Heat & fescue:

Bad Combination for Heifers

Researchers identify direct links between high ambient temperatures, the consumption of toxic fescue and impeded ovarian development in heifers.

Story & photos by ***Ed Haag***

It is hard enough breeding heifers under the best of conditions, so when heat stress and endophyte-infected fescue are added to the mix, reproductive systems, pregnancy rates and the long-term bottom line are all bound to suffer.

Dave Patterson, University of Missouri Extension researcher and reproductive specialist, notes that reproductive performance is the most important economic trait in a beef cow herd, and anything a rancher can do to reduce his percentage of open and late-bred animals will pay off handsomely at sale time. He adds that this premise is particularly relevant to the breeding of heifers in today's production environment, one which demands that cows conform to an increasingly narrow breeding window.

"It is an issue of labor and economics," he says, adding that if a heifer falls behind the herd in breeding there is a strong likelihood she will remain behind the herd in breeding back the rest of her productive life.

So how does endophyte-infected fescue enter this critical equation? As early as 1986, researchers from the Alabama Agricultural Experiment Station in Auburn reported in their documented study, "Fescue Toxicity and Reproduction in Beef Heifers," that weaned beef heifers who were assigned to pastures with low, medium or high levels of infection and received hay of similar infection levels during winter had decreased pregnancy rates as the infection level in the forage increased.

Feeding & Feedstuffs

These decreases in pregnancy rates could hardly be considered insignificant, with first-time pregnancy rates dropping from 96% for heifers that consumed 0%-5% toxic fescue to 82% for animals with a diet of 25%-60% fescue to 55% for heifers that ate 80%-99%

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►**Above:** Unlike adult beef cows, whose pregnancy rates are not affected by eating endophyte-infected fescue, Burke's study shows that heifers that are heat-stressed and consume toxic fescue are less likely to produce calves.

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toxic fescue. Significant reductions in daily weight gain and milk production were also documented as the percentage of fescue consumed was increased.

Control chambers open doors to new research

While subsequent research confirmed the main thesis of the Alabama study, very little of that work has focused on understanding exactly what is occurring in the heifer reproductive system when toxic fescue is being consumed. Joan Burke, research animal scientist at the Dale Bumpers Small Farms Research Center, Booneville, Ark., explains that this is due, in no small part, to the difficulties associated with closely monitoring subtle changes in the reproduction systems of heifers in a pasture environment.

Additionally, researchers exploring the effects of toxic fescue on animals fed outdoors were faced with an even more daunting challenge. Anecdotal and some empirical evidence led them to believe that heat stress exacerbated the negative effects of toxic fescue. How could they factor, into an exacting study, the effect of the changing weather patterns that continuously swirled around their bovine subjects?

In spite of these obvious obstacles, the scientists at the Dale Bumpers Research Center were convinced that a heifer study would provide a wealth of information that could be of benefit to the beef industry. Burke notes that up until then the effect of heat stress on reproduction in beef heifers affected by fescue toxicosis was not understood.

"Aside from the effects of endophyte-infected fescue on heat stress, we thought that it may cause other problems, such as decreased pregnancy and conception rates, and changes in follicular dynamics," she says. "We needed to know what was happening."

Burke adds that anecdotal evidence indicated heifers responded differently to toxic fescue than mature cows. "When we compared cows grazing on toxic fescue and those on other grasses, there didn't seem to be any difference in pregnancy rates," she says. As long as they had good body scores it didn't seem to affect them."

For Burke the solution lay in a fescue feeding study that utilized the Brody Climatic Laboratory at the University of Missouri.

"There were control chambers that allowed us to control the temperature, light and humidity," she says. "When you do the study on a pasture, you never know what the temperature is going to be. The chambers dealt with that issue."

The laboratory contained a set of four identical environmental chambers with a capacity of six heifers per chamber. Not only would the researchers be able to fully control the climatic conditions surrounding the heifers, the laboratory setting provided the ideal environment for the comprehensive monitoring of the subject animals.

A cooperative effort

Working in cooperation with departments of animal science at the University of Missouri–Columbia and the University of Arkansas–Fayetteville, Burke's U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS) research team designed a study that would examine the interaction of endophyte-infected tall fescue and environmental temperature on follicular and luteal development and function in beef heifers.

In order to accomplish this, 24 Angus or Angus×Hereford heifers between 10 and 18 months of age, weighing approximately 840 pounds (lb.), were assigned to one of two feeding regimens.

All heifers were initially subjected to thermoneutral conditions (66.2° F, 50% relative humidity) from Days -7 to -2.

Half the animals were then split into two groups, with six receiving endophyte-infected tall fescue seed at a thermoneutral (66.2° F) temperature and six at heat-stress temperatures. Creating the heat-stressed environment involved raising the temperature incrementally from days -1 to 0 and then cycling between 77° F and 88° F from Day 1 to Day 20. This continued from four weeks before to three weeks after synchronized ovulation.

The other half was fed endophyte-free fescue under exactly the same thermoneutral and heat-stressed conditions.

Throughout the experiment, heifers consumed a total mixed ration consisting as a percentage of dry matter (DM) of 39.4% corn; 20.5% soybean hulls; 18.4% fescue seed; 10% cottonseed hulls; 4.5% soybean meal; 6% molasses; 0.25% trace mineralized salt; 0.25% salt; 0.6% limestone; 0.035% vitamins A, D and E premix; and 0.025% vitamin E premix. Daily feed intake was measured.

Initially, all heifers were fed 1.75% of body weight (on a DM basis), which was formulated for a 0.68-kilogram (kg) gain per day. After 19 days, when it was determined 30% of the animals had lost weight, their ration was raised to 2.5% of body weight (DM basis).

Once heifers entered the heat stress/thermoneutral period, the feed offered to endophyte-free heifers was reduced to the average intake of endophyte-infected heifers, as a percentage of body weight, from the previous day for thermoneutral and heat-stressed treatments, so that intake between diets was similar.

Monitoring a key to study's success

For Burke and her research colleagues, one of the real limitations associated with earlier fescue studies was the impractical nature of conducting a comprehensive monitoring regimen in a pasture environment. Having the test animals confined in an area designed for monitoring reduced the variables significantly, Burke says.

Respiration rate and rectal temperature were measured daily at 6 a.m. and 4 p.m. Serum prolactin and total cholesterol were analyzed from blood collected on Day 17 (heifers were expected to be in the luteal phase of the estrous cycle) of the experiment to confirm toxicity from the endophyte-infected fescue diet.

Fig. 1: Effect of endophyte-infected fescue on gains, pregnancy rates and milk yield of heifers

%	Initial wt., lb.	Daily gains, lb./day		Pregnant, %	Postcalving, pregnant, %	Milk produced, lb./12 hr.
		Grazing	Winter			
0-5	562	1.65	0.18	96	93	8.16
25-60	560	1.26	0.35	82	45	7.06
80-99	591	0.75	1.19	55	33	3.97

Sources: Danielson, D.A., S.P. Schmidt, C.C. King, L.A. Smith and W.B. Webster, 1986. Fescue toxicity and reproduction 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.

Serum was collected and tested for progesterone and estradiol levels every other day after induced luteolysis between Day 1 and Day 23 or until ovulation. On that same day, follicular and luteal dynamics were examined using ultrasound for a synchronized estrous cycle. The size and location of follicles >4 mm and corpora lutea were recorded.

"This was done using the transrectal ultrasound," Burke says. "By moving things around you can get a pretty good picture of the ovaries."

Heat stress amplifies fescue effect

To the researchers involved in the study, the evidence was clear. Unlike previous fescue studies involving mature cows, heifers had a significant reproduction-related response to toxic fescue, especially when animals were heat-stressed. Burke notes that serum concentrations of prolactin were reduced in heat-stressed heifers fed infected seed, and both heat stress and infected seed decreased total cholesterol.

She adds that rectal temperature and respiration rate proved greatest in heifers fed the infected seed when exposed to maximal temperatures. Heat stress led to reduced diameter of the corpus luteum and serum progesterone compared with thermoneutral conditions. Progesterone was reduced more so in heifers fed infected seed.

The combination of infected seed and heat stress was associated with reduced diameter of the preovulatory dominant follicle, and consumption of infected seed led to fewer large follicles during the estrous cycle. Both stressors led to reduced serum estradiol. Burke concludes that impaired follicle function may explain reduced pregnancy rates commonly observed in heifers grazing infected tall-fescue pasture.

Heifers receive double whammy

Burke says what makes the heifer study relevant to U.S. beef producers in the Southeast and Midwest is the fact that a substantial number breed their animals on fescue pastures during late spring and early summer months.

"Lower fertility in heifers that graze endophyte-infected fescue could be explained by decreased luteal function resulting in early embryonic loss, which has been observed in sheep," she says. "Alternatively, there could be an asynchrony of reproductive hormones between the dam and the conceptus as evidenced by the earlier rise in serum progesterone and delayed rise in estradiol production in endophyte-infected fescue-fed heifers in the current study."

►If you graze breeding heifers on fescue, avoid months that are likely to produce heat stress.

She adds that altered follicular function occurs when heifers are heat-stressed and exposed to endophyte-infected fescue, which contributes to poorer fertility. The inability to regulate body temperature, triggered by fescue toxicosis, predisposes the animal to heat stress, which by itself is associated with reduced conception rates.

Burke notes that while there was a significant response to the consumption of toxic fescue when animals were heat-stressed, that negative response was not observed in endophyte-infected fescue-fed heifers under thermoneutral conditions, with the exception of decreased circulating estradiol.

"This indicates that signs of fescue toxicosis are certainly less severe when heifers are not heat-stressed and may explain lack of consistent results to treatment with endophyte-infected fescue as reported in the literature," she says, adding that some researchers reported no decrease in reproduction responses in association with endophyte-infected fescue.

Proceed with caution

For Burke the "take home" message from the study is: Proceed with caution, especially if there is likelihood that heifers will be bred on fescue pastures during the hot summer months. Instead, she recommends either shifting the breeding season to a period when heat stress is not an issue or moving the animals to a non-fescue grass pasture during the breeding season.

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