Cow and bull fertility in a fescue challenged environment

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Associate Prof. & Ext. Beef Cattle Specialist
Prof. & Department Head

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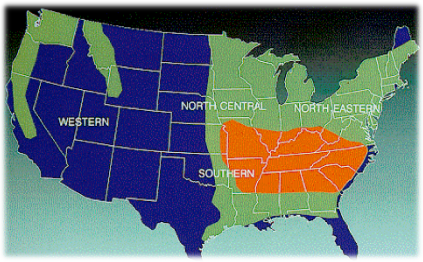
Tall Fescue



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Characteristics of Fungus

- Produced by Neotyphodium coenophialum
- Peptide ergot alkaloids
- Concentrations of ergovaline increase in spring and fall

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Tall Fescue Toxicosis Reduces Performance in Cattle

- Reduces forage intake
- Increases respiration rates
- Reduces serum prolactin
- Excessive salivation
- Fescue foot

(Porter, 1995, Browning et al., 1997; Oliver, 1997; Burke et al., 2001; Browning, 2004)

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Tall Fescue Toxicosis Reduces Performance in Cattle

- Less time spent grazing
- Rough hair coats
- Reduces weight gain

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Tall Fescue Toxicosis Reduces Performance in Cattle

- Reduced milk production
- Lowered fertility

(Porter and Thompson 1992; Porter, 1995; Browning et al., 2001; Burke et al., 2001)

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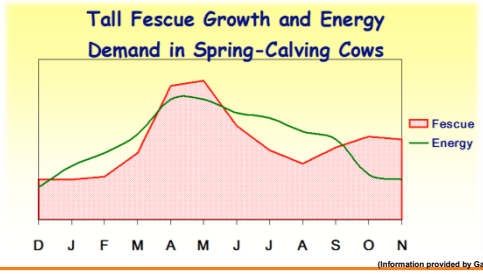
Why Graze with Tall Fescue?



(Information provided by Gary Bates)

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Benefits of Endophyte-Infected Tall Fescue

- Tall fescue is able to withstand:
  - Drought
  - Poor soil condition
  - Intensive defoliation
  - Insects

(Hill et al. 1984)

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- Detrimental effects produced by consumption of endophyte-infected tall fescue on female reproduction are well known…

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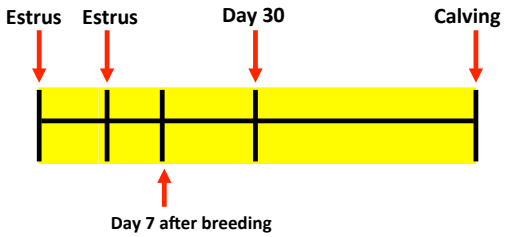
Timing of Reproductive Losses



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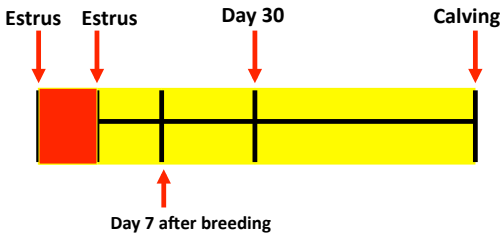
Timing of Reproductive Losses



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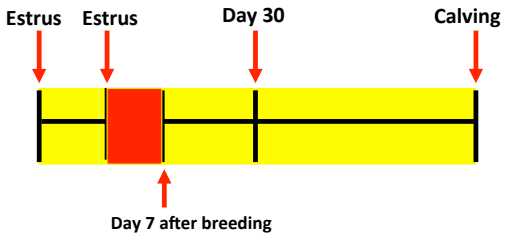
Timing of Reproductive Losses



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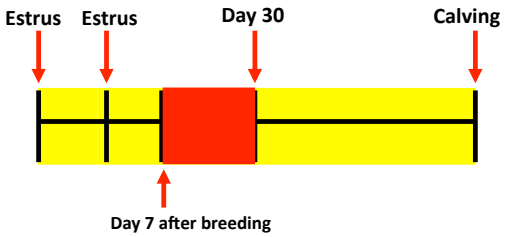
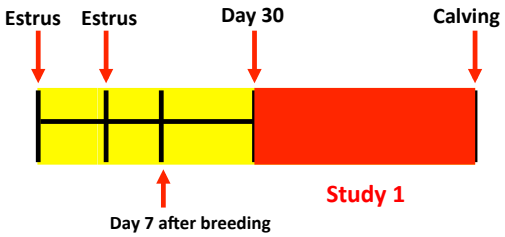
Timing of Reproductive Losses

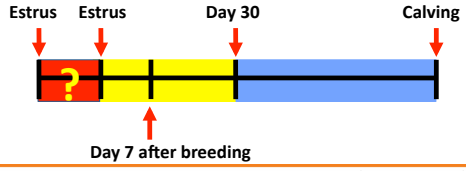


Timing of Reproductive Losses



Study 2

- Determine if ergotamine tartrate administration prior to estrus altered follicular and luteal dynamics and pregnancy rates

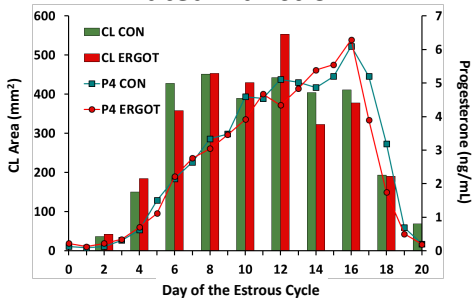


(Seals et al., 2005)

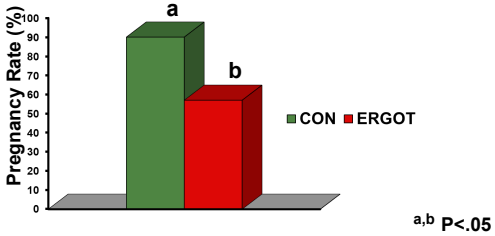
Follicular Dynamics

	Control	Ergotamine
Ovulatory size (mm)	15.1 ± 1.2	15.5 ± 1.2
Age (d)	9.1 ± 1.2	9.8 ± 1.2
E_2 at estrus	9.8 ± 0.9	9.1 ± 0.9
Estrus to ovulation (h)	40.5 ± 5.9	40.2 ± 6.3
Dominance (d)	3.6 ± 1.1	5.0 ± .9

Luteal Function



Pregnancy Rates



a,b P<.05

Summary of Study 2

- Follicular and luteal dynamics were not affected in heifers administered ergotamine tartrate
- Pregnancy rates and prolactin were significantly decreased

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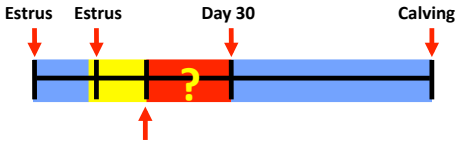
Study 3

- To determine if the uterine environment, in heifers consuming ergotamine tartrate, was suitable for maintenance of pregnancy



(Schuenemann et al., 2005)

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Summary of Study 3

Uterine environment was capable of maintaining pregnancy after day 7 in heifers consuming ergotamine tartrate

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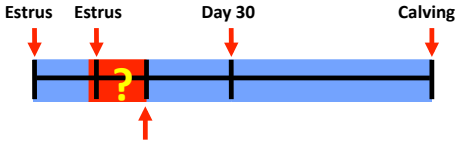
Study 4

To determine if administration of ergotamine tartrate to simulate fescue toxicosis affected embryo development



(Schuenemann et al., 2005)

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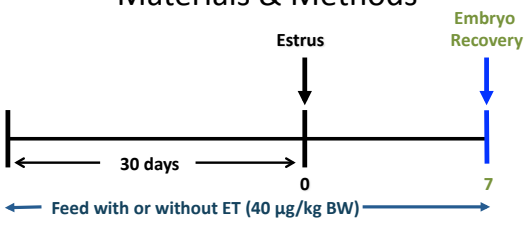
Materials & Methods



- Single embryo recovery
- Embryo evaluation

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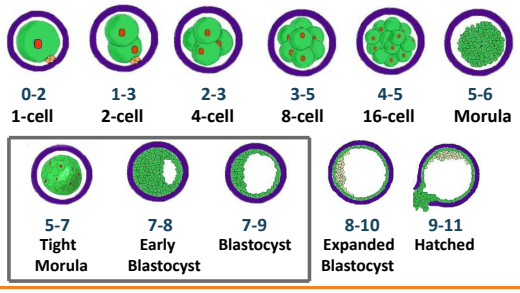
Embryonic Development



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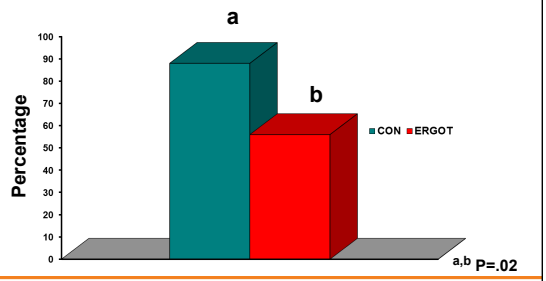
Embryo Development



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Embryo Quality

- Quality 1=Excellent
- Quality 2=Good
- Quality 3=Fair

Transferable Embryos

- Quality 4=Poor (Degenerate)

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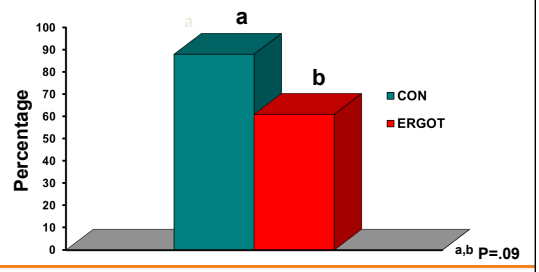
Transferable Embryos



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Summary of Study 4

- Lowered prolactin concentrations
- Decreased embryo development
- Decreased embryo quality

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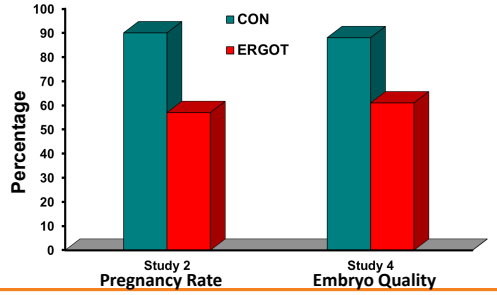
Comparison Between Study 2 & 4



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Conclusions

- Pregnancy rates are reduced due to decreased embryo quality and development
- Effects of ergotamine tartrate (fescue simulation) may be on the developing oocyte or early embryo

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Future Studies and Solutions

- Focus on the period before day 7
  - Oocyte issues
  - Oviductal/early uterine environment
- Solutions
  - Dilution, grazing and clipping
  - Supplemental feeding is beneficial
  - Avoid the heat!

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Detrimental effects produced by consumption of endophyte-infected tall fescue on female reproduction are well known…

However, limited studies have examined whether fescue toxicosis affects reproductive performance in the male

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Experimental Design – Study 1

Grazing Study

2 years

ERGOT Study

1 year (n=16)

350 kg and an average of 270 days of age (n=80; 40/year)

Grazing Fescue
E+ (New & Old)
E+Clover
MaxQ

Control

Treated

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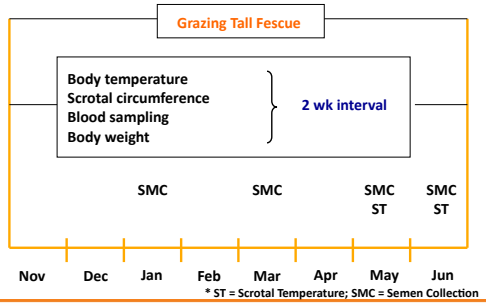
Timeline of Experimental Period



* ST = Scrotal Temperature; SMC = Semen Collection

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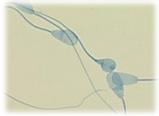
Semen Collection

- Collected using an electroejaculator
- Motility
- Morphology
  - Primary Abnormalities
  - Secondary Abnormalities
- IVF



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Experimental Parameters

Performance	Fertility Parameters	Oocyte Development
ADG	Motility	Motility
RT	Morphology	% Cleavage
HC	SC - ST	% 8-16 Cell
Prolactin	Testosterone	% Blastocyst
	Arginine	Nuclei #

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Materials & Methods

Concentrations of ergovaline (EV):

Treatment	EV (ppb)	Endophyte %
E+Old	360	90
E+New	340	92
E+Cl	395	94
MaxQ	< 50	52

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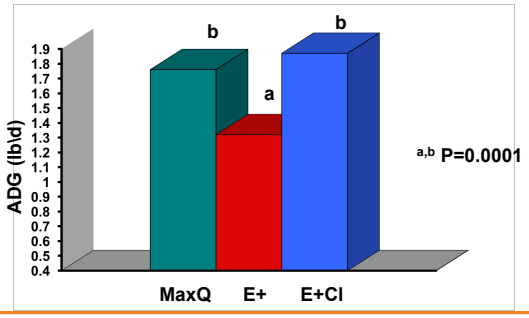
Average Daily Gain



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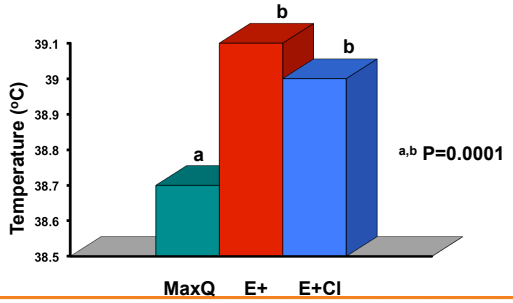
Rectal Temperatures



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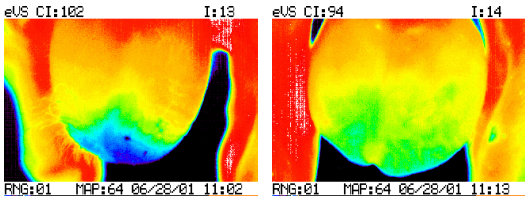
Which one is grazing Fescue?

BOTH!



E+ Tall Fescue **MaxQ**

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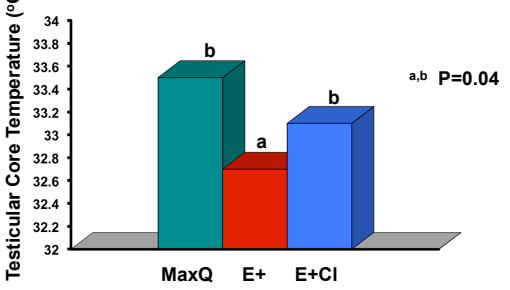
Testicular Core Temperature



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Semen Evaluation

Treatment	Normal Morphology (%)	Primary Abnormality (%)	Secondary Abnormality (%)
MaxQ	84.6 ± 2.4	6.5 ± 0.8	6 ± 1.2
E+	85.5 ± 1.7	5.4 ± 1.1	9.1 ± 1.6

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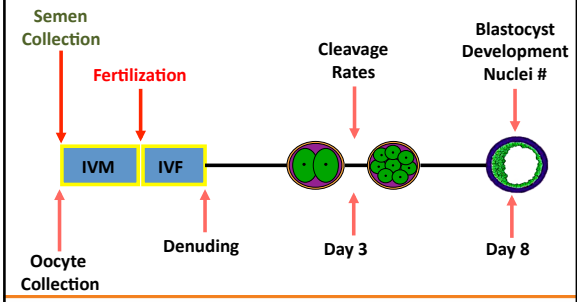
Experimental Design for IVF



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IVF Fertility Assessment (ERGOT)

Treatment	# Oocytes	Cleavage %	8-16 Cell %	Blastocyst %
CON	200	69.2[a]	75.2	29.6
ET	200	51.1[b]	64.4	34.0

[a,b] P=0.001

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IVF Fertility Assessment (Grazing Study)

Treatment	# Oocytes	Cleavage %	8-16 Cell %	Blastocyst %
MaxQ	850	84[a]	82.3	30.1
E+	873	73.5[b]	85.4	32.4

[a,b] P=0.02

Conclusions

Results suggest that while gross motility and morphology of semen remained unchanged, ability of oocytes to cleave following fertilization was affected, implying that alkaloids may damage sperm in ways undetectable under normal semen inspection

Objective – Study 2

- Determine if down stream issues of sperm from bulls grazing E+ Tall Fescue affect fertilizing capabilities.

Grazing Fescue
E+
MaxQ (NTE)

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Experimental Design – Study 2

Grazing Study

~550 kg and an average of 450 days of age (n=6)

Grazing Fescue
E+
MaxQ (NTE)

MaxQ (NTE)

Et

Materials and Methods

- 6 Bulls - Phenotypically similar
- 3 Max Q
- 3 E+ KY-31
- Grazed pastures April 18 – June 29
- Collected semen weekly for 7 weeks

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Materials and Methods

- Blood Samples
- Weights
- Rectal Temperatures
- Testicular Temperatures
- Scrotal Circumference Measurements
- Semen Measurements
- Ergovaline content

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Semen Collection

- Collected using an electroejaculator
- Motility
- Morphology
  - Primary Abnormalities
  - Secondary Abnormalities
- Freeze/AI

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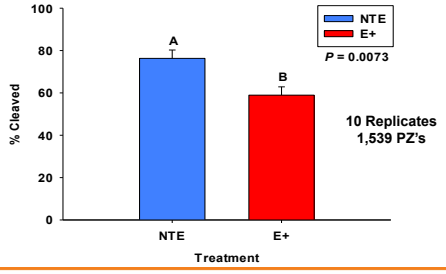
Decreased Cleavage Rates



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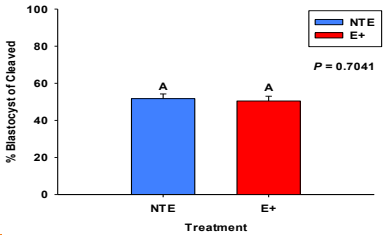
Blastocyst Development

- Percent blastocyst development of cleaved not altered
- No difference in blastocyst nuclei numbers (*P* = 0.2337)

- Schuenemann *et al.* 2004, 2005a



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Gross Motility and Morphology

- On farm motility and morphology did not differ

Trt	Motility (%)	Normal (%)	Primary (%)	Secondary (%)
NTE	90.9 ± 2.7	77.1 ± 1.9	18.6 ± 1.7	4.0 ± 0.6
E+	85.6 ± 2.7	77.6 ± 1.9	17.7 ± 1.7	4.7 ± 0.6
P-value	0.1679	0.8675	0.7159	0.3978

- Schuenemann *et al.* 2004, 2005a

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Motility Decreased

Variable	NTE	E+	*P*-value
Gross Motility (%)	90.95 ± 2.67^{A}	85.62 ± 2.67^{A}	0.1679
Pre-Freeze Motility (%)	94.88 ± 0.98^{A}	94.23 ± 1.01^{A}	0.6458
Post-Thaw 0hr. (%)	58.27 ± 2.81^{A}	43.84 ± 5.30^{B}	0.0240
Post-Thaw 3hr. (%)	51.13 ± 3.88^{A}	*23.33 ± 3.23^{B}	< 0.0001
0hr. – 3hr. Difference (%)	-5.99 ± 3.81^{A}	*-18.50 ± 4.12^{B}	0.0476

* Indicates sperm were negatively affected by cryopreservation

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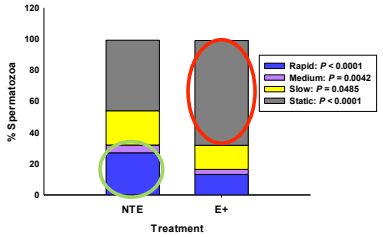
Reduced Velocities

- Agrees with Looper et al. 2009
- E+ bulls had slower and more "static" sperm



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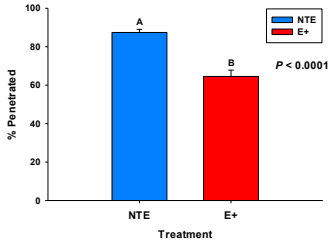
Decreased Penetration

- Penetration rates were significantly reduced for sperm from E+ bulls, explaining decreased cleavage



33 Replicates

n = 2,547 PZ's

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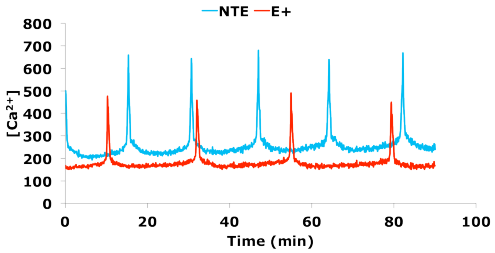
Reduced Calcium Parameters



- Intracellular calcium oscillations (area under the curve, duration, amplitude, baseline) are reduced in presumptive zygotes fertilized with semen from E+ bulls

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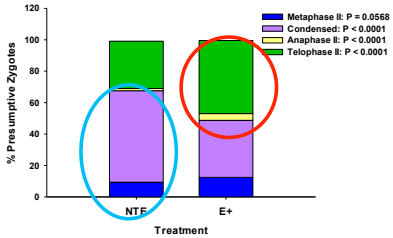
Accelerated Meiotic Progress

Meiotic progression of maternal chromatin hastened in zygotes fertilized with sperm from E+ bulls



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Summary

- Altered bull performance between E+ and NTE grazing bulls
- Reduced cleavage rates but blastocyst development is not different
  - Of the E+ sperm that do get in, blastocyst development occurs so if they make it this far then they are ok
- Reduced CASA motility & altered parameters
  - Slower sperm that act "impaired"

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Summary

- Reduced penetrating ability
  - They do not knock on the oocyte's door properly!
- Altered oocyte activation (Ca 2+)
  - E+ sperm do not "turn on the lights" as well as NTE sperm

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Overall Summary

- Female fertility affected during the first week of pregnancy
  - Appears to be through altered embryonic development (not uterine)
  - Not likely an issue with oocyte quality
- Male fertility affects not obvious during breeding soundness exam
  - Molecular impact on early embryonic development

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Overall Summary

- Management of fescue toxicosis affects on fertility can be simple
  - Dilution or strategic grazing
  - Targeted breeding season
  - Selection for adaptation

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- Dr. G. Schuenemann
- Dr. Gina Pighetti
- Nancy Rohrbach
- Dr. J. Klotz
- HRREC Beef Crew
- ETREC Beef Crew
- PREC BEEF Crew
- Dr. Ricky Seals
- Dr. Tulio Prado

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SOLUTIONS

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