Scientific Papers. Series B, Horticulture. Vol. LXVII, No. 2, 2023
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

# RESULTS REGARDING THE 24-HOUR COMPOSTS (OKLIN) COMPOSITION AND THEIR USE AS FERTILISER

**Adrian George PETICILĂ, Roxana Maria MADJAR, Elena Maria DRĂGHICI, Florin STĂNICĂ, Adrian ASĂNICĂ, Raluca CIUBOTĂRĂŞU, Ana Cornelia BUTCARU**

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania

Corresponding author email: anabutcaru@gmail.com

***Abstract***

*The paper aims to present some of the results of the project "Research on the use of composts obtained from food waste", where more compost variants obtained with OKLIN series composters were analyzed and tested on two horticultural species (germination and total growth). According to the specifications, OKLIN composters are designed to produce compost 24 hours after the organic residues are introduced. Compost obtained from different sources (grounds of coffee, vegetables (40%) and fruits (60%), vegetables (40%), fruit (50%), and fish (10%), food and vegetable waste (100%), etc) were analyzed regarding microbiota (bacteria, fungi, and respiration coefficient) and agrochemical parameters. Several ratio variants were tested on parsley (Petroselinum crispum) and Luffa, monitoring germination rate and total growth. All the compost variants, in general, presented beneficial and neutral bacteria and fungi with high potential as fertilizer. 10% and sometimes 20% were the most favorable compost ratios as fertilizer for the horticultural plants tested.*

***Key words***: *bacteria, fungi, composter.*

## INTRODUCTION

Food waste management, along with other categories of waste, has become an increasingly current problem in many countries caused by the increase in population and the need and consumption of food (Chen, 2016). Following studies by Chen et al. (2020), 1.13 million tons of food waste were thrown away worldwide daily. At the level of the European Union, 89 million tons of food waste are thrown away annually, and in Romania, 5 million tons (Romania - Insider, 2020).

These figures are continuously increasing both due to the growth of the population and its purchasing power, an aspect with direct effects on the environment, greenhouse gas emissions, and water pollution (Malamis et al., 2017; Scherhaufer et al., 2018; Wei et al., 2017).

At the level of the European Union, waste management is regulated by Directive 851/2018 of the European Parliament and of the Council amending Directive 98/2008/EC.

Non-hazardous waste management activity in Romania is regulated by Law 181/2020, which will be in force starting February 2021. This regulates, among other things, the conditions for the use of non-hazardous waste for composting, establishes the categories of waste intended for composting and the quality categories of compost, the methods of use of compost, the ways to establish the quality of compost according to European regulations, the obligations of economic operators and the measures to supervise the compost market in Romania.

Regulated activities for food waste treatment are animal feeding (Mo et al., 2018), pyrolysis (Kim et al., 2020), incineration (You et al., 2016), anaerobic/aerobic digestion (Wainaina et al., 2020), and composting (Cesaro et al., 2019). Composting is the most technically, economically, and ecologically viable and reliable of all these activities (Awasthi et al., 2020).

Compost is the result of the process of decomposition of organic matter, called composting.

In 1983, Bertoldi et al., defined composting as a way to obtain a stable product through an oxidative biological transformation similar to what happens in nature. Other authors define composting as a natural decay/decomposition process that changes organic waste into a humus-rich material called compost (Mustin, 2016).

A broader definition is given by Tiquia et al. (2000) in which composting is an effective and safe method by which the mass and volume of organic waste can be reduced (food waste, manure, vegetable residues of agricultural and horticultural crops, the organic fraction of municipal solid waste, etc.) can destroy pathogens and stabilize nutrients and organic matter. Composting occurs naturally and continuously in nature without human intervention; practically everything organic is a potential compost.

Composting occurs in the presence of oxygen, through which organic matter is decomposed by microorganisms, under controlled conditions. During composting, they consume oxygen, releasing considerable amounts of water vapor, heat, and carbon dioxide (Pace et al., 1995).

Often, in recent years, the question arises: Why compost? Here are some arguments:

➢ uses materials that are otherwise useless;

➢ reduce waste;

➢ it results in a safe and effective modification of the soil, by supplying essential nutrients to the plants;

➢ reduce the costs of mulching and fertilization;

➢ it is completely ORGANIC!

➢ it is a way for nature to return to nature.

A quality compost must present certain hydrophysical characteristics (easy release of water, high water retention capacity, high aeration capacity, medium porosity and density, specific electrical conductivity) and chemical (pH, cation exchange capacity, organic carbon, and ash) (Corti et al., 1998.) and depending on them the intended use of the compost is different.

Obtaining quality compost is given by the raw material, as well as the conditions and time in which composting is carried out (Soto-Paz et al., 2019). In this sense, there are several categories of raw materials: urban organic waste (households, restaurants, fast food, grocery stores, food markets, etc.), plant materials (gardening, urban vegetation cleaners, leaves, etc.), garbage from animals, food waste, sludge from wastewater treatment plants, lignocellulosic biomass (agricultural residues, energy crops, forest residues), etc.

Depending on the collection system, food scraps may also contain a high percentage of inert materials such as glass or plastic, which can affect the quality of the compost. Also, food waste has a high moisture content, inadequate C/N ratio, and low aeration rate, all of which lead to an improper composting process with foul-smelling emissions and a negative effect on the environment and obtaining compost of poor quality.

These shortcomings can be countered by using co-composting or bulking agents, such as green leaves, straw, hay, manure, sawdust, etc. (Oviedo-Ocana et al., 2019). The ratio of the components mixed to form the compost and their aeration in the composting process are considered operational strategies to minimize the lack of all materials and shorten the composting process (Ge et al., 2015). The mixing ratio or C/N ratio of the components participating in food waste composting was set within 15-25/30. A ratio of less than 15/30 may reduce the need to add co-components but foul-smelling substances such as ammonia may be released. (Kumar et al., 2010). The performance of the composting process can be increased in terms of nutrient losses and gas emissions over time by the simple process of aeration (Kalamdhad & Kazmi, 2009; Waqas et al., 2018).

Aeration is given by the rotation frequency so that, too excessive but also too low, it influences the decomposition of organic matter through variations in the humidity and temperature of the compost, ultimately resulting in nutrient losses (Kalamdhad & Kazmi, 2009). Fan et al. (2018) showed that an efficient composting of vegetable food waste can be done together with garden waste (grasses, leaves) in proportion of 40% to which dry leaves and rice bran can be added with a role in increasing the microbial community. In this case, the time was about 60 days with a rotation frequency of 3 times a week.

If the optimal composting parameters are not respected, unpleasant odors may appear. They have a negative impact on the environment, leading to the closure of composting facilities (Colon et al., 2012).

The primary source of these odors is volatile organic compounds, the most frequent being terpenes, aliphatic carbons, aromatic hydrocarbons, ketones, and esters (Zhang et al., 2016). Other authors (Komilis et al., 2004) established that the most abundant groups of volatile organic compounds in food waste were sulfides, acids, and alcohols. Their presence may result from reactions that occur during the food cooking process, due to the small amounts of pesticides present on raw vegetables or as a result of atmospheric deposition (Cerda et al., 2018). A low C/N ratio leads to the release of ammonia ($NH_3$), which is derived from nitrogen compounds and the most critical pollutant resulting from food waste composting (Zang et al., 2016). Pagans et al. (2006) point out that ammonia release is favored by a high pH (alkaline) and a high compost pile temperature. In the case of protein-rich food waste, odors derived from sulfur (dimethyl sulfide, dimethyl disulfide, and methyl mercaptan) can develop (Cerda et al., 2018).

Compliance with the composting parameters, along with the incorporation of gas treatment units in the composting facilities, as well as biofiltration, can reduce the emission of these gases, thus being able to locate these composting facilities near inhabited areas (Cerda et al., 2018).

Composting can be done by several methods depending on the type of food waste, its quantity, the place where the composting is done, and the desired time for obtaining the compost.

Bulk composting (piles of various lengths and shapes) consists of placing food scraps in narrow piles that are aerated by mechanical turning. The frequency of these returns is given by the composition of the waste and the transformation phase. Composting mass aeration can also be forced with pressurized air through bottom suction (negative pressure), bottom blowing (positive pressure) (Feinstein et al., 1983), and alternate ventilation.

Composting in compost bins or containers has applicability inside buildings, containers, and ships. In-vessel composting systems limit the amount of waste used, being able to shorten composting time by monitoring and controlling the entire process. This category includes continuous vertical reactors (the height of food waste can reach 9 m) and horizontal reactors (the height of food waste does not exceed 2-3 m). Of the two, the horizontal one is easier to handle. (Haug & Haug, 1993). The rotating compost bin shortens the composting process to turn food waste into compost takes approx. 4-7 days (Chen, 2016).

The technical method presented in this study involves the use of equipment that produces compost from food waste: Oklin GG-02 composter.

The advantages were:

- Eliminates the need for long-term storage of food waste, as we no longer need specially arranged spaces, thus determining an alignment, without effort, with the legal provisions in force regarding food waste;
- Substantially reduces the costs related to waste collection. Practically, food scraps are removed from the mass of waste that must be given to specialized companies for collection, the collection can be done at longer intervals and in much more advantageous cost conditions.
- Allows for maintaining a high level of hygiene. Odors, microbes, insects, or rodents will no longer appear due to stored food waste, nor will it be necessary to sanitize the spaces where such waste is kept permanently.
- Generates more time for productive activities. Implementing complicated sanitation and waste handling policies and monitoring how the staff applies these policies is no longer necessary.

The paper aims to present some of the results of the project ”Research on the use of composts obtained from food waste”, where more compost variants obtained with OKLIN series composters were analyzed and tested on two horticultural species (germination and total growth).

## MATERIALS AND METHODS

The project involved obtaining compost from five different sources: coffee grounds, ground coffee (CAF), food waste (USAMV, CBA, CBV, SBA, CTG, RC), and plant residues (E). In the first stage, the compost variants were analyzed from a mineral, organic, and microbiological point of view.

Compost obtained from different sources (grounds of coffee, vegetables (40%) and fruits (60%), vegetables (40%), fruit (50%), and fish (10%), food and vegetable waste (100%) were analyzed regarding microbiota (bacteria, fungi, and respiration coefficient) and agrochemical parameters.

Table 1. Testing substrate variants (%)

| Compost / Variants | S1 vegetables (40%) and fruits (60%) | S1 vegetables (40%) and fruits (60%) | Coffee | Coffee | S2 vegetables (40%), fruits (50%), and fish (10%) | S2 vegetables (40%), fruits (50%), and fish (10%) | S3 vegetables (40%), fruits (50%), and fish (10%) | S3 vegetables (40%), fruits (50%), and fish (10%) | CTG | CTG | Peat | Per lite |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V0 | - | - | - | - | - | - | - | - | - | - | 80 | 20 |
| V1 | 10 | - | - | - | - | - | - | - | - | - | 80 | 10 |
| V2 | - | 20 | - | - | - | - | - | - | - | - | 70 | 10 |
| V3 | - | - | 10 | - | - | - | - | - | - | - | 80 | 10 |
| V4 | - | - | - | 20 | - | - | - | - | - | - | 70 | 10 |
| V5 | - | - | - | - | 10 | - | - | - | - | - | 80 | 10 |
| V6 | - | - | - | - | - | 20 | - | - | - | - | 70 | 10 |
| V7 | - | - | - | - | - | - | 10 | - | - | - | 80 | 10 |
| V8 | - | - | - | - | - | - | - | 20 | - | - | 70 | 10 |
| V9 | - | - | - | - | - | - | - | - | 10 | - | 80 | 10 |
| V10 | - | - | - | - | - | - | - | - | - | 20 | 70 | 10 |
| V11 | 1 | - | - | - | - | - | - | - | - | - | 89 | 10 |
| V12 | - | 5 | - | - | - | - | - | - | - | - | 85 | 10 |
| V13 | - | - | 1 | - | - | - | - | | - | - | 89 | 10 |
| V14 | - | - | - | 5 | - | - | - | - | - | - | 85 | 10 |
| V15 | - | - | - | - | 1 | - | - | - | - | - | 89 | 10 |
| V16 | - | - | - | - | - | 5 | - | - | - | - | 85 | 10 |
| V17 | - | - | - | - | - | - | 1 | - | - | - | 89 | 10 |
| V18 | - | - | - | - | - | - | - | 5 | | - | 85 | 10 |
| V19 | - | - | - | - | - | - | - | - | 1 | - | 89 | 10 |
| V20 | - | - | - | - | - | - | - | - | - | 5 | 85 | 10 |

Several ratio variants were tested on parsley (*Petroselinum crispum*) and Luffa, monitoring germination rate and total growth (Table 1).
For the descriptive statistics of the data, Microsoft Excel 2016 and IBM SPSS v. 28.0.1.1 with a significance level of p = 0.05 were used.

## RESULTS AND DISCUSSIONS

The following results were obtained for the quantitative microbiological analysis of several variants of compost and substrate.

**Bacteria**

The compost variants showed values between 2020 viable cells/g dry soil (CAF) and 99,012,000 viable cells/g dry soil (coffee). The substrates, however, showed values between 473,955,000 viable cells/g dry soil (V6) and 883,448,000 viable cells/g dry soil (V2).
V3 presented at the time of analysis 492,780,000 viable cells/g dry soil and V9 716,892,000 viable cells/g dry soil (Figure 1).
The experimental variant V3 presented among the identified taxa: *Arthrobacter globiformis, Bacillus cereus, Bacillus cereus* var. *mycoides, Bacillus megaterium, Bacillus mesentericus, Pseudomonas fluorescens, Pseudomonas* sp., *Actinomycetes Series Albus* known for their positive influence on plant growth.
In the experimental variant V9, the species *Arthrobacter globiforms, Bacilllus circulans, Bacillus megaterium, Bacillus polymixa, Bacillus subtilis, Paenibacillus* sp., *Pseudomonas fluorescens, Pseudomonas* sp., *Actinomycetes Series Fuscus* predominated.

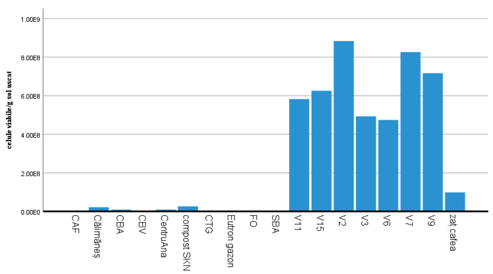


Figure 1. Quantitative determinations of bacteria (viable cells/g dry soil)

**Fungi**

The compost variants presented values between 2 cfu/g dry soil (E) and 103,281 cfu/g dry soil (coffee). The substrates showed values between 12,593 cfu/g dry soil (V6) and 52,640 cfu/g dry soil (V9). V3 was presented at the time of analysis in 27,088 cfu/g dry soil. (Figure 2).
The V3 variant presented *Trichoderma harzianum* and *Actinomucor elegans* among the species and the V9 variant *Verticillium tenerum*, *Rhizpus stolonifera*, and *Trichoderma harzianum*.

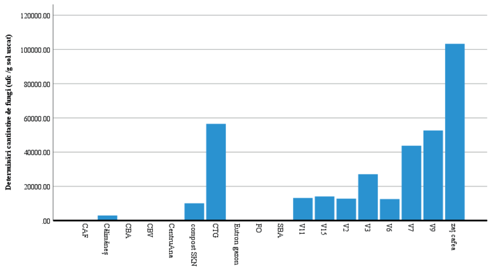


Figure 2. Quantitative determinations of fungi (cfu/g dry soil)

**Compost and substrate macro and microelements**

Table 2 presents minerals and contaminants for the compost and substrate variants.
For the nitrogen, values ranged between 1.69% (CBV) and 2.64% (CAF), and for substrate, between 1.04% (V3) and 1.17% (V2). Phosphorus ranged between 0.206 (SBA) and 0.284 (CTG) at compost and 0.065% (V11) and 0.290% (V6). Potassium content in compost was between 0.91% (coffee ground) and 3.53 (CAF), respectively, 0.13% (V15) and 0.43 (V6). Calcium, sodium, magnesium, zinc, copper, manganese, iron, lead, cadmium, cobalt, and chromium were analyzed also (Table 2).

**The influence of experimental variants on germination and growth in parsley**

***Germination***

The parsley germination rate, determined 7 days after sowing, is presented in Figure 3.
The experimental variant PV10 (20% CTG) presented the best germination rate (97%), followed by PV6 (20% S2) and PV3 (10% coffee) with 87%, PV7 (10% S3) and PV4 (20% coffee) with 77%. The variants PV9 (10% CTG) and PV5 (10% S2) showed a germination rate similar to the control variant (70%).

Table 2. Compost and substrate macro and micro elements analysis

| Variant | N | P | K | Ca | Na | Mg | Zn | Cu | Mn | Fe | Pb | Ni | Cd | Co | Cr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Compost** | % | % | % | % | % | % | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| Coffee ground | 2.21 | 0.230 | 0.91 | 0.85 | - | 0.15 | 25.2 | 13 | 15.5 | 23.1 | - | - | - | - | - |
| CBA | 1.86 | 0.229 | 1.35 | 0.29 | 0.28 | 0.096 | 9.8 | 3.5 | 10.6 | 18 | nd | nd | nd | 0.3 | 1.1 |
| CBV | 1.69 | 0.259 | 1.63 | 0.29 | 0.17 | 0.111 | 15.7 | 4.8 | 13.5 | 49 | nd | 2.2 | nd | 0.6 | 9.7 |
| SBA | 1.11 | 0.206 | 3.34 | 0.13 | 0.18 | 0.093 | 11.0 | 6.6 | 18.4 | 64 | nd | 0.6 | nd | 0.2 | 5.0 |
| CAF | 2.64 | 0.223 | 3.53 | 0.79 | 0.16 | 0.164 | 6.2 | 10.1 | 12.6 | 25 | nd | nd | nd | 0.4 | 17.9 |
| CTG | 2.35 | 0.284 | 1.27 | 1.27 | 0.50 | 0.100 | 21.4 | 4.8 | 15.8 | 68 | nd | nd | nd | 0.5 | 10.3 |
| RC | 1.74 | 0.228 | 1.30 | 0.78 | 0.257 | 0.095 | 44.1 | 6.72 | 19.9 | 152 | 1.3 | 1.00 | nd | 0.27 | 6.4 |
| E | 2.59 | 0.234 | 2.22 | 0.253 | 0.048 | 0.173 | 67.7 | 10.8 | 30.2 | 817 | 0.90 | 1.5 | nd | 0.05 | 29.5 |
| **Substrate** | | | | | | | | | | | | | | | |
| V2 | 1.17 | 0.233 | 0.24 | 1.05 | 0.131 | 0.228 | 26 | 3.7 | 16 | 909 | nd | nd | nd | nd | 2.3 |
| V6 | 1.08 | 0.290 | 0.43 | 0.74 | 0.113 | 0.183 | 23 | 2.4 | 15 | 841 | nd | nd | nd | nd | 5.9 |
| V11 | 0.92 | 0.065 | 0.17 | 1.30 | nd | 0.254 | 11 | 2.7 | 14 | 639 | nd | nd | nd | nd | nd |
| V15 | 0.83 | 0.069 | 0.13 | 1.30 | nd | 0.247 | 9.7 | 2.5 | 16 | 1228 | nd | nd | nd | nd | 0.5 |
| V3 | 1.04 | 0.170 | 0.314 | 0.227 | 0.124 | 0.213 | 16.1 | 3.6 | 21 | 852 | 0.885 | nd | nd | nd | nd |
| V7 | 1.11 | 0.200 | 0.264 | 0.247 | 0.148 | 0.209 | 14.8 | 2.7 | 21 | 733 | 0.614 | nd | nd | nd | 1.18 |
| V9 | 1.07 | 0.086 | 0.186 | 1.150 | 0.157 | 0.229 | 14.1 | 3.1 | 21 | 657 | 0.549 | nd | nd | nd | nd |

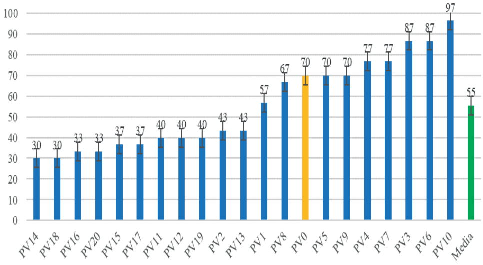


Figure 3. Germination rate (%) in parsley at 7 days from the time of sowing

The lowest values were recorded for the experimental variants PV14 (5% coffee) and PV18 (5% S3) with 30%, PV16 (5% S2) and PV20 (5% CTG) with 33% respectively, PV15 (1% S2) and PV17 (1% S3) with 37%.

**Plant growths**

The variants with the highest growth (similar values) were PV0 (control), PV1 (10% S1), PV17 (1% S3), PV3 (10% coffee) and PV9 (10% CTG).

Variants V2 (20% S1), V4 (20% coffee), V6 (20% S2), and V8 (20% S3) presented the lowest values in plant growth at several 14 days from the time of sowing (Figure 4).

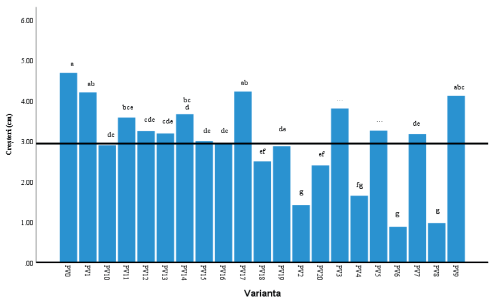


Figure 4. Parsley plant growth at 14 days from sowing

Centralizing the two parameters (Table 3), germination rate and plant growth, in the *Petroselinum crispum* species, the variants PV3 (10% coffee) and PV9 (10% CTG) obtained maximum results in both parameters.

The lowest values were obtained in composts with lower concentrations (1% or 5%) for the germination rate. In plant growth, lower values were obtained with four types of composts with concentrations of 20%.

Table 3. Centralization of maximum and minimum values for the two analyzed parameters

| **Maximum** | | **Minimum** | |
|---|---|---|---|
| **Germination rate** | **Growth** | **Germination rate** | **Growth** |
| PV10 | PV0, PV1, PV17, **PV3, PV9** | PV14, PV18 | V2 |
| PV6 | | PV16, PV20 | V4 |
| PV7, PV4 | | PV15, PV17 | V6 |
| **PV9,** PV5, PV0 | | | V8 |

**The influence of experimental variants on germination and growth in *Luffa cilindrica* plants**

**Germination**

The loofah germination rate, calculated 33 days after sowing, is presented in Figure 5. The experimental variant LV6 (20% S2) presented the best value (97%) being, followed by LV8 (20% S3) with 93%. Very close and with similar values are the following variants: LV10 (20% CTG), LV7 (10% S3), LV4 (20% coffee), LV2 (20% S1), LV9 (10% CTG), LV5 (10 % S2), and LV3 (10% coffee).

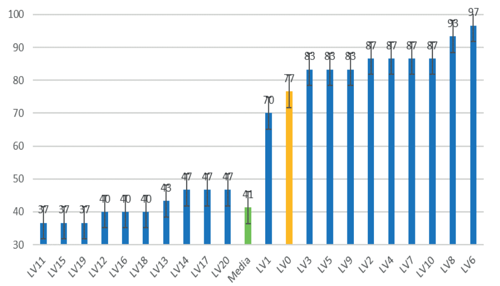


Figure 5. Germination rate (%) *Luffa cilindrica*

The lowest values were recorded for the experimental variants LV11 (1% S1), LV15 (1% S2), LV19 (1% CTG) with 37%, LV12 (5% S1), LV16 (5% S2) and LV18 (5% S3) with 40%.

**Plant growths**

33 days after sowing, in the experimental variants LV0 - LV10, the growth varied between 11.25% (LV6 - 10% S2) and 28.98% (LV3 - 10% coffee) and in the experimental variants LV11 - LV20 between 13% (LV15 - 5% coffee) and 23.92% (LV12 - 1% S1) (Figure 6).

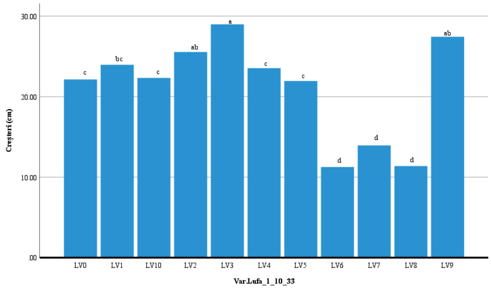

Figure 6. Growth of loofah plants 33 days after sowing

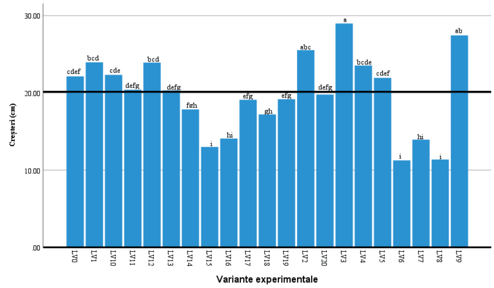

Figure 8. Growth of loofah plants 33 days after sowing

The highest values were recorded for the experimental variants LV3 (10% coffee), LV9 (10% CTG) and LV2 (20% S1).
The lowest values were recorded for the experimental variants LV6 (20% S2), LV8 (20% S3), and LV7 (10% S3).
Thirty-three days after sowing, the experimental variants LV11 - LV20 had the plant growth values shown in Figure 7. The best results were obtained by the variant LV12 (5% S1), and the smallest variants were LV15 (1% S2) and LV16 (5% S2).

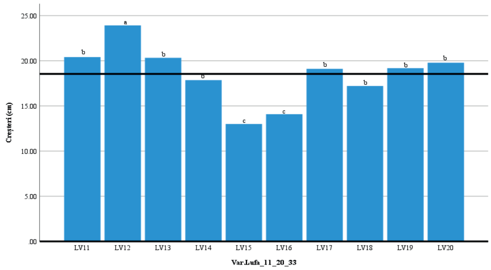

Figure 7. Loofah plant growth 33 days after sowing (LV11-LV20)

Analyzing all the experimental variants 33 days after sowing, we have the distribution shown in Figure 8. The best growth was given by the experimental variant LV3 (10% coffee), similar to LV9 (10% CTG) and LV2 (20% S1). The smallest values were present in variants LV6 (20% S2), LV8 (20% S3), and LV15 (1% S2).
Analyzing the growth of the plants comparatively in the two moments when the measurements were made (July and August) (Figure 9), differences in the increase in growth are noted (Figure 10). The most significant increase was in the LV12 variant (5% S1), followed by LV3, LV2, and LV20.

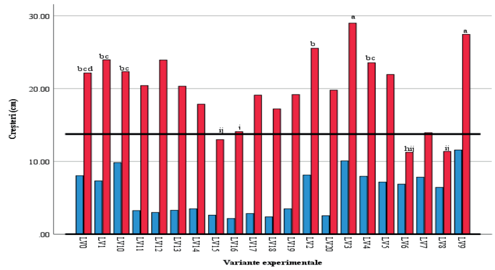

Figure 9. Growth of loofah plants (LV0-LV20) July (blue) and August (red)

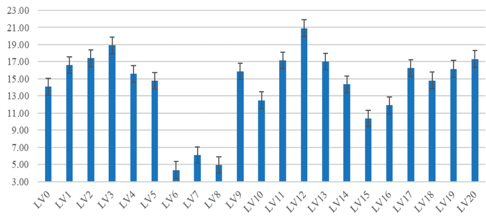

Figure 10. The growth rate between the two measurements

Table 4 shows the variants with the best or lowest response for loofah, which are centralized.

Table 4. Maximum and minimum values for the two analyzed parameters for loofah

| Maximum | | Minimum | |
|---|---|---|---|
| **Germination rate** | **Growth** | **Germination rate** | **Growth** |
| LV6 | **LV3, LV9** | LV11, **LV15,** LV19 | LV6, LV8 **LV15** |
| LV8 | **LV2** | LV12, LV16, LV18 | |
| LV10, LV7, LV4, **LV2, LV9,** LV5, **LV3** | | | |

## CONCLUSIONS

All the compost variants, in general, presented beneficial and neutral bacteria and fungi with high potential as fertilizer. 10% and sometimes 20% were the most favorable compost ratios as fertilizer for the horticultural plants tested.

Analyzing the two species, we notice that the compost variants that gave the best values are present in both analyses, and V3 (10% coffee) and V9 (10% CTG) had the best yield.

The lowest values were obtained at 1% and 5% concentrations for different compost variants. Also, for concentrations of 20% at V6 (20% S2) and V8 (20% S3).

## ACKNOWLEDGEMENTS

This research work was carried out within the project 771/15 02 2022 “Research on the use of composts obtained from food waste”, financed by Eutron Invest Romania SRL.

## REFERENCES


Awasthi, S.K., Sarsaiya, S., Awasthi, M.K., Liu, T., Zhao, J., Kumar, S. & Zhang, Z. (2020). Changes in global trends in food waste composting: research challenges and opportunities. *Bioresour. Technol. 299*, 122555.

Cerda, A., Artola, A., Font, X., Barrena, R., Gea, T. & Sánchez, A. (2018). Composting of food wastes: Status and challenges. *Bioresource Technology*, *1*(248), 57–67.

Cesaro, A., Conte, A., Belgiorno, V., Siciliano, A. & Guida, M. (2019). The evolution of compost stability and maturity during the full-scale treatment of the organic fraction of municipal solid waste. *J. Environ. Manag. 232*, 264–270.

Chen, C., Chaudhary, A. & Mathys, A. (2020). Nutritional and environmental losses embedded in global food waste. *Resour. Conserv. Recycl. 160*, 104912.

Chen, Y.T. (2016). A cost analysis of food waste composting in Taiwan. *Sustainability*, *8*(11), 1210.

Colón, J., Cadena, E., Pognani, M., Barrena, R., Sánchez, A. & Font, X. (2012). Determination of the energy and environmental burdens associated with the biological treatment of source-separated Municipal Solid Wastes. Energy, *Environ. Sci. 5*, 5731–5741.

Corti, C., Crippa, L., Genevini, P.L. & Centemero, M. (1998). Compost use in plant nurseries: hydrological and physicochemical characteristics, *Compost Science & Utilization, 6* (1), 35-45.

de Bertoldi, M., Vallini, G. & Pera, A. (1983). "The biology of composting: a review". *Waste Management & Research 1* (2), 157–176.

Fan, Y., Klemeš, J., Lee, C.T. & Ho, C. (2018). Efficiency of microbial inoculation for a cleaner composting technology. *Clean Technologies and Environmental Policy. 20*. 10.1007/s10098-017-1439-5.

Finstein, M., Miller, F., Strom, P. et al. (1983). Composting Ecosystem Management for Waste Treatment. *Nat Biotechnol 1*, 347–353.

Ge, S., Wang, S., Yang, X., Qiu, S., Li, B. & Peng, Y., (2015). Detection of nitrifiers and evaluation of partial nitrification for wastewater treatment: a review, *Chemosphere, 140*, 85–98.

Haug, R.T. & Haug, H.T. (1993). Practical Handbook of Compost Engineering. *Lewis Publishers*, Boca Raton.

Kalamdhad, A.S. & Kazmi, A.A. (2008). Effects of turning frequency on compost stability and some chemical characteristics in a rotary drum composter. *Chemosphere, 74*(10), 1327-34.

Kim, S., Lee, Y., Lin, K.-Y.A., Hong, E., Kwon, E.E. & Lee, J. (2020). The valorization of food waste via pyrolysis: a review. *J. Clean. Prod.*, 120816.

Komilis, D., Ham, R. & Park, J. (2004). Emission of volatile organic compounds during composting of municipal solid wastes. *Water research. 38*. 1707-14.

Malamis, D., Bourka, A., Stamatopoulou, E., Moustakas, K., Skiadi, O. & Loizidou, M. (2017). Study and assessment of segregated biowaste composting: the case study of Attica municipalities. *J. Environ. Manag. 203*, 664–669.

Mo, W.Y., Man, Y.B. & Wong, M.H. (2018). Use of food waste, fish waste and food processing waste for China’s aquaculture industry: needs and challenge. *Sci. Total Environ. 613*, 635–643. https://doi.org/10.1016/j.scitotenv.2017.08.321.

Mustin, M. (1987) Le compost: gestion de la matière organique.

Oviedo Ocaña, R., Dominguez, I., Komilis, D. & Sánchez, A. (2019). Co-composting of Green Waste Mixed with Unprocessed and Processed Food Waste: Influence on the Composting Process and Product Quality. *Waste and Biomass Valorization. 10.*

Pace, M.G., Miller, B. E & Farrell- Poe, K. L. (1995). The composting processes. *Utah State University Extension*.

Pagans, E., Font, X. & Sánchez, A. (2006). Emission of volatile organic compounds from composting different solid wastes: abatement by biofiltration, *Journal of hazardous materials*, *131* (1-3), 179-186.

Romania – Insider, 2020, https://www.romania-insider.com/food-waste-romania-study, accessed on July 14, 2023.

Scherhaufer, S., Moates, G., Hartikainen, H., Waldron, K. & Obersteiner, G. (2018). Environmental impacts of food waste in Europe. *Waste Manag. 77*, 98–113.

Soto-Paz, J., Oviedo-Ocaña, E.R., Manyoma-Velásquez, P.C., Torres-Lozada, P. & Gea, T. (2019). Evaluation of mixing ratio and frequency of turning in the co-composting of biowaste with sugarcane filter cake and star grass, *Waste Management, 96*, 86-95.

Tiquia, S. M. & N. F. Y. Tam. (2000). Co-composting of spent pig litter and sludge with forced aeration. *Bioresource Technology 72* (1), 1-7.

Wainaina, S., Awasthi, M.K., Sarsaiya, S., Chen, H., Singh, E., Kumar, A., Ravindran, B., Awasthi, S.K., Liu, T. & Duan, Y. (2020). Resource recovery and circular economy from organic solid waste using aerobic and anaerobic digestion technologies. *Bioresour. Technol., 301*, 122778.

Waqas, M., Dr. Abdul-Sattar, N., Asad, A., Barakat, M.& Ismail, I. & Rashid, M. (2018). Optimization of Food Waste Compost with the Use of Biochar. *Journal of Environmental Management. 216*. 70–81.

Wei, Y., Li, J., Shi, D., Liu, G., Zhao, Y. & Shimaoka, T. (2017). Environmental challenges impeding the composting of biodegradable municipal solid waste: a critical review. *Resour. Conserv. Recycl. 122*, 51–65.

You, S., Wang, W., Dai, Y., Tong, Y.W. & Wang, C.H. (2016). Comparison of the co-gasification of sewage sludge and food wastes and cost-benefit analysis of gasification-and incineration-based waste treatment schemes. *Bioresour. Technol. 218*, 595–605.

Zhang, H., Li, G., Gu, J., Wang, G., Li, Y. & Zhang, D. (2016). Influence of aeration on volatile sulfur compounds (VSCs) and $NH_3$ emissions during aerobic composting of kitchen waste. *Waste Manage. 58*, 369–375.