

Technology for biohumus production, an alternative to conventional fertilizers for bio agriculture

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Abstract. Composting is the process of decomposition and transformation of solid organic substances by microorganisms (mainly bacteria and fungi) into a stable material, which can be used (depending on characteristics) in agriculture, instead of chemical fertilizers or land improvement works (soil improvement). The composting process consists of two stages: mechanical treatment and decomposition (fermentation). In the case of mechanical treatment, the waste is crushed, homogenized and prepared for biological treatment, fermentation. The fermentation stage consists in three main stages, namely the mesophilic fermentation stage, the thermophilic fermentation stage and the maturation stage of the compost.

1. Introduction

This paper aims to bring to the attention of farmers the benefits of reusing animal and agricultural waste through composting. Composting is the process of decomposition and transformation of solid organic substances by microorganisms (mainly bacteria and fungi) into a stable material, which can be used (depending on characteristics) in agriculture, instead of chemical fertilizers or land improvement works (soil improvement) [1,2].

Compost is the best mulch and natural soil amendment and it can be used instead of commercial fertilizers. But the most important thing is that it is a cheap product. The use of compost leads to improved soil structure, improved excessive textures, improved aeration and increased water storage capacity, increased soil fertility and stimulated the development of a healthy root system of plants. Organic matter applied through the compost is like food for microorganisms in the soil[1,2].

Composting can be done in households, in open piles, in special plastic compost bins or in other containers. In the case of farms and composting stations, composting can be done on specially designed platforms, the material for composting being arranged in long rows (furrows) and turned periodically (using special furrow reshaping equipment), in systems of aerated static piles using perforated pipes or in special containers. Good composting consists in ensuring adequate environmental conditions for microbial life. Organisms responsible for composting need three elements to live [2,3,4]:

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- *Food for microorganisms*, composed of a mixture of carbon-rich ingredients (brown-hard-dry, such as straw, tree branches, sawdust) and nitrogen-rich ingredients (soft-green-moist such as weeds, leaves, residues of fruits and vegetables). It is important that both dry and green waste be used in the composting process to obtain a high quality compost [4,5,6].
- *Humidity*, especially present in nitrogenous ingredients, or from water added separately; the humidity ensures an environment favorable for the multiplication of aerobic bacteria and accelerates the composting process [4,5,6].
- *Air*, whose circulation is favored by hard carbonate ingredients. The microbes involved in the composting process are aerobic, they need air to grow and decompose waste. In the absence of proper aeration of the mixture, rotten compost is formed (anaerobic), a low quality organic fertilizer and dangerous for the environment. It generates unpleasant odors and methane gas, while the leachate resulting from rot drains into the soil and later reaches the groundwater [4,5,6] .

2. Methodology

A suitable location was found for the production of compost (platform for its production). The organic materials were stored on the composting platform so that they could be transformed into compost. They were carried out regular inspections of temperature and humidity and to prevent dispersal of the waste and the penetration of rodents and insects. A compost aerator was used to aerate the compost. In order to speed up the composting process of the plant residues that were to be used, they were chopped as small as possible. On the platform for composting was added a first layer of resulting waste from trimming trees or other plant debris will be obtained until the film thickness of residues 10-15 cm. This is actually a base layer for the rest of the waste added later in the composting process.

To activate the composting process, soil and manure was added. Once the "bed" of garden waste was finished, the addition of vegetable waste and and other garden waste began.

As main operational stages in the production of compost we list: humidity regulation in hot periods twice a week, aeration at least once a week, the compost that went through the thermophilic phase was covered with foil. The prisms were covered again when lower temperatures were recorded in order to better maintain the temperature overnight (higher thermal inertia), the parameters were monitored once every 2 weeks (internal) and general outsourced analyzes 1 time per month and the activity of bacteria / fungi / insects present in the compost was monitored. A cylindrical sieve was used to sort the resulting compost.

The determination of the macroelements, microelements and other elements necessary for the good development of the plants in the obtained compost was performed with the help of the Elemental Analysis Kits. Compost samples subjected to chemical analysis were taken from the composting platform.

Figure 1 shows a mobile compost kit for on-site analysis and figure 2 shows a thermometer for measuring the temperature of the compost



Fig.1. Mobile compost test kit



Fig. 2 Thermometer

When making the composting recipe, the specialized information on the carbon / nitrogen ratio in table 1 was taken into account.

Table 1 Materials rich in Nitrogen and carbon

Type of waste	C / N ratio	Type of waste	C / N ratio
Waste rich in Nitrogen		Waste rich in Carbon	
Liquid manure	2 – 3	Fruit leftovers	34
Solid manure	10	Leaves	50-65
Cut grass	12-15	Straw, oats	50-63
Vegetable waste	13	Tree bark	110-140
Kitchen waste	23	Remains from bush cleaning	110-160
Potato plant	25	Sawdust	120-510
Horse manure	25	Paper / cardboard	220-520

With the help of this information we adjusted the C / N ratio of the material introduced in to the pile.

The process of decomposition depends on several factors. These factors and the relationships between them, influence the speed of the decomposition process, the decomposition phase and the activity of microorganisms.

The type of substrate , by using a certain material or a mixture of different materials, many properties of the process can be influenced, such as: the volume of interstices, humidity, or particle size of the material introduced in the pile, but also the quality of the compost. Therefore, the mixture of introduced materials (the substrate used) is the most important step in producing a quality compost.

Temperature is a value for determining the degree of putrefaction.

Humidity, the microorganisms need water to survive and a constant humidity is required to ensure the continuation of the decomposition process.

pH level: The pH values must be between 7 and 11.

C / N ratio:. The optimum carbon : nitrogen ratio should be between 20: 1 and 35: 1

Figure 3 shows the materials used to prepare the compost, and figure 4 shows Images during the experimentation of the recipe for composting



Fig.3 Materials used to prepare the recipe for composting



Fig. 4 Images during the experimentation of the recipe for composting

3. Results and discussions

When the temperature is below 40 ° C, the composting process it's over. In table no 2 are listed values of the quality of the resulting compost

Table 2 The quality of the resulting compost

Characteristic	U/M	Characteristic value
Hygiene		A hygienic product that ensures the exclusion of germs
Impurities	%	Impurities greater than 2 mm is not more than 0,6%
Glass, plastic, metal		0,73
Vegetable residues (2 mm)		0,6
Stones		0,5
Type of compost and material introduced in the pile		Green plant residues (plant removed from the vegetable crops) Chopped apples Chopped vegetables (waste tomatoes and peppers) Waste from a poultry farm Deciduous leaves and vegetable scraps from harvesting onions that limit dehydration
The compost maximum particle size	mm	15
Material density	Kg/m ³	410
Salt content		0,09
pH value		9
The decomposition degree		Mature compost: phase IV (degree of rot)
The compost water content	%	43 %
Zinc (Zn)		400 mg/kg DS
Lead (Pb)		150 mg/kg DS
Copper (Cu)		100 mg/kg DS
Chrome (Cr)		100 mg/kg DS
Nickel (Ni)		50 mg/kg DS
Cadmium (Cd)		1,5mg/kg DS
Mercury (Hg)		1,0mg/kg DS

4. Conclusions

So, in conclusion we can say that the temperature is the most important value that must be monitored during the process of transformation into compost, because it can be very easily be measured and shows the progress of the process. The decomposition of organic substances as a result of the activity of microorganisms due to their self-heating capacity is the reason for the temperature differences in the center of the pile and the surrounding temperature. Compost is the result of microbial decomposition of dead matter by oxygen.

With the use of compost, there is a wide range of benefits. Factors, such as the input material or raw material, the method of composting, storage and application of compost, all these things have an influence on the characteristics of the compost.

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