Process-Based Modelling of Timothy Survival in Winter

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Introduction Timothy (*Phleum pratense* , L .) is the most widely grown sown grass species for silage and hay production in Scandinavia , and is common in many other countries with a cold and maritime climate , like Canada and the Baltic countries . Although timothy is a winter hardy species , every winter some damage is suffered . The two most severe damage mechanisms are frost and ice-encasement followed by anoxia and build-up of toxic compounds in and around the plants . The major tolerance mechanism is hardening , which can be quantified as the LT50 (Lethal Temperature for 50% of the plants in standard testing) . Climate change is expected to increase both average winter temperature and weather variability . This may impede the hardening process . The international project WINSUR aims to quantify the associated risks for Norwegian grassland , using both experimentation and process-based modelling .

Materials and methods Our work builds on previous work with the grassland model LINGRA (Schapendonk et al . 1998) . We reviewed the literature on timothy (Höglind et al . , 2001) and performed simulations with the model showing that tillering dynamics and the formation and loss of leaves from tillers were key knowledge gaps for timothy . This was addressed by experimentation followed by model improvement in these areas (Van Oijen et al . 2005) . We now have expanded the model to include simulation of snow and frost dynamics , and damage and tolerance mechanisms .

Results The model was extensively tested for various sites in Southern and Middle Norway . The dynamics of LT50 and total tiller density , showing severe tiller loss during February—April (days 400-500 in the Figure below) showed reasonable correspondence with observations .

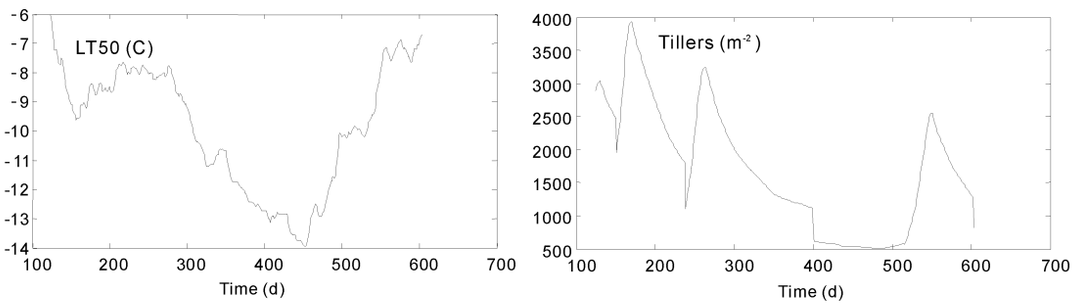

Figure 1 *Simulation of LT50 and Tiller density in Saerheim , Southern Norway during the growing seasons of 2000 and 2001 and the winter in between .*

Conclusions and outlook The process-based timothy model seems to capture the essential dynamics of the grassland system in both summer and winter . Hardening is the key tolerance mechanism , not only against frost but also against ice encasement . Further model development is under way .

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