

***Development of Pasture Growth Models for  
Grassland Fire Danger Risk Assessment***

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## ***Declaration***

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## ***Abstract***

Assessment of grassland curing (the proportion of dead to total material in a grassland fuel complex) is of great importance to fire authorities, which use it as an input into fire behaviour models and to calculate the Grassland Fire Danger Index. Grass curing assessments require improved accuracy to better define fire danger periods and improve management of resources, particularly around the use of prescribed burns.

This project investigated the suitability of existing plant growth models in three agricultural decision support tools (DST), namely, APSIM, GrassGro™ and the SGS Pasture Model, to estimate curing in a range of grass growth types. Simulations using appropriate DST were developed for phalaris (perennial introduced), annual ryegrass (annual introduced), or perennial native pastures, and for wheat (annual cereal) crops. The DST were not able to produce reliable curing estimates compared to the field assessments of curing, in part because the current state of knowledge on the senescence stage of leaf development has not been easy to incorporate into DST algorithms.

A Leaf Curing Model was developed for the same species grown under glasshouse conditions. The Leaf Curing Model was based on the proportion of cured leaf material over time but was not suitable for estimating curing in the field because it lacked responsiveness to plant leaf development and assumed irreversibility of curing.

This thesis provides a comprehensive study of leaf turnover rates determined from leaf measurements recorded on glasshouse-grown plants, over the entire lifecycle. The relationship between leaf appearance rate (LAR), leaf elongation

rate (LER), leaf life span (LLS), leaf length, and leaf senescence rate (LSR) with leaf position on the plants were determined.

The effect of terminal water stress imposed early, mid-way, or late in spring in glasshouse-grown plants was contrasted to LSR and leaf length of field-grown plants. In most conditions, water stress increased LSR but did not affect leaf length. The relationship between the leaf rates and leaf position was maintained under conditions of water stress.

Finally, a Bayesian model was developed from the full range of leaf turnover characteristics calculated from glasshouse-grown plants under optimal conditions. The Bayesian model predicted green leaf biomass and percentage of dead material (curing percentage) over thermal time. A derivative of the curing output of the Bayesian model was successfully validated against field methods, and would provide a higher level of accuracy of grass curing prediction than the pasture growth models currently incorporated into commonly-available DST.

**Keywords:** grassfire, grass curing, fire danger rating, plant growth modelling, Bayesian modelling

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