# A herbage growth model for different types of natural grassland

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**Introduction** The aim of this work was to extend existing growth models established for pure stands to a wide range of grassland communities. For this purpose we built a simple growth model, including sub-models for radiation interception and use. Parameters for the effect of nutrient rates (N, P) and defoliation regimes were based on a plant trait database. Senescence and reproductive processes were particularly considered because of their importance in late spring growth. The model makes it possible to simulate the daily biomass production as a function of both environmental factors and the functional type of the dominant species in the community.

**Materials and methods** Grasslands were characterised by the functional type of dominant plants as defined by Ansquer *et al*. (2004), according to their leaf dry matter content (LDMC), i.e. for example, type **A**: *Lolium perenne*; type **B**: *Dactylis glomerata*; type **C:** *Festuca rubra* and type **D**: *Brachypodium pinnatum*. Vegetation types also were associated with differences in leaf life span (LLS), beginning of stem elongation (BSS from February 1$^{st}$), and beginning of flowering (BF from February 1$^{st}$), which all were expressed on a thermal time (ST) basis. The model structure derives from Duru *et al*. (2002). Plant traits were used to parameterise the growth model over the reproductive phase (BSS and BF), and the senescence sub-model (LLS). The values of LLS, BSS and BF characterising the different types vegetation were 500, 600, 800 and 1000; 500, 700, 900 and 1100; 1200, 1400, 1600 and 1800 for the types A, B, C and D respectively. The model was evaluated by comparing the simulations to the growth recorded during spring 2002 on 8 natural grasslands located in the Pyrenees region, France. Four grasslands were close to type A, and 4 were intermediate between types B and C (type BC). The nutrient index (Ni) was assessed using plant analysis, and was an input variable of the growth model, being calculated accordingly Duru *et al.,* 2002. The Ni affects the radiation utilisation efficiency, and the growing differences of the LAI. It also modifies the intensity of the reproductive process.

**Results** The model estimated adequately the daily biomass production (Figure 1). In the case of type A, the model's predictions differed from the observations with an average root mean square deviation (RMSD) of 43 g/m$^2$ (Ni=77%). The model is less capable of simulating the growth of grasslands with lower nutrient levels. For type BC the model results deviated from the observations with an average RMSD of 36 g/m$^2$ (Ni=65%).

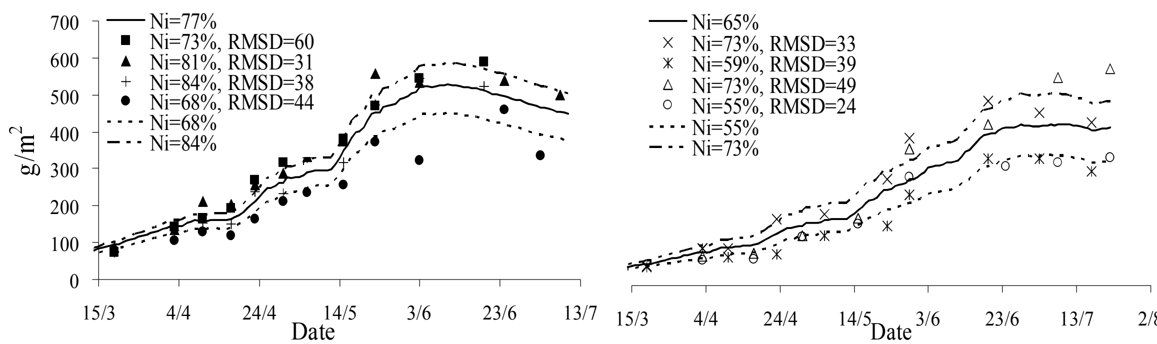


**Figure 1** Estimated and measured herbage biomass accumulation on grassland of type A with an initial biomass (Wo) of 40 g/m$^2$ and a leaf area index (LAI) of 1.0 on February 1$^{st}$ (1a), and type BC with Wo= 40 g/m$^2$ and LAI=0.2 (1b). The Ni for all situations and the RMSD for the simulation in relation to the measured data are given in the legends. Full lines correspond to the simulated herbage mass for the average Ni of the four grasslands, and dotted lines correspond to the simulated herbage mass for the lowest and highest Ni.

**Conclusions** The results show that the proposed models are well suited for the purpose; however more validation analyses are needed, specifically for type D vegetation.

**References**

Ansquer P., J.P. Theau, P. Cruz, J. Viegas, R. Al Haj Khaled & M. Duru (2004). Caractérisation de la diversité fonctionnelle des prairies naturelles. Une étape vers la construction d'outils pour gérer les milieux à flore complexe. *Fourrages*, In press.

Duru M., H. Ducrocq, C. Fabre & E. Feuillerac (2002). Modelling net herbage accumulation of an orchardgrass sward. *Agronomy Journal*, 94, 1244-1256.