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Water stability of structure of arable soils of Ukraine

Goal. To construct a map of water resistance of the structure of arable soils of Ukraine and to determine the area of soils with improved, average and deteriorated indicators. **Methods.** Selection of data from the "Properties of Soils of Ukraine" database, their processing and map construction. **Results** Area of arable soils with improved water resistance of the structure occupy about 14% of arable land, or 4.2 million hectares, the average - respectively 32.4% and 9.7, deteriorated - 27.8% and 8.4 million hectares. Other areas occupy conditionally unstructured sandy and sandy soils and soils for which water resistance measurements were not measured. **Conclusions** Water resistance of the structure as a highly informative soil quality indicator should be included in the list of monitoring indicators, and the soil area with its various indicators should become the object for the use of differentiated structurally-preserving measures.

Key words: water resistance of soil structure, humus content, monitoring.

Water resistance is a fundamental characteristic of soil, since it is based on ecological and productive functions, practically all regimes. Only soil, enriched with an agronomically useful water-resistant structure, is capable of providing harmonious water and air regimes [12] and maintaining moisture inside aggregates, supporting biological activity and providing metabolic processes and best nutrient conditions for plants. Structural soil is easier to cultivate, it allows to formulate the structure parameters required for plants, provides smooth development of soil space and penetration of plant roots deep into the soil, where moisture is almost always present. Only the structural basis can maximize the possibilities of cultural adaptation plants to adverse environmental conditions. We are confident that this is true for almost all soils, except for light sand and sandy soils, where the formation of a water-resistant structure is impossible due to the domination of large-sized elementary particles and the addition of components that glue them in aggregates.

Consequently, agronomic activity, and especially soil cultivation, should not lead to the loss of a water-resistant structure, the inhibition of aggregation processes, since soil fertility will inevitably be lost along with them.

Despite the importance of the water-resistant structure as an indicator of the state and quality of the soil, its dimensions are unpopular and in the database "Properties of soils of Ukraine" [2] are insufficiently presented. Only recently employees Laboratory of Soil Geoecophysics of NSC "IGA named after O.N. Sokolovsky "base was replenished with the necessary number of corresponding dates, which made it possible to get an idea of the simple features of this indicator on the country's arable lands.

The purpose of the research - is to construct a map of water resistance of the country's arable soils, to identify the area of soils with improved, medium and worse structures, to justify the use of this indicator in the monitoring programs and to outline the regions where structurally-saving measures should first be used.

Methods and objects of research. Water resistance of soil was determined by MI method. Savinova, which is the state standard of Ukraine [11]. Altogether, 683 definitions are included in the database, covering mostly the steppe and lyso-steppe zones of Ukraine. Definition is generally carried out in the laboratory of soil geoecophysics, and other dimensions are derived from the sources given in the book [2]. The data is based on the water resistance of the arable layer obtained in the middle of the vegetation spring cereal crops, that is, in the state of equilibrium density of the structure. The method of map construction and the determination of areas with different water resistance is given in [7].

Research results. According to various estimates, SI Debt and so on. [5], IV Kuznetsova [6], EV Sheina [10] and her own experience [8], if the arable soil contains approximately 50% and more waterproof aggregates of size > 0.25 mm, obtained using the Savinov method, it should be considered as a soil with good and even excellent water resistance. With the decrease in the number of water-resistant aggregates, the soil gradually deteriorates, and when their number reaches 30% or less, the structure of the soil becomes unstable, it easily collapses, swells, water erosion, and then forms crust and cracks.

Water resistance of the arable soils of the country is shown in the figure, and the area of soils with different water resistance - in Table. 1. It should be noted that the soil with the best water resistance in Ukraine (> 50%) is not so much - only 4.2 million hectares, or 14%. It is worth noting that this area almost coincides with the area of valuable soils [9]. Obviously, soils with an average water resistance (40-50%) - 32.4% or 9.7 million hectares, soils with deteriorated water resistance (<40%) - 27.8% or 8.4 million hectares.

Taking into account the types of soils, the general consistency of water resistance geography is as follows (Table 2):

- higher water resistance indexes are typical and regular chernozem, well-humused and enriched with calcium absorbed;

- in the north and south of this territory water resistance decreases;

- with increasing sand and dusty components in the soil and lowering of humus content, water resistance decreases. Waterlogging, which is accompanied by gelling, acidification of the soil solution, water-erosion or deflation processes, contribute to its reduction;

Overspray, as a rule, forms a blast aggregate that is destroyed in water for pre- and prolonged wetting before sifting [8]. By P.V. Topic [3], such water resistance can not be called true.

Consequently, a real assessment of water resistance (the basic quality assessment) is modest. We believe that these parameters are the result of degradation arable land of the country, in particular due to the loss of organic matter. Water resistance on the target - preferably more than 50%, and the water resistance coefficient - 0.5-0.7, while at arable land - only 0.2-0.5 (Table 3). It should be noted that prolonged plowing reduces the number of volatile aggregates by more than 1 mm, and especially more than 3 mm, that is, it sprays the soil structure.

Prolonged soil plowing significantly reduces the content and significantly increases the mobility of organic matter (Table 4, 5). This affects the water resistance of the aggregates and causes the negative changes in physical properties and modes. Reliable (at $P = 0,95$) reduction of the general humus is detected in all analyzed depth to 60 cm.

Increased mobility of organic matter on arable land is determined not only by known methods of colloid-chemical "anatomy" of soil aggregates IM Antipova-Karataeva and others. [1] or colloid-chemical approaches O.N. Sokolovsky [4], but also by means of a micromorphological analysis. In the aggregates of arable land, moving amorphous forms of organic matter, which do not have strong bonds with the mineral part of the soil, are significantly dominated by arable land.

Given the obvious negative trends in deterioration of water resistance of the structure under the influence of modern agricultural practices and the exceptional significance of this indicator for ecological and productive functions of soils, one should rethink the indifferent attitude of the agronomic community to the evaluation, control and management of this most important the property of soils.

Since water resistance of soils is a rather complicated object of monitoring, an optimal approach will be to control its state and changes in the background, production, scientific, and, if necessary, crisis types of monitoring. Background monitoring will give an opportunity to evaluate the water resistance level in soils under natural conditions vegetation and in the initial state of arable soils. These will be natural and original standards. Production - the current state of arable soils, which are under the influence of various anthropogenic loads, scientific - refined materials for the forecast of water resistance of soils for increasing or reducing anthropogenic burden. Certain value will also be crisis monitoring (soil condition monitoring, in which environmental and productive functions are substantially violated). His results should be the basis for the first-step measures to remedy the situation.

Consequently, introducing into the program of soil monitoring the definitions of water resistance of soils is an urgent task that needs to be solved.

In conditions of application of modern agricultural technologies, water resistance of arable soils is deteriorating, and the main causes are excessive mechanical cultivation and scarcity of organic matter [8]. That is why minimizing the cultivation and improving the humus balance are the most important measures to maintain water resistance.

In many cases (especially for black earths or similar to the genesis of soils), such a measure would be quite appropriate to radically change the situation, that is, to improve the quantitative and qualitative structure of the structure. However, this will not be enough for a wide variety of other soils - dehydrated, gley and acidic. The same as for steppe soils, the cultivation of which, as a rule, is carried out in a dried state, or light granulometric soils, they must also be supplemented by other

measures. This confirms the general consistency: the diversity of soil conditions (and aggregation conditions) requires an individual approach to the choice of orientation of structurally-saving technologies.

Water resistance of the structure is one of the conditions of stable land use, the care of which should become an important part of state policy and the purpose of all land users. Crop rotation, crop rotation and all other elements of crop production technologies should be structurally preservative.

Conclusions

The area of the arable soils of the country with the best, medium and worst indicators of water resistance of the soil structure has been established. Considering the importance of maintaining the water resistance of soils from ecological and agronomic positions and preventing its degradation, the necessity of systematic monitoring (monitoring) of this soil property and a system of conservation differentiated under ground conditions has been grounded.

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