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THE PRODUCTION OF BIOHUMUS FOR A HEALTHY AND ORGANIC AGRICULTURE

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Abstract: One of the ways to solve the processing and transformation of organic household waste from agriculture and various branches of industry, turning them into precious organic fertilizers, like biohumus (biocompost, vermicompost) is vermiculture. The production and use of biohumus is addressed to those with livestock farms, but also to those who have vegetable, fruit, greenhouse, vegetable farms and have access to animal manure from other livestock farms. This paper aims to highlight the advantages of using biohumus for healthier and more natural agricultural production.
Keywords: vermiculture, biohumus, organic agriculture

INTRODUCTION

Vermicomposting is the process in which earthworms are used to convert organic materials (usually waste) into humus - a material known as vermicompost (Betz, 1999).

The processes of vermiculture and vermicomposting are similar, but different. A maximum density of earthworms is needed to produce vermicompost. If the goal is to produce earthworms, the density of earthworms must be kept low enough for the breeding rate to be optimal (Betz, 1999; Laza et al., 2019).

Vermicompost is generally superior to conventionally produced compost (Caba et al., 2019; Olan et al., 2020; Vlăduţ et al., 2019; Voicea et al., 2019) in several important ways, vermicompost is far superior to compost as an inoculant in the production of compost teas.

Figure 1- Biohumus

Biohumus contains in a balanced optimal form a lot of useful components:

≡ mineral elements;
≡ enzymes that ensure the transformation of organic residues into nutrient compounds;
≡ substances that prevent the spread of pathogens;
≡ phytohormones, which improve the growth and stress resistance of plants.

This type of organic fertilizer (biohumus) contains 4-8 times more humus than cow dung or compost derived from vegetable waste. Its advantages include good moisture capacity, friability, compatibility with other types of organic fertilizers, there is no need to use significant energy inputs in production and use.

The possibility to sell surplus products will allow to recover the costs and to obtain a certain income (Glenn,, 2009; Rink, 1992; PN 19.10.02 Contract no . 5N / 7.02.2019).

MATERIALS AND METHODS

Vermicomposting is a bit more variable, and this is due to the fact that there are several variations in how the process is performed. In composting, mixtures of materials rich in nitrogen and carbon are made at the beginning and then nothing is added. In vermicomposting or vermiculture operations, carbon-rich materials are used as a bed, while nitrogen-rich materials are generally food stocks.

Although similar processes take place in the bed (including conventional composting due to the action of microorganisms), some systems encourage the addition, during the process, of higher amounts of nitrogen compared to carbon than in the case of conventional composting. This is because the food is gradually added to the surface of the pile or string, and not mixed from the beginning (Gunadi B., Blount C., Clive A. E., 2002).

Since some nitrogen-rich materials (eg fresh food scraps) may have a higher water content than carbon-rich bedding, weight loss during the vermicomposting process may be higher (Rink, 1992).

For the production of biohumus the following things are required: earthworms, a hospitable living environment, usually called “bedding”, a food source, adequate moisture (greater than 50% water content by weight), adequate aeration and protection from extreme temperatures. Bedding is any material that provides the worms with a relatively stable habitat. This habitat must have high absorbency because worms breathe through their skins and therefore must have a moist environment in which to live because if a worm’s skin dries out, it dies. So the bedding must be able to absorb and retain water fairly well if the worms are to thrive, the beeding must have a good loosening potential, because if the material is too dense to begin with, or packs too tightly, then the flow of air is reduced or eliminated. Different materials affect the overall porosity of the bedding through a variety of factors, including the range of particle size and shape, the texture, and the strength and rigidity of its structure. The overall effect is referred to in this document as the material's bulking potential, protein and nitrogen content (although the worms do consume their bedding as it breaks down, it is very important that this be a slow process. High proteinor nitrogen levels can result in rapid degradation and its associated with heating and creates inhospitable, often fatal, conditions. Heating can occur safely in the food layers of the vermiculture system, but not in the bedding (Short et all, 1999; Sudha et al, 2000).

Some materials make good beddings all by themselves, while others lack one or more of the above characteristics and need to be used in various combinations.

The vermicomposting system used to carry out the experiment is shown in the figure (Figure 2).

Figure 2 - Vermicomposting system

The vermicompost system Figure2 is a wooden construction provided at the bottom with a grate and vermicompost scraping system (compost subjected to the action of earthworms). This system consists of the following: Bracket, Geared motor transmission, Housing, Scraper knife.

On this system is also placed the wetting system that ensures the humidity (70% humidity) of the compost in which the earthworms move from the bottom up. The general technical characteristics of the vermicomposting system are the working capacity of1500 kg/h, installed power 1,5 kW, electric motor rotation frequency 1000 rot/m, sieve rotation frequency 35 rot / min, active sieve length 2000 mm, volume 3 m^3 installed power 1,1 kW.

RESULTS

In Table 1 is listed a number of materials along with their characteristics, absorption rate, loosening potential, carbon and nitrogen concentration, in order to highlight the efficiency of each material used.

Table 1. Materials used for bedding

Material	Absorption	Loosening Potential	Carbon/Nitrogen Report
Animal manure	medium-good	good	22-56
Domestic waste	good	medium	58
Silage corn	medium-good	medium	38-43
Hay - generally	low	medium	15-32
Straw - generally	low	medium-good	48-150
Paper from the municipal waste stream	medium-good	medium-good	127-178
Bark hard essence	low	good	116-436
Bark soft essence	low	good	131-1280
Corrugated cardboard	good	medium	563
Shredded sawmill waste	low	good	170
Waste paper fibers	medium-good	medium	250
Paper mill waste	good	medium	54
Sawdust	low-medium	low-medium	142-750
The chips from cleaning shrubs	good	low	53
Strong wood chips	low	low	451-819
Soft wood chips	low	low	212-1313
Leaves (dry, free)	low-medium	low-medium	40-80
Corn strains	low	good	60-123

Under ideal conditions, earthworms are able to consume in excess of their body weight each day, although the general rule-of-thumb is ½ of their body weight per day. They will eat almost anything organic (that is, of plant or animal origin), but they definitely prefer some foods to others. Manures are the most commonly used worm feedstock, with dairy and beef manures generally considered the best natural food for earfworms, with the possible exception of rabbit manure. The former, being more often available in large quantities, is the feed most often used (Clive and Lofty, 1972; Clive, 1998).

There are a number of other parameters of importance to vermiculture and biohumus production like pH, worms can survive in a pH range of 5 to 9 (Gaddie, R.E. and Donald E. D., 1975; Rink, Robert 1992). Most experts feel that the worms prefer a pH of 7 or slightly higher.

In general, the pH of worm beds tends to drop over time. If the food sources are alkaline, the effect is a moderating one, tending to neutral or slightly alkaline. If the food source or bedding is acidic (coffee grounds, peat moss) than the pH of the beds can drop well below 7.

This can be a problem in terms of the development of pests such as mites. The pH can be adjusted. Earthworms are very sensitive to salts, preferring salt contents less than 0.5% (Glenn, 2009). In case the manure is from animals raised or fed off in concrete lots, it will contain excessive urine because the urine cannot drain off into the ground. This manure should be leached before use to remove the urine. Excessive urine will build up dangerous gases in the bedding (Glenn, 2009).

The right mixtures used to create the bed are an essential element in meeting these needs. They provide protection in case of extreme temperatures, the required level and consistency of humidity and an adequate supply of oxygen. Fortunately, given their critical importance in the process, good mixtures are generally easy to find on farms.

The most difficult criterion to satisfy adequately is usually the absorption, because most of the straw and not even the hay are not too good at retaining moisture. This can be easily addressed by mixing manure or mature compost from cattle or sheep with straw.

The result is somewhat similar in characteristics to mature horse manure. The process of creating bed mixes does not have to be a burden, it can be done manually with a fork (small operations), with a bucket tractor (larger operations), or if available, with a mystery mixer. The latter would be suitable only for large commercial vermicomposting operations, where a high level of efficiency and constant product quality is required.

CONCLUSIONS

Biohumus contains the necessary set of macro and micro nutrients, enzymes, soil antibiotics, vitamins, growth hormones and humic substances, it contains on average a higher concentration of nitrogen, phosphorus, potassium, calcium and a number of beneficial microorganisms and bacteria than the ones we usually find in the upper layers of the soil.

The application of biohumus generates multiple benefits for farmers:

≡ by applying biohumus, significant production increases are obtained because the plants easily assimilate nutrients substances;
≡ increases the water retention in the soil (the amount of water needed for irrigation decreases by about 30%);
≡ the biohumus obtained can be used directly on the farm by distributing it on the area intended for fodder;
≡ fix soils affected by prolonged use of chemicals. By repeated application, the soil will be completely repopulated with microorganisms beneficial to plants destroyed by chemicals over the years.
≡ the application of biohumus improves the structure of the soil, aerates the soil and makes it easy to work, which leads to lower costs of providing fuel for agricultural machinery;
≡ it is non-toxic, does not burn plants, has no restrictions on use, can be used in any crop, greenhouse or field, with excellent results;
≡ it is compatible with any chemical preparation;
≡ it is excellent in the prevention of diseases (Alternaryosis, Gray mold, Fusariosis, Mana, Root rot, Bacterial burning in peas, Rhizoctoniosis, Septoriosis, Black tobacco rot, Apple rot).

Acknowledgement

This paper was financed by grant of the Romanian Research and Innovation Ministry, through Programme 1 – Development of the national research-development system, sub-programme 1.2 – Institutional performance – Projects for financing excellence in RDI, contract no. 16 PFE.

Note:

This paper is based on the paper presented at ISB–INMA TEH' 2020 International Symposium (Agricultural and Mechanical Engineering), organized by Politehnica University of Bucharest – Faculty of Biotechnical Systems Engineering (ISB), National Institute of Research–Development for Machines and Installations Designed to Agriculture and Food Industry (INMA Bucharest), Romanian Agricultural Mechanical Engineers Society (SIMAR), National Research & Development Institute for Food Bioresources (IBA Bucharest), National Institute for Research and Development in Environmental Protection (INCDPM), Research-Development Institute for Plant Protection (ICDPP), Research and Development Institute for Processing and Marketing of the Horticultural Products (HORTING), Hydraulics and Pneumatics Research Institute (INOE 2000 IHP) and "Food for Life Technological Platform", in Bucharest, ROMANIA, 30 October, 2020.

References

[1] Beetz A., (1999), Worms for Vermicomposting, Information Service ATTRA National Sustainable Agriculture, Livestock Technical Notes;
[2] Caba I.L., Laza E-A, Vlădut V., Bordean D-M, Atanasov At. (2019), Technical methods to hasten the obtaining of compost, Research People And Actual Tasks On Multidisciplinary Sciences, pp. 384-389, Lozenec – Bulgaria;
[3] Clive, A. E., (1998), The Use of Earhworms in the Breakdown and Management of Organic Wases. Edwards, C.A. (ed) Earthworm Ecology. St. Lucie Press, Boca Raton, pp. 327-354;
[4] Clive, A. E., Lofty, J.R., (1972), Biology of Earthworms, London: Chapman and Hall Ltd, pp. 283;
[5] Gaddie, R.E., Donald E. D., (1975), Earthworms for Ecology and Profit, Scientific Earthworm Farming. Bookworm Publishing Company, Vol. 1, pp.180;
[6] Glenn, M., (2009), Manual of On-Farm Vermicomposting and Vermiculture, Organic Agriculture Centre of Canada;

[7] Gunadi B., Blount C., Clive A. E., (2002), The growth and fecundity of Eisenia fetida (Savigny) in cattle solids pre-composted for different periods, Ed. Pedobiologia 46;
[8] Laza E-A, Caba I.L., Vlăduţ V., Bordean D-M, Atanasov At. (2019), Vermiculture, the future of bio agriculture, Research People And Actual Tasks On Multidisciplinary Sciences, pp. 390-394; Lozenec – Bulgaria;
[9] Olan M., Zaica Al., Bunduchi G., Vlăduţ V., Păun A., Găgeanu P., Caba I. (2020), Criteria analysis of equipment for biohumus production and establishment of the optimal solution for a new type of installation, ISB INMA TEH' 2020 International Symposium, pp. 635-643, Bucharest.
[10] PN 19.10.02, Contract no . 5N / 7.02.2019, (2019), Research on the development of a technology for the production of biohumus (vermicompost);
[11] Rink R., (1992), Farm Composting Guide, Natural Resources, Agriculture and Engineering Service (NRAES-54);
[12] Short J.C.P., Frederickson J., Morris R.M., (1999), Evaluation of traditional composting and string vermicomposting for the stabilization of paper sludge (WPS) sludge, VI International Symposium on Earthworm Ecology, Vigo, Spain, 1999;
[13] Sudha B., Kapoor K.K., (2000), "Vemicomposting of agricultural and cattle residues with Eisenia foetida". In Bioresource Technology.
[14] Vlăduţ V., Atanasov At., Biriş S., Ungureanu N., Caba I., Olan M., Epure M., Cristea O. (2019), Production of biohumus - a biological method for the processing of organic waste, Research People And Actual Tasks On Multidisciplinary Sciences, pp. 406-410; Lozenec – Bulgaria;
[15] Voicea I., Vlăduţ V., Matache M., Dumitru D., Isticioaia S., Trotuş E., Arsenoaia V. (2019), Considerations concerning the composting of organic waste, Annals Of The University Of Craiova – Agriculture, Montanology, Cadastre Series, pp. 389-394, Craiova, România;

ISSN: 2067-3809