

Fescue Toxicosis

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Tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh.] is a cool-season, perennial grass frequently infected with the fungal endophyte *Neotyphodium coenophialum*. An endophyte is a fungus or bacteria that lives entirely within the tissue spaces of plants and is only visible microscopically. The plant and fungus enjoy a relationship that is symbiotic—mutually beneficial to both organisms. The fungus has free access to the plant's nutrients and the plant provides a means for the endophyte to reproduce through infected seeds. The fungus, in turn, produces chemicals (ergot alkaloids) that function as chemical defenses, making the plant more vigorous, pest-resistant, drought-resistant, and tolerant of many adverse soil and environmental conditions. The endophyte produces a variety of ergot alkaloids, of which ergovaline is the primary concern and accounts for approximately 80 percent to 97 percent of the alkaloids in tall fescue. Ergovaline concentrations in tall fescue can range between 0-3,000 ppb (DM) with the highest concentrations in the stem and seedhead and in the bottom 3 inches of the plant. Hay from infected fields can remain high in ergovaline even when stored over several years. "Fescue toxicosis" is the general term used for the clinical diseases that can affect cattle consuming endophyte-infected tall fescue.

Cause

Tall-fescue pastures (Figure 1) containing ergot alkaloids are responsible for the toxic effects observed in livestock, including hyperthermia (elevated body temperature), gangrene of the extremities, decreased weight gain, and poor reproductive performance. The alkaloids cause vasoconstriction or narrowing of the arteries which leads to poor blood supply to many body systems. Generally signs of fescue toxicosis become evident when ergovaline levels are within the range of 200-800 ppb (DM) in the total diet or higher. Clinical signs vary depending on the cattle, the environmental conditions, and the level and duration of the exposure. Early clinical signs are often reversible after removal from contaminated pastures or hay.

Signs

Hyperthermia is the hallmark effect of ergot alkaloids and is frequently referred to as "summer slump," "summer syndrome," or "summer fescue toxicosis" (Figure 2). Agronomists also use the term "summer slump" to describe the decline in cool-season grass growth observed in July and August, so summer slump is not limited to tall fescue, but is exacerbated with this grass species. The expected response in cattle to warm temperatures is an increase in blood flow to peripheral tissues (skin and extremities) in order to dissipate heat from the body core to the



Figure 1. Tall fescue.

skin surface. However, with fescue toxicosis, the blood flow to the skin is reduced by the constrictive effects of the ergot alkaloids on the blood vessels, limiting the ability of the body to cool itself. Clinical signs in cattle include poor growth or weight loss due to decreased feed intake, a dull rough hair coat caused by failure to shed the winter coat and excessive growth of hair, excessive salivation, labored respiration (open mouth and/or rapid breathing) and an increased susceptibility to heat stress. Affected cattle appear hot, avoid grazing during the day, and seek shade or mud wallows to find relief from heat. Accumulation of the alkaloids in the tissues may cause the vessels to stay constricted for up to six to seven weeks after removal of the animal from infected pasture. Summer fescue toxicosis in steers has been reported at low concentrations of approximately 200 ppb ergovaline and cattle may show a vasoconstrictive response to the alkaloids in as little as two days after initial exposure. The clinical signs may be more severe if tall fescue



Figure 2. Summer slump.

or other grasses have developed black ergot bodies in place of the seed caused by the fungus *Claviceps purpurea* which also causes vasoconstriction.

Fescue foot (Figure 3) is dry gangrene of the extremities (usually hooves) that occurs due to narrowing of the blood vessels supplying blood to these distant areas. It generally occurs in late fall or winter when environmental temperatures are cooler. Vasoconstriction affects the hind limbs first. The condition appears as swelling and redness at the coronary band and progresses to knuckling at the pastern joint. Other signs include shifting hind limb lameness, unthriftiness, and finally necrosis (dry gangrene) of the hooves. The affected portions of the hoof will fall off or slough. Tips of the ears and tail also may be affected. Typical ergovaline levels found in the feed of cattle affected with fescue foot is greater than 400 ppb DM.

Fat necrosis or “lipomatosis” has been observed with chronic fescue toxicosis and is associated with masses of necrotic fat in the abdominal and/or pelvic cavities. These hard areas of fat can obstruct the birth canal and contribute to dystocia (difficult birth). Hard fat masses in the abdomen may lead to colic and intestinal blockage. This condition may be diagnosed with rectal palpation or may be found at necropsy.

Ergot alkaloids can adversely affect both male and female reproductive function, including delayed puberty and reduced conception rates. Bulls may have altered sperm motility parameters while female ovarian follicular dynamics can be adversely affected. Recent studies indicate embryo quality and subsequent embryo development are negatively affected as well. Decreased feed consumption and a disrupted ability to maintain steady copper levels may also contribute to poor reproductive function, especially when accompanied by heat stress. Decreased serum prolactin levels due to inhibition of secretion from the pituitary gland may decrease milk production and cause other reproductive effects, although this effect is much more pronounced in mares than ruminants.

Diagnosis

The diagnosis of ergot alkaloid-associated problems is based on clinical signs as well as knowledge of the geographical area, weather conditions, and forages present. Testing for the pres-



Figure 3. Fescue foot.

ence of the endophyte in the forage is performed by Regulatory Services at UK. Detailed directions for sampling and submission are available at the University of Kentucky Regulatory Services website (<http://www.rs.uky.edu/>) under the “seed” tab. Diagnostic testing at the UK Veterinary Diagnostic Laboratory can also be performed on forage samples for ergovaline concentration. Details on sample collection can be found at: <http://www.uky.edu/Ag/Forage/ForagePublications.htm#Tall Fescue>. Information also may be found in the University of Kentucky publication PPA-30, *Sampling for the Tall Fescue Endophyte in Pasture or Hay Stands*, which is available at the local cooperative extension office or on the Web at <http://www2.ca.uky.edu/agc/pubs/ppa/ppa30/ppa30.pdf>.

Prevention and Control

Several management practices can be used to improve cattle production on toxic endophyte-infected tall fescue.

Grazing. Intensive grazing of endophyte-infected tall fescue reduces ergot alkaloid concentration in vegetative tillers and sends carbohydrates toward regrowth instead of alkaloid production.

- Greater concentrations of ergot alkaloids are in the leaf sheaths than in the blades so by adopting practices that maximize consumption of leaf blades (i.e. rotational grazing), the potential is there to reduce ergot alkaloid consumption.
- Careful attention to soil test recommendations for fertilizer and good weed control are necessary to sustain the stand when tall fescue is intensively grazed or it will not persist.

Cultivars. Use of tall fescue cultivars artificially infected with novel or “friendly” endophyte strains that do not produce toxic ergot alkaloids results in greater average daily gain (ADG), lower body temperatures, and sleek hair coats.

- Careful grazing management is required during periods of slow pasture growth because cattle will continue to graze these fescue stands “into the ground” without the negative effect of the alkaloid present. These friendly endophyte pastures may have decreased carrying capacity but overall greater body weight gain per acre than toxic fescue pastures. In Kentucky, novel endophyte varieties have shown 10+ years of stand survival under good management.

- Endophyte-free varieties lack persistence and grazed stands of these cultivars rapidly deteriorate without good management. Stand life of endophyte-free varieties is similar to orchardgrass. Good grazing management practices will be necessary for free and novel endophyte tall fescue to persist if they are grazed in the late spring or summer.

Seed heads. The highly toxic seed heads that are readily grazed by cattle can be regularly mowed or chemically suppressed with metsulfuron containing herbicides.

- Seed heads and stems in underutilized endophyte-infected tall fescue pastures show high levels of ergot alkaloids. Reductions in seed presence can reduce toxicity of the overall forage since ergovaline concentrations are three to ten times greater in the seed heads than the leaf blades or sheaths. Seed heads are selectively grazed when they are immature and moderately digestible.
- Steers grazing endophyte-infected tall fescue treated to suppress the seed head development had a 39 percent greater ADG, much higher serum prolactin levels and much lower rectal temperatures than steers on untreated fescue.
- Grazing management will be necessary to accommodate the reduction in forage production when seed heads are suppressed. Forage availability may be reduced by as much as 50 percent, which may be due to a reduction in the presence of seeds and stems, greater forage intake, and/or direct negative effects on vegetative growth.

Rotation. Moving cattle to warm season grass pastures during the late spring and early summer when alkaloid concentrations are high and seed heads are present.

- When seed heads are present in the stand, cattle are the most vulnerable to severe heat stress and depression in performance.
- This management technique provides grazing during active growth of the warm-season grasses when there is a decline in tall fescue growth.
- May not see a benefit in performance if the warm-season grass is of low quality or becomes overgrazed.

Legumes. Interseeding legumes into endophyte-infected tall fescue pasture or supplementation with grain or co-product feeds to improve the diet of the animal.

- This management approach can benefit animal performance mainly through better diet quality and dilution of ergot alkaloids. It should be cautioned that cattle can be very sensitive to the effects of ergot alkaloids even at low concentrations and there is a tendency for alkaloids to accumulate in cattle tissues and induce signs of toxicosis despite small concentrations in the diet. Providing pasture with a diverse mixture of forage species will reduce the impact as animals will selectively graze other forages.

Minerals. It is essential to provide a complete mineral mix to compensate for reductions in forage intake and to ensure adequate intake of the trace elements.

Testing Guidelines

There are two major options for testing of tall fescue: one is to determine the level of fungal toxins in pasture plants, and the other is to determine the percentage of plants that are infected with the fungus. Each test provides different information.

Ergovaline Testing

To determine the levels of endophyte-associated toxins in the fescue forage, ergovaline testing can be performed. Testing for other endophyte-associated toxins can also be done, but ergovaline is the toxin of highest concentration and is thought to be the toxin of most concern. This test can be performed at the University of Kentucky Veterinary Diagnostic Laboratory Toxicology section. Please see the UKVDL website <http://vdl.uky.edu/> for submission forms and shipping information.

Sample collection. Each pasture or field should be sampled separately. To collect samples, randomly select 20 to 30 separate sites within a pasture and pull out a handful of grass, including some root material and the entire plant above ground. Walk in a zig-zag pattern through the field to get samples. Some suggest walking the field in a W fashion and collecting a large handful of pasture grass at the five ends of each “W.” Samples for ergovaline testing should be placed on ice immediately after collection and kept on ice until either shipped or placed in a freezer for storage until time of shipment. Samples should be shipped on ice by overnight courier, or else delivered directly to the laboratory by the client. Samples need to be taken when plants have been growing well for at least a month, so early summer is a good time for testing.

Ergovaline concentrations vary among different fields even with the same grass variety. Levels also vary from season to season and from year to year. Increased fertilization can increase ergovaline concentrations, as can stressful growing conditions. Ergovaline concentrations vary by part of plant, with seed heads typically containing the highest concentrations. One batch of samples collected at one time cannot be considered representative of the field at all times over the year.

Endophyte Testing

To determine the percentage of plants infected with the toxin-producing endophyte fungus in a particular field, endophyte testing can be done. There are several laboratories that do this test, including the University of Kentucky Regulatory Services laboratory. This test indicates how heavily infected pastures are, but does not give information on the levels of the endophyte toxins. Please see the University of Kentucky Regulatory Services website (<http://www.rs.uky.edu/>) for more information on sample collection for endophyte testing. Note: The UK Regulatory Services accepts samples only from Kentucky farms.

Summary

In summary, fescue toxicosis is due to a fungal endophyte within the tall fescue plant which produces ergovaline, a compound that causes profound constriction of blood vessels in cattle. The hallmark effect of this vasoconstriction is hyperthermia or elevated body temperature which most often results in poor animal growth and weight loss. Accumulation of the alkaloids in the tissues may cause the vessels to stay constricted for up to seven weeks after removal of the animal from infected pasture. Solutions to the problem may include replanting endophyte-infected pastures with cultivars infected with novel or friendly endophyte or endophyte-free seed, diluting infected pastures with other grasses or legumes, managed intensive grazing of the infected fescue to reduce ergovaline production, or using warm season grass pastures in late spring and early summer instead of fescue as the main forage source.

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Photos

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Figure 2: Michelle Arnold, University of Kentucky.

Figure 3: Eldon Cole, University of Missouri Extension.

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