Virginia Tech
Shenandoah Valley Agricultural Research and Extension Center

2011 Field Day Proceedings

August 3, 2011

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2011 Field Day Program

12:00 – 1:15	**Registration and visit with sponsors – Bank Barn**
1:15 – 1:20	**Welcome**, *David Fiske, Superintendent, Shenandoah Valley Agricultural Research and Extension Center*
1:20 – 1:30	Load wagons and travel to the east end of McCormick Farm Circle
1:30 – 2:45	**Concurrent Sessions**
	Forage Species Demonstration Plots – *Jason Carter and Matt Yancey, Virginia Cooperative Extension*
	Phosphorus Removal Plots - *Jason Carter and Matt Yancey, Virginia Cooperative Extension*
	Forage Research Plots - *Dr. Ozzie Abaye, Crop and Soil Environmental Science, Virginia Tech*
	Pasture Rainfall Simulator – *J.B. Daniel, Forage & Grassland Agronomist, USDA-NRCS*
2:45– 2:55	Load wagons and travel to Forestry Demonstration
2:55 – 3:45	**Pine Planting Demonstration Plot Overview** – *Matt Yancey, Virginia Cooperative Extension*
	Pine Production in the Shenandoah Valley – *Patricia Nylander, Virginia Department of Forestry*
	What about Bio-mass? – *Dr. John Munsell, Department of Forestry, College of Natural Resources, Virginia Tech*
	Land Clearing Options – *Adam Downing, Virginia Cooperative Extension*
	Mulcher Demonstration
3:45 – 3:55	Load wagons and travel to Big Meadow area
3:55 – 5:40	**Overview of the Pasture-Based Beef Systems for Appalachia Project – What we've learned the first 10 years –** *Dr. Terry Swecker, VA-MD Regional College of Veterinary Medicine, Virginia Tech, Dr. Ron Lewis, Department of Animal and Poultry Sciences, Virginia Tech, Dr. William Clapham, USDA-ARS, and Dr. Joe Fontenot, John W. Hancock Jr. Professor Emeritus, Department of Animal and Poultry Sciences, Virginia Tech*
	Concentrated Hay Feeding During Winter and its Effect on Pasture - *Dr. Ben Tracy, Crop and Soil Environmental Science, Virginia Tech*
	Is Bigger Better? Beef cow size, Efficiency, and Profitability – *Allison Echols, Graduate Student, Beef Management, Department of Animal and Poultry Sciences, Virginia Tech*
	Weed Identification and Botanical Composition of Pastures – *Dr. Ozzie Abaye, Crop and Soil Environmental Science, Virginia Tech*
5:40 – 5:55	Load wagons and travel back to the McCormick Memorial
5:55 – 6:20	**Poster session and visit with sponsors – Bank Barn**
6:20 – 6:40	**Introductions and Comments from Special Guests – Memorial grounds picnic area**
6:40 – 6:50	**Pre-dinner Speaker –** ***Mr. Matt Lohr, Commissioner, Virginia Department of Agriculture and Consumer Services***
6:50	**Dinner**

FORAGE SPECIES DEMONSTRATION PROJECT

Matthew W. Yancey, Jason H. Carter, David A. Fiske, and Jonathan P. Repair [1]

Introduction

The concept and purpose of this Forage Species Demonstration Project is to provide agricultural producers a side by side visual demonstration of various forage species that are conducive for growth and production in western Virginia. Through this project, producers will be able to appraise for themselves both traditionally grown forage species and new forage species, which have been developed and released in recent years. The forages in this demonstration project can be used in agricultural production systems, as mechanically harvested forages or grazed forages, while some can be utilized in both type production systems.

Demonstration Plots

Forage Species and Variety Identification in plots:

1 / 2 / 3 / 4 / 5 / 6 / 7/ 8 / 9 /10 / 11 / 12 / 13 / 14 / 15 / 16 / 17 / 18 / 19 / 20 / 21

1. Meadow Brome
2. Timothy
3. Orchardgrass
4. Tall Fescue – Kentucky 31
5. Tall Fescue – Max Q
6. Tall Fescue – E34
7. Praire Bromegrass
8. Red Clover
9. Ladino Clover
10. Pasture Mix – sprayed with 2,4-D
11. Pasture Mix unsprayed
12. Alfalfa – Round Up Ready
13. Alfalfa – Traditional Type
14. Smooth Bromegrass
15. Bermudagrass
16. Pearl Millet
17. Crabgrass
18. Eastern Gamagrass
19. Big Bluestem
20. Switchgrass managed for grazing
21. Switchgrass managed for wildlife

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[1] Crop Extension Agent, VCEPD6, Livestock Extension Agent, VCEPD6, Superintendent, Virginia Tech Shenandoah Valley AREC, and Former Forage Extension Agent, Virginia Cooperative Extension, Planning District 6 (VCEPD6) respectively.

Forage Specie Information

1 **Meadow brome, 'Cache'**

Long lived perennial grass, regenerating through rhizomes
pH range – slightly acid to mildly alkaline
Start grazing at 8", stop at 4" for rapid regrowth.
Primarily used as pasture, but can be suitable for hay.
Good early spring growth & highly palatable
Seed in early spring ¼-1/2" at 10 lbs/ac
Very compatible with legumes.

2 **Timothy**

Use – mechanically harvested forage. Highly acceptable by equine
Time of Seeding – Early Spring or Late Summer
pH Range – 5.8-6.2
Seeding Rate – 8-10 lb/acre alone or 2-8 lb. in mixtures
Generally only one harvestable crop per year

3 **Orchardgrass**

Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – Early Spring or Late Summer
pH Range – 5.8 -6.2
Seeding Rate – 8-12 lb/acre alone or 3-6 lb. in mixtures

4, 5, &6 **Tall Fescue (4 – Kentucky 31; 5 – MaxQ; 6 – E34)**

Use – Pasture and/or Mechanically Harvested
Strong late fall & winter grazing crop
Time of Seeding – Early Spring or Late Summer
pH Range – 5.6 -6.2
Seeding Rate – 15-20 lb/acre alone or 6-12 lb. in mixtures
Kentucky 31 (4) – Can be highly infected with toxic endophyte fungus
Max Q (5) – Free of toxic endophyte fungus
E34 – Contains endophyte beneficial to growth, lacks toxic alkaloids

7 **Praire Bromegrass**

Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – Early Spring or Late Summer
pH Range – 6.0 – 7.0
Seeding Rate – 25 lb/acre drilled, 30-40 broadcast or 10-15 lb. in mixtures
Seeding Depth ¼ - ½ inch deep; planting depth is critical
Does not tolerate continuous grazing
Must be allowed to reseed naturally once per year

8 **Red Clover**

Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – Early Spring or Late Summer
pH Range – 5.8 -6.5
Seeding Rate – 8-10 lb/acre alone or 2-6 lb. in mixtures
Excellent response to frost seeding

9 **Ladino Clover**

Use – Pasture
Time of Seeding – Early Spring or Late Summer (preferred)
pH Range – 6.0 -6.5
Seeding Rate – 3-5 lb/acre alone or 1-2 lb. in mixtures
Excellent response to frost seeding
Excellent grazing tolerance
Reproduces excellent form plant runners and stolons

10 & 11 **Pasture Mix (10 – sprayed with 2,4-D; 11 – unsprayed)**

Orchardgrass, timothy, alfalfa, bluegrass, and white and red clovers
Plot 10 will be sprayed with a broadleaf herbicide to demonstrate the development of the grass/legume mix

12 & 13 **Alfalfa (12 – RoundUp Ready; 13 – conventional)**

Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – Early Spring or Late Summer
pH Range – 6.8 -7.0
Seeding Rate – 15-25 lb/acre alone or 10-20 lb. in mixtures
Should be planted in highly fertile and well drained soils
Needs 2-4lb/acre of boron annually
High potassium user
Grazing tolerant varieties available
Should not use in continuous grazing situations
Very drought tolerant
Round up Ready (13) allows for glyphosate to be used for grass and broadleaf weed control without injury to alfalfa.

14 **Smooth Bromegrass**
Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – Early Spring or fall with small grains
pH Range – 5.8 -6.7
Seeding Rate – 10 lb. in mixtures, do not seed alone
Very drought tolerant
Prefers well drained drought tolerant soils
Excellent nitrogen responder

15 **Bermudagrass**
Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – April 1 –June 1
pH Range –6.0 -6.5
Seeding Rate – 15- 20 bushels/acre as sprigs in rows or 30-40 sprigs if broadcast.
Seed Use 5-10 lb./acre
Warm Season Grass with excellent summer production

16 **Pearl Millet, 'Leafy 2000'**
Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – May 1 – July 1
pH Range – 5.5 -6.5
Seeding Rate – 25-40 lb/acre
Re-grows after each cutting until frost
Harvest as heads emerge (30-40")

17 **Crabgrass**
Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – March - May
pH Range – 5.8 -6.2
Seeding Rate – 4-6 lb/acre alone
Warm Season Annual Grass
Excellent natural re-seeder

18 **Eastern Gamagrass**
Tripsacum dactyloides
Use – Primarily Pasture but also Mechanically Harvested Forage
Time of Seeding – Late Spring or November-December
pH Range – 5.8 -6.5
Seeding Rate – 8-10 lb/acre alone
Native Warm Season Grass
Does well in moist, highly fertile soils, Excellent nitrogen responder
Grazing and cutting height critical 6-8 inches
Best planted with corn planter at a depth of 1-1.5 inch depth

19 **Big Bluestem, 'Niagara'**
Andropogon gerardii, 'Niagara'
Use: hay or pasture
Native warm season perennial grass
Seeding – April – June at 7 lbs/acre
Excellent forage producer in summer months
Excellent nitrogen responder

20 & 21 **Switchgrass (20 – managed for forage; 21 – burned for conservation)**
Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – May 15 – July 15
pH Range – 5.5 -6.5
Seeding Rate – 6-8 lb/acre of pure live seed
Seed must be chilled for adequate germination
Do not seed in mixtures
Graze or cut at 6-8 inch height
Excellent forage for summer months
Drought tolerant
Does well in less fertile soils

Acknowledgements

Sponsors:
Augusta Farmers Coop
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Utah Seed

Forage Phosphorus Removal Trials

Matthew W. Yancey, Jason H. Carter, and David A. Fiske

Phosphorous (P) supplementation of grazing beef cows is a commonly recommended and accepted management practice. Deficient P intake levels have been reported to negatively impact cow reproduction rates. In an environment of inexpensive P, the level of supplementation many times exceeded requirement to provide reproductive insurance. Recent increases in P costs have removed the low cost factor, but cattlemen are ingrained with the concept of P and bovine mineral supplementation. Educating cattlemen on the status of P in their soils and forages as compared to the needs of their cattle over stage of production will allow a more efficient, economical and environment-friendly means of meeting their cow's P requirements. The impact of commonly fed corn byproducts such as distillers grains and corn gluten feed which are all high in P will also be highlighted in the context of total P imports to the farm and beef herd. Phosphorous is also one of the more expensive components of a mineral mix. Reducing P content of mineral mixes has the added benefit of potentially lowering the cost of mineral supplements.

The draft TMDL proposal by EPA for the Chesapeake Bay outlines significant reductions in target loads for sediment, nitrogen and phosphorous. These proposed targets will likely lead to heightened future scrutiny of agriculture's contribution in the bay watershed as one of the contributing sources. The regulation of animal production in the watershed has historically focused on concentrated animal feeding operations (CAFOs). New TMDL reduction targets will likely expand the scope of non-point source pollution control efforts to include grazing beef cattle. Over 50% of Virginia's 650,000 beef cows are located in the bay watershed counties. If cows in the Virginia watershed receive the recommended 4 ounces/d of a free-choice mineral containing 6% phosphorous (P), 1100 tons of P is imported into these counties on a yearly basis. This amount of imported P is similar to the P reduction needed to meet Virginia's 2015 reduction target and approximately a third of Virginia's 2025 P reduction target.

Currently, recommendations to reduce nonpoint source pollution from grazing beef cattle focus on engineering solutions such as stream exclusion, alternate water sources, grazing management and stream crossings. Of the main contributors to nonpoint source (nitrogen, phosphorous and bacteria) pollution from the grazing beef animal, phosphorous could hold a different solution. Removal of phosphorous from the mineral supplements of Holstein steers grazing Wisconsin pastures had no negative impact on daily gain (Brokman et al., 2008). When phosphorous was added to the supplement, fecal phosphorous excretion increased. Subsequent forage analysis confirmed that grazed forage in the trial was adequate for growing steers. Analysis of over 600 grass hay samples produced in Virginia in 2006 revealed a ten-fold variation in P content (0.6-6.0%). The P requirement of a mature beef cow varies 100% over the course of her production year (14-28g/d). Recent efforts in Virginia and other bay watershed states focused on dairy cattle have demonstrated that P supplementation can be decreased without detrimental effects on cow performance and reproduction.

The purpose of this demonstration is to measure the agronomic available P in the soil of forage test plots that have been managed for P by traditional means including poultry litter

supplementation and inorganic P additions. The plant P and soil P will be measured over the next 3 years to assess both the potentially bovine available P and the P removal capacity of common pasture and hay forages. Both of these may provide insight as to how P removal in pasture and hay can be anticipated and how forage available P can meet the production phase dietary requirements of beef cattle.

In this initial year of the study (2011), twelve 300 ft^2 orchardgrass plots were established to conduct four treatments, each replicated three times. The soil in each plot was sampled to establish the baseline P level. From the baseline soil P level on three of the treatments, triple phosphate and diammonium phosphate were added to bring the soil P levels to medium (21-30 lbs/ac P), high (56-85 lbs/ac P), and very high (110 lbs/ac P) (VA DCR 2005). On the fourth treatment, two tons per acre of poultry litter were applied (contributing approximately 55 total lbs/ac P). These levels will be monitored over time for change in phosphorous level with forage removal.

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Study 1: Nitrogen Rate and Source on Biomass Yield of Teff Grown for Livestock Feed in the Mid-Atlantic Region

Study 2: Exploring the Forage Potential of Teff: A Grazing Study

Katie Hurder, Ozzie Abaye, Chris Teutsch, Ben Tracy, Rory Maguire, and Mark McCann

The main benefit of warm-season annual grasses is that they are most productive during hot weather and can provide badly needed forage during times of water deficit. Incorporating warm-season annual forages into a grazing system is another way producers reduce the risk of low forage supply. Unfortunately, integrating these grasses can be challenging because of management factors such as negative quality and lack of versatility in utilization. Teff, (*Eragrostis tef* (Zucc.) Trotter), a new forage to the mid-Atlantic region could offer a possible alternative to current options of warm season annuals. Because teff is a relatively new forage crop, little is know about proper management guidelines.

The 2010 growing season was much hotter and drier than the 2009 growing season. At the Southern Piedmont and Blacksburg locations, the average June and July rainfall was by far less than the 2009 and the historic average rainfall. Subsequently, the first harvest was delayed by 2-3 weeks compared to the Steeles Tavern location. Biomass production peaked at the N rate of 80 lbs N/acre, but in most cases leveled off at 40 lbs N/acre. Teff biomass yield, in general, reduced with each subsequent harvest. Nitrogen source had minimal effect on biomass yield. Seasonal biomass yield, totaled over locations, year, N rate, and N source ranged from 1317 to 7908 lbs DM per acre with an average production level of 4054 lbs DM/acre. Generally, in 2010, the potential biomass yield of teff was hindered by lack of rainfall. However, the tolerance of teff to severe drought, and its quick recovery upon minimal rainfall, makes it a valuable alternative summer annual crop where the occurrence of draught is inevitable. Under favorable growing conditions, a cutting interval of 28-30 days is possible. In 2010, at Steeles Tavern location, teff was ready for harvest 23 days after the first harvest.

Nitrogen source had little effect on nutritive value of teff whereas N rate showed effects on CP but not on ADF, NDF, or TDN. Our study showed that harvest date had a more pronounced effect on nutritive values than either N rates or sources. Crude protein values ranged from 7 to 24 %, with an average value of 12.5% while the ADF, NDF, and TDN values ranged from 27 to 48, 51 to 76 and, 46 to 67 %, respectively. Based on the nutritional requirements of various livestock classes, the nutritive values of teff we reported can be adequate to fulfill the needs of animals at or above maintenance level.

In our study**,** nitrate accumulation in teff was reported at both dangerous and toxic levels. In general, these levels were only evident at the 80 and 120 lbs N/acre rates with ammonium nitrate in first cut samples. Where only severe drought was experienced (Blackstone, 2010), broiler litter had the same effect. That is, dangerous level of nitrate was reported at a high rate (120 lbs

N/acre) of broiler litter application. Based on our two year study across three geographical locations in Virginia, we can conclude that 40 lbs N/acre is the rate where the optimum biomass yield can be achieved while maintaining a safe nitrate level in teff. In terms of N source, generally no significant difference in biomass yield was observed between the two N sources. This can be beneficial to those who have access to broiler litter. In summary, the ability of teff to withstand severe droughts and recover quickly upon receiving minimum amount of rainfall, and its ability to produce optimum yield at N rates between 0-40 lbs N/acre regardless of N source, make it a viable alternative annual summer forage crop for the mid-Atlantic region.

Grazing Study

A grazing experiment was initiated the first week of June, 2010 at the Kentland Research Farm near Blacksburg, VA. Teff was no-tilled into an existing sod at a rate of 6.0 lb/A on 22 acres. Teff established and emerged 3 days after seeding (Picture 1). Two grazing treatments, one grazing only (no hay was harvested) the second hay/grazing (harvest the first growth for hay and graze the re-growth) were implemented. Four to five heifers depending on forage mass (average weight of (550 lbs) were assigned to each pasture, resulting in a stocking density of 1.0 AU/A. Using electrified temporary fencing, animals were allocated enough forage for 4-5 days. Grazing began when Teff reaches pre-boot stage. Animals were weighed on consecutive days at the beginning and end of the grazing season, and full weights were taken every 28 d. Portable 227 liter troughs were used to provide water in paddocks being grazed. Forage samples were obtained before animals entered each paddock, for forage biomass yield and quality determinations.

Results to Date:

Due to severe drought during the month of June, grazing did not start until mid-July. Initial biomass yield ranged from 2500-3000 lbs/acre. Where animals grazed the initial and the subsequent re-growth of Teff (grazing only treatment, 77 grazing days), average daily gain was 1.78 lbs/day compared to those animals on hay/grazing pastures (35 grazing days) which was 1.92 lbs/day (Table 1). However, the number of animal grazing days was higher (256 days) in grazing only treatments compared with the hay/grazing (391 day) treatment. From the hay/grazing treatment, we obtained 20 round bales (1.5 ton/acre). With higher average daily gain (although the number of grazing days were fewer), and hay, the hay/grazing treatment might be more profitable than the grazing alone treatment. It was obvious that the heifers liked the teff (couldn't wait to be moved – pictures attached).

Picture 2. Heifers grazing teff, July, 2010 – cattle grazing tall fescue in the background.

Picture 3. Heifers grazing teff, July, 2010 – Resting –satisfied customers

We like to acknowledge the support provided by Target Seed Co., The Teff Company, and the USDA Grass-fed Beef Initiative.

Assessing the Potential Use of Teff as an Alternative Grain Crop in Virginia

Jennifer Coleman, Ozzie Abaye, William Barbaeu, Wade Thomason, and Jactone Ogejo

"The Lost Seed"

With shifting trends in consumer preferences and an increasing demand in a healthier, wider selection of ethnic and alternative food crops, consumers are no longer satisfied with traditional crops, such as corn and wheat. Instead the demand in specialty crops has expanded beyond our borders to international cuisine. The unique taste and nutritional value of teff (Eragrostis tef (Zucc.) Trotter), a small grain crop native to Ethiopia, has led interest to spread to a diverse array of countries around the world. Though the art of growing and milling teff has been mastered in its Ethiopian homeland, little is known about this crop in other parts of the world.

With a population exceeding 60 million people, Ethiopia is the only country in the world where teff is intensely grown and produced for human consumption. Teff is a C4, annual grass widely adapted to a variety of environmental conditions: tolerant of water-logged, drought-stressed and low fertility soils. Above all, teff is most known for having a minute seed head with a diameter of only 0.7 to 1.0 mm. In fact, teff literally means "lost seed" in Ethiopia because if dropped, it is so easily lost. While this ancient crop leaves much room for technological innovation in threshing and harvesting the grain for commercial marketing, teff has long established itself as a valuable part of the Ethiopian diet.

Why Produce Teff?

Teff has an excellent chemical composition that makes it a very nutritious alternative to other cereal crops. It is high in amino acids and has higher lysine (the most limiting amino acid in most grains) content than all other cereals except oats and rice. Teff also contains 12-17% protein with the highest protein storage components being glutelins (44.55%) and albumins (36.6%) (Gamboa, 2008; Ketema, 1997). Teff is also reported to have the highest iron content of

all cereals though whether the source of iron is from the grain or from soil contamination is disputed. Teff also contains more calcium, copper, zinc, aluminum, and barium than winter wheat, barley, and sorghum (Ketema, 1997).

Teff is also gluten-free, appealing to the millions of people in the United States that have been diagnosed with Celiac Disease. It was originally believed that Celiac Disease was a rare childhood symptom, however; it has more recently been categorized as a common genetic disorder affecting more than 2 million people in the United States or 1 in 133 people (Health, 2008). Celiac disease (CD) is a digestive disease that affects nutrient adsorption in the inner lining of the small intestines. Those affected by CD cannot tolerate gluten, a protein present in wheat, barley, and rye. In a study performed by Hopman (2008), it was found that CD patients with teff frequently used in their gluten free diet reported fewer symptoms and in shorter duration as opposed to reported symptoms that were much more severe before using teff (Hopman, 2008). When teff was added to the diet, there was a significant reduction in symptoms from 58 to 17% (Hopman, 2008). This suggests that teff may be a viable alternative to other cereal crops for CD patients.

Cultural Practices

Sensitive to day length, teff thrives in areas having 12 hours of daylight but also does well in areas with shorter day lengths. Requiring a frost-free growing season, the emergence rate of teff increases as temperature increases with an optimum temperature within 10-27°C (Evert et al., 2009). Weed competition can result in up to a 35% loss, thus the main advantage of multiple plowings prior to sowing is weed control (Habtegebrial et al., 2007). Lightly covering or packing the seedbed after sowing will increase seed-to-soil contact and promote germination, resulting in a higher yield (Ketema, 1997).

The recommended planting depth for teff seed is between 0.6 and 1.3 cm (Evert et al., 2009). Planting too shallow (broadcasting) or too deep (5.0 cm or greater) should be avoided. The recommended seeding rate according to Ketema (1997) is 15 kg ha-1 if drilled and 25-30 kg ha-1 if broadcasted. Optimum yield was obtained at around 60-70 kg nitrogen ha-1. Nitrogen application above 70 kg ha-1 encouraged lodging by up to 65% with a high yield in straw production and consequently low grain yield (van Delden et al., 2010).

Teff is harvested when the vegetative part of the plant turns a yellowish color. The time of harvest varies between 60 and 120 days (Ketema, 1997). It is important to harvest before the plant turns too dry to prevent yield losses from shattering (Ketema, 1997). In Ethiopia, the dried and harvested plant is laid out on hard, flat, cemented ground and oxen are used to thresh the crop. Oxen are used by walking back and forth on the crop in the process of separating the grain from the head. The grain is then separated from the straw by tossing the grain and threshed material into the air using the different aerodynamic properties (Zewdu, 2007). The grain is manually cleaned by wafting air over the grain to blow the chaff from the mix using a hard leather strap (Zewdu, 2007).

Proposed Research

Average annual teff production in Ethiopia is estimated to be 1.38 million tons, yielding 1,420 kg ha-1 in 1991(Ketema, 1997). Small-scale teff grain production has started in the United States, with approximately 200 acres of teff grown for grain production in Carleson, Idaho (Ketema, 1997). Growing interest in producing teff in other regions of the United States has led to the development of this study. The adaptive nature of this grass, along with the success of growers in other regions of the United States, has led us to believe that teff can be established and produced locally. The objective of this study seeks to assess the adaptations of teff and grain yield potential throughout various physiographic regions of Virginia.

The baking quality of teff flour is determined by its physical and chemical characteristics. Physical characteristics include those that affect the milling or processing of teff grain. The milling potential is assessed by the grade, test weight, and falling number of teff grain. Grade is most important to millers because it determines the quality of the end product. In addition to the falling number, the flour must be ground fine enough to make good baking flour. The baking potential of teff grain is also defined by its chemical composition. Protein content and quality are important factors to consider when determining end product quality. Protein quality, or gluten strength, is also a principle characteristic influencing baking quality. Since teff is gluten-free, exploring methods of improving the baking characteristics of teff will be a key component of this study. Consumer acceptance of the end product will be greatly influenced by the ability of teff to imitate the baking characteristics of products that contain gluten, such as wheat.

Though teff produces a lower grain yield compared to other cereal competitors, the price teff producers receive for a tasty, gluten-free flour may compensate for the differences in yield and make teff a profitable alternative. Since this price is dependent on the quality of teff flour, the feasibility of teff production must incorporate a detailed analysis of teff baking quality. Once the quality of the end product has been explored, then a complete evaluation of the marketing potential of teff can be determined, taking into consideration all inputs and outputs from field to market.

Materials and Methods

Small plot experiments were conducted in 2010 at three locations: Blacksburg, and, Steeles Tavern, VA, and in Dobson, NC to evaluate the grain production potential of teff across different geographic regions. The experiment utilized two planting dates, June and July, and two grain varieties, brown and white. The treatments were arranged in a randomized complete block design with four replications of red and four replications of white teff varieties for each planting date, with a total of eight replications in June and eight replications in July. Each plot was 3 by 5 meters with the exception of the plots in Dobson, NC which consist of two half-acre plots, one for each variety.

The teff seed was planted in early June and July at Blacksburg and Steeles Tavern on a conventionally prepared seedbed using a cultipacker type seeder. Teff was planted in early July in Dobson, NC at a site previously planted with wheat where teff was planted no till into wheat stubble. The seeding rate was 6.7 kg PLS ha-1. Nitrogen fertilizer was applied in the form of urea at planting at a rate of 50 lbs. ac-1. Field data was collected at each location to determine the number of tillers per plant and plant height.

Teff plots were harvested using a different method at each location. In Blacksburg, plots were only harvested for the first replication of the brown variety for the June planting. The entire plot was harvested by cutting all biomass at 5 cm above the soil surface. In Steeles Tavern, plots were harvested in strips using a 100 cm self-propelled cycle mower. The cutting height was 10 cm above the soil surface. The area harvested varied slightly from plot to plot but the exact measurements were recorded and the average area was around 186 m2. Lodging presented a major obstacle to harvest in Steeles Tavern. Samples were collected from Dobson, NC by cutting all biomass 5 cm above the soil that fell into a randomly placed 1 m2 quadrant. Ten samples were collected for both the white and brown variety.

The harvested samples are currently being threshed by hand using a rubber mat and grout, along with a 0.7 – 1.0 mm sieve and sorting pan. The seeds are separated from the chaff via friction between the grout and mat and sorted and cleaned with different sized sieves. Alternative methods of threshing are being explored, including the use of a mechanized, small-grain thresher.

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Using a Rainfall Simulator on Pasture to Demonstrate How Grazing Management Impacts Pasture Condition and Rainfall Infiltration

J.B. Daniel, NRCS Grassland Agronomist

Many factors contribute to the yield and productivity of pasture during the growing season but one of the most important is water, and more specifically available soil moisture. Available soil moisture is arguably the greatest limiting factor to forage growth during the growing season. Other management factors do contribute to overall growth and productivity of the pasture, but when it gets dry plant growth stops. Many livestock producers don't realize there is a practical way to truly increase a pasture's ability to capture and store rainwater and it begins with improved grazing management.

In Virginia depending on where a farm is located, it likely receives anywhere from 35 to 49 inches of precipitation annually. Most people think available soil moisture is just related to the amount of rainfall you receive, but that is incorrect. Of course the amount and timing of rainfall throughout the growing season is important, however; the condition of the pasture surface is of equal importance because that is what largely determines how much rainfall is captured for forage use versus what runs off as a lost resource.

Pasture condition is estimated by several indicators of the forages and soils in a pasture. Certain site characteristics such as slope, aspect, soil type, and depth to rock cannot be changed, however; other characteristics that also affect runoff of rainwater can be managed. Some manageable pasture characteristics include living plant cover, dead plant residue on the surface, livestock concentration areas, soil compaction and soil erosion. These 5 indicators of pasture condition are usually related to the stocking rate and management of the grazing livestock within a pasture system.

Many livestock producers in VA, like most of the eastern United States, have higher livestock numbers than their pastureland acres can sustainably support and they don't actively manage the grazing of their livestock on the pasture. These two factors combined often result in overgrazed pastures with less plant cover, greater compaction near the soil surface, suppressed forage yield, concentrated feeding areas and increased erosion and runoff. In contrast, livestock producers who adjust stocking rate to closely match annual pasture production and implement rotational stocking, can greatly improve pasture condition. By committing to managing the grazing animals on the pasture based on forage height and sufficient rest periods, forages are allowed to regrow and recover. These management strategies ultimately result in thick, dense pasture sod with greater surface cover throughout the year and fewer livestock concentration areas. The thick plant canopy helps protect the soil from direct raindrop impact. Plant residue on the soil surface slows rainfall runoff to allow more time for infiltration into the soil. Research shows that grazing management practices which leave 4 inches of forage residue on the surface after grazing, in cool season grass pastures, improves rainfall infiltration and decreases erosion (Hann et al. 2006). Although managing grazing animals to maintain surface cover is important

research indicates that other forage and soil characteristics including forage mass, forage height and soil organic matter are also important for controlling runoff and decreasing the loss of sediment and valuable nutrients from pastures.

NRCS uses a rainfall simulator demonstration to help people visualize the potential for greater rainfall infiltration on pastures with a high level of grazing management. Actual samples of pasture sod are carefully collected from representative pastures of long term, continuous stocking versus long term, rotational stocking systems. The sod is placed firmly in trays and secured on a demonstration table at a 20% slope. A high intensity, short duration rainfall simulation begins and all rainfall runoff is funneled into collection jars on the front of each respective pasture sample. At the end of demonstration it is amazing to see the amount of runoff and suspended sediment collected from an overgrazed pasture sod in a continuous stocking system versus a well rested pasture sod from a rotational stocking system (Figure 1). Furthermore the rainfall that actually infiltrates the pasture surface and moves downward through the soil from these same samples is captured and funneled into collection jars beneath the demonstration table. This comparison emphasizes the improved potential for capturing rainfall and storing it in a well conditioned pasture soil for future forage growth in a rotationally stocked grazing system.

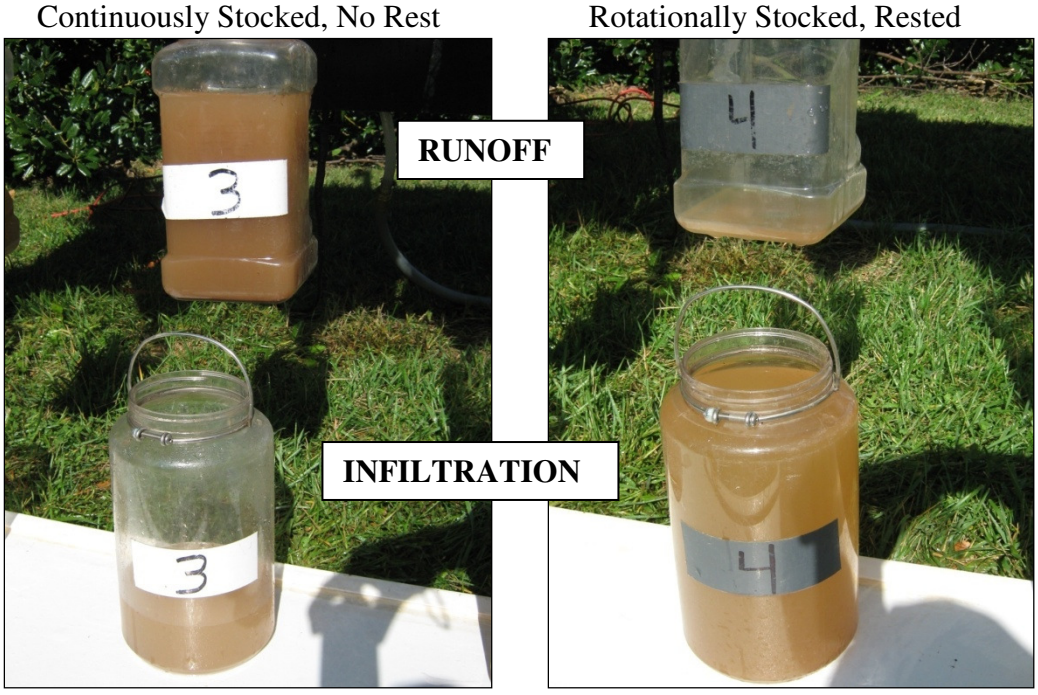

Figure 1. Rainfall runoff versus infiltration from a rainfall simulator demonstration comparing a continuously stocked, overgrazed pasture to a rotationally stocked, rested pasture.

Although the results shown in Figure 1 are from a demonstration, field scale research studies support that improved grazing management positively affects pasture condition, rainfall runoff and forage yield (Pennington, J. et al. 2009). Once a person understands these

relationships, they begin to see the need to better manage the grazing animal for improving soil and water resource management and increasing forage yield across the entire pasture landscape.

For more information about improved grazing management, get to know the successful graziers in area of the state. Visit www.vaforages.org to see what forage educational events are planned near you. Tap into the knowledge and resources available within your local community to help you begin planning a grazing system that will meet the goals of your operation. Start the process by contacting your local USDA Natural Resources Conservation Service office, the Soil and Water Conservation District and your local Extension Agent to see what resources they can offer to help you along the way.

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Pines, Bio-mass and Land-clearing: Options for Producers to Consider

Adam K. Downing,[1] Patti Nylander[2], John Munsell[3] and Joe Lehnen[4]

Background

Agricultural producers face a myriad of choices when it comes to determining how to best use their land. Economics is often the driving factor but decisions may also consider additional objectives such as recreation, soil conservation and wildlife habitat direct land-use decision making. The Shenandoah Valley Region is rich with resources for growing plants & animals and multiple market options. In many cases, producers have not only the resource capability but also the market viability to run a multifaceted, diverse operation

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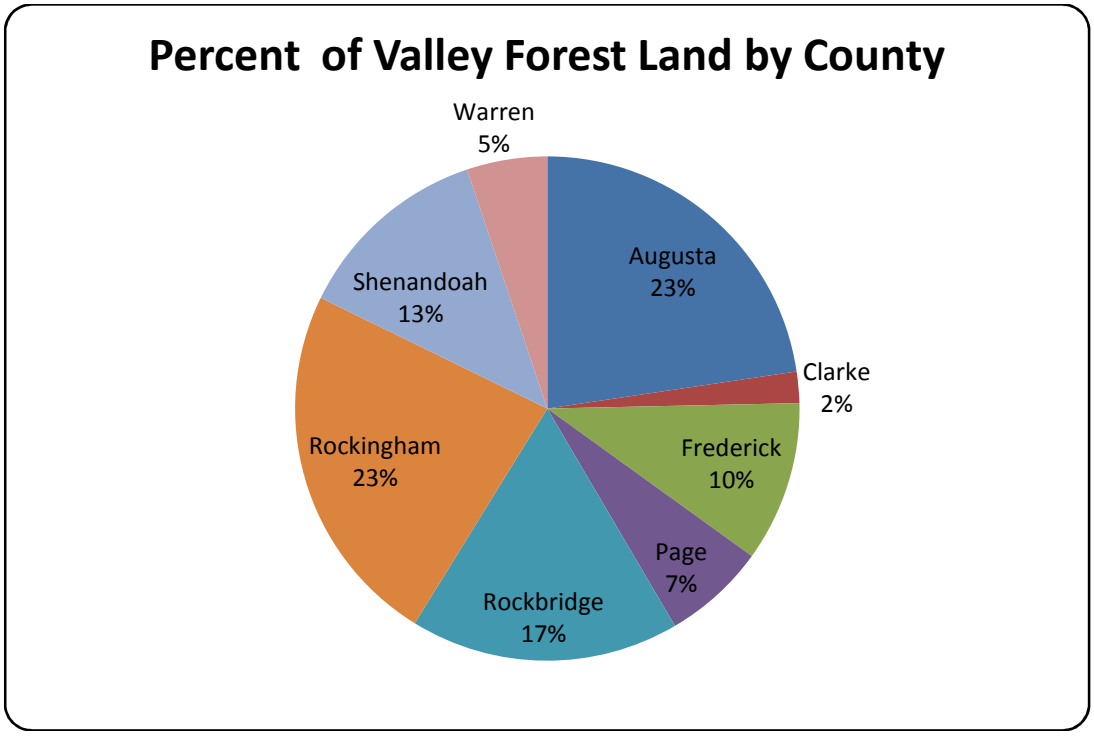
The Shenandoah Valley, which for the purposes of these proceedings will include the counties of Augusta, Clarke, Frederick, Page, Rockbridge, Rockingham, Shenandoah and Warren, is currently 57.8% forested. The following pie chart displays the contribution of each county to the total forest land area of the Shenandoah Valley.



The majority of this forest land, nearly 60 percent, is owned by farmers and other private landowners.

County	Total Forest Acres	Private Forest Acres	% Private Forest Land
Augusta	340,345	131,202	38.5
Clarke	30,132	30,132	100
Frederick	154,640	154,640	100
Page	99,226	53,483	53.9
Rockbridge	259,328	174,970	67.5
Rockingham	352,249	167,279	47.5
Shenandoah	189,485	111,356	58.8
Warren	77,397	46,906	60.6
Total	**1,502,802**	**869,968**	**57.9**

Based upon Forest Inventory Analysis (FIA) data the predominant tree species (in terms of volume per acre) is chestnut oak a common component of the most common forest type in the region, oak-hickory. Perhaps the most lacking forest/tree type in the Shenandoah Valley is the pine family which collectively constitutes only about 9% of the forest resources in the valley counties.

Presently most of the trees harvested from Shenandoah Valley forests are utilized for products such as: veneer, sawtimber, pulpwood, shavings or firewood.

Conifers, such as pine trees and other evergreen needle bearing species, can provide a missing component of wildlife habitat (thermal cover and some food) as well as an economic investment of intermediate length (approximately 30 years) that might provide a missing piece of your investment portfolio. The potential for future bio-mass markets is an additional reason to consider investing in pine.

In some cases, landowners may be interested in reclaiming land for pasture or otherwise putting it back into an agricultural use incompatible with dense forest. Land clearing is traditionally an expense and unavoidably destructive practice resulting in significant losses of organic matter and top soil. In some cases, new land clearing technologies provides landowners with less destructive options to clear areas of trees, shrubs & stumps.

This printed material is to compliment the forestry related field portions of the 2011 SVAREC Field-day and briefly explore Pine, Biomass and Land-clearing.

Pine Points… Planted Pine stands can offer *financial* benefits as well as benefits to *wildlife*
The expense factor

- With better harvesting practices, site preparation work is rarely necessary, keeping establishment costs lower.
- A cost-effective way to minimize erosion on marginal pasture.
- Pine trees tolerate poor soil conditions, so can be planted on poor ground and still generate income, whereas other crops on that same site may not.
- Trees and labor average around $100/acre, depending on species and spacing.
- Cost-share funds are often available.
- Pine stands have a relatively short rotation, so you may see 2, possibly 3 harvests in your lifetime (Commercial thinning, then harvest)

The wildlife factor

- Young pine stands provide cover for deer, turkey, bear, small mammals, and songbirds
- Older pine stands provide thermal cover for wildlife, and roosting sites for turkey

Species to consider for the Shenandoah Valley:

Species	**Benefits/Characteristics**
Eastern White Pine	Native to much of the Shenandoah Valley, fast growing, aesthetics, markets exist for White Pine pulpwood and lumber
Shortleaf Pine	Native, trying to re-establish in the Valley, markets exist for pulpwood and lumber
Pitch-Loblolly Pine	Produced for "hardiness" and quick growth, pulpwood products
Improved Loblolly Pine	Fast growing, good for pulpwood markets, "hardiness" may be an issue in some parts of the Valley

Spacing Considerations: Depends on landowner objectives

Spacing	Benefits/Characteristics
8'x10' 544 trees/acre	Common density for pine production. Expect to perform commercial thinning in 17-20 years
12'x12' 300 trees/acre	Beneficial for wildlife habitat. Stand grows into mixed pine/hardwood. Lower density allows for more herbaceous cover and food available.
10'x6' 720 trees/acre	Consider for biomass production, or other "special use" market. Sawdust for poultry houses, chips for pulpwood. First "removal" is 12-14 years.

Pine Planting Demonstration Site

Shortleaf Pine 8' x 10' 544 trees/acre	Pitch-Loblolly 8' x 10' 544 trees/acre	Loblolly Elite 8' x 10' 544 trees/acre	Premium Loblolly 8' x 10' 544 trees/acre	2nd Generation Loblolly Pine 8' x 10' 544 trees/acre	2nd Generation Loblolly Pine 10' x 6' 720 trees/acre	Hardwoods (no pine trees planted)
Hardwoods (no pine trees Planted)	Pitch-Loblolly Pine 12' x 12' 300 trees/acre	Shortleaf Pine 12' x 12' 300 trees/acre	Hardwoods (no pine trees planted)	Loblolly Elite 12' x 12' 300 trees/acre	Premium Loblolly 12' x 12' 300 trees/acre	2nd Generation Loblolly Pine 12' x 12' 300 trees/acre

This area was clearcut harvested in the fall of 2009. Following the harvest, the area was planted with a variety of pine species and at different densities.

We used several different species so that we will be able to make side-by-side comparisons of how each species will grow here in the Valley. The different spacings were used to demonstrate managing pines for different objectives; the three we chose to focus on were timber production, wildlife habitat, and biomass production.

Each "block" is roughly one acre in size.

Considering Woody Biomass

Biomass from the 32 million acres of southern US pine plantations could provide a substantial amount of feedstock for emerging bioenergy industries. Research results and operational field trials indicated that total plantation biomass productivity exceeding 10 green tons per acre per year with rotations less than 25 years is biologically possible, financially attractive, and environmentally sustainable. Such output is achieved through the use of intensive management practices where the plantation is treated as an agro-ecosystem by managing both the crop trees and the soil to optimize productivity and value. Intensive management of southern US pine plantations could significantly increase the amount of biomass available to supply bioenergy firms. Results from growth and yield simulations published in Munsell and Fox (2010) using models and a financial analysis suggest that if the 32 million acres of cutover pine plantations and an additional 6 million acres of planted idle farmland are intensively managed in the most profitable regimes, up to 86.7 million green tons of woody biomass could be produced annually. However, there are important questions about the financial gains associated with intensive management for biomass production and whether landowners would adopt these systems.

The analysis in Munsell and Fox (2010) shows that providing biomass for energy from pine plantations on cutover sites is most profitable when a mixture of traditional forest products and biomass for energy is produced using intensive practices. Unless the prices paid to the landowner increase to $12 per ton of biomass or sizable subsidies are available, the analysis indicates that returns from dedicated biomass plantations on cutover sites and idle farmland will be lower than

integrated product plantations. If such prices or subsidies existed, the volume of biomass supplied to bioenergy firms in the southern US could be substantial. At present prices, traditional timber products and biomass will need to be produced in conjunction on existing plantations to realize highest returns, which considerably reduces the volume of available biomass. Planting specifically for biomass on idle farmland appears to be financially feasible, but incentives in combination with significant price increases will be necessary to increase large-scale adoption on cutover sites.

Land Clearing Options

There are nearly as many methods to clear land as there are reasons to clear. Both should be considered when making decisions. Why do you want to clear land? Is the land well suited for the different use you have planned for it? What method of clearing will give you the best end result? What clearing options are available within the confines of the site and available resources?

In a nutshell, the basic land-clearing options should be considered in two parts. First of all, is the current vegetation valuable enough to consider a commercial timber harvest which can offset the cost of clearing. Secondly, how will the woody stumps and roots be removed (if not removed or killed, most will resprout)? There are good reasons to consider alternatives to traditional grubbing/bulldozing for productivity and environmental reasons. These traditional methods usually result in a tremendous loss of soil organic matter and present a higher risk of erosion, both of which lead to reduced productivity.

A method well known by our forefathers that is still viable today for anyone with patience is the "**delayed stump removal**". Regardless of how the above ground vegetation is removed (by hand or through a timber harvest) the roots and stumps need to be dealt with or they will simply resprout and provide you with another woody plant dominated site. While some stumps may be physically pulled from the ground with tractor and chain, others need to be treated chemically to eliminate sprouting. A simple treatment of the stump with the appropriate herbicide will do the trick. Another variation of this option is to treat stumps chemically and let decomposers do their work to slowly rot it away.

A second alternative to consider is "**in-place forest mulching**". This newer land clearing method preserves soil integrity and quickly removes stumps and other woody debris. Specialized machines equipped with mulching/chipping implements chip vegetation and incorporate this organic matter it into the soil. Mulching heads can be mounted on large or small tracked and wheeled equipment and used to push down and mulch nearly any size stem and grind out stumps. Mulching is better alternative to help maintain and even increase soil organic matter, reduce erosion, and prepare sites for planting into pasture. This

method of clearing is generally more expensive on a per-acre basis; however, depending on site factors and overall project costs such as fertilization, it can be cost competitive. A 2007 research project (Teutsch, 2007) at the Southern Piedmont Agricultural Research and Extension Center compared the costs of mulching and conventional clearing and found mulching to be cheaper ($850 per acre for mulching compared to $1,650 per acre for conventional clearing). Other factors include particulars such as the type of vegetation being processed (pine is easier), vegetation size (smaller is faster), soil characteristics (very rocky sites are not conducive to mulching), terrain, and landowner preferences for "cleanliness." Depending on these aspects, an acre may take anywhere from one to eight hours to clear.

Finally, a third alternative makes use of the insatiable goat. **Goats** can be used to harvest and clear underbrush and smaller trees in designated areas before timber harvesting. The role of goats as biological control agents in forested areas may become increasingly important in the future due to environmental concerns and elevated costs associated with mechanical cutting and herbicide application. During dry weather especially, a goat's diet becomes diverse. In a study of goats grazing in a power line right of way for five years in West Virginia, they reduced the brush cover from 45 percent to 15 percent in one year. Sheep, on the other hand, took three years to achieve the same results (Magadlela *et al.,* 1995). After five years of grazing, goats reduced brush cover to 2 percent.

Goats will not eat through the hard bark of mature trees, but may girdle younger, thinly barked trees if better forage is unavailable. The mature tree can remain unharmed as long as the goats have other forage to graze. Three to five goats per acre (more if you want to clear the area in reduced time) should be kept contained by solar or battery-powered or electric mesh fences.

Using goats to clear land is not the fastest method but allows one to harvest value (goat meat) from undergrowth and reduce debris before trees are removed. Goats can also be used post-clearing for sprout and weed control. It should be noted, however, that in most cases goat browsing, like other mechanical methods, does not kill the roots of most woody plants. Repeated browsing or follow-up chemical control is necessary to limit resprouting.

Citations:

Magadlela, A.M., M.E. Dabaan, W.B. Bryan, E.C. Prigge, J.D. Skousen, G.E. D'Souza, B.L. Arbogast, G. Flores. 1995. Brush clearing on hill land pasture with sheep and goats. Journal of Agronomy and Crop Science 174:1-8.

Munsell, J.F. and T.R. Fox. 2010. An analysis of the feasibility for increasing woody biomass production from pine plantations in the southern United States. Biomass and Bioenergy. 34(12):1631-1642.

Teutsch, C. Land Clearing & Pasture Update. Unpublished research presented at the 2008 Biosolids Workshop. http://www.arec.vaes.vt.edu/southern-piedmont/forages/camtasia/08biosolids.html (Accessed 4/6/2011). Blackstone, VA.

Appendix: Additional Resources

Cost-Share Programs available for Pine Planting

RT – Reforestation of Timberlands – Virginia Department of Forestry

http://www.dof.virginia.gov/boards/rt/index-rt-program.htm

This program provides cost-share funds to establish pine species. The payment rate depends on the species planted. Minimum acreage requirement of 5 acres.

Projects covered: Open Field plantings
Reforestation sites following harvest
Some site-preparation practices (herbicide, machine, burning)
Release spraying of pine stands

Species covered: White Pine, Loblolly Pine, Shortleaf Pine, Longleaf Pine, Pitch-Loblolly Pine, Virginia Pine

Pine Bark Beetle Prevention Program – Virginia Department of Forestry

http://www.dof.virginia.gov/mgt/cip-fact-pbbp.htm

This program provides cost-share assistance for thinning pine stands in an effort to reduce the risk of a bark beetle infestation.

Projects covered: Pre-commercial thinning (at least 800 stems/acre and no more than 15 yrs old)

Paid to loggers during a commercial thinning of pine (at least 350 stems/ac and 12-22 yrs)

Other cost-share sources:

Local Soil and Water Conservation Districts

Name	Location	Contact
Headwaters – Augusta Co.	USDA Service Center, Verona	540-248-4328 ext. 3
Natural Bridge – Rockbridge Co.	40 Magnolia Square Way, Suite 5, Lexington, VA 24450	540-463-7124, Ext. 3
Shenandoah Valley – Rockingham Co.	1934 Deyerle Avenue, Suite B, Harrisonburg, VA 22801	540-433-2853, Ext. 4

http://www.dcr.virginia.gov/stormwater_management/index.shtml

Natural Resource Conservation Service

Verona Service Center 70 Dick Huff Lane Verona, Va. 24482	(540) 248-6218 (540) 248-3723 fax
Harrisonburg Service Center 1934 Deyerle Avenue Harrisongburg, Va 22801-3484	(540) 433-9126 (540) 574-0646 fax
Lexington Service Center 40 Magnolia Square Way, Suite 5 Lexington, Va. 24450	(540) 463-7124 (540) 463-7124 fax

http://offices.sc.egov.usda.gov/locator/app

Woody Biomass/Bio-energy Resources:

Wood Biomass for Energy: http://www.fpl.fs.fed.us/documnts/techline/wood-biomass-for-energy.pdf

- One page fact sheet/primer on the technical aspects of generating energy from wood

Forest Bioenergy: http://www.forestbioenergy.net/

- Sustainable Forestry for Bioenergy and Bio-Based Products: An Online Landowner Shortcourse
- Training tools
- Case studies
- Presentations

Wood to Energy: http://www.interfacesouth.org/products/wood-to-energy

- Southern Region in scope
- Case Studies
- Factsheets
- Presentations

Land Clearing Resources:

- To Clear or Not to Clear – That is the Questions
  http://pubs.ext.vt.edu/465/465-340/465-340.html

- Options for Clearing Land: Pasture Establishment for Horses (or other livestock)
  http://pubs.ext.vt.edu/465/465-341/465-341.html

- Land Clearing and Pasture Update from Chris Teutsch (an online presentation)
  http://www.arec.vaes.vt.edu/southern-piedmont/forages/camtasia/2008biosolids/2008land.html

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[4] Joe Lehnen, Forester, Shenandoah Resource & Conservation Development Council and Virginia Department of Forestry

Acknowledgements

Elkora Firewood/William Pepper
Sustainable Agriculture Research & Education (SARE grant)
Shenandoah Valley Agricultural Research & Extension Center/McCormick Farm
Shenandoah Valley Resource Conservation & Development
Shenandoah Valley Soil & Water Conservation District
Society of American Forester, Skyline Chapter of the Virginia Division
United State Forest Service, National Agroforestry Center
VA LEAF Program (Link to Education About Forestry)
Virginia Cooperative Extension
Virginia Department of Forestry
VT, College of Natural Resource, Department of Forest Resources and Environmental Conservation

Overview of the Pasture-Based Beef Systems for Appalachia Project – What we've Learned the First 10 Years

Terry Swecker (VT), Ron Lewis (VT), William Clapham (USDA-ARS), Joseph P. Fontenot (VT)

Phase I

The research at the Shenandoah Valley Agricultural Research and Extension Center (SVAREC) is part of a large initiative, cooperative with USDA, ARS, Beaver, WV, West Virginia University, and Clemson University. The overall goal of the Appalachian Pasture-Based Beef Production Systems Regional project is: development of innovative concepts/practices to enhance the efficiency, profitability and sustainability of grassland-based beef production systems in the Appalachian Region that are economically viable, and environmentally sound. Major components included cow-calf, backgrounding, stocker systems (winter), pasture finishing systems, product quality, and marketing strategies.

For the first phase six cow-calf forage systems were used at the Shenandoah Valley AREC. The backgrounding and feedlot finishing were also done at the SVAREC. The first phase is complete. The winter stockering was conducted at Morgantown, WVU, the pasture finishing was done at Beaver, WVU and the product quality evaluation was done at the University of Georgia and Clemson University.

Summary of Results of the First Phase:

- Conception rates were lower than desirable, due to drought for most years. There were no consistent differences among forage systems.
- During backgrounding, similar daily gains were observed when concentrate supplementation was provided at 0.5 or 1.0% of body weight. Performance was similar for calves grazing fescue on fescue-alfalfa pastures. Supplementation with vitamin E, selenium or a combination of both did not affect calf performance..
- Wintering stocking treatments (0.5 1.0 or 1.5 lb ADG) resulted in differences in final bodyweights and daily gain
- Cattle with lower ADG during winter exhibited compensatory gain during finishing however lower gain cattle were not able catch higher gain cattle in terms of final body weight.
- Cattle gaining at the faster rate during winter stockering, had higher visual carcass quality grades than those of low or median ADG.
- Rate of gain during winter stockering did not influence beef quality thus allowing system flexibility prior to finishing.
- Steers finished in the feedlot had higher final weights, dressing percent, carcass fat, and carcass quality grades than those finished on pasture.
- Meat from feedlot and pasture finished calves were similar in tenderness. Thus, finishing steers on pasture reduced carcass fat, but did not alter steak tenderness.

- Beef was found to be highly desirable by taste panel, regardless of finishing method.
- Conjugated linoleic acid (CLA) was higher in meat from pasture than feedlot finished steers.
- In pasture finished cattle the CLA in fat tissue peaked on day 28 and remained high for the finishing period.
- Beef from pasture-finished cattle had greater content of B-vitamins and antioxidants.

Additional information can be found in the list of publications at the end of this manuscript.

***For further information*: Please contact Joe Fontenot, Animal and Poultry Sciences. E-mail: cajunjoe@vt.edu phone: 540- 231-5136.**

Phase II

Cow and Calf Productivity

Since the 2007 calving season, cows and pastures were managed to make 2 comparisons: 1) Cow Size and 2) Creep Grazing methods. To maintain stocking density of 1.75 acres / animal unit, either 7 Large cows or 8 Moderate cows were stocked in a system. Large cows were bred to "growth bulls" with high yearling wt EPDs while Moderate cows were bred to bulls with breed average yearling wt EPD. Calves could either forward creep graze ahead of the cows or calves had access to a dedicated creep (no cows) that had alfalfa and friendly endophyte fescue. Below are the results since our last field day in 2009.

Cows at Weaning (September, 2009-10)

Cow Group	Average wt (lbs)	Average hip ht	Total cow weight per grazing system
Large	1362	53.9	9820
Moderate	1235	51.6	10169
Difference L-M	128 lbs	2.3	299
(Ratio L/M)	(1.10)	(1.04)	(1.01)

Calf Weights by Cow Groups

Cow Group	Average wean wt (lbs)	Total Weight (lbs)	Age at weaning (days)
Large	526	3682	182
Moderate	470	3768	176
Difference L-M	56	-86	-6
(Ratio L/M)	(1.12)	(0.98)	(1.03)

Calf Weights by Grazing System

Grazing System	Average wean wt (lbs)
Dedicated Creep	504
Forward Creep	492
Difference D-F	12
(Ratio D-F)	(1.02)

Another variable was how many days did we have to feed hay (lack of forage for grazing)? The moderate frame cows needed 13 more hay feeding days than the large frame cows and the difference occurred in the late summer / early fall period when hay was needed while paddocks were being stockpiled for winter feeding.

Conclusion: Compared to the previous results, the difference in weaning weight increased between the Large and Moderate frame cows to the point where pounds of calf produced per system total was similar. Differences in creep grazing systems were still present, but less than the initial 2 years of the study.

***For further information*: Please contact Dr. Terry Swecker, College of Veterinary Medicine, Virginia Tech. E-mail: cvmwss@vt.edu; phone: 540-231-7375.**

Forage Dynamics and Calf Behavior In Forward Creep versus Dedicated Creep Grazing Systems

No consistent differences in available forage were observed between creep grazing treatments but was usually higher in large frame score treatments ($P < 0.001$). In two out of three years, however, available forage in pastures grazed by large frame cows averaged 1805 lbs/ac. compared with 1513 lbs/ac. for medium frame cows, respectively. These differences may reflect the fact that 8 cows grazed in each medium-framed treatment vs. 7 cows in the large-framed.

We also observed that grazing of winter stockpiled forage increased forage availability and nutritive value in the subsequent growing season. Greater productivity on formerly stockpiled paddocks could be related to several factors including: 1) additional manure and urine inputs from winter grazing, 2) residual N from fertilization of stockpiled paddocks that occurred in August (60 lbs/ac.), 3) rest periods during fall stockpiling that may allow grasses to accumulate nonstructural carbohydrates and root mass to help support re-growth in spring, and 4) removal of winter forage that created a more favorable light environment for grass tiller growth in the spring. Regardless of the cause, our data clearly point to lingering positive effects of stockpiled tall fescue beyond the winter grazing phase.

Lastly, we used GPS collars to track calf movements in creep grazing treatments and found that calves spent more time in DCR pastures (15%) compared with FCR pastures (4%). Greater time in DCR pastures likely reflected higher forage nutritive value during summer months and lower fescue toxicity. Overall, our initial findings suggest that dedicated creep paddocks planted with non-toxic grasses and legumes may be a better option than simple forward creep grazing in the tall fescue region. Perhaps more important to beef producers, our results also suggest that forage productivity during the growing season may benefit from fall stockpiling and winter grazing the previous year.

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Alternate Weaning Techniques for Calves

Producers are acutely aware of the alterations in behavior, performance and sickness of weaned calves. To that end, we have evaluated alternate weaning techniques, fenceline weaning and nose clips, to hopefully minimize weaning stress and improve performance in calves. After two years, we discontinued the nose clip technique as calves with nose clips have a difficult time getting water from the ball waterers that we have present on the farm, but they still may be of value for producers without a fence to wean and alternate water systems. The behavior of calves that are fenceline separated for a period of 6-10 days are noticeably different from abruptly weaned calves. They spend less time bawling and walking and more time grazing and resting. We also have documented an increase in cortisol metabolites in the feces of abruptly weaned calves as compared to abruptly weaned calves, which indicates more stress. Of interest, we have not been able to document a difference in immune function or in gain over a 20-30 day period post-weaning. In our case, the calves are weaned on the farm (no shipping) and are not mixed with other calves, both of which are also known stressors of calves. In conclusion, fenceline weaning decreases the classic weaned calf behavior.

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Management of calves post-weaning (backgrounding)

Spring-born calves are typically weaned in late summer or early fall, where forages adequate for a mature animal may not be adequate for the maintenance and growth requirements of newly weaned calves. Our aim was to determine if alternate forages could be used to improve weight gains of newly weaned calves during this backgrounding period.

After weaning (at 195 days of age on average) in each of two years, 24 large and 24 moderate framed Angus-cross steers were assigned to one of four forage types: (i) non-toxic endophyte-infected Tall Fescue (MaxQ®), (ii) endophyte-free Tall Fescue (Bronson®), (iii) orchardgrass and alfalfa mixture, and (iv) orchardgrass and red and white clover mixture. At weaning, the large framed calves weighed 555 lb, while the moderate framed calves weighed 514 lb. The steers were divided into groups of four (two per frame size) and grazed on one hectare paddocks for 42 days. With this design, each forage type was replicated three times.. Paddocks had approximately the same amount of forage on offer (1,650 lb per ha), with no differences in crude protein (13% on a dry matter basis) or fiber (33% on a dry matter basis) contents between forage types. Large framed steers were heavier than moderate framed steers at both the beginning and end of the study; the two frame size groups differed in live weight by 36 lb by the end of backgrounding. However, there was little difference in average daily gain among forage types or frame sizes (1.1 lb per day).

Under the climatic conditions prevalent in the Shenandoah Valley, the forages tested did not produce different gains during backgrounding of steers. The question therefore remains: are there alternative forage types that may better offset weaning stress by improving gains in fall-weaned calves in pasture-based systems in this region?

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Assessing docility in calves post-weaning

Within cattle operations, animals undergo routine management to maintain the health and productivity of the herd. However, all producers recognize that some cattle can be very difficult to handle and pose a risk to other animals and farm staff. Temperament is inherited, with docility now incorporated into genetic evaluation programs in cattle breeds. Likewise, ill tempered cattle have reduced performance and reduce the profitability of livestock enterprises. Easy and reliable on-farm tools for assessing stress and fearful behaviors in young growing cattle during normal management practices are therefore needed.

Our aim was to evaluate the utility of a simple subjective measure of calf behavior in defining temperament, and to determine whether values of that measure changed with repeated handling of cattle. In each of two years, 40 Angus-cross heifer calves were evaluated for temperament starting at two weeks post-weaning. Half of the heifers were handled once per month. They were 'calmly' placed into a squeeze chute and weighed, their head caught, followed by a series of management procedures. The other half of the heifers was handled in a similar fashion, although they underwent these same procedures three consecutive days each month. In other words, calves were handled either less or more regularly. Once weighed and caught in the head catch, the heifers' behaviors were scored from 1 (docile) to 5 (aggressive) by 3 trained observers. Heart rate and blood samples were then collected. On release from the chute, their velocity was

measured over a 6 ½ foot distance using electronic timers. The blood samples were analyzed for cortisol concentration, an indicator of stress.

Repeated calm handling significantly reduced ill temperament and signs of stress. Chute score and heart rate were less (by one-third a chute score, and 20 heart beats per minute), and exit velocity slower (by 0.43 seconds), in the more regularly handled cattle. Chute score also decreased across months in the more regularly handled cattle (by one-third a chute score), yet increased slightly in those less regularly handled. Cortisol levels were significantly higher in heifers with higher chute scores. Our results suggest that chute score is indicative of anxiety in young cattle. Since it is quickly and easily assessed, it could be used to monitor husbandry practices with the aim of increasing docility in cattle herds.

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Assessment of Worms and Coccidia in Cow-calf Systems

Cattle are infected with a variety of gastrointestinal parasites that have the ability to negatively impact overall performance. These parasites generally fit into one of two broad categories that behave differently both inside the animal and in the animal's environment. The first of these broad groups is known as the nematode worms. These worms are intimately associated with pastured cattle because they require the pasture environment to develop to infective larvae once eggs are passed from the host. The second broad group is the protozoan parasites known commonly as coccidia. These organisms live inside the intestinal cells in cattle and destroy these cells as they erupt out to form environmentally resistant oocyst stages passed out in the animal's manure. This oocyst stage does not require grass for development and tends to build up in areas where susceptible animals congregate.

Research on both groups of parasites has been undertaken at the SVAREC over the past several years. Studies investigating the impact of internal parasitism in cattle managed in total forage based production systems are lacking. On such systems, where pastures are continually used to maximize animal performance, both groups of parasites have the potential to impact overall animal performance. The focus of our research was to describe the dynamics of both nematode worms and coccidia in naturally infected calves on these systems over the course of a year. Seventy-two cow calf pairs were used in this study and feces was collected from the calves monthly from May – October and from the cows in May, July, and September. Additionally, a subset of 36 replacement heifers were sampled monthly from November – April. Analysis of these fecal samples showed that calves, weaned heifers and adult cows managed in these systems are exposed to and infected with a diverse population of parasites from both groups. The numbers of nematode worm eggs found in the feces of the calves increased throughout the grazing season and were highest at weaning in October. These numbers were greatly reduced in the replacement heifers following deworming at weaning and remained low throughout the

winter and early spring. The average number of worm eggs recovered from the adult cows at all 3 sampling times was low and remained relatively constant over the course of the study. The numbers of coccidia in the feces of the calves increased sharply from May through July and subsequently decreased at weaning in October. The number of coccidia in the feces of the replacement heifers also remained low throughout the winter and early spring sampling. The number of coccidia recovered from the cows was also low at all sampling dates.

Although both groups of parasites were present in the animals throughout the duration of the study, no signs of disease or correlation between parasite numbers and weight gain were detected. Young calves less than one year of age shed the majority of these organisms, while the older animals shed a constant lower level of both parasite groups. Parasite numbers increased in calves as they progressed through their first grazing season. The nematode worm numbers were highest at weaning, but application of a dewormer at the time of weaning decreased the numbers significantly and they remained low in replacement heifers through the winter and early spring. The number of nematode worms shed by the cows was constantly low without any treatment and cows appeared to suffer no ill effects from the low level infection. Coccida numbers decreased in the calves near weaning and remained low in the replacement heifers throughout the winter and spring without treatment suggesting natural immunity develops with time and continued exposure. In conclusion, gastrointestinal parasites are ever present in grazing beef cattle in Virginia, but with adequate management their impact on animal performance can be minimized.

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Acoustic Estimation of Forage Intake

Measurement of how much an animal eats (or its intake) allows selection and breeding for increased livestock performance. However, measuring intake of grazing livestock is difficult and expensive due to the complexity associated with estimating the amount of forage that is consumed on pasture. The intake process includes biting, chewing, and swallowing forage. Livestock producers are familiar with the sounds generated by their animals while actively grazing. We developed a system that records the sounds generated by grazing livestock and relates the sound energy of each bite to the amount of forage consumed. One of the greatest obstacles was developing computer software that could identify biting events while ignoring other sounds. By using an expanded frequency range, biting events were separated from other grazing events (such as chewing) that allowed us to automate detection and data processing. We found that sound energy recorded with each bite was related to intake. This minimally invasive technique allows for real-time analysis of grazing behavior and is less expensive to apply than traditional marker techniques.

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Influence of Forage Species on Pasture Finishing Performance and Beef Quality

In 2005, 2006, and 2007, cattle were finished on naturalized, alfalfa, or pearl millet pasture during the final 30-45 days of pasture finishing. Animal performance, carcass attributes and meat quality were evaluated.

- Naturalized and alfalfa pasture were available during all three years for finishing, while pearl millet was not available in 2007 due to NO_3 issues during drought.
- Naturalized pasture provided the most consistent finishing performance averaging 2.4 lb ADG.
- Alfalfa provided gains of 3.2, 1.6, and 3.2 lb ADG during ’05, ’06, and ’07.
- Pearl millet cattle had similar performance during the two years it was available (3.3 lb ADG).
- When available, pearl millet tended to produced heavier carcasses (~ 30 lb), and produced larger ribeye area (10.3 Vs 9.7 sq in) than naturalized and alfalfa.
- Forage species did not influence carcass quality grade, tenderness, or taste panel evaluation.
- All product was deemed desirable by taste panel evaluation however, naturalized pasture produce a higher incidence of “off flavor” (livery flavor).

Relationship Between Residual Feed Intake (RFI), Performance, and Carcass Parameters

Prior to pasture finishing in 2009 and 2010, cattle were evaluated and classified as to relative RFI while consuming an all forage diet. Steers were then finished on pasture and carcass data collected. Preliminary data suggests RFI may be negatively correlated to pasture finishing ADG, and positively correlated to KPH (kidney, pelvic and heart fat).

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Risk Analysis for Forage Management

Farmers are gamblers and every time they put seed in the ground, buy livestock or make capital investments, they are making a business decision, and a wager based on the probability or risk of a positive return. Risk should be considered in any business enterprise and is especially important in agriculture where farmers face inherent uncertainty from both environmental and market forces. Any information or data that reduces uncertainty in management decisions can have a large impact on net profits. Agricultural researchers develop recommendations based upon interpretations of data that are compiled and subjected to statistical analysis. Traditional statistical techniques are used routinely to estimate differences among managements, species, cultivars etc., however traditional methods do not provide insight into the production risks associated with the agricultural practices under study. Risk analysis provides an alternate and complimentary analysis of the data and provides a way of assigning a probability of success or failure to a treatment or management method. We employed risk analysis to evaluate the probability of successfully reaching set production goals for a range of forage and management systems including: split N applications on stockpiling tall fescue; overseeding tall fescue with Teff (a summer annual grass); using Triticale (an annual cereal) to supplement perennial, cool-season pasture production and; evaluating Bermuda grass cultivars. We conclude that it is possible to develop reasonably good probability estimates for achieving production goals. Such knowledge should aid producers in developing management systems with acceptable levels of risk.

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Pasture-Based Beef Systems for Appalachia
Potential Economic Impacts

• **Profitability and Risk**: We conducted a comprehensive economic assessment (from conception through sale of final product) to address the lack of producer-level information on the economics of pasture-based beef (PBB) systems. Results show pasture-based protocols to be more profitable for Appalachian producers under the conditions investigated; in fact, in all but two of the eight scenarios examined, PBB systems earned more than double that required to cover operating expenses. This information should benefit both current and potential producers. For example, our analysis is useful in demonstrating the farm-level economic impacts of variation in factors such as production capacity, input expenditures, pasture management practices, processing protocol, and marketing strategy (i.e., direct sales vs brokers or wholesalers). With respect to marketing strategy, for example, since retail beef prices are much less volatile than live cattle prices over time, farmers can potentially reduce price risk by direct marketing harvested beef; of course, retaining cattle for finishing adds to production risk, the impacts of which have yet to be measured. In the long run, if more producers switch to PBB systems, there will be substantial economic development benefits to Appalachia. For example,

take just one state in the Appalachian region, West Virginia (WV). Beef cattle production in the state is a $250 million sector, utilizing a million-acre pasture resource. Pasture-raised beef is a relatively new product whose demand is growing in part due to the perception of its being healthier, locally-produced, and environmentally friendly. If all the beef currently used in school lunch programs across WV were replaced by pasture-raised beef (an unlikely outcome, but one useful for illustrative purposes), this would necessitate the production of an additional 40 million pounds of beef (or 60,000 animals), resulting in an estimated $115 million increase in total statewide (WV) output and 1,700 additional jobs in various sectors**.**

• **Market Acceptance**: Next, to address information gaps in market viability, including the target market, consumer willingness to pay, desired product forms and other consumer preferences, we conducted a comprehensive market assessment using retail surveys and in-store product evaluation in both rural and urban settings. An overwhelming majority of participants in both steak and ground beef groups (74% and 82%, respectively) preferred the grass-fed product, with appearance and relative nutritional information being the most commonly cited primary reasons for stated preferences. Survey results also suggest that grass-fed specialty meat products would meet with notable consumer acceptance at the retail level at premiums of $2.00 to $5.00 per pound above conventional beef prices and that a marketing strategy with education as a key component could be effective in promoting grass-finishing as a viable and profitable production alternative for the region's producers. A preliminary conclusion is that a target carcass endpoint of Select could satisfy consumer preferences for a leaner yet highly palatable cut, while simultaneously reducing the amount of finishing time necessary. Overall, information from the market assessment can provide an idea of how consumers react to the products after experiencing them and how they value them in relation to other retail products. This information can ultimately be used to set "marketing claim standards" so that products labeled "Appalachian Pasture Raised Beef" can be sold at the retail level and consumers can be assured of product quality and consistency.

• **Decision Support Tools**: Finally, we developed a set of user-friendly on-line tools to assist producers make better management decisions. One such tool is designed to assist producers in estimating the costs and profits associated with their cow-calf operation, given various calf-marketing options including forage finishing. By helping producers make better economic decisions, such tools can potentially enhance profitability and better manage risk. The tool is available on-line [http://www.wvu.edu/~beefbudgetingtool/], and can be accessed by any producer who has access to the Internet. No specialized training is needed to use the tool.

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Web-based Decision Tools:

- Pasture-Based Beef Systems for Appalachia: Web-based Beef Cattle Budgeting Tool (2009):

http://webtest.wvu.edu/users/vkomarne/tanya0725/
[This tool facilitates the calculation of production costs, break-even prices and profits for different calf marketing options, including pasture/forage finishing].

- Rainfall Option Calculator (2010):

http://www.gatorquant.net/
[The user chooses the given choice of option type (call/put), pricing type (Burn or Monte Carlo) and the reference weather station (Monongalia/Martinsburg/Monroe/Randolph) from the pull down menu; subsequently, the user also chooses the strike/exercise rate which is in Rain Inches. According to the chosen parameters in steps 1 &2, the calculator returns the call and put prices].

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Concentrated Hay Feeding During Winter and its Effect on Pasture

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Feeding beef cattle year round on pasture is limited by weather conditions. Hay or other stored feeds must be fed part of the year when pasture forage runs out - usually a 3-4 month span in winter. For convenience, hay is often fed out in a small pasture areas or feedlots. Feeding hay this way may damage pasture and degrade the environment. Soil compaction from excessive trampling, increased weed problems, and water quality impairment from high inputs of cattle waste and subsequent runoff are examples. More information on the impacts of hay feeding sites is needed to ensure they are managed to limit negative effects on pasture. In 2008, we initiated a field experiment to address this issue at the Steeles Tavern site. Our specific objectives were to evaluate how winter hay feeding would affect: 1) plant variables that included forage accumulation, forage nutritive value, and plant species composition, and 2) soil variables that included compaction, respiration, and soil nutrient concentrations. We compared pasture variables in 12 paired paddocks (1.8-2.0 acres) that each contained a winter hay feeding site (HF) paired with a paddock that had no hay feeding (NHF). Seven or eight cows grazed each HF paddock usually from December to April and were allowed access to hay placed in open top, round bale feeders. Data were collected from 2008 to 2010.

Forage accumulation, or production, was higher in HF paddocks (1543 kg ha $^{-1}$) than NHF paddocks (1027 kg ha $^{-1}$) in 2009. Forage accumulation did not differ between paired paddocks in 2010, however. Forage crude protein concentrations were higher in most samples collected from HF paddocks compared with NHF paddocks. Fiber components (e.g., NDF) were usually lower in HF samples as well. White clover was more abundant in HF paddocks (16 % ground cover) compared with NHF sites (8 % ground cover) and no difference in weed abundance was noted.

After 2008, both P and K concentrations were higher in HF pastures (27 and 154 mg kg $^{-1}$, respectively) compared with NHF pastures (16 and 83 mg kg^{-1}, respectively). Temporally, P and K concentrations remained constant in HF pastures while concentrations declined after 2007 in NHF paddocks. Concentrations of other soil nutrients were similar between paddocks. By the end of the study, HF paddocks had built up more SOM than NHF paddocks (6.7% vs. 6.1%). Soil compaction (i.e., penetration resistance) increased with depth to 10 cm and was higher in HF paddocks likely due to cattle presence in winter. Soil respiration was unaffected by the winter hay feeding sites.

Overall, winter hay feeding sites had generally positive effects on pasture variables. The presence of hay feeding sites had neutral to positive effects on forage productivity and nutritive value. More white clover was found in winter hay feeding paddocks but no increase weed pressure was found. Greater clover abundance improves forage nutritive value and may help increase cattle performance. Soil in hay feeding paddocks was more compacted, but it had no negative affect on forage production or soil respiration. Soil compaction could increase nutrient losses from runoff, however. Winter hay feeding paddocks had higher soil P and K

concentrations after two years and higher SOM after three years. These increases were likely the result of extra manure and urine deposited during winter. Locating concentrated hay feeding sites strategically (e.g., away from surface waters) and rotating them around farm every two or three years could help restore or increase pasture productivity.

Is Bigger Better? A Look into Cow Size and Efficiency

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Volatile grain prices and costs of production receive constant consideration by producers in an attempt to maintain profitability and efficiency. Defining and assessing optimum cow size and efficiency have been debated for years, and is challenging as differing biological types of cattle vary in performance and adaptation in different environments and production systems.

Efficiency

In food animal production, efficiency is generally defined as the ratio of total costs to the total animal product from females and their offspring over a specified time period. This definition establishes a standard for overall efficiency without delineating between biological efficiency, defined as conversion of physical inputs into marketable product; and economic efficiency, which relates financial expenditures to gross receipts. The complexity lies in optimizing the relationship between biological and economic efficiency, which requires considerations of the genetic potential of cattle, the environment, and objectives for products marketed, and are further complicated by underlying economic issues.

An efficient cowherd has been described to contain females that exhibit early sexual maturity, high reproductive rates, longevity, minimum maintenance requirements, and the ability to convert available energy from forage into the greatest possible pounds of weaned calves. While these are all important attributes, the ability of the cow to reproduce is key. Generally, cattle excelling in production of retail product have heavier birth weights, later onset of puberty, decreased marbling scores, and have higher maintenance requirements due to heavier mature weights. Historically, low feed costs in the feedlot industry, and changing industry technologies have favored heavier slaughter weights for packers. Industry acceptance of larger, heavier carcasses has proven to be a powerful influence on the creation of incentives for cattle producers to select for increased growth traits and carcass weight. Management and the rapid evolution of genetic selection tools made dramatic increases in growth possible. Traditionally, farmers and ranchers have effectively mitigated the increased costs of larger cows with low costs of supplemental feed. This may not be a reasonable management practice as producers now face high input costs.

Maintenance implications

Cows use the nutrients provided to them for bodily processes, first allocating to maintenance (energy intake that will result in no loss or gain of energy from body tissues), then to growth, followed by lactation, and finally reproduction. Of energy consumed by the cow herd, 70-75% is used for cow maintenance. Fifty percent of the total energy expended in producing beef is used for maintenance of the cow. High maintenance cows have been described as those tending to have high milk production, high visceral organ weight, high body lean mass, and low body fat

mass. Low maintenance cows are those with lower propensities for milk production, low visceral organ weight, low body lean mass, and high body fat mass. Even as maintenance requirements vary with different biological types of cattle, feed resources and environment influence the impact of maintenance on overall efficiency.

Matching feed resources to growth and milk production is crucial to creating efficient cows. Moderating cow size and milk production is beneficial to controlling costs, regardless of environment, given that milk production has been estimated to explain 23% of variation in maintenance requirements. Cows with a higher milk yield tend to have increased visceral organ mass thus increasing energy requirements even when a cow is not lactating.

Tools to increase efficiency

Mature cow size impacts the profitability of beef enterprises making it a fundamental consideration in selection programs. Early estimates of direct heritability of mature weight and mature height have been generally moderate to high, and recent research supports high heritabilities of both traits. Selection for either trait would lead to a correlated response in the other.

Until recently, beef genetic selection tools were absent of selection tools for traits controlling inputs. Improvements in existing phenotypic databases for traits have been proven to further aid producers in selecting for optimal cow size and cattle that fit management and marketing practices. Beef breed associations now have more EPDs and selection index EPDs that incorporate economic factors. The indices are a collection of EPDs that are relevant to a particular breeding objective, where each EPD is multiplied by an associated economic weight. Weaned Calf Value ($W) is a selection index EPD released by the American Angus Association. This index is used to compare expected average difference in future progeny performance for pre-weaning merit. Revenue and cost adjustments associated with differences in birth weight, weaning weight, maternal milk, and mature cow size are all variables included in this index. Breed associations continue to work on the development of tools to accommodate varying market interests and production systems.

Recent research conducted at Virginia Tech

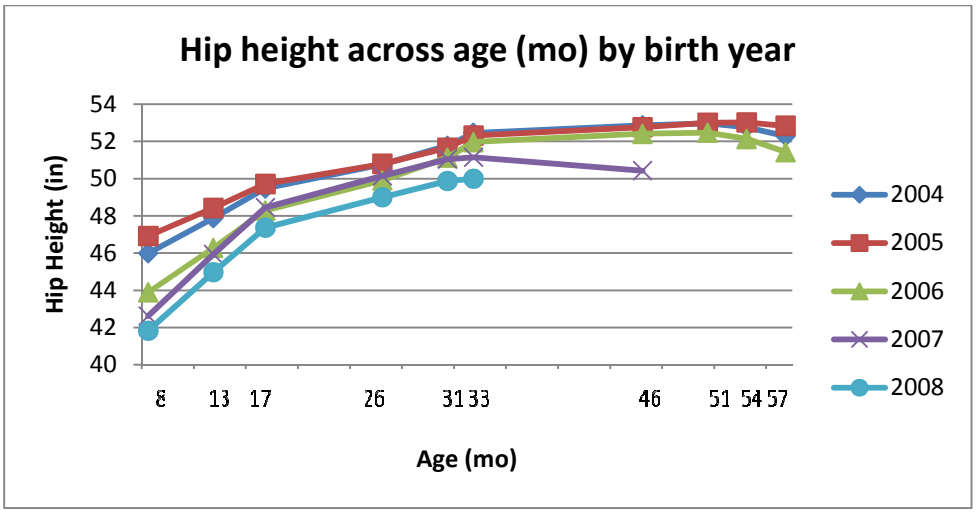
Utilizing performance records of beef females raised and kept as replacements at Shenandoah Valley Agricultural Research and Extension Center, a dataset was developed to determine the relationships among lifetime measures of body weight and frame size of commercial beef females in this pasture-based production system. Weight and hip height measurements included were collected on 232 Angus crossed females from weaning and until almost five years of age at the final observation. Cows were born 2004-2008. The majority of cows were sired by Angus bulls, but 6 Hereford and 1 Red Angus bull have progeny included in this study. There were 58 sires represented, 14 of which were common AI sires. These 14 individuals sired 70% of cows, while the balance was sired by bulls leased from seedstock producers in Virginia.

Beef Improvement Federation describes frame score as a suitable way of describing the skeletal size of cattle. The 1 to 9 scoring system has become the standard for in the beef industry for describing cattle skeletal size. It has been accepted that most animals should maintain the same frame score throughout their life while their actual height increases with age. This permits one frame score value to be used regardless of when the animal was evaluated. Early literature on frame score concluded that visual appraisal of frame score was moderately to highly heritable and repeatability (0.8-0.9) of scoring cattle for frame was highest of any trait measurement taken with physical appraisal. The precision of repeated frame score measurements resulting in the same value (repeatability) was determined to be 0.72 for this cowherd.

Strong, positive genetic correlations have been found between weight and height in previous research. With the information compiled, inferences were made as to the relationships of weight and frame score observations at immature ages compared to those same observations collected later in life. A limited number of these correlations are included in the table below. This yields an indication of how accurately early weights predict mature size. When used to predict mature size of cows, measurements taken at breeding (13 months) appear to be superior to those taken at weaning. The strength of these relationships is important as it is at these earlier ages that selection for replacement females occurs. It is also important to understand the impacts of increased emphasis on selection for growth at these immature ages.

Correlations of weight(WT) and frame score (FS) at weaning and breeding (13 mo) with weight and frame score observations at 2.5y and 3.8y of age

	2.5 y		3.8 y	
Variable	FS	Wt	FS	Wt
Weaning FS	0.71	-	0.71	0.54
Weaning Wt	0.48	0.7	0.58	0.53
Breeding FS	0.81	0.53	0.85	0.52
Breeding Wt	0.43	0.65	0.49	0.58



Conclusion

Optimal values for cow size and milk production may vary as future industry profitability, competitiveness, and sustainability will necessitate prioritization on efficiency as we operate in an era of high input costs. With highly variable and dynamic physical and economic environments, one may consider variability of cow size as an asset to cow-calf producers. Nonetheless, producers must start thinking about optimums instead of maximums. Advances in genomics and refinement of methodology to assess traits such as residual feed intake may further enhance information for genetic improvement to enhance profitability. These tools hold potential to provide predictions for difficult to measure traits that focus on input costs. More consideration must be given to optimal size(s) with respect to achieving the best strategy to cope with dynamics of location, producer skills, markets, resources, breeding systems, and environment.

Plant Identification, and Botanical Composition Assessments

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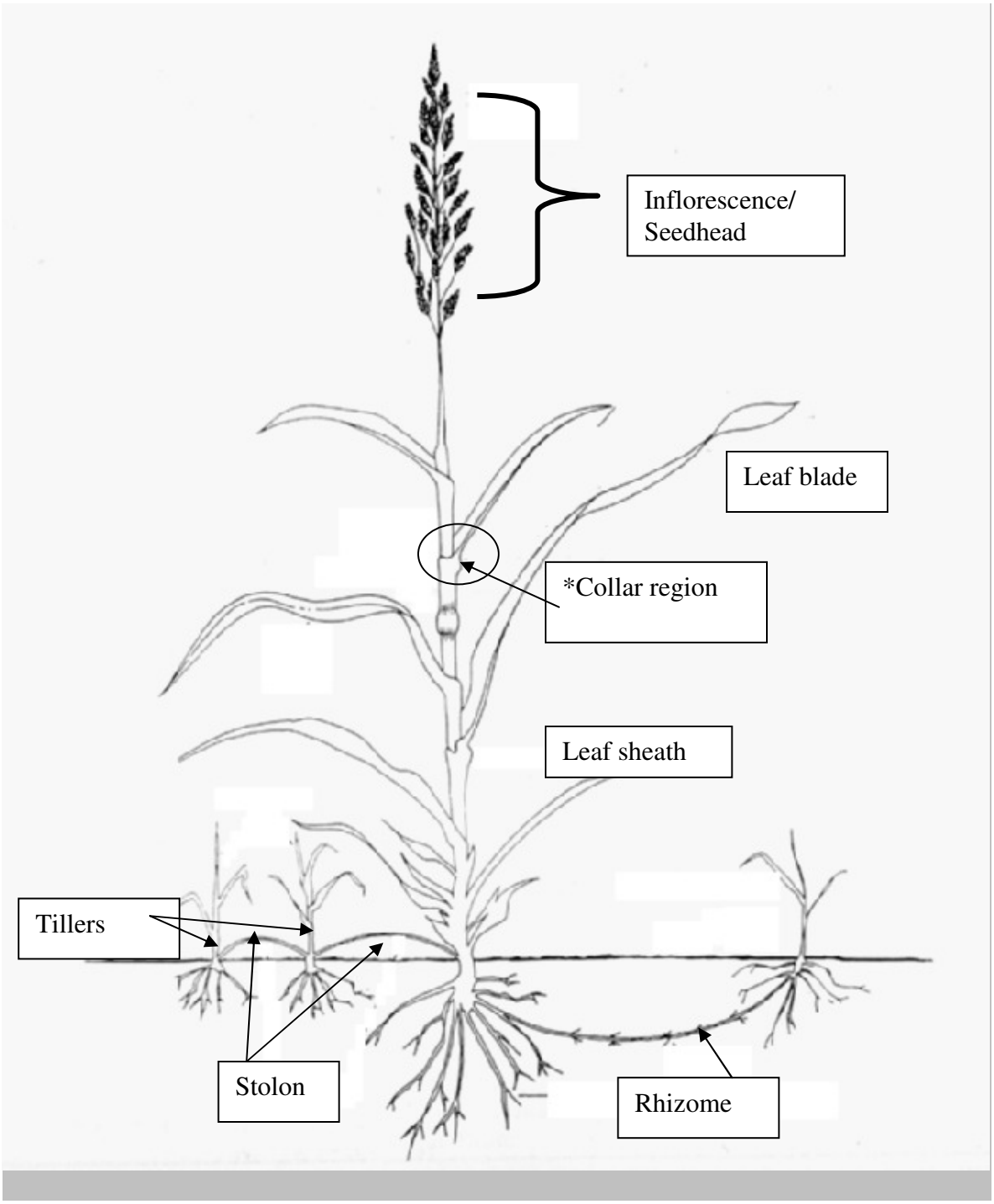
Many factors are involved in the identification of plants. In addition to morphological characteristics, environmental setting where the plant is adapted can affect the growth pattern and the general morphological characteristics of the plant. To identify grasses vegetatively one need to know plant parts such as leaf, leaf sheath, auricles, collar, ligule, and blade. Identification of grasses at their flowering stage is relatively easy (Figure 1 and 2). Broadleaf plants (forbs) are often identified by specific plant parts such as leaf, leaflet, petiole, petiolule, and stipule (Figure 3).

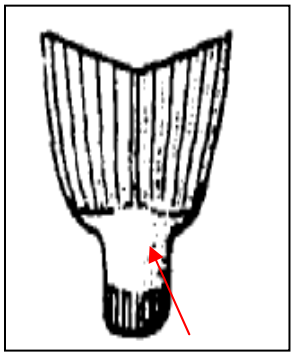
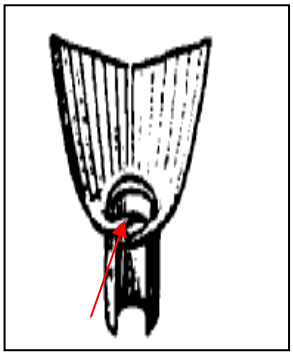
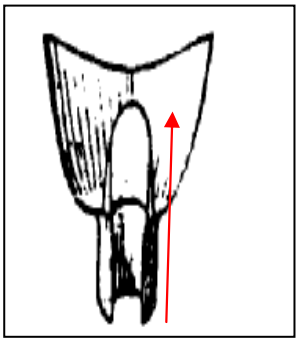
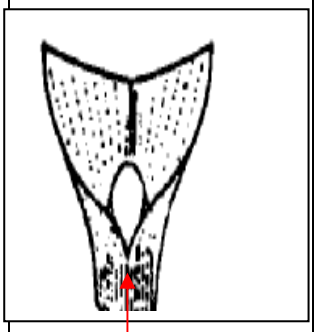
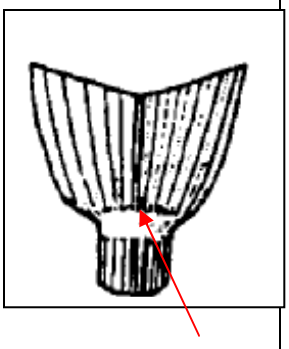
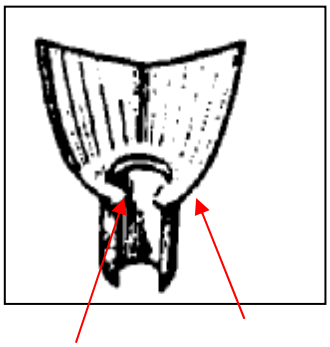
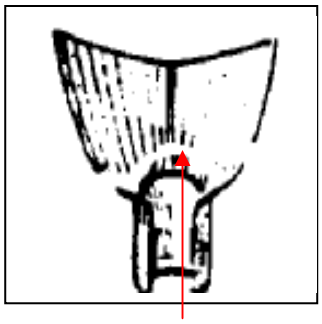
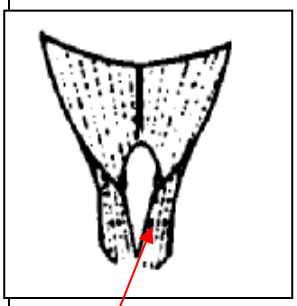
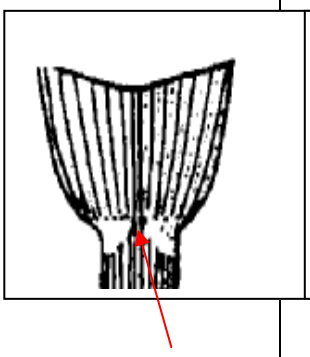
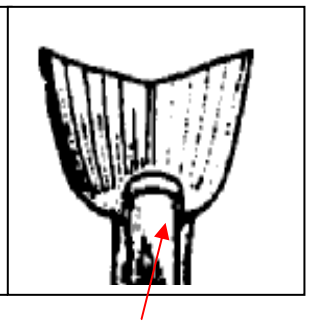
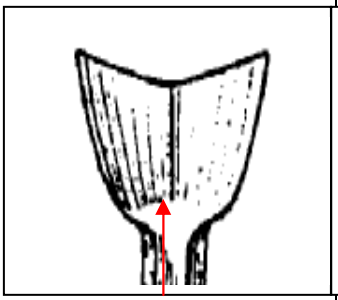
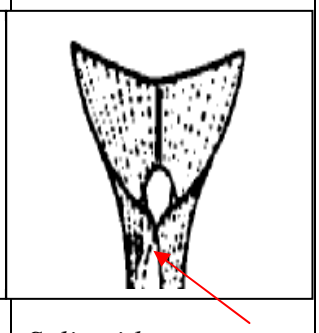
Knowing the plant species that make up a pasture and the relative amounts of each species present is important to interpreting potential animal performance. It is also important to know the relative amounts and kinds of weeds present and to monitor for the presence of poisonous plants or noxious weeds. Plant composition of a pasture can change rapidly. Most currently used techniques to describe the plant species composition of a pasture are laborious, time consuming ,and may require specialized equipment. This presents challenges to producers and researches who need this information and may require it on a frequent basis. We tested the DAFOR Scale, a visual method reported previously by J. Brodie in 1985, to describe the relative abundance of plant species. We then modified this procedure as the Double DAFOR Scale for use more specifically in pastures. This modification provides a visual estimate within two scales, one for forages and one for weeds. The Double DAFOR Scale provides a rapid method to describe the species composition of a pasture that would be useful to both producers and researchers. It does require an ability to identify plant species. With a good manual on forage plant and weed identification and a small amount of training, the Double DAFOR Scale is a useful tool for describing the plant make up of pastures (Table 1).

Figure 1. Characteristics and parts of a grass plant



* Collar regions includes collar, auricle and ligule (see next page)

Figure 2. The collar region of the leaf consists of collar, auricle, ligule and leaf sheath.

Collar type	Auricle type	Ligule types	Leaf sheath
 **Broad**	 **Claw-like**	 **Membrane-like**	 *Closed*
 **Narrow**	 **Rudimentary**	 **Hair like**	 **Open**
 **Divided by midrib**	 **Absent**	 **Absent**	 *Split with over-* **lapping margins**

Collar: The auter side of a grass leaf at the junction of the blade and sheath. Collar may be divided by midrib or continuous. Collars vary in shape from broad to narrowand may have straight or slanted sides.

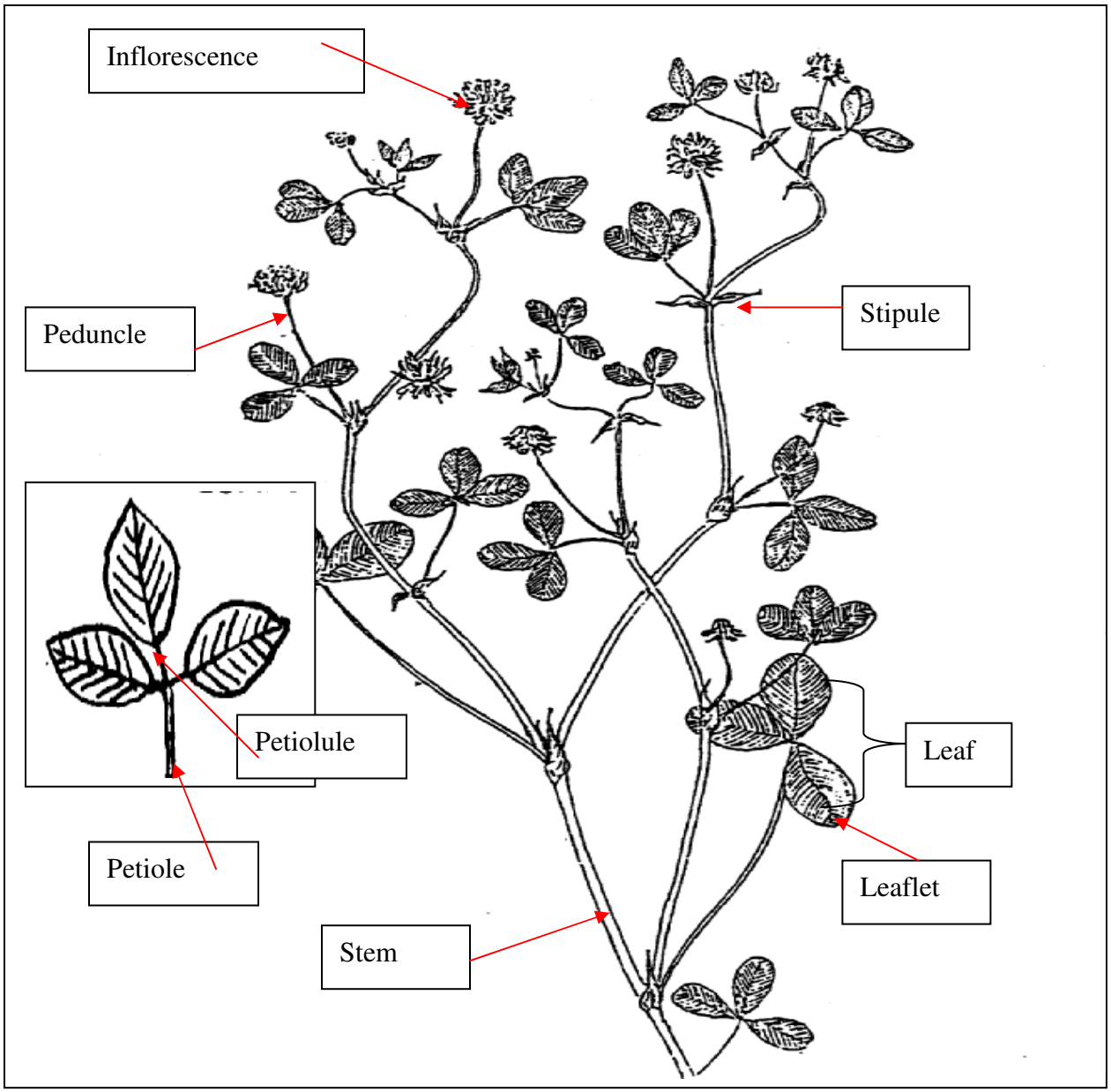
Auricle: An appendage protruding from the side of the grass leaf blade at its junction with the sheath. Auricles may be blunt (rudimentary), large and claw-like, hairy or absent.

Ligule: A projection on the inner side of the junction of the grass leaf blade and sheath. Ligules vary in size and shape; they may be membrane-like, hair-like or may be absent in some species.

Leaf sheath: The lower portion of a grass leaf which encirles the stem. Sheath margins may be open, split with overlapping margins or closed.

Colvin, D. L., R. Dickens, J. W. Everest, D. Hall, and L. B. McCarty. (year?). Weeds of Southern Turfgrasses. Golf Courses, Lawns, Roadsides, Recreational Areas. Commercial Sod. p. 7. Cooperative Extension Service/The University of Georgia College of Agricultural and Environmental Sciences. Athens, GA.

Figure 3. Legume plant parts: leaf, leaflets, stipule, peduncel, leaf, petiole, petiolule and stem



Inflorescence: Entire flowering part of a plant; example are spike, panicles, and head.
Peduncle: The structure that supports the entire inflorescence (flower head).
Petiole: Stalk of a leaf.
Petolule: The stalk that supports a leaflet (example, clovers).
Stipule: A leaf like, paired appendages, on either side of the petiole (leaf stalk) base; may be modified as spines.
Leaflet: One part of a compound leaf.

Phillips, C. E. Weeds of the Northeast. Aids to their identification by Basal-Leaf Characteristics. University of Delaware. Agric. Exp. Stat. Newwark, Delaware.

Uva, R. H., J. C. Neal, and J. M. DiTomaso. 1997. Weeds of the northeast. P. 374-387. Cornell University Press. Ithaca, New York.

The Double DAFOR Scale

Location: _____ Date: _____ Recorder: _____

Treatment:_____ Replication:_____

D=Dominant; A=Abundant; F=Frequent; O=Occasional; R=Rare

ID		Ground Cover %		Grass %		Legume %		Weed %		Forages						Weeds				
											D	A	F	O	R	D	A	F	O	R

DAFOR scale (Brodie, 1985) ;**D** = Dominant - if most or all of the area is covered (1) ;**A** = Abundant - if species cover about ½ to ¾ area (2); **F** = Frequent - refers to species that are well scattered (3); **O** = Occasional - occurs at few times (4) ;R = Rare – species present only once or twice.

The challenge of estimating forage intake in grazing cattle: steps toward a solution

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Introduction

Managing the diet of grazing cattle is of considerable importance in beef operations. The drivers of a ruminant's "nutritional success" in a pasture system are the amount it eats, the composition of its intake, and the characteristics of the forages available to it. Still, relatively little is known about the actual intakes and diet choices of cattle on pasture, although they are key elements of efficiency. Reliably estimating intake and diet preference presents substantial challenges, particularly in grazing ruminants. However, if successfully accomplished, doing so has practical application. It allows development of new management strategies that favor preferred forages, and selection strategies that favor more efficient cattle genotypes.

A series of studies are underway at the Shenandoah Valley AREC aimed at developing tools for estimating the intakes and diet preferences of grazing cattle. The approach being adopted involves the use of wax-like compounds found in the cell walls of plants. These plant waxes provide a natural profile or "signature" of a plant. When sufficiently unique, these signatures can be used to characterize the composition of plants in the diets of cattle, and to determine their intakes.

As part of a collaboration with the Macaulay Land Use Research Institute in Scotland, a research team at Virginia Tech is exploring the use of plant-wax markers as a means to reliably predict intake and diet choice in grazing animals. Before applying this technique in cattle under grazing conditions, its reliability must first be validated using plants found in Appalachia. This entails indoor (feedlot) studies where intake can be measured and then predicted on individual animals.

Measuring intake

The intake of fescue and red clover hay was measured in 24 Angus heifers using a Calan-gate system (American Calan, NH) installed in a feedlot at the Shenandoah Valley AREC. The hays were cubed to minimize wastage. In using the calan-gates, following training, cattle were fitted with a key that allowed them to open a single bunk. The intakes of each individual animal were measured. A purpose-built insert (Figure 1) was constructed for the bunks that held two buckets. This allowed the two forages to be offered separately, and for the heifers to freely choose between the two forages.

Figure 1. Calan-gate system bunk with insert

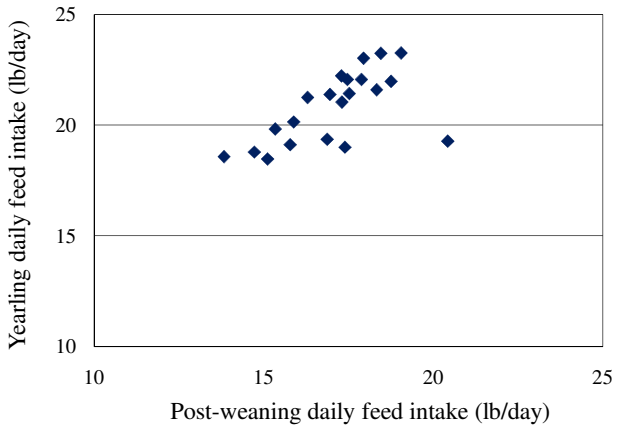

Figure 2. Comparison of daily feed intakes

Two studies were conducted. The first was done post-weaning when the heifers were about 260 days of age. The second was conducted when the heifers were about one year of age. This allowed their intakes and diet preferences to be evaluated twice, and at different live weights. At the end of the first study, the heifers weighed, on average, 659 lb. By the end of the second study they weighed, on average, 796 lb.

Post-weaning the intake of red clover in the heifers ranged from 35 to 70% of the diet. However, overall, they showed no clear preference; most ate equal weights of red clover and fescue. On the other hand, at one year of age, one half of the heifers showed clear preferences: 33% consistently favored red clover while 17% favored the fescue. The red clover had higher protein and lower fiber contents than the fescue; the greater preference for red clover may have reflected increased nutritional requirements as the heifers grew towards heavier weights.

Food intake increased with live weight. In the first study, the heifers ate on average 16.8 lb per day. In the second study, they ate on average 20.7 lb per day. Daily intake increased by 1.5 lb per day for each 100 lb increase in live weight. Furthermore, those heifers that ate more post-weaning usually ate more as yearlings (Figure 2). Clearly, with increased live weights, feed intake and, often, costs increase both at and across ages.

Predicting intake

Laboratory analyses are underway that will allow prediction of diet preferences and intakes in these two studies. This involves use of gas chromatography, where the plant-wax signatures of the two forages fed – red clover and fescue – and of their residues in fecal samples collected on the individual heifers will be determined. By comparing these sets of signatures, the diet preference and intake of each heifer in both studies will be predicted. The measured and predicted values will then be compared to validate the technique. This, and other results of this research program, will be reported at future Shenandoah Valley AREC field days.

Thanks for attending and have a safe trip home

Next Field Day

Wednesday, August 7, 2013

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