Diagnosing nitrogen, phosphorous and potassium status of natural grassland in the presence of legumes

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Introduction In most temperate areas, sustainable management of grassland ecosystems has to deal with evaluation and management of N, P and K resources. For this purpose, appropriate diagnostic systems are needed in order to manage fertilisation accordingly. The nutrient index method based on nutrient concentrations in plant tissues relative to the degree of growth has been developed; it relies on critical curves which serve for diagnostic: for N, the critical curve gives the optimum N concentration for different levels of biomass accumulation in swards, for P and K optimum concentrations are a linear function of sward N concentration (Duru & Thélier-Huché, 1997). However limitations in the use of P nutrient index (PNI) were reported when the herbage contained a large proportion of white clover (Jouany *et al*., 2004). Our objectives were to verify whether similar behaviour were observed with other legumes and for K and N nutrition indices (KNI, NNI) as well.

Materials and methods This work was conducted on meadows and native grasslands of the Ercé valley in the Central French Pyrenees (0°30E, 42.48N). These grasslands are located between 600 and 1000 m asl. In spring 2001, 10 grasslands have been characterized for N, P, and K Nutrition Indices. Biomass samples were collected for dry matter yield measurement, and sorted into 2 fractions: non-legumes and legumes fraction where trifolium pratensis, lotus corniculatus, medicago sativa, represented more than 75 % of the total legume fraction. Total N, P and K concentrations were measured on oven dried, (80°C) ground milled herbage (0.5 mm). Nutrition indices were calculated according to Duru & Ducrocq (1997). They were 3 repetitions plots sampled per grassland.

Results The average nutrition indices calculated on the non-legume fraction were always higher than for the mixed one. For a given sward, the difference between indices calculated for mixed sward and non legume fraction increased with the legume content of the sward (Figure 1), the relationship is similar to the one obtained for clover in previous work. Calculated PNI and KNI from mixed sward concentrations resulted in an underestimation of the sward nutrition while difference between NNI for mixed sward and NNI for non legume fraction increases with the legume content and leads to an overestimation of sward N nutrition status (Figure 2).

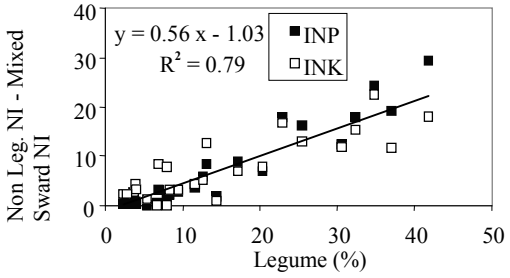

Figure 1 Difference between non legume fraction PNI and (KNI) and mixed sward PNI (KNI) as a function of legume content

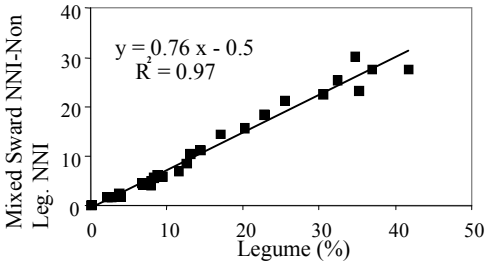

Figure 2 Difference between mixed sward NNI and legume fraction NNI as a function of legume content

Conclusions High legume proportions limit the use of nutrient diagnosis systems. Whatever the diagnostic index used, measurements on mixed swards could substantially underestimate sward PK status and overestimate N status. We suggest basing diagnosis on the non-legume fraction when nutrition indices are used for fertiliser recommendations.

References

Duru, M., & H. Ducrocq (1997). A nitrogen and phosphorus herbage nutrient index as a tool for assessing the effect of N and P supply on the dry matter yield for permanent pastures. *Nutrient Cycling in Agroecosystems*, 47, 59-69.

Duru, M., & L. Thélier-Huché (1997). N and P-K status of herbage : use for diagnosis of grasslands. In: G. Lemaire & I.G. Burnes (eds.) Diagnostic procedures for crop N management and decision making. INRA, pp 125-138.

Jouany, C., P. Cruz, P. Petibon & M. Duru (2004). Diagnosing phosphorus status of natural grassland in the presence of white clover. *European Journal of Agronomy*, 21, 273-285.