Examination of chemical and physical properties of halomorphic soils in the Surčin area– Republic of Serbia

Radmila Pivić[1], Aleksandra Stanojković-Sebić[1], Zoran Dinić[1], Jelena Maksimović[1], Darko Jaramaz[1], Grujić Tara[1], Dragana Vidojević[2]

[1] Institute of Soil Science, Belgrade, Serbia
[2] Ministry of Environmental Protection, Serbian Environmental Protection Agency, Belgrade, Serbia

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Introduction, scope and main objectives

Halomorphic soils, as stated in a recent survey (Škorić, Filipovski, Ćirić, 1985; Miljković, 1996) are divided into three classes: the class of saline soils–solonchak type of soil, the class of alkalized soils–solonetz type of soil, and the class of dealkalized soils–solod type of soil. This research was conducted in the area of the Surčin municipality, CM Petrovčić and CM Progar, Belgarde city, in order to determine its suitability for intensive agricultural production on saline soils as stated in a recent survey (Group of authors, 2019). According to pedological map of the Republic of Serbia, in the area of CM Petrovčić, of 2086 ha of agricultural soil, 34.88 percent belongs to solonchak and solonetz soils, while within CM Progar, of 3587.24 ha of agricultural soil, 8.24 percent belongs to mentioned soil types. Saline soils are used mainly as pastures and meadows with very low grass yields and less often as arable soils. On these soils (Belić, Nešić and Ćirić, 2014), agricultural production is difficult and depends on the method of cultivation and agricultural techniques, the distribution of moisture during the year, and the selection of appropriate crops that can thrive in the given conditions.

Methodology

Composite soil samples at pre-determined locations (CM Petrovčić–104 locations, CM Progar–21 locations) were taken in disturbed condition from a depth of 0–30 cm, according to standard sampling methods and available professional literature. In the prepared soil samples, the following analyzes were performed: granulometric composition (%) of the soil, by the combined sieving and pipette method, after preparation with Na pyrophosphate (JDPZ, 1997); pH in 1M KCl and H_2O–potentiometric; $CaCO_3$ (%)–volumetric; P_2O_5 (mg/100 g)–spectrophotometric; K_2O (mg/100 g)–flame photometric; total carbon and nitrogen content (C, N, %), using CNS Analyzer; humus (%)–by calculation from total C; electrical conductivity (EC, μS / cm)–conductometric; hydrolytic acidity (TS, cmol/kg) and the sum of base cations (S, cmol/kg)–by the Kappen method; total cation adsorption capacity (CEC, T, cmol/kg)–by calculation; degree of saturation with base cations (V, %)–by calculation; ion balance (Na, mekv/L)– flame photometric; Ca^{2+} and Mg^{2+}–spectrophotometric; SAR (Sodium Adsorptio Ratio)–computational (JDPZ, 1966; Jakovljević, Pantović and Blagojević, 1985; Džamić, Stevanović and Jakovljević,1996).

Results

The presence of total sand, silt and clay soil fractions indicates a relatively uniform texture composition, where 94– 98 percent of the samples belong to the texture class of light clays. A more unfavorable ratio of total sand: clay fractions is noticeable, where the clay fraction dominates.

The largest number of tested samples has a strongly acidic, moderately acidic and acidic reaction. The soils are moderately provided with total N whose value is in the range of 0.12 to 0.41 percent, which makes 80–85 percent of the samples. Humus supply ranges from 1.82 to 4.59 percent and is present in 97–98 percent of the examined samples. In relation to P_2O_5 content, the largest number of samples taken from the area of CM Petrovčić has a very low P_2O_5 content, which makes 94 percent of the samples, while in the area of CM Progar this amount is 77 percent. In relation to K_2O content,

the largest number of samples (80 percent), taken in the area of CM Petrovčić, is moderately provided, while 11 percent of samples have high K_2O provision. In the area of KO Progar, the largest number of samples is moderately (61 percent) to highly (28 percent) provided with K_2O.

Ninty-two–ninty-eight percent of the analyzed samples are carbonate-free and have these values below the detection limits. The determined values for EC are in accordance with the obtained values for pH and $CaCO_3$.

The values of the soil adsorption complex parameters indicate the highest representation of samples with moderately saturated and moderately unsaturated base cations (85–87 percent). Na^+ content is low in all soil samples and ranges from 0–1 meq/L. In accordance with this, the SAR values were obtained, which are also very low in all tested samples.

Discussion

Based on the conducted examinations, the basic indicators of characteristics of solonchak and solonetz were obtained. Since the examined area is mostly flat terrain, swamps often occur. The conversion of solonchak into arable soil should include eliminating the causes of soil salinization (lowering saline groundwater below the critical depth, application of chemical ameliorative measures, leaching of salt from the soil profile using various measures such as drainage, irrigation, etc., ameliorative fertilization with organic and mineral fertilizers). Salt leaching can also have negative consequences, such as deterioration of the structure, reduction of the amount of humus and nutrients, which should be taken into an account by applying appropriate agrotechnical measures. The time required for soil reclamation of solonetz depends on climatic conditions, applied reclamation measures, as well as the degree to which its properties are to be improved, then, on the classification of solonetz type according to salt content, lime content, reaction of the environment and possibilities of individual soil horizons.

Conclusions

Due to the unfavorable water-air regime on the examined soils, agricultural production is limited and the yields are uneven. Permanent results of saline leaching can generally only be ensured by the application of appropriate drainage. The efficiency of the drainage system can be enhanced by the application of the so-called "biological drainage" by growing trees along irrigation canals and roads, planting protective belts, growing grass, crops, etc. The application of reclamation measures must be based on the specifics of the area such as climatic factors and they include the application of chemical reclamation measures, scattering compacted and monolithic Bthorizon, installation of drainage and open canal network, irrigation, ameliorative fertilization with organic and mineral fertilizers and cultivation of appropriate plant species.

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