Plant and Soil Science

Journal homepage: https://agriculturalscience.com.ua/en
Plant and Soil Science, 12(3), 76-84
Received xx.xx.2021 Revised xx.xx.2021 Accepted xx.xx.2021

UDC 631.452: 631.86:631.555

DOI: 10.31548/agr2021.03.0076

O.A. Litvinova*

PhD in Agricultural Sciences, Associate Professor
National University of Life and Environmental Sciences of Ukraine
03041, 15 Heroiv Oborony Str., Kyiv, Ukraine

S.E. Dehodiuk

Doctor of Agricultural Sciences, Head of Agrochemistry Department
National Scientific Center "Institute of Agriculture of the National Academy of Agrarian Sciences of Ukraine"
08163, 2B Mashinobudivnikiv Str., Chabany, Ukraine

Effect of Systematic Fertilisation on Soil Fertility in the Cultivation of Corn for Grain

Abstract. The article presents the results of studies on the systematic application of organic and mineral fertilisers on the fertility of grey forest soil and the formation of corn yield. It was determined that in the five-field crop rotation during the cultivation of crops, the formation of soil backgrounds with different physicochemical properties took place. Application of litter manure (direct action) at a dose of 60 t/ha against the background of moderate fertiliser rates ($N_{40-80}R_{30-60}K_{40-80}$) contributed to the neutralisation of the soil solution to the values of a slightly acidic reaction (pHsal -5.2-5.3 units), while in the absence of manure (mineral fertiliser system), the pHsal remained within the range of medium acidic reaction. The most effective in terms of humus soil condition was the organic-mineral fertiliser system (12 t/ha of manure + $N_{80}P_{60}K_{80}$) and organic (12 t/ha of manure per 1 ha of crop rotation area), respectively, the total humus content was 1.35 and 1.37% or in percentage terms 25-27% higher compared to the control (without fertilisers) – 1.08 t/ha. Optimisation of nutrient regime indicators (hydrolysed nitrogen, mobile forms of phosphorus and potassium) of the soil at the end of the rotation was provided by the organo-mineral fertiliser system ($N_{100}P_{60}K_{100}$ against 60 t/ha of manure). The highest productivity of corn per grain (9.49 t/ha) was provided by the organic-mineral fertiliser system (60 t/ha of manure + $N_{100}P_{60}K_{100}$), which is 86% higher than the control variant (without fertilisers), under such conditions the highest yield of crude protein was obtained – 0.98 t/ha

Keywords: content, nitrogen, phosphorus, potassium, soil fertility, fertiliser system, yield, protein collection

Suggested Citation:

Litvinova, O.A., & Dehodiuk, S.E. (2021). Effect of Systematic Fertilisation on Soil Fertility in the Cultivation of Corn for Grain. *Plant and Soil Science*, 12(3), 76-84. doi: 10.31548/agr2021.03.0076.

*Corresponding author

RELEVANCE

Corn is one of the most strategic agricultural crops, which by its economic and biological properties is used in various industries, including livestock, food and processing industries. Corn grain production is a complex and costly process with strict adherence to technological discipline, and timely and high-quality performance of all technological operations (Tsikov, 2003; Zubets, 2004).

High productivity of any crop, including corn, mainly depends on the technology of its cultivation, the main component of which is a properly selected fertiliser system. This contributes to the cultivation of the arable layer and improves its water-air, thermal and nutrient regimes for growing crops. Fertilisers regulate biological and agrochemical processes occurring in the soil, the intensity of decomposition and accumulation of organic matter, accumulation of nutrients in the soil (Volodin V.M., 2000; Degodyuk E.G., Degodyuk S.E., 2006). Today, there is still no precise stance on the rational use of fertilisers for agricultural crops, including corn. Therefore, to increase the level of realisation of the biological potential of the crop in grey forest soil, it is important to introduce effective cultivation technologies into production, which should be based on the widespread use of evidence-based fertiliser systems. Answers to these questions can be obtained in stationary experiments, which help to identify and study the most effective components of fertiliser systems. Therefore, research in this area is relevant. An in-depth study of the effect of agrochemicals on potential soil fertility, crop yield and quality remain important.

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

The realisation of the available agricultural resource potential is achieved through the use of significant resource sources of anthropogenic origin, in particular: mineral fertilisers, ameliorants, and plant protection products. At the present stage of agricultural production, the issue of developing new technologies for growing crops, as well as studying their impact on changes in soil properties with their long-term use, is acute. This necessitates constant monitoring of changes in soil properties, in particular, nutrient regime, nutrient cycle, and humus content, as the most important indicator of fertility and agroecological status (Mukha *et al.*, 2001; Litvinova *et al.*, 2019). The humus content ensures the resistance of soils to external influences and thus supports one of the main functions – their biogenicity (Boyko *et al.*, 2019; Litvinov *et al.*, 2019). The humus content contributes to the resistance of soils to external influences and thus supports one of the main functions – their biogenicity (Boyko *et al.*, 2019; Litvinov *et al.*, 2019). The importance of determining optimal doses of mineral fertilisers in crop cultivation technologies is well known (Pellerin Sylvain, 2000; Likhochvor, 2002; Shevchenko, 2018). Therefore, in the new economic conditions, there is a need to improve traditional fertiliser systems and develop new types of fertilisers that can quickly respond to changes in the market (Mazur G.A., 2008; Moskalenko A.M., 2013; Polupan M.I. *et al.*, 2009). According to many authors, corn is a very nutrient-demanding plant. To produce one ton of grain yield together with the total mass of the vegetative part, 25 kg of N, 13 kg of P2O5 and 22 kg of K2O per active substance are required. That is, corn is a nitrogenophile and potassiumophile, as it requires a large amount of nitrogen and potassium, and the requirement for phosphorus in corn is average. Therefore, its cultivation in the conditions of grey forest soil requires optimal ways of fertilisation with the inclusion of organic components in the fertiliser system.

The lack of even one of the elements in the nutrient balance slows down the growth and development of plants – the formation of leaves, flowering panicles, fertilisation and the formation of corn grain. It is established that nitrogen deficiency delays development and reduces the productivity of plants. Lack of phosphorus nutrition negatively affects the conditions for the formation of the root system, affects the development of reproductive organs, plants ripen much later, etc. (Movsesyan, 2009; Vlashchuk, 2016).

It is important to note that increasing crop productivity remains the main issue of agricultural production. And improving quality contributes towards providing the market with products of greater value. Moreover, it is important that improving the quality of agricultural products is the most effective factor in raising the economic efficiency of its production (Mazur, 2017; Shevchenko, 2018;). Therefore, it is particularly relevant to address the whole range of issues related to ensuring a sustainable increase in the production of high-quality corn grain in Ukraine, including the optimisation of the nutrition system.

The purpose of the study is to establish the indicators of grey forest soil fertility and corn productivity depending on the agrochemical load in field crop rotation.

MATERIALS AND METHODS

The research was conducted during 2017-2019 in a stationary experiment of the Department of Agrochemistry of the National Research Center "Institute of Agriculture of NAS" on grey forest coarse-dusty light loamy soil in a five-field crop rotation: corn for grain, spring barley, buckwheat, peas, winter wheat. The following physical, chemical and agrochemical parameters were determined in the initial soil samples. The average soil sample of arable layer 0-20 cm was characterised by the following agrochemical parameters: ph $_{KCl}$ – 4,8 potentiometrically; hydrolytic acidity – 1.61 mg-eq. per 100 g by Kappen, the content of hydrolysed nitrogen – 50.8 mg/kg of soil according to Kornfield; mobile phosphorus – 188 mg/kg of soil, mobile potassium – 100 mg/kg of soil according to Chirikov, total humus content – 1.20% (by Tyurin). The study of the agronomic value of organic fertilisers – bedding-free cattle manure was conducted. It was found that the content of basic nutrients in 1 ton of manure is: N – 4.0 kg, P_2O_5 – 2.0 kg, K_2O – 4.0 kg.

The experiment was established in 2011 and conducted in three fields, includes 11 variants, and was replicated four times. The sown area of the plot is 52 m^2, and the accounting area is 22 m^2. Cattle bedding manure was applied under corn for grain with a single dose of manure – 60 t/ha, mineral fertilisers – $N_{40}P_{30}K_{40}$. The experiment scheme includes the following fertiliser options: 1 – no fertilisers (control variant); 2 – 60 t/ha of manure; 3 – 60 t/ha f manure+ $N_{40}P_{30}K_{40}$; 4 – 60 t/ha of manure+ $N_{80}P_{60}K_{80}$; 5 – $N_{40}P_{30}K_{40}$; 6 – $N_{80}P_{60}K_{80.}$ Corn hybrid – Trubizh, listed in the State Register of Plant Varieties of Ukraine.

Soil samples were taken during the cultivation of corn for grain. The samples were analysed for: total humus content – by Tyurin; ph$_{K\text{-}Cl}$ – potentiometrically (DSTU ISO 10390:2001); hydrolytic acidity – by Kappen (GOST 26212-91); content of hydrolysed nitrogen – by Cornfield; content of mobile phosphorus and potassium – in grey forest soil – by Chirikov (DSTU 4115: 2002). The qualitative composition of corn grain was determined by infrared spectroscopy on an Infratek 1241 infrared analyser (DSTU 4117: 2007). The yield of corn grain was determined by the weight method, separately, including moisture content.

RESULTS AND DISCUSSION

The application of fertilisers in a stationary experiment on grey forest soil using the traditional system of their direct application created a tendency to differentiation in terms of potential soil

fertility. However, the application of litter manure both under direct action at a dose of 60 t/ha and against the background of moderate fertiliser rates ($N_{40-80}R_{30-60}K_{40-80}$) contributed to the neutralisation of the soil solution to the values of a slightly acidic reaction (pHsal – 5.2-5.5), while in the absence of manure (mineral fertiliser system), the pHsal remained within the range of medium acidic reaction. This indicates that the process of systematic fertilisation affects changes in the physical and chemical parameters of the arable layer of grey forest soil.

The results of the research showed that with a mineral fertilisation system, hydrolytic acidity in the arable (0-20 cm) layer was close to 1.77 mg-eq. per 100 g of soil, which indicates the need for liming, except for fertilisation systems with the use of organic fertilisers both separately (60 t/ha) and against the background of mineral fertilisers applied in moderate rates ($N_{40}R_{30}K_{40}$) (Table 1).

Table 1. The effect of fertilisers on the fertility of arable (0-20 cm) layer of grey forest soil in the field experiment, 2017-2019

Fertilisers per 1 ha of arable land		pHsal	Hydrol. qty, mg-eq per 100 g of soil	Humus content, %	Hydrolysed nitrogen	Mobile	
manure, t	NPK, kg					phosphorus P2O5	potassium K2O
					mg/kg		
No fertilisers (control)		5.4	1.36	1.08	50.8	160.0	85.8
Organic fertiliser system							
60	–	5.5	1.40	1.37	80.0	255.5	137.2
Organic-mineral fertiliser system							
60	$N_{40}P_{30}K_{40}$	5.3	1.45	1.30	75.0	243.0	132.5
60	$N_{80}P_{60}K_{80}$	5.2	1.47	1.35	78.0	265.5	147.5
Mineral fertiliser system							
-	$N_{40}P_{30}K_{40}$	4.9	1.74	1.28	71.0	257.0	120.5
-	$N_{80}P_{60}K_{80}$	4.6	1.77	1.24	74.0	260.0	128.5
LSD_{05}		0.1	0.08	0.02	0.7	4.0	3.0

Note: direct effect of litter manure

During the years of research, the tendency is observed to reproduce the content of total humus in the arable layer (0-20 cm) of the soil, so in the organic fertiliser system, the content of this indicator exceeded the initial level in percentage terms by 13%, at the initial values it was in absolute units – 1.14%. The most effective were both the organic-mineral fertiliser system (60 t/ha of manure + $N_{100}P_{60}K_{100}$) and organic (60 t/ha of manure), respectively, the content of total humus was 1.35 and 1.37% or 25-27% higher in percentage terms compared to the control (no fertilisers) – 1.08 t/ha. When using purely mineral fertilisers, the humus content in the arable layer was 1.24-1.28% or 14-18% higher than the control variant.

In all variants with fertilisation, there was an increase in the content of hydrolysed nitrogen from 71.0 to 80.0 mg/kg of soil with a content of 50.8 mg/kg in the control without fertilisers. The most active processes of accumulation of hy-

drolysed nitrogen up to 80.0 mg/kg in the layer 0-20 cm were observed with the application of organic fertilisers of 60 t/ha and ($N_{80}P_{60}K_{80}$) against the background of the aftereffect of 60 t/ha of manure. In terms of mineral content, its content was only 71.0-74.0 mg/kg, which is on average 45% higher than the control variant with a gradation of very low soil supply of this form of nitrogen.

It was established that given the increased level of supply of mobile phosphorus in the soil before the experiment, during its systematic conduct, there was an accumulation of this element corresponding to the amount of phosphorus applied as part of organic and mineral fertilisers. With the content of mobile phosphorus in the arable (0-20 cm) layer of soil in the control variant in the amount of 160.0 mg/kg of soil, its greatest increase occurred in the organic-mineral fertiliser system (60 t/ha of manure + $N_{100}P_{60}K_{100}$) – 265.5 mg/kg of soil, and purely mineral fertiliser system with the same rate of fertiliser.

Thus, the content of mobile phosphorus was within the limits that correspond to the gradation of a very high level of provision with this element. The findings suggest that with the systematic application of fertilisers, the content of mobile phosphorus in the root layer of the soil will gradually increase.

The use of organic and mineral fertilisers for crops contributed to an increase in the content of mobile potassium in the soil on average from 120 to 147 mg K_2O per 1 kg of soil while maintaining its content within the high supply in the soil. When the K_2O content in the control group without fertilisers was 85.8 mg/kg of soil, its increase (by 51.4 and 61.7 mg/kg of soil) was observed, respectively, with the application of increased NPK, both separately and against the background of 60 t/ha of manure.

The analysis of the research results showed that the accumulation of mobile potassium in the soil is slower, which can be explained by its transition to non-exchangeable forms and removal by crops.

It should be noted, that the content of hydrolysed nitrogen in both control and fertilised variants at the end of the rotation corresponded to a gradation of very low supply, and the content of mobile phosphorus – high supply, with an increase compared to the control variant (no fertilisers) by 62% for the organic-mineral fertiliser system $N_{80}P_{60}K_{80}$ on the background of 60 t/ha of manure. With the systematic application of organic and mineral fertilisers for corn for grain, there was a clear upward trend (by 61.7 mg/kg of soil) – organic-mineral fertiliser system, the content of mobile potassium, which compensates for its constant deficit in the soil, on average, its content ranged from 120-147 mg/kg of soil.

Creating necessary fertility levels of grey forest soil creates conditions for obtaining sustainable corn yields with a consistent quality of the main product. The highest grain yield in the control variant (no fertilisers) of 5.1 t/ha was 4.39 t/ha, which was obtained at the aftereffect of 60 t/ha of manure and direct action of double rate of mineral fertilisers ($N_{80}P_{60}K_{80}$), which is 86% higher than the yield in the control variant without fertilisers and 1.39 t/ha more effective than the single rate of NPK against the background of manure aftereffect (Fig. 1, 2).

It was determined that under the organic fertiliser system, the increase in corn yield (60 t/ha of crop rotation area) was 2.9 t/ha or higher by 56% compared to the control without fertilisers. The use of mineral fertilisers (mineral fertiliser system), in its pure form, resulted in increased yields of corn grain – at a single rate of 1.89 t/ha, at double rates – 3.01 t/ha, or respectively by 37 and 59% compared to the control (without fertilisers). Such a trend of producing the main crop at a sufficient level is consistent with the indicators of soil fertility and the intensity of biological processes in it.

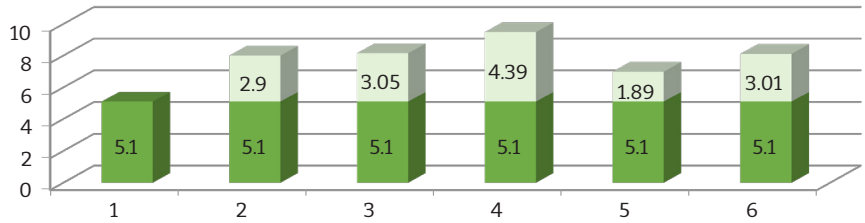

Figure 1. Effect of different fertiliser systems on corn grain yield, t/ha, the average for 2017-2019
Note: Variant 1 – no fertilisers (control); 2 – 60 t/ha of manure; 3 – 60 t/ha of manure+ $N_{40}P_{30}K_{40}$; 4 – 60 t/ha of manure+ $N_{80}P_{60}K_{80}$; 5 – $N_{40}P_{30}K_{40}$; 6 – $N_{80}P_{60}K_{80}$

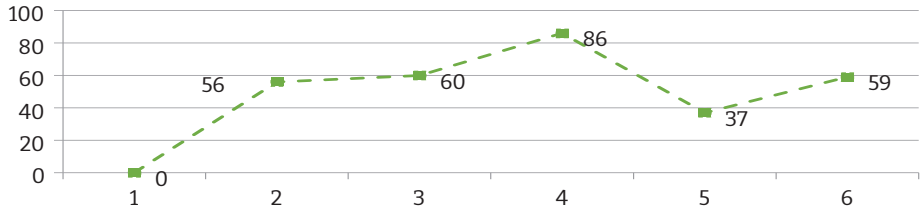

Figure 2. Effect of different fertilisation systems on corn grain growth, %, the average for 2017-2019
Note: Variant 1 – no fertilisers (control); 2 – 60 t/ha of manure; 3 – 60 t/ha of manure+ $N_{40}P_{30}K_{40}$; 4 – 60 t/ha of manure+ $N_{80}P_{60}K_{80}$; 5 – $N_{40}P_{30}K_{40}$; 6 – $N_{80}P_{60}K_{80}$

One of the main indicators of corn grain quality is the crude protein content. The quality of corn grain tends to raise this index in the case of the application of organic and mineral fertilisers. At the same time, the main role in the accumulation of protein belongs to nitrogen. The highest content of crude protein was obtained by applying the organic-mineral fertiliser system at a rate of 60 t/ha of manure + $N_{40}P_{30}K_{40}$ and amounted to 10.64, as compared to the control variant – 9.36%. The variant with organic fertilisers was at the level of 10.08%, under a purely mineral system at a single rate – 10.29 (Fig. 3).

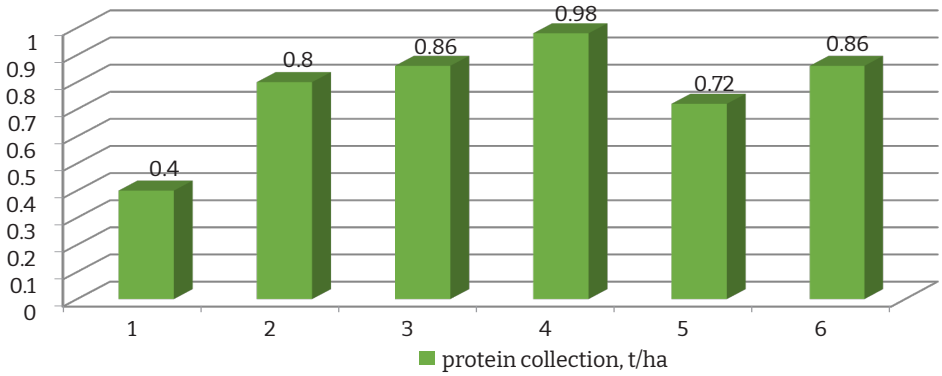

Figure 3. Effect of different fertiliser systems on corn protein yield, t/ha, the average for 2017-2019
Note: Variant 1 – no fertilisers (control); 2 – 60 t/ha of manure; 3 – 60 t/ha of manure+ $N_{40}P_{30}K_{40}$; 4 – 60 t/ha of manure+ $N_{80}P_{60}K_{80}$; 5 – $N_{40}P_{30}K_{40}$; 6 – $N_{80}P_{60}K_{80}$

The collection of crude protein from 1 ha was consistent with the patterns established by its content and yield. When conducting crop rotation without fertilisation, one can expect indicators at the level of 0.40 t/ha, while with systematic fertilisation it is possible to obtain a protein collection at the level of 0.72-0.98 t/ha.

CONCLUSIONS

It was established that during the systematic application of fertilisers in five-field crop rotation under the influence of different systems, the formation of soil backgrounds with different physicochemical properties is observed, the reaction of the soil solution at the introduction of litter manure at a dose of 60 t/ha and against the background of moderate fertiliser rates ($N_{40-80}P_{30-60}K_{40-80}$) contributed to the neutralisation of the soil solution to the values of slightly acidic reaction (pHsal – 5.2-5.5), while in the mineral fertiliser system, the pHsal remained within the medium acid reaction, which indicates the need for its periodic liming once per crop rotation in grey forest soil when only mineral fertilisers are used in the fertiliser system.

In the arable layer (0-20 cm) a trend towards an increase in humus reserves was observed. The most effective was the organic-mineral fertiliser system (12 t/ha of manure + $N_{80}P_{60}K_{80}$) and organic (12 t/ha of manure per 1 ha of crop rotation area), respectively, the total humus content was 1.35 and 1.37% or in percentage terms 25-27% higher compared to the control (without fertilisers) – 1.08 t/ha.

It was found that the content of hydrolysed nitrogen both in the control and fertilised variants at the end of rotation corresponded to the gradation of the level of very low supply, which is associated with a high level of yield and removal of this element by the crop, the content of mobile phosphorus – high level of supply, with an increase of 1.6 times in the organic-mineral fertiliser system $N_{80}P_{60}K_{80}$ against the background of 60 t/ha of manure. With the systematic application of organic and mineral fertilisers for the cultivation of corn for grain, a clear upward trend (up to 61.7 mg/kg of soil depending on fertiliser) of mobile potassium content was observed, which compensates for its constant deficit in the soil, on average, its content fluctuated within the high supply – 120-147 mg/kg of soil.

It is proved that the maintenance of appropriate levels of soil fertility provides conditions for obtaining sustainable yields of winter wheat with relevant quality indexes of the main products. The highest yield levels were achieved by applying the organic-mineral fertiliser system (60 t/ha of manure + $N_{80}P_{60}K_{80}$) – 9.49 t/ha, which is 86% higher than in the control variant (fertilisers), under these conditions the highest yield of crude protein was obtained – 0.98 t/ha.

REFERENCES

[1] 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), 9(1): 155-162 doi: 10.31407/ijees9118 (ISSN: 2224-4980)

[2] Dehodyuk, E.H., & Dehodyuk, S.E. (2006). Ekoloho-tekhnohenna bezpeka Ukrayiny [Ecological and technogenic safety of Ukraine]. K.: EKMO. 306 s.

[3] Dehodyuk, E.H., Sayko, V.F., Korniychuk, M.S., Sokolov, O.O. *et al.* (1992). Growing environmentally friendly crop products za red. E.H. Dehodyuka. K.: Urozhay. 318.

[4] Likhochvor, V.V., & Against, R.R. (2002). Corn: teaching practice. kind. Lviv: Ukraine. Technologies, 48 p.
[5] 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 2019, 9(3), 92-98 doi: 10.15421/2019_714
[6] Mazur, H.A. (2008). Reproduction and regulation of light soil fertility. K.: Ahrarna nauka. 308.
[7] Mazur, V.A., Shevchenko NV Influence of technological methods of cultivation on formation of qualitative indicators of grain. Agriculture and forestry. Vinnytsia, 2017, 6(1), 7-13.
[8] Moskalenko, A.M. (2013). Biological and economic factors of expanded reproduction of soil fertility in Polissya. Orhanichne vyrobnytstvo i prodovol'cha bezpeka. Zhytomyr: Polissya. s. 83-92.
[9] Movsesyan, D.N. (2009) Features of mineral nutrition of corn // Pearls of the steppe region, (November 4-6, 2009): materials region. scientific-practical agroecologist. conf. stud., graduate students and young scientists / editor.: VM Ganganov and others. Mykolaiv: Moscow State Agrarian University, 119-122.
[10] Mukha, V.D. *et al.* (2001). Agrochemistry. M.: Kolos. 503 s.
[11] Pellerin Sylvain, Mollier Alain, Plinet Daniel. (2000). Phosphorus Deficiency Affects therate of Emergence and Number of Corn Adventitious Nodal Roots. Agronomy Journal, 92, 690-697.
[12] Polupan, M.I., Velychko, V.A., Solovey, V.B., & Bilivets', I.I. (2009). Productive ability of Forest-Steppe soils by natural and effective fertility. Visnyk ahrarnoyi nauky, 7, 27-31.
[13] Scientific bases of agro-industrial production in the steppe zone of Ukraine / editor: MV Zubets and others. Kyiv: Agrarian. Science, 2004. 844 p
[14] Shevchenko, N.V. (2018) Yield of corn grain depending on seed treatment and foliar fertilization. Scientific reports of NULES of Ukraine: electronic scientific professional publication. Vip. 3(73). URL: http://journals.nubip.edu.ua/index.php/Dopovidi/article/view/10820/9463.
[15] Shevchenko, N.V. (2018). The duration of interphase periods of plants of maize hybrids depending on seed treatment and foliar feeding. Balanced nature management. Kyiv, 1, 73-76.
[16] The formation of the yield of new hybrids of corn of different maturity groups depending on the elements of technology in the steppe zone of Ukraine under irrigation / A.M. Vlaschuk, O.P. Konashchuk, A.G. Zheltova, O.S Kolpakova. Irrigation 49 agriculture. 2016. Vip. 65, 86-89.
[17] Tsikov, V.S. (2003) Corn: technology, hybrids, seeds. Dnepropetrovsk: Zorya, 296 p.
[18] Volodin, V.M. (2000) Ekologicheskiye osnovy otsenki i ispol'zovaniya plodorodiya pochv [Ecological bases for assessment and use of soil fertility]. M.: TSINAO. 336 s.

О.А. Литвинова

Кандидат сільськогосподарських наук, доцент
Національний університет біоресурсів і природокористування України
03041, вул. Героїв Оборони, 15, м. Київ, Україна

С.Є. Дегодюк

Доктор сільськогосподарських наук, завідувач відділу агрохімії
Національний науковий центр "Інститут землеробства
Національної академії аграрних наук України"
08163, вул. Машинобудівників, 2Б, м. Чабани, Україна

Вплив систематичного внесення добрив на родючість ґрунту при вирощуванні кукурудзи на зерно

Анотація. У статті наведено результати досліджень з вивчення впливу систематичного застосування органічних і мінеральних добрив на родючість сірого лісового ґрунту та формування врожаю кукурудзи. Встановлено, що в п'ятипільній сівозміні під час вирощування сільськогосподарських культур відбувалося формування ґрунтових фонів з різними фізико-хімічними властивостями. Внесення підстилкового гною (прямої дії) в дозі 60 т/га на фоні помірних норм добрив ($N_{40-80}R_{30-60}K_{40-80}$) сприяло нейтралізації ґрунтового розчину до значень слабокислої реакції (pHsal -5,2-5,3 од.), тоді як за відсутності гною (мінеральна система удобрення) pHsal залишався в межах середньокислої реакції. Найефективнішою з точки зору гумусового стану ґрунту була органо-мінеральна система удобрення (12 т/га гною + $N_{80}P_{60}K_{80}$) та органічна (12 т/га гною на 1 га сівозмінної площі), відповідно, загальний вміст гумусу становив 1,35 та 1,37% або у відсотковому відношенні на 25-27% більше порівняно з контролем (без добрив) - 1,08 т/га. Оптимізацію показників поживного режиму (гідролізований азот, рухомі форми фосфору і калію) ґрунту в кінці ротації забезпечила органо-мінеральна система удобрення (N100P60K100 проти 60 т/га гною). Найвищу продуктивність кукурудзи на зерно (9,49 т/га) забезпечила органо-мінеральна система удобрення (60 т/га гною + $N_{100}P_{60}K_{100}$), що на 86% перевищує контрольний варіант (без добрив), за таких умов отримано найвищий вихід сирого протеїну - 0,98 т/га

Ключові слова: вміст, азот, фосфор, калій, родючість ґрунту, система удобрення, урожайність, збір білка