SEASON OF PRESCRIBED BURNING ON KLEBERG BLUESTEM (*DICHANThIUM ANNULATUM*) IN SOUTH TEXAS

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Fire Effects

- Invasive Old World bluestems (OWB) have increased by 6-fold in Kleberg County from 1999-2009
- Control-oriented recommendations?
- Often difficult to predict
  - Vegetation community
  - Distinct growth forms and tolerances
  - Heterogeneous fuel structure
  - Fire intensity and frequency
  - Post-fire weather (Precipitation)
- Conduct fires when the effects may be beneficial or neutral for desirable species, and detrimental
Objectives

- Fire treatments are no silver bullet
- Merit of prescribed burning for exotic control

How season of prescribed burning influences:
1. Invasive species mortality and recruitment
2. Individual morphology and production
Focal species

- *Dichanthium annulatum* (Forssk.) Stapf
- Old-world bluestem
- Warm-season perennial bunchgrass

Characteristics:
- Elevated productivity
- Drought and grazing tolerance
- Establishment
South Pasture Research Facility

- 252 Acres
- Blackland ecological site description
- Annual mean rainfall: 16-35”

- Past management
  - Root plowed
  - Cattle & goats in 2008
  - Burned December 2010
Exclosures

- 10 exclosures
  - ~10x10m
- Cattle panels
- Chicken wire

Randomly assigned
- 4 Summer burn
- 4 Winter burn
- 2 Controls
Burn Day Conditions

**Summer Treatments**
Date: 8/31/2013
Mean fuel moisture: 19.1%
Mean fuel load: 5,824 kg/h [2.6t/acre]
Wind speed: 0.4-1.8km/h [1-4 mph]
Average RH: 40%
Mean air Temp: 36.1°C [97°F]
Mean max fire temp: 401°C

**Winter Treatments**
Date: 1/17/2014
Mean fuel moisture: 23.6 %
Mean fuel load: 6742kg/h [3.01t/acre]
Wind speed: 4.9-5.4km/h [11-12 mph]
Average RH: 32%
Mean air temp: 18.3°C [65°F]
Mean max fire temp: 225°C [437°F]
Period-precipitation-timeline
Objective 1: mortality and germination

- Permanent 1m² quadrats (4)
  - Dead crown density
  - Seedling density
Objective 1: mortality density

- Pre-Treatment: Control, Summer burn, Winter burn
  - No. of Dead Crowns (m\(^{-0.25}\))
  - Control: a
  - Summer burn: a
  - Winter burn: a
  - Sampling Date: Pre-Treatment
  - p = 0.3569

- October: Control, Summer burn, Winter burn
  - No. of Dead Crowns (m\(^{-0.25}\))
  - Control: a
  - Summer burn: a
  - Winter burn: b
  - Sampling Date: October
  - p = 0.0003

- February: Control, Summer burn, Winter burn
  - No. of Dead Crowns (m\(^{-0.25}\))
  - Control: a
  - Summer burn: b
  - Winter burn: a
  - Sampling Date: February
  - p = 0.0016

- June: Control, Summer burn, Winter burn
  - No. of Dead Crowns (m\(^{-0.25}\))
  - Control: a
  - Summer burn: a
  - Winter burn: a
  - Sampling Date: June
  - p = 0.0028

- December: Control, Summer burn, Winter burn
  - No. of Dead Crowns (m\(^{-0.25}\))
  - Control: a
  - Summer burn: a
  - Winter burn: a
  - Sampling Date: December
  - p = 0.0008
Objective 1: seedling density

![Graph showing seedling density over different sampling dates and treatments.](image)
Objective 1: Summary

- Summer burning increases dead crown density
  - Winter treatments ~ Control treatment

- Burning treatments increase seedling germination
  - Lag effect until next growing season
Objective 2: morphology and production

- Exotic and native Individuals
- Non-destructive method
- Morphological Characteristics to Predict Plant Biomass

- Permanently Marked
  - 16 Kleberg Individuals
    - 8 basal dia > 30mm
    - 8 basal dia < 30mm

- All Native Grass Species
  - Texas Tridens (*Tridens texanus*)
  - **Additional**: Mourning lovegrass (*Eragrostis lugens*), Tumble Love grass (*Eragrostis sessilispica*), Purple three-Awn (*Aristida purpurea*), Texas Grama (*Bouteloua regidiseta*), Sandbur (*Cenchrus spinifex*), Texas Winter Grass (*Nassella leucotricha*), Hooded Windmill (*Chloris cucullata*), Southern Witchgrass (*Panicum capillarioides*), Plains Bristlegrass (*Setaria vulpiseta*), four-flower trichloris (*Trichloris pluriflora*)

- Individual Mortality Probabilities
Objective 2: morphometrics

Number of tillers

Basal area

Area at 7.5cm
Objective 2: morphometrics

Longest length

Area at 50%
Objective 2: morphology and production

- Treatment effects on plant morphology
  - Plant length
  - Basal area
  - 7.5cm area
  - 50% area
  - Individual Predicted Biomass

- Kleberg bluestem and Texas tridens
- Period 1 to Period 3 (Summer to Summer)
- Mixed linear model using initial metric as covariate
Objective 2: individual production

- Individual biomass
- ~50 regression plants
- Multiple regression with morphometrics as explanatory variables for individual dry weight
- Variable selection was based on MAXR

<table>
<thead>
<tr>
<th>Period</th>
<th>Intercept</th>
<th>Length</th>
<th>Number of tillers</th>
<th>Area at 7.5 cm above ground (cm²)</th>
<th>Area at 50% plant height (cm²)</th>
<th>Square of basal area</th>
<th>Square of 7.5 cm area</th>
<th>Square of 50% area</th>
<th>Adj. R²</th>
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<tbody>
<tr>
<td>1</td>
<td>-7.38 (1.87)</td>
<td>0.01 (0.002)</td>
<td>-</td>
<td>0.01 (0.001)</td>
<td>0.05 (0.01)</td>
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<td>-8.4⁻⁵ (2.90⁻⁶)</td>
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<td>2</td>
<td>-16.24 (4.41)</td>
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<td>0.02 (0.003)</td>
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<td>0.02 (0.001)</td>
<td>0.08 (0.01)</td>
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<td>-1.0⁻⁴ (3.00⁻⁵)</td>
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<td>4</td>
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<td>0.14 (0.06)</td>
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<td>4.78⁻⁷ (1.46⁻⁷)</td>
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*D. annulatum*

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<th>Adj. R²</th>
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<td>0.29 (0.02)</td>
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<td>2.19⁻⁵ (2.66⁻⁶)</td>
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*T. texanus*
Objective 2: Figure Example

- **Red**: Summer
- **Blue**: Winter
- **Green**: Control

- Initial metric
- Final predicted metric
- Raw Data
- Covariate means
- Deceased individuals
Objective 2: Kleberg biomass

**Treatment:** $P = 0.696$

**Initial:** $P \leq 0.001$

**Interaction:**
- **Summer:** $\geq 16 \text{ g}, P = 0.047$
- **Winter:** $\geq 13 \text{ g}, P = 0.037$
Objective 2: Texas tridens biomass

Treatment: $P = 0.135$
Initial: $P \leq 0.001$
Objective 2: mortality probabilities

- **Control**
- **Summer burn**
- **Winter burn**

- **Kleberg bluestem**: $p = 0.0595$
- **Texas tridens**: $p = 0.5087$
- **Native grasses**: $p = 0.3907$
Objective 2: Summary

- Near treatment effect on indiv. mortality probabilities
  - Kleberg bluestem

**Kleberg bluestem**
- No treatment effect on individual morphometrics
- Large summer and winter treated individuals have a reduced biomasses than control individuals

**Texas Tridens**
- No treatment effects detected on the measured variables
Management implications

- Summer burning > Winter burning
- Increase dead crown density
- Individual production allows for repeated burns

Considerations

- Repeated treatments may produce variable results
- Impact of precipitation on vegetation response
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Considerations
- Repeated treatments may produce variable results
- Impact of precipitation on vegetative responses
Precipitation Aug.-Sept. 2013

Favorable post-treatment precipitation

- Little post-treatment precipitation
Acknowledgments

- Dr. Greta Schuster
- René Barrientos Scholarship
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- TAMUK South Pasture Facility
- Ashley McCloughan, Josh Grace, Mylea Lovell, Mike Golla, Luis Bartolo
QUESTIONS?
Seedbank Composition

- **149-617 seedlings/tray**
  - ~1246 germinates/m²
  - Richness \([S]\)^{11}
  - Diversity \([\exp H']\)^{11}
  - Evenness \([\exp H'/S]\)^{11}

- **Permutational analysis of variance**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seedbank (mean (SD))</th>
<th>All Forbs (mean (SD))</th>
<th>Annual Forbs (mean (SD))</th>
<th>Perennial Forbs (mean (SD))</th>
<th>All Grasses (mean (SD))</th>
<th>Native grasses (mean (SD))</th>
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<tr>
<td>Richness</td>
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<tr>
<td>Summer</td>
<td>9.150 (1.486)</td>
<td>7.800 (2.141)</td>
<td>2.666 (1.365)</td>
<td>3.600 A(0.600)</td>
<td>2.000 (0.204)</td>
<td>1.000 (0.204)</td>
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<td>Winter</td>
<td>12.50 (0.989)</td>
<td>10.20 (1.177)</td>
<td>4.300 (0.771)</td>
<td>0.900 B'(0.300)</td>
<td>2.250 (0.176)</td>
<td>1.250 (0.176)</td>
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<td>Control</td>
<td>11.90 (2.029)</td>
<td>9.900 (1.803)</td>
<td>3.400 (2.586)</td>
<td>3.350 A(1.675)</td>
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<td>Summer</td>
<td>0.440 (0.034)</td>
<td>0.481 (0.032)</td>
<td>0.689 (0.128)</td>
<td>0.392 (0.024)</td>
<td>0.632 (0.075)</td>
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<td>0.405 (0.037)</td>
<td>0.486 (0.131)</td>
<td>0.320 (0.030)</td>
<td>0.665 (0.051)</td>
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<tr>
<td>Control</td>
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<td>0.541 (0.163)</td>
<td>3.664 (2.231)</td>
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<tr>
<td>Summer</td>
<td>4.932 (0.618)</td>
<td>4.354 (0.657)</td>
<td>3.331 (0.829)</td>
<td>2.010 (0.170)</td>
<td>1.206 (0.107)</td>
<td>1.000 (0.159)</td>
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<tr>
<td>Winter</td>
<td>4.620 (0.615)</td>
<td>3.839 (0.571)</td>
<td>2.132 (0.456)</td>
<td>2.198 (0.161)</td>
<td>1.431 (0.099)</td>
<td>1.150 (0.170)</td>
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<tr>
<td>Control</td>
<td>4.648 (5.968)</td>
<td>4.135 (1.070)</td>
<td>2.212 (0.703)</td>
<td>2.525 (0.445)</td>
<td>1.308 (0.687)</td>
<td>1.000 (0.000)</td>
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