Visual Modelling of Alfalfa Growth and Persistence Under Grazing

S. R. Smith Jr.
University of Kentucky

L. Muendermann
Stanford University, CA

A. Singh
Agrapoint, Canada

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S.R. Smith, Jr.[1], L. Muendermann[2] and A. Singh[3]
[1]N222-E Ag. Science North Dept. Plant and Soil Sciences University of Kentucky Lexington, KY 40390-0091, USA, Email: raysmith1@uky.edu, [2]Biomedical Eng. Division, Stanford Univ., Stanford, CA 94305-4038, USA, [3]Agrapoint, Truro, Nova Scotia B2N 6Z4, Canada.

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Introduction A 'virtual' alfalfa plant model was developed at the University of Manitoba in Canada as part of a comprehensive grazing research project. This model shows an alfalfa plant 'growing' on a computer screen and the plant's response to grazing (similar to time-lapse photography). The original model was constructed by Singh (2005) to show the research potential of visually modelling alfalfa plant growth. The ability to visually 'grow' a plant on a computer screen also offers tremendous opportunities for teaching and extension. Detailed morphological measurements were used in the construction of Singh's model, based on single plants subjected to the following management strategies: 1) no grazing; 2) rotational grazing; and 3) continuous grazing. The modelled growth of these three plants is accurate and can be modified, but has not been rigorously verified in comparison to other alfalfa plants. Singh's model can be downloaded as a video clip at http://www.cpsc.ucalgary.ca/~lars/models/. The objective of this project was to modify the current single plant alfalfa model to simulate an alfalfa sward under various grazing management scenarios.

Materials and methods The morphogenetic rules describing alfalfa development were written using the plant modelling language of L-systems and were interpreted by the program *cpfg* (continuous plant and fractal generator). L-studio™ (University of Calgary, Calgary, Alberta, Canada) is a software package that creates a user-interface between L-system based modelling and the simulation program, *cpfg* under Windows (Microsoft Corporation, Redmond, WA). The current project represents ongoing work to modify the existing 'virtual' alfalfa plant model from a research model into a user-friendly extension tool. Software development and programming changes include the following: 1) easier modification of individual alfalfa plants and alfalfa swards in response to different management scenarios, and 2) simpler format for data entry and manipulation.

Results The revised visual model incorporates 20 alfalfa plants growing simultaneously in a stimulated alfalfa sward. One scenario shows stand persistence over time between grazing tolerant and intolerant cultivars. Another scenario shows stand persistence of 'Florida 77' from the seedling stage (Figure 1), after two years of continuous grazing (Figure 2), and after two years of rotational grazing (Figure 3) using data from research conducted at the University of Georgia (Bouton and Gates, 2003). The actual model shows plant growth and mortality on a daily basis over the two-year stand life. Visual quality is crisp in the original working model or with large file size video clips. The visual model is not limited to these scenarios. Simple modifications in plant growth parameters allow simulation of numerous grazing or clipping scenarios.

Figure 1 Simulated alfalfa sward at the seedling stage

Figure 2 Florida 77 following two years continuous grazing

Figure 3 Florida 77 following two years rotational grazing

Conclusions These results show the value of visual modelling as a research tool, but its greatest value may be in showing livestock producers the effect of mismanagement and/or poor cultivar choice. A visual model allows producers to observe the implications of different management decisions without having to wait for several years and suffer economic losses due to poor decisions.

References

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