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

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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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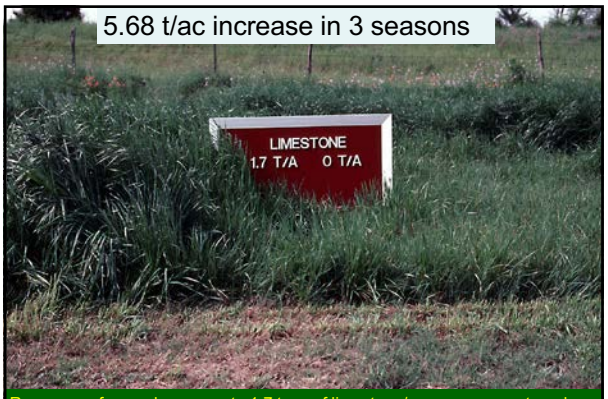

Response of annual ryegrass to 1.7 tons of limestone/acre on a very strongly acid Lilbert loamy fine sand (pH_w 4.5) compared to zero limestone on the Coastal Plain of the East Texas Timberlands.

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

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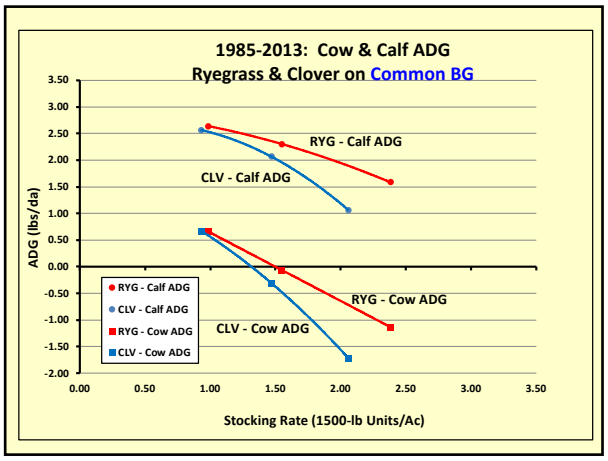

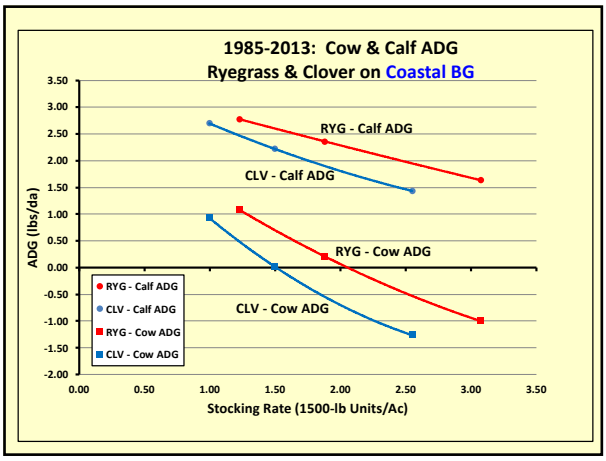

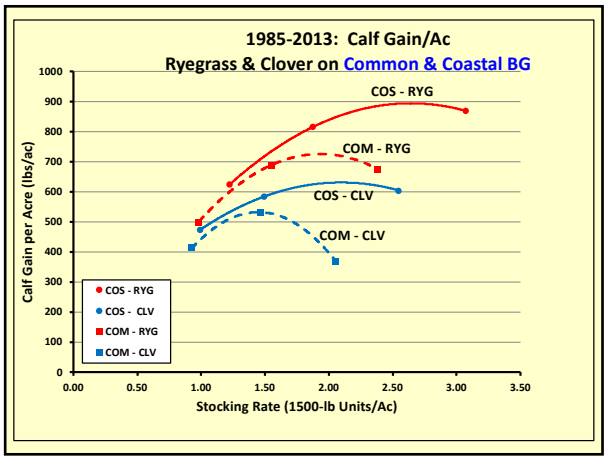

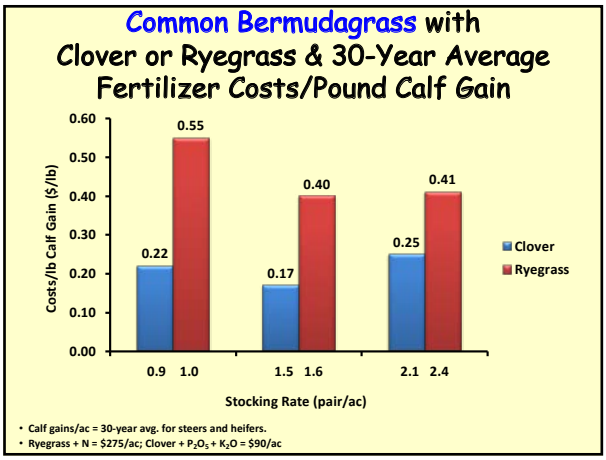

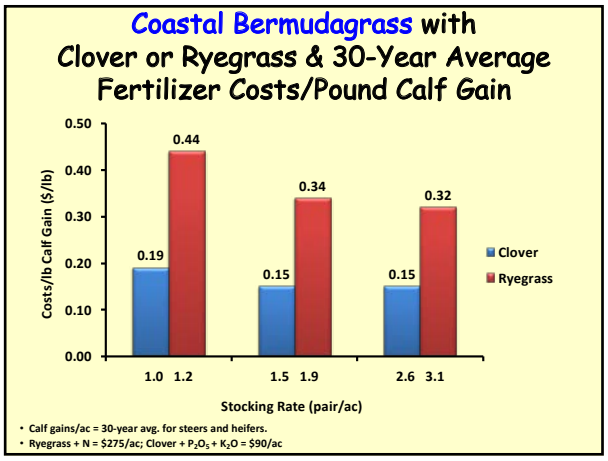

Impact of Long-Term Stocking Rates & Fertility Regimens on Stand-Maintenance, Genetic Diversity, & Sustainability of Bermudagrass Pastures

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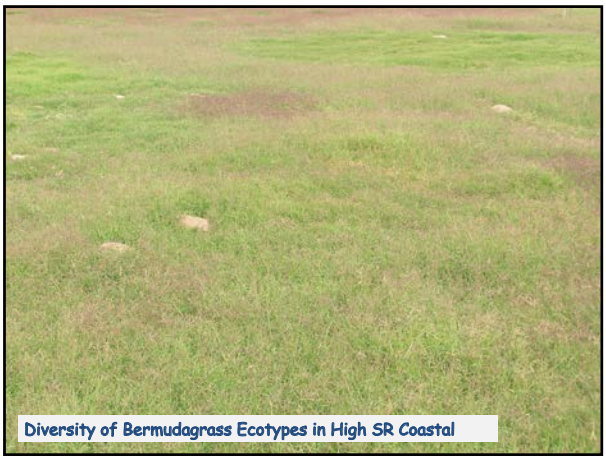
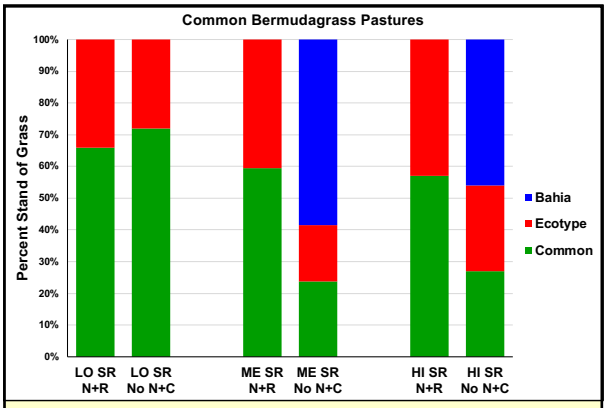
Soil Organic C and N in Pastures

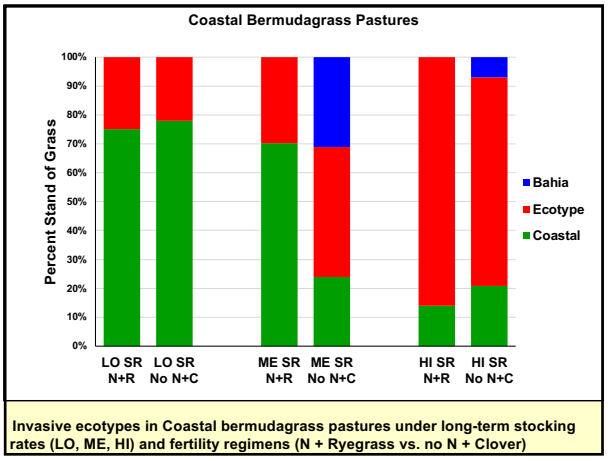
- Increase in SOC and SON 32 yrs after establishment of bermudagrass
- Grazing Strategies affected C & N Sequestration
  - Low Stocking Rate > High Stocking Rate
  - N + Ryegrass > no N + Clover

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.....

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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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