

Experience of pedo- transfer simulation in probes of soil physics // News of agrarian sciences

The purpose. To develop (on the basis of information gathered in the database «Properties of soils of Ukraine») pedo-transfer models presenting influence of the content of physical clay and humus (basic indexes) upon density of build, structural composition and some soil-hydrological constants (functional indexes). **Methods.** Mathematical-and-statistical processing of samplings from database «Properties of soils of Ukraine». **Results.** 1- and 2-factor linear and square models of various kinds are discovered. **Conclusions.** The elaborated pedo-transfer models can be applied for prediction of state of water-and-physical properties of soils, with the purpose of their monitoring, effective use in land reform, mapping out and developing soil-protection measures.

Key words: pedo-transfer simulation, soil physics, forecast and monitoring of physical properties.

Models will enable to develop a direction in soil science, connected with forecasts, different estimations and management of a ground.

The purpose of the research is to develop pedotransfer models describing the structural composition, the equilibrium density of the structure and the soil-hydrological constants as the basic indicators of the granulometric composition and the content of humus contained in the database "Soil Properties in Ukraine". On the basis of models, evaluate the possible changes in physical properties for changes in the baseline indicators and determine possible directions for their further use.

Research methods. From the above database, previously described by T.M. Laktionov and others. [2], the data on the content of physical clay and humus (baseline) and the content of the agronomically useful fraction of the structure were taken. The experience of pedotransfer modeling in soil physics studies was verified by means of the determination coefficient and other generally accepted estimates.

Research results. The influence of organic matter on the formation of water-physical indicators of soils is described by quadratic, log-normal and indicative pedotransfer functions with high determination coefficients (Fig. 1). As it should be expected, the density of the structure with an increase in the content of humus decreases, and the yield of the agronomically useful fraction of the structure synchronously increases. It is typical that the water resistance of the structure increases significantly only after the content of humus in the soil exceeds 3.5%. Almost the same capacity for capillary moisture increases. Unfortunately, the humidity of persistent plant wilting also grows at the same time. The reason for such changes is evident: with the increase in the content of humus, the structure is improved and due to the extremely high surface energy of humus, the moisture-retaining capacity of the soils. The smallest density of the structure has the most well-structured typical black soil, the largest - turf-podzolic clay-sand gleyed soil, in which aggregation is absent at all. In such a ground, if aggregates of 10-0.25 mm are formed, its water resistance, structure density, moisture resistance of plants (VV), the lowest moisture content (HB) and the range of active moisture (functional indicators) of the arable soil layer are formed. All initial information about basic and functional

indicators was systematized depending on the content of humus and physical clay (Table 1, 2). Unfortunately, it was not possible to use an important factor in the formation of water-physical properties - the saturation of the colloidal complex with calcium. However, in our opinion, such loss was not so significant, as most of the country's arable land (except for the Polissya soils) develop in forests and loamy loams, and the content of calcium in them is slightly different. The reason for this is a small variation of this indicator in the soil of the country [1]. However, this observation does not apply to podzolized soils, the process of podzolization in which (especially under the condition of medium and high degree) is accompanied by a marked decreasing migration of calcium and the deterioration of water-physical properties of soils.

These tables are mathematically processed for constructing 1- and 2-factor linear and quadratic pedotransfer models. Their reliability was verified using the determination coefficient and other generally accepted estimates. Research results. The influence of organic matter on the formation of water-physical indicators of soils is described by quadratic, log-normal and indicative pedotransfer functions with high determination coefficients (Fig. 1). As it should be expected, the density of the structure with an increase in the content of humus decreases, and the yield of the agronomically useful fraction of the structure synchronously increases. It is typical that the water resistance of the structure increases significantly only after the content of humus in the soil exceeds 3.5%. Almost the same capacity for capillary moisture increases. Unfortunately, the humidity of persistent plant wilting also grows at the same time. The reason for such changes is evident: with the increase in the content of humus, the structure is improved and due to the extremely high surface energy of humus, the moisture-retaining capacity of the soils. The smallest density of the structure has the most well-structured typical black soil, the largest - turf-podzolic clay-sand gleyed soil, in which aggregation is absent at all. In such a ground, if aggregates are formed, then they are characterized by minimum strength and porosity indices and false water resistance. Therefore, sandy soil has an equilibrium density of the structure, usually above 1.5 g / cm³, loamy and clay - below 1.3 g / cm³. A slightly unexpected (at first glance) characteristic of water resistance of soils, which is getting better than humus content less than 3%. Undoubtedly, as noted by P.V. Vershinin [4], while in the soil not true, but falsely stable aggregates formed, which, under the more prolonged period, as recommended by Savvinov's method, soften the wetting. One can not but pay attention to the log-normal model that binds humus and physical clay and shows a strong correlation between the indicators for the content of humus 1,5-3,5%, which weakens for more significant humus content. It should be noted that O.O. Batsula [6] for the analysis of synchronous samples - changes in the content of humus in soils and crops, it was found that the latter did not grow on the content of humus in the soil of 3.5% [9]. The influence of the contents of physical clay on the formation of water-physical properties of soils is described by quadratic and indicative functions, mainly with very high determination coefficients. With the growth of physical clay in the soil, the density of the structure decreases - first quickly, and when the soil becomes moderately heavy and heavier - very slowly. The disproportionate influence of physical clay on the formation of water-physical properties (strong - with a content of 10-35% and very weak - content over 35%) calls into question the correct use of the index of physical clay to characterize physical properties in the current technique of boniting [7]. The largest content of aggregates of agronomically useful size can be traced to the average amount of physical clay, in its amount less than 30 and more than 80%, the aggregation ability of clay significantly weakens. The interconnection of physical clay with water resistance of aggregates is simple - than it is in the soil more, the water resistance is higher. All the exceptionally wide range of contents in the soil of physical clay, available in the base (from less than 10 to more than 80%), affects a rather narrow range of changes in BB and HB, respectively 2-16% and 10-

30%. Moreover, for the soils of the light granulometric composition, this bond is very significant, and in soils of medium and heavy one can hardly be traced, since the approximated curves are located almost parallel to the abscissa.

It should be noted that the range of active moisture (DAV) least depends on the content in the soil of physical clay. Thus, according to its content, 10% of DAV reaches 11%, content of 80% - only about 16%. The combined effect of the content of humus and physical clay on the formation of water-physical properties of soils is given in Table. 3, in fig. 2, and see also Fig. On the 4th cover page. Using mathematical data processing, two-factor models of linear and quadratic types are obtained. The models for the density of the structure and the soil-hydrological constants (VV and HB) proved to be more reliable, less reliable (but reliable due to the predominantly significant size of the samples) - for other functional indicators. Linear models were simpler, clearer, but less correct. Pedotransfer models can have the most diverse application. For example, to predict functional indicators, subject to a change in the baseline. Let's show it on an example. In about 50 years, the average content of humus in arable soils in the country has decreased from 3.5 to 3.1%, or by 0.008% per year [8].

If the quality of land use is maintained at the current level, then after 50 years the equilibrium soil structure density will increase by 0.1 g / cm³, which will indicate an annual decline in yields by 6 c / ha (according to normative estimates of the effect of compaction on yields [3]), Or in the gross measure, each year, the loss will be almost 100 thousand tons of grain in the area of cultivation of grain crops about 20 million hectares. Another example is to assess the physical properties of soils in areas where water-physical properties have not previously been studied. This question is quite relevant for Polissya, where measurements of water-physical properties are much less than in the Forest-steppe and the Steppe. Particularly important pedotransfer models can be in irrigated agriculture to determine the NP - a key parameter for calculating irrigation norms. They can be used instead of a cumbersome measurement of this characteristic by the method of pouring platforms. It should be noted that in the production this method is not used, and the necessary parameters are borrowed from directories. It can be argued that this is one of the causes of excessive irrigation and, as a consequence, a significant development of the processes of secondary salinization and salinization for irrigation. Similarly, pedotransfer models are promising to determine another important soil-hydrological constant - the humidity of persistent plant wilting. The direct method of measuring this characteristic using vegetative miniatures is rarely used, and calculation from the data of maximum hygroscopicity by multiplying it by a coefficient of 1.34, as noted by AG Doyarenko [5] is very inaccurate, because it does not take into account the different ability of crops to absorb hard-to-reach moisture. Therefore, it can be argued that there are currently virtually no experimental data on the actual amount of inaccessible soil moisture. There is reason to believe that the pedotransfer VV calculation will significantly improve the situation. Pedotransfer estimates of the water-physical properties of soils can be useful in deciphering remote information, especially considering that humus and physical clay are already reliable in analyzing space images. This will make it possible to substantiate the available spatial information on the state of physical properties of soils. Another example: to identify areas where there is an expression of physical degradation. The reason for the latter - most often in the loss of humus and reduced ability of the soil to form an agronomically useful structure. Calculation using models can be a simple way of detecting so-called "hot spots" - "hot spots" - places where rebreathing, blasting, spraying and possible wind erosion are more often detected. The obvious perspectives of pedotransfer models in monitoring at the benchmarking of indicator indicators of soil condition depending on local values of the basic indicators and to reveal the trend of changes of the same indicator indicators. Finally, for further regionalization and reliability testing of the

model, it is possible to apply in the control of the state of the soil in the conditions of long-term lease of land, clarification of the cost of land for its sale and for more effective and objective market transformation.

Conclusions

The formation of water-physical properties of soils (their structural status, density of structure and key soil-hydrological constants - functional indicators) can be quantified by means of physical clay and humus content (basic indices). Basic and functional indicators are connected by various pedotransfer models, which differ in form and degree of reliability. Obviously, the advantage is to give multi-factor models a quadratic form, but this statement needs to be checked and further explored. Established pedotransfer models can be used to predict the state of water and physical properties, with a view to their monitoring, effective use in land reform, planning and organization of soil protection measures.

Bibliography

1. Atlas of soils of the Ukrainian SSR; Ed. N.K. Krupsky and others - K.: Harvest, 1979. - 160 p.
2. Database "Soil Properties of Ukraine". Structure and use of the procedure / [T.N. Laktionova, VV Medvedev, K.V. Savchenko and others]. - [2nd. Ed.]. - Kh. TsT № 1, 2012. - 150 p.
3. Bondarev AG Conclusion / AG Bondarev, VA Rusanov, VV Medvedev // Condensation of Arable Soils: Causes, Consequences, Way to Decrease. - Moscow: Nauka, 1987. - P. 205-209.
4. Vershinin P.V. Solid phase of soil as the basis of its physical regime / P.V. Vershinin // Fundamentals of agrophysics. - M.: Gos. Publisher: Phys.-Math. Literature, 1959. - P. 209-404.
5. Doyarenko AG Selected Works / AG Doyarenko - M.: Izd.v.s.-h. Liters, magazine And posters, 1963. - 495 p.
6. Maintenance of the deficit-free humus balance in the soil; by. Ed. O.O. Batsuli - K.: Harvest, Bibliography 1987. - 128 p.
7. Technique of boniting of soils of Ukraine / [L.Ya. Novakovsky, AP Kanash, AI Intelligent, etc.]. - K., 1992. - 102 p.
8. Methodological guidelines for the protection of soils / [V.O. Grekov, L.V. Datsky, VA Zhilkin and others.]. - K.: State. Sci.-Tech. Center for soil fertility protection Ministry of Agrarian Policy and Food, 2011. - 108 p.
9. Polupan MI Classification of soils of Ukraine / M.I. Polupan, V.B. Nightingale, VA Velychko - K.: Agrar. Science, 2005. - 299 pp.
10. Shein E.V. Pedotransfer functions: state, problems, perspectives / E.V. Shein, T.A. Arkhangelskaya // Soil Science. - 2006. - No. 10. - P. 1205-1217.
11. Bowman J. Using soil survey data for quantitative land evaluation / J. Bouma // Advances in Soil Science. - 1989. - No. 9. - P. 177-213.

Posted on 11.3.2014.