Virginia Tech Shenandoah Valley Agricultural Research and Extension Center

2007 Field Day Proceedings

August 1, 2007

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2007 Field Day Program

Shenandoah Valley Agricultural Research and Extension Center

Wednesday, August 1, 2007

1:00 – 1:30	**Registration**
1:30 – 1:40	**Welcome**, *David Fiske, Superintendent, Shenandoah Valley Agricultural Research and Extension Center*
1:40 – 1:50	Load wagons and travel to the east end of McCormick Farm Circle
1:50 – 2:20	**Overview of the Pasture-Based Beef Systems for Appalachia Project –** *Dr. William Clappham, USDA-ARS and Dr. Joe Fontenot, John W. Hancock Jr. Professor Emeritus, Department of Animal and Poultry Sciences, Virginia Tech*
	SVAREC Cow / Calf Forage Systems Project – Past, Present, and Future - *Dr. Terry Swecker, VA-MD Regional College of Veterinary Medicine, Virginia Tech and Dr. Guillermo Scaglia, Department of Animal and Poultry Sciences, Virginia Tech*
2:20 – 2:35	**Forage Species Plot** – *Jon Repair & Jason Carter, Virginia Cooperative Extension*
2:35 – 2:55	**Nitrogen Sources, Rates, and Timing on Cool Season Pastures** – *Dr. Ozzie Abaye, Crop and Soil Environmental Science, Virginia Tech, and Libby Yarber, Graduate Student, Crop and Soil Environmental Science, Virginia Tech*
2:55 – 3:05	Load wagons and travel to Big Meadow
3:05 – 3:15	**Overview of Sustainable Forest Management Project at SVAREC** – *Matt Yancey, Virginia Cooperative Extension, Karen Stanley & Patricia Nylander, Virginia Department of Forestry*
3:15 – 3:35	**Invasive / Exotic Plant Species: Identification and Control** – *Matt Yancey, Virginia Cooperative Extension*
	Demonstration / Overview of Shiitake Mushroom Cultivation - *Matt Yancey, Virginia Cooperative Extension*

3:35 – 4:20 **How to Make the Best of Pasture Weeds** – *Dr. Ozzie Abaye, Crop and Soil Environmental Science, Virginia Tech*

Pasture Measurements and Evaluation Exercise – *Dr. Ozzie Abaye, Crop and Soil Environmental Science, Virginia Tech*

4:20 – 4:30 Load wagons and travel to Ram Evaluation Center

4:30 – 4:50 **Practical Lessons from the Virginia Ram Test** – *Dr. Scott Greiner, Department of Animal and Poultry Sciences, Virginia Tech*

4:50 – 5:00 Load wagons and travel to Feeding Barn

5:00 – 5:25 **Steer Finishing Results from the first five years of the Pasture-Based Beef Systems for Appalachia Project** – *Dr. Susan Duckett, Department of Animal and Veterinary Sciences, Clemson University*

5:25 – 5:50 **Forage Systems for Grass Finishing Beef –** *Dr. John Andrae, Department of Entomology, Soils, and Plant Sciences, Clemson University*

5:50 – 6:00 Return to the Memorial grounds for dinner

6:00 – 6:30 Introductions and Comments from Special Guests

6:30 – 8:00 Dinner

Pasture-based Beef Systems for Appalachia

W.M. Clapham, USDA-ARS, Beaver, WV and J.P. Fontenot, Dept. Animal and Poultry Sciences, Virginia Tech, Blacksburg, VA

The market for pasture-finished beef is growing at 21% per year, and this demand is currently met by Australian and South American exports. The East Coast, particularly throughout Appalachia, appears to be the only region in the United States that could produce beef to meet this demand. Appalachia has the comparative advantage of having the natural resources, particularly water and land, to meet market demand. Research is needed to develop production systems that result in a 12 month steady supply of beef. Meeting this goal will require identification of finishing end points for small and large frame heifers and steers. Research is needed to understand the relationships among forage use efficiency and quality factors in the beef that relate to taste. Coupled with the forage and beef production research are the economic, marketing and risk-assessments. The Pasture-Raised Beef Systems Project is now focusing on a business model within the scientific effort in which US livestock producers will ally themselves with processors and purchasers to gain market share and eliminate the need for imported value-added beef products. No one institution alone has the resources to conduct the research required to develop this opportunity.

Initially, the Appalachian Pasture-based Beef Project was a regional collaborative project among USDA-ARS, West Virginia University and Virginia Tech and was started with an initial appropriation $1,000,000 in FY 2000. Additional resources were appropriated increasing the base to develop the project: $1,000,000 in FY 2001, $125,000 in FY 2003 and $100,000 in FY 2004. University of Georgia and later Clemson University joined the project to conduct research on meat composition and physical quality, cooking characteristics and taste. The Pasture-based beef research program for Appalachia is a research project designed to develop systems for pasture-based beef products that promote health and well-being to humans and financial benefits small farmers. . The project has approximately 25 researchers organized as a virtual institute and includes a multidisciplinary team consisting of animal and forage scientists with ARS, West Virginia University and Virginia Tech and a meat scientist at Clemson University. The project includes analyzing growth and development of all phases of livestock production for pasture-raised beef. Each phase is addressed by one institution, but the resources of all are pooled into one research initiative.

Results from this initiative demonstrate that pasture-raised beef is leaner than feedlot beef and has twice the conjugated linoleic acid composition compared with beef produced in feedlots. Conjugated linoleic acids are associated with numerous human health benefits such as lower incidence of certain cancers, lower heart disease, and reduction of obesity.
The funding has demonstrated that beef calves grazed on a diverse pasture mixture are capable of achieving the same level of quality of taste as those fattened on a grain diet. Research conducted by Virginia Tech showed that the most important time during beef production occurs at weaning and period of 42 days after weaning and that this is a period in which we must concentrate on meeting the nutritional requirement of the calves. Economic analyses conducted by WVU during 2003 and 2004 showed that pasture-based enterprises

were more profitable for producers willing to participate in alternative marketing versus conventional operations.

Since West Virginia, Virginia and other Northern states rely on Spring calving, in order to access the larger markets, there is a need to expand production to 12 months a year. The coastal plains in South Carolina and other parts of the South have the land, forage and cattle resources to complement the pasture-based systems in West Virginia to develop a twelve-month continuous supply of pasture-based beef.

We are currently cooperating with Clemson University to develop a component of a 12-month program to meet the demand for pasture-based beef in the U.S. This system would take advantage of the comparative advantages of geographic latitude and altitude in West Virginia and South to meet the nutritional needs of cattle and produce a consistent product over 12 months. This year Clemson University is obligating one million dollars for infrastructural improvements at their Edisto Research and Education facility in Blackville, SC for pasture-based beef research. We are exploring adding another University in the Southeast to conduct stocker/forage system research in the coastal plain for a 12-month supply of pasture-finished beef

Developments in the market and demand for pasture-raised beef present Appalachian farmers with an opportunity that has not been seen for a long time. The Appalachian – Coastal plain region is unique in the U.S. because it is the only region where the water and forage resources will permit a 12 month forage-based production system. The comparative advantage of the Appalachia – coastal plain region has the potential to become a major supplier of pasture-based products in the U.S. and could lead to export markets. This could have major impact on small family farms and on rural economies.

This project continues the initiative to develop economic pasture-based beef production systems for Appalachia established in the previous project. Virginia Tech has responsibility for cow/calf/forage systems and backgrounding; West Virginia University responsibility for winter stocker and heifer development/forage systems; ARS responsibility for forage finishing/forage systems; and Clemson for meat evaluation, post harvest science and taste (Fig. 1). This architecture of the collaboration pools animal/land/and scientific resources across the entire project. This new project deviates significantly from the previous project by focusing on new objectives important to the success of building a pasture-based supply of beef for domestic consumption and export that will require a consistent volume of a 12-month supply of a consistent product. Although the production stream remains essentially the same, the scientific emphasis is placed upon the following areas: 1) utilizing those degrees of freedom at hand that will allow us to expand the harvest window; identify the "window of acceptability" for harvest end point for the producer based upon carcass quality and acceptable economic return. 2) Develop specification of the ranges for set of parameters that define quality and consistency for pasture-raised beef; identify and define in our population genetic and phenotypic markers of efficiency, specifically frame scores and residual feed intake 3) develop and/or utilize measures of livestock stress to develop management strategies and tactics to minimize stress to reduce fear and hence improve performance and carcass quality; and 4) address forage/livestock system development from the point of view of risk assessment or probabilities of success or failure taking into account environmental, and market-related variability.

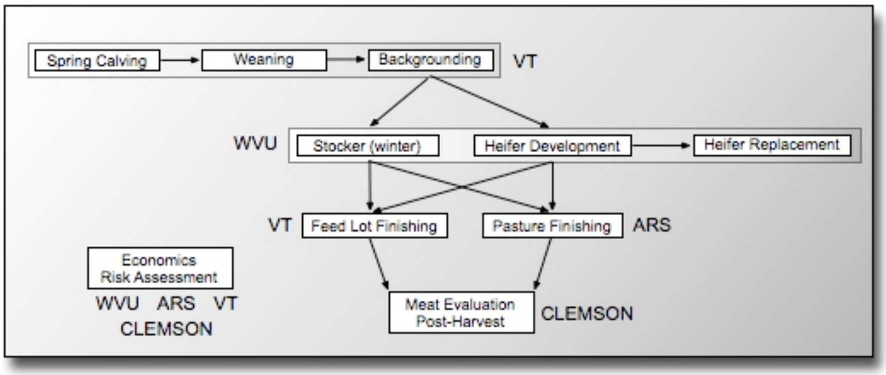

Fig. 1. Organization of the project: Pasture-based Beef Systems for Appalachia

SVAREC Cow-Calf Forage Systems Project – Past, Present, and Future

G. Scaglia, W. S. Swecker, Jr., D. A. Fiske
Virginia Tech

The Past

In 2006, we concluded the original phase of the cow-calf forage systems experiment at the Shenandoah Valley Agricultural Research and Extension Center (SVAREC). In the present article you will find a summary of the results. We had 6 different cow-calf systems, most of which were based on the Middleburg 3 paddock system. In this experiment, 45% of the grazing area in all systems was endophyte-infected tall fescue, which was stockpiled each fall, used for winter grazing, calving, spring grazing and limited summer grazing. The remaining 55% of the grazing area was split into two paddocks with different forages based on system, but alternate forages included orchardgrass / alfalfa, switchgrass, birdsfoot trefoil, lespedeza, and tall fescue with frost seeded clover. These paddocks were used for 1 cutting of hay in May / June, summer grazing and fall grazing when the large paddock was being stockpiled for winter grazing. The first 3 systems had the same forages, but differed in stocking rate and grazing management. Calves were allowed to creep graze in paddocks adjacent to their dams. A more complete description is found in Table 1.

Cows were bred once AI off a synchronization program and bulls were turned in 14 days later and remained with the cows for approximately 45 days. Cows calved from February to May and calves were weaned in October. The 6 treatments were replicated at 3 sites on the farm and the experiment lasted for 4 years. The cows utilized in the study were Angus and Angus – cross cows, with an average weight of 1216 pounds at weaning and an average frame score of 5.3. Average age during the experiment was 5.5 years, so we had a relatively young herd during this experiment. All bulls utilized were Angus (average EPD for weaning weight, yearling weight, and milk were 41, 82, and 26, respectively).

Results and Observations (Tables 1 and 2)

Result: System 2, which was 1.75 acres / cow and fescue, fescue/clover forages had the highest weaning weights and lbs calf weaned / acre

Observation: Addition of alfalfa, clover, switchgrass, or lespedeza / birdsfoot trefoil did not enhance cow or calf productivity in this experiment

Result: System 1: which was 2.25 acres / cow and fescue, fescue/clover had the lowest lbs of calf weaned / acre, but was the only system that produced enough hay to support itself

Observation: Of interest, even though System 1 produced more forage, it did not result in increased cow or calf weights. This represents a classic compromise: you can increase productivity / acre with increased stocking rates, but how much forage or feed are you willing to buy?

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Table 1: Systems Descriptions and Cattle PerfomancePerformance (average of 4 years)

Forages: Fescue+	Grazing system	Acres per cow	Cow wt. Weaning, lbs	Calf 205 d Adj. WW., lbs	Lbs calf weaned per acre	Lbs calf weaned % of dam
Fescue-Clover	3-Paddock	2.25	1219	497	200	44
Fescue Clover	3-Paddock	1.75	1208	524	275	47
Fescue Clover	Strip w/in paddock	1.75	1210	478	250	43
Fescue / Clover & OG/Alfalfa	Strip w/in paddock	1.75	1232	469	239	40
Fescue / Clover & Switchgrass	3-Paddock	1.75	1239	484	244	41
Fescue / Clover & Fescue / Lespedeza / Trefoil	3-Paddock	1.75	1186	497	260	45

Table 2: Systems Descriptions, Hay Production and Hay UsageFed (average of 4 years)

Forages: Fescue +	Grazing system	Acres per cow	Hay fed per cow (lbs)	Hay produced per cow (lbs)	Surplus or deficit per cow (lbs)
Fescue-Clover	3-Paddock	2.25	929	1259	330
Fescue Clover	3-Paddock	1.75	1429	941	-488
Fescue Clover	Strip w/in paddock	1.75	1376	819	-557
Fescue / Clover & OG/Alfalfa	Strip w/in paddock	1.75	1250	941	-309
Fescue / Clover & Switchgrass	3-Paddock	1.75	1519	538	-981
Fescue / Clover & Fescue / Lespedeza / Trefoil	3-Paddock	1.75	1237	843	-394

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General observations:

1. The use of a warm season grass, switchgrass in the present experiment, did not expand grazing days and was the system with the most hay fed. The switch grass paddocks had the highest weed infestation of all the paddocks utilized.
2. Hay was fed during August – October while the large paddock was stockpiled for winter grazing. The productivity of the neighboring paddock for creep grazing depends on the timeliness and adequacy of fall rains.
3. The vitality of birdsfoot trefoil / lespedeza in the present experiment was potentially compromised by grazing management. These paddocks were heavily grazed in late summer and fall, whereas, to promote these forages, a rest period during these periods would be beneficial.
4. Pregnancy rates for all systems (80% over the 4 years) were below our goals of 90-95%. We believe the substandard results were a combination of high stocking rates, predominance of young cows, and forage availability in the critical period between calving and breeding.

The present and future:

After meeting with stakeholder groups, two themes became evident: "Are cows getting too big to maintain on our predominant forages" and "Can we minimize hay feeding or design a no hay system?" Today you can visualize the new cow-calf systems which are based on fescue/clover, 8 paddock, rotational grazing systems. Each 16 acre paddock will contain either 8 medium frame cows or 7 large frame cows with calves, with the goal of have the same number of cow pounds per system. Cows are bred to a bull of similar frame score. The second factor is the utilization of a small area of the system (10%) with superior forages (Max Q fescue / alfalfa), which will be predominantly creep grazed by calves, but also flash grazed by cows to manage the forage. The systems have been rotationally grazed since March and four of the eight paddocks will be fertilized with N after the field day for stockpiling.

Below are weights for the two groups of cows that you can view on the tour today. Weights were taken on July 9, 2007

Group	N	Total cow wt., lbs	Avg cow wt., lbs	Total calf wt., lbs	Avg calf wt., lbs
K3	7	9605	1372	3040	434
K4	8	10035	1254	3190	399

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We are excited about the collaboration with USDA-ARS, West Virginia University, and Clemson University on the Pasture-based beef systems for Appalachia Initiative. We appreciate your attendance at the field day and welcome comments or suggestions about the project. If you have questions, please feel free to contact us to further discuss the Project.

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FORAGE SPECIES DEMONSTRATION PROJECT

Jonathan P. Repair, Jason H. Carter, David A. Fiske[1]

Introduction

The concept and purpose of this Result Demonstration Project is to provide agricultural producers a side-by-side visual demonstration of both perennial grass and legume forage species and one warm season annual grass 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, that 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. There are a total of seventeen forage species available for observation with two different varieties of alfalfa and tall fescue.

Demonstration Plots

Forage Species and Variety Identification in plots (from left to right):

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

1. Chicory
2. Timothy
3. Orchardgrass
4. Tall Fescue – Kentucky 31
5. Tall Fescue – Max Q
6. Reed Canarygrass
7. Praire Bromegrass
8. Red Clover
9. Ladino Clover
10. White Dutch Clover
11. Birdsfoot Trefoil
12. Alfalfa – Round Up Ready
13. Alfalfa – Traditional Type
14. Smooth Bromegrass
15. Bermudagrass
16. Eastern Gamagrass
17. Crabgrass
18. Caucasian Bluestem
19. Switchgrass

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1 Forage Extension Agent, Virginia Cooperative Extension, Planning District 6 (VCEPD6); Livestock Extension Agent, VCEPD6; Superintendent, Virginia Tech Shenandoah Valley AREC, respectively.

Forage Specie Information

Chicory (1)

Use- Grazing
Time of Seeding - Spring or Fall
Ph Range – 6.0-6.5
Seeding Rate – 10-15lb. / acre

Timothy (2)

Use – Primarily as mechanically harvested forage. Highly acceptable by equine producers
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

Orchardgrass (3)

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

Tall Fescue (4) (5)

Use – Pasture and/or Mechanically Harvested Forage / Strong late fall and 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 endyphyte fungus

Reed Canarygrass (6)

Use – Pasture and/or Mechanically Harvested Forage
Time of Seeding – Spring or Late Summer
Ph Range – 5.8 -6.2
Seeding Rate – 12-14 lb/acre alone or 6-8 lb. in mixtures
Very conducive for wet soils, however will also respond well In upland soils
Excellent nitrogen responder

Praire Bromegrass (7)

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 of an inch deep, planting depth is critical
Needs more intensive management

Excellent nitrogen responder
Does not tolerate continuous grazing
Must be allowed to reseed naturally once per year

Red Clover (8)
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

Ladino Clover (9)
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
Reproducers excellent form plant runners and stolens

White Dutch Clover (10)
Use – Pasture in mixtures with cool season grasses
Time of Seeding – Early Spring or Late Summer
Ph Range – 5.8 -6.5
Seeding Rate – 1-2 lb. in mixtures
Excellent response to frost seeding
Establishes naturally very readily in rotational grazing systems
Not excessively tolerant to hot dry weather

Birdsfoot Trefoil (11)
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 4-8 lb. in mixtures
Can be difficult to establish
Best suited in combination with other cool season grasses

Alfalfa (12) (13)
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 are best used in grazing situations

Should not use in continuous grazing situations
Very drought tolerant
Round up Ready (12) allows for glyphosate to be used for grass and broadleaf weed control without injury to alfalfa.

Smooth Bromegrass (14)

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

Bermudagrass (15)

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 production in summer months
Varieties that are sprigged at planting and there are seed types also available
Excellent grazing crop in summer months
Excellent hay producer
Excellent nitrogen responder

Eastern Gamagrass(16)

Use – Primarily Pasture 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
Warm Season Grass
Does well in wet 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

Crabgrass (17)

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 reseeder
High quality forage
Excellent nitrogen responder

Caucasian Bluestem (18)

Use – Primarily Pasture can be used as Mechanically Harvested Forage
Time of Seeding – Late May - August
Ph Range – 5.5 -6.2
Seeding Rate – 2-3 lb/acre alone
  Do not seed in mixtures
  Seed needs to be mixed soybean meal to allow for adequate and even flow in seeder
Adaptable to a wide range of soils
Excellent forage producer in summer months
Excellent nitrogen responder

Switchgrass (19)

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 to make it more viable (live)
  Do not seed in mixtures
  Seed quality can vary
Graze or cut at 6-8 inch height
Excellent nitrogen responder
Excellent forage for summer months
Drought tolerant
Does well in less fertile soils

Project Goals

Once forage species plots are well established, there will be a plot plan and forage description available on site at all times. This will allow agricultural producers the opportunity to visit the plots at anytime of the year, to familiarize themselves with the forage species available. It is hoped that this will better help them to evaluate the forage species and to make sounder decisions when looking to select the various forage species that will be best suited for their particular farming operation.

Acknowledgements

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  Evergreen Seed Company
  Rockbridge Farmers Cooperative
  Augusta Cooperative Farm Bureau

Research Assistants:
  Shenandoah Valley AREC Research Technicians
    Mr. Andrew Mackey
    Mrs. Marnie Caldwell

Rockbridge Extension Summer Research Assistant
Mr. Donald Repair

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Effect of Nitrogen Source and Rate on Yield and Quality of Stockpiled Fescue

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Introduction

Tall fescue is grown on more than 24 million acres in the east-central and southeastern United States. It is the primary forage base for more than 9 million beef cows in this region. One of tall fescue's strongest and most under-utilized attributes is its ability to be stockpiled for winter grazing.

Stockpiling tall fescue for winter grazing is accomplished clipping pastures in late summer, applying 60 to 80 lb nitrogen/acre, and allowing the growth to accumulate until December (NRCS, 2007). Recent research in Virginia found that the type of nitrogen applied for stockpiling can dramatically affect yield (Teutsch et al., 2005). Ammonium nitrate was shown to be the most effective nitrogen source for stockpiling. However, the future availability of this source is uncertain. Global use of ammonium nitrate has decreased and many agricultural suppliers are reluctant to sell ammonium nitrate due to security concerns. Although newly available nitrogen sources and additives (Table 1) may provide a suitable replacement for ammonium nitrate, currently the effectiveness of these nitrogen sources for stockpiling tall fescue is unknown. This study was designed to determine the effect of N source and rate on the yield and nutritive value of stockpiled tall fescue.

Methods and Materials

Small plot experiments were established near Blacksburg, Steeles Tavern and Blackstone, VA to evaluate the effectiveness of nine nitrogen sources (Table 1) applied at five nitrogen rates (0, 25, 50, 75, and 100 lb nitrogen/A). Prior to fertilization, soil samples were obtained and pastures were and clipped to stubble height of 3 to 4 inches. Nitrogen treatments were applied in mid-August to mid-September depending on the location. Forage growth was allowed to accumulate until mid-December.

Table 1. Description of nitrogen sources to be used for the stockpiled tall fescue experiments conducted at three locations in Virginia.

Nitrogen Source	Analysis (N-P-K)	Description
Ammonium Nitrate	34-0-0	Normally contains 34% N, half as NH_4^+ and half as NO_3^-. Not susceptible to volatilization when surface applied to pastures in late summer.
Ammonium Sulfate	21-0-0	In addition to 21% N, also contains 24% S making it a good N source when S is needed. Low risk of volatilization when applied in late summer. Results in greater soil acidification, requiring more lime per unit N applied.

Urea (granular)	46-0-0	Contains a relatively high concentration of N. Susceptible to volatilization when surface applied to pastures in late summer.
Urea (granular) + Agrotain	46-0-0	See above. The addition of Agrotain reduces N losses via volatilization.
Environmentally Smart Nitrogen	44-0-0	Urea N that is encapsulated in polymer coating that results in a slow release N Source.
Nitamin	42-0-0	Slow release N source. This source is degraded to a plant available form by soil microbes over a 60-90 day period.
Pelleted Biosolid	6-3.5-0.5	Pelletized biosolids product that can be spread with conventional equipment. Approximately 60% of the total N is plant available (Teutsch and Tilson, 2006).
Microstart60	4-2-3	Granluar/pelletized poultry litter product produced by Perdue AgriRecycle, LLC, Seaford, DE. This product can be spread with conventional equipment. First-year N availability is not known.
Broiler Litter	5-3-1.5	Widely available organic N source in poultry producing areas of the state. First-year N availability is 60% (VDCR, 1995).

In mid-December, the yield of the stockpiled forage was determined by clipping a swath through the center of each plot using a mechanical forage harvester. A subsample of fresh forage was collected from each plot for dry matter, nutritive value, and nitrogen uptake determinations. Subsamples were dried in a forced-air oven at 60°C for 3 to 5 days and ground to pass through a 2 and 1 mm screen using a Wiley (Thomas Scientific, Swedesboro, NJ) and Cyclone (Udy Corporation, Fort Collins, CO) sample mills, respectively.
Samples will be analyzed for acid and neutral detergent fiber (ADF and NDF), in vitro true digestibility (IVTD), and crude protein (CP) using near infrared spectroscopy.

Preliminary Results

Rainfall during the fall 2006 stockpiling period was 12, 17, and 19 inches for the Blacksburg, Blackstone and Steeles Tavern locations, respectively. The Blackstone and Blacksburg location received rainfall greater than 0.1 inches within 5 days of N application, which is sufficient for incorporation (Havlin et. al., 2005). The first killing frost occurred on 4 Nov 2006 at the Blackstone location and 3 Nov 2006 at both the Blacksburg and Steeles Tavern locations.

There were significant N rate x location ($P < 0.001$) and N source x location ($P < 0.03$) interactions for the DM yield. Therefore, data is presented by location. For each of the three locations, N rate x N source interactions were not present for the DM yield. Consequently, the main effect of N rate and N source are presented for the yield data.

Yield ranged from 1300 to 2900, 1700 to 3000, and 2600 to 3300 lb DM/A for the Blacksburg, Steeles Tavern and Blackstone locations, respectively, and increased with N fertilization in a linear manner (Fig. 1 and 2). The higher yield for the no N control at the Blackstone location was likely due to a higher clipping height prior to stockpiling (6 in vs 3 in). Stockpile yield increased at a rate of 16.2, 7.6, and 14.2 lb DM/lb N applied for the Blacksburg, Blackstone, and Steeles Tavern location, respectively. The lower N response observed at the Blackstone location was likely related to the shorter stockpiling period. At this location, N was applied approximately one month later. Due to this shorter period, the forage was not able to accumulate as much growth before the first killing frost occurred.

There were no significant differences among N sources at any of the three locations (Fig. 3). This was likely due to timely rainfall occurring during the early stockpiling period. Rainfall shortly after N application helps to move N into the soil where it can be rapidly assimilated to nitrate, reducing losses via volatilization. A recent study on the effects of N sources on stockpiled tall fescue reported that N rate increased linearly; however, the rate of increase varied among N sources (Teutsch et. al, 2005). Teutsch et al found significant differences among the N sources due to the lack of rainfall following the application; this favored volatilization.

The results of the current study were influenced by adequate rainfall during the early stockpiling period. In years with below normal rainfall, high volatilization from urea-based N sources would be expected. N loss from non urea-based fertilizers typically occurs via the conversion of NO_3^- to N_2 gas through denitrification or leaching of NO_3^-. These are not a concern in the late summer due to the dry conditions. Rainfall was not higher than normal this year so N loss from the fertilizers such as ammonium nitrate and ammonium sulfate were not a concern. The conditions following N application allowed all fertilizers to be incorporated efficiently with little N loss. More work is needed to evaluate the effectiveness of the alternative N sources used in this study during years with normal or below normal rainfall. In addition, the effect of N rates and sources on economics of stockpiling will be examined. Currently the quality and nutritive values for samples collected in December 2006 are being determined. The general experimental procedure for the 2007 study will remain the same as the previous year. In the fall of 2007, Small plots will be reestablished at all the three locations, Blacksburg, Steeles Tavern and Blackstone, VA.

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Acknowledgements

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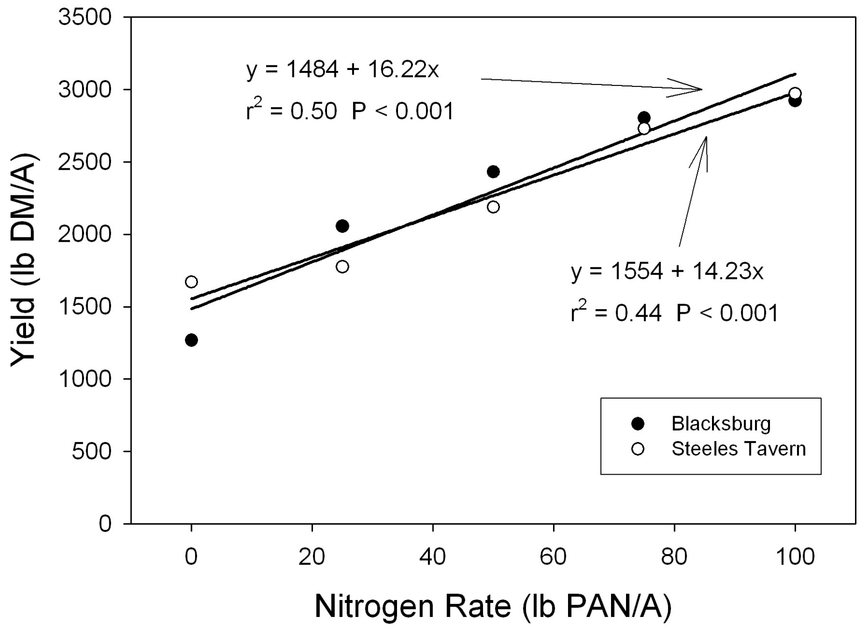


Figure 1. Nitrogen rate and location effects on the yield of stockpiled tall fescue averaged over N sources over the 2006 growing season at Blacksburg and Steeles Tavern locations. PAN is the plant available-N.

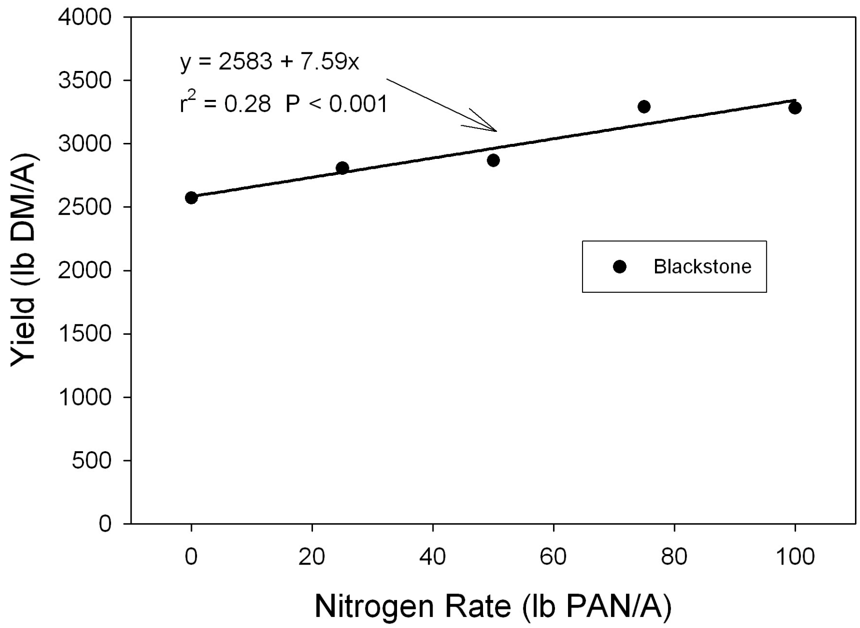


Figure 2. Nitrogen rate and location effects on the yield of stockpiled tall fescue averaged over N sources over the 2006 growing season at Blackstone location. PAN is the plant available-N.

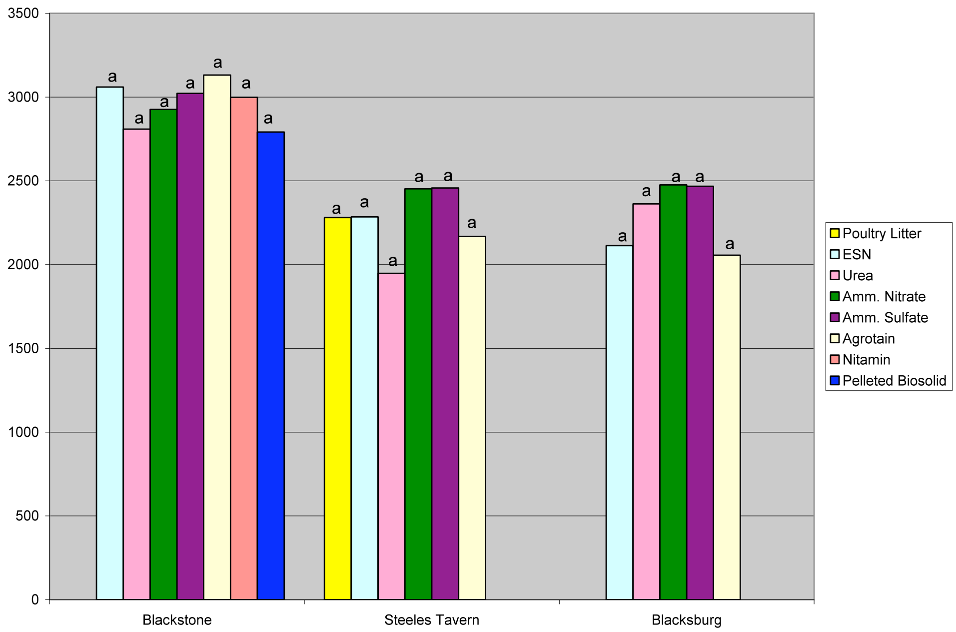


Figure 3. Nitrogen source effect, by location, on the yield of stockpiled fescue averaged over the N rates.

Invasive Exotic Plant Species in Forest Stands at the Shenandoah Valley Agricultural Research and Extension Center*

Matthew Yancey, Extension Agent, Virginia Cooperative Extension

Invasive exotic species are plants that are not native to a given area and have the ability to out-compete indigenous plant species. Invasive exotics are often brought into their non-native surroundings by humans with good intentions. In order to overcome the past mistakes of humans, today's landowners need to be informed about invasive exotics and educated as to the best methods to correct the resulting problems.

Since invasive exotic plants out-compete native plant species, there is much concern over the displacement of native plants, and ultimately, native habitats and ecosystems, due to invasive exotic plants. These plants also invade agricultural fields and even home landscapes, which can be equally problematic.

Ailanthus

Leaf

Pith

Bark

Leaf scar

Ailanthus (*Ailanthus altissima*)

Ailanthus, also known as tree-of-heaven and paradise-tree, has become a major nuisance to foresters, farmers, and homeowners alike. Its prolific seeding and ability to sprout from roots and stumps make it a serious competitor and threat to native species and cultivated crops. These factors combined with the facts that it grows quite rapidly just about anywhere make the species invariably invasive. On top of that, ailanthus is allelopathic, producing substances that are toxic to and inhibit the growth of neighboring plants.

Autumn Olive (*Elaeagnus umbellata*)

Autumn olive was introduced to the US from Japan and China in 1830. It was originally planted for wildlife habitat, shelterbelts, and mine reclamation but has escaped cultivation. It is dispersed most frequently by birds and other wildlife, which eat the berries.

It spreads rapidly in open and disturbed areas. Autumn olive's ability to fix nitrogen and drought tolerance allow it to colonize readily in dry, bare soil.

Honeysuckle (*Lonicera spp.)*

Several species of honeysuckle have been introduced in the United States from Asia for their ornamental and wildlife values. Honeysuckle is perhaps the most widespread exotic invasive in the US, now found in at least 38 states. Seeds are abundantly produced and disseminated by birds and other wildlife. It also spreads by sprouting from its roots. Its tolerance of shade from other plants allows it to grow in forest understories.

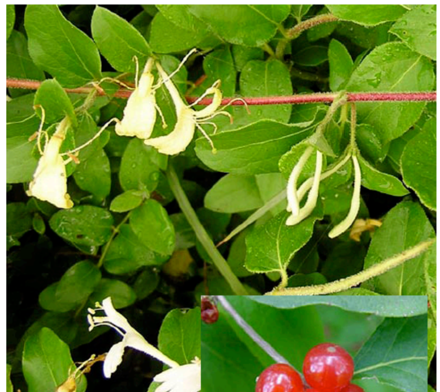
Honeysuckle is found in two forms; several species known collectively as bush honeysuckle (*Lonicera spp.*) grow in shrub form; Japanese honeysuckle (*Lonicera japonica*) is a vine that covers the ground or climbs trees, and eventually girdles and kills them.


Figure 1. Autumn olive twig and leaf


Figure 2. Autumn olive berries


Figure 3. Autumn olive

Japanese honeysuckle flowers leaves twigs




Honeysuckle fruit


Japanese honeysuckle form on ground

*All text and photos from Invasive Exotic Plant Species Identification and Management, VCE publication series.

Shiitake Mushroom Cultivation
Matthew Yancey, Extension Agent, Virginia Cooperative Extension

Shiitake (Lentinus edodes) is a delicious, healthy, edible mushroom that is easily cultivated in Virginia. They have a garlic-like taste and chewy texture and are high in D and B vitamins, protein, and minerals. Shiitake mushroom production is a potential income opportunity for forest landowners, particularly those located adjacent to larger urban areas. Since they are typically grown on small, low value hardwood logs, it is also a good use for waste wood that would be removed during a thinning operation. For instance, small crooked trees will never make high quality sawlogs and should be removed to provide additional growing space for favorable growing stock. Additionally, top limbs from felled trees in a harvest are also highly suitable, due to their high sapwood content.

Production Summary

The following table outlines the timeline of shiitake mushroom cultivation:

Table 1: Timetable of shiitake cultivation (from Cotter et als., 1986)

1. November-early March (dormant season)	Cut oak logs and stack for curing • Logs should be from **living** trees • white or chestnut oak are most suitable • ideal size is 2-6" diameter by 39" long Order spawn (see list at end of report)
2. March (3-12 weeks after cutting)	Inoculate logs with spawn and stack
3. September/following spring	Soak logs with water
4. Spring and fall	Harvest mushrooms

Logs are inoculated by drilling a series of holes into the logs and inserting the spawn into the holes. Spawn can be purchased in sawdust or wood plug form. Most spawn needs to be sealed with wax after it is inserted. A typical log will accept 30-40 holes. The holes are usually drilled ¾" deep by 5/8" diameter.

Once inoculated, the logs are stacked to allow air flow, placed in the shade (under partial evergreen cover or with shade cloth). First fruiting will occur within six months or more. Logs should be soaked or sprayed with water to induce fruiting in September. Once fruiting begins, a grower can expect to harvest mushrooms for five years or more with maximum harvests occurring in the second and third year.

For more information on growing and marketing shiitake mushrooms, contact your county Extension agent.

Sources
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Sources of shiitake mushroom spawn and supplies

Field and Forest Products 800/792-6220 www.fieldforest.net
N3296 Kozuzek Rd.
Peshtigo, WI 54157

Fungi Perfecti 800/780-9126 www.fungi.com
PO Box 7634
Olympia, WA 98507

Hardscrabble Enterprises, Inc. 304/358-2921 hardscrabble@mountain.net
PO Box 1124
Franklin, WV 26807

Northwest Mycological Consultants, Inc. 541/753-8198
702 NW 4th St.
Corvallis, OR 97330

Disclaimer: Commercial products are named in this publication for informational purposes only. Virginia Cooperative Extension does not endorse these products and does not intend discrimination against other products which also may be suitable.

Nutritive Value of "Weeds"

O. Abaye, G. Scaglia, C. Teutsch and P. Raines

Introduction

Weeds are a constant invader of crop fields and pastures so it is important to know the nutritive value of individual weed species to make good management decisions concerning their control. Frequently, researchers and producers assume that weeds have little nutritive value and livestock will not eat them, so expensive and time-consuming measures are used to control them (Marten and Andersen, 1975). Weeds compete with cultivated crops and forages for moisture, light, and nutrients, but many of them are nutrient rich and digestible (Green, 1998). Cool-season weeds can extend the growing season for warm-season pastures due to their excellent growth in late winter and early spring (Bosworth et al., 1985). Sometimes a producer might realize more benefits by not eliminating weeds but using them as a feed source.

Competition

Weeds will compete with crops and forages for water and it is especially challenging if the forage or crop has shallow roots that cannot obtain moisture from deeper in the soil profile (Green, 1998). Summer annual weeds can have large water requirements and possess extensive root systems to obtain water (Green, 1998). Many weeds can grow and reproduce more easily than cultivated plants when soil fertility is low (Vengris et al., 1953). Research shows that many weed species can use soil phosphates that are not available to the cultivated plants. These weeds may then be able to improve soil fertility because phosphorus is taken up in unavailable forms and released in available forms when the weeds die and decompose (Vengris et al., 1953).

Digestibility

Digestibility is the extent to which fractions of the forage are digested and absorbed as it passes through an animal's digestive tract (Ball et al., 2001). Many cool- and warm-season weeds have high in-vitro dry matter digestibility (IVDMD) at the vegetative stage, even higher than some cultivated forages, especially grasses (Bosworth et al., 1985, 1980) (Tables 1, 2). The digestibility of many weeds tends to decrease more rapidly than cultivated forages as the plant matures. There are some exceptions like the cool-season weeds henbit and Carolina geranium which maintained high IVDMD at later maturity stages (Bosworth et al., 1985) (Table 1).

Crude Protein

Protein is essential in all livestock diets, but the specific protein requirement varies with each type of animal. In research conducted by Bosworth et al. (1985) all the cool- and warm-season weeds and cultivated forages (Table 1) had more than enough crude protein to satisfy the requirements for a growing beef steer (11%) and a high producing ruminant (14%). Cool-season and warm-season forb weeds had similar crude protein at the vegetative stages. However, cool-season grass weeds and cultivated forages had higher crude protein than warm-season grass weeds and cultivated forages at the vegetative stage (Table 1, 2).

Protein decreases as a plant matures because the proportion of leaves on plants decreases with maturity. Leaves contain the highest amount of protein in a plant (Ball et al., 2001). Bosworth et al. (1985) demonstrated a decline in crude protein with maturity for all of their cool-season weeds and cultivated forages (Table 1). However, Virginia wildrye and Carolina geranium were the only two species that had crude protein levels at the latest stage of maturity that would not meet the requirements of a growing steer (Bosworth et al., 1985). At the most mature stage the crude protein percentages of the warm-season grass weeds and cultivated grasses would not meet the requirements for a high producing ruminant, but would still be satisfactory for a growing beef steer or dry pregnant ruminant (Bosworth et al., 1980) (Table 2). Crude protein concentrations in forb weeds remained high at the latest maturity stage.

Hay Quality

Weeds can often make up a large percentage of a hay crop, especially in early spring when cool-season weeds are thriving (Bosworth et al., 1985). At the first hay cutting many cool-season weeds may be mature, which may cause hay quality to drop (Bosworth et al., 1985). The amount of weeds contained in the hay is an important factor to consider when determining hay quality. Dutt et al. (1982) conducted research examining the quality of weedy and weed-free hay, and the effects of individual species on hay quality. The weedy hay in one experiment contained 15% weeds (dandelion, yellow rocket, white cockle) with the remaining 85% consisting of grass and alfalfa. There were no differences in animal intake or digestibility between the weedy and weed-free hay, but crude protein was slightly lower. Another test showed that weedy hay containing 20% yellow rocket had lower crude protein, digestibility, and intake as compared to hay with no yellow rocket (Dutt et al., 1982). The third experiment had weedy hay containing 34% white cockle, which had similar intake and digestibility to hay without white cockle and crude protein was only slightly decreased (Dutt et al., 1982). This research emphasizes the importance of not only knowing the amount of weeds in hay, but also the species of weeds.

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Table 1. Crude protein (CP) and in vitro dry matter digestibility (IVDMD) of cool season weeds and forages at three stages of maturity.[a]

Weeds	Vegetative		Flower/Boot		Fruit/Head	
	CP (%)	IVDMD (%)	CP (%)	IVDMD (%)	CP (%)	IVDMD (%)
Forbs						
Carolina geranium	19	78	19	70	11	68
Curly dock	30	73	19	54	16	51
Cutleaf evening primrose	20	72	14	69	11	52
Henbit	--	--	20	78	16	75
Virginia pepperweed	32	86	26	72	17	63
Grasses						
Cheat	23	81	18	69	14	61
Little barley	24	82	18	78	14	62
Virginia wildrye	23	80	19	74	7	60
Wild oats	23	75	--	--	--	--
Forages						
Hairy vetch	30	80	29	77	26	77
Ladino clover	27	81	22	85	23	83
Rye	28	79	24	81	13	70
Tall fescue	22	78	17	73	13	67

[a]Adapted from Bosworth, S. C., C. S. Hoveland, and G. A. Buchanan. 1985. Forage quality of selected cool-season weed species. Weed Sci. 34:150-154; Green, J. T. 1998. Pasture weeds and forage.

Table 2. Crude protein and in-vitro dry matter digestibility (IVDMD) of warm season weeds and forages at three stages of maturity.[a]

Weeds	Vegetative		Flower/Boot		Fruit/Head	
	CP (%)	IVDMD (%)	CP (%)	IVDMD (%)	CP (%)	IVDMD (%)
Forbs						
Bur gherkin	--	--	17	75	14	79
Coffee senna	17	81	22	75	15	67
Common purslane	--	--	19	80	--	--
Cypressvine morningglory	20	80	--	--	13	77
Florida beggarweed	22	74	17	65	13	55
Hemp sesbania	31	70	14	66	11	52
Ivyleaf morningglory	20	80	--	--	11	78
Jimsonweed	25	72	21	66	17	59
Prickly sida	17	80	18	70	12	56
Redroot pigweed	24	73	17	71	11	64
Sicklepod	22	84	14	76	17	71
Tall morningglory	20	82	--	--	14	76
Grasses						
Crabgrass	14	79	8	72	6	63
Crowfootgrass	16	67	8	54	9	43
Fall panicum	19	72	9	63	7	54
Texas panicum	16	74	11	62	8	52
Yellow foxtail	18	73	12	66	14	57
Forages						
Bermudagrass	16	58	7	51	8	43
Pearlmillet	17	59	6	60	8	60

[a]Adapted from Bosworth, S. C., C. S. Hoveland, G. A. Buchanan, and W. B. Anthony. 1980. Forage quality of selected warm-season weed species. Agron. J. 72:1050-1054; Green, J. T. 1998. Pasture weeds and forage.

Virginia Sheep Evaluation Station: Research Update

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The Virginia Sheep Evaluation Station, housed at the Virginia Tech Shenandoah Valley Agriculture Research and Extension Center, provides opportunity to conduct research and educational programs in conjunction with the programs hosted at the station. Annually, the station is home to the Virginia Ram Test and Virginia Commercial Ewe Lamb Development Program which are conducted for the state's sheep industry in collaboration with the Virginia Sheep Producers Association. In addition to providing development and marketing opportunities for rams and commercial ewes for Virginia sheep flocks, these programs provide opportunities to conduct applied research and demonstrations for the benefit of the industry. This proceedings will provide a summary of two such research endeavors.

Development of Endpoint Adjustment Factors for Sheep Ultrasound Measures

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Ultrasound scanning technology has proven to be a useful tool in estimating carcass merit as well as genetic potential for carcass traits in live animals of multiple livestock species. In the U.S. cattle and swine industries, and to a lesser degree, the sheep industry, ultrasound-derived measures of loin eye area and backfat thickness have been shown to be reasonably accurate indicators of actual carcass measurements for these traits. However, for the purposes of genetic evaluation, considerable research remains to be done in the area of adjusting raw scan data to compensate for differences in sex, weight and age. This statement is particularly true for the U.S. sheep industry, which lags far behind the cattle and swine industries in terms of its use of large-scale genetic evaluation, particularly with respect to carcass traits.

In response to interest from a progressive group of Suffolk breeders, Virginia Tech recently developed and released expected progeny differences (EPDs) for ultrasound-derived carcass traits as part of the National Sheep Improvement Program (NSIP). EPDs were reported for loin eye area and backfat thickness, and were based on ultrasound scans of 572 Suffolk sheep from five participating flocks nationwide. As the size of the database increases and more genetic links across flocks are made, the EPDs will become more reliable estimators of breeding animals' genetic merit for carcass traits.

Adjustment of raw scan data to a constant endpoint (age or weight) is a key component in the formation of EPDs. While there is considerable literature to be found in the area of growth and development related to ultrasound scan traits, the majority of this research has been done in Australia, New Zealand, and the United Kingdom on sheep of different biological type and under different management systems than typical U.S. sheep. For the initial NSIP carcass EPD run, the ultrasound measures were adjusted to a constant age of 120 days, using adjustment factors developed from serial scans collected on rams of all breeds at the Virginia Ram Test from 1999-2002. While these initial adjustment factors have proven useful, additional data collected over a broader age and weight range and under different feeding conditions will allow for refinement of the existing equations for enhanced accuracy when applied to a larger population.

As part of an ongoing process to validate and improve the adjustment methods, a serial ultrasound scanning project has been undertaken during the summer and fall of 2007. Over 100 lambs born at Virginia Tech were scanned beginning at approximately 60 days of age. Scans are being taken at the 12th and 13th rib interface for measurement of backfat thickness, loin eye area and loin eye depth. Accompanying weights and ages are also recorded on each lamb for the purpose of adjustment analysis. The scans will be repeated at approximately three week intervals until the animals either are sold or enter into the breeding flock;with the number of repeated scans on any one individual will be at least six.

All of the early-born Suffolk and Dorset ram lambs chosen for the project were fed at the SVAREC ram test facility. Those that were not entered as part of the official 2007 Virginia Ram Test were custom fed alongside the others to allow for proper contemporary grouping. Together these groups totaled 28 Suffolk and 16 Dorset ram lambs. The ewe lamb contemporaries of these Suffolk ram (n=40) were maintained as a group at Virginia Tech. A late-born group of VT Suffolks was added to the project in early June, which consists of 10 ram lambs and 15 ewe lambs. These late lambs were also fed as a group at Virginia Tech.

Results from this project will be available Fall 2007.

Evaluation of the FAMACHA System in Tested Rams

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and Department of Animal & Poultry Sciences, Virginia Tech

During the 2005 Virginia Ram Test, the FAMACHA© selective deworming program as the primary parasite management program. The objective of this study was to assess the usefulness of the FAMACHA system in controlling *Haemonchus contortus* (the barber pole worm), and to evaluate the relative parasite susceptibility of individual test rams. In the FAMACHA© system, sheep are examined every 2 weeks and the color of the membranes of the lower eyelid are matched to illustrations on a card. The eye color is an indication of anemia caused by barber pole worm. Each sheep is given a score of 1 to 5, with higher scores associated with increased anemia and accompanying parasitism. During the ram test, any lamb receiving a score of 3, 4 or 5 was given a deworming treatment. Lambs scored 1 or 2 were not treated. In addition, fecal samples were collected for the determination of fecal egg count every 2 weeks. Blood samples were also collected and red blood cell levels determined to confirm the association between the assigned FAMACHA score and anemia.

On arrival at the Virginia Ram Test Station at the SVAREC on May 3, each ram (n=75) was dewormed with 2 anthelmentics: ivermectin (Ivomec) and levamisole (Prohibit). Two drugs were administered at arrival to ensure that worms were removed from the lambs at the initiation of the study. Egg counts in the manure were therefore effectively zero in early May. Apparently, there was very little parasite transmission under the conditions of the ram test, even though the rams had continuous access to pasture. Fecal egg counts stayed very low during the summer (rams monitored through mid July) and red blood cell levels remained in the normal range. FAMACHA© scores throughout the study period in all lambs were in categories 1 and 2 so no deworming treatments were given. There was one ram lamb on the last sampling date with a FAMACHA score of 3 which was dewormed, although its fecal egg count and red blood cell level were similar to those of the other lambs. As a result of very low levels of parasitic infection, there was little difference in FAMACHA scores between individual rams.

Conclusions from this study:

1. The FAMACHA© system accurately indicates the parasite status of the lambs during the ram test and could be used in the future to eliminate unnecessary deworming treatments.

2. There appeared to be very low levels of worm transmission during the test. While levels of parasites can vary from year to year, this study indicates that under ram test conditions, worms are not a major issue if effective deworming is performed at the start of the test.

As a result of this study, changes have been adopted in the Ram Test protocol. Rams are now dewormed with two products on arrival. The FAMACHA system is utilized to monitor the rams throughout the test to determine if subsequent dewormings are warranted. If FAMACHA scores dictate, the entire group of rams is dewormed so that all rams are treated equally and levels of parasitism will not impact measurement of growth performance during the test period.

Steer Finishing Results from the First Five Years of the Pasture-Based Beef Systems for Appalachia Project

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The results from the first three years of the Appalachian Pasture Beef Systems Project are shown in Table 1. Steers (12 mo of age) were finished on either concentrate/corn silage diet in the feedlot or on pasture for 150 d after stockering at three growth rates (LOW, MED, and HI). Steers on pasture treatment grazed "naturalized" pasture, which consisted of a mix of bluegrass, orchardgrass, endophyte-free tall fescue and white clover for majority of the time and hay meadow regrowth and triticale for short periods of time. The percentage of saturated (SFA), odd-chain, or omega-6 polyunsaturated (PUFA) did not differ between concentrate and grass finished beef. Monounsaturated fatty acid (MUFA) percentage was greater for concentrate than grass-finished. Omega-3 PUFA percentage was greater for grass- than concentrate-finished. This resulted in a lower, more desirable, ratio of omega-6 to omega-3 fatty acids in grass-finished beef (1.65) compared to concentrate-finished beef (4.84). The percentage of CLA, cis-9 trans-11 isomer, was greater for grass- than concentrate-finished. Vaccenic acid (VA) percentage was also greater for grass- than concentrate-finished beef. Grass-finished beef contains half (2.1 g/serving) of total fatty acids compared to concentrate-finished beef (4.2 g/serving). Cholesterol content per serving did not differ among finishing systems.

The fatty acid composition of beef produced from finishing on various forage species versus concentrate finished beef is shown in Table 2. This project is on-going and additional data will be collected for another two-year period. Thirty-six steers (12 mo of age) grazed native pastures consisting of bluegrass and white clover for 110 d and then were randomly allotted to grazing paddocks containing alfalfa, pearl millet or native pastures. Steers grazed these paddocks containing the three forage species for an additional 40 d. Twelve steers were also finished on concentrate/corn silage diet for 150 d.

The percentage of SFA was greater for Native and Alfalfa-finished than concentrate-finished beef. Monounsaturated fatty acid percentage was greater for concentrate than forage finished, regardless of forage species. Omega-3 PUFA, CLA, and VA fatty acid percentages were greater for forage finished, regardless of forage species, than concentrate-finished. Ratio of omega-6 to omega-3 fatty acids was lower (1.3), more desirable for forage finished, regardless of forage species, compared to concentrate finished (6.4). Total fatty acid content was lower (2.5 g/serving) for forage-finished, regardless of forage species, compared to concentrate finished (6.0 g/serving). Cholesterol content did not differ among finishing systems. Overall, finishing on different forages resulted in minor changes in fatty acid composition.

Table 1. Fatty acid composition (% of total fatty acids) of ribeye steaks from concentrate- or grass-finished beef.

Fatty acid, % of total fatty acids	Concentrate-finished	Grass-finished
n	103	95
Saturated	43.44	44.24
Odd-Chain	1.79	1.74
Monounsaturated	41.99[a]	33.97[b]
Polyunsaturated, omega-6	3.71	3.77
Polyunsaturated, omega-3	0.79[b]	2.32[a]
Ratio omega-6:omega-3	4.84[a]	1.65[b]
Conjugated Linoleic Acid, cis-9 trans-11	0.36[a]	0.78[b]
Vaccenic acid	0.32[a]	3.34[b]
Total fatty acid content, g/3 oz. serving	4.16[a]	2.13[b]
Cholesterol, mg/3 oz. serving	64.17	65.29

[ab]Means in the same row with uncommon superscripts differ ($P < 0.05$).

Table 2. Fatty acid composition of beef finished on three different forages species or a high concentrate diet.

Fatty acid, % of total	Native	Alfalfa	Pearl Millet	Concentrate
n	12	12	12	11
Saturated	46.60[a]	47.42[a]	45.72[ab]	44.16[b]
Odd-Chain	1.55	1.51	1.47	1.59
Monounsaturated	35.24[b]	35.91[b]	37.18[b]	44.68[a]
Polyunsaturated, omega-6	3.43	3.66	3.39	3.14
Polyunsaturated, omega-3	2.55[a]	2.81[a]	2.56[a]	0.56[b]
Ratio omega-6:omega-3	1.34[b]	1.29[b]	1.32[b]	6.37[a]
Conjugated linoleic acid, cis-9 trans-11	0.67[a]	0.65[a]	0.68[a]	0.26[b]
Vaccenic acid	3.15[a]	2.83[a]	2.82[a]	0.12[b]
Total fatty acids, g/serving	2.54	2.66	2.22	6.03
Cholesterol, mg/serving	66.21	62.78	64.54	64.26

[ab]Means in the same row with uncommon superscripts differ ($P < 0.05$).

Complementing Tall Fescue for Forage-finished Beef Production

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Selecting the appropriate forage(s) for grazing animals is a complex issue. Persistence, quality and production usually determine which species and variety will be planted. The most appropriate forage crop depends on soil type, climate and producer expectations. If possible, grazing systems should be based on perennial forages. Perennial species are typically more productive and tolerant to grazing than annual species and do not require annual establishment. Virginia's Shenandoah Valley has an excellent environment for the production of tall fescue. While tall fescue is a persistent cool season perennial forage with a high nutrient density, this species typically is infected with a fungal endophyte. This endophyte produces toxins which severely impact animal performance. Tall fescue must be managed appropriately (particularly in late spring through summer) to obtain sufficient animal gains for the production of forage-finished beef.

In addition, several forage production "gaps" exist where tall fescue is the predominant forage species. Tall fescue typically produces adequate forage during fall and spring months, but does not provide an abundance of forage from July-September or from December-February. These "forage gaps" can be filled with other forages, or tall fescue must be managed appropriately to leave adequate residual forage for grazing during this period.

Issues to consider before selecting complementary forages:

Soil resources, slope and fertility. Soil type and fertility should <u>always</u> be considered before establishing forage crops. For example, assume that a summer annual forage is desired in a grazing system. Which should species should be established, pearl millet or sorghum-sudan? The decision is more complicated than simply comparing seed prices. If the soil has good moisture holding capacity and pH is not too acidic, sorghum-sudan will normally outperform pearl millet. Pearl millet is better adapted to drought prone, sandy or acidic soils, and will outperform sorghum-sudan in these environments. All plants will normally prefer to live in a specific environment. Alfalfa, red clover and many winter annual legumes do not tolerate poor drainage. White clover, ryegrass and some native warm season grasses can perform well in poorly drained areas.

Consider timing and quantity of forage needed. Determine how much forage is needed by your animals and how much is produced monthly by pastures to highlight your "forage gaps". Seek out alternative forages to improve production or quality during these time periods and decrease stored feed requirements. Tall fescue growth often decreases during hot summer months. Summer annual forages like pearl millet can be established to improve forage availability and quality.

It is also important to consider competition between forage species. For example, there is frequently an early winter forage gap in tall fescue grazing systems even when stockpiling is effectively practiced. Even though winter annual forages can help fill this gap, sodseeding rye, triticale, annual ryegrass or winter annual clovers into a vigorous stand of tall fescue is usually an unwise decision since fescue will compete with these forages in the seedling stage. A wiser choice would be to identify a weak stand of tall fescue that is in need of replacement. Kill this area with a herbicide and establish a winter annual (i.e. triticale) followed by a summer annual (i.e. pearl millet) before permanent establishment of a nontoxic tall fescue the following autumn. There are potentially large efficiency gains available when long term goal-oriented planning is conducted at the whole farm level.

What quality of forage do your animals require? Matching forage quality to animal physiological stage is critical for efficient forage management. There is no reason to waste ryegrass or high quality hay on dry cows that are in good condition. Producers should store this high quality hay to feed to growing or lactating animals and provide lower quality forage for feeding dry animals. Graziers also can fall into this “high-quality” trap. There is no need to graze dry cows that are in good body condition on expensive high quality winter annuals when crop residues or perennial forages are available. Alternatively, attempting to finish animals on mature, toxic tall fescue is also a losing proposition. Establish high quality forages and utilize creep or forward grazing techniques with growing, finishing or lactating animals to take advantage of these forages.

Consider time required to establish forages. Animal producers often fail to consider how much time it takes for forages to become well established and provide grazing. Annual forages like rye or pearl millet normally establish rapidly and can be grazed a few weeks after emergence. Perennials like tall fescue must establish adequate root systems to weather the upcoming summer and cannot be grazed quickly. Allocate other grazing resources to rest freshly planted areas.

Consider producer management style. While most producers desire high quality and high productivity, many are unwilling to invest in nitrogen applications and lime to encourage growth and correct soil acidity. Producers should carefully weigh a plant’s management and monetary input requirements and determine if these can be provided. Some low-input producers may be better served by establishing toxic tall fescue and grazing this forage continuously with beef cow-calf pairs.

Similar decisions should be made on complimentary forages. Chicory, for example, will perform well with nitrogen inputs and rotational stocking. Endophyte-free tall fescue can be a reliable forage with summer deferment and rotational stocking. Annual lespedeza is a low yielding forage, but requires few, if any, fertility inputs and is a fairly dependable reseeder under grazing. Usefulness of these species will vary depending on the producer’s management inputs and performance expectations.

Forage complements for tall fescue based systems.

Nontoxic tall fescue is an excellent complement to toxic tall fescue and should be strongly considered when forage-finished beef is produced. MaxQ tall fescue does contains an endophyte which confers drought and grazing tolerance, but this endophyte does not impact animal performance. Expect daily gains on MaxQ tall fescue monocultures to approach 2 lbs/hd/day and MaxQ + white clover blends to approach 2.5 lbs/day.

Bermudagrass is a logical summer compliment to tall fescue production in lower elevation areas. It is a persistent, dependable and productive complimentary species, but can have poor quality when improperly managed. It is a good addition for cow-calf systems, but is probably not appropriate for forage-finished production operations where high quality forages are needed.

Crabgrass is an annual warm season species that has extremely high quality and also dilutes tall fescue toxins during hot summer months. Crabgrass is present in many tall fescue pastures, but is likely underutilized for one reason- poor fertility. Crabgrass responds well to early or mid-summer nitrogen applications when moisture is not limiting. Currently ‘Red River’ is the only variety available for purchase. Crabgrass should be spring planted and managed to reseed in late summer.

Chicory offers some promising characteristics for graziers producing forage-fed beef. This species produces high quality forage and can produce daily gains that exceed 2.5 pounds per head. Chicory has excellent seedling vigor and has been successfully sod seeded into thin stands of tall fescue. Chicory is tolerant of acid soils but responds to high fertility. It has a deep taproot and is drought tolerant. Chicory functions as a weak perennial under rotational stocking. Expect persistence of 3-4 years under good fertility and management. Summer production is also good so chicory may be valuable as a creep grazing crop. Chicory mixtures with white and red clover have also been successfully established and managed.

Pearl millet and sorghum-sudan. These annual species also provide large amounts of high quality forage in summer months. Pearl millet is tolerant of soil acidity and droughty soils and does not produce prussic acid. Sorghum-sudan is typically higher yielding, but is more drought prone and less tolerant of soil acidity than pearl millet. It can be difficult to optimally graze these species because of extremely rapid summer growth rates. Both species can accumulate nitrates.

Prariegrass- a.k.a. Matua brome. This is a high-quality forage with good establishment year traits. Even though this is a cool season species, summer productivity is higher than tall fescue and there are no alkaloid toxicity issues as with tall fescue. Bromegrass is susceptible to powdery mildew which can be severe in wet summers. Bromegrass is a short-lived perennial and must be managed to reseed each September.

Annual Lespedeza is a warm season legume that is extremely tolerant of low fertility acidic soils. This is a good compliment for tall fescue *in low input situations* and can be easily established by broadcasting in the spring. Do not expect high yields of forage. Annual lespedeza is often (normally) outcompeted by grasses in moderate or high fertility situations.

Perennial cool season clovers. Perennial clovers are an attractive compliment to tall fescue for several reasons. These legumes are high quality forages that often lengthen the grazing season, increase overall forage production and eliminate nitrogen requirements. These clovers also help to dilute toxins present in tall fescue thereby improving animal performance. *White clover* is the most popular legume compliment for tall fescue and is more tolerant of close grazing than red clover. White clover has a creeping growth habit and is highly tolerant of close continuous grazing. *Red clover* has better seedling vigor and produces more summer forage than white clover. Red clover is less tolerant of wet soils and is more disease susceptible than white clover. Rotational stocking should be practiced for better plant persistence. Expect stands to last around two years under average grazing conditions.

Winter annual grasses. Rye, triticale, wheat, oat, and ryegrass are popular winter forage sources for producers. Rye and triticale are cold hardy and normally produce more fall and early spring herbage than other species. Wheat is cold hardy and produces slightly less fall forage but later spring forage than rye. Oat varieties can be prone to cold damage, but produce palatable high quality forage. Ryegrass produces large amounts of forage later in the spring than the cereals, but fall and winter production is limited. Fall moisture can be undependable resulting in low forage production oftentimes until February. These annuals can also be expensive to establish and should be managed to maximize utilization and quality.

Brassicas like rape, turnips and kale have recently received attention as a grazing crop. These species are said to establish rapidly in the fall and produce high quality forage. Several improved varieties target dairy producers in the Upper South and Midwest. These species may offer great potential for early fall grazing, but to my knowledge are largely untested under controlled conditions. They are reportedly best utilized in combination with winter annual grasses.

Summary.

Several perennial and annual forage options exist for complementing tall fescue pastures. Utilizing these forage species can improve forage distribution by improving forage quality and filling “forage gaps” in summer or winter months. Generally, allowing animals to graze forage will be more economical than producing, storing and feeding hay. If these forage compliments can be established economically and grazed efficiently, their addition should be strongly considered in grazing systems.