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

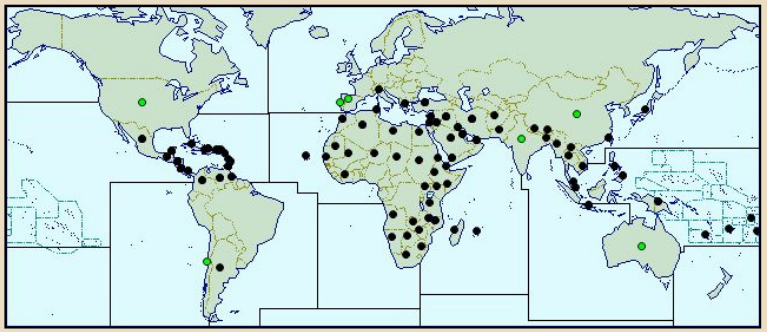
- Fire treatments are no silver bullet
- Merit of prescribed burning for exotic control

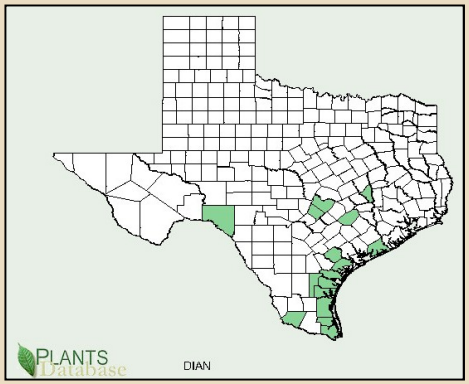
How season of prescribed burning influences:

1. Invasive species mortality and recruitment
2. Individual morphology and production

Focal species

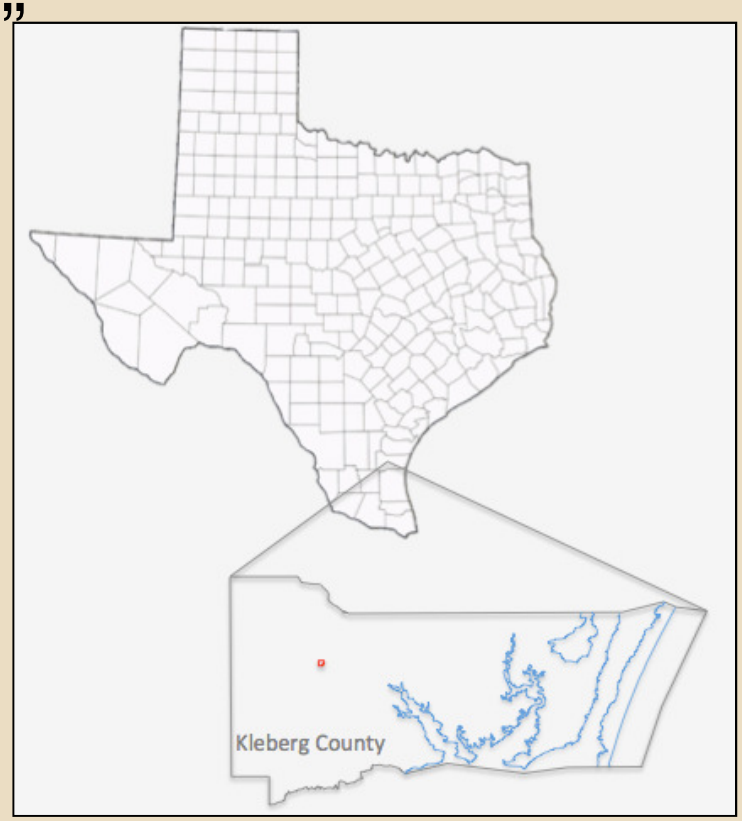
- *Dichanthium annulatum* (Forssk.) Stapf
- Old-world bluestem
- Warm-season perennial bunchgrass
- Characteristics:
  - Elevated productivity[6]
  - Drought and grazing tolerance[7]
  - Establishment[7]





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

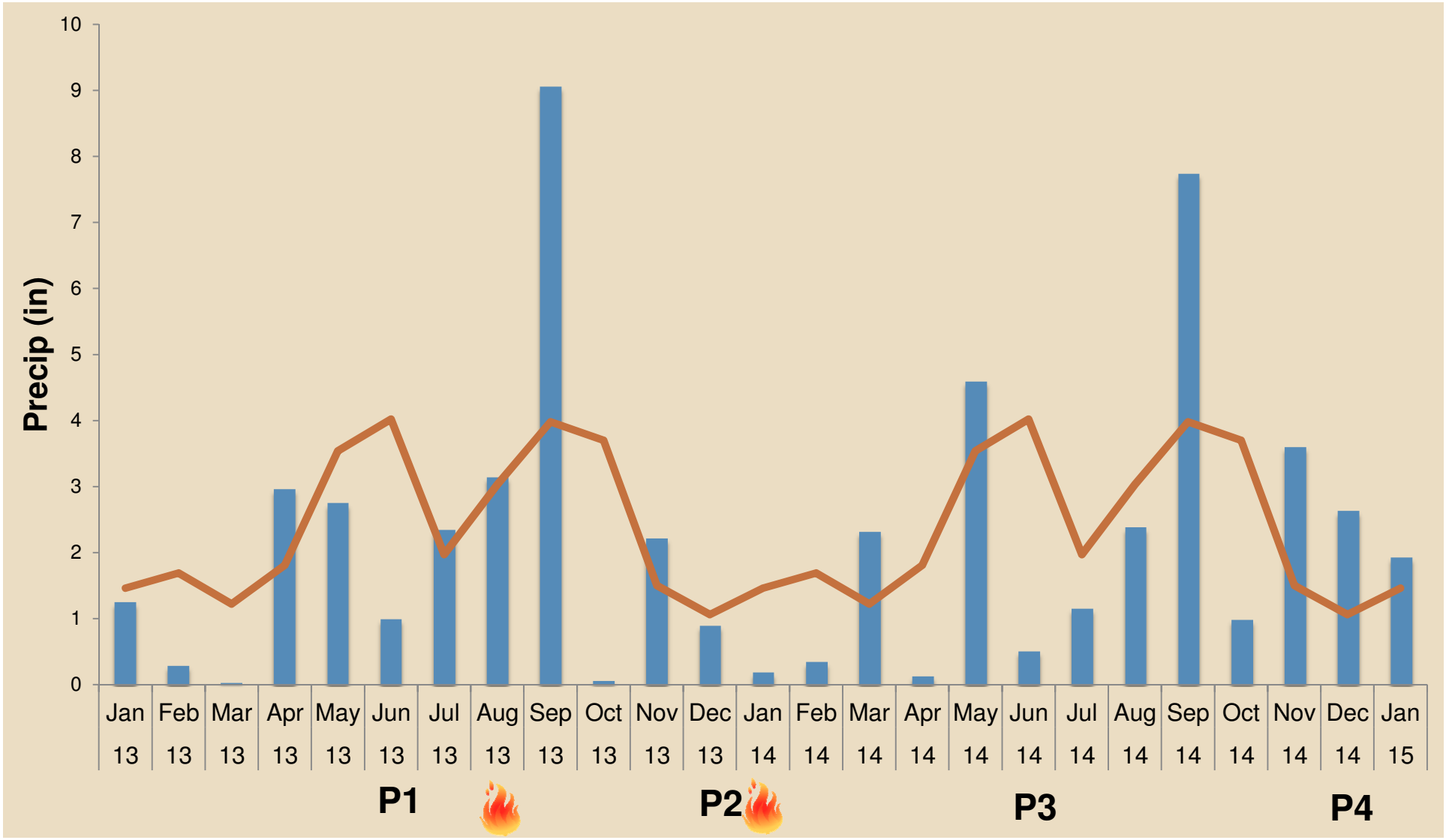
Wind speed: 4.9-5.4km/h [11-12 mph

Average RH: 32%

Mean air temp: 18.3˚C [65˚F]

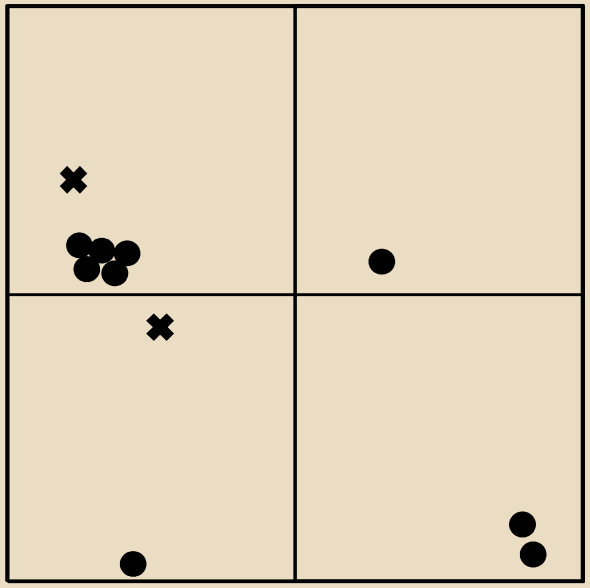
Mean max fire temp: 225˚C [437˚F]

Period-precipitation-timeline

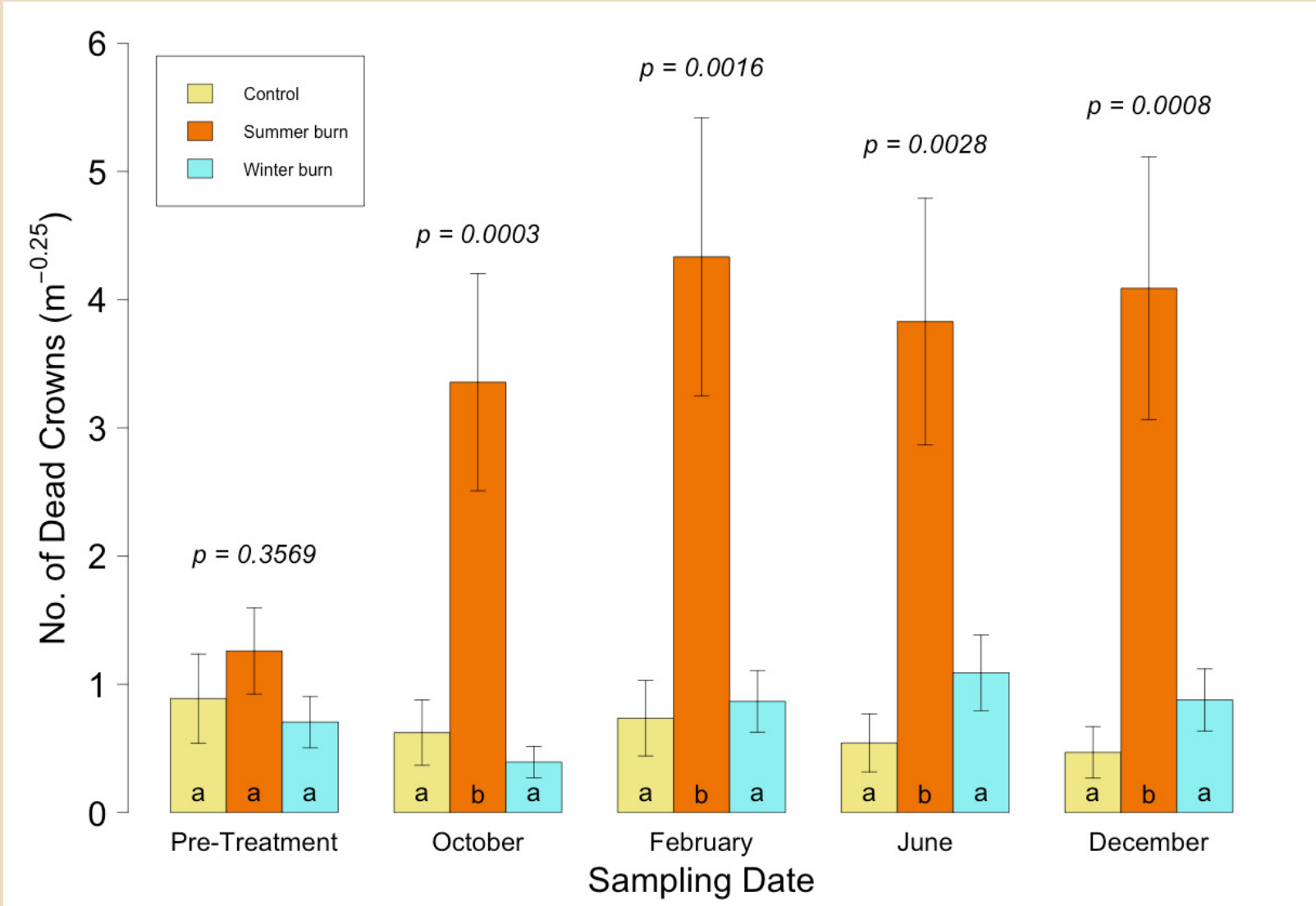


Objective 1: mortality and germination

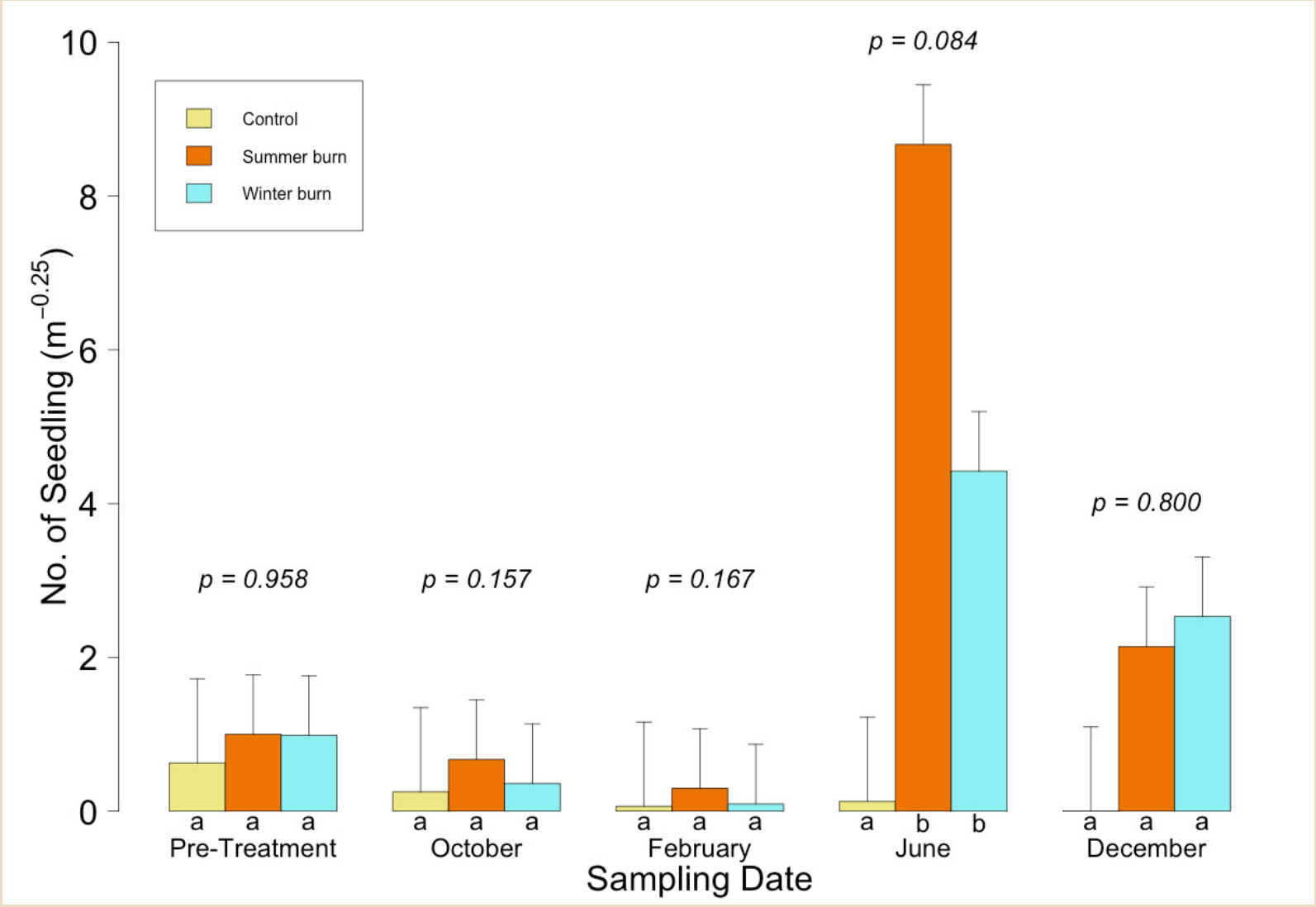
- Permanent 1m^2 quadrats (4)
  - Dead crown density
  - Seedling density



Objective 1: mortality density



Objective 1: seedling density



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[9]

- 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

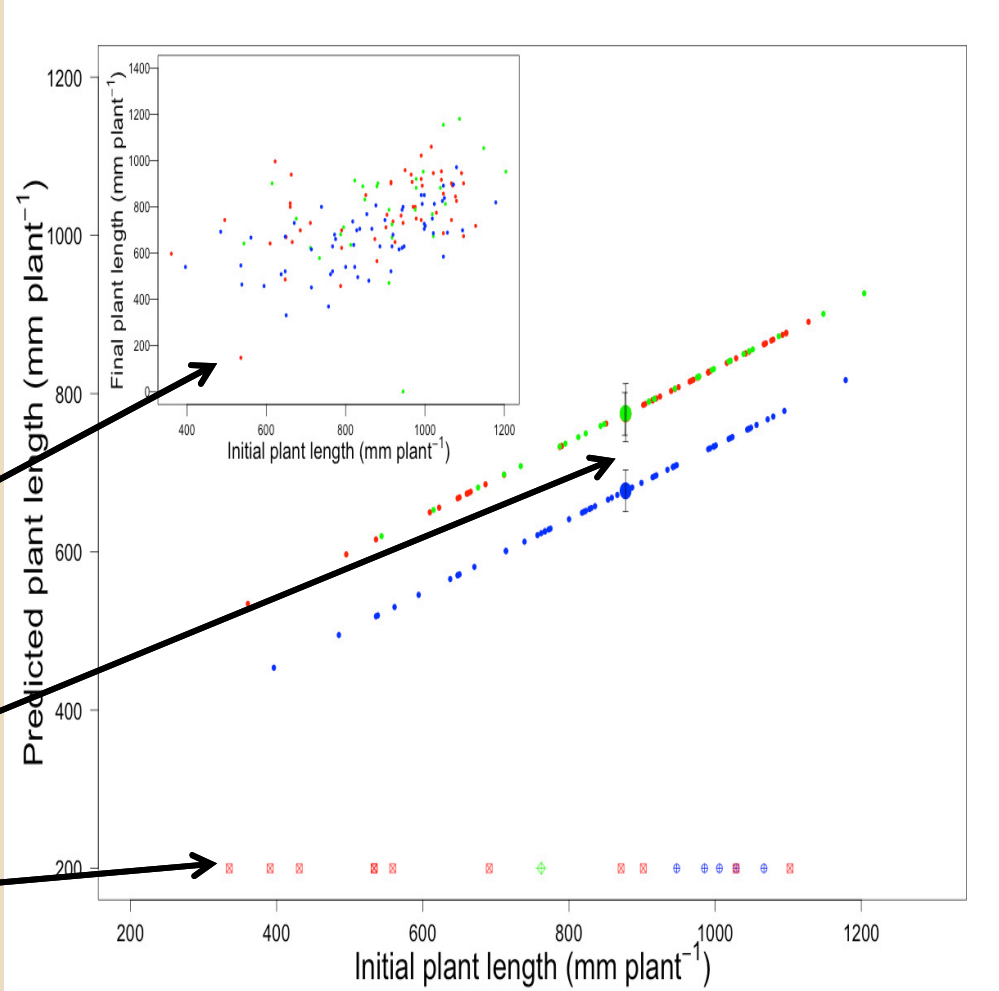
- Individual biomass
- ~50 regression plants
- Multiple regression with morphometrics as explanatory variables for individual dry weight
- Variable selection was based on MAXR

Period	Intercept	Length	Number of tillers	Area at 7.5 cm above ground (cm^2)	Area at 50% plant height (cm^2)	Square of basal area	Square of 7.5 cm area	Square of 50% area	Adj. R^2
				D. annulatum					
1	-7.38 (1.87)	0.01 (0.002)	-	0.01 (0.001)	0.05 (0.01)	-	-	-8.4^{-5} (2.90^{-6})	0.923
2	-16.24 (4.41)	0.24 (0.005)	-0.13 (0.05)	0.05 (0.008)	-	-	$-2.73^{-}5$ ($6.94^{-}7$)	1.3^{-4} (2.64^{-5})	0.848
3	-10.69 (2.69)	0.02 (0.003)	0.06 (0.03)	0.02 (0.001)	0.08 (0.01)	-	-	-1.0^{-4} (3.00^{-5})	0.932
4	3.38 (1.47)	-	0.14 (0.06)	-	0.08 (0.03)	$4.78^{-}7$ ($1.46^{-}7$)	-	-	0.893
				T. texanus					
1	1.23 (0.36)	-	-	0.01 (0.002)	0.05 (0.01)	-	-	-	0.955
2	-2.61 (0.62)	-	0.29 (0.02)	-	0.05 (0.01)	-	-	-	0.982
3	-2.58 (1.48)	0.01 (0.002)	-	0.03 (0.001)	-	-	-	2.19^{-5} (2.66^{-6})	0.957
4	2.30 (0.72)	-	-	0.21 (0.004)	0.13 (0.03)	-	-	-	0.856

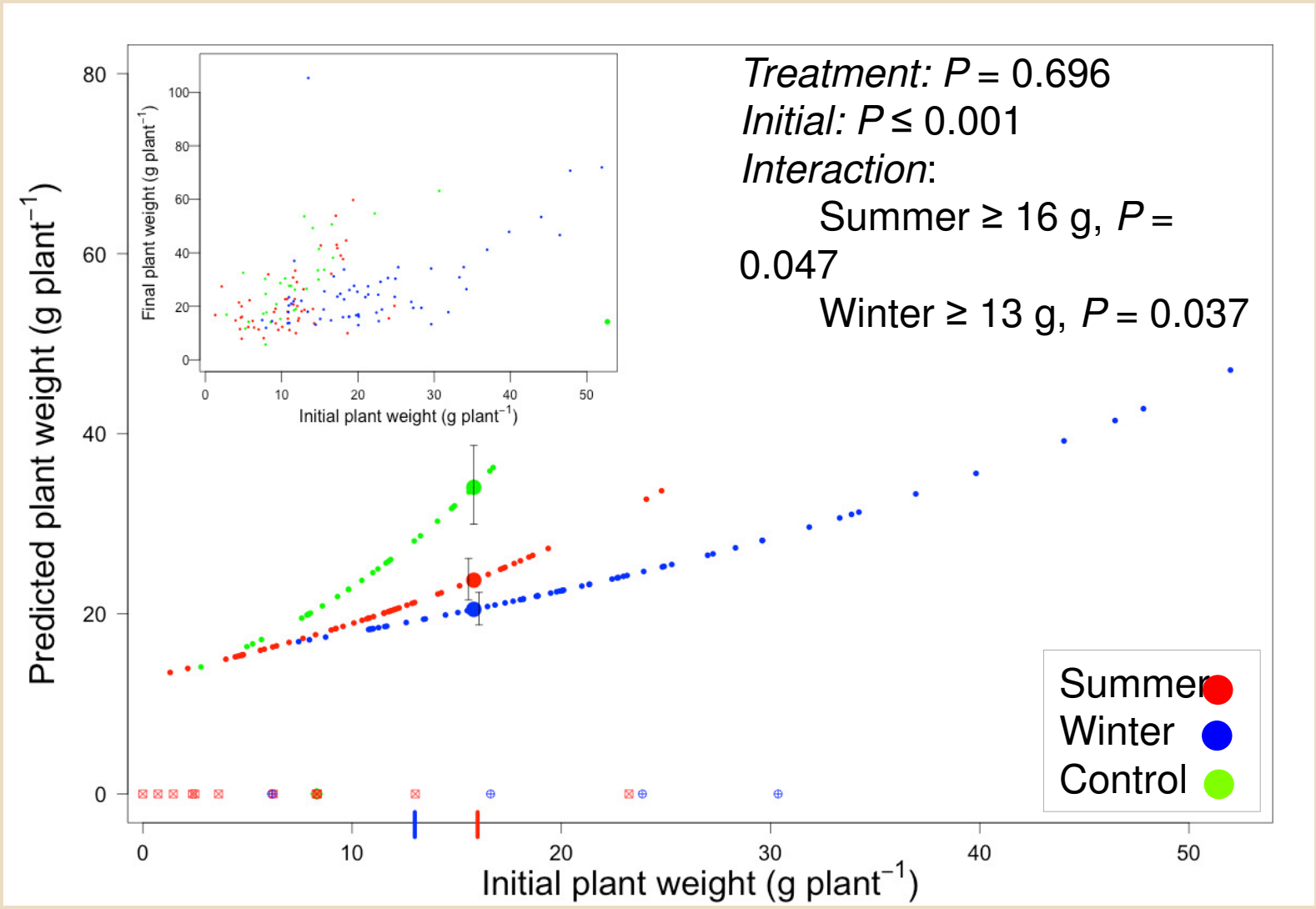
Objective 2: Figure Example

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

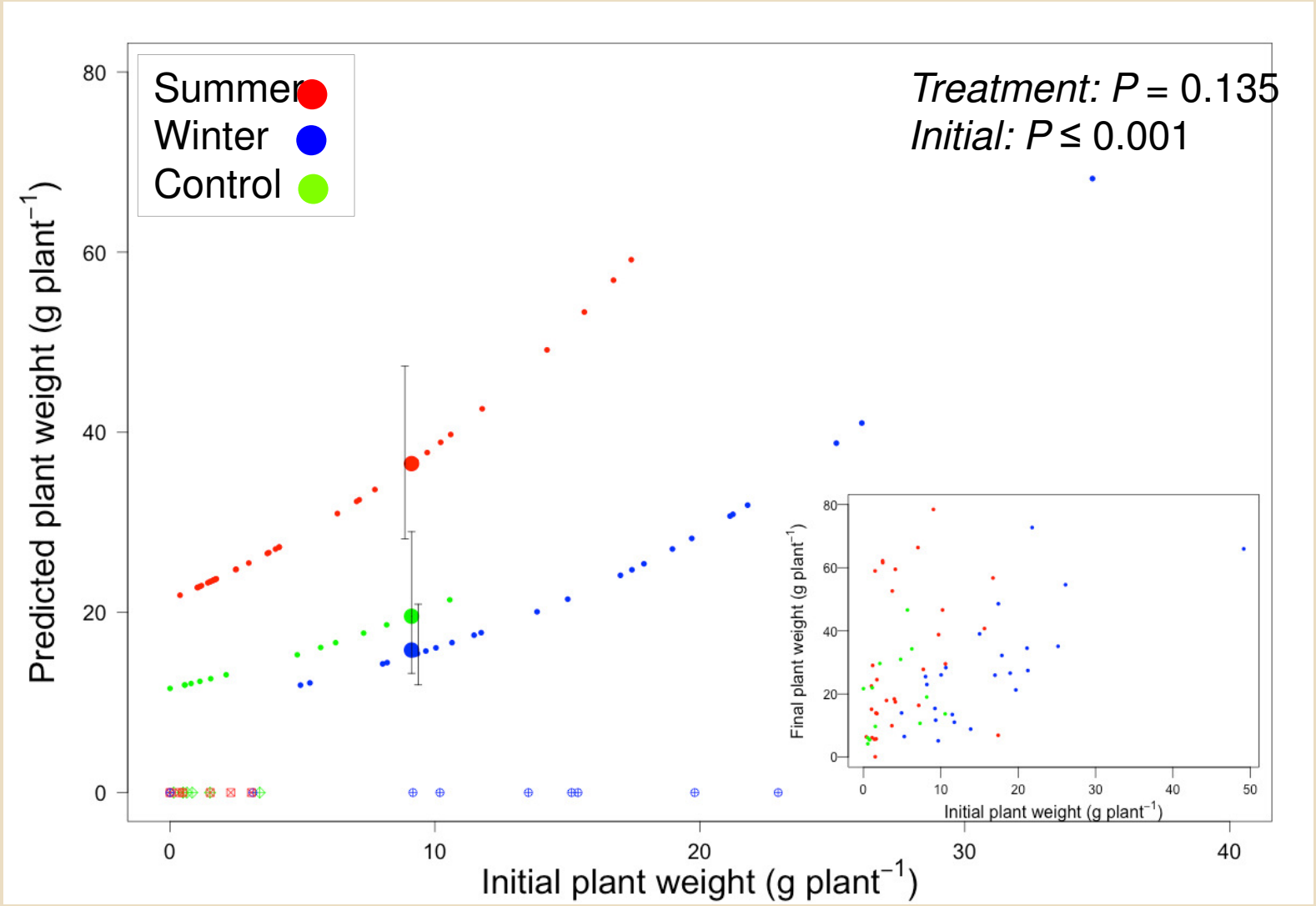
- Initial metric
- Final predicted metric
- Raw Data
- Covariate means
- Deceased individuals



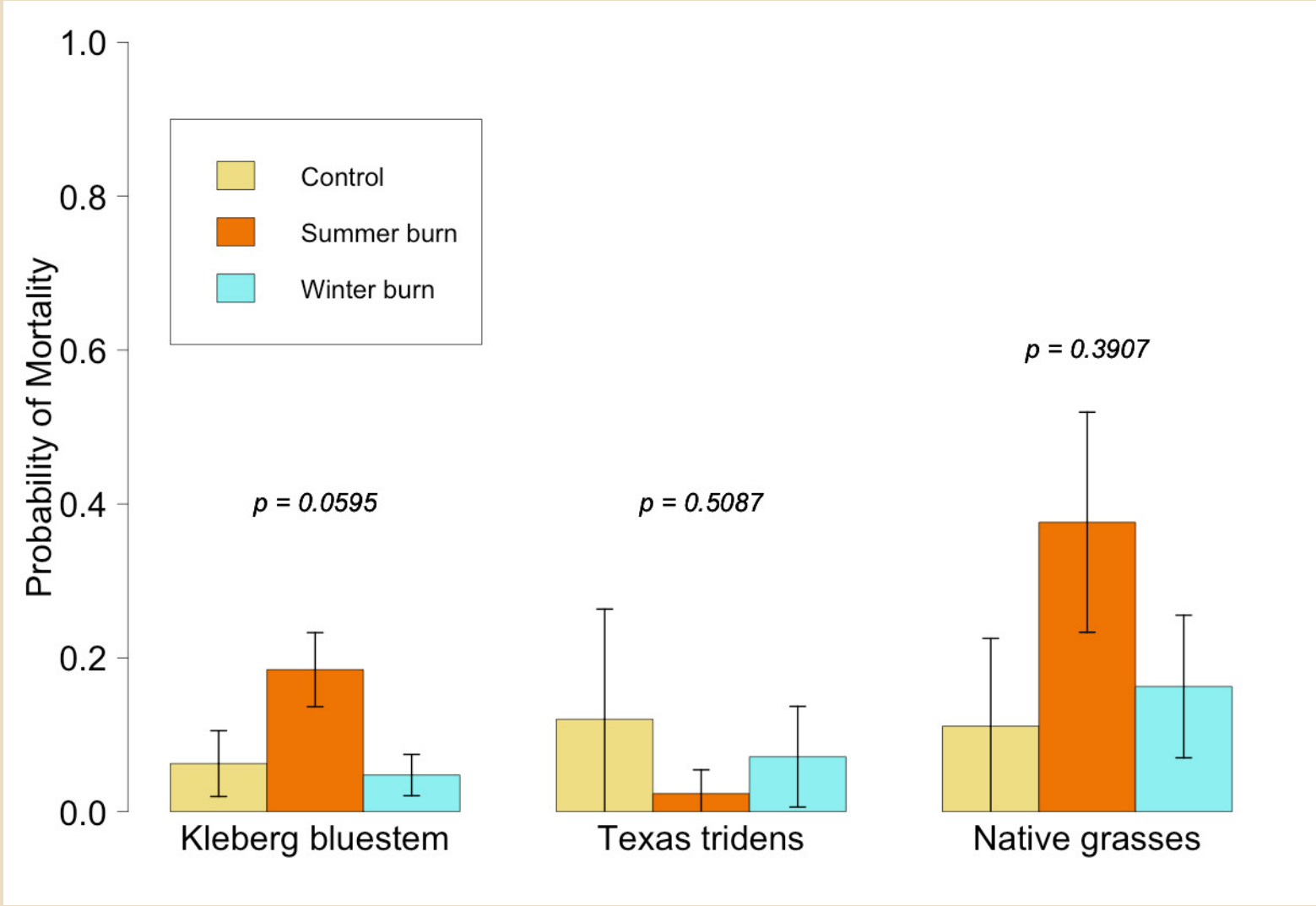
Objective 2: Kleberg biomass



Objective 2: Texas tridens biomass



Objective 2: mortality probabilities



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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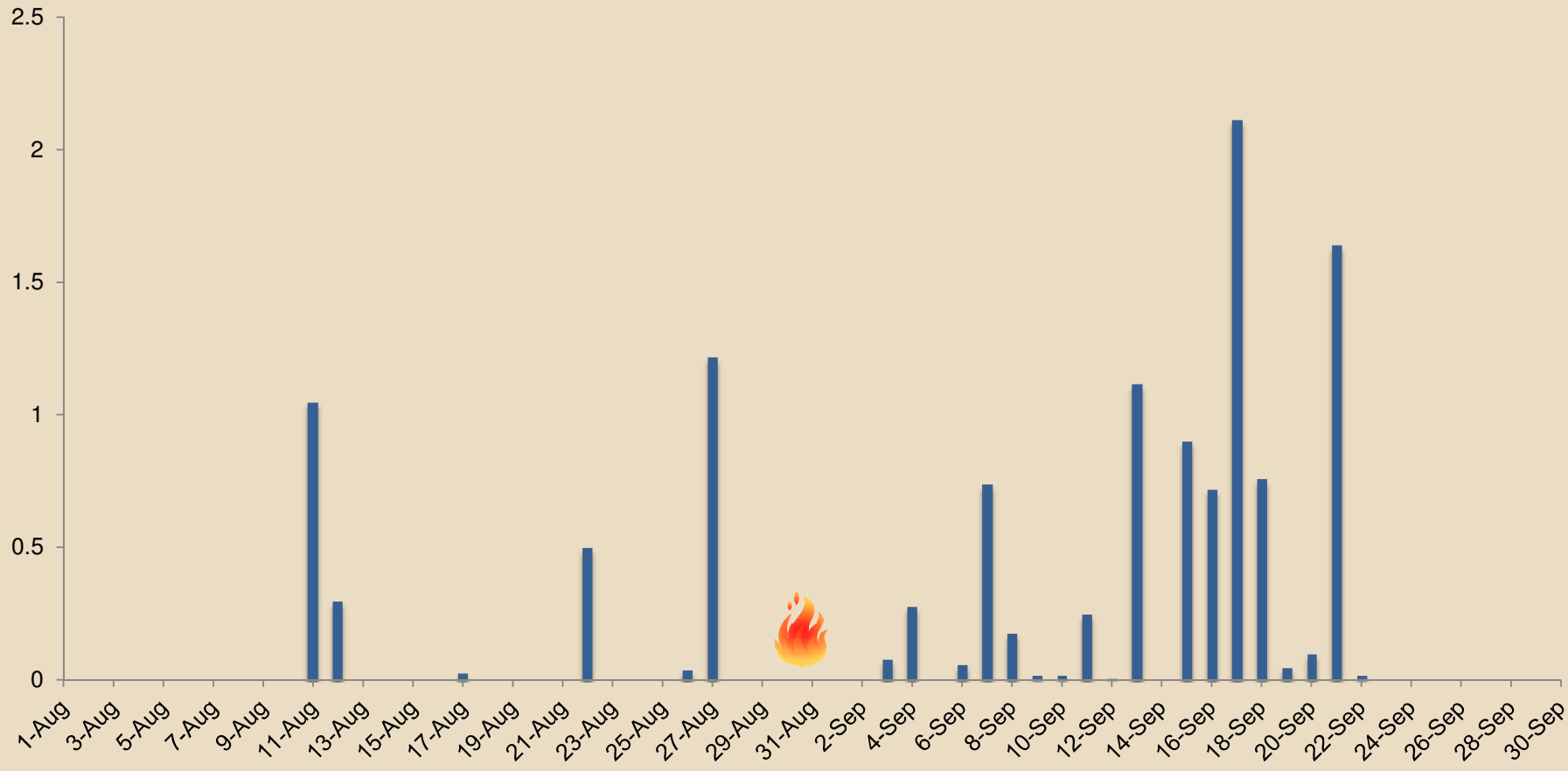
- Repeated treatments may produce variable results
- Impact of precipitation on vegetative responses

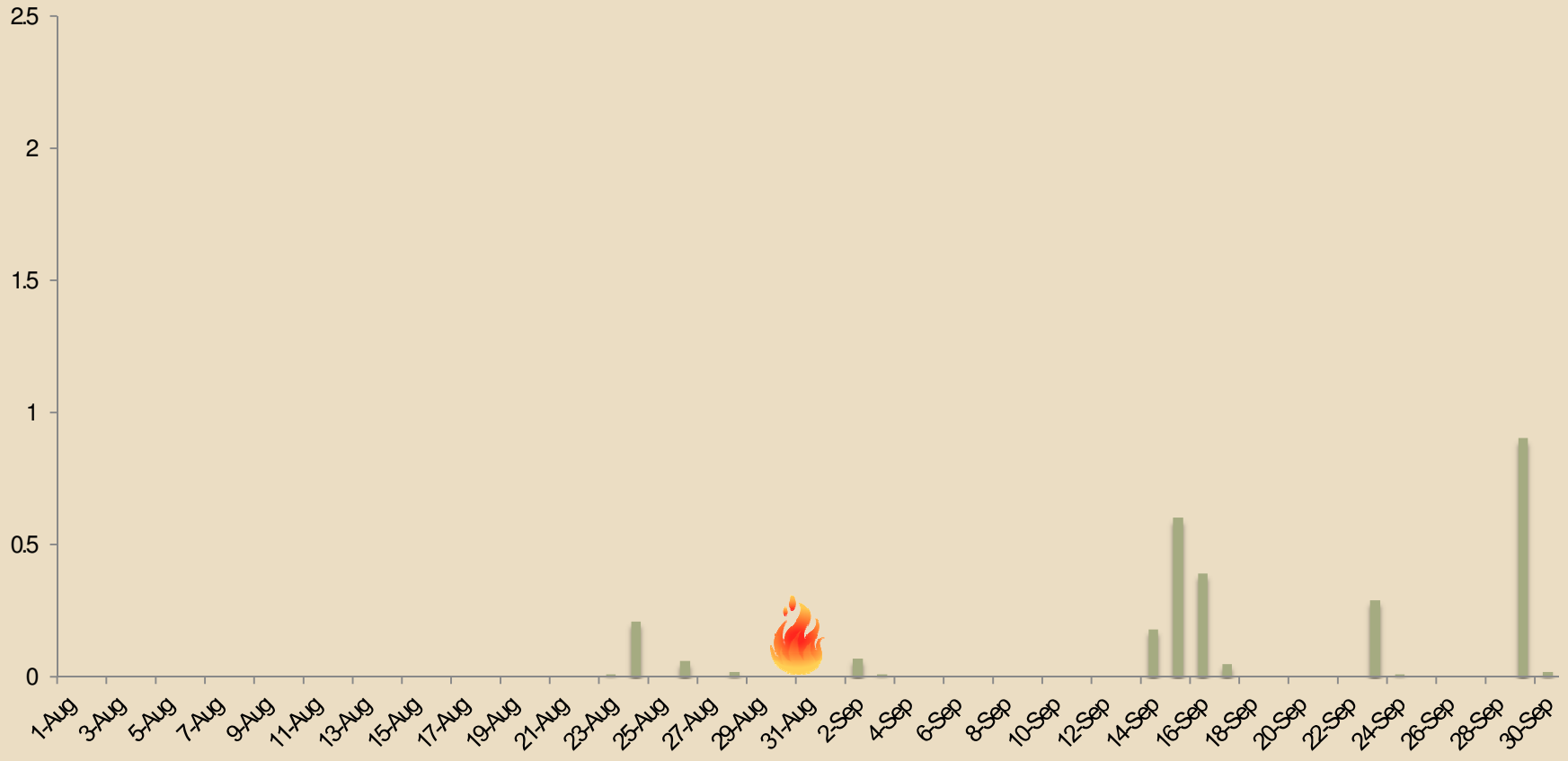
Precipitation Aug.-Sept. 2013

- Favorable post-treatment precipitation



Precipitation Aug.-Sept. 2012

- Little post-treatment precipitation



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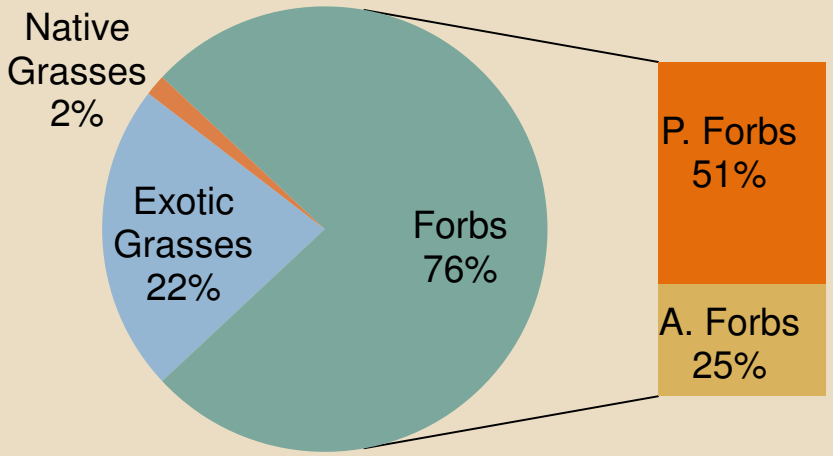
QUESTIONS?

Seedbank Composition

- 149-617 seedlings/tray
  - ~1246 germinates/m^2
    - Richness [S][11]
    - Diversity [exp H`][11]
    - Evenness [exp H`/S][11]



- Permutational analysis of variance

	Treatment	Seedbank	All Forbs	Annual Forbs	Perennial Forbs	All Grasses	Native grasses
Richness	Summer	9.150 (1.486)	7.800 (2.141)	2.666 (1.365)	3.600 A(0.600)	2.000 (0.204)	1.000 (0.204)
	Winter	12.50 (0.989)	10.20 (1.177)	4.300 (0.771)	0.900 B[1](0.900)	2.250 (0.176)	1.250 (0.176)
	Control	11.90 (2.029)	9.900 (1.803)	3.400 (2.586)	3.350 A(1.675)	2.000 (0.353)	1.000 (0.353)
Evenness	Summer	0.440 (0.034)	0.481 (0.032)	0.689 (0.128)	0.392 (0.024)	0.632 (0.075)	1.000 (0.000)
	Winter	0.388 (0.031)	0.405 (0.037)	0.486 (0.131)	0.320 (0.030)	0.665 (0.051)	1.000 (0.000)
	Control	0.391 (0.055)	0.407 (0.058)	0.541 (0.163)	3.664 (2.231)	0.569 (0.076)	1.000 (0.000)
Diversity	Summer	4.932 (0.618)	4.354 (0.657)	3.331 (0.829)	2.010 (0.170)	1.206 (0.107)	1.000 (0.159)
	Winter	4.620 (0.615)	3.839 (0.571)	2.132 (0.456)	2.198 (0.161)	1.431 (0.099)	1.150 (0.170)
	Control	4.648 (5.968)	4.135 (1.070)	2.212 (0.703)	2.525 (0.445)	1.308 (0.687)	1.000 (0.000)