SOME PHYSICAL PROPERTIES OF VERTIC SOILS FROM PODRIGA-BODEASA AREA

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Abstract

On interfluvial Podriga Bodeasa predominates soils with fine texture such as Vertisols and vertic soils. The presence of these soils is associated with formation of the gilgai micro-relief consisting of small mounds and depressionsAlthough the Eastern part of Romania gilgai micro-relief characteristic of the rivers plains with salinized soils. The gilgai micro-relief was noted in the platforms of sliding slopes and valleys Podriga Bodeasa. Vertisols and vertic soil, associated with gilgai micro-relief, strong shrink in dry season. After soil drying some vertical oblique and horizontal cracks are forming. Non-uniformity of water distribution increase due to more intense evaporation of water in marginal areas polyhedron bounded by cracks. Heterogeneity of moisture is evident in underlying horizons or the arable layer or under soil layer resulted after self-mulching processes. One of the reasons given soil moisture heterogeneity even within the same soil horizon is due to preferential water movement through fissures and cracks formed in the dry and hot season of the year. After drying and contracting processes are changed compactness state of soil.Penetration resistance increases considerably in marginal areas of polyhedron bounded by cracks. In the central area of polyhedron recorded the lowest values of resistance to penetration.

Key words: water distribution, gilgai microrelief, shrinking - swelling

In many soil clasifications, such as World reference base of soil resources (2014), USDA soil taxonomy, Romanian System of Soil Taxonomy a vertisol (Vertosol in the Romanian System of Soil Taxonomy and Australian Soil Classification) is a soil in which there is a high content of expansive clay known as smectite.

There are manumore familiar name of this soil such as *black earths* in Australia, *black gumbo* in East Texas, *black cotton soils* in East Africa, morogan, karasuluc, smolnitza, compacted chernozems in Romania, Terra negra in Italy, Teras negra de Andalucia in Spain, Terros Negras Tropicais in Mozambic, Terra Negras plastic in South America. (Story C.G., 1970; Paltineanu C. *et al*, 2003). The popular names given to vertic soils in different countries shows that these have a dark color (black) and show essentially deep soil profiles.

Vertisols are called by farmers the lunchtime soil. These soils could be too wet to cultivate in the morning, too dry in the afternoon and have good workability at the lunchtime. In Romania these soils are called by farmers soils of 5 minutes or soils of 12 o'clock. These names confirm that the optimum time for soil cultivation is very short. Vertisols are friable only over a narrow range of moisture content and tillage is difficult, excepting a short period during the transition from wet soil to the dry.

It can be said that Vertisols belongs to the lithomorphic soils group. Vertisols genesis is conditioned by the parent material with a high content of swelling clay minerals from the group of smectites.

The dominance of smectite or montmorillonite minerals in the parent material favors high shrink-swell potential. The mineral particles are able to adsorb high content of water, both on the surfaces particles and between inter-layers (Craciun C, 2000). After Anderson (2010), the vertisolic soils require at least 30% smectite minerals in order for the shrink-swell process to be dominant.

Alternate shrinking and swelling processes causes formarion of the gilgai microrelief.

Gilgai (from aboriginal australian *gilgai*- small water hole) is a microtopography of the surface of Vertisols that includes alternating mounds or micro knolls and small depressions. The gilgai micro relief is known in Romania “microrelief de coscove”. Referenced studies concerns to the gilgai

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microrelief from Romania have been conducted by the Bucur (1960). Microdepression has a roughly oval shape, large diameter sizes ranging between 150 and 280 cm and a smaller diameter varies between 110 and 250cm (Bucur N., 1960).

Alternate shrinking and swelling causes self-mulching. The term self-mulching is used for soils that, during drying, breaks spontaneously into fragments with diameter smaller than 1cm. These fragments form a cover or mulch over the soil surface (Story C.G, 1977).

After drying of soil some vertical oblique and horizontal cracks are forming. Water distribution increase after crakes forming, the lowest content of water being recorded in the marginal area of polyhedron bounded by cracks.

Heterogeneity of moisture is evident in underlying horizons or the arable layer or under soil layer resulted after self-mulching processes. After drying and craks forming processes are changed compactness state of soil. Penetration resistance is strongly influenced by momentan content of water. In the central area of polyhedron recorded the lowest values of resistance to penetration.

MATERIAL AND METHODS

Our studies were were done in the area of Bodeasa Podriga rivers. The area belong to the Moldova Plain.

In order to point the heterogeneity of water distribution in the vertic soils we studied many representative such as soils developed on the flat land (*figure 1 and 2*) and on the slope, covered with grass vegetation or are used for crop growing (*figure 1*).

The water content in soils with fine texture strongly influences the state of compactness and resistance to penetration.

The resistance to penetration is a means of determining the ground load-bearing capacity, and the ease with which roots will grow through the ground. The resistance to penetration is a mechanical characteristic that, given a certain texture, depends on changing parameters such as degree of humidity, density and the strength of the connection between mineral particles. Measuring the resistance to penetration of the soil in a great number of measurements is best executed applying an electronic penetrometer together with a datalogger, allowing for immediate storage and processing of the data in the data logger.

The measured resistance to penetration and the GPS coordinates are stored in the internal logger of the penetrologger.

In this paper we presents some obtained results about resistance to penetration values obtained from soils developed under grassland vegetation and from arable land. The micro-relief of gilgai from the platform of pseudoterrace, used as pasture, is asociated with a obvious network of cracks.

To reflect the heterogeneity water distribution, were made some measurements of the resistance to penetration (both in the cracks and in the central area of polyhedron bounded by cracks).

On the arable land distribution of water is more homogeneous and the medium value of resistance to penetration is representative for this land use.

The soil units were completed with new obtained data, in the field and laboratory. It was necessary the equivalence of taxonomic units name, from the Romanian System of Soil Classification (Conea A. *et al*, 1980) and the Romanian System of Soil Taxonomy published 2003, 2012 and 2014 (Florea N. *et al*, 2003 and 2012,Vlad V *et al*, 2014).

Disturbed samples from the soil profiles were used to determine some soil analyzes such as the particle size distribution, humus content. The textural classes and subclases were established after Romanian clasification system (Soil Survey Methology, 1987).

Figure 1 **Location of the soil profiles (A - platform pseudoterrace on the slope used as pasture; B – arable land)**

RESULTS AND DISCUSSIONS

The studied soil are developed on the sweling clay deposite. Fine texture deposits favored the formation of a gilgai microrelief. The soils from microdepression are more humid and favors the growing of plants with higher moisture requirements. Microdepression can be easily recognized in dry periods of summer by more intense green color of the different grass species (*figure 2*).

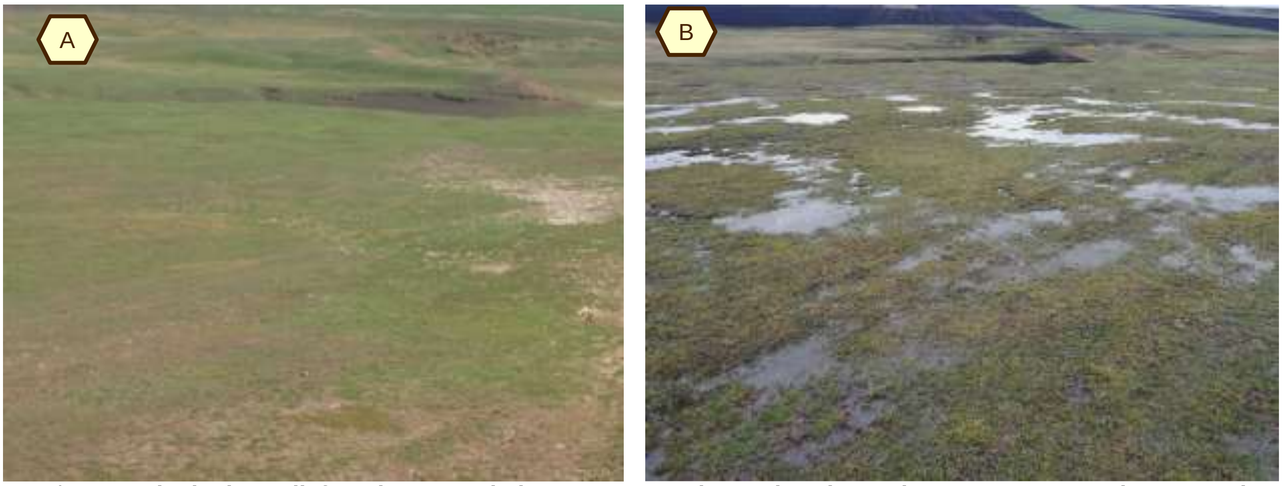

Figure 2 **Gigai microrelief on the acumulativ area near Bodeasa river (A-on the summer; B -on the autumn)**

The content of clay of studied vertisols is greater than 70% in all horizons pedogenetical horizons. Sand content is less than 2%. The soil has very low permeability to water and air due to high proportion of clay colloids. The wet soils are very plastic and sticky and become very hard when dry.

Inaccessible water for plant is high, the values of wilting points are over 20%.

The heterogeneous distribution of water on the soil developed under natural vegetation could be easily noticeable in the field by different values of color and by the presence of cracks under depth of 20 cm (*figure 3*).

We mention that the investigation took place in the spring, after a droughty winter.

The distribution of water on the soil from arable land is more uniform (*figure 3*)

Figure 3 **The soil profiles de veloped under pasture (A) and from arable land (B)**

In the mound area of gilgai micro-relief, the lowest values of resistance to penetration is recorded in self mulching layer and are less than 1 MPa. On the depth of 19-45 cm depth, penetration resistance values increase gradually from 1.5 up to about 7 Mpa (*figure 4*). Under depth of 45 cm, these values fit into a narrower range of variation of 7.5-8.5 MPa.

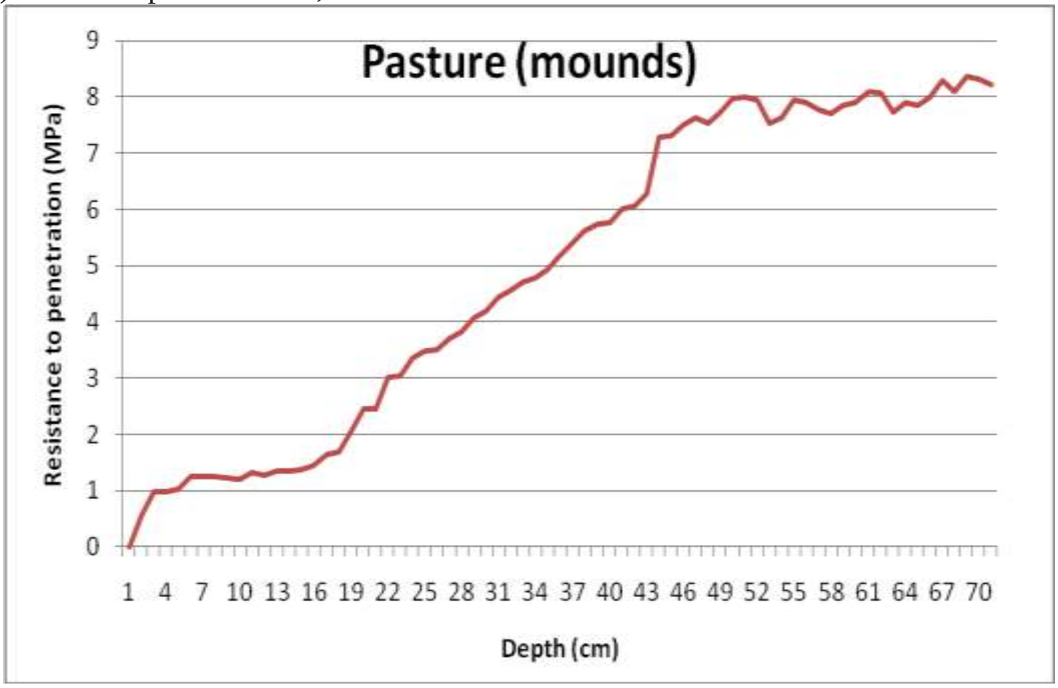

Figure 4 **Resistance to penetration in the soil from mounds of gilgai micro-relief**

In self-mulching horizon and thatch layer, the soil penetration resistance is also small. On interval of 7-34 cm penetration resistance gradually increase from 1 up to 3.8 MPa. On the depth of 35-52 cm the values of penetration resistance are maintained between 3.3 and 3.8 MPa. At depths greater than 55 cm, penetration resistance increases up to almost 6 MPa.

The different values of resistance to penetration registered in the soils from mounds and micro-depressions of gilgai microrelief could be explain by diferent momentan water content. If the water content is high and soil is moister, the value of resistance to penetration decreases.

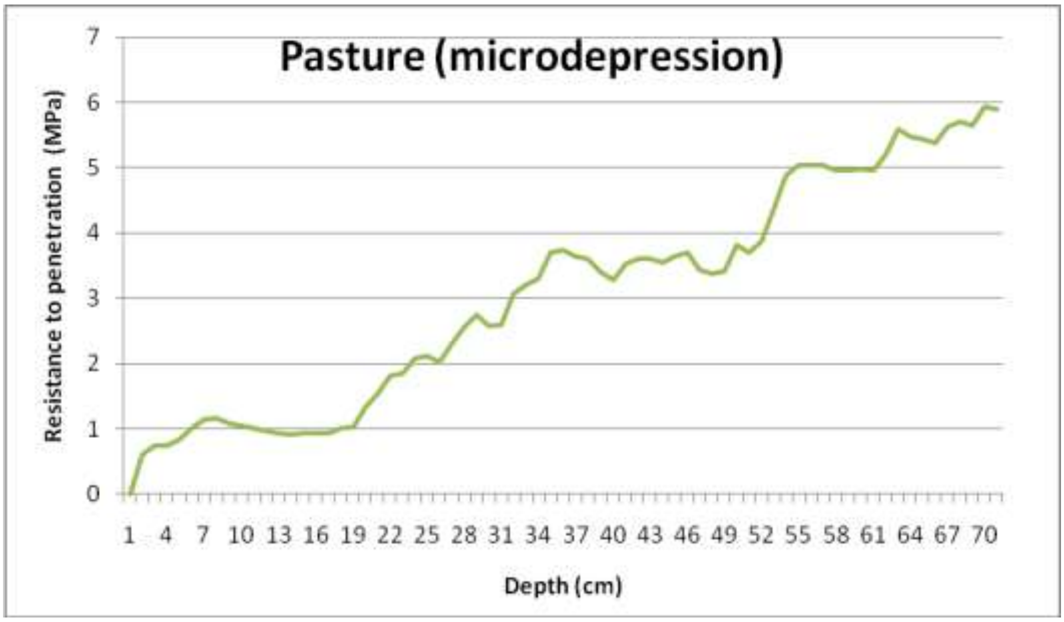

Figure 5 **Resistance to penetration in the soil from micro-depession of gilgai micro-relief**

On the soil from arable land, the penetration resistance values increase gradually up to 4 MPa (*figure 6*). On depth higher that 45 cm the penetration resistance values are smaller that 4.5. These values of resistance to penetration could be explained by more homogenous distribution of water and by decreasing of water loss through evapotranspiration.

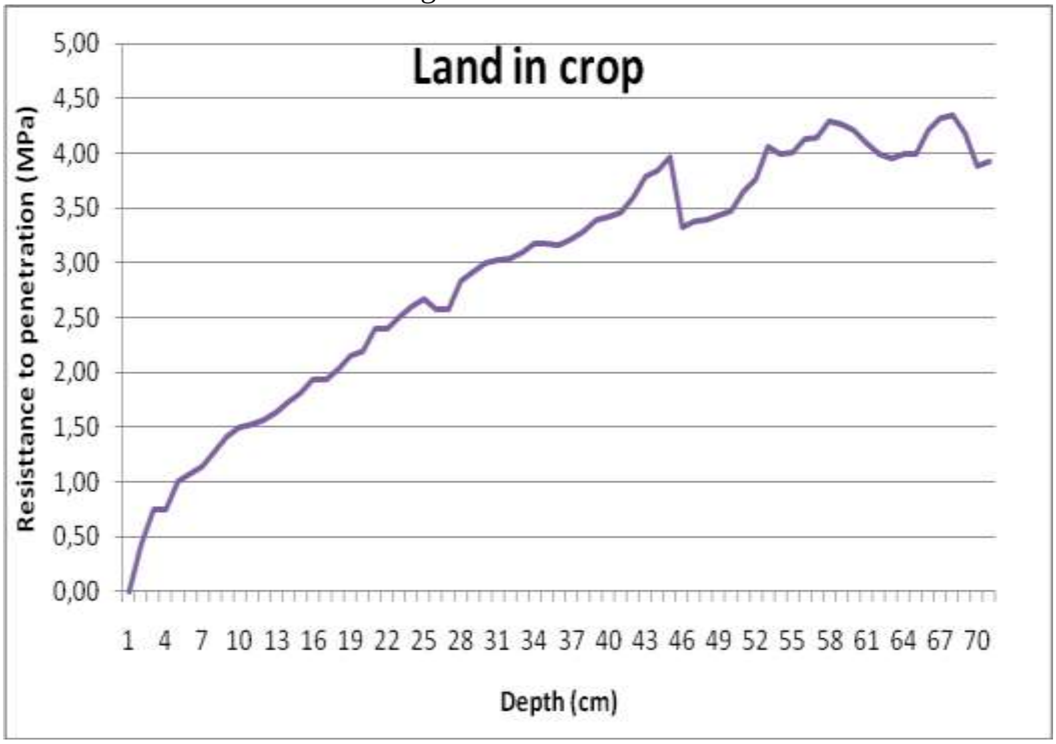

Figure 5 **Resistance to penetration values in the soil from arable land**

On slopes, landslides occur frequently and are favored by uneven wetting of soils, by deep cracks formed in the dry season of the year. Following the landslide, occur mixing soil particle from different pedogenetical horizons. Shallow landslides pronounced degrade land and increase heterogenity. The humidity of the soil used as arable is relatively uniform and was not observed cracks formed in the dry season of the year. Water from rainfall moisten uniform ploughed horizon.

CONCLUSIONS

The studied soils are developed on the sweling clay deposite. The soils from microdepression are more humid and favors the growing of plants with higher moisture requirements. Microdepression can be easily recognized in dry periods of summer by more intense green color of vegetation.

The content of clay of studied vertisols is greater than 70% in all pedogenetical horizons. The soil has very low permeability to water and air due to high proportion of clay colloids.

The different values of resistance to penetration registered in the soils from mounds and micro-depressions of gilgai microrelief could be explain by diferent momentan water content. If the water content is high and soil is moister, the values of resistance to penetration decrease.

On the soil from arable land, the penetration resistance values increase gradually up to 4 Mpa. These values of resistance to penetration could be explained by more homogenous distribution of water and by decreasing of water loss through evapotranspiration.

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