INFLUENCE OF LEGUMINOUS FRACTIONS ON IN AND IP INDEX

Ciprian STROIA[1], Claire JOUANY[2], Eric LECLOUX[2], Gicu–Gabriel ARSENE[1], Alina NEACŞU[1], Veronica SĂRĂȚEANU[1], Marius STROIA[1]

[1]Banat's University of Agricultural Sciences and Veterinary Medicine, Faculty of Agricultural Sciences, Timisoara, Aradului Street, no. 119, RO-300645, Romania,
[2]INRA Toulouse, France
Corresponding author: cipistroia2001@yahoo.com

Abstract: *The studies where carried out since 1999 on a permanent grassland placed on an alluvial soil from France, in the Central Pyrenees (Ercé). The experiment consisted from 2 annual doses of fertilization with N and P arranged in 4 randomised blocks. The analysis of IN and IP index using the cycle of growth method will provide the opportunity to analyze the effect of N and P levels on the nutrition of the grassland, and their impact on plants growth. The method for determining the nutritional index are based on plant analysis and show the concentration of mineral elements N and P depending on their accumulation in the plant biomass. The literature data have shown that considering the biomass of the legumes fraction in the calculation of IN and IP index, there are resulting errors in the estimation of nitrogen and phosphorus nutrition level, the index being overestimated in comparison with its real value. The data presented were collected only on the N_0P_0 and N_0P_1 fertilisation doses (where N_0= 0 kg N ha-1 yr-1; P_0= 0 kg P ha-1 yr-1; P_1= 50 kg P ha-1yr-1), for cycles in that legumes percentage over 10% was registered in 2000 and 2002. IN and IP index of mixture fractions were calculated from N% and P% concentration of mixture fraction; IN and IP index of fractions without legumes (nonleg) were calculated from the levels of N% and P% of nonleg fractions. The difference between the index calculated from the mixture fraction and calculated for the nonleg fraction is even more important than the contribution of legumes harvested biomass. The results for the IN as well as for the IP confirm the need of doing tests on mineral-free forage legumes, if is necessary to eliminate the inaccuracies of the obtained results when the percentage of legumes in mixture biomass is higher then 10%.*

Key words: *nitrogen nutrition index, phosphorus nutrition index, legumes*

INTRODUCTION

Researches carried out by a series of researchers (NEVENS *ET* REHUEL, 2003; STROIA, 2007) have shown that the nitrogen presence originating from different sources has a significant negative or positive effect on the legumes contribution from the harvested biomass. The literature data have shown that the absence of separation of the legumes from the total biomass, necessary for the calculus of the phosphorus nutrition indexes (IP), is translated by errors regarding the estimation of the phosphorus nutrition level, the IP index being overestimated in comparison with its real value (JOUANY *et al*., 2004). In the same way for the nitrogen nutrition index (IN), the difference noticed between the total IN (total biomass) and the biomass index from that were extracted the legumes (IN nonleg) increases with the percentage of legumes from the total biomass is greater (CRUZ *et al*., 2006). In this work we are looking to check how the data collected from Ercé experimental field are allowing to determinate the same comportment known by other researchers.

MATERIAL AND METHODS

Grassland experimental field has been located since 1999 to the village of Ercé in the French Pyrenees (0° East, 43° North; elevation 660 a.s.l.). The mean annual rainfall is 1200 mm and the mean annual air temperature is 12.7. The soil was alluvial developed on alluviums. The site was set by team Orphée (INRA Toulouse).

The researches were intended to study the effects over time of N and P fertilisation and frequent defoliation on soil fertility and changes in the vegetation cover. It had a 2*2 factorial design with two rates of N and P, resulting in four treatments denoted N_0P_0, N_0P_1, N_1P_0 and N_1P_1, where N_0 = 0 kg N ha^{-1}; P_0 = 0 kg ha^{-1}; N_1 = 160 kg N ha^{-1}; P_1 = 50 kg P ha^{-1}. Nitrogen was spread every year as ammonium nitrate (NH_4NO_3): 60 kg N ha^{-1} in first cycle and 100 kg N ha^{-1} in the second cycle. Phosphorus was spread every year as commercial triple super phosphate (45% P_2O_5).

The presented data are only for the variants N_0P_0 and N_0P_1 and only for the years and vegetation cycles where the legumes percentage was greater then 10% (first and second cut for the years 2000 and 2002).

Indexes of nitrogen nutrition, which are able to diagnose the nutritional status of grasslands and assess the bioavailability of soil nutrients for plants were calculated whit the method developed by LEMAIRE and SALETTE (1984). This method is based on the principle of dilution of nutrients during growth. At each cycle of regrowth of the prairie vegetation, the nitrogen content of grass (%N) decreases as the quantity of biomass (DM) produced increases what determines a dilution of N. In normal nitrogen supply, the critical nitrogen content is determined following:

$$N\% = 4.8\ (DM)^{-0.32}$$

The index of nutrition is the ratio, expressed as a percentage of the content measured on the content given by the critical dilution curve:

$$IN = (N\%\ measured/4.8\ (DM)^{-0.32})*100$$ (LEMAIRE *et al.*, 1989)

For an available P concentration from soil the grass concentration in this element is depending by its concentration and the equation that allows the defining of the non-limiting P concentration for the allowed N increase is:

$$P\% = 0.15 + 0.065\ N\%$$ (SALETTE *et* HUCHÉ, 1991)

The P nutrition index in this case is calculated using the next equation:

$$IN = (P\%mesured/(0.15 + 0.065\ N\%))*100$$ (DURU *et* THÉLIER-HUCHÉ, 1997)

IN and IP nutrition indexes for the total biomass were calculated starting from the N and P concentration from the total biomass; IN and IP nutrition indexes being calculated with the N and P concentration of the nonleg fraction.

RESULTS AND DISCUSSIONS

In figure 1 is presented the relationship between the difference (IN total – IN nonleg) and the legumes percentage from the total biomass. There can be noticed a significant relationship among these two variables for a legumes contribution comprised between 10% and 28% in the first cycle (first cut) and between 15% and 45% in the second cycle (second cut).

The difference between the index calculated without legumes and the one calculated for the total biomass is more important while the legumes presence in biomass is greater. A similar relationship was obtained by CRUZ *et al*. (2006) for an experimental field with a legumes percentage in biomass lower then 50%.

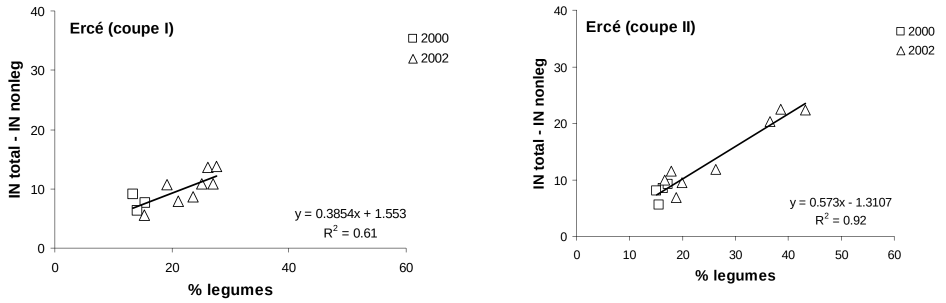

Figure 1: Relationship between the difference (IN total – IN nonleg) and the legumes percentage for the first and second cut from Ercé

In the same way in figure 1 is presented the relationship between the difference (IP total – IP nonleg) and the legumes percentage from the total biomass for the two cycles (first and second cut). There is noticing that in the case of phosphorus is a relationship between the two variables, too.

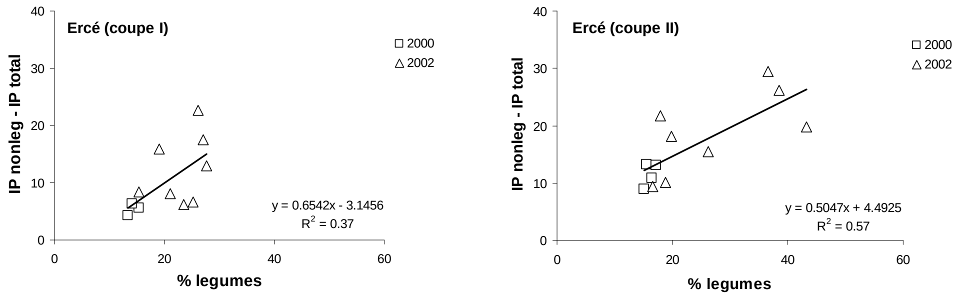

Figure 2. Relationship between the difference (IP total – IP nonleg) and the legumes percentage for the first and second cut from Ercé

The difference between the index calculated for the total biomass and the one calculated for the fraction without legumes is as important while the legumes presence in biomass is important. This result is in conformity with the conclusions presented by JOUANY *et al.* (2004) and obtained following the analyses done in an experimental field where the legumes percentage from the total biomass is comprised between 0 and 32%.

CONCLUSIONS

Results obtained for IN and IP are confirming that there is necessary to be realized the mineral analyses on forages separated by legumes if there is the intention to eliminate the errors when the legumes percentage from the total biomass is greater then 10%.

BIBLIOGRAPHY

1. CRUZ, P., JOUANY, C., THEAU, J.P., PETIBON, P., LECLOUX, E., DURU, M., 2006. Le diagnostique de la disponibilité en azote du milieu sous prairie naturelle contenant des légumineuses. Fourrages, 187, in press.
2. DURU, M., and THÉLIER- HUCHÉ L., 1997. N and P-K status of herbage: use for diagosis of grasslands. INRA (Eds.). Diagnostic procedure for crops N management and decision marketing, Paris (Les Colloques n° 82) pp. 125 – 138.

3. JOUANY, C., CRUZ, P., PETIBON, P., DURU, M., 2004. Diagnosing phosphorus status of natural grassland in the presence of white clover. European Journal of Agronomy, 21, 273 – 285.
4. LEMAIRE, G. and SALETTE, J., 1984. Relation entre dynamique de croissance et dynamique de prélèvement d'azote pour un peuplement de graminées fourragères. I. Etude de l'effet du milieu, II. Etude de la variabilité entre génotypes. Agronomie, 1984. 4 (5) 423 – 430 et 431 – 436.
5. LEMAIRE, G., GASTAL, F., SALETTE, J., 1989. Analysis of the effect of N nutrition on dry matter yield of a sawrd by reference to potential yield and optimum N content. XVI International Grassland Congress, Nice, 179 – 180.
6. NEVENS, F. and REHUEL, D., 2003. Effects of cutting or grazing grass swards on herbage yield, nitrogen uptake and residual soil nitrate at different levels of N fertilization. Grass and Forage Science, 58, 431 – 449.
7. SALETTE, J. and HUCHÉ L., 1991. Diagnostic de l'état de nutrition minérale d'une prairie par l'analyse de végétal: principes, mis en œuvre, exemples. Fourrage, 125, 3 – 18.
8. STROIA, C., 2007. Etude de fonctionnement de l'écosystème prairial en conditions de nutrition N et P sub limitantes. Application au diagnostic de nutrition. Thèse de Doctorat INPT – INRA Toulouse. 257 p.