RESEARCHE ON SOIL FERTILITY IN A CALCAREOUS ALLUVIUM FROM THE PRUT RIVER VALLEY AND IN A CAMBIC CHERNOZEM LOCATED ON DOBREANA HILL, VASLUI COUNTY

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Abstract

Fertility is the fundamental ability of the soil to provide conditions for plant growth and development through the accumulation of vegetative factors (light, water, air, heat, nutrients and biological activity) and the assurance of conditions for these factors to be used in sufficient quantities. Spatial mapping of nitrogen, phosphorus and potassium in the soil is done to determine the nutrient supply status and to correlate this with the consumption requirements of the plants to be grown. The studied plots are part of 936 and 1856 land parcels, exploited by company AGROTUR S.R.L., which owns and works land both in the Prut river valley in the Lunca Veche area and on the Dobreana Hill, Vaslui County. In this scientific research, soil fertility is characterized using agrochemical (soil reaction and nutrients) and agrobiological (humus) indicators. Soil reaction (pH) is one of the most important properties of soil as a medium for plant growth, in the conducted research the pH is between 6.0 on 936 land parcel in Dobreana Hill and 7.9 on 1856 land parcel in the Prut river valley. The accessible nutrients supply is an indispensable factor for plant growth, according to the obtained results the studied plots are from low supply of mobile phosphorus in the case of cambic chernozem, to very good supply on the calcareous alluvial soil type of the Prut river valley and in the case of accessible potassium, both plots are very good supplied. The humus level is 3.1% on both land parcels, a value indicating a soil with an average humus content.

Key words: soil fertility, nutrients, soil reaction

Phosphorus (P) is an essential mineral nutrient for plant growth with important nutritional and physiological functions and in addition to nitrogen (N), is crucial in soil ecosystems (Fu D. *et al*, 2020).

Plant roots absorb available P, resulting in P deficiency in rhizosphere soils. However, because of both mass flow and diffusion, other available P is transported from nonrhizosphere to rhizosphere soil (Azcon-Aguilar C., Barea J.M., 2015).

Globally, 18% and 43% of the natural terrestrial land area (excluding cropland, urban and glacial areas) is significantly limited by N and P, respectively; whereas 39% is co-limited by N and P or weakly limited by either nutrient alone (Hou E.Q. *et al*, 2020).

Erosion affects soil fertility by removing together with eroded soil significant humus and mineral element amounts which in maize and sunflower crops reach 17.43-18.40 kg/ha of nitrogen, 1.06-1.12 kg/ha of phosphorus and 2.36-2.39 kg/ha of potassium, representing on the average between 10-16% of chemical fertilizers necessary for these crops (Bucur D. *et al*, 2007).

In soil, K exists in exchangeable and non-exchangeable forms. Non-exchangeable K forms are attached to a crystal lattice of mica or between layers of phyllosilicates. Exchangeable K consists of potassium adsorbed onto clay and organic matter particles, potassium dissolved in water as free ions, and plant extractable potassium (Ka) Potassium, like nitrogen and phosphorus, is a limiting factor in plant productivity, which can be managed by accurate potassium-based (K_2O) fertiliser application (Sardans J., Penuelas J., 2015).

In terrestrial ecosystems, soil carbon and nitrogen pools play a significant role in the biochemical cycle. Nitrogen and organic carbon are not only important soil quality indicators for crop production, however increase of their storages can reduce the increase of atmospheric CO_2 and N_2O concentration in the atmosphere resultant to decrease the greenhouse effect. Currently, ecological environment and climate change, the research on soil carbon and nitrogen pool is extensive (Eduardo V. *et al*, 2019).

Phosphorus is important for the normal cell division, growth, and establishment of

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sugarphosphate (Zhang W. *et al*, 2019). Soil P is an essential nutrient for plant growth and biomass production (Smith D.R. *et al*, 2015).

The productivity of soil depends on several soil physicochemical properties. For instance, soil texture influences soil biophysical properties and is interrelated with soil fertility and soil quality (Upadhyay S. and Raghubanshi A., 2020). The soil pH affects the bioavailability of nutrients. The optimum soil pH controls the microbial activities in the soil and enhances the availability of mineral nutrients. Plants absorb P in the form of orthophosphate ions $H_2PO_4^-$ and HPO_4^{2-} (Becquer A. *et al*, 2014).

The uptake of phosphate decreases as the pH of the soil solution increases (White P. *et al*, 2012).

The aim of this study is to evaluate the soil fertility of two land parcels geographically located on two different landforms, exploited by company AGROTUR S.R.L.

MATERIAL AND METHOD

The study was conducted on the lands exploited by AGROTUR S.R.L., in Lunca Veche, Vaslui County, in two different areas in terms of relief, being located both on the Prut River valley and on its inferior terraces.

The soils in the inferior terraces area are represented by chernozem and those in the Prut Valley by lacustrine and alluvial soils.

It is important to note that for both land parcels the farmer applies the same cultivation technology, except for the 1856 parcel which is irrigated.

For field crops located on flat or gently sloping land, the average agrochemical sample size ranges from 2 to 5 ha, up to 2 ha for eroded soils and up to 1 ha for strongly eroded and colluvial soils.

The average agrochemical sample consists of a number of partial samples, namely: 25 for uniformly fertilised soils, 30 for weakly and moderately eroded soils and 40 for strongly eroded, unevenly fertilised soils.

The area covered by an average soil sample is represented on the maps by broken lines and is called the harvest plot.

These plots with similar characteristics form the fertilisation plots which are represented on the maps with a solid line.

Sampling was carried out with agrochemical soil probes. The probe itself consists of a metal rod with a 0 - 25 (40) cm long channel into which at the insertion the soil sample is collected. In our case, the WINTEX 1000 sampling mechanism is attached to the HONDA ATV.

After sampling, the removal of plant residues and their grinding followed, and subsequently introduced into the analytical flow of the Research Institute for Agriculture and Environment (I.C.A.M.) Iasi chemistry laboratory where the following determinations were carried out: pH, humus percentage, nitrogen index, P-ppm, K-ppm.

Soil reaction (pH_{H_2O}) was determined by the potentiometric method, in aqueous suspension at a ratio 1:2,5 (soil: distilled water). *Table 1* shows the limits for soil pH values

Table 1

Soil reaction characterisation limits
(ICPA București, 1981)

pH	Soil reaction status
< 5.0	strongly acid
5.01 – 5.80	moderately acid
5.81 – 6.80	slightly acid
6.81 – 7.20	neutral
7.21 – 8.40	slightly alkaline

Mobile phosphorus is determined by extraction with a solution of ammonium lactate acetate (AL) at pH 3,75 using the Egnér Riehm-Domingo method, and determined colorimetrically with molybdenum blue using the Murphy-Riley method - reduction with ascorbic acid (STAS 7184/19-82).

The characterisation of the phosphorus supply status is made according to *table 2.*

Table 2

Soil phosphorus status (ICPA București, 1981)

P ppm	Characterisation of phosphorus status
< 8.0	very low
8.1 – 18.0	low
18.1 – 36.0	medium
36.1 – 72.0	good
72.0 – 144.0	very good

Accessible potassium is also determined in ammonium acetate-lactate extract at pH 3,75, determined by the Egner-Riehm-Domingo method using the atomic absorption apparatus, flame technique - CONTR AA 700 (STAS 7184/18-80).

The description of the phosphorus supply status is given in *table 3.*

Table 3

Soil potassium status (ICPA București, 1981)

K ppm	Characterisation of potassium status
< 66.0	low
66.1 – 132.0	medium
132.1 – 200.0	good
200.1 – 265.0	very good

RESULTS AND DISCUSSIONS

a. Agrochemical characterisation of the 936 land parcel – Dobreana Hill.

The study area is located at the north-west of the Lunca Veche locality, with a minimum altitude of 132 m (sample 309) and a maximum altitude of 180 m (sample 302).

There are 65 ha of area analysed (*figure 1*) and it was cultivated with spring peas, 11 average

agrochemical samples were taken. The land is slightly undulating, with both flat and sloping portions. The soil is a cambic chernozem (SRTS, 2012).

Figure 1 **Agrochemical soil sampling by ATV from the Dobreana land parcel**

The pH values are between 6.0-7.0 resulting in a slightly acidic to neutral soil reaction (*figure 2*). From 11 agrochemical samples collected, 10 indicate a weak acid pH and only one sample was neutral. Neutral pH level (sample 310) is caused by erosion of the fertile soil layer.

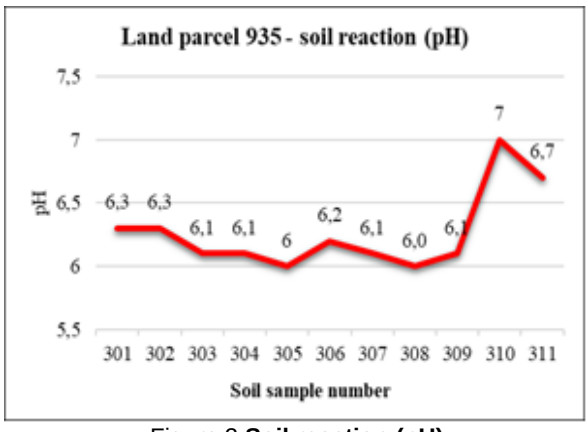

Figure 2 **Soil reaction (pH)**

Mobile phosphorus (P) content is expressed in ppm (parts per million) and ranges from 12-23 ppm P_2O_5, indicating that soil are low to medium supplied (*figure 3*).

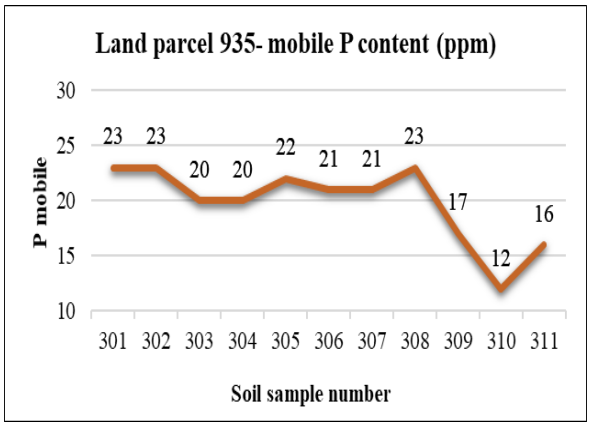

Figure 3 **Mobile P content (ppm)**

The mobile potassium (K) content in this field has values between 251-262 ppm, indicating a very good status (*figure 4*).

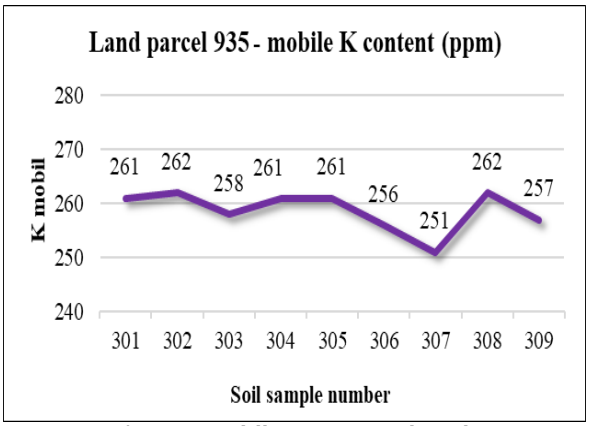

Figure 4 **Mobile K content (ppm)**

The humus content was determined by the Schollenberger method and is expressed as a percentage. For the samples analysed, the humus content is 3.4%, so the soil has a medium humus content. The nitrogen index value is 3.1 which, correlated with the humus value, indicates a medium nitrogen status of soils.

b. Agrochemical characterisation of the 1856 land parcel – Prut Valley.

The land parcel is located in the south-eastern part of Lunca Veche, in the Prut valley, on a flat field, with an altitude between 15 and 16 m. The soil is a calcareous alluvium (SRTS, 2012). The analyzed area covers 35 ha and was cultivated with winter wheat *(figure 5)*, 5 average agrochemical samples were taken.

Figure 5 **View of the 1856 land parcel, Vaslui County**

All samples analysed have a pH value of 7.9, which means that the soil has a slightly alkaline reaction.

Phosphorus (P) content is between 72-80 ppm P_2O_5, which means a very good supply of mobile phosphorus *(figure 6)*.

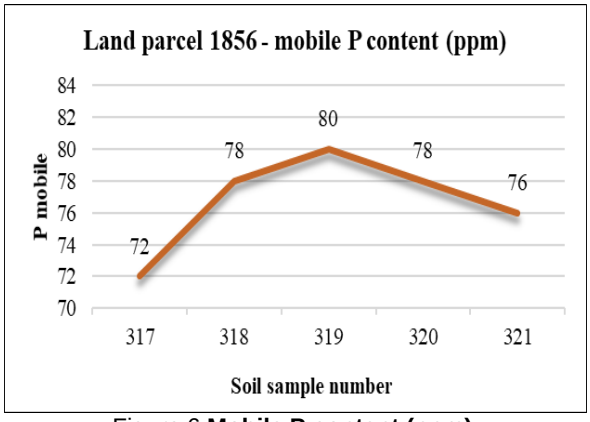

Figure 6 **Mobile P content (ppm)**

The mobile potassium (K) content reaches values between 272-298 ppm, indicating that the soils have a very good status of this nutrient *(figure 7)*.

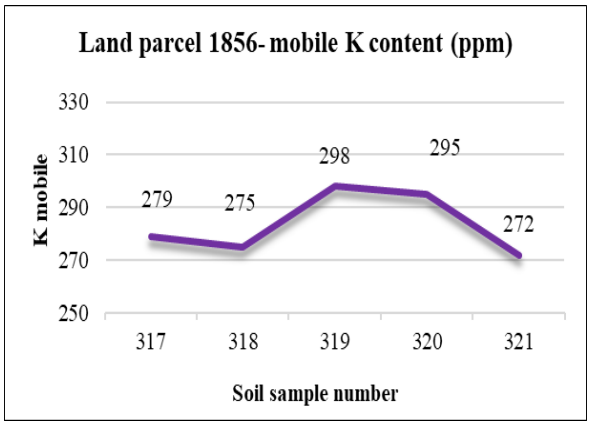

Figure 7 **Mobile K content (ppm)**

CONCLUSIONS

In this study we compared the soil fertility states of two land parcels located on different types of relief.

Regarding the location and soil type studied, one land parcel is located in the Prut valley, on a calcareous alluvium soil and the second land parcel is located on the Dobreana Hill, on a cambic chernozem, near Lunca Veche.

In terms of soil reaction, it is slightly alkaline in the Prut valley and slightly acidic in the Dobreana Hill, the exception being sample 310, which has a neutral pH due to erosion phenomenon.

Analysing the main macroelements (P, K) indicates that the soil in the Prut valley has a higher phosphorus content, with values above 72 ppm across the entire studied area, in contrast with a low to medium supply in the Dobreana hill.

For both land parcels the potassium content is very good and the humus content is medium with a value of 3.1%.

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