

Bulls and Fescue Toxicity

If you want your bulls performing at the top of their game, know what they are eating.

by Ed Haag

It is common knowledge that under certain circumstances endophyte-infected tall fescue can have a negative effect on beef cow reproduction, but now, researchers have determined that that effect can extend to bull fertility.

For the beef industry, tall fescue is both a boon and a curse.

While it remains one of the most common and productive pasture grasses in the U.S., providing forage for an estimated 8.5 million cattle,

it also costs the U.S. beef industry between \$500 million and \$1 billion in lost revenues, most of which is attributable to reduced reproduction and growth rates.

The culprit in this good-and-evil scenario is an endophytic fungus that commonly exists in tall fescue in a symbiotic relationship that helps the perennial cool-season grass to survive severe environmental stress. Unfortunately, that same fungus produces ergot alkaloids known to have a negative effect on the health of livestock.

A significant number of research projects through the years have focused on the effect of endophyte-infected tall fescue on female reproduction and stocker weight gain. Until the turn of the century, very little was known about the links between the toxic fescue and bull performance. For many in the beef industry, the conclusions to emerge from the

recent bull-oriented research have proved a revelation.

Michael Looper, research animal scientist at the Dale Bumpers Small Farms Research Center, Booneville, Ark., believes that this information could harbor serious consequences in relation to beef production

and should not be ignored.

“Think about it. If toxic fescue influences the fertility of a single bull, then that could reduce the

pregnancy rate of 20 to 25 cows in a natural-service situation,” he says.

Looper, who has focused his research efforts during the past several years on determining how and when endophyte-infected fescue affects cattle, points out that his study on the relationships among toxic fescue, heat stress and bull fertility is the most recent of two such studies conducted during the last four years.

Answers needed

The first study, designed to determine the effect of toxic fescue consumption on bull reproductive rates, was conducted in 2003 by Karen Jones, an animal science, food and nutrition researcher at Southern Illinois University.

“There has been decades’ worth of reports that have said that reproductive

rates decreased as a result of fescue toxicity, but it all focused on females,” she says. “We surmised that if it was affecting females it was probably affecting the males as well.”

Like Looper, Jones too was concerned about the multiplying effect a negatively affected bull could have on a herd under natural-service conditions. She had scrutinized the results of an earlier study involving the feeding of toxic fescue to male rats, and it did reveal a correlation between the fescue and a diminished ability to impregnate female rats. Whether or not this predisposition extended to bulls was yet to be proved, but if previous studies involving females were any indication, Jones felt it was likely that bulls, too, would be affected by toxic fescue.

Jones’ 60-day summer study involved six Angus bulls between 21 and 29 months of age allocated by body weight into two groups with three bulls in each group.

“I specifically chose summer because I knew we were going to have heat issues,” Jones says. “Previous research with females indicated that it was more likely that we would see an effect in the bulls in the warmer months of the year.”

For the 30 days prior to the study, all six animals received a diet that excluded fescue. Once under way, one group of three bulls received pelleted fescue seed known to contain 1,005 parts per billion (ppb) ergovaline, a concentration of ergot alkaloids that exceeded the threshold to induce clinical disease. The other group, functioning as a control, received a ration of corn and wheat middlings that was equal in protein and calories to the fescue seed ration. In addition, all the study animals were fed 7.72 kilograms (kg) per day of fescue-free alfalfa hay and were confined to individual pens to prevent diet cross-contamination.

Data collected and evaluated

For Jones, it was essential to the integrity of the study that a variety of measurements be taken. Twice a week during the 60-day period, researchers collected and analyzed semen samples, recorded the atmospheric heat index, measured scrotal circumferences, and took both rectal temperatures and the temperatures of blood moving through the testicular arteries into the testes.

While Jones’ research team initially believed that the cost of the equipment required to record the testicular temperatures was beyond the study’s budgetary means, they managed to devise an innovative low-cost solution that proved more than satisfactory.

“We didn’t have a lot of money to buy high-tech and expensive thermo-measuring



Table 1: Semen characteristics of bulls grazing either endophyte-infected (EI) or novel endophyte (NE) tall-fescue pastures

Item	EI	NE
Live semen, %	67.4	80.1
Minor defects ¹ , %	17.8	13.5
Major defects ² , %	11.3	10.9

¹Distal droplet, bent/coiled tail, headless, tailless.

²Malformed, abnormal acrosome, proximal droplet, folded tail, midpiece defect, cratered head, pyriform head, small/giant head.

Source: M.L. Looper, R.W. Rorie, C.N. Person, M.D. Person, T.D. Lester and C.F. Rosenkrans Jr., USDA-ARS, Dale Bumpers Small Farms Research Center, Booneville, Ark.; University of Arkansas, Fayetteville.

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devices, so we just went up to the local Walgreen's and got one of those human digital thermometers that is used to measure the temperature of the blood vessels in the forehead," she says, adding that by holding the thermometer on the study bulls' scrotums, the researchers were able to record the temperature of the blood entering the testes.

The ejaculate was evaluated for concentration, motility and morphology. Concentration was recorded using a densimeter calibrated to bovine parameters. Spermatozoal motility was determined using light microscopy, while samples were checked for abnormal sperm shape by

staining ejaculate with eosin/nigrosin and then viewing the results under an inverted microscope.

Sperm affected in fescue-fed bulls

As Jones suspected before beginning the research, study data revealed a definite correlation between the consumption of the endophyte-affected fescue seed, hot weather and a drop in the quality of the sperm collected.

While the ingestion of toxic fescue by bulls did not affect percent motile spermatozoa or abnormal spermatozoal morphology until after a sustained period of high environmental heat index, once it occurred, researchers did not have to look far to detect changes.

"It was very obvious that the motility of

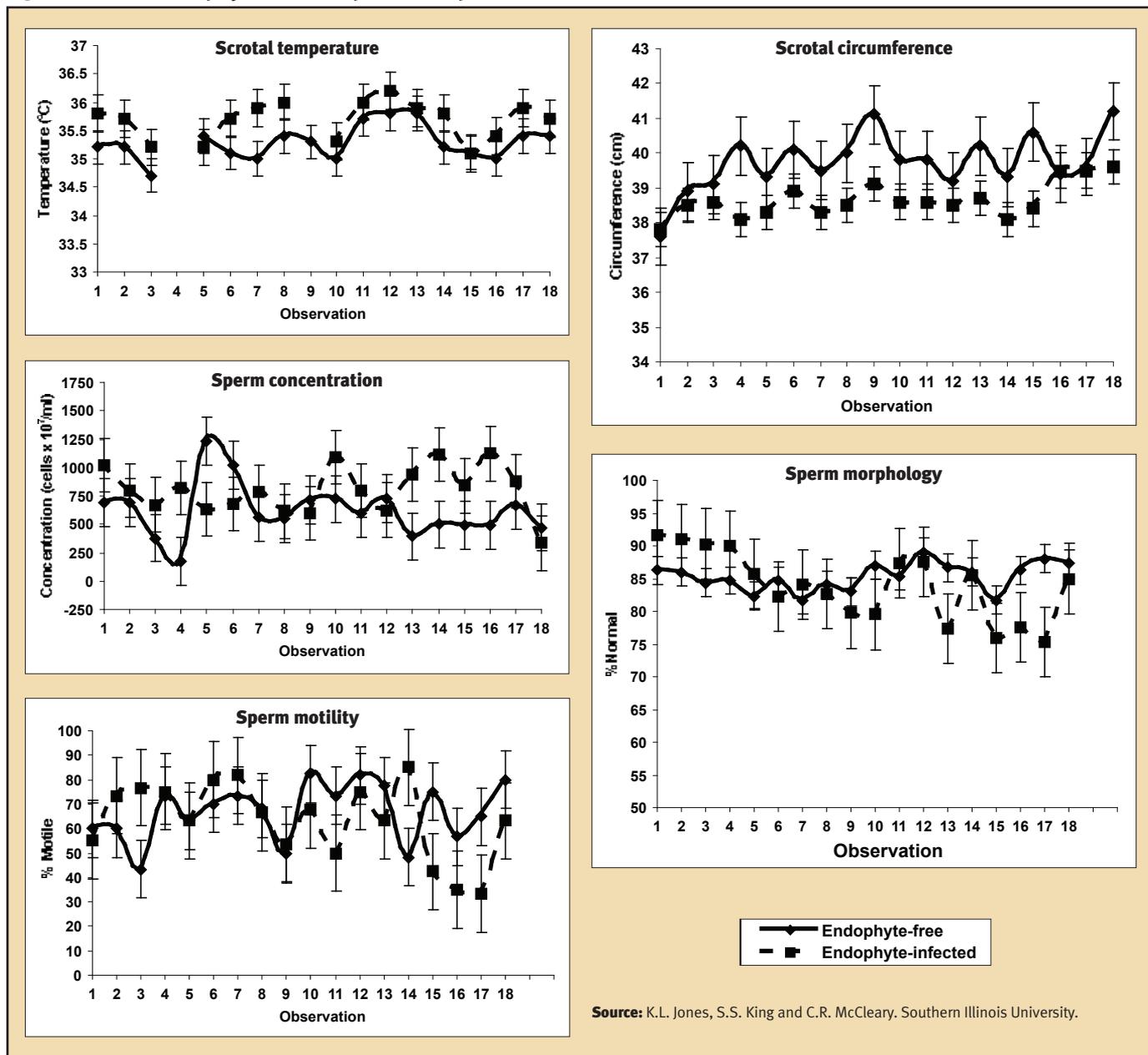
the sperm was negatively impacted in the fescue-fed bulls when it got hot outside," Jones says. "In a race that requires sprinters, these sperm were barely walkers."

She adds that there was also a reduction in the circumference of scrotums in the fescue-fed bulls — which can be construed as a precursor to reduced sperm production — and a rise in the frequency of aberrant sperm, especially when environmental temperatures increased.

No change was detected in the motility or quality of the sperm collected from the control bulls nor was there any reduction in their scrotal circumference when those animals were exposed to the same hot weather.

While many of the differences between the fescue-fed bulls and the control group were

Fig. 1: Effects of endophyte on bull reproductive parameters



somewhat predictable, one observation was not predicted.

"I certainly didn't expect sperm concentrations increasing in the animals that consumed the fescue," Jones says, adding that this didn't necessarily mean the fescue animals were producing more sperm. "What I really think is happening is that we are getting a reduction in fluid production from accessory sex glands such as the prostate."

She notes that this fluid functions as a lubricant, helping the sperm to travel and reach the egg.

Arkansas study confirms earlier correlations

In the most recently conducted study exploring the connections among fescue toxicity, the onset of heat stress and resulting effects on bull reproductive viability, Looper, in cooperation with researchers from the University of Arkansas, blocked 16 Brahman-influenced yearling bulls by body weight, scrotal circumference and pre-grazing semen characteristics.

Unlike Jones' study that involved feeding treatments of fescue seed, Looper's work focused on grazing fescue in a pasture setting. Toward that end, half of the 16 study animals were randomly assigned to graze on two endophyte-infected tall-fescue pastures (four bulls per pasture.)

The other half was grazed on two novel tall-fescue pastures. Novel tall-fescue varieties host animal-friendly or "novel" endophytes that produce the alkaloids necessary for maintaining stand hardiness but do not produce ergot alkaloids responsible for fescue toxicosis in livestock.

All 16 animals were grazed 119 days, from mid-April to mid-August. Each month scrotal circumferences were measured and semen samples were collected and evaluated using a computer-assisted sperm analysis system.

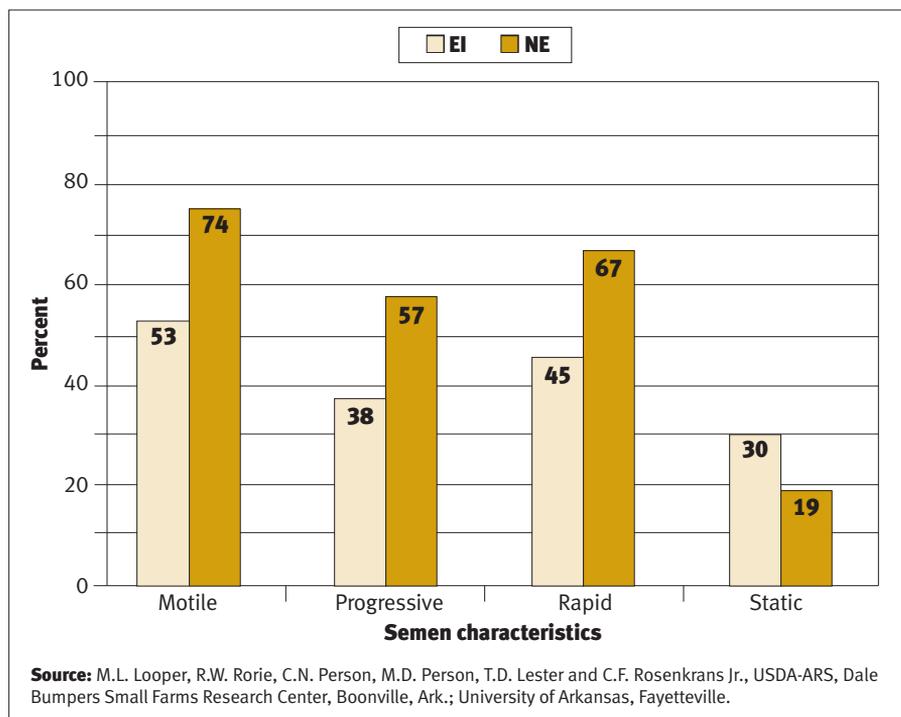
While scrotal circumference, body weight change and rectal temperatures (July and August) did not differ between bulls grazing endophyte-infected fescue (EI) and bulls grazing on novel-endophyte tall fescue (NE), the concentrations of prolactin were reduced in the EI bulls when compared with NE animals.

For Looper and his fellow researchers, this variation between EI and NE animals extended to semen quality. The percentage of live sperm tended to be greater from NE bulls than from EI bulls during July and August.

The NE bulls also had higher percentages of motile, rapid and progressive sperm than the EI bulls, which tended to have more static sperm.

"The average velocity of sperm decreased in bulls grazing endophyte-infected tall

Fig. 2: Semen characteristics of bulls grazing either endophyte-infected (EI) or novel endophyte (NE) tall-fescue pastures in July and August



fescue," says Looper, adding that this was not the case with the animals grazing the novel fescue. "That boils down to the fact that toxic fescue bulls had slower sperm cells."

He adds that while researchers have evidence from studies not related to toxic fescue that slower sperm cells are less likely to effectively perform their reproductive role, determining how much this actually affects the reproductive process within the endophyte context is worthy of further scientific exploration.

"What is the chance of that sperm and egg not meeting up at the opportune time?" he says. "That is the next study."

Based on his current study's data, Looper notes that it is not unreasonable to assume that the semen from bulls grazing on endophyte-infected tall fescue may have reduced sperm motility and that this deterioration in semen quality may be further exacerbated by increased ambient temperature.

Strategies to consider

Jones believes there is enough evidence at hand now to recommend proceeding with caution, especially when a breeding season involves grazing tall fescue in hot weather. She notes that one of the easiest ways to avoid problems with fescue is to be conscious of when animals are bred in relation to the plant's growing season.

"If you can adjust your breeding season so you are not trying to get your animals bred when the fescue is out you should be in good

shape," Jones says. "In our area this would mean after September."

She adds that fescue toxicity has a confirmed carryover effect on semen quality, so it makes sense to allow some lead time between when bulls are taken off of endophyte-infected fescue and when breeding season commences.

For Looper a good first step in dealing with fescue toxicity is knowing exactly what your animals are eating.

"Be aware of what your pasture mixes are," he says. "Once you know that, then you can start developing a strategy."

These strategies can range from dilution to making sure breeding actually takes place on non-fescue pastures, Looper says. "If you make grain or some other alternative feed available, animals will usually choose to eat that instead of fescue, especially during the hot parts of the year," he says.

For those who are ambitious enough to replant their stands, Jones recommends switching to a novel, or animal-friendly, fescue. Unlike the endophyte-free varieties that were marketed in the 1970s, the new novel varieties available today are as hardy as the ergot varieties.

She adds that if one plans to continue using the old varieties of tall fescue, it is also important to keep the plants from going to seed.

"The seedheads have concentrated amounts of endotoxins," Jones says. "It is a matter of managing your grass to preserve the health of your operation." 