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SOME METHODS OF IDENTIFYING SURFACES WITH COMPACT SOILS FROM RESIDENTIAL AREAS

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Abstract

Healthy soils are good for sustainable landscape and for the environment protection. Its protect wildlife, allow water infiltration, reduces soil erosion, allow carbon sequestration from the atmosphere, ensure the growth of trees. These functions are disturbed if the soil drainage is not ensured due to the strong compaction or to the presence of artefacts (bricks, concrete, plastic and others). Frequently, the soils in the individual gardens are highly compact in the underlying layer at about 20 cm deep. Top soil is usually loose because the setting up of the gardens in the residential buildings occurs by levelling of land surface and cover it with fertile soil brought from other locations. After carrying out field investigations we found that the fertile soil material used to cover the land surface is not sufficient to ensure growth of all species in individual gardens. The results obtained during the investigations made it possible to develop a useful diagram for the identification of the owners of the dwellings and the gardens of the areas where the soil properties are deficient and some measures necessary to reduce the restrictions for plant growth.

Key words*: residential area, diagram, compacted soils, identification.*

INTRODUCTION

The development and improvement of the urban horticulture is one of the current demands of residents and communities from residential area. The benefits of urban gardens and green spaces are also included control urban temperatures (i), offers favourable conditions for wildlife (ii); improve human health (iii) etc.

Achieving sustainable landscapes in individual gardens could be done only if the soil is kept loose, healthy (without pathogens), well supplied with nutrients and without pathogens contaminants. Soil in individual gardens must also ensure organic matter recycling, rain or irrigation water retention for continuously supply of plants, vigorous root system development, water infiltration and, last but not least, plant protection against pathogens.

For communities interested in gardening on a site, it is usefully to know the characteristic of the soil.

For residential area it is very important to test soil characteristics such as pH and nutrient availability, state of compactness etc. In order to create green spaces in residential areas it is also required to take into consideration the site's land use history and test the soil accordingly for potential contamination.

Soil compaction in the residential areas occurs during construction cutting and filling operations, general grading works, and other processes of running heavy equipment over the soil. After construction, soil compaction can occur with site activities such as walking, sports, and even parking heavy vehicles on grassed areas.

The strong compaction of soil causes a considerable decrease in the rate of infiltration of water into the soil. It should be noted that the root systems of plants are not symmetrical and are not a "mirror image" with the aerial part of the trees. In compacted soil a "pancake" type root system will be evident. Trees with a "pancake" type root system have not roots in a well-known shaped root ball, root growth. In compacted soil roots spread up to more than three times the diameter of the tree crown. Compaction also appears to decrease tree establishment, as roots are unable to penetrate dense soils encountered beyond the planting hole. This dramatically also reduces shoot growth (Malerechera et al., 1991; George et al., 2014; Filipov et al., 2019).

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MATERIALS AND METHODS

The studied sites are located in the residential area of Iasi city (North East of Romania).
We studied several locations in the urban area of Iasi. In each location we studied topography and realized several soil profiles.
The representative soil for the studied area is Haplic Chernozems (Figure 1).

Figure 1. Haplic Chernozems with high biological activity

The choice of the location of the soil profiles was made according to the following criteria: uniformity of soil surface color (i); soil crusting susceptibility (ii); uniformity of the wetting strip after drip irrigation (iii); the growing stagnation of plants (iv); and the uniformity of root distribution (vi). The presence of the artefacts was also taken into account. In determining the locations we also took into account the instructions within Soil Survey Methodology (Florea et al., 1987).
The studied soils have been diagnosed according to the Romanian System of Soil Taxonomy (Florea et al., 2012) and World Reference Base for Soil Resource (WRB, 2014). Characterization of soil profiles was done following the instructions from guidelines for soil and land descriptions (Munteanu, 2009; Guidelines for soil description FAO, 2006).
Soil samples were taken from each pedogenetic horizon in order to conduct laboratory analyses: according to the current methodology (Dumitru et al., 2009; Lacatusu et al., 2017).
Following the processing and analysis of the data obtained in the field and laboratory, we develop a useful diagram for the identification of the owners of the dwellings and the gardens of the areas where the soil properties are deficient and some measures necessary to reduce the restrictions for plant growth.

RESULTS AND DISCUSSIONS

Our studies regarding on the establishment of some criteria for identifying surfaces with compact soils from residential areas were made in residential areas of Iasi.
The representative soil of the studied region is a Cambic Cernoziom Chernozem (after Soil Taxonomy System of Romanian Soils - 2012) or a Haplic Chernozems (after World References Base for Soil Resources-WRB, 2014).
In most cases, in the studied residential area there are several types of soil even on small areas around buildings. Within the studied location was also frequently identified Urbic Technosols, Ekranic Technosols, Humic Technosols etc.
The soil survey of disturbed soil in urban area has certain peculiarities compared to soil survey of undisturbed soil.
Disturbance of urban soil properties occurs through cutting, filling (Figure 2), compaction (Figure 2) insignificant residential areas.

Figure 2. Covering the surface of the land with subsoils material followed by strong compaction

In our studies we frequently find high proportion of artefacts (Figure 3) such as bricks, concrete, bricks, concrete, pieces of iron, nails.

Figure 3. Strong compacted soil with artefacts and stones

In frequent cases, after finishing the buildings, the soil is levelled and covered with humiferous soil material. Input of good soils does not remove plant restrictions of soil covered with a fertile layer of soil. In the first stage the plants can develop in the imported soil, but later the growing stalling or even dried. In the first stages the plants can grow in the imported soil, but later the growth is slowed down or even the plants dry out.

After construction, soil compaction can also occur with site activities such as walking, sports, and even parking heavy vehicles on grassed areas.

Identifying areas with poor soil for plants and establishing limiting properties for growing plants are useful for a successful landscaping.

After carrying out field investigations we found that the fertile soil material used to cover the land surface is not sufficient to ensure growth of all species in individual gardens. The results obtained during the investigations made it possible to develop a useful diagram (Figure 4) for the identification by the owners of the dwellings and the gardens of the areas where the soil properties are deficient and some measures necessary to reduce the restrictions for plant growth.

The required input data in order to identify area with where the soil properties are deficient for plant growing are uniformity of soil surface color, soil crusting susceptibility, uniformity of the wetting strip after drip irrigation, the growing stagnation of plants, uniformity of root distribution etc.

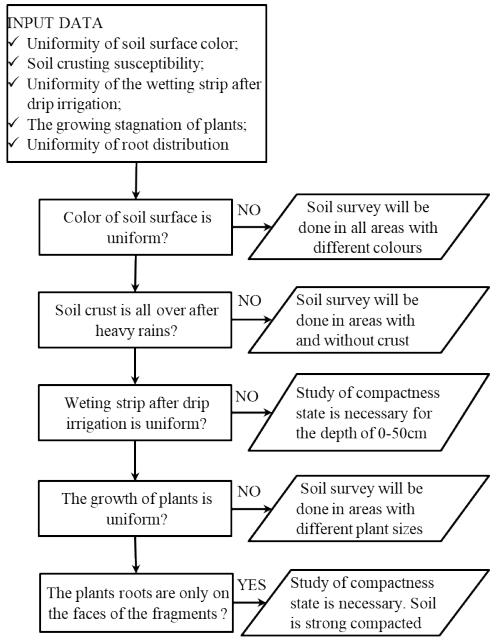

Figure 4. Flowchart for the identification area with possible restriction for plants growth

If the areas delimited according to the criteria in the diagram (Figure 4) are common for

several restrictions, then a larger study is made corresponding to all the limiting factors for plant growth.
In the cases where after the application of drip irrigation, the width of the wet band from the soil surface extends in some places, then we consider that the soil is compact and prevents water infiltration.
The restoration of compacted soils on the depth of 0-50cm could be done by the spading works and incorporation of the plants stems fragments (Figure 5).

Figure 5. Reclamation works of the strong compacted Urbic Technosols by soil loosening and incorporation into the soil of the plant stems for providing vertical drainage

The incorporation of plant stems fragments in the soil layer on the depths 20-50 cm will gradually improve the internal drainage of the macro pores that will result after decomposition of the organic matter.
The stages of improvement of the highly compacted consist of the loosening and removing of the soil of a strip of 1m and depth of 0-20cm (i), the loosening of the soil on the depth of 20-50 cm and the incorporation in the vertical or slightly oblique position of the fragments of plant stems (ii), covering the loose soil layer with the soil that was initially removed from the depth 0-20cm (iii), covering with a fertile soil layer of a thickness of 10-15cm.

CONCLUSIONS

After carrying out field investigations we found that the fertile soil material used to cover the land surface is not sufficient to ensure growth of all plants in individual gardens.
We develop a useful diagram for the identification of the owners of the gardens of the areas where the soil properties are deficient and some measures necessary to reduce the restrictions for plant growth.
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