



Making the Most of Tall Fescue in Virginia

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Tall fescue (*Festuca arundinacea* Schreb.) is the predominant forage species on over one million acres of hay and pastureland in Virginia and over 35 million acres across the USA. It is a cool-season perennial grass that is well adapted to much of Virginia's soils and climate. Tall fescue has many desirable agronomic and forage attributes. It is relatively easy to establish, forms a dense persistent sod once established, and is tolerant of a wide range of management regimes. On some shallow, drought-prone soils and in certain regions, tall fescue is the most reliable perennial cool-season grass.

Tall fescue generally starts growth in late winter to early spring, but can remain green and growing throughout the winter, primarily in southeastern Virginia, but also in other areas of the state during mild winters. As is typical for cool season grasses, tall fescue has greatest growth rates during spring and fall. Tall fescue is superior to all other perennial cool-season grasses in its ability to be stockpiled for late fall and winter grazing. This characteristic makes tall fescue a key resource for livestock producers, as it enables producers to dramatically reduce winter feeding costs (see VCE Publication 418-009, Stockpiled Tall Fescue For Winter Grazing). Contrary to popular opinion, tall fescue forage is generally of high quality and digestibility, similar to that of other cool-season perennial grasses, if grazed or harvested at a proper stage of growth.

Despite its positive agronomic traits, many Virginia producers are often disappointed with the performance of livestock grazing on tall fescue. Mid-summer performance of livestock grazing primarily tall fescue

pasture is often inferior to that of animals grazing other grass or grass-legume pastures. Milk production of lactating beef cows is often reduced, contributing to lower calf weaning weights, and milk production of dairy cows can be severely reduced. First-cutting tall fescue hay is frequently harvested when too mature, resulting in lower digestibility, energy, and protein content than desired and/or needed. These problems, however, can be minimized or eliminated with sound management. Tall fescue is a vigorous seed producer and strong competitor in mixed stands and thus tends to encroach over time until it becomes the dominant forage in a pasture. Its tendency for encroachment and survivability are evidenced by the fact that it was not planted on a wide-spread basis in the USA until the 1940's, and 50 years later, it is the dominant pasture grass in the eastern states.

The Tall Fescue Fungal Endophyte

While occasional negative responses of animals consuming tall fescue were observed for several decades, it was not until the late 1970's that the cause of these responses was discovered. Many tall fescue plants are infected with a fungus that grows inside the plant. This fungus is called an *endophyte* because it is found within tissue and does not affect the outward appearance of the grass. In the scientific community, the tall fescue fungal endophyte was formerly known as *Acremonium coenophialum*, but has recently been reclassified as *Neotyphodium coenophialum*.

Interestingly, it is not the fungus itself that is toxic, rather the fungus produces alkaloid(s) that are toxic to

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animals that consume the plant. Ergot alkaloids are the group of alkaloids produced in endophyte-infected (EI) tall fescue that have definitively been linked to toxic responses in animals.

The fungus resides in the spaces between plant cells, predominately in the stem and seedhead. As the seedhead develops, the fungus invades developing seeds, which provides a means for spread of the fungus from infected plants to seedlings. Spreading through seed is the only known means of transmission of the fungus. An uninfected tall fescue plant cannot “catch” the fungus from an infected plant. This knowledge is important to management of tall fescue stands. The fungus is generally not present in leaf blades, which suggests that maintaining tall fescue in a leafy, vegetative condition might reduce toxic effects. During the winter, the fungus survives in living plants in crown tissues near ground level.

During the last 15 years, universities and companies have released several endophyte-free (EF) or low endophyte tall fescue varieties. In these varieties only 0 to 5% of the plants contain the endophyte; therefore, ergot alkaloids levels are very low or non-existent. Livestock grazing EF pastures show virtually no negative responses. When buying tall fescue seed, assume that it is endophyte-infected unless it is clearly marked otherwise on the seed tag.

Currently, varieties are also being developed that contain a non-toxic/novel or “friendly” endophyte that produces little or no ergot alkaloids. Research studies have shown that livestock grazing non-toxic endophyte varieties show little or no fescue toxicosis symptoms. These varieties and their advantages will be discussed at the conclusion of this paper.

Livestock Disorders of Endophyte-Infected Tall Fescue

Fescue toxicosis, fescue foot, and fat necrosis are the three major disorders observed in cattle consuming tall fescue forage infected with the endophyte. Fescue foot is a dry, gangrenous condition that causes lameness or the loss of the tips of tails and/or ears, and in severe cases the sloughing of hooves or feet. These responses are due to restricted blood circulation to the extremities and occur most often in winter. Fat necrosis is characterized by the abnormal accumulation of masses of hard fat in the abdominal cavities of cattle. This fat can cause digestive or calving problems. Occurrence of fat necrosis is generally limited to cattle grazing

pure tall fescue pastures that have been heavily fertilized with poultry litter or nitrogen fertilizer. Fescue foot and fat necrosis can be important to individual producers, but are of relatively little consequence on a statewide basis. Fescue toxicosis, however, is of widespread occurrence and major economic importance in Virginia.

Fescue toxicosis is sometimes referred to as “summer syndrome” and is evidenced by diverse symptoms including:

- Reduced feed intake
- Lower weight gains (Table 1)
- Decreased milk production
- Higher respiration rates
- Elevated body temperatures
- Rough hair coats (Table 1)
- More time spent in/near water and shade
- Less time spent grazing
- Excessive salivation
- Reduced blood serum prolactin levels
- Reduced reproductive performance

Some or all of these symptoms can be observed in dairy cattle, beef cattle, and sheep consuming endophyte-infected (EI) tall fescue pasture, greenchop, hay, and/or seed. Symptoms are most noticeable when temperatures exceed 88°F and are generally reduced in cooler weather.

Effects on Beef Steers:

Research throughout the southeastern U.S. suggests that gains in yearling cattle are reduced by an average of 0.1 lb per day with each 10% increase in the level of endophyte infection in a pasture. Data collected in Virginia (Table 1), however, suggest that while the effect of EI on steer performance is significant, the relationship between animal gain and EI level may be closer to a 0.04-0.06 lb per day loss with each 10% increase in EI level. This may be a result of Virginia’s cooler climate compared to other southeastern states. Even though fescue toxicosis is often referred to as summer syndrome, poor steer gains can occur throughout the season (Table 1). Nevertheless, the extent to which animal gain suffers usually increases as temperature increases.

Effects on Beef Cows:

Cows grazing EI tall fescue generally have reduced weight gain and lower pregnancy rates. Their calves have slower weight gains and reduced weaning weights. Gains and pregnancy rates of heifers decrease as endophyte levels increase. Following first calf

Table 1. Endophyte infection of tall fescue reduces stocker cattle performance in Virginia¹

Location and Parameter	Low endophyte ²	High endophyte ³	% Difference
Southwest Virginia			
	<i>lb/head/day</i>		
ADG ⁴ (Apr-July 1988-91)	1.88	1.48	27
ADG (July-Oct 1988-91)	0.92	0.74	24
ADG (Apr-Oct 1988-91)	1.37	1.10	25
ADG (Apr-Oct 1995-96)	1.30	0.93	40
Hair Coat Score ⁵ (Oct 1988-91)			
	2.2	3.6	39
Southern Piedmont Virginia			
	<i>lb/head/day</i>		
ADG (Apr-July 1988-91)	1.76	1.25	41
ADG (July-Oct 1988-91)	1.20	0.87	38
ADG (Apr-Oct 1988-91)	1.45	1.04	39
Hair Coat Score (Oct 1988-91)			
	2.2	3.6	39

¹ Sources: a) Tully, J., J. P. Fontenot, V. G. Allen, R. A. Brock, and N. B. Frank. Grazing low and high endophyte infected fescue with and without clover by cattle and subsequent feedlot performance. 5 p. In 1992-94 Virginia Tech Livestock and Poultry Research Report. and b) Allen, V. G., J. P. Fontenot, C. P. Bagley, R. L. Ivy, and R. R. Evans. 1997. Effects of seaweed treatments of tall fescue on grazing steers. p. 168-172. In Proc. American Forage and Grassland Council. Fort Worth, TX. 13-15 April 1997.

² <5% endophyte-infected.

³ >70% endophyte-infected

⁴ ADG = Average Daily Gain.

⁵ Hair Coat Score: 1 = smooth and shiny; 5 = rough and dirty.

births, pregnancy rates are also reduced. Reduced pregnancy rates are due not to reduced conception rates, but rather early embryonic death. Estrus cycling is unaffected by EI tall fescue.

Influence of Breed on Response to Fescue:

Although Angus and Brahman-Angus cross steers both exhibited decreased gains when grazing EI tall fescue, the magnitude of the decrease was less for the Brahman-cross steers. Brahman cattle are inherently more heat tolerant and thus may be better adapted to resist or tolerate higher body temperature when consuming EI tall fescue in hot weather. However, with the heavy discounts for Brahman cross cattle in Virginia, cross breeding with Brahman cattle is not recommended.

Effects on Milk Production:

Dry cows and pregnant dairy heifers grazing EI tall fescue in late summer and fall can have reduced milk production after freshening. Consumption of EI tall fescue has reduced milk production by as much as 45% in beef cows, 50% in beef heifers, and 60% in dairy cows. This reduced milk production is thought to be due primarily to reduced intake as well as reduction in the milk producing hormone prolactin.

Effects on Horses:

Mares grazing EI tall fescue pasture have fewer live foals, more foaling problems which result in foal and/or mare deaths, greater gestation lengths and foal weights, moreagalactia (no milk production), more thick and retained placentas, lower conception rates, and lower blood prolactin levels. Lactating mares placed on EI tall fescue have been known to stop lactating within a few days. Mares during the last three months of pregnancy are most sensitive to EI tall fescue, and especially during the last 30 days where they can show a negative response even to low levels of ergot alkaloids. There is no firm evidence that any other class of horse is adversely affected by EI tall fescue. In fact, in most areas of Virginia, EI tall fescue is probably one of the best, most durable forages for horse pasture. For more details on managing fescue problems with horses, see VCE Publication 406-475, Broodmares Grazing Tall Fescue Pastures or Fed Tall Fescue Hay Require Careful Management and Close Observation.

How the Endophyte Benefits Tall Fescue Plants

The infection of tall fescue by the endophyte is a good example of a symbiotic association in nature. The tall fescue plant provides a home and energy for the endophyte's

survival, and research has confirmed that the endophyte actually strengthens the tall fescue plant. Several insect species prefer and/or develop more rapidly on endophyte-free (EF) than on EI tall fescue. The alkaloids produced by EI plants increase resistance of tall fescue plants to insect feeding. In addition, EI plants are more vigorous than EF plants in some environments as evidenced by superior establishment success and greater persistence. EI tall fescue is also more drought-tolerant than EF tall fescue. Additionally, EI tall fescue has a competitive advantage in pastures with other grasses, since livestock tend to graze the EI tall fescue less severely than EF plants when given a choice.

Extent of Endophyte Infection in Virginia

Sampling in the 1980's revealed that 75% of fields surveyed had fungus present in 50% or more of the plants. Levels of 40% or more can generally be expected to produce moderate to severe adverse effects in animals, although no level of infection can be considered completely safe. To determine the infection level of a pasture, it is necessary to obtain a good plant tissue sample for analysis. A minimum of 40 tillers (basal stems of young plants) is required for each sample and tillers should be taken from the lowest 4 inches of the plant. Tillers should be sampled BEFORE they have formed seedheads and should not include roots or soil. When sampling, only one tiller should be obtained per fescue plant (clump). Samples should be taken at random points throughout the field, avoiding areas that are not typical of the pasture as a whole. For pastures larger than 20 acres, it is advisable to obtain more than one sample. Be sure that only tall fescue plants are sampled. Samples can be tested for a fee by either Auburn University, the North Carolina Department of Agriculture, or a new company in Georgia, Agrinostics Ltd. Co. (2850 Elder Mill Rd., Watkinsville, Ga., 30677, (796)-769-2397), which guarantees a 5 day turn around for test results.

Fescue Diagnostic Laboratory
209 Life Science Building
Auburn University, Alabama 36849-5409
<http://www.ag.auburn.edu/dept/plp/fescue.htm>

Fescue Endophyte Testing Service
Plant Industry Division, Seed Section
N. C. Dept. of Agriculture
P.O. Box 27647
Raleigh, NC 27611
Phone: 919/733-3930

Contact these laboratories directly for current fees and more details on sampling and shipping.

Strategies for Managing Endophyte-Infected Tall Fescue Stands

- Keep tall fescue in a vegetative stage. Timely grazing and clipping and appropriate stocking rates will help to keep plants young and vegetative. Grazing should occur when plants are in the vegetative to boot stage. Controlled grazing at high stocking densities is an effective way to ensure that tall fescue is grazed at the proper stage of maturity. The spring growth of tall fescue should be cut for hay no later than in the boot stage when it is less toxic and higher in digestibility and protein than at the heading stage.
- Dilute the endophyte by introducing legumes. No-till seeding red clover, ladino clover, alfalfa or lespedeza into EI tall fescue will dilute the effect of the toxins in addition to improving the overall forage quality and productivity of the stand (For detailed no-till seeding procedures, consult VCE Publication 418-007, No-Till Seeding of Forage Grasses and Legumes). It is not generally recommended to interseed other perennial cool-season grass species into an existing EI tall fescue pasture. The introduced grass(es) will tend to be overgrazed because of their greater palatability, and the existing EI tall fescue will be undergrazed, allowing it to outcompete the introduced grass(es).
- Avoid or reduce grazing endophyte infected stands during summer. High stocking rates on EI tall fescue in spring and using other forages for summer grazing (orchardgrass, forage legumes, bermudagrass, warm season annuals, switchgrass, caucasian bluestem, etc.) will prevent or reduce the consumption of toxic alkaloids during heat stress periods. Also, tall fescue quality and palatability tend to be low in the summer.
- Do NOT use high rates of nitrogen. Tall fescue is very responsive to high rates of poultry litter or synthetic nitrogen fertilizer. However, toxicosis is also greater at high N levels. In addition, it is more difficult to maintain legumes in grass pastures receiving heavy N applications. Arkansas research has demonstrated that poultry litter application at rates of 3 ton/acre/year and greater produced toxic levels of ergot alkaloids in EI tall fescue.
- Ensure that dietary copper is adequate. The symptoms of copper deficiency in cattle closely resemble symptoms of fescue toxicosis. Feeding supplemental copper will ensure that poor animal performance is not due to a deficiency in this mineral nutrient.

Remember that sheep are very susceptible to copper toxicity. Levels over 40 ppm are toxic to sheep.

- Feed additives or dietary treatments to reduce fescue toxicosis. Although there has been a tremendous amount of research on feed additives or dietary treatments to reduce fescue toxicosis, currently there are no approved medications to alleviate fescue toxicity in beef cattle.
- Replace endophyte-infected stands. This is an option that can solve fescue toxicosis problems, but is not simple and involves reestablishment and seed costs. EI stands can be replaced with either an adapted endophyte free (EF) tall fescue variety, a non-toxic endophyte variety or another forage species entirely. Careful consideration should be given to choosing new varieties. A new tall fescue variety that is simple “endophyte-free” will be of little or no value if it is not well adapted to your region. Since EF tall fescue has less stress tolerance than EI tall fescue, a higher level of management will be required for successful establishment and long-term persistence. Fields to which EI tall fescue is only marginally adapted should not be planted to EF tall fescue. If EI tall fescue pastures are renovated with EF or non-toxic endophyte tall fescue, the following steps are critical to long-term success: 1) Do NOT allow EI tall fescue to go to seed during the year prior to establishment; 2) Make sure that EI tall fescue is completely killed before reseeding; 3) If possible, kill EI tall fescue in the fall, and follow it with a winter annual and a summer annual prior to establishing EF or non-toxic endophyte tall fescue the following fall (see VCE Publication 418-007, No-Till Seeding of Forage Grasses and Legumes); 4) To prevent later establishment of volunteer infected plants, the new stand should NOT be allowed to produce seed during the re-establishment year using rotational grazing and/or clipping; and 5) Do NOT overgraze EF or non-toxic endophyte tall fescue, especially during the establishment year. Some people have chosen to only harvest new stands for hay during the establishment year. Manage EF or non-toxic endophyte tall fescue as you would orchardgrass for best results. non-toxic endophyte varieties show better persistence than EF varieties, but without ergot alkaloids they still have the potential to be overgrazed.
- Stockpiling endophyte-infected stands. Stockpiling is one of the most efficient ways to utilize tall fescue. Simply put, stockpiling means to store up fescue pasture growth from August until mid-fall and then to graze this growth during late fall and early winter. Tall fescue maintains quality better than any other

forage grass grown in Virginia under stockpiling and cattle rarely show fescue toxicosis grazing stockpiled fescue pasture. Follow these steps for successful stockpiling: 1) Graze or mow the fescue down to 2 to 3 inches during early to mid-August. Grazing or mowing removes low quality summer growth and allows the plant to produce new high quality leaves. Make sure to remove animals once the pasture is grazed down because overgrazing slows recovery growth and reduces the amount of stockpiled forage. 2) Topdress pure stands of tall fescue with 60 to 80 lbs N per acre during early to mid-August. Without a N application forage yield and protein will be lower. This is also a good time to apply phosphorus, potassium and lime according to soil test recommendations. In the absence of a soil test, apply 40 to 60 lbs each of phosphorus and potassium per acre. Optimal growth will occur when pH is maintained above 6.0. N may be reduced if clover is present. 3) Keep livestock off this pasture until the fall growth of other pastures is grazed (usually November or December), then turn the animals onto the stockpiled tall fescue. 4) If pastures run short in the fall, consider feeding hay during favorable weather from September to November. This allows stockpiled tall fescue to accumulate and stretches the supply of grazable forage. 5) Where possible, stockpiled tall fescue fields should be strip grazed and stocked heavily enough to graze down the accumulated growth in each paddock in 7 to 14 days or less. This allows the forage to be fully utilized without excessive trampling and wastage. Since tall fescue does not regrow in the winter, a back fence is not essential when strip grazing stockpiled growth.

A ‘Forage Systems’ Approach to Managing EI Tall Fescue

Most of Virginia’s tall fescue pastures are endophyte-infected. It is critical that producers take steps to reduce the negative impact of EI tall fescue on their livestock and on the economic performance of their farm. Renovation of existing stands of EI tall fescue with new forages can approach \$200 or more per acre. This cost, combined with the narrower range of adaptation and lower stress tolerance of most other forage options, often makes it unrealistic to consider renovation as a way of addressing the problem.

The large negative impact of EI tall fescue on feed intake and milk production makes pasture-based dairies one of the most serious candidates for major stand renovations. However, it is important to look at

the entire farming operation with the year-round forage system in mind. EI tall fescue is ideal for loafing lots and can provide good quality grazing for dry cows and young stock, especially as stockpiled forage in late fall and winter (See VCE Publications. 418-009, Stockpiled Tall Fescue For Winter Grazing; and 404-252, Dairy Loafing Lot Rotational Management System). After implementation of a rotational grazing system, interseeding of legumes may be a better option than complete renovation, especially on more marginal soils. Red and ladino clover mixtures should be broadcast or drilled at 6-8 and 1-2 lb per acre, respectively, in late winter every two years. Several Virginia dairies have been successful at generating a profit by rotationally grazing EI tall fescue pastures. However, on dairy pastures with productive soils, it is usually economical to replace a significant portion of EI acreage with other forages. The remaining EI tall fescue pasture can then be utilized at optimum times using a forage systems approach.

It is often not economical to renovate large acreage's of EI tall fescue in a beef operation, especially with cow-calf production. Interseeding with legumes to maintain a significant (25-40%) legume content in at least 50% of the EI tall fescue acreage is desirable. Implementation of a rotational grazing system will also help to maintain tall fescue in a vegetative state while enabling legumes to be more competitive and persistent in the mixture. Once EI pastures are effectively managed, beef producers may consider renovating 15-25% of their acreage to include warm season species such as bermudagrass, annual grasses or switchgrass for summer grazing. Additional high-quality cool-season species (orchardgrass, winter cereals, annual ryegrass, etc.) may be planted to provide high quality forages for calf creep grazing or for other high producing animals.

Non-toxic Endophytes in Tall Fescue

Forage grass breeders are continuing their efforts to reduce the toxicosis of EI tall fescue without significantly weakening plant survival. Selection under stressful environments is resulting in new EF tall fescue varieties that are more stress tolerant than earlier EF varieties. As mentioned earlier, grass breeders have also been successful in developing tall fescue varieties with non-toxic/novel or "friendly" endophytes, fungal strains that confer stress tolerance without producing toxicosis symptoms in livestock. Simply put, non-toxic endophytes produce zero to very low levels of ergot alkaloids, but still produce other chemicals that allow insect resistance and stand persistence. The first non-toxic endophyte varieties are now available and are marketed under the MaxQ trademark. Preliminary results show that animal gains in tall fescue varieties with the MaxQ endophyte are equal to EF varieties, but stands show similar survival to EI infected varieties. If a tall fescue variety name is followed by the MaxQ trademark, then you know that the variety contains this non-toxic endophyte. During the next few years a number of tall fescue varieties will be released that contain non-toxic endophytes. Before planting new non-toxic endophyte varieties, it is still important to determine if they are adapted to Virginia growing conditions.

The Future of Tall Fescue in Virginia

Tall fescue is well adapted to much of Virginia and with effective management can provide an excellent resource for low-cost livestock production. In Virginia, we should consider tall fescue as the foundation around which other forages are added to form an effective, year-round forage system.