Scientific Papers. Series A. Agronomy, Vol. LXII, No. 2, 2019
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

COMPARATIVE EVALUATION OF THE AGREGATIVE STRUCTURE OF ORDINARY CERNOZIOMS WITH DIFFERENT DEGREE OF EROSION FROM THE NEGREA VILLAGE

Olesea COJOCARU

Agrarian State University of Moldova, 50 Mircesti Street, 2049, Chisinau, Republic of Moldova

Corresponding author email: o.cojocaru@uasm.md

Abstract

Soil is a limited means of production in space that cannot be multiplied as other means of production. The purpose of our research is to highlight the various aggregate particles of the ordinary chernozems in Negrea village, subject to the erosion process. Thus, we can appreciate the suitability of soils for different uses and recommend measures to mitigate the negative consequences. It is necessary to emphasize that any eroded soil is a result of a balance between the permanent process of pedogenesis and the process of its physical deterioration through erosion (Canarache, 1990; Cerbari, 2010; Kacinskii, 1958). The diversity of the natural conditions of solification and their interaction with the anthropic factors led to the formation on the researched territory of a soil with variable and complex character. A particular feature of the soil cover is the absolute predominance of ordinary chernozems in its structure (Kuznetova, 1979). The complexity of the soil cover structure, the diversity of the destructive influence of natural factors (Jigău et al., 2002; Jigău, 2008) the intensity of anthropogenic activity determined the widespread manifestation of land degradation processes in agricultural fields. According to dry curing data, the studied soils are characterized by favorable, predominantly satisfactory agronomic structure, and reduced hidrostability. Exceptions are made only by not eroded ordinary chernozems and mollic delluvial soil. Their structure, according to dry data, is appreciated as good and the hydrostability of their structure, according to wet milling data, is classified as satisfactory. The characteristic of the not eroded ordinary chernozem is the possibility of accumulation of comparatively large amounts of precipitation water as a positive factor contributing to the reduction of the soil erosion hazard (Cojocaru, 2016).

***Key words**: aggregative structure, ordinary chernozem, soil erosion process.*

INTRODUCTION

Aggregate soil condition is the most important condition for soil fulfillment of biosphere functions, including fertility, human health, implementation of major cycling phenomena in the biosphere (water, energy, gas, material cycles), biodiversity and many other soil functions.

Due to soil aggregate soil stability, it has the property of erosion resistance, mechanical agrotechnical influences, repackaging, dense waterproof horizons and other natural effects and anthropogenic phenomena.

Soil aggregates constituting a certain hierarchical level of soil must possess resistance to water impact, ie water resistance (or water resistance is an obsolete term) as well as resistance to mechanical influences in the form of resistance to normal or tangential pressure applied (pressure). The specific soil phenomenon, in the form of the aggregate soil structure, has always occupied and continues to occupy one of the main locations in the exploratory research of soil researchers, soil physicists and natural scientists in general.

The origin, formation, aggregate stability and processes of loss of aggregate structure, its degradation are the processes that directly affect the complex physicochemical and biological complex processes in the soil and, at the same time, have a real direction.

However, the generally accepted and comprehensive theory of forming an aggregate and, in addition, of structure management, has so far not existed. Until now, the mechanisms that determine such an important property of aggregates as water resistance are unclear.

Despite the fact that a large number of works (Antipov-Karatayev et al., 1948; Williams, 1936; Kaczynski, 1965; Voronin, 1984). Water resistance of aggregates with organic matter of the soil, its quantity and quality, is not yet a satisfactory hypothesis explaining the mechanisms of this link, and therefore the main purpose of this work was to study and quantitatively describe the water resistance processes and the resistance of soil aggregates to mechanical stress. , these were the objectives of the paper and the objectives.

Work on stability of aggregates under different natural conditions, conditions of formation in different types of soil formation (chernozem and types of soil formation), as well as the anthropogenic impact (the characteristic rotations of arable crops in the chernozem and forest soils gray).

Of great importance for modern agrophysics is the fight against physical degradation of soil. Habitat disorder under the influence of anthropogenic factors and, therefore, soil degradation in agroecosystems. Changes in environmental ecology lead to chemical physical, chemical and physical properties of the soil and, as a consequence, reduce fertility.

The restoration of degraded soils should include first the restoration of natural mechanisms causing sustainability of agroecosystems (Kuznetsova, 1990; 1999). Although the soil structure does not belong to factors that directly determine crop yield, it plays an important role in water and air mode, root growth, availability and activity of macrophage batteries.

The favorable structure for plant growth can be defined with regard to the presence of pores for water storage in the area, the pressures available for crops, pores for water and the air and pores in which the roots can grow (Oades, 1991).

The study of physical soil degradation processes (soil compaction, loss of water resistance, dust growth etc.) is an urgent scientific problem of agrophysics. Under the degradation of the physical state of the soil it refers to a constant change of physical properties, leading to deterioration of water, air, nutrients and other regimens.

Considering that most of the physical properties of soils are not independent quantities, but they are dependence on properties (eg humidity at moisture pressure, moisture penetration resistance etc.) or some distributions (pore size distribution, mass of elemental particles per diameter etc.), the analysis and the quantitative comparison of these dependencies (distribution) is difficult, especially if the experimental procedure for their determination leads to a variation of the values. The study of the soil cover structure can be considered as the theoretical basis for large-scale mapping of the soil. It provides a rationale for the concept of "map soil precision", standards for the number of discounts per unit area, division of territory into complexity categories. For this type of evaluation and comparison, the approximation parameters of the experimental dependencies have recently been widely used (Poluektov et al., 2006; Shein et al., 2007).

Description of structural separation according to S.A. Zaharov classification, V.A. Kovda noted that the most valuable, which contributes to a favorable combination of properties that determine the optimal development of the soil biota and root system of plants and their level of productivity, are the granular, granular, granular and nutty structure, of higher horizons. It is characteristic of soils of chernozem, meadows and sludge. Instead, the quality of the structure depends on a combination of a complex of factors determined by the organisms that live in the soil, especially plants and micro-organisms.

Soil structure is an important component that affects physical properties and soil regimes (Roar, 1965; Bahtin, 1971; Panfilov, 1971; Karpachevski, 1999; Suyundukov, 2001; Tatarintsev et al., 2003).

Soil aggregates of between 10 and 0.25 mm are considered to be agronomically valuable: a granular form, resistant to water erosion. Less than 0.001 mm soil particles are not considered, they have a negative impact on the soil.

According to V.R. Williams, N.I. Savvinov, pieces with a diameter of 1 to 10 mm are considered the most valuable (Milanovsky et al., 1993). Soils with high content of water-resistant structures have an increased absorption capacity, while reducing energy costs for the work (Suyundukov, 2001).

- contributes to the optimal ratio of the solid, liquid and gaseous layers of the upper layer soil, favoring the development of the grass root system and the vital activity of soil biota; - water-resistant structural units reduce soil consistency, helping to save energy and resources in soil processing;
- structural soil is characterized by high water permeability, improving water absorption and

preventing surface leakage and soil washing; - optimal soil structure that ensures high porosity and high non-capillary friability, reduces water movement and evaporation, reduces moisture consumption and prevents the development of salinisation processes;
- in the structural soils, a positive air regime is created for the formation of roots, soil algae and microorganisms;
- water-resistant granular aggregates resist water deflation and erosion. The size and quality of soil structures depends on the soil particle ratio and properties (Voronin, 1986). Mechanical elements consisting of particles of different sizes represent the solid phase of the soil. Different ratios of granulometric components affect physico-physical, physicochemical, physico-mechanical properties and other properties (Braunack, 1989). The structural and aggregate state also determines the degree of soil erosion resistance (Cojocaru, 2016). So, according to. Khaziyev F. Kh. et al. (Kay et al., 1999) in the chernozem of average average water resistance of eroded aggregates from 5 to 24% less than in non-degraded soil. When it enriches the upper layers of soil with fresh organic matter, it becomes more resistant to wind erosion due to refilling of adhesives (Antipov-Karatayev et al., 1948). Kozlov V.P. (Kaurichev et al., 1972) found that the water resistance of a soil rich in colloids saturated with exchangeable calcium is much higher due to good aggregation. That is, the quality of the structure depends on the composition of the absorbent complex and the particle size distribution.
High carbonate content in structural aggregates leads to lower soil leakage resistance (Cerbari, 2010). Carbonates contribute to a significant decrease in soil cohesion, having a negative effect on the formation of large aggregates. The coalescence of powdered soil aggregates, calcium carbonates prevents the formation of a macrostructure (Canarache, 1990), whose quantity and quality determines soil erosion resistance (Canarache et al., 2005). The larger the aggregates in the valuable agronomic fraction, the greater their stability (Williams, 1936). The erosion resistance of the aggregates also depends on the genetic identity of the soil. So experiments have established that for the destruction of an aggregate size of 3-5 mm of gray forest soil requires an impact of 10-300 drops of water for the same chernozem soil aggregates - about 2,000. Machining, which affects its structural state, also determines erosion resistance. Thus, the most important property of the aggregates is their water resistance, which has a direct effect on erosion control, soil stability. Therefore, all factors that influence the formation of a solid structure act simultaneously as factors that determine the degree of soil resistance to erosion processes.
However, using this type of approach, the limits of its use, the scientific use of approximation parameters is a pressing scientific issue.

MATERIALS AND METHODS

The study of the physical properties of soils and structural aggregates was performed on the example of ordinarz chernozem in Negrea village.
The properties of selected soil samples were determined by classical soil methods. An aggregate analysis of the soil ("dry" and "wet") was performed. Aggregate (structural) analysis makes it possible to determine the relative content of aggregates in the soil, consisting of a mixture of different particles. During the analysis it is not recommended to grind and apply a vigorous rotation of the sites. This will lead to aggregate destruction and biased results.

Principle 1. *Determination of soil structural composition by dry sieving according to N.I. Savvinov.* From an agronomic point of view, the grain structure is granular with the size of aggregates of 0.25 to 10 mm, with porosity and water resistance. Such a structure determines the most favorable air-water regime of the soil. Determination of the soil's structural composition is the sifting of soil samples by means of a special set of sites with different holes in diameter. Such sites put each other together and quarrel the soil through all the sites at once.
Reagents and equipment: 1) a sieve column with a diameter of 10, 7, 5, 3, 2, 1, 0.5, 0.25 mm with a pallet; 2) cups of porcelain or aluminum; 3) technical-chemical balances.
Process of the paper. We take an average sample of 0.5-2.5 kg of a dry airless, dry air

sample. Carefully select pebbles, roots, and other inclusions. The medium sample in small portions (100-200 g) is sieved through a sieve column, avoiding vigorous stirring. The aggregates in the sieve are transferred into individual cups. Each fraction is weighed on the scales. When the webs are deactivated, each of them is struck slightly on the edge with the palm to release the blocked aggregates. When the entire average sample is sifted and distributed in fractions, each fraction is weighed at the analytical balance and its percentage is calculated. The results are written as a Table 1.

Principle 2. *Aggregate "wet sieving" analysis according to N.I. Savvinov*. Determining the number of water resistant units in the selected structural units. They are called water resistant units that resist water erosion.

Reagents and equipment: 1) a set of 5 sites with a diameter of 20 cm, height of 3 cm, with holes from top to bottom 3; 2; 1; 0.5; 0.25 mm, fixed with metal plates; 2) water tank; 3) a cylinder of one liter of water and a stopper; 4) clock glass; 5) large and small cups of porcelain; 6) water bath; 7) analytical balance.

Process of the paper: we make a sample of the soil from the fractured structural fractions. To do so, the number of structural units (in g) of each fraction (> 0.25 mm) weighed on the scale is equal to half the percentage of this fraction in the soil. Assembled sites are installed in a water tank so there is a 5-6 cm water layer above the top of the site. We run the sample into the drum and saturate it with water, which we lightly roll over the walls of the cylinder (we force the air from the ground). Leave the drum alone for 10 minutes, then fill with water. To completely remove the air, the cylinder is covered with a clock glass and sloped in a horizontal position, then positioned vertically. Then close the cylinder with a stop (ensure that there is no more air under it), turn it quickly with your head down.

We maintain this position until most of the aggregates decrease. Then rotate the cylinder and wait until the soil reaches the bottom. This is repeated ten times. At the last turn, we leave the cylinder up, transfer it to the site set, and sink it into the water over the top sieve. Under water, open the drum plug and, without breaking the water, gently distribute the soil on top of the top. Within one minute the cylinder is closed with a plug in the water and taken out. I'm sick of the soil under water: we raise the set of water from the site without exposing the remaining aggregates on the upper sieve with a quick movement, lowering it down. In this position, keep pressed for 2-3 seconds, then slowly and quickly. Agitate the sieve 10 times, then remove the upper set 2 and shake the smallest remaining water 5 times. Aggregates left on the site are washed with a stream of water in large porcelain cups and excess water in the cups is emptied. From the large cups, the aggregates are washed in pre-weighed small cups, then dried in a water bath to a dry air and weighed.

The mass of fractions, multiplied by 2, gives the percentage of aggregates with large volumes of water of a certain size. The percentage of aggregates <0.25 mm is determined by subtracting from 100 the percentage of the fractions obtained. The results of the determination of water resistance of soil aggregates are recorded in a table.

According to the aggregate analysis results, the structural coefficient (K) is calculated:

$$K = A/B.$$

where:

K is the structural coefficient;

A - sum of aggregates from 0.25 to 10 mm (aggregates of agronomic value);

B - sum of aggregates <0.25 mm and blocks> 10 mm, %.

According to the number of air dry and water resistant aggregates with an optimal size, Dolgov S.I. and Bahtin P.U. proposes the following scale for assessing the structural state of soil presented below.

Table 1. Scale for assessing the structural state of the soil

Aggregate content 0.25-10 mm, % from the dry soil to the air		Assessment of structural condition	
Dry sieving	Wet sieving	after the state of the soil	in points
> 80	> 70	excellent	5
80-60	70-55	good	4
60-40	55-40	satisfying	3
40-20	40-20	unsatisfactory	2
< 20	< 20	very unsatisfactory	1

The water resistance of the structure is the main factor determining soil erosion resistance. Soil disturbance of the balance of humic compounds and cations reduces the formation of water-resistant aggregates. According to Shein E.V. et al. (2001), low content of organic matter (less than 2%) in the soil generates small aggregates and at higher levels large aggregates of over 3 mm are formed. In soil destruction, the percentage of water erosion is 56%, wind - 28%, chemical degradation - 12% and physical - 4% (Lal, 1991).

The intensity of the erosion manifestation depends to a certain extent on the hydrothermal regime of the cold season, as well as the underlying soil properties (Vadyunina et al., 1986; Voronin, 1984, 1986).

RESULTS AND DISCUSSIONS

For agriculture, the soil should not only have a good structure but also a structure that will last for a long time, for example, the structure is of high quality and stability, water resistance and mechanical stability (Barlow et al., 2002). This author classifies the structure's stability in two main types: (a) the soil's ability to maintain its structure under the action of water; and (b) the wet soil's ability to maintain its structure under the influence of external stress mechanisms. The first type of structure stability is usually estimated using wet sieve techniques to determine cumulative water stability, as suggested (Kay et al., 1999; Milanovsky et al., 1993).

Structural stability under the influence of external loads can be determined in the compressibility of experiments (Oades et al., 1991) and the shear force (Gedroits, 1926). Further studies (Braunack et al., 1989) have shown that organic substances, consisting mainly of hydrophobic components, are more efficient and as long-lasting aggregation factors, compared to the hydrophilic components of root exudates or polysaccharides from plant tissues.

The territory of Negrea village is not an exception, which can be characterized as an area with an ecologically intense situation. The analysis of the aggregate structure of the ordinary chernozem on dry and wet sieving method is presented in Figures 1-7.

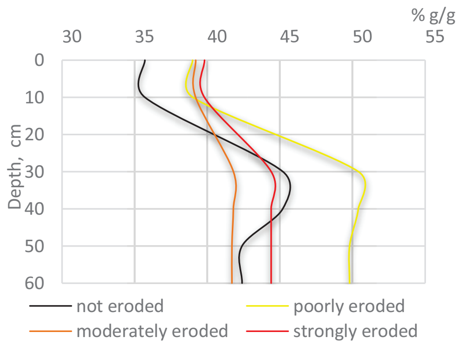

Figure 1. The structural composition of the aggregates > 10 mm (*dry sifting*)

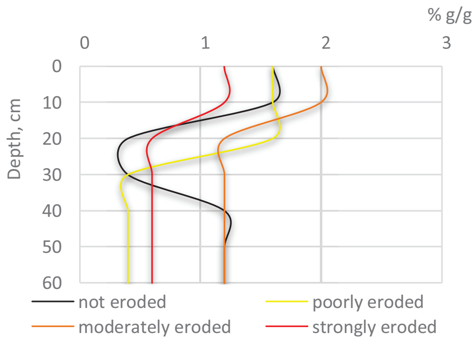

Figure 2. The structural composition of the aggregates < 0.25 mm (*dry sifting*)

A number of properties, such as contraction, swelling, penetration resistance etc., despite their name, imply the dependence of these moisture properties, ie the physical dependence of the soil (Shein, 2005). Quantifying and comparing these dependencies is difficult. Thus, numerous functions are known to approximate the main hydrophysical characteristics (OGH) and moisture conductivity function (Shein, 2005; Poluektov et al, 2006); tries to use functions of different types for the quantitative description of granulometric and microaggregate compositions (Shein, 2005; Berezin, 1983); aggregation shrinkage (Berezin, 1995) and a number of other soil properties.

However, the conditions for the competent application of this approach, the limits of use, the scientific use of approximation parameters is a pressing scientific issue.

In most cases, regression analysis is used to evaluate the relationship (Dmitriev, 1995). How is the response model regression analysis based on two components: deterministic, describing the dependence of the mean response on the explanatory variables (arguments or predictors) and the random component, describing the deviations of the observed response from this dependence.

The enormous loss of productive land due to various types of degradation (Lal, 1991), dehumidification (Klimentyev, 1997) dictates the necessity of conserving agri-food resources, including soils, to ensure food security (Berezin, 1983; Canarache, 1990; Kay, 1990; Kaurichev et al., 1972; Milanovsky et al., 1993).

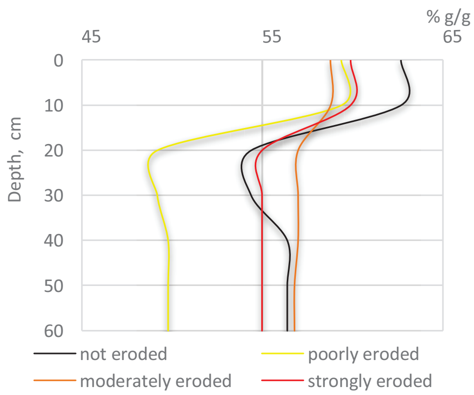

Figure 3. The structural composition of the aggregates sum 10 - 0.25 mm (*dry sifting*)

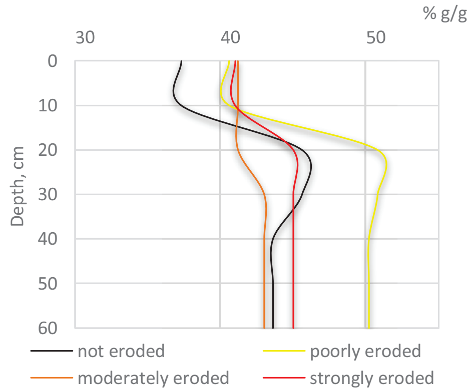

Figure 4. The structural composition of the aggregates sum > 10 - < 0.25 mm (*dry sifting*)

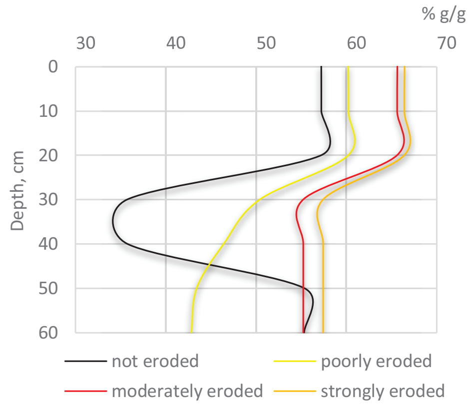

Figure 5. The structural composition of the aggregates < 0.25 mm (*wet sifting*)

The main factors that cause the degradation of the soil cover in the Republic of Moldova are dehumidification and destruction of the structure, repackaging due to intensive use of arable land and meadows because of the erosion process.

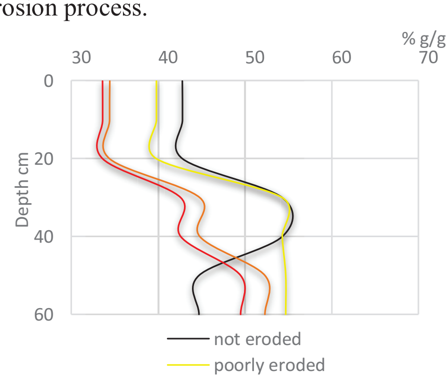

Figure 6. The structural composition of the aggregates sum 10 - 0.25 mm (*wet sifting*)

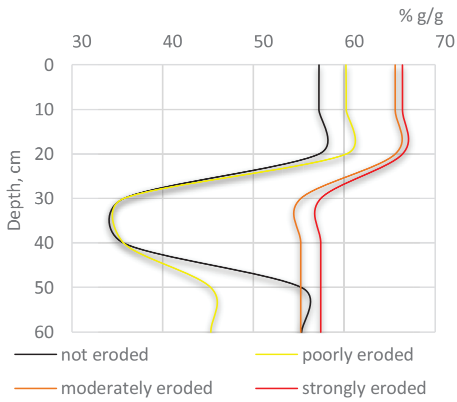

Figure 7. The structural composition of the aggregates sum > 10 - < 0.25 mm (wet sifting)

The reason for this is a significant deterioration of the agroecosystem of the territory, mainly represented by agricultural land, which for a long time has been exposed to an excessive anthropogenic impact due to the high degree of development of the land.

Increased anthropogenic stress can lead to deterioration of agrophysical properties and disruption of the soil profile, which is considered as soil physical degradation (Shcherbakov, 2000; Shein, 2005). Under these conditions, soil conservation becomes the most important task of agroecology, for which it is necessary to protect it from the development of degradation processes, as well as the creation of a balanced ratio between mineral nutrients and organic matter (Dmitriev, 1995; Kachinsky, 1958; Kuznetsova, 1979; 1998; Jigău, 2008). Of all the factors, the most damaging effects on the soil are erosion processes, which can lead to a high degree of physical degradation - the complete destruction of the soil as a natural object.

This situation is observed (Figures 1-7) and in our case, according to the results obtained in Negrea village. Chernozems are unique natural formations characterized by high fertility and are therefore almost always shown and are actively used for agricultural crops. At the same time, there are various processes in soils, usually associated with the deterioration of chernozem soil structure, compaction, disaggregation and other processes called physical degradation of soil during agricultural development.

It should be noted that there are significant differences in study objects, both in morphology and in physical properties (aggregate structure). The structure of the upper part of the arable layer is quite typical for the not eroded ordinary chernozem (Figure 1) - generally it can be characterized as a granular arable layer being dust. The data on dry and wet sieve aggregate analysis (using the Savvinov method) reveals an accentuated difference in the water content of the structure of the investigated aggregates in Negrea village (Cojocaru, 2016). If the majority of the units are not water resistant and the percentage of impermeable units > 0.25 mm, the structure refers to "satisfactory" or "good", then for the common chernozem with different degrees of erosion the percentage of units that does not resist water is insignificant. The analysis of the soil's structural condition makes it possible to observe that for a typical area of Central Moldova with unordered chernozems, the amount of valuable agronomic aggregates varies from 71.56% to 68.34%, with a maximum content of 71.56% of this fraction in a layer of 10-20 cm, and those with different degrees of erosion the first third of the soil profile decreases, together with a relative increase in the content of compacted aggregates. On the eroded lands there was a decrease in the value of the agronomic aggregates (55.98%-59.78%) compared to the area of the non - eradicated ones.

CONCLUSIONS

The main factors that cause the degradation of the soil cover in the Republic of Moldova are dehumidification and destruction of the structure, repackaging due to intensive use of arable land and meadows because of the erosion process.

For agriculture, the soil should not only have a good structure but also a structure that will last for a long time, for example, the structure is of high quality and stability, water resistance and mechanical stability

The territory of Negrea village is not an exception, which can be characterized as an area with an ecologically intense situation. The analysis of the aggregate structure of the ordinary chernozem on dry and wet sieving method.

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