Theme 4
Governance of soil fertility/soil nutrients

Peculiarities of cation exchange capacity of agricultural soils of Kakheti region (Georgia)

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INTRODUCTION

Cation exchange capacity (CEC) and base saturation (BS) are one of the important characteristics of a soil, which affect its physical, chemical, physico-chemical properties and, consequently, the level of fertility.

It is important to consider CEC in agricultural practice, as this parameter is closely correlated with soil texture and organic matter. BS is a criterion for soil leaching [1].

The aim of our work was to determine the peculiarities of CEC composition in soils under different climate and land use conditions in Kakheti region and correlation of exchangeable Ca and Mg concentrations with organic matter (OM) and texture, and evaluation of soils according to the exchangeable Ca/Mg ratio.

METHODS

Soils of different farms in municipality of Kakheti region under moderately humid (Kvareli) and dry (Sighnaghi, Dedoplistskaro, Sagarejo, Akhmeta, Telavi) subtropical climate conditions. In total 16 sites were assessed in each climatic zone. Composite soil samples were taken at depths of 0-30 and 30-60 cm.

Soil samples were analysed for basic soil parameters: soil texture by sedimentation using pipette method; soil pH in aqueous solution using 1:2.5 ratio by potentiometric method; Total organic matter content by dry combustion method [1]; Exchangeable cations content on atomic absorption spectrometer in extracts of barium chloride solution [2].

RESULTS & DISCUSSION

The results showed that under moderately humid subtropical climate of Kakheti region, the sum of exchangeable Ca and Mg at the depth of 0-30 cm of the study soils is 14.35-51.45 cmol (+) kg-1, while OM varies in the range of 1.69-6.86%. The content of physical clay fraction (<0.01 mm) varies from 32 to 73%, and in case of its maximum content, the highest content of exchangeable cations is observed, indicating a direct correlation between them (Fig. 1).

In soils with a relatively light texture and pH <7, a tendency to reduce the number of individual cations is observed. The ratio of calcium to magnesium indicates on magnesium deficiency (> 10). The optimal ratio of exchange cations (4-6), so balanced condition, is detected in a single location in Kvareli, while low magnesium (6-10) is the most common.

Fig. 1. Correlation between soil characteristics in humid subtropical region

	pH (H_2O)	OM	Ca^{2+}	Mg^{2+}	CEC	Phys. Clay
pH (H_2O)	1					
OM	0.457	1				
Ca^{2+}	0.837	0.730	1			
Mg^{2+}	-0.176	0.409	-0.104	1		
CEC	0.828	0.765	0.997	-0.030	1.00	
Phys. Clay	0.438	0.765	0.767	0.385	0.800	1

Under the dry subtropical climate of Kakheti region, at a depth of 0-30 cm exchangeable Ca is very high (24.44-63.61 cmol (+) kg^{-1}), which also shows an increased amount of OM, the concentration of exchangeable Mg is mostly average and high; At a depth of 30-60 cm in the soil, concentration of exchangeable cations is reduced in most cases. The high concentrations of exchangeable cations are directly correlated with the high content of OM and physical clay fractions (Fig. 2). In heavy-textured soils exchangeable Ca+ Mg>50 cmol (+) kg^{-1}.

The percentage of exchangeable calcium is quite high compared to that of magnesium; Magnesium deficiency (Ca/Mg>10), low exchangeability of magnesium (Ca/Mg - 6-10) and optimum exchangeable cation content (Ca/Mg - 4-6) are rarely observed for almost all sites.

Fig. 2. Correlation between soil characteristics in dry subtropical region

	pH (H_2O)	OM	Ca^{2+}	Mg^{2+}	CEC	Phys. Clay
pH (H_2O)	1					
OM	-0.852	1				
Ca^{2+}	-0.480	0.500	1			
Mg^{2+}	-0.182	0.384	0.430	1		
CEC	-0.461	0.502	0.990	0.536	1	
Phys. Clay	-0.404	0.624	0.758	0.768	0.803	1

CONCLUSIONS

- The tendency of increasing calcium and magnesium sums is conditioned by the relatively high content of physical clay and OM;
- Soils with relatively low pH and more leaching conditions, content of exchangeable calcium is decreased;
- The variability of exchangeable cations is associated with change in OM and clay content.
- The most of the study soils suffer from magnesium deficiency.

REFERENCES

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