

# Utilization of local feed resources by dairy cattle

Perspectives of environmentally balanced production systems

Symposium proceedings

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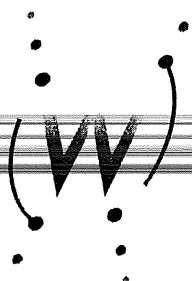
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Elements for modelling *in vitro* digestibility of grass on the basis of morphological and physiological plant characteristics

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# Elements for modelling *in vitro* digestibility of grass on the basis of morphological and physiological plant characteristics

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## Summary

A glasshouse experiment with perennial ryegrass (*Lolium perenne*) and a simulation model were used to explore possible avenues for improvement of digestibility through breeding. The model calculations suggested that improvement of cell wall digestibility of stem internodes has a great impact on crop digestibility.

## Introduction

Roughage digestibility can be improved through breeding or management. A simulation model is being developed to evaluate changes in digestibility of plant organs throughout the growing season and to explore possibilities for improvement of whole crop digestibility of grass cultivars through breeding. Preliminary results of model simulations are presented.

## Materials and methods

The model simulates crop growth and composition, as determined by the development and composition of separate organs: leaf blades and leaf sheaths in a vegetative crop (V0), and also stem internodes in a reproductive crop (R0), as follows:

- A constant, temperature dependent rate of appearance of leaf blades, sheaths and stem internodes was assumed, while leaf sheaths lagged behind leaf blades by 1 appearance interval and stem internodes lagged by 2 appearance intervals.
- Light interception, photosynthesis and respiration were calculated as described by Goudriaan & Van Laar (1993).
- Cell wall mass was calculated for separate organs.
- The cell wall digestibility (CWD) for each organ declined to an asymptotic value with age following a negative exponential saturation curve (Groot & Neuteboom, 1996).
- Apparent crop organic matter digestibility (OMD) was calculated from the ratio between cell contents and cell wall mass, and CWD of each organ.

The model was used to calculate the effects on above ground crop OMD, of an increase of 5 percent units in asymptotic CWD for *i*) leaf blades in a vegetative crop (VB); *ii*) leaf blades in a reproductive crop (RB); and *iii*) stem internodes in a reproductive crop (RI).

In glasshouse experiments, perennial ryegrass was grown at 18/13 °C day/night temperatures, either from seed (vegetative; V0) or after vernalization outdoors during winter (reproductive; R0). Harvests were made each leaf appearance interval after cutting (V0) or

from the start of stem internode elongation (R0). Plant organs were separated and oven-dried at 70 °C, and CWC, CWD and apparent OMD were determined.

## Results

Simulations were made for an average daily temperature of 15 °C, starting with one leaf per tiller. The experimentally determined asymptotic CWD amounted to 77% for leaf blades, 60% for leaf sheaths and 25% for stem internodes. Crop digestibility declined faster in R0 than in V0 (Fig. 1A). The improvement in total crop OMD as simulated by the model (Fig. 1B) was only marginal (approximately 0.5 percent units) for VB and RB, while the effect of improved stem internode CWD (RI) increased to approximately 2.8 percent units after 50 days.

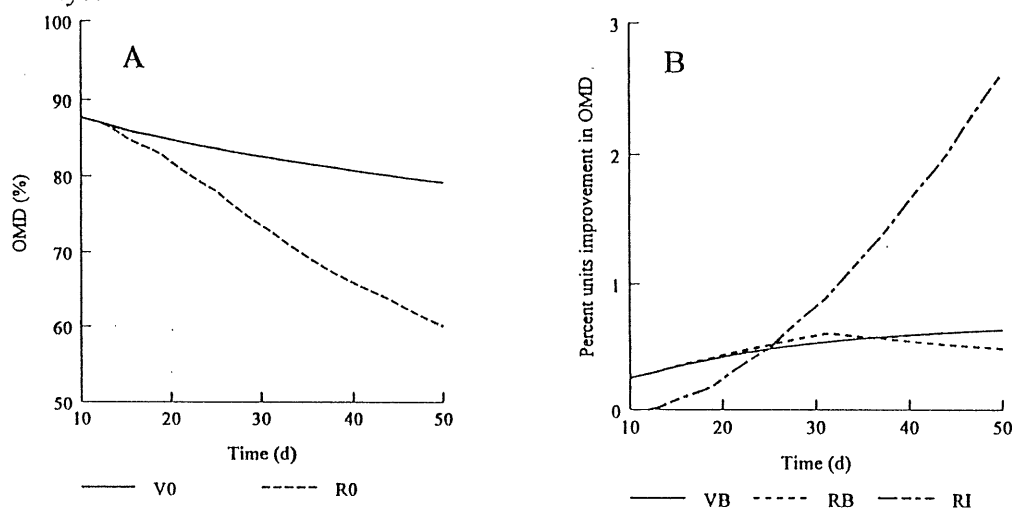


Figure 1. A. Experimentally determined crop OMD (%) of a vegetative crop (V0) and a reproductive crop (R0). B. Modelled improvement in total crop OMD (percent units) in the case of an increase of 5 percent units in asymptotic CWD for leaf blades in a vegetative crop (VB); for leaf blades in a reproductive crop (RB); and for stem internodes in a reproductive crop (RI).

## Discussion

The effects of improved asymptotic CWD on crop OMD were greater for stem internodes than for leaf blades. This was attributed to different causes. The reproductive crop contained a high proportion of less digestible stem internodes, and the number of plant organs was fixed after ear initiation, so that only ageing occurred. In the vegetative crop, the effect of improved CWD was largely subdued by the continuous production of new, highly digestible leaves. These preliminary simulation results show that enhanced stem internode CWD can contribute to improved digestibility of high yielding grass stands.

## References

- Goudriaan, J. & H.H. Van Laar, 1993. *Modelling potential crop growth processes*. Kluwer Academic Publishers, Dordrecht, The Netherlands, 238 pp.
- Groot, J.C.J. & J.H. Neuteboom, 1996. Composition and digestibility during ageing of Italian ryegrass leaves. *Annals of Botany*. Submitted.