MP504

# Research-Based Answers to Frequently Asked Questions on Fescue Toxicity


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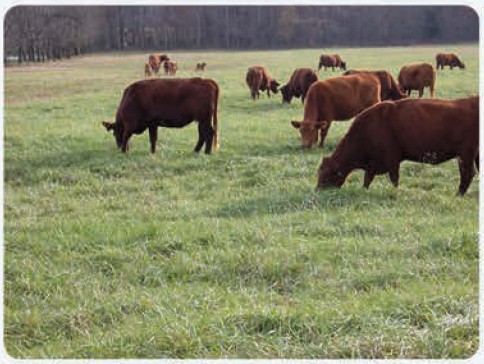

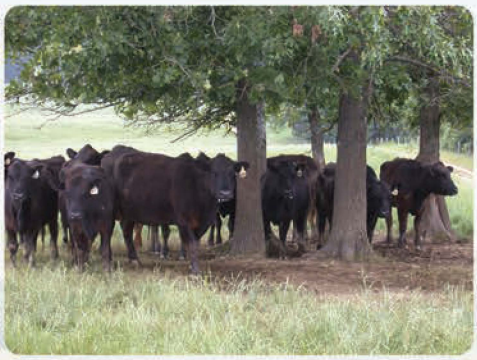

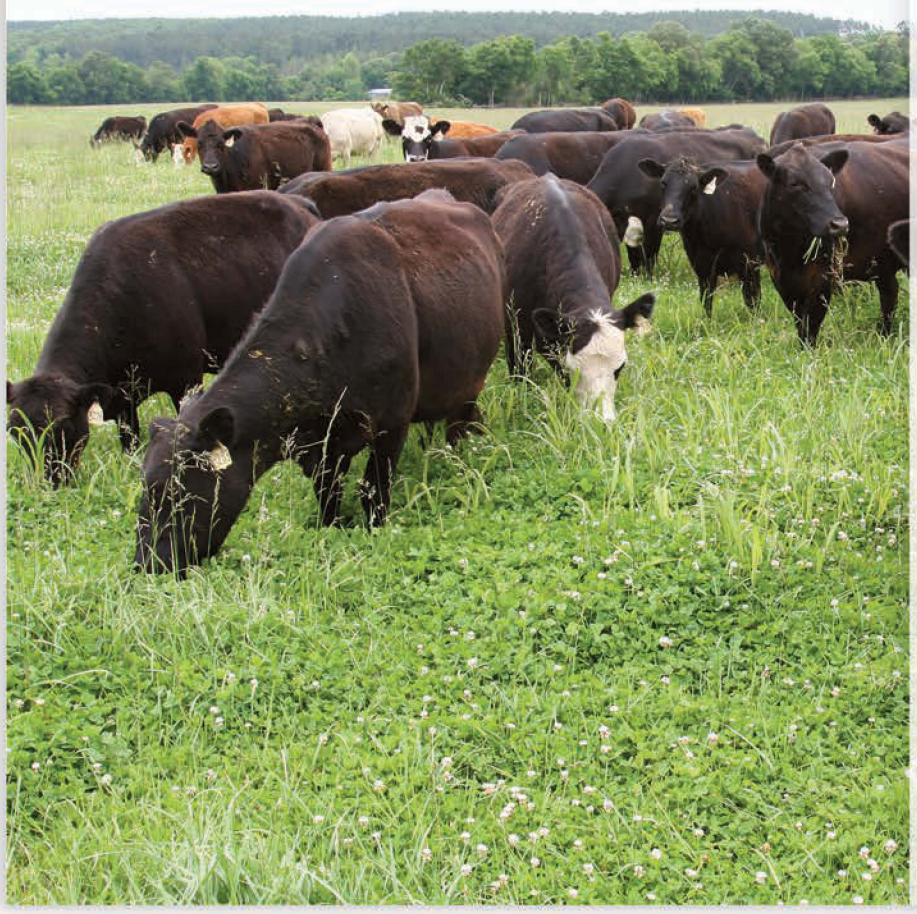

# Table of Contents




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# Research-Based Answers to Frequently Asked Questions on Fescue Toxicity

*By: John Jennings, Ken Coffey, Paul Beck, Mike Looper, Chuck West, Shane Gadberry, Kenny Simon, Glen Aiken, and Rich Poling*

## Introduction

Tall fescue is grown on about 2 million acres in Arkansas, and most of it is infected with the toxic fescue endophyte. The fescue endophyte is a fungus that grows inside the fescue plant. The endophyte produces toxins that reduce livestock growth and cause other physiological problems, but provides benefits to the plant making it more tolerant of drought, overgrazing, and pest attack. Symptoms resulting from the endophyte were noted in cattle grazing fescue soon after the KY-31 fescue variety was released in 1943 (Table 1). But the presence of the endophyte was not known as the cause of fescue toxicity until 1977. Recent research has focused on replacing the toxic endophyte with a nontoxic novel endophyte to improve animal growth, while maintaining good plant persistence.

Many questions are often discussed regarding the use and management of toxic fescue as well as some myths or misconceptions about the fescue endophyte. Toxic fescue causes the annual loss of millions of dollars in livestock production of beef, milk, horses, and small ruminants. A recent Arkansas survey (2011) noted that 60% of producers indicated that either their livestock did not have fescue toxicity problems when grazing fescue pastures or they were not sure if their livestock had fescue toxicity problems. However, 78% of those same respondents observed common fescue toxicity behaviors in their livestock. These results suggest that the fescue toxicity issue and research advances are not well understood by producers.

This publication includes answers to some frequently asked questions about fescue and fescue toxicity based on research from Arkansas and other states. Research studies from Arkansas are denoted with an "*". Questions are categorized by Forage Management, Animal Management, and Environmental Considerations. For brevity, endophyte-free fescue is noted as E-, KY-31 toxic fescue is noted as E+, and novel endophyte nontoxic fescue is noted as NE+.

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**TABLE 1. Brief Chronology of Fescue Toxicosis**

| Year | Event |
|---|---|
| **1943** | KY31 fescue variety was released by Kentucky Agricultural Experiment Station |
| **1950s** | Fescue foot and other fescue toxicosis symptoms were noted |
| **1977** | Discovery of the endophyte as a cause of fescue toxicosis |
| **1980s** | Endophyte-free fescue was a recommended solution for fescue toxicity |
| **1990s** | Endophyte-free fescue was not a recommended solution for fescue toxicity |
| **2001** | Novel endophyte fescue was developed and was a recommended solution for fescue toxicity |

## QUESTION 1: What are the toxins in E+ fescue?

**Answer:** The alkaloid, ergovaline, is considered to be the primary toxin produced by the E+ fescue endophyte. Other alkaloids have been found and are grouped together under a broad category of ergot alkaloids. The main physiological effect of ergovaline is "vasoconstriction" or narrowing of the capillaries. Vasoconstriction reduces an animal's ability to cool down during hot weather and to stay warm during cold weather. Ergot alkaloids from E+ fescue have been linked to other symptoms including reduced forage intake, reduced serum prolactin, fat necrosis, fescue foot, failure to shed rough hair coat in summer, summer slump, poor reproductive performance, and general reduced productivity of meat and milk.

## QUESTION 2: Can I test my fescue to find out if it has the toxic endophyte?

**Answer:** Yes. Testing procedures can detect the presence of the endophyte in fescue tiller samples. Plant samples for endophyte detection **should not be taken** between January and April because the endophyte needs a higher minimum temperature to grow (50°F) than the fescue plant (41°F). Samples taken during this time could yield false negative results (Ju et al., 2006). Endophyte tests will help determine which pastures have high or low toxicity potential for more effective management.

**Recommendation:** Check with your county agent for specific sampling procedures and laboratories offering testing services.

## QUESTION 3: When is E+ fescue most and least toxic during the year?

**Answer:** The general concentrations of ergot alkaloids that cause fescue toxicity are highest in spring and fall and lowest in summer and winter (Figure 1). Specific years vary in that a wet summer can cause high levels and a dry, cold fall can cause low ergovaline levels (West et al., 1994*). Therefore, when weather conditions favor tall fescue growth, potential toxicity levels are likely to be high. The more severe symptoms of heat stress often appear after the peak of alkaloid production in spring and fescue foot following severe cold temperatures in winter, which suggest a cumulative effect.

Although the toxins in E+ fescue affect cattle performance throughout the year, there appear to be times of the year that cattle are affected more severely than others. From the figure below (Figure 2), we can conclude that stocker calves were affected to a greater extent between mid-May and mid-June and in September than in other months. This mid-May response was verified in work at the LFRS near Batesville (Coffey et al., 2001*). In that study, the difference in gain between calves grazing E+ and E- fescue pastures was 0.3 lb/day between April 13 and May 19, but was 0.8 lb/day between May 19 and June 16.

**Recommendation:** Remove stocker calves from E+ fescue pastures by early to mid-May and remove bulls and spring-calving cows before breeding season to reduce the negative impacts.

**FIGURE 1. Trends in plant concentrations of ergot alkaloids over the year.** ***Source: L. P. Bush, University of Kentucky.***

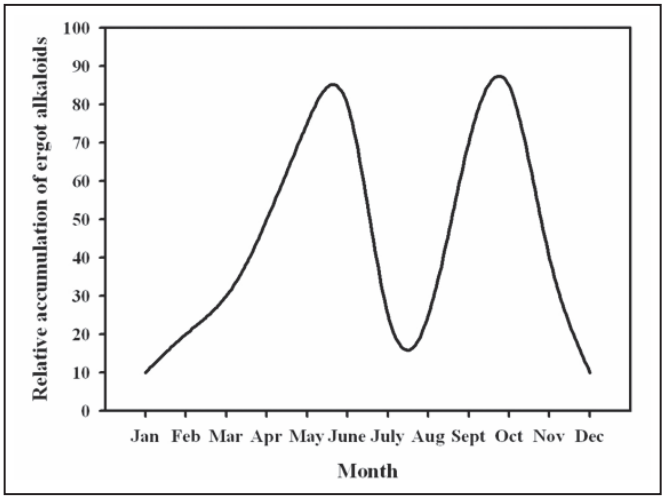
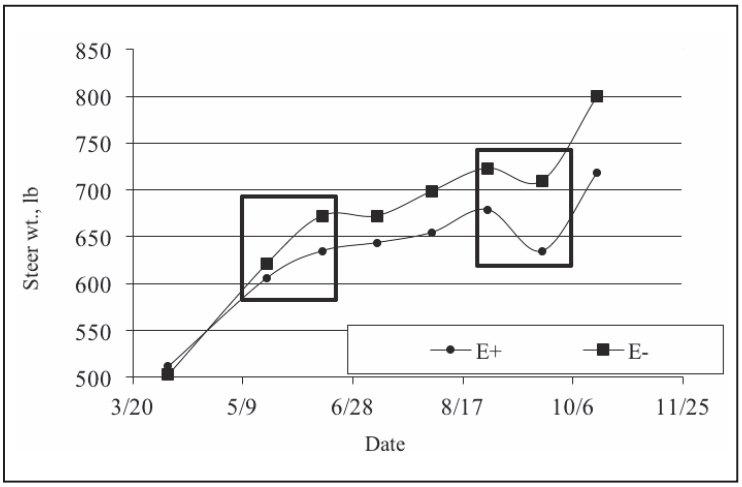



**FIGURE 2. Cumulative weights of steers grazing E+ or E- fescue in southeastern KS over a 7-year period. Boxes denote periods where the calf weight gain differences between grazing E+ and E- were changing at a greater rate. This can be interpreted to mean that these times are more critical for animal performance.**



## QUESTION 4: What plant parts of E+ fescue are most and least toxic?

**Answer:** The endophyte grows in the tiller portion of the fescue plant (stem-like portion growing from the plant crown where the lowest leaves are attached) and is usually not found in the leaves. However, the ergot alkaloids can migrate into leaf blades where they are consumed by livestock. The ergot alkaloid concentration in the tiller base is 2-3 times higher than in the leaf blades. Young leaves from 2-4 weeks of age have more than twice the concentration of alkaloids than leaves older than 6 weeks and make up most of the forage yield. The endophyte concentrates into the developing seed resulting in the infected seed having the highest concentration of toxic alkaloids. Studies have shown that frequent, close defoliation resulted in lower ergot alkaloid concentration. Longer rest periods allowing 2-4 weeks of forage growth increased ergot alkaloid concentration. High nitrogen (N) fertilization also increased alkaloid concentration (Belesky and Hill, 1997).

**Recommendation:** This is a tradeoff situation. Maintaining short, frequently grazed forage will reduce alkaloid concentration, but overgrazing will lead to inadequate forage dry matter availability for the livestock. This practice will also reduce vigor and survival of any E- plants in the pasture and potentially cause the overall stand infection rate to increase. Recommended practices such as rotational grazing will allow a 3-4 week forage growth period and will increase ergot alkaloid content. Grazing intervals of 6 weeks or more may reduce toxins, but also reduce forage quality due to more mature forage that leads to lower animal performance. Nitrogen fertilization, either with commercial fertilizer or animal waste, will increase forage growth and alkaloid concentration as well. A grazing system that produces adequate forage availability and maintains a good legume content with reduced N fertilization would be more favorable than any benefits of overgrazing.

## QUESTION 5: Does rotational grazing reduce the fescue toxicity?

**Answer:** No. In a 3-year Arkansas study, there was no difference in cow or calf performance in a fall-calving herd rotated twice per month or twice per week on predominantly KY-31 E+ pastures (Coffey et al., 2005*). This was a well-managed study in which the pastures were not overgrazed. In overgrazing conditions, just maintaining nontoxic forages such as legumes and other cool-season grasses while providing adequate forage is difficult, so in an indirect way, rotational grazing may reduce fescue toxicity if it reduces overgrazing and maintains higher content of legumes and nontoxic forages.

**Recommendation:** Improve the forage base to dilute the E+ fescue with legumes and nontoxic forages and rotationally graze to maintain stands and forage production. Do not depend on rotational grazing by itself to offset fescue toxicity.

## QUESTION 6: Can fescue toxicity be reduced by adding clover to E+ fescue pastures?

**Answer:** Yes and No. Rate of gain is improved somewhat with addition of legumes, but animals will still be affected by fescue toxicity showing symptoms of higher body temperatures, rough hair coat, and other factors. Arkansas research showed that adding clover to E+ fescue improved calf gain by 0.4 lb/hd/day during the spring grazing season. However, on NE+ fescue without clover, calf gains were 1.1 lbs/hd/day higher than on E+ fescue. Interestingly, clover also increased calf gain on the NE+ fescue by 0.3-0.4 lb/hd/day. Clover did not improve calf gain on E+ fescue or NE+ fescue during the fall grazing season, but calf gain on NE+ fescue was still 0.4-0.6 lb/hd/day higher than on E+ fescue. Because of the lower cost of production, the addition of clover increased return/acre on both E+ and NE+ fescue. (Beck et al., 2012*)

**Recommendation:** Adding clover to fescue pastures is a good management practice that reduces N fertilizer need, improves animal performance, and increases returns/acre regardless of endophyte status, but does not completely offset fescue toxicity. Soil tests and site evaluation of the pasture should be made to determine suitability for growing clover.

## QUESTION 7: Can I reduce fescue toxicity by maintaining mixed pastures with bermudagrass?

**Answer:** Yes, but not entirely. Calves weaned from spring-calving cows grazing bermudagrass pastures mixed with either E- fescue or orchardgrass had adjusted weaning weights of 52 lbs per head more than calves weaned from E+ toxic fescue mixed pastures diluted nearly 50% with bermudagrass. Cows on the bermudagrass pastures mixed with orchardgrass or E- fescue also had greater body condition scores between breeding and weaning and gave 17% more milk during May than cows on the bermuda/E+ fescue forage. (Coblentz et al., 2006*)

**Recommendation:** Even at 50% dilution with bermudagrass, E+ fescue reduced calf weaning weights and cow body weight substantially. Avoid planting E+ fescue purposely into bermudagrass. If a mixture of cool-season grass is desired in existing bermudagrass, plant NE+ fescue or winter annuals as appropriate.

## QUESTION 8: Does clipping fescue seedheads reduce toxicity?

**Answer:** Yes, but toxins still remain in the leaves. Seedheads contain the greatest toxin concentrations, and cattle readily consume fescue seedheads at certain times of the year. A study in SE KS (Coffey et al., 1994) reported no benefit of clipping seedheads on long-term (April-October) stocker cattle gains. However, chemical seedhead suppression with Chaparral herbicide improved stocker cattle performance and increased serum prolactin concentrations indicating that the effects were more than simply a forage quality response (Aiken et al., 2012).

**Recommendation:** Chaparral herbicide has residual negative impacts on pasture legumes and should be used with caution. Seedhead reduction through use of herbicide or other means combined with other management options should be implemented to reduce the negative impacts of grazing E+ pastures.

## QUESTION 9: Does the toxic fescue endophyte die in seed during storage?

**Answer:** Yes. The E+ endophyte in seed dies after 18-24 months of storage under typical conditions in a bin or in poly-type bags resulting in low-endophyte or endophyte-free seed. The endophyte in seed can survive longer under more controlled storage conditions. Long-term storage can also reduce seed germination. Long-term storage of NE+ seed can have the same consequences of lower seed germination and loss of the beneficial NE+ endophyte. Endophyte-free fescue has poor persistence under grazing and stressful conditions. (Wheatley, 2005).

**Recommendation:** Fescue seed stored 18-24 months should be planted and managed as E- fescue. It will likely have lower germination and shorter term persistence than E+ and NE+ fescue under stressful conditions. **E- fescue is not recommended in Arkansas due to poor stand persistence.**

## QUESTION 10: Does fescue hay become less toxic during storage?

**Answer:** Yes, but some toxin remains. Levels of ergovaline, the toxic alkaloid produced by the endophyte, has been shown to decline in E+ fescue hay by 79% at Fayetteville and 23% at Batesville over a 9-month storage period between June 1 (Fayetteville) or July 12 (Batesville) harvest and sampling in February. Hay storage method (net-wrapped hay stored inside vs. net-wrapped hay stored outside on pallets) did not affect ergovaline content of hay. Forage quality and dry matter changed little under these storage methods. (Norman et al., 2007*)

**Recommendation:** Harvest quality hay and use good storage management to preserve quality and dry matter. Manage pastures to extend grazing seasons to reduce hay need.

## QUESTION 11: What is the best method to kill E+ fescue for pasture renovation?

**Answer:** The "spray-smother-spray" (S-M-S) method has been reliable for renovating toxic fescue pastures and can begin in the fall or spring. In spring (late April to early May) when fescue is actively growing and before any new seed is produced, clip or graze fescue to a height of 4-6 inches and apply a nonselective herbicide such as glyphosate. After the fescue topgrowth dies down, no-till plant a summer annual forage, such as pearl millet or sorghum-sudan. The summer annual forage provides heavy shade and competition for any remaining fescue plants and can be harvested for hay or grazed. After the final harvest of the annual forage in late summer, follow up with a second herbicide application. The field can be planted with NE+ fescue or other cool-season grass in the fall. If starting in fall, apply a nonselective herbicide to the actively growing fescue during fall (September to early October) and no-till drill a small grain for winter/spring forage. Do not plant annual ryegrass because natural reseeding from ryegrass will cause severe competition when NE+ fescue is planted later. In spring, follow harvest or grazing of the small grain with a second herbicide application, then no-till drill a summer annual. In fall, no-till drill NE+ fescue after the summer annual is harvested. (Munson and Bailey, 1990; Jennings et al., 2006*)

Another method that is effective in southern areas is to mow fescue in spring two or more times to prevent seed production. In late summer about 6 weeks before the recommended planting date, spray the fescue with glyphosate. Make a second glyphosate application the day before planting. No-till plant the NE+ seed into the killed sod. **Spring mowing to prevent seed production is critical** to success of this method (Roberts and Andrae, 2004).

**Recommendation:** Both the S-M-S method and late summer kill method are effective for killing E+ fescue to renovate with NE+ fescue. Both methods require advance planning to adequately kill all the E+ fescue. Taking care to prevent seed production of the E+ fescue in spring before planting NE+ fescue helps reduce the potential number of toxic fescue seedlings in the fall.

## QUESTION 12: What varieties of NE+ fescue are available?

**Answer:** The term "variety" in the case of NE+ fescue is a misnomer. In this case, a specific

nontoxic novel endophyte is inserted into a known fescue variety (cultivar). The resulting novel endophyte/fescue variety combination is given a name for marketing purposes. Currently the commercially named NE+ fescue products on the market include MaxQ (2001, Pennington Seed, Madison, GA), Texoma MaxQ II (2011, Pennington Seed), BarOptima (2009, Barenbrug USA, Tangent, Oregon), and one with an endophyte from Arkansas research called Estancia with ArkShield (2011, Mountain View Seeds, Salem, Oregon).

**Recommendation:** NE+ fescue should be considered where a cool-season perennial grass is needed. More research and producer acceptance will lead to a larger selection of NE+ fescue options. Review research information for each variety, area of development, and local Extension recommendations to help make variety choice decisions.

### QUESTION 13: Are novel endophyte fescues considered GMOs?

**Answer:** No. The nontoxic endophyte fungus is grown outside the plant under specific conditions, then physically inserted into plant tissue of the fescue cultivar of choice using specialized techniques. The plant tissue with the successfully inserted endophyte is grown into mature plants and seed is harvested.

### QUESTION 14: Aren't fungus-free fescue (E-) and novel endophyte (NE+) fescue the same?

**Answer:** No. Fungus-free fescue (E-) contains no endophyte. It provides good animal performance, but has poor stand persistence under grazing and stressful growing conditions. The NE+ fescue has a nontoxic endophyte that provides both improved animal performance and improved plant persistence.

**Recommendation:** Endophyte-free fescue is not recommended in Arkansas due to poor stand persistence. Where good animal performance and plant persistence are important, plant NE+ fescue varieties and avoid planting E- fescue varieties. (Jennings et al., 2006*)

### QUESTION 15: How long will stands of NE+ survive?

**Answer:** Stand persistence studies show that NE+ fescue has a definite advantage in survival over E- fescue. Comparisons of NE+ fescue to E+ fescue are mixed showing that NE+ fescue survival ranges from equal to slightly lower than E+ under harsh grazing conditions. In North Carolina after 5 years, E- fescue stands were 80% of E+ fescue stands and NE+ fescue was 90% of E+ fescue stands (Vibart et al., 2008). A 6-year study in Georgia showed that NE+ fescue persistence was not different from E+ fescue and both were greater than E- fescue (Franzluebbers et al., 2009). In Arkansas, it was noted that NE+ fescue pastures that were grazed heavily in the late spring had greater encroachment of warm-season forages than those that were managed in a rotational system (Caldwell et al., 2013*). In southwest Arkansas, NE+ fescue with different nontoxic endophytes all survived as well as E+ fescue after 5 years, whereas E- fescue died out in the third year (West and Gunter, 2004*).

**Recommendation:** Under good grazing management, NE+ fescue can be expected to persist as well as E+ fescue. Under poorly controlled grazing, especially during the heat of summer, persistence of NE+ fescue could be expected to decline. Observations have been reported that livestock graze NE+ fescue much shorter than E+ fescue since NE+ does not cause fescue toxicity. This can lead to weakened forage plants that would not be as persistent. Nutrient reserves are stored in the tiller bases of fescue plants, so maintaining adequate leaf area and protecting the tiller bases during summer heat stress are important for plant survival.

### QUESTION 16: Do fields planted with NE+ fescue revert back to toxic fescue after a few years?

**Answer:** No under recommended management. Toxicity status of NE+ fields only changes if contaminated by toxic E+ seed. The toxic endophyte cannot spread from plant to plant, so a NE+ fescue plant will never become an E+ toxic fescue plant. However, if toxic fescue seed is spread into a NE+ fescue field, E+ fescue can become established and spread from seed produced by those plants (Hume and Barker, 2005). Other research showed that fungus-free (E-) fescue fields readily became contaminated from volunteer E+ fescue, but NE+ fescue fields had a very low contamination level from volunteer E+ toxic fescue (Barker et al., 2005). Research has shown that cattle can pass viable seed with viable endophyte in manure for up to 38 hours after ingestion (Shelby and Schmidt, 1991). This is primarily a concern in late spring through mid-summer when seed is present in pastures or when animals have been fed hay containing mature seed.

**Recommendation:** Prevent contamination of NE+ fescue fields with E+ seed. Don't allow E+ fescue seed to be transported into NE+ fescue fields either on machinery, vehicles, hay, or through animals that have grazed mature E+ fescue seedheads or consumed mature E+ fescue hay within the previous 48 hours.

### QUESTION 17: What are common symptoms of fescue toxicity in cattle grazing E+ fescue?

**Answer:** The behaviors shown in Figure 3 below are commonly observed for cattle grazing E+ fescue in Arkansas. The top five symptoms are visual and easily noticed and show up during both warm weather (rough hair coat, standing in ponds, and panting/salivating) and in cold weather (lameness and fescue foot which includes loss of a hoof, ear tip, or tail switch). The next two including low percent calf crop and low weaning weights have the highest impact on livestock profitability, but require records and measurements to document. Other symptoms not noted in Figure 3 include elevated body temperature, low milk production, fat necrosis, and thickened placentas particularly in horses.

**Recommendation:** Carefully observe livestock when grazing E+ fescue for signs of fescue toxicity. Follow Extension recommendations to improve management practices for reducing fescue toxicity as needed.

### QUESTION 18: What are the most common practices for reducing fescue toxicity?

**Answer:** In a recent Arkansas survey (2011), respondents were asked what practices they used to reduce fescue toxicity in their livestock. The responses are shown in Figure 4. The most frequently used practices include several Extension Service recommendations as well as using mineral supplements to reduce fescue toxicity, which is not an Extension Service recommendation and is not based on published research.

### QUESTION 19: Should I use fall-calving or spring-calving when grazing E+ fescue?

**Answer:** Recent research shows that toxic fescue reduces reproduction rates of spring-calving herds much more than fall-calving herds. At the LFRS near Batesville, spring-calving herds had calving rates (63-day breeding season) of only 44% when grazing toxic fescue year-round. Converting 25%

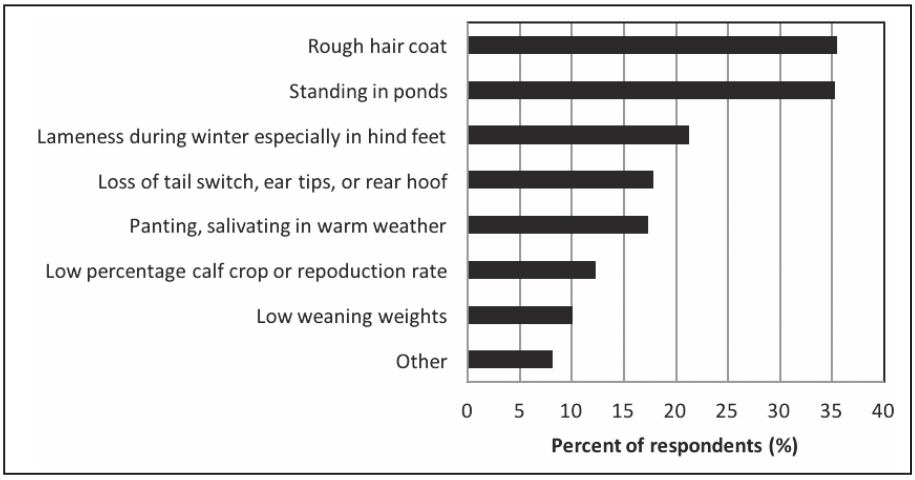



**FIGURE 3. Common behaviors of cattle when grazing E+ fescue based on a 2011 Arkansas producer survey. The "other" option included "none of these behaviors observed," problems with pregnant mares, and reddish hair coat in black cattle.**

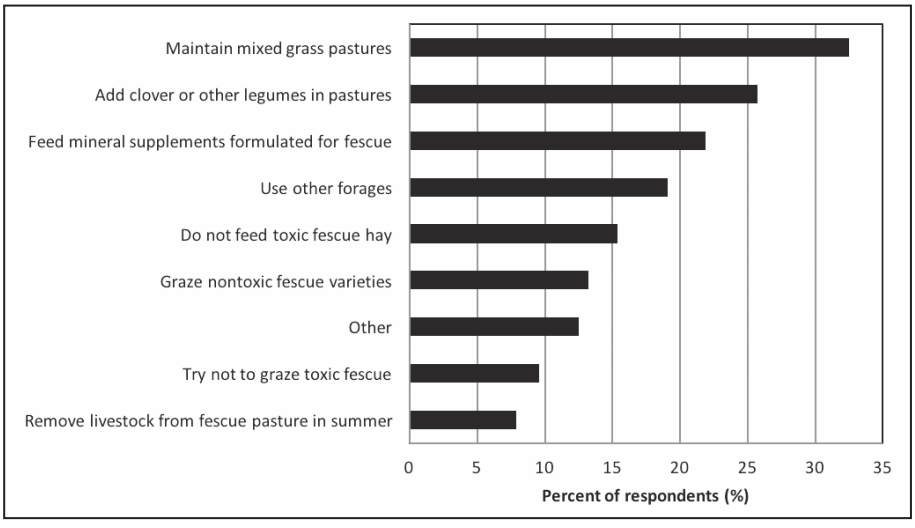



**FIGURE 4. Management practices used to reduce fescue toxicity in livestock by Arkansas producers based on a 2011 producer survey. The "other" option included clipping seedheads and changing to fall calving.**

of the pasture to NE fescue improved spring-calving rates to 80%. Fall-calving herds maintained calving rates of over 92% whether on toxic E+ fescue year-round or if 25% of the pasture was converted to NE+ fescue. Spring-born calf weaning weights were only improved by 10 lbs by moving spring-born calves to NE+ fescue for one month prior to weaning in fall. However, calf weaning weights on 100% NE+ toxic fescue averaged 82 lbs more than for calves weaned from 100% E+ fescue. (Caldwell et al., 2013*)

**Recommendation:** E+ fescue has greater impact on calving rates for spring-calving herds than fall-calving herds. Avoid E+ fescue prior to breeding for spring-calving herds. One option is renovate 25% of E+ fescue with NE+ fescue and graze starting a month prior to and through breeding season. Where renovation is not an option, add nontoxic forages such as clover, bermudagrass, and others to dilute livestock intake of toxic fescue. Another option is converting to a fall-calving system which greatly reduces negative effects of toxic fescue on calving rates and allows for marketing weaned calves in spring/summer when market prices are typically higher.

### QUESTION 20: What effect does E+ fescue have on calving rates of thin cows?

**Answer:** Spring-calving cows that are thin at the beginning of the breeding season lost more body fat when grazing toxic fescue; however, thin cows grazing bermudagrass gained body weight and body condition during the breeding season. Calving rate was reduced by 20% in thin cows grazing E+ fescue. Cows with BCS of 4.9 (BCS = 1 being extremely thin and BCS = 9 extremely fat) had 20% lower (68%) calving rate than cows with a BCS of 6.5 (88%) that grazed toxic fescue. (Looper et al., 2010b*)

**Recommendation:** Monitor and manage body condition of cows grazing toxic fescue during the breeding season to compensate for the likely loss of fat stores during this period. To maintain optimal reproductive performance, maintain a higher BCS for cows breeding on E+ fescue and/or utilize nontoxic forages during the breeding season.

### QUESTION 21: What effect does E+ fescue have on bulls?

**Answer:** E+ fescue reduces semen quality of bulls especially in July/August. Exposure to E+ fescue pasture 60 days prior to breeding may affect bull fertility status. E+ fescue exposure tended to reduce live semen, increase static rate, and reduce motile, progressive, and rapid movement measurements of semen. (Looper et al., 2009a*)

**Recommendation:** Limit exposure of breeding bulls to E+ fescue before and during breeding season and avoid late-summer breeding on E+ fescue.

### QUESTION 22: What effect does E+ toxic fescue have on my young calves?

**Answer:** Spring-born calves are more affected than fall-born calves. In a 3-year study, spring-born calves on E+ toxic fescue had adjusted weaning weights 73 lbs lower than calves on 100% NE+ fescue. Converting 25% of the pasture to NE+ fescue only improved weaning weights by 10 lbs. Fall-born calves on toxic E+ fescue had adjusted weaning weights 49 lbs lower than their spring-born counterparts on 100% NE+ fescue. Converting 25% of the pasture to NE+ fescue improved fall-born calf weaning weights by 26 lbs, or more simply, converting 25% of the pasture to NE+ offset 53% of the reduction in calf weaning weight. (Caldwell et al., 2013*)

**Recommendation:** Reduce exposure to E+ fescue for growing calves. Renovate 25% of E+ fescue with NE+ fescue and graze a month prior to weaning.

### QUESTION 23: How does E+ fescue affect stocker calves?

**Answer:** E+ fescue causes very low weight gains in stocker calves. NE+ fescue provides nontoxic forage and calf weight gains are nearly as good as small grain (1.9 vs. 2.1 lbs/d). NE+ fescue provides a longer grazing season with less annual cost than small grains/winter annuals (211 vs. 138 grazing days) (Beck et al., 2008*). In another study, stocker calves' ADG was 1.28 lbs/day on E+, but was 1.8-2.3 lbs/day on NE+ fescue (Beck et al., 2009*).

**Recommendation:** For optimum weight gain of stocker calves, avoid grazing E+ fescue. Provide NE+ fescue or other nontoxic forage.

### QUESTION 24: What effect does fescue toxicity have on heifer development?

**Answer:** In a 2-year study at the LFRS near Batesville, heifers weaned from E+ fescue pastures had 30% lower calving rates than those weaned from NE+ fescue with only a 22 lb difference in body weight at breeding (Coffey et al., 2015*). In a subsequent 3-year study, spring-born heifers weaned from E+ pastures had 15% lower calving rates than those weaned from NE+ (Caldwell et al., 2012). Once weaned, all heifers were grazed on winter annuals prior to breeding in both studies and were bred while grazing bermudagrass, so the pre-weaning exposure to E+ fescue carried through to the later breeding.

**Recommendation:** This is another tradeoff. We want our heifers to breed, but we also want to be careful to select heifers that perform in our environment. Minimizing exposure of our heifers to E+ fescue prior to weaning may increase their chances for calving as 2-year-olds. However, retaining heifers that successfully calved as 2-year-olds while on E+ may be a long-term goal since those animals might be more readily adapted to an environment of E+ fescue.

## QUESTION 25: Can stockpiled E+ fescue be utilized in heifer development programs?

**Answer:** Endophyte status of stockpiled tall fescue had little practical effect on the forage nutritive value for dairy heifers (approximately 800 lbs). Further, the nutritional value of stockpiled fescue exhibited minimal decline throughout the winter months (early December to late February) (Flores et al., 2007*, 2008*). Ergovaline content of stockpiled fescue declines during winter (Rottinghaus et al., 1991).

**Recommendation:** E+ effects on weight gain are not as severe in winter as in summer. Large replacement heifers have lower gain requirement than stocker calves. Stockpiled E+ tall fescue forages are a legitimate and lower cost alternative to harvested forages and possess suitable nutritional characteristics for developing dairy heifers. It should be possible to meet the energy requirements for developing dairy heifers with little or no energy supplementation. Do not apply more than 50-60 lbs/acre N fertilizer for stockpiling fescue. Observe animals frequently for symptoms of lameness or fescue foot which can occur during winter on E+ fescue.

## QUESTION 26: Are Brahman cross cattle more tolerant of fescue toxicity than other breed types?

**Answer:** Not always. Brahman-influenced cattle are able to dissipate heat better than *Bos taurus* (for example Angus) cattle. Several studies (Brown et al., 1997*, 2001*) have suggested that Brahman-influenced cattle appear to be more tolerant of the negative effects of toxic fescue than *Bos taurus* (Angus) cattle. However, Brahman-influenced cattle in studies at the USDA-Booneville station exhibited negative impacts of fescue toxicity in several studies (Looper et al., 2009a; Looper et al., 2010b). A study by Burke et al. (2010*) showed reduced serum prolactin for both Angus and Romosinuano (*Bos taurus* breed of cattle) when grazing E+ fescue. Milk yield was not affected by E- or E+ fescue for either breed. Rectal temperature was lower for Romosinuano cattle, but other parameters were negatively affected as for Angus.

**Recommendation:** No beef breed is immune to fescue toxicity. Use of Brahman-influenced genetics could be a beneficial strategy for producers faced with the management of endophyte-infected tall fescue. However, Brahman cattle are not completely resistant to the negative effects of E+ fescue and have been noted to be more susceptible to cold-weather fescue toxicosis such as fescue foot, which includes loss of a hoof, tail switch, or ear tip. So maybe Brahman-influenced cattle are more heat tolerant, but they are not endophyte proof and still show reduced performance from fescue toxicity.

## QUESTION 27: Can cattle be selected within a herd for tolerance to fescue toxicity?

**Answer:** Genetic differences in cattle (across breeds as well as within a breed type) allow some cattle to be more tolerant of the toxic effects of E+ fescue. Current research efforts are focused on genetic markers that can accelerate the selection of cattle that are more productive on toxic tall fescue (Looper et al., 2010a*; Rosenkrans et al., 2010*).

**Recommendation:** At this time, there is not a practical genetic marker that will identify cattle that are more tolerant of E+ fescue. Some commercially available genetic tests are currently being evaluated to determine associations between genetic markers and profitability traits of cattle. Retaining heifers from cows that have rebred successfully on E+ fescue is a viable strategy for long-term herd improvement.

## QUESTION 28: Do I need to convert all my E+ fescue to NE+ or other forage to do any good?

**Answer:** No. Converting 25% of the E+ fescue acreage to NE+ fescue allowed spring-calving cows to be removed from E+ fescue long enough before and during breeding to eliminate the negative effects of E+ fescue on the reproductive rates. However, calf weaning weights were still reduced by 81 lbs. (Caldwell, et al., 2013*)

**Recommendation:** Converting up to 25% of the E+ fescue acreage to NE+ fescue is a good investment to improve calving rates. However, to have a greater benefit on calf weaning weights, a greater percentage of the E+ fescue pasture area would have to be converted to nontoxic forage.

### QUESTION 29: Can fescue toxicity be reduced with mineral supplements?

**Answer:** No. If the forage is deficient in specific minerals, then reduced intake caused by E+ fescue could cause mineral deficiency. E+ fescue reduced dry matter intake by 18% by cattle in one experiment (Aiken et al., 2009), and the reduction in forage intake can range up to 25%. Mineral supplementation would only help correct the mineral deficiency, but other toxicity symptoms would remain. Fescue toxicity reduces copper levels in grazing calves, but supplemental copper did not improve animal performance in growing cattle (Coffey et al., 1992; Saker et al., 1998). This may diminish reproductive rates in cows, however. No other mineral supplement has been shown to reduce fescue toxicosis.

**Recommendation:** Provide a free-choice high-quality mineral supplement for cattle as a general management practice, but don't depend on it to reduce fescue toxicity. Make sure the copper source in the mineral is biologically available to the animal (copper sulfate, copper amino acid complex) and not copper oxide, which is not available.

### QUESTION 30: Does feed supplementation reduce fescue toxicity?

**Answer:** Only indirectly. As supplement intake is increased, forage intake tends to decrease, which will ultimately reduce toxin intake. Supplements also have greater energy concentrations than the E+ fescue forage, so rate of gain for calves should be improved as well because of increased energy intake. However, in a grazing situation, the efficiency of conversion of supplements to gain decreases as the amount of supplement fed increases.

**Recommendation:** Feed stocker calves low levels of supplements (up to 0.5% of body weight) to increase calf gains and reduce toxin intake.

### QUESTION 31: Do growth implants reduce fescue toxicity?

**Answer:** A number of studies have looked at implants for cattle grazing E+ fescue. In most studies evaluating implants containing progesterone and estradiol (Synovex-S), estradiol-17ß (Compudose), or trenbolone acetate (Revalor-G), the response to the implant was similar between cattle grazing E+ and those grazing E-. This implies that implants will improve performance but will not offset the toxicity. However, in another study, stocker cattle grazing low endophyte-infected fescue gained 12% faster when implanted with zeranol (Ralgro), while those grazing high endophyte-infected fescue gained 37% faster when implanted with zeranol (Brazle and Coffey, 1991). This implies that zeranol may actually offset some of the negative impacts of tall fescue toxicosis.

**Recommendation:** Implant steers grazing E+ pastures to achieve economical improvements in gain. These improvements may be greater if zeranol is used as the implant.

### QUESTION 32: Does ivermectin dewormer reduce the effect of fescue toxicity?

**Answer:** One study from Alabama showed a correlation between ivermectin use and reduced fescue toxicosis, but the results could not be duplicated in other studies (T. Yazwinski, University of Arkansas, personal communication; Gunter et al., 2006*).

**Recommendation:** Dewormers are part of a good livestock production system but are not effective for reducing fescue toxicity.

## Environmental Considerations for Fescue Toxicity

### QUESTION 33: Does the endophyte toxin(s) influence foodborne pathogen (for example *E. coli* O157:H7) shedding in livestock?

**Answer:** Cattle grazing toxic fescue are stressed and usually have reduced dry matter intake. Cattle that are stressed and nutrient restricted typically shed more foodborne pathogens in their feces. Ruminants fed a toxic fescue diet for 7 days shed more *E. coli* O157:H7 than animals fed a nontoxic fescue diet (Looper et al., 2007*). Further, *E. coli* O157:H7 and *Salmonella* were found in the wet areas surrounding water tanks in toxic fescue pastures (Looper et al., 2006*).

**Recommendation:** Cattle exposed to toxic fescue prior to sale or harvest may shed more bacterial pathogens in their feces. A single animal shedding *E. coli* and *Salmonella* at sale barns and/or feedyards has the potential to infect numerous other animals. Remove cattle from toxic fescue 7 to 10 days prior to sale or harvest to minimize shedding of foodborne pathogens and ensure food safety.

# Producer Attitudes Toward Renovating Toxic Fescue With Novel Endophyte Fescue

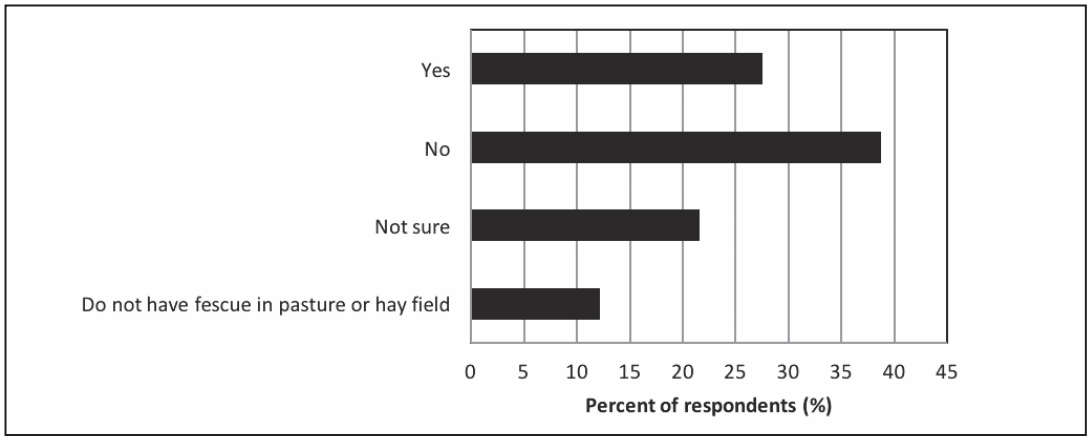
*K. J. Simon, J. A. Jennings, K. P. Coffey, B. L. Barham, R. L. Poling, J. L. Gunsaulis, and D. G. Henderson*

The following Arkansas survey was conducted (2011) to determine producers' knowledge about managing fescue toxicity and to determine their interest in converting toxic fescue to nontoxic forage or novel endophyte fescue. The survey was taken by 456 producers by three methods including mail surveys from field day participants (33), online (323), or audience response at producer conferences (100).

**Denotes significant association at 0.05 level using Pearson Chi-Square test.*

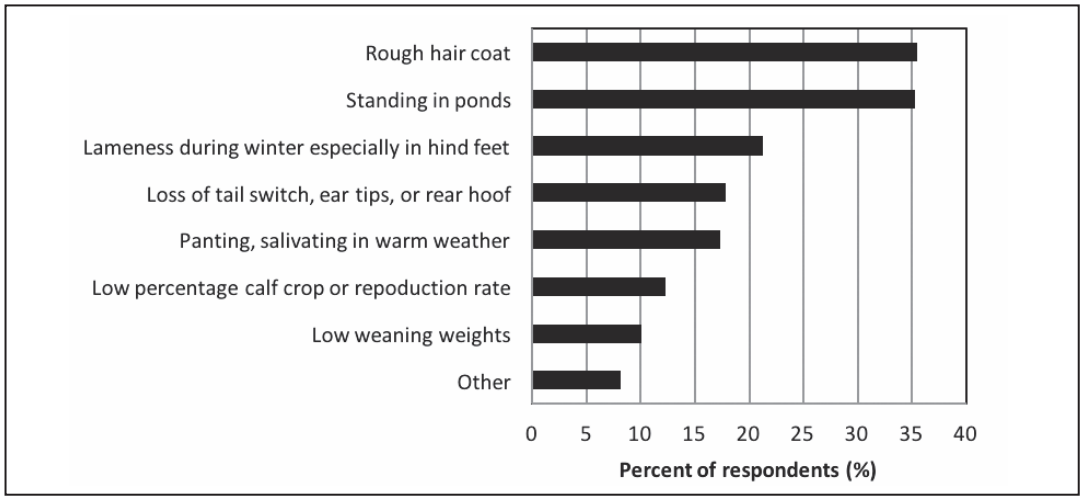
## – Survey –

**QUESTION 1: If you have fescue in your pastures or hay acreage, do you have any problems with fescue toxicity in your livestock?**



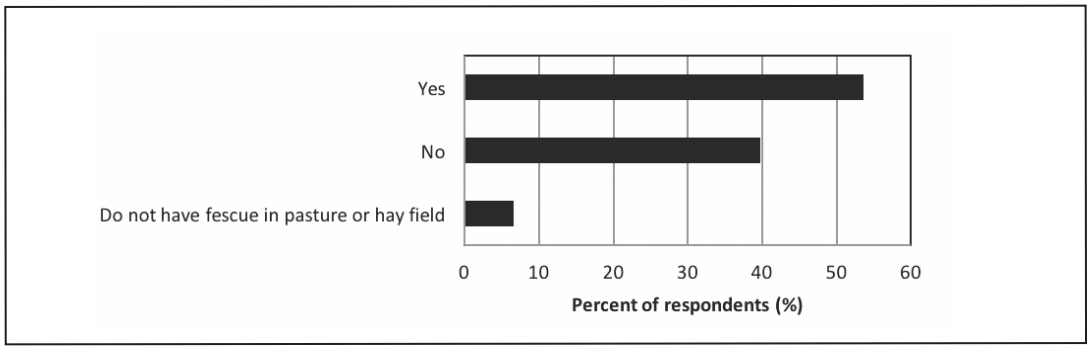

- *96% of those answering "yes" reported at least 1 of the behaviors in Question 2 in their livestock.*
- *78% of those answering "no or not sure" **also reported at least 1** of the behaviors in Question 2 in their livestock.*
- **Producers answering "yes" were more likely to make efforts to reduce fescue toxicity.*
- *79% of those answering "yes" had made an effort to reduce fescue toxicity in their livestock.*
- **Producers answering "no/not sure" were less likely to recognize typical symptoms of fescue toxicity.*
- *Only 47% of those answering "no/not sure" had made an effort to reduce fescue toxicity in their livestock.*

**Question 2: Have you observed any of the following behaviors or characteristics of your livestock while grazing fescue? (Check all that apply)**

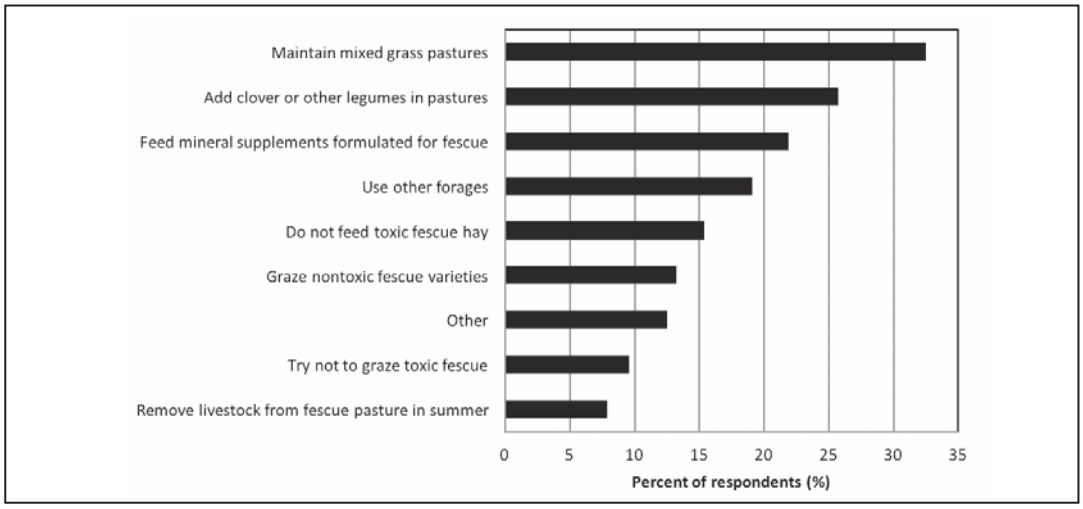



- *Of those that reported at least one of these behaviors, there was no significant association for those using continuous grazing, rotating pastures <2 weeks, or rotating pastures >2 weeks.*

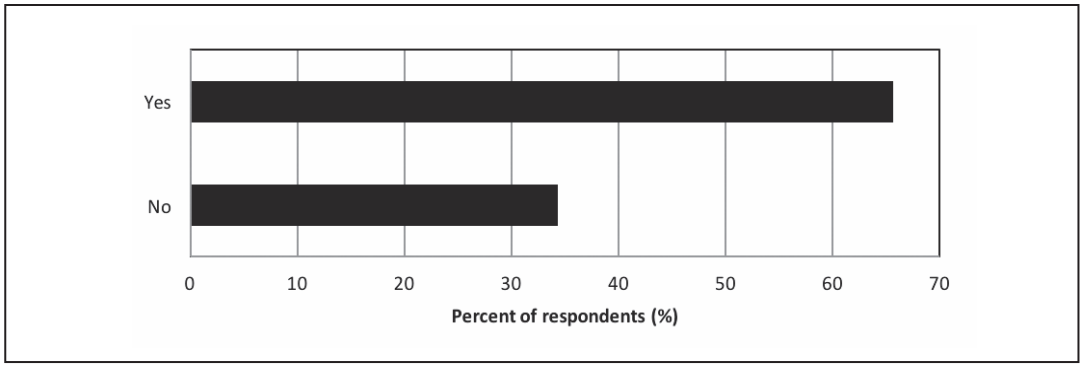
**QUESTION 3: Have you made an effort to reduce fescue toxicity in your livestock?**




**QUESTION 4: If you have tried to reduce fescue toxicity, which of the following actions have you taken? (Check all that apply)**

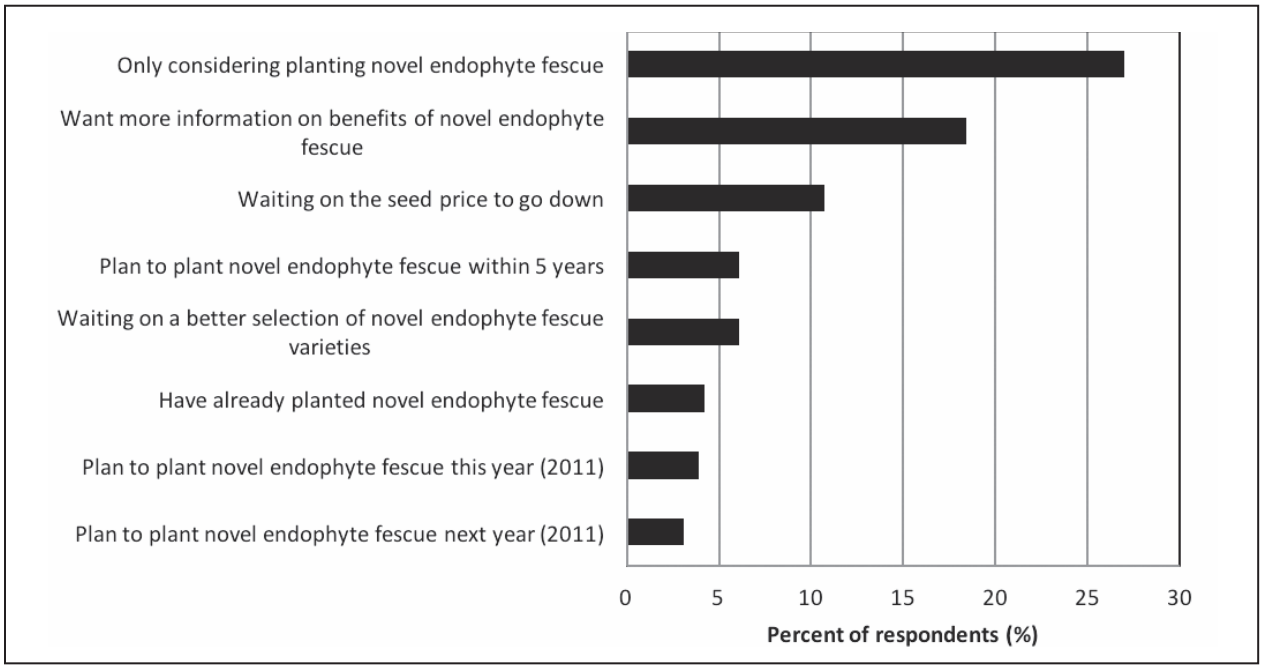



**QUESTION 5: Based on the information about novel endophyte (nontoxic) fescue varieties presented at the U of A Division of Agriculture programs, would you consider planting a novel endophyte (nontoxic) fescue variety?**

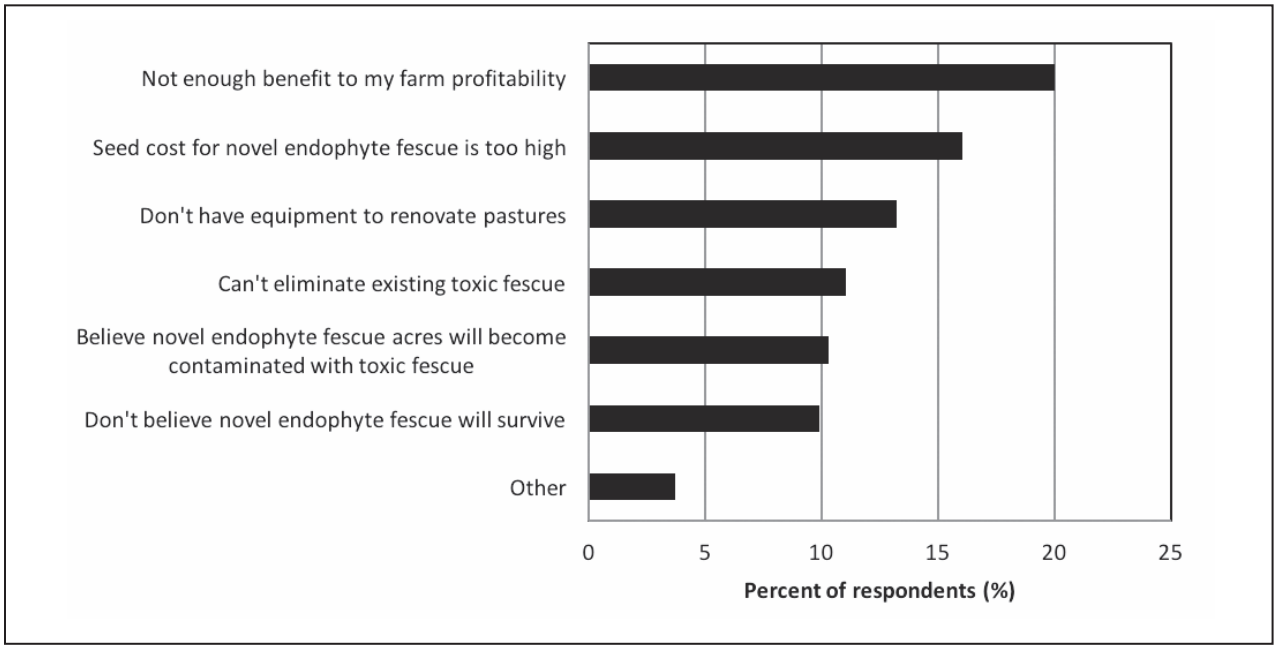



- **Comparing cow/calf, stocker, small ruminant, and horse producers, cow/calf producers were the most likely to consider planting NE+ fescue.*
- *Full-time producers **were not** more likely than part-time producers to consider planting NE+ fescue.*
- *Producers that reported problems with fescue toxicity were not more likely to consider planting NE+ fescue than those that said they do not have problems with fescue toxicity in livestock.*

**QUESTION 6: If you <u>WOULD</u> consider planting a novel endophyte fescue, which of the following statements best describe(s) your plans? (Check all that apply)**




**QUESTION 7: If you <u>WOULD NOT</u> consider planting a novel endophyte fescue, which of the following statements best describe(s) your reasons? (Check all that apply)**




- *Perceptions of lack of benefit to profitability, high seed cost, and beliefs that NE+ would not survive or would become contaminated were all drawbacks for those that would not consider planting NE+ fescue.*

# Management Strategies for Using E+ Toxic Fescue and NE+ Nontoxic Fescue in Beef Production Systems

Toxic fescue is grown on countless sites where complete renovation is not a desirable option so it will remain as a major forage grass in those areas. Research has shown that no "silver bullet" exists for eliminating fescue toxicity. However, a management strategy can be developed to reduce the negative impact.

Spring-calving beef herds suffer the highest negative impact from fescue toxicity. Calving rates, calf weaning weights, and bull fertility decrease due to fescue toxicity during warm weather. Fall-calving herds have near-normal conception rates while grazing E+ fescue which indicates the lower impact of fescue toxicity on breeding in cooler weather. To recap some of the negative impacts from the toxic endophyte in KY-31 fescue, consider the following points from questions presented previously in this publication:

- Calf crop percentage is reduced for spring-calving cows grazing E+ fescue before and during breeding season. Calf crop percentage for fall-calving herds is not affected. – *Question 17*
- Cow milk production is lower for cows grazing E+ fescue. – *Question 7*
- Thin cows have a lower conception rate when grazing E+ fescue. – *Question 19*
- Calf weaning weights are lower from cows grazing E+ fescue. – *Question 21*
- Bull fertility is reduced by E+ fescue in July/August breeding seasons. – *Question 20*
- Lameness or loss of hoof, tail switch, or ear tip especially during winter. – *Question 16*

Clearly the endophyte has a compounding effect on a spring-calving beef system. Cow herds grazing E+ fescue have fewer calves, produce less milk, and wean lighter calves. Bull fertility is reduced which further reduces conception rates. The critical periods for a spring-calving herd to reduce fescue toxicity are during late spring when ergovaline levels are high and prior to and during breeding season.

Developing a defined calving season is advisable to keep all cows in the herd on a similar production level to maximize the effect and timing of improved management practices. Herds with a calving season of 90 days or less can be managed as a unit more effectively than herds with a year-round calving season. This also makes it easier to manage limited acreage of nontoxic forages to fit into key periods of the herd's production cycle.

Late-winter or early-spring calving results in earlier breeding before hot weather and helps avoid some negative effects of fescue toxicity on conception rates. Fescue toxins are high in spring and have an increasing effect as temperatures increase in late spring and early summer. Mid- to late-spring calving may result in high forage availability for the lactating cow, but the ergovaline level in E+ fescue reaches the highest level during that period. Ergovaline has a drastic effect on milk production which will reduce calf growth. Calving in late spring results in late summer breeding. Conception rates of cows breeding in late summer are lower and bull fertility is reduced.

Maintaining cows in good body condition in late winter before calving can improve conception rates on E+ fescue. Often in late winter, cows lose body condition due to colder temperatures, low-quality hay, and increasing nutritional requirements prior to calving. The nutritional demands of lactation make it difficult for very thin cows to gain enough weight while grazing E+ fescue in spring to be in adequate body condition before breeding. In late winter and early spring on predominantly E+ fescue systems, cows should be fed the best hay in late winter and have high-quality pasture available to improve body condition scores up to BCS 6 before breeding season begins in late spring.

Graze bulls on nontoxic forage starting 60 days before breeding season. The negative effects of E+ fescue on spermatogenesis can begin 60 days prior to breeding. As temperatures increase in summer, negative effects increase. Avoid late summer breeding and provide nontoxic forage for as much of the breeding season as possible.

| Suggested Management Schedule for Beef Herds on E+ Fescue | |
|---|---|
| **January** | • Assess cow body condition and plan a feeding program to maintain cows in good BCS.<br>• Graze stockpiled fescue. |
| **February** | • Provide good quality hay to maintain good BCS for the start of calving season.<br>• Overseed legumes in closely grazed pastures/hayfields. Plant clover for spring/fall grazing and lespedeza for summer grazing.<br>• Graze stockpiled fescue or winter annuals. Winter annuals like wheat/ryegrass can be limit-grazed 2-3 days per week to add body condition to cows before calving. |
| **March** | • Graze E+ pastures first before ergovaline levels become high. This is one time of the year when frequent close grazing (i.e., continuous grazing) can be a good practice to reduce ergot alkaloid levels. However, do not limit available forage to the point of restricting forage intake and losing body condition.<br>• Avoid use of N fertilizer or poultry litter on E+ pastures in spring to reduce ergovaline and ergot alkaloid levels. Try to incorporate legumes where possible to reduce N fertilizer need and to improve forage quality.<br>• Rotate to clover/fescue pastures after grazing the E+ pastures. Legumes help improve animal performance.<br>• Use rotational grazing when possible. Rotational grazing does not reduce fescue toxicity, but does improve legume persistence and growth as well as persistence of orchardgrass and other nontoxic forages in mixed forage pastures.<br>• Graze off winter annual weeds in warm-season grass pastures. This can reduce shading of bermudagrass and will promote earlier bermudagrass growth. Having nontoxic forage such as bermudagrass or NE+ fescue available in May before breeding season is important.<br>• If bermudagrass pastures are contaminated with E+ fescue, apply glyphosate herbicide to kill the toxic fescue in late February or the first week of March before bermuda greenup. This will provide a nontoxic pasture for grazing in late spring before breeding season when ergovaline levels in the E+ fescue are high. Mixed pastures of E+ fescue and bermudagrass may provide a long grazing season but expose cattle to fescue toxicity for a longer period of time. |
| **April** | • Graze spring forages as needed. |
| **May** | • Clip seedheads from E+ pastures to prevent cattle from grazing seedheads.<br>• Rotate to NE+ fescue or other nontoxic pasture before breeding season begins.<br>• E+ fescue can be cut for hay since ergovaline content declines in hay during harvest and storage.<br>• Select E+ fescue pastures to renovate and spray with glyphosate herbicide. No-till summer annual to smother fescue sod.<br>• Avoid putting weaned calves or stocker calves on toxic E+ fescue. |
| **June** | • Avoid grazing E+ fescue during breeding season.<br>• Avoid grazing E+ fescue with stocker calves during summer. Plan to feed supplement if grazing E+ fescue is necessary. |
| **July** | • Plan to have breeding season finished before late July and August. |
| **August** | • Graze fescue/lespedeza pastures or warm-season grasses. |
| **September** | • Clip or graze E+ fescue pastures to 3-inch stubble and fertilize with 50 lbs/acre N for stockpiled winter pasture. Ergovaline declines in late winter reducing toxicity potential.<br>• Graze spring-calving cows and calves on nontoxic forage or NE+ fescue starting a month prior to weaning to improve weaning weights.<br>• Make last grazing or harvest of summer annual in pastures selected for renovation. Spray again with glyphosate and then no-till plant NE+ fescue. Delay grazing the new stand until spring. |
| **October** | • Graze established NE+ fescue or fescue/clover fields. |
| **November** | • Graze established NE+ fescue or fescue/clover fields. |
| **December** | • Begin grazing stockpiled E+ or NE+ fescue. |

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