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GENERAL ASPECTS REGARDING WASTE MANAGEMENT IN SUSTAINABLE DEVELOPMENT OF AGRICULTURE

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A*bstract.*

The paper summarizes the world and own experience using worm culture (earthworms) for utilization of various organic wastes, use of products worm cultivation (worm compost, biomass, worms and alarm pheromone) in a number of industries. Recognized features of physiological development and maintenance of worm culture, the stages and the basic conditions of industrial cultivation technology, the product features and their use. The bioconversion process of organic wastes is implemented in the Experimental Section of the Scientific and Practical Institute of Biotechnologies in Animal Husbandry and Veterinary Medicine. The studies conducted by several states, including Moldova, concluded that worm compost has a positive influence on crop productivity, reducing growth period, their resistance to unfavourable climatic conditions and common plant diseases.

Worm cultivation opens up new perspectives and opportunities for introducing technology of obtaining the protein not only for feed purposes, but also in the food industry for the production ecological products. The results of research showed that the products obtained from biomass worms and alarm pheromone, can serve as raw material for the preparation of medicinal products used in medicine and in veterinary medicine for the control and prevention of various diseases.

Technology of bioconversion of organic waste using worm culture is designed for landowners, farmers, ranchers, and agricultural enthusiasts, and others as an alternative method for the sustainable development of agriculture.

The research conducted and analysis of results about the development of worm cultivation found that: worm cultivation is a branch that has the ability to solve stringent ecological problems existing in some sectors of the national economy, contributing to the development of sustainable agriculture and otained ecological agricultural productions, products obtained as a result of worm cultivation can be widely used in crop, livestock, human and veterinary medicine.

Keywords: *bioconversion, organic wastes, organic fertilizer, worm compost, worm culture.*

INTRODUCTION

Organic waste management, the diverse origin of ancient times had spreading range of practical people. Livestock waste, plant growing and food can be used as raw material in organic waste bioconversion technology by worm cultivation to obtain valuable organic fertilizer and biomass with a high content of protein (Condîreva et al., 1994; Cremeneac, 2003).

Biotechnology used, along with organic waste management and production aspect, manifest an environmental aspect, which allows solving the problems of environment protection and sustainable development of agriculture.

Special attention in the last decades of the twentieth century was directed to use worm culture biotransformed as organic waste. Was found that worm culture (earthworms), as biotransformed, is able to process organic waste of different origin, transforming them into valuable organic fertilizer - worm compost (biohumus, biocompost).

An important support in the elaboration bioconversion technology of organic waste has served long observations made on the lives of earthworms in nature. It was found that search of food earthworms swallow soil particles with organic waste, which enter the digestive tract of worm culture is enriched with micro- and macro turning into worm compost, characterized by major agrochemical properties. "Domestication" of

earthworm served as the basis for the management of organic waste and use of worm culture in the process of bioconversion of organic waste in the branches of the economy in general and especially in agriculture,of food industry, of household waste and of sludge from wastewater as a result of treatment.

Based on the research conducted and results obtained (Gorodniy, 1990; Melnik, 1994; Cremeneac, 2003) was elaborated a complex program of management and bioconversion of organic waste by worm cultivationthat includes following directions: bioconversion of organic waste by worm cultivation to obtain valuable organic fertilizer, biological transformation of organic waste and getting worm compost, obtaining biologically active preparations of tissues worm culture, prospects and effectiveness in agriculture of worm compost (as fertilizer) and biomass earthworm as the protein supplement in animal feed rations) to obtain otained ecological agricultural production (Cremeneac et al., 2012).

So in the article are described aspects of organic waste management for use in environmental quality of life and nutrition of worm culture and possibilities of using products from sustainable development of agriculture in addressing issues of environmental protection in society.

MATERIAL AND METOD

Research in the domain management of organic waste and appreciation of worm compost have been carried out in the Technological-Experimental Station "Maximovca", where he was held the household for worm cultivation and the experiment in field conditions in order to evaluate the influence of worm compost on quality and yield of agricultural crops.

In organizing of household for worm cultivation was taken into account the objectives and tasks that must be solved. It was found that the dominant household for worm cultivation will be: processing of organic waste, increasing the population of earthworm, production of worm compost for resort needs.

The field chosen for worm cultivation was located in an area accessible for use the organic waste, less inclined, with drainage into the ditch, for the water from sectors because worm culture not support high humidity. Sectors for worms cultivation were oriented in the direction of predominantly wind in order not be situated in the wind and to receive the sufficient amount of warmth, with south exposition. Formed sectors for worm cultivation in household were oriented from north to south.

The next step was to prepare the sectors and departments. for worm cultivation According to the technology of bioconversion the organic waste for worm cultivation in households is practiced by pairs sectors 1m wide and 50m long. The distance between the two sectors can be 1m, and of the pair - 4,0m -4,5m Taking into account these requirements STE "Maximovca" were used 5 sectors for worm cultivation, in which initially were placed about 125 tons of organic waste (manure of cattle) that were previously undergone fermentation during 6 months. During six months in sectors were added as supplementary food for still about 25 tonnes.

So, in total have undergone processing about 150 tons of organic waste. Each sector was divided into 25 sections, with dimensions 1,0m × 2,0m. Bioconversion technology of the organic waste by worm cultivation in this household was held at the open air.

In the first year of work the main objective was the accumulation of increased population the earthworm Red Hybrids of California therefore the process has been used only two sectors that have been placed organic waste and worm culture. In each sector for worm cultivation were placed about 25 tons of organic waste subjected to bioconversion to increase population of earthworm, which can then be used to manage organic waste and obtain worm compost. Each sector for worm cultivation were divided into sections, where was placed each a ton of organic waste. Nutritive substrate thickness in the sectors for worm cultivation was 25-35cm - summer and 35-45cm - winter. Under one month nutritive substrate from sectors was sprayed for a week - every day, then once a week. After the period of

spraying, the substrate prepared for worm cultivation has undergone biochemical analysis to determine quality indices.

Initially, and then permanently in order to determine the quality of the organic waste placed in areas for worm cultivation was make analyzes: biochemical, determination of active acidity (pH), ammonia nitrogen content, total nitrogen, organic matter, magnesium, phosphorus, potassium and calcium and microbiological taking into consideration pathogenic and non-pathogenic microflora present, using the usual methods (Razumova, 1986). Also to determine the quality of nutritional substrate for worm culture is used "50-the earthworm test" that provide control of the organic waste by using 50 earthworms. In a container were placed 2-3kg of organic waste that is located 50 earthworms. If after 24 hours the earthworms does not leaving the substrate and were active when it is considered that organic waste can be used as a nutritional substrate for worm culture.

Complete cycle of processing of organic waste vary from 5 to 8 months, depending on climatic conditions earthworms and population density located to substrate .

As a result of use of bioconversion technology of organic waste by worm cultivation final products were obtained: worm compost - valuable organic fertilizer, organic mass of earthworms and ecologycal production.

For assessment purposes the influence of viermicompostului on quality and yield of agricultural crops in conditions of field was organized experiment in which research materials have served viermicompostul and agricultural crops: peas, fodder beet and corn. For each agricultural crop were used a control group (with natural background) and two experimental groups (with background of worm compost). Worm compost was incorporated into the soil at a dose of 4t/ha (experimental group I) and 3t/ha (experimental group II).

To determine the quality of nutrient substrate, organic fertilizer produced (of worm compost) and cultivated agricultural crops with fund of worm compost were used following methods: the determination of active acidity - using pH meter, total nitrogen - using the Kjeldahl method; nitro-compounds – using the electro colorimetric method, magnesium, calcium, phosphorus and potassium - using the usual methods (Petuhova et al.,1989). Determining the harvest productivity was made by weighing. Control counting of earthworm population was carried out by special method, which consists in using a form with size 10cm × 10cm, with a length of 20 cm (corresponding nutritive substrate thickness of sectors). With this form are taken three samples of nutritive substrate from each section. By counting is determined the number of earthworms of all ages in all three samples, and then the necessary calculations were made taking into account the surface section and then sectors.

Subsequently, in the second and subsequent years, the population of earthworm obtained was used as organic waste biotransformed in the 5 sectors.

So, the objectives and the proposed duties for organic waste management in sustainable agriculture have been met. Statistical processing of the results was performed according to the method developed by E.Mercurieva

RESULTS AND DISCUSSIONS

As a result of biochemical analyzes of nutritive substrate placed for worm cultivation sectors, it was found that it coincided with necessary parameters for bioconversion of organic waste by worm cultivation, being used as a nutritive and life medium for worm culture (Table 1).

Through the quality control of nutritive substrate according to test "50 of earthworm" also was confirmed quality of nutritive substrate because after 24 hours of placement of earthworms in substrate, all 50 earthworms used in testing, remained alive and active. In April in each section were placed each 2,000 mature earthworms. Placement of earthworms was made early morning, since under the influence of sunlight they quickly hide in the substrate.

Table 1. Chemical composition of the nutrient substrate

No	Indices	Index value, M ±m
1	Active acidity (pH), units	7,57 ± 0,08
2	Ammoniacal nitrogen, mg / kg	5,56 ± 0,57
3	Total nitrogen, %	0,83 ± 0,63
4	Organic substanc, %	30,35 ± 0,60
5	Magnesium, %	1,17 ± 0,52
6	Phosphorus(P_2O_5), %	0,65 ± 0,32
7	Potassium (K2O), %	0,68 ± 0,01
8	Calcium, %	1,55 ± 0,35

During the first week, daily, investigations were performed to establish the presence of abnormalities in behavior and development of worm culture. As a result of investigations it was found that at the end of the first week, mature individuals began to use in nutrition the substrate in which they were placed. This showed that the substrate is benific for use as living environment for worm culture. During of investigations, over 6 months, were made observations on the process of reproduction of worms culture by conducting monthly control count of individuals of all ages present in sections. Results regarding the developer population earthworm are presented in Table 2.

Table 2. Dynamics of population development of earthworm of California Red Hybrid

No.	Population of earthworm	During of investigations, month		
		One month	Three month	Six month
1	Mature earthworms	2000	2000	10077
2	Juvenile earthworms	5125	17490	70113
3	Cocoons	4320	5200	20740
4	Total: (mature earthworms + juvenile earthworms)	7125	19490	80190

Analysis of the results has found that over six months, the number of mature earthworms in a section increased 5 times compared to their number in the initial stage. During the investigation were found significant changes in correlation: Cocoons: mature earthworms, earthworms juvenile: cocoons and juvenile earthworm:mature earthworms. It was found that in the first month these indices were 2,2 cocoons to one mature earthworm, 1,2 juvenile earthworms to a one cocoon and 2,6 juvenile earthworms to one mature earthworm. After three months, this correlation has changed constitute: 2,6 cocoons to one mature earthworm, 3,4 a juvenile earthworms to one cocoon and 8,7 juvenile earthworms to one mature earthworm. To the end of the sixth correlations cocoons: mature earthworms and juvenile earthworms: earthworms mature decreased and correlation juvenile earthworms: cocoons remained at level of the first month. These changes at the end of the sixth were influenced by increased earthworm population in sectors, which resulted decline in reproduction. According to the results obtained after six months of earthworms population in a sector was about 2004750 individuals of all ages. Such in both sectors was obtained for worm cultivation a population of about 4 million earthworms, which was later used for biotransformed as the organic waste 5 sectors ready for bioconversion of waste by worm cultivation. After being determined quality of nutritional substrate for worm cultivation in the sectors in these worms were placed culture reasons in a section 32000 earthworms or earthworm 800000 in a sector. Complete duration of processing of nutritional substrate is 6 months. During the experimental period nutritive substrate was sprayed with water (according to necessity). For worm cultivation sectors were covered with straw in order to reduce evaporation - summer and protection from the cold - winter.

During the experimental period requirements have been bioconversion technology of organic waste by worm cultivation (humidity - 70-80 %, content of ammoniacal nitrogen 1,0 to 20mg / kg, active acidity (pH) - 6,8 to 7,6 units and content of cellulose - 30 %). After 30 days from the beginning of the experiment, it was found that worm culture completely processed the nutritive substrate, so started adding new amounts of nutritive substrate, as additional food. This process was conducted (according to necessity) every 10-14 days. At the end of the experimental period worm culture was separated from the substrate and placed in other sectors, prepared

in advance. As a result of bioconversion was obtained about 90 tons of worm compost, valuable organic fertilizer.

In Table 3 are exposed quality indices of worm compost obtained as a result of bioconversion of organic waste by worm cultivation.

Table 3. Quality indices of worm compost obtained from cattle manure

No	Indices	Index value, M ±m
1	Active acidity (pH), units	7,81 ± 0,03 - 8,08 ± 0,02
2	Organic substance, %	32,92 ± 0,02 - 39,96 ± 0,03
3	Total nitrogen, %	1,09 ± 0,01 - 3,00 ± 0,04
4	Potassium (K_2O), %	1,92 ± 0,02 - 2,80 ± 0,05
5	Magnesium, %	1,18 ± 0,03 - 2,50 ± 0,04
6	Phosphorus (P_2O_5), %	1,37 ± 0,08 - 2,50 ± 0,06
7	Calcium, %	1,62 ± 0,02 - 3,80 ± 0,05
8	Humus, %	29,66 ± 1,40 - 35,91 ± 1,90
9	Nonpathogenic bacterial flora, colonies	$2x10^{12}$-$3x10^{12}$

Comparing the values of worm compost obtained with the the nutritive substrate was found that the amount of active acidity, total nitrogen, potassium, magnesium, phosphorus and calcium have exceeded that of a the nutritive substrate, ie 3,17 % - 6,74 % , 31,32 % - 261,14 % 182,40 % - 311,8 %, 110,77 % - 284,62 % and 4,52 % - 145,20 %. Organic matter content decreased by 8,46 % - 31,66 % respectively. As a result of the investigations it was found that worm compost contain 100 times more non-pathogenic microflora (2x1012 colonies) than traditional compost. In worm compost are concentrated considerable quantities of enzymes, vitamins and stimulators of growth. It was also found that in the worm compost is well balanced content of macro-and microelements, which allows decreasing the dose of incorporation in soil of 8-12 times compared to ordinary compost. When using worm compost as organic fertilizer savings are considerable taking into account that at one hectare using 3-6 tons of worm compost compared to 40-70t/ha of traditional compost. Efficacy action of worm compost is kept over 3-4 years.

So, according to the results obtained it was found that after the biochemical composition and usage, worm compost is upper traditional compost.

According to the research found that one tonne of compost worm contained an amount of 270-300kg of humus. This allows to significantly decreased period for completing the amount of humus in the soil, thus restored soil fertility and soil resistance to wind and alluvial erosion.

In order to determine the particularities of the development process of plants and agricultural productivity cultivated with fund of worm compost in field conditions of Technological-Experimental Station "Maximovca" was organized experiment.

At the initial stage of the experiment it was found that all cultures of the experiment cultivated with fund of worm compost sprang with 5-7 days earlier than those in control groups. This demonstrates that the beneficial influence viermicompostul germination and springing of agricultural crops.

Comparing the development of plants in all variants was found that in lots of worm compost fund of agricultural crops have grown more intense, early flowering of peas and formation earlier of maize cobs took place 5-6 days earlier than in control groups.

So, as a result of studies found that incorporation of worm compost in the soil, at a dose of 4t/ha, resulting in faster development of crops, reduce the period of flowering and ripening of crops. At the end of the experiment there was an essential difference in the productivity of crops, depending on the fund that was grown and crop type (Table 4).

Analyzing obtained found that harvested pea obtained varied from lot to lot. The experimental groups I and II harvested grains peas exceeded that of the control group, respectively 47,50 % and 35,30 %.

Table 4. Indices of agricultural crop productivity

No.	Agricultural crop	Lots and quantity of yield, kg		
		Control	Experi-mental I	Experi-mental II
1	Peas	10,640	15,700	15,400
2	Maize	57,000	77,000	69,000
3	Fodder beet	630,000	1115,000	907,000

Harvest of maize in the experimental group was 35,08 % and 21,05 % more increased than the control group of plants.

On the experimental groups where fodder beet was cultivated with worm compost fund

has collected 76,98 % and 43,96 % more productive than the control group.

So, the results of investigations involving different crops and incorporation of worm compost in the soil reduce phenological stages of plant development increases yield of agricultural crops.

Thus, as a result of organic waste management and their use as living environment and nutrition for the worm culture was possible solve some problems of the environment protection and obtaining increased quantities of agricultural production.

CONCLUSIONS

Bioconversion of organic waste by worms cultivation solves some important issues in the sustainable development of agriculture: the complete processing of organic waste, protect the environment, obtaining organic ecological fertilizer, long-acting, increasing crop yield and improving the quality of agricultural production.

Qualitative indexes values of worm compost have exceeded those essential the nutritive substrate.

Worm compost used for growing crops, beneficial influence their developers in different phenological phases contributing to increased harvest obtained per unit of area.

Incorporation of compost worm in the soil, at a dose of 4t/ha and 3t/ha, expected decrease springing and ripening period and increases of agricultural crops harvest by 21,05 %-76,98 %.

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