization recommendations typically based on routine soil test… BUT … N-fertilization based on potential yield and economic expectations,… AND… in general does not account for residual soil N,
- N rates in grazed pastures may range from 50 to 300 lbs/ac per year

Management Strategies and Costs

Management Options with Increased Costs

Option or Strategy	Expected Results
• Reduce and/or Eliminate Fertilizer	• Reduced DM • Reduced Nutritive Value • Increased Species Diversity • Reduced Stocking Rate • Increase Herbicides

Management Options with Increased Costs

Option or Strategy	Expected Results
• Reduce and/or Eliminate Hay Production & Use	• Purchase Hay • Requires Deferred WSPG Pastures • Requires Supplementation and/or Winter Pasture • Change Calving Date

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Management Options with Increased Costs

Option or Strategy	Expected Results
• Shift Calving Dates to Spring-Summer and eliminate winter pasture for cows	• Reduced Weaning Weight • Reduced Pregnancy • Retained Ownership and Winter Pasture • Cow Genotype to include Percent Brahman

Where are we headed?

Nitrogen Drives Grass Production

Good news.....

Bad news.....

Impact of Long-Term Stocking Rates & Fertility Regimens on Stand-Maintenance, Genetic Diversity, & Sustainability of Bermudagrass Pastures

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Impact of Long-term Stocking Rates & Fertility Regimens on Stand-Maintenance and Genetic Diversity of Bermudagrass Pastures

Effects of 37 years of Stocking & Fertility Regimens on Soil Chemical Properties in Bermudagrass Pastures

Summary
- No detrimental impacts on soil chemical properties.
- Nutrient recycling in soil-plant-animal systems can sustain long-term pasture productivity while preserving soil resources, and without environmental contaminants on these soil-Vegetational Zone pastures.

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Requirements for Successful Implementation of Management Strategies

- Forage-Animal Information; Facts
- Comparative Databases (minimum perceptions)
- Targeted Objectives with Flexible Application
- Risk Involvement - Risk Aversion; Equity Stability
- Economy of Scale
  - Financial Plan
  - Borrowing Power; Access to Funds
  - Understanding Banker/Lender

Strategies for Reducing Costs of Forage and Pastures for Cow-Calf Operations

- Nitrogen Fertilization;
- Alternative Forage Varieties
- Reduced Need for Stored Forages
- Reduced Forage Losses and Feeding Costs of Harvested Forages
- Reduced Forage Risk Management

* Benson - 2010

Cow-Calf Sustainability in Southeastern US

- Land-Use & Sale Options
- Retained Ownership & Management Considerations
- Forage Options for Pastures
- Soil Fertility & Fertilization Options

mis-Management Strategies Results in non-Sustainable Pastures and may Effect:

- Soil Erosion
- Weed-Invasion
- De-Stocking; Sell Cattle
- Re-Directions for Land Area
- Sale of Property

Bermudagrass Pastures and Sustainable Cow-Calf Production

God Bless America

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Section 5

Interseeding alfalfa into bermudagrass to reduce N costs, increase yields, and decrease supplementation needs

Project supported by:

Georgia Forages Conference

Interseeding alfalfa into bermudagrass to reduce N costs, increase yields, and decrease supplementation needs

Using Alfalfa Interseeded Into Bermudagrass to Decrease Nitrogen Cost, Increase Yield, and Decrease Supplementation

Taylor Hendricks, University of Georgia

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Why Alfalfa-Bermudagrass?

1. Grow your own Nitrogen!
2. Increase yield by extending the growing season
3. Increase forage quality
4. Reduce supplementation
5. If all else fails, you still have bermudagrass!

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1. Grow Your Own Nitrogen

Adding legumes adds N to the system!

Species	Annual lbs (N/acre)	N value at $0.45/lb. of N
Alfalfa	200-300	$90-135
Red clover	100-200	$45-90
White clover	100-150	$45-68
Annual clover	50-150	$23-68

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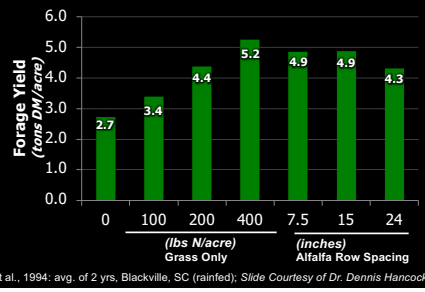
Forage Yield of Bermudagrass Fertilized w/ N or w/Alfalfa Interseeded – SC Coastal Plain



Stringer et al., 1994: avg. of 2 yrs, Blackville, SC (rainfed); *Slide Courtesy of Dr. Dennis Hancock*

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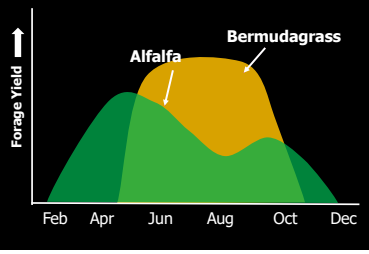
2. Increase Forage Yield and Extend the Growing Season



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Current Research

To compare the forage quality and yield of bermudagrass with and without alfalfa interseeded when harvested as baleage

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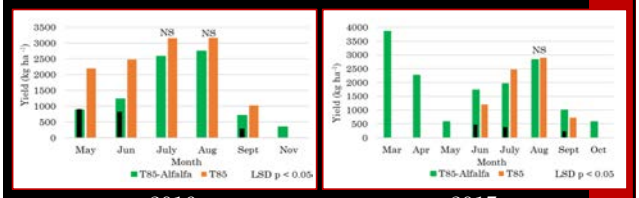
Interseeding alfalfa into bermudagrass to reduce N costs, increase yields, and decrease supplementation needs

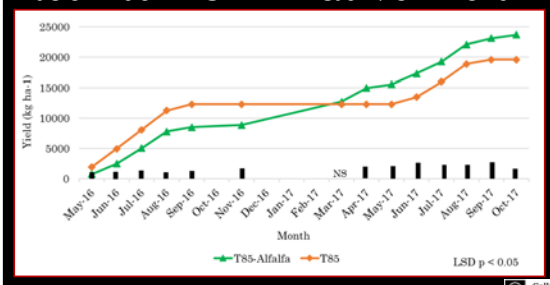
Forage Yield By Harvest



2016 2017

T85-alfalfa produced harvestable forage both earlier in the spring and later into the fall

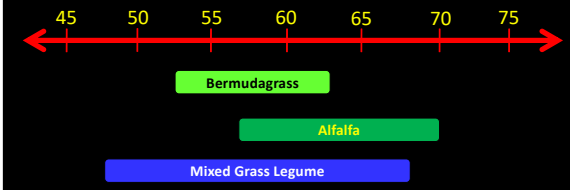
Results – Cumulative Yield



3. Improve Forage Quality

- Bermudagrass is high yielding with moderate quality
- Adding alfalfa to bermudagrass increases quality!
  - RFQ by 25-40 points
  - CP to 14-18% +
  - TDN to 60-64% +

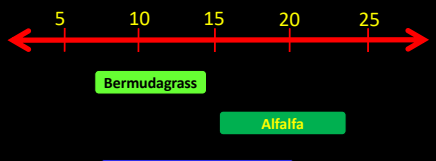
Total Digestible Nutrients (% TDN)



Typical Expected Ranges

Adapted from UGA Extension Bulletin Understanding and Improving Forage Quality, Fig 11

Crude Protein (%)



Typical Expected Ranges

Adapted from UGA Extension Bulletin Understanding and Improving Forage Quality, Fig 11

Relative Forage Quality (RFQ)

Typical Expected Ranges

Adapted from UGA Extension Bulletin Understanding and Improving Forage Quality, Fig 11

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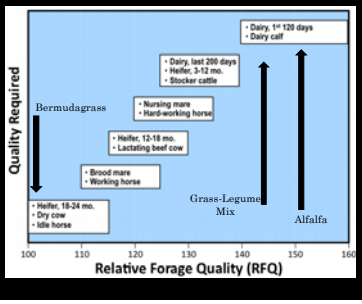
Results – 2016 Forage Quality

- Crude protein was greater in T85-alfalfa in 5 of 6 harvests (13.3% vs 10.2%)
- IVDMD and TDN were greater in every harvest
  - TDN: 54.5% vs. 51.8%
  - IVDMD: 74.1% vs. 71.1%

4. Reduce Supplementation



5. If all else fails, you still have bermudagrass!

Summary

Interseeding alfalfa into bermudagrass can add another tool in the toolbox

- Reduce Supplementation
- Improve forage quality
- Extend the growing season
- Growing your own nitrogen!

Questions?

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Section 6

Benefits and limitations to replacing commercial N with legumes in bermudagrass-based pastures

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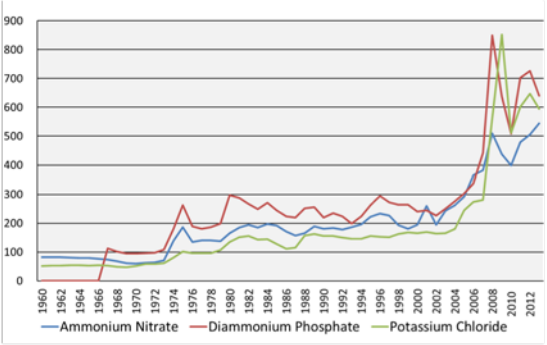
Benefits and limitations to replacing commercial N with legumes in bermudagrass-based pastures

Benefits and Limitations to Replacing Commercial N with Legumes in Bermudagrass-Based Pastures

P. Beck

University of Arkansas
Southwest Research & Extension Center, Hope

Fertilizer Prices



What should I do if I can't afford fertilizer?

Two choices.....

- Apply fertilizer at a reduced or targeted rate
- Don't apply any fertilizer

One outcome.....You WILL improve management!

Original research idea…

What is the benefit of legumes?
…N or forage quality

Why Legumes?

- **N fixation – reduce fertilizer costs**
- **Increase forage quality**
- **Increase animal performance**
- **Extend grazing season**

Replacing synthetic N with legumes for stocker cattle on bermudagrass

- **Stocker cattle research at Batesville, AR**
- **40 acre Bermudagrass**
- **5 Treatments**
  - **Pastures fertilized with 0, 50, and 100 lb N/acre (split application May and July).**
  - **White and Red clovers**
  - **Alfalfa**

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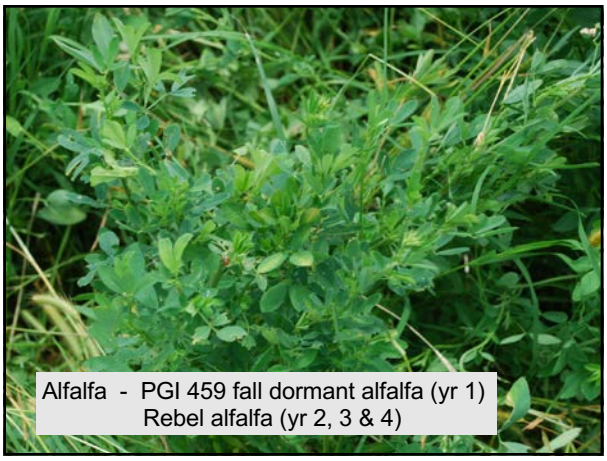
Benefits and limitations to replacing commercial N with legumes in bermudagrass-based pastures

Clover – Morningstar Red (10 lb/acre)
Regal Graze White (3 lb/acre)
Planted in the fall of years 1 and 3



Alfalfa - PGI 459 fall dormant alfalfa (yr 1)
Rebel alfalfa (yr 2, 3 & 4)

Cattle and pasture management

- Pastures divided into 4 paddocks, rotated weekly.
- Steers grazed from
  - Yr 1 May 29 to Sept. 9
  - Yr 2 May 25 to Aug. 20
  - Yr 3 – Alfalfa, April 14 to Aug. 18
    Clover , April 29 to Aug. 18
    Bermudagrass, May 12 to Aug. 18
  - Yr 4 – Alfalfa & Clover, April 5 to July 10
    Bermudagrass, May 9 to July 10

Average Stocking Rate, hd/acre

Treatment	2009	2010	2011	2012
0 N	2.5	2.1	2.3	3.5
50 N	2.8	2.2	2.5	3.5
100 N	2.9	2.3	2.3	3.5
Alfalfa	2.8	3.6	3.2	4.5
Clover	2.9	3.5	2.8	4.5

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Benefits and limitations to replacing commercial N with legumes in bermudagrass-based pastures

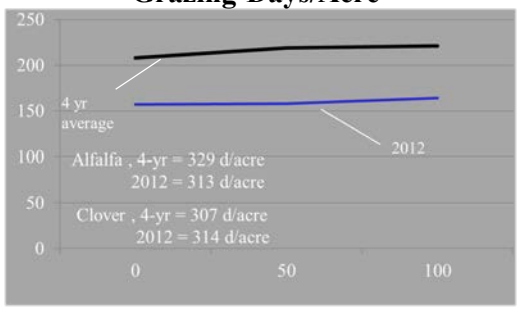
Cattle Performance, 4-yr average

Treatment	In BW	Out BW	ADG	Gain
0 N	532	642a	1.2a	110a
50 N	534	664b	1.4b	131b
100 N	538	691c	1.7c	152c
Alfalfa	534	691c	1.5b	157c
Clover	539	698c	1.6b	159c

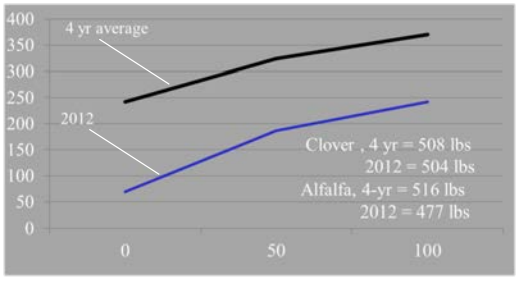
Cattle Performance 2012

Treatment	ADG	Gain
0 N	0.75a	46a
50 N	1.18b	73b
100 N	1.47c	91c
Alfalfa	1.52b	146d
Clover	1.61b	154d

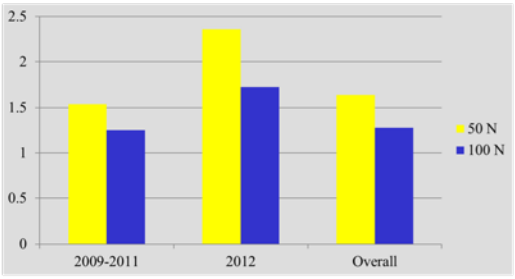
Grazing-Days/Acre



BW Gain/Acre, lbs



Nitrogen Response, lb gain:lb N



Summary

- Legumes increased BW gain per acre and grazing days per acre
  - No increase in ADG
  - Extended grazing season by allowing earlier stocking and heavier SR in spring

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Objective

- This research was designed to determine the effects of rotational or continuous grazing at the same stocking rate on performance of growing steers and persistence of interseeded alfalfa in bermudagrass pastures.

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Effect of Grazing Management on Performance of Steers Grazing Mixed Alfalfa and Bermudagrass Pasture

Materials and Methods

- 10 – 4 acre bermudagrass pastures interseeded with 25 lb/acre Bulldog 505 alfalfa in October 2013.
- Randomly assigned to either Continuous or Rotational grazing
- Year 1 – from May 15 to August 7 (84-days)
- Year 2 – from April 15 to September 2 (140-days)
- Year 3 – from April 21 to August 11 (112-days)
- Rotationally grazed pastures
  - 8 paddocks
  - 3 day graze & 21 day rest

Animal Management

- Start with 4 steers/acre each year for early summer grazing
  - 532 lbs
  - Reduced to 3.5 steers/acre in July for late summer grazing

RESULTS

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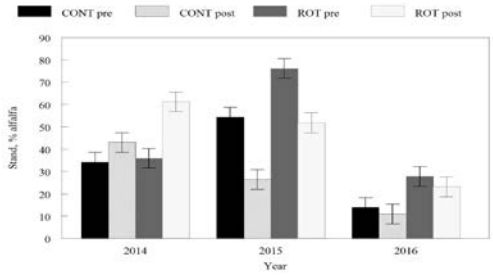
Steer Body Weight

Item	CONTINOUS	ROTATIONAL	*P* =
Initial	543	543	0.88
July	678	669	0.47
Ending	706	708	0.80

Average Daily Gains, lb/d

Item	CONTINUOUS	ROTATION
Early Summer	1.76	1.65
Late Summer	0.80	1.18
Overall ADG	1.48	1.52
Gain/ha	575	589

Alfalfa Stand Percentage



Conclusions

- Rotational grazing of mixed alfalfa/bermudagrass pastures increased late season ADG.
  - Increased forage mass and resulting increased forage allowance.
  - Increased alfalfa presence at end of grazing season resulting in increased diet quality.
- Rotational grazing increased alfalfa stand counts at end of grazing
  - Indicates advantages in stand persistence.
  - This has implications for other perennial crops that have persistence issues.

Seeding Method and Clover Species for Grazing Calves in Southern Arkansas

P. Beck, B. Stewart, C. Shelton, A. McWilliams, M. Sims and J. Jennings

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Benefits and limitations to replacing commercial N with legumes in bermudagrass-based pastures

Objective

- This research was designed to determine the effects of strip vs solid seeding of Red, White, or Subterranean clovers into warm-season grass sward on clover establishment and performance of growing heifers.

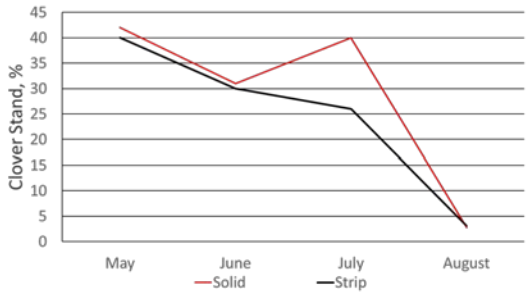
Materials and Methods

- October 2013 18 - 1.6 ha bermudagrass/Dallisgrass pastures
- Randomly assigned to either Solid or Strip seeding
  - Solid seeding interseeded with:
    - 2 lbs/acre Barblanca white clover (Barenbrug, Tangent, OR).
    - 8 lbs/acre Barduro red clover (Barenbrug, Tangent, OR).
    - 20 lbs/acre subterranean clover (VNS, River City Seed Co. Little Rock AR)
  - Strip seeding – ½ of total pasture area (4 strips) interseeded with
    - 4 lbs/acre Barblanca white clover
    - 16 lbs/acre Barduro red clover
    - 20 lbs/acre subteranean clover

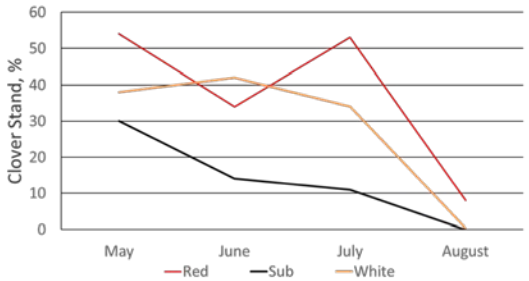
Animal Management

- 90 growing heifers each year
  - 615 lbs
  - Placed on pastures May 21, 2014
  - Grazing ended September 10, 2014
  - 112-d grazing
- 1.25 calf/acre stocking rate (n=5 per pasture)
  - Pastures divided into 2 acre paddocks
  - Grazed paddocks on alternating weeks
    - 7-d graze/7-d rest
  - All pastures fertilized with 30 lbs N/acre in mid-June
- Body weight collected full at beginning and end of grazing

Stand Counts



Stand Counts



Seeding Method Heifer Performance

Item	Solid	Strip	SE	*P* =
Bodyweight May	617	612	45.2	0.61
July	709	700	16.5	0.19
September	767	760	30.0	0.25
ADG, lb/d	1.31	1.24	0.17	0.21

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Clover Species Heifer Performance

Item	RED	SUB	WHITE	SE	*P* =
BW, lbs May	613	617	613	45.2	0.94
July	710	696	708	16.5	0.22
Sept	775[b]	751[a]	763[ab]	30.0	0.01
ADG, lb/day	1.38[b]	1.16[a]	1.29[ab]	0.03	0.05

Conclusions

- Red clover grew later into summer and produced superior animal performance
  - Very mild summers may have contributed to this
- White & Sub clover stands were very limited after June sampling date.
- Stand density was acceptable in both Strip and Solid for all species.

Economics of Legumes

- Enterprise budgets used to determine most profitable option.
  - Modeling used based on 100 acre farm

Item	0N	50N	100N	ALF	CLVR
Establishment	-	-	-	122.50	43
Cost per year	153	195	231	204	182
Gross Return	208	281	322	440	448
Net Return Year 1	55	86	91	131	215
Year 2	55	86	91	244	258
Year 3	55	86	91	244	215
Year 4	55	86	91	244	258

Economics of Legumes

- Most profitable option was Clover interseeded over entire area with maximized stocking rate at 500 steers/year.
  - Total profit of $94,600
- Second most profitable was Alfalfa
  - Total profit of $86,300
- Third most profitable was 100 lbs N/acre
  - Total profit of $36,400

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Section 7

Benefits and limitations to replacing commercial N with legumes in cool season grass-based pastures

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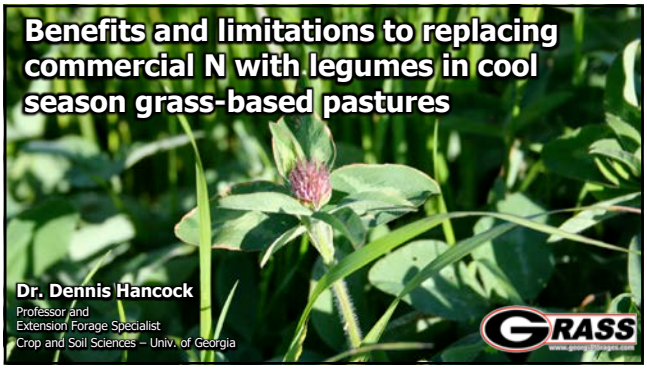
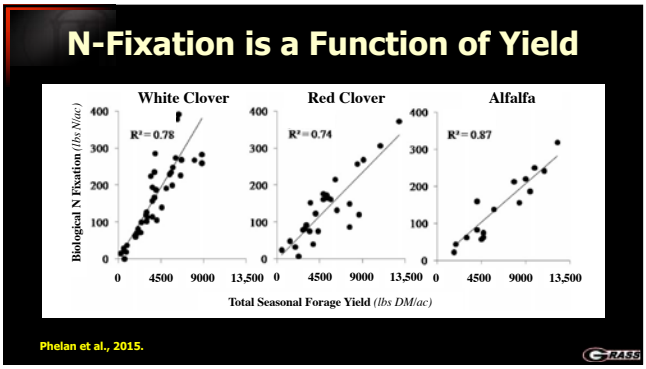
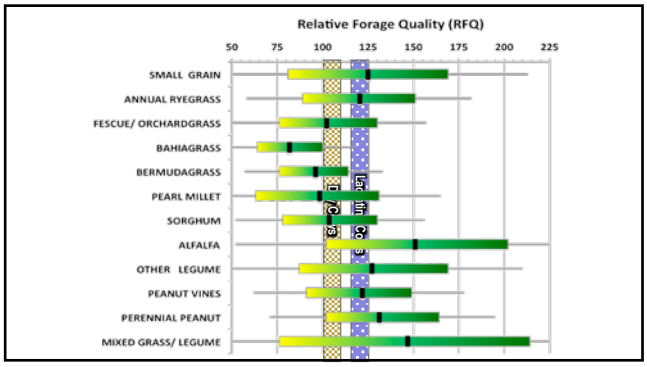
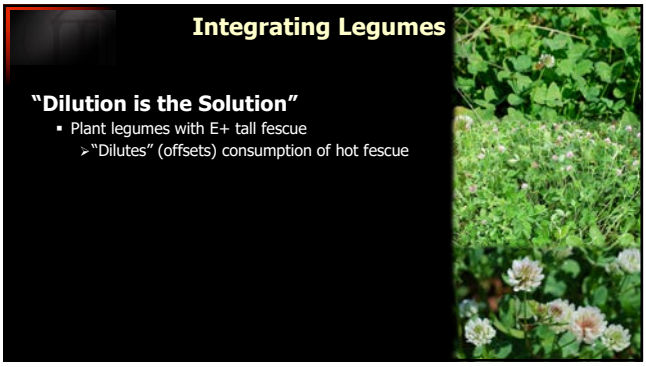
Benefits and limitations to replacing commercial N with legumes in cool season grass-based pastures









The Effect of Clover Addition to Grass on Animal Performance and Productivity

Blaser, et al. 1956. (Virginia).

Treatment	ADG	Steer days	Gain/acre
	lbs/hd/d	Steer-days/ac	lbs
Orchardgrass + 216 lb N/ac			
Orchardgrass + Clover			
Fescue (?E+) + 216 lb N/ac			
Fescue (?E+) + Clover			

The Effect of Clover Addition to Grass on Animal Performance and Productivity

Blaser, et al. 1956. (Virginia).

Treatment	ADG	Steer days	Gain/acre
	lbs/hd/d	Steer-days/ac	lbs
Orchardgrass + 216 lb N/ac	1.07b		
Orchardgrass + Clover	1.19a		
Fescue (?E+) + 216 lb N/ac	0.89c		
Fescue (?E+) + Clover	1.01b		

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Benefits and limitations to replacing commercial N with legumes in cool season grass-based pastures

Summary of Animal Production Data

- Burns and Standaert (1985) found 42 experiments measuring ADG in grass+N vs. grass+clover comparisons. 90% reported advantage for grass+clover (mean = 18% inc.)
- Only 38 studies with production/acre reported.
  - Mean inc. in production/acre was 18% inc.
  - But, only 50% of studies showed a real (significant) increase. 27% showed no difference, and 23% showed a DECREASE!
- Persistence an issue in some of the others exhibiting a dec.?

Persistence is a KEY Consideration

Table 6. Beef steer performance on tall fescue pastures planted fall 1998 with Durana white vs Regal ladino clover in central Georgia, fourth year after establishment, March 28-June 14, 2002. Paddocks were not grazed the first year due to extreme drought. (Bouton et al., 2003).

Pasture	Average daily gain (lb/d)	Gain per acre (lbs)
Toxic tall fescue + N	0.60	187
Toxic tall fescue + Durana	1.79	296
Toxic tall fescue + Regal	0.89	136

Forage Persistence is a Major Limit

- Reviewing 18 trials measuring legume proportion in the diet self-selected by a ruminant, Phelan et al (2015) found that the average preference was a diet consisting of 72 +/- 4% legumes.
- Management factors (e.g., broadleaf weed management, N fert., manure application, short rest periods, hoof damage, etc.)
- Seed yield and persistence are inversely related.

Annual Cost Advantage for Grass + Clover Depends on N Price and Stand Life[1]

Differences in animal performance still must be factored in before assuming profit or loss!

Clover stand life, years				
1	2	3	4	5
Annualized cost of clover establishment				
$24.19	$12.53	$8.65	$6.72	$5.56

[1] Low cost conditions scenario. The estimated variable cost of clover establishment **($22.50/acre)** was annualized assuming a **7.5%** interest rate. Annual variable cost of maintaining grass + clover was estimated to be **$106/acre**. A spreadsheet containing the input costs and rates of fertilization is available at (http://bit.ly/grasscloverN).

Annual Cost Advantage for Grass + Clover Depends on N Price and Stand Life[1]

Differences in animal performance still must be factored in before assuming profit or loss!

Clover stand life, years				
1	2	3	4	5
Annualized cost of clover establishment				
$168.78	$87.44	$60.37	$46.88	$38.80

[1] **Challenging** conditions scenario. The estimated variable cost of clover establishment **($157/acre)** was annualized assuming a **7.5%** interest rate. Annual variable cost of maintaining grass + clover was estimated to be **$106/acre**. A spreadsheet containing the input costs and rates of fertilization is available at (http://bit.ly/grasscloverN).

Effect of Tall Fescue, Endophyte, and White Clover on Stocker Production in the Spring

	ADG (lbs/hd/d)	Gain (lb/acre)
E+	1.10	126
NE		
E+ & WC		
NE & WC		

Jesup Tall Fescue and Durana White Clover. 3-yr trial. Eatonton, GA. Hill, Andrae, and Bouton (unpublished data)

Dr. Dennis Hancock
Professor and Forage Extension Specialist

Georgia Forages Conference

Benefits and limitations to replacing commercial N with legumes in cool season grass-based pastures

Integrating Legumes

Not really

"Dilution is the Solution"

- Plant legumes with E+ tall fescue
  - "Dilutes" (offsets) consumption of hot fescue
- May only add quality rather than diluting the toxins. May still consume toxic dose!

Economics of E+ and NE Fescue With and Without Clover

	E+ Fescue + N	E+ Fescue + Clover
ADG (lb)[1]	1.1	1.6
Gain/acre[1]	126	150
Stocking rate (cows/acre)[1]	0.5	0.41

[1] Based on Hill et al., 2007.
[2] Current maintenance costs and rates for inputs listed in UGA enterprise budgets (Russell and Hancock, 2016), and Extension rec. P, K, & lime rates assuming medium soil test P and K.
[3] Assumes feeder calf prices of $148/cwt.
[4] Assumes non-pasture related cow costs are $325/hd from UGA enterprise budgets.

The most challenging issues I face on my farm:

Rating	Challenge

Most Challenging

Least Challenging

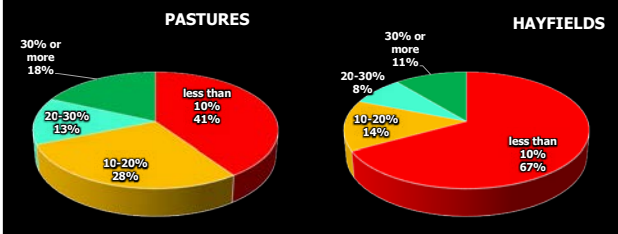
Hancock, unpublished data. Legume usage survey of GA Cattlemen, spring 2007.

How would you finish the following sentence? The use of legumes in my pastures and hayfields will:

Percent of Responses	
33%	increase forage quality.
25%	lower nitrogen fertilizer costs.
21%	put more weight on my weanlings.
8%	too severely limit weed control.
4%	not be cost-effective.
4%	reduce my carrying capacity.
4%	cause bloat problems.

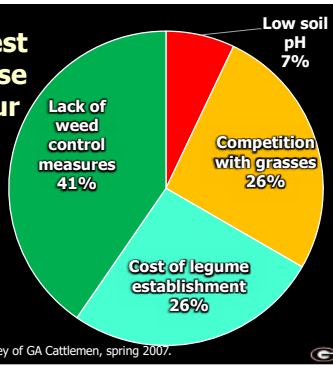
Hancock, unpublished data. Legume usage survey of GA Cattlemen, spring 2007.

What Percentage of Your Fields Contain Forage Legumes?



Hancock, unpublished data. Legume usage survey of GA Cattlemen, spring 2007.

What is the greatest limitation to the use of legumes on your farm?



Hancock, unpublished data. Legume usage survey of GA Cattlemen, spring 2007.

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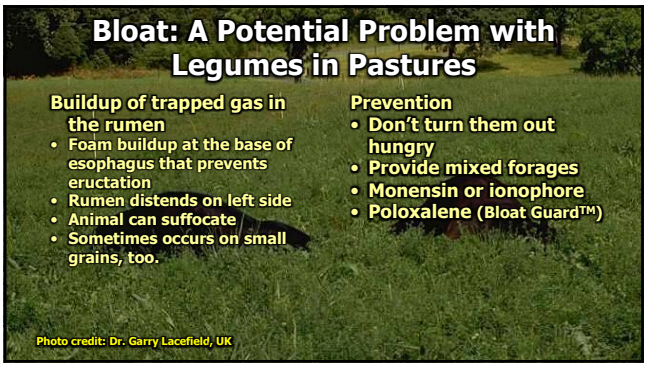
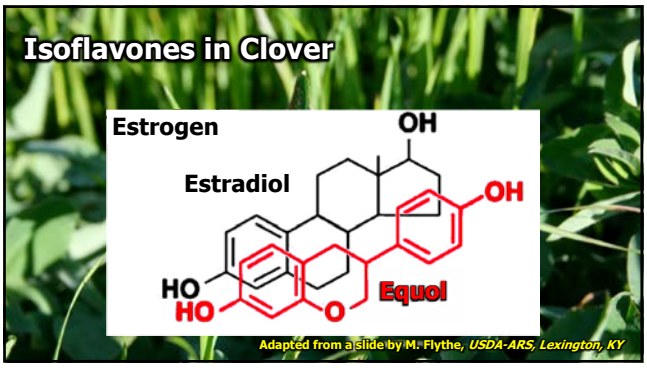
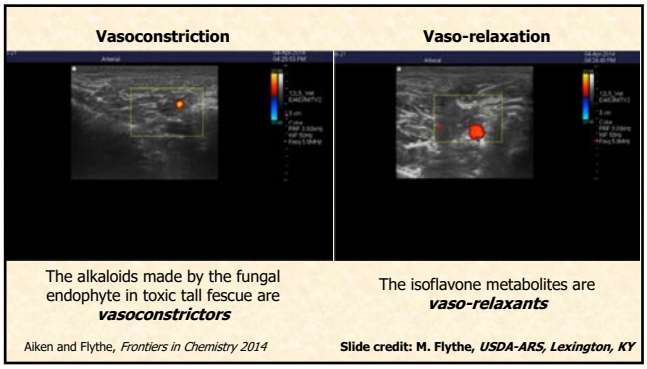
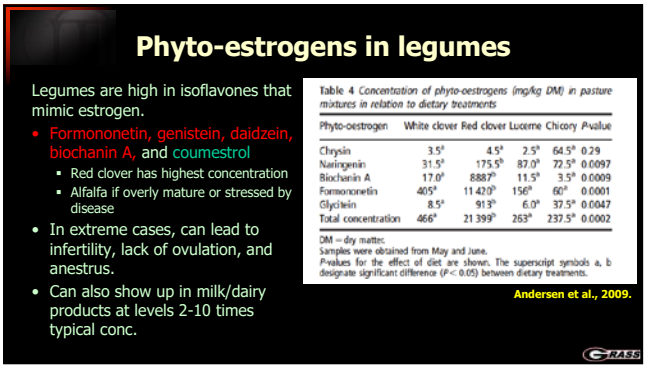
GRASS
www.georgiaforages.com


Dow AgroSciences Symposium
January 15, 2018 | Louisville, KY


Bloat: A Potential Problem with Legumes in Pastures
Buildup of trapped gas in the rumen
• Foam buildup at the base of esophagus that prevents eructation
• Rumen distends on left side
• Animal can suffocate
• Sometimes occurs on small grains, too.
Prevention
• Don't turn them out hungry
• Provide mixed forages
• Monensin or ionophore
• Poloxalene (Bloat Guard™)
Photo credit: Dr. Garry Lacefield, UK

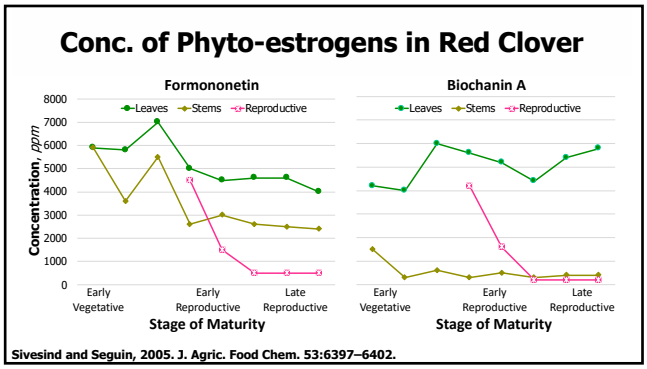

Isoflavones in Clover
Estrogen
Estradiol
OH
OH
HO
HO
O
Equol
Adapted from a slide by M. Flythe, USDA-ARS, Lexington, KY


Vasoconstriction
Vaso-relaxation
The alkaloids made by the fungal endophyte in toxic tall fescue are vasoconstrictors
The isoflavone metabolites are vaso-relaxants
Aiken and Flythe, Frontiers in Chemistry 2014
Slide credit: M. Flythe, USDA-ARS, Lexington, KY

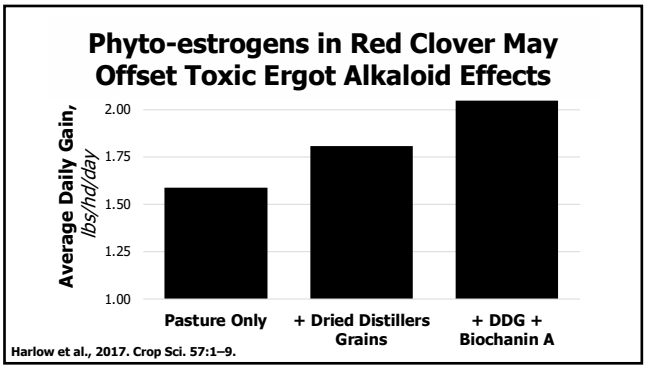

Phyto-estrogens in legumes
Legumes are high in isoflavones that mimic estrogen.
• Formononetin, genistein, daidzein, biochanin A, and coumestrol
▪ Red clover has highest concentration
▪ Alfalfa if overly mature or stressed by disease
• In extreme cases, can lead to infertility, lack of ovulation, and anestrus.
• Can also show up in milk/dairy products at levels 2-10 times typical conc.
Table 4 Concentration of phyto-oestrogens (mg/kg DM) in pasture mixtures in relation to dietary treatments
Phyto-oestrogen White clover Red clover Lucerne Chicory P-value
Chrysin 3.5a 4.5a 2.5a 64.5b 0.29
Naringenin 31.5a 175.5b 87.0a 72.5a 0.0097
Biochanin A 17.0a 8887b 11.5a 3.5a 0.0009
Formononetin 405a 11 420b 156a 60a 0.0001
Glycitein 8.5a 913b 6.0a 37.5a 0.0047
Total concentration 466a 21 399b 263a 237.5a 0.0002
DM = dry matter.
Samples were obtained from May and June.
P-values for the effect of diet are shown. The superscript symbols a, b designate significant difference (P < 0.05) between dietary treatments.
Andersen et al., 2009.

Georgia Forages Conference

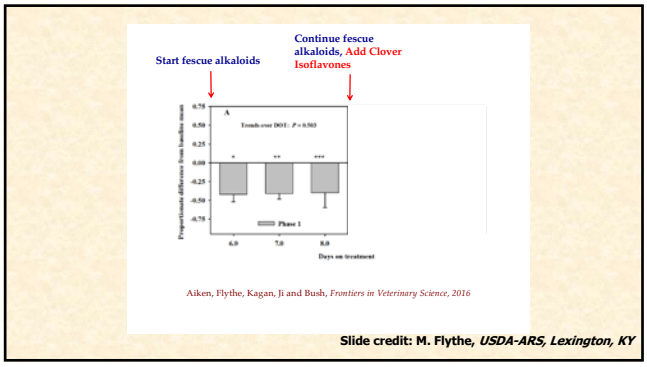
Benefits and limitations to replacing commercial N with legumes in cool season grass-based pastures



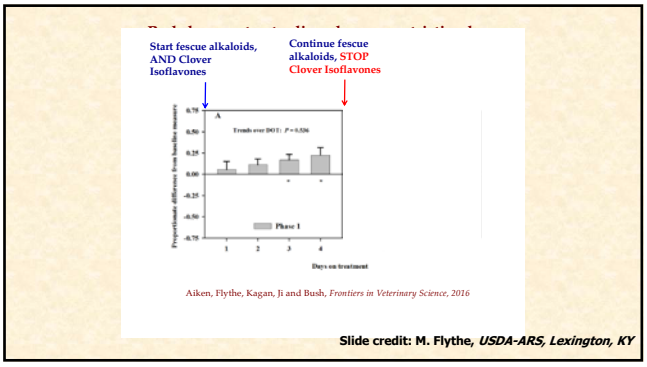
Sivesind and Seguin, 2005. J. Agric. Food Chem. 53:6397–6402.



Harlow et al., 2017. Crop Sci. 57:1–9.



Slide credit: M. Flythe, *USDA-ARS, Lexington, KY*



Slide credit: M. Flythe, *USDA-ARS, Lexington, KY*

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Questions?
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Appendix

Forage Systems for
Stocker Cattle

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Extension Forage Agronomist
Department of Crop and Soil Sciences

R. Curt Lacy
Extension Livestock Economist
Department of Ag and Applied Economics

R. Lawton Stewart Jr.
Extension Beef Nutritionist
Department of Animal and Dairy Science

Forages can be a relatively inexpensive feedstock for stocker development in the Southeast. With the luxury of a nearly year-round growing season, beef producers in this region have a competitive advantage over producers in other regions with a shorter grazing season and cattlemen who primarily use concentrate-based rations. However, it is critical to appropriately match the animal's nutritional needs to the forage base. This publication provides a guide to the various forage systems that could be used for stocker development and provides guidelines for managing grazing or hay harvests for optimum forage yield and quality.

Comparing Forage Systems

When evaluating or comparing forage systems for stocker development, a number of factors need to be considered. Many of these considerations are specific to the individual farm, situation, or management ability (e.g., the capability to plant, manage, and use annual forage crops; appropriateness of the site to the requirements of the forage system in question, etc.). With all other factors being equal, the primary basis for comparing forage systems includes:

1. **Average daily gain** - ADG; the expected average rate of gain per animal,
2. **Gain/acre** - the amount of gain expected to be produced per acre,
3. **Grazing period** - the expected number of days when the forage system can be grazed at a specified stocking rate, and
4. **Stocking rate** - the expected number of animals capable of being grazed on a given acre for the specified grazing period.

These factors individually influence the profitability of the forage system but they are also interrelated. The interrelationship between some of these factors can be seen in their definitions (e.g., stocking rate and grazing period) or their mathematical relationships (e.g., gain/acre = ADG x days in grazing period x stocking rate). To understand how these aspects interact, it is important to understand that the grazing pressure applied by different stocking rate levels can affect ADG and gain/acre.

In general, the goal is to maintain ADGs at least above 1.5 lbs/head/day so that the animal's weight stays appropriate to its age. However, this must be done while optimizing gain/acre, since this term is a primary determinant of profitability. Though one may think that gain/acre could be increased merely by increasing the stocking rate, this may be counter-productive. Certainly, increasing the stocking rate up to a certain level improves gain/acre (Figure 1). However, ADG generally decreases as stocking rate increases. As the stocking rate increases beyond an optimum, the lower ADG of the individuals can begin to cause gain/acre to decrease. The reason for this is that as stocking rate increases, an individual animal may not be able to select high quality forage and, ultimately, may not have enough forage available to meet its nutritional needs for high production.

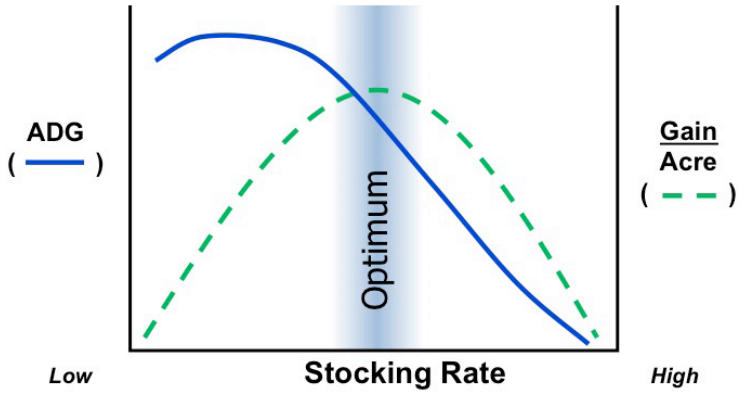

Figure 1. The general interrelationship between stocking rate, average daily gain (ADG), and gain/acre for a given grazing period.

Since these four key aspects are interrelated, it is important to consider them collectively when comparing forage systems. Like a jigsaw puzzle, the only way to see the whole is to simultaneously consider these four core pieces (Figure 2). In this publication, research results for a number of different forage systems for stocker development have been summarized using these four factors whenever possible. Unfortunately, not all of the research that has been done was performed in such a way as to provide all of these four factors.

It is also important to recognize that the provision of supplemental feed can influence or improve all four of these key factors. The results of research trials reported here are from trials where no supplemental feed was provided to the animals. This makes for a good comparison of the different forage species and indicates the species (or varieties) that would need to be supplemented more or less. Additional information about improving ADG, gain/acre, stocking rate, and grazing period with supplemental feed can be found in the Related Publications section at the end of this document.

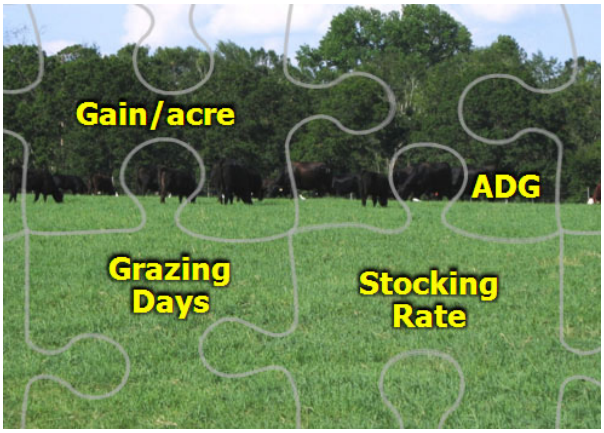

Figure 2. Gain/acre, average daily gain, the days in the grazing period, and stocking rate are interrelated and central to understanding how one forage system for stockering compares to another.

Forage Systems Overview

The Southeast's mild climate and high rainfall allow for excellent forage production conditions. More than 60 forage species are grown and used in Georgia. Of these forage crops, several are capable of producing the quality and quantity of forage necessary to support a stocker beef cattle production system. Table 1 presents a summary of the 12 forage crops that are most commonly used for stocker development in Georgia.

Table 1. Key characteristics of forage systems commonly used for pasture-based stocker development programs in Ga.

Forage	Type[†]	Yield[‡] (tons/a)	Quality[§]		Cost of[¶]		Ease of Use For[††]	
			CP (%)	TDN (%)	Establishment	Production	Grazing	Hay
Annual Ryegrass	CSAG	4-5	10-20	56-74	Medium	Medium	1	3
Oats	CSAG	3-4	8-17	55-70	Medium	Medium	2	2
Rye (cereal)	CSAG	2-3	8-17	52-70	Medium	Medium	2	4
Wheat	CSAG	3-4	8-17	50-70	Medium	Medium	2	2
Arrowleaf Clover	CSAL	1.5-2	14-24	56-75	Low	Low	1	4
Crimson Clover	CSAL	1.5-2	14-24	57-75	Low	Low	1	4
Tall Fescue	CSPG	4-5	10-16	58-62	Medium	Low	1	1
Crabgrass	WSAG	2-5	9-12	58-65	Low	Medium	1	3
Pearl Millet	WSAG	4-6	8-12	52-58	Medium	High	3	4
Sorghum-Sudangrass	WSAG	4-10	9-12	53-60	Medium	V. High	4	4
Bahiagrass	WSPG	3-5	9-12	50-56	High	Medium	1	1
Bermudagrass (hybrid)	WSPG	5-8	10-14	55-60	V. High	V. High	1	1

[†] Cool season annual grass (CSAG), cool season annual legume (CSAL), cool season perennial grass (CSPG), warm season annual grass (WSAG), and warm season perennial grass (WSPG).
[‡] Typical range in yields of recommended varieties, but highly dependent on growing season and conditions.
[§] Assumes harvest or grazing occurs at recommended stages of growth.
[¶] Based on 2010 seed, fertilizer, and fuel costs and assuming moderate soil fertility.
[††] Ratings are 1 – 4: 1 = relatively easy and 4 = quite difficult or requires high level of management.

Cool Season Annual Forage Programs

Mild weather and the ability to grow high quality forages during late winter and spring make the cool season annual forage program an excellent option for forage-based stocker systems. In general, cool season annuals are high in crude protein and very digestible (Table 1). Cool season annual forage grasses and legumes can maintain high quality through the spring if the forage is kept in a vegetative stage of growth by proper grazing

management. Research suggests that lightweight calves should gain an average of 1.8 to 2.3 pounds per day on productive, well-managed cool season annual pastures with little or no supplementation. The performance of cool season annual crops varies with location in the state, soil type, and management. However, it is generally useful to combine cool season annuals either individually in separate paddocks or as mixtures within a paddock. The primary reason for doing this is that the crops differ in when they are most productive and complement the forage quality of one another (Figure 3). Using two or more species, either in a mixture or in different areas, provides better distribution of forage production.

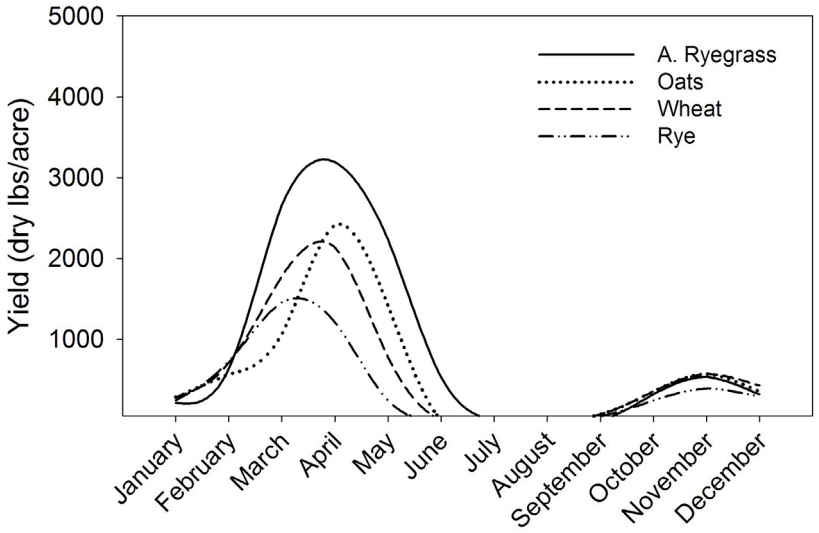

Figure 3. A typical seasonal yield distribution of selected cool season annual grasses in Georgia.

Cool Season Annual Forage Crops

Small Grains – Rye, wheat, and oats are widely used in stocker programs. Rye and wheat are more cold tolerant than oats and can be grown statewide. Oats are best adapted to south Georgia. Rye produces more forage in late fall and late winter than wheat but matures earlier in spring. Wheat will provide grazing about three weeks later in spring than rye. The growing season for oats is similar to wheat. Rye is the best choice for land that will be plowed in spring for a summer row crop because it matures in early spring. Wheat and oats are slightly more palatable than rye, and cattle generally gain slightly faster than when grazing pure stands of rye. Rye can mature very rapidly. As a result, the forage quality can decrease very quickly. Triticale (a hybrid of rye and wheat) can also be used, but it is not as grazing-tolerant and offers no substantive advantage over rye or wheat.

Annual Ryegrass – Annual ryegrass is a highly productive cool season annual grass with excellent forage quality. It is widely used in forage programs throughout the Southeast. In Georgia, ryegrass is more productive on heavier soils (those with a high clay or loam content or moist low-lying soils) than on deep well-drained sandy soils. Ryegrass is more productive in late spring than the small grains and will extend the spring grazing season. Ryegrass may be seeded in pure stands. However, it may be necessary to mix ryegrass with rye and/or an annual clover so that high-quality forage can be maintained from late winter through spring (Table 2).

Table 2. The effect of a cool season annual mixture on stocker production.[†]

	ORG[‡]	RG	RRG	TRG	WRG
ADG (lbs/hd/d) [§]					
Winter	1.2	0.7	1.4	1.1	1.2
Spring	2.5	2.6	2.4	2.1	2.4
Gain (lb/acre)	253	239	281	219	256
Cost of Gain ($/lb)	$0.29	$0.28	$0.25	$0.39	$0.28
Net Return ($/acre)	$110	$106	$144	$56	$115

[†] Adapted from Beck et al., 2007. J. Anim. Sci. 85:536-544 (SW Arkansas, Avg. of 2 yrs). Costs and returns based on actual values at the University of Arkansas' Southwest Research and Education Center in 2002 and 2003.
[‡] ORG = oats + ryegrass; RG = ryegrass; RRG = rye + ryegrass; TRG = triticale + ryegrass; WRG = wheat + ryegrass.
[§] Stockers weighed between 500 and 575 lbs. Note that the stocking rate in this study began at 1.5 stockers/acre and additional calves were later added to maintain equal grazing pressure on each treatment (a research method called "put-and-take"). In this study, grazing began in early winter (early January) and continued through early May in each system.

Cool Season Annual Clovers – Arrowleaf and crimson clover are cool season annual legumes adapted to well-drained, fertile soils in the Coastal Plain and Piedmont areas. These clovers are most productive in spring. Crimson matures earlier in spring than arrowleaf and provides less grazing in late spring. In the Piedmont, arrowleaf may provide grazing until early June.

Legumes are generally higher in protein and more digestible than cool season annual grasses, particularly as the grasses mature in late spring. As a result, gains of 2.5 lbs/head/day and 260 lbs/acre can be expected during spring grazing when an annual clover is used. In addition, these legumes may contribute as much as 100 lbs of nitrogen (N)/acre via nitrogen fixation.

Management Considerations for Cool Season Annual Stocker Pastures

Detailed recommendations for managing cool season annual forages are covered more fully in other Extension publications such as "Georgia Forages: Grass Species" and "Georgia Forages: Legume Species." However, there are some slight variations on the recommendations for planting, fertilizing, and managing the grazing of cool season annuals that should be considered when they are to be used in a stocker development enterprise.

Planting – The first priority is to ensure that adequate forage is available when the grazing period needs to begin. The timing of forage availability is primarily affected by the cool season annual species (and, in some cases, variety) that is used, the type of seedbed into which the crops are to be planted, and the planting date. If late fall or early winter grazing is desired, rye or oats should be used (Figure 3). However, if peak forage availability is needed in the spring, annual ryegrass and wheat will generally provide more forage during those months. Crops planted into a prepared seedbed start quickly and provide grazing as early as late November in south Georgia or late December in north Georgia. However, to allow for the earliest possible grazing, the crop will need to be seeded as early as possible (early to mid-September in the Limestone Valley/Mountains region, mid- to late September in the Piedmont region, late September to early October in the Coastal Plain region).

If grazing in mid- to late winter is the goal, then cool season annuals can be planted into an existing warm season perennial grass sod. However, sod-seeded cool season annuals are slow-growing in the fall, and the forage is unlikely to achieve a sufficient height for grazing until late December or the end of January. Planting early may not allow for much earlier grazing when it is sod-seeded, and these early plantings may be slowed by the perennial grass or damaged by disease. When sod-seeding into perennial grass pastures, it is best to wait until growth of the perennial grass has been slowed by cool temperatures (mid-October).

Seeding rates can also affect the timing of forage availability in certain situations. When attempting to graze as early as possible, use a seeding rate that is on the high end of the recommended range, as this will generally provide more grazing earlier in the season (Table 3). Seeding rates higher than the recommended range are unlikely to provide any additional or earlier grazing and may increase the risk of disease. Late winter and spring forage yields are not influenced by seeding rates in the recommended range.

Table 3. Seeding rates and target planting dates for cool season annual forages.

Species	Seeding Rate*	
	Grown Alone	Mixture
	lbs / acre	
Ryegrass	25-30	15-25
Rye	90-120	60-90
Wheat	90-120	60-90
Oats	90-120	60-90
Triticale	90-120	60-90
Arrowleaf Clover	6-8	5-6
Crimson Clover	20-30	10-15

* Use higher seeding rates when broadcasting and lower rates when drilling into a prepared seedbed or existing sod (overseeding pasture).

Fertilization – A good fertilization program is necessary to produce high yields of high quality forage. Obtain a representative soil sample from each pasture and apply the recommended rates of phosphorus (P) and potassium (K) before planting. Amend the soil with lime to maintain soil pH above 6.0.

Small grain and ryegrass pastures can utilize up to 150 lbs of N/acre. Nitrogen fertilization is a key management tool to control forage growth. Adding N at the right time can increase tillering (thickening of the stand) and forage yield. Withholding N at certain times can help prevent the crop from growing too fast. Applying N at planting or soon thereafter is critical, since that initial 50 lbs of N per acre increases initial tillering and provides earlier grazing. A second application of N per acre should be applied in mid-January to early February to increase winter and spring forage production. If there is a great need for forage at that time and the coming weeks, 50 lbs of N per acre should be applied. If the need is less, decrease the N rate accordingly. If cool season annual legumes were used and they contribute 30 to 40 percent or more of the stand, then no more than 25 lbs of N per acre will be necessary in the winter application.

Because ryegrass is longer-lived, a third application of up to 50 lbs of N per acre may be needed in early spring when ryegrass is grown alone or used in a mix for late spring grazing, hay, or silage. If cool season annual legumes constitute 30 to 40 percent or more of the stand, then little if any additional N will be necessary in the spring. The key to remember is that ryegrass is very responsive to N. Take care to only apply enough N to meet the forage yield goal. Excess ryegrass forage, if it cannot be utilized, can be wasteful and pose risks to the grass crop that follows. This is especially problematic if the annual ryegrass is sod-seeded into bermudagrass, as late ryegrass production has been shown to decrease bermudagrass yields by 30 to 50 percent.

Grazing Management – Well-managed stands of cool season annual forages can provide excellent grazing. Grazing management can influence forage growth and utilization and animal performance. Limited grazing can begin in the fall as soon as the plants are well established and have 6 to 8 inches of accumulated growth. This ensures that root development is sufficient to prevent grazers from plucking the plant from the soil. Limited early grazing will improve tillering and increase stand density. However, it is critical that the pastures are not overgrazed during the early grazing period (i.e., maintain at least 2.5 to 3 inches of stubble height). This is also important in late winter when pastures start to recover from extreme cold. Allowing some regrowth to occur before putting significant grazing pressure on the pasture will significantly improve spring forage production.

Achieving the proper balance between cattle stocking rate and the forage growth rate is difficult. Forage growth varies during the growing season with changes in temperature and moisture conditions. The correct number of animals per acre in one week may be far too many the next week. To best utilize the forage that is grown, plan to provide supplemental feed and/or conserved forage during periods of slow pasture growth so that pastures will not be overgrazed.

Another way to prevent damage to late fall and winter pasture is to implement a rotational grazing program. Rotational grazing systems (sometimes called management-intensive grazing or MiG) allow the forage crop to recover more fully before being grazed again. Further, rotational grazing can substantially increase forage utilization efficiency (i.e., more of the forage that is produced ends up being consumed by the grazing animals) and this can increase the stocking rate that the forage system can sustain. More detailed information about the benefits of rotational grazing/MiG and the steps necessary to develop an efficient grazing system can be found on the University of Georgia's Management-Intensive Grazing website (www.caes.uga.edu/topics/sustainag/grazing).

Another strategy to more tightly control grazing is a method called "limit grazing." Limit grazing is a system by which the animals are only allowed a brief opportunity to graze (usually one to two hours). Limit grazing works best when the cattle are allowed access at strategic times during the day. Cattle generally consume large quantities of forage in the morning (~6:00 to 8:30 a.m.) and mid-afternoon (3:00 to 5:00 p.m.) with a smaller bout around the time the sun sets. Timing a limit grazing bout to align with one or more of these natural grazing behaviors during a day can allow the animals to obtain much of their diet from the available pasture while minimizing hoof traffic and other damage to the stand. Of course, this assumes that one has another pasture or lot and enough conserved forage and feed for the animals when they are not present in the limit grazed pasture.

Regardless of the grazing system, it is important to measure how much forage is on offer, monitor the growth rate of the forage, and manage how much forage is allocated to the herd. The forage can easily be measured using a grazing stick or rising plate meter. This data can then be entered into a spreadsheet that can display the total forage in each pasture or paddock and the growth rate. More information on how to measure, monitor, and manage forage growth and allocation can be found on the University of Georgia's Management-Intensive Grazing website on the page titled "Decision Support Tools for the 3 Ms of Grazing Management" (www.caes.uga.edu/topics/sustainag/grazing/3Ms.html).

Cool Season Perennial Forage Programs

The only cool season perennial forage systems recommended for use in stocker development in Georgia are those based on tall fescue. However, a large number of cool season perennial forage species can be used for stocker development in other parts of the U.S.

Tall Fescue as a Forage for Stocker Cattle

Tall fescue is grown throughout the Piedmont and Mountain regions in Georgia. Tall fescue is best adapted to moist soils and is most productive in spring and fall, but it is dormant during July and August in Georgia. When adequate moisture is available, tall fescue will provide excellent grazing in spring, fair to good grazing from June through early July and good grazing in the fall (Figure 4). However, tall fescue productivity in the fall is highly dependent on rainfall. Under conditions of average rainfall and temperature, tall fescue may yield 8,000 to 10,000 lbs of DM/acre/year (Table 1).

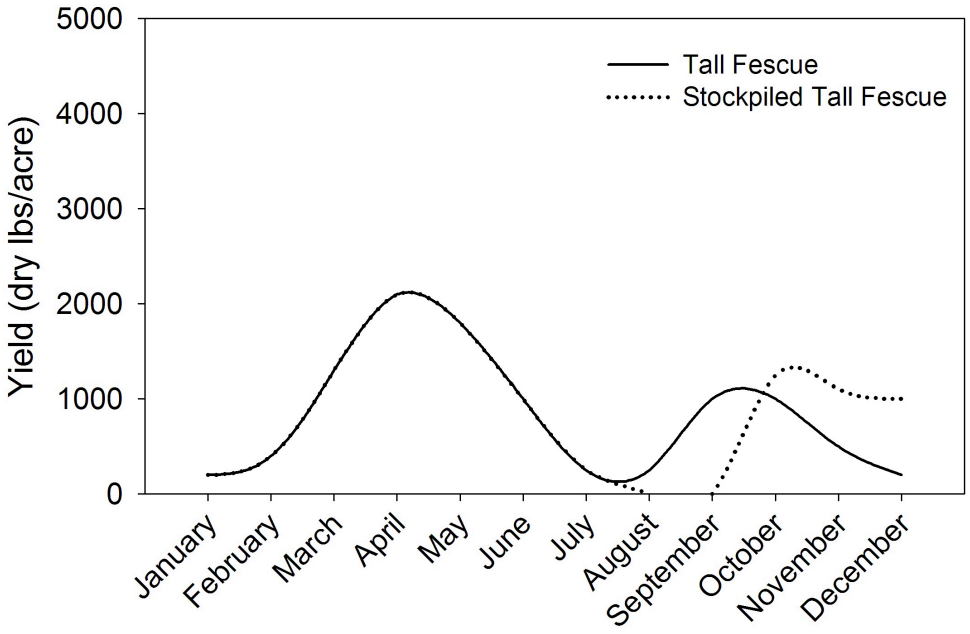

Figure 4. Forage distribution of tall fescue and the typical amount and timing of stockpiled tall fescue.

Tall fescue is also very tolerant of grazing and environmental extremes in Georgia. Much of this versatility is due to an endophytic fungus (*Neotyphodium coenophialum*) that grows within the plant. Unfortunately, this fungus also produces toxic alkaloids that cause several metabolic problems (collectively termed "fescue toxicosis") in animals consuming endophyte-infected varieties. These problems often lead stocker calves to have ADGs of less than 1.0 lbs/head/day (Table 4).

Table 4. The effect of endophyte status on stocker performance on tall fescue in the fall and spring.†				
	ADG (lbs/hd/d)	**Gain** (lb/acre)	**Stocking Rate** (hd/acre)	**Grazing Time** (days)
Fall				
Toxic Endophyte-Infected Jesup	1.5	137	1.5	63
Endophyte-Free Jesup	2.3	211	1.5	63
Jesup MaxQ™	2.1	188	1.5	63
Spring				
Toxic Endophyte-Infected Jesup	0.8	119	1.6	91
Endophyte-Free Jesup	2.2	313	1.6	91
Jesup MaxQ™	1.8	251	1.6	91
† Adapted from Parish (2001).				

In the past, only endophyte-free varieties of tall fescue were recommended for stocker cattle. These varieties can produce ADGs of 1.5 to 2 lbs/head/day during the spring and fall seasons. However, **fungus-free varieties ARE NO LONGER RECOMMENDED** because their reduced drought and heat tolerance, increased susceptibility to insects and nematodes, and propensity to be overgrazed has led to persistence problems.

In the late 1990s, strains of the fungal endophyte that do not produce toxic alkaloids were identified and inserted into tall fescue varieties. The development of these "novel endophytes" (NE) was a joint venture between Dr. Joe Bouton, professor emeritus at the University of Georgia, and Dr. Gary Latch at Ag-Research Limited of New Zealand. Varieties that have been infected with the novel endophyte are now marketed in the U.S. Several researchers have evaluated the productivity and persistence of NE tall fescue varieties throughout the tall fescue-producing areas of the state (Figure). Over these several years of research, NE tall fescue varieties have consistently resulted in ADGs of 1.8 lbs/head/day or greater. Similar studies throughout the Southeast have shown similar results to those listed in Table 4. These studies also indicated the stockers on NE tall fescue pastures had hair coats that were less rough, lower body temperatures, spent more time grazing, and spent less time standing in the shade or in pools of water (Figure 6). The gains and animal performance improvements observed for stockers on NE tall fescue pastures were essentially the same as those on fungus-free pastures, but the NE tall fescue varieties persisted substantially better. More information about novel endophyte-infected tall fescue is available in the UGA Extension bulletin "Novel Endophyte-Infected Tall Fescue."

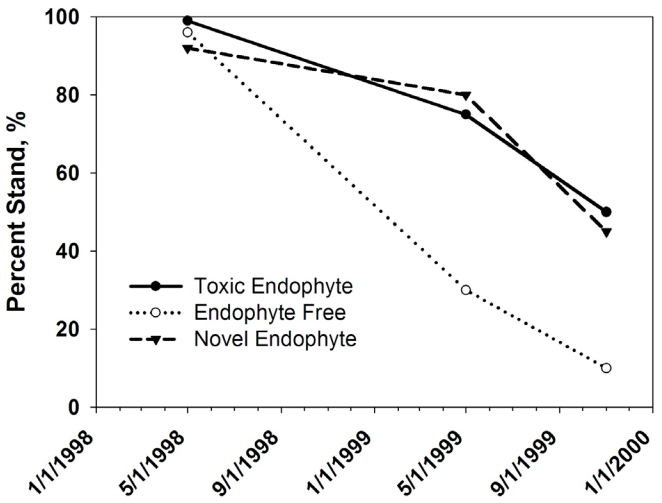

Figure 5. Stand persistence of novel endophyte-infected ('Jesup MaxQ™'), toxic endophyte-infected, and endophyte-free tall fescue in bermudagrass sod after two years of close grazing near Eatonton, Georgia (Bouton et al., 2000).

Figure 6. Cattle grazing toxic tall fescue (foreground) spent less time grazing, while cattle grazing MaxQ™ (background) and endophyte-free tall fescue had higher intakes and performance (Parish, 2001).

Subsequent Feedlot Performance

One of the major problems facing cattle producers in the Southeast is the stigma associated with calves that have been stockered on tall fescue. The perception among many of the cattle buyers is that calves that have been stockered on tall fescue will not gain as well in the feedlot, may have increased morbidity or pull rates, or may not be as efficient as feeder calves that were stockered in other areas or on other forage systems. This perception is based on biases about stockers that had been backgrounded on toxic endophyte-infected tall fescue.

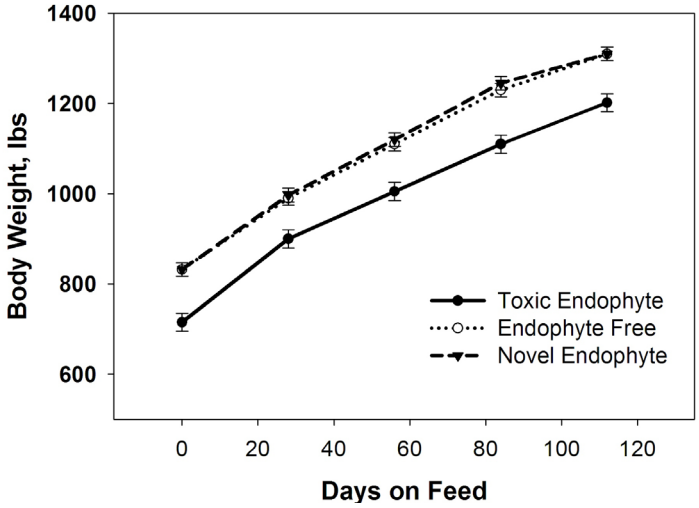

Figure 7. Subsequent feedlot performance of cattle that had grazed toxic, endophyte-free, and novel tall fescue during the stocker phase. Cattle originally grazed pastures in Eatonton and Calhoun, Georgia, and were finished in Stillwater, Oklahoma (Duckett et al., 2001).

Research that followed three of the aforementioned NE tall fescue grazing studies in Georgia examined the legitimacy of these perceptions. The stocker cattle from these studies were finished on high-concentrate diets and their feedlot performance was tracked. No difference in animal performance, feed efficiency, or most carcass quality measurements were found in those calves that had been grazing novel endophyte, endophyte-free, or toxic endophyte tall fescue. However, because of improved stocker performance, the cattle that grazed endophyte-free and novel endophyte tall fescue entered the feedlot heavier and reached targeted harvest weights sooner (Figure 7). While there appeared to be no feedlot performance depression from fescue toxicosis, heavier weights going into the feedlot will either (1) increase finished weights or (2) decrease time-on-feed, either of which translates into more profitable beef production.

Including Legumes in Tall Fescue Pastures

The addition of legumes to tall fescue pastures has only a minimal impact on total forage yield. However, including a legume increases the quality of the pasture and results in the addition of biologically-fixed nitrogen. The effect of these two factors result in increased ADG and gain/acre and a substantial decrease in the total cost of the forage system. As a result, the cost of gain of tall fescue-clover pastures is low and profitability is increased. In fact, research in Alabama has shown that tall fescue-based pastures where legumes were used provided the lowest cost of gain of any forage system. Thus, the practice of adding a legume to tall fescue stands is highly recommended (see the inset titled "Adding Clover to Toxic Endophyte and Novel Endophyte Tall Fescue").

A number of cool season legumes are used in Georgia. However, there are two forage legumes that fit best with tall fescue: white clover and red clover.

White Clover – White clover is a low-growing legume that spreads by stolons and can tolerate close grazing. It furnishes grazing in fall, late winter, and spring. Yields of white clover are usually not sufficient for it to be grown alone or as a hay crop, but it contributes a substantial amount of high quality forage when produced with tall fescue. White clover grows best on moist soils and can die during hot, dry summers. However, some new varieties of white clover are more persistent and will either survive these conditions or return from seed.

There are three basic types of white clover: large (e.g., Ladino clover, 'Patriot,' 'Regal'), intermediate (e.g., 'Durana,' 'Osceola'), and low-growing (e.g., Dutch clover). Large or ladino types are higher yielding than other types, but they do not reseed as well as the other types and are generally more short-lived. The intermediate types are well adapted to most sites, and they are prolific reseeders. Intermediate white clovers are more tolerant of grazing and persist better than red clover (especially in some drought-prone and infertile sites). Consequently, white clover often fits better within tall fescue-based pastures that are continuously stocked or stocked in a way that leaves animals in the pasture while the clover is recovering from grazing.

Red Clover – Red clover is a short-lived perennial legume that is adapted to a fairly wide range of soils. It can be seeded into tall fescue stands along with or instead of white clover. Red clover is taller growing and higher yielding than white clover. It is also more deeply rooted than white clover. Consequently, it is more productive than white clover during periods of drought stress. However, even under the best conditions, red clover stands start to thin in the second year. Moreover, red clover does not tolerate close grazing and will not produce or survive well in continuously stocked pastures. As a result, red clover will need to be replanted every two to three years and should only be used in well-managed, rotationally grazed, tall fescue pastures.

Additional information about establishing and managing white and red clover in tall fescue pastures is available in other UGA Extension publications such as "Georgia Forages: Legume Species," "White Clover Establishment and Management Guide," "Grazing Impacts on Pasture Composition," and "Seeding Methods for Small-Seeded Legumes" (www.caes.uga.edu/commodities/fieldcrops/forages/species/documents/SeedingMethodsforSmall-SeededLegumes.pdf).

Adding Clovers to Toxic Endophyte and Novel Endophyte Tall Fescue

Adding clover to toxic endophyte-infected tall fescue pastures generally increases stocker ADGs to a level that is similar to endophyte-free and NE varieties. However, the effect of the clover addition is not a "dilution effect," as has been previously assumed. When clover is included with the NE tall fescue, an additional improvement in animal performance and gains/acre is observed (Table 5). Thus, the addition of clover is an additive benefit.

Table 5. The effect of tall fescue endophyte status and the use of white clover in the pasture on stocker performance.[†]

	ADG (lbs/hd/d)	**Gain** (lb/acre)
Toxic Endophyte	1.1	126
Novel Endophyte	1.8	186
Toxic + White Clover	1.6	150
NE + White Clover	2.6	252

[†] Bouton, Andrae, and Hill (unpublished data).

Management Considerations for Tall Fescue Pastures for Stockers

Detailed recommendations for establishing and managing tall fescue are available in other UGA Extension publications such as "Georgia Forages: Grass Species" and "Novel Endophyte-Infected Tall Fescue." However, there are some slight variations on the recommendations for fertilizing and managing the grazing of tall fescue that should be considered when it is to be used in a stocker development enterprise.

Fertilization – As with all the other forage systems, it is critical to have a soil fertility program based on representative soil samples from each pasture or management area. Lime and P and K fertilizer should be applied based on soil test recommendations. Pure stands of fescue (no clover) should receive 60 to 80 lbs of N/acre in early spring (March) before rapid growth starts. When a good stand of clover (greater than 30 percent) is present in the pasture, little or no additional N is needed. However, if N is to be applied, avoid using more than 40 lbs of N per acre, as this may cause the clover stand to be reduced. Well-fertilized tall fescue or fescue and clover mixtures typically can carry 1.5 to 2 stockers (~600 lbs/stocker)/acre during the spring.

The amount and duration of the fall grazing season is temperature- and moisture-dependent. Additional N in early fall (40 lbs of N/acre) will allow the forage to take advantage of favorable growing conditions and produce good grazing from late September through November. During this period, well-managed fescue can carry up to 1.5 stockers (~600 lbs/stocker)/acre if growing conditions are favorable. Early fall N applications also can induce tall fescue to produce more tillers and form a denser sod. This will help prevent weed encroachment in the future.

With sufficient rainfall, a late summer application of 40 to 60 lbs of N/acre will produce 2,500 to 3,500 lbs of tall fescue that could be allowed accumulate and stockpiled for later grazing in late fall and early winter. Stockpiled tall fescue can sustain approximately 0.75 stockers (~600 lbs/stocker)/acre and can extend the grazing season well into late fall or early winter (Figure 4). For more information on stockpiling tall fescue, see the UGA Extension publication titled "Stockpiling Tall Fescue for Fall and Winter Grazing."

Grazing Management – Fescue pastures grow rapidly in the spring. Pastures should be stocked heavy enough to maintain high-quality forage. The ADGs of calves in a rotational grazing system may be similar to those in continuously stocked pastures. However, rotational grazing improves forage utilization and has been shown to increase animal gains per acre on tall fescue-based systems.

Rotational grazing also helps keep fescue plants vegetative in the spring. When cattle graze a fescue tiller that has started to produce a seedhead, the growing point is often removed. This prevents that tiller from producing a seedhead. Other tillers will then grow more rapidly, increasing forage production. Having several pastures allows the manager to focus the grazing pressure on smaller areas during periods of rapid pasture growth, keeps the fescue vegetative, and enables greater yields of digestible nutrients. Paddocks not needed for grazing can be set aside and harvested for hay. A stocking rate that is too low in late spring may not apply enough grazing pressure to keep up with the forage growth. As a result, forage quality may decline rapidly, especially once the plants begin to produce seedheads.

Avoid overgrazing in summer by adjusting stocking rates, providing supplemental feed, or transitioning to a warm season annual forage. This is especially important for endophyte-free and NE infected varieties since cattle will continue to graze these crops during the summer.

Warm Season Annual Forage Programs

Some warm season annual grasses can provide high yields of good quality forage for short periods during the summer (Table 1). Warm season annuals can work well in rotation with winter grazing crops and small grains harvested for grain or for use during tall fescue's summer dormancy. However, only a few warm season annual forages have the quality and yield required to sustain adequate stocker gains in Georgia. Furthermore, a 2009 analysis by forage agronomists and livestock economists at Auburn University found that warm season annual forage programs resulted in the second highest cost of gain ($1.35/lb of gain) of 37 forage systems evaluated. Consequently, it is important for stocker developers to ensure that the production costs associated with a warm season annual forage-based stockering program will be such that they can make the system profitable.

Warm Season Annual Forage Crops

Pearl Millet – Pearl millet is a warm season annual grass commonly used in Georgia. Dwarf millets, such as Tifleaf-3, have a higher percentage of leaves (fewer stems) and produce relatively high animal gains. Tifleaf-3 tends to yield well compared to the tall growing varieties and it is resistant to leaf spot diseases, which frequently reduce yield and forage quality in other pearl millets. Pearl millet is well adapted to sandy soils but will perform well throughout the state. Unlike sorghum-sudangrass hybrids and other members of the sorghum family, pearl millet does not cause prussic acid poisoning during periods of drought. Pearl millet yields quite well, even when subjected to drought or low soil pH. However, like all warm season annuals, nitrate accumulation in drought-stressed crops pose a significant risk to the health of ruminant animals that may graze them under such conditions.

Pearl millet can be grazed or harvested at any growth stage. To optimize forage quality, however, grazing of pearl millet should start when plants accumulate 20 to 24 inches of growth and stockers should be removed when 6 to 12 inches of stubble remain. These rotational stocking methods also promote good regrowth.

Research on the use of pearl millet for stocker development is limited. However, a few studies have demonstrated that ADGs of 1.4 to 2 lbs/day are possible. However, gains per acre vary widely with growth conditions, grazing management, condition of the animals, stocking rate, and the number of days in the grazing period. In general, a stocking rate of 2 to 2.5 stockers (~600 lbs/stocker)/acre over an 80- to 100-day grazing period should be anticipated if rotational stocking is used.

Sorghum-Sudangrass Hybrids – Crosses of sorghum and sudangrass have resulted in hybrids that are high yielding and high in forage quality. Sorghum-sudangrass hybrids are available that have the brown-midrib (BMR) trait. Varieties with the BMR trait have lower lignin levels, which can substantially increase the digestibility of

their forage. Sorghum-sudangrass hybrids are commonly used in Georgia, and the BMR hybrids are becoming more popular. However, none of the sorghum-sudangrass hybrids are as tolerant of high grazing pressure, low soil pH, or drought as pearl millet. The latter can pose a significant risk to stocker producers, since drought-stressed sorghum-sudan is not only at risk of toxic levels of nitrates but it may also contain toxic concentrations of prussic acid (cyanogenic compounds). Prussic acid problems are also problematic in the fall when the forage has been subjected to frost.

In general, forage systems based on sorghum-sudangrass will provide similar to slightly better ADGs than pearl millet-based forage systems. However, the maintenance of similar or higher gains/acre will require good growing conditions and excellent grazing management. Like pearl millet, a stocking rate of 2 to 2.5 stockers (~600 lbs/stocker)/acre and an 80- to 100-day grazing period should be anticipated if rotational stocking is used.

Crabgrass – Crabgrass is a warm season annual forage grass that is well adapted to the soils and climatic conditions in the humid Southeast. Though it is most widely known as a weed, it has excellent palatability and produces exceptionally high forage quality relative to other warm season annuals and warm season perennials. Another distinct advantage for crabgrass is that it readily reseeds itself each year as long as it is allowed to produce a seedhead and mature. Crabgrass yields are quite variable, as they are dependent on the selection of a well-drained site, soil fertility, and rainfall. Forage yields for crabgrass generally range between 1 and 5 tons/acre, but one should expect yields to be 3 to 4 tons/acre. These yields are slightly lower than those typical of other warm season annuals; thus, a stocking rate of ~ 1.5 stockers (~600 lbs/stocker)/acre should be expected. In trials in north Florida, stockers grazing crabgrass gained 1.1 to 1.9 lbs/head/day. Research from other states in the Southeast confirms that ADGs of 1.5 to 1.8 lbs/head/day can be expected. The length of the grazing period for crabgrass ranges from 60 to 120 days in the limited research that has been conducted. Additional research into stocker performance on crabgrass in Georgia is needed to determine best management practices and the economic viability of its use. However, it appears to have potential as a warm season annual forage crop for stocker development, especially if rotationally stocked.

Others – A number of other warm season annual forages are grown in Georgia, including forage sorghum, sudangrass, browntop millet, and teff. Either because of poor yields, low quality, a predisposition to nitrate accumulation, or grazing management problems, these forage crops are generally not useful in stocker development programs in Georgia and are not recommended.

Management Considerations for Warm Season Annual Stocker Pastures

Detailed recommendations for establishing and managing warm season annuals are available in other UGA Extension publications such as "Georgia Forages: Grass Species" and the fact sheet titled "Planting Warm Season Annual Grasses" (www.caes.uga.edu/commodities/fieldcrops/forages/documents/PlantingWarmSeasonAnnualGrasses.pdf). There are some slight variations on the recommendations for fertilizing and managing the grazing of warm season annuals that should be considered when they are to be used in a stocker development enterprise.

Planting – Pearl millet and sorghum-sudangrass hybrids should be planted into a moist, well-prepared seedbed to a depth of 1 inch. Seeding these forage crops in rows using a well-calibrated grain drill usually results in better stands than broadcast methods. Wider row spacings (e.g., 30 inches) will reduce damage from hoof traffic. However, narrow row spacings (less than 15 inches) will result in a better coverage of the soil and should be used when the site is prone to erosion. Planting rates when drilled or planted into rows are 10 to 15 lbs/acre for pearl millet and 15 to 20 lbs/acre for sorghum-sudangrass hybrids. Higher seeding rates are often used to increase the proportion of leaves to stems and to increase forage quality. However, this can result in lodging problems in the sorghum-sudangrass hybrids, especially if they contain the BMR trait. Broadcast plantings of these species can also be made, but may result in erratic stands with poor vigor. Since early planted stands will produce more forage than stands planted late, it is recommended that plantings be made in early April in south Georgia, mid-April in the Piedmont region, and late April to early May in the Limestone Valley/Mountains region.

In contrast, crabgrass should be planted at a depth of 0.25 to 0.5 inch in a well-prepared seedbed at a rate of 4 to 6 lbs/acre. It is best to plant crabgrass with a drill (7 to 7.5 inch spacing) or to use a cultipacking seeder (e.g.,

Brillion). Crabgrass seed can be broadcast, but it is best to mix the seed with coarse sand (similar in size to the seed). The sand acts as a carrier to increase the volume being broadcast and to improve the distribution and accuracy of the seeding rate. Crabgrass can be planted in spring after the danger of frost has passed.

Fertilization – Despite their tolerance to low fertility, it is critical to have a soil fertility program for warm season annual forages. For best results, these high-yielding grasses will need high levels of fertility. Soil test and apply the recommended quantities of lime, P, and K before planting. Though these crops are quite responsive to N, high rates of N in combination with dry weather may result in high nitrate levels in the forage. Split applications of N reduce this risk and even out forage production peaks. Apply 40 to 60 lbs of N/acre when these warm season annuals are planted (or soon thereafter) and an additional 40 to 60 lbs of N/acre every four weeks or when cattle are rotated to a fresh pasture. When warm season annual grasses are irrigated, nitrogen rates may need to be increased to 60 to 80 lbs of N/acre at planting and 60 to 80 lbs of N/acre prior to regrowth. Nitrogen applications after early August are not justified, as the forage produced thereafter will generally be low in quality and unpalatable.

Grazing Management – Warm season annual grasses can usually be grazed within 30 to 35 days after planting. Graze when the plants have reached the target height and remove them when the residual height approaches the target stubble height (detailed for individual crops above). Grazing warm season annuals is most efficient when cattle are rotated from paddocks that have been grazed to another paddock that is ready to graze. This allows the forage to regrow before being grazed again. Dividing large pastures into smaller units for rotational grazing will improve control over the utilization. Warm season annual grasses that are not regularly grazed will start reproductive growth (heading). If this occurs, mowing the pasture to the target stubble height (see above) may stimulate vegetative growth.

The most difficult challenge when using pearl millet or sorghum-sudangrass hybrids is that they generally produce forage over a relatively short grazing period (usually less than 120 days), and the majority of this forage is produced in the first 60 to 75 days after planting. This can make grazing management of these stands challenging. Under good growing conditions, these warm season annuals may grow so rapidly that sufficient grazing pressure is difficult to maintain. This is especially problematic in the first 15 to 30 days after grazing begins. The consequence of this is that the forage may mature very quickly and result in poor quality forage. To minimize this effect, be prepared to initiate grazing earlier or stock more heavily.

The rapid growth of these species in the first half of the growing season can also result in poor forage distribution throughout the grazing period. Cattlemen who plan to utilize pearl millet or sorghum-sudangrass hybrids for grazing throughout the summer should plan to make more than one planting. Staggering plantings by two to three weeks can help distribute the forage growth. However, staggering plantings later than mid- to late May is unlikely to substantially improve forage distribution and may severely reduce total forage productivity. Stocking rates may start higher early in the season and may need to be reduced as forage growth and/or quality declines. With irrigation and higher rates of fertilization, stocking rates can be increased.

Warm Season Perennial Forage Programs

Warm season perennial forage crops are widely used throughout Georgia for grazing and hay production. In general, the most common warm season perennials are bermudagrass and bahiagrass. Bermudagrass is productive from spring until fall and responds well to fertilization and harvest (grazing or haying) management. Though the forage quality of bermudagrass is generally lower than cool season species, it can be highly digestible and high in crude protein when kept vegetative (Table 1). Bahiagrass productivity is less tied to fertility and more tolerant of overgrazing, but it is typically less productive and lower in forage quality than bermudagrass. With bahiagrass, the forage quality is not sufficient to attain an ADG of 1.5 or greater (Table 6) without substantial supplemental feed. Some bermudagrass varieties can achieve this goal, but a supplemental feeding program may be necessary to ensure that this goal is consistently achieved while maintaining high stocking rates.

Table 6. Stocker performance on 'Pensacola' bahiagrass and preferred bermudagrass varieties in selected research trials in the Coastal Plain.

	State	ADG (lbs/hd/d)	Gain (lb/acre)	Stocking Rate (hd/acre)	Grazing Period (days)
Pensacola (bahia)	GA[1]	1.0	222	1.5	131
Coastal	GA[1]	1.1	331	2.5	131
Coastal	TX[2]	1.0	279	3.0	92
Coastal	GA[3]	1.5	641	2.5	168
Tifton 44	GA[3]	1.6	681	2.5	168
Tifton 78	GA[4]	1.4	704	3.2	169
Tifton 85	GA[4]	1.5	1032	4.4	169
Tifton 85	TX[2]	1.7	465	3.0	92

[1] Utley et al., 1974. J. Anim. Sci. 38:490-495.
[2] Rouquette et al., 2003. Beef Cattle Research in Tx. pp. 62-66.
[3] Utley et al., 1981. J. Anim. Sci. 52:725-728.
[4] Hill et al., 1993. J. Anim. Sci. 71:3219-3225.

Warm Season Perennial Forage Crops

Hybrid Bermudagrass – Because of their high yield potential and, in some cases, increased digestibility, cattlemen grazing stockers should consider the use of hybrid bermudagrass as their primary basis in their warm season perennial forage system. Many years of selection, breeding, and research have led to the release of several hybrid bermudagrass varieties. However, only a few of these have been shown to consistently provide high yields, increased digestibility, and improved animal gains in university research and on-farm trials (Table 6).

The best of the hybrid bermudagrass varieties for stocker development is 'Tifton 85' (Table 6). Tifton 85 has been shown to produce the highest yield, digestibility, ADG, stocking rate, and gain per acre of any of the forage bermudagrasses. Tifton 85 is clearly the best choice for new pastures for cattlemen in the Coastal Plain. Unfortunately, Tifton 85 lacks the cold tolerance of some hybrid bermudagrasses. Thus, it is not recommended for latitudes in Georgia north of approximately 32° N (roughly south of Interstate 20) until longer-term cold tolerance assessments can be made. Other hybrid bermudagrasses, such as 'Tifton 44,' 'Russell,' 'Tifton 78,' and 'Coastal,' are used in cow-calf production systems in Georgia and can also be used in stocker development systems. However, substantially more supplemental feeding will be necessary (relative to that on Tifton 85 pastures) to attain satisfactory ADG, stocking rate, and gain per acre of stockers grazing these other varieties. More detailed information on bermudagrass varieties can be found in the UGA Extension publication titled "Selecting a Forage Bermudagrass Variety."

Bahiagrass – Since bahiagrass is adapted to a wide range of soils in the Coastal Plain region and persists well under the hot, dry summers of the Southeastern U.S., bahiagrass is a common pasture species in the southern half of Georgia. However, it will not consistently support the stocking rate and live-weight gains per acre that hybrid bermudagrasses can provide. Even improved bahiagrass hybrids produce lower yield, digestibility, ADG, stocking rate, and gain per acre than most bermudagrass varieties. Consequently, the rate of supplemental feed required to attain satisfactory ADG, stocking rate, and gain per acre usually makes stocker development programs on bahiagrass unprofitable. As a result, bahiagrass is not recommended as a forage system for stocker development.

Management Considerations for Warm Season Perennial Stocker Pastures

Since bahiagrass is not recommended for stocker pastures, the following recommendations focus on the management of bermudagrass in the context of a stocker development program. Detailed recommendations for establishing and managing bermudagrass can be found in the UGA Extension publication titled "Georgia Forages: Grass Species." However, there are some slight variations in the best practices for establishing, fertilizing, and managing bermudagrass that should be considered when it is used in a stocker development enterprise.

Planting – New bermudagrass plantings require several months to become well established. Grazing while

attempting to get the bermudagrass to establish will severely reduce the speed at which the stand completely closes. If a new field is to be planted, it should be established for one year before the stocker program begins. Some grazing can be used later in the grow-in period as an alternative to mowing to remove excess forage and encourage thickening of the stand.

If a stocker program is planned, establishment of hybrid bermudagrasses is best accomplished by transplanting freshly-dug sprigs (rhizomes or stolons dug from existing stands) in May or early June. Though bermudagrass can be successfully established at other times, mid-spring plantings generally take advantage of better rainfall distribution and allow the bermudagrass to compete better with summer weeds. The application of diuron immediately after sprigging is recommended, as it provides excellent suppression of summer weeds during the early stages of bermudagrass establishment. However, diuron-treated fields cannot be grazed (or harvested for hay) within 70 days of application.

Fertilization – Soils in individual pastures should be tested every two to three years and recommended rates of lime and fertilizer should be applied. This is essential to maintaining high-yielding, productive stands. Bermudagrass responds well to high rates of N, but 150 to 200 lbs of N/acre is generally sufficient when grazed. Higher rates are appropriate if the stocking rate and the intensity of grazing management are high enough to utilize the forage produced. It is best to apply N in late March or early April (60 to 80 lbs/A) to stimulate new growth, and split the remaining N between two additional applications (one in late spring and one in mid-summer). When pastures are intensively managed, N and K should be applied about every four to five weeks from spring until late summer (March to August). Splitting the N and K fertilizer applications in this way will improve utilization of these important nutrients.

Grazing Management – Some bermudagrass varieties break dormancy and initiate new growth as early as mid-March in south Georgia and early April in north Georgia. However, grazing pressure should be avoided or kept low until the bermudagrass reaches a height of at least 4 inches and the forage is growing rapidly (usually after nighttime temperatures are consistently above 55° F).

Bermudagrass productivity, stand persistence, and forage quality are directly related to the height at which bermudagrass grazing begins and the residual height that remains after grazing. Because of this, it is best to initiate grazing when the forage reaches 8 to 10 inches in height and avoid grazing bermudagrass shorter than 2.5 to 3 inches. Maintaining these initial and residual grazing heights will optimize the amount of high-quality forage that is available and the rate of forage intake. This may require that the bermudagrass be given longer rest periods in periods of slow growth and shorter rest periods during periods of rapid growth.

Since the growth rate is not uniform throughout the season, the correct stocking rate one week may be too heavy or too light the next week. Varying the stocking rate from week to week is a good way to manage pasture growth. This will be difficult unless extra animals are added to the pastures over time. As a result, most cattlemen tend to stock lighter (slightly fewer head/acre) and allow some forage to accumulate in the pasture as a buffer against slow growth due to dry weather. Accumulated forage can also be cut for hay or, later in the season, stockpiled for deferred grazing as an alternative to feeding hay to a brood cow herd once the bermudagrass goes dormant. This is a reasonable approach when a rotational grazing program is used to help improve forage utilization.

Related Publications

Cutting Costs, Not Corners: Managing Cattle in Tough Times. University of Georgia Extension Bulletin 1373.

Fences for the Farm. University of Georgia Extension Circular 774.

Georgia Forages: Grass Species. University of Georgia Extension Bulletin 1351.

Georgia Forages: Legume Species. University of Georgia Extension Bulletin 1347.

Grazing Impacts on Pasture Composition. University of Georgia Extension Bulletin 1243.

Leaf Spot Diagnosis and Management in Bermudagrass Forages. University of Georgia Extension Circular 887.

Planting Guide to Grasses and Legumes for Forage and Wildlife in Georgia. University of Georgia Extension Circular 814.

Selecting a Forage Bermudagrass Variety. University of Georgia Extension Circular 919.

Soil and Fertilizer Management Considerations for Forage Systems in Georgia. University of Georgia Extension Bulletin 1346.

Stockpiling Tall Fescue for Fall and Winter Grazing. University of Georgia Extension Circular 920.

UGA Basic Balancer Instructions. University of Georgia Extension Bulletin 1371.

UGA Feed Cost Analyzer. University of Georgia Extension Bulletin 1377.

White Clover Establishment and Management Guide. University of Georgia Extension Bulletin 1251.

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ALABAMA A&M AND AUBURN UNIVERSITIES

Stocker Cattle

Performance and Calculated Pasture Costs

ALABAMA COOPERATIVE Extension SYSTEM
Alabama A&M and Auburn Universities

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ALABAMA A&M AND AUBURN UNIVERSITIES

Stocker Cattle

Performance and Calculated Pasture Costs

ALABAMA COOPERATIVE EXTENSION SYSTEM

Most livestock producers know, or can easily determine, which forage species and varieties are suited for land they have available for pasture. However, before choosing the one or ones to be grown, it is critically important to understand the level of animal performance expected from those forages and the cost of that production. Given the recent volatility in production input prices, this is more important than ever.

Many grazing experiments have provided stocker cattle performance data on various forage species. However, because of the expense of conducting grazing research, it is rare to see animal performance comparisons on more than two or three species or species mixtures at a time. Thus, it is difficult for livestock producers to obtain an overall view of the relative productivity of various forages.

This publication provides a comparison of stocker cattle performance criteria from several selected steer grazing experiments conducted in Alabama. It also provides pasture cost/acre and pasture cost/pound of gain information for the forage crops used in these tests, based on 2008 Auburn University enterprise budgets. Collectively, these data provide an interesting and useful comparison of many of the forage crops commonly used in the Southeast.

Studies Selected for Comparison

Auburn University scientists have conducted numerous steer grazing experiments that have involved various forage species. These studies have generally involved crossbred animals of similar breeding and weights, and they were conducted over multiple years. They provide a good basis for comparison of both the animal production potential and the production cost of various forage species commonly used in Alabama.

An early test at the Wiregrass Substation (WG) near Headland evaluated steer performance at four nitrogen levels on 'Coastal' bermudagrass and at three levels each on both 'Pensacola' bahiagrass and common

bermudagrass. A later study at the Tennessee Valley Substation (TVS) near Belle Mina compared bermudagrass interseeded with either hairy vetch or 'Explorer' rye.

At the Black Belt Substation (BBS) near Marion Junction, the tall fescue varieties 'AU Triumph' (0 percent toxic fungal endophyte) and 'Kentucky 31' tall fescue (having approximately 1, 34, or 90 percent toxic endophyte) were compared. In another study, 'Kentucky 31' pastures having approximately 5 percent toxic endophyte and 94 percent toxic endophyte were tested. Also at that station, highly toxic endophyte-infected 'Kentucky 31' fescue and "AP-2," an experimental line of hardinggrass (*Phalaris*), were evaluated.

In addition, toxic endophyte-infected tall fescue was grazed in pure stands as well as with either ladino clover or birdsfoot trefoil at the Sand Mountain Substation (SMS) near Crossville. Steer gains on an orchardgrass-ladino clover mixture were obtained in a test at TVS. In another study at TVS, toxic endophyte 'Kentucky 31' tall fescue and common orchardgrass (both grown with and without 'Regal' white clover) were evaluated.

Continuously grazed 'AU Lotan' sericea lespedeza was tested against rotationally grazed 'AU Lotan' sericea, 'Serala' sericea, and 'Cimarron' alfalfa at the Upper Coastal Plain Substation (UCP) near Winfield. At TVS, 'Funk's 78F' sorghum-sudan was evaluated. Various winter annual mixtures including rye, oats, ryegrass, and crimson clover were tested at the Lower Coastal Plain Substation (LCP) near Camden.

Procedure

To get a clearer view of the performance of stocker cattle on forages, performance criteria for stocker steers grazing the 37 different pasture treatments used in these Auburn University grazing studies were summarized from various research reports and articles. These experimental results provide a basis for comparison of animal performance among the treatments (table 1).

Subsequently, Auburn University 2008 budget estimates for the various forage species or species mixtures involved in these studies were used to determine both the approximate pasture costs/acre and the pasture costs/lb of gain. This information, also in table 1, provides a basis for economic comparison. The ranking (least to most expensive) of variable and total pasture cost of gain for each forage species is also provided.

Animal Performance Comparisons

As expected, the animal performance reported in these experiments varied greatly among the various pasture species or mixtures. The number of calendar grazing days ranged from a low of 77 for sorghum-sudan at TVS to a high of 238 for an orchardgrass-white clover mixture, also at TVS.

The variation in calendar grazing days was greater among cool-season species and mixtures than it was among warm-season species. In comparisons of these studies, neither endophyte status nor presence of a legume companion species seemed to affect the number of grazing days obtained from pasture treatments involving tall fescue (although legumes can lengthen the grazing season in some situations).

High per-day gains (1.7 pounds or more) were obtained with alfalfa, continuously grazed 'AU Lotan' sericea lespedeza, tall fescue having low or medium endophyte infection, common orchardgrass, hardinggrass, orchardgrass with ladino clover, and tall fescue with ladino clover. In several cases in which ADG was high, a relatively short grazing season reduced gain per steer. In other cases, a lower ADG coupled with a long grazing season resulted in impressive gains per steer. It should be noted that winter annuals often produce higher individual animal gains than were obtained in the experiments selected for this exercise.

Table 1. Production and Economic Performance Data for Stocker Steers Using Various Forage Types and Varieties[a]

Description	Item no.	Pasture	Line or variety	Calendar days grazing	Average grazing dates	Years of data	Location[b]
Warm-Season Perennial Grasses (WSPG)	1	Bermudagrass	Coastal	168	NS[g]	4	WG
	2	Bermudagrass	Coastal	168	NS	4	WG
	3	Bermudagrass	Coastal	168	NS	4	WG
	4	Bermudagrass	Coastal	168	NS	4	WG
	5	Bahiagrass	Pensacola	168	NS	3	WG
	6	Bahiagrass	Pensacola	168	NS	3	WG
	7	Bahiagrass	Pensacola	168	NS	3	WG
	8	Bermudagrass	Common	168	NS	3	WG
	9	Bermudagrass	Common	168	NS	3	WG
	10	Bermudagrass	Common	168	NS	3	WG
WSPG W/Winter Annuals	11	Bermudagrass w/vetch	Coastal/Hairy	161	4/4 –9/27	8	TVS
	12	Bermudagrass w/rye	Coastal/Explorer	161	3/19–9/27	8	TVS
Summer Annuals	13	Sorghum-Sudan	Funks 78-F	77	6/6–8/22	3	TVS
Perennial Legumes	14	Alfalfa[h]	Cimarron	163	3/30–9/8	3	UCP
	15	Sericea Lespedeza[h]	Serala	139	4/22–9/8	3	UCP
	16	Sericea Lespedeza[h]	AU Lotan	139	4/22–9/8	3	UCP
	17	Sericea Lespedeza	AU Lotan	139	4/22–9/8	3	UCP
Cool-Season Perennial Grasses	18	Tall Fescue[i]	AU Triumph (0%)	161	10/5–12/26 & 2/28–5/27	3	BB
	19	Tall Fescue	KY 31 (1%)	161	10/5–12/26 & 2/28–5/27	3	BB
	20	Tall Fescue	KY 31 (34%)	161	10/5–12/26 & 2/28–5/27	3	BB
	21	Tall Fescue	KY 31 (90%)	161	10/5–12/26 & 2/28–5/27	3	BB
	22	Tall Fescue	KY 31(<5%)	172	10/23–12/24 & 2/26–6/16	4	BB
	23	Tall Fescue	KY 31 (94%)	172	10/23–12/24 & 2/26–6/16	4	BB
	24	Tall Fescue	KY 31 (>90%)	150	3/18–7/9 & 9/25–11/22	8	TVS
	25	Orchardgrass	Common	139	3/23–7/9 & 9/25–11/11	8	TVS
	26	Tall Fescue	KY 31 (0%)	177	10/17–12/26 & 3/7–5/19	3	BB
	27	Hardinggrass	AP-2	177	10/17–12/26 & 3/7–6/19	3	BB
	28	Tall Fescue	KY 31 (>90%)	206	10/15–1/15 & 3/15–7/19	2	SM
Cool-Season Perennial Grasses w/ Legumes	29	Orchardgrass w/Ladino	Hallmark/Regal	238	9/5–12/5 & 4/1–8/27	2	TVS
	30	Tall Fescue W/Ladino	KY 31/Regal	143	3/18–7/9 & 9/25–11/15	8	TVS
	31	Orchardgrass w/Ladino	Common/Regal	143	3/23–7/9 & 9/25–11/15	8	TVS
	32	Tall Fescue w/Ladino	KY 31/Regal	205	10/15–1/15 & 3/15–7/19	2	SM
	33	Tall Fescue w/Birdsfoot	KY 31/Fergus	194	10/15–1/15 & 3/15–7/19	2	SM
Winter Annuals	34	Rye, Oats & Crm. Clover[j]	NS	121	10/18 – 5/2	2	TVS
	35	Rye & Ryegrass[k]	NS	153	10/24–5/15	7	TVS
	36	Rye, Ryegrass & Crm Clover	NS	177	10/6–5/2	6	BB
	37	Oats & Crm Clover	NS	201	10/29–5/18	2	BB

[a]Data complied from AAES reports (see references). The majority of steers were crossbred with an initial weight of approximately 500 pounds.

[b]WG = Wiregrass; TVS = Tennessee Valley Station; UCP = Upper Coastal Plains; BB = Black Belt; SM = Sand Mountain

[c]Put-and-take grazing was employed in most of these tests, which precludes calculation of figures in this column from other data presented. For example, if you multiply Gain Per Steer times the Stocking Rate, the number does not necessarily equal Gain/Acre as it normally would.

[d]Variable costs (2008 estimates) include annual maintenance items such as fertilizer, mowing, etc. (excluding labor).

[e]Total costs (2008 estimates) include variable items plus fixed costs associated with establishment and ownership of machinery and equipment.

The ten lowest pasture costs/lb of gain are highlighted.

Table 1. (continued)

Item no.	Nitrogen rate	Stocking rate	Average daily gain[c]	Gain/ Acre[c]	Gain per steer[c]	Variable pasture costs[d]	Total pasture costs[e]	Variable pasture cost		Total pasture post	
								$/lb	Ranking[f]	$/lb	Ranking[f]
	Lb/A/Yr	Head/A	Lb/Head	Lb/A	Lb/Head	$/A	$/A	$/Lb		$/Lb	
1	0	1.40	NS	250	179	26.59	50.04	0.47	8	0.69	14
2	80	1.70	NS	340	200	50.22	75.32	0.54	14	0.71	17
3	160	2.60	NS	480	185	73.85	100.61	0.59	18	0.65	11
4	320	3.50	NS	620	177	121.11	151.18	0.60	19	0.73	18
5	0	1.20	NS	220	183	26.59	43.94	0.54	15	0.73	20
6	80	1.80	NS	290	161	50.22	69.22	0.63	22	0.80	24
7	160	2.00	NS	350	175	73.85	94.51	0.70	26	0.86	28
8	0	0.70	NS	100	143	26.59	43.83	1.18	35	1.33	35
9	80	1.40	NS	230	164	50.22	69.12	0.79	31	0.88	29
10	160	1.80	NS	300	167	73.85	94.40	0.82	32	0.90	30
11	0	2.26	1.29	493	218	47.46	73.05	0.35	5	0.47	4
12	150	2.45	1.30	530	216	94.89	123.81	0.49	9	0.62	9
13	100	2.80	1.10	210	84	78.96	93.89	1.18	36	1.35	36
14	0	1.30	2.16	475	352	51.49	131.51	0.51	10	0.91	31
15	0	1.30	1.39	248	193	21.49	37.54	0.42	7	0.60	7
16	0	1.20	1.65	276	229	21.49	37.54	0.37	6	0.54	6
17	0	1.20	1.87	306	260	21.49	37.54	0.34	4	0.49	5
18	200	1.54	2.09	519	336	89.85	112.01	0.55	17	0.65	12
19	200	1.32	2.16	462	348	89.85	112.01	0.61	21	0.73	19
20	200	1.40	1.76	397	283	89.85	111.44	0.71	28	0.85	26
21	200	1.77	1.41	370	227	89.85	111.44	0.77	30	0.91	32
22	200	1.32	1.82	426	323	89.85	112.01	0.67	25	0.79	23
23	200	1.73	1.00	301	174	89.85	111.44	0.94	34	1.12	34
24	150	2.13	1.31	268	126	75.08	95.64	0.91	33	1.11	33
25	150	1.27	1.77	200	157	75.08	97.00	1.22	37	1.49	37
26	200	1.40	1.78	434	310	89.85	112.01	0.65	23	0.78	21
27	200	1.26	1.73	347	275	89.85	112.86	0.70	27	0.85	27
28	150	1.76	1.06	374	218	75.08	95.64	0.65	24	0.79	22
29	0	1.97	1.62	576	292	38.83	58.85	0.22	2	0.30	2
30	0	1.81	1.46	244	135	38.83	57.49	0.52	12	0.71	16
31	0	1.46	1.83	244	167	38.83	58.85	0.52	12	0.71	15
32	0	1.63	1.53	582	314	38.83	57.49	0.22	1	0.30	1
33	0	1.24	1.51	398	293	57.43	77.40	0.32	3	0.44	3
34	130	2.00	1.37	544	272	97.07	111.50	0.59	18	0.65	10
35	130	1.86	1.36	528	278	91.71	105.77	0.54	16	0.60	8
36	100	1.31	1.57	364	278	94.85	109.13	0.76	29	0.85	25
37	100	1.38	1.60	443	321	86.04	99.70	0.61	20	0.68	13

[f]Ranking Based on lowest to highest; fractional differences not shown allowed separation of treatments rounded to the same cost/lb.
[g]NS = Not Specified.
[h]Rotationally grazed.
[i]Tall fescue varieties, where indicated, are identified by percentage of endophyte infestation.
[j]Average of 78 days of grazing; dates not specified.
[k]Average of 52 days of grazing; dates not specified

The gain per acre was at least 475 pounds on ten of the pasture treatments. These were alfalfa, 'Coastal' bermudagrass receiving at least 160 pounds of nitrogen per acre, 'Coastal' bermudagrass overseeded with vetch or rye, endophyte-free 'AU Triumph' tall fescue, endophyte-infected tall fescue-white clover (SM), 'Hallmark' orchardgrass-white clover, and with two of the four winter annual mixtures. The lowest gain per acre (100 pounds) was obtained on common bermudagrass receiving no nitrogen fertilizer.

Notable Points Revealed

- The seven lowest total pasture costs/lb of gain and eight of the ten lowest total pasture costs/lb of gain involved legumes (Table 2).
- The range of total pasture costs/lb of gain (lowest to highest) is much broader than it was in the early 1990's when a similar exercise (calculating pasture costs using this data) was conducted. This provides evidence that as input costs increase, producers need to be increasingly focused on costs and returns to guide their decisions.
- Forage yield is an important economic factor, as evidenced by the fact that in the Wiregrass test, total pasture costs/lb of gain for 'Coastal' bermudagrass were less than for bahiagrass, and those for bahiagrass were less than for common bermudagrass. The forage quality of these three is similar, so the primary difference in pasture cost/lb of gain was forage production/acre. Data from this test also indicate that application of nitrogen is a more cost efficient practice (results in more dry matter production/lb of N applied) on some forages than on others.
- Coastal bermudagrass overseeded with vetch was a significantly lower-cost treatment than any of the other warm-season perennial grass treatments, which suggests that overseeding a legume can be a cost effective practice.
- Use of a sorghum/sudangrass hybrid was a very expensive option. Both average daily gain and calendar days of grazing provided by this grass were low compared to most other treatments.
- In general, the higher the percentage infection by toxic endophyte in tall fescue, the more costly the gains. For example, among treatments at the Black Belt the total pasture cost/lb of gain was almost double ($1.12/lb vs $0.65/lb) in the high versus low endophyte treatments.
- Adding legumes to either tall fescue or orchardgrass substantially lowered pasture cost/lb of gain. In fact, this management practice resulted in the lowest three pasture costs/lb of gain of the 37 forage alternatives evaluated.
- It appears that both improved forage quality and reduction of the amount of fertilizer nitrogen used were factors in substantially lowering total pasture cost/lb of gain when forage legumes were included in pastures for stocker cattle. An important concept is that stocker cattle producers who are able to increase animal performance via providing higher quality pasture and/or who are able to lower fertilizer inputs (with legumes or by other means) can achieve lower pasture costs/acre and lower costs/lb of gain.
- Of the 37 forage treatments, only five treatments had less than a $0.50 total cost/lb of gain. Careful assessment of performance and pasture cost/lb of gain are the crux of sound pasture decisions.

Table 2. Ten Lowest Calculated Pasture Costs/lb of Gain

Pasture type	Line or variety	Grazing days	Grazing dates	ADG	Pasture cost/Ac	Pasture cost/lb
Tall Fescue w/Ladino	'KY 31'/ 'Regal'	205	10/15–1/15 & 3/15–7/19	1.53	$172.26	$0.30
Orchardgrass w/Ladino	'Hallmark'/ 'Regal'	238	9/5–12/5 & 3/15–7/20	1.62	$172.08	$0.30
Tall Fescue w/Birdsfoot	'KY 31'/ 'Fergus'	194	10/15–1/15 & 3/15–7/20	1.51	$173.28	$0.44
Bermudagrass w/Vetch	'Coastal'/ Hairy	161	4/4–9/27	1.29	$230.75	$0.47
Sericea Lespedeza	'AU Lotan'	139	4/22–9/8	1.87	$148.84	$0.49
Sericea Lespedeza	'AU Lotan'	139	4/22–9/8	1.65	$148.84	$0.54
Sericea Lespedeza	'Serala'	139	4/22–9/8	1.39	$148.84	$0.60
Rye & Ryegrass	NS*	153	10/24–5/15	1.36	$318.34	$0.60
Bermudagrass w/Rye	'Coastal'/ 'Explorer'	161	3/19–9/27	1.30	$328.35	$0.62
Rye, Oats & Crim. Clover	NS*	121	10/18–5/2	1.37	$352.78	$0.65

*NS = None Stated

Other Factors to Consider

Various types and classes of livestock have different nutritional requirements. The data summarized in this publication pertain to stocker-steer tests. Nonetheless, this data has some relevance to other types of livestock operations, as it should facilitate obtaining a better understanding of the relative level and duration of nutrition provided by these forage species and mixtures.

The data summarized here are from multiple-year experiments at various locations and under environmental conditions unique to the years during which the studies were conducted. While valuable for the purpose of making general comparisons, any of various animal or plant factors can influence such results.

Pasture cost values provided were **calculated** assuming the application of recommended management practices with commercially purchased inputs as reflected in 2008 Auburn University forage crop budgets. In addition, although pasture cost/lb of gain is an important measure of production efficiency, it is not the only factor that affects profit. In particular, pasture cost/lb of gain does not take into consideration seasonal price fluctuations (buy-sell relationships) or other expenses associated with owning animals over time.

In addition, animal management and marketing costs should always be considered when evaluating forage and livestock systems. For example, the pasture costs/lb of gain for some of the warm-season perennial grass treatments are relatively low. In most years, however, few stocker cattle operations are in this circumstance because of unfavorable buy-sell price margins during this time of year. In addition, greater production and marketing risks are associated with higher stocking rates and higher nitrogen fertilization levels required for high per-acre gains with warm-season perennial forage species. Also, the market for animals coming off warm-season species is usually poorer than for animals coming off cool-season species. As a result, summer stocker programs are usually difficult to justify.

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ALABAMA COOPERATIVE Extension SYSTEM

ANR-1348

Don Ball, *Extension Agronomist,* Professor, Agronomy and Soils, and **Walt Prevatt,** *Extension Economist,* Professor, Agricultural Economics and Rural Sociology, both at Auburn University

For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

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UNIVERSITY OF GEORGIA
EXTENSION

GRASS

Meeting Evaluation:
2018 Cattlemen's Forage Conference

Return to Dr. Dennis Hancock, Forage Extension Specialist

Overall, how helpful was this meeting? (Check ONE).

- ☐ I plan to make some major changes.
- ☐ I might try a few things differently.
- ☐ Got me thinking, but that's about all.
- ☐ Total waste of time.

During this training, what percentage of the time were you saying to yourself…?

I knew that already! (i.e., it was too simple).	
That was new to me and I understood the idea!	
You lost me on that! (i.e., that was over my head)	
Must Total	**100**

In general, how do you rate the content of this training? (Circle a number)

Better than I expected	5	4	3	2	1	Not as good as I expected
Good style & delivery	5	4	3	2	1	Poor presentation style & delivery
Well-organized	5	4	3	2	1	Totally unorganized
Too much information	5	4	3	2	1	Too little information

How likely is it that you would recommend our program to a friend or colleague? (Circle a number)

Extremely likely	10	9	8	7	6	5	4	3	2	1	Not at all likely

How did this workshop change… (Circle a number)

Your knowledge?	Greatly Improved	5	4	3	2	1	No change
Your interest in this topic?	Greatly Improved	5	4	3	2	1	No change
Your confidence in using these skills?	Greatly Improved	5	4	3	2	1	No change

As a result of this meeting, what do you plan to do differently in your operation? How has this workshop helped you?

(Please do the Second Page, too!)

Please rate the effectiveness of each of the instruction modules and activities.

Module/Activity	Excellent	Very Good	Good	Fair	Poor
Balancing calf performance while maximizing profit per acre	5	4	3	2	1
Management strategies for intensive, sustainable beef cattle production on bermudagrass	5	4	3	2	1
Management strategies for intensive, sustainable beef cattle production on tall fescue and winter annuals	5	4	3	2	1
Long-term impacts of fertilization and stocking rate decisions on soil fertility	5	4	3	2	1
Interseeding alfalfa into bermudagrass to reduce N costs, increase yields, and decrease supplementation needs	5	4	3	2	1
Benefits and limitations to replacing commercial N with legumes in bermudagrass-based pastures	5	4	3	2	1
Benefits and limitations to replacing commercial N with legumes in cool season grass-based pastures	5	4	3	2	1

This event has been a very successful annual program and we like to provide varying topics. However, we need your input on the most pressing issues that you face.

Please list three forage-related topics that you'd like to see addressed at next year's program.
1)

2)

3)

What should we have done differently to make this program more helpful/informative?

Additional Comments:

Thanks for Coming!