Modelling tiller density dynamics in a grass sward

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Introduction Simulation models are useful tools for grassland management. Among many quantitative and qualitative attributes describing vegetation of grasslands, density of plant population is important because of its close relationship with persistence of grasslands (Hirata, 2004), which in turn is crucial for sustainable agricultural production and/or conservation of the environment, wildlife and recreational resource. Although various models have described grassland vegetation, relatively few models have dealt with plant population density. This paper presents a model describing dynamics in tiller population density in a grass sward.

The model The framework of the model is shown in Figure 1. Since the present model is intended to be a submodel of an integrated model for canopy dynamics in a grass sward, it requires daily herbage mass as an input. The model also needs daily mean air temperature, annual nitrogen fertiliser rate and month of the year as inputs, and initial tiller density at the commencement of a simulation.

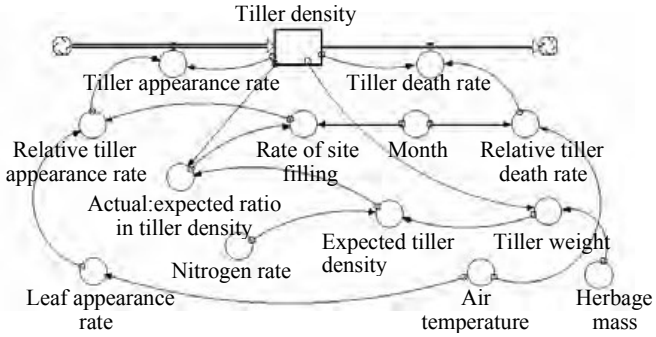

Figure 1 The framework of the model.

Results The model was parameterized or calibrated to data from bahia grass swards under different nitrogen fertiliser rates and cutting heights (Hirata & Pakiding, 2004). The simulated tiller densities mostly showed good agreement with observed densities, i.e. tiller densities increased as the cutting height decreased and as the nitrogen rate increased under the lowest cutting height (Figure 2). The parameterisation results were thus successfully tested. The model was then validated against data from bahia grass swards under cattle grazing (4 years data) and under different cutting heights (3 years data). As a whole, the validation results were acceptable (not shown as figures).

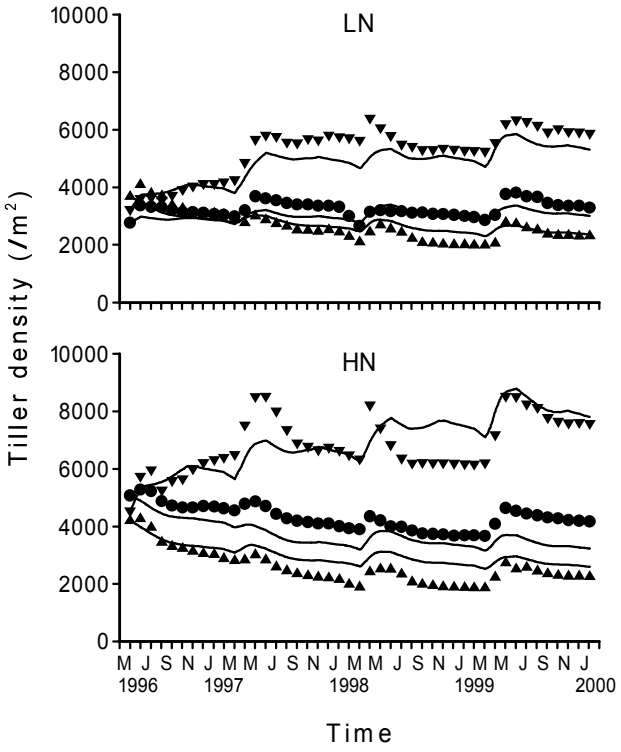

Figure 2 Observed (symbols) and simulated (lines) tiller population densities in bahia grass swards under different nitrogen rates and defoliation intensities (parameterisation results). LN=low nitrogen (5 g/m^2/year), HN=high nitrogen (20 g/m^2/year), Low (2 cm, ▼), medium (12 cm, ●) and high (22 cm, ▲) heights of cutting above ground.

Conclusions The results show potential value of the present model as a submodel of an integrated model of a grass sward canopy.

References

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