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Changes in the Nitrogen Status of Grey Forest Coarse Dusty Light Loam Soil under Different Systems of Fertilisation and Chemical Amelioration

Abstract. This paper presents the results of research in a stationary experiment, launched in 1992 on grey forest coarse-dusty light loamy soil, aimed at studying the influence of long-term chemical amelioration and various fertilisation systems (mineral, organic, organic-mineral) on the nitrogen regime. Nitrogen is extremely important in agriculture, as all growth processes, photosynthesis, metabolism, and yield volume and quality eventually depend on this element. In Ukraine, the share of soils of woodland composition in total soil cover exceeds 33%, while the share of agricultural land is 25%. Since the humus content and its total reserves are an integral measure of soil formation and a key characteristic that determines the overall habitat of the soil, the article analyses changes in humus content as a response to the above factors. It has been found that the gross nitrogen content reflects the humus content, fully depends on and varies with the humus content of the latter. There is a high

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correlation between these indicators for all variants of the experiment (r = 0.991). The data obtained indicate that only with the use of green manure and by-products of the predecessor and moderate doses of mineral fertilisers in combination with liming, there is a moderate increase in total nitrogen as compared to the initial level. The rise amounted to 0.36-0.45 t/ha and in this case, it is possible to observe its extended reproduction. Only after mineralisation does the nitrogen of organic compounds become available to plants. The easily hydrolysed form of nitrogen is a fairly reliable indicator of whether the plants are supplied with this element. According to the classification, the soil under study, with a mobile compound content of 81.2-103 mg/kg, falls into the group of soils with a very low degree of nutrient supply, but the degree of hydrolysis of organic matter in it is high (9.6-10.2%). With the combined use of green manure, non-commodity crop products, and one-dose mineral fertilisers along with lime, this form of nitrogen increased by 27.5% compared to the control. Under the above fertiliser complex, there was an increase of 16.5 mg/kg in the amount of $N\text{-}NO_3^-+N\text{-}NH_4^+$ compared to the control, plus 7.4 mg/kg of soil nitrification capacity.

Keywords: total nitrogen, ammonia and nitrate, nitrification capacity, humus, soil, yield increase

RELEVANCE

Nitrogen in the soil plays a special role. Its content and reserves depend on the type of soil (the nitrogen content in humus is about 5%). According to M. Melnychuk and other scientists (Melnychuk M. *et al.*, 2004), the greater part of nitrogen in the soil is contained in the form of complex organic substances, which account for 93-97% of its total content, while mineral nitrogen compounds make up only 3-7%. Only the latest forms of nitrogen are available for plant nutrition. The main issue with nitrogen is its high uptake by plants, significant leaching by infiltration water under flushing conditions, and denitrification processes. This element is at the lowest level among the nutrients in the grey forest soils of the Right-Bank Forest-Steppe. The content of gross nitrogen they contain is low (0.05-0.08%), which is due to their low humus content. The accumulation of mobile forms of nitrogen is slow. Nitrification processes are particularly critical (Bober L.V., 1991; Kauricheva I.S., 1989; Vernander N.B., Godlin M.M., Sambur G.N., 1951), which is to some extent related to the acid reaction of these soils. Notably, forest soils cover a large area in the country (25% of agricultural land), and the problem of their genesis remains open to debate. Nitrogen also plays a crucial physiological role in plant growth, as it is the basis for protein synthesis. All growth processes such as photosynthesis, metabolism and other important growth functions would be impossible without the presence of this element.

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Long-term use of soils in agriculture changes their humus status, affecting not only the total humus content but also its quality composition. These changes depend on many factors, including the effect of fertilisers, ameliorants, soil cultivation, crop rotation, etc. (Dehodyuk S.E., Litvinova O.A., Smishna-Starynska L.V., 2014; Boyko P., *et al.*, 2019; Sufia Murtazina, *et al.*, 2020). The problem of nitrogen in agriculture is closely related to the content of organic matter in the soil. It contains 97-99% of all nitrogen reserves, the content of which is entirely determined by the processes of humus formation and biological activity of the soil (Saydak R.V. *et al.*, 2013; Litvinova O. *et al.*, 2019). Optimization of the soil nitrogen status under the influence of different fertilisation and tillage systems contributes to a more complete fulfilment of the genetic potential of plant productivity, obtaining consistently high yields of crops (Kolos M.O., 2017).

The study and optimisation of the nutrient nitrogen status of the soil as one of the leading factors in the formation of organic matter of plants will make it possible to increase the efficiency of growing key crops. Therefore, in this context, it is important to conduct research aimed at establishing the impact of fertilisation and tillage systems on the dynamics of mobile nitrogen compounds in the tilth layer of soil (Centilo L.V., Tsyuk A.A., 2019; China Yushu Zhang, *et al.*, 2018).

Purpose of the study. The main goal of the study was to evaluate different fertilisation systems and the long-term effects of chemical amelioration on the nitrogen regime of forest soils, which is the basis for crop formation and quality, and therefore to find the best combinations of integrated application of these fertilisers for enhanced nitrogen reproduction in the soil.

MATERIALS AND METHODS

The object of the study was grey forest coarse-dusty light loamy soil of the long-term field experiment "Study of technological methods of reproduction and regulation of grey forest soil fertility" of the Department of Agrosoil Science and Soil Microbiology of the National Research Centre "Institute of Agriculture of the National Academy of Sciences of Ukraine", which was launched in 1992 on 3 fields of seven-field grain crop rotation. The chemical reclamation was carried out in 2006, lime was applied with a full dose of 1.0 pH (defecate 4.5-6.0 t g ha $CaCO_3$), and in the reporting year, after-effects studies were conducted for the 12th to 14th year.

The fertilisation system for crop rotation and the calculation of doses of biogenic and alkaline earth elements were based on the utility model patent. No. 133924. According to the calculations, the application of biogenic and alkaline earth elements for crops according to their SSGR is as follows: winter wheat N-51.4%; P-16.7%; K-22.1%; Ca-5.7%; Mg-4.1%; soybean N-57.6%; P-12.2%; K-14.5% Ca-14.3%, Mg-2.5%; spring barley N-38.8%; P-19.7%; K-29.0%; Ca-8.2%; Mg-4.8%; white lupine N-47.0%; P-13.4%; K-23.2%; Ca-10.0%; Mg-6.4%. Accordingly, a one-dose active ingredient for winter wheat is $N_{60}R_{30}K_{60}$ and $N_{60}P_{20}K_{26}Ca_7Mg_5$, soy – $N_{30}R_{30}K_{45}$ and $N_{30}P_6K_8Ca_7Mg_1$, barley – $N_{60}R_{30}K_{45}$ and $N_{60}P_{25}K_{36}Ca_{10}Mg_6$ and lupin $N_{30}P_{30}K_{45}$ and $N_{30}P_{8,54}K_{14.8}Ca_{6.4}Mg_{4.1}$. Besides the efficiency of introducing different doses of biogenic and alkaline soil elements, their combination, the experiment studied the effectiveness of seed inoculation, which was carried out with a microbial preparation: winter wheat, spring barley – "Phosphoagrobacterin" which is a composite of several poly-strains *Agrobacterium radiobacter* + poly-strain *Bacillus subtilis*, for soy "Phosphonitragin" (*Bradyrhizobium japonicum* 634b + poly-strain *Bacillu subtilis*). In 2019, fertilisers Omya Calciprill (CaO 52% + MgO 0.5%) and Omya Magprill (CaO 36% + MgO – 15%) produced by Omya were applied.

For a more objective assessment of these effects on the soil nitrogen status, the variant results were compared not only with the absolute control but also with the initial status. A full-profile soil transect was dug on a fallow land (the age of fallow land is 28 years), which is located next to the experimental field, in which soil samples were taken across the entire surface profile. The thoroughly mixed samples were analysed simultaneously with the stationary samples according to the scheme. Agrochemical sampling and analysis of soils were carried out according to generally accepted methods: total humus content according to DSTU 4289:2004, total nitrogen according to DSTU ISO 11261: 2001, the content of highly hydrolysable nitrogen according to Kornfield; ammonium nitrogen content – by the photocolorimetric method with Nessler's reagent (DSTU 4729: 2007); nitrous nitrogen – by the inometric method (DSTU 4729:2007), nitrification capacity according to DSTU 4362:2004. The analytical work was carried out at the Laboratory of Ecological Safety of Land, Product Quality and Environment of the Soil Protection Institute of Ukraine. Abbreviations used in the article: SAC – soil-absorbing complex, SSGR species-specific genotype ratio.

RESULTS AND DISCUSSION

Humus content and its total reserves are an integral index of soil formation. The agronomic properties of arable land and the dynamics of soil fertility are closely related to the transformation of humus through agricultural use (Lykov A.M., Eskov A.I., Novykov M.N., 2004; Sypko A.O., Goruk G.S., 2014; Chebotarev N.T., Yudin A.A., Bubnova V.N., 2014). It is worth noting that grey forest soils are characterised by a distinct profile differentiation by eluvial-illuvial type and a specific accumulation of humus in it. According to the data, out of the generalised 124.0 t/ha of the soil under study in long-term fallow, 44.1 t/ha is contained in the 0-20 cm layer, which is 35.5%. Thus, the vast majority of humus reserves are concentrated mainly in the upper humus layer (Table 1). A variant comparison of the humus content without considering its initial content shows that all fertilisation systems contribute to its increase in one way or another. However, if the results are compared with the original data, the conclusions differ significantly. The data obtained show that the use of soils in agriculture without fertilisation leads to the predominance of humus decomposition over synthesis, which gradually reduces its content.

Table 1. Nitrogen status of grey forest soil depending on liming and fertilisation

Experimental variants	Humus content		Total nitrogen content (N)		highly hydrolysable nitrogen		$N\text{-}N0_3^- + N\text{-}NH_4^+$	Soil nitrification capacity
	%	t/ha	%	t/ha	mg/kg	kg / ha	mg/kg	
No fertilisers (control)	1.40	42.1	0.082	2.46	81.2	243.6	36.5	6.4
$CaCO_3$ (1.0Hr)	1.42	42.6	0.086	2.58	81.8	245.4	37.0	7.4
NPK	1.45	43.5	0.087	2.61	80.0	240.0	37.1	6.8
NPK + $CaCO_3$ (1.0Hr)	1.50	45.1	0.089	2.67	83.8	251.4	37.9	8.9
2NPK + $CaCO_3$ (1.0Hr)	1.30	39.1	0.078	2.34	75.0	225.0	35.9	5.5
NPK by SSGR	1.52	45.6	0.090	2.70	81.2	243.6	37.6	7.0
NPK by SSGR + $CaCO_3$ (1.0Hr)	1.60	48.1	0.095	2.85	81.4	244.2	38.8	7.5
Green Manure + $CaCO_3$ (1.0Hr)	1.62	48.6	0.098	2.94	84.0	252.0	42.4	9.5
Green manure + BP + NPK by SSGR	1.65	49.5	0.099	2.97	86.8	260.4	44.3	11.2
Green manure + BP + NPK + $CaCO_3$ (1.0Hr)	1.63	48.9	0.098	2.94	103.6	310.8	50.1	13.5
Green manure + BP + 1.5 NPK + $CaCO_3$ (1.0Hr)	1.68	50.4	0.101	3.03	102.8	308.4	53.0	13.8

Table 1, Continued

Experimental variants	Humus content		Total nitrogen content (N)		highly hydrolysable nitrogen		$N\text{-}NO_3^-+N\text{-}NH_4^+$	Soil nitrification capacity
	%	t/ha	%	t/ha	mg/kg	kg / ha	mg/kg	
Output sample	1.47	44.1	0.086	2.58	82.4	247.2	37.0	6.8
Average	1.5	45.6	0.1	2.7	85.3	256.0	40.6	8.7
Sx=	0.03	1.01	0.002	0.06	2.54	7.62	1.65	0.80
V%=	7.7	7.7	8.1	8.1	10.3	10	14.0	31.9
S=	0.12	3.50	0.01	0.22	8.80	26.39	5.70	2.78
LSD05=	0.11	3.14	0.01	0.20	7.90	23.70	5.12	2.49

Note: *Sx* – standard error; *X* – mean; *S* – standard deviation (an indicator characterising the variation of the sample). Main deviation of a statistical series from the arithmetic mean; V, % – coefficient of variation

In this experiment, by 4.5% to the initial level, or by 2.0 t/ha. Liming on an unfertilised base by hydrolytic acidity practically did not affect the total humus content compared to the control variant. Thus, in the control, its content was 42.1 t/ha, and in the limed variant at the full rate of hydrolytic acidity 42.6 t/ha.

Cultivation of crops with one mineral system, despite a significant increase in yield, and thus a larger vegetative mass of root and post-harvest residues entering the soil, resulted in humus reserves in this variant increasing by only 1.4 t/ha compared to the control, but were 0.6 t/ha less than in the original sample. This indicates that, although humus losses have decreased, a positive balance has not been achieved in this variant. Extended humus reproduction is possible if mineral fertilisers are used on limed soil.

Thus, when they were applied in moderate doses against the background of lime by hydrolytic acidity in this experiment, humus reserves increased by 3.0 t/ha relative to the control and by 1.0 t/ha to the baseline. The humus content of the soil decreases by 5.0 t/ha when double rates of mineral fertilisers are applied with lime compared to virgin soil. In this case, there is not enough lime to neutralise excessive acidity.

Organo-mineral fertilisation systems with moderate doses of mineral fertilisers, using green manure and plant by-products, contribute to a deficit-free humus balance with a clear positive trend, especially on limed soils. In this case, the expanded reproduction of humus to the original level in different variants ranged from 8.8 to 14.3%. It should be noted that in the variant with SSGR (species-specific genotype ratio), in which moderate and balanced rates of mineral fertilisers were applied, considering the needs of plants for nutrients and thus high yields of the main crops, and thus an increased mass of by-products and root residues, the positive humus balance increased by 3.4%, and on limed soil – by 8.8% to the initial level.

As for the content of total nitrogen in the HE horizon, it reflects the humus content in this horizon. Its absolute values for all variants presented in the table show that there is a high correlation between them ($r = 0.91$, $D = 982$). Thus, the gross nitrogen content depends almost entirely on the content and reserves of humus and varies depending on the humus content of the latter (Aleksandrova L.N., 1980; Vozbutskaya A.E., 1986; Gamzikov G.P., Emelyanova V.N., 1985; Kononova M.M., 1963; Mukha V.D., Kartamyshev N.I., Mukha D.V, 2003; Litvinov D.V., *et al.*, 2019). It is mainly represented by biologically stable organic compounds, as well as small amounts of labile compounds.

Changes in the humus status of grey forest soil that occur as a result of chemical amelioration and the use of organic and mineral fertilisers determine the dynamics of changes in total nitrogen. The results of research by Shklyar V.M. (Shklyar V. indicate that soil that has not been fertilised for a long time loses organic matter of light fractions, which is accompanied by losses of organic nitrogen and, most importantly, soluble compounds of the latter. A steady trend toward this is observable in the present study. During the operation of the experiment on the control variant, the content of total nitrogen decreased by 0.12 t/ha compared to the initial level. The study of the impact of liming at the full rate, as well as the use of a mineral fertiliser system alone, shows that they had almost no effect on the dynamics of increasing total nitrogen in the soil. When they are used together, the increase of this indicator is observed (an increase of 0.21 t/ha relative to the control). The application of double doses of mineral fertilisers even on limed soil at the full dose reduces the reserves of total nitrogen (by 0.12 t/ha compared to the control). The latter can be attributed to a certain extent to the high acidity of the soil in this variant (pH sol. 4.4, hydrolytic acidity 3.48 mg/eq per 100 g of soil). The results show that only the use of organic fertilisers in the form of green manure and plant by-products in the tilth layer of soil showed a significant increase in total nitrogen compared to the baseline. On these variants, the growth was 0.36-0.45 t/ha. This is caused by the presence of an additional quantity of this element applied with these fertilisers. Only after mineralisation does the nitrogen of organic compounds become available to plants. It is important to analyse the direction of changes under the influence of different fertilisation systems and chemical amelioration of nitrogen forms formed from nitrogenous organic compounds (amides, amino acids, etc.) that decompose rapidly and turn into mineral nitrogen, and they become the closest reserve of mineral nitrogen, and in agricultural use can be both accumulated and consumed. This form of nitrogen is a fairly reliable indicator of plant nutrition. In the original sample, this form of nitrogen according to Kornfield reaches 82.4 mg/kg. Based on this classification, soils with such a content of mobile nitrogen forms are considered to be very low in nitrogen supply. The results of this form of nitrogen also indicate the overall low humus content of virgin soil. However, the level of hydrolysis of organic matter in it is high, and for all variants is 9.6-0.2%. For example, in a typical medium loamy chernozem, it accounts for 2-4%.

The amount of alkaline-hydrolysed nitrogen in the soil varied depending on the fertilisation system and chemical reclamation, similar to the change in total nitrogen content. Thus, in the control variants with lime and only mineral fertiliser system, the content of alkaline-hydrogenated nitrogen was low and amounted to 240.0-243.6 kg/ha. There is a significant upward trend in its content compared to the control (by 3.2%) when applying single doses of mineral fertilisers on limed soil, and the application of double doses reduces its content by 7.7%. Nitrogen reserves remained virtually unchanged when using mineral fertilisers based on the SSGR principle. They increased significantly under the organic-mineral fertiliser system. The combined use of green manure, plant by-products, and single doses of mineral fertilisers on limed soil resulted in the highest growth of this form of nitrogen (27.5% over the control). A further increase in mineral fertiliser doses did not have a positive impact on the content and reserves of alkaline hydrolysed nitrogen.

Among the mineral nitrogen compounds, nitrate and ammonium nitrogen are important in plant nutrition, although the amount of mobile mineral nitrogen compounds is very small. These compounds are easily dissolvable, mobile, and dynamic in time. The content of these forms of nitrogen fluctuates significantly during the growing season, and soil moisture and temperature are of great importance, with which the activity of microorganisms is closely related. The experiment did not reveal a clear dependence of ammonium and nitrate nitrogen content on liming, the use of mineral fertilisers applied separately or in combination or by the SSGR principle. Their content increases significantly when using an organic-mineral fertiliser system. The maximum growth was achieved with the combined use of green manure, plant by-products and one and a half doses of mineral fertilisers on limed soil (an increase of 16.5 mg/kg or 45.2% compared to the control).

An important indicator of the soil's nitrogen regime is its nitrification capacity, which is the ability of the soil to accumulate nitrate-nitrogen under favourable conditions, allowing to draw conclusions about potential nitrogen reserves and its impact on crop formation. Nitrification can accumulate 100-300 kg/ha of nitrogen in the soil. The variant analysis shows that the soil under study has a low nitrification capacity according to Kravkov (5.1-8.0 mg/kg) in the vast majority of variants. The use of organic and organo-mineral fertilisation systems contributes to its transfer to the group of soils with an average nitrification capacity of 8.1-15 mg/kg.

CONCLUSIONS

The studied grey forest soils fall into the group of soils with a low humus content (1.47%) and total humus reserves (124.0 t/ha), which are inherited from the original pedogenesis and modern soil formation processes. The humus type (humate-fulvate) does not change over time under the influence of a set of agrotechnical practices, which indicates the unchanging direction of soil formation processes.

Gross nitrogen reserves (2.58 t/ha) depend almost entirely on the content and stock of humus and vary depending on the humus content of the latter. There is a high correlation between these indicators for all variants of the experiment (r = 0,991, D = 98,2). Grey forest soils are characterised by a high degree of hydrolysis of organic matter. The highly hydrolysable fraction of nitrogen in the 0-20 cm layer of the initial soil is 81.2 mg/kg of soil, which corresponds to 9.6% of the gross content. This form of nitrogen is a fairly reliable indicator of nitrogen supply to plants. The integrated use of fertilisers in combination with chemical amelioration will optimise the nitrogen status of grey forest soil, allowing for higher crop productivity.

REFERENCES

[1] Aleksandrova, L.N. (1980). Organic matter of soil and processes of its transformation. L.: Nauka. [in Russia].

[2] Bober, L.V. (1991). The effectiveness of fertilizers in crop rotation on gray forest soil of the forest-steppe zone of Ukraine. Ukrainian Academy of Agrarian Sciences. Ukrainian Research Institute of Soil Science and Agrochemistry. Kharkiv [in Ukrainian].

[3] Boyko, P., Litvinov, D., Demidenko, O., Blashchuk, M., & Rasevich, V. (2019) Prediction humus level of black soils of forest-steppe Ukraine depending on the application of crop rotation, fertilization and tillage International Journal of Ecosystems and Ecology Science (IJEES) Vol. 9(1): 155-162 doi: 10.31407/ijees9118 (ISSN: 2224-4980)

[4] Chebotarev, N.T., Yudin, A.A., & Bubnova, V.N. (2014). Complex application of fertilizers in fodder crop rotation on sod-podzolic soil. Agriculture. [in Russia].

[5] Degodyuk, S.E., Litvinova, O.A., & Smishna-Starynska, L.V. (2014). Influence of long-term application of organo-mineral fertilizer system on humus condition of gray forest soil and crop productivity. Collection of scientific works of Podolsk State Agrarian Technical University. 59-65 [in Ukrainian].
[6] Gamzikov, G.P., & Emelyanova, V.N. (1985). Balance and nitrogen conversion of fertilizers. Novosibirsk: Nauka. [in Russia].
[7] Kauricheva, I.S. (ed.). (1989). Soil Science. M: Agropromizdat [in Russia].
[8] Kolos, M.O. (2017). The study of nitrogen regime and humus status of gray forest soils depends on tillage technologies. Scientific Journal: ScienceRise, 12(41), 26-29 [in Ukrainian].
[9] Kononova, M.M. (1963). Organic matter of the soil. M.: Izdatelstvo Akademii nauk SSSR. [in Russia].
[10] Litvinov, D.V., Butenko, A.O., Onychko, V.I., Onychko, T.O., Malynka, L.V., Masyk, I.M., Bondarieva, L.M., & Ihnatieva, O.L. (2019). Parameters of biological circulation of phytomass and nutritional elements in crop rotation. Ukrainian Journal of Ecology, 9(3), 92-98 doi: 10.15421/2019_714.
[11] Lykov, A.M., Eskov, A.I., & Novikov, M.N. (2004). Organic matter of arable soils of the Non-Black Earth. M. [in Russia].
[12] Melnychuk, M., Hoffman, J., & Gorodny M. (Eds.). (2004). Soil quality and modern fertilization strategiesї. Kyiv: Aristeas [in Ukrainian].
[13] Mukha, V.D., Kartamyshev, N.I., & Mukha, D.V. (2003). Agrosoil science. M: Kolos. [in Russia].
[14] Murtazina, S., Gaffarova, L., Murtazin M. & Saimardanova, A. (2020). Evaluation of anthropogenic sustainability of agro-gray forest soil in intensive agriculture by change of its biological activity indicators BIO Web of Conferences doi: 10.1051/bioconf/20201700235 [in Russia].
[15] O. Litvinova, D. Litvinov, S. Romanova, & S. Kovalyova. (2019). Soil biological activity under the human-induced impact in the farmed ecosystem. International Journal of Ecosystems and Ecology Science (IJEES), 9(3): 529-536. doi: 10.31407/ijees9316.
[16] Saidak, R.V., Soroka, Yu.V., & Forest Yu.G. (2013). Nitrogen regime of sod-podzolic soil depending on fertilizer systems with periodic washing type of moistening. Reclamation and water management [in English].
[17] Shklyar, V.M. (2017). Humus state of gray forest soil depending from chemical melioration and different fertilization systems – agropedology and argophysics. Candidate's thesis. Chabany [in Ukrainian].
[18] Sypko, A.A., & Goruk, G.S. (2014). Reproduction of humus content in weakly acidic gray forest soil by chemical reclamation in the conditions of the Right-Bank Forest-Steppe. Bulletin of Agrarian Science, 1, 55-58 [in Ukrainian].
[19] Tsentilo, L.V., & Tsyuk, A.A. (2019). Nitrogen regime of typical chernozem depending on fertilizer and tillage. Bioresources and nature management, 1-2, 107-114 [in Ukrainian].
[20] Vernander, N.B., (ed.). Godlin, M.M., Sambur, G.N., etc. (1951). Soils of the USSR. K. [in Ukrainian].
[21] Vozbutskaya, A.E. (1986). Soil chemistry. M. [in Russia].
[22] Zhang, C.Yu., Ding, H., Xiangzhou Zheng, Zucong Cai, Tom Misselbrook, Alison Carswell, & Christoph Müller Jinbo Zhang. (2018). Soil N transformation mechanisms can effectively conserve N in soil under saturated conditions compared to unsaturated conditions in subtropical. Biology and Fertility of Soils. 495-507 [in English].

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Зміни азотного режиму сірого лісового крупнопилуватого легкосуглинкового ґрунту за різних систем удобрення та хімічної меліорації

Анотація. У статті наведено результати досліджень у стаціонарному досліді, закладеному в 1992 р. на сірому лісовому крупнопилувато-легкосуглинковому ґрунті з метою вивчення впливу тривалої хімічної меліорації та різних систем удобрення (мінеральної, органічної, органо-мінеральної) на азотний режим ґрунту. Азот є надзвичайно важливим елементом у сільському господарстві, оскільки від нього залежать усі ростові процеси, фотосинтез, обмін речовин, а також об'єм та якість врожаю. В Україні частка ґрунтів лісового складу в загальному ґрунтовому покриві перевищує 33%, тоді як частка сільськогосподарських угідь становить 25 %. Оскільки вміст гумусу та його загальні запаси є інтегральним показником ґрунтоутворення та ключовою характеристикою, що визначає загальне середовище існування ґрунту, у статті проаналізовано зміни вмісту гумусу як реакцію на вищезазначені фактори. Встановлено, що валовий вміст азоту відображає вміст гумусу, повністю залежить від нього і змінюється разом із вмістом гумусу. Між цими показниками спостерігається високий кореляційний зв'язок на всіх варіантах досліду ($r = 0{,}991$). Отримані дані свідчать, що лише при використанні сидератів і побічної продукції попередника та помірних доз мінеральних добрив у поєднанні з вапнуванням спостерігається помірне зростання загального азоту порівняно з вихідним рівнем. Приріст становив 0,36-0,45 т/га і в цьому випадку можна спостерігати його розширене відтворення. Лише після мінералізації азот органічних сполук стає доступним для рослин. Легкогідролізована форма азоту є досить надійним показником забезпеченості рослин цим елементом. За класифікацією, досліджуваний ґрунт з вмістом рухомих сполук 81,2-103 мг/кг відноситься до групи ґрунтів з дуже низьким ступенем забезпеченості поживними речовинами, але ступінь гідролізу органічної речовини в ньому високий (9,6-10,2%). При сумісному застосуванні сидератів, нетоварної продукції рослинництва та одноразового внесення мінеральних добрив разом з вапном ця форма азоту зросла на 27,5% порівняно з контролем. За вказаного комплексу добрив відбулося збільшення на 16,5 мг/кг суми $N\text{-}N0_3^-$+$N\text{-}NH_4^+$ порівняно з контролем, а також на 7,4 мг/кг нітрифікаційної здатності ґрунту

Ключові слова: загальний азот, аміак і нітрати, нітрифікаційна здатність, гумус, ґрунт, прибавка врожаю