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Changes of quality and spectroscopic characteristics of the organic matter of typical chernozem under various tillage soil systems

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The purpose. To study influence of systems of soil cultivation of different intensity on quality and spectroscopic performances of organic matter of a surface layer of typical black earth. **Methods**. Field, laboratory-analytical, spectroscopic. From probed soil they extracted specimens of humic acids of 2-nd fraction. **Results**. Data are given concerning quantitative and quality parameters of organic matter of a surface layer (0-10 cm) of typical black earth at application of different systems of cultivation. It is determined that the content of general carbon and fraction of humic acids linked to calcium (HA-2) of organic matter decreases with increase of intensity of cultivation. The content of the most mobile fraction of humic acids (HA-1) and carbon of labile humus, on the contrary, increases. The most condensed aromatic structures of organic matter were organized after minimum and zero cultivation of typical black earth. **Conclusions**. Minimization of cultivation decreases loss of organic matter due to formation of stable ripe aromatic elements of humic acids.

***Key words**: typical black earth, organic matter, techniques of cultivation, spectroscopy, humic acids.*

It is known that environmentally sustainable ecosystems such as virgin soil, the thermodynamic processes of synthesis and breakdown of organic matter by soil balanced self-openfunctional thermodynamic system [1,2]. Humus self-regulation in the soil due to the nature caused of self-organization by structural elements (molecular association's heterogeneous molecules and macromoleculars) into supramacromolecular humic and fulvic acids [2-4]. The main structural elements of humic acids are moving aliphatic hydrophilic and hydrophobic aromatic resistant structural elements, as well as various functional groups represented oxygen-group (hydroxyl, fenolhidroksylni, carboxyl, ketones and other) and nitrogen (amine, etc.) compounds. In the process of transformation of soil organic matter is the selection and subsequent condensation of the most thermodynamically stable aromatic structures through semyhinon radicals. This causes biotermodynamic and hydrophobic properties of stable humus, which in turn leads to the accumulation in soil organic matter [1, 3].

Modern understanding of the structural and functional properties, various molecular weight and conformation (spatial dynamics of macromolecules) humic acid based on the principle supramolecular self-assembling structural elements in the mature stable humic acid through the formation between weak intermolecular interactions (Van der Waals force, hydrophobic-hydrophilic and hydrogen interactions) [2, 4]. It is believed that the compensation unstable conformation weak interactions is due to internal intermolecular interactions in condensed structure by enzymesphenoloxidase, which causes an increase in size and weight macromolecules [4], but there is direct evidence of intra-molecular interactions were not be found. As know that the phenoloxidase enzymes responsible for the formation hinonns structures of the main precursor of humic acid soil - lignin [1].

Tillage systems as anthropogenic factor impact on transformation processes of soil organic matter, determine the activity of humification and mineralization processes.

Intensive cultivation leads to losses of humus due to decay and stable accumulation of labile pool of soil organic matter, creating thus ecologically unstable soil areas [3]. We know that physical and chemical properties of bioorganic compounds variable is a function of their spatial structure, whose activity caused by nature supramolecular [5]. It can be assumed that the formation of humic acids typical black soil under different systems of cultivation will be reflected in the molecular structure of its components. One of the methods available to study the structural features of humic acid is spectroscopy in the visible and ultraviolet absorption zones [1, 5-7]. It is known that humic acids are very well absorb light in the ultraviolet region due to the presence condensed system aromatic structural elements [6, 7].

Materials and methods. Studies were conducted on the experimental field of agriculture department of V. V DocuchaewKharkiv National Agrarian University. (responsible officer – candidate of Agricultural Sciences M. V. Shevchenko), soil - typical black soil.. Cultivation systems - traditional intensive cultivation (plowing, aggregate PLN-4-35) to a depth of 20-22 cm; minimum tillage (disc unit DMT-4) to a depth of 10-12 cm; zero tillage technology - the direct seeding unit Grateplains. Fertilizers were adopted. Culture - winter wheat. Total area of the experiment - 1.4 hectares. Location sites consistent, three-time repetition, land area of 800 m2. The experiment conducted in 2006.

Soil samples were taken from the surface layer 0 - 10 cm for ISO 4287: 2004 [8]. Analytical work was carried out by conventional methods [9-11].

For preparations of humic acids decalcify study soil, then dissolve humic acid 0.1 N was performed. NaOH.After settling (24 hours) performed separation of clay minerals by centrifugation (3000 rev / min). Humic acid deposition conducted 10% HCl. Then a solution of humic acid gel crystallized and adjusted to air-dry state in the oven (80ºC). Ultraviolet (UV) and visible electronic absorption spectra of selected prepared humic acid (second fraction) were obtained on a spectrophotometer Stellarnet BLACK-Comet in the UV spectral region of 230 - 400 nm and in the visible range 410 - 700 nm.

Results of research. Revealed that as a result of the cultivation of different intensity in typical black soil redistribution of quantitative and qualitative parameters of organic matter compared to uncultivated virgin (Table. 1). The largest total carbon content was observed in uncultivated virgin soil as a result of natural processes of dominance (humification) and the accumulation of humus mineralization process it.

1. Effect of different tillage systems on the performance of a typical black soil humus state in the layer 0 - 10 cm

Index	Variant			
	Contol (virgin soil)	Traditional (plowing)	Minimal (wheels)	No till (direct seeding)
% Ctotal	3,13	2,77	2,85	2,84
% Clabil	0,15	0,16	0,15	0,11
Cha1, % to amount of Cha	12,40	18,79	16,14	7,04
Cha2, % to amount of Cha	39,84	22,74	33,86	39,86
Cha3, % to amount of Cha	6,39	4,33	5,36	5,63
Cha, % to amount of Ctotal	58,63	45,86	55,36	52,53
Cfa, % to amount of Ctotal	15,74	20,35	18,44	15,00
C/N	12,06	10,45	11,85	11,73

Intensive cultivation of traditional helped increase organic matter mineralization typical black soil, due to intense mechanical mixing of the surface layer of soil. Also found a slight increase in natural humus content by reducing the salinity in the surface layer of soil at the minimization of cultivation.

Revealed that the smallest content of labile carbon fraction HA-1 (as we know, the first fraction of humic acids reflects the first stage of humification - tumors young humic acids, which have mobility observed at zero cultivation technology typical black soil. Indicator of biological mineralization of organic matter in the ratio of C\N naturally increased with increasing intensity of cultivation and formation available and labile organic compounds of the soil. The data indicate accumulation of labile pool of organic matter in the version with traditional intensive cultivation, in turn, for the actions of Lean technologies (especially the version zero tillage and virgin) is accumulation faction HA-2, showing the formation of mature stable humic substances. Thus, it was found that a variant of the traditional cultivation of typical black soil accumulation occurs first fraction of humic acids on Lean and zero tillage - fixed reduction of this fraction. Content fraction HA-2 on virgin land (39.84%) contents faction close to HA-2 variant for zero technology (39.86%). It should be noted that the largest content in typical black soil fulvic acids, which are characterized, as we know, the more oxidized structure [1], there is intense for traditional cultivation.

Deeper changes in quality indicators typical black soil organic matter were investigated by spectroscopic methods. It is known that the second group of humic acids reflects the second stage of humification through condensation hinonns stable radicals condensed aromatic structures that determine the maturity and stability of the entire humic acid [1]. The spectra of humic acid preparations in the UV / visible region represented in Figure 1.

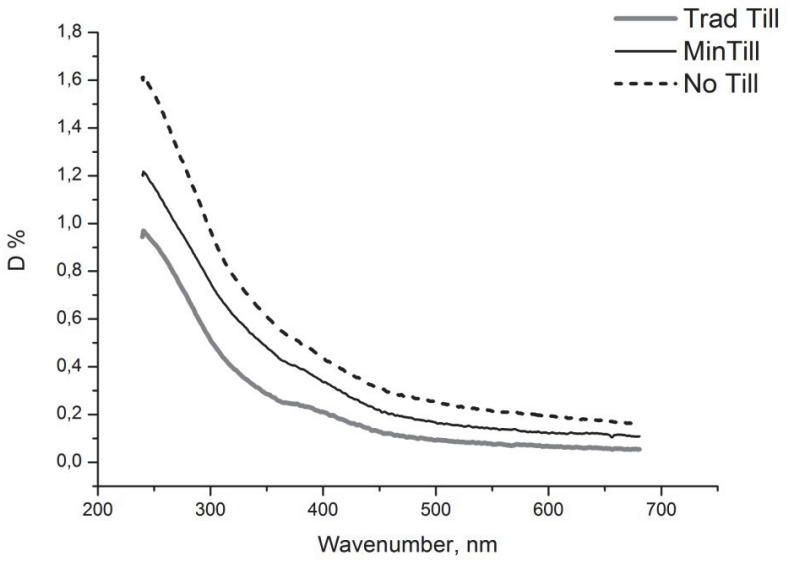

Fig. 1. UV\Vis absorption of the second fraction of humic acids in the UV and visible spectrum where No till - zero tillage, Min till - minimum tillage, Trad till - traditional tillage)

The curves are characterized by absorption of humic substances typical absorption spectrum (from 230 nm to 700 nm) and different angle lines A, which reflects the degree of aromatic condensation system. It is known that the presence of condensed aromatic structures (together with chromophore groups) determines the color of humic substances, due to the developed system of double bonds of the aromatic system and correlated with the molecular weight of the entire supramolecular humic acid [6]. This schedule reflects a natural change of angle of incidence and reduces the absorption depending on cultivation. The stability of black soil organic matter due to the typical fused aromatic structures because technology minimized leading to the generation of stable mature aromatic humic acids. With the concept of supramolecular architect of humic acids in the soil, increasing the angle of incidence in the UV region of the spectrum in the extracted humic acids from native soil leads to more self-flavored associates that contribute to the stability of organic matter [2-4]. Reducing the optical density of the extracted humic acid typical black soil plowing processed due to the decrease of molecular associates degree flavor entire supramolecular structure of humic acids bound with calcium.

Conclusions

1 Revealed that as a result of intensive cultivation (plowing) in typical black soil redistribution of quantitative and qualitative parameters of surface organic matter soil compared to virgin soil and minimized systems. The content of mobile compounds typical black soil organic matter after intensive cultivation of arable highest.

2. It is established that in the traditional intensive cultivation typical black soil is formed labile pool of organic matter, and if cultivation technology is minimized observed accumulation of a stable pool of black soil organic matter model (by increasing humic acid bound to calcium). The active fractions tumors labile organic matter associated with an increased rate of biological mineralization after intensive plowing.

3. According to the UV absorption spectra of the second fraction of humic acids typical black soil, found that the most condensed aromatic structures formed byNo tillage, which naturally offset the intensification of cultivation.

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