RESEARCH REGARDING THE FERTILITY CONDITION OF FARM LAND IN ORDER TO IMPROVE SOIL AND PROFITABILITY THROUGH DIFFERENTIAL FERTILIZATION

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Abstract

Nowadays the real problems regarding agriculture are the need of food production in larger quantities and the need of protecting the resources of soil and its fertility. As a consequence, the current trends are increasingly based on the adoption of sustainable agriculture through the implementation of agricultural practices aimed to protect the environment while meeting the nutritional needs of a growing population. The application of chemical and organic fertilizers plays an important role in the process of maintaining the soil productivity and that is the reason why it must be done with discernment. The productivity of the crop depends very much on the degree to which the nutrient requirements of the plants are met, avoiding situations where some elements are in excess or deficit. The researches were conducted in the lands managed by I.I CIUBOTARU BOGDAN, territory of Spineni, Iasi County. In order to determine the state of soil supply in macronutrients accessible to plants, multiple average agrochemical samples were taken from every land parcel of the farm, at the depth range of 0-20 cm using the equipment consisting of ATV HONDA 750 + auger sampler WINTEX 1000. The results obtained identifies the range of variation of the soil reaction, i.e. pH 7.5-8.1, resulting in a slightly alkaline soil reaction. The nitrogen index value on which we evaluate the nitrogen supply status of soils ranging between 2.0–4.3%. The accessible phosphorus content varies between 16-67 ppm, so the level of phosphorus in soil is low to good, and the available potassium content has values between 236-460 ppm, indicating that the soils are very good provided with potassium. Humus is present in a percentage between 2.0 and 4.8%, indicating a wide range of content.

Key words: differential fertilization, macronutrients, soil fertility

Soil degradation is a critical and growing global problem. As the world population increases, pressure on soil also increases and the natural capital of soil faces continuing decline (Andrea Koch *et al*, 2013).

Due to population growth and changing diet patterns, the global demands for food, livestock feeds, and fuel have increased. The increasing demand for land-based goods and services has contributed to global soil degradation and negative ecosystem impacts, adversely affecting global sustainability (Sommer S. *et al*, 2017).

Soil conservation is a vital regulating service, which is defined as the ability of the ecosystem to prevent soil erosion (Zhao W. *et al*, 2017). Terrestrial ecosystems protect soil from water and wind erosion through surface cover and supply humankind with soil conservation service, thus maintaining soil productivity and contributing to human welfare (Liu H. *et al*, 2020; Yin C. *et al*, 2022).

However, soil erosion and land degradation have been intensified due to anthropogenic activities and climate change, especially since the 1990s (Amundson R. *et al*, 2015; García-Ruiz J.M. *et al*, 2015; Jenny J.P. *et al*, 2019).

Soil acidity is one of the most yield-limiting factors for plant growth (Olego M. Á. *et al*, 2021a), with trivalent aluminum being the major cation on the exchange complex when the pH is below 5.5 (Olego M. Á. *et al*, 2021b). Soil acidity correction is, therefore, essential for improved soil fertility and increased crop growth and yield. A crucial need of the hour is to enhance soil fertility as it is key to the growth, productivity, and quality of crops (Nira R. and Miura S., 2019). Soil pH is reported to be the "master soil variable" that influences myriads of soil properties that define the chemistry and fertility of soils for plant growth and biomass yield (Neina D., 2019). Therefore, for a sustainable soil fertility and productivity, it is of paramount importance to apply soil amendments that have the potential to increase soil pH to

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appreciable levels needed to support the soil ecosystem functions and services.

Soil fertility affects plant growth and productivity directly through nutrient supply and indirectly through its influence on root growth and water supply. Interactions between soil fertility and cover crop growth may therefore occur (Blesh J., 2018). Sufficient or high soil fertility supports optimal biomass production and nutrient accumulation in cover crops, which in turn have the potential to enhance soil fertility and functioning (Mortensen E.Ø. *et al*, 2021), while low soil fertility may limit cover crop growth and hence become a barrier to improving soil fertility.

Nowadays, agricultural ecosystems are suffering from increasing anthropogenic pressures and environmental disturbances, such as land use intensification, nitrogen enrichment, climate change and accumulation of pollutants in soils (Cleland E.E. and Harpole W.S., 2010; Trenberth K.E. *et al*, 2014). These longstanding disturbances and pressures can severely impact multifunctionality in agricultural ecosystems through regulating soil microbial community diversity and abundance (Soliveres S. *et al*, 2016; Jiao S. *et al*, 2019). In addition, evidence is mounting that conventional agricultural management practices, such as intensive fertilization, soil tillage and crop rotation, can cause irreversible impacts on microbial community and interactions and their responses to changing environmental conditions (Dai Z.M. *et al*, 2018; Zhang B. *et al*, 2019).

The aim of the research was to determine and present the fertility status of the soil throughout the farm in order to implement future differentiated fertilization according to the supply and needs of crop plants.

MATERIAL AND METHOD

This study was conducted on the lands managed by I.I CIUBOTARU BOGDAN, territory of Spineni, Iasi County and topographically located on the Moldavian Plain.

In order to determine the state of soil supply of plant-accessible macronutrients, humus content and soil reaction (pH) after harvesting the crops, 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 (*figure 1*), 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.

Figure 1 **Soil samples preparation**

Soil reaction (soil pH) was determined by the potentiometric method, in aqueous suspension in a 1:2.5 ratio (soil: distilled water). *Figure 2* shows the limits for soil pH values.

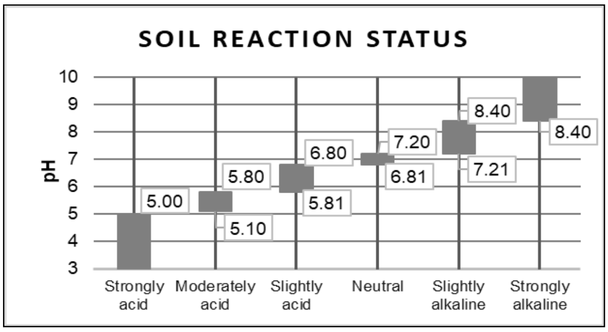

Figure 2 **Soil reaction characterization limits**
(ICPA București, 1981)

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 3*.

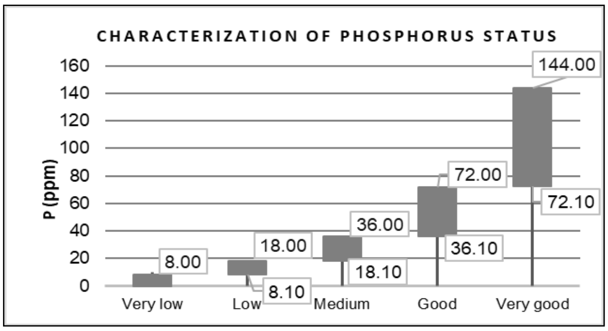

Figure 3 **Soil phosphorus status**
(ICPA București, 1981)

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 4*.

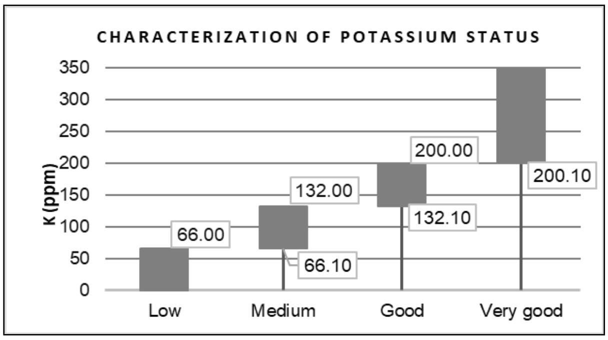

Figure 4 **Soil potassium status**
(ICPA București, 1981)

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 the samples were taken from plots that are located in a large area.

The results obtained identifies the range of variation of the soil reaction, i.e. pH 7.5-8.1, resulting in a neutral to slightly alkaline soil reaction (*figure 5*).

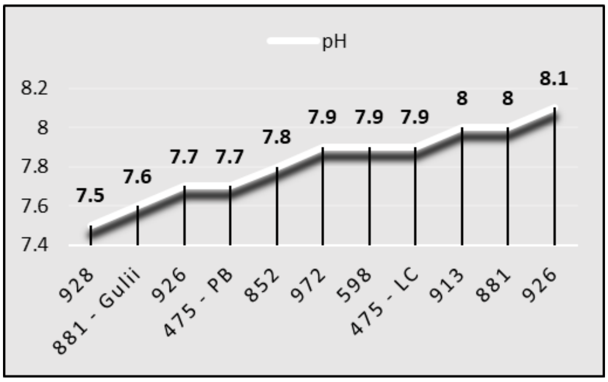

Figure 5 **Soil reaction (pH)**

The pH (*figure 5*) determined presents different values for each physical block, due to the fact that they have different natural fertility within the farm analyzed and also because over the past years, the crop technology applied was different.

Phosphorus values obtained were in a very wide range from the lowest of 16 to the highest of 67 ppm (*figure 6*).

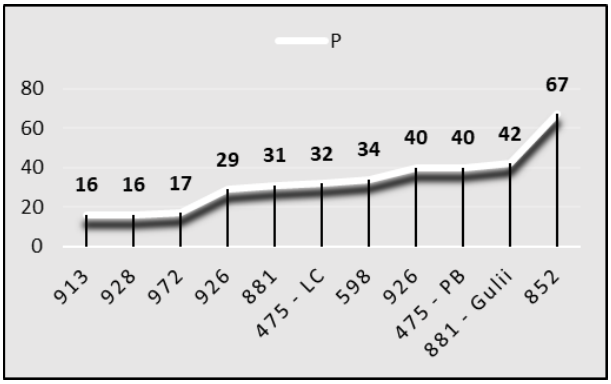

Figure 6 **Mobile P content (ppm)**

According to the results obtained, we observe that the 913, 928 and 972 agrochemical plots have a low phosphorus supply, the 926, 881, 475 - LC and 598 have an average phosphorus supply and that the plots 926, 475 - PB, 881 - Gulii and 852 have a good phosphorus source, which means that there are plots that require special attention in terms of fertilization and others that do not require much additional phosphorus.

By standards, the potassium content is very good on all agrochemical plots, values fluctuated between 226–460 ppm, which is also due to the potassium-rich parent material of the area (*figure 7*).

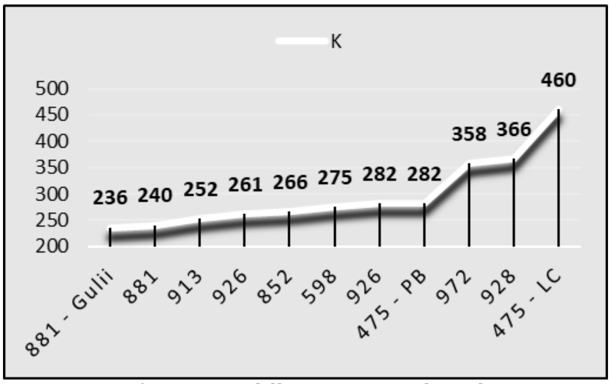

Figure 7 **Mobile K content (ppm)**

Humus is present in a percentage between 2.0 - 4.3%, which indicates a medium, but wide range of content, that generally provides good conditions for plant growth.

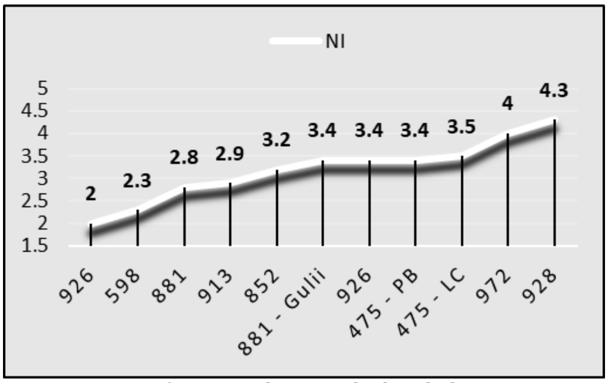

Figure 8 **Nitrogen index (%)**

The nitrogen index values (*figure 8*) according to which we evaluate the soil supply status is between 2,0% and 4,3%. This range indicates a medium nitrogen supply status of soils, correlated with the humus value.

CONCLUSIONS

In this study, we determined and presented the fertility status of the soil throughout the farm in order to implement future differentiated fertilization according to the supply and needs of crop plants.

The results obtained identifies the range of variation of the soil reaction, i.e. pH 7.5-8.1, resulting in a neutral to slightly alkaline soil reaction. The range of pH variation present on the farm land represents the optimum soil reaction in which most crop plants grow and develop normally.

Phosphorus values obtained were in very wide range from the lowest of 16 to the highest of 67 ppm. If fertilizer doses are not correlated according to the degree of supply, excess areas, wasting and pollution can result. In addition, inconsistent application rates will result in economic losses due to inadequate consumption.

Humus content and nitrogen index have normal values in most areas of the plot, indicating a high potential for soil productivity.

Thus, it is recommended to exploit the land according to the state of fertility, with the application of differentiated fertilization for each agrochemical plot, and maintaining a constant degree of periodic evaluation.

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