RESEARCH ON NUTRIENT IMBALANCE CAUSED BY INAPPROPRIATE AGRICULTURAL PRACTICES AND HYDRIC EROSION ON HILLSIDE FARMLAND

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Abstract

Although the methods of tillage on hillside agricultural land and the disastrous effects of not respecting them are well known, it can be said that the human factor is still the main driving force behind surface erosion and pollution. The way in which tillage is carried out on such land produces a number of destructive effects that propagate over time both on soil quality, yields and the degree to which consumer demand is met. Thus, due to the movement of soil and water over the cultivated area, the nutrients already existent in the soil, as well as those allocated through fertilization, are unevenly distributed over the cultivated area, resulting in a disproportionate growth of cultivated plants, zones of deficiency and excess, and also a consumption of fertilizers that can lead to water pollution and reduce economic efficiency. The research was carried out on the farm of S.C. BERGOLO S.R.L, located in Cozmești, Vaslui County. To determine the macronutrient content of the soil, 6 average soil agrochemical samples were taken from 0-20 cm depth using the sampling equipment consisting of ATV HONDA 750 + WINTEX 1000 sampler auger. The results obtained indicate the values in which the soil reaction ranges, between 6.1 and 7.8, which indicates the presence of a slightly acidic to slightly alkaline soil reaction. The average value of the nitrogen index on the basis of which we determine the nitrogen supply to the soil is 3.3%. The results show that the accessible phosphorus content varies between 11-50 ppm (wide differences for the same plot), thus the degree of supply in the soil ranges from low to good. Potassium content ranges from 200 to 336 ppm, indicating good and very good soil supply. Humus is present in a percentage of 3.5%, indicating a medium content.

Key words: tillage, erosion, soil fertilization, macronutrients

A significant worldwide environmental problem is soil erosion that reduces land yield and has implications for agriculture and environmental safety (Rentian Ma *et al*, 2023, Lal R. and William C., 1987, Shao P.H. *et al*, 2019).

The primary causes of soil erosion processes, which have a gradual negative impact on soil yield, are wind and precipitation (Hjelm L. and Dasori W., 2012).

When water penetrates soils, a potent net repulsive force—that is, a force that repels—is created between soil particles. This force causes the soil's aggregates to break down and exacerbates soil runoff (Carstens J.F. *et al*, 2018).

Soil erosion causes the shortage of land resources by destroying the soil structure, causing soil loss, reducing soil richness and yield (Chen H. *et al*, 2017, Li R. *et al*, 2021).

Erosion reduces soil productivity by eliminating substantial humus content and mineral components along with eroded soil. (Bucur D. *et al*, 2007).

Cultivation is a major contributor to severe soil erosion (Li K.K. *et al*, 2022, Han J. *et al*, 2020), and crop cultivation and hillside management contribute to the occurrence of soil erosion and have a significant impact on deterioration. Understanding these factors is the key to preventing and controlling local soil erosion and plays an important role in soil conservation (Preiti G. *et al*, 2017). Appropriate soil protection measures can effectively control soil erosion (Labrière N. *et al*, 2015).

Numerous soil properties important for agricultural development, including nutrient levels, pH, water-holding capacity, texture, infiltration rates, and soil organic matter, are impacted by water erosion (den Biggelaar C. *et al*, 2001). Precipitation intensity, slope steepness, soil composition, and plant cover are the primary determinants of water erosion intensity. The main variables affecting water erosion, aside from weather, can be directly changed by field management practices like crop selection, lowering

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tillage intensity, fallow and crop waste cover, terracing, and shape plowing (Panagos P. *et al*, 2016, Poesen J., 2018).

Land degradation is the loss of productivity caused by river erosion and other processes like the decline of soil minerals (Vogt J.V. *et al,* 2011). It has become evident that a sizeable portion of farmland is degraded and in danger of losing outcomes, despite the fact that there is no distinct agreement on the magnitude of land degradation on a worldwide scale. Gibbs H.K. and Salmon J.M. (2015) calculated that 1-6 billion ha of ice-free land area (up to 66%) is degraded to various degrees based on a study of the most notable land degradation studies.

Soil nutrient transport through soil erosion is a major cause of soil fertility loss and soil quality degradation. Nutrient transport refers to the movement or mobilization of nutrients from their original location. Nutrient loss often refers to nutrients lost or transported to endpoints such as rivers and lakes (Mutema M. *et al,* 2015).

The aim of the present study was to highlight the nutrient imbalance caused by inappropriate tillage methods and hydric erosion on slope parcel.

MATERIAL AND METHOD

This study was conducted on S.C. BERGOLO S.R.L., administrative area located on the territory of the Cozmești commune, Iasi County and topographically located on the Moldavian Plain.

The analysed field of plot 273, cultivated with maize on an area of 27.5 ha, presents in the upper part a plateau area, in the middle part a convex slope - moderately to strongly eroded, and in the lower part the deposition of humus material and nutrient particles occurs, resulting in a cumulated layer.

It is important to note that the farmer applies the same tillage and crop technology to the entire area within the topographical plot. Thus, in order to determine the state of soil supply of plant-accessible macronutrients, humus content and soil reaction (pH) after harvesting the maize crop, 6 agrochemical samples were taken from the 0-20 cm depth range based on landforms and soil types. Each average agrochemical sample consists of at least 30 partial samples. These were taken using equipment consisting of a HONDA 750 ATV + WINTEX 1000 drill sampler. Subsequently, after drying, removal of plant residues and grinding, the soil samples were analyzed in the laboratories of the Research Institute for Agriculture and Environment (R.I.A.E.) Iasi, owned by the University of Life Sciences Iasi, according to standards.

Soil reaction (soil pH) was determined by the potentiometric method, in aqueous suspension in a 1:2.5 ratio (soil: distilled water). *Figure 1* shows the limits for soil pH values.

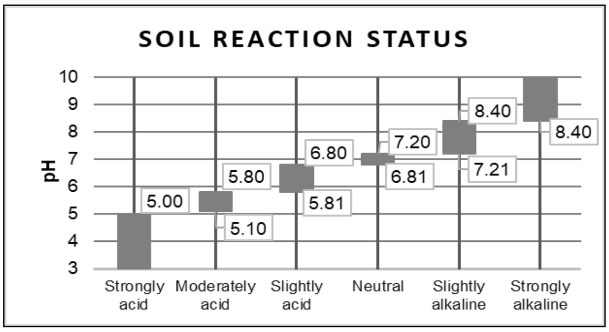

Figure 1 **Soil reaction characterization limits**
(ICPA București, 1981)

Mobile phosphorus is measured by extraction with an ammonium lactate acetate (AL) solution at pH 3.75 by the Egnér-Riehm-Domingo method and determined calorimetrically with molybdenum blue by the Murphy-Riley method - reduction with ascorbic acid (STAS 7184/19-82). The state of phosphorus supply is characterized as shown in *Figure 2*.

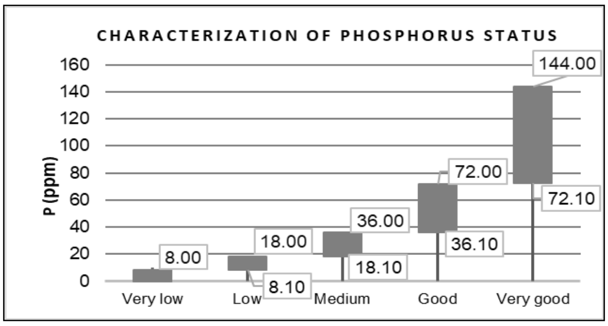

Figure 2 **Soil phosphorus status**
(ICPA București, 1981)

Accessible potassium is also measured in ammonium acetate lactate extraction at pH 3.75, using the Egnér-Riehm Domingo method determined using the atomic absorption apparatus, flame technique - CONTR AA 700 (STAS 7184/18-80). The desciption of the potassium supply status is shown in *Figure 3.*

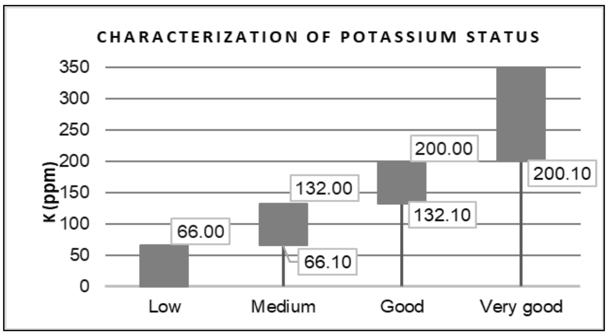

Figure 3 **Soil potassium status**
(ICPA București, 1981)

Humus content (H%) was calculated based on organic carbon and nitrogen index (NI%), according to which the nitrogen (N) supply status of soils was evaluated based on humus and base saturation. The nitrogen index helps to distinguish organic fertilization doses as they are inverse proportional to the NI index (doses diminish as the NI value rises).

$$NI = H \times BS\% / 100,$$

where:

H = humus;
BS% = base saturation.

RESULTS AND DISCUSSIONS

To highlight the differences between the agrochemical samples, it should be noted that sample 882 was taken from the base of the hillslope (slope <5%), 883 and 884 were taken from the lower part of the slope (slope 8-12%) and 885, 886, 887 were taken from the upper part of slope and the plateau area (slope <5%).

The results obtained identifies the range of variation of the soil reaction, i.e. pH 6.1-7.8, resulting in a slightly acidic to slightly alkaline soil reaction (*figure 4*).

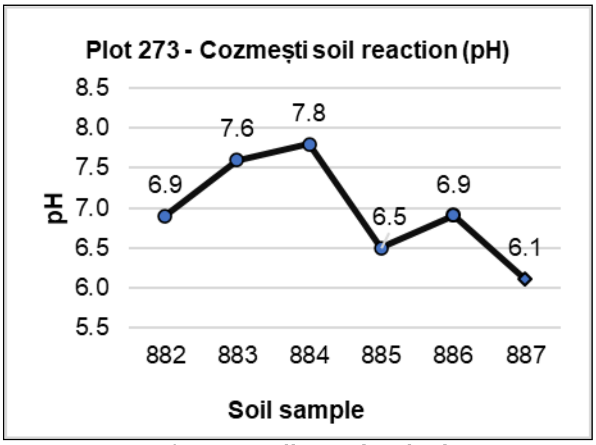

Figure 4 **Soil reaction (pH)**

Regarding the soil reaction on the plateau and upper slope, it is slightly acidic (pH 6.1- 6.9) in the 3 plots (885, 886, 887).

In the lower part of the slope, affected by erosion, the pH is slightly alkaline (pH 7.6 - 7.8) in plots 883 and 884 due to the removal of the fertile layer caused by the erosion phenomenon and the presence of a calcium carbonate layer near the soil surface.

At the base of the slope, in plot 882 the pH value of 6.9 is attributed to the migration of the soil horizon from the eroded area and the accumulation at the base of the slope of fertile soil.

Phosphorus values ranged from 11 to 50 ppm (*figure 5*).

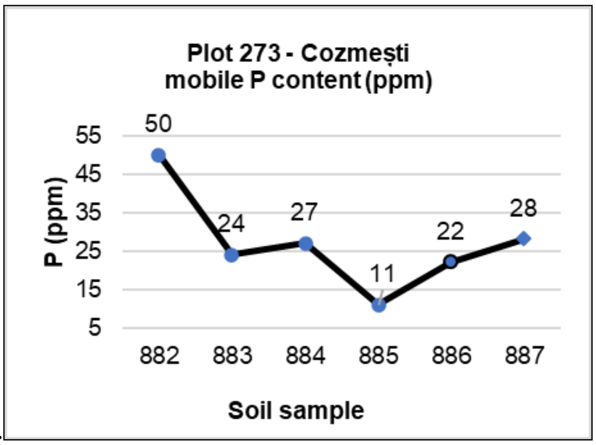

Figure 5 **Mobile P content (ppm)**

According to the results obtained, we observe that 4 of the 6 agrochemical plots have an average phosphorus supply, with the exception of the plot at the top of the slope where a poor supply is observed and the plot at the bottom of the field where a double value of plant accessible phosphorus is identified compared to the other samples analyzed, due to its runoff through rainfall from the upper parts of the field.

By standards, the potassium content is very good on all agrochemical plots, values fluctuated between 200–366 ppm, which is also due to the potassium-rich parent material of the area (*figure 6*).

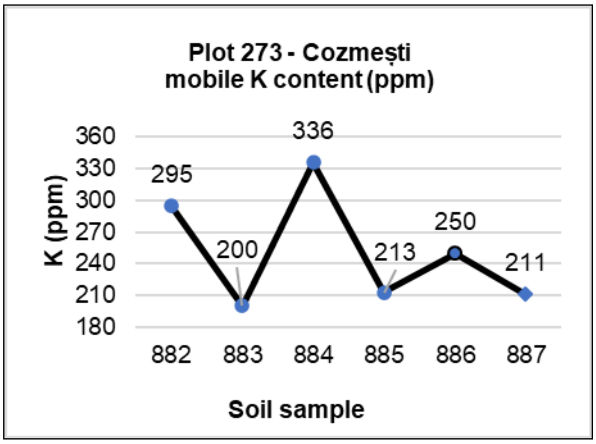

Figure 6 **Mobile K content (ppm)**

It should be noted that although plot 273 is well supplied with potassium, the areas of high slope show the lowest contents and at the same time an accumulation can be observed in the basal part of the plot, probably also due to the movement of fertilizers through the soil surface.

Humus is present at 3.5%, which indicates a medium content and generally provides good conditions for plant growth.

CONCLUSIONS

In this study, we analyzed and highlighted the nutrient imbalance caused by inappropriate tillage methods and hydric erosion to a slope parcel on plot 273 - Cozmești.

As for the soil reaction in the plateau area, considered as reference, it is slightly acidic and in the sloping area, i.e. in moderately eroded soil, the pH becomes slightly alkaline due to erosion leading to weakening and downward migration of the fertile layer.

By analyzing the main nutrient contents of six agrochemical plots, it can be seen that in the area with the steepest slope, they have the lowest values, due to the removal of the surface layer of soil and at the same time a significant accumulation is observed in the lower part of the plot, particularly in the case of phosphorus, where values reach up to five times higher compared to other areas of the plot.

Humus content and nitrogen index are also influenced by slope and soil erosion conditions, but still showing normal values in most areas of the plot, indicating a potential for fast soil recovery if appropriate soil tillage and technology is used.

Thus, it is recommended to exploit the land according to the slope, with the application of differentiated fertilization for each agrochemical plot, and in the eroded area, to use crops with high soil cover.

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