
## Factors Affecting Plant Response to Fire Damage

- Physical
- Physiological
- Morphological
- Phenological

## Physical Resistance to Heat

- Lethal Temperature to Plant Tissue - 140ºF
  - Coagulation of Proteins
  - Cellular Membranes Rupture
- Ambient Temperature at Time of Burning Impacts Temperature Rise Needed to Reach Lethal Point

## Physical Resistance to Heat

- Heat Resistance Varies
  - Moisture Content
  - Among Plants within the Same Species
  - Between Species
  - Among Organs of the Same Plant
    - Location in Relation to Flame
    - Seed Coat
    - Moisture Content

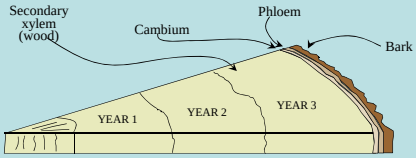
## Physical Resistance to Heat

| Temperature °F | Exposure Time for Lethality (seconds) |
|---|---|
| 147 | 3 |
| 142 | 5 |
| 140 | 31 |
| 126 | 660 |

(Data from Hare 1961)

## Physical Resistance to Heat

- Dormant Tissue (Low in Water Content) Have Increased Heat Resistance
- "Watered" Bluestem was Killed in Four (4) Hours by the Same Heat Intensity that Required sixteen (16) Hours to Kill Drought-Hardened Plants (Hare 1961)
- Bark is a Natural Insulator - Evergreen Bark Better than Hardwood Bark of the Same Thickness




Fire-caused mortality is result of killing cambium (source of new growth) and phloem (pipeline for photosynthates) by heat.

## Physical Resistance to Heat

- A Plant Already at 95 ºF Require only about Half the Temperature Rise as One at 50 ºF to Reach Lethal Temperature
- Lethal Temperature Occurs as a Result of the Combination of Temperature and Exposure

## Physiological - Morphological - Phenological Influences

- Growth Forms of Plants Responsible for Susceptibility to Fire
- Perennial Sod-Forming More Tolerant than Most Other Growth Forms
- Plants with Less Dead Material are Less Susceptible

## MORPHOLOGICAL INFLUENCES

Relative elevation of buds important to fire resistance, but not sole regulator of heat damage potential. Relative compactness of bunchgrasses and amount of standing fuel largely regulate temperature and duration of heat exposure to growing points.

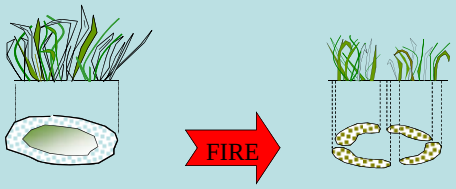
Compact bunches, elevated buds, and high amount of standing fuel = greatest potential for fire damage.

Loosely arranged bunch, little standing fuel = low probability of heat damage if buds not elevated.



Many sodgrasses produce so little standing fuel that probability of heat damage is low (ex. Buffalograss).

## FIRE-INDUCED CHANGES IN MORPHOLOGY OF GRASSES




Single clump of bunchgrass with hollow center

Series of small clumps eventually function as individual plants

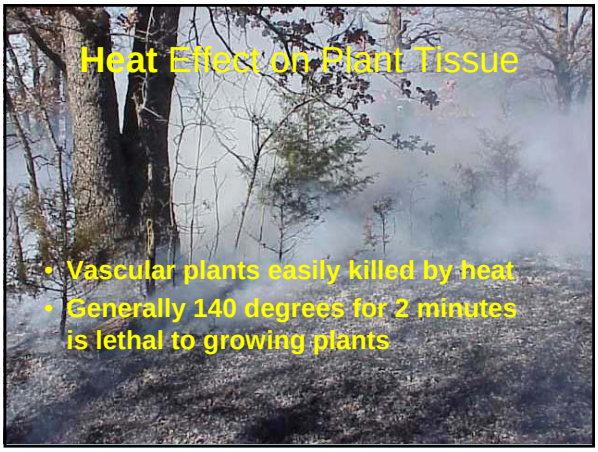
(Example: little bluestem)

## Physiological - Morphological - Phenological Influences

- Less Vigorous Plants are More Susceptible
- Root Sprouting Plants Invigorated
- Fire Preconditions Plants for Insects and Disease
- Any Species of Plant will Not React Consistently to Fire Since Characteristics of Fire are Widely Variable

## Physiological - Morphological - Phenological Influences

Frequently, there is a shift from vegetative to reproductive activity during the year of the burn.




## Heat Effect on Plant Tissue

- Plant moisture *increases* the plants susceptibility to heat
- 3 minutes to kill 166% moisture Stipa comata at 140 degrees
- 100 minutes to kill 28% moisture Stipa comata at 140 degrees

## Heat Effect on Seeds

- Seeds very tolerant to heat
- Grass seeds can tolerate 180 - 240 degrees for 5 minutes
- Little effect on seeds at soil surface
- Sometimes heat can increase germination

## Fire Adaptations

- Bark insulation
- Seed  serotiny
- Growth form


## Fire Adaptations

### Serotiny

- Heat above 140 degrees melts resinous bonds
- Legumes
- Redbud
- Jack pine

Redbud thickets can usually be traced back to a fire.

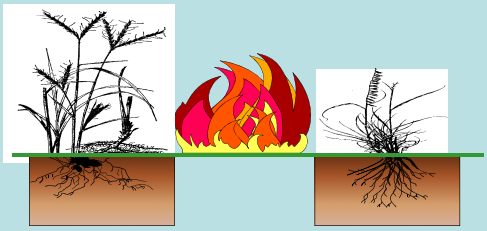
## Fire Adaptations

### Growth Form

- Bunchgrass with old growth susceptible
- Growing point close to surface are susceptible
- Rhizomatous grasses fire-tolerant
- Growing annuals usually killed outright

•Little bluestem: bunchgrass
•Sand Sage: resprouts

Soil Texture - water holding capacity greatly influences post burn plant growth



CLAY SOIL
High $H_2O$ holding capacity

Water available for plant regrowth

SANDY SOIL
Low $H_2O$ holding capacity

Water stress following burning

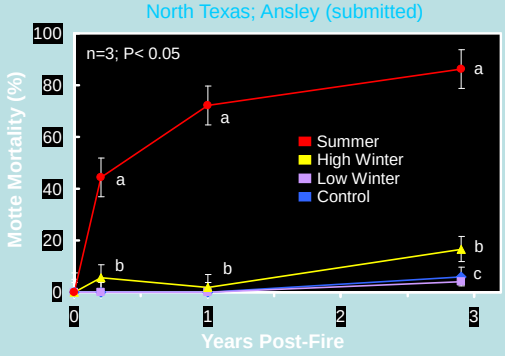
## Summer Fire Effects on Prickly Pear Cactus

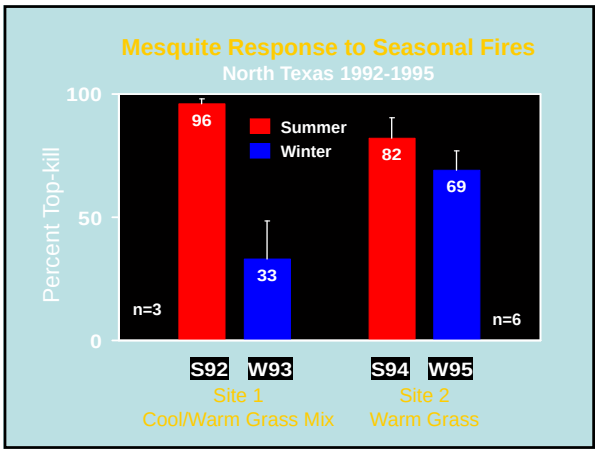
## Medium Motte (31 Pads) Summer Fire

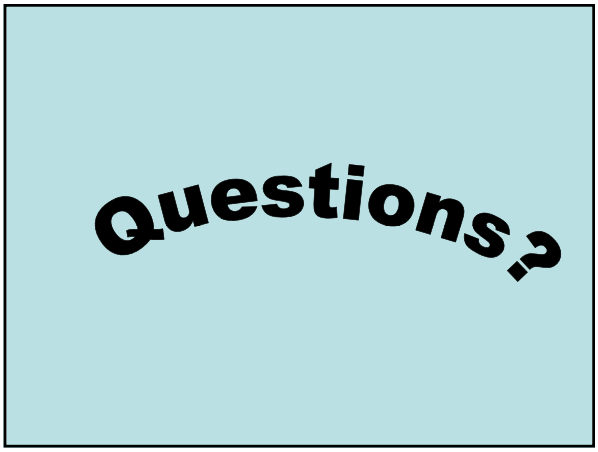



## Prickly Pear Motte Mortality

North Texas; Ansley (submitted)




Mesquite Response to Seasonal Fires
North Texas 1992-1995
Percent Top-kill
100
50
0
96
33
82
69
Summer
Winter
n=3
n=6
S92
W93
S94
W95
Site 1
Cool/Warm Grass Mix
Site 2
Warm Grass


Questions?