Modelling Winter Grass Growth and Senescence

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The XX International Grassland Congress took place in Ireland and the UK in June-July 2005. The main congress took place in Dublin from 26 June to 1 July and was followed by post congress satellite workshops in Aberystwyth, Belfast, Cork, Glasgow and Oxford. The meeting was hosted by the Irish Grassland Association and the British Grassland Society.

Proceedings Editor: D. A. McGilloway

Publisher: Wageningen Academic Publishers, The Netherlands

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Keywords: tissue turnover, winter, model, modelling

Introduction In temperate climates, because net grass growth in winter is low, most grass growth models deal with the main growing season (Mar-Oct in the N Hemisphere), with little emphasis on grass growth in winter (Nov-Feb). However, grass tissue turns over continuously (Hennessy *et al.*, 2004) and the fate of herbage entering the winter is important in extended grazing season systems. This study aimed to model winter grass growth for the period 15 Oct 2001 to 28 Jan 2002 for a range of autumn closing dates (1 Sep, 20 Sep and 10 Oct) by modifying an existing model, so that the amount of green leaf could be predicted at intervals over the winter.

Materials and methods The model of Johnson and Thornley (1983) was selected for modification. This is a vegetative grass growth model incorporating leaf area expansion and leaf senescence. It was run in Excel. The model suited the requirements of this study as it characterises leaves according to age (in line with tissue turnover concepts) and it was designed for an established vegetative grass crop supplied with unlimited nutrients and water. Tillers are mainly vegetative in Ireland during the winter, and water and nutrients are seldom limiting. As tissue turnover data were available from two sites, data from site 1 (Grange) were used to develop coefficients to modify the model, while data from site 2 (Moorepark) were used to validate the model. Mean daily air temperature and radiation, initial leaf area index (LAI) and amount of leaf in each age category were inputs to the model. The output predicted LAI at intervals over the winter. Daily meteorological data for the experimental period and latitude for the site, and initial lamina and sheath weight/unit area and LAI on 15 Oct were the inputs to the modified model. Leaf appearance rate (LAR) was modified for the winter period based on a simple regression equation between measured LAR and temperature. Coefficients for leaf senescence rate (LSR) of the 2nd and 3rd youngest leaves were derived from Grange data, based on the flux of material between leaf age categories. These coefficients were varied and the model run until the output (predicted LAI) was similar to the measured LAI for each of the closing date treatments at Grange. The output of the modified model was tested against actual LAI from Moorepark. Measured and predicted LAI were compared using mean squared prediction error (MSPE). Mean prediction error (MPE) was calculated also.

Results The model predicted the rapid decline in LAI on the 1 Sept and 20 Sept closing date treatments (Table 1.) However, the model predicted an increase in LAI on the 10 Oct treatment, which did not occur. Overall MSPE was 0.47. Most of the variation in the model was random (0.728) and LAI was not consistently over or under predicted (low mean bias value of 0.085). Where differences between measured and predicted LAI occurred they were short lived e.g. on 5 Nov on the two earlier closing treatments. This may be explained by an over-prediction of LAI as autumn moves into winter at the end of Oct/start of Nov.

Table 1 Measured and predicted LAI over the winter for 3 closing dates for Moorepark (the validation site)

Closing Date	1 September		20 September		10 October	
	Measured LAI	Predicted LAI	Measured LAI	Predicted LAI	Measured LAI	Predicted LAI
5 Nov	5.47	4.14	4.02	2.76	2.82	2.11
26 Nov	2.98	3.37	3.61	2.72	2.53	2.61
17 Dec	2.35	2.67	2.61	2.46	2.34	2.84
7 Jan	2.23	2.22	2.32	2.20	2.28	2.85
28 Jan	1.36	1.11	1.59	1.26	2.17	2.42

MSPE = 0.47; MPE = 0.25; R^2 = 0.65; Mean bias = 0.085; Line bias = 0.187; Random variation = 0.728

Conclusions This study suggests that it is possible to model winter leaf growth and senescence, and hence LAI, when swards are closed in autumn at a range of dates and at more than one sward state or site. This has potential for use as the basis of a winter grass growth model.

References

Hennessy, D., P. French, M. O'Donovan & A. S. Laidlaw (2004). Tissue turnover during the winter in a perennial ryegrass sward. *Grassland Science in Europe*, 9, 766-768.

Johnson, I. R. & J. H. M. Thornley (1983). Vegetative crop growth model incorporating leaf area expansion and senescence, and applied to grass. *Plant, Cell and Environment*, 6, 721-729.