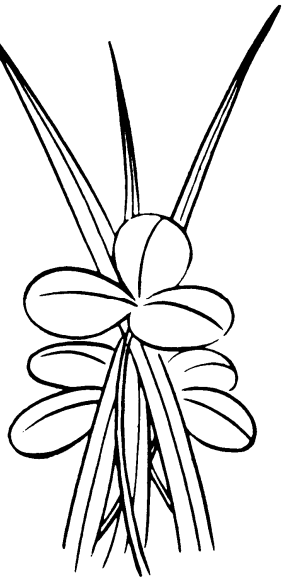
9th Kentucky Grazing Conference



October 23, 2008

Fayette County Extension Office
Lexington, Kentucky

Sponsored by:
Kentucky Forage & Grassland Council
University of Kentucky

Special Publication KFGC-08-02
Garry Lacefield and Christi Forsythe, Editors

SCHEDULE FOR THE DAY

8:00 Registration, Visit Exhibits, Silent Auction

8:30 Welcome

8:45 Growth of Grasses & Legumes: Impact on Grazing – *Dr. Ray Smith*

9:00 Forage Legumes vs. Fertilizer Nitrogen – *Dr. Garry Lacefield*

9:20 Horse Pasture Monitoring Program: Results After Three Years – *Mr. Tom Keene*

9:40 Herbicide Options for Pasture Weed Control – *Dr. J.D. Green*

10:00 Break, Visit Exhibits, Silent Auction

10:30 Practical Grazing Management and Feed Strategies to Alleviate Fescue Toxicosis – *Dr. Glen Aiken*

11:00 Fencing and Watering Systems: Simpler is Better – *Mr. Ralph Quillin*

11:30 Supplementing Cattle on Pasture: When, What and How Much? – *Dr. Roy Burris*

12:00 Lunch

12:45 KFGC Business Meeting / KFGC Awards / Silent Auction Results

1:15 Forage Spokesman Contest

3:00 Adjourn

KFGC Award Winners History				
Year	**Grassroots**	**Public Service: County**	**Public Service: State**	**Industry**
2008	Todd Clark	Chris Milam	Ray Smith	Jeff Medlin
2007	John & Randy Seymour	Rick Greenwell	Lowell bush	Ralph Quillin
2006	Bill Payne	George Kelley	Mike Barrett	Buddy Rowlett
2005	Paul Beauchamp Ova Alexander	Rankin Powell	Byron Sleugh	Bred Winsett
2004	Lee Robey	Don Sorrell	Donnie Davis	Joe Stephens
2003	Jason Sandefur	Keenan Turner	Tim Phillips	Mike Feldhaus
2002	Jimmy May	Doug Shepherd	Chuck Dougherty	Charlie Leppert
2001	Steve Johnson	Charlie McIntire	Donna Amaral-Phillips	Sharon Burton
2000	Nicky Baker	Gary Tilghman	Oran Little	Phil Rowland
1999	Russell Hackley	Bill Green	Joe Wyles	John Long
1998	Minos Cox	Dr. Luther Smith	Billy Ray Smith	Bill Cisney
1997	Cecil Cade	Terry Gibson Darrell Burks	David Stipes	J.W. Stephens
1996	Bryan Hatfield	John Fourqurean	Jimmy C. Henning	Phil Howell
1995	Donnie Shaw	Steve Moore	John Johns	Tim Keene
1994 (Nov)	J.B. & Bill Holtzclaw	Steve Osborne Ken Johnson	David Williamson	Bill Talley
1994 (Jan)	Ben Crawford	Jack Ewing	Mike Collins	Gary Coughlin
1993	Larry Shirley	Paul Deaton	Roy Burris	Gary Lane
1992	Larry Jeffries	Tom Curtsinger	Harold Vaught	Dink Embry
1991	John Nowak	Dan Grigson	Ken Wells	Tim Sickman
1990	Wallace Campbell	Kelsey Driskill	Don Henry	Charles Dobbs
1989	None	None	None	None
1988	None	None	Normal Taylor	Henry T. McCarley
1987	Hillary Skees	John Kavanaugh (1st year awarded)	Paul Burris	Wayne Harr
1986	Don Moore		Curtis Absher	Garland Bastin
1985	Lenn Lee Nelson Dr. G.L. Simpson		Monroe Rasnake	
1984	Paul McCarthy		A.J. Hiatt	Jack Crowner
1983	Dale Lovell		Bobby Pass	
1982	Larry Campbell			
1981	Harry Goodin Henry Besuden		Garry Lacefield J. Kenneth Evans	Aubrey Warren
1980	Charles Schnitzler Harold Rose John Turner Don Evans		Tim Taylor	Warren Thompson
1979				
1978				
1977				
1976			E.N. Fergus Bill Johnstone	Barney Arnold

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Growth of Grasses & Legumes: Impact on Grazing

Ray Smith
Extension Forage Specialist
University of Kentucky

The primary, cool season, perennial pasture grasses used in Kentucky are orchardgrass, bluegrass, and tall fescue. When not grazed or harvested, each of these passes through successive stages of growth in the spring: 1) leafy vegetative; 2) boot with seed heads enclosed in leaf sheath; 3) heading when the seed heads begin to show and, 4) bloom when pollination has occurred (Figure 2). Since fiber and lignin contents increase steadily beyond the vegetative stage, while percent protein and digestibility decrease, a major goal in grazing management is to maintain these grasses in the leafy, vegetative stage at all times. Once the spring season is past, these grasses do not go through this series of growth stages until the next spring. Therefore, the regrowth after each grazing period is leafy and high in quality.

The bottom leaves of the grasses, especially the tall-growing orchardgrass and tall fescue, die due to shading and diseases as the plants grow tall. Such tall growth also shades clover plants, making it difficult for them to compete or even survive. As leaves mature they decrease in quality and growth rate slows. Removal of these leaves by the grazing animal stimulates new tillers and increases the vigor of the plants if conditions are favorable for regrowth. Legumes, such as red clover, ladino clover, and alfalfa, also go from leafy to stemmy growth stages with the same lowering of quality as the grasses. Except for calcium, the mineral content in these forages decreases from the leafy to the stemmy growth stages.

Nonstructural carbohydrates and other energy reserves are produced when plants are growing. The excess nonstructural carbohydrates are stored in roots, rhizomes, stolons, and tillers. They provide energy and nutrients while plants are being grazed and as they make regrowth. Reserves provide energy for persistence during drought, periods of low or high temperatures, and for growth when conditions improve. Levels of nonstructural carbohydrates are reduced as they are utilized for rapid plant growth, particularly after the plants are grazed so short that little leaf area remains. As leaf area increases, nonstructural carbohydrate reserves also increase due to the positive balance between photosynthesis and respiration.

When leaf area on plants is low, such as after close grazing or hay making, there is not enough energy (sugars) being produced by photosynthesis to provide for both leaf and root development. To "stay alive" the plant uses all available energy for producing new leaves until there is excess for root development. If the leaf area, and indirectly the stored energy, is always low due to continuous overgrazing, the root system is small, weak, and shallow. The deprived root system cannot provide adequate water and nutrients which contributes to a weakening of the entire plant.

Maximum growth of forage plants generally occurs when there are enough leaves present to intercept 90 percent of the sunlight, with less than 10 percent falling on the soil surface below the plants. Additional leaves do not increase production due to shading and loss of efficiency of the older lower leaves. This is the optimum time to begin grazing.

Utilizing these principles, the goal of efficient grazing management, with the plant in mind, is to practice grazing management which results in plant persistence plus high yields and quality while maintaining adequate leaf area and levels of nonstructural carbohydrates for stored energy. This means removing a major portion of the leaves by grazing at a time when plant reserves are adequate, then allowing the plant enough time to produce leaf area sufficient to replace the reserves utilized in the process of making regrowth.

Perennial Forage Species for Grazing

Orchardgrass and tall fescue are tall growing, perennial, cool season grasses. Bluegrass is also a perennial, cool season grass which is shorter and has finer stems and leaves. Very close continuous grazing suppresses new growth of these grasses, but bluegrass is less affected than the two taller growing grasses. In addition to stored energy at the base of its tillers, bluegrass also has relatively high levels of nonstructural carbohydrates stored in its rhizomes which serve as sources of energy when it is grazed closely. Each of these cool season grasses, especially bluegrass, slows down dramatically in growth during the hot summer months.

The primary storage of nonstructural carbohydrates in orchardgrass is in the base of its tillers. Since it is also a tall grass compared to bluegrass, a large percentage of its tillers and their high levels of stored energy are susceptible to being removed by close grazing. Unlike bluegrass, orchardgrass has no rhizomes and tall fescue has only very short rhizomes for storage of energy.

Tall fescue is better able to withstand close, continuous grazing than orchardgrass. In addition to the nonstructural carbohydrate reserves in the base of its tillers, tall fescue has reserve energy stored in its short rhizomes. Tall fescue also has more leaves closer (semi-prostrate) to the ground. Based on these characteristics, bluegrass can be grazed

down to 1 inch, tall fescue to 2-3 inches, and orchardgrass to 3-4 inches without causing injury to the plants. However, each species benefits from recovery periods following grazing to allow accumulation of leaf area and nonstructural carbohydrate energy reserves. The cool season species benefit from longer rest periods and from not being grazed as closely during periods of stress such as drought or high temperatures.

Light grazing pressure results in orchardgrass and tall fescue dominating bluegrass and the clovers due primarily to shading by the two tall growing grasses. In tall fescue-orchardgrass pasture mixtures, tall fescue can be expected to overcome the orchardgrass. This is partly because tall fescue is adapted to a wider range of soil moisture, temperature, and soil fertility than orchardgrass. Another factor is that animals often overgraze the more palatable orchardgrass. Tall fescue also is better able to withstand close grazing due to its semi-prostrate tillers and leaves. In controlled grazing systems with adequate, but not extreme, grazing pressure, bluegrass can often be maintained with orchardgrass and even tall fescue if soils and climate are favorable for bluegrass.

Ladino and white Dutch clover are the same (*Trifolium repens*) except for size. Ladino is a giant type while white Dutch is much smaller. These perennial legumes have shallow root systems which make them susceptible to drought injury. They spread by stolons which are actually stems laying on the soil surface producing roots and leaves at each node. Since the stem (stolon) is on the soil surface rather than upright, grazing animals remove only leaves. This is a primary reason for the high quality of these plants and their ability to withstand close grazing.

Red clover is a perennial legume that generally persists for only one and half to three years in Kentucky due to crown and root diseases (common seed – 1 to 1 ½ yrs, improved varieties 2 to 3 years). It has excellent seedling vigor and develops a strong taproot. Red clover can tolerate close grazing even on a continuous basis. Regrowth is initiated from buds in the crown. It is an excellent companion legume with orchardgrass and tall fescue because it grows tall enough to compete with them. It adds to the quality and productivity of pasture and is also well suited for grazing and for hay or silage.

When properly managed, alfalfa and alfalfa-orchardgrass mixtures provide high-quality, high-yielding forage throughout the grazing season. Its large tap root enables alfalfa to obtain water during dry periods when more shallow rooted plants slow down in growth or dry up. Alfalfa needs a rest period following grazing. There are several unique considerations when grazing alfalfa though. Do not allow livestock to remain on the field more than 7 days (to avoid regrazing young shoots). Since plants should be at a late bud to early bloom stage before grazing, rotational grazing is essential for stand survival and productivity. Some producers prefer grazing alfalfa before the bloom stage for maximum quality. It is essential though to give alfalfa a sufficient rest period before regrazing because it stores carbohydrates (starches and sugars) in its large taproot and then uses these carbohydrates for regrowth following grazing (Note: alfalfa typically

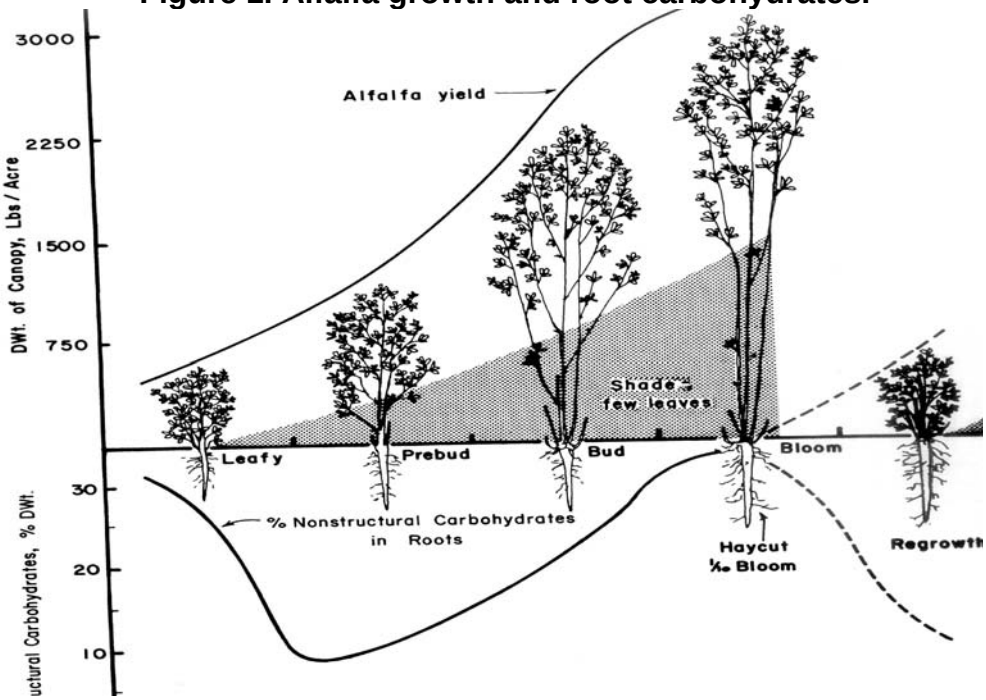
reaches the late bud to early bloom stage in 28 to 35 days). See Figure 1 for an overview of root regrowth and root carbohydrate storage in alfalfa.

Managing alfalfa based on root carbohydrates is an important consideration during the fall. Alfalfa stands should not be grazed during the critical fall period to allow sufficient root carbohydrate storage before winter. This critical period is 6 weeks before the first killing frost (normally defined in alfalfa as 24^{o}F or below). In Kentucky this period is considered September 15 to November 1, although it will vary somewhat from north to south and from one year to the next. Therefore, the last grazing for the summer should occur before September 15th, and then a final grazing can occur after November 1. Killing frosts do not always occur on or before November 1st, but the cooler soil temperatures during November generally prevent enough regrowth to allow carbohydrate depletion before winter.

There are exceptions to every rule and when forage it is short supply you may decide to take a risk and graze during the critical fall period. The following considerations may aid in making your decision concerning fall grazing timing: 1) Older stands have a greater chance of winter injury than younger stands; 2) If killing frosts normally occur earlier or later than November 1 in your area then shift your critical fall period earlier or later; and 3) Livestock producers will break the critical period rule when the need for high quality pasture is critical and enough to offset the risk of winter injury.

If you would like early or more frequent grazing to be an option, then it is essential that you choose a grazing tolerant variety (see KY variety test reports to choose adapted grazing type varieties, www.uky.edu/Ag/Forage. These varieties have been developed specifically for grazing are often able to withstand closer grazing and require less recovery period than the traditional hay varieties. To ensure persistence and high yields, grazing tolerant alfalfa varieties should be grazed to 3-4 inches within five days, then given at least 21 days for recovery growth before being grazed again.

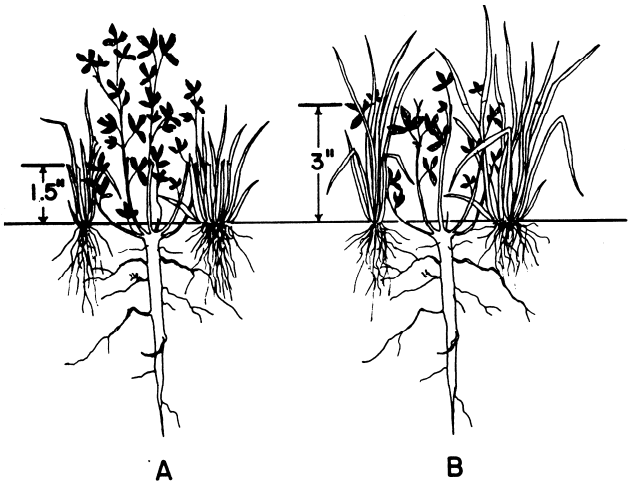
Figure 1. Alfalfa growth and root carbohydrates.



Managing mixed stand – favor alfalfa

For many hay and pasture stands of alfalfa, mixtures with grass species such as orchardgrass is preferred. The grass adds to the nutritional balance, improves hay curing, and help provides a sod for hoof traffic. The common rule of thumb when managing a legume/grass mixture is to manage for the legume. For example, with an alfalfa/orchardgrass mixture you want the alfalfa to reach the late bud to early bloom stage before cutting or grazing. If the grass starts to dominate the stand then closer cutting or grazing will benefit the alfalfa since it's regrowth energy comes from root carbohydrates (Figure 2). If the alfalfa starts to dominate the stand then and higher cutting or grazing height (3 to 4", even 5") benefits the grass since it retains sufficient green leaf area for continued photosynthesis.

Figure 2. Alfalfa/orchardgrass stand at two grazing heights.



The two figures shown above can be found in Roy Blaser's classic "Forage Animal Management Systems" available at http://www.caf.wvu.edu/~forage/books/fams/index.htm. Another excellent publication is the "Alfalfa Management Guide" by Undersander and others available at http://www.asa-cssa-sssa.org/publications/pdf/alfalfa_guide_production.pdf. The University of Kentucky's forage website also contain a tremendous amount of forage management information at www.uky.edu/Ag/Forage.

FORAGE LEGUMES VS. FERTILIZER NITROGEN

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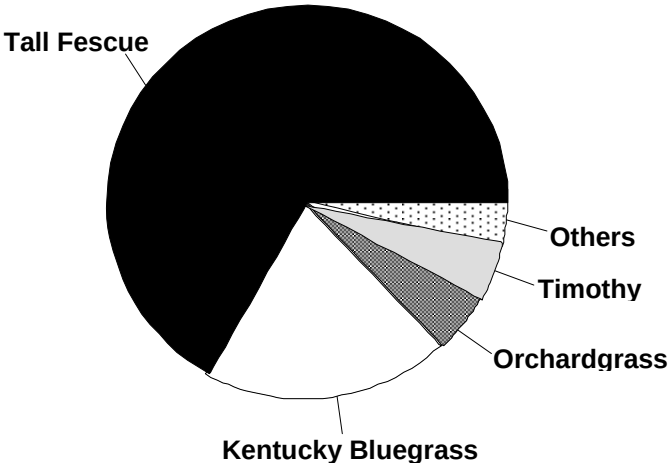
Extension Forage Specialist
University of Kentucky

A few weeks after I started to work as a Forage Extension Specialist at the University of Kentucky, I heard my mentor and forage idol, Mr. Warren Thompson, speak on forage legumes. Warren, along with Dr's. Tim Taylor and W.C. Templeton had pioneered the "Pasture Renovation Program" in Kentucky. In addition, Mr. Ed Smith had joined the team and collectively they developed the "Power-til Pasture Renovator." Warren began his presentation by talking about Kentucky Forages pointing out we were so fortunate to have a good grass base and the opportunity to grow lots of legumes. He also talked about all the good things legumes could do once established into grass dominant pasture and hay fields. He stated "Pasture renovation is the most important pasture improvement practice in Kentucky". At that time, corn was under $2.00 per bushel, gas was 69 cents/gal, and nitrogen was readily available as ammonia nitrate and less than twenty cents per pound. Since that time, a lot of things have changed, especially corn, nitrogen and fuel prices; however, Warren's statement about the important of legumes is still valid. In fact, considering the merits of forage legumes and change in nitrogen and other input costs, forage legumes are more important today than ever.

Successful livestock production is dependent on forage programs which supply large quantities of adequate quality, homegrown feed. A major percentage of the feed units for beef (83%) and dairy (61%) cattle come from forages. In addition, forages supply an estimated 91%, 72%, 15% and 99% of the nutrients consumed by sheep and goats, horses, swine and ruminant wildlife, respectively.

Kentucky's forage base is composed of cool-season grasses and legumes. Four grasses occupy the vast majority of forage land with Kentucky 31 tall fescue occupying the largest number of acres (Figure 1). Clovers (red, ladino, white) (Figure 2) are, by far, the dominant legumes found. Pasture production from the cool-season species varies greatly during the growing season (Figure 3).

Figure 1. Forage Grasses



Legumes are present at a high enough level to significantly improve overall animal production on less than one-fourth of the acreage needed. Research, demonstration and farmer experience have clearly documented the positive contribution legumes can make when incorporated into grass pastures. Adding legumes to hay and pasture fields can bring at least five major benefits:

Figure 2. Forage Legumes

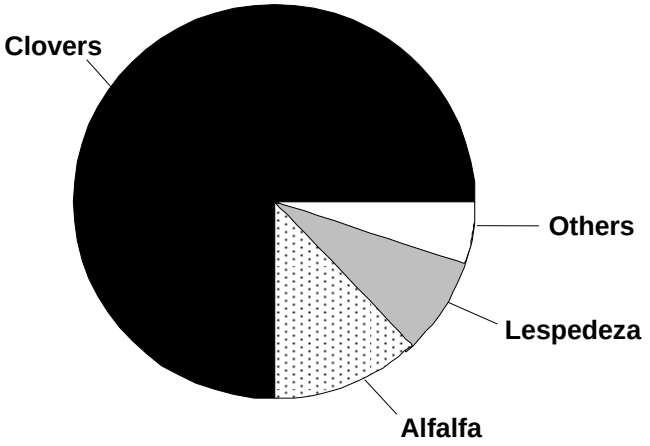
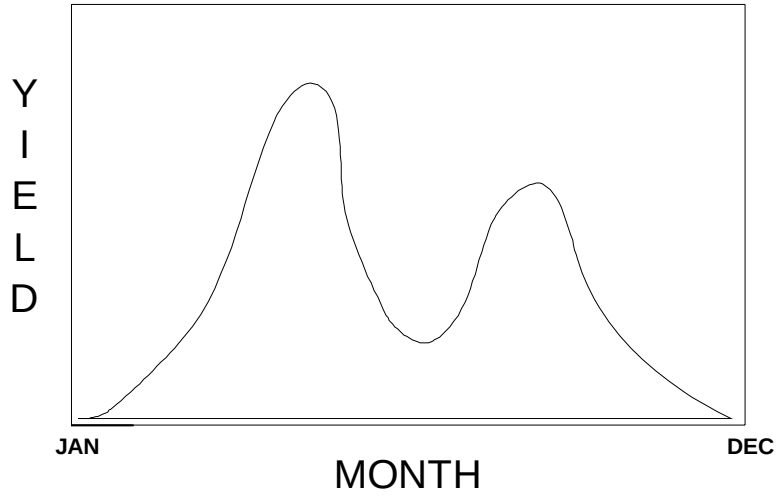


Figure 3. Seasonal Yield Distribution of KY 31 Tall Fescue.



(1) Higher Yields

The total yield of forage per acre is usually increased when forages are added. For example, a study conducted at Lexington compared renovating a fescue pasture using red clover to fertilizing the grass with nitrogen (Table 1). In this study, red clover growing with fescue produced higher yields than fescue fertilized with up to 180 lb N/ac.

Table 1. Dry Matter Yields of Fescue-Clover vs. Fescue-Nitrogen– Lexington, 1978, 2 Yr. Average.

Treatments	Yields, lb/ac
Fescue-Red Clover 6 lb Seed/ac	11,100
Fescue + Nitrogen 0 lb/ac 90 lb/ac 180 lb/ac	 3,900 6,700 9.900

Taylor, T.H., et.al. University of Kentucky.

(2) Improved Quality

Adding legumes to grass fields improves forage quality over grass alone. This added quality includes increases in palatability, intake, digestibility, and nutrient content. The result is improved animal performance. Research has shown that legumes improve animal growth rates, reproductive efficiency, and milk production. The three studies summarized in Table 2 show improved growth rates of beef cows, calves, and steers when legumes are used. The study reported in Table 3 shows increased growth rates of beef steers grazing a fescue-ladino clover pasture. It also shows higher gains per acre as a result of improved forage quality and higher yields.

Table 2. Animal Performance on Grass vs. Legume-Grass Mixtures.

Species	Length of Trial (Yrs)	Gain/Head (lb/day	Animal Class	State
Tall Fescue	3	0.12	Cows	IN
Tall Fescue + Red & Ladino Clover		0.74		
Tall Fescue	3	1.30	Calves	IN
Tall Fescue + Red & Ladino Clover		1.80		
Orchardgrass	10	1.07	Steers	VA
Orchardgrass + Ladino Clover		1.28		

Table 3. Av. Daily Gain and Gains/Acre of Steers Grazing Tall Fescue & Tall Fescue-Clover Pastures.

Pastures	Daily Gain (lb/steer)	Total Gains	
		lb/steer	lb/ac
Fescue + Ladino Clover	1.53	307	582
Fescue + 150 lb N/ac	1.06	203	374

Hoveland, C.S., et al. 1981. Bulletin 530. Auburn, AL.

High quality feed is important in getting beef cows rebred after calving. Research conducted in Illinois and Indiana (Table 4) compared conception rates of cows

Table 4. Conception Rates on Grass vs. Grass-Legume Pastures		
Species	Conception Rate %	State
Tall Fescue	75	IL
Tall Fescue + Legume	89	
Tall Fescue	72	IN
Tall Fescue + Clover	92	

grazing tall fescue pastures with and without legumes. In both tests, the cows grazing legume-grass pastures had much higher conception rates.

(3) Nitrogen Fixation

Legumes get their nitrogen needs from symbiotic bacteria that live in "knots" (nodules) on their roots. These bacteria are added when legume seed is inoculated. This "fixed" nitrogen provides the nitrogen needed by the legumes and also by grasses growing with them. Different legumes are able to "fix" different amounts of nitrogen (Table 5). Alfalfa usually fixes the most, while annual legumes fix the least. The value of the nitrogen fixed by legumes depends on the cost of nitrogen fertilizer.

Table 5. Value and Amount of Nitrogen Fixed by Various Legumes.					
Crop	N fixed, Lb/A/year	N value, $, @			
		55¢/lb	65¢/lb	75¢/lb	$1.00/lb
Alfalfa	150-250	83-138	98-163	113-188	150-250
Red clover	75-200	41-110	49-130	56-150	75-200
White clover	75-150	41-83	49-98	56-113	75-200
Vetch, lespedeza, and other annual forage legumes	50-150	28-83	33-98	38-113	50-150
SOURCE: Adapted from Southern Forages 2007					

(4) More Summer Growth

Most of the growth of cool-season grasses occurs during the spring and fall. Legumes (alfalfa, lespedeza, red clover) make more growth during the summer months than cool-season grasses. Growing grasses and legumes together improves the seasonal distribution of forages and provides more growth during summer.

(5) **Legumes in Rotations**:

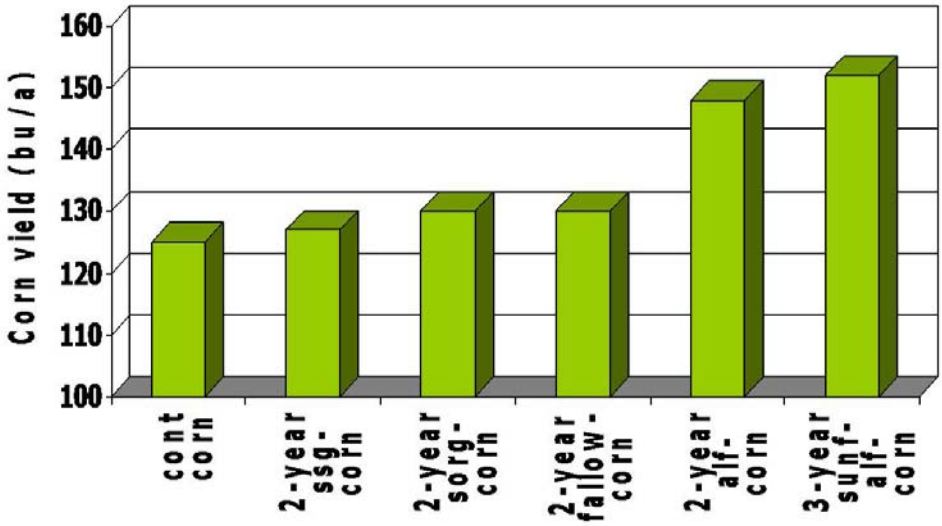
Legumes can play an important role in crop rotations. In general, any non-legume crop following legumes will show some improved production. Legumes can provide nitrogen for the following crop (Table 6, Figure 4), help break disease and insect cycles, improve soil conditions, reduce erosion (Table 7) and potentially improve profit.

Table 6. Alfalfa Legume Credits.

Stand Density	Medium/Fine Soils		Sandy Soils	
	----- Regrowth after last cutting -----			
	> 8 inches	< 8 inches	> 8 inches	< 8 inches
	---------- lb nitrogen/acre ----------			
Good, > 4 plt/ft^2	190	150	140	100
Fair, 1.5 to 4 plt/ft^2	160	120	110	60
Poor, < 1.5 plt/ft^2	130	90	80	40

SOURCE: Dan Undersander, Agronomy, University of Wisconsin Extension, AITS March 2008.

Figure 4. Rotational benefit of alfalfa on corn



Source: Dan Undersander, Agronomy, University of Wisconsin Extension, AITS March 2008.

Table 7. Relative Erosion of Cropping Systems	
System	Relative Erosion
Fallow	244
C-Sb*	120
C-C-Sb	112
Continuous corn	100
C-C-C-O-A	46
C-C-O-A	32
C-C-O-A-A	27
C-C-O-A-A-A	22
C-O-A-A-A	9
Continuous Cover	0
*C=Corn, Sb=Soybeans, O=Oats, A=Alfalfa	

SOURCE: Dan Undersander, Agronomy, University of Wisconsin Extension, AITS March 2008.

Summary

Legumes have played an important role in Kentucky pasture and hay fields in the **PAST**. They are playing an important role at **PRESENT**; however, they must play a more important role in the **FUTURE** as we exploit these unique plants to improve our overall forage-livestock programs.

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Horse Pasture Monitoring Program: Results after Three Years

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Hay Marketing Specialist
Extension Forage Specialist
University of Kentucky

Overview

Since 2001-2002 and the outbreak of Mare Reproductive Loss Syndrome (MLRS) the University of Kentucky has been developing stronger ties with the state's equine industry. Approximately 30% of the foal crop was lost in the Central Bluegrass region during this period with a devastating impact on the industry. Traditionally, many Thoroughbred farms have functioned as independent entities, but MLRS helped them to realize that the University of Kentucky had tremendous amount of expertise that they could provide in the areas of animal health, forage management, and other areas. Initially, there were many theories as to the cause of MLRS with tall fescue and other potential toxic plant species often mentioned. In the end, MLRS was found to be caused by the accidental ingestion of eastern tent caterpillars, but one of the positive outcomes was that farms realized the need to better understand the composition of their pastures.

Horse farms in the Central Kentucky are interested in UK's assistance with pasture evaluation. Although some farms rely on the expertise of their county agents or independent consultants, during the fall of 2005 a team from the UK Forage Extension Program conducted a pilot project to provide an extensive evaluation of horse pastures on 14 Central Kentucky farms. One of the focuses of the pilot project was the evaluation of pastures for percent tall fescue and the potential for stands with significant fescue to cause fescue toxicity in pregnant broodmares. In 2006 and 2007, the program was continued with tremendous success and now almost 50 farms have been enrolled in the program totaling almost 10,000 acres.

Evaluations from participants in the program have been very positive. Mike Owens, past president of the Kentucky Thoroughbred Farm Managers Club (KTFMC) and a program participant said, "UK's Pasture Evaluation project has proved to be a very useful tool in pasture management on the farm. The project identifies and gives the percentage of grasses and weeds in any given pasture, along with the ergovaline levels. Their identification and recommendations are presented in a professional package with a CD that makes for a quick reference tool." Another former KTFMC president, Steve Johnson, states that the "equine industry sorely needs the monitoring and consultation

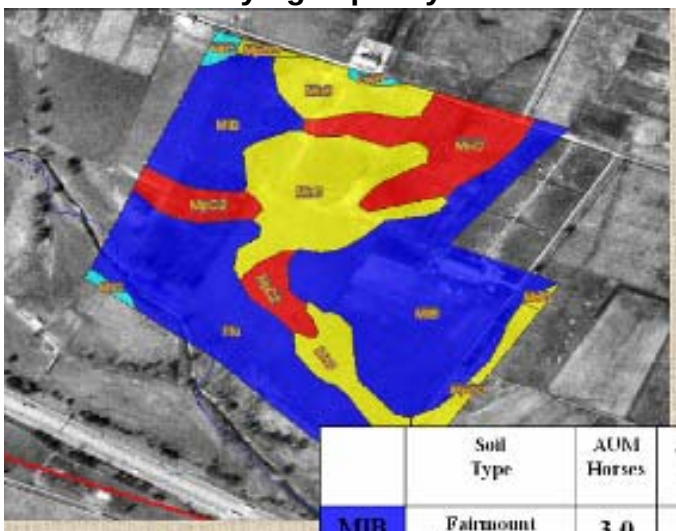
being provided with this service." Steve goes on to add that "It's very gratifying to know that UK is addressing the issues that are important on horse farms in Central Kentucky." A recent participant adds, "I cannot imagine having access to a program that will have as much overall impact on the quality of the horses that we are producing here in the Bluegrass. This program is long overdue!"

With the success of the program, we are offering an expanded pasture evaluation service to horse farms in the Central Bluegrass area in 2008. At the end of this paper an excerpt of the registration form provided to farm owners and managers is included.

Information Provided to Farms

After the pasture evaluation is completed, the program leader and coordinator sit down for 1 to 1 ½ hours with the farm manager and/or owner and explain the data obtained from their farm evaluation. Each farm receives a notebook containing an overall farm map, a soils map taken from web soil survey, detailed species composition charts from each paddock (20 quadrat samples per paddock), photographs of all quadrat areas, individualized pasture management recommendations, additional publications, and other information on their farm. Since many horse farms do not have a strong agronomic background, a complete explanation of soil types and carrying has proved very useful (Figure 1).

Figure 1. Horse farm soil map taken from web soil survey with explanation of carrying capacity and acres in each soil type.



	Soil Type	AUM Horses	Acres/Horse per Year	Acres of Soil Type	% of Soil Type
MIB	Fairmount Flaggy silty clay	3.0	4.0	19.2	37%
MnB	Faywood silt loam	5.3	2.3	2.2	4%
MnC	Huntington silt loam	6.8	1.8	5.4	11%
MIC	McAfee silt loam	5.3	2.3	14.3	28%

UK UNIVERSITY OF KENTUCKY College of Agriculture

Although there are many pages of data provided to each farm one of the most useful tables is the average species composition from the evaluated pastures, including the percentage of tall fescue, endophyte infection rate, and ergovaline levels at the time of sampling (Figure 2). Part of the discussion includes an explanation of tall fescue consumption by broodmares grazing mixed species pastures and the potential health risks during the last trimester. Microhistological analysis conducted by Morrison (2008) showed that tall fescue consumption is closely correlated with botanical composition in the pasture (Figure 3).

Figure 2. Average species composition, endophyte percentage, and ergovaline (ppb), from 47 horse farms evaluated in Central Kentucky during 2005-2007.

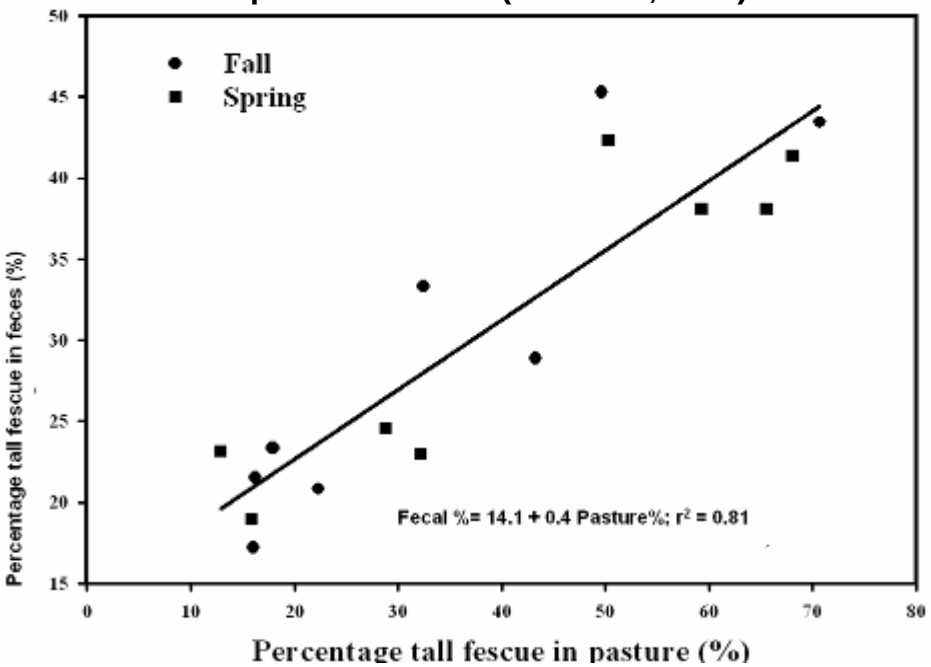
Tall Fescue	Blue Grass	Orchard Grass	White Clover	Weeds	Bare Soil	Ergovaline ppb	Endophyte infection %
24	26	12	8	20	10	301	71

Amount of Available Forage = 70%

Amount of Tall Fescue in Forage = 34%

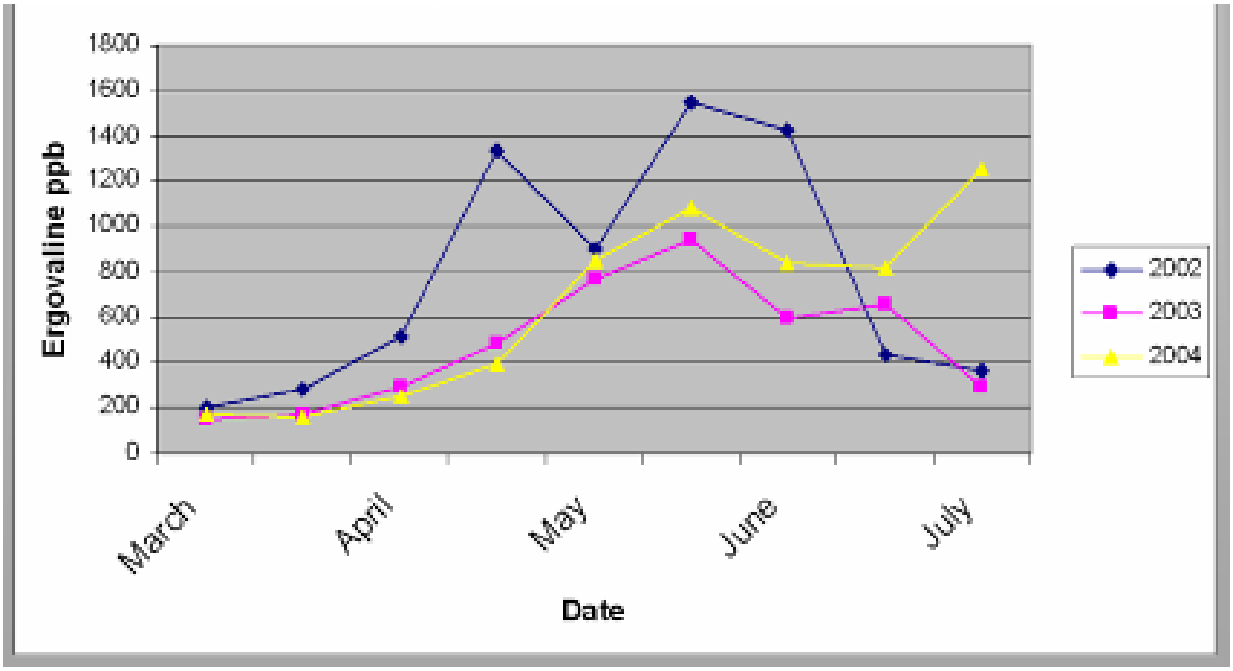
Ergovaline Conc. of Available Forage = 102 ppb

Figure 3. The percentage of tall fescue consumed by grazing broodmares compared to the percentage of tall fescue in the pastures based on microhistological analysis of fecal samples taken from mixed season grass species mixtures (Morrison, 2008). .



The results from each farm make up the majority of information presented, but some time is spent discussing the principles of pasture management based on research findings in other studies. A number of researchers have shown the variation in ergovaline levels over the growing season, but most horse farm owners and managers are not aware of these findings. They are surprised to learn that ergovaline levels are low in Central Kentucky from December into early April (Bush and Long, unpublished data). Since the goal for Thoroughbred births is early January and the majority are born by early April, then there is a wide window of opportunity for safe late term gestation even on pastures with high percentages of tall fescue. The take home message is tall fescue is an excellent cool season forage grass for pasture cover, non-pregnant mares and other classes of horses, but care should be taken when grazing broodmares on fescue pastures.

Figure 4. Ergovaline levels (ppb) from all farms monitored during the spring and summer of 2002-2004 (Bush and Long, unpublished data). The levels presented at each data point represent the average of the maximum levels from each farm.



The last part of the final presentation to farms is the individualized recommendations sections. Although the most important question for most broodmare farms is “how much tall fescue do I have and how do I get rid it,” the program emphasized the need for a wholistic approach to pasture management including the value of rotational grazing, timely fertilizer applications, general weed control, and other management options available to the horse farms.

HERBICIDE OPTIONS FOR PASTURE WEED CONTROL

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Weeds have become more evident and problematic in grazed pastures as forage and livestock production systems have intensified. As animals consume the more desirable and palatable plant species in pastures, weedy plants become more abundant. In particular, animals tend to avoid grazing plants which contain thorns, prickly spines, or are unpalatable making some pastures less productive. In fact, many of the more problematic plants observed in Kentucky's grazed pastures possess these characteristics including thistles, spiny amaranth (spiny pigweed), horsenettle, common cocklebur, tall ironweed, and buttercups.

Traditionally, mowing or clipping fields has been one of the primary means to deal with weed problems in pastures. To be the most effective as a weed control tool, mowing should be done in a timely manner during the growing season, specifically just before problematic weeds begin to produce new seed. More frequent mowing may be needed to curtail growth of perennial weeds. However, costs associated with mowing have increased as diesel costs have risen. Therefore, more producers are beginning to consider herbicide options as an alternative method for weed control.

Table 1 lists several of the herbicides labeled for use in Kentucky which control broadleaf weeds in established grass pastures. Herbicide selection will depend on various factors including the specific weeds present and the forage species growing in the field. Many variables can affect the performance of herbicides including weed size and growth stage, weather conditions before and after spraying, and application methods. Often the growth stage of weeds is at or near maturity before a significant problem is recognized. Learning to identify weedy plants at younger growth stages is important for some herbicide treatments to be effective. A detailed discussion of herbicide options can be found in University of Kentucky Extension Bulletin titled "*Weed Management in Grass Pastures, Hayfields, and Other Farmstead Sites*" (AGR-172).

Although chemical control options can be an effective tool for dealing with troublesome plants, there are issues which can limit herbicide use. One of the principle concerns is the negative impact broadleaf pasture herbicides have on clovers since many grass forages are interseeded with clover or other legumes. Most broadleaf herbicides labeled for use on grass pastures are likely to kill or severely injure established clovers. Furthermore, if a forage producer wants to reestablish clovers after an herbicide application, an important consideration is how long should you wait before reseeding. For herbicides that contain 2,4-D a 6 to 8 week waiting period may be sufficient; whereas, for herbicide products that contain active ingredients such as aminopyralid a minimum waiting period of at least 6 months may be necessary.

Another consideration before making herbicide applications are grazing or haying restrictions. In general, most herbicide products listed in Table 1 have no restrictions or a waiting period before beef animals can graze treated pastures; however, a waiting period may be required before harvesting treated areas for hay. The most restrictive intervals are for lactating dairy animals. The label guidelines for horses are generally the same as beef animals.

The cost of herbicide treatment is another issue that limits some applications. Herbicide costs can be quite variable (Table 1) and the cost of making an application should be added to the total cost of the treatment. When considering herbicide cost; however, it is also important to compare with the cost for mowing. If the primary purpose for mowing is just for weed control, mowing cost (such as fuel, equipment, and labor) may be more expensive than an herbicide application.

One of the more important considerations is the presence of sensitive crops growing nearby. Tobacco, grapes, several vegetable crops, and ornamentals can be sensitive to many of the herbicide products labeled for use on pastures. When applied under the wrong environmental conditions (high temperatures and humidity) and/or when wind conditions are favorable for off-site spray drift the risk of causing injury to sensitive crops increases. Consult the herbicide product labels for precautionary statements and be aware of your surroundings and the time of the season before making herbicide applications.

In summary, herbicides can be an important tool in pasture weed management. However, they are not a cure for all pasture weed problems. In some cases they may only be a short-term solution to a longer-term problem. They are generally more effective when used in combination with other pasture management practices which promote healthy pasture stands such as maintaining proper fertility and good grazing practices. In many cases, overall pasture management must improve to obtain the maximum benefit from an herbicide application.

Table 1. Herbicides labeled for use on permanent grass pastures in Kentucky.

Herbicide		Estimated Cost/Acre*	Type of Weeds Controlled
Cimarron Plus (0.125 to 0.5 oz/A)	*metsulfuron + chlorsulfuron*	$2.25 - $9.00	Selected broadleaf weeds and certain woody plants. ***Do not use on timothy.*** *Growth of tall fescue and certain other pasture grasses may be suppressed* (consult label).
2,4-D [*3.8 lb ae/gal formulations*] (1 to 2 qt/A)	*2,4-D* [various products]	$3.75 - $7.50	Herbaceous broadleaf weeds.
Banvel, Clarity, etc. (0.5 to 2 pt/A)	*dicamba*	$5.50 - $22.00	Broadleaf weeds and woody brush
Weedmaster (2 to 4 pt/A)	*dicamba + 2,4-D*	$7.00 - $14.00	Herbaceous broadleaf weeds
Remedy (2 to 4 pt/A)	*triclopyr*	$14.00 - $28.00	Woody plants and selected broadleaf weeds
Crossbow (1 to 2 qt/A)	*triclopyr + 2,4-D*	$15.00 - $30.00	Woody plants and broadleaf weeds
PastureGard (1.5 to 4 pt/A)	*triclopyr + fluroxypyr*	$10.50 - $28.00	Woody plants and broadleaf weeds
Milestone (3 to 7 fl.oz/A)	*aminopyralid*	$8.25 - $19.25	Herbaceous broadleaf weeds
ForeFront R&P (1.5 to 2.6 pt/A)	*aminopyralid + 2,4-D*	$10.50 - $18.20	Herbaceous broadleaf weeds
MOWING		$12.00 - $20.00	Suppression of broadleaf weeds, weedy grasses, and small brush

**The estimated cost ($/A) does not represent the use of spray additives or the cost for application.*

Practical Grazing Management and Feed Strategies to Alleviate Fescue Toxicosis

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Tall fescue grown in Kentucky is productive and persistent and that is why the state has 5 million acres of the stuff! Fescue has tolerances to drought, low fertility, and over-grazing that are attributed to a fungal endophyte which infects most tall fescue plants. Unfortunately, these advantages of tall fescue that livestock producers appreciate are offset by reduced calving percentages and calf weight gains caused by consumption of ergot alkaloids produced by the endophyte. Ergot alkaloids affect the physiology of cattle to cause elevation in body temperature, reduced sweating, retention of winter hair coats and uncontrollable growth of summer hair coats, and a reduction in the prolactin hormone (not just the milk hormone!). Cattle inflicted with this toxicosis suffer from heat stress with high air temperature and humidity to reduce grazing time and dry matter intake. Consequently, with endophyte-infected tall fescue it can be difficult to maintain body condition and acceptable reproductive performance of cow herds and weight gain of yearling cattle is generally regarded as unacceptable for profitable stocker and replacement heifer production.

There presently are three management options for improving cattle performance on tall fescue. First, cattle can be moved from endophyte-infected fescue to warm-season perennial grass pastures (for example, eastern gamagrass or bermudagrass) in the late spring or early summer when maximum daily air temperatures increase (> 80°F). Secondly, ergot alkaloids can be diluted in the diet by feeding concentrates/by-product feeds, or by interseeding fescue pastures with legumes, such as ladino white clover or red clover. A third option is to replace 'Kentucky 31' tall fescue infected with the wild type endophyte with tall fescue that is infected with novel endophytes that do not produce the toxic ergot alkaloids. This paper will discuss results of grazing experiments that have evaluated these management options for improving cattle performance on tall fescue.

Rotating Cattle to Warm-Season Perennial Grass Pasture during the Summer

Research has shown that a warm-season perennial grass can be utilized in a forage system to avoid vulnerability to heat stress during the summer. Brown and others

(2001) found that spring calving cows grazed on toxic tall fescue during the fall through spring and moved to bermudagrass in the summer to have 34% greater milk yields than those that remained on fescue through the summer. Aiken and others (1999) in a 2-yr grazing experiment grazed yearling steers on toxic fescue in April and May and rotated the cattle to eastern gamagrass during the summer from early June to early August. Those grazed with light stocking rates (avg. total body weight = 993 lb/acre) had average daily gains of 2.2 lbs/day and those on heavy stocking rates (avg. total body weight = 1938 lb/acre) had average daily gains of 1.7 lb/day. Average daily gain of yearling cattle on toxic fescue typically range from 0.2 to 1.2 lb/day. It was further observed in the study that 50% of the steers had sleek hair coats and 33% were expressing some shedding of hair coats by the end of summer grazing on eastern gamagrass. Rotating to a non-toxic grass during the warm season appears to provide some relief from the toxicosis, but extent of this relief likely depends on previous time on toxic pasture, pasture fungal infection levels, and animal genetics.

Two perennial warm-season grasses with potential are eastern gamagrass and bermudagrass. Eastern gamagrass is a native grass that provides robust growth from mid-May through September. To maintain stand persistence the grass should be rotationally grazed to provide 45 days of regrowth and should not be grazed to less than an 8-inch stubble. 'Pete' eastern gamagrass, the first released cultivar, gained considerable popularity in the southeast, but USDA-NRCS has released other cultivars with improved forage yield and quality. One of interest to Kentucky producers is 'Highlander', which was originally collected in Montgomery County, TN (across the border from southwest Kentucky). The other warm-season perennial, bermudagrass, can be continuously grazed, but fertility with this grazing method is more critical in maintaining productive stands as grazing intensity increases. Planting of bermudagrass cultivars with cold tolerance ('Wrangler', 'Quickstand', or 'Greenfield') will be required in Kentucky. Grazing should be deferred or lenient in the fall to prepare these grasses for winter dormancy.

Feeding Concentrates or Over-seeding Clovers

Replacing some of the fescue in cattle diets with concentrates or clovers has consistently been shown to dilute the ergot alkaloids and enhance performance and physiology. Grazing experiments have shown substantial improvements in average daily weight gain when feeding broiler litter-ground corn (1:1 ratio) (Aiken and others, 1998) or soybean hulls (Aiken and others, 2008) (Table 1). Another experiment showed that feeding soybean hulls to yearling steers grazing endophyte-infected fescue substantially increased steer daily weight gain and the shedding of winter hair coats, and there was an almost 4-fold increase in prolactin concentrations in the blood serum (low serum prolactin is an indicator of fescue toxicosis), as compared to those not fed. Although symptoms of toxicosis were not completely alleviated, there appeared to be

enough dilution of ergot alkaloids to reduce the severity of toxicosis. Steers in each of these experiments were group fed at a rate of 5 lbs/steer/day (as fed). Amounts of offered feed should be 0.75 to 1% of body weight to adequately overcome the low intake of cattle grazing fescue and to adequately dilute the ergot alkaloids. Therefore, cheaper by-product feeds (view Table 2 for examples) will be needed for this management option to be cost effective.

Table 1. Average daily gain between with and without supplemental feeding of yearling steers grazing endophyte infected all fescue.

Feed	With	Without	Location
Broiler litter-corn	1.48	0.82	Booneville, AR
Pelleted soybean hulls[1]	1.17	0.62	Versailles, KY
Pelleted soybean hulls[2]	2.10	1.58	Versailles, KY

[1] Aiken and others, 1999.

[2] Graduate research conducted by Jessica Carter

Table 2. Nutrient composition for various by-product feeds.*

Feed	Dry matter	Total digestible nutrients	Crude protein	Neutral detergent fiber
	%	---------- % of DM ----------		
Dried distillers grains	91	88.0	30.4	46.0
Wet distillers grains	25	25.0	29.7	40.0
Bakery waste	92	89.0	9.0	18.0
Dried brewers grains	92	66.0	29.2	48.7

* Nutrient Requirements of Beef Cattle, National Research Council, 2000

Escalating cost of nitrogen fertilizers is making the interseeding of clovers into fescue pastures a management tool that should be considered. Animal performance and a reduction in the severity of fescue toxicosis can be achieved if the stand has a minimum of 10 to 25% clover. High-quality clovers and other legumes can boost animal performance and soil nitrogen, but a lack of persistence under grazing has minimized the commercial acceptance of clovers. However, costs of sources of commercial nitrogen are presently at levels that justify shifts in pasture management needed to improve clover stand persistence. Implementing rotational stocking systems that complement the clover and fescue are definitely needed. Stocking rates may need adjustments to provide enough residual clover at end of grazing a given paddock. Although clovers do not require nitrogen fertilization, soil phosphorus, potash, and pH will have to be maintained at recommended levels to improve persistence.

Planting Novel Endophyte Tall Fescue

Novel endophyte strains have been discovered and developed by AgResearch Ltd. (New Zealand) that do not produce the toxic ergot alkaloids. A novel endophyte (AR542) has been inserted into the cultivar 'Jessup' and is commercially sold under the trade name MaxQ. Reproductive performance of cows and growth performance of yearling cattle have shown to be similar to endophyte-free fescue (Parish and others, 2003; Watson and others 2004). MaxQ persisted well over a 5-yr grazing experiment conducted in Oklahoma and Louisiana (Hopkins and Alason, 2006), but more cultivars are needed to provide alternative novel endophyte fescues throughout the fescue belt. A different endophyte, AR584, has been inserted into a fescue that was developed by Dr. Tim Phillips, a forage breeder in the Plant and Soil Sciences Department at UK, to provide a productive and persistent novel endophyte fescue for the upper south. A grazing evaluation is presently being conducted with this novel endophyte fescue to compare steer weight gain, stand productivity and persistence with wild-type endophyte Kentucky-31 and MaxQ.

It should be understood that good grazing management practices are required for novel endophyte fescue. The major concern is that novel endophyte pastures will not carry as many animals as Kentucky-31 pastures in the late spring and summer. This is because cattle in novel endophyte fescue pasture will be grazing at times when cattle in wild-type Kentucky-31 pastures are normally standing in the shade or ponds. Therefore, stocking rates should be adjusted lower to accommodate greater grazing during the warmer months. Otherwise, rotational stocking will be needed to reduce chances of stand deterioration.

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Fencing and Watering Systems: Simpler is Better

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Paris, KY

Sustainability and Grazing Management have taken on a new importance in the Americana farm community. The key components of the sustainable approach, profitability, agronomic, social and ecological responsibility and quality of life are becoming obtainable goals for this and future farming generations.

The increased interest in Grazing Management has offered a number of challenges to the New American Grass Farmer, as well as, agricultural support staff and information specialists. New tasks, opportunities and non-traditional strategies have become commonplace along with a resurgence in farmer based Grass Roots Research. Today's need for practical, farm proven grazing techniques and tools have turned farmsteads throughout the United States into mini research stations.

The information herein is from just such a process, solution/farm based research done in an incremental fashion (trial and error) over the past 27 years. We have had to address four areas simultaneously in the development of our total farm system.

Flexible Management

Permanently fenced paddocks create a nightmare if you must use anything other than livestock to harvest the forage. You will only cut hay off of a number of 2 acre plots once and custom operators will avoid your farm like the plague. Our solution was to divide our farm into grazing grids – smaller, more manageable, areas that could be further subdivided as required. Uniformity in size was not a concern, but shape of the paddock – long and narrow, was. The key was this configuration was our ability to alter paddock size and have a positive impact on daily forage allocation and management.

We offer the proper amount of feed, no matter the growing conditions or animal type. Long narrow fields are simply subdivided using polywire with no concern as to area, only to proper forage quantity. Allocation was easily determined by using post spacing (each post equates to ¼ acre) in the subdivision fences. Proper feed budgeting … simply count the fence posts and string up polywire. Adjusting forage allocation, on the fly is, as simple as, visually assessing the previous grazing area and counting the number of fence posts.

Key design and management considerations are:

- Even number of subdivisions allow one water supply line to serve two paddocks.
- Multiple water access points, along the supply line, allow for variation in break (paddock) size.
- Long narrow strips lend themselves to mechanical management if necessary.
    - Hay harvest
    - Spraying (foliar)
    - Renovating
    - Spreading / fertilizing
- Gateways at each end of the paddocks allow livestock to shift fields without the need of laneways.
- Post spacing, within the paddocks, can be used to measure area (acres) and assist in feed budgeting – simply count posts to determine the area to be allocated and put up polywire.
- Daily feed allocation can be varied infinitely. It is possible to have the right amount of forage each day.
- Paddocks that are right in size, with respect to feed availability – not right in number; You'll never have to worry about the appropriate number of paddocks again – the number will always be right.
- Soil fertility and nutrients are recycled, not transferred.
- Fence and water systems can be installed in a grid pattern. Portions of either system can be shut down for repair or conservation. This advantage offers a certain amount of system redundancy without duplication or the need for back up equipment.
- Fertility enhancement or improved forage species can be focused on particular areas, rather than the entire farm. Specialty crops can be introduced into the system – trickle irrigation is possible due to the expanded water delivery system.
- Supplementation and medication delivery are possible through the water system. Water soluble mineral (kelp), worming products and anti-bloat products have all been successfully inducted and administered using pasture/paddock water systems.

Fence Systems

Little needs to be said about modern energized fencing systems – other than they are incredibly effective and cost efficient. When it comes to grazing management we've found that internal subdivisions can be as little as a single energized high tensile (12.5 gauge) wire. In fact, for cows and calves we prefer a single wire. Posts are generally no more than small fiberglass or PVC on roughly 50 foot centers with a simple wire to

attach the fence to the post. We've used a number of posts and don't have a clear favorite. All have advantages and disadvantages but the one thing in common is that they can all be installed with a small handheld pipe driver.

Corner / end posts are either small unbraced treated wooden posts or fiberglass (1.2 inch) and we've opted for gate ways made from standard poly tape and a gate handle. Single wire fencing requires about 125 pounds of pressure to pull the slack out of the wire – thus very little bracing, if any is needed on these single wire internal fence lines.

Standard polywire or polytape and portable reels along with plastic tread-in post make up the rest of our needs for fencing our daily paddock breaks. Internal subdivisions are generally less than 400 foot wide so a handful of posts is all that is needed to build the temporary fence. We're using a single energizer to power the entire farm along with a number of strategically placed switches to simplify troubleshooting. Because we run a number of mobs, the entire farm is energized and we use our switching system to isolate power robbing shorts and quickly repair them.

Pasture / Portable Water Systems

The need for an improved water delivery system becomes apparent to anyone practicing grazing management. In fact, one of the major hurdles in the transition to managed grazing is overcoming the stock water problem. Traditional agriculture models have relied on permanent (costly) watering points, natural/manmade water impoundments or creeks and streams. None of which is adequately suited to enhance grazing management, optimize forage production or, animal performance or ease labor constraints.

No matter what the traditional water source, the following management problems can be encountered as grazing intensity and management develops:

- Cost – The need for additional watering points, for an efficient grazing system, soon become cost prohibitive, limiting more intensive management and system expansion.
- Design Shortcomings – The needs of stock movement, to and from the watering points, can cause increased erosion, fertility transfer and a loss of land base – (5 to 6% of a systems land base can be lost due to high animal traffic/impact in and near the hub area).
- Productivity – Decreased animal and agronomic performance due to travel distance to and from the watering points, and less than ideal grazing patterns.
- Erosion – Laneway traffic can cause severe erosion, even on the mildest of slopes. Vegetative losses in the laneway can lead to wind erosion and grazing animals can have a negative impact on ponds and streams, as well as, contribute to pollution and animal health problems.
- Fertility Transfer – Simply put, the animals do not recycle nutrients (manure and urine) in the paddocks where they graze, but at the watering point and in the lane area.

- Static Paddock Size – Permanently size paddocks and connecting laneway are not conducive to maximizing efficiency or flexibility.

Move the Cows and Move the Water

As a grazing manager you only have one job – to make the animals happy! They know how to graze, it's their job. Your job is to see that they can go about their work in as efficient a manner as possible. That means having the best quality and quantity forage in front of them and the water to go with it. There is a direct correlation between dry matter intake and water consumption. As feed intake increases so does water consumption. Intuitively we can deduce that the reverse is also true. As water consumption decreases so does dry matter intake. With the relationship between feed and water an important one, the question of quality now also enters into the equation.

Providing cool, clean and convenient water to our livestock was our goal in 1988. Our solution was to devise a system that could deliver piped water to the livestock when and where they grazed. We found with proper design (pipe sizing) we could simply tie into the farm's pressurized system and move water any place on the farm, while maintaining adequate volute and minimal pressure loss.

Low Cost, Flexibility, Durable and Simple (farmer friendly)

Our approach to pasture watering systems have evolved around 3 major points and address the needs of stock watering during periods of grass growth (dynamic), not winter time delivery static).

- The cost should be low; typically we found the water system to be about twice the cost of fencing in a grazing system or $20.00 to $30.00 per acre.
- Nothing should be permanent the first year or two. We continually update and change our thinking on grazing management.
- Standardized products/sizes – IPS pipe sizing that would make the addition to the existing farm pressure systems as simple as a trip to the hardware store for the necessary pipe adapters.

The Tools

- Pasture Pipe™ "burst proof" (high density poly pipe PE3408 / ASTMd 2239) provides an economical alternative to PVC. It can be laid on top of the ground, buried shallow or plowed in. The pipe looks and goes together like the black water pipe from years gone by, but the materials used today, high density, are far superior to the medium density poly used a few years back. The elastic nature of the pipe and its flexibility, even in sub-zero temperatures, keeps frozen water from rupturing the pipe, and makes it extremely adaptable in grazing systems. The pipe's durability allows it to be dragged from paddock to paddock like a

super garden hose or laid on top of the ground to be buried later when permanent paddocks start to take shape.

- AgriFit™ Compression Couplings. Simple Pasture Pipe™ coupling system that goes together hand tight and is far superior to the old insert fittings and clamps. Suitable for above or below ground application, rates to 140 psi and available in a number of sizes and configurations for most plumbing needs.
- The need for multiple water tanks in a system that only had one grazing group seems to be unnecessary. Relatively small watering tanks that were easily moved to the next paddock were a primary consideration. These small tanks, 100 gallons or less, can water a large number of animals with only minimal changes in management (see Rules). Being able to move the tanks location did away with the need for rock and concrete. Cattle trails become nonexistent, as the tanks can be placed at a different location at each rotation. The larger tanks, 100 gallons or more can be placed in a common fence line and water two groups (leader-follower) at the same time.
- A number of valves have been tried in our water tanks. The best seem to be the simplest – lever style valves.
- Quick couplers in the water line, instead of hydrants offer an easy and cost effective means of hooking up moveable watering tanks to the supply hose. Similar in action to a tractor hydraulic coupler, they automatically cut on when plugged in and shut off the instant the coupler is unplugged. Whether the system is above or below ground, these system couplers work equally well.

The Rules

Even though the tools that are being used in today's pasture water system are simple, cost effective and easy to install, there are a few management changes that assure these watering systems will work and work well.

- Tanks need to be protected. Simply placing them under an energized fence line (polywire) is all that is needed. Allowing access to only a portion of the tank (generally 2/3 of the tank) accomplishes three things. Protects the valve and float, protects the tank supply hose from hoof damage and limits the number of animals that can drink at the tank at any one time.
- Try and keep water within 500 to 700 feet of the animals. Travel distance greater than this will cause the animals to graze closer to the tank and when they do move away from the tank, they will come to water in a group. Close proximity to water allows the animals to graze and drink throughout the day rather than going to water in mobs and less frequently.
- Pipe systems should be designed to deliver a minimum of 5 gallons a minute at the tank. Lower flow rates can work, but tank size must be increased to make up for slower/longer tank recovery.

Ralph's Rule of Thumb

Pipe Size / Distance for 5 Gallon Flow Rate	
¾ inch	1000 feet
1 inch	2000 feet
1¼ inch	3000 feet
1½ inch	5000 feet
Elevation plays a significant role in performance and can effect flow dynamics greatly.	

In an intensively managed grazing system, allow 1 gallon per 100 pounds of live weight per day. As dry matter content of the forage and ambient air temperature increase so will water requirements. Cool, convenient water can offset the need for shade.

Watering Solutions

Unfortunately there is no universal solution to pasture water system … only innovative approaches to individual pasture situation. The traditional approach to livestock watering system are costly and outdated in today's dynamic grazing systems. New materials and management can offer the answer to livestock water delivery today and tomorrow.

Supplementing Cattle on Pasture: When, What and How Much?

Roy Burris
Extension Beef Cattle Specialist
University of Kentucky

The biggest advantage of maintaining cattle in the southeast is our ability to grow forages. It is generally an economic advantage to make maximum use of our forage and then supplement only when needed to meet our production goals. Judicious use of extra nutrition to grazing cattle can allow us to meet an objective which was best stated by Hoveland in 1986:

> "Our objective is to maintain pasture at the highest quality that the environment will allow and efficiently convert as much of the pasture as possible into saleable animal product."

There are times when we might consider supplementation on pasture:

- Increase daily gains
- Increase carrying capacity (maybe)
- Provide a carrier for growth promotants, coccidiostats, bloat control products, etc.
- Teach calves to eat before weaning
- Tame cattle or facilitate daily "checking" of cattle
- Increase protein intake on dormant grass

There are some things to consider when selecting a feed ingredient or deciding how much of an ingredient to feed. Sometimes when concentrates (grains) are used to supplement forage diets, gain responses may not be as expected. The difference between expected and observed gain may be due to the effects of concentrate on voluntary forage intake (it may decrease or increase). There may also be <u>associative effects</u> between concentrates for forages which may result in cattle gains on mixed (forage/grain) being lower than expected.

- **High starch containing feeds have a negative effect on forage digestibility**

Research at Kentucky has shown that supplementing pasture with a high starch feed (corn) does not give a linear increase in gain as we increase supplementation.

Corn supplementation to steers grazing fescue.				
	Corn (lbs) per head			
Item	0	1.4	2.8	4.2
ADG, lbs	1.32	1.75	1.75	2.00
Increased ADG, lbs	--	0.43	0.43	0.68
Feed/gain, lbs	--	3.5	7.0	6.0

Ely (1995) UK

The first level of supplementation gave a good increase in performance with a 3 to 1 ratio of feed to gain. However, further increases were not as efficient. These data are similar to work at Michigan State University.

Different levels of grain supplementation to pasture cattle.			
Amount of grain addition (lbs/d)	Gain response		F/G
	lbs	%	
1	.23	+15.2	4.3
2	.24	+15.4	8.3
3	.28	+18.1	10.7
4	.38	+30.1	10.5
6	.47	+33.1	12.8
8	.41	+35.7	19.5

Rust (1987) Michigan State University

Data from the following trial illustrates what happens to hay (forage) intake and hay organic matter digestibility as we increase the grain (starch) supplementation.

Effect of increasing corn on hay intake and digestibility.				
	Corn, lbs/day			
	None	2.2	4.4	6.6
Hay DMI, lbs	19.3	18.0	14.1	11.2
Total DMI, lbs	20.9	21.1	18.6	17.2
DOMI, lbs	7.5	8.4	7.1	7.3
Hay OM Digest, %	36.5	35.1	23.6	18.9

JAS 65:557

More interesting, perhaps, is what happens to hay intake when we use soyhulls at the same rates as the previous trial, instead of corn.

Effect of increasing soybean hulls on hay intake.				
	SH, lbs/day			
	None	2.2	4.4	6.6
Hay, DMI, lbs	21.4	22.3	21.6	19.9
DOMI, lbs	10.6	11.8	12.3	12.7

JAS 68:4319

These data indicate that soyhulls were not decreasing voluntary intake of hay. In other words, soyhulls supplemented the hay rather than replacing it. That is usually our goal when supplementing forages.

- **Highly digestible fiber feeds to not have the negative effect on forage digestibility**

Supplements with high grain content have high energy values due to their high levels of starch. High levels of starch and sugar are rapidly fermented, resulting in a lower rumen pH. This results in lower intake and digestibility of forage when starch intake reaches a critical level. It can possibly result in acidosis and founder. Some feeds have low levels of starch but relatively high levels of energy because of highly digestible fiber – like soyhulls (SBH), corn gluten feed (CGF), dried distillers grains (DDG), etc.

High energy low start supplements.

Feed	CP	UIP % CP	TDN %	Starch %
DDG	30.4	52	90	18
DBG	29	50	66	10.7
SBH	12	25	77	6
CGF	23.8	22	80	25.4

NRC – Beef 2000 Update, PAS 16:69-99

Research at UK-Princeton has shown that high-fiber supplements are better choices than traditional grain-based supplements for cattle on pasture. The following trial indicated that on a pound-per-pound basis soyhulls are better than grain.

Type of energy supplement and gain of steers grazing stockpiled fescue

Supplement	Corn/SBM	Soyhulls
Steer Wt., lbs	648	629
Sup. Intake, lbs	7	7
ADG, lbs	1.4	1.8

KY. PR-417, p. 86

The next trial showed the same trend when calves were fed different supplements and given free-choice access to hay. Calves consumed about 3½ lb more hay when they were fed the high-fiber supplement (SH/CGF).

Different feeding regimes for conditioning weaned calves (45 days postweaning)			
	Feed		
	Corn/SBM[1]	Soyhulls/ Corn Gluten Feed[2]	Commercial[3]
Steer calves, no.	15	15	15
Pens	3	3	3
Calves/Pen	5	5	5
Initial (Weaning) Wt. lb	517.4	515.9	516.5
Final Wt. lb	628.1	655.3	658.3
Postweaning gain, lb	111.5	138.7	141.7
Postweaning ADG, lb	2.48	3.08	3.15
Suppl. Intake, lb/da	10.4	10.4	10.4
Hay Intake, lb/da	11.8	15.1	11.5

[1]Diet consisted 88% corn and 12% soybean meal with hay ad lib
[2]Diet consisted of 67% soyhulls and 33% corn gluten feed with hay ad lib
[3]Diet consisted of a commercial preconditioning feed (14.6% CP) with hay ad lib

Another study shows that steers are more likely to need extra feed during the last part of the grazing season – when forage quality might diminish and, more importantly, maintenance requirements increase as bodyweight increases.

Supplement (soyhulls) timing for steers grazing brome pasture			
	None	3 lbs all season	6 lbs last half
Steer Wt., lbs	689	689	689
ADG, lbs	1.38	1.45	1.69
Lb feed/lb added gain	--	42	9.7

JAS 66:2959

To summarize, we supplement when the animal needs more nutrients than the pasture will provide. That may be when pasture quality diminishes and when bodyweight of calves increase – generally in the latter part of the grazing season. We only supplement when it will yield a positive economic return and not decrease utilization of the forage.

What do we feed? Unless we feed at very low amounts (1 to 2 lb/hd/day), we should choose one of the high-fiber/low starch supplements – like soyhulls, corn gluten feed, distillers grain, etc.

How much do we feed? Cattle are more efficient at lower levels of supplemental feed intake and they won't reduce forage intake as much at lower levels (less than free-choice, for sure). The biggest enemy to profitable supplementation of cattle on grass is starch and … self-feeders.

Forage Spokesman Information

Clayton Geralds

Geralds Farms
Hart County, KY

Clayton Geralds runs a commercial hay farm in Hart County near Munfordville, Kentucky. His total farm size is 560 acres, 300 of which are leased. The focus of his operation is producing small square bales for the horse market. Clayton currently grows a range of forage species including 400 acres of alfalfa and alfalfa/orchardgrass and 150 acres timothy, orchardgrass, and teff. On average he puts up 70,000 small square bales a year. Clayton is one of best hay producers in the state and last year won the Charlie Schnitzler Producer Award at the 28th Annual Kentucky Alfalfa Conference. In his presentation Clayton will overview the storage facilities that he has constructed over the years on his hay operation. He will also explain the yield expectations he has for the farm each year, the input requirements for growing top quality horse hay, and Clayton will provide an overview of the forage quality expectations of his clients.

Brady Jarvis
Muhlenberg County, KY

Brady Jarvis is a lifelong native of Muhlenberg County, Kentucky. He resides on the family farm with his wife Michelle and their four year old son Cayden. He and his dad Gary farm twenty acres of burley tobacco, 150 acres of hay and 140 acres of pasture. They have a 90 head cow calf operation which consists of 70 fall calving cows and 20 Spring Calving cows. Thirty six of these cattle are registered angus which he uses for producing breeding stock. He also owns and operates a lawn mowing service. Brady has completed the University of Kentucky Master Cattlemen program and is an active member in the Muhlenberg County Cattlemen's Association. After attending a grazing and fencing field day hosted by the County Extension Service and reading an article about Winter Strategic Grazing authored by Kevin Laurent, Extension Associate for Livestock production, he and his dad decided to adopt the practice. The grazing practice enabled them to sell 150 rolls of hay that ordinarily they would have had to have for their herd. This was on the heels of the Spring freeze and drought of 2007. Realizing that grazing management pays dividends, Brady and his dad utilized rotational grazing this summer and highlighted this practice during the Cooperative Extension Service Field Day.