MULTIANNUAL EVOLUTION OF THE NUTRITION INDEX IN RELATIONSHIP WITH THE ANNUAL BALANCES

C. STROIA[1], Claire JOUANY[2], E. LECLOUX[2], Veronica SĂRĂȚEANU[1], M. STROIA[1], G.–G. ARSENE[1], Alina NEACŞU[1], Ramona ŞTEF[1]

University of Agricultural Science and Veterinary Medicine, Plant protection, Timisoara, Romania
INRA UMR AGIR 1248, F-31326 Castanet Tolosan, France
E-mail:cipistroia2001@yahoo.com

Abstract: *Nutrition index are used on a wide scale for the diagnsosis of the mineral nutrition of the grasslands and to facilitate the decisions regarding their fertilisation mode.In literature are available few data regarding the inter-annual evolution of the nutrition indexes in relationship with the cumulated mineral balances. The problems that are coming from are to find out the measure in that those indexes are able to provide piece of information on the evolution of the N and P supplies level in the case that the mineral balance is positive or in the case in that the mineral balance is negative. The experimental fields were set by the Orphée team (INRA Toulouse) on two grassland types different from the pedological and climatic point of view, placed in Ercé in Central Pyrenees in 1999 (0° east, 43° north) and in Gramond in Massif Central in 1998 (2° east, 44° north). There were applied four treatments: N_0P_0, N_0P_1, N_1P_0 et N_1P_1; where 0 is correaponding to a treatment wihout N or P input; 1 is correasponding to a variable input depending by year and P correasponds to a unique annual dose of 50 kg ha^{-1}. On the ensemble of the plots was provided an input of 400 kg ha^{-1} year^{-1} of K as KCl applied in every year to provide a non-limited potassium level. The results are showing that IN are able to provide pieces of information regarding the finish the nitrogen supply level under the influence of the balance cumulated in time. When the available P level is low, the IP nutrition indexes measured for P_0 treatments show that the level of the available P supplies are finishing when the cumulated balance I–O becomes negative. In some situations the cumulative effects haven't diminished significantly the available P level from soil, the IP nutrition indexes being sensitive to the evolutions of P balance during time.*

Key words*: nitrogen and phosphorus balance, nutrition index, grasslands fertilization*

INTRODUCTION

At this time the nutrition indexes are used on a large scale for the diagnosis of the mineral nutrition of the grasslands and to facilitate the decisions regarding their fertilisation mode. The prescription of the fertilisers' doses is based on an "instant"value of the nutrition indexes and on the evolution of this value in report with the previous value of the nutrition index realised on the same plot, without considering the fertilisation regime applied on the plot (FARRUGGIA *et al*., 2000). For a fertilisation level set in time the plot can be in a saturation, maintenance or defficient regime, situation in that the annual mineral balance Input–Output (I–O) can be positive, null or negative. The question is what is or not the measure of the influence of the plots fertilisation regime on the nutrition indexes for a year in relationship with the previous year.

Less data are available regarding the inter-annual evolution of the nutrition indexes in relationship with the cumulated mineral balances. The problems that arise are to find out what is the measure in that those indexes are able to provide a piece of information on the evolution of the level of the N and P supplies level from soil, respectively:

1. In the case of the systems with positive mineral balance where the soil is enriched with nutrients there is noticed an increase of the nutrition index during time in relationship with the mineral balance that is becomming more and more positive?

2. In the case of the systems with negative mineral balance for that the soil is depleted in nutrients there is noticed a diminishing of the index in relationship with the mineral balance that becomming more and more negative?

MATERIAL AND METHODS

The experimental fields were set by the Orphée team (INRA Toulouse), they being placed at Ercé in Central Pyrenees (1999) and at Gramond in Massif Central (1998).

The experimental field from in Ercé (0°east, 43°north) is a plot placed in valey and it was designed mainly for the realisation of the forage stocks for winter. On this plot were applied regularly organic fertilisers, it being exploited by two cuttings and one grazing in fall (STROIA C., 2007).

The experimental field from Gramond (2°east, 44°north) is placed on a natural grassland from an area of hilly relief, the plot being set on a flat area. The plot was exploited in an extensive manner before the setting of the experimental field, respectively one grazing in spring with sheep followed by a cut after that was following other grazing in fall with the sheep too.

The relative data of the soil and climatic conditions are presented in Table 1, the climatic data corresponding the the calculated averages for the last 20 years before the setting the the experimental plots.

Table 1.

Soil and climatic data of the experimental fields

	Ercé	**Gramond**
Altitude (m)	660	607
Rainfalls (mm)	1200	960
Temperature (°C)	12.7	11
Soil type	Aluvial soil	Brown soil

The experimetnla plots have a size of 3 m * 5 m at Gramond and 3 m * 4 m at Ercé. They are distributed randomly in four blocks with four replicates. On the two experimental fields the mineral fertilisers were applied starting from the setting of the plots at the end of winter before the vegetation start; on the plots ensemple was applied 400 kg ha^{-1} an^{-1} K as KCl in every experimental year to provide a non-limited provision level of potassium. In Gramond was applied annually 90 kg CaO because the soil has a pH comprised between 5.5 and 5.9.

There were set four treatments: N_0P_0, N_0P_1, N_1P_0 et N_1P_1, where 0 corresponds to a treatment without P and N input; 1 is corresponding to a variable input depending by year, and P is correaponding to a yearly unique dose of 50 kg ha^{-1}.

The annual dose of N (N as NH_4NO_3) is fractioned: 100 kg ha^{-1} in the first cycle and 60 kg ha^{-1} for the other cycles at Gramond and for Ercé is 60 N kg ha^{-1} for the first cycle, 100 N kg ha^{-1} in the second cycle and 60 N kg ha^{-1} in the third. The phosphorus dose is applied as triple super-phosphate (45% P_2O_5) in the first cycle.

The experimental period was 6 years (between 1999 and 2004) for the experimental field from Ercé and 7 years (between 1998 and 2004) for the experimental field from Gramond.

RESULTS AND DISCUSSIONS

In Figure 1 are presented the evolutions of the nitrogen nutrition indexes (IN), fraction from that were extracted the legumes (nonleg) in relationship with the balance calculated at the end of the previous year campaign. There is noticed that for the N_0 treatment the index value are decreasing progresivelly and continuously while the balance becomes more and more

negative starting from the first experimental year, the values of the index being always inferior to the value of 80 (satisfactory nutrition level). For the experimental field from Gramond this decrease is continuing until in the last year of study, while at Ercé was noticed a low stopping of the IN value during the last two years. For the treatments N_1 the evolutions in time are mach more contrasting between the two experimental fields. At Ercé the value of the index is decreasing during four years and than is increasing sudden. At Gramond was noticed a first phase when the IN index varies great from a year to another followed by a phase in that it remains stable and after that decreases sudden.

The obtained data for the N_0 treatments for the two experimental fields show that there is a powerful diminishing of the IN values when the balances are becoming negative.

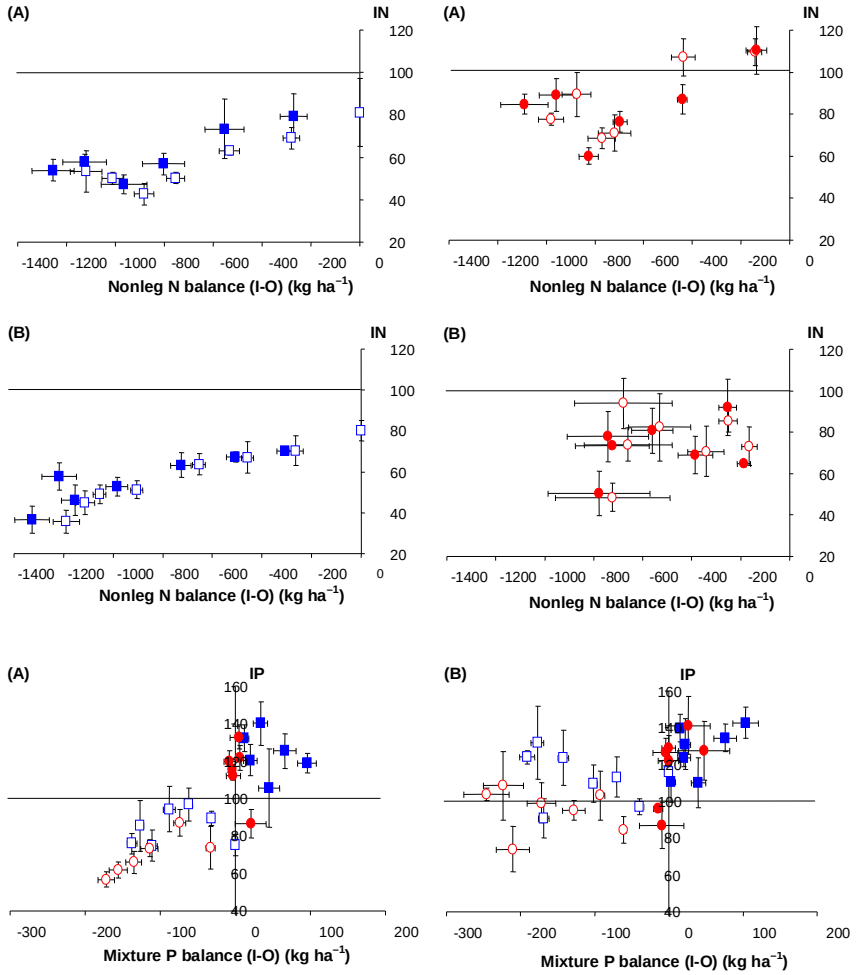

Figure 1. The evolution of the nutrition indexes IN, nonleg fraction and IP mixture fraction, first cut in relationship with the cultural balance (I – O) (□ N_0P_0; ■ N_0P_1; ○) N_1P_0; ● N_1P_1) for the experimental field from Ercé (A) and the experimental field from Gramond

Regarding the IP indexes (Figure 1) it was noticed that the evolution during time is variable depending by the fertilisation regime and the experimental field; there were represented the balance valued of the mixture (grasses + legumes) fraction including the leached P amount for the exported fraction. For the P_0 treatments (N_0P_0 şi N_1P_0) at Ercé it was noticed that IP is decreasing progresivelly when the balance becomes negative. This evolution is more highlighted for the treatment N_1P_0 where the exports are superior. At Gramond it wasn't noticed a relationship between the two variables indifferent by the N level. The P index oscilates between 72 (insufficient nutrition level) and 132 (excessive nutrition level) for a range of the balance comprised between 0 and -246 kg of P; the index isn't evidencing a certain specific tendency.

For the P_1 treatments that are corresponding to a enriching regime (N_0P_1) or null (N_1P_1) isn't evidenced any trend in the evolution of the two variables for the two experimental fields. There isn't any relationship between the value of the index and the increase of the cumulated balance.

CONCLUSIONS

These results tend to show that IN are able to provide a piece of information regarding the depletion of the level of the nitrogen supplies from the point of view of the balances evolution during time. Thus, there is an interrogation point in case that indexes evolution wasn't influenced by the hydric conditions that have outweighted during the last two campains (2003 and 2004).

For the experimental field from Ercé where the available P level is low the measured IP indexes for P_0 treatments show that the level of the available P supplies are depleting when the cumulate balance I – O becomes negative (THÉLIER–HUCHÉ *et al*., 1996). Contrary to this situation, for the Gramond experimental field, the cumulative effects haven't diminished significantly the available P level from soil, the IP nutrition indexes being sensitive to the evolutions of the P balance during time.

ACKNOWLEDGEMENTS.

This work was published during the project "POSTDOCTORAL SCHOOL OF AGRICULTURE AND VETERINARY MEDICINE", POSDRU/89/1.5/S/62371, co-financed by the European Social Fund through the Sectorial Operational Programme for the Human Resources Development 2007-2013.

BIBLIOGRAPHY

1.FARRUGGIA, A., THÉLIER-HUCHÉ, L., VIOLLEAU, S., LEBRUN, J.M., BESNARD, A., 2000. L'analyse d'herbe pour piloter la fertilisation phosphatée et potassique des prairies. Exemples d'application de la méthode. *Fourrages*, **164**, 447 – 459.

2.THELIER - HUCHE, L., BONISCHOT, R., CONTAT, F., SALETTE, J., 1996. Indice à long terme d'une absence prolongé de fertilisation phosphatée sur prairie permanente. *Fourrages*, **145**, *53 – 63.*

3. 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.