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Fescue Toxicosis in Cattle

Cooperative Extension Service

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Tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh., previously known scientifically as *Schedonorus arundinaceus* (Schreb.) Dumort.] is a cool-season, perennial grass (Figure 1). The Continental type, most notably the Kentucky-31 variety, is frequently infected with an endophyte (*Epichloë coenophiala*). An endophyte is a fungus that grows inside the grass, specifically within the intercellular spaces of the leaf sheaths, stems, and seeds, and is invisible to the naked eye. The plant and fungus have a mutually beneficial relationship, wherein the plant provides the fungus access to its nutrients and a means of asexual reproduction through infected seeds. In turn, the fungus produces compounds called ergopeptine alkaloids that increase the plant's vigor by making the plant more pest- and drought-resistant and more tolerant of other adverse soil and environmental conditions. Although advantageous to the plant, ergopeptine alkaloids adversely affect the health and productivity of grazing livestock. Ergovaline is the most abundant (more than 90 percent) and most toxic ergopeptine alkaloid in endophyte-infected (E+) tall fescue. The highest alkaloid concentrations are found within the seedheads and in the bottom few inches of the plant.

Figure 1. Tall fescue.
Photo courtesy of Jimmy Henning, University of Kentucky Forage Extension, Lexington, Kentucky.

Cattle grazing toxic E+ pastures may develop a variety of disorders, collectively known as fescue toxicosis, although the underlying cause is the alkaloids produced by the fungus. The most common and economically damaging disorder in cattle is "summer slump," a syndrome characterized by an increased sensitivity to heat and retention of rough winter hair coats during the summer. The resulting heat stress decreases grazing time, feed intake, and liveweight gain. Mature cows experience decreased milk production and poor reproductive performance. "Fescue foot" is a dry gangrenous disorder of the extremities seen when cattle graze E+ pastures during cold weather, resulting in lameness, loss of tail switch and ear tips, and sometimes sloughing of hooves. "Fat necrosis" refers to development of fatty abdominal masses associated with grazing toxic fescue pastures after high nitrogen fertilization. In some cases, these masses have no health impacts, while in other cases, they can cause obstructions, resulting in digestive or calving issues.

Cause

Ergopeptine alkaloids are structurally similar to neurotransmitters (the body's chemical messengers that relay signals between cells) including dopamine, epinephrine, and serotonin. By binding to various receptors in place of the normal neurotransmitters, the alkaloids can change the signals responsible for maintaining certain biological processes. For example, dopamine decreases prolactin, a hormone important for milk production, mammary gland development, and other vital metabolic functions in non-lactating as well as lactating animals. Ergopeptine alkaloids activate dopamine receptors, decreasing prolactin release into the bloodstream and consequently decreasing milk production. Most of the observed signs of fescue toxicosis in cattle are due to vasoconstriction (narrowing of the blood vessels), caused by activity of the alkaloids at multiple receptor types. For example, during hot, humid weather, cattle experience heat stress due to reduced blood flow to the skin surface, limiting the animal's ability to dissipate heat and cool itself.

Signs

Signs of fescue toxicosis observed in cattle depend on the amount of alkaloid bound to receptors, the level and duration of alkaloid exposure, the environmental conditions (temperature and humidity), and the individual animal's susceptibility to ergopeptine alkaloids.

Decreased reproductive performance and milk production

The vast majority of economic loss from ergopeptine alkaloids is due to adverse effects on reproductive performance and milk production. Decreased reproductive performance is caused by a variety of effects, many of which are poorly understood. In addition to decreased prolactin resulting in less milk, females also have a lower level of progesterone necessary for establishment and maintenance of pregnancy. One study found a 41 percent lower

conception rate in cows grazing ergopeptine alkaloid-containing pastures versus ergopeptine alkaloid-free pastures. Bulls may have altered sperm motility parameters and reduced fertilization potential. Research indicates embryo quality and subsequent embryo development are negatively affected as well. Decreased feed consumption and nutrient absorption and the inability to maintain steady copper levels also contribute to poor reproductive function, especially when accompanied by heat stress.

Heat stress

Simply stated, cattle affected by summer slump graze less and therefore gain less weight, resulting in lower average daily gain (ADG) in stocker calves and lower calf weaning weights. Milk production declines in dams, further contributing to lower calf weaning weights. In addition to decreased feed intake, slower gut motility and decreased nutrient absorption may also occur. Affected cattle exhibit rapid and labored respirations, open mouth breathing or panting, excessive salivation, and elevated rectal temperatures. Cattle spend more time idling in shade, mudholes, ponds, and streams, and less time grazing during the day. A dull, rough hair coat caused by failure to shed the winter coat exacerbates the heat's effect (Figure 2). Signs can develop quickly, often within one to two days of exposure, and can persist up to six to seven weeks after removal from the source. Early clinical signs are sometimes reversible if removal is prompt.

Fescue foot

Fescue foot, or gangrenous ergotism, refers to necrosis (tissue death) of the extremities (hooves, ear tips, tail switches) that occurs due to persistent vasoconstriction and damage to the blood vessels supplying oxygenated blood to these distant areas. Development of this condition is not common with toxic E+ tall fescue in Kentucky, as it requires exposure to extremely high concentrations of ergopeptine alkaloids during very cold environmental temperatures. It is more commonly seen with exposure to ergot-infected grasses or grains (see the fact sheet *Forage-Related Cattle Disorders: Ergotism* [VET-34] for more information). Vasoconstriction typically affects the rear limbs first, appearing as swelling and redness just above the hoof at the coronary band and progressing to rear limb lameness (Figure 3). The tail may also become discolored. Later, affected portions of the hooves, ear tips, and/or tail switch fall off, or "slough," from lack of blood supply.

Figure 2. Example of "summer slump."
Photo courtesy of Jimmy Henning, University of Kentucky Forage Extension, Lexington, Kentucky.

Fat necrosis

Fat necrosis, or abdominal lipomatosis, is the least studied result of long-term ergopeptine alkaloid toxicosis. It is associated with grazing pastures receiving high-nitrogen fertilization, particularly fertilization with poultry litter. Firm masses of necrotic fat can develop in the abdomen that may or may not cause problems, depending on their location. Masses in the pelvic cavity can obstruct the birth canal and contribute to dystocia (difficult birth). Hard fat masses in the abdomen may compromise abdominal organs or cause intestinal blockages with outward signs that may include chronic diarrhea and weight loss, trouble urinating, and loss of appetite. Fat necrosis is occasionally diagnosed by rectal palpation but is most often found during necropsy.

Diagnosis

The diagnosis of problems associated with toxigenic E+ tall fescue is based on the observed signs in cattle, examination of forages present, and ruling out other possible causes of similar signs. There are two major options for testing tall fescue; each test provides different information. Endophyte testing is used to determine the percentage of plants in the pasture infected with the fungus, while ergovaline testing measures the level of that alkaloid present in forages.

Endophyte Testing

To determine the percentage of plants infected with an endophytic fungus in a particular field, endophyte testing can be performed. Once the level of endophyte infection is known, an appropriate management strategy can be developed. The test can be conducted on both live tillers (shoots that arise from the base of a grass plant and produce new leaves and stems) and seed. For endophyte analysis, please refer to the "Services" tab of the Agrinostics Ltd. Co. laboratory website at https://www.agrinostics.com. Details on sample collection can be found in the University of Kentucky fact sheet *Sampling for the Tall Fescue Endophyte in Pasture or Hay Stands* (PPA-30), which is available at the local cooperative Extension office or on the web at https://publications.ca.uky.edu/sites/publications.ca.uky.edu/files/PPA30.pdf .

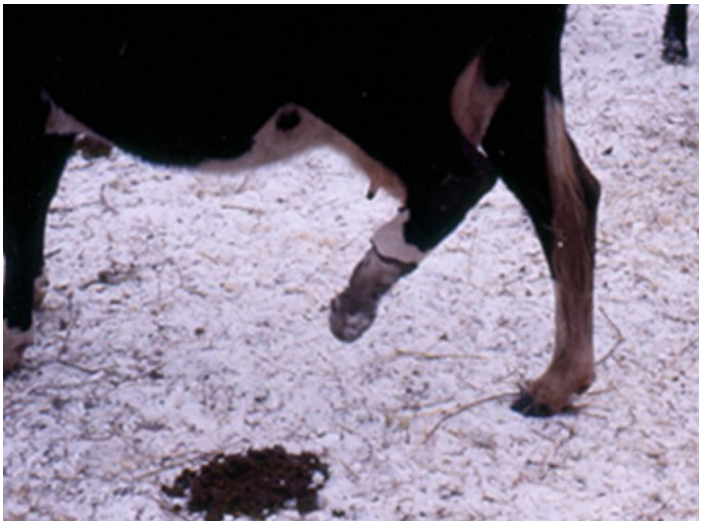

Figure 3. . Example of "fescue foot."
Photo courtesy of Eldon Cole, University of Missouri Extension.

Ergovaline Testing

To determine the levels of endophyte-associated toxins in fresh tall fescue forage, ergovaline testing can be performed in the Toxicology Section of the University of Kentucky Veterinary Diagnostic Laboratory (UKVDL). Please see the UKVDL website (http://vdl.uky.edu/) for submission forms and shipping information. Testing for other ergopeptine alkaloids can be performed at other laboratories, but ergovaline is the toxin of highest concentration and is thought to be the toxin of most concern in toxigenic tall fescue.

A brief summary of the sample collection process is provided in this publication, but full sample collection instructions are available at the following link: https://vdl.uky.edu/ergovaline-sample-collection-guidelines. Each pasture or field should be sampled separately. To collect samples, randomly select 20 to 30 separate sites within a pasture and cut handfuls of tall fescue at grazing height. Walk in a zigzag 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 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 late spring or early summer is a good time to begin testing, as well as in the fall when cool-season grass growth resumes. Tall fescue hay can also contain significant concentrations of ergovaline and can be tested. Ideally, core samples should be collected from as many bales as is reasonable to obtain a composite sample that is representative of what the animals will ingest. Hay samples can be placed into paper bags and kept cool (room temperature is fine) and dry. Wrapped/wet forages can likewise be sampled but should be kept in the refrigerator.

Ergovaline concentrations vary among different fields even with the same grass variety. Levels also vary from month to month and from year to year. Increased fertilization can increase ergovaline concentrations, as can stressful growing conditions. Ergovaline concentrations vary by part of plant, with seedheads and the bottom few inches typically containing the highest concentrations. One batch of samples collected at one time is not representative of the field at all times over the year.

Interpretation of these test results is dependent upon several factors such as the intended species and class of animal to which this forage will be fed and how the sample was collected. Guidelines for how much ergovaline can be safely ingested by cattle are not well established. Some suggest that 100 to 300 parts per billion (ppb) ergovaline on a dry matter basis in the total diet for cattle could result in clinical signs, while other studies found that higher concentrations (up to 750 ppb dry matter) are required before clinical signs occur. With high heat and other environmental stressors, the lower-level guidelines are considered more appropriate. Different laboratories may use different cutoffs for level of concern for ergovaline concentrations, depending on the method of analysis performed, type of standard used, and other variables. Regardless, it is important to determine the percentage of tall fescue present in the pasture so the overall risk can be calculated. Currently, there are no tests commercially available to confirm fescue toxicosis in cattle from blood or tissue samples.

Prevention and Control

Management practices for improving cattle production include strategies for minimizing exposure to toxigenic E+ tall fescue.

1. **Change fescue varieties.** Replacement of toxic E+ fescue stands with tall fescue varieties infected with novel or "friendly" endophyte strains that produce lower concentrations of ergopeptine alkaloids results in 20 to 50 percent greater average daily gain (ADG), lower body temperatures, increased prolactin concentrations, and sleek hair coats. An excellent publication covering elimination of toxic stands and addition of novel varieties, entitled *Tall Fescue Novel Endophyte Varieties and Establishment for Livestock and Horse Farms*, is available online at https://forages.ca.uky.edu/files/establishing_novel_endophyte_tall_fescue_agr275.pdf.
    a. Careful grazing management is required during periods of slow growth because cattle will continue to graze novel endophyte fescue stands without the negative effect of the alkaloid present. Novel endophyte pastures may have decreased carrying capacity but overall greater body weight gain per acre than toxic fescue pastures.
    b. Endophyte-free varieties lack persistence, and grazed stands of these varieties rapidly deteriorate without good grazing management, especially in the late spring or summer. Endophyte-free varieties are also more susceptible to drought, insects, and other plant stressors and are usually eventually overtaken by nearby toxigenic fescue varieties.
2. **Intensively graze tall fescue.** Intensive grazing is a livestock management practice that involves rotating animals through small pastures, each grazed for a short period and then given an adequate rest period for regrowth. The goal is to increase the quality of the forage, the amount of muscle mass produced per unit area, and the uniformity of forage utilization. Intensively grazing E+ tall fescue sends carbohydrates towards grass regrowth instead of alkaloid production.
    a. Greater concentrations of ergopeptine alkaloids are in the leaf sheaths (the part of the leaf that wraps around the stem) than in the leaf blades (the broad, flat leaf part). By adopting practices that maximize consumption of leaf blades, such as intensive grazing, the potential is there to reduce alkaloid consumption. However, it is important not to graze lower than three to four inches. Not only will this reduce alkaloid consumption from the base of the tiller, but it will also enhance regrowth.
    b. Careful attention to soil testing recommendations for fertilization and good weed control are necessary to sustain the stand when tall fescue is intensively grazed, or it will not persist.
3. **Remove seedheads.** Seedheads are readily grazed by cattle and should be regularly mowed, or they may be controlled by herbicides that can almost eliminate seedhead formation when applied at the proper time.
    a. Seedheads and stems in underutilized or undergrazed E+ tall fescue pastures are a rich source of ergopeptine alkaloids. Reductions in seed presence can reduce overall toxicity of the forage, since ergovaline concentrations are *three to ten times greater in the seedheads than the leaf blades or sheaths*. Cattle will selectively graze immature seedheads, which are moderately digestible.

b. Grazing E+ tall fescue with seedhead development chemically suppressed with metsulfuron-containing herbicides can markedly reduce alkaloid consumption. Steers had a 39 percent greater ADG, higher serum prolactin levels and lower rectal temperatures grazing chemically treated E+ fescue pasture than steers on untreated fescue.
c. Grazing management will be necessary to accommodate the reduction in forage production when seedheads are chemically suppressed. A fine line must be walked relative to timing and amount of metsulfuron used to avoid drastically stunting forage growth and grazing in pastures. Be aware that forage availability may be reduced by as much as 50 percent due to a reduction in the presence of seeds and stems, greater forage intake, and the direct negative effects of the chemical on vegetative growth.

4. **Avoid ergovaline seasonally.** Offer cattle an alternative forage source to avoid periods of high ergovaline concentrations in E+ tall fescue.
   a. Move cattle to warm-season grass pastures during the late spring and early summer, especially when seedheads are present. This management technique provides grazing during active growth of the warm-season grasses when there is a decline in tall fescue growth. Agronomists also use the term "summer slump" to describe this decline in cool-season grass growth associated with increased summer heat. This decline in grass growth coincides with the decline in cattle's forage intake as core body temperatures increase.
   b. Feed hay in the fall while "stockpiling" fescue (ideally non-fescue hay). Stockpiling is simply removing cattle from a pasture in the late summer or early fall to allow forage to accumulate for high-quality late-fall and early-winter grazing. Delay grazing stockpiled fescue until ergovaline concentrations in the plant drop to safe levels after one or two hard freezes (less than 25ºF) in the late fall. These levels typically stay low until early to mid-April in Kentucky.
5. **Improve overall diet.** Interseed legumes and other cool- and warm-season grasses into E+ tall fescue pastures and supplement with grain or coproduct feeds to improve the overall diet of the animal.
   a. This management approach can benefit animal performance mainly through better diet quality and dilution of ergopeptine alkaloids. Providing pasture with a diverse mixture of forage species will reduce the impact of the alkaloids, as animals will selectively graze other forages.
   b. Interseeding legumes such as *Trifolium pratense* (red clover) that contain isoflavones, which are natural compounds that actively help reverse vascular constriction, will help mitigate fescue toxicosis as well as improve forage quality. Please see the University of Kentucky fact sheet *Frost Seeding Clover: A Recipe for Success,* available online at http://www2.ca.uky.edu/agcomm/pubs/AGR/AGR271/AGR271.pdf.
6. **Provide minerals.** It is essential to provide a complete mineral mix to ensure adequate intake of the trace elements, especially copper and selenium. The UK publication *Minerals Matter for Beef Cattle* (ASC-258), available online at https://publications.ca.uky.edu/sites/publications.ca.uky.edu/files/ASC258.pdf, explores the importance of minerals for supporting growth, reproduction, lactation, and health.

Summary

Fescue toxicosis occurs due to ergopeptine alkaloids of fungal origin within toxigenic E+ tall fescue plants. The most common and economically damaging manifestation of fescue toxicosis in cattle is summer slump, a syndrome resulting in decreased grazing time and decreased liveweight gain. It can be recognized by lower calf weaning weights, lower ADG, and poor reproductive performance. The diagnosis of ergopeptine alkaloid-associated problems in cattle is based on clinical signs as well as knowledge of the geographical area, weather conditions, and feed and forage alkaloid testing. There are two major options for testing tall fescue: one option is to determine the percentage of plants infected with the fungal endophyte and the other option is to determine the level of ergovaline in pasture plants. Each test provides different but useful information. Tall fescue management strategies include replanting E+ pastures with varieties infected with novel endophyte or endophyte-free seed; diluting infected pastures with other grass types or legumes; intensively grazing E+ tall fescue to reduce ergovaline production; using warm-season grass pastures in late spring and early summer as the main forage source; and grazing stockpiled tall fescue in the winter months.

Note: all UK Extension publications linked in this publication may also be found online at https://publications.ca.uky.edu.

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