



Tall Fescue/Endophyte/Animal Relationships



TALL FESCUE/ ENDOPHYTE/ ANIMAL RELATIONSHIPS

Tall fescue (*Festuca arundinacea* Schreb.) is a versatile perennial grass used for livestock feed, various turf purposes and for erosion control. Commonly referred to simply as "fescue," it is easy to establish, tolerant of a wide range of management regimens and a good forage yielder. Laboratory nutritive analyses of fescue compare favorably to those of other cool-season grasses.

Fescue was first planted on a widespread basis in the USA in the 1940's, and now occupies some 35 million acres. Since the discovery in the late 1970's that an endophyte (fungus) within this grass affects both grazing animals and the grass itself, attitudes toward fescue have changed greatly. This publication provides a review of current knowledge of the effects of endophyte infected (EI), as compared to endophytefree (EF) Fescue and explains options livestock producers have for using this important grass.



LIVESTOCK DISORDERS

Fescue has numerous attributes, but three livestock disorders have come to be associated with it. A brief description of these problems is helpful in understanding the importance of fescue endophyte research.

Fescue Foot

"Fescue foot" is a dry, gangrenous condition of the extremities of the bodies of cattle consuming fescue. Usually it causes lameness or the loss of the tips of tails or ears, but may result in sloughing of hooves or feet. Animal gains also are reduced. Fescue foot is generally associated with cold weather.

Bovine Fat Necrosis

Bovine fat necrosis is characterized by the presence of masses of hard fat in the abdominal cavities of cattle. This fat can cause digestive or calving problems, but is

likely to occur only where pastures are essentially pure fescue and have been heavily fertilized with poultry liver or nitrogen fertilizer.

Fescue Toxicity

The signs of fescue toxicity include: (1) reduced feed intake; (2) lower weight gains; (3) decreased milk production; (4) higher respiration rates; (5) elevated body temperature; (6) rough hair coats; (7) more time spent in water and/or shade; (8) less time spent grazing; (9) excessive salivation; (10) excessive blood serum prolactin levels; and (11) reduced reproductive performance. Some or all of these responses have been observed with dairy cattle, beef cattle and sheep consuming EI pasture, greenchop, hay and/or seed. Fescue foot and bovine fat

Table 1. Percentage of time steers grazed during daylight or dark hours.

	Endophyte	
	Low	High
Daylight	52	34
Dark	14	22

Bond, J., J.B. Powell and B.T. Weinland. 1984. Behavior of steers grazing several varieties of tall fescue during summer conditions. *Agron. J.*76:707

necrosis can be important to individual producers, but are of relatively little consequence on a nationwide basis. However, fescue toxicity is of widespread occurrence and of much economic importance.

Horse Disorders

Reproductive difficulties of mares grazing fescue have been widely recognized. They include: abortions, prolonged pregnancy, foaling problems which can result in foal and/or mare deaths, thick or retained placentas and agalactia (poor milk production).

ENDOPHYTE DISCOVERY

It is remarkable that a detrimental agent could have been undetected for so long in such a widely grown forage species, but the fungal endophyte *Acremonium coenophialum* was not associated with animal disorders until the late 1970's. Since then our understanding of the

potentials of fescue in livestock production has increased greatly.

Two characteristics of the endophyte have real practical importance. First, the **fungus lives within fescue plants and does not affect the appearance of the grass.** A laboratory analysis is required to detect its presence. Secondly, **it is transmitted only by seed.** Thus, once an EF stand is established, it will remain non-infected unless infected seed (either present before seeding EI Fescue or introduced later) germinate and become established.

ENDOPHYTE EFFECTS ON ANIMALS

Grazing Time

Several studies have shown that animals on EI pastures spend less time grazing during the day and more time grazing at night. In Maryland, grazing time was reduced by approximately 20% as compared to steers grazing EF fescue. (Table 1).

In a Georgia study in which steers were switched from EI (>95% infected) to EF (<1% infected) fescue steers on EF fescue spent 60% of the time between noon and 6:00 p.m. grazing, as compared to only 4 to 6% by steers on EI fescue. Steers switched to EI fescue showed a reduction in grazing time within two days, and intake for this group was depressed within one week. Forage intake for the group switched to EF fescue remained lower for at least 10 days following the switch, but was normal after 28 days. However, grazing time for those switched to EF was still reduced one month later.

Intake and Digestibility

Both on-farm observations and research have provided evidence that cattle prefer EF fescue. In Tennessee, steers had a preference for clover in EI pastures, but there were indications that they preferred fescue to clover in EF pastures. When heifers in Missouri were offered diets containing 60% fescue seed, either EF or 75% EI, 11 of 12 heifers avoided the EI diets. Much, but not all, of the reduction in livestock average daily gain (ADG) or gain per unit area of land on EI fescue is due to reduced intake.

Normally, physical factors such as high fiber content are associated with poor intake, but they do not explain intake differences between EI and EF fescue. Further, the toxicants do not appear to have a major effect on ruminal microbial digestion.

Digestibility and crude protein content are small in EI and EF fescue.

EFFECTS ON BEEF YEARLING GAINS

Since the early reports of the association of the endophyte with fescue toxicosis, many grazing and feeding trials with EI and EF fescue have been conducted. A summary of data (Table 2,) illustrate, that decreased gains of steers grazing EI forage are widespread, quite uniform and not limited to certain geographic areas or management conditions.

Fescue toxicosis is commonly referred to us "summer syndrome" or "summer slump" because visible signs are most pronounced during hot weather. However, poor weight gains on EI pastures can occur throughout the grazing season (Table 3, Page 4). During November, December and March there was a 50% decrease in ADG of steers grazing EI fescue, as compared to EF fescue. During the warmer months of April, May and June, the decrease was 59%.

Though air temperature, humidity, presence of other forages and animal management are known to have an influence, steer ADG has been shown to decrease approximately 0.1 lb for each

EFFECTS ON BEEF COWS AND CALVES

Most of the fescue in the United States is used in commercial beef cow-calf operations. In several studies (Table 4, Page 5), cows grazing EI fescue lost weight and had lower pregnancy rates, and their nursing calves had slower gain, and reduced weaning weights compared to those grazing EF pastures.

It is known that a decline in body condition can affect reproduction, and cows that are thin before and at calving have a long interval between calving and first estrus. Therefore, cows entering the breeding season in a poor or negative gaining condition because of EI fescue probably will have a prolonged post-partum interval regardless of late, endophyte effects.

In Kentucky and Missouri, supplementary feed (in the form of either, clover or grain) for cattle on EI fescue improved pregnancy rates, but not up to economically acceptable levels. Thus, it appears that factors other than nutrition are involved in the reduced pregnancy rates associated

with EI fescue.

EFFECTS ON BEEF HEIFERS

In an Alabama study, weaned beef heifers were assigned to pastures having low, medium or high levels of infection (Table 5, Page 6), and received hay of similar

Table 2. Daily gains of steers as affected by low or high incidence of endophyte infection.

Location	Endophyte		Daily gain		Feed	Reference
	Low E	High E	Low E	High E		
	%	%	lb/Day	lb/Day		
Alabama	2	>90	1.83	.99	Pasture	Hoveland et al , 1983
Alabama	0	>90	1.46	.62	Hay	Schmidt et al.,1982
Alabama	0	100	2.12	.44	Seed	Schmidt et al , 1982
Arkansas	0	81	1.57	1.21	Pasture	Goetsch et al., 1988
Georgia	0	76	1.30	.99	Pasture	Stuedemann et al., 1986
Kentucky	<1	87	1.54	.99	Pasture	Boling et al, 1885
Mississippi	NR ²	NR	1.50	1.01	Pasture	Evans et al., 1989
Missouri	3	83	1.37	.46	Pasture	Crawford et al., 1989
Oklahoma	<1	76	1.87	1.37	Pasture	McMurphy et al., 1990
Tennessee	2	71	1.48	1.06	Pasture	Chestnut et al., (In press)
Texas	8	91	2.14	1.01	Pasture	Read and Camp, 1986
Virginia	0	77	1.43	.90	Pasture	Tulley et al., 1989

¹Number of informed tillers per 100 tillers

²Not reported.

Boling, J.A. 1985. Endophytic fungus and tall fescue utilization by ruminants. Prof. Anim. Sci. 1:29.
 Chestnut, A.B., H.A. Fribourg, J.B. McClaren, D.G. Keitner, B.B. Reddick, R.J. Carlisle and M.C. Smith 1991. Effects of *Acremonium coenophialum* infestation, bermuda grass and nitrogen or clover on steers grazing tall fescue pastures. J. Prod. Agric. 4:208
 Crawford, R.J., J.R. Forwood, R.L. Belyea and G.B. Garner. 1989. Relationship between level of endophyte infection and cattle gains on tall fescue. J. Prod. agric. 2:147.
 Evans, R.R., R.L. Ivy, A.W. Groce and W. Cox. 1989. Selenium supplementation for steers of fungus free and fungus infested fescue pastures. (Preliminary report.) Proc. Tall Fescue Toxicosis Workshop, Nov. 13-14, Atlanta GA.
 Goetsch, A.L., K.L. Landis, G.E. Murphy, B.L. Morrison, Z.B. Johnson, E.L. Piper, A.C. Hardin and K.L. Hall. 1988. Supplements, parasite treatments and growth implants for Brahman or English crossbred steers grazing endophyte-infected or non infected fescue in the spring and fall. Prof. Anim. Sci. 4:32
 Hoveland, C.S., Schmidt, C.C. King, J.W. Odem, E.M. Clark, J.A. McGuire, L.A. Smith, H.W. Grimes and J.L. Hollman. 1983. Steer performance and association of *Acremonium coenophialum* fungal endophyte on tall fescue pasture. Agron. J. 75:821.
 McMurphy, W.E., K.S. Lusby, S.C. Smith, S.H. Muntz and S.H. Strassie. 1990. Stear performance on tall fescue pasture. J. Prod. Agric. 3:100.
 Read J.C. and B.J. Camp. 1986. the effects of the fungal endophyte *accremonium coenophialum* in tall fescue and animal performance, toxicity and stand maintenance. Agron. J. 78:848.
 Schmidt S.P., C.S. Hoveland, E.M. Clark, N.D. Davis, L.A. Smith, H.W. Grimes and J.L. Hollman. 1982. Association of an endophytic fungus with fescue toxicity in steers fed Kentucky 31 tall fescue seed or hay. J. Anim. sci. 55:1259
 Stuedemann, J.A., B.H. Wilkinson, D.P. Belesky, C.S. Hovelenad, O.J. Devine, F.W. Thompson, H.S. Campbell, W. E. Townsend and H. Ciordia. 1986. Effect of level of fungus and nitrogen fertilization rate of KY-31 tall fescue on steer performance. J. Anim. Sci 63(Suppl. 1):290(Abstr.).
 Tulley J.K., J.P. Fontenot and V.G. Allen. 1989. Influence of endophyte infection in performance of steers grazing tall fescue with and without clover. (Preliminary report). Tall Fescue Toxicosis Workshop, Nov. 13-14, Atlanta GA.

10% increase in infection rate.



Increased nitrogen (N) fertilization increases the incidence of bovine fat necrosis, but investigations have revealed that N fertilization does not affect steer ADG on EI fescue. However, N fertilization of EI fescue can increase gain per acre because of higher stocking rates.

with EI fescue.

EFFECTS ON BEEF HEIFERS

In an Alabama study, weaned beef heifers were assigned to pastures having low, medium or high levels of infection (Table 5, Page 6), and received hay of similar

infection levels during winter. Heifer ADG decreased as infection level increased. However, the later ADG of cattle led hay was the opposite, with the high infection group having the fastest gains. All heifers were observed in estrus prior to their first breeding, but pregnancy rates decreased as infection level increased. Following first calf births, pregnancy rates were further reduced in heifers grazing pastures with medium and high infection level, but not in those grazing low-endophyte pastures. Initiation of the estrus cycle to heifers grazing EI fescue is not delayed, and cessation of the estrus cycle in animals already cycling does not occur. Research in Alabama indicates that conception is not affected by the endophyte. Reduced calving percentages of cattle on EI fescue appear to be due to early embryonic death. Experiments to date have not made clear whether the endophyte affects calf birth weights.

BRAHMAN VS BRITISH BREEDS OF CATTLE

Brahman cattle are known for their heat tolerance and may be better adapted to

resist or tolerate the hyperthermia (high body temperature) observed during hot weather. In breed comparison, Angus and Brahman-Angus cross steers have exhibited decreased gains when grazing EI fescue, but the magnitude of the decrease was less for the Brahman-cross steers. Brahma-cross animals frequently gain better due to greater heterosis, thus reduced endophyte effects, if any, are difficult to detect.

FEEDLOT GAINS OF STEERS THAT PREVIOUSLY GRAZED FESCUE

Because of their unthrifty appearance, steers, that have grazed EI fescue often bring reduced prices, making it important to determine whether there are carryover effect, on feedlot performance. Studies in Georgia, Arkansas, Oklahoma and Tennessee indicate that when steers grazed on EI fescue arrived at a feedlot during cooler weather, they gained faster than steers which had grazed EF fescue, especially during the first 28 days. Steer,

arriving during hot weather did not show increased gains, but their gains were not reduced as a result of previous exposure to EI fescue.

EFFECTS ON MILK PRODUCT ION

Consumption of EI fescue reduced milk production to as much as 45% in beef cows and 50% in beef heifers in Alabama, and by 60% in dairy cows in Kentucky. Milk production of lactating dairy cows can be sharply reduced even when fescue has low infection levels, but EF provides excellent nutrition for lactating animals. Milk production by dairy cow, consuming EF fescue was similar to those grazing alfalfa-orchardgrass in Kentucky, and

and the reduction in numbers of mares lactating, foals surviving and mares surviving (Figures 1 and 2, Pages 6 and 7) provide convincing evidence of the dangers associated with grazing pregnant mares on EI fescue.

A striking difference between horses and cattle is the lack of carryover effects when mares are removed from EI pastures. Test results show that horses respond rapidly to EF fescue and have a rapid turnover of toxicants, allowing them to quickly overcome the negative effects. Conversely, lactating mares moved onto EI fescue will cease lactating within a few days.

Mares removed from EI fescue one month before foaling can often recover from fescue toxicosis and have normal foals. The prevalent recommendation to producers, however, is that mares be removed from EI fescue 60 to 90 days before anticipated foaling. Grain supplementation to mares grazing EI fescue has no benefit with regard to endophyte effects.

EFFECTS ON THERMOGREGULATION

Cattle consuming EI fescue typically exhibit hyperthermia (abnormally high body temperature) as shown by increased rectal temperature. Studies in Kentucky have shown that EI fescue has the most detrimental effect on cattle when the ambient temperature exceeds 88F.

In Alabama, steers were fed non-infected or infected hay and seed in controlled environments at 70F (cool) and 90F (hot). Feed intake was reduced 36% by steers fed the EI diets in the cool environment, but rectal temperatures and respiration rates were not affected. In the hot environment feed intake was reduced 60% in steers fed the EI diet, and rectal temperatures and respiration rates increased.

In the cool environment steers fed the EI diet exhibited reduced temperatures at the extremities (ear tips, tail tip, hooves). This hypothermia (reduced temperature) in animals consuming EI fescue is most likely a result of vasoconstriction caused by the toxicants. The vasoconstriction (constriction of the blood vessels) would decrease the animals ability to dissipate this increased heat load, and is further confounded by high air temperature. Reduced blood flow in the extremities due

Table 3. Seasonal daily gains (lb) of steers grazing infected and non-infected fescue (3 year average)

Months	Endophyte		ADG Decrease
	<5%	>94%	
Nov. Dec Mar	1.59	.79	50%
Apr , May, June	1.72	.71	59%

Hoveland, C.S., S.P. Schmidt, C.C. King, Jr. and E.M. Clark. 1984. Association of fungal endophyte with seasonal gains of beef steers grazing tall fescue pasture. In:H. Riley and A.D. Skelvag (Ed.) Proc. Eur. Fed. p. 382-386.



annual ryegrass in Alabama. Differences in milk production appear to be primarily due to differences in intake.

EFFECTS ON HORSES

Several studies have provided evidence that the fungus is associated with horse reproductive problems. Clemson University scientists found that mares grazing EF pastures produced more live foals, and had less agalactia, fewer retained placentas and greater conception rates than mares on EI fescue. In Kentucky, 40 % of the mares grazing EI fescue, had reproductive abnormalities. In Georgia, prolactin levels in the blood (associated with milk production) were depressed when mares grazed EI, but not EF, fescue.

In a classic study in Auburn University, pregnant mares of various breeds were placed on adjacent EI and EF pastures, where they remained until foaling. The dramatic increase in foaling problems, foal deaths, gestation lengths and foal weights,

to vasoconstriction caused by fungus toxins could also be associated with the fescue foot syndrome.

It now appears that the toxicants in EI fescue result in abnormal function of the thermoregulatory center in many animals. This, coupled with high environmental temperature, could lead to the hyperthermia observed in cattle consuming infected fescue. Increased respiration rates (often evidenced by panting) probably helps animals to cool themselves and dissipate the increased heat load. Excessive salivation, also a sign of fescue toxicosis, may be due to the panting.

ENDO-PHYTE EFFECTS ON PLANTS

Several years ago, scientists in New Zealand found that the Argentine stem weevil would devastate EF, but not EI, perennial ryegrass. This insect is not a pest in the United States, but this knowledge is of concern because the endophytes in the two grasses are closely related.

Greenhouse and environmental chamber work at several locations has shown that several insect species prefer and/or develop more rapidly on EF fescue. Kentucky studies provided evidence that alkaloids in EI fescue are associated with increased resistance to insect feeding. A greenhouse study in Alabama revealed over three times as many spiral nematodes associated with the roots and soil of EF, than of FI, plants.

A difference in vigor has been observed between EI and EF fescue pastures in some environments. This has usually been seen only in new plantings, but in stressful environments in Louisiana and Texas (marginal areas for growing fescue), stand

loss was greater in established EF pastures. EI is also more drought tolerant than EF fescue. Drought tolerance seems to be associated with EI plants having improved osmotic adjustment, greater sugar accumulation, better root growth and more leaf rolling to conserve water.

These findings have important implications. First, while fescue is regarded as a forage crop which is easy to establish, that may be less accurate when the fescue is EF. Thus, when planting EF fescue, a producer should carefully follow all establishment recommendations. **Overgrazing of EF**

separated from infected fields only by a barb wire fence. Despite the need for higher management levels, the opportunities provided by EF fescue are great.

SEED PRODUCTION

The cool-season grasses are well adapted to the mild winters and/or harvest season found in the valley, of the Pacific Northwest. Oregon has thus established a reputation as a dependable supplier of high-quality forage grass seed, and provides that seed for much of the forage production in the U.S.A.

Table 4. Effect of Endophyte-infected fescue on the performance of cows and nursing calves

COWS				CALVES				Ref.
Daily gain	Pregnancy rate	Daily gain	205-day wean wt.	Daily gain	205-day wean wt.	Daily gain	205-day wean wt.	
Low E	High E	Low E	High E	Low E	High E	Low E	High E	
lb./day	---	%	%	lb./day	---	lb.	lb.	
1.01	-.51	--1	--	2.56	1.87	520	434	Schmidt Ed al 83
.46	-.11	95	55	1.72	1.37	474	410	Gay et al., '88
.44	-.15	87	58	1.63	1.30	489	419	Essig of al, '89
.09	-.24	892	74	1.61	1.28	--	--	Tucker et al., '89b
.79	.46	78	49	2.25	1.90	529	461	McDonald 89

¹Not determined or not reported.

²Low E fescue was 21% INF as 77% for High E.

Essig, H.W., C.E. Cantrell, F.T. Withers, Jr., D.H. Laughlin and M.E. Boyd. 1989. Performance and profitability of cow-calf systems grazing on EF end EI KY-31 fescue. (Preliminary report.) Proc. Tall Fescue Toxicosis Workshop, Nov. 13-19, Atlanta, GA

Gay, N., J.A. Boiling, R. Dew and D.E. Miksch. 1988. Effects of endophyte infected tall fescue on beef cow-calf performance. Appl Agric. Res. 3:182.

McDonald, W.T. 1989. Performance of Cows and Calves Grazing Endophyte infested Pastures. M.S. Thesis. University of Tennessee, Knoxville.

Schmidt, S.P., C.C. King, Jr., C.S. Hoveland, E.M. Clark, L.A. Smith, H.W. Grimes and J.L. Holliman. 1983. Cow-calf performance as affected by fungus infestation of Kentucky-31 tall fescue pastures. J. Anim. Sci. 57(Suppl. 1):295(Abstr.).

Tucker, C.A., R.E. Morrow, J.R. Gerrish, C.J. Nelson, G.B. Garner, V.E. Jacobs, W.G. Hires, J.J. Shinkel and J.R. Forwood. 1989. Forage systems for beef cattle: Effects of winter supplementation and forage system on reproductive performance of cows. J. Prod. Agric. 2:217.

The discovery of the role of the endophyte in reducing performance of animals grazing on tall fescue pastures resulted in the Oregon Department of Agriculture being assigned responsibility for testing and issuing the *Oregon Forage Grass Seed Endophyte Test and tag* for forage grass seed.

Results from the Oregon Department of Agriculture on endophyte testing of tall fescue seed from 1983-1989 show over 90% of Oregon's tall fescue contained 5% or less endophyte. Of 2,381 tall fescue



fescue should be avoided, especially during the establishment year. Fields to which EI fescue is only marginally adapted should not be planted to EF fescue.

Experience has shown that if overgrazing, severe drought or other highly stressful conditions occur, EF fescue will not persist as well as, EI fescue. However, EF fescue stands at the Auburn University Black Bell Substation have persisted and remained non-infected for over 15 years though

seed lots tested, representing 111, million pounds of seed, 93% contained 5% or less endophyte-infected seeds. Of the seed lots tested, 1,271 were public cultivars (Alto, Fawn, Kentucky 31 and Kenhy) and 894 lots comprised 40 proprietary cultivars. Lots with 5% or less infection received a state endophyte tag for seed bags

STRATEGIES FOR COPING WITH THE ENDOPHYTE

Livestock producers who have, or who plan to establish fescue fields should

develop an intelligent "endophyte strategy" based on research findings. The following is, a review of options available for avoiding or minimizing endophyte effects.

Establishing New Fescue Stands

When planting a new fescue field for livestock in an area where fescue is well adapted, a livestock producer should use non-infected seed, assuming overgrazing of the EF stand will be avoided.

In a few states, it is required that percent endophyte infection be stated on fescue seed tags. The importance of knowing the level of endophyte infection in seed can hardly be over-emphasized. **The dramatically increased beef production on FF fescue can be expected every year for the life of the stand!**

It is highly desirable to plant a legume companion species with fescue, especially with EI fescue. The optimum approach is to seed tall fescue in late summer/fall, then plant clover in late winter or the following late summer/fall. Legumes may dominate EF fescue if planted at the same time. Kentucky research indicates that clover in a EF stand will further increase young animal gains by 0.2 pounds per animal per day. However, the primary justification for planting a legume with EF fescue is to reduce N fertilizer expense.

White clover, seeded at the rate of 1 to 3 pounds per acre, is the best legume companion in most fescue pastures. However, red clover, at a rate of 10 to 15 pounds per acre broadcast or 8 pounds per acre drilled, is another good possibility, especially when fields are to be cut for hay. Other legumes such as birdsfoot trefoil or alfalfa may also be used.

Dealing With Existing Infected Stands

Producers with established fescue fields need to carefully assess their situation. Exiling fescue stands should be tested for endophyte infection on a field-by field basis. Several states now have laboratories for determining endophyte level. County agricultural agents can provide information regarding cost, sampling methods, and laboratory addresses.

Once the endophyte level in existing

Table 5. Effect of endophyte-infected fescue on gains pregnancy rates and milk yield of heifers¹.

Endophyte level	Initial weight	Daily gains		Pregnant	Post-calving Pregnant	Milk produced
		grazing	winter			
%	lb.	lb./day		%	%	lb./12 hr.
0-5	562	1.65	.18	96	93	8.16
25-60	560	1.26	.35	82	45	7.06
80-99	591	.75	1.19	55	33	3.97

Danielson, D.A., S.P. Schmidt, C.C. King, L.A. Smith and W.B. Webster, 1986. Fescue toxicity and reproductin in beef heifers. j. Anim. Sci 63(Suppl.1):296(Abstr.)
 Schmidt, S.P., D.A. Danielson, J.A. Holliman, H.W. Grimes and W.B. Webster. 1986. Fescue fungus supresses growth and reproduction in replacement beef heifers. Alabama Agric. Exp. Stn. Highlights Agric. Res. 33(4):15

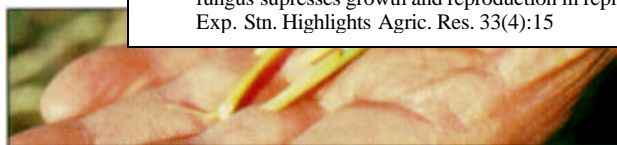
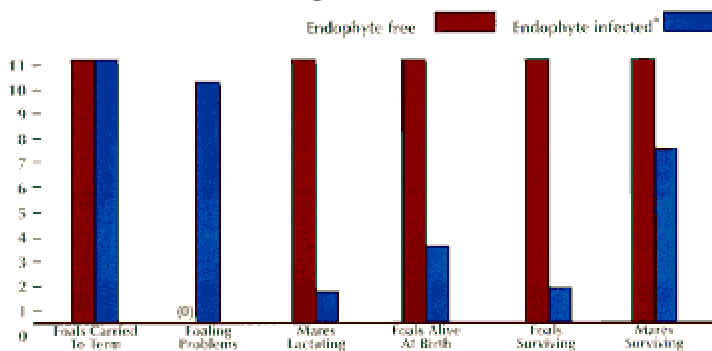


Figure 1. Effects Of The Fungal Endophyte On Pregnant Mares And Foals Grazing Tall Fescue.



*Greater than 80% of plants testing positive for *A. coenophialum* in analyses conducted in the Auburn University Fescue Diagnostic Laboratory.

Source: Putnam, et. al, 1990. The effects of fungal endophyte *Acremonium coenophialum* in fescue on pregnant mares and foal viability. Am. J. Vet. Res. 52:2071.

On average, the gestation period for mares grazing infected fescue was 20 days longer than for those grazing non-infected fescue (Figure 2). Evidence in foals of this longer gestation period was provided by overgrown hooves, poor and irregular incisor eruption, a long hair coat, poor muscling, large skeletal development, and heavier birth weights.

fescue pastures is known, a producer can select the best option for dealing with the problem. The best way to handle one field may not be best for another. Four general approaches are available.

1. Manage to minimize the effect -

Endophyte effects on animals can be minimized with management practices. Grazing and/or clipping management that keep, plants young and vegetative will result in better animal performance. Likewise, if fescue is cut for hay in the boot stage, better annual performance will be obtained than from late-cut hay.

2. Avoid the Endophyte-

Use of other forage species avoids the endophyte. Using EI fescue in spring and use of other grasses or grass-legume mixtures for summer grazing will avoid the endophyte during the summer when fescue forage quality is low. Because annual performance is adversely affected by consuming EI fescue hay, feeding of hay of another species also can be helpful.

3. Dilute the Endophyte-

The endophyte or its products can be diluted through the use of other feeds in the diet. Growing legumes with EI fescue is a particularly attractive option. Many studies have shown greater liveweight gains, and improved (though Sometimes still unacceptable) pregnancy rates when pastures are renovated to include legumes.

4. Kill infected stands and replant

EF seed is now readily available in most areas of the United States where fescue is grown. Careful consideration should be

given to choosing new varieties. A new variety that is simply "endophyte-free" will be of little or no value if it is not well adapted. In view of reduced stress tolerance of EF fescue, the area of

adaptation may be slightly less than for EI fescue, and a higher level of inconvenient establishment and for long-term persistence. University trials are a good source of variety information.

In order to prevent later establishment of volunteer infected plants, any EI field which is to be replanted should not be allowed to produce seed during the reestablishment year. Seedhead formation should be prevented by heavy grazing, clipping or chemical application.

Under usual storage conditions, the endophyte will die in seed within one or two years. Thus, volunteer plants from old seed will usually be EF or have a very low level of infection. Unfortunately the germination level of fescue seed can drop sharply during long term storage, depending on temperature and humidity conditions. Furthermore, the vigor of seedlings resulting from planting old seed is likely to be reduced.

Methods of replacing EI stands Include:

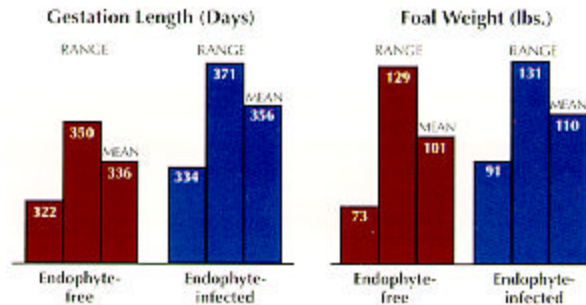
A. Rotation - Rotating with other crops, followed by seeding EF, is an excellent approach. There are many options ranging from no-till corn or a summer annual forage such as pearl millet, to longer term rotations involving a perennial such as alfalfa or two or three annual crops.

B. Prepared Seedbed - Certain situations permit destroying the old sod through tillage, preparing a seedbed, and then replanting EF fescue. However, it is often difficult to completely destroy an old fescue sod by tillage.

C. Chemical Kill No-till - Where methods A and B are not feasible, chemical kill of EI fescue followed by no-tillage planting of EF is the only remaining option. This technique can be used to go directly from EI to EF fescue, or other forage crops can be used in a rotation. It is critical that chemicals be used effectively, thus killing all the existing EI fescue. Furthermore, in

some cases there may be common bermudagrass or other species, which must also be killed, requiring the use of more than one herbicide or a higher herbicide rate. Effective sod kill requires attention to label instructions and striving for optimum environmental plant conditions

Figure 2. Effects OF The Fungal Endophyte On Length Of Gestation And Foal Weight When Mares Grazed Tall Fescue.



Source Putnam, et. al., 1990 the effects of the fungal endophyte *Acremonium coenophialum* in fescue on pregnant mares and foal viability. Am.J. Vet. Res. 52:2071.



that will permit greatest chemical effectiveness. Consult state recommendations on chemicals, rates, restrictions and time of application.

Best result from no-till tests have been found with late summer or early autumn seedings of fescue, except in the northern fescue belt where spring seedings are feasible. Although chemical kill has been satisfactory in spring, summer drought and weed competition often reduce stand, of spring-seeded fescue.

A particularly effective approach is to use no-till plantings of annual forages after killing EI fescue. For example, EI fescue can be chemically killed in the spring and a summer annual grass can be drilled into the killed sod followed by no till planting of EF fescue in the fall. Similarly, fescue can be killed in the fall followed by sod planting of winter annuals and, if desired, sod planting of a summer annual grass the next spring. Use of annual, in this manner "smothers" fescue plants which were not killed, and also reduce, the likelihood of insects in the old fescue sod damaging young fescue seedlings.

Current Outlook

There are many studies in progress which may answer remaining questions relating to the fescue endophyte, and perhaps provide additional solutions. Without question, application of the existing and forthcoming technology relating to this breakthrough will have an immense impact on livestock production in the fescue growing region of the United States, and perhaps in many other parts of the world.

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