

Contents

- 1 Introduction
- 1 Objectives
- 2 Methodology
- 2 Results
- 3 Discussion
- 4 Implementation
- 4 Conclusions
- 5 References
- 5 Acknowledgements

Grass fuel loads on linear disturbances in Alberta

Abstract

The difficulty of controlling a wildfire may be increased if the fire involves a linear disturbance. Cured grass allows fire to spread quickly and for extended distances. Accurately predicting fire behaviour and thus understanding possible tactics to slow or stop fire spread require a knowledge of the amount of fuel available to burn. The Forest Engineering Research Institute of Canada (FERIC) tested a technique to quickly assess grass fuel loads using a grass disc meter developed in South Africa that is used to determine a relationship between disc height and fuel load.

Keywords

Fire management, Wildfires, Fuel loads, Landscape, Fire behaviour, Alberta.

Author

Greg Baxter,
Western Division

Introduction

Linear disturbances¹ are man-made corridors of varying widths that cut through forested lands, such as powerline right-of-ways, pipelines, seismic lines, railroads and roads. Often in north-central Alberta when a disturbance has been cleared, reed grass (*Calamagrostis* spp.) quickly invades and dominates the vegetation and generally becomes the dominant fuel type. When cured and dry, grass easily ignites and can carry fire quickly, even during evening hours when other sections of a fire become quiet. Therefore, to help fire managers more accurately estimate fire behaviour along these disturbances, the fuel loads must be quantified. Knowing the fuel loads on these disturbances will assist in understanding potential fire behaviour and, with this knowledge, firefighters will have a better chance of controlling or stopping these fires.

Fuel loads are usually determined by sampling with a specified plot size over the target area, and clipping and weighing fuels within the plot. This method is time consuming and cannot be easily used during firefighting operations. Therefore, FERIC tested a disc meter method developed in

South Africa (Trollope and Potgieter 1986) to determine if it could be used to quickly estimate grass fuel loads. FERIC is also developing a photo reference guide to assist in making quick fuel load estimates.

Because problematic fire behaviour involving linear disturbances occurs primarily in north-central Alberta, FERIC focused its study in this region. Fuel load data were collected in the spring and fall because it is during these periods that grass is cured and most likely to contribute to wildfires. This report presents the fuel load values and the results of the comparison between the “clip and weigh” and the disc meter sampling methods.

Objectives

There were three main study objectives:

- Build a database of the fuel loads along linear disturbances in north-central Alberta, for both spring and fall.
- Determine if the disc meter sampling procedure can be used in the field by fire managers to estimate fuel loads.

¹ In some industries, the term “linear developments” is used.

- Develop a photo reference guide to aid in field estimation of fuel loads along linear disturbances.

Methodology

Data collection occurred during the spring of 2004 and the spring and fall of 2005. Maps of the study area showing up-to-date linear disturbances were produced by Alberta Sustainable Resource Development and supplied to FERIC. A travel route along the established road networks was planned. Where linear disturbances crossed the travel route, the researcher walked into the disturbance and threw the disc to randomly select the location for the sample. During the 2005 spring collection, site locations were entered into a handheld GPS so the same sites could be re-sampled during the fall.

At each location, two sampling methods were used: the disc meter method and the traditional clip and weigh method. The disc apparatus consists of a long pole and aluminum circular disc that slides down the pole until supported by the grass (Figure 1). The height of the disc was measured as it rested on the grass at each sample point, and then the grass under the disc was clipped—the total area clipped at each sample point

was 1662 cm². The samples were bagged and transported to Hinton to determine moisture content and oven dry weights. At each sample location, photographs were taken and the following were recorded: disturbance type, vegetation, standing grass height, disc height, aspect and other site observations such as weather conditions. Only the 2005 data were used to compare fuel loads from the spring and fall.

Disc height was related to fuel load based on the method described in Trollope and Potgieter (1986). The disc height data were sorted in 5 cm categories (i.e., 5–10 cm, 10–15 cm, etc.), and a mean value in tonnes per hectare (t/ha) for each class was calculated from the samples recovered using the clip and weigh method. All the data collected in 2004 and 2005 were plotted to determine the relationship between disc height and fuel load.

Photographs representing fuel loads in increments of 1 t/ha were selected to form the basis of the photo reference guide.

Results

Sixty-four spring and 62 fall fuel load samples were taken in 2005. These were added to 29 samples collected in 2004, for a total of 155 samples in the database.

The mean fuel load of the 64 spring samples from 2005 was 3.47 t/ha. These samples ranged from 0.69 to 7.63 t/ha and had a standard deviation of 1.83. Mean disc height was 10.2 cm with a standard deviation of 4.7. The mean weight of the spring samples is slightly higher than the 3.0 t/ha default used in the Canadian Fire Behaviour Prediction (FBP) model (Forestry Canada Fire Danger Group 1992) to predict grass fire behaviour. Although the similarity

Figure 1. The disc meter that was used to estimate fuel loads.



Forest Engineering Research Institute of Canada (FERIC)

Eastern Division and Head Office
580 boul. St-Jean
Pointe-Claire, QC, H9R 3J9

(514) 694-1140
(514) 694-4351
admin@mtl.feric.ca

Western Division
2601 East Mall
Vancouver, BC, V6T 1Z4

(604) 228-1555
(604) 228-0999
admin@vcr.feric.ca

Disclaimer

Advantage is published solely to disseminate information to FERIC's members and partners. It is not intended as an endorsement or approval of any product or service to the exclusion of others that may be suitable.

© Copyright 2006. Printed in Canada on recycled paper.



to the default fuel loads provides fire managers with some confidence in the prediction, the higher fuel load may result in more intense fire behaviour.

Fall fuel loads based on 62 samples from 2005 averaged 5.42 t/ha. These samples ranged from 0.91 to 21.0 t/ha and had a standard deviation of 3.56. Mean disc height was 24.2 cm with a standard deviation of 10.1. This value was higher than the spring fuel load, due in part to snow press and decomposition that occurs over winter to reduce fuel loads.

When the disc heights and fuel loads were compared (Figure 2), the statistical relationship was strong ($r^2 = 0.93$) which indicates that the grass disc meter could be used to estimate fuel load.

The example photo reference guide (Appendix I) illustrates varying levels of fuel loads. The guide will be completed in 2007 with additional images and in a card format to improve its utility.

Discussion

Comparison of spring and fall fuel loads

The data show that the mean fuel load was 2.0 t/ha higher in the fall compared to the spring due to the build-up of grass during the growing season. This equates to a difference of 1500 kW/m in fire intensity

under the same environmental conditions. This increase in intensity can make the difference between using ground crews and calling for additional equipment or air support. Fire behaviour specialists on active fires can include this information in their fire behaviour models to predict potential fire behaviour and thus determine appropriate tactics. Fortunately, fall fires are not as common as spring fires. In the fall and early spring, decomposition of the grass, combined with snow press, reduces fuel loads by 2 t/ha to the lower spring value measured. This illustrates that natural processes are important in reducing fuel loads and thus in reducing the potential for problematic fire behaviour in the spring.

Application of the disc meter

The strong relationship between grass disc height and fuel load shows that the disc meter method can be used to quickly estimate fuel loads on the fireline. An average of 10 sample heights could be used in conjunction with either Figure 2 or a regression equation to determine mean load, which could then be used in fire behaviour models.

The default value of 3.0 t/ha for the grass fuel types in the Canadian FBP model appears slightly low to accurately predict fire behaviour in north-central Alberta. This is 0.5 t/ha lower than the spring mean value found in this study, which equates to a difference of

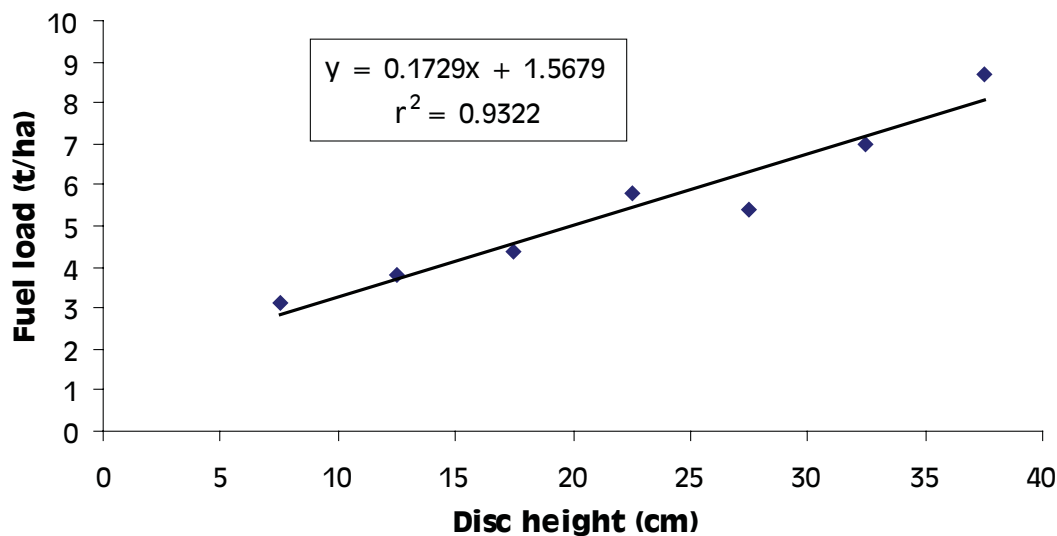


Figure 2. The disc height – fuel load relationship from linear disturbances in Alberta. This figure was developed using data collected in 2004 and 2005.

approximately 300 kW/m in fire intensity under the same fire weather conditions. The fall samples had a mean value of 5.4 t/ha, which is 2.4 t/ha more than the default in the FBP model. This represents a substantial difference in fire intensity and could lead to underestimating potential fire behaviour, sending too few resources to the site, and subsequently losing control of the fire.

Other observations

Some of the corridors contained both pipelines and powerlines, and were wider than forestry cutblocks; one of the corridors measured 200 m wide. The continuity of the fuel combined with heavy loads on these sites will pose control problems if fires occur. These are excellent avenues of rapid fire spread, especially during the spring when fire occurrence is higher. Therefore, because of their size and because retardant cannot be air-dropped over the powerlines, these corridors would create fire control problems and require hazard reduction measures.

Implementation

The database developed in this study can be used to estimate firebreak widths required to control fires along linear disturbances in different fire weather conditions. Research in Australia (Wilson 1988) has led to the development of equations relating fire intensity to the firebreak width required to halt or slow a fire's progress. To estimate fire intensity, a fuel load and a rate of spread value are required.² The load data can be taken directly from the database. Firebreaks can be ploughed or seeded with less flammable species for longer-term control.

This database will contribute towards FERIC's linear disturbance project and is a key first step to a potential solution to the problems associated with these corridors of grass crossing Alberta's forested landscape. The data will be available for use by fire behaviour specialists and will also contribute to other components of the linear disturbance project.

The disc meter method can be used to determine the mean height of grass. The equation or graph shown in Figure 2 could then be used to estimate the fuel load on the site. Alternatively, the photographic reference guide currently being developed by FERIC could be used to make a quick estimate of the fuel load.

All sites with the potential for rapid fire spread (i.e., wicking greater than 300 m along the corridor) on linear disturbances should be identified on a fire incidence or fuels map used to plan and dispatch suppression forces and equipment during initial wildland fire responses. Small corridors such as connecting flow lines which are about 20 m wide are not a large concern, but larger lines should have some regulatory form of periodic vegetation reduction (i.e., at one- to five-year intervals).

Conclusions

FERIC field sampled 155 plots to determine mean fuel loads for linear disturbances in north-central Alberta for both early spring and fall conditions. Based on 64 spring and 62 fall samples, mean fuel loads were 3.47 and 5.42 t/ha, respectively. The Canadian FBP model uses a 3.0 t/ha default value to predict grass fire behaviour, so fire managers in north-central Alberta should be aware that predictions made with this default value could be too conservative, especially in the fall.

FERIC found a strong linear relationship ($r^2 = 0.93$) between the conventional clip and weigh method and the disc meter method to determine fuel loads. This indicates that the disc is a simple and effective tool that could be used by fire managers to quickly acquire fuel load values for inputs into the Canadian FBP model.

² Fire intensity can also be estimated using flame length.

References

- Forestry Canada Fire Danger Group. 1992. Development and structure of the Canadian Forest Fire Behavior Prediction System. Forestry Canada, Ottawa, Ont. Information Report ST-X-3. 63 pp.
- Trollope, W.S.W.; Potgieter, A.L.F. 1986. Estimating grass fuel loads with a disc pasture meter in the Kruger National Park. *Journal of the Grassland Society of South Africa* 3(4):148–152.
- Wilson, A.A.G. 1988. Width of firebreak that is necessary to stop grass fires: some field experiments. *Canadian Journal of Forest Research* 18(6):682–687.

Acknowledgements

The author extends his appreciation to Ken South (contractor) who conducted the fuel data collection during the spring and summer studies.

Appendix I

Example photo reference guide



Fuel load of 0.1–0.99 t/ha



Fuel load of 1.0–1.99 t/ha



Fuel load of 2.0–2.99 t/ha



Fuel load of 3.0–3.99 t/ha



Fuel load of 4.0–4.99 t/ha



Fuel load of 5.0–5.99 t/ha



Fuel load of 6.0–6.99 t/ha



Fuel loads >7.0 t/ha (7.6 t/ha)