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Physical properties of ploughed up soils of Ukraine

Goal. Identify indicators characterizing the current state of physical properties of arable soils in Ukraine. **Methods.** Creation of samples of spatial data of equilibrium density of structure, structural state and soil-hydrological constants on the basis of the database "Properties of soils of Ukraine". Calculation of average values and coefficients of variation of samples. **Results** The parameters of the basic physical properties of arable soils within the natural zones, provinces and the country as a whole on the maps of scale 1: 1500000 have been established. **Conclusions** The standard indices of the physical properties of arable soils should be used in assessing their quality and bonitets, determining prices, rent, monitoring, planning and organizing soil protection measures.

Key words: physical properties of arable soils, reference indices.

Physical properties of the arable soils of Ukraine were not studied either during a solid ground survey, nor in the process of agrochemical and technological certification of fields, nor during other studies of soil cover. Lack of information about physical properties affects the imperfect solution of many practical problems, for example, reclamation or punitive, where physical properties are the most important. In recent years, it has become possible to eliminate this gap at least partially at the expense of the database "Properties of Soils of Ukraine", created in the NSC "IAA named after O.N. Sokolovsky [12], which contains a lot of information about the physical properties of the arable soils of Ukraine.

The purpose of the research - is to determine the indicators characterizing the current state of physical properties of the most common arable soils of the natural zones and soil provinces of Ukraine. This can be useful in calculations of bonitets and land prices, more reasonable calculation of irrigation regulations, monitoring and other aspects.

Methods and objects of research. Data samples were created using a specified database containing information from more than 2,500 sections covering all natural and climatic zones and soil provinces of the country. The direct physical object was the basic physical properties - the equilibrium density of the structure, the content of the agronomically useful fraction of aggregates, their water resistance and soil-hydrological constants (BB - humidity of stable wilting, HB - the lowest moisture content and DAV - range of active moisture). The granulometric composition of the soil was also the most widespread. The number of dates in natural zones and provinces varied among themselves. Unfortunately, there are clearly insufficient definitions of physical properties carried out in Polissya.

Research results. Consider the results of generalizing physical data Soil properties in natural zones. It should be emphasized that the strict dependence of almost all indicators of granulometric composition. Due to the sandy and sandy granulometric composition of the soil, Polissya significantly differs from the soils of the forest-steppe and the Steppe. As one would expect, in Polissya, the highest levels of equilibrium density of the structure and the minimum soil-hydrological constants. However, the active moisture range is slightly lower than in other natural areas. With a weighing of granulometric composition in the forest-steppe and, especially in the Steppe, the moisture content of the fading increases. However, other researched indicators in the Forest-Steppe and Steppe are very close to each other, despite the fact that data of different types of soils were involved in the samples but related to granulometric composition, which is a decisive factor in the formation of parameters of physical properties of soils

If the moderation of the coefficients of variation to take 25% (as is customary in precision agriculture for the separation of spaces with different fertility [15]), then the structural parameters, especially water resistance, exceed this value, but the majority of the studied parameters varies slightly. This can be the result of a small variety of soils and soil-forming rocks, taking into account the variability of physical characteristics within natural zones.

The evaluation of the physical properties parameters regarding the requirements of grain and technical crops grown in Ukraine is positive. Even in Polissya, where the equilibrium density of the structure exceeds the optimal range, it is much smaller than the allowable amount of seal, which does not limit the growth of the roots due to sufficient airway space [5]. This is about the equilibrium density of the structure, and not about what can be created after the spring field work performed with the help of heavy tractors. The equilibrium density of such technologies and equipment can be overcome and maintained at least until the middle of the growing of crops [6].

Consider the physical properties of soils in individual provinces (Table 1). The equilibrium density of the structure in all the provinces of Polissya is equal to 1.5 g / cm³, but even for soils of light granulometric composition, which are not susceptible to recombination under the influence of heavy machine-tractor aggregates, it can amount to more than 1.7 g / cm³, which is unacceptable.

Almost no change in the provinces and other survey indicators. Only the humidity of persistent wilting in Western Polessie through the lighter compared to other provinces, granulometric composition is noticeably smaller [3].

The coefficients of the spatial variation of the studied parameters are generally moderate or close to them, with the exception of the moisture content of the wilting.

The determined parameters due to the increased density of the structure and the light granulometric composition indicate that the Polissya soils can maintain a relatively small amount of available moisture in the arable layer, and in the case of overfilling, they can enhance the gluing in the surface layer.

Thus, despite a small number of dates in the samples, but given their similarity in different provinces for Polissya, the following indicators that characterize the current state of physical properties can be considered as benchmarks: an equilibrium structure density of 1.5 g / cm³, a moisture content of 1, 7 - 2%, minimum moisture content - 15 - 16%, maximum range of active moisture - 13 - 15%. It should be noted that the given parameters make up only 48.9 - 82.5% of the arable land of Polissya and do not characterize medium gluten, peat and other soils, the share of which is also ruined.

The soils of forest-steppe provinces vary considerably from the soil of Polissya. It should be emphasized the increased equilibrium density of their structure. It varies in the range of 1.2 - 1.3 g / cm³ and is close to the upper limit of optimal density for most crops grown in this zone on loam soils. According to the authors [6], the density, as evidenced by the stairs, the growth of roots, the flow of nutrients to the plant, deteriorates the coefficient of beneficial effect of moisture and so on. Such a level of sealing can be established in the crop layer 2 to 3 weeks after the last pre-sowing and sowing, that is to say, during a significant part of the vegetation. If we compare the established parameters with the density on the virgin or long-term turn, then the difference is quite significant and is 1.0-1.1 g / cm³. This means that the problem of overdensing requires special attention on the chernozem loamy soils, the propensity of which for such development is obvious, as indicated in the literature [7, 13, 14].

Soils of the forest-steppe can retain moisture at the lowest moisture content, but about 40% of this moisture is inaccessible to plants. Because of the increased amount of moisture in the VV, the active moisture range is almost the same as in the poor soils of Polissya. Under the current method of boniting, the basis of evaluation Soil is the granulometric composition and amount of humus. According to these indicators, the Polissya soils are really poor and poorly populated, but by other indicators (physical, agrochemical and climatic), and especially when fertilizers are introduced, these soils are approaching forest-steppe soils [2].

The structure of forest-steppe soils is quite satisfactory. If you do not take into account the right bank of the province due to the small number of dates, the number of agronomically useful aggregates in the range of 64-69%, their water resistance - 52 - 53%, parameters corresponding to the quality arable layer on the known evaluation scales [1], it should be recognized exactly such.

Listed in tab. 1, the physical parameters of forest-steppe soils are considered as reference, suitable for the evaluation of the quality of arable soils and use in market relations.

1. Physical properties of the most common arable soil in the provinces (a layer of awn)

The physical properties of soils in the Steppe provinces can be evaluated almost as well, which confirms the leading role of granulometric composition in their formation. If there are some differences in the soils of the forest-steppe, they can be explained by a slight increase in the content of physical clay. Prevaillingly moderate in the Steppe and coefficients of variation of the properties under study.

Consequently, for the soil provinces of the Steppe, the density of the structure in the range 1.1-1.2 g / cm³, VV - 11 - 14%, HB - 26 - 32%, DAV - 15 - 19% should be considered as the reference. The structure of the soil varies widely - 62 - 78% for the number of agronomically useful aggregates, their water resistance - 28 - 55%. In these ranges of indicators to state that uniform standards for all provinces would be rude, additional measurements are required. The latter is also relevant for a more precise definition of HBs in selected provinces and soils in the zone, which will contribute to a more precise calculation of the irrigation rules.

The figure shows cartographic information on the physical properties of the arable land of the country on the basis of digitized (digitized) map of the soil of Ukraine on a scale of 1: 1500000. In addition, the analytical material available in the database allows to obtain similar maps of physical properties of arable soils of steppe and forest-steppe administrative areas (if available digitalized soil map areas). For these areas, the database contains the necessary analytical material for almost all arable soils. In the absence of data on some soils can be used pedotransfer models, according to which physical properties are calculated based on granulometric composition and humus content and reliability of which has been mathematically proved (Table 2) [9].

2. Pedotransfer models of linear and quadratic species and their statistical estimations

For the purpose, we intended to determine the characteristic physical properties of soils in natural zones and soil provinces and for the whole country on the basis of a ground map of scale 1: 1500000 on specific arable soils in order to provide more widespread use of them in the evaluation of soil quality, in particular monitoring, hacking, pricing, rent, and generally in market transformations. It was repeatedly noted [4, 8, 10] that the current technique of boniting [11], which is based on indicators that assess only the potential fertility of soils and completely ignore physical properties, will not contribute to an objective assessment of soils.

Conclusions

The reference parameters and the vast variability of the leading agrophysical properties for the most widespread soils of natural zones, soil provinces and the whole country on maps of scale 1: 1500000 are determined.

The physical properties determined in equilibrium indicate their favorable conditions for the cultivation of the main field crops in Ukraine, with the exception of the provinces of Polissya (high density of the structure), the forest steppe and the Steppe (lowered parameters of the capacity of available moisture - DAV and water resistance and increased equilibrium compaction compared to natural soils-analogues).

The standard indicators of the current physical condition of the soil of arable land should be taken into account when assessing the quality of soils: in calculations of bonitetes, prices for land, in monitoring.

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