Hay Production and Quality

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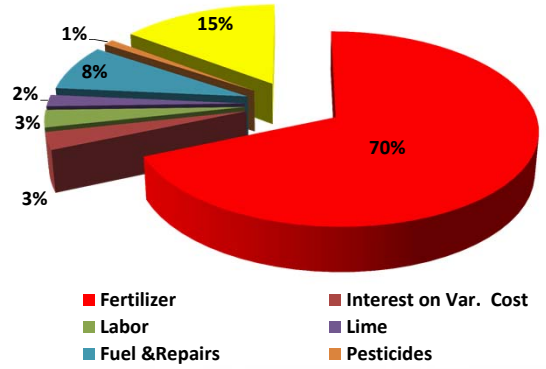
Hay Production

- Over 80% of feed costs are made up of homegrown feed, the majority of which is undoubtedly hay.
  - Anything producers can do to reduce the costs associated with hay production and harvesting should help improve the profitability of their beef business.

Hay Production

- **Mississippi Hay Production**
  - 28% of the total forage production (590,549 acres)
    - Bermudagrass (345,928 acres)
    - Bahiagrass (244,621 acres)
  - $124 Million enterprise

Hay Production Cost



Selecting the Appropriate Species

1. Acceptable to the market
   A. Supreme quality demands?
      I. Good-fair quality hay.
      ✓ Bermudagrass, tall fescue.
      II. Premium quality hay.
      ✓ Bermudagrass, annual ryegrass, alfalfa.
      iii. Supreme quality hay.
      ✓Tifton 85 bermudagrass, annual ryegrass, alfalfa.

Selecting the Appropriate Species

2. Agronomically acceptable
   b. Tolerant of climatic conditions
      ii. Tall fescue (North and Central MS)
      iii. Berdmudagrass, bahiagrass (South MS)
   c. High yields
   d. Vigorous establishment
   e. Soil fertility demands
   f. Tolerant to soil conditions

Selecting the Appropriate Species

Variety	Overall Rating	Relative Yield	Digestibility	Winter Hardiness	Persistence	Leaf Spot Resistance
Alicia	2.5	100	P	G	P	P
Coastal	3.5	100	F	G	G	E
Sumrall	3.5	98	G	G	G	G
Tifton 44	4.0	90	E	E	G	E
Tifton 85	5.0	102	E	F	E	E

Rating: 1 = Poor, 3=Good, 5= Excellent

Selecting and Establishing a Hay Crop

- "No-till"
  - Best when terrain is rolling or soil is at risk of erosion
  - Primary used for seeding or inter-seeding
  - Not feasible for vegetative establishment (sprigging)
  - Seeded type blends of bermudagrass varieties:
    - Cheyenne, Cheyenne II, Ranchero Frio, Sungrazer, Sungrazer Plus, Sungrazer 777, CD90160, KF194, Pasto Rico, Laredo.

Establishing Hybrid Bermudagras

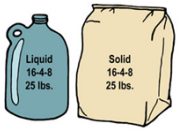
- **Best methods:**
  - Dormant sprigs (rhizomes) – 40-50 bu/ac
    - Dec. to early Mar.
  - Sprigs with green tops – 30-50 bu/ac
    - Sprig late April (after last freeze) to early Aug.
  - Top/green stems – 50-60 bu/ac
    - Jun. – Aug.
    - Coastal, 85, Sumrall
    - Not recommended for Tifton 44
- Best is seedbed is well-prepared

Fertilization Strategies for Hay Production

- **Questions to be addressed:**
  - What nutrients are essential for high yields/quality?
  - What is "goin' on" with the fertilizer market?
  - How do I get the most out of my fertilizer?
  - What are the differences between N fertilizer products?
  - What are the implications for using poultry litter (or other wastes) as my main source of fertility?

Fertilizing Summer Hay Fields

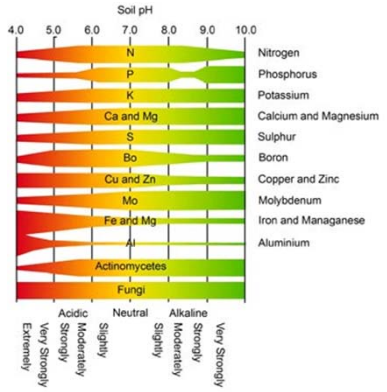
- Fertilizer cost accounts for about 70% of the input associated with hay production.
- **Keys to successful fertilization?**
  - Soil testing
  - Applied nutrient with the right source, at the proper rate, at the proper time
    - Especially nitrogen.



Functions of N,P, and K.

- **Nitrogen**
  - Increases forage production and quality
- **Potash**
  - It is important for plant persistence and survival under stress (drought).
- **Phosphate**
  - It helps to ward off diseases and prepare for dormancy

Soil pH Affects Availability of Nutrients



Low Soil* pH Makes Fertilizers Work Less Efficiently

SOIL ACIDITY	NITROGEN	PHOSPHATE	POTASH	FERTILIZER WASTED
Extremely Acid 4.5 pH	30%	23%	33%	71.34%
Very Strong Acid 5.0 pH	53%	34%	52%	53.67%
Strongly Acid 5.5 pH	77%	48%	77%	32.69%
Medium Acid 6.0 pH	89%	52%	100%	19.67%
Neutral 7.0 pH	100%	100%	100%	00.0%

* Mineral soils

Nutrient Removal by Harvest

	N	P_2O_5	K_2O	Grade
Forage	**Dry matter basis (lb/ton)**			
Alfalfa[1]	**56**	**15**	**60**	**42-11-46**
Annual Ryegrass	**68**	**16**	**67**	**45-11-44**
Bahiagrass	**43**	**12**	**35**	**48-13-38**
Bermudagrass	**46**	**12**	**50**	**42-11-46**
Clover-grass[1]	**50**	**15**	**60**	**40-12-48**
Tall Fescue	**38**	**18**	**52**	**33-17-48**
Orchardgrass	**50**	**17**	**62**	**39-13-48**
Sorghum-Sudan	**40**	**15**	**58**	**35-13-51**
Vetch[1]	**56**	**15**	**46**	**49-13-39**

[1]Legumes obtain N from the air
Source: Snyder, 2003.

The Effectiveness of N Sources at Low, Medium, and High Fertilization Rates on Hybrid Bermudagrass (Relative to Ammonium Nitrate)

Nitrogen Source	Fertilizer Rates (lb/ac)*		
	<200	**250-350**	**>400**
Ammonium Nitrate	100%	100%	100%
Amm. Sulfate	95-97%	95-105%	60-70%
UAN Solution	70-75%	93-95%	94-95%
Urea	79-82%	82-92%	88-93%

***Actual lb or units of N per acre per year**
Source: Burton and Jackson, 1962; Silveria et al., 2007

Split Your Nitrogen Applications

- Long-term
  - **This can increase yields by 1200-2400 lbs/acre**
  - **This can increase NUE by 25-30%**
- Especially important under extremes
  - Leaching
  - Volatilization (in the case of urea-based products)
  - Late freeze
  - Drought

A Fertilization Trick

Avoid the Use of Standard Blends

Fertilizer Strategy	Lbs of Product/acre	Price, $/acre
Blended Fertilizer		**$367.65**
17-17-17	1471	$367.65
Mixed Fertilizer		**$263.69**
Urea (46-0-0)	488	$85.43
DAP (18-46-0)	141	$28.26
Potash (0-0-60)		
Poultry Litter		**$164.00**
3-3-2	8000	$120.00
Potash	110	$ 44.00

Target Fertilizer Rate: 250-65-225 (Assumes Medium Soil Test Level of P and K)

Effect of K_2O Rate on Yield and Stand of Coastal Bermudagrass (6-year Avg.)

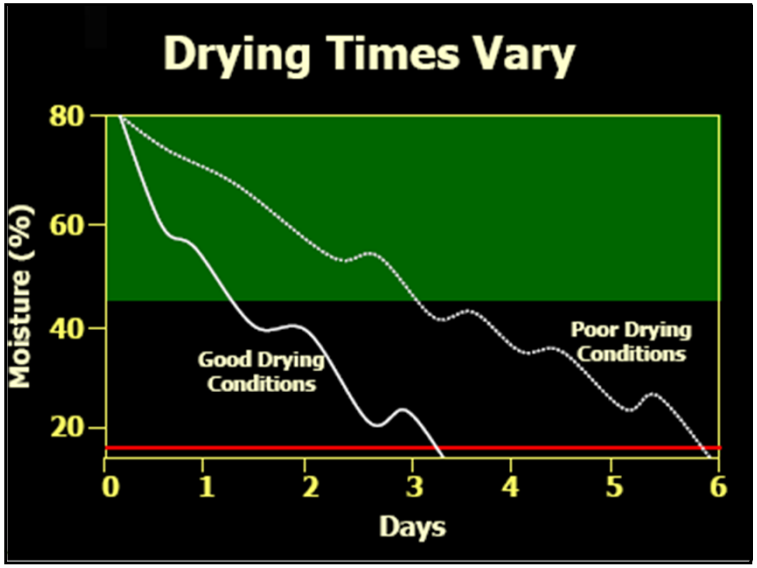
K_2O Rate	Hay Yield		Year 1	Year 6
--------- (lb/ac) ---------			---------- Stand (%) ---------	
0	8919		57	29
100	12399		47	84
200	13583		45	89
400	14341		41	88

Soil test K was very low.
Source: Fudenburg and Twidwell, 2000

Dry Matter Loss

Components of Hay Losses

- Field curing
- Harvesting
- Storage
- Feeding



Hay Curing Management

- Conditioner? **YES.**
- Wide or narrow swath? Wide as possible.
- When to mow? Early as possible.
- Ted it? **YES**, but only when damp and toward the end of when the dew is on.
  - Avoid tedding legumes when >50% moisture
  - Moisture at raking?
    - 35 – 40% for legumes
    - 20 – 25% for grass/legumes mixture
    - < 20% for bermudagrass
  - Moisture at Bailing?
    - Small squares = 18%
    - Round bales = 15%

Conditioner Styles

Flail (impeller)

Roller (crimper)

Conditioner Styles

Flair impeller

- Fine stemmed grass
- The goal of impeller conditioning is to gently remove the waxy surface from the plant, so it will dry down more quickly.
- This process exposes the inner moisture, which allows the crop to dry down faster than if it were simply cut and laid out on the field.

Roller (crimper)

- Thick stemmed grass and leafy legumes
- Roll conditioning occurs by applying intermittent pressure to the crop in order to crimp the stem.
- This break in the stem allows moisture to escape from the plant where it is crimped.

Hay Raking Systems

- **Parallel bar rake**
  - The lowest amount of hay loss, particularly with legumes.
  - Usually good drive system.

- **Rotary rakes**
  - Some are dual function (rake or ted).

- **Wheel rakes**
  - Operated at higher speed (saves time)
  - Tend to leave more biomass in the field.

"My Buddy, Ted"

- Increase hay drying rates by 20-40% (~0.5 – 1.0 day)
- DM Loss: Grasses (<3%), Legumes (7 – 10% +)
- Break up clumps and distribute the crop over the entire area.
  - Increase sun exposure.
  - Fluffed for better air movement.
- Initial tedding: within 2 – 4 hrs (clumps break better).

Bailing Moisture

- First cutting hay normally baled around 15% moisture.
- Most baled hay will reach 12% moisture in about two months
  - 4 to 5% dry matter loss
    - Dry matter loss directly related to heat generation by microbial activity
  - Energy, protein, phosphorus, and calcium levels change little at this moisture

Temperature (°F)	Monitoring Recommendations
< 130	Monitor temperatures in the hay stack twice a day.
130 to 150	Temperature may fluctuate up and down. Check temperature every few hours.
150 to 175	Move hay out of the barn to provide air circulation and cooling since temperature will most likely increase. Monitor temperature every two hours.
>175	Fire is imminent or present. Contact the fire department immediately. Continue to monitor the temperature and do not attempt any put out any possible fires or move hay.

Source: Gay et al., 2003.

Table 1. Effect of Moisture Content at Baling on Dry Matter Loss and Quality Changes during Storage.

% Moisture	% DM Loss	Quality Changes
≤15	None	None
15-20	1-5*	Loss of moisture, slight loss of digestibility or energy (less than 5 percentage units).
>20	5+	Significant loss of digestibility (more than 5 percentage units), extensive loss of green color, lower protein digestibility due to heat-damaged protein.

Storage Losses

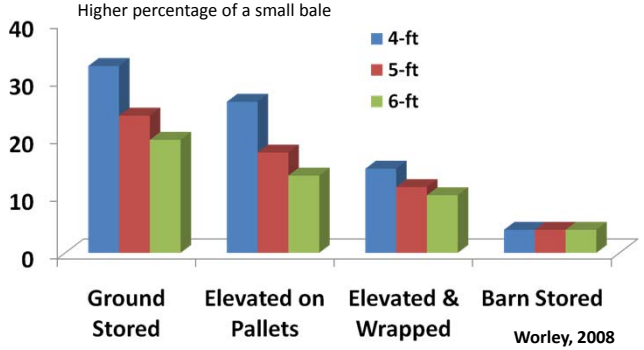
- **Dry matter loss during storage is primarily non-structural carbohydrates.**
  - These are the most digestible portions of the plant
  - Increases the concentration of structural carbohydrates = less digestible.
- **Protein is lost at a much slower rate**
  - Percentage of protein can actually increase (due to loss of NSC and water)
  - Total of protein will be less

Dry Matter Losses (%)

Worley, 2008

Dry Matter Losses (%) as Affected by Bale Size

Outer 4 to 6 inches is lost
Higher percentage of a small bale



Worley, 2008

Table 1. Value of hay lost in storage.

Storage loss (%)	Hay price (per ton) $40	$60	$80	$100	120
5	2	3	4	5	6
10	4	6	8	10	12
15	6	9	12	15	18
20	8	12	16	20	24
25	10	15	20	25	30
30	12	18	24	30	36
35	14	21	28	35	42
40	16	24	32	40	48

Note: **Does not include losses associated with shrinkage or reduced quality.**

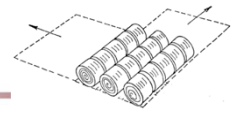
Source: Raymond, 2004

Situation

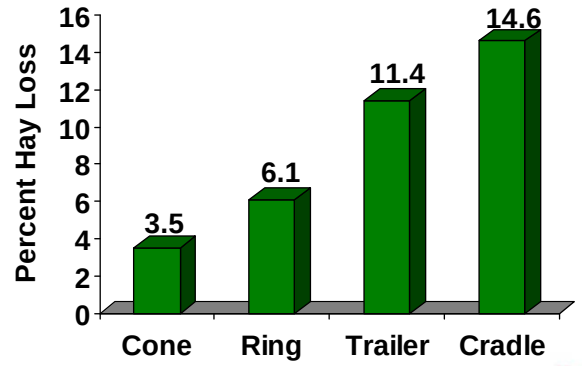
- 1200 lb round bale stored in the ground with 33% DM loss (400 lbs)
  - Initial forage quality: 8% CP, 55% TDN
  - Losses:
    - 32 lbs of CP and 220 lbs of TDN.
    - TDN replaced with corn at a cost of $5.50 per cwt, replacement cost is $15.12 per bale for TDN only.
    - Replacement cost for protein losses during storage is $8.32 when using soybean meal at $11.00 per cwt, but can be as high as $20 if self-feeding protein blocks are used as the supplemental protein source.
    - Purchase of additional hay to replace the dry matter losses from storage and feeding is ~ $10 per bale.
    - Approximate loss per bale is $8 - $10

Field Storage Recommendations

- Store on high, well-drained ground
- Store in open, sunny area
- Store in rows with flat edges touching and round edges separated (unless tarped)
- Orient rows North and South
- Orient rows down slope, not across slope
- Store near feeding area



Hay Feeding Losses



Estimated Losses from Feeding Methods

	With Rack		Without Rack	
Bale Type	1-day supply	7-day supply	1-day supply	7-day supply
	---------- % ----------			
Small square bales	3.9	4.1	6.7*	--
Large round or square bales	4.9	5.4	12.3*	43.0*
Formed haystacks	8.8	15.0	22.6	41.0
Small round bales (fed in place on pasture)	--	--	10.0	30.0

*Bales spread or unrolled across pasture.
Source: Kallenbach, 2000

Hay

Major Factor for Hay Quality Loss

- **Maturity**
  - Late maturity: higher yields, less quality, more hay need to be fed to meet requirements, or more $ invested in supplementation.

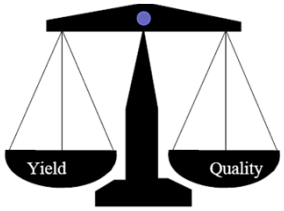
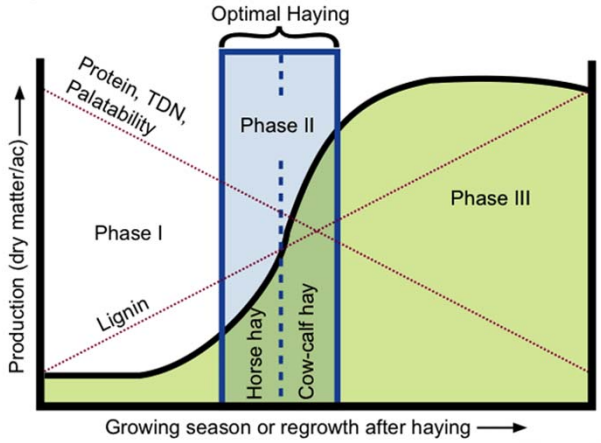


Figure 1. Phases of Plant Maturity



Potential for Hay Quality

Higher Quality → Lower Quality

Legumes	Cool Season	Warm Season	Crop Residue
Alfalfa	Ryegrass	Bermudagrass	Wheat Straw
Clovers	Tall Fescue	Pearl Millet	Cotton Stalks
Soybean	Small Grains	Sorgun-Sudan	Corn Stover

Annuals > Perennials

Rain Effect in Quality Losses

Hay Forage	Leaves retained (%)	CP Retained (%)	TDN Retained (%)
Standing Crop	100	100	100
Field Cured			
No rain	62	72	59
Rain	32	55	52

Rainfall amounts up to one inch.
Source: Evans, J. Univ. of KY.

Cutting Frequency

Effect of harvest frequency on yield and digestibility of hay.

Harvest frequency weeks	acre Yield/ (tons)	Percent crude protein	Percent leaf	Percent stem	Percent fiber	Dry matter digestibility
3	7.9	18.5	83	17	27.0	65.2
4	8.4	16.4	79	21	29.1	61.9
5	9.2	15.4	70	30	30.6	59.3
6	10.3	13.3	62	38	31.6	58.0
8	10.2	10.7	56	44	32.9	54.1
12	10.4	9.0	51	49	33.4	51.0

Stichler and Bade, 1998

Maturity Affects Nutrient Composition

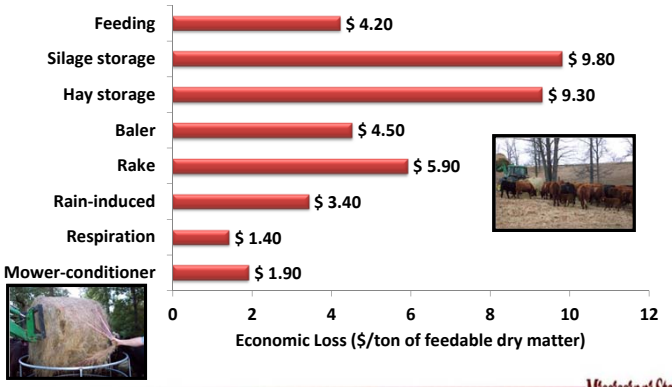
- The decision of cutting time: early July vs. early August.
  - The July harvest produced about 2400 lb DM/ac vs. 2800 lb DM/ac in August.
  - The July cutting was tested at about 7% CP and 55% TDN and the August cutting was about half as good for protein content (3%) and 46% TDN.
    - July = 168 lb of CP
    - August = 84 lb CP

Calculation

- **For a ton of SBM ($200/ton)**
  200 x (90/100) x (49/100) = **822 lb CP/ton**
  ($200/200 lb) /(822 lb/2000 lb) = $**0.227/lb CP**

- CP value in the hay?
  - July = 168 lb * 0.227 = $38.14
  - August = 84 * 0.227 = $ 19.07
  - Loss = $15.05 /ac
  - Assume you have 20 acres = $301.00

Economic Value of Hay Losses



Baleage- An Option for Harvesting Quality

Advantages:

- Lower the risk of rain damage
- Less shatter loss
- Higher forage quality
  - Lower NDF, ADF, and ADL
  - Higher CP
  - Increased Digestibility
  - Increased Palatability

Hancock and Collins, 2006.

Baleage

- **Disadvantages**
  - **Higher cost than conventional hay methods**
    - **Costs are offset by losses in hay methods**
  - **Bales can be very heavy**
  - **Some balers can't bale wet forage**
  - **Tears or punctures can lead to spoilage**
  - **Possibility of spoiled silage causing sickness**
  - **Disposal of used plastic**

Baleage Production Cost

- **Plastic**
  - $5.00 - $15.00/ton DM
- **Wrapper Cost**
  - $2.00 - $5.00/ton DM
- **Fuel & Repairs**
  - $0.50 - $2.00/ton DM
- **Labor**
  - $0.75 - $2.00/ton DM
- **Total**
  - $12.00 - $25.00/ton DM

Bale Harvest Management

- Cut mid-afternoon on one day, bale and wrap the next day.
- Amount cut = how much can be baled and wrapped the next day.
- Bales should be wrapped within 12 hrs of bailing.
  - Large Tubes
    - Use 6-10 layers (+ double on joints)
  - Individual bales
    - 4-6 layers

Bale and the Right Moisture

- Ideal range, 50-65% Moisture

Toxic Potential (Clostridial, Listerosis ← **70%** — **Moisture** — **40%** → **Poor Fermentation**

Rule of Thumb: Bale when the forage is no longer wet enough to writing juice out of a handful.

Baleage and Animal Performance

Treatments	CP	TDN	RFQ	ADG
	%	%		(lb/hd/d)
Bermudagrass Hay	16.1a	62.9b	116c	1.56b
Ryegrass Baleage	16.3a	65.9a	174a	1.94a
Ryegrass Hay	14.7b	62.4c	133b	1.26c

Hancock, 2010

Where are we now?

- Presently, hay is marketed predominantly on a per bale basis.
  - Weight and quality are rarely accounted for
- Will we ever get to weight-based marketing?
  - Fertilizer, fuel, squeeze on forage inputs may eventually *force us!*

Hay Production Summary

- **Harvesting forage on time is the first principle in producing good-quality forage.**
- **Providing plants with the proper nutrition is critical to high yield and quality.**
- **Include legumes in your forage stands.**
- **Protect your investment by storing hay properly.**

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