Flammability Characteristics of Landscape Mulches

Alan Long, Brian Hinton	*University of Florida*
Wayne Zipperer	*U.S. Forest Service, SRS*
Alex Maranghides, William Mell	*NIST*

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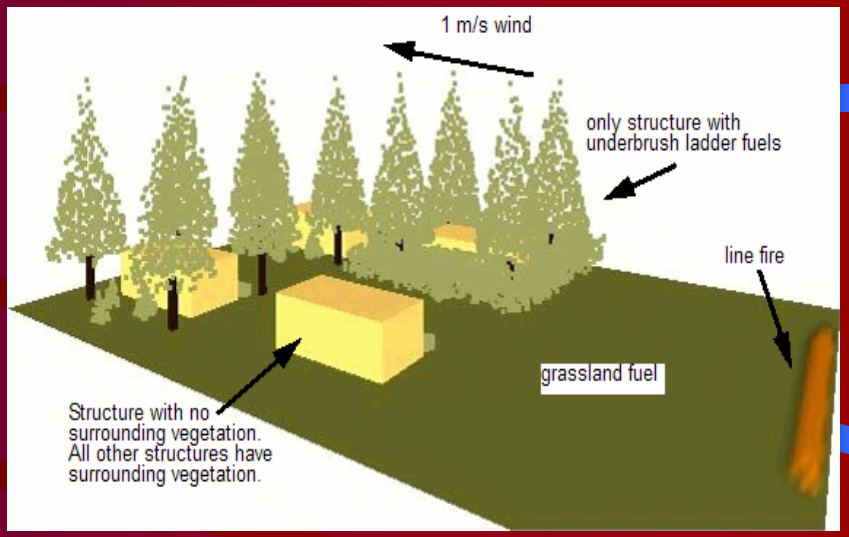
Objectives

- Determine rate of spread, heat release, flame length, and consumption for:
  - Four common southern mulches
  - Three drought regimes
- Further evaluation:
  - Shrub density impacts on fire characteristics
  - Fire transfer from landscaped beds to structural walls

The bigger picture . . .

- NIST's *Wildland-Urban Interface Fire Dynamics Simulator* (WFDS):
  - Physics-based model
  - Simulates fire behavior in mixed fuels
  - Uses inputs for fire characteristics in various landscape fuels

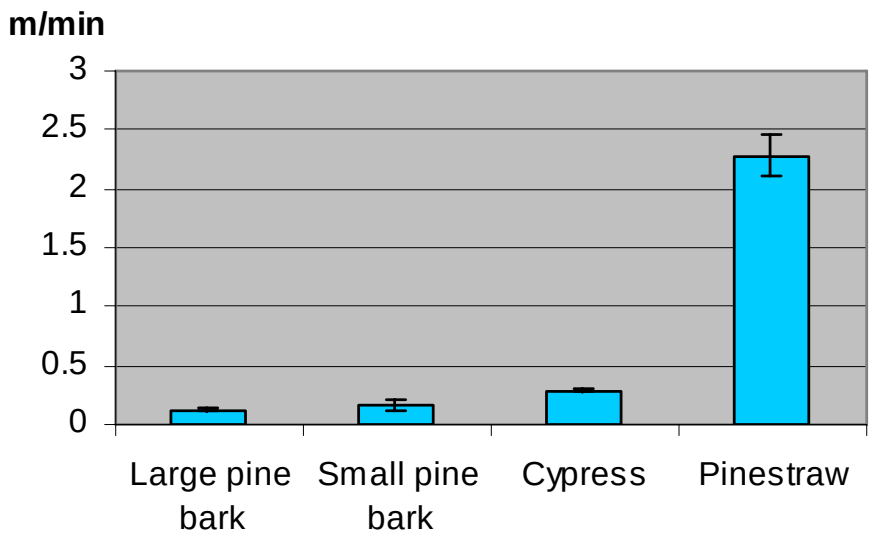


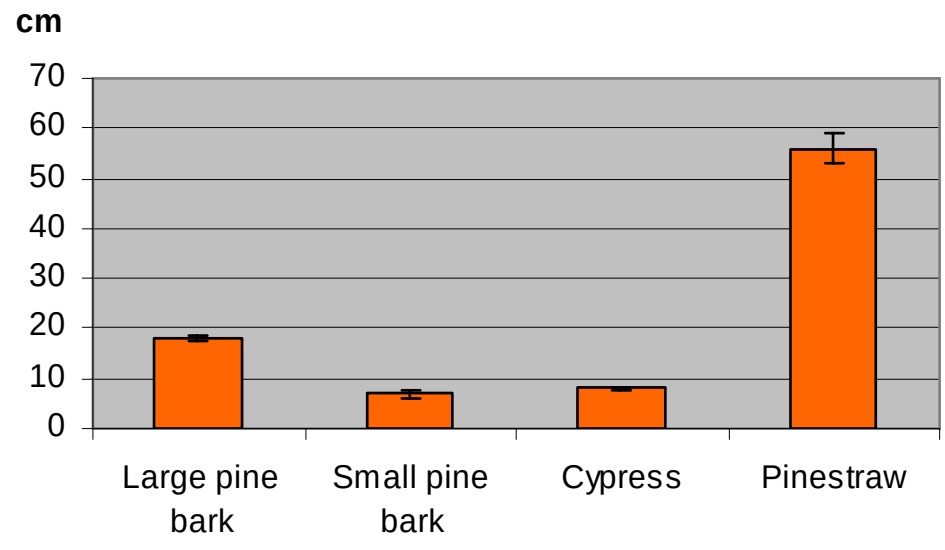
Field Studies - Methods

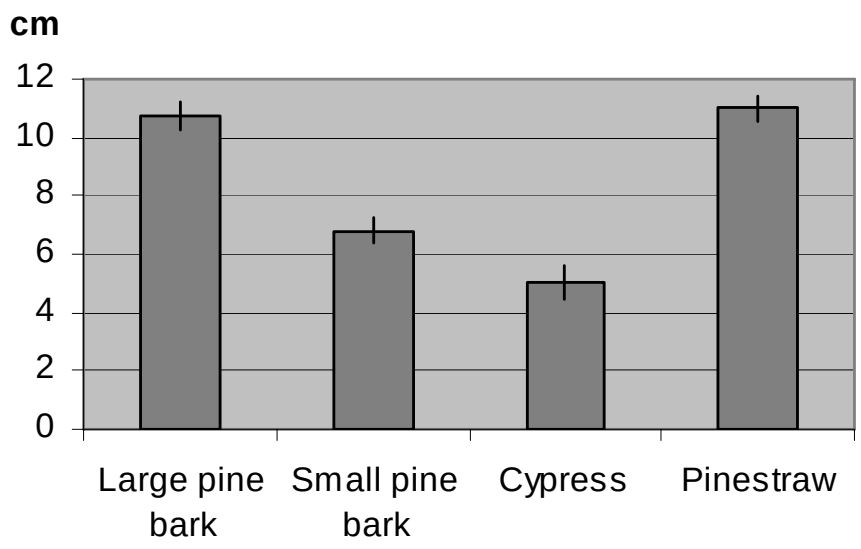
- 4 m diameter circular plots
- Mulches (10-12 cm deep)
  - Pine straw
  - Pine bark – 2 sizes
  - Shredded cypress
- 3 drought regimes
- Linear ignition pattern - upwind
- 1-hr burn period
- Early May
- Original design included shrubs

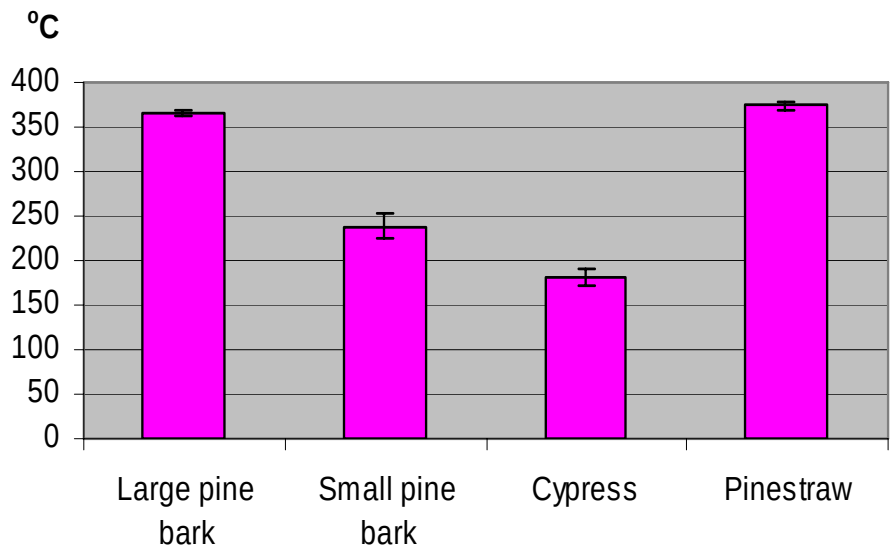
Field Studies - Methods

- Measured
  - Rates of spread
  - Flame height
  - Temperatures in flame zone
  - Fuel consumption
  - Fuel moisture and weather conditions


Rate of spread
m/min
3
2.5
2
1.5
1
0.5
0
Large pine bark
Small pine bark
Cypress
Pinestraw

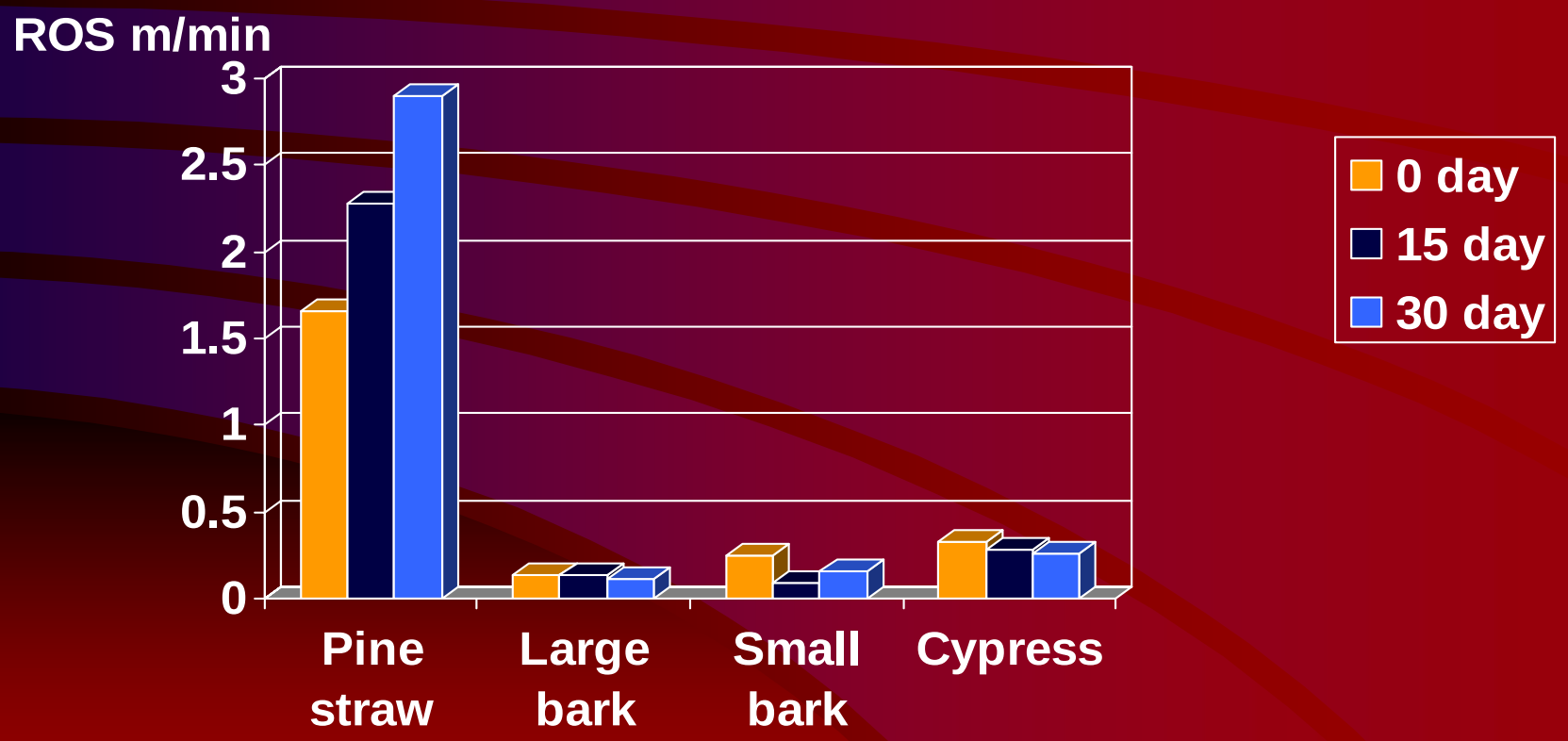

Flame height
cm
70
60
50
40
30
20
10
0
Large pine bark
Small pine bark
Cypress
Pinestraw


Burn depth
cm
12
10
8
6
4
2
0
Large pine bark
Small pine bark
Cypress
Pinestraw


Temperature 10 cm above surface
°C
400
350
300
250
200
150
100
50
0
Large pine bark
Small pine bark
Cypress
Pinestraw

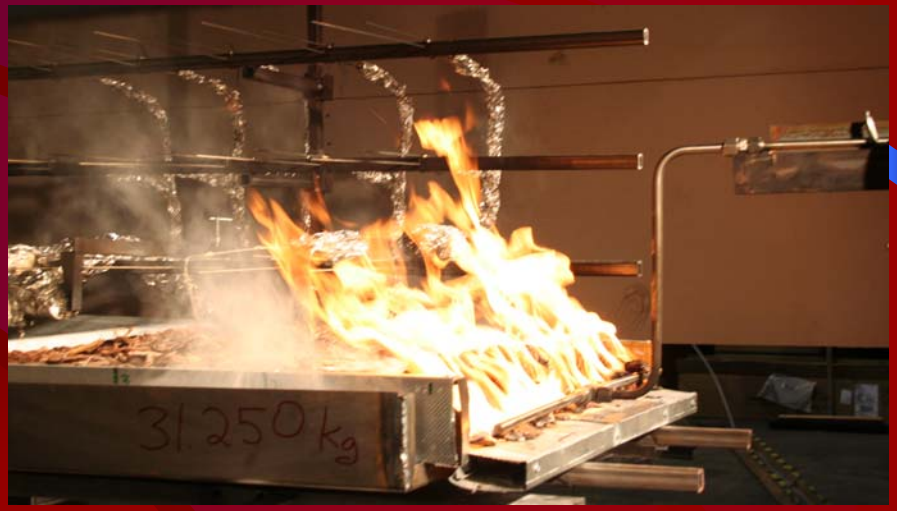
Field Studies - Results

Rate of spread by drought condition



NIST/BFRL Studies - Methods

- 1 x 1 m aluminum trays
- Same 4 mulches
- 3 drought regimes
- Linear ignition with propane burner
- 45-minute burn period
- 3m x 3m hood

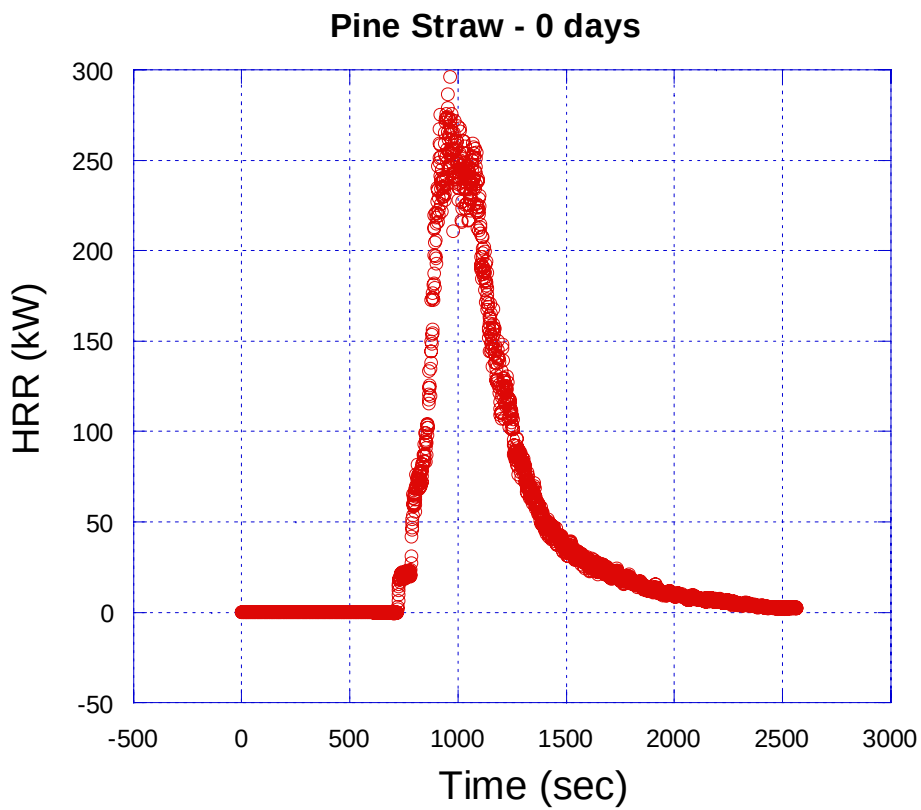


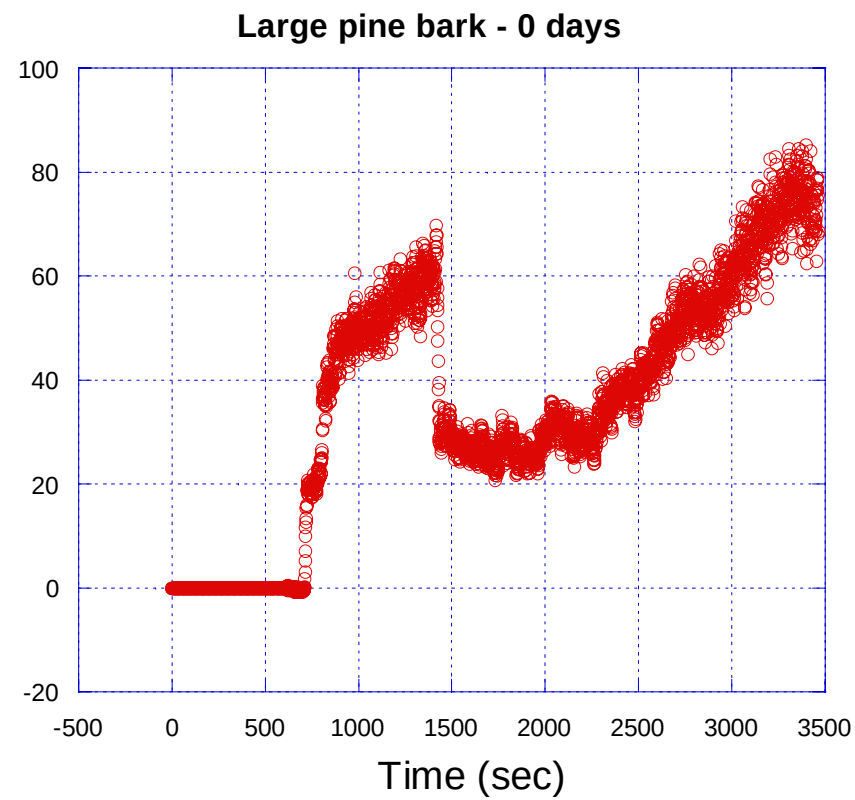
BFRL Studies - Methods

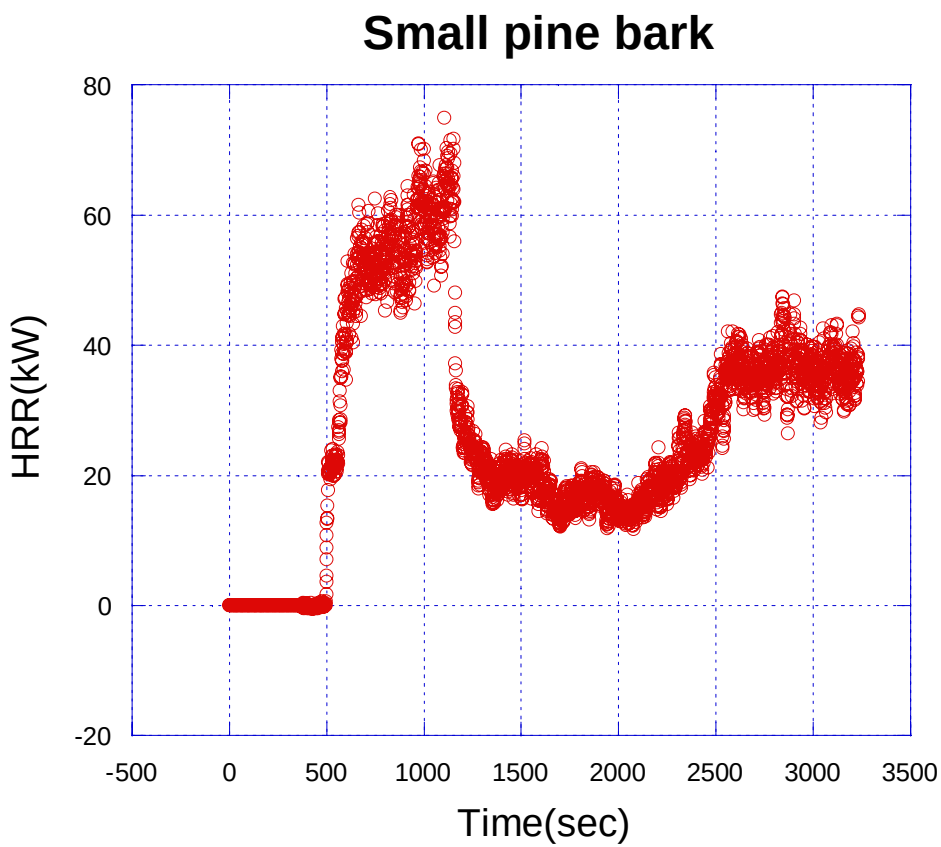
- Measured
  - Heat release
  - Temperatures
  - Rates of spread
  - Flame height
  - Mass loss
  - Fuel moisture

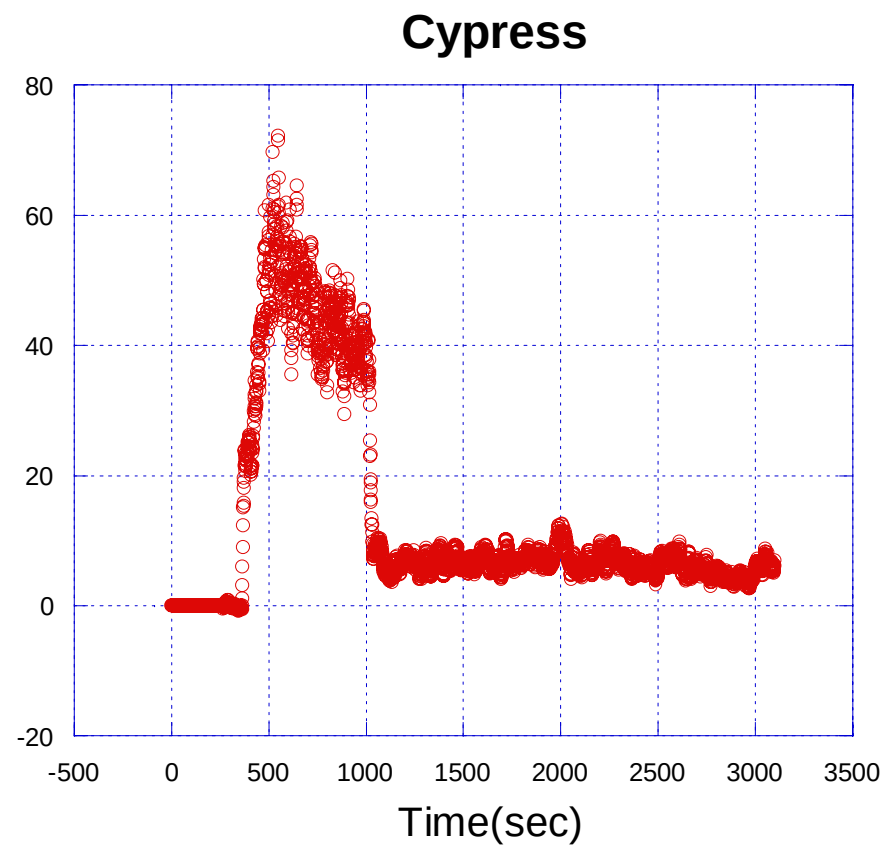
BFRL Studies - Results

- Pine straw produces highest peak heat release rate
- Bark produces lower but longer heat release period
- Wind really helps!

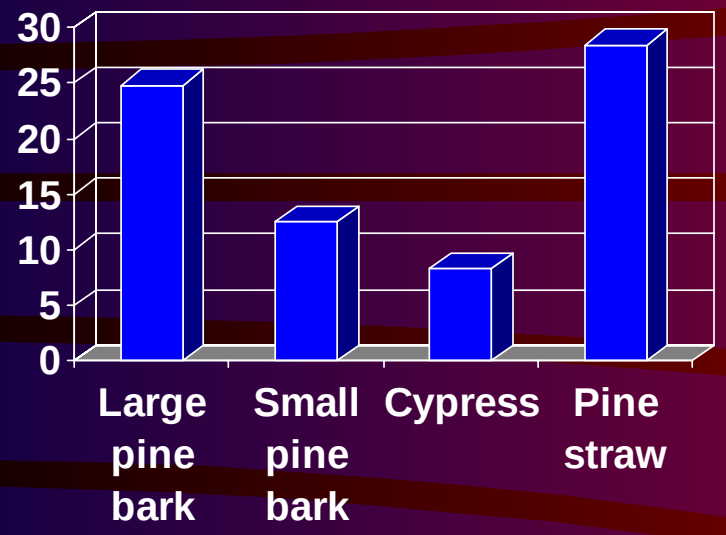




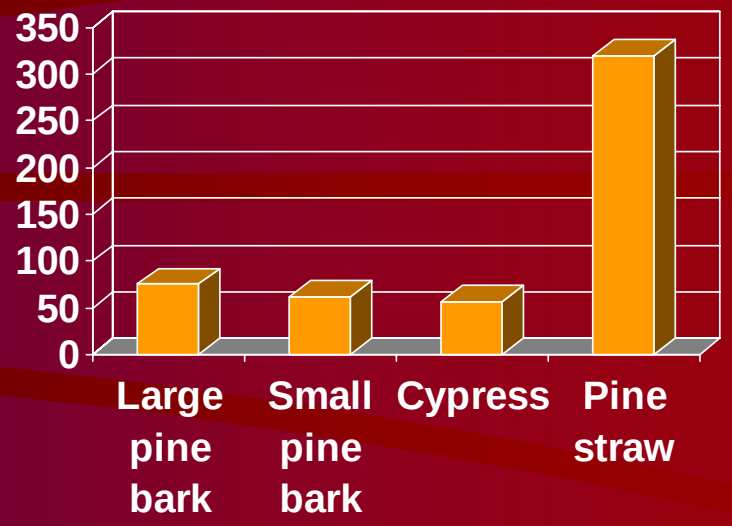

Small pine bark
HRR(kW)
80
60
40
20
0
-20
-500
0
500
1000
1500
2000
2500
3000
3500
Time(sec)


Cypress
80
60
40
20
0
-20
-500
0
500
1000
1500
2000
2500
3000
3500
Time(sec)

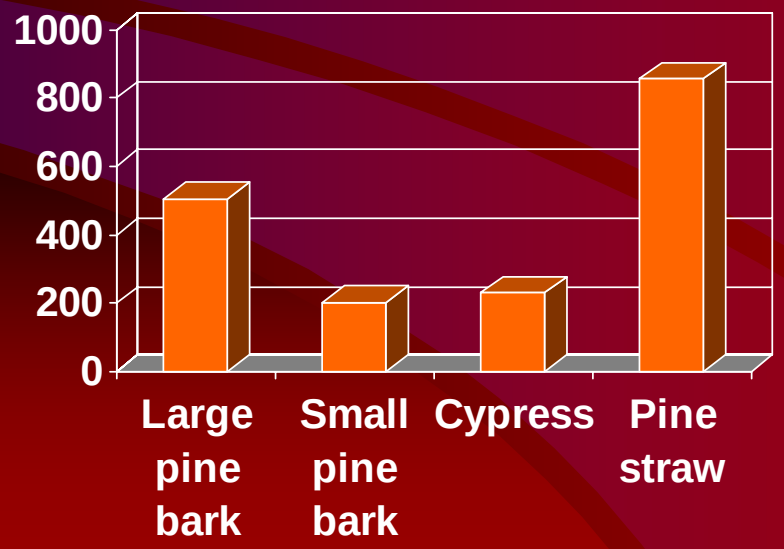
Total heat release (kW-hr)

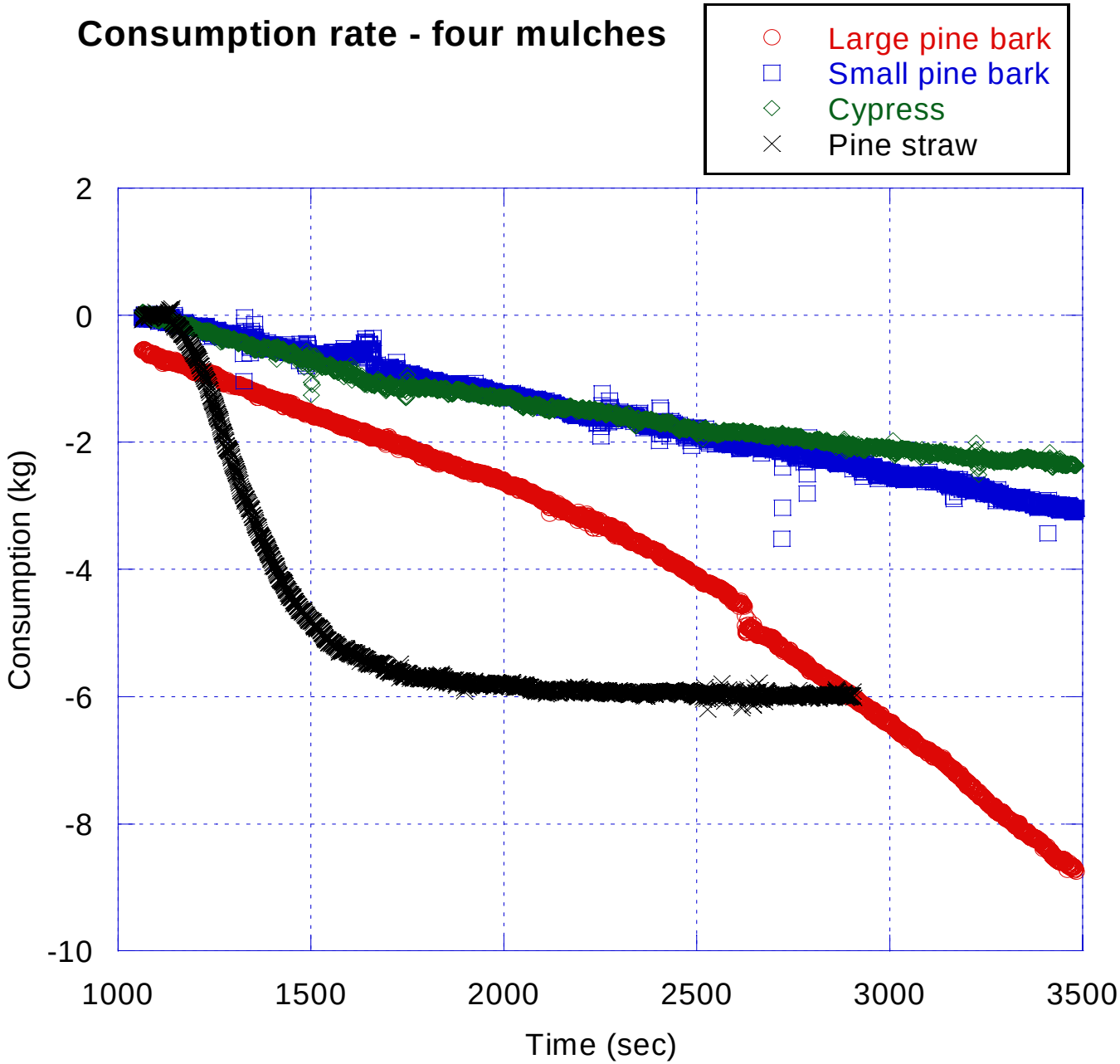


Peak heat release rate (kW)



Maximum TC temperature (C)




Consumption rate - four mulches
Large pine bark
Small pine bark
Cypress
Pine straw
2
0
-2
-4
-6
-8
-10
Consumption (kg)
1000
1500
2000
2500
3000
3500
Time (sec)

Summary

- What do we know?
  - *Pine straw – not close to structures*
  - *Pine bark burns hot*
  - *Cypress a good option, but..*
- How is it being used?
  - *Redesign shrub x mulch study*
  - *Add mulches to online shrub key*
- What is next?
  - *Shrub - mulch interaction*

2007 Mulch-Shrub Interaction Study

- Two species
  - Boxwood
  - Walter's viburnum
- Two densities
- Two mulches
  - Pine straw
  - Large pine bark

The Dilemma of Recommendations

- Cypress
  - Favorable characteristics
    - Low flame length, heat release & consumption
    - Conserves moisture well
  - Unfavorable characteristics
    - Decomposition & termite infestation
    - Limits on renewability of the resource
    - It will burn if ‘prodded’

Acknowledgements

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School of Forest Resources & Conservation

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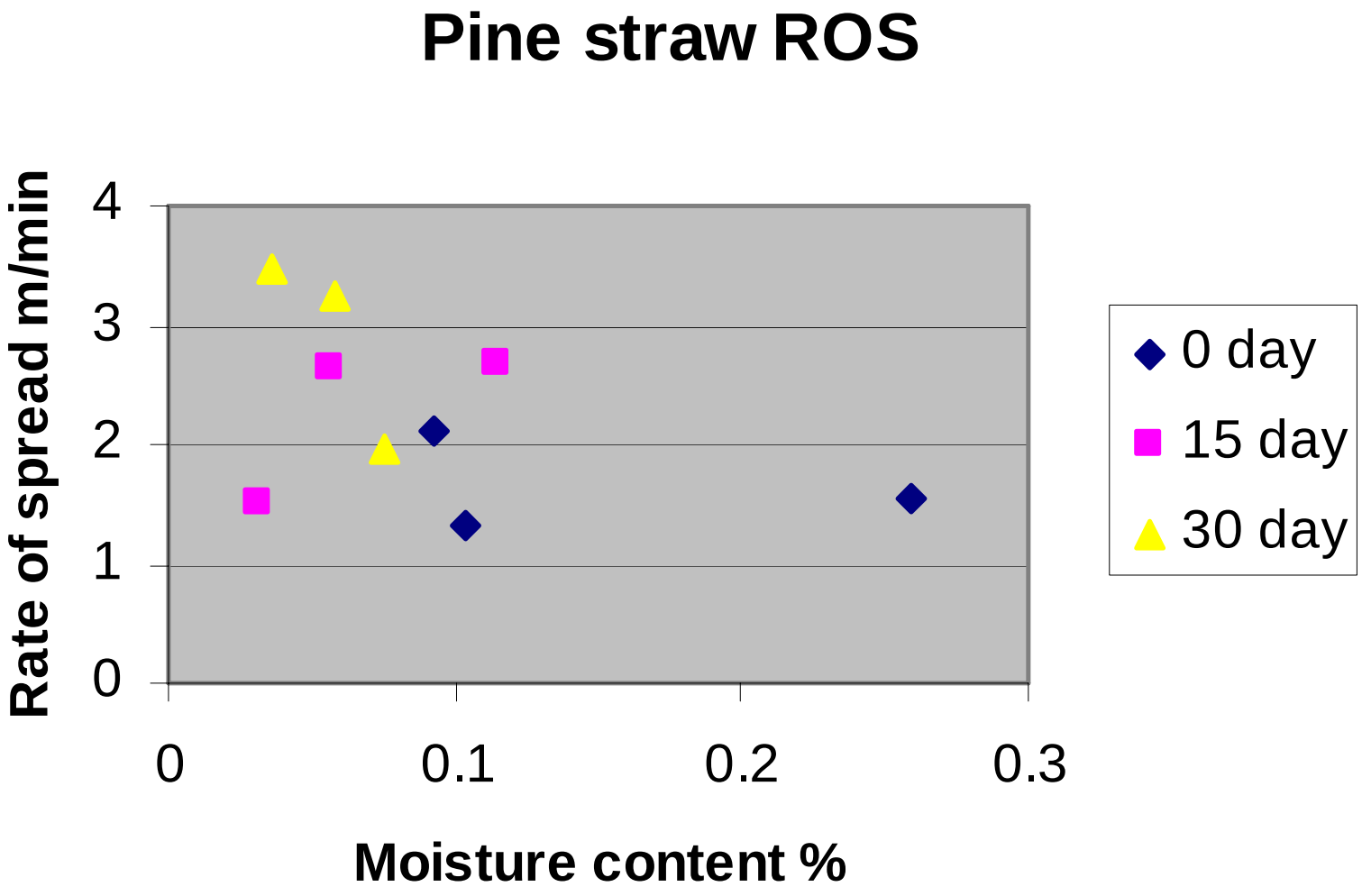
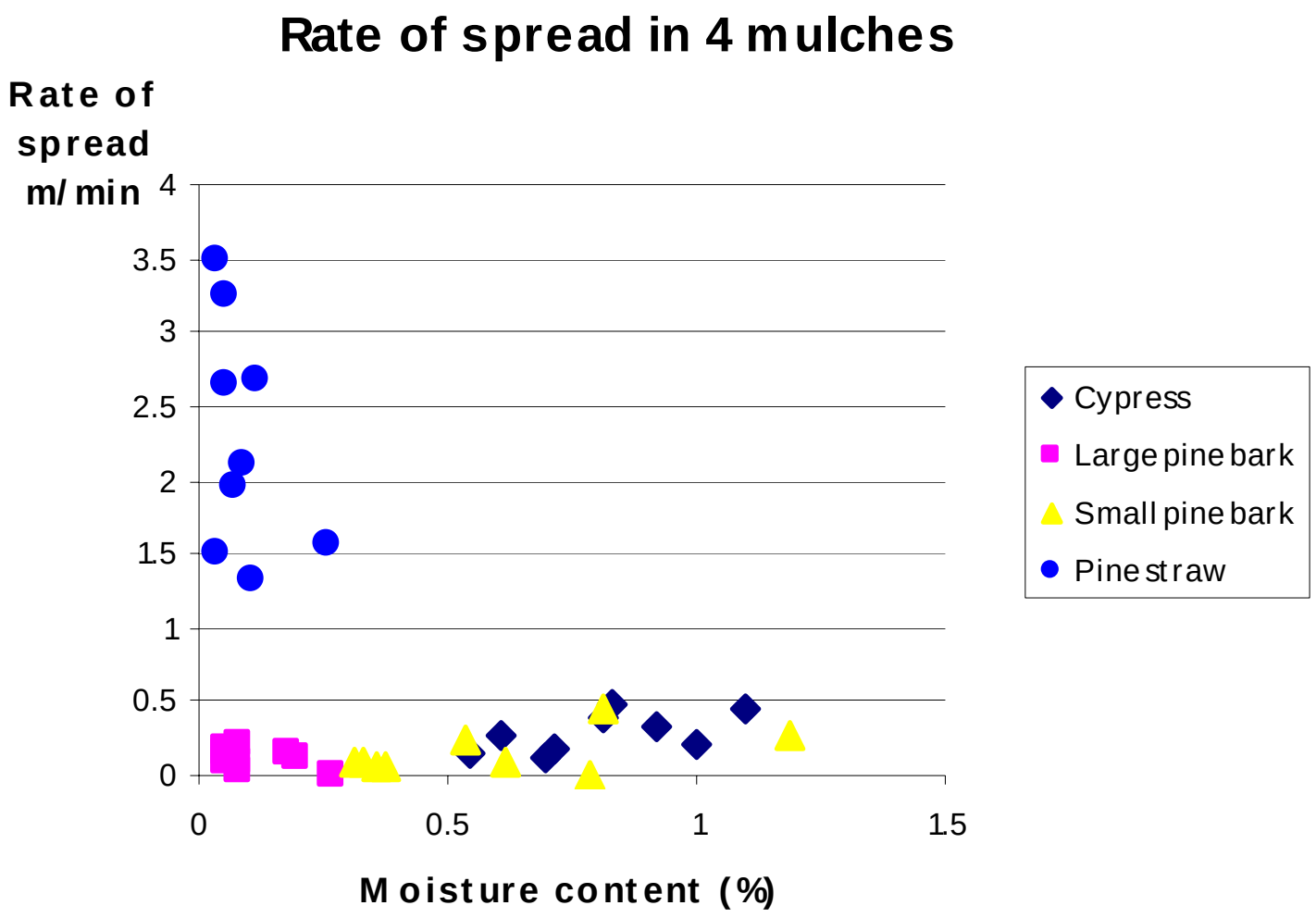
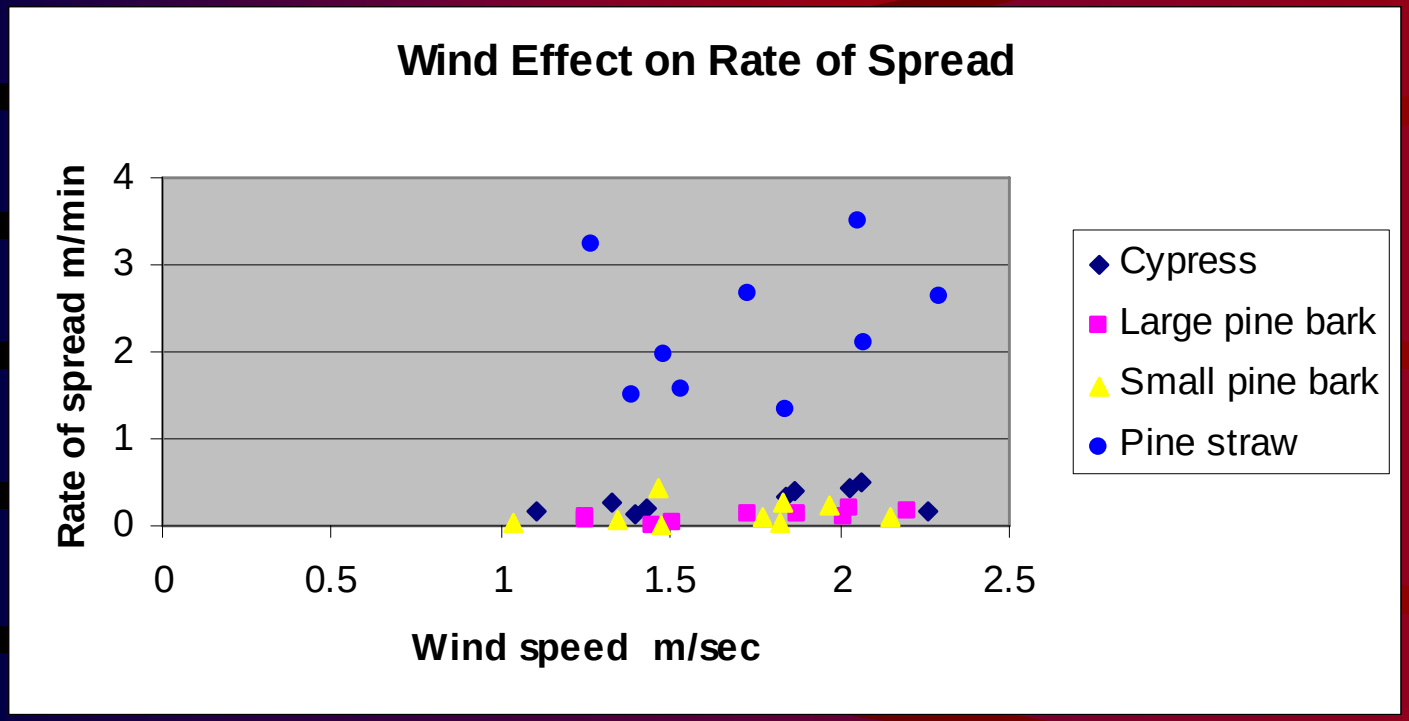
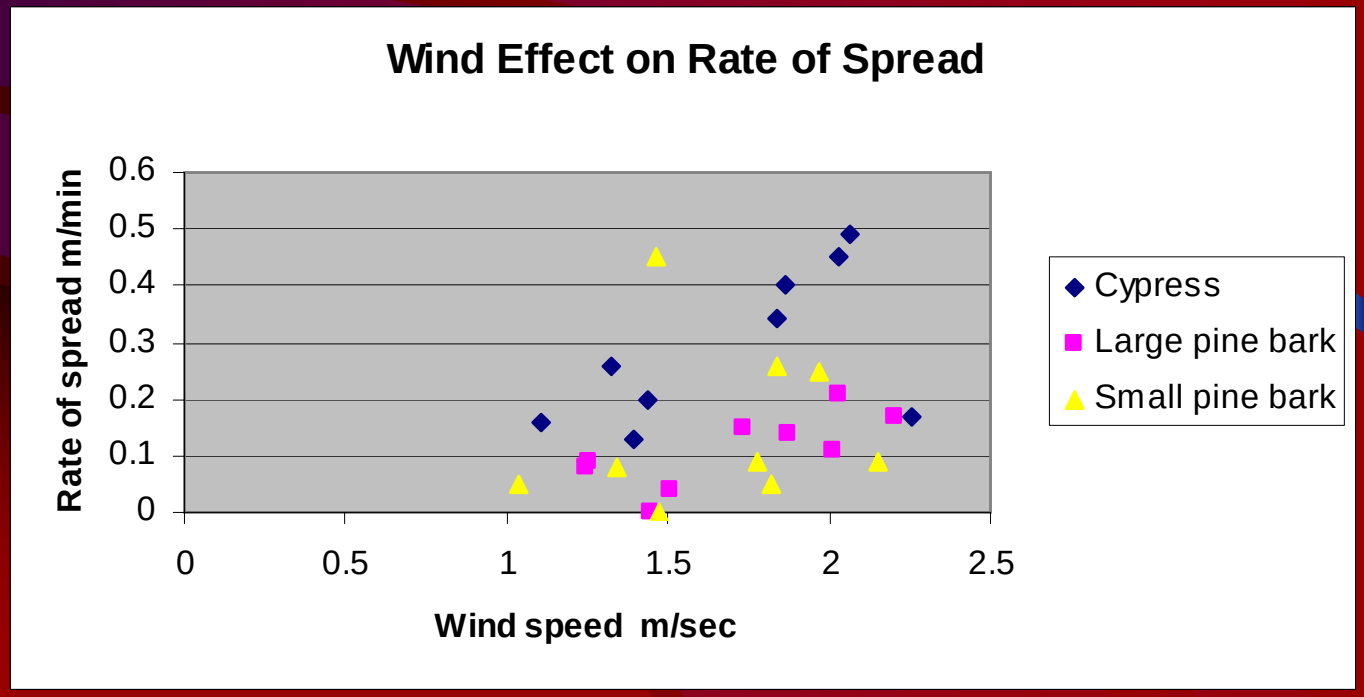
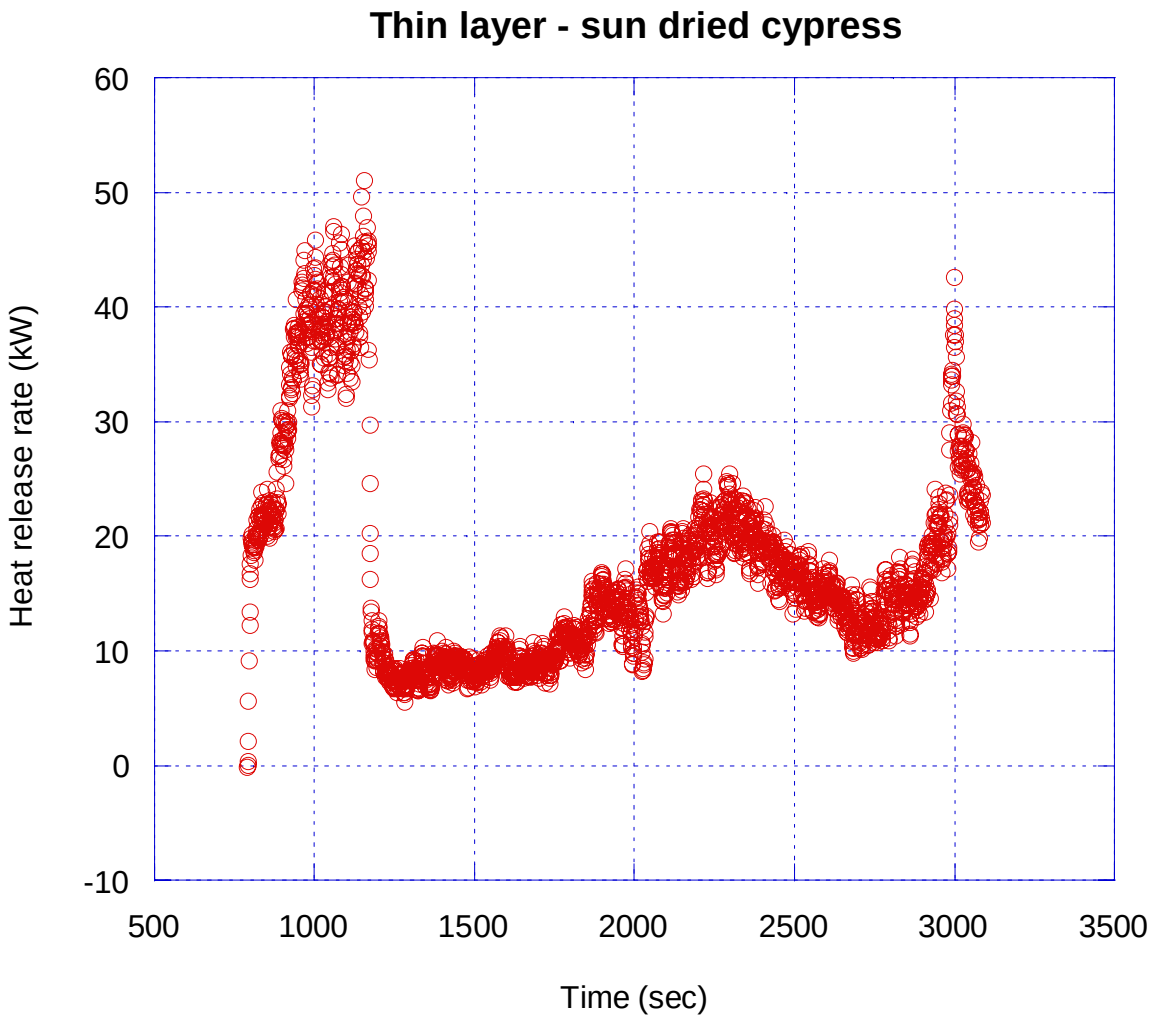

Pine straw ROS
Rate of spread m/min
4
3
2
1
0
0
0.1
0.2
0.3
Moisture content %
0 day
15 day
30 day


Rate of spread in 4 mulches
Rate of spread m/min
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
Moisture content (%)
Cypress
Large pine bark
Small pine bark
Pine straw


Wind Effect on Rate of Spread
Rate of spread m/min
4
3
2
1
0
0
0.5
1
1.5
2
2.5
Wind speed m/sec
Cypress
Large pine bark
Small pine bark
Pine straw


Wind Effect on Rate of Spread
Rate of spread m/min
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.5
1
1.5
2
2.5
Wind speed m/sec
Cypress
Large pine bark
Small pine bark


Thin layer - sun dried cypress
Heat release rate (kW)
60
50
40
30
20
10
0
-10
500
1000
1500
2000
2500
3000
3500
Time (sec)