FPInnovations INFO NOTE
November 2016 - no. 01

Windrow Burning

Exploratory Research Beaver Ranch, Alberta

Greg Baxter, Kevin Hunt and Roy Campbell

Background

Northwestern Alberta has been a focal point for agricultural expansion for many years. More recently, accelerated lands sales have led to the clearing of large tracks of land and significant burning projects aimed at preparing the land for agricultural use. Given the requirement for land owners to have burning permits during "Fire Season" (March 1st – October 31st) and the risks involved in large scale burning during fire season, sites are often differed to time frames outside the established fire season. Although windrow burning outside of fire season often poses less fire escape risk, other issues can arise and result in public safety concerns e.g. smoke, which can increase the potential for health issues and traffic accidents. Given these concerns local forestry and municipal authorities have engaged in discussions aimed at identifying potential burning options.

Approach

Alberta has engaged FPInnovations to conduct a windrow burning project aimed at identifying potential scenarios under which windrow burning can be conducted safely during fire season. This INFO NOTE documents exploratory research completed in the fall of 2016 to identify potential research methods and windrow burning results on October 12th, 2016

Fire Environment

Burning took place approximately 90 km east of High Level on flat terrain. The predominantly trembling aspen windrows had been cleared approximately 20 months previous and debris fuel moisture averaged 17%. The selected windrows were guarded by bare mineral soil and the closest non-targeted fuels were the adjacent windrows and a field buffer on the west end of the windrow, which was comprised of standing Aspen with light white spruce understory, shrubs and grasses. An on-site weather station provided the following values: temperature: 0°C; relative humidity: 56%; wind direction / speed: East / 2 km/hr.); sky conditions: overcast with low cloud ceiling.

Methods

A trip was made in September to review the site, select potential windrow samples and collect pre-burn data. Three windrows were selected for potential study and data was collected, including: windrow age, orientation, dimensions and moisture content. Sampling was determined by establishing plots at the end of each windrow and at 50 m intervals up to a 350 m distance on both the north and south sides of the windrow. Five 5 data points were collected at each sampling point.

A second trip was made in October and the burning of one of the previously identified windrows occurred on October 12th. The other two previously identified samples were not burnt due to initial windrow burning results and the ground conditions surrounding the remaining two windrows (duff layer broken but not disked).

To provide insight on windrow multi-ignition vs single ignition an adjacent windrow sample was added and ignited simultaneously with the original sample. Immediately prior to windrow ignition additional moisture content data was collected from the original sample (see Table 1.Windrow and FWI Values). Fire behavior was observed and documented through notes, pictures and video. The two selected 350 metre windrows were ignited simultaneously at 12:40 using handheld drip torches containing a diesel / gasoline mix (see Figure 1. Windrow Ignition).

Single point ignition was applied at the east end of Windrow # 1 (original site) while the adjacent Windrow # 2 was ignited on the east end with continued ignition occurring every 50 meters through to the west end of the windrow. Note: once a 50 metre ROS was recorded in Windrow # 1 multiple ignitions were added to speed up consumption.

Table 1. Windrow and FWI Values

Windrow Data		Fire Weather Data			
Species	Aw (90%) Sw (10%)	FFMC	82	FWI	3
Mean Diameter	14.4 cm	DMC	14		
Mean Moisture content (%)	17.5	DC	428		
Avg. Windrow height (m)	3.5	BUI	26		

Figure 1. Windrow Ignition

Observations

The 50 m spread rate for Windrow # 1 was 86 minutes compared to 70 minutes in Windrow #2. Windrow #1 was fully on fire within 127 minutes compared to 80 minutes for Windrow #2 (taking into consideration the added ignition points applied to Windrow #1 after a 50m spread rate was established, which would assume a longer consumption time should late multi-ignition not occurred in Windrow #1).

Dust devils and firewhirls developed in and around the ignited areas and burning debris could be seen being transported up to 50m which resulted in spot fires occurring both within and outside both windrows (see Figure 2. Predominant Smoke Whirl Windrow #1).

Figure 2. Predominant Smoke Whirl Windrow #1

Burning was monitored until 16:00 at which time all fuel in both windrows had collapsed into a linear deposit of extremely hot burning coals.

Findings

1. Moisture content in Windrow #1 dropped roughly 3% from values collected in mid-September.
2. Fine fuel availability increased ignition success.
3. Multiple ignition points significantly increased windrow consumption time.
4. Fuel moisture content of 20% or less provided for full consumption and contributed to active fire behaviour e.g. firewhirls.
5. In-drafts winds were recorded up to 22 kmh between the windrows.
6. Burning debris (including those of considerable size) was transported considerable distances both within and outside the target windrows.
7. The presence of a 5 metre fuel break at the east end of the target windrows provided a control point, but did not prevent spotting.
8. Overcast skies and a low cloud ceiling contributed to smoke accumulation immediately over the test site.

Future Work

Exploratory research findings will now be used to assist in detailed project plan development. The ultimate goal of this project will be to identify and validate potential burning conditions and time frames suitable for windrow removal. Fuel moisture content, reduced non-target fuel values and venting conditions are expected to be major focal points.