INFLUENCE OF SLOPE ASPECT ON THE SOIL MACRONUTRIENTS ON THE MOLDAVIAN PLAIN

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Abstract

Current trends are increasingly based on the adoption of sustainable agriculture, through the implementation of farming practices designed to protect the environment and at the same time ensure the food needs of a growing population. The rational application of fertilizers and liming materials in agriculture is one of the most important practical technological actions that efficiently exploit the roles of fertilizing elements and substances in crops. In the current concept, the application of chemical and organic fertilizers must be done with discernment, depending on the specific local soil conditions, its nutrient supply, the nutrient requirements of the plants and the expected yields. The benefits of nutrients in chemical fertilizers are evidenced by their quantitative participation in biomass production and their specific roles in essential plant metabolic processes. The researches were conducted in the lands managed by S.C. FARMBĂLȚAȚI S.R.L., located on the territory of Balțați commune, Iasi County. In order to determine the state of soil supply in macronutrients accessible to plants, 4 average agrochemical samples were taken from the depth range 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 6.9-8.0, resulting in a neutral to slightly alkaline soil reaction. The nitrogen index value on which we evaluate the nitrogen supply status of soils ranging between 1.4–3.9%. The accessible phosphorus content varies between 16-29 ppm, so the level of phosphorus in soil is low to medium, and the available potassium content has values between 247-299 ppm, indicating that the soils are very good provided with potassium. The highest value of humus content is 3.9%, indicating a medium content.

Key words: soil fertilization, sunflower, slope of land, macronutrients

Due to population growth and changing diet patterns, the global demands for food, livestock feeds, fiber, 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 *et al*, 2017).

Soil is the foundation of agriculture and it has provided humans with the ability to produce food for our sustenance (Bouma, 2014; Keesstra *et al*, 2016).

Accurate and quantitative soil resource information can be used to assess potential agricultural productivity, and to develop sustainable agriculture and soil management (Bouma, 2014).

The effects of soil degradation processes on soil productivity are gradual and are mainly due to wind and water erosion processes (Hjelm and Dasori, 2012).

Liming of soil can be used to increase soil pH and can enhance the benefits provided by inorganic fertilizers (Chimdi *et al*, 2012). Studies have found that the application of lime increases soil pH and can improve crop yields (Getachew *et al*, 2017). Low soil fertility and inefficient

Soil management technologies effectively decrease soil erosion and maintain soil productivity (Garbrecht *et al*, 2015).

Soil erosion destroys the soil structure, leads to soil loss, reduces soil fertility and productivity, and exacerbates the scarcity of land resources (Chen *et al*, 2017, Li *et al*, 2021).

Using soil fertility management technologies is necessary to improve farm productivity, reduce poverty, and address challenges due to climate change (Katengeza *et al*, 2019).

Erosion affects soil fertility by removing together with eroded soil significant humus content and mineral elements (Bucur *et al*, 2007).

Effective soil fertility management improves soil properties, including soil organic matter, which ensures the sustainability of soil functions that are critical in maintaining agricultural productivity (Powlson *et al*, 2011).

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management of soils have been the major challenges facing productivity among smallholder farmers in many developing countries in general (Adekunle *et al*, 2017).

In a smallholder mixed farming system, the loss of soil fertility results from, soil erosion and excessive nutrient mining through complete crop harvest for food, animal feed and fuel, without adequate replenishment (Tolessa *et al*, 2001; FAO, 2017; Mekuanint *et al*, 2020).

Unfortunately, inorganic fertilizer used as major soil nutrient management is unsustainable, causing soil degradation and environmental pollution and its increased prices make it unaffordable for many farmers (Byerlee *et al*, 2007; Adekunle *et al*, 2017).

The slope position affects soil nutrients by influencing the amount of solar radiation, wind speed, and the movement of soil particles and water (Sariyildiz *et al*, 2005, Nahidan *et al*, 2015).

The slope aspect can significantly affect the six forms of nitrogen found in soil and their proportions North-facing slopes usually have lower temperatures, higher soil moisture contents, higher soil nutrient contents, and more vegetation cover than south-facing slopes (Huang *et al*, 2015).

The aim of the present study was to highlight the influence of slope aspect on the supply status of macroelements, humus content and on soil reaction.

MATERIAL AND METHOD

The study was conducted in the lands managed by S.C. FARMBĂLȚAȚI S.R.L., located on the territory of Balțați commune, Iasi County, and from a geomorphological point of view, they are located in the Moldavian Plain.

Topographic plot 363-Trestiana from land parcel 2098, cultivated with sunflower on an area of 25 ha, presents in the upper part a plateau zone, in the middle part a convex slope - moderately to strongly eroded, and in the lower third the deposition of humiferous material occurs, resulting in a cumulate layer.

It is important to note that within the topographic plot, the farmer applies the same crop technology over the whole area. Thus, in order to determine the state of soil supply in macronutrients accessible to plants, humus content and soil reaction (pH), after harvesting the sunflower crop, 4 agrochemical samples were taken from the depth range 0-20 cm on the basis of landforms and soil types. Each average agrochemical sample is composed of at least 30 partial samples. These were taken using the equipment consisting of ATV HONDA 750 + auger sampler WINTEX 1000. Subsequently, 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 soil reaction (soil pH) 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 characterization 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
> 8.40	strongly 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 by the Murphy-Riley method - reduction with ascorbic acid (STAS 7184/19-82). The characterization of the phosphorus supply status is made according to *table 2.*

Table 2

Soil phosphorus status

(ICPA București, 1981)

P (ppm)	Characterization 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 Egnér-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)	Characterization of potassium status
< 66.0	low
66.1 – 132.0	medium
132.1 – 200.0	good
>200	very good

The humus content (H%) was determined by calculation, based on organic carbon, and the nitrogen index (NI%), according to which we assess the nitrogen (N) supply status of soils based on humus and base saturation. The nitrogen index helps to differentiate organic fertilizer rates, as they are inversely proportional to the NI (doses decrease as the NI value increases).

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

where:

H = humus;
BS% = base saturation.

RESULTS AND DISCUSSIONS

To highlight the differences between the agrochemical samples, it should be noted that samples 349 and 350 were taken from the plateau area (slope <5%), 351 from the base of the hillslope (slope 5–8%) and 352 from the upper part of the slope.

The results obtained identifies the range of variation of the soil reaction, i.e. pH 6.9-8.0, resulting in a neutral to slightly alkaline soil reaction *(figure 1).*

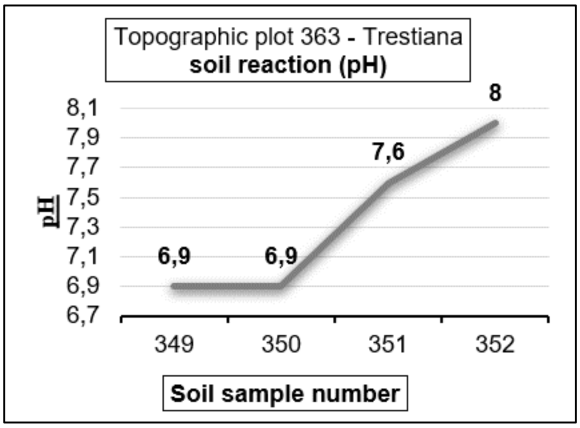

Figure 1 **Soil reaction (pH)**

Regarding the soil reaction in the plateau area, it is neutral (pH 6.9) for both agrochemical plots (349, 350).

In the upper part of the slope, affected by erosion, the pH is slightly alkaline (pH 8) due to removal of the fertile layer caused by the phenomenon of erosion and the presence of calcium carbonate-rich layer close to the soil surface.

In the lower part, the pH value of 7.6 is attributed to the migration of the soil horizon containing calcium carbonate from the eroded area and accumulation at the base of the slope.

Phosphorus values ranged from 16 to 29 ppm *(figure 2).*

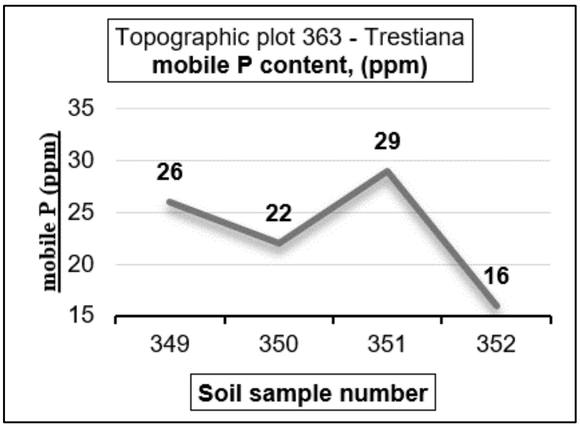

Figure 2 **Mobile P content (ppm)**

According to the results obtained, we observe that 3 out of 4 agrochemical plots have a medium phosphorus supply, except for the plot with the highest slope (8-12%), where we identify a lower value of plant accessible phosphorus due to its rain runoff, being a low mobility nutrient.

By standards, the potassium content is very good on all agrochemical plots, values fluctuated between 247–299 ppm, which is also due to the potassium-rich parent material of the area (figure 3).

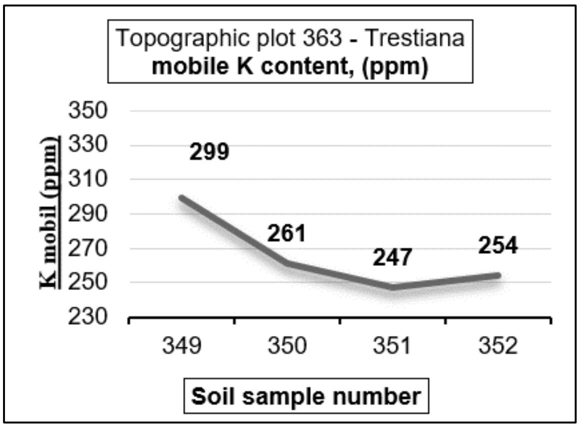

Figure 3 **Mobile K content (ppm)**

In the plateau zone, for samples 349 and 350, the nitrogen index value is 3.3%, indicating a medium nitrogen supply status. The value of nitrogen index for sample 352 is 1.4% (low nitrogen supply) due to accentuated slope and the migration of the fertile layer, deposited at the base of the slope, which is shown by the increase of NI value (3.9%) in that area.

CONCLUSIONS

In this study, we analyzed the influence of slope aspect on the supply status of the main macroelements, humus content and on soil reaction from topographic plot 363–Trestiana.

Regarding the soil reaction in the plateau area, considered as the reference, it is neutral and in the sloping area, i.e. moderate-eroded soil, the pH becomes slightly alkaline as a result of erosion leading to the loosening and downward migration of the fertile layer.

By analysing the main nutrient content of the four agrochemical plots, it can be observed that in the area with the steepest slope, these have the lowest values, also due to the removal of the surface horizon, except for the content of mobile potassium, which is also available to the plants from the parent material.

Humus content, i.e. nitrogen index, is also influenced by slope and soil erosion conditions, showing normal values in the plateau area and lower values in the eroded area.

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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