Endophyte-Free Tall Fescue Improves Cattle Production

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Summary

A fungal endophyte was discovered infecting over 95% of tall fescue swards in the U.S. and also in European swards. This asymptomatic intercellular parasite appears to be transmitted only vertically, through infected seed. The fungus is associated with decreased animal performance. Specific toxin(s) produced by the fungus or by the fescue plant in response to the fungus has not been identified. Signs of toxicosis in cattle include increased body temperature, harsh hair coat, reduced serum prolactin, impaired reproduction, decreased rate of gain and/or milk production. Upon removal of cattle from toxic fescue to feedlots, performance is impaired 6 weeks or more. Replacement of infected fescue swards with new endophyte-free varieties greatly improves animal performance.

History of Tall Fescue

Tall fescue *(Festuca arundinacea)* was first described and named by the German botanist Schreber in 1771. Schreber described tall fescue as being "more robust" than meadow fescue. Europeans have generally regarded tall fescue as too coarse and unpalatable to be a first class pasture grass (1). When tall fescue was introduced to the United States is not recorded. Records indicate small plot evaluations of the species early in this century. In 1931, Dr. E. N. Fergus, a University of Kentucky agronomist, collected seed from a sward of tall fescue on a steep hillside in eastern Kentucky. Evaluation of this ecotype led to the release, in 1942, of the variety, Kentucky 31. Eventually, Kentucky 31 tall fescue became one of the most widely grown and important pasture forages in the United States. It is now the primary ground cover on approximately 14 million hectares (2).

Tall fescue is a high-yield, persistent, cool-season grass, adapted to a wide range of soil and climatic conditions. It is a near perfect plant for soil conservation, responds well to nitrogen fertilization and has a chemical composition similar to other forage grasses. Performance of cattle consuming tall fescue as pasture, hay or silage has been inconsistent, and generally below predictions based on forage analysis. Some of this deficit has been related to reduced intake and attributed to poor palatability. However, this has never provided a fully acceptable explanation for the ofttimes disappointing animal performance.

Paper presented at the 14th World Congress on Cattle Diseases, Dublin, Ireland, August, 1986.

Fescue Toxicity

Fescue toxicity in cattle includes three distinct entities; fescue foot, fat necrosis and summer syndrome. The predominant feature of fescue foot is vasoconstriction manifested by lameness and sloughing of extremities; rear claws or feet, tail switch, and tips of ears. It is most prevalent in cattle grazing tall fescue in winter, following a dry summer and a cool, dry autumn (3). High levels of ergovaline have been found to be present in swards when fescue foot has occurred (4). Fat necrosis has been reported mostly in cattle that have grazed tall fescue fertilized with poultry manure. Indurated fatty tumors develop mostly in the abdomen, and can usually be palpated per rectum. Summer syndrome denotes decreased productivity by cattle ingesting tall fescue, especially notable during hot, humid weather. Signs include reduced feed intake, decreased rate of gain and/or milk production, rough hair coat, increased respiratory rate and body temperature and general unthriftiness.

The Endophyte Fungus

Bacon et al., in 1977 reported the presence of an endophytic fungus, *Epichloe typhina* (later renamed *Acremonium coenophialum*), in tall fescue (5). The endophyte affects neither growth nor outward appearance of the grass and cannot be detected macroscopically. *A. coenophialum* is present in more than 95% of tall fescue swards and is apparently a parasite of several grasses. Signs of choke disease are caused by *A. coenophialum* in bent grass, prairie wedge grass and orchardgrass. Intercellular, systemic infections without signs occur in tall fescue and perennial ryegrass. In New Zealand, the endophyte has been known since 1941 (6) and, in perennial ryegrass, has been reported to cause ryegrass staggers in sheep. The endophyte appears to be transmitted only vertically, through infected seed. A toxin produced by the fungus or by the plant in response to the fungus has not been proven. Several ergopeptide alkaloids were identified in toxic fescue by Yates, et al. Ergovaline was the most abundant and no ergotamine was detected (4).

Animal Performance

Cattle consuming high-endophyte-infected fescue, compared to low-endophyte-infected fescue, in controlled studies, have demonstrated decrease in 1) feed intake, 2) weight gains, 3) milk yield, 4) animal production per hectare,

5) calving rate, and 6) serum prolactin. They have exhibited increases in 1) respiration rate, 2) body temperature, 3) harshness of hair coat, 4) water consumption, 5) time spent in shade, 6) salivation, 7) urine output, and 8) nervousness. Hot, humid weather exacerbated the effects. Fescue seed, hay, soilage, silage and pasture were all toxic. When comparisons were made between swards with differing proportions of plants infected, there was an apparent near straight-line effect on animal performance. Cattle were adversely affected by plant infection rates as low as 10%.

Growing Cattle

In a representative trial, beef steers grazing high-endophyte fescue pasture versus low-endophyte, responded with an average increase in body temperature of 0.8°C, a decreased averaged daily gain of .33 kg and a decreased gain per hectare for the season of 108 kg (7). Available data suggest that with growing animals, for every 10% increase in plants infected, there is a reduction in daily gain of about .045 kg. Steers removed from high-endophyte fescue pasture and comingled in a feedlot with steers removed from low-endophyte fescue pasture required more than 6 weeks for body temperature, respiration rate and serum prolactin to equalize (8). Feedlot veterinarians in the Panhandle region of the U.S. Southwest have circumstantially diagnosed fescue toxicosis as a contributor to heat stress in cattle upon arrival in hot weather from having grazed endophyte-infected fescue. As environmental temperature increased, cattle exhibited open-mouthed breathing, salivation and gathering around water sources. Mortality reached 10% in some groups. Deaths ceased in 3 to 5 days but cattle remained extra-sensitive to heat for 2 to 4 weeks. Reduced gain and feed conversion for survivors were estimated at 5-10% for the full feeding period.

Breeding Beef Cattle

Pregnancy rates in beef cows grazing low-endophyte and high-endophyte fescue were 89.9% and 63.8% respectively (10). When beef heifers grazed tall fescue with 6 different levels of infection, ranging from less than 5% to greater than 88%, pregnancy rates ranged from 100% downward to 55 percent (11).

Lactating Dairy Cows

Holstein cows fed high-endophyte fescue soilage, in 2 trials, consumed 32 and 22% less dry matter, produced 37 and 21% less milk, and lost weight rather than gained, compared to cows fed low-endophyte fescue (12, 13). Decreased performance of dairy cows consuming endophyte-infected tall fescue, even at a relatively low level, was evident.

New Varieties of Tall Fescue

New varieties of tall fescue have recently been developed. The primary advantage has been freedom from infection with *A. coenophialum*. Kenhy, Missouri 96 and Kentucky 31 were evaluated at the same grazing pasture for 2 years. Gains of heifers grazing Kenhy and Missouri 96 were 44% greater than on infected Kentucky 31 (14). The Johnstone variety is characterized as having low levels of perloline alkaloid, improved forage quality during the summer and near freedom from the endophyte. Mozark is a 4-clone endophyte-free variety selected for increased vigor after defoliation, high seed and forage yield, and resistance to crown rust. Martin, a 2-clone endophyte-free variety, was released for high seed and forage yield plus high magnesium content. Au-Triumph was developed from a Mediterranean cultivar for adaptation to the southern part of the U.S. fescue belt.

To Replace a Sward or Not

Replacing a high-endophyte fescue sward with a new variety can greatly improve animal performance. A new variety that is simply "endophyte-free" will be of little value, however, if it is not adapted, does not produce well, or is susceptible to disease or insect pests. When considering a new variety, attention should be given to adaptability, agronomic and animal performance, insect and disease resistance, and persistence. Negative effects on animal performance associated with the endophyte can be diluted and compensated substantially by legumes in the infected sward. Growth, grazing and harvest of endophyte-infected fescue can also be managed to minimize adverse effects on the animals. Level of infection should be determined before deciding to replace an old stand of fescue. Most U.S. states where fescue is grown now have laboratories which will determine presence or absence of the endophyte in seeds and plants. Accurate, representative sampling of a sward is important for valid assessment of the infection rate.

How to Replace an Existing Sward

An infected field to be replanted should not be allowed to go to seed during the re-establishment year. Seedhead formation can be prevented by heavy grazing, clipping or by application of chemicals. Preventing seed formation will insure that any seed remaining in the soil will be over one year old at time of the new seeding. The endophyte eventually dies in seed, usually within one year. Therefore, most volunteer plants would be endophyte-free. On steep land, where crop rotation and a prepared seedbed are not feasible because of erosion hazard, chemical kill of infected stands, followed by direct drilling, is a viable alternative. Satisfactory results have been achieved in Kentucky trials using either Roundup or a split application of Paraquat to kill the existing plants. Best results in Kentucky were with September seedings; poorest were with spring seedings. Chemical kill was satisfactory in spring, but war-season annuals crowded out the new fescue seedlings.

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