Spring Forage Conference
Proceedings - Day Two

February 24, 2021

Utilizing cattle to graze a milo grain crop, eliminates the mechanical harvest expense of combining while providing an energy-rich diet for the cattle through the winter feeding season. This system of daily paddock allocations of the mature grain achieves carrying capacities greater than 400 cow days to the acre, and a feeding expense of less than $0.60 per cow per day. This creates a savings to the cattle producer approaching $1 per day per head. An unconventional approach for certain, but the significant cost savings has producers continuing with this system year after year.

1

Cost of Hay?

$60-80 per ton

2

Fertilizer Value Estimation for Hay Feeding Excellent Nutrient Distribution				
	Price ($/unit)	lbs per Ton Hay	% Effective as Fertilizer	**Nutrient Value /Ton**
Nitrogen	**$0.40**	**35**	**75%**	**$10.50**
P_2O_5	**$0.30**	**12**	**75%**	**$2.70**
K_2O	**$0.30**	**53**	**75%**	**$11.93**
Total				***$25.13***

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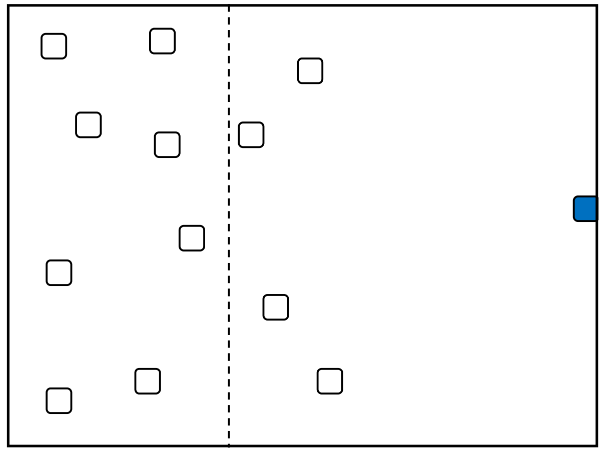

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Bale Grazing Requirements

1) Advanced planning
2) Strength to roll/flip hayring
3) Cattle trained to electric
4) Healthy sod

10

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Nutrient Value per Acre by Bale Grazing Densities

Bale Grazing Density	N	P_2O_5	K_2O	Organic Matter
Low (2 tons/acre)	35	18	80	???
Medium (4 tons/acre)	70	36	159	???
High (6 tons/acre)	105	54	239	???

Note: Assumes 75% of P and K and 50% of N in hay are effectively utilized.

13

14

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Seeding Mix Recommendation

- Chicory
- Plantain
- Italian Ryegrass
- Annual Lespedeza
- Clovers
- Orchardgrass

17

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How would the Labor and Machinery Cost Compare?

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23

Jungnitsch Research

Bale Grazing vs. Dry-Lot:

- Bale-grazing directly pasture
- Dry-lot Manure spread pasture

Paul Jungnitsch, 2008 University of Saskatchewan Master's Thesis

24

Forage Response Two Years		
	lbs / acre	*% Inc.*
Control	2098	**--**
Dry Lot - Spread	3019	***44%***
Bale Grazing	6843	***226%***

Note: Pasture growth the two years after winter feeding; Jungnitsch 2008

25

Forage Response Protein Levels (1st year)		
	Protein	***% Inc.***
Control	*10.2%*	**--**
Dry Lot - Spread	*10.6%*	***4%***
Bale Grazing	*18.4%*	***80%***

Note: Protein levels of pasture forage one year after winter feeding, Jungnitsch 2008 .

26

Cattle Urine

Contains:

- 67% of nitrogen (N)
- 90% of potassium (K)

How to capture this in drylot?
Nutrients most important hay?

27

Drylot Feeding

Nitrogen Retention:

- 57-67% Volatilized (lost in air)
- 5-19% Lost as runoff
- 10-15% Soil below feeding
- ***9-19% Retained in manure***

Biermann (1999) Nebraska study; conventional drylot feeding

28

Ohio County Cattle Farmer

"We put in a gravel pad about 7 years ago. We created a wintering area around the gravel pad.

The result was large stockpiles of manure that I didn't have time to spread and was poorly utilized."

29

Nutrient Value Effective Capture			
Nutrient Capture	25 Cows	50 Cows	100 Cows
10% (Poor)	$200	$300	$700
25% (Fair)	$400	$800	$1,700
50% (Good)	$800	$1,700	$3,400
75% (Excellent)	$1,300	$2,500	$5,000

Note: Assumes 2.0 tons hay/cow per year

30

Other Advantages Bale Grazing

- Improved nutrition
  → mixing bales with stockpile
- Improved herd health
  → Clean coats all winter long

31

32

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Progressive Forages Bale Grazing Articles:

https://www.progressiveforage.com/forage-types/grasses-and-grazing/winter-bale-grazing

https://www.progressiveforage.com/forage-production/management/fertilizer-value-of-hay-feeding

36

Managing Your Grazing System in Winter Months

Mark Green
Lead Resource Conservationist
USDA - Natural Resources Conservation Service
Springfield, MO

1

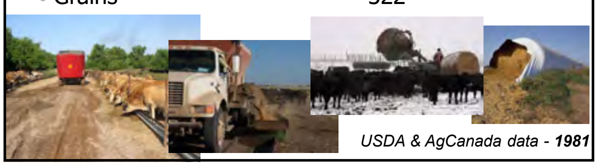
What to do with your grazing system in the winter

- Still a grazing system
- Dealing with mud
- Feeding areas
- Providing feed for the livestock
- Winter protection against rough weather
- Supplement
- Winter water

2

Relative Cost of Supplying a Unit of Energy to Ruminants

Pasture	**100**
Alfalfa hay	192
All types of hay	222
Silage	277
Dehydrated forage	419
Grains	322



*USDA & AgCanada data - **1981***

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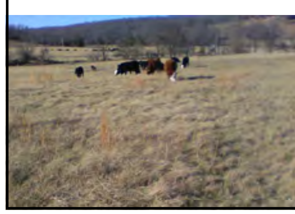
Grazing Management Strategy 101

Cow, sheep, goat, or horse can all harvest forages cheaper than you can!

Wesley Tucker



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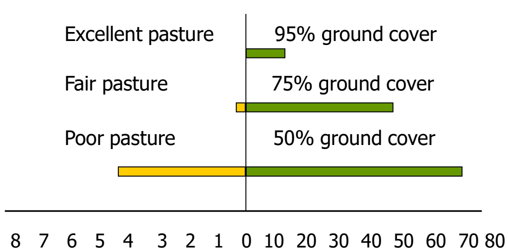
Infiltration and Runoff

3 inches of rainfall in 90 minutes, 10% slope, silt loam soil
(University of Nebraska & USDA-SCS, 1937)



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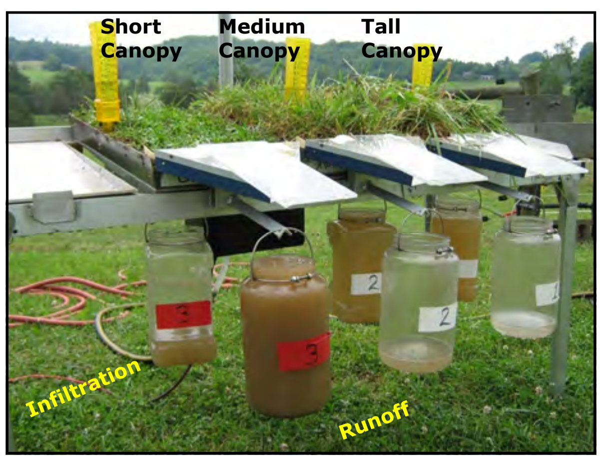

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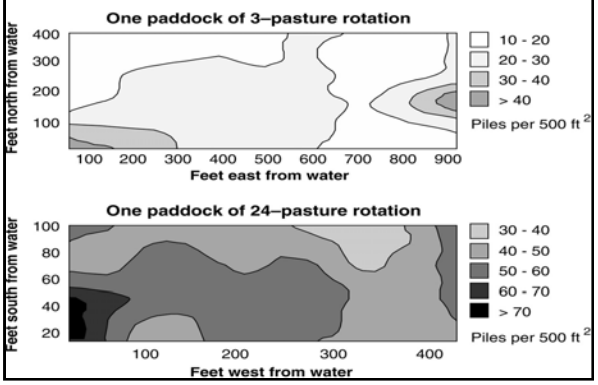
Manure Distribution



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Nutrient Distribution

Rotation Frequency	**Years to get 1 pile / sq. yard**
Continuous	**27**
14 day	**8**
4 day	**4-5**
2 day	**2**

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Nutrients in Hay What's It Worth?

1000 lb. bale of grass hay

- **25 lb. of N**
- **7.5 lb. P_2O_5**
- **20 lb. K_2O**

Wesley Tucker

9

"The more metal and fuel you put between solar energy and a cow's belly the less profitable you will be."

Jim Gerrish

10

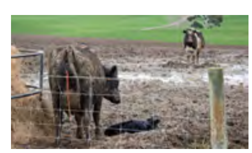
What about my paddocks?

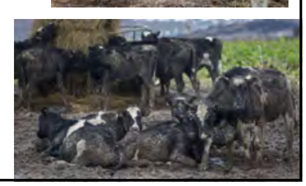
- Keep rotating as much as possible
  - Helps keep grass cover (good sod)
  - Helps avoid mud problems
  - Spread manure
- Take away or minimize the need to feed
- Ground Frozen – good chance to keep rotating
- Ground Thawed – have to watch mud, but keep rotating as much as possible
- May be times that you have to pull up into one area, but try to avoid as much as possible

11

Avoid concentrated areas as much as possible

- Any time we concentrate animals, we create potential problems.
- Keep this in mind with most or all management decisions in grazing, any time of the year





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Providing feed for the livestock

- Pasture
- Hay
- Supplement

13

Feeding Hay

One spot vs Spreading it out

14

Spreading it out - Feeding Hay Small Square Bales

- "The way we used to do it"
- Spread out livestock
  - Helps "Boss" Cow situation
- Spread out manure
- Spread out nutrients in manure and hay
- Less Mud



15

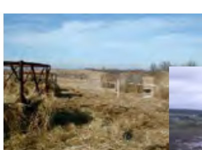
Big Round Bales

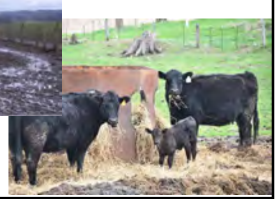
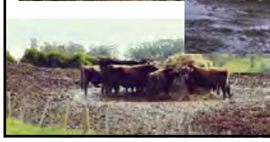
- Less Labor
- Feed in same area
- Possibly Concentrate animals more


16

One Spot Feeding Hay

- Mud
- Manure
- "Boss" Cows
- Herd Health



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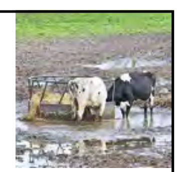
Mud

- Mud
  - Some of this could be avoided
  - Vehicle traffic
- Heavy Use Areas
  - Geotextile and Gravel

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Fixing or maintaining problem areas
$$

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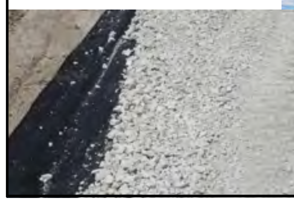
Heavy Use Feeding Area

- Geotextile Fabric
- 2” minus gravel
- 6”+ thick
- $$


20

Winter Hay Feeding Structures

- Can help avoid mud areas to a point.
- Area around structure can become a problem with increased animal traffic in mud times.
- Concentrating Animals
- Hauling manure
- $$$$




21

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23

TABLE 1 Cost scenarios for a compost-bedded pack barn

Cost scenario	Barn cost (out of pocket)	Sawdust cost (triaxle load)	Stirring time (min/day) winter	Increased cost (per cow per year)
Low	$40,000	$250	20	$190
Medium	$60,000	$500	30	$294
High	$80,000	$750	40	$399

Assumptions: 40 cows, 30-year life, 5% interest rate, $1,000 barn cleanout every two years, $500 farm insurance increase, 120-day winter period

Sawdust (triaxle loads): 15 initial loads to fill barn (interest cost only), five additional loads per year, half of compost pack cleaned out every second year

Sawdust stirring: 20-40 min per day stirring during the winter season and five minutes per day during the off-season

Machinery and labor (sawdust stirring and spreading sawdust): $15/hour labor rate and $10/hour variable tractor cost (fuel, repairs/maintenance and variable depreciation)

Other costs and assumptions: 30-minute spreading time per sawdust load, $1,000 barn cleanout, $500 per year increase in farm insurance, 30-year barn lifespan, 5% interest rate, 40-cow herd, 120 wintering days

Dr Greg Halich, University of Kentucky

24

Feeding Hay – Move areas around

- Reduce Mud
- Spread Manure Areas
- Move often

25

Feeding Hay - Unrolling Bales

- Mimic feeding small square bales
- Spread out animals – "Boss" cows
- Spread out manure
- Spread out nutrients in manure and hay
- Lessen mud issues

26

Stockpiling/Stripgrazing Fescue for Winter Pasture

The managed accumulation of new growth

27

Stockpiling Keys to Success

- Growing the stockpiled fescue
- Proper utilization of stockpile

28

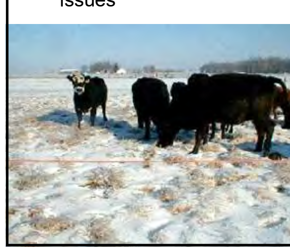
Stockpiling Fescue Recipe

- Use spring growth (hay or graze off)
- Goal: fescue pastures that have 3 to 6 inches of leaf in mid to late August
- Apply 40 - 60 lbs. N, Aug. 15 to 31, or 60 to 90 days prior to end of growing season
- Defer grazing until growth stops (late Nov to early Dec.) or until needed
- Utilize all other pastures in rotation first.

29

Stockpiling Fescue Recipe (cont'd)

- Strip Graze
- Maximum 2 to 3 days worth of grazing at a time
  - Greatly increases utilization and preserves quality
  - Reduces time on one area to reduce tromping and mud issues



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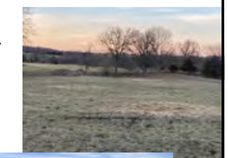
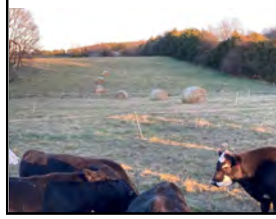
Things we have learned

- Fall Application of Nitrogen will usually pay for itself
- Forage quality in a managed grazing system can be better than we thought
- Protein is seldom deficient in vegetative pastures
- Quality of tall fescue fall regrowth is very high
- Tall fescue holds quality well into late winter and early spring

31

Feeding Hay - Bale Grazing

- Spread out animals – “Boss” cows
- Spread out manure
- Spread out nutrients in manure and hay
- Lessen mud issues
- Extend stockpile
- Less labor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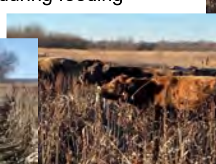
Strip-Grazing Milo

- Spread out animals
  - “Boss” cows
- Spread out manure
- Spread out nutrients in manure
- Less labor during feeding time



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Strip-Grazing Milo

Possible Mud Problems
- Southern Missouri
- Ground does not freeze all winter
- Keep grazing time short


34

Supplement – Energy vs Protein

- Which is deficient?
- Move around when possible

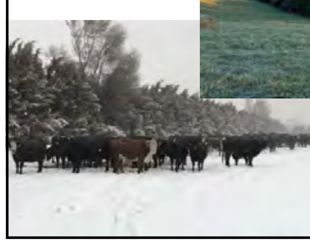
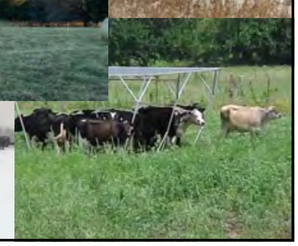



35

Winter Protection

- Natural
- Man-Made
- **Only use when needed**
- **Avoid using one spot all winter long**



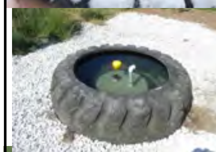
36

Winter Water

– Freeze Proof?
– Distance to water
– Heavy use areas around tanks



37


"Freeze-proof" tanks
- No such thing
- Any tank can freeze up
  - installed incorrectly
  - not maintained correctly

38

Winter Water

- Travel distance to water
  - Still important, but not as much for grazing distribution as for manure distribution
- More than One Winter Water Source
  - Be able to rest watering points
    - Dry up
    - Less tromp out area

39

Winter Water

Tend to drink "individually" when:
- 1/8 mile or less to travel
- Less animals around watering area at any one time.
  - Possibly less mud issues.

Tend to drink "socially" when:
- Traveling farther or in larger paddock
- Livestock go as a group
- Concentrated animal numbers
  - more mud issues

40

Maintain area around water tank



41

Quick Connects Underground to replace above ground hydrants




42

Summary

- Vehicle Traffic
- More Than One Winter Water Site
- Find ways to avoid concentrating animals
- **Keep rotating pastures and moving livestock**

43

THANK YOU
for 39 Great Years!

44

Managing Annual Forages for Livestock Production

Paul Beck

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Warm Season Annuals

When we think of warm season annual forage crops the summer annual grasses such as pearlmillet (*Pennisetum glaucum*) and sorghum sudan (*Sorghum bicolor*) quickly come to mind. Often warm season annual forages are thought of as an emergency source of hay for their ability to produce a lot of forage quickly during periods of dry weather when other forage sources are limited. However, they are much more versatile than just providing a quick hay crop. Thanks to emphasis placed on cover crops and soil health their role in forage systems in addition to hay now includes providing quality grazing, adding soil organic material, soil cover, wind and water erosion control, increasing soil microbial diversity, silage, baleage, and weed suppression among others. The species considered for use as forage crops during the summer has also broadened beyond the sorghums and millets.

Sorghum Sudan and Sudangrass (Sorghum bicolor)

The sorghum sudan hybrids are very popular due to the amount of forage that they can produce in a short period of time. Sorghum-sudan hybrids are well adapted across the region and will perform well over a wide range of soil textures but production may be reduced on very light textured or sandy soils. Sorghum-sudan can be established with tillage or with no-till.

For grazing purposes, sorghum-sudans should be grazed when they reach 24 inches in height to help reduce potential issues with prussic acid poisoning. Prussic acid can be an issue with any of the sorghum species. It can build up any time the plant has undergone a period of stress. Common plant stresses that can induce buildup include drought, frost and herbicide application. It is generally best to avoid grazing 14 days after any stress period. Another potential issue with grazing or stored forage is nitrate accumulation, which occurs when a plant takes up nitrogen during a period of rapid growth followed by a period of little to no growth. This accumulation of nitrate is generally in the base of the stem of the plant. If nitrate accumulation is suspected, testing is recommended.

Average daily gain of stocker cattle grazing sorghum sudan hybrids have been reported in excess of 2.0 lb/day which demonstrates the potential of animal gain grazing sorghum sudan. A producer should always keep in mind that stocking rate, environment and agronomic management all influence animal performance on sorghum sudans or for that matter any forage. For grazing planning purposes, it will take the crop 45-60 days approximately to reach a forage mass great enough for grazing to begin.

Pearl millet

Pearl millet is the major millet used for forage in the U.S. Other millets include proso, foxtail (German), and browntop and these are finding their way into several cover crop or hay mixtures to add diversity but, they are much lower yielding than pearl.

Pearl millet is an excellent warm season annual forage and offers some advantages over sorghum sudan. The largest is that since it is not a sorghum, it does not accumulate prussic acid, a major concern with sorghums during periods of plant stress. Millet can accumulate nitrates that are a concern with grazing and hay. Nitrate levels can be tested in forage and should this be a concern it is advisable that the forage be tested. Pearl millet is very well adapted to the region and is not as sensitive to soil pH as sorghum sudan but soil pH should be maintained above 5.0. It will tolerate drought well and as mentioned previously, it is not a prussic acid accumulator but, if drought is severe enough to slow plant growth, nitrate accumulation can then become a concern. Pearl millet also works well on lighter textured soils and can out yield sorghum sudan on sandy soils.

Grazing should be deferred until pearl millet reaches a height of 18-30 inches, usually occurring 45-60 days after planting. Cattle readily consume pearl millet forage and stocker gains can be good. Regrowth of pearl millet can be delayed or eliminated if grazed too closely. The recommended grazing or haying residual height is 6-10 inches. Stocker ADG has been reported in excess of 2.00 lb/day but can be greatly influenced by stocking rate and forage availability.

Pearl millet can develop a massive root system that is a desirable characteristic in building soil health. It works well in cover crop mixtures with legumes such as cowpeas, soybeans and sun hemp, okra and other broadleaf cover crops.

Crabgrass (Digitaria sanguinalis)

Giant crabgrass is cursed by many a gardener and row crop producer as being a prolific never ending weed pest. In the eyes of a forage producer that grazes livestock, it is an excellent forage crop. It is a summer annual grass that germinates in spring, grows through summer, and dies at frost in fall. Daily weight gains or milk production of livestock grazing crabgrass can easily exceed that from bermudagrass. It is very productive under good management. Crabgrass can be double cropped behind a small grain crop (June) for late summer forage production or behind small grain grazeout (May) which will provide a longer period of forage production. Crabgrass is a prolific re-seeder and if allowed to produce seed prior to frost it can volunteer in following years especially in no-till situations.

Stocker cattle gains on crabgrass can be very good with ADG in excess of 2.5 lb/day. Grazing of crabgrass should begin when it reaches 8-10 inches in height which under good growing conditions should occur 30-45 days after emergence. To keep the crabgrass in an actively growing vegetative stage, it should be grazed to a residual height of 3 inches.

Plantings of warm season annual grasses can be staggered in order to provide a steady flow of forage through the summer and avoid an overabundance of forage at one point and time. They can also be creatively utilized. An example might be a late summer planting to provide quality forage to start stocker cattle on prior to the development of a cool season annual forage crop such as wheat. Another variation could be to use warm season annuals to further develop stocker cattle on forage following winter pasture graze out or as a source of creep grazing for calves.

The following pictures show the ability of warm-season annual plantings outside of the 'normal' planting window to fill gaps in quality forage availability. Following an unusually dry early summer in central Oklahoma, over 15 inches of rainfall was accumulated between mid-July and mid-August. Summer cover crop blends or pearl millet was no-till planted in early August and allowed to accumulate 24 to 30 inches of topgrowth before grazing in mid-September.

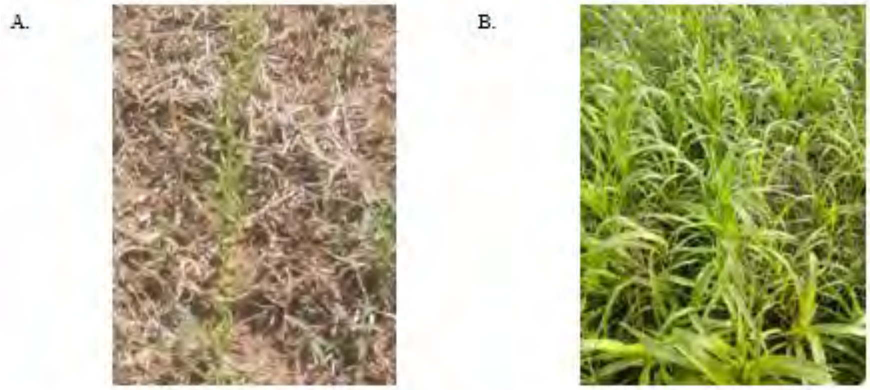


Figure 1. BMR Pearl Millet planted in early August. A. 10-days after planting and B. 40 days after planting

Composite Dairy x Angus steers that had grazed crabgrass and warm-season perennial pastures from June to September, grazed no-till cover crops from September 10 to October 30 (Figure 2). These calves would be considered novice grazers with no previous exposure to any of the forages in these mixtures. Initial preference seemed to be for the BMR pearl millet, but soon transitioned to sorghum x sudangrasses. When broadleaf species (soybean, cowpea, mungbean, and okra) began to be utilized in early October it was soon fully grazed out. These lightweight calves gained 2 pounds per day.

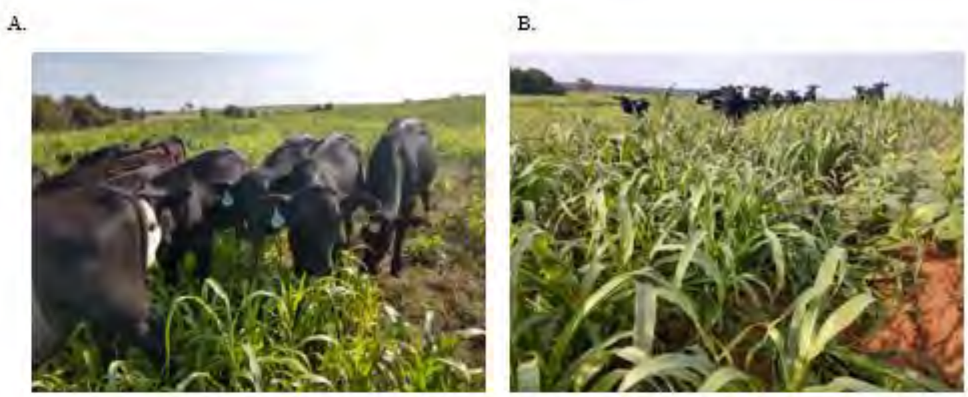


Figure 2. BMR Pearl Millet (A.) and cover crop blend (B.) planted in early August being grazed by Composite Dairy X Angus steers initial preference was for PM, but later broadleaf species were fully utilized > Sorghum x Sudangrass > PM

Warm season annual grasses are productive and well adapted to the region. They are also versatile in their use supplying emergency forage in dry weather conditions, a soil cover for fallow ground, quality grazing, and erosion control. As with any forage when grazed, stocking rate greatly influences both plant and animal performance. Warm season annual grasses fit well and have their place in forage systems.

Cool Season Annuals

Annuals Interseeded into Permanent Pastures

Cool-season annuals are commonly planted into permanent warm-season pastures and this provides that largest number of acres utilized for grazing cool-season annuals in the Southeast. Because these pastures are being managed for multiple uses, productivity is generally less for each season compared with pastures managed for single purposes. For instance, because pastures are planted into existing warm-season perennial sods managed for haying or grazing, cool-season annual plantings must be delayed until the growth of warm-season pastures decreases in the fall, which decreases potential fall forage production. Also, growth of cool-season annuals during late spring will delay warm-season forage production.

Planting cool-season annuals should be delayed until warm-season forage growth slows in the fall. If warm-season grasses are still actively growing they will compete with the cool-season annual seedlings for sunlight, water and nutrients. Cool season seedlings can easily get shaded out decreasing the eventual stand of cool season annuals and decreasing forage yield. When nighttime temperatures get below 60° F for several nights in a row growth of warm-season grasses slows considerably.

Establishing Cool Season Annuals in Dedicated Crop Fields

Small grains can be established using either conventional tillage methods to establish a weed free, firm seedbed or with no-tillage. Clean tilled pastures have been more common than no-till until recently, but no-till is gaining in popularity. Prior to no-till planting small grains, the area should be chemically burned down to eliminate potential weed competition.

Seeding Rates and Managing Establishment for Cool Season Annuals

Seeding rates for establishing small grains for grazing is higher than rates for grain only. Typical seed rate recommendations for grazing is 100 to 120 lb/ac. Planting date for grazing small grains is also earlier than for grain only. Depending on the goals of the operation and weather conditions, planting dates can range from mid-August to mid-October or later. Yearly nitrogen rates for small grains can be as high 150 lb N/acre with a fall and spring split application. Well drained soils work well for small grain stocker cattle grazing as these types of soils hold up better in wet conditions with less damage to the forage from hoof action than what will occur on heavier soils. Under favorable weather conditions, fall grazing can begin in November and continue to May.

The figure below shows the impact of planting date of cool-season annuals on forage production from Arkansas in 2011. The tall fescue (blue line) in this chart was stockpiled for grazing beginning in December. Using tall fescue as a comparison, cool season annuals planted in crop fields (green line) in early September produced similar forage mass by November when grazing with growing calves was started. Small grains were interseeded into bermudagrass in late September when bermudagrass growth began to slow (black line) or in November following a rainfall event (red line) and ryegrass alone was interseeded in November. As planting was delayed grazeable forage amounts were likewise delayed. Grazeable forage accumulations were not adequate for September interseeded small grains until December, January for November interseeded small grains, or February for November interseeded annual ryegrass.

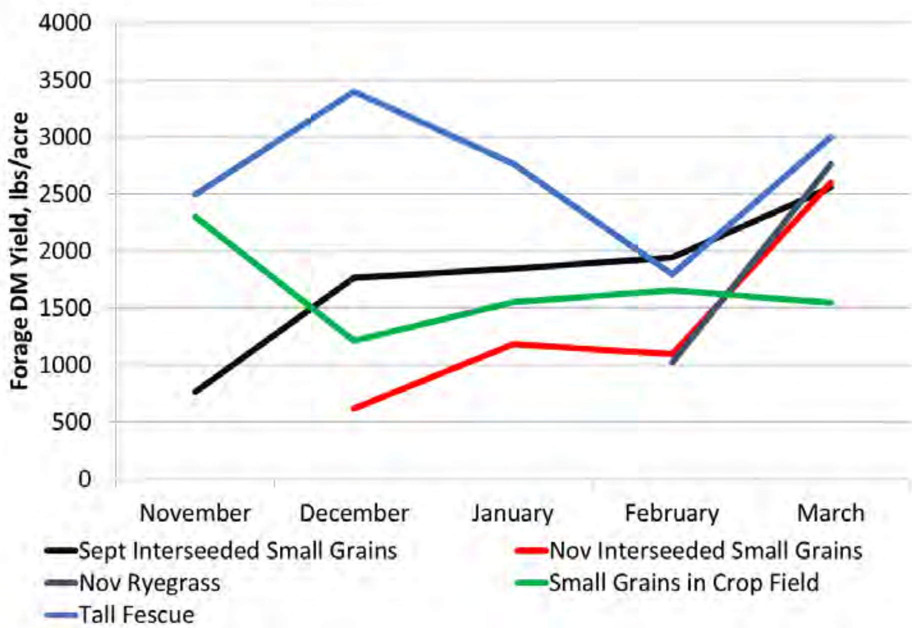


Figure 1. Example of forage production potential based on planting date and production system compared to tall fescue.

Forage nutritive quality

The balance between individual animal performance and total bodyweight gain per acre defines profitability of grazing systems. In all situations the most profitable stocking rate is between the maximum individual animal performance and the maximum total body weight gain per acre. The maximum average daily gains during the fall occurs when average forage allowance was a minimum of 3.5 pound of forage dry matter per pound of calf bodyweight. During the spring the increased forage growth rate allows for increased stocking rates. Forage allowance during the spring should be maintained at a minimum of 1 pound of forage DM per pound of calf bodyweight to maximize steer gains. Stocking rates in the fall will range from 250 to 600 lbs of animal weight per acre and will increase to 800-1200 lb/ac in the spring. Having adequate forage biomass on hand when initially stocking small grains pasture is important. Using the 3.5 lbs of forage DM per pound of calf bodyweight rule of thumb in the fall, indicates that to effectively stock at the "normal" 2-acre per 500-pound calf stocking rate a minimum of 875 pounds of forage DM accumulation per acre is required before turnout.

Small grains forage is low in calcium (≤0.55%), magnesium (especially for cows, ≤0.33%), copper (≤8 ppm), and zinc (≤27 ppm), marginal in phosphorus (~0.2%) and adequate for most other macro and trace minerals. Research in Oklahoma showed that providing a non-medicated mineral supplement to steers grazing small grains pasture increased gains by 0.25 lbs/day. The mineral supplements used in these experiments were commercially available and supplied high levels of calcium (> 12%) and low levels of phosphorus (4 to 6%). When the ionophore Rumensin was included in the mineral supplement additional gains of 0.2 lbs/day were seen over offering non-medicated mineral.

Nutritive value of small grains is high. When nitrogen is supplied in levels to meet production requirements, crude protein concentrations in excess of 30% are commonly observed in the fall, with levels in the mid to upper 20's being common through the winter and spring until plant maturity leads to reduced protein concentrations. Some caution must be taken when grazing small grains. Due to small grains's high nutritional value, low fiber content, and low calcium content (which is tied to muscle contraction), bloat can occur with cattle on small grains. The compound poloxalene is a curative for pasture bloat. Blocks containing this compound (bloat blocks) will reduce the incidence of bloat. The ionophore monensin decreases the incidence and severity of pasture bloat. If monensin is fed to calves grazing small grains pasture, then when bloat is observed the ability to provide poloxalene in an outbreak is enhanced, probably decreasing losses due to bloat. Providing a long stemmed grass hay to cattle while on small grains can help to slow the rate of passage through rumen and provide a source of fiber that can aid bloat incidence.

Cool-Season Annual Options

Wheat – Wheat is very popular as both a forage and grain crop. Because of its dual purpose capabilities, it is grown throughout the mid-south region. Wheat is best adapted to loam to clay loam soils with a minimum pH of 5.5. It is tolerant of cold and dry weather conditions making it suitable for some of the harsher environments found in the more western regions of production.

Other cool season annual forages can be added to wheat to extend the grazing season. The most common is to add annual ryegrass, which can extend the grazing period later into the spring. Annual ryegrass is an excellent forage providing good production and excellent quality but producers need to be aware that annual ryegrass can be a serious weed in wheat grown for grain.

Cereal Rye - Rye is the most cold tolerant of the cool season annual grasses with the earliest seasonal forage production. It is also the highest producer of forage biomass but, it is lower in nutritive value than other cool season annual grasses. Compared to wheat, rye is more adapted to sandy acidic soils and will produce grazeable forage earlier in the fall. With earlier seasonal production, rye will begin to go reproductive and lose forage quality earlier in the spring than other cool season annual forages. This makes rye and excellent crop to double crop with a summer annual forage such as crabgrass.

Agronomic production of rye is very similar to wheat. Seeding rates for grazing will be 100-120 lb/ac with fertility requirements like that of wheat. Rye can be a weed pest in wheat for grain and if it is grown in an area wheat grain production, rye is generally discouraged. In recent years, rye has seen a surging interest due to its use as a cover crop. Because of its high biomass production, it can suppress winter annual weeds and when terminated in the spring and rolled down onto the ground it produces a thick mat that can further suppress weeds for spring planting and serve as a source of organic material. Stocker cattle gains on rye will be similar to wheat as long as rye is vegetative but when stem elongation begins, forage quality and animal performance will quickly decline.

Oats - Oat forage has the highest nutritive value of all small grains. It is an excellent producer of early forage biomass and will perform best on lighter textured soils. The major drawback to the use of oats is cold tolerance. Livestock grazing preference for oats is high and livestock will preferable graze oats compared to the other small grains. Oats are normally planted in the late winter for spring grazing or forage harvest. Recent research with oats indicate that late summer planting has potential to provide forage to fill the fall forage gap during October and November before normal wheat pastures are available for grazing.

Triticale - Triticale is a hybrid cross of wheat and rye. Forage production is higher than wheat and nutritive value is greater than rye. It producers a large broad leaf that is grazed well by livestock. Triticale is a versatile crop that can be used for grazing, hay and silage. Under the right growing conditions and management, triticale can be harvested more than once. Triticale will tolerate more acidic soils than will wheat. Triticale has been around for many years but lack of variety selection, seed sources, and a grain market have limited its use. Seeding rates will be 100-120 lb/ac and cultural practices will be as those followed for wheat and rye. Seasonal production will be earlier than that of wheat in the fall but later than rye in the spring.

Annual ryegrass - Annual ryegrass is a wonderful high quality, high producing forage grass. However, it is a pesky weed in grain producing areas. Annual ryegrass can be seeded as a monoculture at a seeding rate of 20 lb/ac and is very easy to establish. It prefers good moisture conditions and performs well on heavier textured soils. There can be cold tolerance issues especially with tetraploid varieties. In monocultures it will produce a thick sod and tolerates close grazing but overgrazing should be avoided for greatest productivity. In many areas it is overseeded into bermudagrass to provide high quality forage prior to bermudagrass breaking dormancy in the spring. Caution should be advised with this practice because if underutilized in the spring, it can create a shading effect that can delay bermudagrass spring development and production. Annual ryegrass is an excellent re-seeder and after a few years a large amount of seed can be built up in the seedbank. Annual ryegrass is sensitive to some of the new pasture herbicides (aminopyralid) which can cause yellow, stunting and seed head suppression. Annual ryegrass is responsive to nitrogen fertilizer but due to a shortened growing season compared to some of the small grains, yearly rates are lower.

Native Warm Season Grasses – Testing vs. Performance

An ongoing discussion that I have had with producers and livestock specialist in the laboratory is on warm season grass (specifically native warm season grass (NWSG)) and how poorly they test in the laboratory. However, data suggest that cattle performance does not reflect laboratory analysis of NWSG.

Perennial grasses used in livestock production can be classified in two categories: cool season grasses (CSG; Temperate; C_3) and warm season grasses (WSG; Tropical; C_4). Warm season grasses capture carbon dioxide during photosynthesis by a C_4 (4-carbon molecule) pathway compared to cool season grass that follow a C_3 (3-carbon molecule) pathway. Difference in pathways means different growth requirements and preferred environments. Warm and cool season grasses will vary in cell wall structure and proportions of components because of differences in plant anatomy. During photosynthesis, carbon dioxide and water enter the plant cell through the stomata before being converted to glucose (sugar). Cool season grasses can only perform photosynthesis while the stomata are open allowing water to escape during warmer temperature and thus requiring more water for production. Warm season grasses, on the other hand, can conduct photosynthesis while the stomata is closed resulting in more efficient growth, water retention (drought resistance), and higher dry matter yields (efficient growth). Cool season grasses undergo photorespiration wasting the energy produced by photosynthesis. Warm season grasses have little to no photorespiration resulting in less wasted energy.

Cool season grasses favor cooler ambient temperatures (68-77°F), cooler soil temperatures (40-45°F), and shorter photoperiods (daylight hours) found in the spring and fall going dormant or slowing production in the summer and winter months. Every year, producers struggle to make it through the "summer slump," or when CSG stop production and cattle graze off what spring growth is left. As stated in the name, warm season grasses prefer warmer ambient temperature (86-104°F), warmer soil temperature (60-65°F), and longer photoperiods. In Missouri, warm season grasses will peak production in the summer months of the year between June and August and slow production during the cooler months.

Due to plant anatomy, cool seasons prefer wetter conditions. Wetter conditions in the spring and fall increase the amount of nitrogen available in the soil due to an increase in soil microorganism activity. Higher nitrogen concentrations can be found in cool season grasses than warm season grasses when compared at similar growth stages and similar fertilizer rates (frequently observed in laboratory; cool season higher CP values than warm season). Cool season grasses store fructans for energy while warm seasons store starch for energy. Due to higher accumulation of sugars, cool seasons will have higher concentrations of water soluble carbohydrates that are highly digestible in the rumen.

In a forage laboratory, Crude Protein (CP), Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) are measured using wet chemistry and Near-infrared reflectance (NIR) spectroscopy. Crude protein is the measurement of nitrogen multiplied by 6.25 (most plant based proteins contain 16% nitrogen). Neutral Detergent Fiber measures partially digestible structural components of the plant, specifically cell wall (hemicellulose, cellulose and lignin). Acid Detergent Fiber measures the less digestible portion of the cell wall (cellulose and lignin). Measured values can be used to equate energy values (Total Digestible Nutrients and Net Energy) for various forages based on CP, ADF and NDF values. Therefore, the higher the fiber values, the lower the digestibility and less energy the forage has to supply to livestock. Energy values can be used to predict how much of a feedstuff is needed to maintain an animal or promote production (growth, lactation, or work). Energy equations vary between state, laboratory and type of feedstuff. Communicating with your laboratory on what equation to use is important in predicting cattle performance. Cell wall structures are dependent on type of plant (cool season versus warm season; grasses versus legumes) and growth stage. As plants mature, cell walls become a large proportion of the plant to support the emerging seed head with higher lignin concentrations and lower digestibility. Due to more efficient growth (high dry matter yield) and larger plant size, warm season grasses will have higher cell wall concentrations (Higher ADF and NDF values) than cool season grasses when compared at similar growth stages.

Since CP, ADF and NDF are crude measurements, further breaking down each component can better predict digestibility of a feedstuff and how each component is utilized by the animal. Though crude protein works for most feedstuffs, switch from a crude protein system to a metabolizable protein system can further break down how the animal utilizes nitrogen. Metabolizable protein separates the needs of the microorganisms in the rumen from the needs of the animal as either rumen degradable protein (RDP, DIP) or rumen undegradable protein (RUP, bypass protein). Rumen degradable protein (RDP) contains peptides, amino acids, ammonia and NPN utilized by rumen microbes. Rumen undegradable protein (RUP, bypass protein) escapes microbial degradation, enters the small intestine and is utilized directly by the animal. Data suggest that native warm season grasses have higher concentrations of RUP (bypass protein) than cool season grasses. Higher RUP concentrations could explain high rates of gain of native warm season grass despite having low CP values. Balancing RDP and RUP is crucial for optimizing production in cattle. Unfortunately, RDP is not frequently measured by beef producers compared to dairy producers for RUP plays a crucial role in milk production by suppling limited amino acids. Limited amino acids are usually supplied by supplementing processed grains high in RUP.

Neutral detergent fiber is used for predicting dry matter (DM) intake in cattle, the lower the proportion of NDF the higher the intake. A higher NDF causes the rumen to fill faster and take longer for rumen microbes to break down the fiber portion. On the contrary, if the NDF is too high and insufficient amount of nutrients are available, cattle can starve on a full belly. Mature forages that contain high amounts of lignin and low digestibility are known to have lower intake than young vegetative forage. Since warm season grasses are higher in NDF than cool season grass, we would expect them to have lower DM intakes. Dry matter intake was originally predicted by dividing NDF by 120 to determine a percentage of DM an animal can eat per pound of body weight
(ex. 120/65 = 1.85% DM; 1000lb x 0.0185 = 18.5 lb dry matter). Relative feed value (RFV) uses this dry matter equation along with DM digestibility to give a universal value for hay (designed for Alfalfa). However, the equation does not take into account the NDF portion being partially digestible. Measuring neutral detergent fiber digestibility (NDFD; as a % of NDF) and incorporating into the DM intake equation can better predict intake (especially in grasses). Relative feed quality (RFQ) utilizes NDFD and TDN to determine a universal value for forages. Neutral detergent fiber digestibility is higher in younger forages than mature. Some data suggest that native warm season grasses have similar to better digestibility to cool season grasses when compared at similar growth stages but more research is needed. In my laboratory, I find NDFD to be lower in NWSG than cool season grasses but the majority of NWSG samples are mature hays.

One of the major advantages of native warm season grasses is their ability to produce high amounts of dry matter in a short period of time, often twice the amount of cool season grasses. When kept in vegetative state, warm season grasses can produce high rates of gain at high carrying capacity. High dry matter yield when compared to cool season grasses may better explain high rates of gain in NWSG despite having low test values.

No forage can supply the nutrient needs of animals year round. Utilizing both forages for livestock production (grazing and hay production) can be difficult for producers due to cost and unforgiving weather patterns (especially in Missouri). Better knowledge of the types of forages suitable for your area and their growth habits can further help management decisions. Making your land work for you rather than against you is essential. Getting the most out of each acre is crucial to being profitable in the cattle industry.

A lack of data (especially in Southwest Missouri) has left producers (and me) asking questions. Further research and utilizing new laboratory techniques is needed to better predict the potential of native warm season grasses in cattle production for both cow-calf and stocker operations. New energy equations specifically designed for native grasses have been discussed but not actively being pursued, that is if new equations are the answer. New technology (in commercial laboratories) has provided producers with more tools for understanding forages but are not being utilized to their full ability among beef cattle producers. Producers' willingness to dig deeper into the plant components of grasses and how they are utilized by the animal is low (due to cost and time) but may be necessary to better predict and optimize cattle performance in the future.

Forages and Humanity's Future

Dr. Peter J. Ballerstedt
Forage Ambassador

Southwest Missouri Spring Forage Conference
February 24, 2021

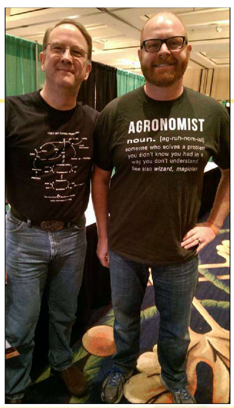
BARENBRUG

The opinions expressed in this presentation are based upon Dr. Ballerstedt's understanding of the relevant published scientific literature. They are not necessarily the opinions of Barenbrug Holding, Barenbrug USA or the other Barenbrug companies.

But I'm workin' on 'em!

Disclosure

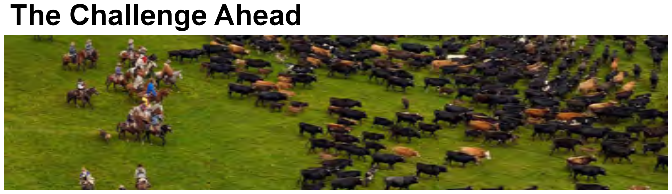
- I've worked in forage agriculture
- I work for a forage seed company



Disclosure

- I'm an advocate for therapeutic carbohydrate reduction and ruminant agriculture

The Challenge Ahead



In 29 years:

- World population will reach 9+ billion
- Double world food production
- 66% increase in demand for animal protein
- Must come from virtually the same land area as today.
- Double electrical generating capacity
- 70% of humanity will live in urban areas

UN, (2009): UN, (2017): FAO, (2017); Bryce, (2020); UN, (2018).

Essential ruminants & forages

- We can't feed TODAY'S world without ruminant animal agriculture, let alone the world of 2050.
- We must improve efficiency & productivity of ruminant animal agriculture.

The Next Revolution

“Green Revolution”

“Ruminant Revolution”

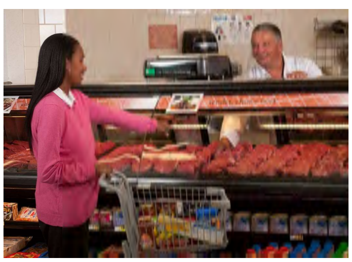
Perspective matters

“The notion that raising livestock and consuming animal-source food (milk & dairy products, meat, fish, and eggs) is fundamentally incompatible with sustainable development is flawed.”

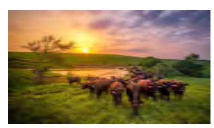
Adesogan, A. T., et al. (2019). "Animal source foods: Sustainability problem or malnutrition and sustainability solution? Perspective matters." Global Food Security: 100325.

“Consumers and producers alike care about animal welfare, environmental stewardship, food safety, nutrition and taste.”

- Amanda Radke



Forage Agriculture



Forage agriculture is also

- Conservation

The peel of 1/32

- Imagine 1/32 of this apple. That small slice represents the portion of the earth’s surface that is cultivatable (can produce food crops for human use)
- Now imagine the peel of that 1/32 portion. That represents the soil which supports worldwide food and fiber crop production.
- Soil degradation is a significant threat to worldwide human flourishing.

Can't Eat the Rocks

"When our soils are gone, we too, must go unless we find some way to feed on raw rock."

Thomas C. Chamberlain, 1908

Thomas C. Chamberlain, ca 1870s

Arable Land Limited

Of Earth's total land area -

- 37% can produce food
- 25% is perennial forage & rangeland
- 12% is cultivated crops
  [which can include short-term forages]

Arable Land Limited

20% of global cultivated land was lost from agriculture in 40 years (1960-2000)

True sustainability

THIS is Unsustainable!

24 billion metric tons of top soil lost due to erosion per year, worldwide.

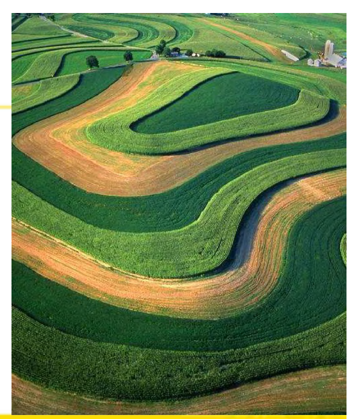
Imagine removing 6 inches of soil from an area the size of Kentucky (37th largest state).

Every year.

Editorial, 2017. Safeguarding our soils. Nat. Commun. 8:1989. doi:10.1038/s41467-017-02070-6. Available from: http://www.nature.com/articles/s41467-017-02070-6

Forage agriculture is also

- Conservation



Forage agriculture is also

- Conservation
- Cover crops
- Soil health

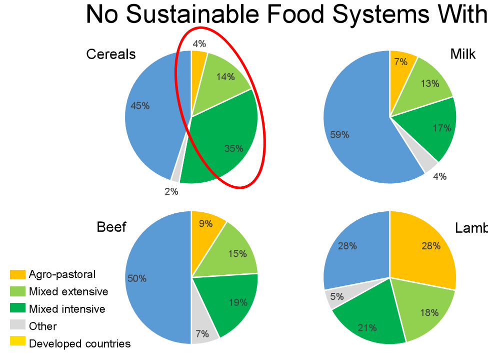
Keys to Healthy Soil

- Cover the soil
- High plant diversity
- Minimize soil mechanical disturbance
- Grow plants for maximum days each year
- Incorporate well-managed ruminants
- Manage livestock to enhance soil function

Forage agriculture is also

- Conservation
- Cover crops
- Soil health
- Integrated cropping systems

No Sustainable Food Systems Without Livestock



At least half the cereals in the world can *only* be produced with animals in the farm system

Developing-country mixed crop-livestock systems, most of them smallholders, supply a large proportion of cereal and livestock products

Forage agriculture is also

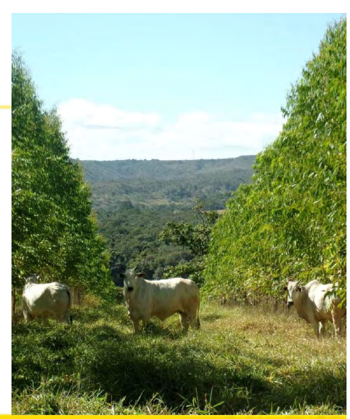
- Conservation
- Cover crops
- Soil health
- Integrated cropping systems
- Agro-forestry (silvopasture)

The future

Integrated Livestock-Cropping Systems

- More food
- Same land
- Same/lower inputs
- Improved soil health

Farias, G. D., et al. (2020). "Integrated crop-livestock system with system fertilization approach improves food production and resource-use efficiency in agricultural lands." Agronomy for Sustainable Development 40(6): 1-9.



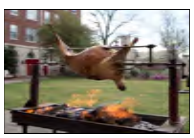
“The greatest wealth is health.”

- Virgil

Dr. Ballerstedt says…

True health food comes from ruminants!

Lamb (sheep)



Chevon or cabrito (goats)

Venison (deer)

Beef (cattle)

Fermented plant products

Animal source foods are superior

Animal Source Foods are superior to Plant Source Foods as sources of the amino acids and the other essential nutrients humans require for proper development and health.

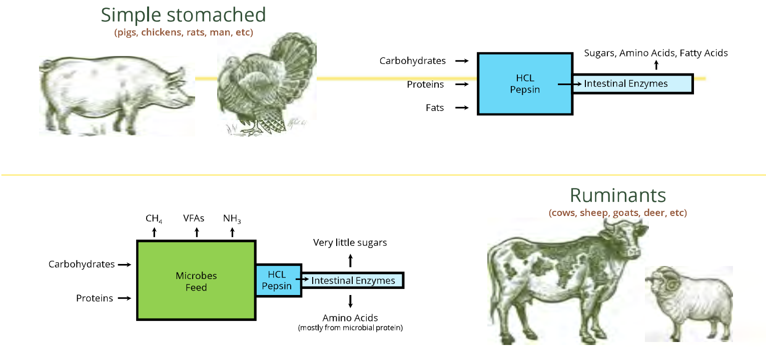
Animal source foods contain unique nutrients

- Only dietary source of:
  - Retinol
  - Heme iron
  - Vitamin B12
  - Vitamin D
- Highly bioavailable forms of zinc
- Superior protein:
  - Complete amino acid profiles
  - Highly digestible
- Only source of EPA and DHA (except sea vegetables)
- Unique bioactive compounds:
  - CLA
  - Bioactive peptides
  - Carnitine

Animal source foods are essential

“Livestock source foods are important if the global nutritional, educational and economic needs are to be met and can be used to feed developing countries out of poverty.”

Scholtz, M. M., et al. (2020). "A balanced perspective on the importance of extensive ruminant production for human nutrition and livelihoods and its contribution to greenhouse gas emissions." South African Journal of Science 116(9-10): 115-117.



"Cattle thus contribute directly to global food security."

"…because cattle rely on grazing and forages, they need only 0.6 kg of protein from human-edible feed to produce 1 kg of protein in milk and meat, which is of higher nutritional quality than the plant proteins."

https://www.feedipedia.org/content/more-fuel-foodfeed-debate

Essential ruminants

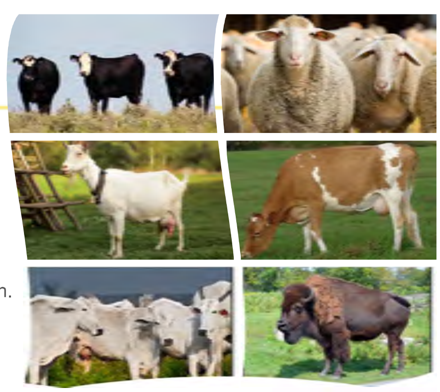
- Upcycling
- Income
- Fertilizer
- Draft
- Ecosystem Services
- Fuel

Essential ruminants

- Convert structural and non-structural carbohydrates into fat.
- Convert plant "protein" and non-protein nitrogen into high-quality animal protein.
- Reduce unstable polyunsaturated fatty acids to monounsaturated and stable saturated fatty acids (biohydrogenation).
- Produce B12 & other vitamins.

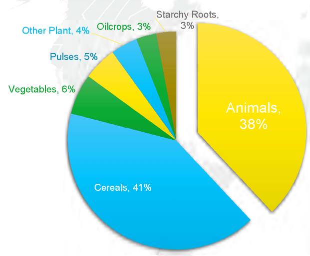
Essential ruminants

- Increase bio-availability of essential minerals.
- Degrade anti-quality plant components (e.g. phytates)
- Maintain health of grassland ecosystems.
- Recycle nutrient and build soil health.
- Provide services (e.g. draft) and byproducts (e.g. leather).
- Generate new wealth.



"What do you know? You're just a forage agronomist!"

Global [Crude] Protein Supply



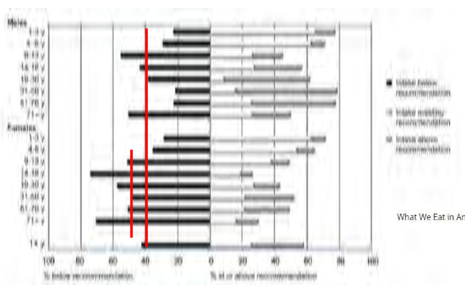
10% Milk (excluding butter)
7% Pig
6% Fish & Seafood
6% Poultry
4% Cattle & Buffalo
3% Eggs
1% Sheep & Goat
1% Other Animal

"For the poorest 20 per cent of the tropical population around the world, rice provides more protein per person than beans, meat or milk."
Alice Roberts, Tamed

Rice, polished white, cooked, as fed (86.5 % DM)
Crude Protein = 9.0 %
DIAAS = 64 %
Lysine = 0.3 % as fed

Beef, ribeye roast, medium as fed (86.5 % DM)
Crude Protein = 28 %
DIAAS = 121 %
Lysine = 2 % as fed

Over 40% of Americans don't get enough protein



What We Eat in America, NHANES 2007-2010

Most females over age 8 don't get enough protein

Plant source foods are variable

In soybeans -
- Crude Protein can vary by 20%
- Individual AAs +/- 45%

https://www.cropcomposition.org
5,995 samples

Humanity's #1 Protein Source…

Wheat
- Highest Crude Protein Cereal (9 – 15 % CP)

…is a poor quality protein source…

Wheat

(Lysine limiting)

	DIAAS
Birth to 6 months	37
6 months to 3 years	45[2]
3 years and above	54

Mathai, J. K., et al. (2017). "Values for digestible indispensable amino acid scores (DIAAS) for some dairy and plant proteins may better describe protein quality than values calculated using the concept for protein digestibility-corrected amino acid scores (PDCAAS)." British Journal of Nutrition 117(4): 490-499.
2 - Han, F., et al. (2019). "Digestible indispensable amino acid scores of nine cooked cereal grains." British Journal of Nutrition 121(1): 30-41.

…that's made worse by processing.

	DIAAS
Wheat, whole, cooked (bread)[1]	20
Corn-based breakfast cereal[2]	1

1 - Han, F., et al. (2019). "Digestible indispensable amino acid scores of nine cooked cereal grains." British Journal of Nutrition 121(1): 30-41.
2 - Rutherfurd, S. M., et al. (2014). "Protein digestibility-corrected amino acid scores and digestible indispensable amino acid scores differentially describe protein quality in growing male rats." The Journal of nutrition 145(2): 372-379.

That doesn't happen with Animal Source Foods

Animal Husbandry vs. Human Husbandry

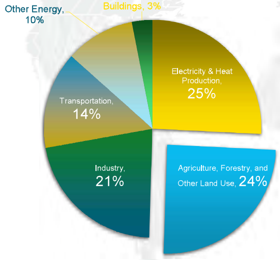
For almost four decades swine nutritionists have balanced rations on essential amino acid content.

Properly valuing protein

"…the "environmental footprint" associated to the production of animal vs. vegetal protein-containing food products, needs to be re-evaluated on the basis of the content of essential amino acids in foods."

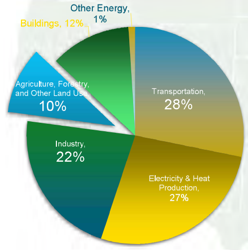
Tessari, P., et al. (2016). "Essential amino acids: master regulators of nutrition and environmental footprint?" Scientific reports 6: 26074.

Global Emissions



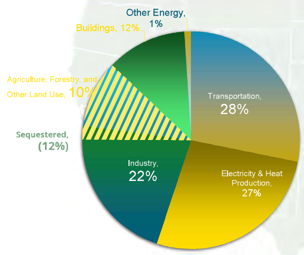
- 25% Electricity & Heat Production
- 24% Agriculture, Forestry, and Other Land Use
- 21% Industry
- 14% Transportation
- 10% Other Energy
- 3% Buildings

US Emissions



- 28% Transportation
- 27% Electricity & Heat Production
- 22% Industry
- 10% Agriculture, Forestry, and Other Land Use
- 12% Buildings
- 1% Other Energy

US Emissions

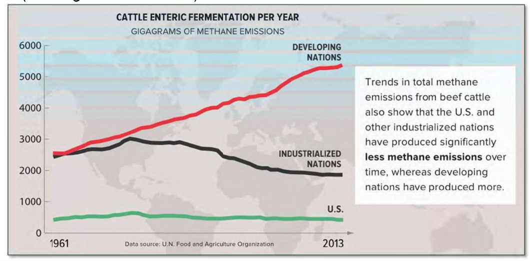


28%	Transportation
27%	Electricity & Heat Production
22%	Industry
10%	Agriculture, Forestry, and Other Land Use
12%	Buildings
1%	Other Energy
(12%)	Carbon Sequestered

BARENBRUG

Global Anthropogenic Greenhouse Gas Emissions

- Livestock (global) - 14.5%
  - Beef cattle production (global) – 6%
    - US beef cattle production - 0.47%
      (8% of global beef cattle)



BARENBRUG

If animal agriculture (and all pets!) were eliminated in the US:

Potential benefit

- Anthropogenic GHG reduction
  2.6% (US)
  0.36% (global)

Potential costs

- Unbalanced food ecosystem
- The creation of essential dietary nutrient deficiencies.

White, R. R. and M. B. Hall (2017). "Nutritional and greenhouse gas impacts of removing animals from US agriculture." Proceedings of the National Academy of Sciences: 201707322 http://www.pnas.org/content/pnas/early/2017/11/15/1707322114.full.pdf

BARENBRUG

Lifecycle CO_2e from TWICE the average US consumption of raw boneless trimmed beef per day is

LESS than the tailpipe emissions for-
driving 2,700 miles per year
or
flying commercial JFK to LAX via DEN, round-trip

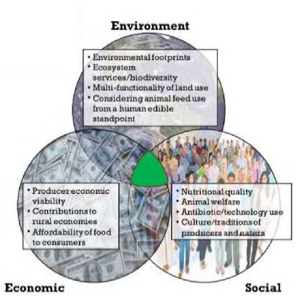
14.82 kg CO2e/lb of boneless, trimmed beef (raw)
24.7 mpg = 9.5 liters per 100 km
0.65 kg CO2e/mile driven
203 kg CO2e/1,000 km, two-leg flight
0.327 kg CO2e/mile flown

BARENBRUG

True sustainability

System sustainability must include:
- Societal
- Economic
- Ecological

What if the burden of chronic diseases (which are mostly metabolic) - globally the largest cause of death & driver of health care - could be dramatically reduced?



BARENBRUG

Heath care's "Footprints"

- What are the impacts of the "healthcare" & pharma industries?
- What if the health effects of what we eat has greater environmental effects than the food we eat does?

Carbon footprint of the global pharmaceutical industry and relative impact of its major players

Show more

Highlights

- Assessment and comparative analysis of GHG emissions of Top-15 global pharmaceutical companies.
- The pharmaceutical industry emission intensity is about 55% higher than the automotive's.
- There is a great level of variability in emissions (up to 5x) between peers with comparable revenues.
- We calculate the intensities and maximum emissions required to comply with the Paris Agreement.

Belkhir, L. and A. Elmeligi (2019). "Carbon footprint of the global pharmaceutical industry and relative impact of its major players." Journal of Cleaner Production 214: 185-194.

BARENBRUG

Heath care's "Footprints"

"Surprisingly, our analysis reveals that the pharmaceutical industry is significantly more emission-intensive than the automotive industry."


Journal of Cleaner Production

Carbon footprint of the global pharmaceutical industry and relative impact of its major players

Belkhir, L. and A. Elmeligi (2019). "Carbon footprint of the global pharmaceutical industry and relative impact of its major players." Journal of Cleaner Production 214: 185-194.

Heath care's "Footprints"

U.S. health care sector "was also responsible for significant fractions of national air pollution emissions" including 10% of greenhouse gas emissions.


RESEARCH ARTICLE

Environmental Impacts of the U.S. Health Care System and Effects on Public Health

Abstract

Eckelman, M. J. and J. Sherman (2016). "Environmental impacts of the US health care system and effects on public health." PLoS One 11(6): e0157014.

Both professions wear white coats. Which produces more greenhouse gases?


US animal agriculture – 4% (beef alone – 2%)[1]


US health care system – 10%[2]

1 - Dr. Frank Mitloehner, quoted in "Sustainable beef? U.S. has most environmentally friendly livestock industry in the world." Beef. Jun 27, 2016. https://goo.gl/WFWWdD
2 - Eckelman MJ, Sherman J (2016) Environmental Impacts of the U.S. Health Care System and Effects on Public Health. PLOS ONE 11(6): e0157014. https://goo.gl/5KeUQR

Type 2 Diabetes' "Footprint"

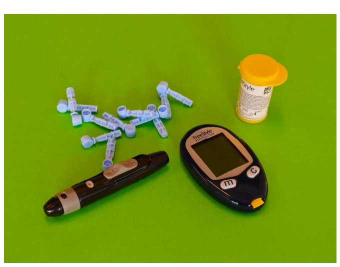
The average American with Type 2 Diabetes uses pharmaceuticals equal to 2 metric tons of CO2 equivalent.

Reducing footprint and keeping their feet

If the average American diabetic could eliminate their medication use, they would reduce their CO2e ("carbon") footprint 29% MORE than if they switched from a high-meat to a vegan diet.

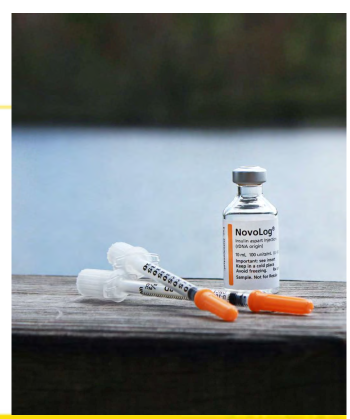
kg CO_2e/year avoided

- 2,010 eliminating medications
- 1,560 shifting from high meat to vegan diet



Type 2 Diabetes' "Footprint"

If their use of those diabetes-specific pharmaceuticals was eliminated, it could result in a reduction of almost 50 million metric tons CO2e.



That's equivalent to

The carbon sequestered by more than 65 million acres of forests in one year.

That area of forest would be:

- The 9th largest state in the US (between Colorado and Oregon)
- The 76th country in land area (larger than the United Kingdom)

If *only*…

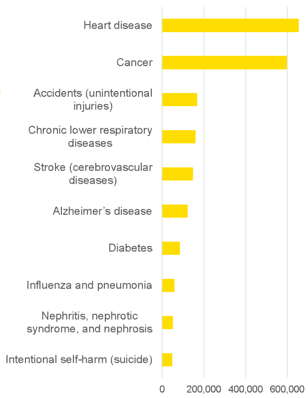
"While reducing and eliminating glycemic control medications, Virta patients lowered HbA1c by 1.3% on average after one year and improved insulin resistance measured by HOM-IR. 60% of patients attained an HbA1c below 6.5% without the use of diabetes-specific medications."

Leading Causes of Death

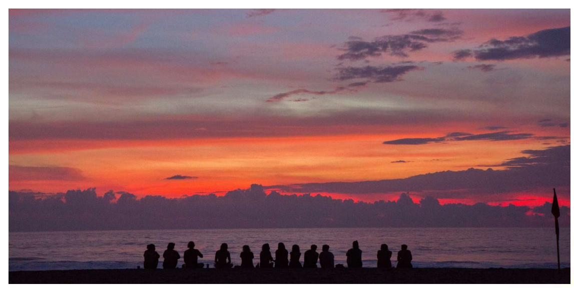
(US, 2018)

The Burden of Hyperinsulinemia

- Diabetes is the 7th leading cause of death in the US.
- What percent of the other 9 leading causes is due to hyperinsulinemia?
- What percent of healthcare is result of that burden?
- What are the potential emission reductions if these burdens could be lifted?



When you improve your health, you are improving the world!

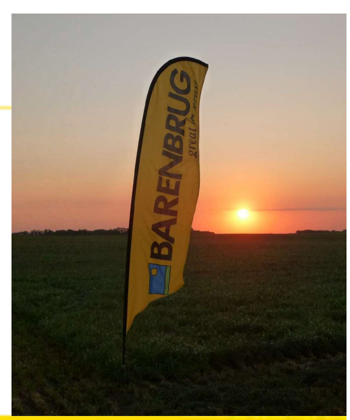


Contact me

Thank you!

Our mission

"Increase animal productivity to help feed the world and enhance the enjoyment of green spaces."



Native Warm Season Grasses: Performance vs. Test

Michael Hickinbotham

C_3 versus C_4


C_3 (Cool Season)

- Temperature
  - Optimum 68-77°F
  - Restricted Growth below 41°F above 95°F
- Photoperiod - Shorter
- Soil Temperature
  - 40-45°F

C_4 (Warm Season)

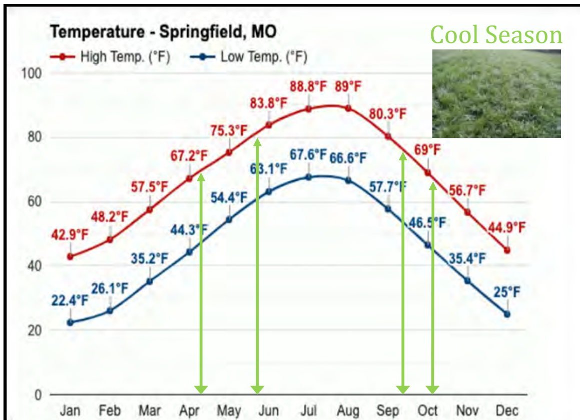
- Temperature
  - Optimum 86-104°F
  - Restricted Growth below 59-68°F
- Photoperiod – Longer
- Soil Temperature
  - 60-65°F

(Moser and Hoveland, 1996; Downton, 1971)

Cool Season VS. Warm Season (Native)

Tall Fescue (Introduced)

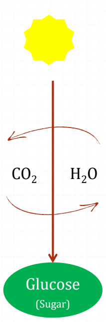
Big Bluestem (Native)



C_3 versus C_4


C_3 (Cool Season)

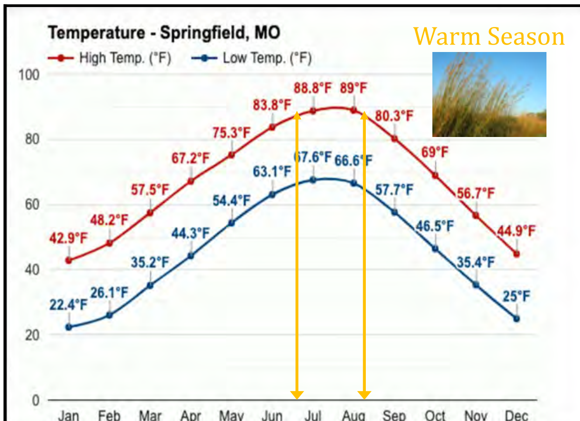
- Photosynthesis
  - 3 carbon acid PGA (3-phophoglyceric acid)
  - Can only fix CO2 while stomata is open (releases water/ require more water)
  - Undergo photorespiration = cost of energy for growth



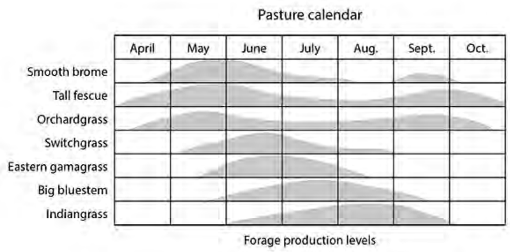
C_4 (Warm Season)

- Photosynthesis
  - 4 carbon acid OAA (oxaloacetic acid)
  - Can fix CO2 with stomata closed (water retention)
  - Absence of photorespiration = more efficient growth

(Moser and Hoveland, 1996; Waller and Lewis 1979; Meacham-Hensold, 2018))

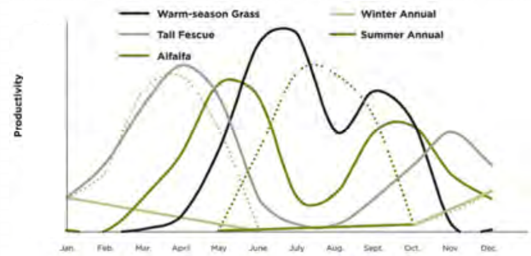


Forage Availability



(University of Missouri Ext.)

Forage Availability



(Noble Research Institute, 2018)

C_3 versus C_4

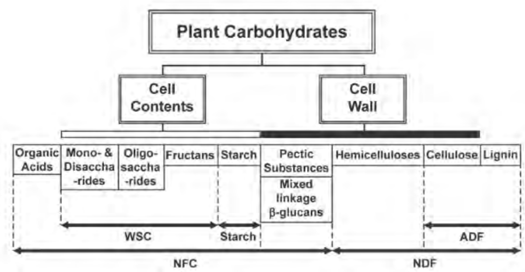
C_3 (Cool Season)

- Higher Nitrogen concentration in tissue
- Store fructans for energy
- Higher accumulation of water soluble carbohydrates

C_4 (Warm Season)

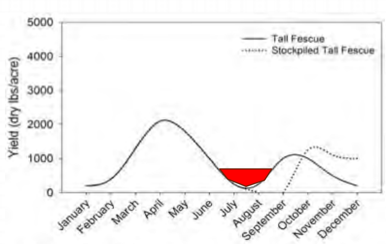
- Less Nitrogen in tissue
  - Less available in soil
  - More efficient use in tissue
- Store starch for energy
- Higher carbon accumulation (dry matter)

(Shewmacker et al., 2006; Norton, 1981)



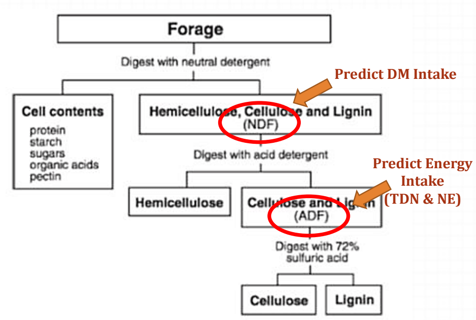
(Hall, 2014)

Forage Availability



(UGA Ext Bulletin 1351, 2018)

Van-Soest Fractionation



Laboratory Analysis

/ AVA MO

		WET	DRY
Moist / Dry Matter	%	19.1845	80.8155
Protein	%	7.214569	8.92721
Adj Cr Protein ...	%	0	0
Avail Protein	%	0	0
A.D.F. - N	%	0	0
Urea	%	0	0
A D Fiber	%	32.91615	40.73
N D Fiber(a)	%	52.48967	64.95
Crude Fiber	%	0	0
Lignin	%	0	0
T D N	%	43.9259	54.35331
NE Lactation	MCAL/LB	.435589	.538992
NE Gain	MCAL/LB	.2056418	.2544584
NE Maint ...	MCAL/LB	.4101037	.5074567
Digst Energy	MCAL/LB	.8783186	1.08682

Performance Data

In House Data (Hay)

Fescue/Clover Fall Grazing

- Grazing ended when canopy height was 2-3"

(Nov-Mar; 130d)	CP % DM	ADF % DM	NDF % DM	TDN % DM	ADG lb/d	Availability lb/acre	Beef lb/acre
KY-31	16.6	28.6	57.1	66.42*	0.73	2364	180
KY-31 R-Ladino	16.1	28.7	57.5	66.32*	0.73	2329	185
KY-31 P-Ladino	16.7	28.7	57.0	66.32*	0.73	2272	171
MaxQ	17.2	28.6	57.2	66.42*	0.82	2139	203
MaxQ R-Ladino	17.0	30.1	58.4	64.97*	0.88	2251	215
MaxQ P-Ladino	17.5	29.9	57.6	65.17*	0.88	2418	207

(Stewart, 2013)

Fescue*	Average (Range)
Crude Protein	**9.84** (6.79 - 13.15)
ADF	**39.49** (31.4 - 46.57)
NDF	**61.40** (54.06 - 71.53)
TDN	**55.38** (49.53 - 62.06)

Switchgrass	Average (Range)
Crude Protein	**7.71** (4.60 – 10.67)
ADF	**43.49** (38.07 – 50.83)
NDF	**66.81** (64.36 – 76.60)
TDN	**52.07** (46.01 – 56.55)

Bermuda	Average (Range)
Crude Protein	**10.74** (6.74 – 15.91)
ADF	**35.96** (27.68 – 42.74)
NDF	**61.36** (53.37 – 68.07)
TDN	**58.29** (52.69 – 65.13)

Bluestem*	Average (Range)
Crude Protein	**7.94** (4.61 – 10.24)
ADF	**41.48** (36.53 – 48.59)
NDF	**66.38** (62.71 – 75.93)
TDN	**53.73** (47.86 – 57.82)

Fescue/Clover (30%) Spring Grazing

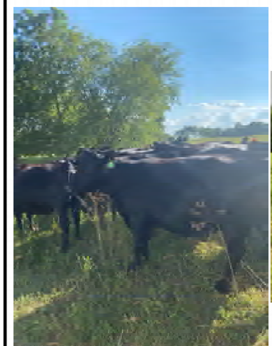
(Mar-June; 107d)	CP % DM	ADF % DM	NDF % DM	TDN % DM	ADG lb/d	Availability lb/acre	Beef lb/acre
KY-31	18.4	28.7	59.9	66.32*	1.12	2434	194
KY-31 R-Ladino	17.3	28.8	59.4	66.23*	1.15	2274	204
KY-31 P-Ladino	19.3	27.3	56.5	67.67*	1.90	2122	324
MaxQ	18.2	27.3	59.3	67.67*	2.12	2185	363
MaxQ R-Ladino	20.1	26.9	56.3	68.06*	2.47	1730	421
MaxQ P-Ladino	20.0	27.7	57.7	67.28*	2.80	2129	481

(Stewart, 2013)

Native Warm Season Grazing

	CP (% DM)	ADF (% DM)	NDF (% DM)	TDN (% DM)	ADG (lb/d)	Availability (lb/acre)	Beef (lb/acre)
Big Blue/Indian (May – June; 30d)	9.9	41.4	68.0	52.4/ 54.09*	2.40	2668	188
Big Blue/Indian (May – August; 115d)	8.6	41.9	70.0	51.8/ 53.61*	2.12	2587	370
Switchgrass (May – June; 30d)	6.6	42.4	74.5	51.3/ 53.13*	1.94	3667	199
Switchgrass (May – August; 115d)	7.7	40.6	72.4	53.3/ 54.86*	1.74	4256	435

Started Grazing at 12-15" with target at 18-24" for full
Dickson and Sango Silt Loam Soil (Soil pH average 6.6*)
Clipped in March to 8"
Nitrogen applied at 60lb/acre
*Big Bluestem and Indian Grass mature later than Switchgrass (Backus et al., 2017)



In House Data (Fresh Forage)

In House Data (Fresh)

WSG Fresh Forage (7/10/20 – 8/30/20)	Average (Range)
Crude Protein (**CP**)	**6.47 % DM** (6.02 – 7.26)
Acid Detergent Fiber (**ADF**)	**42.54 % DM** (41.56 – 43.41)
Neutral Detergent Fiber (**NDF**)	**66.27 % DM** (64.09 – 67.68)
Total Digestible Nutrients (**TDN**)	**52.86 % DM** (52.14 – 53.67)
Net Energy Gain (**NEg**)	**0.233 mcal/lb** (0.222 – 0.245)

Nutrient Requirements of Beef Cattle

550 lb Steer	DMI	CP	RDP	MP	TDN	Neg
1.90 lb/d	13.36 lb	12.6% DM	50.6 %CP	547 g/d	65% DM	0.422 mcal/lb
2.30 lb/d	13.08 lb	14.2% DM	48.1 %CP	607 g/d	70% DM	0.485 mcal/lb
2.58 lb/d	12.61 lb	15.7% DM	46.3 %CP	652 g/d	75% DM	0.549 mcal/lb
660 lb Steer	**DMI**	**CP**	**RDP**	**MP**	**TDN**	**Neg**
2.07 lb/d	16.03 lb	11.3% DM	55.4 %CP	583 g/d	65% DM	0.422 mcal/lb
2.47 lb/d	15.68 lb	12.6% DM	53.2 %CP	640 g/d	70% DM	0.485 mcal/lb
2.78 lb/d	15.13 lb	13.9% DM	51.6 %CP	682 g/d	75% DM	0.549 mcal/lb

(NRC, 2016)

Metabolizable Protein (MP)

Change from Crude Protein (CP) system to metabolizable protein (MP)
- Accounts for rumen degradation of Crude Protein
- Separates requirements needs of microorganisms in rumen and the animal
  - Rumen Degradable Protein (RDP/DIP)
    - Broke down rumen and provide N to microbes = bacterial crude protein
  - Rumen Undegradable Protein (RUP/UIP/"bypass protein")
    - Digested in the small intestine
    - Utilized directly by the animal (supply limited AA)

(NRC, 2016)

Forage Availability

	Availability lb/acre	ADG lb/d
KY-31 Spring	2434	1.12
KY-31 Fall	2364	0.73
MaxQ Spring	2185	2.12
MaxQ Fall	2139	0.82
Big Blue/Indian (May – August; 115d)	2587	2.12
Switchgrass (May – August; 115d)	4256	1.74

New TDN and NE Equations???

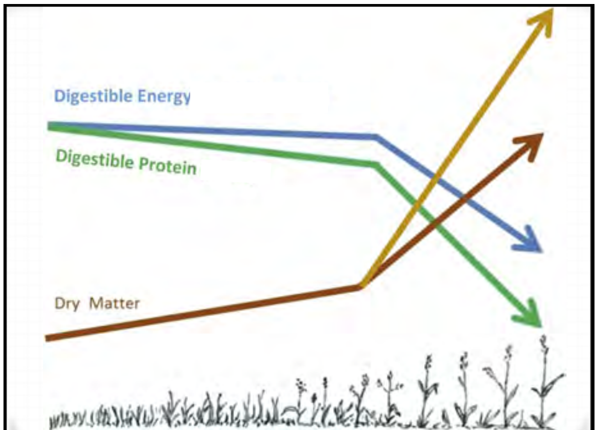
C_3 versus C_4

Protein

C_3 (Cool Season)
- Highly digestible in the rumen
  - High Digestible Dry Matter (DDM/lower ADF)
  - **Higher RDP**

C_4 (Warm Season)
- Less digestible in the rumen
- Enzymes in bundle sheath cells resistant to microbial degradation*
- Higher % escape protein(RUP)*

(Mullahey et al., 1992; Akin, 1989)



(Jensen et al., 2016; Unpublished UW-Madison 2013; Griffin et al., 1979; Temu et al., 2014; Backus et al., 2017))

DMI = 120/NDF + ((NDFD – 45) x .374/1350) x 100

	NDF % DM	NDFD %NDF	IVDMD % DM	DMI % BW*
TF (April-Oct)	54.7	65.8	80.9	2.77
TF+C (A-O)	49.0	67.2	83.6	3.06
TF (July 14)	64.3	64.3	47.8	2.40
Switch Grass S	64.4	62.6	N/A	2.35
Switch Grass T	66.5	60.9	N/A	2.25
Big Blue/Ind. (May – June)	68.0	N/A	66.6	2.09*
SG (May – June)	74.5	N/A	58.1	1.66*
Mix NWSG 08	69.0	62.0	44.0	2.21
Mix NWSG 09	62.0	72.0	63.0	2.68

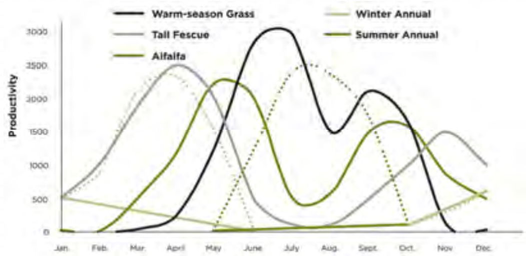
Increased Lignin

Quality and Quantity

- Stage of growth/Time of harvest
  - maturity = decreased nutritive value
- Fertilization
  - (Nitrogen = Protein = Nitrates)
- Weather Conditions
  - (2019 hay {early spring} versus 2020 hay)
- Management
  - Keeping forage in vegetative state
- Age of stand (Fescue)

CUSTOM LABORATORY

"NO grass meets the production and quality requirements of livestock year-round"



(Noble Research Institute, 2018)

Questions?

Developing Forage Pest Issues in Missouri – Be on Guard for Insect and Weed Pests

Tim Schnakenberg, Field Specialist in Agronomy, University of Missouri Extension, Stone County

Agricultural pests seem to develop when we least expect them. There are the perennial pests that we have dealt with for years, such as alfalfa weevils, armyworms and thistles, but there are a few newer ones that some producers are already contending with that have potential to become regular invaders of our pastures and hay fields.

Being on guard for pests is more important than ever. Insect invasions used to be more gradual simply because our transportation with ships and wagons to get across the face of the earth was much slower. Today, they can hop onto an airplane shipment and be at our doorsteps in short order.

There are a few insects that producers should be on guard for in 2021. In 2016, fellow extension agronomists and I started noticing significant **sugar cane aphid** populations in late season sudangrass and other forage sorghums stands, specifically around Stone and Christian Counties. The aphid populations would be so intense that late-season harvests of forage sorghum fields would be severely reduced or destroyed. Sometimes the problem may be minimal just twenty miles away. This has been found on Johnsongrass as well.

Sugar cane aphids are yellow in color and have moved in from the south and will congregate on the stems and leaves of individual plants by the hundreds, sucking life out of the plant, leading to yellowing or reddening of the leaves and reducing yield. Traditional insecticides are not effective for control. So far the products of Transform WG and Silvanto Prime or 200SL are the only products that seem to work. These are generally legal for grain sorghum but consult the label for special labelling in your state and if it can be used in a forage situation. The most practical way to deal with this pest is to convert acreage to one of the millets, which do not appear to be affected by the aphid. Many growers I have worked with have made this switch.

Another new insect to our area affects bermudagrass growers. The **bermudagrass stem maggot** has now moved into our area. I first laid eyes on it with certainty in Barry County in 2019 but suspect it has been here for a while. Other southern Missouri agronomists have been finding it as well for a couple of years now. Gulf states bermudagrass growers have dealt with it for several years and it has now moved north.

Like sugar cane aphid, the stem maggot seems to be an issue with mid-late season growth and can cause yields to taper off quickly. The first sign of infestation appears when the upper terminal leaves look like they have been frosted and die. Closer examination inside the stem reveals a small white maggot feeding. This maggot originated from a fly that laid eggs on the plant a few weeks before. Infestations may vary with different varieties of bermudagrass.

The standard threshold for control used in the southern states is to spray with an insecticide 7-10 days following the previous hay harvest or grazing. Fortunately, inexpensive pyrethroid insecticides can be effective on this insect if applied timely. Unfortunately, the routine insecticide use in bermudagrass stands is not a desirable practice by most producers. The University of Florida is working on pheromone traps to monitor fly movement and I am hopeful this could be a good tool for the future to determine if sprays are needed.

Dr. Kevin Rice, MU Extension state entomology specialist, has warned us of two other potential pests that should be watched closely and monitored. These can affect alfalfa but the extent of damage is yet to be determined for us. The **brown marmorated stinkbug** is known to feed on many plants, including alfalfa. Moving in from the northeast states, it is now believed to be in most Missouri counties. I have not witnessed it in crops or forages yet but we are keeping a close eye for it. Unlike the green stinkbug, it has potential for a high dispersal rate once it is established here.

Dr. Rice also warns of an insect that is of great concern for vineyard owners and walnut growers. That is the **spotted lanternfly**, which has been devastating in the northeastern states. It is still a good distance away from us, but the fact that it has been known to lay eggs on metal surfaces (i.e. trains and truck trailers) concerns entomologists that it could arrive quicker than expected into Missouri. It can be a potential pest for alfalfa, corn and soybeans. It is known to contain the poisonous substance, cantharidin, which is a toxin we are familiar with in blister beetle infestations in alfalfa that can kill horses if consumed in certain quantities.

On the weed side of pests, there are many that have been here for some time but some of these just seem to be getting continually worse. The reasons they may be getting worse in our region can be from several causes. There are many worn-out and unproductive pastures and hayfields. This can be a result of over-grazing, lack of fertility management, the effects of drought years, occasional wet summers and where we may feed weed-infested hay.

Many producers have reported that **green or yellow foxtail** has been getting worse. Grazing palatability of these species is poor. This weed occurs when the stand is either over-grazed or our forages have gotten thinner in these fields. Being an annual species, if there is something growing in their space where they would normally germinate in the spring, they will be crowded out. If the forage has been over-grazed or is non-existent, these will fill the space like "nature's band aid". First, address the stand or grazing issue. If that doesn't work there are limited options for herbicides that could be used. These include pre-emergence products like Prowl H2O, Rezilon (not for fescue) or possibly Facet L as a postemergence product.

Broomsedge has been around for years but with less fertility maintenance, this perennial grass weed can begin to dominate. It can be exceptionally hard to control once established and you should not expect a quick fix. There has been research done at the University of Missouri that has found a significant decline of its dominance within about three years by following soil test recommendations precisely. It is believed to be worse in cases of low phosphorus levels or low pH.

Another weed that appears to have gotten more traction lately is **nimblewill**. Also known as "false bermuda", it is a perennial grass weed with stolons and looks similar to bermudagrass. It's leaves typically are much shorter than bermudagrass. It is adapted to acidic soil conditions and can tolerate shade and wet sites. Currently I have found no labelled herbicide that will control it. Complete renovation may be in order if it has taken over a pasture.

A weed that seems to be new to some areas of Missouri is **Chinese fountain grass.** It has mostly been found in southeast Missouri but could easily be in other parts of the state. A related species is purple fountain grass that is commonly sold as an ornamental. That grass has a high level of sterility, but Chinese fountain grass tends to produce viable seed. It tends to grow in clumps that are very unpalatable to livestock. Dr. Kevin Bradley, MU Extension state weed scientist, conducted a weed control evaluation on this species and found few herbicides that will work well on it. The best was glyphosate that provided about 90 percent control of it. Being a non-selective herbicide, that is not a great option for in-season weed control.

In this discussion I can't leave out **Johnsongrass** which has been around for decades. However, many report that it is worse on their farms, and certainly in road ditches, than ever before. Discussing Johnsongrass is like the old 1960s movie, "The Good, The Bad and The Ugly". It is good because some research has found that it is one of the most palatable forages for livestock and can thrive in hot and dry summers as well as anything. It is bad because of its ability to spread to areas where it may not be wanted due to its rhizomes and seed production. It can be ugly, especially if there is a drought the issue of high nitrates or prussic acid can potentially kill cattle. There haven't been widespread problems with that, but it can happen if producers aren't paying attention.

Some have reported that heavy grazing or continual low mowing has eliminated it over time. This can work when the rootstocks are depleted of carbohydrates and it begins to starve to death. Weed wipers or spot treatment with glyphosate or mixture with other grass herbicides have helped the situation. Others have used products like Outrider on fescue, native grass and bermudagrass stands, Pastora on bermudagrass stands or Plateau/Panoramic on bermudagrass or native grass stands. Do not expect one pass with a herbicide to fix the problem. It will take persistence.

Sedges such as globe sedge or flatsedge have gotten worse in some fields that have wetter areas. We now have a herbicide called Permit that is labeled in grass pastures that works pretty well.

Looking at broadleaf weeds, we have found that one of the more difficult weeds to control is **maypop passionflower**. More producers are reporting this problem in fields lately. University research from Dr. Bradley has determined that the most effective treatment has been a heavy dose of Surmount herbicide. Even with this application, one year after treatment the success rate was not as good as we would like.

Poison hemlock continues to dominate pastures and hay fields around southwest Missouri. This weed has a parsley-like leaf structure, hollow stems, strong smell, white umbrella-like flowers and it is known to be toxic to livestock and humans. If you handle it, be sure to wear gloves. This biennial weed will germinate in the fall and bolt in the spring. It can easily be treated with many herbicides on the market today.

Another broadleaf weed with a strong smell that is getting worse is **perilla mint**. Perilla mint is a shade-tolerant summer annual with square stems, minty smell and contains ketones that cause respiratory stress in animals. We believe there have been numerous cow deaths as a result of this weed if nutrition is lacking. We have even found cases of cow deaths in winter months when cattle have clipped off the poisonous seed-heads. Many broadleaf herbicides on the market today will treat this weed effectively.

Invasive and developing species are nothing new. But it's all of our jobs in the industry to keep watch for these infestations and act quickly in eliminating them when first observed on a property. Also, if it is new to you, keep the industry informed. If you see something that is questionable or new in your forage or row crop, please contact any extension field specialist in agronomy or an entomologist with the Missouri Department of Agriculture.