

The background of the slide is a photograph of a grassy field. In the foreground, there are tall, thin stalks of grass, some with brown, feathery seed heads, slightly out of focus. The middle ground shows a dense field of similar grass. The sky in the background is blue with scattered white and grey clouds.

# **Management of Invasive Bluestems to Restore Native Grasslands**

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November 29, 2016**



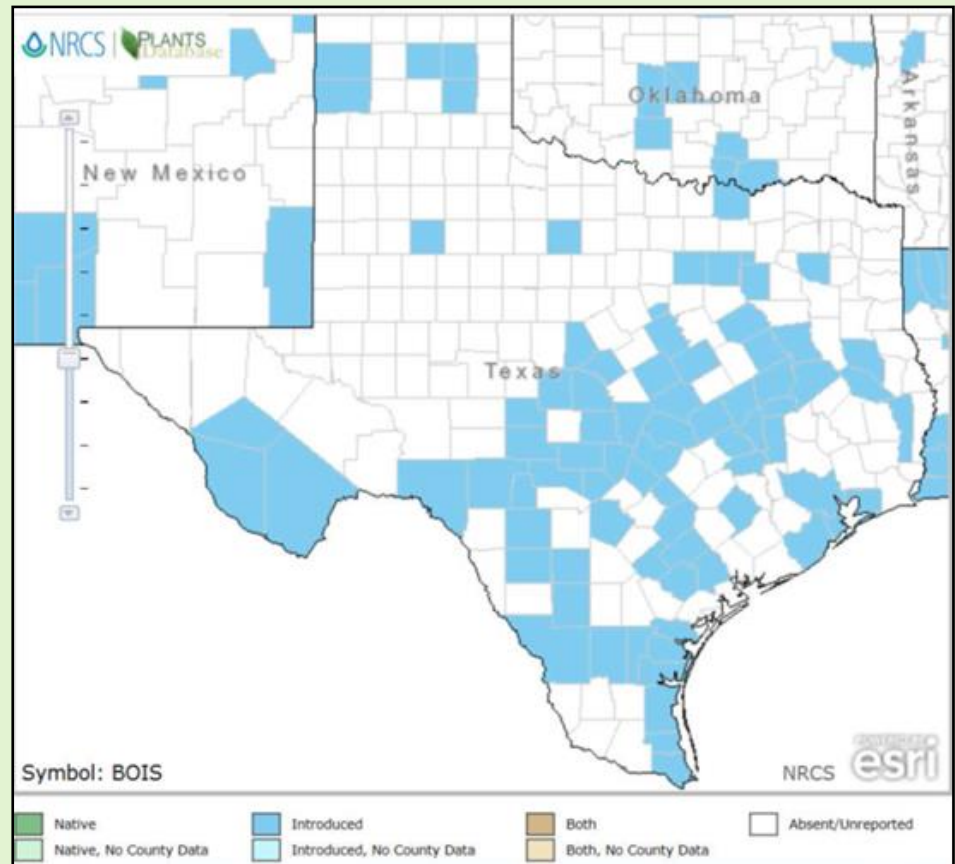
# INTRODUCTION

- **Old World Bluestems; OWB**
  - *Dichanthium annulatum*
  - *Bothriochloa ischaemum*
- **C4 perennial grasses introduced from Europe and Asia**
- **Cultivars arrived in Texas around the 1930s**



# INTRODUCTION

- Map of known introductions of *B. ischaemum* in Texas (NRCS)
- Encroaching into rangelands
- Decreasing native diversity



NRCS Plants Database, 2015

# INTRODUCTION

- **Landowners and managers searching for appropriate control methods**
- **Previous studies have found only short-term control or no effect on Old World Bluestems**





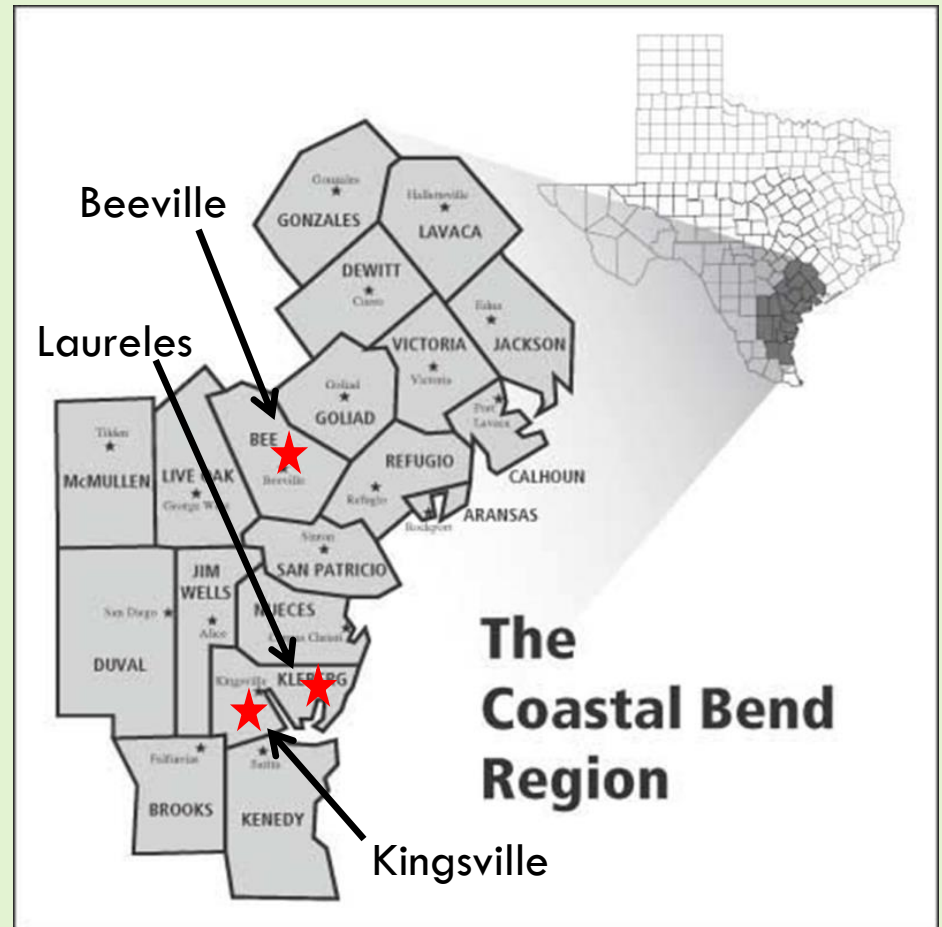
# OBJECTIVE

- **Determine which primary (summer fire, Pastora, glyphosate + seeding, control) and secondary (fertilize, mow, plow, plow + seeding, and control) treatment combinations were the most effective to manage OWB invading grassland sites**



# METHODS

- **Study Sites**
  - Three locations in two different counties representing different soil types and climatic conditions in south Texas
- **Experiment Locations**
  - Beeville, Kingsville & Laureles



# METHODS

- **Study Sites**
  - **Experiment Locations**
    - **Beeville, Kingsville & Laureles**

Site	Location	Soil type	pH	N (mg kg <sup>-1</sup> )	P (mg kg <sup>-1</sup> )	K (mg kg <sup>-1</sup> )
A	Beeville	Parrita sandy clay loam	7.1	2	7	146
B	Kingsville	Cranell sandy clay loam	7.7	1	8	385
C	Laureles	Aransas clay	7.5	2	23	793

# METHODS

- **Combination of primary and secondary treatments**
- **Primary treatments-**
  - **Summer fire**
    - Air temperatures below 38°C
    - Relative Humidity above 25%
    - Wind gusts below 17 knots



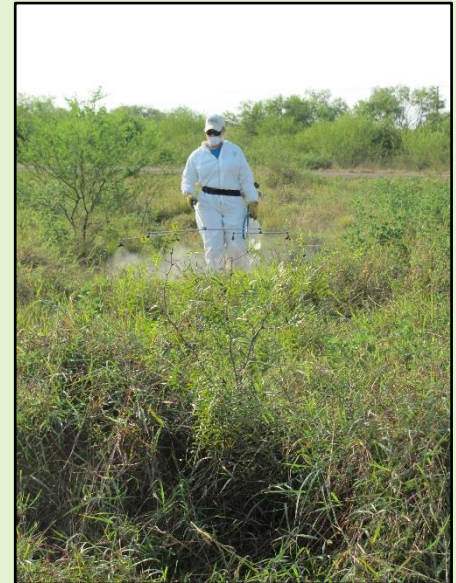


# METHODS

- **Combination of primary and secondary treatments**
- **Primary treatments-**
  - **Summer fire**
  - **Nicosulfuron + Metsulfuron methyl (Pastora)**
    - **CO<sub>2</sub> pressurized backpack sprayer**
    - **1.5 m boom**
    - **4 XR 8001VS TeeJet with Extended Range Flat Spray nozzles**
    - **Walking speed: 2.7 MPH**
    - **Application Rate: 0.04 kg · ha<sup>-1</sup> of nicosulfuron and 0.01 kg · ha<sup>-1</sup> of metasulfuron methyl**

# METHODS

- **Combination of primary and secondary treatments**
- **Primary treatments-**
  - **Summer fire**
  - **Nicosulfuron + Metsulfuron methyl (Pastora)**
  - **Glyphosate + Seed**
    - **Application Rate:  $1.54 \text{ kg} \cdot \text{ha}^{-1}$**
    - **South Texas Natives seed mixture**



# METHODS

- **Combination of primary and secondary treatments**
- **Primary treatments-**
  - **Summer fire**
  - **Nicosulfuron + Metsulfuron methyl (Pastora)**
  - **Glyphosate + Seed**
  - **Control**





# METHODS

- **Combination of primary and secondary treatments**
- **Secondary treatments**
  - **Plow**
    - John Deere 5054D tractor
    - 1.5 m Bush Hog Rotary tiller
    - Depth: 10 cm



# METHODS

- **Combination of primary and secondary treatments**
- **Secondary treatments**
  - **Plow**
  - **Mow**
    - **Echo Weed Trimmer**
    - **Height: 7 cm**



# METHODS

- **Combination of primary and secondary treatments**
- **Secondary treatments**
  - **Plow**
  - **Mow**
  - **Fertilize**
    - **Spring**
      - **Kingsville and Beeville**
        - $50 \text{ kg} \cdot \text{ha}^{-1} \text{ P}_2\text{O}_5$
      - **Laureles**
        - $28 \text{ kg} \cdot \text{ha}^{-1} \text{ P}_2\text{O}_5$
    - **Fall**
      - **All:  $39 \text{ kg} \cdot \text{ha}^{-1} \text{ N}$**





# METHODS

- **Combination of primary and secondary treatments**
- **Secondary treatments**
  - **Plow**
  - **Mow**
  - **Fertilize**
  - **Plow + Seed**



# METHODS

- **Combination of primary and secondary treatments**
- **Secondary treatments**
  - **Plow**
  - **Mow**
  - **Fertilize**
  - **Plow + Seed**
  - **Control**



# METHODS

						6.096 m		
		Secondary Treatments						
		Plow	Mow	Fertilize	Control	Plow + Seed		
BLOCK 1	Primary Treatments	Summer fire					3.048 m *	
		Pastora					3.048 m	
		Glyphosate + Seed					3.048 m	
		Control					3.048 m	
		Fertilize	Plow + Seed	Plow	Mow	Control		
BLOCK 2		Pastora						3.048 m
		Glyphosate + Seed						3.048 m
		Summer fire						3.048 m
		Control						3.048 m
			Plow + Seed	Control	Mow	Fertilize	Plow	
BLOCK 3		Glyphosate + Seed						3.048 m
	Pastora						3.048 m	
	Control						3.048 m	
	Summer fire						3.048 m	



# METHODS



# METHODS

- **Collections**
  - **% Overall cover**
  - **% Grass**
  - **% Forb**
  - **% OWB within the grass**
  - **Herbage mass**



# METHODS

- **Statistical Analysis**

- **SAS 9.3**

- **Model:**

- **Location, primary treatment, secondary treatment, collection, and their interactions**

- **MEANS procedure:**

- **Herbage mass, total cover and botanical composition**

- **CONSTRAST statements:**

- **Herbage mass and total cover**



# METHODS

## ■ Treatment timing:

**8/9/13: Summer fire**

**10/22/13: Plow & Mow**

**3/13/14: Fertilize**

**3/20/14: Pastora & Glyphosate**

**6/13/14: 2<sup>nd</sup> application of Pastora**

**7/17/14: Plow**

**11/12/14: Plow, Mow, & Seed**

**12/10/14: Fertilize**

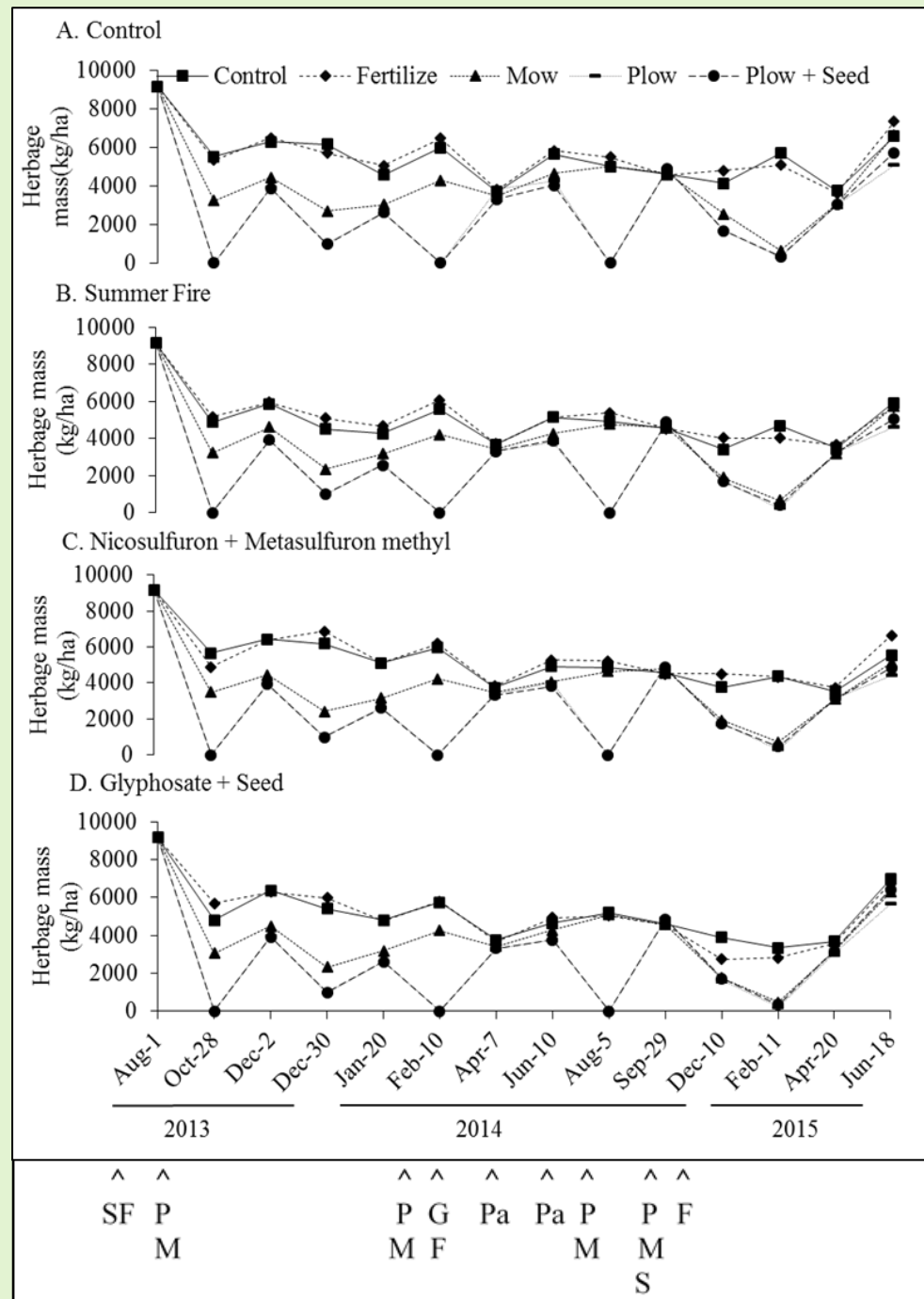


# RESULTS

- **Herbage mass**
  - different ( $P < 0.01$ ) among locations
  - affected ( $P < 0.01$ ) by primary and secondary treatments
  - primary  $\times$  secondary treatment ( $P < 0.01$ ) interaction

# BEEVILLE

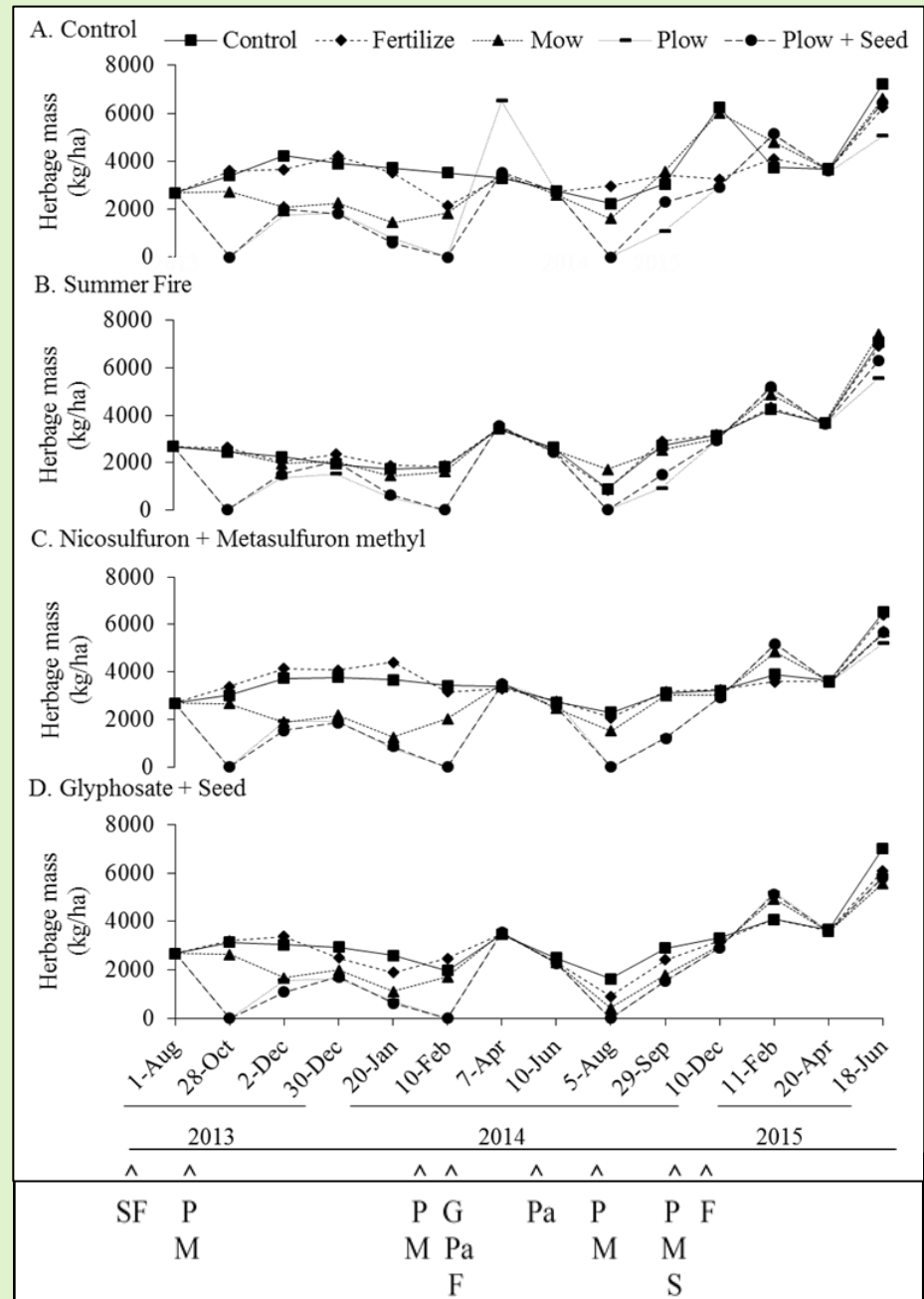
- Initial HM 9160 kg · ha<sup>-1</sup>
- Decreased most by plow and mow secondary treatments
- Increased for Control primary followed by mow, fertilize, and control secondary treatments
- Less HM in primary treatments followed by plow and plow + seed at end of study



# KINGSVILLE

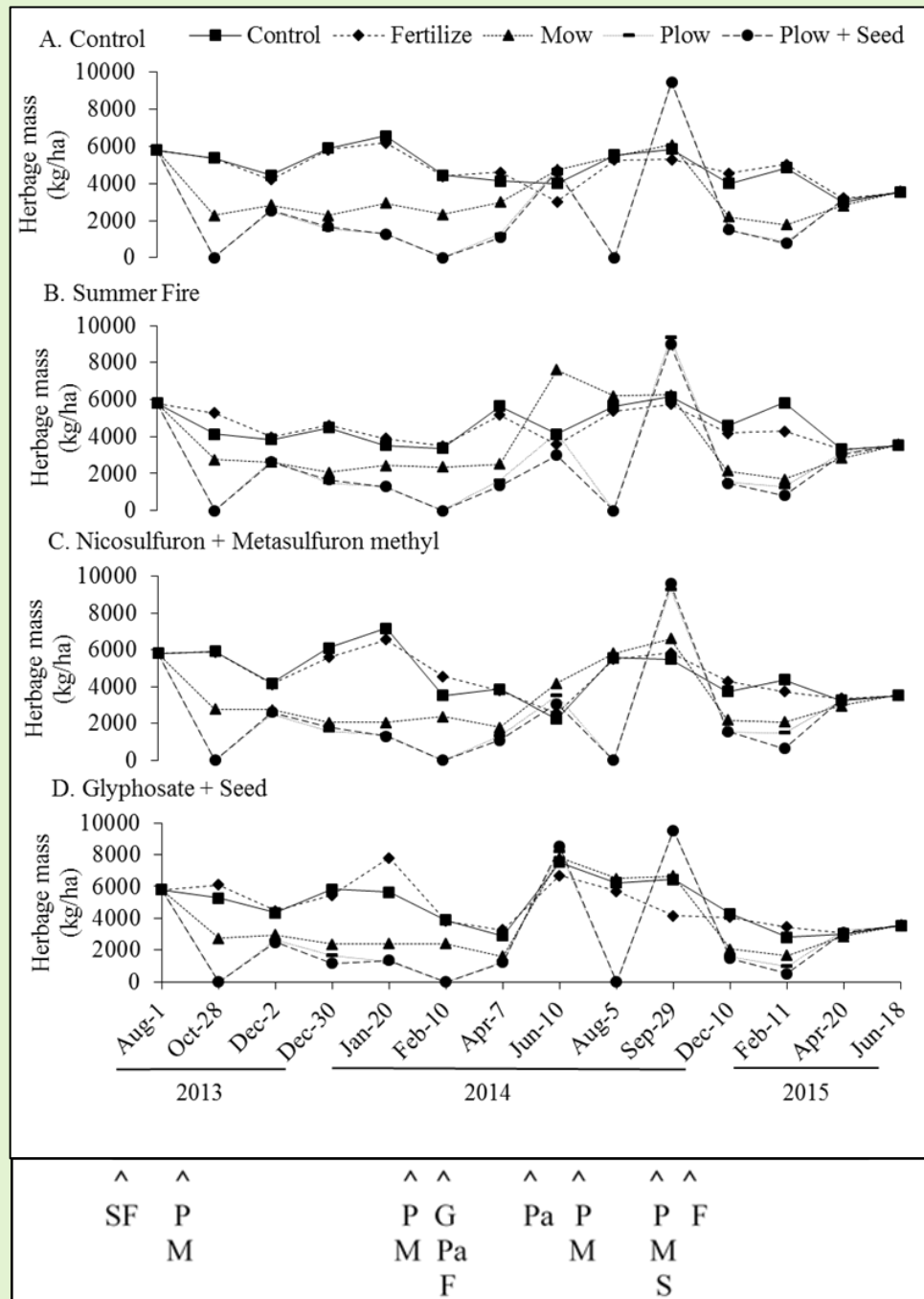
Initial HM 2700 kg · ha<sup>-1</sup>

- Increase of HM for all treatment combinations during experiment
- Reduced most by plow, plow + seed, mow
- Summer fire
  - Below 3500 kg · ha<sup>-1</sup> first two years
  - Increased in 2015 to 7400 kg · ha<sup>-1</sup>
- Range from 5000 – 7400 kg · ha<sup>-1</sup>



# LAURELES

- Initial HM 5400 kg · ha<sup>-1</sup>
- Control primary followed by secondary treatments slowly decreased
- Decreased most by plow and mow
- Summer fire
  - Secondary control and fertilize were similar throughout study
  - Mowing stable HM (2070 – 2770 kg · ha<sup>-1</sup>) for first seven months
- Glyphosate + seed
  - Decreased HM one month post application for control secondary treatment
  - Increased in Jun 2014 for all secondary treatments
- Average HM 3500 kg · ha<sup>-1</sup> at last two collections





# Total Cover

- 
- Figure 1 consists of four line graphs (A, B, C, D) showing the cover (%) of four plant species over time from October 2013 to June 2015. The species are: A. Control, B. Summer Fire, C. Nicosulfuron + Metasulfuron methyl, and D. Glyphosate + Seed. Each graph shows four data series: a solid line with circles, a dashed line with squares, a dotted line with triangles, and a dash-dot line with diamonds. All graphs show a general increase in cover over time, with a notable dip in cover for all species around August 2014.
- | Species                            | Line Style |          |
|------------------------------------|------------|----------|
| Control                            | Solid      | Circle   |
| Control                            | Dashed     | Square   |
| Control                            | Dotted     | Triangle |
| Control                            | Dash-dot   | Diamond  |
| Summer Fire                        | Solid      | Circle   |
| Summer Fire                        | Dashed     | Square   |
| Summer Fire                        | Dotted     | Triangle |
| Summer Fire                        | Dash-dot   | Diamond  |
| Nicosulfuron + Metasulfuron methyl | Solid      | Circle   |
| Nicosulfuron + Metasulfuron methyl | Dashed     | Square   |
| Nicosulfuron + Metasulfuron methyl | Dotted     | Triangle |
| Nicosulfuron + Metasulfuron methyl | Dash-dot   | Diamond  |
| Glyphosate + Seed                  | Solid      | Circle   |
| Glyphosate + Seed                  | Dashed     | Square   |
| Glyphosate + Seed                  | Dotted     | Triangle |
| Glyphosate + Seed                  | Dash-dot   | Diamond  |

$$\begin{matrix} \wedge \\ \text{P} \\ \text{M} \end{matrix}$$
$$\wedge$$

# RESULTS

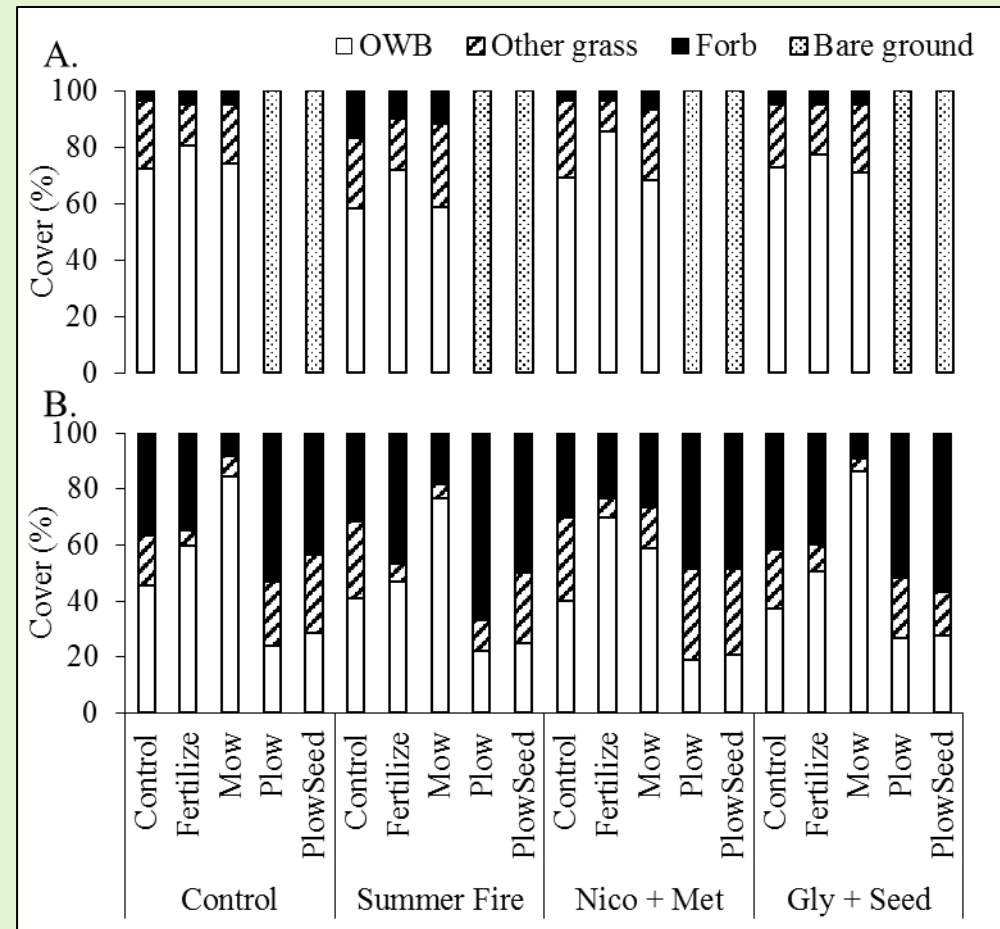
## Total Cover differences

- **Beeville and Laureles**
  - First collection ( $P = 0.012$ ;  $P = 0.002$ )
  - Sixth collection ( $P < 0.01$ )
- **Kingsville**
  - First collection ( $P = 0.08$ )
  - Sixth and seventh collection ( $P < 0.01$ )

# BOTANICAL COMPOSITION

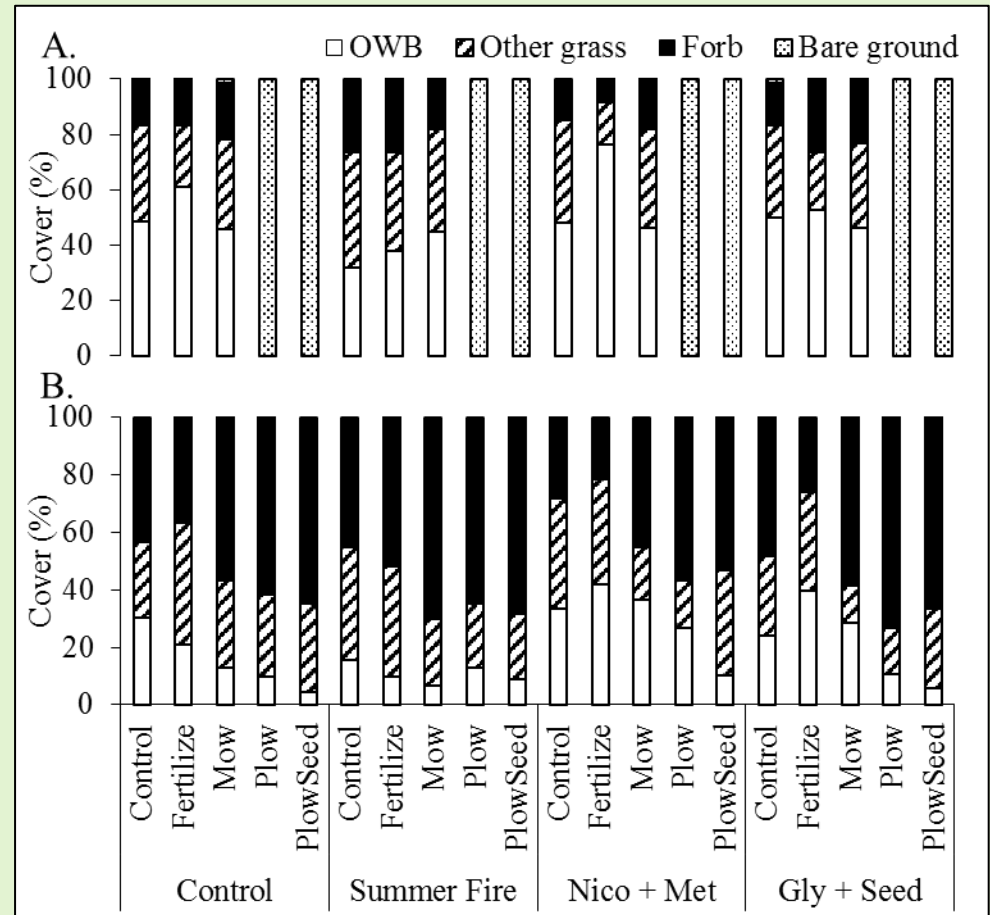
## Site A: Bee County

- Texas A&M AgriLife Research Station, Beeville, TX
- Parrita sandy clay loam



# BOTANICAL COMPOSITION

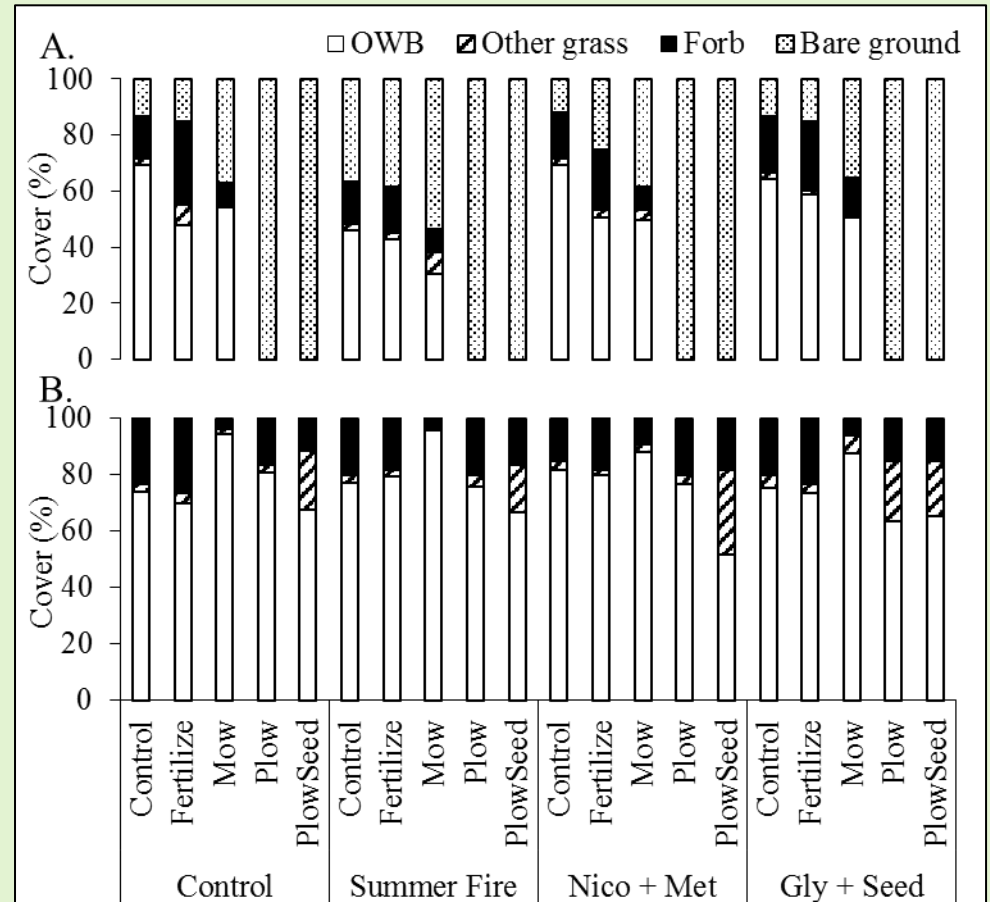
- Site B: Kleberg County
  - Texas A&M University-Kingsville Farm
  - Cranell sandy clay loam





# BOTANICAL COMPOSITION

- Site C: Kleberg County
  - Private Ranch, Kingsville, TX
  - Aransas Clay



# CONCLUSIONS

- Preventative practices
- Management system needed
  - Plowing followed by native seeding
- Future research:
  - Mowing in combination with herbicide



# ACKNOWLEDGMENTS

- **Funding**
  - **Texas Parks and Wildlife**
  - **Federal Aid in Wildlife Restoration Research.**
- **Texas A&M University-Kingsville, Kingsville, Texas**
- **Texas A&M AgriLife Research, Beeville, Texas**
- **Texas A&M AgriLife Extension, Corpus Christi, Texas**
- **South Texas Natives**
- **Undergraduate Student Technicians**



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Function al group	% of mixture	Variety and plant species	% composition (by PLS planting rate)	Full stand planting rate	Planting rate in mix (kg/PLS/ha)
Early/mid seral stage native grasses	65%	Dilley Germplasm slender grama	10%	5	0.56
		Welder Germplasm shortspike windmillgrass	10%	1	0.112
		Mariah Germplasm hooded windmillgrass	5%	1	0.056
		Atascosa Germplasm Texas grama	5%	5	0.28
		Chaparral Germplasm hairy grama	5%	2	0.112
		La Salle Germplasm Arizona cottontop	5%	2	0.112
		Webb Germplasm whiplash pappusgrass	5%	3	0.168
		Maverick Germplasm pink pappusgrass	5%	3	0.168
		Catarina Blend bristlegrass	5%	2	0.112
		Oso Germplasm Halls panicum	5%	1	0.056
		STN Germplasm red lovegrass	2%	1	0.022
		STN Germplasm sand dropseed	3%	1	0.033
Late seral stage native grasses	35%	PMC Germplasm longspike silver bluestem	8%	3	0.268
		South Texas Germplasm sideoats grama	5%	5	0.28
		Hidalgo Germplasm multiflowered false rhodesgrass	10%	1	0.112
		STN Germplasm little bluestem	10%	5	0.56
		Alamo switchgrass	2%	1	0.022
Forbs and legumes	35%	Goliad Germplasm orange zexmenia	5%	1	0.056
		Rio Grande Germplasm prairie acacia	5%	1	0.056
		Bee Germplasm awnless bush sunflower	5%	1	0.056
		STN Germplasm bundleflower	5%	1	0.056
		STN-561 Germplasm Hookers plantain	5%	10	0.56
		STN-496 Germplasm redseed plantain	5%	10	0.56
		Hoverson Germplasm deer pea vetch	5%	8	0.448
Totals	135%	All species	135%		4.804 kg PLS/ha

# Questions

