UDC 663.031.1; 666.098.2
МРНТИ 62.13.53

DOI: **https://doi.org/10.37788/2022-2/147-155**

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Results of application of organomineral fertilizer obtained with biocatalytic processes

Annotation

Main problem: Bird droppings and animal manure contain acids, nitrogen, phosphorus and potassium, heavy metals. The content of nitrogen, phosphorus and potassium changes dramatically depending on the quantity and quality of the feed.

Purpose: To study the effectiveness of the use of organomineral fertilizer from poultry waste, obtained using biocatalytic processes on the growth and development of plants.

Methods: An application for a Patent for the invention of the Republic of Kazakhstan "Method of obtaining organic fertilizer" has been submitted for the developed technology for obtaining organic-mineral fertilizer. In the soil intended for growing seedlings of tomatoes of the "Pepper-shaped Orange" variety and peppers of the "Bogatyr" variety, the resulting fertilizer was applied in the amount of 1 kg per 1 m^2 of soil, which was dug to a depth of 8-10 cm and used to grow seedlings in closed ground and subsequent for planting it in open ground. Soil without fertilization was used as a control. The process of soil preparation for open ground, intended for planting seedlings, was carried out for the experimental field with the introduction and control without fertilization. Experimental and control studies were carried out under equivalent climatic conditions, the scheme and technology of watering plants. In total, 100 bushes of each plant species were used in the experiment.

Results and their significance: The use of the obtained organomineral fertilizer allows to increase the yield of vegetable crops (tomatoes, peppers) by 20-25% compared to the control. In addition, in the experimental samples, an increase in the number of fruits on a bush was noted with an increase in their size, a decrease in the growing season and the number of damaged fruits.

Keywords: bird droppings, sodium humate, biocatalysis, detoxification, organic fertilization, field trials, flowering, ovary, vegetation.

Introduction

Currently, many poultry and livestock complexes have become sources of environmental pollution, thereby causing serious environmental problems and economic and social damage. In the zone of their orientation, it is possible to pollute the atmospheric air with microorganisms, dust, foul-smelling organic compounds that are products of decomposition of organic waste, as well as nitrogen oxides, sulfur, carbon.

Bird droppings and animal manure contain acids, nitrogen, phosphorus and potassium, heavy metals. The content of nitrogen, phosphorus and potassium varies dramatically depending on the quantity and quality of feed.

Nitrogen in manure is in the form of uric acid, which quickly decomposes to form ammonia. Fresh manure greatly oxidizes the soil, inhibits microorganisms and destroys humus, disrupting the natural ecosystem of the biocenosis.

The main disadvantage of the anaerobic digestion process is the low reaction rate, even with significant heating of the reaction mass, which leads to the need to create large-volume bioreactors and, accordingly, increases capital costs for the construction processing facilities.

At the same time, it is known that humic substances isolated from brown coal have a sufficiently high sorption activity and are used as cheap sorbents to solve a number of environmental problems in industry [1, 2, 5, 6, 9, 10, 12].

The use of sodium humate as a catalyst for the anaerobic digestion process will speed up the chemical and biological fermentation process, reduce energy consumption for its implementation, and allow the use of reactor equipment of a smaller volume. In addition, sodium humate, due to its complexing and adsorption-absorption properties, will provide detoxification of the reaction mass from heavy metals and their salts.

There is a known method for disposing of chicken manure by anaerobic thermophilic fermentation and subsequent separation of the fermented mass into solid and liquid fractions by centrifugation, in which, before separation, the fermented mass of chicken manure is alkalized with a concentrated aqueous solution of caustic potassium to pH 9.0-10.5, heated to a temperature of 70-80^{0}C, kept for 3-5 minutes [3, 4, 13, 14, 15, 17].

There is also a known method of utilization and disinfection of chicken manure, including separation of biomass by separation into liquid and solid fractions, disinfection of the liquid fraction by working off in a device with insoluble electrodes, and the liquid fraction passed through the separator is mixed with lime milk in the amount of $CaOH_2$ = $3,7*10^{-6}$ gram per liter, after which it is fed into a horizontal sump with an electrode system, where it is kept for 7 and a half hours, acting with nanocurrents of 40 [4, 15, 19, 20].

The known methods have significant metal and energy consumption, high cost, which limits their use in poultry farms and livestock complexes of small and medium capacity.

In all these methods, there is no binding process of heavy metal salts in the excrement, which reduces the environmental friendliness of the processes.

A method of detoxification of agricultural lands using humic sorbent is also known [8].

The humic sorbent contains hydrated humic acids of brown coal and chemically related mineral components and is obtained by hydration of natural ground brown coal with deionized water in the process of fine grinding to a particle size of no more than 0.1 mm. The proposed method of detoxification of lands and recultivation of agricultural soils is based on the introduction of humic sorbent into the lands and soils. The use of the invention makes it possible to prevent the absorption of metal ions and organic substances polluting the soil by plants, to ensure the moisture retention of the soil, ultimately increasing its fertility. The disadvantage of this invention is the need for a separate sorbent application process from fertilization, which reduces the manufacturability of the process and does not provide quality control for the content of toxic elements during fertilization.

The technology developed by us solves the problem by creating an appropriate method, the implementation of which ensures the achievement of a technical result, which consists in reducing the time spent on fermentation of poultry excrement and, in preserving organic and mineral substances in the final product and improving their quality, in increasing the environmental friendliness of the method through the use of a humic sorbent to convert salts of heavy metals and other toxic substances into an insoluble state.

As described above, the disadvantage of the known methods of anaerobic digestion is the low speed of the process. To increase its efficiency, the proposed technology uses a biological catalyst for the process the stimulator of bacterial growth sodium humate, obtained using the technology we previously developed from the brown coal of the Maykubensky deposit ("Method for obtaining sodium humate" Patent № 4600 RK) [7], as well as a sorbent based on sodium humate (a co-product of obtaining sodium humate), which is used to detoxify the feedstock and the resulting product from heavy metals and their salts due to its absorption-adsorption and complexing properties.

Sodium humate in the technological process significantly accelerates the fermentation process (the process of bacterial development) in an anaerobic environment (without oxygen access), eliminates the unpleasant smell of bird droppings, and also increases the output of biogas.

As a result of fermentation, anaerobic bacteria break down complex organic compounds (fats, proteins, carbohydrates) contained in the fermented product to fatty acids, then to compounds that can be absorbed by plants. As the result of fermentation, heat and biogas are also released, and can be directed to further use or disposal.

The use of sodium humate as a catalyst for the process of anaerobic digestion makes it possible to accelerate the chemical-biological fermentation process, reduce energy consumption for its implementation, and allows the use of reactor equipment of a smaller volume. In addition, sodium humate, due to its complexing and adsorption-absorption properties, provides detoxification of the reaction mass from heavy metals and their salts.

The most important experiments were studies on the effectiveness of the use of sodium humate and its derivatives for the complex detoxification of poultry waste.

Known methods of detoxification of poultry waste in order to obtain organic fertilizer have significant metal and energy consumption, high cost, which limits their use in poultry farms and livestock complexes of small and medium capacity.

In all these methods, there is no binding process of heavy metal salts in the excrement, which reduces the environmental friendliness of the processes.

Also known is the method of detoxification of lands and recultivation of agricultural soils based on the introduction of humic sorbent into the lands and soils. The use of the invention makes it possible to prevent the absorption of metal ions and organic substances polluting the soil by plants, to ensure the moisture retention of the soil, ultimately increasing its fertility. The disadvantage of this invention is the need for a separate sorbent application process from fertilization, which reduces the manufacturability of the process and does not provide quality control for the content of toxic elements during fertilization.

As described above, the disadvantage of the known methods of anaerobic digestion is the low speed of the process. To increase its efficiency, the proposed technology uses as a biological catalyst for the process the stimulator of bacterial growth sodium humate, obtained using the technology we previously developed from the brown coal of the Maykubensky deposit ("Method for obtaining sodium humate" Patent № 4600 RK), as well as a sorbent based on sodium humate (a co-product of obtaining sodium humate), which is used to detoxify the feedstock and the resulting product from heavy metals and their salts due to its absorption-adsorption and complexing properties.

The direction of the selected studies was aimed at creating a method, the implementation of which ensures the achievement of a technical result, which consists in reducing the time spent on fermentation of poultry excrement and, in preserving organic and mineral substances in the final product and improving their quality, in increasing the environmental friendliness of the method through the use of a humic sorbent to transfer heavy metal salts and other toxic substances to an insoluble state.

Sodium humate was used as a catalyst in the technological process, since it has a biological stimulator of bacterial growth. It significantly accelerates the fermentation process (the process of bacterial development) in an anaerobic environment (without oxygen access) at temperatures from 17^0C to 25^0C, eliminating the unpleasant smell of bird droppings, and also increases the output of biogas [7].

The purpose of the research: to study the effectiveness of the use of organomineral fertilizer from poultry waste, obtained using biocatalytic processes on the growth and development of plants.

Materials and methods

In the studies conducted, organomineral fertilizers from poultry manure were used. To increase its effectiveness, sodium humate, a bacterial growth stimulator, obtained by us using a previously developed technology from brown coal of the Maikubenskoye deposit in the Republic of Kazakhstan (RK) ("Method for producing sodium humate" Patent No. 4600 RK) was used as a biological catalyst, as well as a sorbent based on sodium humate (an accompanying product of sodium humate production), which was used to detoxify the feedstock and the resulting product from heavy metals and their salts due to its absorption-adsorption and complexing properties. An application for a Patent for the invention of the Republic of Kazakhstan "Method for obtaining organic fertilizer" (priority No. 2021/0429.1, dated 13.07.2021) has been submitted for the developed technology for obtaining organic-mineral fertilizer.

The study of the composition of organomineral fertilizer obtained from chicken manure showed a high content of the main components: nitrogen, phosphorus, potassium and humic acids and the absence of soluble salts of heavy metals in the product, which implies that the sequence of the proposed technological methods and modes ensure the preservation of organic and mineral substances in the final product and the removal of soluble toxic elements from it, and, therefore, guarantee the production of high-quality complex organo-mineral fertilizer from bird excrement, which is a characteristic sign of good soil digestibility [6].

Tests to determine the effectiveness of the obtained fertilizer were carried out on the experimental plots of the peasant farm (KH) "Flame", Pavlodar district of Pavlodar region of the Republic of Kazakhstan.

During the production field experiment, the resulting fertilizer was applied to the soil intended for growing seedlings of tomatoes of the "Pepper-shaped Orange" variety and peppers of the "Bogatyr" variety in the amount of 1 kg per 1 m2 of soil, which was dug up to a depth of 8-10 cm and used for growing seedlings in closed ground and subsequently for planting it in open ground. Soil without fertilization was used as a control. The process of soil preparation for open ground, intended for planting seedlings, was carried out for the experimental field with the introduction and control without fertilization. Experimental and control studies were carried out under equivalent climatic conditions, the scheme and technology of watering plants.

In total, 100 bushes of each plant species were used in the experiment.

Statistical processing of the analyzed data was performed by the generally recognized method of variation statistics according to Student.

The determination of the economic efficiency of the developed technology when using the obtained organomineral fertilizer in the open ground when growing tomatoes of the "Bogatyr" variety was carried out as follows:

The economic efficiency of the application of the developed technology was characterized by the amount of additional net income per unit weight of fertilizers, per 100 roots of crops and 1000 tenge of costs used for the preparation and application of fertilizers. When calculating the economic efficiency of using the developed technology, the cost of gross output was determined based on the purchase prices for fresh tomatoes and peppers that were in effect in the Pavlodar region as of August 2021.

Results

Table 1 shows that the timing of the beginning of flowering in experimental tomato crops is reduced by 6, and in peppers by 5 days compared with the control group of plants. The timing of the appearance of the first ovary is also accelerated, respectively, by 5 for tomatoes and 8 days for peppers.

The total number of fruits from a bush of tomatoes in the experimental group of plants was significantly higher than in the control group by 44.4%, peppers - by 55.5%.

The yield of a bush of tomatoes after fertilization increases in comparison with the control by 1.4 times (42%), peppers by 1.8 times (44.4%).

The shape of tomato fruits in the experimental group of plants is regular round-oval, in the control group it is oblong-oval and the average size (length/width in the section) is significantly more than 85/40 mm compared to the control samples of plants 72/30 mm.

The shape of pepper fruits of the experimental plants is even, with a pronounced short tail, the control ones are segmented, gradually tapering to the tail and the average size (length/width in the section) in plants grown without fertilization (65/35mm) is somewhat inferior to the experimental samples (70/40mm).

Table 1 – Results of the field experiment to determine the effectiveness of the use of fertilizer obtained using sodium humate (n=200, M ±m)

Indicators	Tomato		Pepper	
	experiment (n=50)	control (n=50)	experiment (n=50)	control (n=50)
Flowering start date	28 May	3 June	12 May	17 May
The date of the appearance of the first ovary	June 1	June 6	May 13	May 21
Average number of fruits per bush	13±2,1*	9±1,3	9±1,5*	5±0,9
Bush yield (g)	1250±91*	880±34	520±71*	360±22
Shape of ripe fruits, average size (mm) (length/width in section)	regular round-oval, 85/40	oblong-oval , 72/30	with a pronounced short tail, 70/40	segmented, gradually tapering to tail, 65/35
Vegetation period before fruit ripening (days)	47	51	44	46
% damaged fruits	3	7	2	5

Note: * - the difference in relation to the control group is significant * - ($P<0.05$).

The vegetation period before the beginning of fruit ripening in plants of the experimental groups of tomatoes and pepper after fertilization is reduced by 4 and 2 days, respectively. The percentage of damaged fruits of tomatoes and peppers (late blight, sunburn) after the application of organomineral fertilizer is reduced by 2.3 and 2.5 times, respectively. Visually, the results of the field experiment are presented in Figures 1, 2, 3.

Figure 1 – The results of the field experiment in growing tomatoes with the application of the developed organomineral fertilizer (experiment)

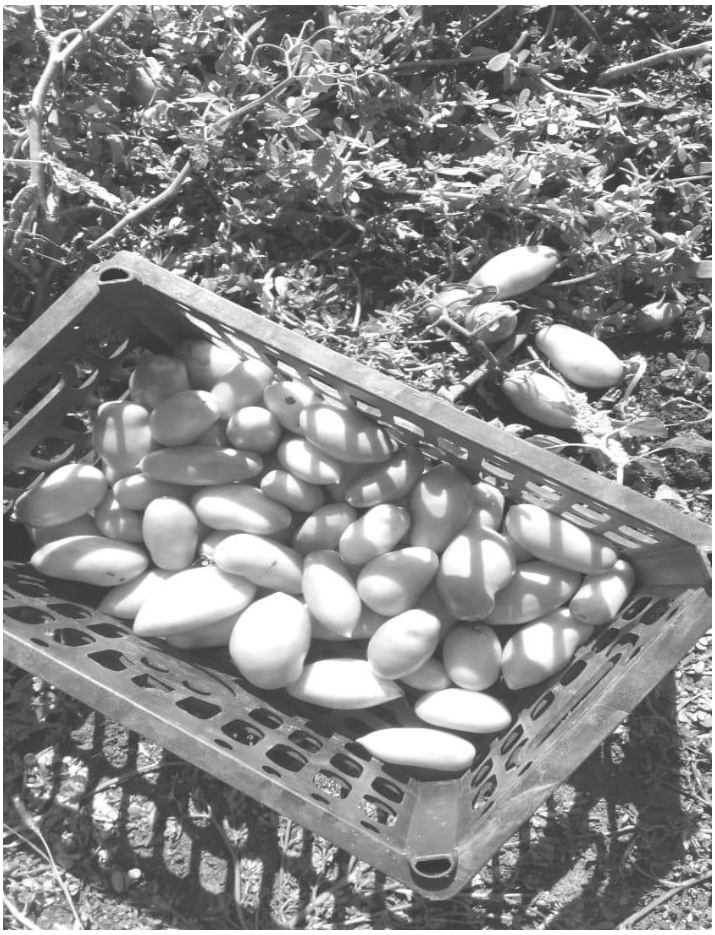

Figure 2 - Results of the field experiment when growing tomatoes without applying the developed organomineral fertilizer (control)

Figure 3 – Results of the field experiment when growing peppers (left - experience, right - control)

Based on the processing of the data presented in the description of the technological process, the market value of vegetable growing products in the Pavlodar region for August-September 2021, it was found that the economic efficiency of the developed technology when using the obtained organomineral fertilizer in the open ground when growing tomatoes of the "Pepper Orange" variety and peppers of the "Bogatyr" variety. It is

established that the economic efficiency is at 1000 tenge of fertilizer production costs 3200 tenge for growing peppers and 7400 tenge of tomatoes at average prices for products in the Pavlodar region for the autumn of 2021 at 400 tenge per 1 kg.

Discussion

Based on the conducted research, a technology for obtaining organic fertilizer from poultry waste by anaerobic digestion of chicken manure with humidity as a temperature of 27-50^{0}C with the addition of sodium humate has been developed.

The fertilizer is intended for use in agricultural production, horticulture, floriculture, forestry, urban farming, on household plots in order to increase productivity, quality of crop production. It is recommended for planting, fertilizing all types of crops, as well as for resuscitation and recultivation of soils.

As a result of the research, a method for obtaining organic fertilizer has been developed, including fermentation of the initial product, removal of biogas, sedimentation, characterized in that the reaction mixture is pre-fermented with the addition of 200 % water and 1-2 % sodium humate, after the end of fermentation, during which the fermentation mixture is self-heated to a temperature of 37 to 51 degrees Celsius, and removal of biogas from the fermentation product, a humic sorbent is added to the reaction mixture in an amount of 1 to 2% mass fraction, stirred for 12-24 hours, by means of sedimentation, the dense component of the initial product is separated, and the liquid component is defended until the separation level of the solid fraction and the liquid is reached in a ratio from 1 to 5 to 1 to 7, dense fraction is removed, and the superadded fraction is used as a liquid organic fertilizer.

The developed technology has been applied for a Patent for the invention of the Republic of Kazakhstan "Method for obtaining organic fertilizer" (priority No. 2021/0429.1, dated 13.07.2021). The invention makes it possible to significantly reduce the fermentation time, enrich the product with organic and mineral products contained in sodium humate, convert heavy metal salts into an insoluble state, and increase the environmental friendliness of the method.

The implementation of the developed technology ensures the complete and safe disposal of extremely aggressive waste from poultry farms, and therefore provides a significant improvement in the environmental situation, in particular, in the regions where poultry farms are located. The developed method of obtaining organic fertilizer significantly reduces the fermentation time, ensures complete and safe disposal of extremely aggressive waste from poultry farms, and therefore provides a significant improvement in the environmental situation, in particular, in the regions where poultry farms are located.

Conclusion

The use of the obtained fertilizer in the field experiment makes it possible to increase the yield of vegetable crops (tomatoes, peppers) by 20-25% higher compared to the control. In addition, the experimental samples showed an increase in the number of fruits on the bush with an increase in their size, a decrease in the growing season, as well as the number of damaged fruits.

Based on the processing of the data presented in the description of the technological process, the market value of vegetable growing products in the Pavlodar region for August-September 2021, it was found that the economic efficiency of the developed technology when using the obtained organomineral fertilizer in the open ground when growing tomatoes of the "Pepper Orange" variety and peppers of the "Bogatyr" variety. It is established that the economic efficiency is at 1000 tenge of fertilizer production costs 3200 tenge for growing peppers and 7400 tenge of tomatoes at average prices for products in the Pavlodar region for the autumn of 2021 at 400 tenge per 1 kg.

Funding information

The work was carried out as a result of the implementation of the grant funding project of the Ministry of Education and Science of the Republic of Kazakhstan (project “Development of poultry waste detoxification technology using biocatalytic processes”, IRN AP09562121).

THE LIST OF SOURCES

1 Способ утилизации и обеззараживания куриного помета: пат. RU2645901C1 Рос. Федерация: МПК C05F3/00, 2018.

2 Способ получения органо-минерального удобрения: пат. RU086 522C1 Рос. Федерация: МПК C05F11/02 C05F17/00, 1997.

3 Способ приготовления органоминерального удобрения: пат. RU2270825C2 Рос. Федерация: МПК C05F3/00, 2006.

4 Способ утилизации и обеззараживания куриного помета: пат. RU2541399C1 Рос. Федерация: МПК C05F 3/00, 2015.

5 Органоминеральное удобрение и способ его изготовления: пат. RU2191764C1 Рос. Федерация: МПК C05F 3/00, 2002.

6 Способ получения органического удобрения: пат. RU2013139068A Рос. Федерация: МПК C05F 3/00, 2015.

7 Способ получения гумата натрия: пат. RU2191798C1 Рос. Федерация: МПК C10F7/00, 2002.

8 Гуминовый сорбент, способ его получения; способ детоксикации земель и рекультивации почв сельскохозяйственного назначения с использованием этого гуминового сорбента: пат. RU2205165C2 Рос. Федерация: МПК C05F 11/02, A01B 79/02, C09K 17/40, 2018.
9 Лысенко В.П. Птичий помет-отход или побочная продукция / В.П. Лысенко // Птицеводство. – 2015. – № 6. – С. 55-56.
10 Семенченко С.В. Утилизация и переработка помета в условиях птицефабрики / С.В. Семенченко, В.Н. Нефедова, А.А. Савинова // Вестник Донского государственного аграрного университета. – 2015. – № 4-1 (18). – С. 28-36.
11 Главная проблема птицепрома. Экономический аспект. - [Электронный ресурс]. - Режим доступа: http://webpticeprom.ru/ru/ articles-processingwaste.html?pageID=1328710142
12 Антонова О.И., Чихарин А.А., Андреев М.Е. Эффективность органо-минеральных удобрений на основе помета под яровую пшеницу / Аграрная наука – сельскому хозяйству: материалы XI Международной научно-практической конференции (4-5 февраля 2016 года). – Барнаул: РИО Алтайского ГАУ, 2016. – С. 3-4.
13 Эрнст Л.К. Переработка отходов животноводства и птицеводства / Л.К. Эрнст, Ф.И. Злочевский, Г.И. Ерастов // Животноводство России. – 2004. — № 9. – С. 23.
14 Неверова О.П. Экосистемный подход к утилизации помета / О.П. Неверова, Г.В. Зуева, Т.В. Сарапулова // Аграрный вестник Урала. – 2014. – № 8 (126). – С. 38-41.
15 Запевалов М.В. Технология приготовления органоминерального удобрения на основе птичьего помета / М.В. Запевалов, С.М. Запевалов // Вестник Алтайского государственного аграрного университета. – 2011. – № 5 (78). – С. 84-90.
16 Аверьянов Ю.И. Анализ существующих способов утилизации птичьего помета / Ю.И. Аверьянов, А.В. Старунов, И.А. Зонова // АПК России. – 2010. – Т. 56. – С. 11-14.
17 Утилизация подстилки после содержания бройлеров. – [Электронный ресурс]. – Режим доступа: http://webpticeprom.ru
18 Канадская технология утилизации куриного помета. – [Электронный ресурс]. – Режим доступа: http://webpticeprom.ru/ru/articlesprocessing-waste.html?pageID=1298890290
19 Технология ускоренного компостирования и утилизации всех видов помёта. - [Электронный ресурс]. – Режим доступа: http://www. nngst.ru/products/1-bioxymin-compost
20 Утилизация птичьего помета на птицефабриках – пути решения. – [Электронный ресурс]. – Режим доступа: http://www.webpticeprom.ru/ru/articlesprocessing-waste.html?pageID=1228313017

REFERENCE

1 Sposob utilizatsii i obezzarazhivaniya kurinogo pometa [Method of disposal and disinfection of chicken manure]. (2018) Russian Federation patent RU2645901C1 [in Russian].
2 Sposob polucheniya organo-mineral'nogo udobreniya [Method of obtaining organo-mineral fertilizers]. (1997) Russian Federation patent RU086 522C1 [in Russian].
3 Sposob prigotovleniya organomineral'nogo udobreniya [Method of preparing organic fertilizer]. (2006) Russian Federation patent RU2270825C2 [in Russian].
4 Sposob utilizatsii i obezzarazhivaniya kurinogo pometa [Method of disposal and disinfection of chicken manure]. (2015) Russian Federation patent RU2541399C1 [in Russian].
5 Organomineral'noye udobreniye i sposob yego izgotovleniya [Organomineral fertilizer and method for its production]. (2002) Russian Federation patent RU2191764C1 [in Russian].
6 Sposob polucheniya organicheskogo udobreniya [Method of obtaining organic fertilizer]. (2015) Russian Federation patent RU2013139068A [in Russian].
7 Sposob polucheniya gumata natriya [Method for producing sodium humate]. (2002) Russian Federation patent RU2191798C1 [in Russian].
8 Guminovyy sorbent, sposob yego polucheniya; sposob detoksikatsii zemel' i rekul'tivatsii pochv sel'skokhozyaystvennogo naznacheniya s ispol'zovaniyem etogo guminovogo sorbenta [Humic sorbent, method for its production; method of land detoxification and soil reclamation for agricultural purposes using this humic sorbent]. (2018) Russian Federation patent RU2205165C2 [in Russian].
9 Lysenko, V.P. (2015). Ptichiy pomet-otkhod ili pobochnaya produktsiya [Bird droppings-waste or by-products]. Ptitsevodstvo – Poultry, 6, 55-56 [in Russian].
10 Semenchenko, S.V., Nefedova, V.N., & Savinova, A.A. (2015). Utilizatsiya i pererabotka pometa v usloviyakh ptitsefabriki [Disposal and processing of manure in a poultry farm]. Vestnik Donskogo gosudarstvennogo agrarnogo universiteta – Bulletin of the Don State Agrarian University, 4-1, 28-36 [in Russian].
11 Glavnaya problema ptitseproma. Ekonomicheskiy aspekt [The main problem of the poultry industry. Economic aspect]. (n.d.). webpticeprom.ru Retrieved from http://webpticeprom.ru/ru/articles-processingwaste.html?pageID=1328710142 [in Russian].
12 Antonova, O.I., Chikharin, A.A., & Andreyev M.Ye. (2016). Effektivnost' organo-mineral'nykh udobreniy na osnove pometa pod yarovuyu pshenitsu [The effectiveness of organo-mineral fertilizers based on dung for spring

wheat]. Agricultural Science – Agriculture: XI Mezhdunarodnaya nauchno-prakticheskaya konferentsiya (4-5 fevralya 2016 hoda) - 11th International Scientific and Practical Conference. (pp. 3-4). Barnaul: RIO Altayskogo GAU [in Russian].
13 Ernst, L.K., Zlochevskiy, F.I., & Yerastov, G.I. (2004). Pererabotka otkhodov zhivotnovodstva i ptitsevodstva [Processing of animal and poultry waste]. Zhivotnovodstvo Rossii – Livestock in Russia, 9, 23 [in Russian].
14 Neverova, O.P., Zuyeva, G.V., & Sarapulova, T.V. Ekosistemnyy podkhod k utilizatsii pometa [Ecosystem approach to litter disposal]. Agrarnyy vestnik Urala – Agrarian Bulletin of the Urals, 8, 38-41 [in Russian].
15 Zapevalov. M.V., & Zapevalov. S.M. (2011). Tekhnologiya prigotovleniya organomineral'nogo udobreniya na osnove ptich'yego pometa [Technology for the preparation of organomineral fertilizers based on poultry manure]. Vestnik Altayskogo gosudarstvennogo agrarnogo universiteta – Altai State Agrarian University Bulletin, 5, 84-90 [in Russian].
16 Aver'yanov, YU.I., Starunov, A.V., & Zonova, I.A. (2010). Analiz sushchestvuyushchikh sposobov utilizatsii ptich'yego pometa [Analysis of existing methods of disposal of poultry manure]. APK Rossii – Agro-industrial complex of Russia, 56, 11-14 [in Russian].
17 Utilizatsiya podstilki posle soderzhaniya broylerov [Disposal of litter after broiler housing]. (n.d.). webpticeprom.ru Retrieved from http://webpticeprom.ru. [in Russian].
18 Kanadskaya tekhnologiya utilizatsii kurinogo pometa [Canadian technology for the disposal of poultry manure]. (n.d.). webpticeprom.ru Retrieved from http://webpticeprom.ru/ru/articlesprocessing-waste.html?pageID=1298890290 [in Russian].
19 Tekhnologiya uskorennogo kompostirovaniya i utilizatsii vsekh vidov pomota [Technology for accelerated composting and disposal of all types of manure]. (n.d.). www. nngst.ru Retrieved from http://www. nngst.ru/products/1-bioxymin-compost. [in Russian].
20 Utilizatsiya ptich'yego pometa na ptitsefabrikakh [Disposal of poultry manure in poultry farms]. (n.d.). webpticeprom.ru Retrieved from http://www.webpticeprom.ru/ru/articlesprocessing-waste.html?pageID=1228313017 [in Russian].

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Результаты применения органоминерального удобрения, полученного с помощью биокаталитических процессов

Птичий помёт и навоз животных содержит кислоты, азот, фосфор и калий, тяжёлые металлы. Содержание азота, фосфора и калия резко изменяется в зависимости от количества и качества корма.

Цель статьи – изучение эффективности применения органоминерального удобрения из отходов птицеводческих производств, полученного с помощью биокаталитических процессов на рост и развитие растений.

В удобрении в качестве биологического катализатора применялся стимулятор роста бактерий гумат натрия, а также сорбент на основе гумата натрия (сопутствующий продукт получения гумата натрия). На разработанную технологию получения органоминерального удобрения подана заявка на получение Патента на изобретение РК «Способ получения органического удобрения». В почву, предназначенную для выращивания рассады томатов сорта «Перцевидный Оранжевый» и перцев сорта «Богатырь», вносили полученное удобрение в количестве 1 кг на 1 м^2 почвы, которую перекапывали на глубину 8-10 см и использовали для выращивания рассады в закрытом грунте и в последующем для высадки её в открытый грунт. В качестве контроля использовали почву без внесения удобрения. Процесс подготовки почвы открытого грунта, предназначенного для высадки рассады, осуществляли для опытного поля с внесением и контрольного без внесения удобрения. Опытные и контрольные исследования проводили при равнозначных климатических условиях, схеме и технологии полива растений. Всего в эксперименте было использовано по 100 кустов каждого вида растений.

Как показал анализ, применение полученного органоминерального удобрения позволяет повысить урожайность овощных культур (томаты, перцы) на 20-25 % по сравнению с контролем. Кроме того, в опытных образцах отмечен прирост количества плодов на кусте при увеличении их размеров, снижении срока вегетации и количества повреждённых плодов.

Ключевые слова: птичий помёт, гумат натрия, биокатализ, детоксикация, органическое удобрение, полевые испытания, цветение, завязь, вегетация.

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Биокаталитикалық процестермен алынған органоминералды тыңайтқыштарды қолдану нәтижелері

Құс саңғырығы мен мал көңінде қышқылдар, азот, фосфор және калий, ауыр металдар бар. Азоттың, фосфордың және калийдің мөлшері азықтың саны мен сапасына байланысты күрт өзгереді.

Мақаланың мақсаты - өсімдіктердің өсуі мен дамуына биокаталитикалық процестерді қолдану арқылы алынған құс қалдықтарынан минералды органикалық тыңайтқыштарды қолданудың тиімділігін зерттеу.

Тыңайтқышта биологиялық катализатор ретінде натрий гуматы, бактериялардың өсу стимуляторы және натрий гуматы негізіндегі сорбент (натрий гуматы өндірісінің жанама өнімі) қолданылды. Органикалық-минералды тыңайтқыштарды алудың әзірленген технологиясына «Органикалық тыңайтқыштарды алу әдісі» Қазақстан Республикасының өнертабысы патентіне өтінім берілді. «Бұрыш пішінді апельсин» сортының қызанақ көшеттерін және «Богатырь» сортының бұрышын өсіруге арналған топырақта алынған тыңайтқыш 1 м^2 топыраққа 1 кг мөлшерінде енгізілді, ол тереңдікте қазылған. 8-10 см және көшеттерді жабық жерге өсіру үшін, содан кейін оны ашық жерге отырғызу үшін қолданылады. Бақылау ретінде тыңайтқышсыз топырақ пайдаланылды. Тәжірибелік алқапқа көшет отырғызуға арналған ашық жерге топырақты дайындау процесі тыңайтқышсыз интродукциямен және бақылаумен жүргізілді. Эксперименттік және бақылау зерттеулері эквивалентті климаттық жағдайларда, өсімдіктерді суару схемасы мен технологиясы бойынша жүргізілді. Тәжірибеде әр өсімдік түрінен барлығы 100 түп пайдаланылды.

Талдау көрсеткендей, алынған органоминералды тыңайтқышты қолдану көкөніс дақылдарының (қызанақ, бұрыш) өнімділігін бақылаумен салыстырғанда 20-25 % арттыруға мүмкіндік береді. Сонымен қатар, тәжірибелік үлгілерде бұтадағы жемістер санының көбеюі олардың мөлшерінің ұлғаюы, вегетациялық кезеңнің азаюы және зақымдалған жемістер санының азаюы байқалды.

Түйін сөздер: құс саңырауқұлағы, натрий гуматы, биокатализ, детоксикация, органикалық тыңайтқыш, далалық сынақтар, гүлдену, аналық без, өсімдік жамылғысы.

Date of receipt of the manuscript to the editor: 2022/06/02