STUDY ON NUTRIENT LOSSES IN THE STANDARD EROSION CONTROL PLOTS FROM PREAJBA EXPERIMENTAL POINT, GORJ

Irina-Adriana CHIURCIU[1], Daniela Dana[2], Tore KROGSTAD[3], Aurelia Ioana CHEREJI[4], Valentina VOICU[5], Andreea Roxana FIRATOIU[1]

[(1)]University of Agronomic Sciences and Veterinary Medicine Bucharest, Faculty of Management and Rural Development, 59 Marasti Blvd, 011464, District 1, Bucharest, Romania, e-mails: chiurciu.irina@managusamv.ro, firatoiu.andreea@managusamv.ro
[(2)]Mihai Viteazul Technological Secondary School Calugareni, Giurgiu, România, Stoenesti School, Giurgiu, România, e-mail: ddanaddaniela@gmail.com
[(3)]Norwegian University of Life Science – NMBU, Faculty of Environmental Science and Natural Resource Management, Fougnerbakken 3, 1432 A°s, Norway, e-mail: tore.krogstad@nmbu.no
[(4)]University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048, Oradea, Romania, e-mail: aureelia_brinaru@yahoo.com
[(5)]National Research and Development Institute for Soil Science, Agrochemistry and Environment - ICPA, 61 Marasti Blvd, 011464, District 1, Bucharest, Romania, e-mail: valy_76@yahoo.com; ”Dunărea de Jos” University of Galati, Faculty of Engineering and Agronomy of Brăila, 29 Călăraşilor Str., 810017, Braila, Romania, email: valentina.cotet@ugal.ro

Corresponding author email: aureelia_brinaru@yahoo.com

Abstract

Recent studies highlight that controlling nutrient emissions from agricultural sources remains one of the most pressing environmental challenges in safeguarding water bodies. The excessive release of nutrients, particularly nitrogen and phosphorus, can lead to the eutrophication of aquatic ecosystems, disrupting water quality and biodiversity. In this context, the present study focuses on the systematic monitoring of agrochemical soil indicators in designated standard plots at the Preajba experimental point in Gorj County. The primary objective is to evaluate and control nutrient losses originating from agricultural practices, with a particular emphasis on understanding the dynamics of nutrient mobility along different topographical positions. Two soil profiles were established for this purpose: one located at the top of the slope and the other at its base. This setup allows for a comprehensive assessment of nutrient losses influenced by slope position, providing critical insights into erosion-driven nutrient transport and soil fertility dynamics. The findings aim to inform sustainable soil and nutrient management practices tailored to mitigate environmental impacts while supporting agricultural productivity.

Key words: nutrient losses, erosion control, Stagnic Luvosol, mitigation option, soil fertility

INTRODUCTION

Recently, the control of nutrient emissions from agricultural sources is considered one of the most urgent environmental protection issues related to bodies of water.

The European Environment Agency – EEA, highlighted how excessive nutrients, mainly nitrogen and phosphorus, disrupt ecosystems through eutrophication, harming biodiversity. It explored cross-sectoral policy measures and strategies aimed at mitigating nutrient loss, such as improved agricultural practices and wastewater management. EEA emphasized collaborative efforts to reduce pollution and support a healthier environment and sustainable food systems (EEA, 2022).

Recent studies have shown that agriculture is responsible for 50% of nitrogen (N) and 30% of phosphorus (P) in anthropogenic nutrient contributions to Norwegian rivers (Selvik et al., 2006; Chiurciu et al., 2022;

Dana et al. 2023). Methods to mitigate nutrient losses in agriculture they included limitations on the number of livestock and mandatory nutrient management planning (Liu, J. et al., 2024).
Another study also in the Preajba Experimental Centre in Gorj County investigated the impact of mineral fertilization and water erosion on Stagnic Luvisol soil. The study, using three experimental versions and repetitions, showed that mineral fertilization enhances yields and helps protect soil by reducing humus and nutrient loss. Influencing factors include rainfall, erosion intensity, vegetation cover, and fertilizer dosage, with implications for soil management and erosion mitigation (Balan, 2023; Balan et al., 2024).
The risk of nutrient loss from agriculture was the highest for areas with the application of manure in large quantities and some areas with a high risk of erosion in combination with a high application rate of fertilizing nutrients (Bechmann et al., 2005, 2007).

MATERIALS AND METHODS

The experimental center for the culture of Preajba - Gorj meadows belonging to the University of Craiova is located 125 km Northwest of Craiova Municipality and 4 km from Târgu-Jiu Municipality in the Subcarpathian area of Oltenia at the foot of the Parâng Mountains. It is located in the basement of the *Quercus petraea* forests at an altitude of 305 m. The average temperature for 34 years was 10.2 ^{0}C, and the temperature during the vegetation period of the meadows (March-September) was 17.2 ^{0}C. Winter months record low temperatures 1.2^{0}C December, -2.0 ^{0}C in January, 0.2^{0}C in February. The highest temperatures are recorded in July, 20.9 ^{0}C and August 20.3 ^{0}C. To identify the type of soil on which the experiments were located, two soil profiles were made: one at the top of the slope, and the second at the base of the slope.
The 9 experimental plots (Fig. 1) included the following crops and treatments (Variants):

- Plot (variant 1) - unfertilized natural meadow,
- Plot (variant 2) - natural meadow fertilized with N138,
- Plot (variant 3) - natural meadow fertilized with dose N162P81K100,
- Plot (variant 4) - unfertilized sown meadow,
- Plot (variant 5) - sown meadow fertilized with N138,
- Plot (variant 6) - sown meadow fertilized with N162P81K100,
- Plot (variant 7) - unfertilized corn,
- Plot (variant 8) - corn fertilized with dose N138,
- Plot (variant 9) - corn fertilized with N162P81K100 dose.

Figure 1. General view from the experimental field Preajba - Gorj (PENSOL Project)

RESULTS AND DISCUSSIONS

Characterization of soil profiles Preajba

Pedogenetic conditions of soil profile 1 PREAJBA (hill)

Name: Stagnic Whitish Luvisol on clays - LN/AL
Location: Preajba Communal territory (Târgu-Jiu), Gorj County;
Geographic coordinates: longitude: 4504'17.1''; latitude: 2321'40.3''
The relief: the Subcarpathian depression of Oltenia; the internal hills; 5th terrace of Jiului (front of the terrace).
Slope: 5 – 6%
Parent rock: clays
Ground water depth: > 10 m;

Characteristic vegetation: xerophilic-acidophilic herbaceous vegetation.

Pedogenetic conditions of soil profile 2 PREAJBA (valley)

Name: Stagnic Luvisol on clay loams, LN/AL

Location: Preajba communal territory (Târgu-Jiu), Gorj county;

Geographic coordinates: longitude: 4504'17.0''; latitude: 2321'40.2''

The relief: the subcarpathian depression of Oltenia; the internal hills; 5th terrace of Jiului (front of the terrace).

Slope: 15 - 20%, at the base of the slope;

Parent rock: clayey loams

Ground water depth: > 10 m;

Characteristic vegetation: mesoxerophilic-acidophilic grassy vegetation.

The two investigated profiles (P1-hill and P2-vale) are part of the class of luvosols, and at the level of type they are whitish luvisols with, in general, common characteristics.

The common feature of the two soils is given by the textural differentiation emphasized on the profile, differentiation that occurs between the surface of the soil and the lower part of the control section. This is how it goes from the sandy loam texture (in the Ao, El and Ea horizons respectively) to the clayey texture (in the Btw horizon). This makes the El (of P1-hill) and Ea (of P2-valley) horizons respectively coarser, while the Bt horizon has a finer texture due to its clay enrichment, which makes it more impermeable.

The enrichment in clay is due to its migration from the upper part of the profile (where the El and Ea horizons are formed) followed by its accumulation in its lower part, where the Bt horizon is formed. Parallel to this accumulation of clay, there is also a stagnation of water (in the upper part of the profile), which favors acidification and the progressive decrease of soil fertility (Figs. 2-3).

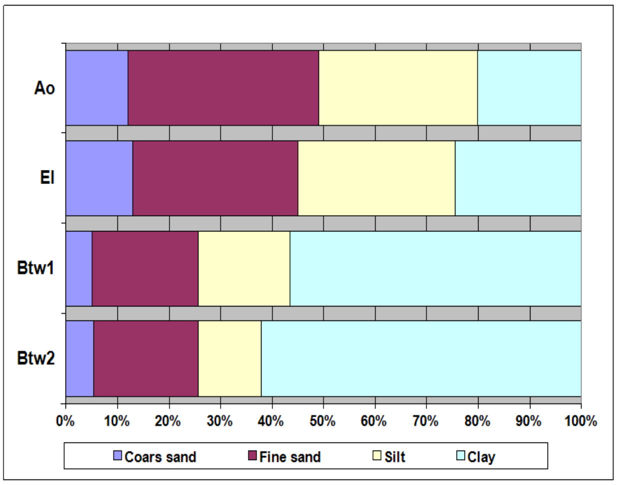

Figure 2. Granulometry of the soil profile 1, hill, experimental field Preajba - Gorj (PENSOL Project)

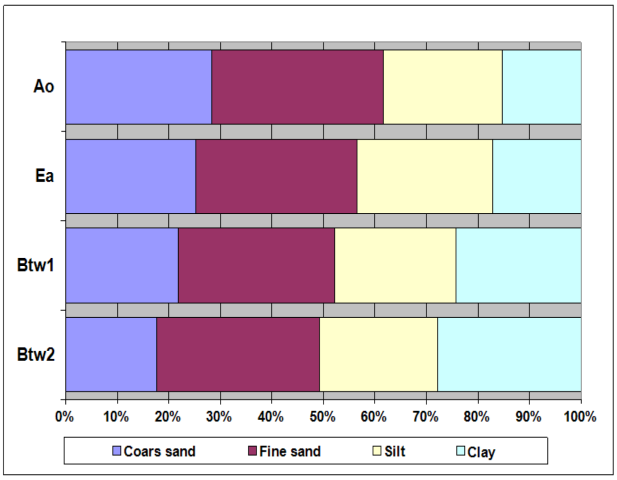

Figure 3. Granulometry of the soil profile 2, valley, experimental field Preajba - Gorj (PENSOL Project)

The content of the soil in organic matter is relatively low, the graph of the values of the two studied profiles describing similar, descending curves (Figs. 4-5) from the surface to the base of the soil profiles. In P1-hill the humus is medium (4.27% in Ao) and very low (1.25% in El) in the upper part and extremely low in the Btw horizon (0.29-0.89%). In P2-valley, the humus values decrease from medium (5.32% in Ao) to low (2.37% in Ao) and extremely low (0.29-0.59% in Btw) towards the base of the profile. Regarding the soil reaction (Figs. 4-5), the analytical data of P1-hill highlight pH values of 5.46 in the Ao horizon and

5.28 - 5.41 in the Btw horizon, the soil being weakly acidic, while at the level of the El horizon the pH value is somewhat lower (5.29). In the case of the P2-valley profile, the pH values are closer and relatively constant, the soil being moderately acidic throughout the profile.

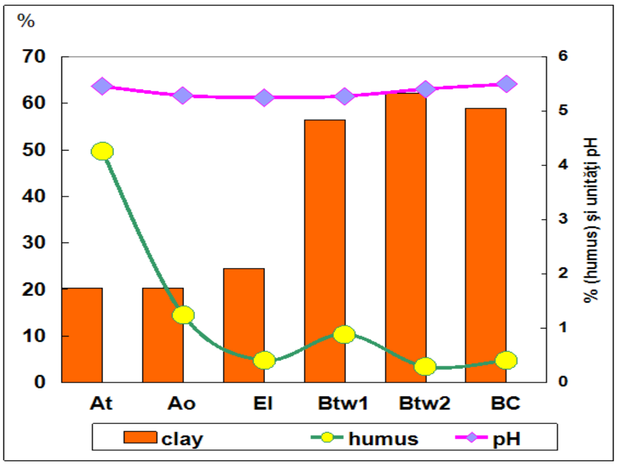

Figure 4. The values of the clay fraction, organic matter and pH of the soil profile 1, hill, experimental field Preajba - Gorj (PENSOL Project)

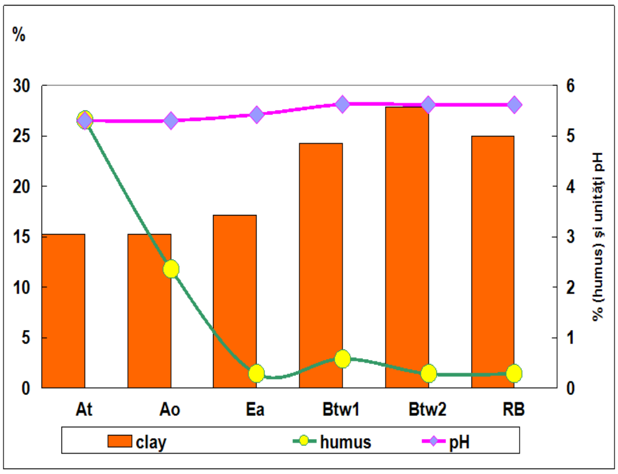

Figure 5. The values of the clay fraction, organic matter and pH of the soil profile 2, valley, experimental field Preajba - Gorj (PENSOL Project)

Analytical data regarding the monitoring of the state of soil supply with nutrients in soil loss control plots and nutrients according to the type of crop and the fertilization system are presented in Table 1.

The obtained results demonstrates differences in pH, nitrogen content, phosphorus and potassium levels, humus percentage, and base exchange capacity between upstream and downstream plots across multiple variants.

Table 1. Analytical results regarding the level of supply of nutrients to the standard plots to control the leakage of nutrients in the experimental field Preajba - Gorj (PENSOL Project)

Variants	The place of harvest	pH	Nt %	P ppm	K ppm	Humus %	SB me/ 100 g soil	Ah me/ 100 g soil	T me/ 100 g soil	VAh %
V7	UPSTREAM	4.94	0,25	5.94	81,66	3.17	5.09	6.89	11.97	42.5
	DOWNSTREAM	5.17	0,24	5.94	62,50	3.17	7.94	4.59	12.53	63.4
V9	UPSTREAM	4.65	0,19	29.00	83.33	2.93	3.05	6.34	9.29	32.5
	DOWNSTREAM	4.87	0,23	36.16	125.00	2.75	3.86	5.63	9.50	40.7
V8	UPSTREAM	4.95	0,22	24.28	125.00	3.71	2.85	5.38	8.23	34.6
	DOWNSTREAM	4.85	0.21	29.00	98.33	3.41	3.25	5.68	8.93	36.4
V4	UPSTREAM	5.08	0.23	16.07	100.83	4.13	4.88	3.84	8.72	56.0
	DOWNSTREAM	5.15	0.21	25.50	51.66	4.55	4.27	5.47	9.74	43.9
V6	UPSTREAM	5.33	0.23	11.88	80.00	2.51	5.29	4.05	9.34	56.6
	DOWNSTREAM	5.11	0.27	4.89	48.33	3.83	5.09	5.34	10.43	48.8
V5	UPSTREAM	5.24	0.35	11.88	62.50	3.29	5.70	4.17	9.87	57.7
	DOWNSTREAM	5.11	0.25	10.83	59.17	3.42	4.48	5.34	9.82	45.6
V1	UPSTREAM	5.10	0.30	37.73	56.66	4.67	3.46	5.05	8.51	40.6
	DOWNSTREAM	5.33	0.27	11.88	46.66	5.21	3.66	4.34	8.00	45.8
V3	UPSTREAM	5.19	0.33	5.94	81.66	4.49	3.86	5.01	8.87	43.6
	DOWNSTREAM	5.17	0.29	17.82	32.50	4.31	3.46	5.80	9.26	37.3
V2	UPSTREAM	5,01	0,35	25,50	66,66	4.73	4.07	6.39	10.45	38.9
	DOWNSTREAM	5,17	0,23	10,83	32,50	4.84	2.85	5.82	8.67	32.8

Notable trends include higher nutrient loss influenced by slope positioning, impacting soil fertility and nutrient mobility.

CONCLUSIONS

The investigated profiles (P1-hill and P2-vale) are part of the class of luvosols, and at the level of type they are whitish luvosols.

The lowest losses of water and soil are recorded in the natural and sown meadow, which covers the soil better and ensures a better developed root system. Therefore, in the variants with sown and natural meadows, water and soil losses reach half of those in the corn culture.

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