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Testing Traceability of Water Nitrites and Nitrates Using Soil Studies

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Abstract

Agricultural nutrients are particularly important as a contributor to coastal and estuarine algal blooms. Increased nutrient input can stimulate excess algal growth, leading to low dissolved oxygen levels, potential for harmful algal toxins, blocking sunlight needed by aquatic organisms and plants, and degraded habitat conditions for benthic macroinvertebrates and other aquatic life. The aim of this study is to emphasize the results of a study concerning site specific soil nitrates and nitrites contents quality by quantifying in proximity of groundwater. The increased input of nutrients to a body of water can stimulate excessive growth of algae and aquatic plants, thereby creating eutrophic conditions that interfere with recreation and the health and diversity of vegetation, insects, fish, and other aquatic organisms.

Keywords: groundwater, indicators, nutrients, spectrometry.

1. Introduction

Agricultural nutrients are particularly important as a contributor to coastal and estuarine algal blooms. Increased nutrient input can stimulate excess algal growth, leading to low dissolved oxygen levels, potential for harmful algal toxins, blocking sunlight needed by aquatic organisms and plants, and degraded habitat conditions for benthic macroinvertebrates and other aquatic life. Sources of excess nutrients to rivers and streams, lakes, and coastal waters include fertilizers, wastewater, animal waste, and atmospheric deposition. In adequate amounts, the nutrients support the growth of algae and aquatic plants [3].

In order to use methodologies to quantify the polluting potential of water, soil and crops with increased effectiveness, it is recommended to use indicators. Most of the indicators are physical, chemical and biological [1, 2].

The most common physical indicators are represented by: texture and structure; influences the retention and transport of water and substances; soil depth and rooting; influences fertility potential, soil erosion, relief stability; infiltration and apparent density; influences erosion potential, porosity, productivity and water retention capacity; it is correlated with the retention and transport of water, with hydraulic erodibility, with workability and trafficability, etc. [3, 4, 5]

The most common chemical indicators are represented by: total organic matter content: defines C storage, potential fertility, structural stability; the content of active organic matter: defines structural stability and food for microorganisms; the pH; defines the thresholds (steps) of chemical and biological activity; electrical conductivity; defines the thresholds of microbial and plant activity and extractable N, P, K; they define the accessibility of nutrients for

plants and the potential for N losses and are indicators of fertility and environmental quality [3, 5, 8].

The most common biological indicators are represented by:

- C and N of the microbial mass: it reflects the microbial catalytic potential and early warning about the effect of management on organic matter;
- potential mineralizable N: reflects the N supply potential and soil fertility (productivity);
- specific respiration: reflects the microbiological activity per unit of microbial biomass;
- the number of macro-organisms: reflects the activity of soil organisms, especially earthworms.

The aim of this study is to emphasize the results of a study concerning site specific soil nitrates and nitrites content quality by quantifying in proximity of groundwater [4, 6, 8].

2. Material and Method

The study was developed according to specific methodologies. Soil samples were collected and analyzed from the point of view of nitrates and nitrites contents using spectrometric methodology. The samples were collected from 8 different points in an area located in the Cluj County. The assessment of soil and water quality was based on the examination of indicators that refer to stable or intermediate properties that determine the functional capacity of the soil for a certain purpose. The nature of the indicators and their number depend on the assessment scale (field, farm, landscape, region) and, obviously, on the purpose for which the assessment is made (the function or service requested in the case of different uses of soil and water). The indicators chosen for the evaluation must be sensitive to changes in properties, reliable, correctly reflect the situation, be easy to obtain or determine and able to detect even small changes in processes, properties and interrelations in the soil; are possible to measure quantitatively.

3.Results and Discussions

Following the studies of water and soil samples, the following tabular results were obtained, in the form of averages for all 8 sampling points. The results of the study emphasize values an average by all 8 points content of 3.79 mg/L for nitrates, and 0.077 mg/L for nitrites. This study has importance because all soils, whether polluted or unpolluted, contain a variety of compounds (contaminants) that are naturally present. Such contaminants include metals, inorganic ions and salts and these compounds are mainly formed by soil microbial activity and decaying organisms.

Table 1. Results of the analysis of water samples in 2021

No. crt.	Parameters	MU	Values	Limit allowed according to Law 458/2002 republicated 2011	Analyze method
1.	Turbiditaty	NTU	15.7	≤5	SR EN ISO 7027:2001
2.	pH	unit. pH	8.03 (19.4°C)	≥6,5 ≤9,5	SR EN ISO 10523:2012
3.	Conductivity	µS/cm	887	<2500	SR EN 27888:1997
4.	Chlorine	mg/L	24.5	250	SR ISO 9297:2001
5.	Permanganate index	mg O_2/L	2.81	5	SR EN ISO 8467:2001
6.	Ammonium	mg/L	0.055	0,5	SR ISO 7150-1:2001
7.	Nitrites	mg/L	0.082	0,5	SR EN 26777:2002/C91:2006
8.	Nitrates	mg/L	3.24	50	SR ISO 7890-3:2000
9.	Hardness	°G	32.31	≥5	SR ISO 6059:2008
10.	Iron	µg/L	79	200	Metoda LCK521 HACH
11.	Coliphorm bacteria	MPN /100mL	>2420	0	SR EN ISO 9308-2:2014
12.	*Escherichia coli*	MPN /100mL	30	0	SR EN ISO 9308-2:2014
13.	Intestinal Enterococi	nr.ufc /100mL	62		SR EN ISO 7899-2:2002

Table 2. Results of the analysis of soil samples in 2021

No.	Parameters	MU	Value
1.	pH	unit. pH	7.78
2.	Conductivity	µS/cm	952
3.	Chlorine	mg/L	23.4
4.	Ammonium	mg/L	0.051
5.	Nitrites	mg/L	0.077
6.	Nitrates	mg/L	3.79
7.	Iron	µg/L	85

Table 3. Results of the analysis of water samples in 2022

No.	Parameters	UM	Value		Limit allowed according to Law 458/2002 with alterations and completations of the Law 311/2004	Analyze method
			Well water	Tip water		
1.	Turbidity	NTU	0.23	<0.20 (0.16)	≤5	SR EN ISO 7027-1:2016 PSLT - 02
2.	pH	unit. pH	6.37 (20.5ºC)	7.23 (20.7ºC)	≥6,5 ≤9,5	SR EN ISO 10523:2012 PSLT - 07
3.	Conductivity at 20ºC	µS/cm	438	305	<2500	SR EN 27888:1997 PSLT - 13
4.	Cloruri	mg/L	31.88	13.29	250	SR ISO 9297:2001 PSLT - 06
5.	Chlorine	mg O_2/L	<0.50 (0.32*)	<0.50 (0.26*)	5	SR EN ISO 8467:2001 PSLT - 11
6.	Permanganate index	mg/L	0.012	0.010	0,5	SR ISO 7150-1:2001 PSLT - 10
7	Ammonium	mg/L	0.008	0.007	0,5	SR EN 26777:2002/C91:200 PSLT-09
8.	Nitrites	mg/L	64.29	26.14	50	SR ISO 7890-3:2000 PSLT - 08
9.	Hardness	°G	10.6	9.18	≥5	SR ISO 6059:2008 PSLT - 05
10.	Calcium	mg/L	52.7	44.3	-	SR ISO 6058:2008 PSLT-03
11.	Magnesium	mg/L	13.97	17.35	-	SR ISO 6059:2008 PSLT - 05
12.	Sulphates	mg/L	68.19	41.06	250	SR ISO 6059:2008 PSLT - 05
13.	Fluorine	mg/L	0.18	0.14	1,2	Metoda 8029 HACH PSLT - 27
14.	Sulphure	µg/L	<5 (1*)	<5 (2*)	100	Metoda 8131 HACH PSLT - 26
15.	Alkalinity	mL HCL 0,1N	1.4	1.76	-	SR ISO 9963-1:2002 PSLT - 17
16.	Bicarbonates	mg/L	85.4	107.4	-	SR ISO 9963-1:2002 PSLT - 17
17.	Iron	µg /L	35	20	200	Metoda LCK521 HACH PSLT – 22
18.	*Phosphates	mg/L	0.0432	<0.03 (0.0105*)	-	SR EN ISO 6878:2008 PSLT - 16

OBSERVATIONS:
„<" - value under the identifiable limit; *- informative value

Table 4. Results of the analysis of soil samples in 2022

No.crt	Parameters	MU	Value
1.	pH	unit. pH	6.37 (20.5ºC)
2.	Conductivity at 20ºC	µS/cm	438
3.	Chlorine	mg/L	31.88
4.	Ammonium	mg/L	0.012
5.	Nitrites	mg/L	0.008
6.	Nitrates	mg/L	64.29
7.	Calcium	mg/L	52.7
8.	Magnesium	mg/L	13.97
9.	Sulphates	mg/L	68.19
10.	Fluorine	mg/L	0.18
11.	Sulphures	µg/L	<5
12.	Alkalinity	mL HCL 0.1N	1.4
13.	Bicarbonates	mg/L	85.4
14.	Iron	µg /L	35
15.	Phosphares	mg/L	0.0432

4. Conclusions

The results of the study emphasize values an average by all 8 points content of 3.79 mg/L for nitrates, and 0.077 mg/L for nitrites. This study has importance because all soils, whether polluted or unpolluted, contain a variety of compounds (contaminants) that are naturally present. Such contaminants include metals, inorganic ions and salts and these compounds are mainly formed by soil microbial activity and decaying organisms.

The increased input of nutrients to a body of water can stimulate excessive growth of algae and aquatic plants, thereby creating eutrophic conditions that interfere with recreation and the health and diversity of vegetation, insects, fish, and other aquatic organisms.

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[1] Florea N., 2000, Using the soil maps for the assessment of the soil vulnerability to the pollutants and the compilation the corresponding maps, Geocarpathica, I, 1 Sibiu.

[2] Florea N., 2000, Reactivitatea solurilor la agenti chimici contaminanti si elaborarea hartilor de vulnerabilitate a solurilor la poluare, Geographica Timisiensis, 8-9, 195-211.

[3] DIRECTIVE 2001/18/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 March 2001 on deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC. To the art. 2 defines the GMO like “an organism, with the exception of human being, in which genetic material has been altered in a way that doesn’t occur naturally by mating and /or natural recombination” (europa.eu.int/eur-lex/pri/en/ oj/ dat/ 2001/l_106/l_10620010417en000 10038.pdf).

[4] REGULATION (EC) N. 1830/2003 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 September 2003 concerning the traceability and labelling of genetically modified organisms and the traceability of food and feed product produced from genetically modified organisms and amending Directive 2001/18/EC (europa.eu.int/eur-lex/pri/en/oj/ dat/2003/l_268/l_26820031018en00240 028.pdf).

[5] COMMISSSION RECCOMANDATION (2003/556/EC) of 23 July 2003 on guidelines for the developmentof national strategies and best practices to ensure the coexistence of genetically modified crops withconventional and organic farming (europa.eu.int/eurlex/pri/en/oj/dat/2003/l_189/l_18920030729en00360047.pdf).

[6] Council Regulation (EC) No. 510/2006 of 20 March 2006 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs and Council Regulation (EC) No. 509/2006 of 20 March 2006 on agricultural products and foodstuffs as traditional specialities guaranteed.

[7] Ministerul Mediului şi Schimbărilor Climatice, Proiectul Controlul Integrat al Poluării cu Nutrienţi, Ghid de Bune Practici. Ordin 1181 / 1270 / 2005 privind aprobarea Codului de bune practici agricole pentru protecţia apelor împotriva poluării cu nitraţi din surse Agricole.

[8] ICPA, 2015 Codul de Bune Practici Agricole pentru Protecţia Apelor Împotriva Poluării cu nitraţi din Surse Agricole.