

## DO CROP CHARACTERISTICS AVAILABLE FROM REMOTE SENSING ALLOW TO DETERMINE CROP NITROGEN STATUS ?

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Precision agriculture's goal of matching nitrogen supply with crop requirements at any point in a field requires spatial information on the nitrogen status of the crop. Some operational methods (e.g. JUBIL<sup>®</sup>, N-tester) have been developed but their implementation at the farm level with a high spatial resolution is not conceivable. Remote sensing techniques based on high spectral resolution images allow establishment of maps which provide two main characteristics of the crop with an appropriate spatial resolution : the leaf area index (LAI) and the chlorophyll content of leaves per unit leaf area (CHL). The aim of our work is to determine whether these two variables allow to evaluate the nitrogen nutrition status of a crop, relative to the Nitrogen Nutrition Index (NNI) which is the reference method<sup>1</sup>.

A field trial was conducted on winter wheat at six nitrogen levels (0-300 kg N.ha<sup>-1</sup>). We measured LAI, CHL (chlorophylls a and b) and NNI by destructive sampling on leaves and shoots. Different relationships were established between NNI, LAI and CHL, but the parameters of these relationships appeared to vary with crop stage. The direct relationship between NNI and CHL led to predict NNI with a relative precision (RMSE) of 20%. The precision was improved when the stage effect was considered through the sum of degree-days : RMSE was reduced to 15%.

We tested an indirect method to estimate NNI through the assessment of two terms : 1) the nitrogen content of the crop, determined from the integrated variable LAI×CHL ; and 2) the aerial dry matter deduced from the LAI variable and the sum of PAR radiation since sowing. The NNI estimate with this method was slightly improved since the RMSE fell to 13%. This accuracy is likely to be insufficient to make a reliable diagnosis of N nutrition at a given time, but may be good enough if NNI is measured at several dates on the same place.

We also tried to evaluate the interest of another index : the nitrogen content of the upper two leaves expressed per unit of leaf area (N<sub>s</sub>). It appeared that this index was not much easier to determine than NNI and that it had a lower discrimination capacity among various nitrogen treatments.

<sup>1</sup> G Lemaire and F Gastal (1997) N Uptake and Distribution in Plant Canopies. *Diagnosis of the Nitrogen Status in Crops, Chapter 1, G Lemaire (ed) © Springer-Verlag Berlin Heidelberg 1997.*