GREENHOUSE GAS EMISSIONS FROM FIRE AND THEIR ENVIRONMENTAL EFFECT

Malcolm Possell and Tina Bell
Faculty of Agriculture, Food and Natural Resources, University of Sydney, NSW

INTRODUCTION

Fire directly impacts the carbon balance of forests through emissions of carbon dioxide (CO_2), carbon monoxide (CO) volatile organic compounds (VOCs) and other greenhouse gases formed during combustion of vegetation and litter. We currently lack all but the most rudimentary knowledge of the direct effects of fuel reduction fires or their secondary effects on ecosystem carbon balances. Consequently, we have very little empirical data to model carbon losses during fire and as yet cannot provide guidelines and advice as to how best to manage these fires to minimise their ecological and economic impacts.

Many environmental factors affect how fuel will burn. In this project we are investigating how the moisture content of green and dead plant material affects smoke composition and the amount of carbon lost during combustion.

METHODS

Leaf litter from *Eucalyptus saligna* was either air dried or wetted for 72 hrs. These materials were then heated in a mass loss calorimeter (Fig. 1 and 2) from ambient temperatures to 600 °C at 20 °C per minute. Measurements of the CO_2 and CO emitted were made using infra-red gas analysers.

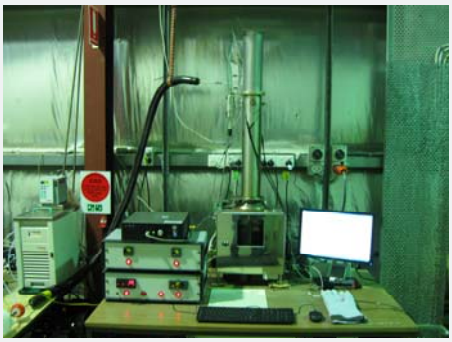

Figure 1: Mass loss calorimeter

Figure 2*: Eucalyptus saligna* litter burning inside the mass loss calorimeter

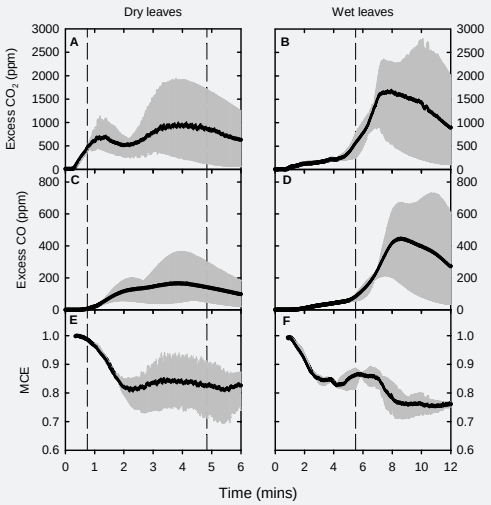

Figure 3: Emission of excess CO_2, CO and the modified combustion efficiency from air dried and re-wetted leaf litter of *Eucalyptus saligna*. The black line represents the mean response from three replicates and the grey shading the minimum and maximum range. The vertical dashed lines indicate the mean period of visible combustion. For the wet leaves, this period ended at 12 minutes

RESULTS

- Wetted leaf litter took significantly longer to ignite but combusted for a much longer period (Fig. 3).
- There was high variability in CO_2 and CO emissions within either treatment but a greater probability of much higher peak values in the wetted leaf litter (Fig. 3).
- CO levels in both treatments peaked above the Australian Safety and Compensation Council's recommended 15 minute exposure limit of 200 ppm. Peak CO levels from the wetted leaves exceeded the recommended instantaneous exposure limit (400 ppm) (Fig. 3).
- In both treatments, the modified combustion efficiency (MCE; a indicator of flaming combustion at values of 0.99 and smouldering combustion at values of approximately 0.8) shows most CO_2 and CO were released during smouldering combustion (Fig. 3).
- Overall, both treatments lost the same amount of carbon as CO_2 and CO (Table 1).

Compound	Emission factor (g kg^{-1} fuel burned)	
	Air dried leaf litter	Wetted leaf litter
CO_2	258 ± 172	435 ± 232
CO	26 ± 18	68 ± 45

Table 1: Emission factors for *E. saligna* leaf litter

CONCLUSION AND FUTURE WORK

The moisture content of *Eucalyptus saligna* leaf litter had no significant effect on the total amount of carbon lost (as CO_2 and CO) during a heating event.

Future work will look at the influence of heating rate and moisture content on the carbon emissions from green (living) plant material. Investigations will examine the indirect effect of whole plant water availability has upon flammability and hence carbon release. Studies will also be made on other *Eucalyptus* species.