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HUMIFICATION OF PLANT RESIDUES UNDER OPTIMAL CONDITIONS

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Abstract

Humus as a specific organic part of the soil is involved in the formation of soil fertility. Humus is formed as a result of humification of decomposition products of organic residues. This process varies depending on temperature and humidity. Plant residues of different crops are subject to the process of humification in different ways. This became a question of our research. The article presents the data of humification of plant residues: winter wheat, barley, corn for grain and sunflower.

Key words*: humus, humification, plant remains.*

INTRODUCTION

The main task of modern agriculture is to create food production on the basis of scientifically sound systems of agriculture and comprehensive growth of fertile soils.

Currently, the basic law of agriculture is rarely supported - the law of return, in accordance with all substances, felt with the harvest of crops, must be returned to the soil in excess, which will increase the process of humus mineralization and dehumidification as a result.

In the soil, the processes of mineralization and humification occur in parallel with each other. As a result of mineralization, carbon dioxide, mineral compounds of nitrogen, phosphorus, potassium and other macro-microelements are released. During humification, a complex biological and chemical process of transformation of high-molecular decomposition products of organic substances into a special class of organic compounds - humic acids takes place.

The intensity of the humification process depends on the amount of newly formed humus, and the soil fertility, which depends on the quantity and quality of humus in the soil. One of the the most fertile soils is considered to be typical chernozem (Fedaka, 2011). The area of chernozems in the world is 314 million hectares, or 2.4% of the area of all soils in the world. Ukraine occupies a leading position among the countries in which chernozems are widespread. The area of typical chernozems in Ukraine is 6.2 million hectares (Pozniak, 2016)

The views of scientists on the process of humus formation and humification are formulated in the following sequence: from chemical to microbiological and later biochemical positions (Kostychev, 1886; Kononova, 1963; Aristovskaya, 1980; Orlov, 1990). However, among the average representatives of the theory of the last confirmed experimental experiment does not exist, and since then until the final understanding of this process, scientists seek to the present day, so this question has not lost relevance in modern soil science.

Most scientists (Alekseev et al., 1970; Tittarelli et al., 2002; Dovban, 2009; Antonets, 2014; Shuvar et al., 2015; Balaev and Pikovskaya, 2016; Vitvitsky, 2016; Segnini et al., 2017) believe that in modern conditions, the main source for improving the fertility soil, increasing the higher yields of crops, as well as replenishment of organic matter in the soil is straw with the crop residues in combination with green manure. They proved that it promotes the activation of the processes of humification of organic matter.

Building on a of scientists (Jones et al., 2012; Adamenko, 2014; Reshetchenko et al., 2015), which indicates that over the past 35 years, the average air temperature rises at 1 ° C and there are significant changes in the distribution of precipitation during the growing season, which makes it a priority to study the processes of intensity of humification of crop residues in climate change.

MATERIALS AND METHODS

The research was conducted on the territory of the state enterprise of educational and research farm "Dokuchaevske" within the training, research and production center "Experimental Field" of Kharkiv National Agrarian University named after V.V. Dokuchaev. The soil was used for research: chernozem typical heavy loam on loess-like loam of the fallow area, which was withdrawn from agricultural use in 1956.

Plant material - surface post-harvest residues of winter wheat, corn, sunflower, barley.

Soil samples of typical chernozem were taken from the arable layer with a depth of 0-30 cm. Determination of mobile phosphorus and potassium by the modified Chirikov method. The method is based on the extraction of mobile phosphorus and potassium compounds from the soil with a solution of acetic acid with a concentration of $c(CH_3COOH)$ = 0.5 mol/dm^3 at a soil to solution ratio of 1:25. And the next determination of phosphorus in the form of a blue phosphorolibdenum complex on a photoelectrocolorimeter and potassium - on a flame photometer. Determination of alkaline hydrolyzed nitrogen by the Cornfield method. The method is based on the hydrolysis of organic soil compounds with an alkali solution of molar concentration $c(NaOH)$ = 1 mol/dm^3 in a thermostat at a temperature of (28 ± 5)°C in a Conway cup with a lid. After hydrolysis, ammonia is quantified by titration with a solution of sulfuric acid of molar concentration $c(1/2\ H_2SO_4)$ = 0.02 mol/dm^3. Determination of total humus by the Turin method. The method is based on the oxidation of soil organic matter by a solution of potassium dichromate in sulfuric acid, followed by determination of organic carbon content through the determination of potassium dichromate after oxidation by titrometry. Dry matter and moisture by weight were determined. Gravimetric method. Soil samples are dried to constant weight at (105 ± 5)°C. And determination of total soil moisture by saturation in cylinders. The principle of the method is based on determining the amount of moisture in soil samples when all pores and voids are completely filled with water.

Calculation and preparation of plant material and soil for composting was performed according to the method of Chesnyak. Plant residues are selected a week before harvest. The rests are selected manually, the crop rests are crushed to the size of 0.5 cm and in a shade bring to an air-dry condition. The weight of the soil in terms of a completely dry sample for each repetition is equal to 100 g. The selected general soil sample to grind it better with plant residues is ground, sifted through a sieve and visible plant remains are selected. Two days before the start of the experiment in the general soil sample determine the moisture content and the content of total humus.

In the laboratory, "composting" of plant samples with soil was performed for 40, 50 and 60 days at optimal languages, namely at a temperature of 26-28°C and at a humidity of 60 % of the total moisture content.

Statistical data processing is performed in Microsoft Excel.

RESULTS AND DISCUSSIONS

Typical heavy loam chernozem on loess-like loam was used for research. With initial data: total humus - 6.24%; light hydrolysis nitrogen - 214 mg/kg of soil; mobile phosphorus - 294 mg/kg of soil; exchangeable potassium - 282 mg/kg of soil.

For calculations and laboratory analysis, the total soil moisture capacity content was determined - 64%. And soil moisture - 4.36%.

Composting was performed in a thermostat for 60 days with stepwise selection for 40, 50 and 60 days.

The results of composting, namely the dynamics of the content of total humus in the soil and the change in the amount of plant material of the surface crop residues of winter wheat are presented in Tables 1, 2.

During the first 40 days of composting, the weight of plant material decreased sharply by 44.3% and amounted to 4.75 g (Table 1). During this period, the content of total humus (Table 2) in the studied soil increased by 0.26% and amounted to 6.50%. Over time, during composting, a sharp decrease in the mass of plant debris grows into a moderate one. Thus, during the 50-day period of composting of plant material of winter wheat, the mass of plant residues decreased by only 0.22 g from the previous 40-day period (Table 1), while the content of total humus, on the contrary, increased sharply and amounted to 6.83%, which is 0.33% higher than the previous value (Table 2).

The tendency of moderate decrease in the mass of surface crop residues of winter wheat is observed in the version for 60 days of composting. The difference between the previous version is only 0.06 g. In this sample, there is also a slowdown in the accumulation of total humus. The difference between the options of 50 and 60 days of composting is only 0.10%.

Table 1. Change in the mass of plant material during the composting period

Composting time, days	Mass of plant material before composting, g	Mass of plant material after composting, g	Change in the mass of plant material after composting
40	8.52	4.75 ± 0.09	3.77* 44.3
50		4.53 ± 0.09	3.99 46.8
60		4.47 ± 0.09	4.05 47.5

*Above the line - the difference in weight of plant material after composting, g; under the line - reduction of plant residues, %

Table 2. Change in the content of total humus in chernozem typical for the composting period

Duration of compostin g, days	The content of total humus in the soil before composting, %	The content of total humus in the soil after composting, %	Increase in total humus in the soil after composting, %
40	6.24	6.50 ± 0.21	0.26* 104.2
		6.83 ± 0.21	0.59 109.5
50		6.83 ± 0.21	0.69 111.1

*Above the line - the increase in the content of total humus in the soil after composting, %; Under the line - % of the control content of humus in the soil

The increase in the content of total humus in the soil, compared with the control, for 40 days of composting was 0.26%, and the weight loss of plant residues was 3.77 g. For 50 days of composting, the increase in total humus content is 0.59%, and the decrease in the mass of plant material of the surface crop residues of winter wheat 3.99 g. During the 60-day period of composting, the increase was 0.69%, and the decrease in the mass of plant material by 4.05 g.

Thus, studies have shown that during the first 50 days of composting in optimal environmental conditions there is an intensive loss of mass of plant material, and there is an intensive humification.

Thereafter, it shall moderate, which is due to a decrease in the activity of microorganisms, as stressed in his writings Aristovs`ka.

Against the background of increasing the content of total humus, the mass of surface crop residues of winter wheat decreased. The intensity of this decrease was proportional to the intensity of humification (Figure 1).

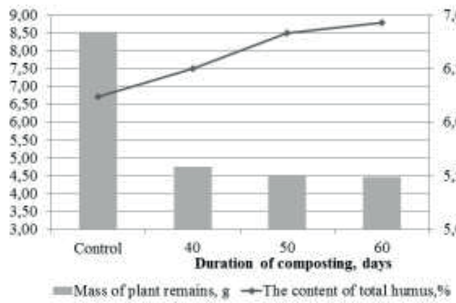

Figure 1. Dynamics of total humus content and mass of plant residues

Confidence interval for changes in total humus content and mass of plant residues of winter wheat in the composting process For total humus content in soil it is ± 0.21%, for plant residues - ± 0.09 g. Therefore, the difference in total humus content in soil between control and all the presented options is significant because it exceeds the icon by 0.21%. In comparison with the different options between each other, that after 40 days and 50 days of the composition is clearly significant difference, while the difference between the 50 and 60 days of the composition is less than 0.21% and is not significant, as defined above, due to the slowdown of the humification process.

Changes in the mass of plant substances containing winter substances between the control and the studied variants are significant. This makes it possible to ensure a continuous process of conversion of plant material during the study, but its intensity decreases over time.

It is established that the humification process is continuous. The content of total humus with the winter period of composting in optimal conditions increases. The intensity of the increase in the content of total humus, as well as the process of humification, varied. Time distribution of humification intensity after the following character: return → peak → recession. When using the humus content, the mass of winter wheat residues decreases. The intensity of this reduction is proportional to the intensity of the humification process.

Dynamics of nutrient content in the version with winter wheat.

Figure 2 shows the dynamics of the content of light hydrolysis nitrogen in terms of composting. As can be seen from the graph, the increase in light hydrolysis nitrogen has an increasing rate. For the first 40 days the increase is 11.7%, for 50 days - 15.4% and for 60 days the increase from control is 24.3%

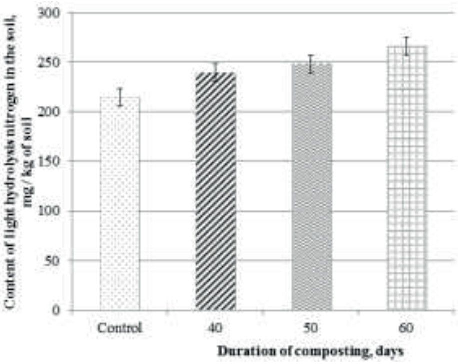

Figure 2. Dynamics of light hydrolysis nitrogen content in soil

The dynamics of mobile phosphorus in the studied variant was as follows (Figure 3). As can be seen from the graph for the period of composting, a significant difference in the content of mobile phosphorus was observed only at 50 days of composting and amounted to 275 mg/kg of soil.

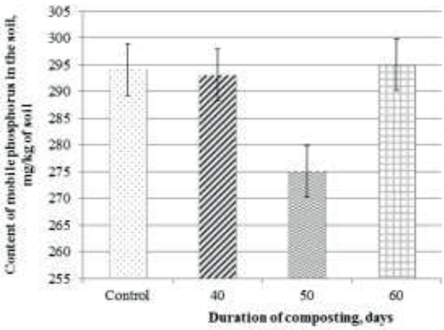

Figure 3. Dynamics of mobile phosphorus content in soil

The dynamics of the content of exchangeable potassium is shown in Figure 4. From this graph we see that from the first 40 days of composting in the studied variant there is a significant increase in potassium and lasts up to 50 days and is 478 and 542 mg/kg of soil, respectively. Starting from 60 days, there is a moderate decrease in the content of metabolic potassium and is 532 mg/kg of soil.

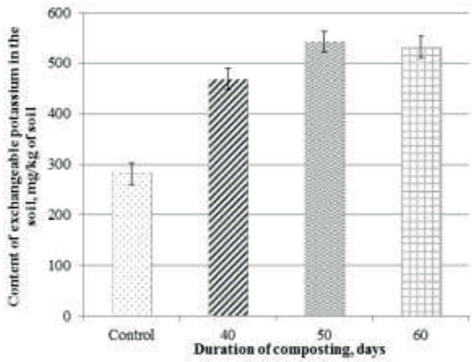

Figure 4. Dynamics of metabolic potassium content

The dynamics of the content of total humus in the soil and the change in the amount of plant material of the surface crop residues of barley are presented in Tables 3 and 4.

During the first 40 days of composting the mass of plant material decreased by 2.79 g (Table 3), during this period the content of total humus (Table 4) in the studied soil increased by 0.11% and amounted to 6.35%. The change in weight over the next 10 days was 1.55 g, and the increase in humus during this period was only 0.10%. In the next 10 days there is a decrease in the intensity of the transformation of surface plant residues. The change in weight during this period is 0.6 g, and the intensity of humus accumulation increases, the difference is 0.32%.

Table 3. Change in the mass of plant material during the composting period

Composting time, days	Mass of plant material before composting, g	Mass of plant material after composting, g	Change in the mass of plant material after composting
40	7.94	5.15 ± 0.11	2.79 * / 35.1
50		3.60 ± 0.11	4.34 / 54.7
60		3.00 ± 0.11	4.94 / 62.2

*Above the line - the difference in weight of plant material after composting, g; under the line - reduction of plant residues, %

The increase in the content of total humus in the soil, compared with the control, for 40 days of composting was 0.11%, and the weight loss of plant residues was 2.79 g. For 50 days of composting, the increase in total humus content is 0.21%, and the decrease in the mass of plant material of the surface crop residues of barley 4.34 g. During the 60-day period of composting, the increase was 0.53%, and the decrease in the mass of plant material by 4.94 g.

Table 4. Change in the content of total humus in chernozem typical for the composting period

Composting time, days	The content of total humus in the soil before composting,%	The content of total humus in the soil after composting, %	Increase in total humus in the soil after composting, %
40	6.24	6.35 ± 0.06	0.11 * / 101.8
50		6.45 ± 0.06	0.21 / 103.4
60		6.77 ± 0.06	0.53 / 108.5

*Above the line - the increase in the content of total humus in the soil after composting,%; Under the line -% of the control content of humus in the soil

Thus, studies have shown that during the first 50 days of composting in optimal environmental conditions there is an intensive loss of mass of plant material.

Against the background of increasing the content of total humus, the mass of surface crop residues of barley decreased. The intensity of this decrease was proportional to the intensity of humification (Figure 5).

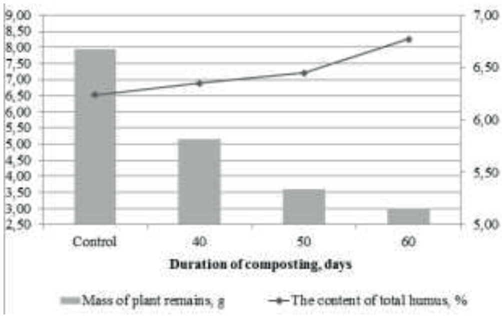

Figure 5. Dynamics of total humus content and mass of plant residues

Confidence interval for changes in total humus content and weight of barley crop residues during composting. For the content of total humus in the soil it is ± 0.06%, for the amount of plant residues ± 0.11 g. Therefore, the difference in the content of total humus in the soil between the control and all the presented options is significant because it exceeds the mark of 0.06%.

The change in the mass of barley crop residues between the control and the studied variants is significant. This makes it possible to argue about the continuous process of transformation of plant material in the process of the experiment, but its intensity decreases over time.

It is established that the humification process is continuous. The content of total humus increases with increasing composting period in optimal conditions.

Dynamics of nutrient content in the version with barley.

Figure 6 shows the dynamics of the content of light hydrolysis nitrogen in terms of composting. As can be seen from the graph, the increase in light hydrolysis nitrogen is oscillating. For the first 40 days, the content of light hydrolysis nitrogen was 203 mg/kg of soil, which is 6% less than the control. Over the next 10 days, the increase in light hydrolysis nitrogen in the studied variant was 34 mg/kg of soil, and over the next 10 days the content decreased by 31 mg/kg of soil and amounted to 206 mg/kg of soil.

The dynamics of mobile phosphorus in the studied variant was as follows (Figure 7). As can be seen from the graph during the composting period, the dynamics of the content of mobile phosphorus has a gradually increasing rate. The increase in composting days was 4.8%, 7.1% and 18.7% of control.

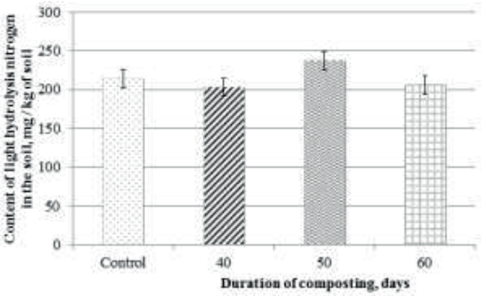

Figure 6. Dynamics of easily hydrolyzed nitrogen in the soil

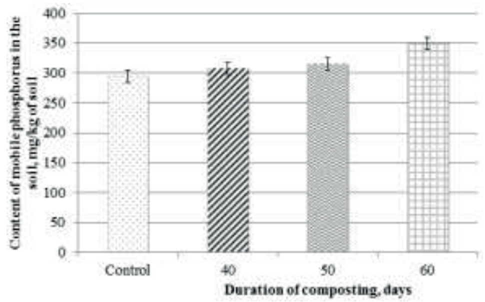

Figure 7. Dynamics of mobile phosphorus in soil.

The dynamics of the content of exchangeable potassium is shown in Figure 8. From this graph we can see that from the first 40 days of composting in the studied variant there is a significant increase in potassium and is 558 mg/kg of soil.

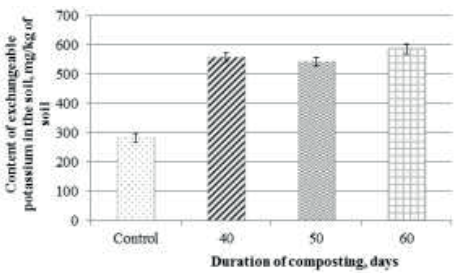

Figure 8. Dynamics of metabolic potassium content in soil

Slightly lower content of metabolic potassium is observed in the studied variant at 50 days, its content is 541 mg/kg of soil. From 60 days there is an increase in the content of metabolic potassium and is 586 mg/kg of soil.

The dynamics of the content of total humus in the soil and the change in the amount of plant material of the surface crop residues of corn for grain are presented in Tables 5 and 6.

During the first 40 days of composting the mass of plant material decreased by 4.26 g (Table 5), during this period the content of total humus (Table 6) in the studied soil was 6.28%. The change in weight over the next 10 days was 1.22 g, and the increase in humus during this period is 0.17%. In the next 10 days there is a decrease in the intensity of the transformation of surface plant residues. The change in weight during this period is 0.67 g, and the intensity of humus accumulation increases, the difference is 0.48%.

Table 5. Change in the mass of plant material during the composting period

Composting time, days	Mass of plant material before composting, g	Mass of plant material after composting, g	Change in the mass of plant material after composting
40	8.28	4.02 ± 0.20	4.26 * / 51.4
50		2.80 ± 0.20	5.48 / 66.2
60		2.13 ± 0.20	6.15 / 74.3

*Above the line - the difference in weight of plant material after composting, g; under the line - reduction of plant residues,%

Table 6. Change in the content of total humus in chernozem typical for the composting period

Composting time, days	The content of total humus in the soil before composting, %	The content of total humus in the soil after composting, %	Increase in total humus in the soil after composting, %
40	6.24	6.28 ± 0.08	0.04 * / 100.6
50		6.45 ± 0.08	0.21 / 103.4
60		6.93 ± 0.08	0.69 / 111.1

*Above the line - the increase in the content of total humus in the soil after composting, %; Under the line - % of the control content of humus in the soil

The increase in the content of total humus in the soil, compared with the control, for 40 days of composting 0.04%, and the weight loss of plant residues was 4.26 g. For 50 days of composting, the increase in total humus content is 0.21%, and reduction of the mass of plant material of surface crop residues of corn per grain of 5.48 g. During the 60-day period of composting, the increase was 0.69%, and the decrease in the mass of plant material by 6.15 g.

Thus, studies have shown that during the first 50 days of composting in optimal environmental conditions there is an intensive loss of mass of plant material.

Against the background of increasing the content of total humus, the mass of surface crop residues of corn for grain decreased. The intensity of this decrease was proportional to the intensity of humification (Figure 9).

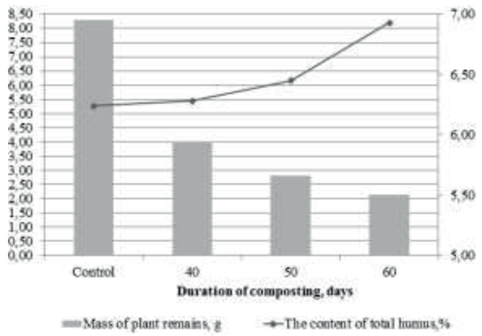

Figure 9. Dynamics of total humus content and mass of plant residues

Confidence interval for changes in the content of total humus and the mass of crop residues of corn for grain during composting. For the content of total humus in the soil it is ± 0.08%, for the amount of plant residues ± 0.20 g. Therefore, the difference in the content of total humus in the soil between the control and all the presented options is significant, except for the difference between the control and the option of 40 daily composting because it does not exceed the mark of 0.08%.

The change in the mass of crop residues of corn for grain between the control and the studied options is significant. This makes it possible to argue about the continuous process of transformation of plant material in the process of the experiment, but its intensity decreases over time.

It is established that the humification process is continuous. The content of total humus increases with increasing composting period in optimal conditions.

Dynamics of nutrient content in the version with corn for grain.

Figure 10 shows the dynamics of the content of light hydrolysis nitrogen in terms of composting. As can be seen from the graph for the first 40 days of composting, the content of light hydrolysis nitrogen decreases to the mark of 164 mg/kg of soil. Over the next 10 days, the decrease in the content of easily hydrolyzed nitrogen is 9 mg/kg of soil. In another 10 days the content of light hydrolysis nitrogen slightly increases to the level of 167 mg/kg of soil.

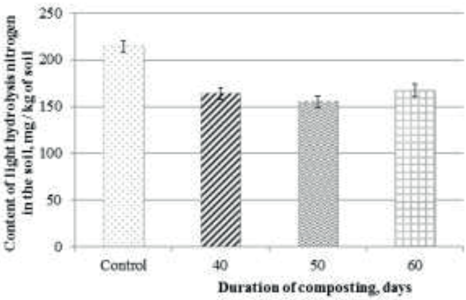

Figure 10. Dynamics of light hydrolysis nitrogen content in soil

The dynamics of mobile phosphorus in the studied variant was as follows (Figure 11). As can be seen from the graph during the composting period, a significant difference in the content of mobile phosphorus was observed during 40 days of composting. During the following periods of composting there is an accumulation of mobile phosphorus where the increase is 18 and 27 mg/kg of soil according to the terms of composting.

The dynamics of the content of exchangeable potassium is shown in Figure 12. From this graph we see that from the first 40 days of composting in the studied variant there is a significant increase in potassium and goes to growth up to 60 days. Thus, as a percentage of control, the increase in potassium exchange in terms of composting is 50.4%, 64.9% and 79.8%, respectively.

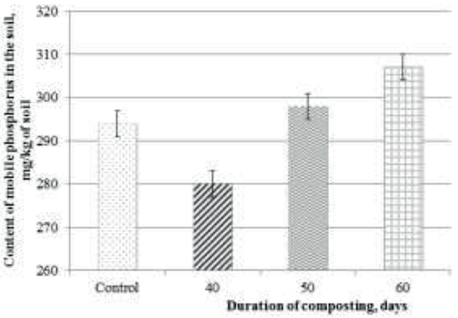

Figure 11. Dynamics of mobile phosphorus in soil

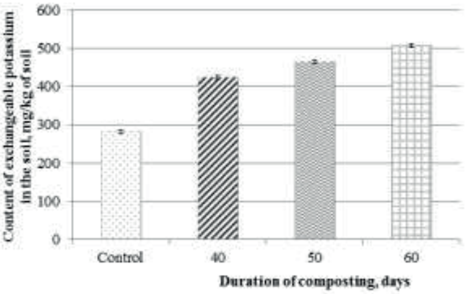

Figure 12. Dynamics of potassium content in soil

The dynamics of the content of total humus in the soil and the change in the amount of plant material of the surface crop residues of sunflower are presented in Tables 7 and 8.

During the first 40 days of composting, the weight loss of plant material was 3.56 g and amounted to 5.63 g (Table 7), during this period the content of total humus (Table 8) in the studied soil was 6.38% the increase is equal to 0.14%.

Table 7. Change in the mass of plant material during the composting period

Composting time, days	Mass of plant material before composting, g	Mass of plant material after composting, g	Change in the mass of plant material after composting
40	9.19	5.63 ± 0.45	3.56 * / 38.7
50		3.85 ± 0.45	5.34 / 58.1
60		2.70 ± 0.45	6.49 / 70.6

*Above the line - the difference in weight of plant material after composting, g; under the line - reduction of plant residues,%

The change in weight over the next 10 days decreased by 58% and amounted to 3.85 g, which is 1.78 less than the 40-day period of composting, and the increase in humus during this period is 0.38%. During the entire composting period, the weight loss was 6.49 g, which is 1.15 g less than 50 and 2.93 g less than 40 days of composting. As a percentage, the weight loss in 60 days of composting was almost 71%. The intensity of humus accumulation during this period increases, the increase was 14.6%, the difference is 0.91% of the total humus in the soil.

The increase in the content of total humus in the soil, compared with the control, for 40 days of composting 0.14%, and the weight loss of plant residues was 3.56 g. For 50 days of composting, the increase in total humus content is 0.52%, and decrease in the mass of plant material of surface crop residues of sunflower 5.34 g. During the 60-day period of composting, the increase was 0.91%, and the decrease in the mass of plant material by 6.49 g.

Table 8. Change in the content of total humus in chernozem typical for the composting period

Composting time, days	The content of total humus in the soil before composting, %	The content of total humus in the soil after composting, %	Increase in total humus in the soil after composting, %
40	6.24	6.38 ± 0.16	0.14 * / 102.2
50		6.76 ± 0.16	0.52 / 108.3
60		7.15 ± 0.16	0.91 / 114.6

*Above the line - the increase in the content of total humus in the soil after composting, %; Under the line -% of the control content of humus in the soil

Thus, studies have shown that during the first 50 days of composting in optimal environmental conditions there is an intensive loss of mass of plant material.

Against the background of increasing the content of total humus, the mass of surface crop residues of sunflower decreased. The intensity of this decrease corresponded proportionally to the intensity of humification (Figure 13).

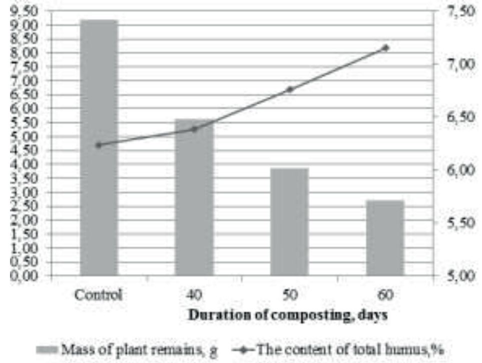

Figure 13. Dynamics of total humus content and mass of plant residues

Confidence interval for changes in total humus content and mass of sunflower crop residues during composting. For the content of total humus in the soil it is ± 0.16%, for the amount of plant residues ± 0.45 g. Therefore, the difference in the content of total humus in the soil between the control and all the presented variants is significant, except for the difference between daily composting because it does not exceed the mark of 0.16%.

The change in the mass of plant residues by sunflower between the control and the studied options is significant. This makes it possible to argue about the continuous process of transformation of plant material in the process of the experiment, but its intensity decreases over time.

Thus, studies have shown that during the first 40 days of composting in optimal environmental conditions there is a moderate process of humification of plant material, when as for the next 20 days the intensity of humification increases.

Dynamics of nutrient content in the version with sunflower.

Figure 14 shows the dynamics of the content of light hydrolysis nitrogen in terms of composting. As can be seen from the graph for the first 40 days of composting, the content of light hydrolysis nitrogen decreases to the mark of 164 mg/kg of soil. Over the next 10 days, the increase is 15 mg/kg of soil. In another 10 days the content of easily hydrolyzed nitrogen decreases to the level of 160 mg/kg of soil.

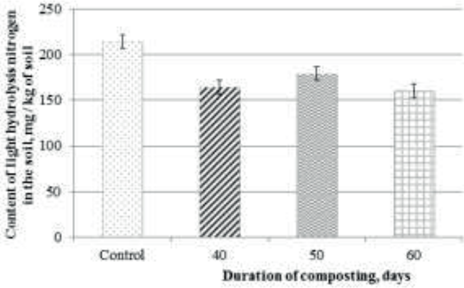

Figure 14. Dynamics of light hydrolysis nitrogen content in soil

The dynamics of mobile phosphorus in the studied variant was as follows (Figure 15). As can be seen from the graph during the composting period, a significant difference in the content of mobile phosphorus was observed throughout the composting period. However, the lowest amount of mobile phosphorus is observed in 40 days of composting on foot and is 270 mg/kg of soil. During the following periods of composting there is an accumulation of mobile phosphorus.

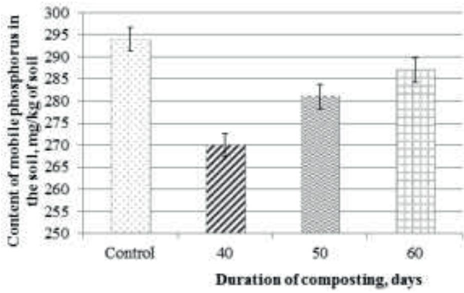

Figure 15. Dynamics of mobile phosphorus content in soil

The dynamics of the exchangeable potassium content is shown in Figure 16. From this graph we see that from the first 40 days of composting in the studied variant there is a significant increase in potassium, for 50 days its content decreases slightly to the mark of 334 mg/kg of soil. Starting from 60 days, there is an increase in the content of metabolic potassium and is 458 mg/kg of soil.

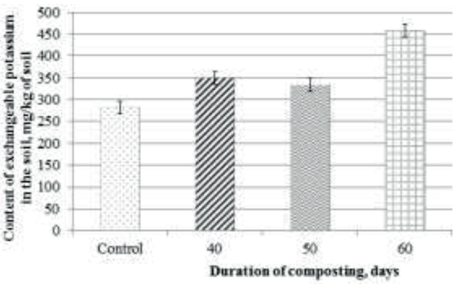

Figure 16. Dynamics of metabolic potassium content in soil

CONCLUSIONS

Thus, based on the above research results, the following conclusions can be drawn:

The intensity of humification as a link in humus formation depends on the climatic factor, this was talking in your time by Vasily Vasilyevich Dokuchaev.

It is established that the humification process is continuous. The content of total humus with the as the length period of composting in optimal conditions increases. The intensity of the increase in the content of total humus, as well as the process of humification, varied.

Amid increasing the humus content, the mass of winter wheat residues decreases. The intensity of this reduction is proportional to the intensity of the humification process. The increase in humus in the laboratory for the full period of composting is 0.69%, and the decrease in plant material for this period is 4.05 g, the increase in humus in the laboratory for barley during the entire period of composting is 0.53% with a decrease in weight for this the same period is 4.94 g. The increase in humus in the laboratory for sunflower during the entire period of the composting is 0.91% for this weight loss for the same period is 6.49 g. Such a high increase in humus in the due to structure of plant residues. The increase in humus in the laboratory for corn for the whole time of composting will be 0.69% for this weight loss for the same period is 6.15 g

The dynamics of the content of nutrients in the soil varies from the options and timing of the analysis.

REFERENCES

Antonets, S.S. (2014). Ecological conditions for the formation of the phytosanitary state of agricultural crops in organic farming. *Journal Grain, 12*(105), 52–60.

Aristovskaya, T.V. (1980). Microbiology of soil formation processes. Ripol Classic Publishing House.

Balaev, A.D., Pikovska, O.V. (2016). The use of straw in restoring soil fertility. Kyiv: Publishing House "TsP Komprynt".

Dovban, K.I. (2009). Green fertilizer in modern agriculture. Minsk: Belarusian Science.

Jindo, K., Chocano, C., Melgares de Aguilar, J., Gonzalez, D., Hernandez, T., Garcia, C. (2016). Impact of compost application during 5 years on crop production, soil microbial activity, carbon fraction, and humification process. Communications in Soil *Science and Plant Analysis, 47*(16), 1907–1919.

Jones et al. (2012). The State of Soil in Europe. Received from: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC68418/lbna25186enn.pdf

Kononova, M.M. (1963). Soil organic matter, its nature, properties and methods of study. Moscow: Moscow State University Publishing House.

Kostychev, P.A. (1886). Soils of chernozem regions of Russia, their origin, composition and properties. Part 1. Formation of chernoze. St. Petersburg: A.F. Devriena Publishing House.

Orlov, D.S. (1990). Humic acids of soils and the general theory of humification. Moscow: Publishing House Mosk. University.

Reshetchenko, S.I., Tkachenko, T.G., Lysenko, O.G. (2015). Change in temperature in the Kharkiv region. Visnik of Kharkiv National University for the Name of V.N. Karazin. Series: *Geology. Geography. Ecology, 43*. 153–158.

Segnini, A., Xavier, A.A.P., Oliveira, P.P.A., Pedroso, A.F., Milori, D.M.B.P. (2019). Soil carbon stock and humification in pastures under different levels of intensification in Brazil. *Scientia Agricola*, 76(1), 33-40. https://doi.org/10.1590/1678-992x-2017-0131

Shuvar, I.A., Berdnikov, O.M., Tsentylo, L.V., Sendets'kyy, V.M., Tymofiychuk, O.V., Hnydyuk, V.S.,...& Tymofiychuk, B.V. (2015). Siderati in the current farming. Ivano-Frankivsk: Publishing house Symphony forte.

Tittarelli, F., Trinchera, A., Intrigliolo, F., & Benedetti, A. (2002). Evaluation of organic matter stability during the composting process of agroindustrial wastes. In Microbiology of composting (pp. 397–406). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-08724-4_33

Vitvits`kyi, S.V. (2016). Humification of tall lattices and pus in black soils of Lisstep and Stepu of Ukraine. Monograph. Kyiv: Publishing house "Harvest".