ASSESSMENT OF SOIL AVAILABLE MACRO AND MICRONUTRIENTS CONTENT AT S.C. EVEL-H COMPANY S.R.L., ROMANIA

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Abstract

In the context of climate change and a growing world population, soil quality assessment is required for food security and for rising the quality of yield and crop production. In order to obtain a sustainable and an efficient production, taking into account the environment, a study was carried out to evaluate the content of accessible macro and micronutrients in plants at S.C. Evel-H COMPANY S.R.L. To evaluate the soil status supply, 12 average agrochemical soil samples from the 0-20 cm depth were taken and analysed. Quantitative analysis of Zn, Cu, Fe, Mn, B, K was performed using a high resolution continuum source, atomic adsorption spectrometer AAS (ContrAA 700, Analytik Jena, Germany) and phosphorus determination was done colorimetrically (Specord 210 Plus). The results obtained reveal an optimal content of macro and micronutrients under the experimental conditions. The trends of the average concentrations of micronutrients were as follows 51.28>18.38>0.9>0.68>0.36 mg/kg for Mn, Fe, Zn, Cu, B, and for macronutrients were S<I.N.<P<K with values 0.027<2.31<142<342. The optimal nutrient ratio ensures a higher yield even if one of the growing factors is at minimum availability and content. Imbalances produced by decreased different nutrient concentrations induce disturbances in plant metabolism manifested by minimizing yield and/or susceptibility to pathogen attack.

Key words: soil, concentrations, micronutrients, macronutrients

Soil is the most important nutrient resource for plant growth and human survival, sustaining crops and human habitation. (Ţopa D. *et al,* 2018).

Agriculture is one of the primary factors of environmental and soil degradation (*Cara et al, 2022*). The main property of soil is fertility, which is the soil's ability to supply plants with water and nutrients and to ensure optimal physico-chemical and biological conditions throughout plant growth phases and development (Jităreanu G. *et al,* 2020).

Macronutrients (Nitrogen (N), Potassium (K), Calcium (Ca), Phosphorus (P), Magnesium (Mg), Sulphur (S), Oxygen (O), Carbon (C) and Hydrogen (H) are nutrients which provide energy to plants and are needed in larger quantities to maintain their growth and development. The most important of these are nitrogen, phosphorus and potassium, which directly affect plant growth. A macronutrient must be applied in the right amount and at the rig[1]ht time, otherwise it can become a pollutant. In addition to macronutrients, micronutrients (Boron (B), Iron (Fe), Chlorine (Cl), Manganese (Mn), Copper (Cu), Zinc (Zn), Molybdenum (Mo) and Nickel (Ni)), are required in very small amounts, but are indispensable to plants and play a vital role in the growth and development of plants (Richardson J.B. *et al,* 2022).

Micronutrients are essential components of enzymes, vitamins, and growth hormones in plants, and their lack or excess can harm plant development and animal life and pose a health risk to humans (Lu I. *et al,* 2015). Micronutrients could be hazardous to organisms, readily poisoning them when micronutrients concentration exceeds the limit that organisms can tolerate (Zhao L. *et al,* 2020).

The application of plant nutrients contributes to manipulating several environmental stresses when applied in a proper manner (*Kumari et al,* 2022). The availability of suboptimal macronutrients and micronutrients retards enzymatic activities and the normal functions of different physiological and biochemical processes *(*Sadeghi-Bakhtavari T. *et al,* 2020*)*. Now, there are several macronutrients and micronutrients considered to be important for the optimum growth, development, and productivity of plants because they are activators and/or cofactors of several physiological and metabolic processes in plants *(*Merwad H. *et al,* 2016*)*. The determination of micronutrients and macronutrients in soil is essential for managing and regulating their concentration for crop health (Ţopa D. *et al,* 2021). Soil nutrient management has an important role in normal plant

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growth and development (Cara I. *et al,* 2022) especially under adverse environmental conditions.

Therefore, a study was carried out to evaluate the content of accessible macro and micronutrients in plants at S.C. EVEL-H COMPANY S.R.L.

MATERIAL AND METHOD

The scientific research was conducted on the land managed by S.C. EVEL-H COMPANY S.R.L. located in Costesti commune, Vaslui County, Romania.

The geographic position is represented by the coordinates: 46°30′01″N 27°45′38″E, and the climatic conditions are shown in *figure 1*.

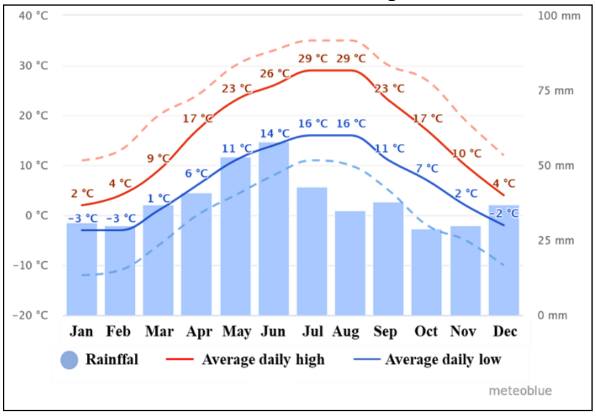

Figure 1 **Climatic conditions in the study area**

The soil is characterized by 2.6% organic matter content (titrimetric dosing - Walkley-Black method in the Gogoasa modification), 16.5 m.e.% total exchangeable bases (extraction with HCl 0.05n), 1.16 m.e.% hydrolytic acidity, 93.5% base saturation and 6.24% total $CaCO_3$ content (gas-volumetric method - Scheibler).

From a pedological aspect (*figure 2*) it is an interfluvial zone, affected by slope processes (surface erosion by water) at the plateau periphery. The S, S-E part is a plain area characterized by slightly degraded cambic cernoziom.

Figure 2 **View of the studied area within topographic plot 809**

The plots 745, 753 represent a plateau area characterized by degraded cambic cernoziom soil.

In the marginal area of the plateau, the N part of the plateau is characterised by moderately to strongly eroded calcareous cernoziom. In the E part of the plateau affected by eolian erosion there is a moderate regraded-eroded cambic cernoziom as in the S-E part (752, 749, 748,750). In the V part of the plateau (marginal area) there is a slight-moderate erosion through water (746).

Fieldwork. The study was conducted in Aug.-Oct. 2022 from topographic plot 809 - cultivated with rape on 38 ha.

To evaluate the soil status supply, 12 compsite agrochemical soil samples were taken from the 0-20 cm depth. Each composite agrochemical sample is composed of 30 subsamples. The soil samples collected were stored in properly labelled plastic containers before taking them to the laboratory for further analysis.

Laboratory internship. After drying, removal of plant residues and grinding, the soil samples were analysed in the laboratories of Research Institute for Agriculture and Environment (R.I.A.E) Iasi, belonging to the Iasi University of Life Sciences, according to the standards.

The pH values were measured potentiometrically in H_2O using a glass electrode.

Available phosphorus is determined by extraction with a solution of ammonium lactate acetate (AL) at pH 3.75 by Egnér-Riehm-Domingo method, and determined colorimetrically with molybdenum blue by the Murphy-Riley method - reduction with ascorbic acid (STAS 7184/19-82).

Available potassium is also determined in ammonium acetate-lactate extract at pH 3.75, determined by the Egnér-Riehm-Domingo method using the atomic absorption, flame technique - CONTR AA 700 (STAS 7184/18-80).

The nitrogen index (NI%), according to which we assess the nitrogen (N) supply status of soils based on humus and base saturation.

NI = H x BS% / 100, where: H% = humus; BS% = base saturation.

Micronutrient extraction: weighed 5 0±.0001 g soil in a plastic bottle and added 50 mL extraction solution CH_3 $COONH_4$ 1n and EDTA-H_2 0.01n at pH=7 shaked (GFL orbital shker, room temperature, 350 rpm). Suspensions shaked for 120 min and then were filtered. Quantitative analysis was performed using a high resolution continuum source, atomic adsorption spectrometer AAS (ContrAA 700, Analytik Jena, Germany) (figure 3).

All reagents and chemicals used in this study were analytical grade and prepared by using high purity deionized water obtained from a Milli-Q water purification system.

Figure 3 **Micronutrients extraction with atomic adsorption spectrometer**

RESULTS AND DISCUSSIONS

Nutrient elements are crucial to sustaining the growth, metabolic activities and physiological functions of plants. The most significant influence of pH on plant growth is its effect on the availability of soil nutrients. Table 1 shows the results of the determinations and the interpretation of the pH and macronutrient values of the samples analysed.

Figure 4 shows the results of the determinations and interpretation of the pH values of the analyzed samples. The pH varies between 6.1 and 8.1, resulting in a slightly acid to slightly alkaline soil reaction.

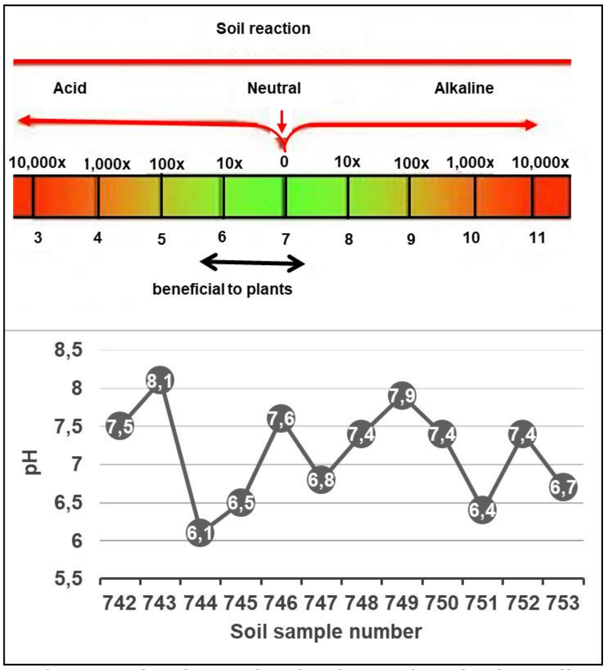

Figure 4 **The determined values of pH in the soil samples**

Nitrogen is maximum available at pH values between 6-8 because this is the most favourable environment at which most soil microorganisms mineralize soil organic matter or synthesize atmospheric nitrogen.

The assessment of the nitrogen supply status of plants is influenced by the content of organic matter in the soil, which stores more than 80% of the total nitrogen stock in the layer analysed.

Under the action of soil microorganisms, mineralisation of organic matter takes place, with release in the form of ammonia (the ammonification process), which is then oxidised and transformed into nitrates (the nitrification process), both forms accessible to plants and easily leachable, especially the second form which is not fixed in any mineral or organic compound in the soil. This process, by which nitrogen is strongly leached, makes it difficult to assess the potential nitrogen supply of plants, which requires the calculation of a synthetic index (N.I. - nitrogen index). The nitrogen index helps to differentiate organic fertiliser rates. The nitrogen index value indicates the nitrogen supply status of soils of 2.3, which correlated with the humus value indicates a medium nitrogen supply status of soils (*table 1*).

Phosphorus is maximum available at pH values of 6.5-7.5. A decrease in pH <6.5 is associated with higher values of iron and aluminium in the soil solution. The available phosphorus content varies between 53 and 283 ppm P_2O_5 (*figure 5*). According to the results obtained, 10 out of 12 agrochemical plots had very good supply status, except for plots 744 and 751 which had good supply (53 ppm). P plays a part in energy transfer as an essential ingredient for nucleic acids, sugar phosphates and lipids.

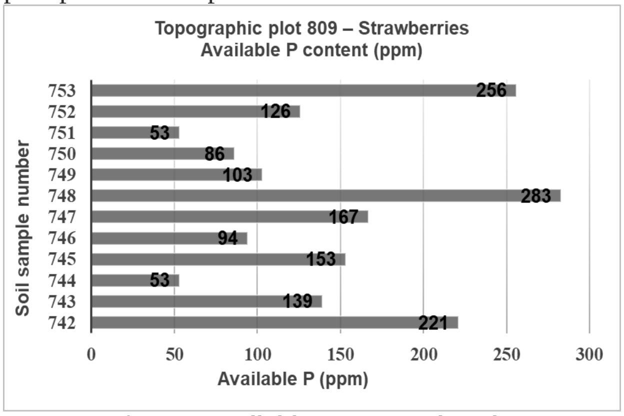

Figure 5 **Available P content (ppm)**

Potassium is highly available in alkaline soils. As soil acidity increases these elements become less available. Within this plot, the available potassium content has values between 172-499 ppm K, indicating that the soils have good to very good available potassium status (*figure 6*).

Table 1

pH and macronutrient values of analysed samples

	pH		N.I. (%)		Available P (ppm)		Available K (ppm)		S (%)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Value	6.1	8.1	2.25	2.38	53	283	172	499	0.023	0.032
Status	slightly acid	slightly alkaline	medium		good	very good	good	very good	low	
Average	**7.15**		**2.3**		**145**		**342**		**0.027**	
Status	**neutral**		**medium**		**very good**		**very good**		**low**	

The trend of concentrations with very good supply status was 499 > 479 > 463 > 442 > 409 > 400 > 293 > 283 > 258 > 203 ppm for plots 742, 748, 753, 743, 746, 747, 752, 745, 750, 749, and plots 744 and 751 had good supply status.

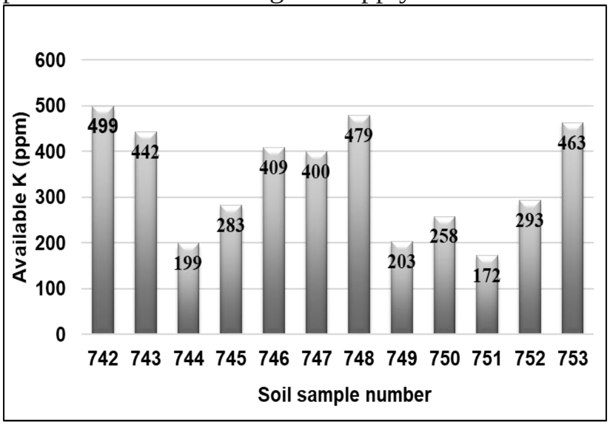

Figure 6 **Available K content (ppm)**

Soil is the main source of microelements for plants, except in situations of large atmospheric deposition or from flooding by contaminated waters.

The trends of the average concentrations of micronutrients were as follows 51.28 > 18.38 > 0.9 > 0.68 > 0.36 mg/kg for Mn>Fe>Zn> Cu> B (*figure 7*). The 753 plot had the highest microelement content except for manganese.

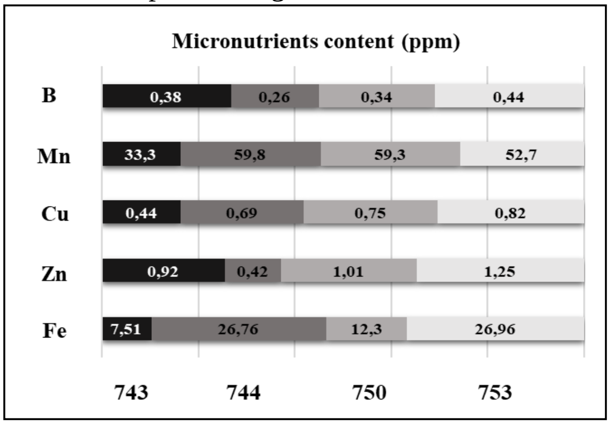

Figure 7 **Micronutrients content (ppm)**

CONCLUSIONS

This study focused on determining pH values and assessment of nutrient availability from topographic plot 809- Strawberries.

Soil nutrient status represented by macro- and micronutrient content was quite variable in all study plots. The optimal nutrient ratio ensures a higher yield even though one of the growing factors is at minimum availability and content. Imbalances produced by decreased different nutrient concentrations induce disturbances in plant metabolism manifested by minimizing yield and/or susceptibility to pathogen attack.

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

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