

Assessment of the Nitrogen Nutrition Index (NNI) by the nitrogen concentration of the upper part of the sward

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Introduction The Nitrogen Nutrition Index (NNI) is based on the concept of a critical nitrogen concentration, defined as the minimum N concentration in the aerial biomass necessary to obtain maximum yield. Values of N_{crit} are high at the start of the growing period and decline during growth, in relation to dry matter accumulation (t DM/ha) according to the equation of Lemaire & Salette (1984): $N_{crit}(\%) = 4.8(DM)^{-0.32}$. The NNI is calculated as the ratio of the actual N concentration of the sward to the N concentration required at a similar biomass to sustain non-limiting growth and biomass accumulation (Lemaire & Gastal, 1997). However, the evaluation of NNI requires the determination of aerial biomass per unit area, in addition to the determination of N concentration. This is time-consuming and is a practical limit to using NNI on farms. The objective of this experiment was to assess NNI by a more practical and easier method based on the determination of the N concentration in the upper leaves, as proposed by Gastal *et al.* (2001).

Materials and methods The experiment was conducted in 2001 and 2002 on eight contrasting sites throughout Belgium. Four sites were common to both years. Each site had one plot of perennial ryegrass (*Lolium perenne*) with no N fertilisation (N_0) and one plot receiving 50 kg N/ha (N_{50}) in four replicates. In each plot, aerial biomass (cutting height = 7 cm) and total N concentration were measured in May 2001 and 2002. Samples of herbage were also selected and cut with scissors at 10 cm from the tip of the longest leaf and total N concentration (N_{up}) was determined.

Results The linear regression between NNI and N_{up} in 2001 and 2002 (Figure 1) showed a significant correlation ($r^2 = 0.78$). The slopes and intercepts of the regression did not differ statistically between the two treatments. The slope of the regression was slightly lower than that obtained by Gastal *et al.* (2001). According to Duru *et al.* (1997), NNI values above 1 indicate that N nutrition is excessive, values between 1 and 0.8 indicate that N nutrition is satisfactory, and values below 0.8 indicate that N nutrition is significantly limiting. In our experiment, NNI values between 0.2 and 0.7 were found indicating a limiting N nutrition of the sward.

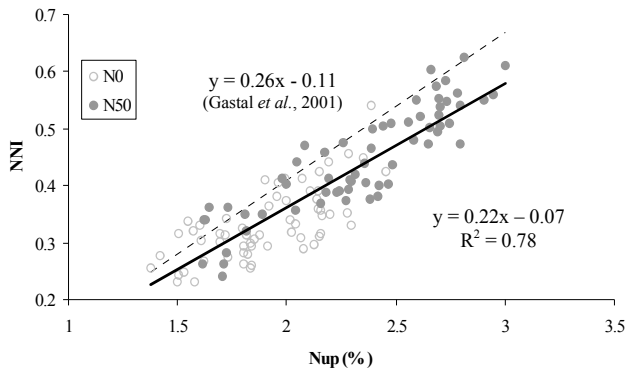


Figure 1 Relation between NNI of the sward and N concentration of the lamina at the 10 cm top of the canopy (N_{up}). Gastal's reference equation is in dashed line

In Gastal's experiment, the NNI values ranged between 0.25 and 1.25.

Conclusions The present results confirm the possibility of using N_{up} to evaluate sward N status (NNI). For most studies, the precision of N_{up} (4.6%) is sufficient and thus the determination of herbage biomass per unit area is no longer necessary, eliminating the most time-consuming step of the conventional NNI sampling procedure. Moreover, N_{up} determination allows the comparison of swards from different sites, different times of growth and different years of harvest with an acceptable approximation.

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