THE UNIVERSITY OF TENNESSEE
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Tall Fescue: Endophyte-Infected or Endophyte-Free?

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Tall fescue is the most important forage crop in Tennessee. It is grown on approximately 3.5 million acres in the state, and is used as the base diet for nearly all beef cattle in Tennessee. An adapted strain of this grass was discovered growing on a farm in Kentucky in 1931. The cultivar "Kentucky-31" was released in the early 1940s, and was widely accepted by farmers throughout the Southeast because of its wide range of adaptation, ease of establishment and persistence. It gained a reputation as a low palatability forage that resulted in poor animal gains and various toxicosis symptoms, even though chemical analysis indicated that tall fescue was as good as any other cool-season grass. It was noted that dry matter intake was less in animals grazing tall fescue compared to those grazing other grasses. Early explanations for the poor palatability and intake were the coarse leaves and stems, and sharp edges on leaves.

Fescue toxicosis

In the late 1970s, it was discovered that the poor performance and toxicosis symptoms were associated with cattle grazing tall fescue infected with the fungus *Neotyphodium coenophialum*. The terms "fescue fungus," "endophyte," "fungal endophyte" and "fescue endophyte" have all been used to describe this fungus. "Endo" (within) plus "phyte" (plant) means a plant living within another plant. This fungus lives and grows between the cells of a tall fescue plant, and produces no signs or symptoms on the plant. Effects of the endophyte on grazing cattle can be seen as one or more of several clinical signs, including: (1) lower feed intake, (2) lower weight gains, (3) rough hair coats during the summer, (4) lower milk production, (5) reduced reproductive performance, (6) more time spent in shade and water, and (7) necrosis of hooves, tail, etc., commonly referred to as "fescue foot." These clinical signs have been documented in various research studies conducted in Tennessee and across the Southeast (Table 1). The toxicosis is the result of chemicals or alkaloids produced inside the plant.

Table 1. Effect of the tall fescue endophyte on beef cattle performance.

Performance measurement	Endophyte level		Reduction (%)
	low	high	
Daily gain (lb/day)	2.04[1]	1.06	48
	2.14[2]	0.99	53
	1.83[3]	0.99	46
	2.18[4]	1.41	35
Gain per acre (lb/acre)	619[1]	449	27
	528[3]	342	35
	462[4]	371	20
Pregnancy rate (%)	95[5]	55	42
Milk production (lb/day)	11.7[6]	6.7	43

1 Chestnut and co-workers. 1991. Tenn. Farm and Home Science. 160:38.
2 Read and Camp. 1986. Agronomy Journal. 78:848.
3 Hoveland and co-workers. 1983. Agronomy Journal. 75:821.
4 Pedersen and co-workers. 1986. New Zealand Journal of Experimental Agriculture. 14:307.
5 Gay and co-workers. 1988. Applied Agricultural Research. 3:182.
6 Schmidt and co-workers. 1984. Alabama Experiment Station Highlights Agricultural Research. 31:17.

In beef cattle, the term “summer slump” has been used to refer to fescue toxicosis, because of the visual symptoms that occur during most summers (e.g. rough hair coat, extended time in shade and water). Because of this, many people assume that fescue toxicosis is primarily a summer problem. Research has shown that animal performance is reduced throughout the year, with the largest decreases in weight gains occurring during spring rather than summer.

Mares seem to be particularly sensitive to the toxins in infected tall fescue. Research has shown that mares grazing endophyte-infected tall fescue have 20-30 day longer gestation periods and more foaling problems than mares grazing endophyte-free tall fescue (Fig. 1). However, limited research has not indicated that the growth rate of yearling horses is affected by the endophyte.

Plant persistence

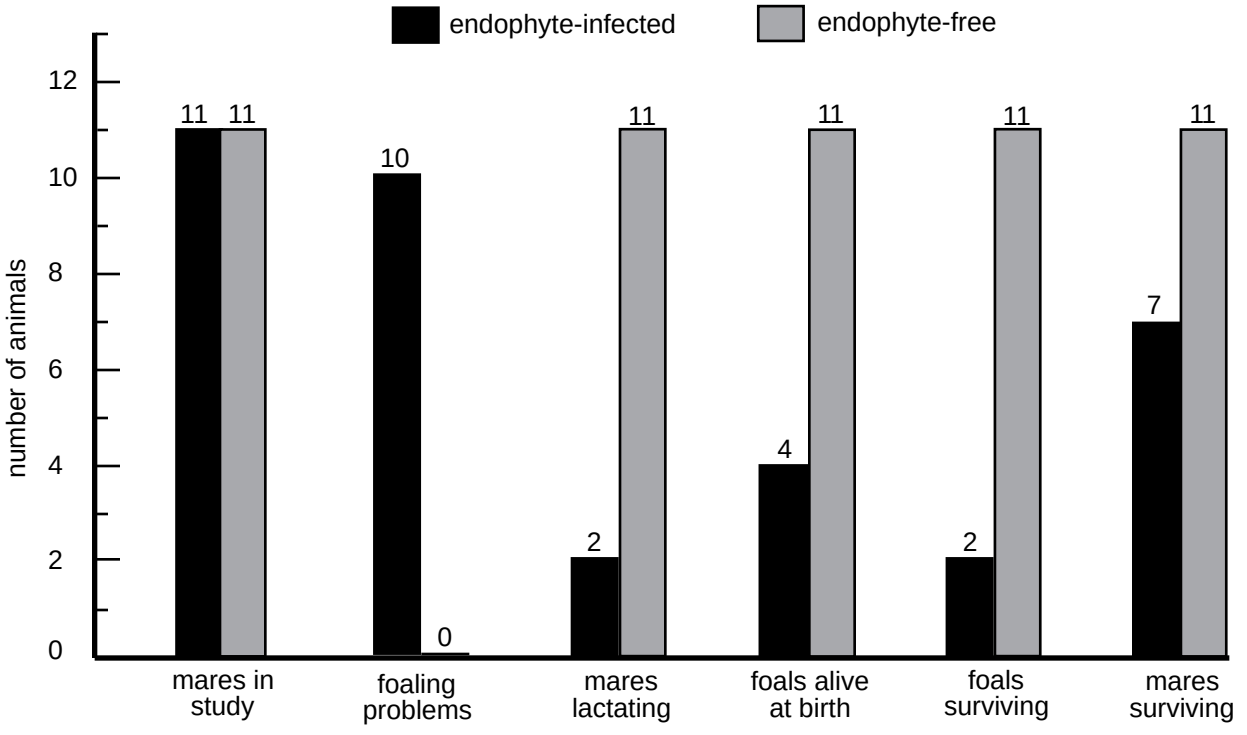
Even though the presence of the endophyte in tall fescue results in toxicity symptoms, there are some positive aspects to endophyte infection. Research and practical experience have shown that endophyte-infected tall fescue is more persistent than endophyte-free fescue in a pasture. This difference became noticeable as the first endophyte-free varieties were used. Stands of endophyte-infected tall fescue had been grazed for many years and were still solid. The new stands of endophyte-free tall fescue became weedy and were often lost after only a few years. The greater persistence of infected tall fescue is due to its enhanced ability to tolerate stress. The endophyte increases the tolerance of tall fescue to drought, disease, insects, grazing pressure or combinations of these, resulting in a more persistent plant.

This discussion leads to the conclusion that there are problems with both infected and non-infected tall fescue. Endophyte-infected tall fescue is persistent in a pasture, but results in animal toxicosis. Grazing endophyte-free tall fescue results in significantly higher animal performance, but the plants are not as hardy and stand life may be reduced. Because of this, all producers with tall fescue pastures should ask themselves two questions:

(1) Are my tall fescue pastures infested with the endophyte?

(2) If my pastures are infested, what should I do about it?

Figure 1. Effect of the tall fescue endophyte on pregnant mares and foals.



Putnam and co-workers. 1990. American Journal of Veterinary Research. 52:2071

Are my tall fescue pastures infested with the endophyte?

This first question is the easiest to answer. Plants exhibit no outward signs of infection. One way to know the infestation level of a pasture (percentage of plants that are infected) is through microscopic examination of tiller samples from the pasture. Past endophyte sampling has indicated that most tall fescue pastures in Tennessee are highly infested, unless they were replanted with endophyte-free tall fescue. Contact your local Extension office for more information on testing for the endophyte.

If my pastures are infested, what should I do about it?

If less than 30 percent of the plants in a pasture are infected with the endophyte, there is no need to re-establish with endophyte-free tall fescue. Renovating these pastures with red or white clover and annual lespedeza will help prevent any loss in animal performance due to fescue toxicosis. The management of these stands should be the same as for endophyte-free pastures (See Management of endophyte-free tall fescue).

In pastures with infestation levels of 30 percent or higher, research has shown that animal performance is significantly reduced by the endophyte. There may not be any visible evidence of toxicosis, such as fescue foot, but weight gains and conception rates are reduced, which results in less beef production per acre. There are two approaches that can be taken to reduce the effects of the endophyte on grazing animals:

1. Avoid the endophyte by re-establishing with endophyte-free tall fescue or another forage species.
2. Continue to use endophyte-infected tall fescue and use management procedures to minimize the losses caused by the endophyte.

Avoiding the endophyte is the method that should provide the highest animal performance. Because of the reduced persistence of endophyte-free tall fescue, proper grazing management will be required to maintain stands. If a producer would rather have a pasture that requires less management and is willing to accept reduced animal performance, then it may be better to continue to use endophyte-infected tall fescue. The decision for or against pasture re-establishment should be based on each producer's priorities. Management will be critical to improve performance, no matter which strategy is used.

Re-establishment with endophyte-free tall fescue

If it is decided that re-establishment with endophyte-free tall fescue is the best option, 25 percent or less of the total acreage should be replanted each year. There are several basic steps in the procedure to re-establish with endophyte-free tall fescue.

1. ***Kill the old stand of endophyte-infected tall fescue.*** This can be done by using chemical or mechanical means. Because of concerns about soil loss and environmental problems with conventional tillage, it may be best to use no-till methods to establish the tall fescue. This will require chemical kill of the infected tall fescue. Graze or cut the tall fescue for hay until about May 1. Do not allow the plants to produce seed. Because the fungus is spread through the seed, preventing seed formation will prevent new endophyte-infected plants from being established. Spray the tall fescue with 1.5 pints of paraquat (Gramoxone Extra®) per acre when the fescue reaches 2-3 inches in

height. After green regrowth is seen (usually 10-15 days), spray again with 1 pint of Gramoxone Extra per acre. Add a non-ionic surfactant at the rate of 1-2 quarts per 100 gallons of spray solution. Two applications of the herbicide will help ensure that all of the infected tall fescue is killed. For better control of perennial, broadleaf weeds, apply glyphosate (Roundup®) at the rate of 1 quart per acre. Add 2 to 4 quarts surfactant per 100 gallons of spray solution.

2. ***Drill a sorghum-sudan grass hybrid or pearl millet into the stubble.*** This will provide grazing or hay production for the summer.
3. ***Kill the summer annual.*** Apply 1 pint of Gramoxone Extra per acre from August 15 to September 1. This will kill the summer annual grass as well as any tall fescue plants that escaped the first two sprays.
4. ***Drill 15 pounds per acre of an endophyte-free tall fescue cultivar.*** **Recommended cultivars are: Alta**, Kenhy, Ky-31, Phyter, and AU-Triumph. Be sure to lime and fertilize according to soil test recommendations.
5. ***Seed red and/or white clover into the pasture the following February.*** If the pasture contains some hillsides that tend to be droughty during the summer, include annual lespedeza.

Following these procedures should eliminate the infected tall fescue and provide successful establishment of endophyte-free tall fescue without a large loss in productivity. The process of spring killing, summer rotation and fall seeding has been the most successful method of changing from endophyte-infected to endophyte-free tall fescue.

Management of endophyte-free tall fescue

Once the endophyte-free tall fescue has become established in the pasture, it is important to use proper management so the stand will persist as long as possible. Management should be focused on decreasing stress and increasing the competitiveness of the endophyte-free tall fescue.

1. ***Fertilize and lime according to soil test recommendations.*** A pH of 6.5 to 6.7 and an adequate nutrient supply will create an environment in which the endophyte-free tall fescue will be most competitive.
2. ***Use proper grazing management.*** Research has shown that overgrazing, especially during the summer and early fall, can result in stand decline. Rotational grazing is the best method because it allows time for the grass to recover from grazing. A 3- to 4-week period between grazings generally will favor stand maintenance. For further information on rotational grazing, obtain TN5053, "Planning an Intensive Grazing System," from your local Extension office.

   If continuous grazing will be used, it is important that the **pastures not be overgrazed**. Continuous close grazing can result in severe stand loss, especially during periods of high temperatures or drought. Endophyte-free tall fescue pastures should not be grazed below about 4 inches. When pasture growth has slowed and overgrazing is likely, either feed hay or move cattle to another pasture that has more available forage.
3. ***Prevent contamination with infected seed.*** Once an endophyte-free stand of tall fescue has been established, it is important to prevent any infected seed from contaminating the field. Since the endophyte does not move from plant to plant, the only way for the infestation level of a pasture to increase is for infected seed to germinate and develop into an infected plant. Do not feed endophyte-infected tall fescue hay on an endophyte-free pasture. Seedheads in hay may drop seed which can germinate and become established. It is also important to prevent the spread of infected seed by machinery. Mowers, rakes, balers, etc. should be cleaned before being brought into a endophyte-free field.

   Another source of possible contamination is cattle movement. Cattle grazing infected pastures will consume seed as they graze. Research has shown that a small percentage of this seed can survive through the animal's digestive tract, and will be excreted on the ground in manure. To prevent this, animals should not be moved directly from infected to non-infected pastures if seedheads are present in the infected tall fescue pasture. Place these animals in a holding area for at least three days and feed a hay other than infected tall fescue hay.

Management of endophyte-infected tall fescue

Research has shown that infestation levels as low as approximately 20 percent can result in reduced weight gain in steers. If the decision is made to keep endophyte-infected tall fescue, it is possible to improve performance through several management procedures. Performance will not be as high as if the cattle were grazing endophyte-free tall fescue, but management of the cattle and pastures hopefully can reduce the losses to an acceptable level.

1. ***Renovate pastures with legumes.*** Adding white and/or red clover and

annual lespedeza has been shown to increase weight gain of steers grazing infected fescue. Legumes contain more crude protein and are more digestible than tall fescue. The presence of legumes in a tall fescue pasture helps reduce the level of toxins ingested through grazing, because the legume substitutes for a portion of the tall fescue in the diet. However, improved diet quality and dilution of the toxin are not the only two explanations for improved performance. Including a legume increases weight gain more than expected if these were the only explanations. The reason is not clear, but the fact remains that adding legumes to an infested tall fescue pasture will improve animal performance.

2. ***Keep pastures grazed or clipped during spring and summer.*** In the spring and early summer, tall fescue pastures will be actively growing and producing large amounts of forage. Research has indicated that grazing these pastures close and preventing the forage from maturing will improve animal performance on highly infested pastures. The best method to accomplish this is to use high stocking rates on some pastures, and use other pastures for hay production. As the spring and summer progress and forage production slows, pastures that have been cut for hay can be used for grazing. This should result in efficient use of forage, improved forage quality and improved animal performance.

3. *Use a controlled breeding season.* Even though fescue toxicosis occurs throughout the year, the most evident and dramatic effects of the endophyte occur from June through August. This is the time when temperatures are the highest and animal performance is the lowest, hence the term "summer slump." Calving time and cow breeding season should be adjusted so they do not occur during summer.
4. *Take the necessary steps to ensure a healthy herd.* Providing a complete mineral mix, adequate protein and regular deworming are examples of procedures that can be used to improve animal performance. Even though these will not offset fescue toxicosis, they will ensure that animal performance will not be reduced by poor management. For more information on techniques for cow and calf management, obtain a copy of the "Tennessee Cow-Calf Handbook" from your local Extension office.

Conclusions

Many producers may feel that there is no use for endophyte-free tall fescue, primarily because of earlier difficulties in stand maintenance. In many cases, it may be best if some fields remain in endophyte-infected fescue. These may be pastures that are difficult to reach with equipment for reseeding, or fields that will be abused for portions of the year. In these cases, persistence is the most important characteristic needed in the pasture. Animal performance is being lost, however. If production records indicate that weight gains and calving percentages are unacceptable, the endophyte-infected tall fescue may need to be replaced. Proper management will allow for the maintenance of endophyte-free fescue stands. Whether endophyte-free or endophyte-infected tall fescue is used, proper management is essential to obtain the highest level of performance possible.

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