

**Measurement of Pasture Growth, Parameterization for Tropical  
Grass and Validation of the GrassGro Model**



**By**

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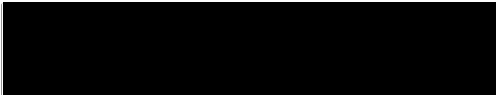
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**Declaration of Originality**

I certify that the substance of this thesis has not already been submitted for any degree and not being currently submitted for any other degree.

I certify that to the best of my knowledge any help received in preparing this thesis and all sources used, have been acknowledged in this thesis.



Yogendra Raut

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### ***Abstract***

The GrassGro model was evaluated using 1995 experimental data from the Temperate Pasture Sustainability Key Program conducted at the Big Ridge 2 experimental site at CSIRO's "Chiswick" farm. The experiment was designed to measure changes in feed on offer ( $\Delta$ FOO) using the enclosure technique on three pasture types: Phalaris (*Phalaris aquatica*), Phalaris-white clover (*P. aquatica-Trifolium repens*) and 'degraded' (a mixture of C<sub>3</sub> and C<sub>4</sub> pasture species). The model was calibrated for daily growth rate (DGR) and  $\Delta$ FOO under grazed and ungrazed conditions for the three pasture types. The parameters for phalaris and white clover pastures supplied with the model were accepted for simulation. A set of model parameters was developed for *Eleusine tristachya*, which was the major contributing species in the 'degraded' pasture.

Comparison of predicted pooled data for ungrazed phalaris showed significant relationships ( $P < 0.05$ ) between observed change in green FOO and observed total FOO. The  $R^2$  value 0.80 and 0.60 and the associated S.E. of the Y estimates were  $\pm 756$  and 1340 kg dry matter respectively. The model's prediction was considerably higher than that observed for both  $\Delta$ green and  $\Delta$ total FOO in the December harvest (3418 vs 5752, 3884 vs 7939). However, when these extreme points were excluded from the regression, the  $R^2$  values improved from 0.8 to 0.9 and 0.6 to 0.91 respectively. The grazed phalaris did not show a significant relationship between observed and predicted for either  $\Delta$ green or  $\Delta$ total FOO. This is because of the frequent change in stocking rate in the experiment which was not compatible with the running of the model.

The Phalaris-white clover pasture showed a significant relationship ( $P < 0.05$ ) for  $\Delta$ green FOO under ungrazed conditions ( $R^2 = 0.94$ ). However,  $\Delta$ green FOO (grazed) and  $\Delta$ total FOO (ungrazed) showed significant relationships ( $P < 0.05$ ) but the coefficient of variation explained by the regression was lower ( $R^2 = 0.71, 0.61$ ) due to over-prediction by the model. This over-prediction was mainly associated with the modelling of white clover which requires some changes to some of its parameters such as the notional net primary production (NPP), the soil moisture response and the allocation to the target root:shoot ratios.

The *Eleusine* based 'degraded' pasture did not show any significant relationship between predicted and observed  $\Delta$ green FOC or  $\Delta$ total FOC under either grazed or ungrazed conditions. This was due to fundamental differences in the botanical composition between observed and predicted pastures. However, when the relationships were explored excluding the spring data points from the regression, (the period when *Eleusine* was virtually absent from the paddocks), the coefficient of variation increased significantly both under grazed ( $R^2 = 0.93$ ) and ungrazed ( $R^2 = 0.84$ ) conditions. The significant relationships of *Eleusine* pasture under grazed conditions which are different with the other two pasture types, are mainly associated with its low digestibility and palatability to stock. Thus, stocking rate does not have much influence on the *Eleusine* pasture. An analysis of simulated growth factors for this species suggested some adjustments which need to be made with its temperature response and its consequent effect on NPP.

Comparison of the measured daily change in FOC of the three pasture types did not match the predicted, mainly because of the differences in the method of its calculation. This is not clearly documented in the model.

Once calibrated, the model was used to simulate the pasture growth under different climatic regimes (Cooma, Armidale and Canberra) and choice of lambing time for matching animal demand to the pasture supply on the Northern Tablelands of New South Wales. The simulated results agreed well with the information provided by various sources.

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*List of abbreviations*

|         |  |
|---------|--|
| °D      | : Degree day or Day degree                                     |
| AbGR    | : Absolute Growth Rate   |
| AGR     | : Apparent Growth Rate   |
| AI      | : Animal Intake  |
| ASW     | : Available Soil Water   |
| BHM     | : Beginning Herbage Mass                                       |
| C       | : Herbage Consumed   |
| CG      | : Continuous Grazing   |
| CSIRO   | : Commonwealth Scientific and Industrial Research Organisation |
| D       | : Herbage Decay, Decomposed                                    |
| DGR     | : Daily Growth Rate  |
| DM      | : Dry Matter   |
| DMI     | : Dry Matter Intake  |
| DSE/dse | : Dry Sheep Equivalent   |
| DSS     | : Decision Support Systems                                     |
| DU      | : Digestibility unit   |
| FC      | : Field Capacity   |
| FOO     | : Feed On Offer  |
| G       | : Herbage Growth   |
| G.FOO   | : Green Feed On Offer  |
| GLA     | : Grazing Land Application                                     |
| GM      | : Gross Margin   |
| HM      | : Herbage Mass   |
| HP      | : Herbage Production (change in green herbage mass with time)  |
| ISPD    | : Integrated System of Plant Dynamics                          |
| LAI     | : Leaf Area Index  |
| MOAF    | : Ministry of Agriculture and Fisheries                        |
| MRC     | : Meat Research Corporation                                    |
| NPP     | : Net Primary Production/Notional Primary Production           |
| NZ      | : New Zealand  |

|          |   |
|----------|---|
| OMD      | : Organic Matter Digestibility  |
| RG       | : Rotational Grazing  |
| RGR      | : Relative Growth Rate  |
| RSR      | : Root Shoot Ratio  |
| RW       | : Reference Weight  |
| SA       | : South Africa  |
| SMR      | : Soil Moisture Response  |
| SPUR     | : Simulation of Production and Utilisation of Rangelands              |
| SR       | : Stocking Rate   |
| T.FOO    | : Total Feed On Offer   |
| U        | : Herbage Utilisation   |
| UG       | : Ungrazed  |
| USDA-SCS | : United States Department of Agriculture, Soil Conservation Services |
| WP       | : Wilting Point   |
| WUE      | : Water Use Efficiency  |