Potentialities of near infrared spectroscopy to assess nitrogen, phosphorus and potassium nutrient status of grasslands in the Reunion Island

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Introduction Controlled mineral fertilisation practices are an important component for sustainable management of grasslands. The assessment of available nutrients for plants and the general recommendations on the level of phosphorus and potassium to apply to grasslands are classically based on classical soil analysis and average regional levels. For nitrogen, mid or long term recommendations cannot easily be derived solely from soil composition, because it may be rapidly leached from the soil. Recent approaches tended to show that herbage plant N (Lemaire & Gastal, 1997), P, K (Duru & Huché, 1997) mineral analyses associated with actual biomass measurement could be useful for the calculation of combined nutrient indices (IN, IP, IK). Expressing these indices along references curves with a standard optimum value of 100, indicates the limiting factors or excess in the mineral feeding of the plants. It provides a diagnosis of the main nutrient status at a specific local plot situation. The step has been successfully implemented to provide local advice in the management of grasslands on Reunion Island (Blanfort, 1998). Nitrogen content can be predicted from NIRs, but this technique is less used for the other elements. However, the concern is here more related to the development of a combined index, it appeared interesting to test the potential of NIRs to predict these or to rank grasslands according to nutrition levels.

Material and methods A large set of 900 milled herbage samples referenced for N, P, K % and DM content were scanned using Nirsystem 6500 (400-2500 nm). Index IN, is calculated according to nitrogen reference content dilution in the measured sward dry biomass DMHA, t/ha: (IN = 100 × N% / 4.8 × DMHA -.32). The IP and IK indexes are adjusted ratios of P and K to N content (IP = 100 × P% / (0.15 + 0.065 × N%); IK = 100 × K% / (1.6 + 0.525 ×N%)). Spectral and calculated indexes were put into calibration. (SNVD scatter correction, 2.5.5.1 pretreatment using the Modified Partial Least Squares procedure, WinisiII 1.5 software).

Results Within the ranges 19 - 106 (IN), 29 -199 (IK), 38 -143 (IP), the calibration cross validated standard error (Secv) and R squared (R^2cv) values were respectively : 7.5-0.81 for IN; 9.2-0.90 for IK and 11.9-0.62, for IP. The narrowness and precision of the relationships for N and P indices were lower than generally observed with organic components, the NIRs predictions appear highly acceptable when compared to a standard optimum of 100 (Figure 1).

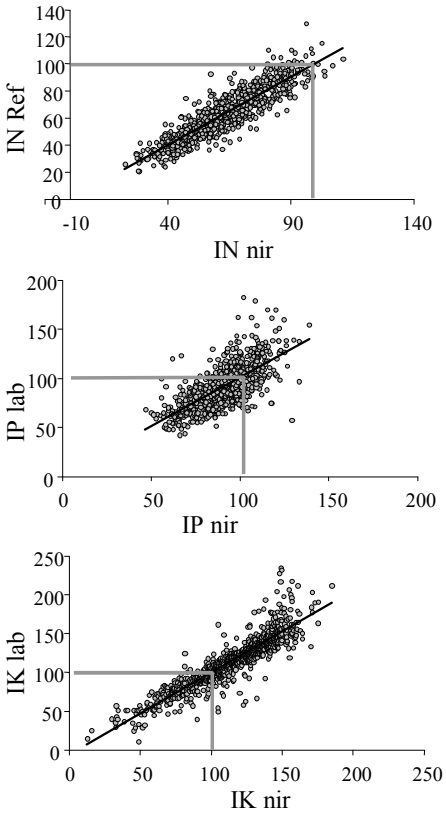

Figure 1 NIR predicted and reference calculated values for IN IP, IK

Conclusions This research supports the interest in using NIRs for rapid diagnosis of grass mineral status, particularly when one considers the low cost of scanning and the delays that occur with classical analysis. The same scanning can be used to predict the feeding value of the forage samples. The data obtained in this study will be used to test PLS2 discriminant models for predicting classes of mineral excess/deficiency.

References

Lemaire, G. & F. Gastal. (1997). N uptake and distribution in plant canopies. In: G. Lemaire (ed.) Diagnosis of the Nitrogen Status in the Crops. Springer Verlag, 3-44.

Duru, M. & L.Thélier (1997). N and P-K status of herbage : use for diagnosis of grasslands. In: I.N.R.A. (ed.) Diagnostic Procedures for Crop N Management and Decision Making, 125-128.

Blanfort, V. (1998). Agro-écologie des pâturages d'altitude à La Réunion. Cirad - Université de Paris-Sud.. 299 pp + annexes.