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PROCESSING OF ANIMAL MANURE, OBTAINED FROM CATTLE, PIGS AND CHICKEN WITH RED CALIFORNIA WORMS

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Abstract

At the present moment approximately 9 million tones of animal manure are accumulated in the Republic of Moldova every year. Due to lack of financial sources livestock waste can't be transported in the field, they are accumulated on small areas for storage, polluting the soil, groundwater and the air. The animal droppings at the same time contain various pathogenic agents, which serve as a source of infection for people, animals and plants diseases.
The livestock waste processing with the California's red earthworms permits to diminish their quantity with 2 times, to increase the NPK concentration and diminish the doses of incorporation of the obtained vermicompost. The obtained experimental dates demonstrate that the processing of various types of animal manure with the aid of California's earthworms in the situation of the Republic of Moldova is related to significant losses of nitrogen and carbon. By the chemical composition of the vermicompost, obtained from different species of animals it is a little different from the properly fermented animal manure. Therefore, the doses of incorporation of the vermicompost for various crops will be very close compared with traditional manure.
The existent recommendations for application of the vermicompost in the countries with advanced agriculture can't be used in the situation of the Republic of Moldova. The content of NPK in the vermicompost from our country is 8 – 10 times lower. In order to obtain a concentrated product (humus, biohumus, vermicompost) it is necessary to use in the process of waste processing with earthworms other additions too such as phosphorites flour (or apatites), bone meal, ash, blood meal, other slaughterhouse waste or food waste.

Key words: *California's red earthworms, vermicompost, biohumus.*

INTRODUCTION

Plant growing aims to provide the people needs with vegetable food. The livestock sector of agriculture consumes a part of the plant production, turning it into food of animal origin. Along with meat, eggs, dairy and other products obtained from livestock, in the Republic of Moldova annually approx. 9 million tonnes livestock waste (manure, grape manure, poultry manure, compost, etc.) are accumulated. But the lack of financial resources and corresponding machines, animal waste can't be transported and incorporeted into the soil. It is accumulated on special platforms in which various substances are washed, polluting the soil, groundwater and air. It should be also mentioned that animal droppings, contain various pathogens and servas a source of infection for people, animals and plants.
In order to minimize the negative impact of the livestock waste on the environment, they are composted, or anaerobically fermented (to obtain biogas). They can also be processed using the California's red earthworms or house fly larvae. Different species of food mushroom grown on some animal waste. But the main way of the use livestock wastes is its incorporation in the soil as organic fertilizer.
The processing of organic wastes with earthworm has the following ***advantages*** compared with other technologies: it is a quite simple technology; waste odour disappears quickly; its decomposition by earthworms is 3-5 times faster; waste volume is reduced by 40-60%; nutrient concentration becomes higher and application rates of this organic fertilizer is approx. 10 times smaller (4-6 t/ha as compared to 40-60 t/ha to traditional manure; earthworms in waste processing destroy many pathogens that cause animals disease, such as septoria, tuberculosis, salmonellosis, anthrax etc.
For example, content of NPK in biohumus, obtained by (Miorzlaia, 2004) in Russia is: N - 0.6-1.4%, P - 0.4-2.7%, K - 0.5-1.9%. Vermicompost produced in Germany contains

much more nutrients: N - 4%, P - 5%, K - 2.5% (Melzer, 1988). Biohumus obtained by Cremeneac (2003) in Moldova contained much loss nutrients: N - 0.8%, P - 1.4%, K - 1.2%. The purpose of this investigation was to study the chemical composition of manure, obtained from cattle, pigs and poultry and the content of NPK of viermicomposts, obtained from the processing of waste using Red California's earthworms, in the situation of the Republic of Moldova. Proceeding from the actual content of NPK in viermicompost, we can determine the application dose of manure in soil of this valuable organic fertilizer.

MATERIALS AND METHODS

The experiments were carried out in 2007-2011 in Mihailovca village, district of Cimislia, Republic of Moldova. In experiments was used litter manure obtained from cattle, pigs and chickens. Before using livestock waste as feed for the California's Red worms, first they were fermented by the mixed method - 5-6 months for cattle and swine feces and about 12 months, for the droppings of chiken. In spring, when the temperature reached 15-20°C worms with pupae (about 20 000 per m^2) were applied to platforms prepared and filled with different livestock waste. Before placing the worms in the substrate it was tried the biological sample: three-liter jars were filled with fermented waste up to 2/3 of the volume. In each jar were placed by 50 earthworms. After 2-3 minutes the earthworms have penetrated the substrate, that confirmed that the substrate was good for earthworms. California red frame, is a specially selected subspecies from manure worms (Eisenia foetida). Unlike the wild specimens California worms are leon multiplied qucker (over 1500 copies per year). It has length of 6-8 cm, weight approx. 1 g and not leave the place of residence, even if the environmental factors are unfavorable. In 24 hours a mature worm processesthrough her body about 0.7-1 g of waste. Worms grow and multiply rapadly if the substrate optimum temperature reaches 15 ... 20° C, pH = 6-7 units, the substrate humidity is of 70-80%. The substrate must also be loose for O_2 sufficiency frames. During the warm period care is to maintain the limited substrate moisture, shading the platforms, turning the waste and feeding them once a week. In samples of organic fertilizers and in the obtained viermicompost was determined: the moisture content by the drying method in an oven at a temperature of 100-105°C to constant weight. Mineralization of organic substance was performed by the Iodlibauer 's method. Total nitrogen content was measured by the volumetric method (Kieldahle's distillation system), total phosphorus by colorimetric method (after Denije), total potassium in the flame of the photometer. The experiment was conducted in 3 replicates.

RESULTS AND DISCUSSIONS

The famous Russian agrochemister D. Preanisnicov mentioned that as many mineral fertilizers would be used, manure will never lose its value. Approximately 30 million tons of wastes are accumulated every year in Republic of Moldova (Bulimaga, 2009). Livestock wastes accounts approximately 9 million tons annually and are concentrated mainly in the private sector. They are the most complex natural fertilizers and at the same time the cheapest fertilizers. Just such fertilizers must be applied in conditions of crisis. If the livestock wastes would be applied fully in the dose of 40 t/ha we would have fertilized every year about 250,000 hectares in Moldova.

The content of nutrients in different types of livestock wastes various greatly. One ton of the bedded manure contains about 5 kg N, 2.5 kg P and 6 kg K, 75% water (Lixandru and Filipov, 2012). Manure without litter has a higher water content - 89-90% in cattle wastes and 95-97% in pigs manure, 0.23-0.30% N, 0.13-0.17% P, 0.08-0.17% K. Chicken manure (with litter) is more concentrated: N 2.0-2.2%, P 1.5-1.8%, K 1.1-1.4%, humidity - 56% (Andrieş, 2011). From feed to manure go approx. 40% organic matter, 50% N, 80% P and 95% K (Lixandru and Filipov, 2012). The chemical composition of different organic waste and vermicompost (biohumus, humus), obtained from them depends on animal species, age, quantity and quality of feed, litter quantity and its composition, method of

fermentation, way of storage and other factors. Storage, transportation and incorporation in soil of a large quantities of organic fertilizers demands a high costs and to reduce those costs is necessary to increase the concentration of nutrients in the compost and to reduce the dose of applied fertilizer. One of the way to resolve this problem is processing of the livestock waste using California red worms. Analysis of chemical composition of manure derived from cattle (Table 1), pigs and chickens show that moisture and NPK content varies significantly (Andries, 2011). Thus, nitrogen, phosphorus and potassium contained in a tone of manure with bedding or solid fraction of bovine waste is approximately the same. Cattle manure without litter contains 2 times less nutrients, than the one litter. Liquid fraction of cattle is the poorest in NPK (content is only 0.02 to 0.09%).

Table 1. Chemical composition of manure, obtained from different animal species

Type of manure	Moisture, %	Dry matter, %	pH	Content, % in mass		
				N	P	K
Cattle manure						
With bedding	58	42	8.2	0.53	0.31	0.81
Without bedding	89	11	8.7	0.30	0.17	0.37
Solid fraction	73	27	8.3	0.57	0.42	0.79
Liquid fraction	98	2	8.2	0.07	0.02	0.09
Swine manure						
With bedding	60	40	7.5	0.89	0.53	0.52
Without bedding	`95	5	8.5	0.23	0.13	0.08
Solid fraction	82	18	8.7	0.56	0.66	0.25
Liquid fraction	98	2	8.0	0.06	0.03	0.05
Chicken manure						
With bedding	48	52	7.7	1.5	1.44	1.00
Solid fraction	52	48	7.1	1.8	1.29	0.92
Liquid fraction	99	1	7.0	0.1	0.03	0.09

Swine manure with bedding is more rich in nutrients, than that of cattle: 0.89% nitrogen, 0.53% phosphorus and 0.52% potassium. Solid droppings without litter have a lower content of NP and the amount of potassium is 2 times lower (0.25% comparatively with 0.52%). Liquid fraction of swine manure differ little from the liquid fraction of cattle or chicken manure.

Poultry manure with bedding or solid excrement of chicken are most concentrated in nutrients. One tone of chicken wastes contains: nitrogen 15-18 kg, phosphorus 12.9-14.4 kg and potassium 9.2-10 kg.

So, for livestock waste processing with red worms of California it is reasonable to use only the bedded manure or solid fermented fractions of different animal species. Liquid fractions contain very little nutrients and can't be processing directly by earthworms.

The manure processing with different content of nutrients by earthworms, changes little the chemical composition of the obtained vermicompost (Table 2). Phosphorus and potassium content in biohumus is slightly high compared to manure (for phosphorus 0.51-1.77% compared to 0.31-1.44%, for potassium 0.76-1.37% compared to 0.52-1.0%). This probably explains that the loss of approx. 50% of the initial mass of manure in the processing with earthworms and almost the same amount of PK, reported to a smaller amount of waste, increased the content of nutrients. It should be noted, that phosphorus and potassium are poorly absorbed by the worms weaker and during the processing these elements are being little washed.

Nitrogen content reverse - is lower in all types of vermicompostes, compared with manure, because that worms use some nitrogen substances, especially proteins. Another part of nitrogen from the waste is eliminated in the air during the processing in the form of NH3, NO, NO2. For example, bovine and porcine biohumus accordingly contain 0.34 and 0.59% nitrogen, compared with 0.53 and 0.89% in cattle and swine manure.

Table 2. Chemical composition of viermicompost, obtained from manure of different animal species in 2007-2010

Moisture, %	Dry matter, %	Natural mass content, % in mass		
		N	P	K
Vermicompost from Cattle manure				
45.1	54.9	0.34	0.51	1.11
Vermicompost from Swine manure				
41.7	58.3	0.59	0.72	0.76
Vermicompost from Chicken manure				
43.8	56.2	1.29	1.77	1.37

So, livestock waste processing using California red worms, leads to considerable loss of nitrogen. At the same time increase the phosphorus and potassium content. Vermicompost obtained in the Republic of Moldova differ a little from traditional manure and can't be applied in very small doses (4-6 t / ha). To increase the content of nutrients in vermicompost it is necessary to use during processing of livestock waste other additives.

CONCLUSIONS

The obtained experimental dates permit to draw the following conclusions:

The highest content of the NPK is observed in the bedded manure or solid fraction of manure, indifferently of animal species. The most concentrated in nutrients is the chicken bedded manure, followed by those obtained from pigs and cattle. Liquid wastes are very diluted and contain only 0.02 to 0.09% NPK. They can't be processed directly with earthworms.

Processing of different types of manure with California red worms is followed by significant losses of nitrogen. Vermicompost, obtained in the Republic of Moldova, is little more concentrated in PK, but poorer in N compared to fermented manure. The content of these elements in vermicompost and different type of manure are quite close. Therefore, the incorporated doses for vermicompost and traditional manure for different cultures will be almost the same.

Existing recommendations for application of vermicompost in countries with advanced agriculture can't be used in the Republic of Moldova. To obtain a more concentrated (vermicompost or biohumus, humus,) it is necessary to use in waste processing technology with earthworms other additives too such as phosphorites meal (or apathy meal), bone meal, ash, blood meal, wastes from slaughterhouses and other food wastes.

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