Tall Fescue Toxicosis: The State of the Science

United States Department of Agriculture
Agricultural Research Service

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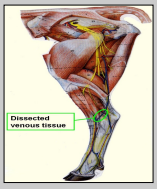
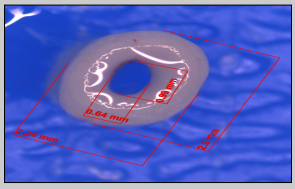
A Specific Cooperative Agreement was established in 2003 between FAPRU and the College of Agriculture, Food and Environment to conduct collaborative research in forage-livestock research

The First Stakeholder Focus Group Meeting was held in 2004 to determine what the research focus of FAPRU should be


The stakeholder group strongly recommended that FAPRU focus their research on fescue toxicosis in determining the mechanisms that ergot alkaloids adversely affect animal physiology

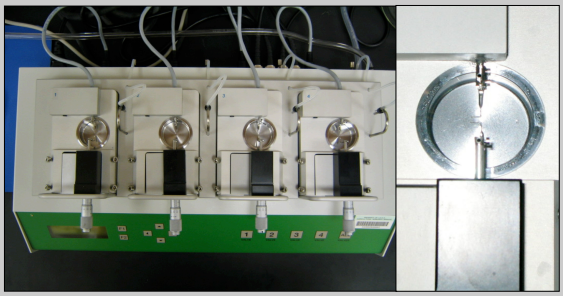




FAPRU Scientists: Klotz and Strickland
UK: Bush

Developed a bioassay to determine potency of various alkaloids in inducing constriction of the saphenous vein from cattle.

The Myograph



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Klotz, Strickand, and Bush

Research Qustion: Do ergot alkaloids accumulate in blood vessels?

Exposure	Ergovaline $1x10^{-7}$
	parts per trillion
2x	310
4x	362
6x	480
8x	524

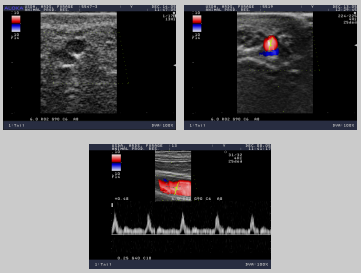
Answer: The highly potent ergovaline accumulates in blood vessels.

Drs. James Koltz, Dave Harmon (UK), and graduate students, Foote and Egert, investigated digestive efficiency of cattle grazed in toxic fescue pastures

- **A series of experiments reported constricted blood flow to the gut that reduced nutrient absorption.**
- **Thus, nutrient efficiency is negatively impacted by ergot alkaloids.**

Aiken, Strickland, and Bush

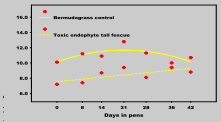
Developed a method using Doppler ultrasound protocol for study of toxic endophyte-infected tall fescue effects on cardiovascular function in grazing animals.



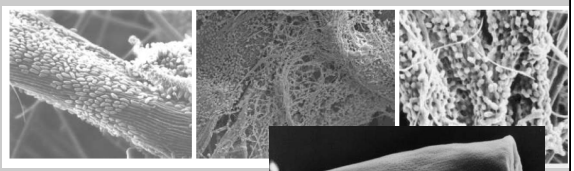
Aiken, Strickland, and Bush

Determined that endophyte-naïve heifers will start vasoconstricting within 24 hours of being exposed to a 0.8 ppm concentration of ergovaline.

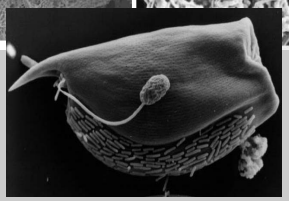
Ergot alkaloid induced vasoconstriction is relaxed and stable in 5 to 7 weeks



Microbial Degradation of Ergot Alkaloids



Picture by Paul Weimer



Picture by Andre Dennis Wright

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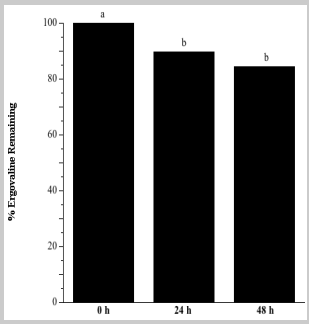
Moyer (Kansas State University) and Hill (University of Georgia) measured in vitro Degradation of ergovaline concentrated in tall fescue incubated in rumen fluid collected from a Jersey steer.

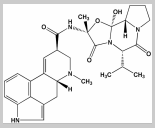
- **39% of the ergovaline was in a soluble form.**
- **95% of the soluble ergovaline was degraded**
- **18% of the insoluble ergovaline was degraded**

48% of the total ergovaline was degraded by either the bacteria or chemical reactions apart from the bacteria.

In our experiment hyper ammonia producing bacteria (primarily tryptophan utilizing bacteria) degraded 11 to 15 percent of the ergovaline in rumen fluid.

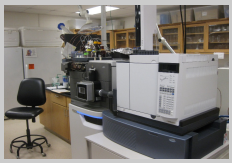
Possible, through the diet (protein supplementation), this degradation could be increased?





Degraded in rumen and liver to what??

Will require high-end technology to determine mass spectroscopy



Rumen degradation of ergot alkaloids could account for the premise that 3 ppm concentrations of ergot alkaloids in the diet is the threshold, below which there are no signs of fescue toxicosis.

Effect of Chaparral Treatment on steer average daily gain (ADG)

	ADG lb/day
With Chaparral	2.05
~~Without Chaparral~~	~~1.48~~

38% Inc.

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Treated Untreated

Seed head suppression can increase the crude protein of fescue tillers by 2 to 4 percentages units and in vitro dry matter digestibility by 8 to 10 percentage units.

Enhanced rumen breakdown of ergot alkaloids?

Search for antimicrobial growth promoters

Hops

Red Clover

Phytoestrogens for growing calves

- **Stocker production**
- **Feedlot**

Our research had shown increases in body weight gain on toxic tall fescue by either feeding soybean hulls (0.75% of BW) or ear implantation (estradiol-progesterone).

Question: Can we get combined effects on beef calf daily weight gain by feeding soybean hulls to implanted steers?

Answer: Feeding SBH and ear implantation for steers grazing toxic fescue had combined effects on average daily weight gain (ADG).

Treatments		
SBH	Implants	lb/steer/day
N	N	1.59
N	Y	1.79
Y	N	2.09
Y	Y	2.71

13% 31% 70%

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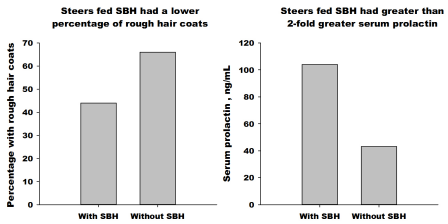
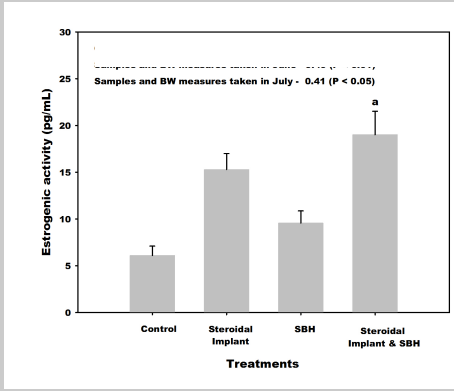
Severity of fescue toxicosis was reduced in steers fed SBH

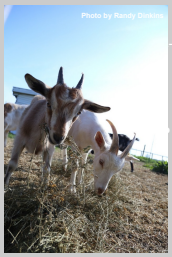


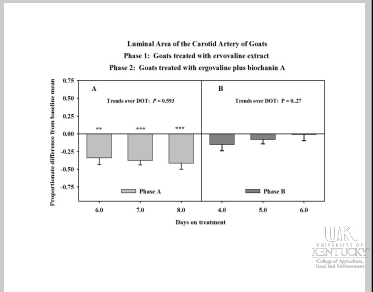
We observed that soybean hulls contain isoflavones (phytoestrogens), but are approximately 4x less than in soybean meal



Red clover in mixture with tall fescue could substantially boost stocker production on tall fescue

Biochanin A, the predominant isoflavone produced by red clover, can be fed to goats as a treatment to relieve ergot alkaloid-induced vasoconstriction





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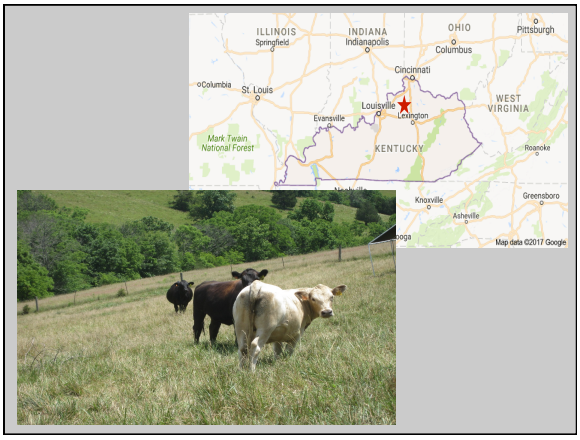

Demonstrations

- **Weed control**
- **New forage varieties**
- **Managements for mitigating fescue toxicosis:**
  - **Chemical seedhead suppression**
  - **Clovers**
- **New technologies for feeding and watering cattle**

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