COMPOUND NATURAL SOURCE OF NUTRIENTS AND HUMUS FOR PLANTS AND SOIL

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ABSTRACT

Composting is the biological decomposition of biodegradable solid waste under controlled conditions in a state that is sufficiently stable to allow trouble-free storage and handling and that is satisfactorily matured for safe use in agriculture. When mineral fertilizers are not available or are too expensive, compost is the most important source to provide plant nutrients and adjust soil condition. Many people today appreciate compost as a natural source of nutrients and humus. The paper will present the partial results obtained in a research project in which a biohumus loosening plant was based and built. The use of the biohumus loosening plant aims to adjust the natural decomposition process, ensure good conditions for the composting process, especially air (oxygen), water, and a good composition of the material introduced into the piles, and monitor them for get a quality product.

INTRODUCTION

An important role in the development of a sustainable agriculture is the conservation and maintenance of the natural fertility of the soils. "The essence of the biological circuit of matter is that it ensures the permanent resumption of the process of life, imprinting on the soil an essential property, which distinguishes it from the rocks from which it came, namely fertility (Nicolas Bernier and Jean-François Ponge 1994). Biohumus (vermicompost) or earthworm soil is a pure natural microbiological organic fertilizer, having in its composition no preservatives, resulting from the mixture of manure and biological waste produced by earthworms. One of the ways to solve the processing and transformation of household organic waste from agriculture and various branches of industry, turning them into precious organic fertilizers - biohumus (biocompost, vermicompost) is vermiculture [3,4,].

Due to its special composition, having in large proportion all the elements that plants need, biohumus can be used in many fields of activity: horticulture, forestry, vegetable growing. Farmers can achieve amazing results by applying fertilizer containing 5% humus (10 to 20% is considered ideal) [5].

The processes of decomposition of organic waste by microorganisms depend on the nature of the organic waste, the environmental conditions and the type of microorganisms. The transformation of organic matter takes place in three main stages: hydrolysis, redox reactions and total mineralization [1]. The final product called compost must not be harmful to nature, must not contain hazardous compounds such as heavy metals, and the decomposition process must be almost complete. Figure 1 shows the resource anagement within the composting process.

Fig.1. Resources management [1]

MATERIAL AND METHOD

Monitoring the composting process is very important to provide the optimal conditions in the pile and to obtain a good and useful final product, compost [7]. Obtaining a quality biohumus requires the application of a technology that establishes all the necessary steps to be completed. In this sense, within INMA, two installations necessary in the process of obtaining biohumus were substantiated, designed and realized: Biohumus loosening plant and IPB biohumus production plant (vermicompost), figure 1 and 2.The experimental model, IAB biohumus (vermicompost) loosening plant, is intended for faster and better quality production of biohumus. The installation will allow operation in variable temperature and humidity conditions, both in summer and winter for the loosening-production of

Fig.2.Instalaţia de afânare a biohumus IAB [8]

Fig.3.Instalație de producere biohumus (vermicompost) IPB [6]

vermicompost

Loosening accelerates the decomposition process - slow fermentation of various plant and animal residues, mixed with some minerals, located on the platform for obtaining biohumus. By using the loosening plant, a rarer, less compact, crushed granular material is obtained. Before starting work, the system is coupled to the tractor via the PTO shaft with the gear unit on the system.

The speed received from the tractor is multiplied by the gearbox and transmitted to the knife drum. Position the system on the side of the tractor so that it covers the compost line. By moving the tractor forward, the plant moves, which loosens the compost line but also shreds the compost components. During travel, the system is brought to the transport position (along the tractor). The plant is equipped with a water spray nozzle when the compost needs moisture.

The IPB biohumus (vermicompost or earthworm) production plant consists of the following components:

1. Cylindrical sieve SC-0;
2. Tilt-conveyor with TIB-0 belt;
3. TB-0 belt conveyor;
4. SV-0 vermicompost system;
5. SU-0 wetting system
6. Electric panel TE-0

Cylindrical sieve SC-0, figure 3, position 1, is a component part of the IPB biohumus (vermicompost) production plant and is used to sort the compost resulting in the decomposition of organic matter from various sources - animal manure, waste vegetable crops, residues from the meat and wine industry, waste. The interphase transport of the installation is performed with the help of belt conveyors.

The TIB-0 belt inclined conveyor figure 3, position 2 is used for loading with the compost resulting in the sieving process in the vermicompost system.

The conveyor belt TB-0, figure 3 position 3, is mobile, with the possibility of changing the height in the vertical plane being used to take the resulting compost as sifted from the cylindrical sieve, in order to feed the vermicompost system.

The vermicompost system SV-0, figure 3, position 4, is a metal construction provided at the bottom with a grate and vermicompost scraping system (compost subjected to the action of earthworms). The granular materials (compost) are introduced into the feed hopper of the cylindrical sieve by means of the inclined conveyor with TIB belt. The cylindrical sieve is equipped with a rotating brush cleaning system. The screened material passes through a circular sieve and then into the discharge funnel and the refuse is removed through the refuse discharge funnel. The sieve is taken up at the exit of the sieve evacuation funnel by a TB conveyor and introduced into the vermicompost system.

Under the action of the earthworms at the bottom of the vermicompost system (by moving them from bottom to top) the compost will be transformed into vermicompost. As the earthworms move to the upper part the scraping knife (electrically operated) in the vermicompost system, performs the evacuation (by scraping the sieve) of the biohumus.

RESULTS AND DISCUSSIONS

For the realization of the compost recipes, a platform was used as a location (Ecological plant and animal waste management system - SEG) located inside INMA Bucharest, figure 4.

The decomposition process is influenced by a number of factors. These factors and the relationships between them, influence the speed of the decomposition process. These factors that influence the process are useful in monitoring and controlling the compost production process.

By using a certain material or a mixture of different input materials, many properties of the process can be influenced, such as: the volume of the interstices, the humidity, or the particle size of the material introduced in the pile, but also the quality of the compost.

Fig.4. Ecological plant and animal waste management system – SEG [2]

Therefore, the mixture of introduced materials (the substrate used) is the most important step in the production of a quality compost. To determine the most effective recipe for copost, 6 types of mixtures were tested as follows:

1. Recipe 1

- Shredded sorghum stalks;
- Chopped apples;
- Chopped vegetables (waste tomatoes and peppers from the greenhouse);
- Waste from a poultry farm;
- Layer of onion leaves and deciduous leaves that limit dehydration.

2. Recipe 2

- Green vegetable residues (plants removed from vegetable crops);
- Chopped apples;
- Chopped vegetables (waste tomatoes and peppers);
- Waste from a poultry farm;

-Deciduous leaves and plant debris from harvesting onion crops that limit dehydration;

3. Recipe. 3

- Shredded sorghum stalks;
- Chopped apples;
- Waste from a poultry farm;
- Chopped wood material, from the grooming of fruit trees / trees

4. Recipe 4 (No poultry waste)

- Chopped sorghum stalks;

-Vegetable residues removed from vegetable crops;

- Chopped wood material, from the grooming of fruit trees / trees;

5. Recipe 5

-Vegetable waste resulting from greenhouse care;

- Vegetable waste resulting from grooming the hedge;

-Waste resulting from biomass distillation processes in order to obtain bioethanol (composed of chopped apples and sorghum that have gone through aerobic fermentation and distillation processes);

-The ash resulting from the incineration of woody plant matter;

6. Recipe 6

-Whole sorghum stalks (they have not been crushed after the juice has been extracted, so they are only crushed by pressing):

- Chopped wood material, from the grooming of fruit trees / trees

-Vegetable material from clearing, mowing the lawn, remains of stems resulting from the uprooting of vegetable crops, etc.

As main operational steps in experimenting with recipes we list:

-Regulation of humidity in hot periods twice a week

-Aeration at least once a week with the IAB loosening system- the compost has passed through the thermophilic phase being covered with foil.

In the vermicompost system it will be permanently filled with compost resulting from the passage through the cylindrical sieve. The prisms will be covered again when there will be lower temperatures to keep the temperature better overnight (higher thermal inertia)

-Monitoring parameters once every 2 weeks (internal) and general outsourced analysis once a month

-Monitoring the activity of bacteria / fungi / insects present in the compost.

Before being stored on the SEG platform, the component materials that form the recipes will be subjected to chopping, grinding and homogenization. The tables below show the test results.

Tabel 1

Monitoring values during the decomposition process on the platform

Parameter	**Obtaining compost / Characteristics**
environment	Aerobic (with air)
Frequency of pile return	1. temperature method; the piles returned if the temperature dropped at values between 40º and 30º degree
Temperature	46º grade
Humidity	Optimal according to the analyzes based on the fist test
Degree of rot	Degree of rot III: (Tmax = 40 - 50 ° C)
Water content	48% WS
pH value	9 (slightly alkaline)
The volume of airless material	43% (the volume of the gaps in the pile depends on the composition of the material introduced)
Proportion C: N	31

Tabel 2

Determination of the characteristics of the compost when passing through the IPB Installation

MEASUREMENT SHEET						
Determining the quality of the processed product						
No.	**Characteristic**	**U/M**	No. sample	**The value of the parameter**		**Obs.**
				Product entry into the machine	Product output from the	

					machine	
0	**1**	**2**	**3**	**4**	**5**	**6**
1	Humidity	%	PI	43	42	
			P II	44,2	42,3	
			P III	43,5	41,6	
			Media	43,5	41,9	
2	Impurities					
	Glass, plastic,	%	PI	0,72	0,19	
			P II	0,68	0,20	
			P III	0,65	0,17	
			Media	0,68	0,19	
	Vegetable residues (greater than 2 mm)		PI	0,62	0,22	Vegetable residues> 2 mm
			P II	0,65	0,25	
			P III	0,63	0,23	
			Media	0,63	0,23	
	Stones		PI	0,7	0,2	Stones ≤10mm
			P II	0,60	0,28	
			P III	0,65	0,3	
			Media	0,65	0,26	
	Metal	%	PI	0,32	0.2	
			P II	0,35	0.25	
			P III	0,41	0.21	
			Media	0,36	0.22	
4	Compost granulation Screen I ø10 mm	mm	PI	15,5	9,2	
			P II	14,3	9,6	
			P III	13,9	9,4	
			Media	14,6	9,4	
	Compost granulation Screen II ø13 mm	mm	PI	15,5	12,3	
			P II	14,3	11,5	
			P III	13,9	12,4	
			Media	14,6	12,1	

Before being used to obtain the vermicompost by introducing into the SV-0 vermicompost System (see figure 3, position 4) the compost obtained on the platform is subjected to the sieving operation with the help of the SC-0 cylindrical sieve (figure 3, position 1), resulting in two fractions.

Table 2 shows the characteristics of the compost obtained from the sieve with the SC sieve which was equipped as follows: sieve I with mesh ø10 mm and sieve II ø13 mm (sieve is provided with two sieves).

CONCLUSIONS

Temperature is the most important value to be monitored during the composting process, as it can be very easily measured and shows the progress of the process.

The decomposition of organic substances as a result of the activity of microorganisms due to their ability to self-heat is the reason for the differences in temperature in the center of the pile and the surrounding temperature. The temperature curve also goes hand in hand with the processes of mineralization and rot.

Degradation of components that are difficult to destroy takes place during the transformation phase. Its duration depends on the environmental conditions. Therefore, a specific time interval for this phase cannot be indicated. During the maturation phase, the activity of bacteria slows down. During this period, soil organisms and worms populate the material and mix the mineral elements with the organic ones. Clay-humic complexes are formed that increase the nutrient content of the compost (especially nutrients available to plants). At the end of this period (the final temperature does not rise more than 40 ° C), the material is ready. During the composting process, the total volume and total mass of the pile decreases. Due to abrasion by other materials and maceration, the particle size decreases. Therefore, the total volume becomes smaller and the density of the pile increases. Vermicomposting is more sensitive than other composting methods and can induce the following problems:

• Extreme weather conditions: Vermicompost is susceptible to extreme weather conditions such as frost, heavy rainfall, drought and overheating.

• Rot: Anaerobic conditions (due to compaction and lack of oxygen) can quickly lead to rot.

• Predators: ants, birds, lizards can disrupt the activity of worms.

The waste collected must be processed for crushing, mechanical separation of metal, glass and ceramics and must be stored in a suitable place.

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