Effect of nitrogen on the radiation use efficiency for modelling grass growth

R. Lambert and A. Peeters
Laboratory of Grassland Ecology, Catholic University of Louvain, Place Croix du Sud 5 bte 1, B-1348 Louvain-la-Neuve, Belgium, Email: lambert@ecop.ucl.ac.be

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Introduction When nitrogen (N) is not at a sufficient level to permit maximum growth rate, dry matter production is reduced. Models of plant growth in relation to solar radiation intercepted by the crop have been largely used. According to these models, N deficiency can act on the leaf extension and thus on the quantity of radiation intercepted by the crop, but also by reducing the radiation use efficiency of the crop (RUE) (Bélanger, 1990). The effect of N on the RUE of ryegrass swards is determined and discussed.

Material and methods Radiation use efficiency is the ratio between the yield and cumulated photosynthetically active radiation absorbed by the crop (PARa) during a period of time. It is expressed in g DM/MJ of PAR. The PARa is determined using a model of leaf area index (LAI) change with temperature (Lambert *et al*., 2004). Incident incoming radiation was measured during all the growing period using a photovoltaic sensor (Solar Haeni 130). The PAR fraction determined using a quantum sensor (Delta-T device LTD) and the McCree (1972) conversion coefficient to translate photon flux into energy units was found to be 0.47. Dry matter (DM) yields were measured during spring growth (generative growth) in 4 week old regrowths of *Lolium perenne* swards (cv Meltra) receiving different N fertilisation levels. Each yield value is the mean of four replicates. The N nutrition index (NNI) was calculated using the dry matter yield and the N content value (Lemaire *et al*., 1989). Data from six different site-year combinations were used to establish the relation between RUE and NNI.

Results As it was assessed by Belanger (1990), N deficiency affected negatively both the RUE of the grass crop and the leaf extension. When N was not limiting for growth (NNI = 100), the RUE was 2 g DM/MJ during the spring (Figure 1). For modelling grass growth, yield can be predicted by multiplying the quantity of radiation intercepted by the crop and the RUE of the crop. RUE can be determined from the NNI of the grass using a linear relation (Figure 1). This model coupled with a model of LAI change with temperature (Lambert *et al*., 2004) and PAR measurements allows yield accumulation during spring to be predicted. The effect of N on grass growth can be analysed in terms of radiation interception by the crop and in terms of transformation of intercepted radiation in biomass.

Conclusions Nitrogen supply acts on the RUE of the crop. A linear equation describes the relationship between RUE and NNI. This relationship can be used for grass growth modelling according to N status and radiation intercepted by the crop.

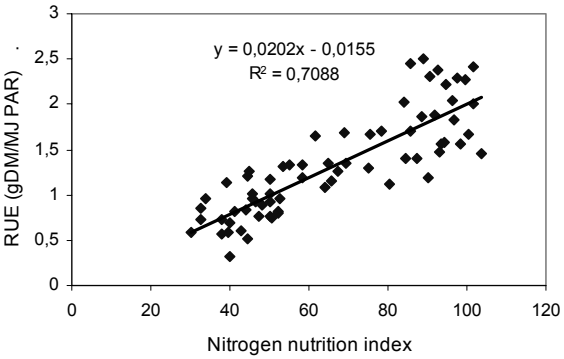

Figure 1 Relationship between radiation use efficiency and nitrogen nutrition index

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