An evaluation of grass growth models for use in perennial ryegrass swards in Ireland

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Introduction There are several grass growth models available; varying from simple empirical to multi-component mechanistic. While empirical models have advantages in that they are usually conceptually and operationally simple, their application is restricted to prediction within the range of conditions to which the original data set relates. On the contrary, a mechanistic model is more likely to be effective across a range of conditions, given the correct inputs. Due to climatic factors the growth pattern for grass is highly variable thus making forecasting of dry matter (DM) yield at farm level difficult. The objective of this study is to compare the accuracy of prediction of three grass growth models using climatic and grass growth data from Teagasc Moorepark Dairy Production Research Centre over three years.

Material and methods The three models selected for evaluation were developed for perennial ryegrass swards in temperate climates. The three models were (1) an English model developed and described by Johnson and Thornley (1983), this is a mechanistic model based on individual plant processes, incorporating leaf area expansion and senescence where the above-ground dry matter is divided into four compartments described by structural weight and leaf area index; (2) an Irish model described by Brereton *et al* (1996) and modified by R. Schulte (unpublished), this static model provides a means to understanding the dynamics of a grazing management system subject to a variable herbage supply taking into account the vegetative and reproductive phase; and (3) a French model described by Jouven *et al* (2005), this is a mechanistic model designed to respond to various defoliation regimes, perform multiple-year simulations and produce simple outputs that are easy to use as inputs for other models, in which the biomass is subdivided into four compartments taking into account their biomass, age and digestibility. The inputs to all three models are meteorological data collected at Teagasc Moorepark. The modelled data were compared to grass growth data measured at Moorepark over the three years (2005, 2006 and 2007) using the methods described by Corral and Fenlon, 1977. The predicted and measured data were analysed using the mean percentage error (MPE) and the root mean square error (RMSE) annually and seasonally - annual data were split into approximately three equal periods to create seasons.

Results Model predictions of grass growth rate for 2005 are shown in Figure 1. Over the three years, the model that best fits the data is the Jouven model (Table 1), although it under predicts for the winter period. The Johnson and Thornley model repeatedly over predicts grass growth from about mid April onwards, particularly in the late spring and summer. The Irish model is over predicting grass growth during the winter period but it closely follows the observed trend during the remainder of the year.

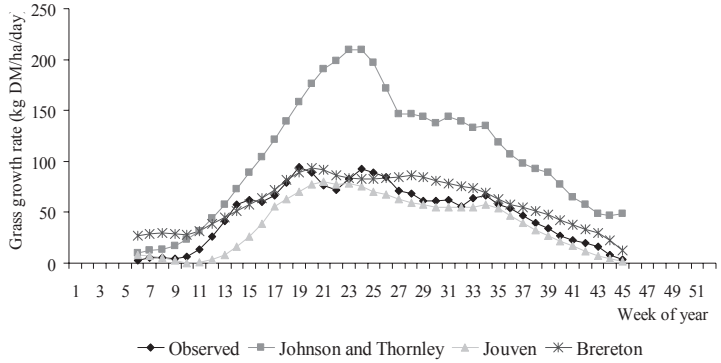

Figure 1 Observed and predicted Moorepark Grass Growth Rates (kg DM/ha/day) for 2005

Table 1 Performance of the models

		Johnson	Jouven	Brereton
MPE	Feb-Apr	-113.60	28.22	-200.99
	May-Aug	-177.17	25.08	-17.31
	Sep - Nov	-193.46	38.37	-36.99
	annual	-161.80	30.42	-83.40
RMSE	Feb-Apr	25.06	33.32	19.34
	May-Aug	108.34	17.85	14.52
	Sep - Nov	55.04	15.62	15.22
	annual	72.78	23.49	16.45

Conclusions The Jouven model and the Brereton model closely predict grass growth when compared with the observed data. Comparison of a greater number of year's data will give more information on the accuracy of the model and highlight times of the year when some modification of one or all of the models is required to improve their predictive ability for perennial ryegrass swards in Ireland.

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