PROGRAM A

IMPROVING SENESCENCE ALGORITHMS IN PLANT GROWTH MODELS TO SIMULATE GRASSLAND CURING RATES

Helen Daily, Peter Lane and Kerry Bridle
School of Agricultural Science, University of Tasmania, Tasmania

Stuart Anderson
Scion, New Zealand

Shaun Lisson
CSIRO Sustainable Ecosystems, Tasmania

Jim Gould
CSIRO Sustainable Ecosystems, ACT

Introduction

- Grass Curing percentage
  - The proportion of dead material in a grassland as a result of senescence[1]
  - Surrogate for live fuel moisture content
  - Grassland becomes more desiccated and flammable[2,3] as curing increases (Fig. 1)
- Agricultural plant growth decision support tools (DST)
  - Focus on the growth stages, rather than the senescence of grasses
  - Have the potential to model the senescence (curing) of grasses
- This project aims to provide the senescence algorithms to adapt these DST's to allow curing to be modelled across the temperate zones of southern Australia and New Zealand.

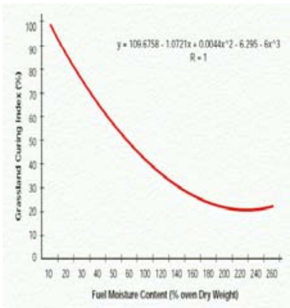

Fig.1. Relationship between Grass Curing Percentage and Fuel Moisture Content taken from Barber (1990).[2]

Glasshouse Trial

- 4 common grasses grown under ideal conditions (Fig. 2)
  – Annuals - wheat, annual ryegrass
  – Perennials – phalaris, wallaby grass
- Measurements
  - Length of green and senescing leaf components
  - Numbers of leaves and tillers
  - Phenological stage of the tiller
- Calculations
  - Rates of leaf appearance, elongation, and senescence
  - Leaf life span

Fig 2. Annual ryegrass plant senescing in glasshouse, February 2009. (photo—H Daily).

Results

- Species differed in
  - Rates of leaf turnover
    - Appearance (Fig. 3)
    - Elongation (Fig. 4)
    - Senescence (Fig. 5)
    - Life span (Fig. 6)
  - Leaf length (Fig. 7)
  - Numbers of leaves and tillers

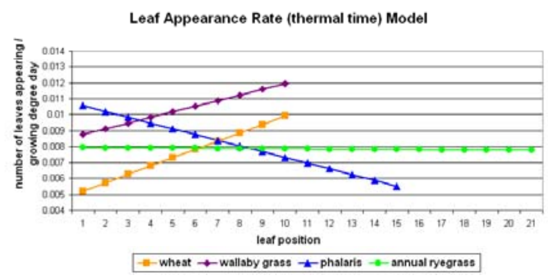

Fig.3. Leaf Appearance Rate (thermal time) Model.

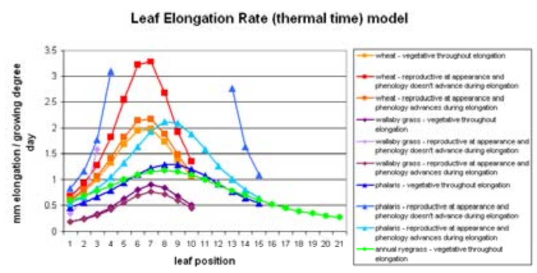

Fig. 4. Leaf Elongation Rate (thermal time) Model.

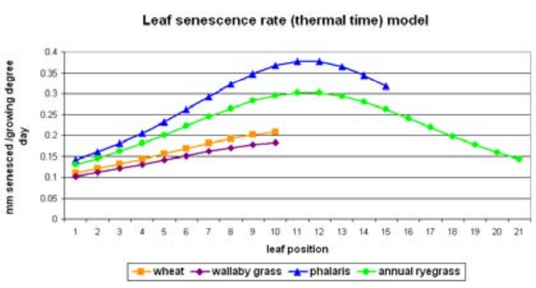

Fig. 5. Leaf Senescence Rate (thermal time) Model.

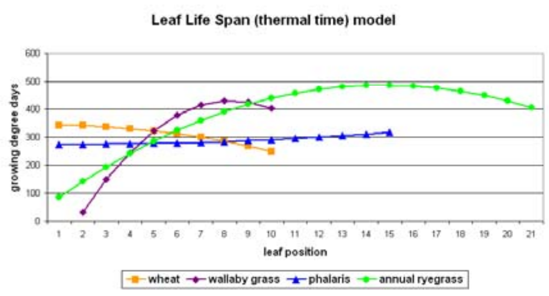

Fig. 6. Leaf Life Span (thermal time) Model.

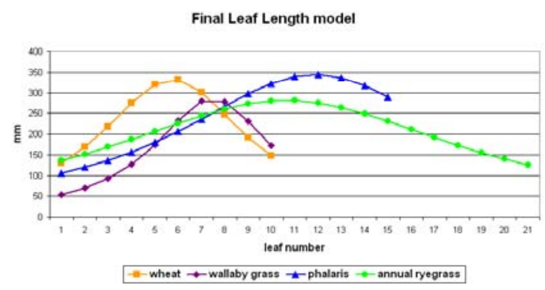

Fig. 7. Final Leaf Length

Discussion

- Leaf turnover rates often changed as more leaves were produced
  - Inverse polynomial relationships
- Next steps
  - Combine models to calculate the percentage of green and cured leaf over time
  - Include these models in agricultural decision support tools (DST) such as GrassGro™,[4]
    - Simulate temperate grassland curing in spring and summer
    - Test the simulations against field data of onset and duration of curing in these species
- Potential innovations
  - Confirm or supplement other curing sources such as visual estimates or remote sensing
  - Test various agronomic strategies to modify curing onset and duration (such as in Fig. 8)
  - Predict future curing percentages and the timing of curing
    - Some DST's take account of current weather conditions and provide probability of future events, e.g. DST may predict a 75% probability that a given area of grassland will have cured to 75% within a fortnight of a hot north wind event in October in southern Australia
    - Predict the timing of suitable curing rates
      - Allow effective prescribed burns
      - Identify grasslands no longer safe to burn
- Benefits for fire agencies
  - Improved ability to identify areas to conduct timely and safe prescribed burning
  - Improved fire danger assessments in grasslands – aiding prevention and response planning

Fig. 8. Senescence progressing in barley (L: unmown; R: mown) Black Springs, South Australia, October 2008. (photo— H Daily).

References

1. Cheney P & Sullivan A (1997) Grassfires: fuel, weather and fire behaviour. CSIRO.
2. Garvey M & Millie S (1999) Grassland Curing Guide. Victorian Country Fire Authority.
3. Parrott RT & Donald CM (1970) *AJEAAH* 10: 76-83.
4. Moore AD, Donnelly JR & Freer M (1997) *Ag. Sys.* 55(4): 535-582.

Acknowledgements

1. Dr. Ross Corkrey – University of Tasmania – for statistical advice
2. University of Tasmania – PhD scholarship
3. Bushfire CRC – top-up scholarship