Late-Season Burning: A Strategy for Sericea Lespedeza Control

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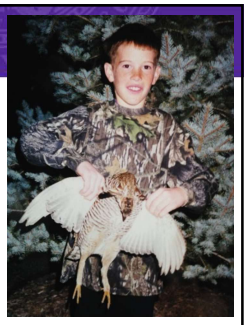
Alan Tajchman – Research Assistant



- Kansan
  - Born in Garden City → Grew up in Junction City
- B.S. & M.S. in Wildlife management
  - Kansas State University
  - Native habitat manipulation to benefit wildlife
  - Passion for the outdoors and our Tallgrass Prairie Landscape
- Mammalogist for a Private Research company
  - Konza Prairie and KU Field Station
- Riley County Volunteer Firefighter
- Currently leading 6-year prescribed fire research project

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Tallgrass Prairie in North America

- **Covered 165 million acres prior to European settlement**
  - 6.2 million acres (4%) remains
- **The remnant is home to more than:**
  - 500 plant species
  - 700 insect species
  - 300 bird species
  - 40 mammal species
  - Countless microorganisms
- **More ecologically diverse than rain forest ecosystems**
- **Provides sustainable income for many families and rural communities**

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What's so special about the Flint Hills?
Soil structure ill-suited to tillage
Frequent prescribed fire

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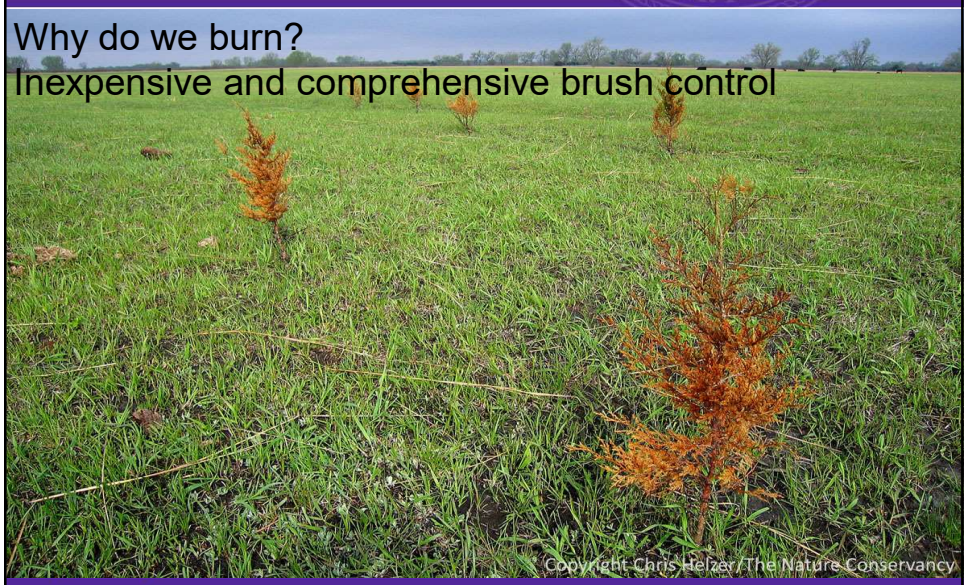
Why do we burn?
Inexpensive and comprehensive brush control



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Why do we burn?
Improved growth performance of yearling cattle

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Economic Impact of Prescribed Fire

- **Estimated net income from improved cattle growth in the Flint Hills**
  - $20 to 50 million annually
- **Inexpensive control of woody-stemmed plants**
  - Estimated cash cost of prescribed burning ≈ $0.75 / acre
  - Estimated cash cost of herbicide w/o application costs ≈ $3 to 82 / acre
  - Estimated cost of mechanical brush control ≈ $85 to 300 / acre
  - Preservation of the native prairie ≈ Priceless!

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Liabilities Associated with Prescribed Fire

- **Use confined to a dogmatically narrow period of time in early spring**
  - Late March and April
- **Smoke Management**
  - Downwind municipalities deal with degraded air quality when burning activities are concentrated in early spring
- **Labor Management**
  - Early spring is the busiest and most stressful time of year for Kansas farmers and ranchers
- **Fire Safety**
  - Prescribed fires can be difficult to control and appropriate weather is relatively rare during early spring
- **Early-spring fires do not control the most pernicious invasive species**
  - Sericea lespedeza is the most visible of these

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Sericea Lespedeza: A Landscape Killer

- Deeply-rooted perennial
- Tolerant of poor soils
- Robust canopy
- Resistant to grazing
- High in condensed tannins
- Prolific seed production
- Extended seed dormancy

- Treatment with specialty herbicides is common
  - Herbicide treatment results in collateral damage to non-target native plants, insects, and wildlife

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Effects of Growing-Season Prescribed Burning on Vigor of Sericea Lespedeza

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Growing-Season Burns for Sericea Lespedeza Control

- This presentation reports results from a 4-yr experiment on native tallgrass prairie that is affected by sericea lespedeza
  - National Fish & Wildlife Foundation (project no. 2003.12.039817)
- The 126-acre site was divided into nine burn units (about 14 acres each) that were **burned annually for 4 consecutive years**
- Prescribed fire treatments were:
  - Early spring (1 April **± 11 d**)
  - Mid-summer (1 August ± 2 d)
  - Late summer (1 September ± 3 d)

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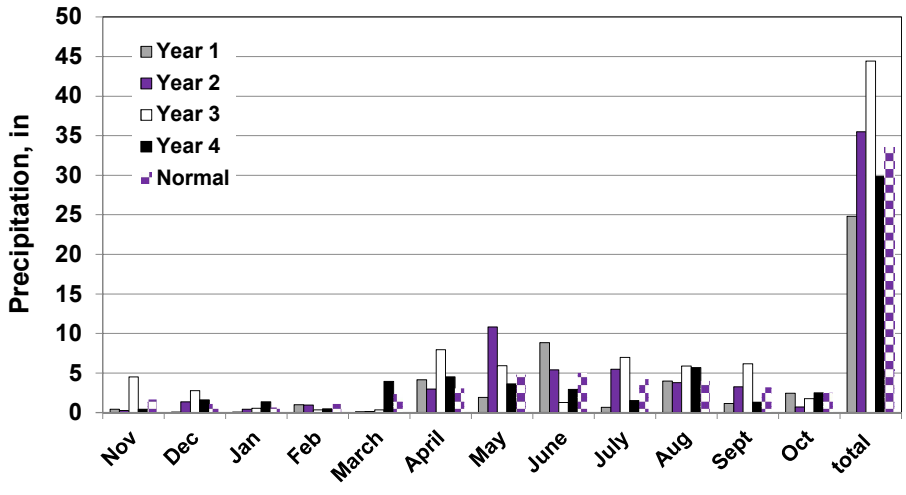
Figure 1. Water-Year Rainfall: Fall 2013 to Fall 2017



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Pasture # 1
Burned 07.28.14
Pictured on 07.28.14
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13


Pasture # 1
Burned 07.28.14
Pictured on 07.28.14
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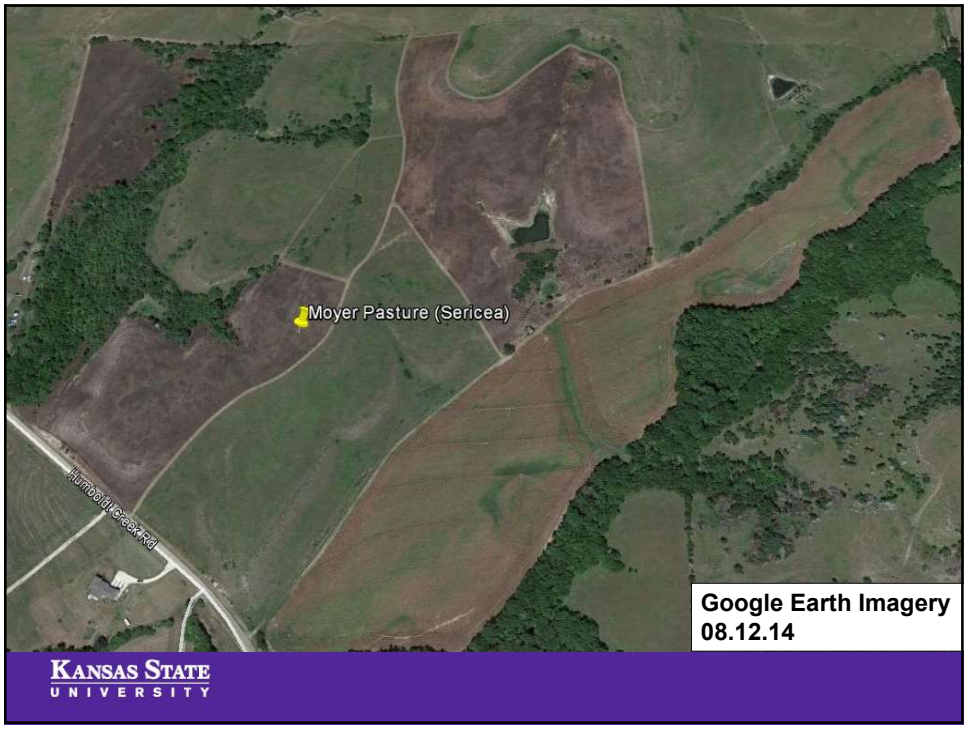
14


Moyer Pasture (Sericea)
Humboldt Creek Rd
Google Earth Imagery
08.12.14
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Pasture # 5
Burned 04.11.16
Pictured on 04.11.16

16


Pasture # 5
Burned 04.11.16
Pictured on 04.11.16
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August 2, 2016
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September 4, 2016

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Pasture # 7
Burned 08.01.14
Pictured on 08.01.14

Pasture # 3
Burned 08.30.14
Pictured on 09.02.14

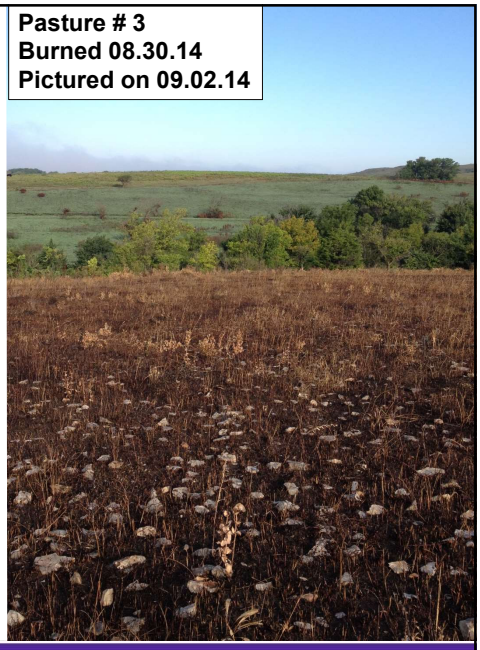

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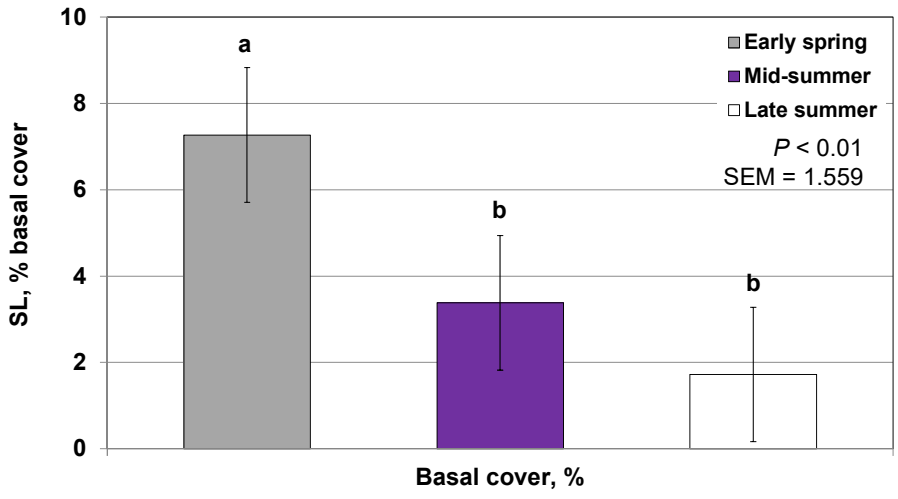
Figure 2. Sericea lespedeza, % basal plant cover



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[a, b] Means w/ unlike superscripts differ ($P \leq 0.01$)

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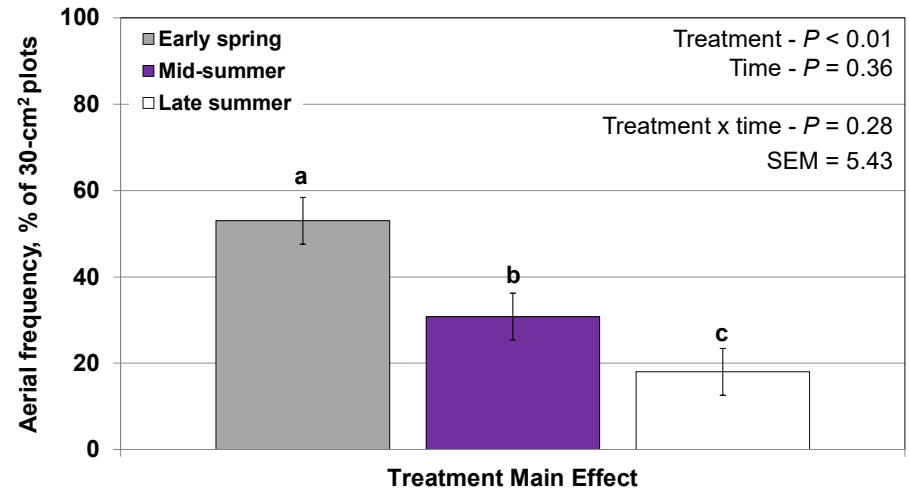
Figure 3. Effect of growing-season fire on SL aerial frequency



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[a, b, c] Means w/ unlike superscripts differ ($P \leq 0.02$)

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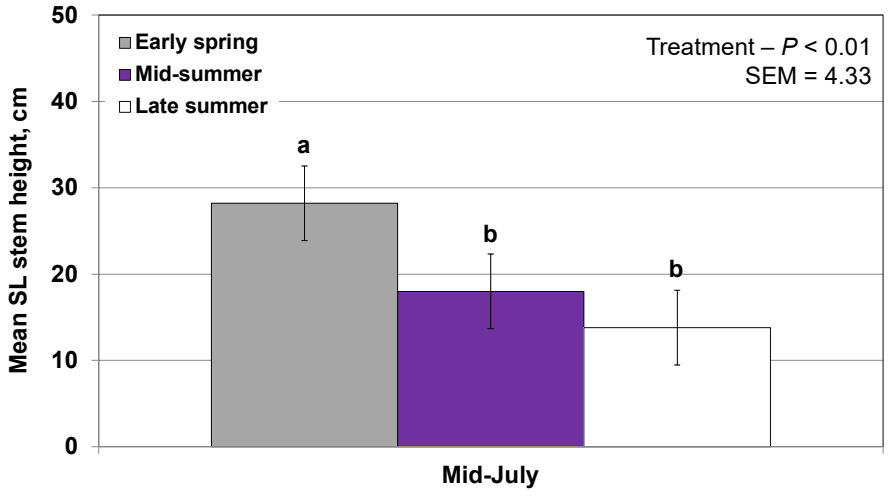
Figure 4. Effect of growing-season fire on SL stem height



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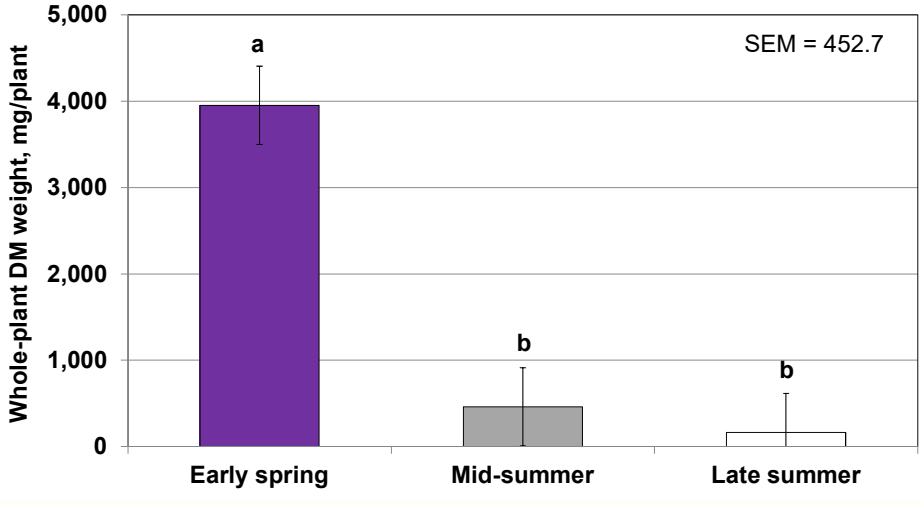
[a, b] Means w/ unlike superscripts differ ($P \leq 0.04$)

23

Figure 5. Sericea lespedeza whole-plant weight at dormancy



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[a, b] Means w/ unlike superscripts differ ($P < 0.01$)

24

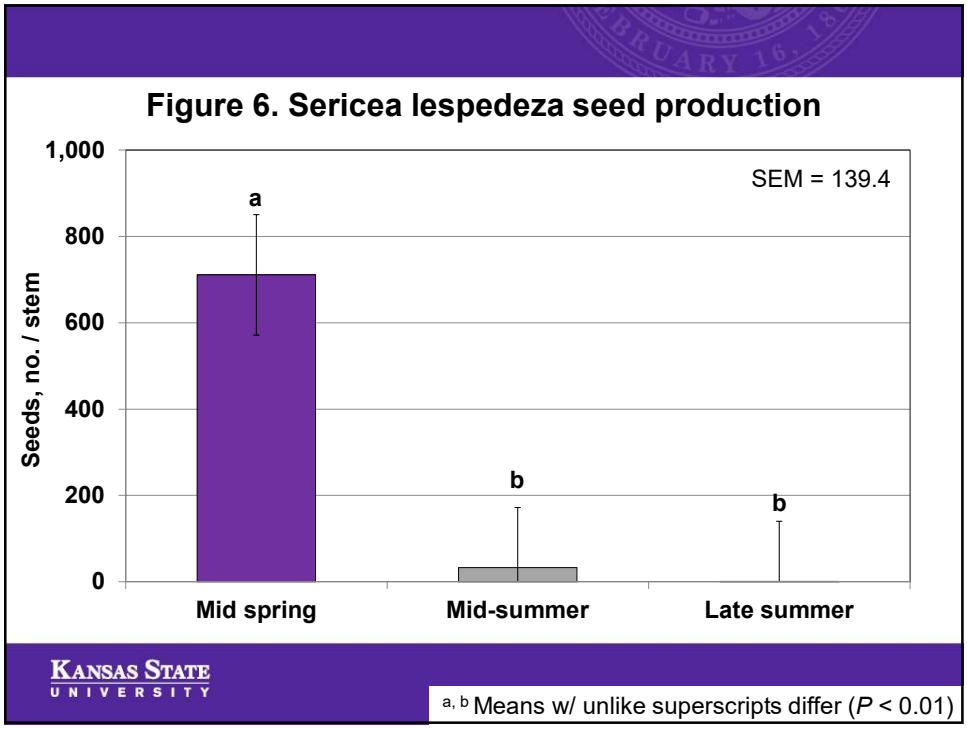
Figure 6. Sericea lespedeza seed production
1,000
800
600
400
200
0
Seeds, no. / stem
SEM = 139.4
a
b
b
Mid spring
Mid-summer
Late summer
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a, b Means w/ unlike superscripts differ (P < 0.01)

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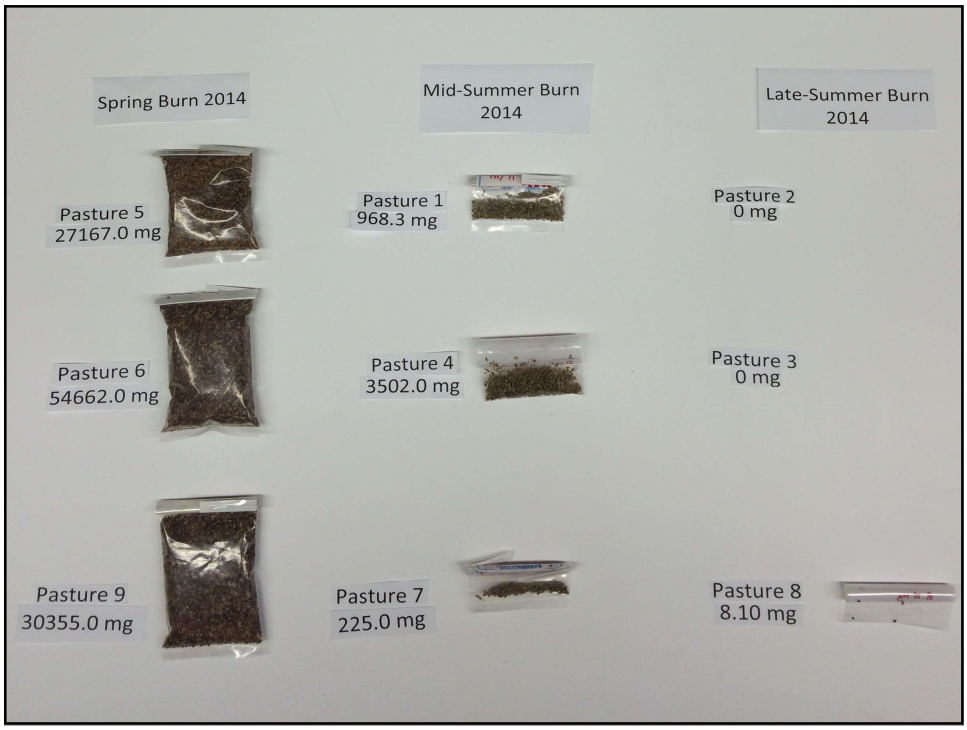
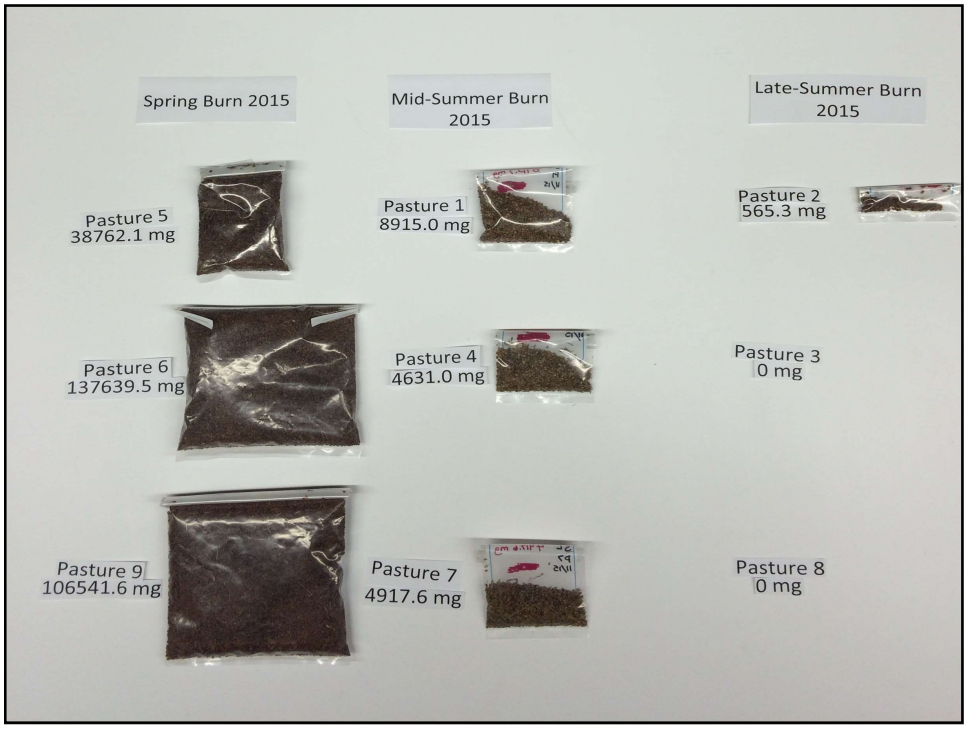
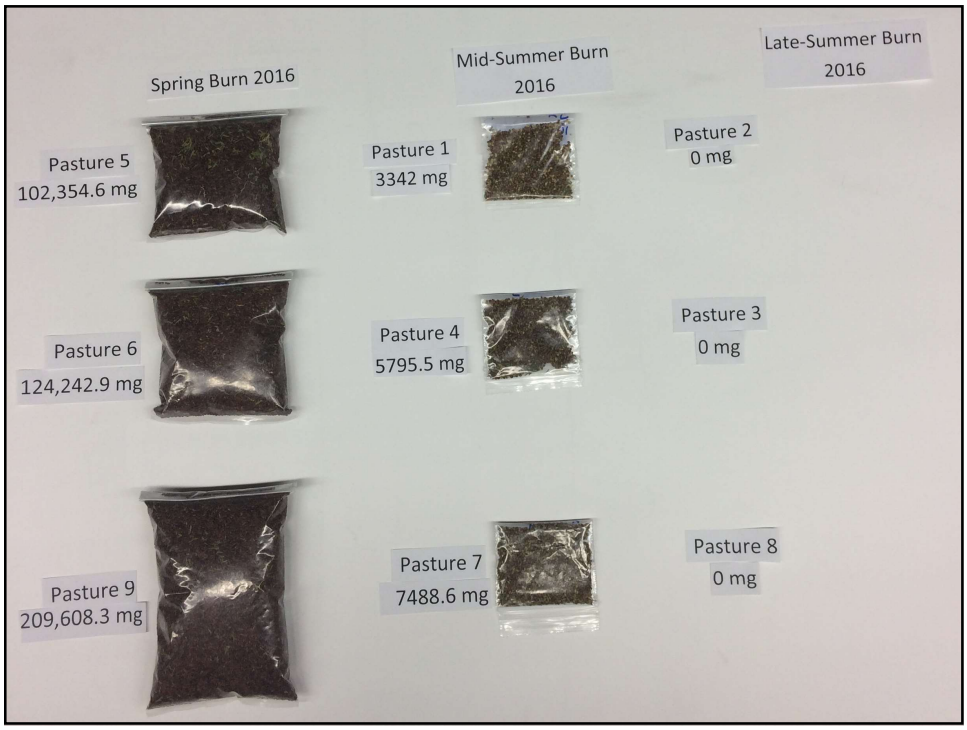

Spring Burn 2014
Mid-Summer Burn 2014
Late-Summer Burn 2014
Pasture 5
27167.0 mg
Pasture 1
968.3 mg
Pasture 2
0 mg
Pasture 6
54662.0 mg
Pasture 4
3502.0 mg
Pasture 3
0 mg
Pasture 9
30355.0 mg
Pasture 7
225.0 mg
Pasture 8
8.10 mg

26


Spring Burn 2015
Mid-Summer Burn 2015
Late-Summer Burn 2015
Pasture 5
38762.1 mg
Pasture 1
8915.0 mg
Pasture 2
565.3 mg
Pasture 6
137639.5 mg
Pasture 4
4631.0 mg
Pasture 3
0 mg
Pasture 9
106541.6 mg
Pasture 7
4917.6 mg
Pasture 8
0 mg

27


Spring Burn 2016
Mid-Summer Burn 2016
Late-Summer Burn 2016
Pasture 5
102,354.6 mg
Pasture 1
3342 mg
Pasture 2
0 mg
Pasture 6
124,242.9 mg
Pasture 4
5795.5 mg
Pasture 3
0 mg
Pasture 9
209,608.3 mg
Pasture 7
7488.6 mg
Pasture 8
0 mg

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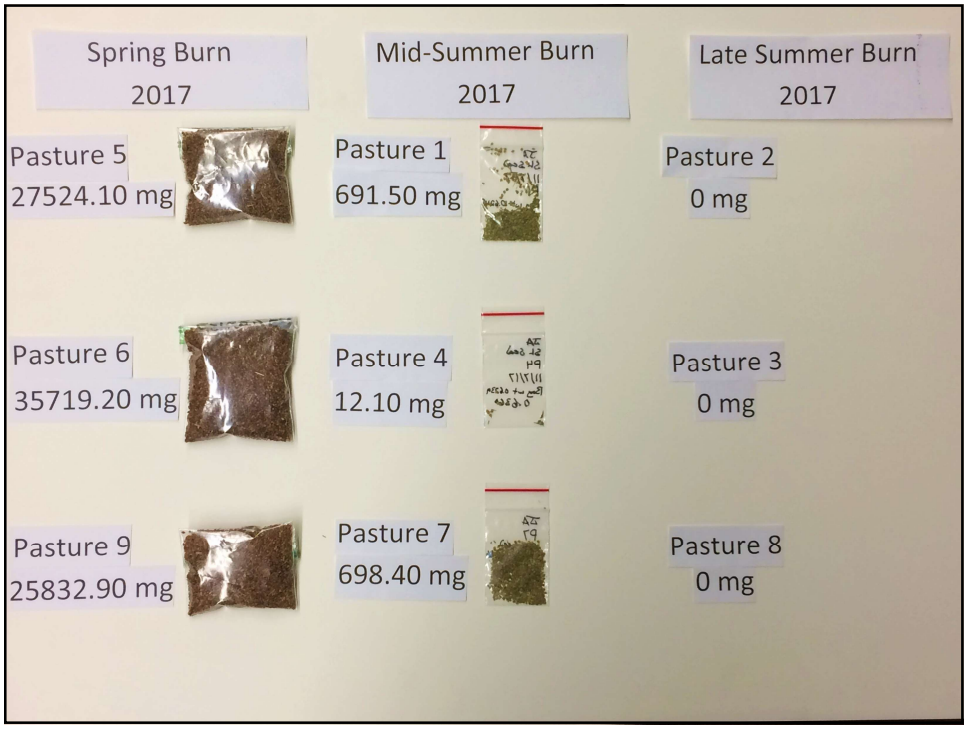

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What happened to the sericea?

- **Sericea plants were progressively weakened over time**
  - Unlike herbicide treatments, understory and overstory plants were equally affected by growing-season fires
- **Growing-season fires strongly suppressed seed production**
- **Regardless of when fire is applied, it scarifies sericea seeds and stimulates germination (Wong et al., 2012)**
  - **Seeds germinated in spring** = juvenile plants with a full growing season to mature = **maximum survival odds**
  - **Seeds germinated in September or October** = juvenile plants with little time to mature before winter = **minimum survival odds**

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Pasture # 2
Burned 08.30.14
Pictured on 09.04.14
So… what happened to everything else?

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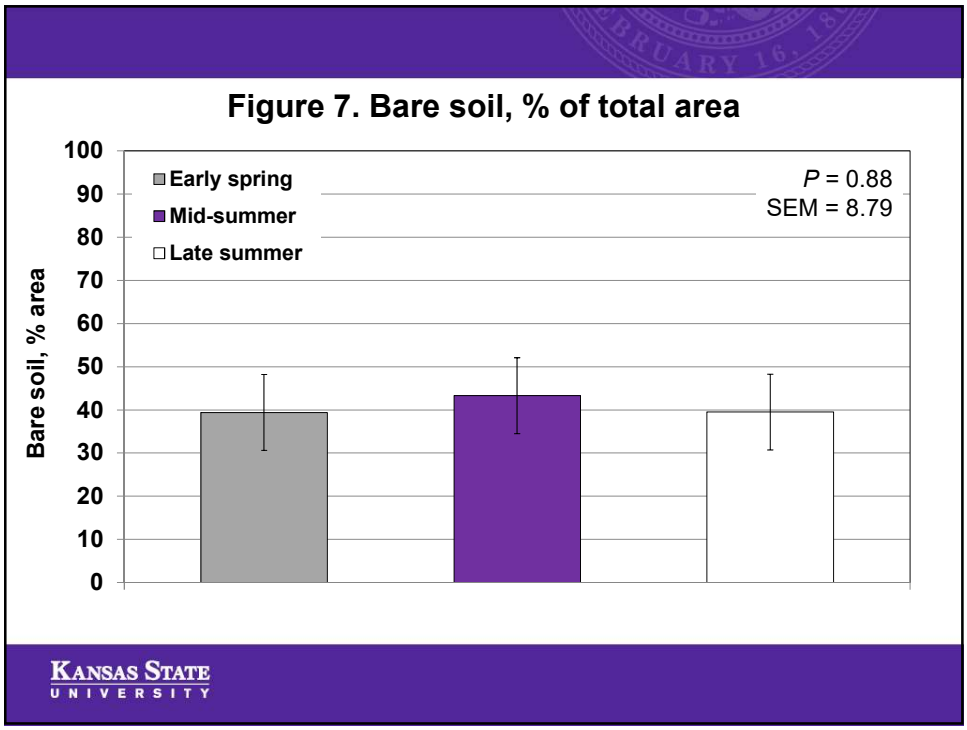
Figure 7. Bare soil, % of total area
Bare soil, % area
100
90
80
70
60
50
40
30
20
10
0
Early spring
Mid-summer
Late summer
P = 0.88
SEM = 8.79
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Figure 8. Litter cover, % of total area

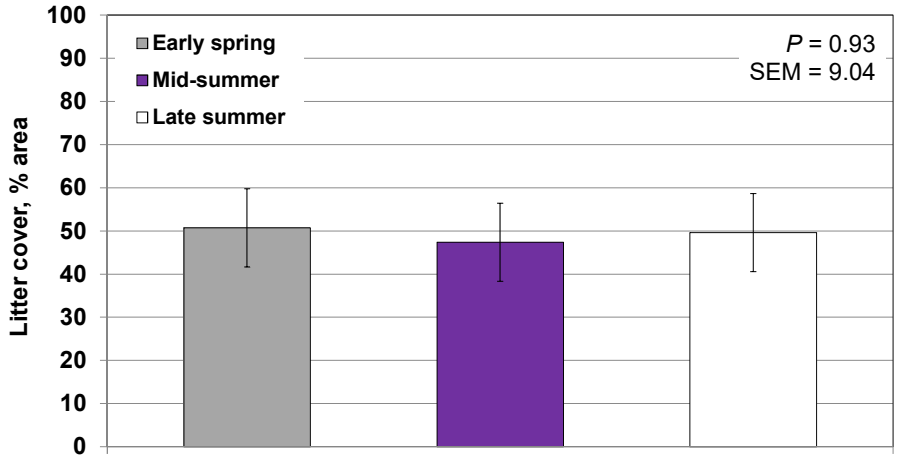

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Figure 9. Plant cover, % of total basal area

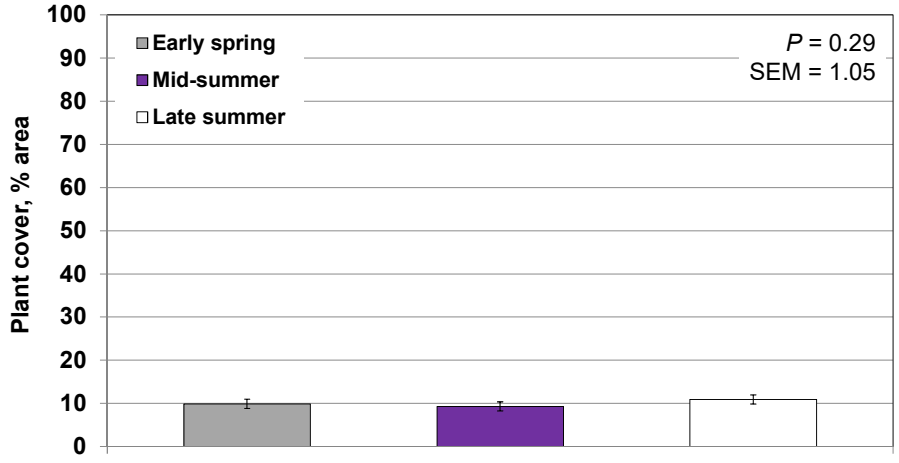

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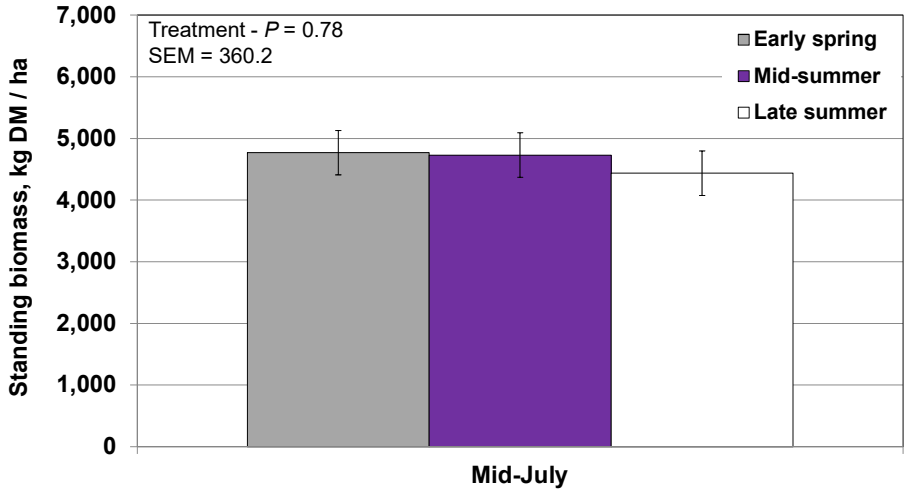
Figure10. Effects of growing-season fire on forage biomass



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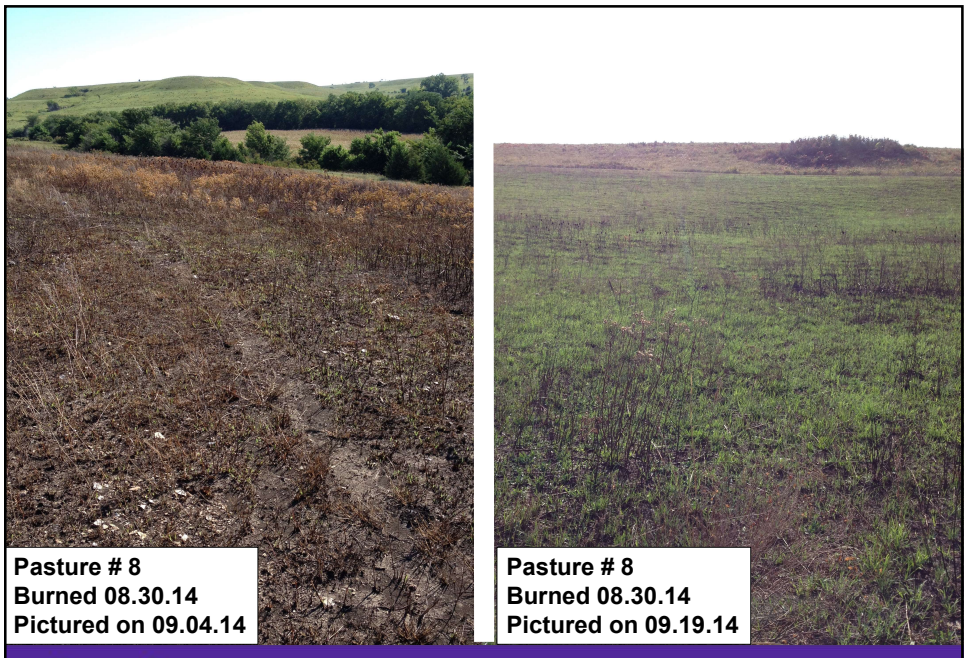

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Pasture # 8
Burned 08.01.14
Pictured on 09.26.14
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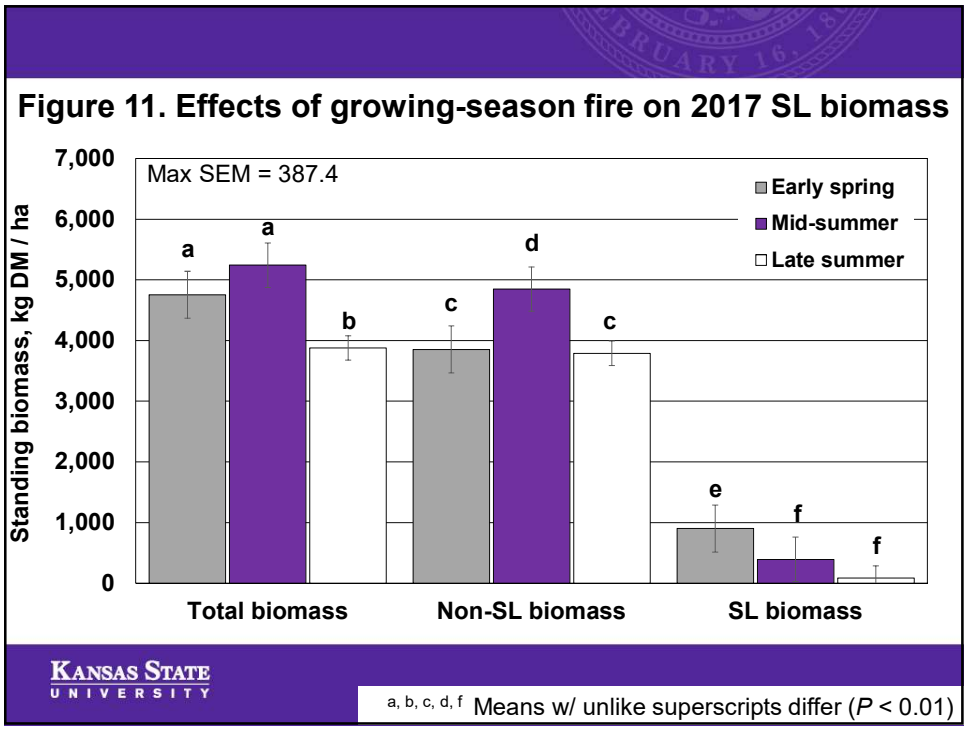
Figure 11. Effects of growing-season fire on 2017 SL biomass
Standing biomass, kg DM / ha
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Max SEM = 387.4
Early spring
Mid-summer
Late summer
a
a
b
c
d
c
e
f
f
Total biomass
Non-SL biomass
SL biomass
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a, b, c, d, f Means w/ unlike superscripts differ (P < 0.01)

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Table 1. Graminoid cover, % of total basal cover

Item	Early spring	Mid-summer	Late summer	SEM*	P-value†
Total grass cover, %	82.8	85.9	86.5	2.17	0.20
C4 grasses, %	67.7	65.9	64.8	3.40	0.70
C4 tall grasses, %	36.2[a]	41.1[a]	22.1[b]	3.52	< 0.01
C4 mid grasses, %	28.2[a]	23.7[a]	39.3[b]	3.48	< 0.01
C4 short grasses, %	3.3[a]	1.1[b]	3.4[a]	1.00	0.04
C3 grasses and sedges, %	15.1	19.7	21.7	3.11	0.11
Annual grasses, %	0.07	0.33	0	0.227	0.31

* Mixed-model SEM associated with comparison of treatment main effect means.
† Treatment main effect.
[a, b] Within row, means with unlike superscripts differ ($P \leq 0.05$).

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Table 2. Specific graminoids, % of total basal cover

Item	Early spring	Mid-summer	Late summer	SEM*	P-value†
Big bluestem, %	18.4[a]	18.1[a]	11.9[b]	2.61	0.02
Indian grass, %	12.1[ab]	15.0[a]	9.4[b]	2.13	0.04
Switchgrass, %	5.5	4.0	1.5	1.70	0.07
Little bluestem, %	14.2[a]	11.8[a]	23.0[b]	3.76	0.01
Sideoats grama, %	9.9	7.4	11.0	3.27	0.53

* Mixed-model SEM associated with comparison of treatment main effect means.
† Treatment main effect.
[a, b] Within row, means with unlike superscripts differ ($P \leq 0.05$).

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Table 3. Forb cover, % of total basal cover

Item	Early spring	Mid-summer	Late summer	SEM*	P-value†
Total forb cover, %	15.4	12.1	11.2	2.28	0.16
Perennial forbs, %	15.3[a]	10.9[b]	9.7[b]	2.05	0.02
Sericea lespedeza, %	7.3[a]	3.4[b]	1.7[b]	1.56	< 0.01
Baldwin's ironweed, %	0.7[a]	0.2[b]	0.4[b]	0.16	0.01
Western ragweed, %	3.3[a]	0.9[b]	0.7[b]	0.53	< 0.01
Major wildflowers, %	0.6[a]	0.9[ab]	1.4[b]	0.28	0.03
Annual forbs, %	0.1[a]	1.2[b]	1.5[b]	0.52	0.02

* Mixed-model SEM associated with comparison of treatment main effect means.
† Treatment main effect.
[a, b] Within row, means with unlike superscripts differ ($P \leq 0.05$).

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Table 3. Forb cover, % of total basal cover

Item	Early spring	Mid-summer	Late summer	SEM*	P-value†
Total forb cover, %	15.4	12.1	11.2	2.28	0.16
Perennial forbs, %	15.3[a]	10.9[b]	9.7[b]	2.05	0.02
Sericea lespedeza, %	7.3[a]	3.4[b]	1.7[b]	1.56	< 0.01
Baldwin's ironweed, %	0.7[a]	0.2[b]	0.4[b]	0.16	0.01
Western ragweed, %	3.3[a]	0.9[b]	0.7[b]	0.53	< 0.01
Major wildflowers, %	0.6[a]	0.9[ab]	1.4[b]	0.28	0.03
Annual forbs, %	0.1[a]	1.2[b]	1.5[b]	0.52	0.02

* Mixed-model SEM associated with comparison of treatment main effect means.
† Treatment main effect.
[a, b] Within row, means with unlike superscripts differ ($P \leq 0.05$).

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Table 3. Forb cover, % of total basal cover

Item	Early spring	Mid-summer	Late summer	SEM*	P-value†
Total forb cover, %	15.4	12.1	11.2	2.28	0.16
Perennial forbs, %	15.3[a]	10.9[b]	9.7[b]	2.05	0.02
Sericea lespedeza, %	7.3[a]	3.4[b]	1.7[b]	1.56	< 0.01
Baldwin's ironweed, %	0.7[a]	0.2[b]	0.4[b]	0.16	0.01
Western ragweed, %	3.3[a]	0.9[b]	0.7[b]	0.53	< 0.01
Major wildflowers, %	0.6[a]	0.9[ab]	1.4[b]	0.28	0.03
Annual forbs, %	0.1[a]	1.2[b]	1.5[b]	0.52	0.02

* Mixed-model SEM associated with comparison of treatment main effect means.
† Treatment main effect.
[a, b] Within row, means with unlike superscripts differ ($P \leq 0.05$).

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Figure 12. Shrub cover, % total basal cover

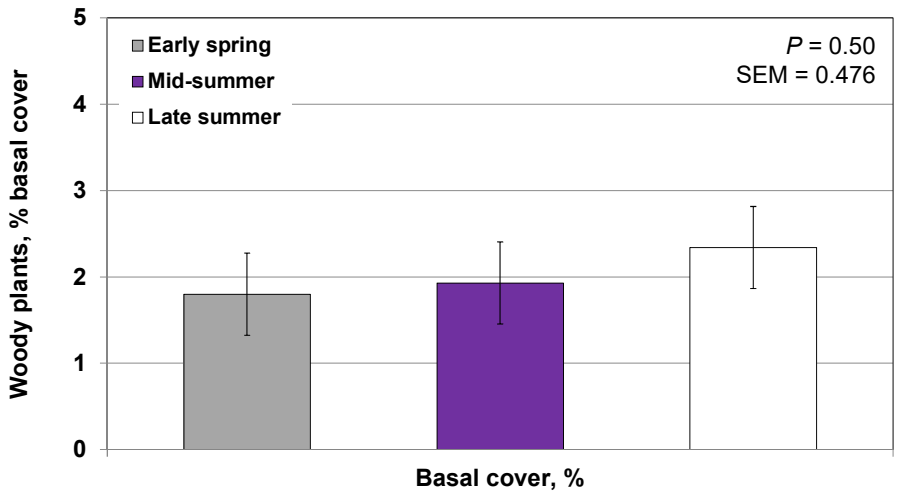

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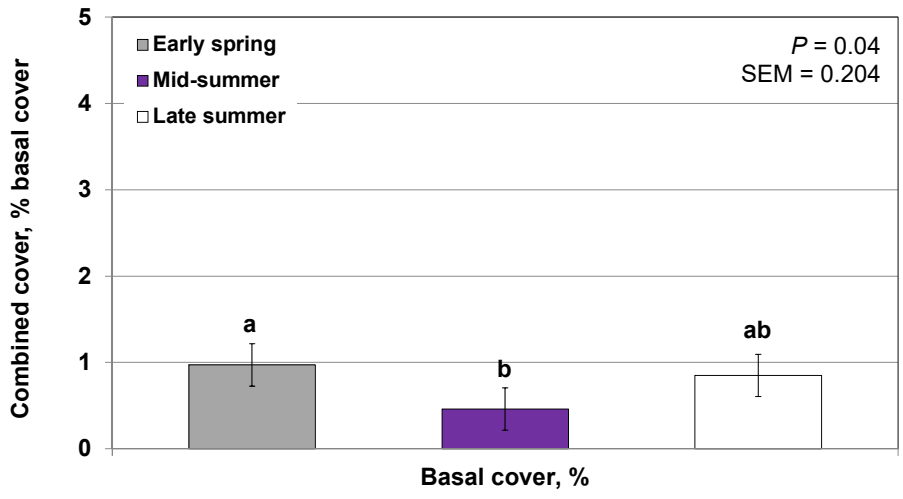
Figure 13. Increaser shrubs*, % total basal cover



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* Combined basal cover of roughleaf dogwood, smooth sumac, and buckbrush.
[a, b] Means w/ unlike superscripts differ ($P = 0.04$)

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Table 4. Species richness (no. of plant species identified)

Item	Early spring	Mid-summer	Late summer	SEM*	P-value†
Overall species richness	22[a]	27[b]	27[b]	1.6	< 0.01
Native species richness	21[a]	25[b]	26[b]	1.6	< 0.01
Graminoid richness	10	11	11	0.6	0.46
Forb richness	10[a]	15[b]	15[b]	1.2	< 0.01

[a, b] Within row, means with unlike superscripts differ ($P \leq 0.05$).

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Table 5. Forb species diversity

Item	Early spring	Mid-summer	Late summer	SEM*	P-value†
Forb richness	10[a]	15[b]	15[b]	1.2	< 0.01
Forb species evenness	0.70[a]	0.76[b]	0.81[b]	0.039	0.02
Simpson diversity index	0.57[a]	0.73[b]	0.83[b]	0.066	< 0.01

[a, b] Within row, means with unlike superscripts differ ($P \leq 0.05$).

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Conclusions

- **Forage biomass on all treatments averaged ≥ 4,000 lbs DM/acre over 4 years on July 17**
  - Prescribed fire timing did not affect peak forage production
  - Minor shifts between big bluestem and little bluestem basal cover occurred on the September treatment only
- **Mid-summer & late-summer prescribed fires reduced basal & aerial frequency of SL**
- **Mid-summer & late summer prescribed fires dramatically decreased seed production by SL**
- **Improved forb heterogeneity in mid- and late summer treatments is a strong indication of improving rangeland health**

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Implications

- **Growing season prescribed burning is consistent with responsible ecosystem stewardship in the Flint Hills**
- **Growing-season prescribed burning appears to be an inexpensive and comprehensive means to control SL**
  - Current cash cost of prescribed burning is about $0.75 / acre
  - Current cash cost of fall-applied herbicide is $18 to $36 / acre
- **Growing-season prescribed burning is temporally compatible with *intensive early stocking***
  - Effects on animal performance are unknown but the cost of any performance decrease is unlikely to exceed the margin between burning and spraying costs

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Implications

- **The cost of any performance decrease is unlikely to exceed the margin between burning and spraying costs**
  - Current value of gain - 650 to 850 lbs (Cattlefax- 02.23.18) = $0.69 / lb
  - Historical IES stocking density = 3 ac / steer (for mean BW of 750 lbs)
  - Cost to burn 3 acres = 3 ac x $0.75 / ac = $2.25
  - Cost to spray 3 acres (including labor) = 3 ac x $18 / ac = $54.00
  - Spray / Burn margin for 3 ac = $54.00 - $2.25 = $51.75
- **Breakeven performance difference**
  - $51.75 ÷ $0.69 / lb = 75 lbs less gain per steer
  - **ADG difference on burned vs. non-burned range is only 0.2 to 0.3 lbs/day (KSRE MF3232)**
    - 0.3 lbs/day x 100 days = 30 lbs extra gain

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Implications

- **Smoke Management**
  - Burning SL-affected acreage outside of the conventional fire season would decrease incidence of downwind air-quality problems
- **Labor Management**
  - Burning some acreage outside of the 'normal' window of time may result in improved time and labor management for ranchers
- **Fire Safety**
  - Much of the 'energy' of a growing-season fire is spent vaporizing water
  - These fires burn with much less intensity, heat, and speed than conventional, dormant-season fires; loss of control is less likely
  - Patience during ignition is required; some cleanup burning may be necessary for complete coverage
  - **Moisture content of the forage is the determining factor in 'fire speed'**

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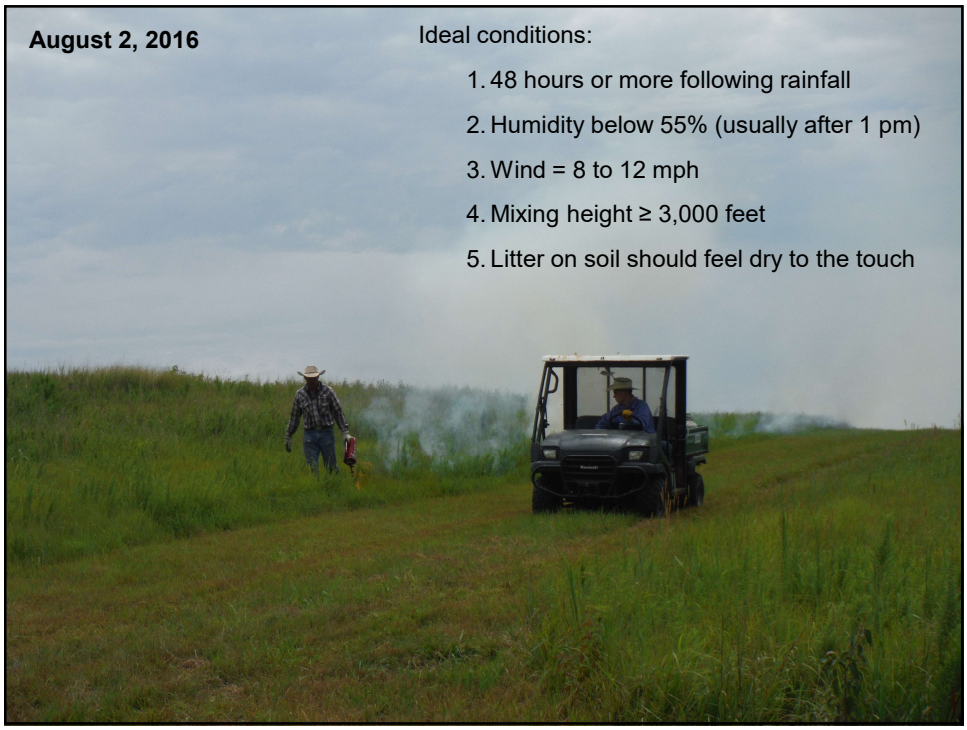

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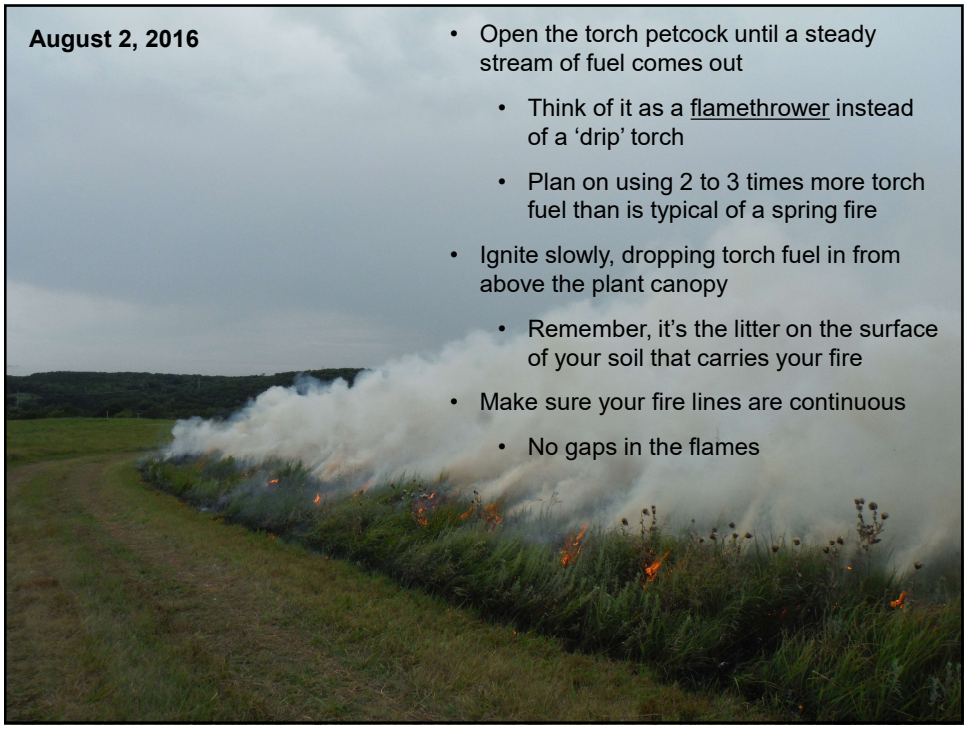
August 2, 2016
• Open the torch petcock until a steady stream of fuel comes out
• Think of it as a flamethrower instead of a 'drip' torch
• Plan on using 2 to 3 times more torch fuel than is typical of a spring fire
• Ignite slowly, dropping torch fuel in from above the plant canopy
• Remember, it's the litter on the surface of your soil that carries your fire
• Make sure your fire lines are continuous
• No gaps in the flames

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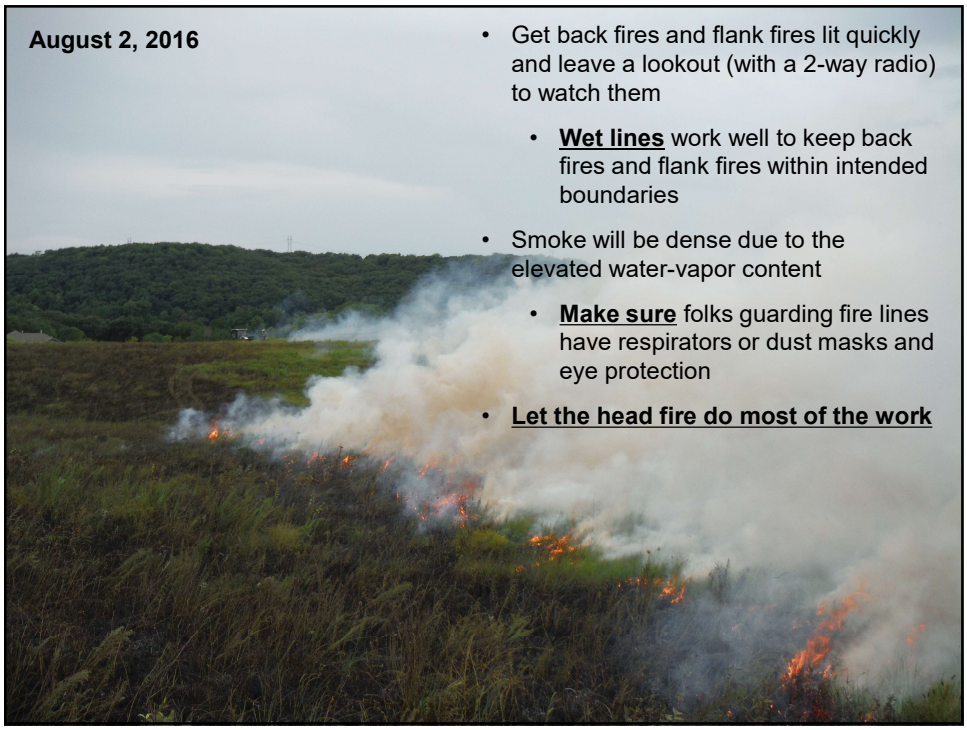
August 2, 2016
• Get back fires and flank fires lit quickly and leave a lookout (with a 2-way radio) to watch them
• Wet lines work well to keep back fires and flank fires within intended boundaries
• Smoke will be dense due to the elevated water-vapor content
• Make sure folks guarding fire lines have respirators or dust masks and eye protection
• Let the head fire do most of the work

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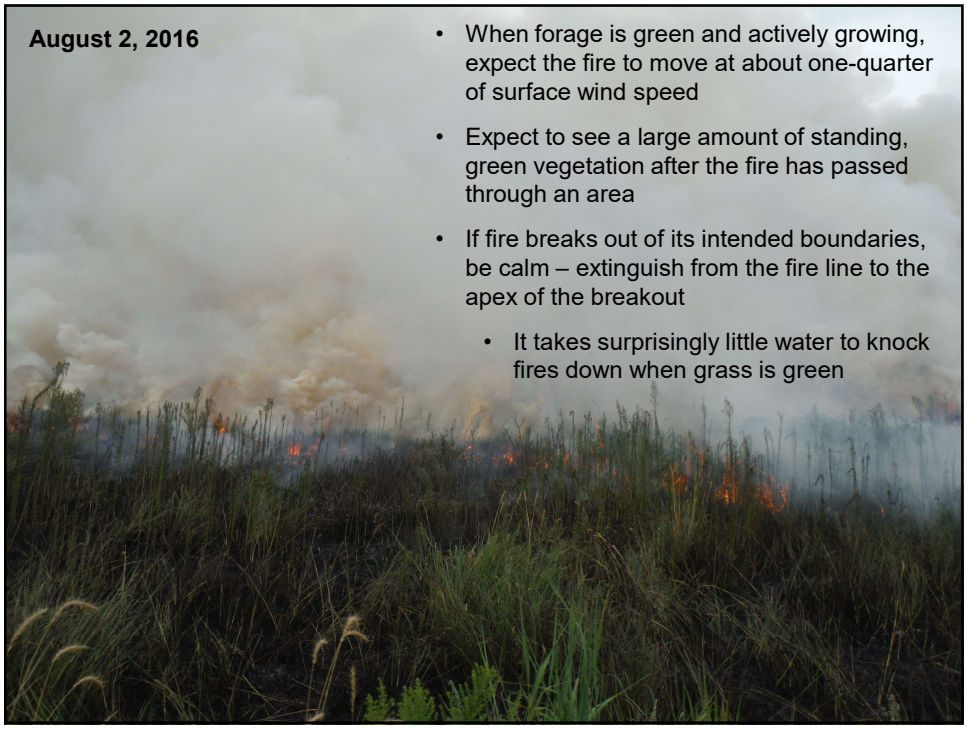
August 2, 2016
When forage is green and actively growing, expect the fire to move at about one-quarter of surface wind speed
Expect to see a large amount of standing, green vegetation after the fire has passed through an area
If fire breaks out of its intended boundaries, be calm – extinguish from the fire line to the apex of the breakout
It takes surprisingly little water to knock fires down when grass is green

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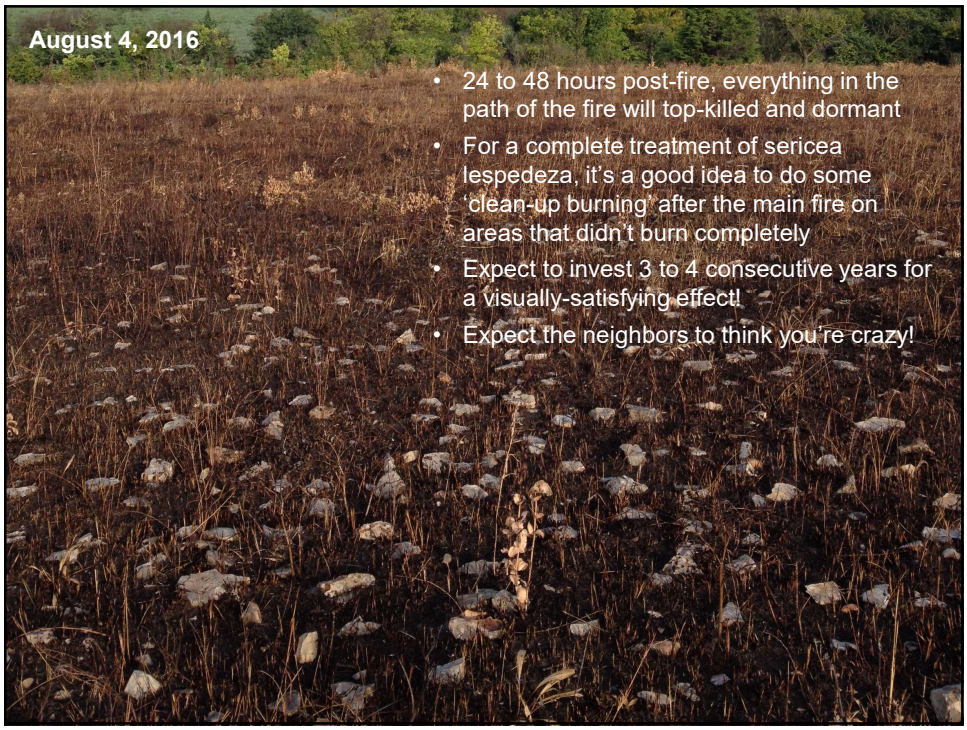
August 4, 2016
24 to 48 hours post-fire, everything in the path of the fire will top-killed and dormant
For a complete treatment of sericea lespedeza, it's a good idea to do some 'clean-up burning' after the main fire on areas that didn't burn completely
Expect to invest 3 to 4 consecutive years for a visually-satisfying effect!
Expect the neighbors to think you're crazy!

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Where do we go from here?

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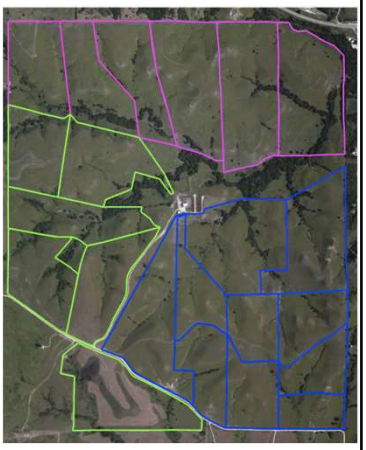
Effects of prescribed fire on yearling beef cattle performance

- Apply annual prescribed fire in the spring, summer and fall for 7 years.
- Evaluate:
  - Growth of yearling beef cattle
  - Plant community population dynamics
    - Special attention to: control of woody-stemmed plants, sericea lespedeza, and old-world bluestem



Spring – Target April 2019
Summer – Burned 8-17-2018
Fall – Burned Sept. 24th & 26th

BEEF STOCKER

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2018 Sampling

- Pastures were grouped by watershed and assigned burn treatment
- 18 plant transects were established, preliminary plant data were taken
  - Plant composition, biomass, and root carbohydrate
- Fire was applied to the summer and fall burn treatments.
- Cattle grazing component will begin in 2019
- Hope to include grassland bird, and pollinator abundance and diversity

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Growing-season prescribed burn at Beef Stocker Unit; Summer Burn Treatment: August 17, 2018

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August 17th:
Two track stopped head fire and we Had to re-ignite on opposite side.

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September 26th 2018

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