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The Virginia Cattleman, September 2018, 40(9):20

Animal performance on toxic tall fescue

In previous articles, we've discussed the mechanism by which toxic alkaloids from the wild type fungus (present in most of Virginia's tall fescue) reduces animal performance. To a great extent, the symptoms that we have coined "fescue toxicosis" are a direct result of the vasoconstrictive effects of ergot alkaloids. Simply put, the blood vessels of livestock are constricted as a result of consuming these toxins. Of particular significance to cattle producers, reductions in blood flow within cattle result in severe heat stress in the summer, poor animal growth, and reduced reproductive performance.

As we discussed earlier ("The Fungus That Allows You to Have Your Grass and [Your Cows] to Eat It Too", May 2018, pg. 14-15), many producers may experience greater cattle performance by converting some toxic pastures to tall fescue with novel endophyte strains that produce little or no toxin. We have been working with producers around the state as part of an NRCS Conservation Innovation Grant to test this idea. In a recent study at a farm in Patrick County, 14 growing heifers (average weight = 530) were separated into two groups and stocked on either toxic tall fescue pastures or novel endophyte tall fescue pastures. The toxic tall fescue pasture, tested in early June of last year, was 100% infected with the toxic endophyte and total ergot alkaloid levels in the leaf tissue were at 1870 parts per billion (ppb). This level is slightly above the average (1660 ppb) of samples we have measured around the state, and considerably higher than the 400 ppb level often mentioned as a threshold for toxicosis issues. In contrast, the novel endophyte tall fescue field was 65% infected with the novel endophyte (E34) and produced 405 ppb of ergot alkaloids. Along with available forage, heifers in the two pastures were provided water and mineral and access to shade. Heifers on toxic pasture also could access a small creek. The average daily maximum temperature during the trial was 88 °F in nearby Stuart and the average minimum temperature was 63 °F. Maximum daily humidity was close to 100%, and the area received about 1.2" of rain during the test. Thus, this was a very representative summertime pasture situation in Virginia.

On July 16 of this year, we inserted blank CIDRs equipped with small temperature loggers into four heifers within each group and returned the heifers to their respective pastures. The temperature loggers allowed us to collect core body temperature measures remotely for four days from both groups of heifers without disturbing them. The heifers on the toxic tall fescue were significantly hotter than the heifers on the novel endophyte tall fescue from 8 PM through the night and morning until 3 PM (Figure 1). Night-time cooling is an important time for recovery from heat stress experienced during the day, and yet the heifers on the toxic tall fescue pastures were not able to cool down as well as the heifers on the novel endophyte tall fescue pastures. In fact, the heifers grazing toxic fescue were 1 °F hotter than the heifers on the non-toxic fescue early in the morning, which represents a large difference in body temperature for a mammal. It was interesting to note that the heifers on the novel endophyte tall fescue were slightly hotter than the other heifers at 5 and 6 PM. This likely can be attributed to differences in grazing behavior, as cattle on novel endophyte fescue were probably out grazing, while cattle grazing toxic fescue typically spend more time off feed and trying to cool themselves in water or shade. Regardless, by 8 PM the heifers on the toxic tall fescue had higher body temperatures. In fact, in a clinical setting a veterinarian would say that they had a low-grade fever (104.1 °F). So what does this mean for animal productivity, both weight gains and reproductive performance?

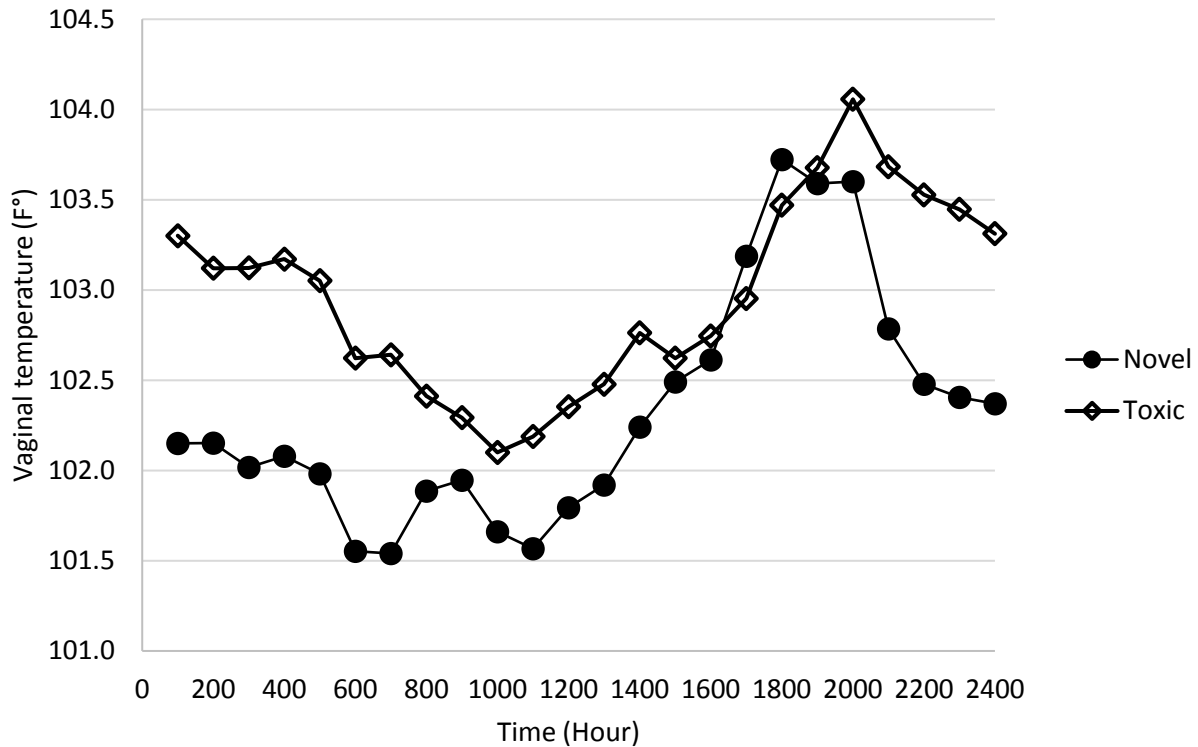


Figure 1: Heifers on toxic tall fescue had significantly hotter maximum body temperatures and failed to cool down at night as quickly as heifers on novel endophyte tall fescue in Patrick County.

During that trial, the heifers on the novel endophyte tall fescue pastures gained 1.78 lb/day while the heifers on the toxic endophyte tall fescue pastures gained 1.33 lb/day. This means that the heifers on the novel endophyte tall fescue pastures gained a total of 16.7 lb more per heifer than the heifers on the toxic pastures over that 37 day period. Similar studies from the 90s in Southwest Virginia and the Southern Piedmont indicated that stockers gained on average about 0.35 lb/day less when they grazed on toxic endophyte-infected tall fescue compared to endophyte-free tall fescue.

In a similar trial in Mecklenburg County, another set of both steers and heifers (average weight = 670 lb) were stocked on toxic endophyte tall fescue pastures or novel endophyte (MaxQ II) tall fescue pastures for four weeks. (A total of seven heifers and two steers were stocked on each pasture, but two of the heifers on the novel endophyte pastures were sick and thus excluded from our analysis, while a heifer in the toxic pasture was excluded for an incorrect weight reading at the end of the study.) In this trial, the calves were provided with 1.5% of their body weight in a 14% protein feed daily. Forage in the pastures should not have been limiting for these cattle, although the height of the forage in the toxic pasture was only a few inches high at the beginning of the trial. This toxic pasture was 75% infected and the ergot alkaloid concentration was 1600 ppb in June 2017. Both groups had access to natural shade. The average daily maximum temperature in nearby Chase City was 87 °F and the average minimum was 66 °F. This area received about 1.7" of rain during the trial and humidity was very high.

At the conclusion of this trial, the calves from the two pastures were not weighed at the same time of day. The calves on the novel endophyte pastures had to be weighed in the morning and the

calves on the toxic endophyte pastures were weighed in the afternoon. With those unadjusted weights, the calves on the toxic pasture appeared to have gained 0.7 lb/day more than the calves on the nontoxic pastures. However, differences in gut fill have a big impact on cattle weights, and after eating in the morning, calves weighed in the afternoon should have had much greater gut fill. Studies have indicated that afternoon weights may be 2% greater than morning weights. If we assumed this difference in gut fill between morning and evening measures, the calves on the novel endophyte tall fescue pastures actually would have gained 2.75 lb/day, while the calves on the toxic endophyte tall fescue pastures gained 2.36 lb/day. This difference of 0.39 lb/day is very close to the averages noticed in previous work throughout Virginia, despite the high level of supplementation provided to these calves. Even with this supplementation, if 50% of the diets of these calves came from the forage, the calves on the toxic pasture would have consumed a diet with 800 ppb total ergot alkaloids. This is twice the putative 400 ppb threshold at which beef cattle are affected by the toxins. To effectively dilute the toxins in the diet to about 400 ppb, calves grazing a pasture with 1600 ppb total ergot alkaloid could consume no more than 25% of their diet from the pasture.

Table 1: Trials in two Virginia counties demonstrated reductions in animal gains as a result of the toxicity of pastures defined here as total ergot alkaloids (TEA).

<i>County</i>	<i>TEA of toxic fescue</i> --- ppb ---	<i>Average air temperature</i>		<i>Average daily gains</i>		
		<i>Maximum</i>	<i>Minimum</i>	<i>Toxic</i>	<i>Novel</i>	<i>Difference</i>
		----- (°F) -----		----- lb/day -----		
Patrick	1870	88	63	1.33	1.78	0.45
Mecklenburg*	1600	87	66	2.36	2.75	0.39

*Gains adjusted based on assumptions about gut fill.

Although most Virginia cattle farms are largely cow-calf and not stocker oriented, toxic tall fescue can have similar effects on the weaning weights of calves. In fact, many research studies have shown that 50-lb reductions in adjusted weaning weights can be expected when cows and calves are stocked on toxic versus non-toxic pastures. This is a result of the effects of the toxins on both the calves directly and the reduction in milk produced by their dams grazing this forage.

Of even greater significance to the cow-calf producer is reproductive performance. We recently compiled data from 14 studies, all of which compared pregnancy or calving rates of spring-calving cows on toxic endophyte tall fescue pastures with reproductive performance of cows on low endophyte, endophyte-free, or novel endophyte tall fescue pastures. From this compilation, we found that pregnancy or calving rates were 65% for the cows on toxic pastures compared to 87% for the calves on non-toxic pastures. A 25% reduction in reproductive performance represents a substantial opportunity cost for cow-calf producers who are breeding cows early in the summer.

However, in one of those studies, the spring calving herds were also compared to fall calving herds. In this case, calving rates for the group on the toxic pastures was 90%, which was only 5% lower than the rate for cows grazing novel endophyte tall fescue during the breeding and calving seasons. It is clear that increases in body temperature due to vasoconstriction and summer heat can make it much more difficult for a cow to conceive or retain her fetus, which is why many producers have switched to breeding in the wintertime. In these situations, the impacts of tall fescue on reproductive performance

may be less severe, and this may be the basis for switching to a cooler breeding season or strategically renovating specific pastures.

Understanding when pasture renovation or other fescue toxicosis mitigation strategies are cost-effective depends largely on the magnitude of the problem. Recent studies, such as the two we have described, continue to confirm what past research has shown to be the effects of toxic tall fescue: 0.35-0.45 lb/day lower gains for stockers, 50-lb reductions in weaning weights, and 25% reductions in calving rates for spring-calving herds. Most, but not all, production systems in Virginia will match these scenarios. In a recent calculation, Dr. Robert Kallenbach, University of Missouri, calculated that if the average calving percent reduction was 16% and adjusted weaning weights were 50 lb lighter in the fescue belt as a consequence of toxic endophyte-infected pastures, the average value lost per cow each year (from 2005 to 2014) due to toxic tall fescue was \$160 per cow per year, or nearly \$2 billion annually.

This project is funded by an NRCS Conservation Innovation Grant. We would also like to thank the farmers who managed these demonstrations, Joe Clark and Calvin Honeycutt.