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THE EVALUATION OF THE ROLE OF THE VARIOUS TYPES OF FERTILIZERS ON THE PROCESS OF THE ACCUMULATION OF CONTENT OF NITRATES IN FORAGE CROPS

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Abstract

The purpose of the conducted researches ascertained in the evaluation of the influence of worm compost and ammonium nitrate on the accumulation of the content of nitrate in forage crops on cultivation of which these fertilizers were used. The article presents results of studies regarding to the role of worm compost and ammonium nitrate in the process of accumulation of nitrates in maize, alfalfa and fodder beet in different phenological stages of development. It was found that the use of worm compost and nitrate, as fertilizers influenced the process of accumulation of the content of nitrate, thus modifying the quality of forage crops. In samples of maize, alfalfa and fodder beet, cultivated by the using of worm compost, this indicator decreased respectively with 2.75% - 23.24%, in comparison with its value in plants of control lot. In the plants cultivated with the fund of the ammonium nitrate the content of these increased by 1.15-4.15 times, in comparison with its value in plants of control lot. Thus, it was evaluated the role of worm compost in the process of obtaining the qualitative forage crops by reduction the content of nitrate in them.

Key words**:** *alfalfa, ammonium nitrate, fodder beet, maize, worm compost*

INTRODUCTION

The development of the intensive agricultural technologies in XX century aimed a broad use of various chemical substances (fertilizers, herbicides and pesticides), which consequently destroyed the micro flora and fauna in the soil, diminishing the amount of humus, one of the main indicators of soil fertility. The humus has a multilateral influence on the hydrophysical activity, thermal, technological and biological of the soil. In the humus are concentrated up to 98% reserves of nitrogen, 60% phosphorus, 80% sulphur, essential amounts of the other micro - and macronutrients.

Scientists pedologists [3, 7] found that the annual losses of humus in the soil is 0.5-0.7 t/ha. To maintain the balance of the humus on the level (zero) without deficit it is necessary to be incorporated into the soil annually, about 6.3 t/ha of conventional compost (regular).

In natural conditions the accumulation of humus in the soil flows very slowly. For the formation of a layer of one centimetre of the soil it is necessary to pass a period of 100 years. Under the influence of anthropogenic factor this process may take only 3-5 years [9].

In order for the degraded soil to give increased crops it is necessary to use new technologies to improve soil fertility and obtaining organic agricultural production. One of these technologies is the bioconversion of organic waste by using worm compost called worm cultivation technology, in the result of which it is obtained an ecological organic fertilizer –worm compost which possesses enhanced biological activity. This technology is widely practiced in some countries of the world (Italy, Netherlands, Germany, Romania, Estonia, Ukraine, Russia, Bulgaria, Slovakia, Japan, a.) [4, 6].

However, the use, of considerable quantities of manure, mineral fertilizers (synthetic) and various pesticides and herbicides in agriculture in the last decades of the twentieth century, has led to the accumulation in the soil

of increased quantities of toxic substances for humans and animals.

One of the actions that can solve these problems of the environment, in order to ensure the human and animal health, is the implementation of bioconversion technology (processing) of organic waste of diverse sources, including those of animal [2, 3].

The presence of significant amounts of manure that can be used in the quality of organic fertilizer, has determined the researchers to elaborate a complex system of measures to improve the ecological situation in the republic, including measures to ensure the veterinary, zoo hygienic and epidemiological health welfare [4].

The incorporation into the soil of the conventional compost is ineffective and expensive because from a ton of this compost is formed only 20 kg of humus. Instead in a ton of worm compost is contained 270-300 kg of humus. Therefore the use of worm compost allows the essential reducing of the completing period of the deficit of humus in the soil, reanimating the soil fertility and increasing there sistance of this to wards the alluvial and aeolian erosion [7; 9].

Worm cultivation technology contributes to solving of some important problems in the zootechnical sector: improving the sanitary status at farms, veterinary welfare and the production of worm compost - organic fertilizer that improves the soil fertility and allows to obtain qualitative agricultural products [1].

Worm cultivation opens new perspectives and opportunities for the technology implementation of obtaining forage with high protein content. It can become the foundation of the effective production of the organic feedingstuffs.

In the result of the conducted investigations it was found that in agricultural crops fertilized with worm compost total nitrogen and crude protein content has increased that of the control lot plants and the nitrosocompounds content has decreased [1;5].

According to the obtained results, it was found that a characteristic property of worm compost is the increased content of organic matter, which constitutes 22.00% - 30.00%, and also in its composition are present beneficial micro organisms, total nitrogen, ferments, micro-and microelements. The ingoing amount of worm compost in the soil is ten times smaller than that of conventional compost. The content of nitrosocompounds in cultivated crops, using the worm compost is smaller than those cultivated with mineral fertilizers fund.

Scientific novelty of the research consisted in examining the possibility of the application of worm compost in the process of obtaining green forage crops with a low content of nitrosocompounds. The studies also have focused on obtaining qualitative animal feedingstuffs.

MATERIALS AND METHODS

In order to assess the influence of worm compost and ammonium nitrate on the accumulation of nitrates content in the forage crops, on the cultivation of which these fertilizers were used, in the field conditions of the Technological- Experimental Section "Maximovca", was organized an experiment. In the experiment were included the mentioned fertilizers and three types of fodder crops: maize, alfalfa and fodder beet. For the cultivation of fodder crops were used 7 lots with an area of 3.0 acres, six - experimental, inclusive three – with worm compost fund (experimental I), three – with the ammonium nitrate (experimental II) and 3 control lots with natural background (without fertilizers).

Before the incorporation of fertilizers, it was performed the soil preparation (autumn plowing to a depth of 30-40 cm and spring harrowing). The used dose of fertilizers was different: worm compost was incorporated into the soil in recital 4 t/ha and ammonium nitrate - 285 kg/ha. The fertilization was done in the early spring after the snow melting, on the autumn plowing to a depth of 5-7 cm. Fertilizers were incorporated manually in accordance with the scheme of the experiment (Table 1).

During the test period, were made observations on the development of plants in dependence on the phenological phases and on the different stages of the growing season.

Table 1. The experimental scheme

No	Types of forage crops	Variant of the experiment and the dose of fertilizers t / ha			Investigations during the experiment
		Control	Experimental		
			Worm compost, t/ha	Ammonium nitrate kg/ha	
1	Maize	Nnatural fund	4.0	285.0	- Observations on phisiological development of plant; - evolution of the nitrate content
2	Alfalfa	Nnatural fund	4.0	285.0	
3	Foder beet	Nnatural fund	4,0	285.0	

In collected samples it was determined the nitrates content, using the method of the electro colorimetric [4]. The analysis of the results was performed by comparing the maximum permissible concentration (MPC) of nitrates with that found in the samples of grown forage crops. Also, the nitrate concentrations in plants of experimental groups were compared with those found in plants of the control lot.

For research, maize sampling was carried out in four phases of the vegetation those of the alfalfa – in two phenological phases and three periods of collection and fodder beet - in three phenological phases.

The experiment duration depended on the vegetation period of each forage crop.

RESULTS AND DISCUSSIONS

The evaluating of the quality of forage cultures was carried out by analyzing the results obtained at the determination of the amount of nitrates in plants, depending on the phase of vegetation and the type of the studied material. In the maize, the nitrate content was determined in samples consisting of stems, leaves and cobs, in alfalfa - in green mass and dried (in accordance with periods of collection), and in fodder beet - in the root and in the leaves.

According to the results shown in Table 2 it was found that the amount of nitrate content in maize samples (in all phenological phases) exceeded the maximum permissible concentration (MPC = 200 mg / kg). In cobs in the wax phase the nitrates were not been detected, and in samples of stems and leaves their content exceeded the MPC.

Table 2. The nitrates content in the maize samples

Phenological phases	Variants of the experiment and the quantity of nitrates (mg/kg)		
	Control	Worm compost	Ammonium nitrate
I	1,011.0 ± 2.94	776.0±11.76	1,320.0±12.65
II	960.0±0.42	750.0±1,68	1,240.0±1.26
III	344.6±0.46	302.0±0.52	1,136.0±0.48
IV	257.8±0.42	250.7±0.46	926.4±0.46

Note: I - The formation of ear (stems and leaves);
II - Forming cobs (stalks, leaves and cobs);
III - Cobs in milk stage (stalks, leaves and cobs);
IV - Cobs in the phase of wax (stems, leaves)

Thus, in the maize samples, collected from the control lot (in all phases), the amount of nitrate exceeded the maximum permissible concentration by 1.29 - 5.06 times, in that collected from the lot with fund of worm compost, the value of the concentration of nitrate esexceeded the MPC by 1.25 - 3.88 times, and in that cultivated with fund of the ammonium nitrate, this indicator exceeded the maximum permissible concentration by 4.63 to 6.60 times.

The content of nitrates in forage crops depended not only on the phase of vegetation and on the type of used fertilizers. In all phenological phases of the maize development cultivated with the fund of ammonium nitrate was found a high nitrate content. In maize samples, collected in the I, II, III and IV phases, from the lot with fund of the ammonium nitrate, the nitrate content surpassed, respectively by 1.31; 1.30; 3.30 and 3.59 times that of maize samples of the control lot and with 1.70; 1.65; 3.76 and 3.69 times that of corn cultivated with worm compost fund.

In maize samples collected from the lot with fund of worm compost in that 4 phases, the nitrate content was with 23.25% (phase I); 21.87% (phase II); 12.36% (phase III) and 2.75% (phase IV) lower than in the control lot and respectively with 41.21%; 39.52%;

73.42% and 72.94% lower than in those cultivated with the fund of the ammonium nitrate. This demonstrates that the process of the accumulation of nitrates in plants cultivated with worm compost fund was lower than in those cultivated with the ammonium nitrate fund.

Therefore, analyzing the obtained results it was found that nitrate accumulation in maize depended on phenological phase and on the type of fertilizers used in the experiment. As maturing crops in all samples constituted of stems and leaves, the amount of nitrate decreased, and in the cobs in a full ripening phase, these were not been found.

Analyzing the concentration of nitrates accumulated in the most samples of alfalfa (green mass and hay obtained from it) it is noticed the same regularity as in case of the maize cultivation.

The evaluating results of the alfalfa quality concerning the nitrate concentration in dependence on the phenological phases the period of the collection and type of fertilizers are presented in Table 3.

Table 3. The content of nitrates in alfalfa (green mass)

The mowing period	Variants of the experiment, phenological phases and the quantity of nitrates (mg / kg)		
	Control	Worm compost	Ammonium nitrate
The burgeoning phase			
I	132.5 ± 1.21	207.0 ± 0.84	550.0 ± 1.68
II	140.0 ± 1.02	186.5 ± 1.21	220.5 ± 0.34
III	178.0 ± 2.10	174.0 ± 2.10	431.0 ± 1.54
The flowering phase			
I	129.0 ± 1.10	200.5 ± 0.86	457.0 ± 1.74
II	123.0 ± 1.22	148.0 ± 0.93	186.0 ± 0.91
III	91.4 ± 1.04	99. 9 ± 0.88	131.1 ± 1.02

Analyzing the exposed results in the table it has been ascertained that the value of nitrates in alfalfa (green mass) cultivated on the control lot and on that with the fund of worm compost in all three rounds of mowing and that two phenological phases did not exceed the MPC, excepting the sample collected from the lot with worm compost fund, in burgeoning phase (mowing I), in which the amount of nitrates exceeded the maximum permissible concentration with 3.5% in the other samples collected from the lot with worm compost fund in both phenological phases, and in the three rounds of mowing, the amount of the accumulated nitrates did not exceed the MPC.

The use of the ammonium nitrate determined the accumulation of increased quantities of nitrates in alfalfa (green mass). The alfalfa samples collected from this lot in the butonization stage, in the time of mowing I, II and III, the nitrate content exceeded the maximum permissible concentration, respectively by 2.8; 1.1 and 2,2times. In the alfalfa samples collected on this lot in the phase of blooming, it was ascertained an accumulation of a greater quantity of nitrates, only in the period of mowing I. The nitrate cconcentration accumulated in these samples exceeded the MPC by 2.2 times.

For the evaluation of the influence of the various types of fertilizers on the nitrate content in the roughage, the alfalfa collected from experimental lots were subjected to the drying process (under natural conditions) thus obtaining the alfalfa hay. In the obtained hay was determined the amount of nitrates (Table 4).

The analysis of the results exposed in the table reveals that the amount of nitrates in samples of hay obtained from alfalfa collected from experimental sectors has increased significantly in comparison with that in samples of green mass. In samples of hay obtained from alfalfa of the control lot and that with fund of worm compost, nitrate concentration was lower than of those cultivated with the ammonium nitrate fund.

But in all samples of hay, the nitrate concentration exceeded essentially the MPC, which constitues for roughage 500mg / kg.

In the samples of hay obtained from the control lot in the burgeoning and blooming phase the nitrate concentrations exceeded the MPC in all three rounds of mowing, respectively by 2.61; 1.74; 2.07 times and 2.46 times; 1.66; 1.40 times.

The same regularity was found and in samples of hay obtained from alfalfa, in the same phenological phase and in the same rounds of mowing, cultivated with the worm compost fund.

Table 4. The content of nitrates in the hay of alfalfa

The mowing period	Variants of the experiment, phenological phases and the quantity of nitrates (mg / kg)		
	Control	Worm compost	Ammonium nitrate
The burgeoning phase			
I	1,305.0 ± 2.12	1,380.0 ± 2.68	1,643.0 ± 2.88
II	871.0 ± 1.08	960.0 ± 1.42	1,259.0 ± 2.06
III	1,036.5 ± 118	1,230.0 ± 2.56	1,420.0 ± 2.62
The flowering phase			
I	1,230.0 ± 2.92	1,318.0 ± 2.78	1,549.0 ± 2.75
II	832.0 ± 1.22	933.0 ± 1.15	1,175.0 ± 1.93
III	701.0 ± 1.17	750.0 ± 1.02	989.0 ± 1.62

In them the amount of nitrates exceeded the MPC respectively by 2.76; 1.92 and 2.46 times, and in the blooming phase this indicator exceeded the MPC by 2.64; 1.87 and 1.50 times. In the hay samples obtained from the lot with ammonium nitrate fund in the burgeoning phase the nitrate concentrations exceeded the MPC, in that three rounds of the mowing respectively by 3.29; 2.52 and 2.84 times. In the hay obtained from alfalfa in the blooming phase in the same rounds of mowing the nitrate concentrations exceeded the value of MPC respectively by 3.10; 2.35 and 1.98 times. It is obvious that as in the green mass as and in the hay obtained from the lot with ammonium nitrate fund (in all three rounds of mowing and in that two phenological phases) the amount of nitrates accumulated in forage crops exceeded the MPC, which diminished the quality of forage. The analysis of the obtained results found that the ammonium nitrate contributed to the accumulation in the alfalfa and the hay obtained from it, of a greater quantities of nitrates in comparison to that of plants cultivated with the worm compost fund.

The analyzes were made on the samples of cultivated fodder beet (the roots and leaves) using two types of fertilizers. The results of the analysis of nitrates content in fodder beet cultivated with worm compost fund and ammonium nitrate are shown in Table 5.

The study of the amount of nitrates in samples of fodder beet, collected in different phenological phases, demonstrated that their value is in direct connections with the type of sample, as and with the used fertilizer.

Table 5. The content of nitrates in the roots and in the leaves of fodder beet

Mowing period	Variants of the experiment and the amount of nitrates (mg / kg)		
	Control	Worm compost	Aammonium nitrate
The root crops			
I	1,320.0 ± 7.08	1,137.0 ± 5.31	2,113.0 ± 3.54
II	508.0 ± 3.54	513.5 ± 5.94	1,183.0 ± 5.10
III	540.0 ± 7.08	523.0 ± 5.31	845.0 ± 8.85
The leaves			
I	1,336.0 ± 7.10	1,336.0 ± 7.08	2,450.0 ± 3.40
II	584.5 ± 4.96	576.0 ± 5.31	1,065.0 ± 1.77
III	583.5±6.19	531.0 ± 7.07	919.0 ± 5.31

Note: I - the beginning of the formation of root crops;
II - the period of formation of root crops;
III - the maturing of root crops;

The analysis of the results in the table demonstrates, that in the phase the beginning of the formation of root crops, in plants collected from all lots the amount of nitrates exceeded the MPC (800 mg/kg). In samples of root crops and the leaves, collected from the control lot, the amount of nitrates exceeded the MPC, respectively by 65.00% and 67.00%, in those from the lot with the fund of worm compost, respectively by 42.13% and 67.00%. An essential increase of nitrates content was detected in fodder beet collected from the lot with fund of ammonium nitrate. The amount of nitrates in the root crops exceeded the MPC by 2.64 times and in the leaves by 3.06 times. In samples of the root crops and in the leaves of beet fodder, collected from the control lot and the with the fund of worm compost in the other two phenological phases, the nitrate content did not exceed the MPC, but in samples collected from the lot, with the fund of ammonium nitrate, this amount exceeded the MPC by 5. 63% - 47.88%.

Therefore, it has been found that the mineral fertilizer contributed to the accumulation of nitrates in forage crops, which decreases the quality of forage.

CONCLUSIONS

In the results of the investigations, it was found that the accumulation of nitrates in

maize depended on the phenological stage and type of fertilizers used in the experiment. As maturity in all samples consisted of stems and leaves, the amount of nitrate decreased, and in the cobs in the fully ripe phase, they were not been found.

The using of the ammonium nitrate determined the accumulation of an increased quantity of nitrates in alfalfa (green mass) and hay obtained from it. The alfalfa samples collected from this lot in the butonization and flowering phase in all three rounds of mowing, the nitrate content exceeded the maximum permitted concentration, respectively by 1.1 - 2.75 times and 2.20 times. In samples of hay obtained from alfalfa, from the control lot, with worm compost fund and with fund of the ammonium nitrate, the amount of nitrate exceeded the MPC, respectively by 1.66 - 2.61 times, 1.50 - 2.76 times and 1.98 - 3.29 times

In the fodder beet the amount of nitrates that exceeded MPC occurred in all the variants of the experiment, in the first phenological phase, but keeping it high in all phenological phases in plants of the lot with the fund of the ammonium nitrate.

So, the using of worm compost, in a quality of organic fertilizer, contributed to obtaining the qualitative fodder crops and the mineral fertilizer (ammonium nitrate) directly influenced the accumulation of nitrates in forage crops, which led to the diminishing of its quality.

REFERENCES

[1]Boclaci, T., Cremeneac, L., 2013, Influence of fertilization of soil with worm compost on the quality of peas, Scientific Buletin, Series F. Biotechnologies, Volume XVII: 39-42, Bucharest

[2]Condîreva, M., Cremeneac, L., Bahcivanji., 1994, Biological processing technology of manure using the mitod worm cultivation, Recomandations, Agroinformreclama, Chisinau

[3]Cremeneac, L., 2003, Bioconversion of organic wastes in Moldova, Summary information, Typografy INEI, Chisinau

[4] Cremeneac, L., Boclaci, T., Chiruneţ, Z., 2012, The technology of bioconversion of organic waste and the use of the obtained products, Recommendations, Chisinau

[5]Cremeneac, L., 2015, The study of the influence of fertilizerson qualities of forage crops, Scientific papers "Zootechnics and Biotechnology", Vol.44, 84-88, Chişinău

[6]Gorodniy, N.,M., and others, 1996, Bioconversion in the Management of Agro-Ecosystems,180-196, Kiev

[7] Melnik, I., 1994, Worm culture: the production and use,UkrSTEI,Kiev

[8]Kondrahin, I.P., Kurilov, N.V., Malahov, A.G., 1985, Clinical laboratory diagnostics in veterinary medicine, Moscow: Agropromizdat, 191-193

[9]Kosolapova, A.I., Smyshlyaev, A.I., Kosolapov, I.N., 1996, Worm culture and its capabilities, Ryazan.