УДК 631.415.12

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DIFFERENTIAL ACID-BASE BUFFERING OF SOIL AS YARDSTICKOF ECOLOGICAL EFFICIENCY OF AN ORGANIC COMPONENT OF FERTILIZINGS OF AGROPHYTOCENOSISES

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ДИФЕРЕНЦІАЛЬНА КИСЛОТНО-ОСНОВНА БУФЕРНІСТЬ ҐРУНТУ
ЯК КРИТЕРІЙ ЕКОЛОГІЧНОЇ ЕФЕКТИВНОСТІ ОРГАНІЧНОГО КОМПОНЕНТА
УДОБРЕННЯ АГРОФІТОЦЕНОЗІВ

Досліджено кислотно-основну буферність (КОБ) сірого лісового ґрунту, який тривало удобрювали різними органічними добривами. Установлено, що застосування підстилкового гною, порівняно із сидератами і соломою, забезпечує у два рази більшу інтенсивність буферності ґрунту в кислотному інтервалі pH. Зміни КОБ ґрунту за відсутності гною можуть призводити до небажаних екологічних наслідків, зокрема підкислення педосфери. Розглядається новий методичний підхід до оцінки екологічної ефективності рециклінгу органічної речовини ґрунту.

Ключові слова: кислотно-основна буферність, ґрунт, екологічна ефективність, органічні добрива, агрофітоценоз.

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The acid-base buffering (*ABB*) of grey forest soil, which has a long been fertilized by different organic fertilizers is investigated. It is revealed, that the application of a farmyard manure, as contrasted to siderates and straw, provides two times as large intensity of a buffering of soil as in lead-acid range pH. The changes *ABB* of soil in case of absence in a system of fertilizing of a farmyard manure can result in undesirable ecological effects and, in particular, acidification of pedosphera. The new methodical approach to an estimation of ecological efficiency of process recycling of organic matter of soil is esteemed.

Key words: acid-base buffering, soil, ecological efficiency, organic fertilizers, agrophytocenos.

Genesis and evolution of soil are intimately connected to constant receipt of products of habitability of all spectrum autotrophic and heterotrophic of organisms. Energy-plastic the potential of these matters became basis for transformation of dead mineral weight for highly organized a bioinert body – soil. The formation of soils in developmental process of a biosphere has decided, at least, three problems: high-performance technology waste utilization of habitability of a biota, maintenance of a biota by food (both autotroph and heterotroph), regulation of flows of matter both energy and integrating of geospheres (atmosphere, hydrosphere, rock sphere) for a biosphere. For fulfilment of such relevant functions it is necessary optimum energy and plastic maintenance of a biological component of soil. In vivo it descends for the score biospheric of a turnover of matters and energy and in agrocenosises, where the significant amount of bioproductions, – are exported by padding fertilizing.

For valuable implementation of the functions, as bioinert body, the specificity of an organic substratum, its adequacy to those trophic circuits and ecological niches is very

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relevant, which one were formed during developmental acclimatization of soil. The example to this is served with different speed of decomposing of vegetative oddments of different genesis.

Among organic substratums acting at soil, the relevant place is taken also with products of habitability of animal organisms, and the covering manure is a main means of recovery of fertility of soils of agrocenosises. In vegetative forages the contents of the main carbon component – cellulose makes from 20 up to 45 %, if there is carbohydrates till 40–80 of %. In an alimentary system ruminants – main producers of a manure used in an agricultural production, the efficiency of overcooking of a cellulose makes 30–38 % and depends on the contents of lignin (Kurilov et al., 1978). The energy potential of lignin in plants serves a physical barrier handicapping of a microbial attack of cicatrix on cellulose. In process of a maturing of plants quantity of lignin in them is augmented and the degree of overcooking of cellulose is descended. Consider, that the contents in hay 10–15 % of lignin descends on 12–18 % of biological availability of polysaccharides (Kurilov et al., 1978).

Thus, the receipt of a cellulose in soil descends both at the expense of vegetative oddments and in a structure feces ruminants animal. It is necessary to take into account, that the cellulose of a manure is apart high stability to microbial decomposing, as digestible the part will be used by an organism animal. It is possible also, that under influencing enzymes of a digestive tube the part of a undigested cellulose subjects to chemical modification (liberation of energy or linkage of functional groups), that promotes change its of a reactivity.

The covering manure, as a conventional means of a fulfilment of organic matter of soil, is a specific mix of lignin – cellulose complexes of a different degree of stability to microbiologic decomposing. In this respect there is an essential difference with such claimants for a role of alternate materials of a manure as green weight siderats or straw.

It is possible, that the fractionating of cellulose and other organic components behind a degree of hydrolytic stability in a digestive tube animal is a pioneering stage of formation high stability of the forms of humic substances, that confirms by high performance of usage of a manure in processes humus formation. Therefore for an estimation of organic matter of soil is relevant not only quantitative yardstick (contents of organic matter or humus), but also its quality.

METHODS

The researches of long-standing application of different organic fertilizers are executed in Institute of agriculture and animal husbandry of Western regions of Ukraine and Lviv national university agrees the schemes:

1. Control (without fertilizings);
2. Farmyard manure, 15 t•ha^{-1} ;
3. Farmyard manure, 15 t•ha^{-1} + N_{90} P_{75} K_{90} ;
4. N_{90} P_{75} K_{90} – background;
5. Background + radish oil-yielding;
6. Background + radish oil-yielding + straw, 2 t•ha^{-1};
7. Background + straw, 2 t•ha^{-1}.

Acid-base buffering determined by a modified method Arrenius agrees the schemes:

Number sample	1	2	3	4	5	6	7	8	9	10	11
0,1 N HCl, ml	16	8	6	4	2	–	–	–	–	–	–
0,1N NaOH, ml	–	–	–	–	–	–	2	4	6	8	16
H_2O , ml	9	17	19	21	23	25	23	21	19	17	9

Ground of outcomes of potentiometric titling of water suspensions of soil calculated values of intensity *pH*-buffering (Hartikainen, 1986) quantity of the added acid or alkalis agrees equations Van Slake:

$$\beta = \frac{d\, m_s}{d\, pH} = -\frac{d\, m_b}{d\, pH} ,$$

m_s and m_b – quantity of the added acid or alkalis.

As the soil has some maxima buffering for miscellaneous intervals *pH*, buffer capacity quantitatively estimate through relation $\beta = f\ (pH)$.

RESULTS

The outcomes of researches are showed in figures 1 and 2. As it is visible from a Fig. 1, the grey forest soils have a low potential buffering to acid loads. In intervals *pH* 5,5–3,5 there are buffering reactings of linkage of protons by anions of specific and nonspecific organic acids, and also cation exchange. The buffering effect is watched only at *pH* < 3,5. The maiden maximum of a buffering is marked at *pH* 2,25 and second – 1,5 un. The intensity of a buffering in these intervals pH makes accordingly 3,5 and 6,0 mMol $\cdot 100g^{-1} \cdot pH^{-1}$. Consider, that a buffering to acid load at *pH* < 2,5 is connected to decontamination of permanent charges and process of destruction of aluminosilicates (Pratt, 1986; Bruggenwert

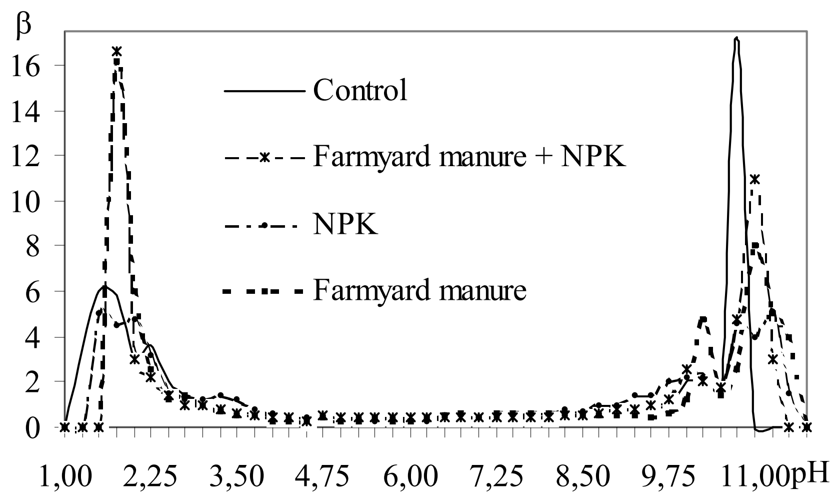

Fig. 1. **Influencing of application of a differentional system of fertilizing on intensity acid-base buffering (*β*, mM . 100 g^{-1} pH^{-1}) of grey forest soil**

et al., 1987; Ulrich, 1987). Behind our data, in this range *pH* the acid buffering also is connected to organic matter, and with its quality. So, on versions, where a source of organic matter of soil is the covering manure, is watched sharp (for 2,7 times) increase of intensity of a acid buffering in range *pH* < 2,5. The considerable buffering capacity to lead-acid load can be explained only by specificity of organic matter of soil derivated from a manure. It also confirms by that at usage of alternate materials of a manure – green manure and straw the acid buffering of soil practically did not change (Fig. 2).

There are differences for intensity of a alkaline buffering, that indicates different influencing of these organic fertilizings on a acid potential of soil.

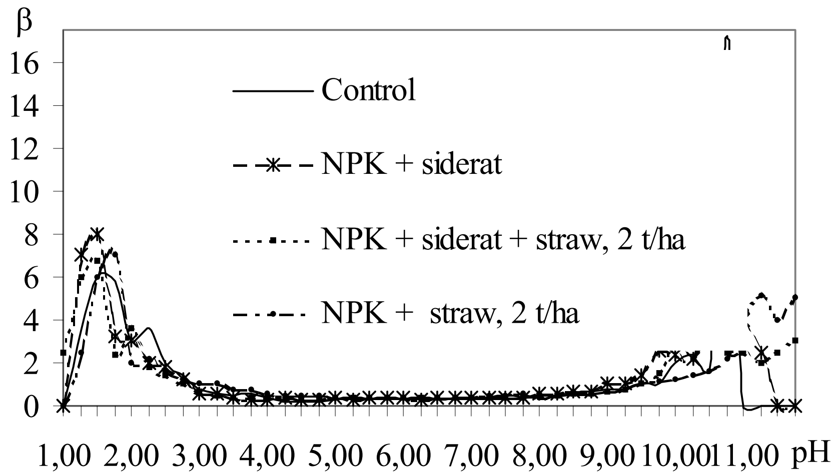

Fig. 2. **Intensity acid-base buffering of grey forest soil at usage of a mineral fertilizer and green manuring**

CONCLUSIONS

1. Qualitative and the quantitative assessment of differential *pH*-buffer capacity of soil demonstrates, that greatest buffering acid load is created with a farmyard manure.

2. Usage as a substitute of organic matter of a manure, green manuring of a radish oil-yielding and its of a complex with straw, and also straw results in change of buffer properties of soil.

3. The change of buffering of soil to acid load at different systems of fertilizings eliminating a farmyard manure, can result in undesirable ecological effects, in particular to progressing acidification of agrocenosises.

4. For reproduction of organic matter of soil in conditions of agrocenosis, recovery its of fertility and ecological functions, as a source of organic matter it is necessary to use carbon substratums with a definite ratio labile and stable forms. Such approach will allow to back up at an optimum level power engineering of biochemical edaphic transformations at the expense of the labile forms of carbohydrates and resynthesis of steady organic matter of soil – humus as multifunctional regulator of soil-ecological processes.

The writer thanks the research workers of Institute of Agriculture and Stok Breading of West Regions of Ukraine Dr. V. Sorochynskogo and V. Buljo for help in realization of researches.

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Надійшла до редколегії 01.11.03