Fire Behaviour in Mulched Fuel Beds

Data Collection in a Unique Fuel Type

INTRODUCTION

Mulching is a forest fuel treatment commonly applied in the WUI to mitigate the risk of wildfire. Mulched fuel treatments attempt to incorporate the following fuel treatment principles:

- Retention of larger, healthier stems
- Reduction of crown bulk density
- Conversion of surface fuels to a less combustible state

Mulched fuel beds vary in volume and nature based on:

- Volume of aerial and surface fuels processed
- Equipment type and treatment intensity

Mulched fuel bed properties such as depth, compaction and particle size can influence moisture retention, ignition potential and fire behaviour.

ISSUE

- Observations and limited documentation of fire in this unique fuel environment have provided insights into potential fire behaviour.
- Fire managers would like to better understand fire behaviour in mulched fuel in order to appropriately and safely resource fires.
- Fuels managers would like to be able to predict fire behaviour in fuel treatments with mulched fuel beds.
- Existing fuel models do not incorporate mulched fuel beds as a surface fuel.
- Current data is not sufficient to develop valid relationships between mulched fuel characteristics, environmental variables and potential fire behaviour.

APPROACH

Fuels managers from Alberta ESRD and researchers from Canadian Forest Service and FPInnovations have developed a data collection process to document fuel characteristics and fire behaviour in mulched fuel environments.

- This data collection process has been used in experimental burns in mulched fuels at various locations in Western Canada.
- With a consistent approach to data collection, data processing and interpretation will be enhanced.

A broad dataset of documented fire behaviour will aid researchers in developing a fuel model that includes mulched fuel.

OBSERVATIONS

- Fires in mulched fuel exhibit typical elliptical growth patterns and acceleration phase.
- Superficial burns were observed with little consumption in fuel layers deeper than 5 cm.
- Moisture content in surface layers responds quickly to changes in temperature, relative humidity and solar radiation.
- Moisture sampling in mulched fuel bed profiles indicate a high level of moisture retention below 5 cm.
- Moisture retention is greater in compacted fuel beds.
- Burns were contained with Wajax backpack pumps.

Canadian Boreal Community Fire Smart Project
Fort Providence, NT

2012
Point source ignitions

Mulch Fuel Bed Characteristics			
Species	Black Spruce/Jack Pine		
Treatment Date	March 2010		
Depth	15 cm		
Compaction	Loosely compacted		
Size Class Distribution	1—2	3—4	≥5
	40%	50%	10%

Date	Time	Weather Conditions				Fire Behaviour		Fire Size	
		Temp (°C)	RH (%)	Wind (km/h)	ISI	Spread Rate (m/min)	Flame Length (cm)	Growth Time (min)	Overall Length (cm)
06/22	1540	26	19	2.4G8	7	.15 (avg.) .5 (max.)	40-100	15	220
06/22	1616	27	17	2G6	7	2.3 (avg.) .5 (max)	45-100	23	350

2014
Point source ignitions

Mulch Fuel Bed Characteristics			
Species	Black Spruce/Jack Pine		
Treatment Date	March 2010		
Depth	15 cm		
Compaction	Well settled over 3 winters		
Size Class Distribution	1—2	3—4	≥5
	80%	15%	5%

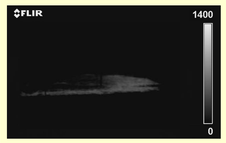
Date	Ignition Time	Weather Conditions				Fire Behaviour			Fire Size	
		Temp (°C)	RH (%)	Wind (km/h)	ISI	Spread Rate (m/min)	Flame Length (cm)	Depth of Burn (cm)	Growth Time (min)	Overall Length (cm)
06/23	1628	33	22	1.5G5	6	.14 (avg.) .30 (max.)	15—25	5	34	460
06/24	1300	30	32	3G4	6	.075 (avg.) .29 (max.)	08—15	4	60	450

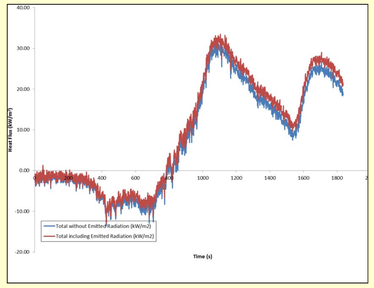
Horse Creek Research Area
Whitecourt, AB

2014
Line Source Ignitions

Mulch Fuel Bed Characteristics			
Species	Lodgepole Pine/ Black Spruce understory		
Treatment Date	June 2012		
Depth	10 cm		
Compaction	Dense (160 kg/m^3)		
Size Class Distribution	1—2	3—4	≥5
	60	30	10

Date	Time	Weather Conditions				Fire Behaviour		Fire Size	
		Temp (°C)	RH (%)	Wind (km/h)	ISI	Spread Rate (m/min)	Flame Length (cm)	Growth Time (min)	Overall Length (cm)
08/13	1420	29	25	5	7	.22 (avg) 1 (max)	20-30	45	1000
08/14	1133	26	41	3G7	6	.23 (avg) 1.25 (max)	20-30	68	1200





Visible and infrared images with heat flux data from Horse Creek experimental burn.

BC Hydro Northern Transmission Line right-of-way
Terrace, BC

September 6, 2013
Point Source Ignitions

Mulch Fuel Bed Characteristics			
Species	Cedar/Hemlock/Aspen		
Treatment Date	July 2013		
Depth	50—70 cm		
Compaction	Dense (170 kg/m^3)		
Size Class Distribution	1—2	3—4	≥5
	90%	10%	0%

Time	Weather and Fuel Conditions					Fire Behaviour		Fire Size		
	Temp (°C)	RH (%)	Wind (km/h)	Fuel Moisture (%)	ISI	Spread Rate (m/min)	Flame Length (cm)	Growth Time (min)	Overall Length (cm)	Width (cm)
1328	25	44	7G16	20	1.9	.25	10	20	415	230
1425	23	43	10G22	15	2.0	.32	15	20	347	120
1540	24	43	6G13	15	3.3	.59	20	30	900	420

September 6, 2013
Line Source Ignitions

Time	Weather and Fuel Conditions					Fire Behaviour		Fire Size		
	Temp (°C)	RH (%)	Wind (km/h)	Fuel Moisture (%)	ISI	Spread Rate (m/min)	Flame Length (cm)	Growth Time (min)	Overall Length (cm)	Width (cm)
1328	25	44	7G16	20	1.9	.26	15	30	610	720
1425	23	43	10G22	15	2.0	.32	20	20	660	780
1540	24	43	6G13	15	3.3	1.5	30	25	2330	900

FUTURE WORK

- Continue data collection at higher FWI values to develop a broader data set
- Process fire behaviour data to develop relationships between fire behaviour, fuel consumption and environmental conditions
- Incorporate mulched fuel beds as a surface fuel in fire behaviour models such as CanFIRE or FireTech

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