FORAGE MANAGEMENT AND GRAZING STRATEGIES TO MINIMIZE FESCUE TOXICOSIS*

Don Ball, Auburn University

Introduction

Tall fescue is native to Europe, but became popular in the United States after the release of the variety 'Kentucky 31' in 1943 (Buckner et al., 1979). This versatile cool season perennial grass has many attributes including wide adaptation, easy establishment, a long growing season, good forage and seed yield, and tolerance of a wide range of management conditions (Ball et al., 2002). Consequently "fescue" has been widely planted for forage, turf, and conservation purposes, and is now the most widely grown introduced grass in the USA.

Through the years, disorders of grazing animals have been associated with fescue (Ball et al., 2002; Schmidt and Osborn, 1993; Stuedemann and Hoveland, 1988). Fescue foot is a dry, gangrenous condition of the body extremities of cattle. This problem, which is usually associated with cold weather, typically causes lameness and/or the loss of the tips of tails or ears, but in some cases may result in sloughing of entire hooves or feet.

Bovine fat necrosis is a condition in which masses of hard fat are deposited in the abdominal cavities of cattle. This disorder can cause digestive or calving problems, and usually occurs in areas in which fescue pastures have received heavy amounts of nitrogen, especially from poultry litter. Fescue foot and bovine fat necrosis can be a serious problem for an individual producer, but occur relatively infrequently.

Fescue toxicosis (also referred to as fescue toxicity, summer syndrome, or summer slump) is a widespread problem. Symptoms include reduced feed intake, decreased weight gain, lower milk production, higher respiration rate, elevated body temperature, rough hair coat, more time spent in water and/or shade, less time spent grazing, low blood serum prolactin level, excessive salivation, and lower reproductive performance (Ball et al., 2003). Some or all of these responses have been observed with various species of ruminant livestock consuming pasture, greenchop, hay, and/or seed of fescue.

In addition, horses consuming fescue forage often have reproductive problems that include abortions, prolonged pregnancy, foaling problems, and agalactia (little or no milk production). In 1993, fescue toxicosis was estimated to cost beef producers at least $600 million per year (Hoveland, 1993). For many years after the release of Kentucky 31, the cause of these disorders remained a mystery.

---

*Prepared by Dr. Don Ball (Extension Agronomist/Professor, Department of Agronomy & Soils, Auburn University, AL 36849) for use at the Cattlemen's College held during the National Cattlemen's Beef Association meeting in Nashville, TN, January 31, 2007.

It was less than 30 years ago that an endophyte (internal fungus) was linked with fescue toxicosis (Hoveland et al., 1980). The endophyte was first identified as *Epichloe typhina*, then renamed *Acremonium coenophialum*, and finally, *Neotyphodium coenophialum*. The fungus is exclusively seed transmitted and its presence can only be detected through a laboratory analysis. Toxins produced by the fungus (believed to be ergot alkaloids) are responsible for the disorders previously mentioned. Unfortunately, most Kentucky 31 fescue has a high level of fungus infection (Shelby and Dalrymple, 1987), indicating that animal production on most fescue pastures in the USA is substantially lower than it could be. Since the role of the fungus in fescue toxicosis became clear, a great deal of research has addressed this problem. Several ways to reduce economic losses caused by the fescue endophyte have been identified.

Avoidance of the Endophyte: There are some situations in which a livestock producer can reduce or avoid some or all of the problems that would otherwise result from the presence of fescue infected with toxic endophyte. The classic example of this occurs with horses. The foaling and other reproductive problems of horses result mainly from mares grazing toxic fescue during late pregnancy (Schmidt and Osborn, 1993). Thus, simply removing a pregnant mare from toxic fescue for the last three months of pregnancy avoids the problem.

With other animal species avoidance is a less useful strategy, but may have some application. For example, consumption of even low levels of endophyte toxins sharply reduces milk production of cattle. Therefore, a dairyman might opt to allow only non-lactating animals to graze a pasture containing toxic fescue. Another example of endophyte avoidance could be a beef producer who pastures beef cows on toxic infected fescue but excludes yearlings because of greater economic impact of ingestion of endophyte toxins. Also, the adverse reaction of grazing animals to the endophyte is greatest during warm weather. Hence, in some situations the timing of grazing of toxic fescue, especially by animals known to be especially sensitive to endophyte toxins, may be an important consideration.

Use of Endophyte-free Tall Fescue: Endophyte infection is not genetically controlled, and thus is not a true varietal trait. However, since the early 1980's, endophyte-free seed of a number of fescue varieties has been commercially available. Endophyte-free fescue does not contain endophyte-produced toxins, and therefore, does not cause any of the livestock disorders associated with the tall fescue endophyte. Animal performance in terms of gain/animal is thus strikingly better (sometimes almost twice as good) as on toxic, endophyte-infected fescue.

It is now known that endophyte-free fescue also does not contain certain endophyte-produced compounds (believed to be non-ergot alkaloids) that are important in stress tolerance and pest resistance in fescue plants (Pederson et al., 1990). Consequently, endophyte-free fescue stands tend to be much less persistent than endophyte-infected stands, especially in climates and soils that are marginal for growing tall fescue, such as in much of the Southeast. As a result, sales of endophyte-free fescue seed are quite limited in such areas, even though persistence can be favored by planting endophyte-free on soils with good moisture-holding capacity, use of rotational stocking, and avoiding grazing during summer.

Dilution of Endophyte Toxins: The quantity of endophyte toxins consumed by animals is directly correlated with the amount of toxic fescue consumed. Therefore, any management technique that reduces the quantity of toxic fescue in an animal's diet will reduce fescue toxicosis. Management of toxic fescue pastures to favor other grasses such as Kentucky bluegrass (*Poa pratensis*), orchardgrass (Dactylis *glomerata* L.), or bermudagrass (Cynodon *dactylon* [L] Pers.) can have the result of diluting the fescue toxins in animal diets. For example, close grazing during spring will reduce shade competition by fescue for lower-growing plants, and summer application of nitrogen will encourage bermudagrass and crabgrass *(Digitaria* spp.).

Planting legumes such as clovers, alfalfa or annual lespedeza in toxic fescue pastures is often a feasible, effective, and relatively inexpensive way to dilute fungus toxins in animal diets (Ball et al., 2002, Hoveland et al., 1981). For most producers this is not a long term solution to the problem, but it can significantly improve animal performance in the short term, especially in beef cow-calf operations.

Close Grazing or Clipping: Keeping toxic endophyte-infected pastures grazed closely has been shown to improve animal performance as compared to allowing forage to accumulate (Bransby et al., 1988). Furthermore, close grazing or mowing of seedheads in toxic fescue pastures during spring and early summer may reduce subsequent toxin intake by reducing the ability of animals to selectively graze seedheads in which endophyte growth (and associated toxins) tends to be greater than in other plant parts.

Nitrogen Fertilization: Increasing the level of nitrogen fertilization of fescue has been shown to increase ergot alkaloid production (Rottinghaus, et al., 1991). Therefore, a strategy for minimizing toxin intake is to avoid applying high rates of nitrogen fertilizer to fescue pastures. Lower levels of nitrogen also make fescue less competitive, thus making it more likely that volunteer species (including legumes) may be present that help dilute toxin intake by grazing animals.

Novel Endophytes: Research has led to identification of endophyte strains that do not produce the toxins that cause animal disorders but that do impart pest resistance and stress tolerance to fescue plants (Bouton et al., 2002). These fungus strains, referred to by scientists as "novel endophytes," produce the desirable alkaloids but not the undesirable ones. Novel or non-toxic endophyte strains have been inserted into a few fescue varieties, some of which are now commercially available.

Grazing trials with lambs, beef steers, beef cows, and horses have shown excellent performance on novel endophyte fescue pastures, similar to that on endophyte-free fescue. A novel endophyte can also give the tall fescue plant enhanced vigor, pest resistance, and tolerance to drought and grazing similar to that of toxic endophyte fescue. Thus, novel endophyte fescue offers the potential for long-lasting pastures and high animal productivity. However, different endophyte strains have different characteristics just as do different varieties of fescue. Therefore, a substantial amount of field-testing will be required to determine the suitability of any particular fungus/variety combination for a given geographical area.

Conclusion: Tall fescue is a widely grown and important forage grass in the USA, but fescue toxicosis is a costly disorder that often occurs in animals grazing it. In the 28 or so years that it has been known that this problem is caused by an endophytic fungus, much research has been conducted by scientists at many locations. Though economic losses associated with the fescue endophyte are still large, they have been significantly reduced by management strategies that have been developed as a result of this research.

Literature Cited

Ball, D.M., C.S., Hoveland, and G.D. Lacefield. 2002 Southern Forages. 3rd ed., Potash and Phosphate Institute and Foundation for Agronomic Research, Norcross, GA.

Ball, D.M., S.P. Schmidt, G.D. Lacefield, C.S. Hoveland, and W.C. Young, III. 2003. Tall fescue/endophyte concepts. Oregon Tall Fescue Commission Special Publication 1-03, Salem OR.

Bouton, J.H., G.C.M.Latch, N.S. Hill, C.S. Hoveland, M.A. McCann, R.H. Watson, J.A. Parish, L.L. Hawkins, and F.N. Thompson. 2002. Reinfection of tall fescue cultivars with non-ergot alkaloid-producing endophytes. Agron. J. 94:567-574.

Bransby, D.I., S.P. Schmidt, W. Griffey, and J.T. Eason. 1988. Heavy grazing is best for infected fescue. Highlights of Agricultural Research. Ala. Agr. Exp. Stn., Vol. 35, No. 4.

Buckner, R.C., J.B. Powell, and R.V. Frakes. 1979. Historical development. P. 1-6 *in* R.C. Buckner and L.P. Bush, (eds.) Tall Fescue, Agronomy Monograph No. 20, American Society of Agronomy, Madison, WI.

Hoveland, C.S. 1993. Importance and economic significance of Acremonium endophyte to performance of animals and grass plant. 3-12 *in* Agriculture, Ecosystem and Environment Special Issue: Acremonium/Grass Interactions, R. Joost and S. Quisenberry (eds.) Elsevier Science Publishers, Amsterdam, Netherlands.

Hoveland, C.S., R.L. Haaland, C.C. King, Jr., W.B. Anthony, E.M. Clark, J.A. McGuire, L.A. Smith, H.W. Grimes, and J.L. Holliman. 1980. Association of Epichloe typhina fungus and steer performance on tall fescue pasture. Agron. J. 72:1064-1065.

Hoveland, C.S., R.R. Harris, E.E. Thomas, E.M. Clark, J.A. McGuire, J.E. Eason, and M.E. Ruf. 1981. Tall Fescue with ladino clover or birdsfoot trefoil as pasture for steers in Northern Alabama. Ala. Agr. Exp. Sta. Bull. 530.

Pedersen, J.F., G.D. Lacefield, and D.M. Ball. 1990. A review of the agronomic characteristics of endophyte free and endophyte-infected tall fescue. Appl. Agric. Res. 3:188-194.

Rottinghaus, G.E., Garner, G.B., Cornell, C.N., and Ellis, J.L. 1991. HPLC method for Quantitating ergovaline in endophyte-infested tall fescue: seasonal variation of ergovaline levels in stems with leaf sheaths, leaf blades, and seed heads. J. Agric. Food Chem. 39:112-115.

Schmidt, S.P., and T.G. Osborn. 1993. Effects of endophyte-infected tall fescue on animal performance. Agric. Ecosyst. Environ. 44:233-262.

Shelby, R.A. and L.W. Dalrymple. 1987. Incidence and distribution of the tall fescue endophyte in the United States. Plant Dis. 71:783-786.

Stuedemann, J.A. and C.S. Hoveland. 1988. Fescue endophyte: history and impact on animal agriculture. J. Prod. Agric. 1:39-44.