

# The Dynamic of Soil Nitrogen in Forage Systems Based on Corn Silage Culture

Ioan Peț<sup>1</sup>, Neculai Dragomir<sup>1</sup>, Sebastian Toth<sup>1</sup>, Corina Cristea<sup>2</sup>, Teodor Cristea<sup>3</sup>,  
Mihai Lunca<sup>1</sup>, Nicoleta Moraru<sup>1</sup>, Claudiu Ghiocel<sup>1</sup>

<sup>1</sup>Banat's University of Agricultural Sciences and Veterinary Medicine from Timișoara,  
Faculty of Animal Sciences and Biotechnologies, 300645-Timisoara. Calea Aradului, 119, Romania

<sup>2</sup>Grass Research- Development Station Timișoara, Calea Urseni, 32, România

<sup>3</sup>Banat's University of Agricultural Sciences and Veterinary Medicine from Timișoara,  
Faculty of Horticulture and Forestry, 300645-Timșoara. Calea Aradului, 119, România

---

## Abstract

The research on soil nitrogen dynamics of crop structures of the feed system studied had se purpose to reveal the amounts of N<sub>t</sub> made at the end of the vegetation periods and on the entire cumulative period of each system, both in unfertilized and fertilized variants with nitrogen. Following the obtained results there was found that the introduction into the feed of corn silage and aristed ryegrass the cumulative amount of N<sub>t</sub> in soil was 181.5 kg / ha, at the unfertilized variants and 190.2 kg/ha in the nitrogen fertilized variants.

**Keywords:** corn silage, feed system, nitrogen fertilizer, total nitrogen in the soil

---

## 1. Introduction

In the sustainable management of agriculture there have been developed several practical systems of agriculture, some of them applied, especially in agri-environmental farming systems, agro biological or organic. In these systems, the feed system applies to all species grown in a rotation system, which provides the necessary feed for a given period of time, by continued cultivation of the agricultural land [1-6].

The paper shows the cumulative amount of total nitrogen in the soil during feed system cultivation, based on corn silage culture.

## 2. Materials and methods

The researches were conducted during 2008-2011 in the Research Center for Grassland and Forage from USAMVB Timisoara and have studied a continuous feed cultivation of the agricultural land, based on the corn silage culture.

The forage crops had the following structure:

- Corn silage (Ps, 2009)→ corn silage (Ps, 2010) Ps→Ps;
- Corn silage (Ps, 2009)→ autumn meslin (Bt, 2009)→ corn silage (Ps, 2010). Ps→Bt→Ps;
- Autumn meslin (Bt, 2009)→ corn silage (Ps, 2010)→ autumn meslin (Bt, 2010)→ corn silage (Ps, 2011) Bt→Ps→Bt→Ps;
- Spring meslin (Bp, 2009)→Sudan grass (IS, 2009)→ autumn meslin (Bt, 2009)→ corn silage (Ps, 2010) Bp→IS→Bt→Ps;
- Aristed Ryegrass (Ra. 2009)→ corn silage (Ps, 2010)→ autumn meslin (Bt, 2010)→ corn silage (Ps, 2011) Ra→Ps→Bt→Ps.

---

\*Corresponding author: Ioan Peț,  
Email: [nelu\\_pet@yahoo.com](mailto:nelu_pet@yahoo.com)

The determinations for the total content of soil nitrogen (Nt) were performed from each version, by soil sampling from 10 to 10 cm, at 30 cm depth, and the amount of Nt was reported at the amount of soil at that depth (30 t/ha).

### 3. Results and discussion

Higher productivity of the component species of the forage system structure, and in default of higher quantities of nitrogen remaining in the soil

by fixing nitrogen, influenced the cumulative amount of Nt in the forage systems based on maize silage culture.

The forage system **Ps** → **Ps**, consisting of monoculture grown corn silage registered a cumulative amount of Nt 83.7 kg/ha, at the nitrogen unfertilized variants, and 88.8 kg/ha at the nitrogen fertilizer variants, respectively with an increase of 6%. On production years, at the end of the vegetation period the accumulated nitrogen quantities were almost equal (Table 1).

**Table 1.** The Nt amount from the soil (0 – 30 cm) in the forage system **Ps** → **Ps**

Nitrogen doses	2009		2010		Accumulated Nt	
	N (g/kgsoil)	Nt (kg/ha)	N (g/kgsoil)	Nt (kg/ha)	kg/ha	%
N <sub>0</sub>	1.43	42.9	1.36	40.8	83.7	100
N <sub>100+100</sub>	1.47	44.1	1.49	44.7	88.8	106

In the **Ps** → **Bt** → **Ps** system the accumulated quantity of Nt was 133.2 kg/ha in the unfertilized variants, and of 137.1 kg/ha in the nitrogen fertilized variants. When compared with the feed **Ps**

→ **Ps** (*untreated*), there was an increase in the amount of accumulated Nt of 59.9%, in the unfertilized variants, and 54.4 %, in the nitrogen fertilizer variants (Table 2).

**Table 2.** The Nt amount from the soil (0 – 30 cm) in the forage system **Ps** → **Bt** → **Ps**

Nitrogen doses	2009		2010		Accumulated Nt	
	N (g/kgsoil)	Nt (kg/ha)	N (g/kgsoil)	Nt (kg/ha)	kg/ha	%
N <sub>0</sub>	1.43	42.9	15.2 + 1.49	45.6 + 44.7 = 90.3	133.2	100
N <sub>100+50+100</sub>	1.47	44.1	1.54 + 1.56	46.2 + 46.8 = 93.0	137.1	103

The introduction into the culture of autumn meslin sown in each feed production system has led to the largest aggregate amount of Nt: the 181.5 kg/ha in unfertilized variants, and 190.2 kg/ha in nitrogen fertilizer variants with an increase of 5% between variants. If these results are compared with the

ones obtained in the forage system **Ps** → **Ps**, there can be seen a doubling of the accumulated nitrogen quantities, respectively of 116.8% at the nitrogen unfertilized variants and of 114.2% at the nitrogen fertilized variants (Table 3).

**Table 3.** The Nt amount from the soil (0 – 30 cm) in the forage system **Bt** → **Ps** → **Bt** → **Ps**

Nitrogen doses	2009		2010		Accumulated Nt	
	N (g/kgsoil)	Nt (kg/ha)	N (g/kgsoil)	Nt (kg/ha)	Kg/ha	%
N <sub>0</sub>	1.59 + 1.50	47.7 + 45.0 = 92.7	1.54 + 1.42	46.2 + 42.6 = 88.8	181.5	100
N <sub>50+100+50+100</sub>	1.61 + 1.58	48.3 + 47.4 = 95.7	1.58 + 1.57	47.4 + 47.1 = 94.5	190.2	105

In the **Bt** → **IS** → **Bt** → **Ps** forage system, the spring and autumn meslin cultures have positively influenced the accumulated Nt from the soil at the end of the vegetation periods. Thereby, at the unfertilized variants, the quantity of accumulated Nt has been of 177.3 kg/ha, and at the nitrogen fertilizer variants 183 kg/ha. At this system, both cultivated variants (with or without nitrogen), the accumulated nitrogen quantities has doubled

compared with the dataq registered in the forage system **Ps** → **Ps** (Table 4).

The **Ra** → **Ps** → **Bt** → **Ps** forage system, has yield nearly the same quantity of accumulated Nt, as in the previous forage system: 177 kg/ha, in the unfertilized variants and 184.2 kg/ha in the nitrogen fertilizer variants (with a growth of 4%) (Table 5).

**Table 4.** The Nt amount from the soil (0 – 30 cm) in the forage system **Bt → IS → Bt → Ps**

Nitrogen doses	2009		2010		Accumulated Nt	
	N (g/kgsoil)	Nt (kg/ha)	N (g/kgsoil)	Nt (kg/ha)	Kg/ha	%
N <sub>0</sub>	1.62 + 1.32	48.6 + 39.6 = 88.2	1.51 + 1.46	45.3 + 43.8 = 89.1	177.3	100
N <sub>50+100+50+100</sub>	1.64 + 1.39	49.2 + 41.7 = 90.9	1.55 + 1.52	46.5 + 45.6 = 92.1	183.0	103

**Table 5.** Cantitatea de Nt din sol (0 – 30 cm) în sistemul furajer **Ra → Ps → Bt → Ps**

Nitrogen doses	2009		2010		Accumulated Nt	
	N (g/kgsoil)	Nt (kg/ha)	N (g/kgsoil)	Nt (kg/ha)	Kg/ha	%
N <sub>0</sub>	1.47 + 1.40	44.1 + 42.0 = 86.1	1.53 + 1.50	45.9 + 45.0 = 90.9	177.0	100
N <sub>50+100+50+100</sub>	1.52 + 1.51	45.6 + 45.3 = 90.9	1.56 + 1.55	46.8 + 46.5 = 93.9	184.2	104

Following the determination of accumulated quantities of Nt, in the unfertilized variants, resulted the following hierarchy of continuous cultivation systems based on the corn silage culture (Table 6):

- forage system **Ps → Ps (untreated)**, has registered an accumulated quantity of Nt of 83.7 kg/ha;
- forage system **Bt → Ps → Bt → Ps**, has registered an accumulated Nt quantity of 181.5 kg/ha, with an increase of 117%, compared to the *untreated* forage system;
- forage system **Bp → IS → Bt → Ps**, has registered an accumulated Nt quantity of 177.3 kg/ha, with an increase of 112%, compared to the *untreated* forage system;
- forage system **Ra → Ps → Bt → Ps**, has registered an accumulated Nt quantity of 177.0

kg/ha, with an increase of 111%, compared to the *untreated* forage system;

- forage system **Ps → Bt → Ps**, registered an accumulated Nt quantity of 133.2 kg/ha, with an increase of 59%, compared to the *untreated* forage system.

In the nitrogen fertilized variants case, the same hierarchy will be kept between forage systems while the accumulated Nt amounts ranged from 137.1–190.2 kg/ha, with an increase between 54–114 % compared to the **Ps → Ps** forage system.

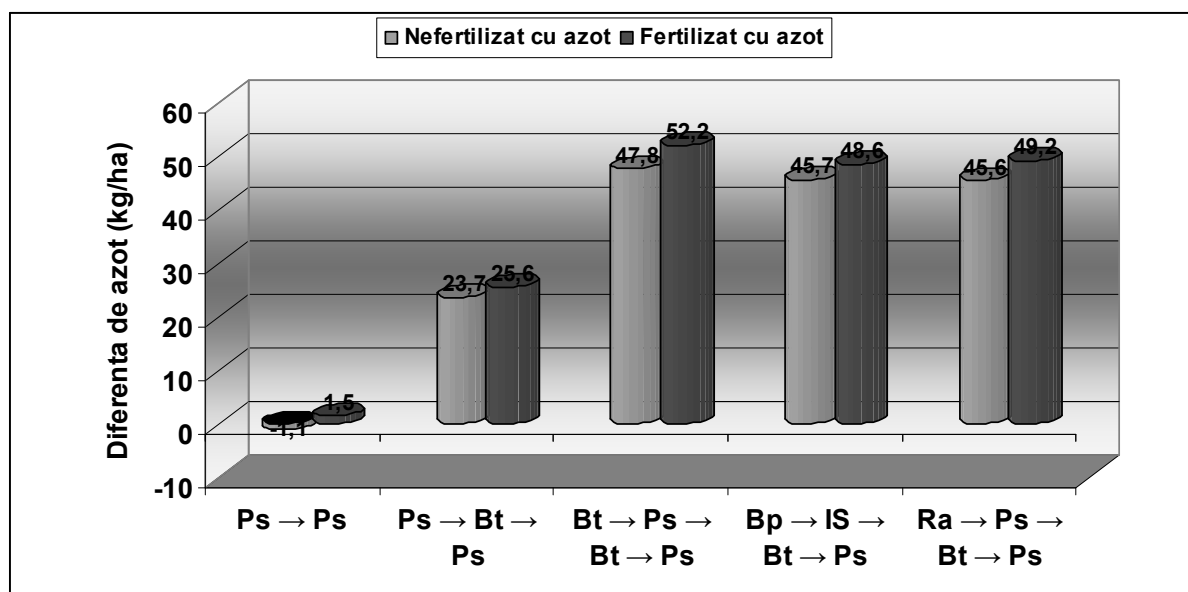
The differences between the soil Nt quantities and the soil's initial quantity of N shows the importance of continuous land cultivation systems with different forage species to maintain a balance of nitrogen in the soil.

**Table 6.** The differentiation of the continuing growth forage systems, based on the corn silage culture, by the quantity of Nt in soil

Forage systems	Unfertilized		Nitrogen fertilized		
	Nt (kg/ha)	%	Accumulated nitrogen doses	Nt (kg/ha)	%
Ps → Ps	83.7	100	200	88.8	100
Ps → Bt → Ps	133.2	159	250	137.1	154
Bt → Ps → Bt → Ps	181.5	217	300	190.2	214
Bp → IS → Bt → Ps	177.3	212	300	183.0	206
Ra → Ps → Bt → Ps	177.0	211	350	184.2	207

Thus, the data presented in Figure 1 shows that in the unfertilized variants, between the quantity of Nt made at the end of each growing season and the initial amount of Nt in the soil, nitrogen differences were positive and ranged from 23.7 to 47.8 kg/ha recording a difference of -1.1 kg/ha, in

the system **Ps → Ps**. In the nitrogen fertilized variants the differences were positive, respectively 1.5–52.5 kg/ha. The forage system which registered the greatest differences of Nt was the one composed of **Bt → Ps → Bt → Ps**.



**Figure 1.** Cumulative difference between the amount of Nt from the soil (at 0-30 cm depth) produced by continuous cultivation of land in the forage systems based on corn silage culture and the initial amount of soil Nt (42.9 kg/ha)

#### 4. Conclusions

In the system **Ps** → **Bt** → **Ps**, the accumulated quantity of Nt was of 133.2 kg/ha, in the unfertilized variants, and of 137.1 kg/ha, in the nitrogen fertilized variants. If it is compared with the forage system **Ps** → **Ps** (*untreated*), there was an increase in the accumulated Nt amount of 59.9% in the unfertilized variants and of 54.4% in the nitrogen fertilized variants;

By the introduction of autumn meslin in the culture structures sown in every production year of the forage system has led to the largest aggregate amount of accumulated Nt t: of 181.5 kg/ha, in the unfertilized variants and of 190.2 kg/in the nitrogen fertilized variants, with an increase of 5% between variants;

#### References

1. Abdin, O. A. et al., Cover crops and interrow tillage for weed control in short season maize (*Zea mays*). European Journal of Agronomy, 2000, 12, 93 – 102.
2. Dragomir, N. et al., The economic effect of wheat cultivation in a „Cover crops” system. introducing the annual forage legume in rotation. Lucrări Științifice seria I., 2005, VII, Management Agricol.
3. Grignani, C. et al., Production, nitrogen and carbon balance of maize – based forage systems. Europ. J. Agronomy, 2007, 26, 442 – 453.
4. Ryu, J.S. et al., Hairy vetch and rye as cover crops to reduce soil erosion from sloped land in highland agriculture. 19<sup>th</sup> World Congress on Soil Science. Soil Solutions for a Changing World 1 – 6 August 2010, Brisbane. Australia.
5. Sainju, M. et al., Biculture legume – cereal cover crops for enhanced biomass yield and carbon and nitrogen. Agron. J., 2005, 97, 1403 – 1412.
6. Smith, M.S., Frye, W. and Varco, J., Legume winter cover crops. Advances in Soil Science., 1987, 7, 95-139.