Evaluation of Biological Nitrogen at *Trifolium pratense, Trifolium repens* and *Lotus corniculatus*, on Harvesting Cycles

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Abstract

The amount of N species of perennial legumes fixed for each harvest and the total annual crop was assessed on a 2-year period, in a mixture with *Festuca arundinaceea*. There are using different nitrogenous fertilizer levels: N_0; N_{50}; N_{100}; N_{150}. The amount of biological N is positively correlated with the percentage of participation of legumes. During the growing, amount of N increases from cycle I (CI) towards cycle III (CIII), being registered for CI - 15 % N, CII - 32% N and CIII - N 53% of the total nitrogen fixed of species *Trifolium repens.* For *Trifolium pratense* and *Lotus corniculatus* species, the maximum amount of N fixed is achieved at CII, registering a distribution harvest cycles thus 28% N - CI, 40% N - CII and 32% N-CIII for *Trifolium pratense* , 25 % N - CI, 45 % N - CII and 30 % N - CIII for *Lotus corniculatus.* The annual amount of N fixed averaged 85 kg / ha in *Trifolium repens,* 210 kg / ha in *Trifolium pratense* and 68 kg / ha in *Lotus corniculatus.* The fertilization with nitrogen at level of 100 and 150 kg / ha negatively influenced symbiotic nitrogen fixation in *Trifolium repens* and *Lotus corniculatus* species.

Keywords: biological N; harvest cycle; perennial legumes; *Lotus corniculatus; Trifolium pratense; Trifolium repens.*

1. Introduction

Symbiotic nitrogen fixation process is the result of mutual symbiosis between plants and bacteria which offers competitive legumes in pastures. The morphological characteristics of legume species , the climatic conditions and plant nitrogen requirements influence the amount of nitrogen available which can be variable [1-4]. The amount of biologically fixed N by perennial legumes is proportional to their participation in the vegetative cover. Annual amount determined by different authors range between 75-280 kg. ha $^{-1}$ for *Trifolium repens*, 140-310 kg. ha $^{-1}$ for *Trifolium pratense* and 65-150 kg. ha $^{-1}$ for *Lotus corniculatus* [2,5-7] The maintenance of an optimal legume content in mixtures is very difficult, with wide variations depending on soil, climate, competition and management system [1,3, 8-11]. The objective of this study was to assess the amount of fixed nitrogen species symbiotic *Trifolium repens* , *Trifolium pratense*, and *Lotus corniculatus*, and nitrogen species of grasses transfer partner in the mixture.

2. Materials and methods

The studies were carried out between 2008-2009 on a sandy loam chernozem soil with pH 6.5, good supply of phosphorus and potassium. The biological materials were a pure grass sward of *Festuca arundinaceea* and mixture with *Trifolium repens, Trifolium pratense* and *Lotus corniculatus.* Four levels of N fertilizer were applied in the spring 0; 50; 100; 150 N kg. ha $^{-1}$, both for pure grass and mixture.

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Three harvests were obtained in 2008 and two harvests in 2009, due to dry in growth period. DM yield, total N content and botanical composition were determined. The amount of symbiotic N fixation was determined by using a simple balance method, calculating the difference between N harvested in mixture and N harvested in pure grass at same level of N fertilization.

3. Results and discussion

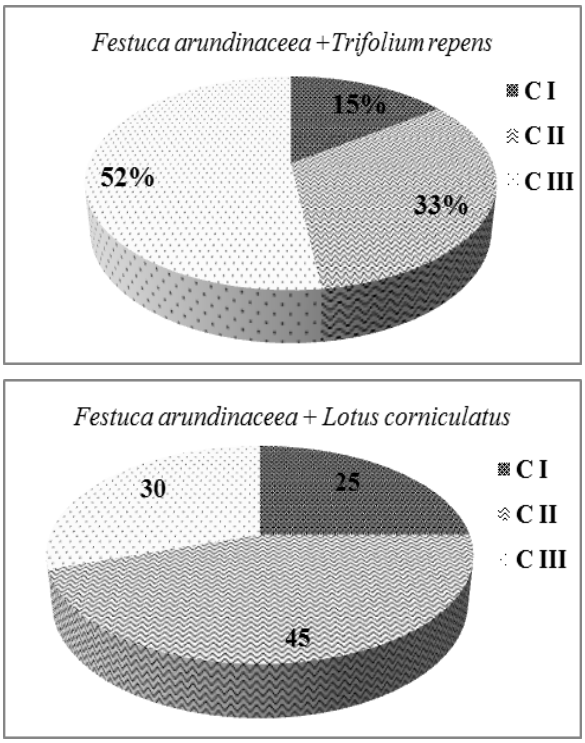
The experimental results showed a positive influence of legume species on DM yield, N content of the feed and the total amount of N harvested (Nh) as a result of an additional intake of N derived from symbiotic fixation. DM yield shows significant increases in mixtures compared with grass in pure crop. These increases can be explained by increasing the amount of leaves that provide nitrogen during periods of high necessity, especially in regeneration of plants after each harvest cycle. Table 1 presented the results obtained as the average of the experimental years. Drought of 2009 had negative impact physiological processes of plant growth and development. For pure crop of *Festuca arundinaceea*, DM yield and amount of Nh show increasing values with increasing amount of N applied as fertilizer. The average amount of Nh exported by harvest increased from 83 kg. ha -1 for unfertilized plots up to 131 kg. ha $^{-1}$ in plots fertilized with 150 N . The presence of legumes in the mixture increases the nitrogen quantity exported (Nh). *Trifolium pratense* species provides the highest amount of Nh 249 kg. ha $^{-1}$ ranging between 129 kg ha $^{-1}$ (N_0) and 300 kg. ha^{-1} (N_{150}). The average amount Nh is of 178 kg. ha $^{-1}$ for *Trifolium repens* range from 154 kg . ha $^{-1}$ (N_0) and 185 kg. ha^{-1} (N_{50}) and of 187 kg. ha $^{-1}$ for *Lotus corniculatus*, ranging between 161 kg. ha $^{-1}$ (N_0) and 97 kg. ha $^{-1}$ (N_{50}). The amount of N determined as a result of the fixation process symbiotic ranges between 57-83 kg. ha $^{-1}$ for *Trifolium repens* species, 96-169 kg. ha $^{-1}$ for *Trifolium pratense* and 65-96 kg.ha $^{-1}$ for *Lotus corniculatus*.

Table 1. Total N yield of pure grass and mixtures and amount of N fixed per hectare mean of 2 years

Sward type	Supply N kg. ha $^{-1}$	DM t. ha $^{-1}$	Total N harvest kg. ha $^{-1}$	Legume content %	N fixed kg. ha $^{-1}$	N fixed kg per % legume
pure grass *Festuca*	0	3.79	83			
arundinaceea	50	5.14	101			
	100	5.68	116			
	150	6.41	131			
	Average	5.25	107			
mixture	0	6.20	154	51	71	1.4
Festuca	50	7.36	184	33	83	2.5
arundinaceea	100	7.19	185	20	69	3.4
Trifolium repens	150	7.83	188	18	57	3.2
	Average	7.14	178		70	2.7
mixture	0	8.67	179	63	96	1.5
Festuca	50	9.40	234	58	133	2.3
arundinaceea	100	9.96	281	42	165	3.9
Trifolium pratense	150	10.71	300	35	169	4.8
	Average	9.68	248		141	3.2
mixture	0	7.00	161	44	78	1.8
Festuca	50	8.18	196	35	96	2.7
arundinaceea	100	8.00	192	32	77	2.4
Lotus corniculatus	150	8.32	195	20	65	2.9
	Average	7.87	186		79	2.5

N fertilization affected negatively the amount of N fixed symbiotic species *Trifolium repens* and *Lotus corniculatus* at doses of 100-150 kg. N ha $^{-1}$. Not register a significant reduction in the amount of N fixed by increasing N fertilization in the mixture with *Trifolium pratense*. During the growing season, the amount of nitrogen fixed increase from the first (CI) to third (CIII) harvest

for *Trifolium repens*.The maximum amount of N fixed are recorded at the second harvest (CII) for *Trifolium pratense* and *Lotus corniculatus*. The results are shown in Figure 1.



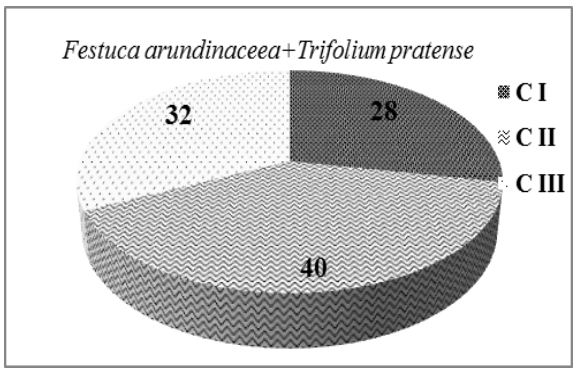


Figure 1. The proportion of fixed on cicle of harvest

4. Conclusions

Analysis of annual quantity of nutrient nitrogen used by plants growth and development, gives us an image of the intensity symbiotic N fixation process and the potential efficiency of forage crops. The amount of N fixed and transferred into biomass by perennial legumes is influenced by the percentage of their participation in the vegetal cover. Depending on the species, mineral fertilization with nitrogen can influence the symbiotic fixation of N. Thus, *Trifolium pratense* species supports a higher fertilization 100-150 N, no repressive effect on symbiotic fixation process. *Trifolium repens* species and *Lotus corniculatus* are required moderate levels of N fertilization quantities greater negative influence symbiotic fixation. The maximum amount of symbiotic nitrogen fixed by legumes was 110 kg. ha $^{-1}$ N to *Trifolium repens*, 112 kg. ha $^{-1}$ N to *Lotus corniculatus* and 210 kg N. ha $^{-1}$ N to *Trifolium pratense*.

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