Management practices to mitigate the adverse physiology in livestock that are exposed to ergopeptines

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An *Epichloë* endophyte that infects ‘Kentucky-31’ tall fescue produces alkaloids that impart tolerances to environmental stresses, but also produces ergot alkaloids that can cause a toxicosis in grazing livestock.
Signs of Fescue toxicosis

- Reduced reproductive performance and milk production.
- Maintain rough hair coats during the summer.
- Core body temperatures are elevated.
- Dry matter intake is reduced.
- Weight gains and thriftiness are low.
Adverse physiology caused by ergot alkaloids

Ergot alkaloids bind to:

• $\alpha$-adrenergic receptors to mediate vasoconstriction of the vasculature.
  
  As much as 50% reduction of blood flow to the skin to hinder thermo-regulation, and to the GI tract to reduce nutrient efficiency.

• $D_2$ receptors of the anterior pituitary to reduce secretion of prolactin.

  Consistently low prolactin, and reductions in progesterone and thyroid hormones have been documented.
Fescue Foot

Why the high incidence in cold weather?

Provided by the Missouri Cooperative Extension Service
Abdominal Fat Necrosis
Fescue toxicosis costs the U.S. beef industry over 1 billion dollars per year.
Extent of Ergot alkaloid toxicity depends on:

- **Plant reproduction development:**
  - Rottinghaus et al. (1991) determined ergot alkaloid concentrations in plant parts rank in order of:
    - leaf blade, leaf sheath, stems, seed heads

- **Plant growth rate:**
  - Soil fertility
  - Air temperature
  - Season
Seasonal Trends in Ergot Alkaloid Concentrations in Tall Fescue
Options in Managing Around Fescue Toxicsosis
Option 1
Feed co-product feeds or inter-seed clovers to increase cattle performance and reduce the severity of toxicosis.
Two-year grazing trial with steers grazing toxic endophyte-infected tall fescue evaluated effects of feeding pelleted soybean hulls combined with ear implants on mitigation or alleviation of fescue toxicosis.
Steers fed Soybean hulls had:

- 32 percent greater daily weight gain than controls without ear implantation and 70 percent greater daily weight gain with ear implantation.
- Greater incidence of shedding rough hair coats
- 2-fold greater serum prolactin than controls
We concluded that ergot alkaloids were deluded in the the diets, but... we are now speculating that isoflavones in the soybean hulls could have been a mitigating factor through their potential function as beta-agonists.

Shappell et al. 2015
What about clovers?
Isoflavones in clovers and other legumes have been indicated to function as beta agonists. Red clover can produce high concentrations of the isoflavone biochanin a.
Cross-sections of the common carotid of wether goats using color Doppler ultrasonography for assessing alkaloid-induced vasoconstriction
Experiment 1

![Graph showing data for Experiment 1]

A
- E+ tall fescue seed plus biochanin a
- Not significant; \( P = 0.112 \)

B
- E+ tall fescue seed only
- Deviations = 3.4 - 2.2 DOT; \( P < 0.001 \)
Experiment 2

A
- Extract only
- Not significant; $P = 0.558$,

B
- Extract plus biochanin a
- Deviation $= 2.5 + 1.9$ DOT; $P < 0.05$
Option 3
Replace toxic endophyte-infected tall fescue with non-toxic, novel endophyte-infected tall fescue
### Percentage Increase in Average Daily Gain with Novel Endophyte Fescue Relative to Wild-Type Endophyte Fescue

<table>
<thead>
<tr>
<th>Class</th>
<th>State</th>
<th>NE/Cultivar</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steers</td>
<td>GA</td>
<td>AR542/Jesup</td>
<td>+152</td>
</tr>
<tr>
<td>Suckling calves</td>
<td>GA</td>
<td>AR542/Jesup</td>
<td>+17</td>
</tr>
<tr>
<td>Postpartum cows</td>
<td>GA</td>
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<td>+142</td>
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<tr>
<td>Heifers</td>
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<tr>
<td>Steers</td>
<td>KY</td>
<td>AR584/9301</td>
<td>+29</td>
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Can novel endophyte-infected tall fescue persist?
THE COMMITTEE ON PERSISTENCE IS NO LONGER OUT!!

Novel endophyte tall fescues can persist under good grazing management.
Option 4
Managing seed heads
Seed heads of tall fescue can be mowed or chemically suppressed to increase cattle performance and reduce the severity of toxicosis.
Metsulfuran

Active ingredient in Chaparral (Dow AgroScience) herbicide that suppresses seed head emergence of tall fescue
2-fold greater prolactin in blood serum of steers grazing seed head suppressed fescue

<table>
<thead>
<tr>
<th></th>
<th>Serum prolactin (ng/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Chaparral</td>
<td>100</td>
</tr>
<tr>
<td>Without Chaparral</td>
<td>47</td>
</tr>
</tbody>
</table>
Leaf blades on tillers sampled in Chaparral treated pastures had 16% greater crude protein and 11% greater in vitro DM digestibility than those in untreated pastures.
Research indicates that treating toxic tall fescue with Chaparral herbicide can increase forage quality and alleviate consumption of highly toxic seed heads.
Summary

Fescue toxicosis can be alleviated by:
• Replacing Kentucky 31 tall fescue with a non-toxic endophyte tall fescue.

Fescue toxicosis can be mitigated by:
• Feeding soybean hulls at approximately 1% of BW or by overseeding with red clover or other legumes.
• Chemically suppressing seed head emergence to maintain fescue in a vegetative growth stage and alleviate very toxic seed heads as a dietary source of ergot alkaloids.
Questions