Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2018, 8(4), 154-157

ORIGINAL ARTICLE

Change of carbon's contain of the main humuse's groups of the black typical soil with the agriculture's ecologization

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Received: 19.11.2018. Accepted: 28.11.2018

The results of investigations for the influence of different systems of the fertilizer and soil's tillage on the carbon's contains of the main humus groups in arable layer of black type soil in grain-tilled crop rotation are presented. Using of organic-minerals fertilization system was provided to improve of humus quality and increasing of the carbon's contains to 1.81%, was broaden the ratio with $C_{humic\ acids}$:$C_{fulvic\ acids}$ to 1.85 compare with minerals fertilizer's systems. Surface nonmoldboard soil tillage was increased to the output of humus matters compare with control variant.

Keywords: Fertilizer's systems; humus; humic acids; fulvic acids

Introduction

In the folding systems of natural spirits and anthropogenic new butters, that formed the soil as a total ecosystem, humus is the main element that may support the ecological equilibrium define the level of natural and effective soilless fertility. Stability of the soil's system lay down in the area of the border of the earth with organic speech, their qualitative composition and direction of processes of transformation of organic matter in the soil (Alexandrova, 1980; Degodiyk et al., 1992; Kononova, 1963; Mazur, 2000; Noscko, 1987). Analyzing the results of numerous field experiments with different types of fertilizers (Kononova, 1963), it is clear that in most cases, their effect is positive, that is, the carbon content of fertilized variants in variants with insertion of fertilizer variants increases compare with the unhealthy background, while much more application of organic, rather than mineral fertilizers.

Some scientists believe the possibility of substantial accumulation of humus in the soil due to fertilizers is limited and their application in optimal doses that do not exceed the needs of plants in the elements of nutrition, does not allow to significantly increase the humus contain in soil (Sharkov, 1987).

The decrease in humus content is usually due to two reasons: due to the advantage of humus mineralization over its formation due to the humification of fresh organic matter and due to erosion of soils (Zhukov, 1988; Lipkin, 1989). In addition, the intensity of the processes of transformation of organic substances in the soil depends on a number of factors: fertilizer's systems (Zagorchka, 1990; Karasyuk, 1998), a method's of cultivating soil (Pavlovskii, 1997). It is believed that the critical content of humus is 1.5%, optimal for typical black soils-4.5-5.0% (Chesniak, 1982).

It should be noted that in the scientific literature there is not enough dates on the qualitative characteristics of humus in the application of various fertilizer's and soil tillage systems. As the direction of change of the humus substances under these conditions was not revealed, which does not create a holistic view of the humus characteristics and generally speaking, the humus state of the soils.

Goal of investigations: to study the influence of various fertilizer's and tillage systems of typical black soil in grain-beet crop rotation on the change of the carbon's content of the main groups of humus.

Methods of investigations

Experimental job's part was done in the meaningful field by LLC "Ahrofirma Kolos" in 2012-2016 years. It is located in Skvirsky district of Kyiv region. The investigations were conducted in stationary's experiment, the gist of its was the ten-field crop rotation. The soil of experiment's field-the typical black soil with low humus and average loaming. The contain of total humus were determined with the methods of Turin, group's humus composition-by the methods of Kononova-Belchikova.

Scheme of alternation of crops in field crop rotation: alfalfa, alfalfa, winter wheat, sugar beet, barley, soybean, winter wheat, corn's silage, winter wheat, sunflower. In this crop rotation were three fertilizer levels from the calculation per hectare of crop rotation are used: for the mineral system-compost 4.5 tons+$N_{80}P_{96}K_{108}$; organic-mineral-compost 4.5 tons+$N_{40}P_{48}K_{54}$+3.5 tons of collateral production and green manure mass and organic-compost 4.5 tons+3.0 tons of collateral production and green manure mass.

The gist of second factor that was studied-were systems of basic tillage of the soil:

- Differentiated tillage (control) recommended in the Forest-steppe and involves rotation of crop rotation are five plowing the soil, two surface cultivation for winter wheat after the soybeans and corn for silage and one nonmoldboard tillage for the barley;
- Periodical plowing tillage predicts two plowing under sugar beet and sunflower and for the rest of the crops-only nonmoldboard tillage;
- Surface nonmoldboard soil tillage for all crops of crop's rotation.

In the experiment, the following fertilizers were used: compost, ammonium nitrate, superphosphate granulated and potassium chloride. Area of plots-240 m^2. repetition of variants in the experiment is 4 times. Soil samples were taken to a depth of 25 cm.

Results

The changes in the content of carbon in humus depend on fertilizer systems are shown in Table 1. In arable soils, loss of humus occurs under different causes, such as the increase in mineralization of organic matter belongs to one of the main places. The modern level of humus couldn't be considered stable. In future, its content in such conditions will probably be further reduced, but the pace of dehumidification will slow down, as humus substances become more resistant to degradation processes. This is due to the increase in the processes of mineralization of humus and the increase in the connection of humus substances with the mineral part of the soil.

The quantity of humus and its qualitative composition reflect the ecological state of the soil (Orlov, 2005). Agrochemical factors significantly affect the composition of the humus compounds of the soil, changing its total carbon stock, the content of moving aggregate's, resistance to biological degradation (Mazur etc., 2011).

The group composition of humus is a direct consequence of processes of transformation of organic matter that is closely related to the system of fertilizer of agricultural crops (Masur, 2008).

Different sources of literature are differently described the influence of fertilizer on the aggregate's composition of soil humus. Some researchers point out that both physiologically alkaline as an acidic mineral fertilizers negatively affect for free and loose-fitting R2O3 humic and fulvic acids due to the growth in the composition of humus of mobile fractions and the simplification of the structure of humus acids (Homonova etc, 1986). Others note the positive influence of mineral and especially organic fertilizers on the humus soil condition, as well as their energy intensity (Skrylnik, 2010).

In some studies, the continued introduction of manure on black usual soil increased the content of humic acids GA-2 and GA-3 and reduced the level of GA-1. The combined use of organic and mineral fertilizers and especially the addition of mineral fertilizers, increased the content of FA-2 and FA-3. Researchers (Tsapko et al., 1992) note the formation of more extent the low molecular weight organic compounds such as fulvic acids under the influence of mineral fertilizers. Other studies indicate a proportional increase in the content of humic and fulvic acids due to prolonged and systematic application of fertilizers (Shevtsova et al., 1989).

Our investigations are showed that significant changes in the humus group composition on the experimental variants have not been noted (Table 1). In the extract of pyrophosphate with alkaline, 50-54% of carbon is passes from its total content in the soil. In hummus, humic substances (GS) are dominate over fulvic acids (FA) in the ratio $C_{humic\ acids}\backslash C_{fulnic\ acids}$, respectively, 1.7-1.88. which practically does not change under the influence of the studied factors.

It should be noted that, in the case of a surface nonmoldboard different depth soil tillage, the actual entrance of humus substances is higher than for differentiated tillage 0.82-0.87%, and 0.87-0.91% of the carbon content of humus substances per solid ground, is transferred to the extractor for surface nonmoldboard different depth tillage. In this case, the content of humus substances is 0.58-0.59% and 0.55-0.60% respectively. The increase of this indicator indicates the tendency of improvement of the humus composition in a surface nonmoldboard different depth soil tillage in the crop rotation.

Table 1. The composition of typical black soil humus depended on fertilizer and soil tillage systems (2012–2016).

Fertilizes system	C total in soil, %	HM (Humic acids)	FA (Fulvic acids)	HM+FA	HM+FA
		C, % to total C in soil			
Differentiations (control)					
Without fertilizers (control)	1.72	32.6	19.2	51.8	1.7
Organic	1.76	32.4	18	50.4	1.8
Organic-mineral	1.78	33.4	18.4	51.8	1.81
Mineral	1.77	32.9	17.9	50.8	1.8
Periodical plowing tillage					
Without fertilizers (control)	1.77	32.3	18.5	50.8	1.7
Organic	1.78	32.7	18.4	51.1	1.8
Organic-mineral	1.79	32.8	18.2	51	1.8
Mineral	1.8	32.9	18.2	51.1	1.8

Surface nonmoldboard to different depth tillage					
Without fertilizers (control)	1.75	33.9	19.4	53.3	1.7
Organic	1.79	33.8	18.3	52.1	1.8
Organic-mineral	1.81	34.5	18.7	53.2	1.85
Mineral	1.79	33.2	18.3	51.5	1.8
Average for fertilizers system					
Without fertilizers (control)	1.74	32.9	19	51.9	1.7
Organic	1.77	32.9	18.2	51.2	1.8
Organic-mineral	1.79	33.5	18.4	52	1.82
Mineral	1.78	33	18.1	51.1	1.8
Average for soil's tillage					
Complex (control)	1.75	32.8	18.4	51.2	1.77
Periodical plowing	1.78	32.7	18.3	51	1.77
Surface nonmoldboard	1.78	33.8	18.7	52.5	1.78
SSD_{05} for fertilizers	0.03	0.4	0.21		
SSD_{05} for tillage	0.03	0.48	0.33		

The use of compost 4.5 tons per 1 hectare of crop rotational area and moderate dose of mineral fertilizers ($N_{40}P_{48}K_{54}$) enriched humus with fractions of humic moss (Chekar, 2009). The quality of humus improved, the type of humus formation acquired the characteristics of humate, the relative content of carbon increased by 1.81% and the correlation $C_{humic\ acids}$:$C_{fulvic\ acids}$ to 1.85 compare to the mineral fertilizer system was broaden.

The use of non-consumable part of crop, green manure mass in combination with moderate norm of mineral fertilizers gives an opportunity to improve the qualitative composition of humus of the typical black soils.

Prolonged application of basic soil cultivation also leads to certain changes in the quality of humus substances. Thus, under the influence of soil tillage in the elemental composition of humic acids and fulvic acids, the proportion of hydrogen decreases and increases-carbon, which, along with the increase in optical density and the higher intensity of absorption of aromatic substances on infrared spectra, increases the degree of condensation of humus substances of arable land.

Condensation processes that occur under the influence of various soil-forming processes lead to a reduction in the content of carbohydrates in humus substances and an increase in the degree of oxidation. Under the influence of intense plowing, the carbon content increases (65-77%) and the oxygen content decreases, that is accompanied by a decrease in the degree of their oxidation (Batsula et al., 1987). The use of organic fertilizer system due to nitrogen deficit in soil caused more intensive processes of mineralization of soil's humus. This option indicates a low content of humic acids.

The application of the organic-mineral fertilizer's system the ratio $C_{humic\ acids}$:$C_{fulvic\ acids}$ was 1.82. which is 1.1% higher compare to the mineral fertilizer system.

The level of fulvic acids in humus also depends on the applied fertilizer systems. The highest content of fulvic acids was characterized by a control variant (without fertilizers). In it the highest index of FA was noted-19.0. that on 3.2-4.9 % prevailed the rest variants of fertilizer systems.

This indicates on intense destruction processes of organic matter, which was reflected in the lowest rates of non-hydrolyzed residue of humus in this variant.

Conclusion

Using of organo-mineral fertilizer system in crop rotation provides reproduction and stabilization of soil fertility. During the growing season in the arable layer, there is a tendency to increase the content of organic humus as well as of its main groups-humic and fulvic acids. The carbon content of humic matters grows to a more extent than carbon fulvic acids.

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Citation: Mazur, V.A., Mazur, K.V., Pantsyreva, H.V., Alekseev, O.O. (2018). Change of carbon's contain of the main humuse's groups of the black typical soil with the agriculture's ecologization. Ukrainian Journal of Ecology, 8(4), 154-157.