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BIRDSFOOT TREFOIL'S CONTRIBUTION TO THE PROVISION OF TEMPORARY PASTURES WITH BIOLOGICALLY-FIXED NITROGEN, IN BANAT'S FIELD

CONTRIBUŢIA GHIZDEIULUI LA APROVIZIONAREA PAJIŞTILOR TEMPORARE CU AZOT FIXAT PE CALE BIOLOGICĂ, ÎN CONDIŢIILE DIN CÂMPIA BANATULUI

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Temporary pastures, with the presence of legume species within the floristic structure, produce important amounts of biologically-fixed Nitrogen (BFN), which partially is used in the increase of the forage biomass yield, and partially remains in the soil for the next crops in the rotation. The results of the researches carried out made evident birdsfoot trefoil's contribution, cultivated in association with perennial graminaceous, to the provision with biological Nitrogen of the temporary pastures. Under such conditions, birdsfoot trefoil leads to the achievement of a BFN amount of 70-96 kg/ha/year, and each percentage of participation leads to the achievement of an average of 2.58 kg/ha/year biological Nitrogen.
Key words: biologically-fixed Nitrogen, birdsfoot trefoil, temporary pasture

Introduction

The biological atmospheric N-fixation, through the participation of the two well-known partners (fixing bacteria and legume species) remains one of the most interesting agro-biological processes for the research activity and for practice, as well.

The multitude of factors influencing this process offers certain specificity to it, in concordance with the natural factors and with the technological factors, too. This explains for many times the differences between the results achieved from the same species, under identical natural conditions, but under different technological conditions.

In the case of associations of species for temporary pastures' crops, perennial legumes fix great amounts of biological Nitrogen, which, in a certain proportion, is made available for the graminaceous species. This amount of fixed

Nitrogen, transferred to forage graminaceous, differs with the ecologic conditions and with the method of cultivation (BROPHY et al., 1987; ELGERSMA and SCHLEPERS, 2001; FARNHAM and GEORGE, 1994; KADZIULIENE, 2001; LIEVEN and WHITTAM, 1997; RAZEC et al., 2001; SIMPSON, 1976).

This work intends to make evident the amount of Nitrogen biologically fixed by birdsfoot trefoil and the BFN proportion transferred to the perennial graminaceous species within the temporary pastures.

Materials and Methods

Researches were performed at USAMVB Timişoara, during 2005-2007, on a cambic chernozen, slightly gleyied.

The experimental device was consisted of a bifactorial experience, with the following graduations:

A. Cultivation method (a_1 = *Festuca pratensis* 100%, a_2 = *Festuca pratensis* 60% + *Lotus corniculatus* 40%, a_3 = *Lolium perenne* 100%, a_4 = *Lolium perenne* 60% + *Lotus corniculatus* 40%).

B. Nitrogen doses ($b_1 = N_0$, $b_2 = N_{50}$, $b_3 = N_{100}$, $b_4 = N_{200}$).

The seeding was performed in August 2005, and the biological material used was seeds belonging to the following varieties: Oltim for birdsfoot trefoil, Tâmpa for orchard grass and Marta for perennial ryegrass.

During the experimental periods, we performed the following determinations: dry matter yield, floristic composition, quantity of total Nitrogen in plants and quantity of fixed Nitrogen.

To estimate the amount of Nitrogen fixed, we applied the Nitrogen balance method, between the quantity of total Nitrogen within the biomass of graminaceous and birdsfoot trefoil association and the quantity of total Nitrogen within the biomass of graminaceous species. This method is the most applied one in the studies of BFN quantification (DRAGOMIR et al., 1992; KADZIULIENE, 2001; RAZEC et al., 2001).

The results achieved make evident the BFN amount transferred to perennial graminaceous within the mixture, too, according to an estimation made by SIMPSON (1976), who considers that about 25.3% of the total quantity of fixed Nitrogen is put in readiness for the graminaceous plants.

Successive to the researches performed, we quantified the relationship existent between the birdsfoot trefoil proportion within the association floristic structure and the amount of fixed Nitrogen, depending upon the graminaceous species used.

Results and Discussions

The analysis of the data presented in Table 1 shows that N-fertilization exerts a strong effect upon dry matter yield, especially in perennial graminaceous seeded in pure crop. So, yield growths depending on the dose applied range

between 8.1-51.5% in *Festuca pratensis* and 19.6-62.7%, in *Lolium perenne*. The association of the two graminaceous studied with *Lotus corniculatus*, under conditions of non N-fertilization, leads to a yield increase, compared to the pure graminaceous crop, with 50% in the association consisted of *Festuca pratensis* and *Lotus corniculatus* and with 27.6% in the association consisted of *Lolium perenne* and *Lotus corniculatus*.

In the case of the variants cultivated in association, we noticed a decrease of birdsfoot trefoil's participation degree in the floristic structure, proportionally with the increase of N doses. So, in the association of *Festuca pratensis* and *Lotus corniculatus*, birdsfoot trefoil's percentage decreases from 52%, in the non-fertilized variant, to 24%, in the variant fertilized with N_{200}. In the association consisted of *Lolium perenne* and *Lotus corniculatus*, the birdsfoot trefoil participation decreases from 46%, in the non fertilized variant, to 17%, in the variant fertilized with N_{200}.

Table 1

N-fertilization influence upon associations of birdsfoot trefoil with some perennial graminaceous species (2005-2007)

Cultivation method	N doses	Dry matter yield				Floristic structure (%)	
		t/ha	Diff. t/ha	%	Signif.	Graminaceous	Legumes
Festuca pratensis (100%)	N_0	3.22	-	100		100	-
	N_{50}	3.48	0.26	108.1	*	100	-
	N_{100}	4.02	0.80	124.8	*	100	-
	N_{200}	4.88	1.66	151.5	**	100	-
Festuca p. (60%) + Lotus c. (40%)	N_0	4.83	-	100		48	52
	N_{50}	5.23	0.40	107.2		54	46
	N_{100}	5.81	0.98	120.3	*	67	33
	N_{200}	6.05	1.22	133.5	**	76	24
Lolium perenne (100%)	N_0	4.08	-	100		100	-
	N_{50}	4.88	0.80	119.6	*	100	-
	N_{100}	5.76	1.68	141.1	**	100	-
	N_{200}	6.64	2.56	162.7	**	100	-
Lolium p. (60%) + Lotus c. (40%)	N_0	5.21	-	100		54	46
	N_{50}	5.61	0.40	107.6		66	34
	N_{100}	6.09	0.88	116.8	*	74	26
	N_{200}	6.44	1.23	123.3	*	83	17

DL 5% = 0.49 DL 1% = 1.32 DL 0.1% = 2.68

Successive to the analysis of the N balance we concluded that, depending on the N doses applied, too, in the association variant consisted of *Festuca pratensis* and *Lotus corniculatus* we estimated an amount of biologically-fixed N of 82-115 kg/ha, and in the association of *Lolium perenne* and *Lotus corniculatus* the amount of biologically-fixed N ranges between 68-80 kg/ha. If we consider the

percentage of birdsfoot trefoil participation into the association, then an amount of biologically-fixed N of 1.69-3.41 kg/ha/year will be achieved for each percent, in the association consisted of *Festuca pratensis* and *Lotus corniculatus*, and of 1.48-4.05 kg/ha/year, in the association consisted of *Lolium perenne* and *Lotus corniculatus* (Table 2). Under the conditions specific to acid soils, DRAGOMIR et al. 1992 consider that each percentage of birdsfoot trefoil participation into the association contributes to the achievement of an amount of fixed N of 2.78 kg/ha.

Table *2*

Estimated quantity of biological Nitrogen in the associations consisted of perennial graminaceous and birdsfoot trefoil (2005-2007)

Crop	N doses	Total N amount in plants (kg/ha)	Amount of N fixed (kg/ha)	Birdsfoot trefoil percentage of participation (% of DM)	Amount of N fixed/birdsfoot trefoil percentage of participation (kg/ha/year)
Festuca pratensis (100%)	N_0	79	-	-	-
	N_{50}	108	-	-	-
	N_{100}	151	-	-	-
	N_{200}	197	-	-	-
	AVERAGE	134	-	-	-
Festuca p. (60%) + Lotus c. (40%)	N_0	167	88	52	1.69
	N_{50}	223	115	46	2.50
	N_{100}	250	99	33	3.00
	N_{200}	279	82	24	3.41
	AVERAGE	230	96	39	2.56
Lolium perenne (100%)	N_0	78	-	-	-
	N_{50}	112	-	-	-
	N_{100}	157	-	-	-
	N_{200}	195	-	-	-
	AVERAGE	135	-	-	-
Lolium p. (60%) + Lotus c. (40%)	N_0	146	68	46	1.48
	N_{50}	173	71	34	1.79
	N_{100}	237	80	26	3.07
	N_{200}	264	69	17	4.05
	AVERAGE	205	70	31	2.59

To evaluate the amount of biological N transferred to the graminaceous species within the association, we took into consideration the estimations made by SIMPSON (1976), who proved that only 25.3% of the amount of fixed N is transferred to graminaceous. Considering this proportion, in our situation, the amount of biological N transferred to the species *Festuca pratensis* ranges between 22-29 kg/ha, and for *Lolium perenne* between 17-20 kg/ha. Compared to other researches, for example in the U.S.A., FARNHAM and GEORGE (1994) consider

that birdsfoot trefoil transfers to the orchard grass within the association an amount of fixed N of only 6 kg/ha, during the first year of vegetation, and of 37 kg/ha, during the second year.

Table 3

Relationships determining the quantity of biologically-fixed N, depending on birdsfoot trefoil percentage of participation into the association

Association type	Equation of determination of the biologically-fixed N
Festuca pratensis + Lotus corniculatus	$y = - 0.0861x^2 + 7.0076x – 37.99$ ($R^2 = 0.5751$)
Lolium perenne + Lotus corniculatus	$y = - 0.0217x^2 + 1.2406x – 55.956$ ($R^2 = 0.329$)

The results achieved have led to the establishment of a relationship of direct determination, depending upon birdsfoot trefoil percentage of participation into the association. This relationship, presented as quadric equations, is specific for each association type (Table 3).

Conclusions

Depending on the cultivation method, the amount of biologically-fixed N ranges between 82-115 kg/ha, in the association consisted of *Festuca pratensis* and *Lotus corniculatus* and between 68-80% in the association consisted of *Lolium perenne* and *Lotus corniculatu*s.

For each birdsfoot trefoil percentage of participation into the floristic structure, we achieve an amount of fixed N of 1.69-3.41 kg/ha/year, in the association consisted of *Festuca pratensis* and *Lotus corniculatus* and of 1.48-4.05 kg/ha/year in the association consisted of *Lolium perenne* and *Lotus corniculatu*s.

Under the conditions provided by cutlivation in associaton with graminaceous, birdsfoot trefoil transfers to the species *Festuca pratensis* an amount of fixed N of 22-29 kg/ha, and to the species *Lolium perenne* an amount of 17-20 kg/ha.

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