HIWASSEE EXTRACTOR EFFICIENCY REPORT

Soil Foodweb Inc.

Introduction

This is a report evaluating differences in microorganism extraction efficiency from a compost sample between 5 auger speeds of the Hiwassee Bio-Extractor. The Hiwassee Bio-Extractor can extract different concentrations of soil food web organisms from the compost by changing the auger speed which affects the concentration of compost used per gallon of water.

This report evaluates the overall extraction efficiency between auger speeds at 40 psi and at the standard (40 mesh) auger mesh screen size of the Hiwassee Bio Extractor. This was done by testing the biological content of the input material and the biological content of the output (waste) material. Further analysis determines the extract quality by comparing the biological content of the input material to the biological content of the extract produced by the Bio-extractor as compared to the control method.

The control method adopted was the "Brewer" extraction method. The results relate to the beneficial groups of microorganisms that were found in the microscopy assessment.

During the evaluation it was found that a key element in comparing microorganism concentrations found in compost to those found in extract is the "dilution adjustment factor". The "dilution adjustment factor" refers to the respective volume of compost which changes according to the different auger speeds and extraction method.

The results strongly suggest that there are differences in extraction efficiency between the auger speeds and when comparing to the control.

It is important to highlight that this report only reflects results found for beneficial microorganism groups. It should be noted that ciliates were also found and accounted for, however this is a consequence of the quality of the compost used in this study, and not the quality of the Bio-Extractor.

Methods

The methodology was developed by both Hiwassee and SFI, by adapting standard Soil Foodweb approach's methods to include the specificities of the Hiwassee Bio-Extractor.

For the control, the brewer extraction method was adopted, as it is a method recognized by the SFW School to be used for extract production on a larger scale.

To achieve the goals of this project, the following studies were performed:

1. Determine the expected extract efficiency of the Hiwassee Bio-Extractor at different auger speeds while at the standard water pressure (40 psi), water flow rate, compost weight (10 lbs), and screen mesh size. By sampling the spent material and subtracting those microorganism values from the microorganism values of the input compost, we obtained the expected concentrations of organisms in the extract.
2. Determine the actual concentration of microorganisms found in the extract at different auger speeds. This was done by using the SFW shadowing microscopy method to assess the microorganism levels of the extract from the Bio-Extractor and the control method (brewer).
3. Determine the efficiency of the Bio-Extractor and the control by comparing the extract results to the results of the input compost. To be able to compare the concentrations of microorganisms in

the solid compost to the concentrations in the liquid extract, it was necessary to consider the dilution adjustment factor. Because different auger speeds and the control method use different volumes of water, the respective dilution adjustment factor was applied to the compost relative to each volume of water used. The efficiency is presented as a percentage of microorganisms found in the extracts to those found in the adjusted compost.

4. Determine the extraction "sweet spot" which is the point where you achieve the best combination of microorganism concentration and extraction efficiency. This will indicate the optimal auger speed to use under the standard conditions for this report.
5. Determine the efficiency of the Bio-Extractor compared to the efficiency of the control method normalized for time. This was done by adjusting results found in each auger speed trial to the time required for the control method (60 minutes). These results were expressed in a percentage of the ratio of auger speed results divided by control results.

Data to be taken:

1. Flow rate of the Bio-Extractor in gallons per minute. Determined by measuring the volume of water used at the end of the extraction process and in a set time.
2. Time spent per extraction at different speeds of the Bio-Extractor. Determined by taking the time necessary to extract a set weight of compost for each auger speed and for the control in minutes.
3. Volume of water utilized in the extraction for each auger speed of the Bio-Extractor and for the Control.

   Volume water used = Time (mins) x Flow rate (gls/min)
4. Microscopy assessment according to the Soil Foodweb approach for:
   a. Compost
   b. Extracts
   c. Spent material
5. Expected Extraction Efficiency (EEE): To determine the EEE it is assumed that the "Spent" material has a consistency similar to that of the compost. This means that a direct comparison of results is possible. To calculate the EEE the following formulas are used:

   Percentage of Microorganisms Remaining on the spent (PMR) = (spent value / compost value) x 100

   EEE = 1 – PMR

   (See graphs 1A-1E)
6. Observed Extraction Efficiency (OEE): To determine the OEE, the different dilutions, respective to each speed, had to be considered for the calculations, as follows:

$$OEE = \left(\frac{\text{microscopy assessment value}}{\text{dilution adjustment factor}} \right) \text{x unit conversion factor}$$

   a. Microscopy assessment value (MAV) refers to the ug per gram or number per gram of microorganism groups, determined by using the *s*Mapp app.
   b. The "dilution adjustment factor" refers to the respective volume of compost used, which changes according to the different auger speeds and extraction method.
   c. Unit conversion factor refers to the number used to convert units from ug per gram (or number per gram) to ug per milliliters. This is necessary to cancel units as dilution factor is unitless. This is used to find the results in the form of a percentage.

7. To find the conversion factor it is necessary to equate grams to milliliters and apply the following equation:

   Grams = milliliters (assumed). 1lb = 453.59 g, and 1 gal = 3785.41 mL

   453.59g/3785.41mL = 0.1198

   0.1198 = unit conversion factor

8. To find the ratio of extracted organisms to the compost adjusted for dilution, the following formula was used:

   $$\text{Observed extract organisms} \div \left(\frac{\text{observed compost organisms} \times 0.1198}{\text{gallons of water} \div 10} \right)$$

9. Normalization equation for time – to adjust the microorganisms' concentration values of the different speeds of the Bio-Extractor and control to 60 minutes:

   Microscopy assessment value ÷ extraction time = units per minute

   Units per minute × 60 minutes = units per hour

Calibration steps for Hiwassee Bio-Extractor (Speed 1 at 40 psi)

1. Set up the extractor as directed by the user manual.
2. Run the extractor without any compost and set the input pressure for the extractor to 40 PSI. Once set, run the extractor for 5 minutes and record how much water is pumped out. Divide the total by 5 so that you get an accurate GPM (gallons per minute) extraction rate which will be used later to calculate extraction efficiency.
3. Take a sample of the input compost and determine the biology in that compost. This will be used as the baseline to compare all of the extraction efficiencies at higher speeds or with different composts.
4. Fill the extractor hopper with 10 lbs BiocompleteTM compost at 50% moisture (using the scale) and run extractor at speed 2 until the compost level in the hopper becomes flush with the bottom of the hopper.
   a. Turn the extractor on and at the same time start the stopwatch.
   b. Time how long it takes for the level of the compost in the hopper to drop flush with the bottom of the hopper.
   c. Record this time so that you can calculate the dilution ratio of your compost at this auger speed. (This will be used to calculate the extraction efficiency of the compost extract)
   d. While running this step take a sample of spent material and extract that is getting pumped out of the extractor to allow for overall efficiency of the extractor. Label each sample with the speed the extractor was running.
5. Repeat step 3 and 4 on speed 3, 5, 7 and 10.
6. Analyze all samples following the SFW microscopy technique and record results.

   Control (brewer method)

For the experiment, we used a 70-gallon tank (brewer) with an electric air pump that introduces air from the bottom, thus creating a constant "bubbling" effect. The brewer also features a lid on top for inserting and removing bagged compost.

1. The 70-gallon compost tea brewer (brewer) was filled to 60 gallons with water and left to aerate overnight.
2. Using the most up to date method for brewer extraction, 14 pounds (about ⅔ capacity of the mesh bag) of un-sieved compost was added to the mesh bag.

3. The compost was gently massaged for 10 minutes inside the bag.
4. The mesh bag with compost was suspended within the main air stream of the brewer, and a timer for 1 hour was started.
5. At the end of 1 hour, the mesh bag was removed from the brewer, and the remaining contents (spent compost) were sampled for analysis 3 times, along with 3 extract samples from the brewer.
6. The Brewer was cleaned with sodium percarbonate (Oxi-Clean) and thoroughly rinsed with water.
7. Extract samples and spent compost samples were analyzed on the same day, using the Soil Foodweb shadowing microscopy method, and biology count results were recorded.
8. All recorded biological analyses were processed through the sMApp 2.0 system for results and analyzed for the final report.

As a standard SFI quality control procedure, 10% of the samples were randomly selected, sent, and analyzed by a Soil Foodweb School Mentor. The quality control demonstrated no significant deviation from the results of the same sample analyzed by the SFI professional.

At the end of the experiment these samples included samples from the Hiwassee Bio-Extractor and from the compost.

Results and Interpretation

It was not possible to achieve the minimum numbers for all microorganisms, neither for the Bio-Extractor nor for the control. The failure has to do with the compost used. The compost chosen for the experiment, historically, in normal conditions, has good quality. Unfortunately, the delivery of the batch sent to SFI, was delayed approximately 30 days due to problems with the shipping company. During this period the compost stayed in cold, rainy conditions for 20 days, which negatively affected its quality. After receiving the batch, the compost was kept under optimized conditions (temperature and moisture), without interference, seeking to improve its quality for a period of 10 days. A longer period was not possible, due to the need to meet deadlines.

Below is the table that describes the determinations of the average flow rate and the average time needed to extract from 10 lbs of compost, at each different auger speed.

Table 1. Averages of three Hiwassee Bio-Extractor equipment Flows.

Bio-Extractor #	E1		E2		E3		Average		SD
Flow test (gal/min)	9.6		9.8		10		9.80		0.16
Extraction speed	**Min/sec**	**Sec**	**Min/sec**	**Sec**	**Min/sec**	**Sec**	**Min/sec**	**Sec**	
2	7':30"	450	6':19"	379	7':48"	468	7':12"	432.33	38.42
3	4':25"	265	3':56"	236	4':11"	251	4':11"	250.67	11.84
5	1':45"	105	2':30"	150	1':54"	114	2':05"	123	19.44
7	1':25"	85	1':25"	85	1':10"	70	1':20"	80	7.07
10	1':04"	64	1':07"	67	1':10"	70	1':07"	67	2.45

Note that for microorganisms which were not identified, no efficiency evaluation was made, represented within tables as "NA". Additionally, the population of bacterial feeding nematodes was too low for an accurate assessment of extraction efficiency and for any further evaluation.

Table 2: Expected extraction efficiency

SPEED	2		3		5		7		10	
	Spent	Compost	Spent	Compost	Spent	Compost	Spent	Compost	Spent	Compost
Bacterial Biomass (µg/g)	58.24	632.25	84.08	632.25	84.42	632.25	102.42	632.25	108.88	632.25
Fungal Biomass (µg/g)	6.09	12.15	6.18	12.15	6.05	12.15	6.70	12.15	7.24	12.15
Total Beneficial Protozoa (number/g)	55026.00	128394.13	41575.33	128394.13	39944.89	128394.13	39129.78	128394.13	36684.11	128394.13
Flagellates (number/g)	52580.33	62362.88	39129.67	62362.88	28532.00	62362.88	30162.44	62362.88	23640.89	62362.88
Amoebae (number/g)	2445.67	66031.25	2445.67	66031.25	11412.89	66031.25	8967.33	66031.25	13043.22	66031.25

Expected	Comp - spent	Expected efficiency	Comp - spent	Expected efficiency	Comp - spent	Expected efficiency	Comp - spent	Expected efficiency	Comp - spent	Expected efficiency
Bacterial Biomass (µg/g)	574.01	90.79%	548.17	86.70%	547.83	86.65%	529.83	83.80%	523.37	82.78%
Fungal Biomass (µg/g)	6.06	49.87%	5.97	49.13%	6.10	50.19%	5.45	44.89%	4.91	40.45%
Total Beneficial Protozoa (umber/g)	73368.13	57.14%	86818.80	67.62%	88449.24	68.89%	89264.35	69.52%	91710.01	71.43%
Flagellates (number/g))	9782.54	15.69%	23233.21	37.25%	33830.88	54.25%	32200.43	51.63%	38721.99	62.09%
Amoebae (number/g)	63585.58	96.30%	63585.58	96.30%	54618.36	82.72%	57063.92	86.42%	52988.03	80.25%

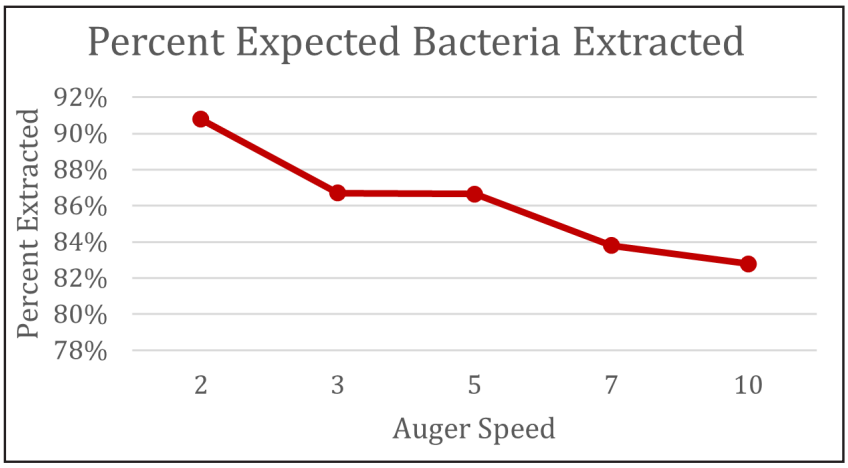
Overall Efficiency

Graphs 1A-1D chart the expected extraction efficiency of each microorganism group based on what is found in the spent compost. These values were found with the following formula:

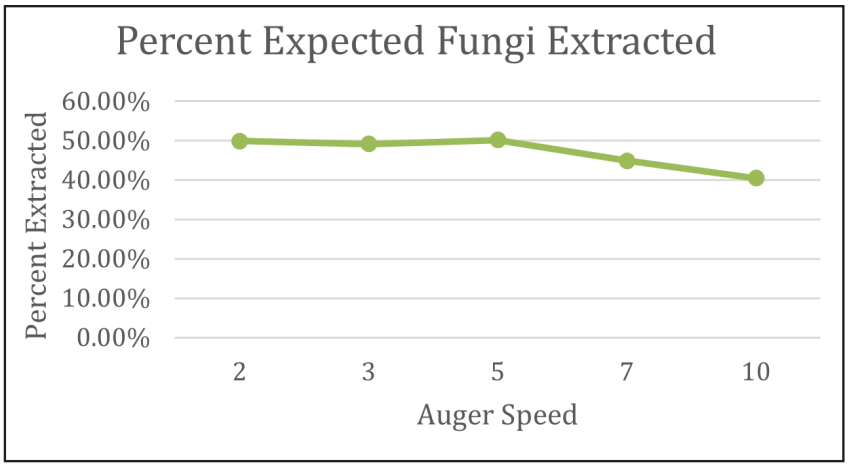
Percentage of Microorganisms Remaining on the spent (PMR) = (spent value / compost value)*100.

EEE = 1 – PMR

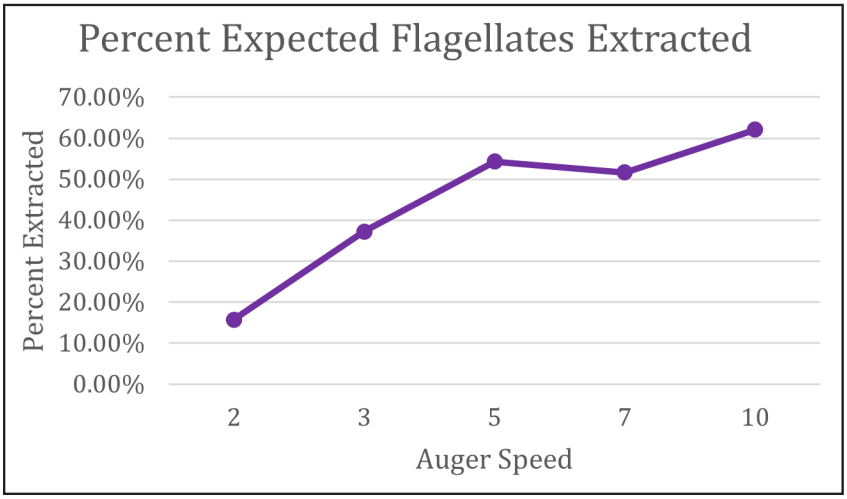
Graph 1A: Average Bacteria Extracted by Auger Speed (EEE)



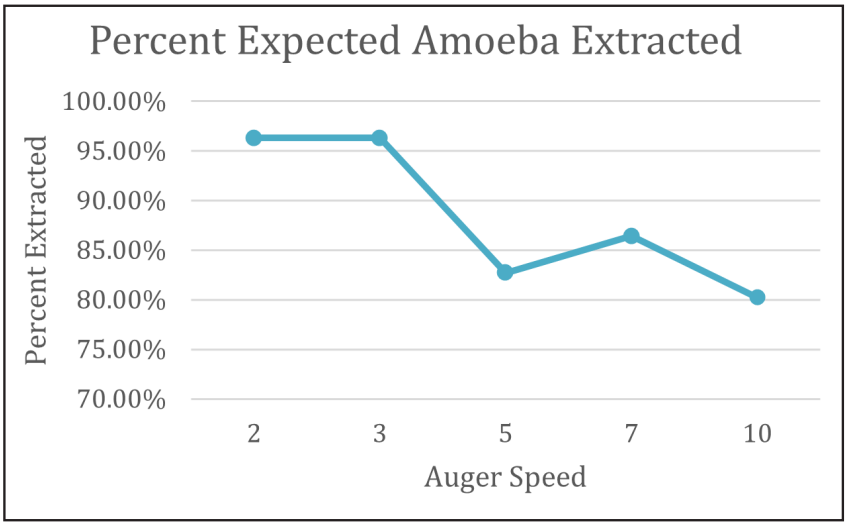
Graph 1B: Average Fungi Extracted by Auger Speed (EEE)



Graph 1C: Average Flagellates Extracted by Auger Speed (EEE)

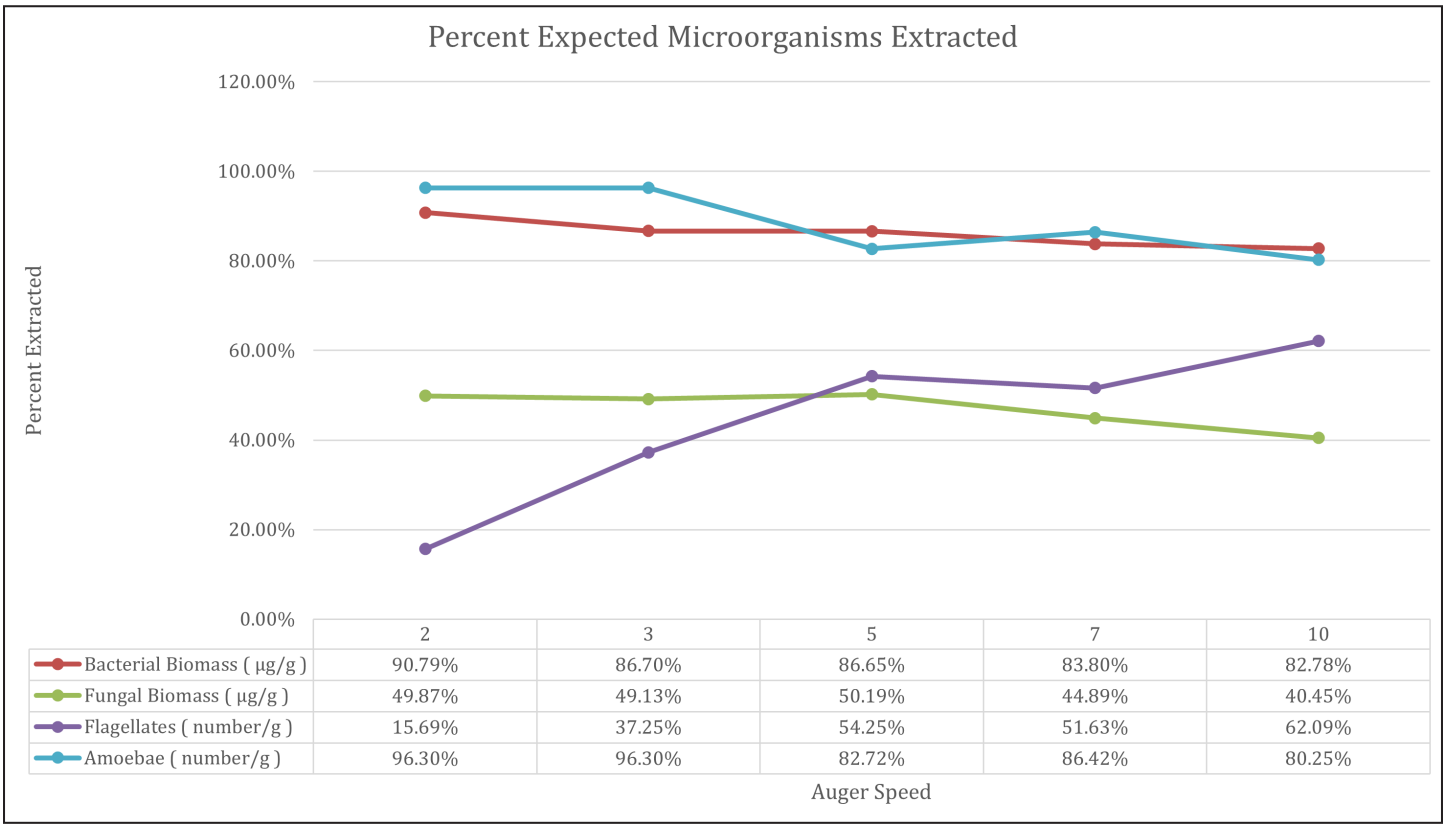


Graph 1D: Average Amoeba Extracted by Auger Speed (EEE)



On Graph 1E, the four microorganism groups are plotted together showing which auger speed(s) cluster more or less groups and which groups to expect to find for different speeds.

Graph 1E: Average Expected Microorganisms Extracted by Auger Speed (EEE)



	2	3	5	7	10
Bacterial Biomass (µg/g)	90.79%	86.70%	86.65%	83.80%	82.78%
Fungal Biomass (µg/g)	49.87%	49.13%	50.19%	44.89%	40.45%
Flagellates (number/g)	15.69%	37.25%	54.25%	51.63%	62.09%
Amoebae (number/g)	96.30%	96.30%	82.72%	86.42%	80.25%

Graphs 1A-1E suggest that:

Bacterial biomass – the results show an expected bacterial extraction efficiency of 82% to 90% across all speeds, with speed 2 being the highest efficiency at 90%.

Fungal biomass – the results show an expected fungal extraction efficiency of 40% to 49% across all speeds, with speed 2 being the highest efficiency at 49%.

Amoebae – the results show an expected amoeba extraction efficiency of 80% to 96% across all speeds, with speed 2 being the highest efficiency at 96%.

Flagellates – the results show an expected flagellate extraction efficiency of 15% to 62% across all speeds, with speed 10 being the highest efficiency at 62%.

Collectively, the data suggests that at speed two, it is expected to obtain three of the main groups: bacteria, fungi and amoeba. In the case of flagellates, speed 10 would be preferred.

The next step was to determine what concentrations were actually found during the experiment.

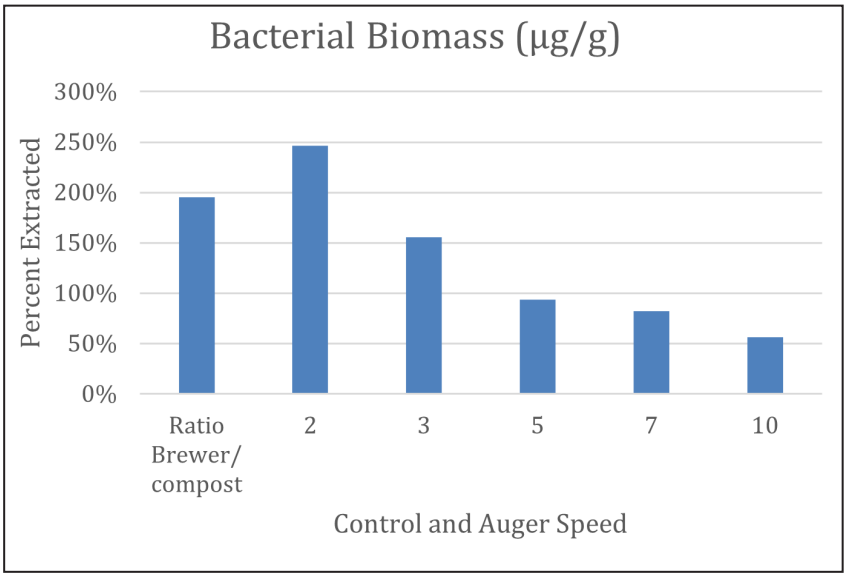
Table 3: Ratio of µg/g and number/g of microorganisms. Extract divided by compost concentrations, adjusted by the dilution adjustment factor.

SPEED	2	3	5	7	10	Brewer
Compost used (lb)	10	10	10	10	10	14
Time (minutes)	7.21	4.19	2.05	1.33	1.12	60
Water Consumed (gal)	70.63	40.93	20.10	13.05	10.95	60
Dilution Adjustment Factor	7.21	4.18	2.05	1.33	1.12	4.29
GROUPS	**Efficiency**	**Efficiency**	**Efficiency**	**Efficiency**	**Efficiency**	**Efficiency**
Bacterial Biomass (µg/g)	247%	155%	93%	82%	56%	195%
Actinobacterial Biomass (µg/g)	0%	1401%	103%	0%	0%	0%
Fungal Biomass (µg/g)	768%	352%	186%	140%	95%	862%
Total Beneficial Protozoa (number/g)	210%	108%	117%	57%	32%	123%
Flagellates (number/g)	185%	98%	83%	48%	33%	84%
Amoebae (number/g)	233%	118%	149%	65%	32%	159%
Bacterial-feeding Nematodes (number/g)	524%	0%	447%	97%	0%	0%
Fungal-feeding Nematodes (number/g)	NA	NA	NA	NA	NA	NA
Predatory Nematodes (number/g)	NA	NA	NA	NA	NA	NA
Detrimental Microorganisms	NA	NA	NA	NA	NA	NA
Oomycetes Biomass (µg/g)	NA	NA	NA	NA	NA	NA
Ciliates (number/g)	524%	2733%	746%	387%	487%	954%
Root-feeding Nematodes (number/g)	NA	NA	NA	NA	NA	NA

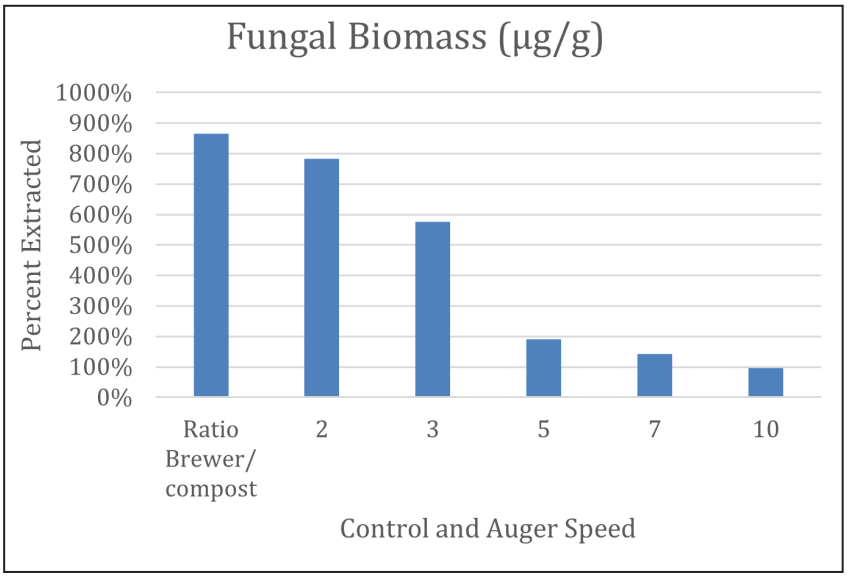
Concentration of microorganisms

For the following graphs (2A-2E) it is important to highlight that this was the first set of results that showed an extraction level above 100%, meaning there would be more microorganisms in the extract than on the source material. Similar results were found later in actual extraction numbers.

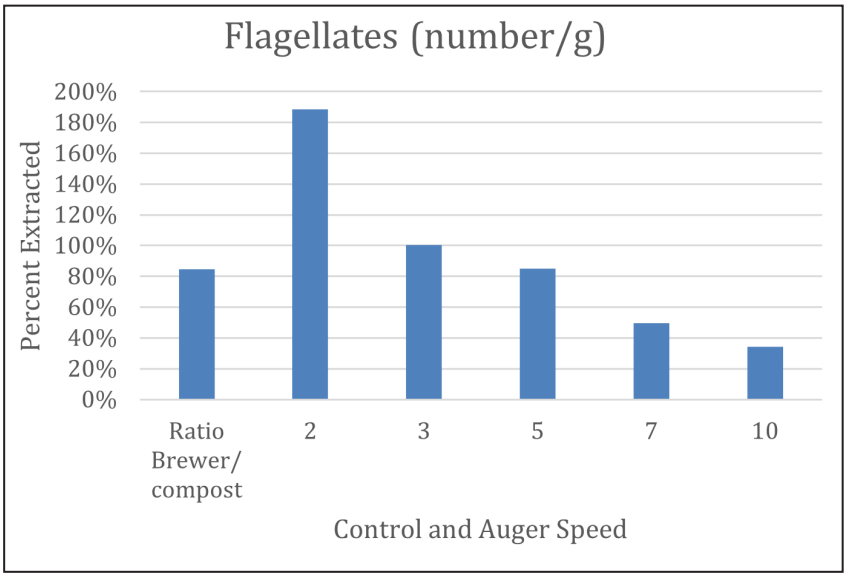
Graph 2A: Bacterial biomass ratio, extracts / adjusted compost



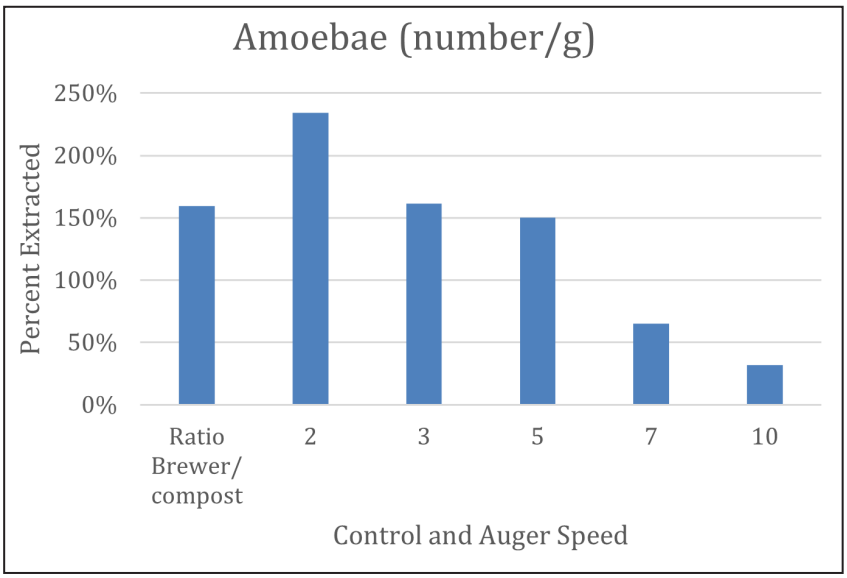
Graph 2B: Fungal biomass ratio, extracts / adjusted compost



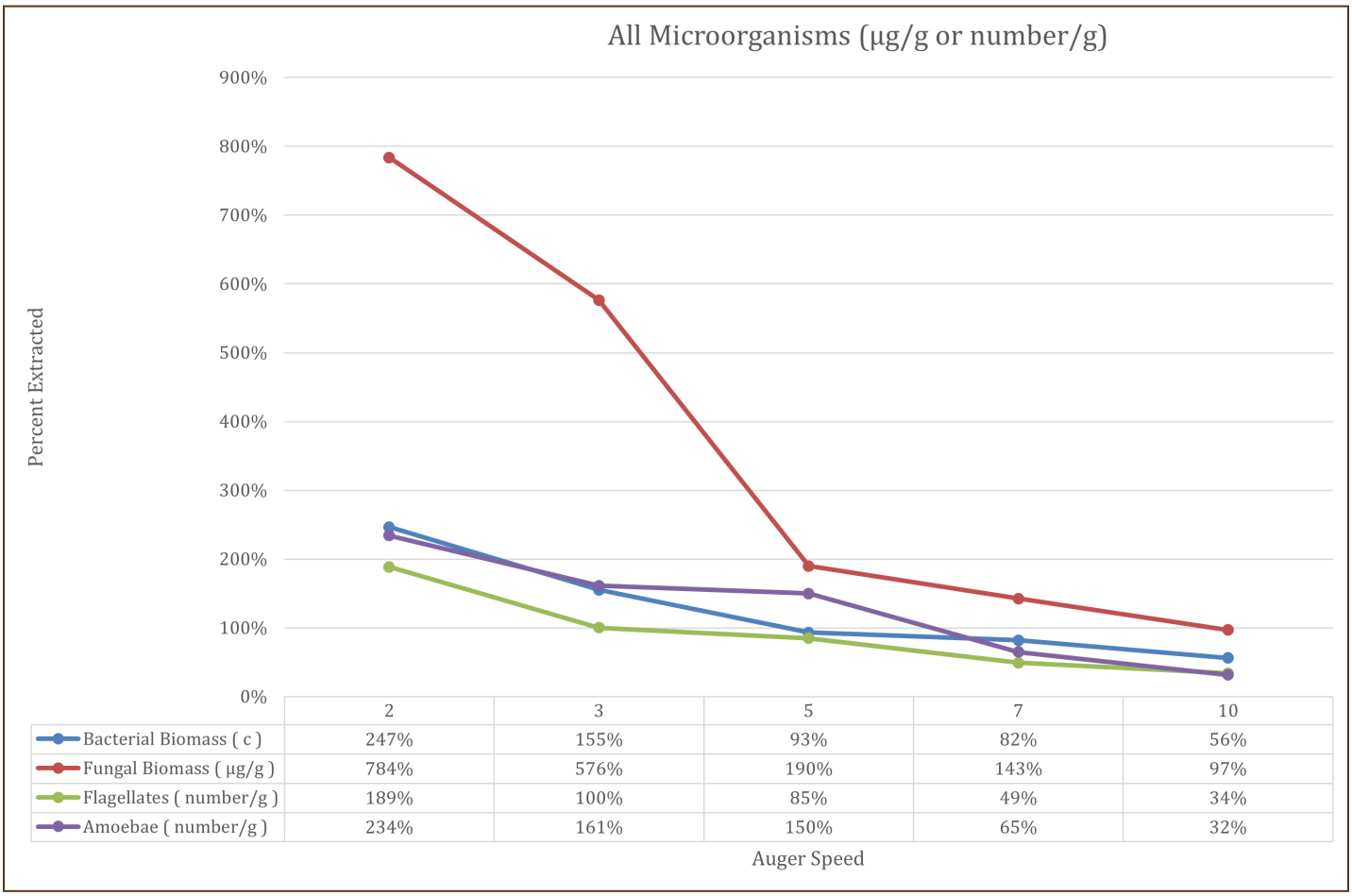
Graph 2C: Flagellate ratio, extracts / adjusted compost



Graph 2D: Amoebae ratio, extracts / adjusted compost



Graph 2E: All microorganisms ratio, extracts / adjusted compost



	2	3	5	7	10
Bacterial Biomass (c)	247%	155%	93%	82%	56%
Fungal Biomass (µg/g)	784%	576%	190%	143%	97%
Flagellates (number/g)	189%	100%	85%	49%	34%
Amoebae (number/g)	234%	161%	150%	65%	32%

From this stage of the work, the results were obtained by applying the dilution adjustment factor to the compost.

Graphs 3A to 3E compare the concentration found for the different organisms at the different auger speeds to the respective concentrations found in the compost adjusted by the dilution factor. The same adjustment to the compost was applied to compare the control (brewer) concentrations to the compost.

The results suggest that the efficiency of the Bio-Extractor at speed 2 outcompeted the control in most cases. Still, the control marginally outcompeted the Bio-Extractor for fungi extraction. For the bacteria and total protozoa, the control ranked second for both groups.

The results from the comparison of the Bio-Extractor extracts to the compost adjusted for dilution suggest that the efficiency varies according to auger speed and microorganism groups.

Bacterial biomass – the results suggest that there is a higher extraction efficiency at auger **speed 2**, outcompeting all other speeds. In 7 minutes of extracting 10 pounds of compost, it outcompeted the control, which extracted for 60 minutes using 14 pounds of compost.

Fungal biomass – the results suggest that there is a higher extraction efficiency at **speed 2**, outcompeting all other speeds. In 7 minutes of extracting 10 pounds of compost, it performed similarly to the control which extracted for 60 minutes using 14 pounds of compost.

Flagellates – the results suggest that there is a higher extraction efficiency at **speed 2**, outcompeting all other speeds. In 7 minutes of extracting 10 pounds of compost, it outcompeted the control, which extracted for 60 minutes using 14 pounds of compost.

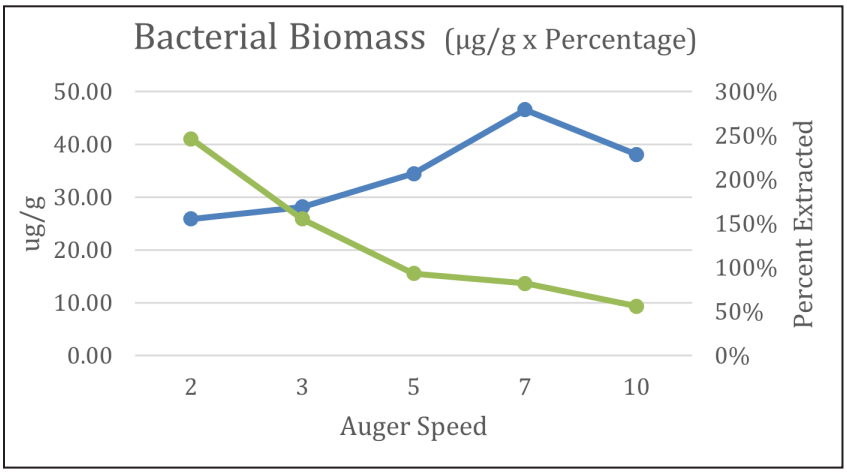
Amoebae – the results suggest that there is a higher extraction efficiency at **speed 2,** outcompeting all other speeds. In 7 minutes of extracting 10 pounds of compost, it outcompeted the control, which extracted for 60 minutes using 14 pounds of compost.

Analyzing across the different microorganism groups (graph 2E), the results suggest that at speed 2, most of the microorganisms needed for the recovery of soil health are identified in the highest numbers. This suggests that speed 2 would have the highest overall concentration when compared to all other speeds and the control. Note that the control method relies on extraction for one hour and will always produce the same volume of extract per hour.

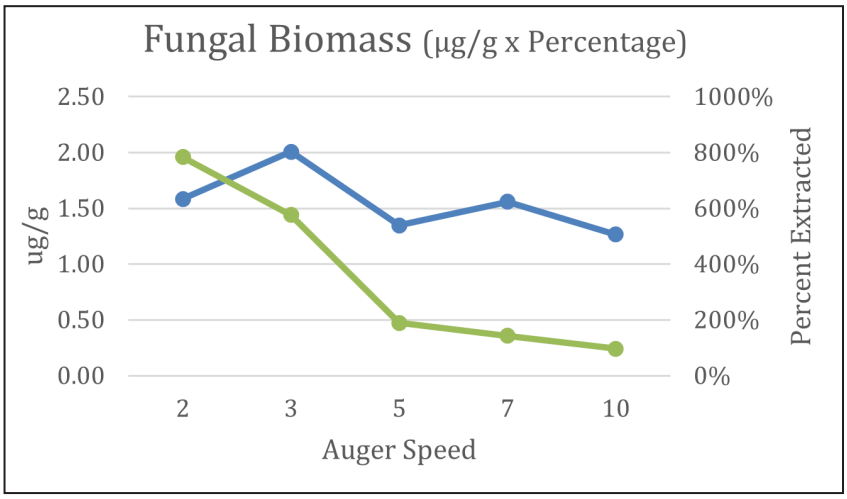
Extraction Efficiency

To determine the optimal extract efficiency for each microorganism group, the intersection of total biomass extracted (blue) and percentage of biomass extracted from the compost (green) was found. This intersection represents the point where you achieve the best combination of microorganism concentration and extraction efficiency.

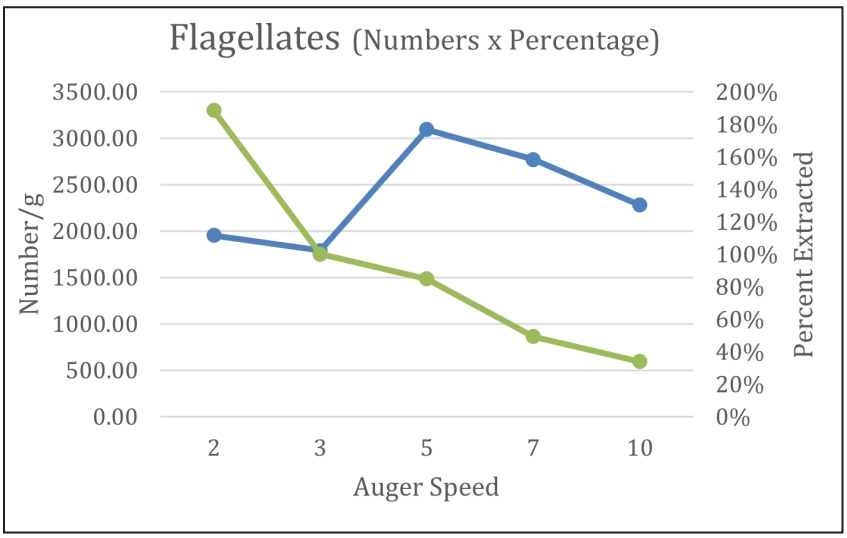
Graph 3A: percentage and µg/g of bacterial biomass at each auger speed



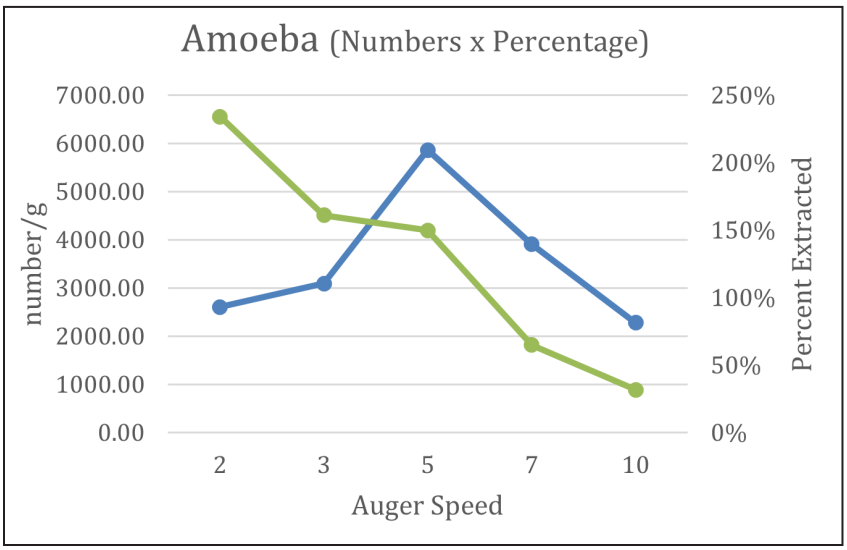
Graph 3B: percentage and µg/g of fungal biomass at each auger speed



Graph 3C: percentage and number of flagellates at each auger speed



Graph 3D: percentage and number of amoeba at each auger speed



For the comparison of efficiency vs. concentration, we focused on the different auger speed results to determine which auger speed extracts compost microorganisms at the highest rate, and what that concentration is. For the 4 different microorganism groups found, the interpretation is as follows.

Bacterial biomass – the results show an intersection of total ug/g extracted and percentage extracted at auger **speed 3**.

Fungal biomass – the results show an intersection of total ug/g extracted and percentage extracted between auger speed 2 and auger **speed 3**.

Flagellate numbers – the results show an intersection of total g extracted and percentage extracted at auger **speed 3**.

Amoeba numbers – the results show an intersection of total g extracted and percentage extracted between auger speed 3 and auger **speed 5**.

Time Normalization

The time normalization results indicate the efficiency of the Bio-Extractor compared to the efficiency of the control method normalized for time. This was done by adjusting results found in each auger speed trial to the time required for the control method (60 minutes). These results were expressed in a percentage of the ratio of auger speed results divided by control results.

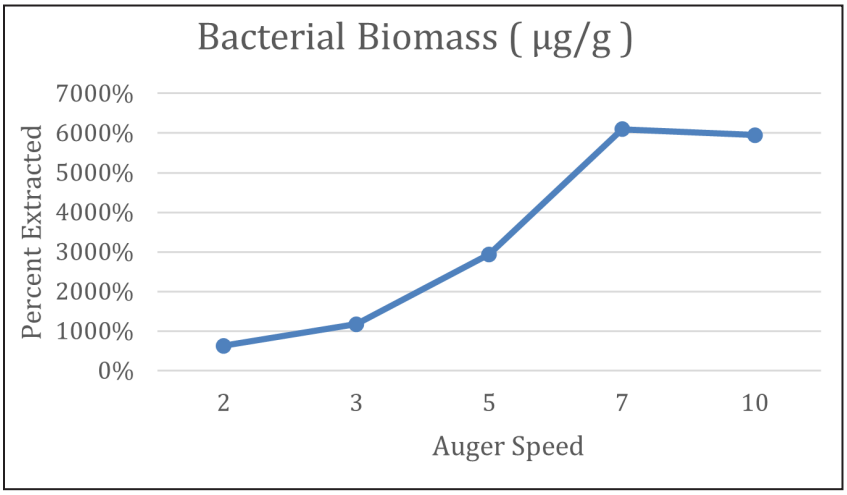
Table 4: Time Normalization, gallons used in 1 hour, and compost used in 1 hour at different speeds.

SPEED	2		3		5		7		10	
	Extract	Brewer	Extract	Brewer	Extract	Brewer	Extract	Brewer	Extract	Brewer
Bacterial Biomass (µg/g)	25.92	34.42	28.18	34.42	34.50	34.42	46.62	34.42	38.12	34.42
Fungal Biomass (µg/g)	1.58	2.93	2.01	2.93	1.35	2.93	1.56	2.93	1.27	2.93
Flagellates (number/g)	1956.33	1467.33	1793.44	1467.33	3097.78	1467.33	2771.89	1467.33	2282.44	1467.33
Amoebae (number/g)	2608.56	2934.67	3097.67	2934.67	5869.33	2934.67	3913.00	2934.67	2282.44	2934.67

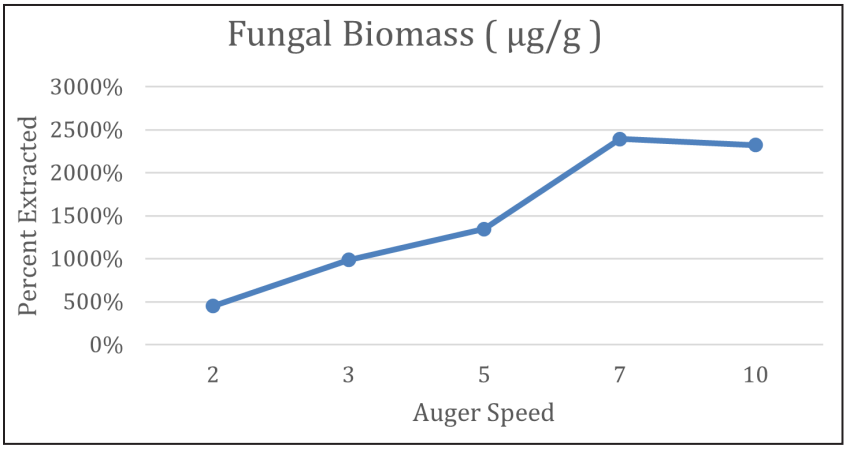
	µg/g extracted in 1 hour	Lbs compost extracted in 1 hour	µg/g extracted in 1 hour	Lbs compost extracted in 1 hour	µg/g extracted in 1 hour	Lbs compost extracted in 1 hour	µg/g extracted in 1 hour	Lbs compost extracted in 1 hour	µg/g extracted in 1 hour	Lbs compost extracted in 1 hour
Bacterial Biomass (µg/g)	215.83	83.27	404.74	143.62	1009.86	292.68	2097.82	450.00	2048.35	537.31
Fungal Biomass (µg/g)	13.18	83.27	28.85	143.62	39.44	292.68	70.13	450.00	68.02	537.31
Flagellates (number/g)	16290.21	83.27	25756.91	143.62	90666.67	292.68	124735.00	450.00	122638.81	537.31
Amoebae (number/g)	21721.20	83.27	44487.77	143.62	171785.37	292.68	176085.00	450.00	122638.81	537.31

SPEED	2		3		5		7		10	
	Ratio (µg/g): Extract / brewer in 1 hour	Extract production (gls) in 1 hour	Ratio (µg/g): Extract / brewer in 1 hour	Extract production (gls) in 1 hour	Ratio (µg/g): Extract / brewer in 1 hour	Extract production (gls) in 1 hour	Ratio (µg/g): Extract / brewer in 1 hour	Extract production (gls) in 1 hour	Ratio (µg/g): Extract / brewer in 1 hour	Extract production (gls) in 1 hour
Bacterial Biomass (µg/g)	627%	588.00	1176%	588.00	2934%	588.00	6096%	588.00	5952%	588.00
Fungal Biomass (µg/g)	450%	588.00	985%	588.00	1347%	588.00	2395%	588.00	2322%	588.00
Flagellates (number/g)	1110%	588.00	1755%	588.00	6179%	588.00	8501%	588.00	8358%	588.00
Amoebae (number/g)	740%	588.00	1516%	588.00	5854%	588.00	6000%	588.00	4179%	588.00

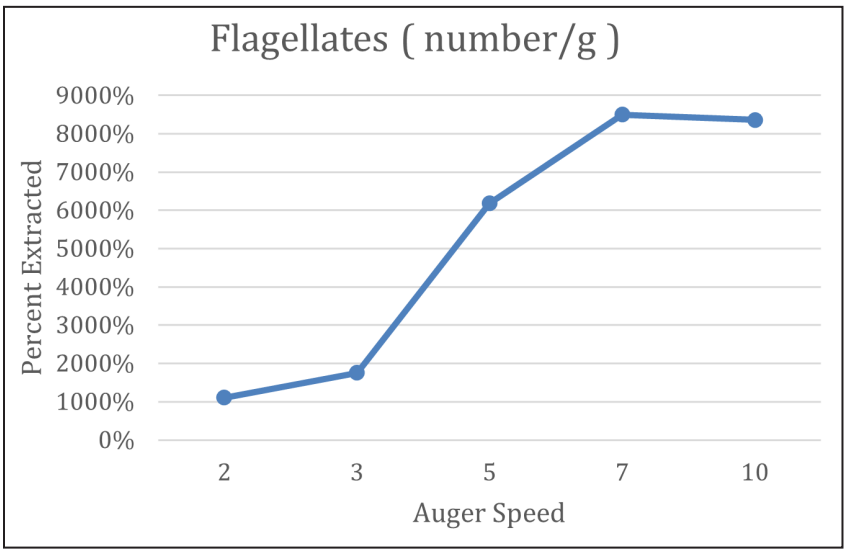
Graph 4A: Percentage Bacterial Extraction Normalized to Control (60 minutes)



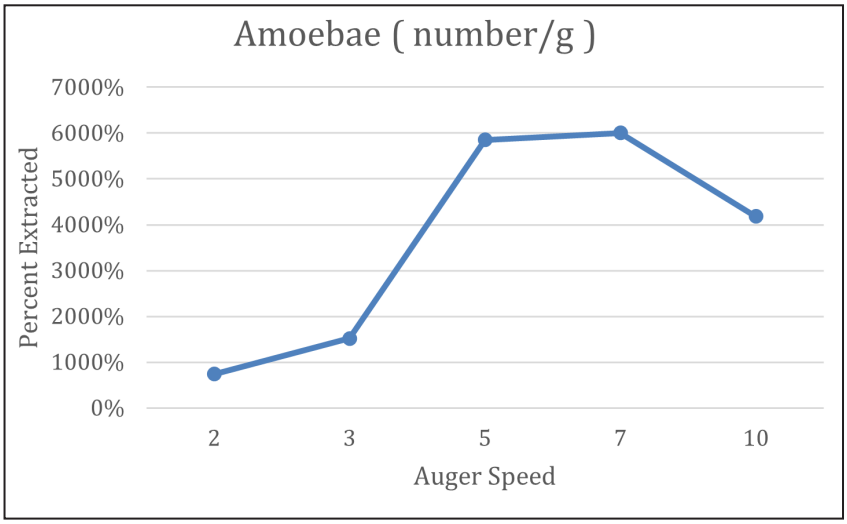
Graph 4B: Percentage Fungal Extraction Normalized to Control (60 minutes)



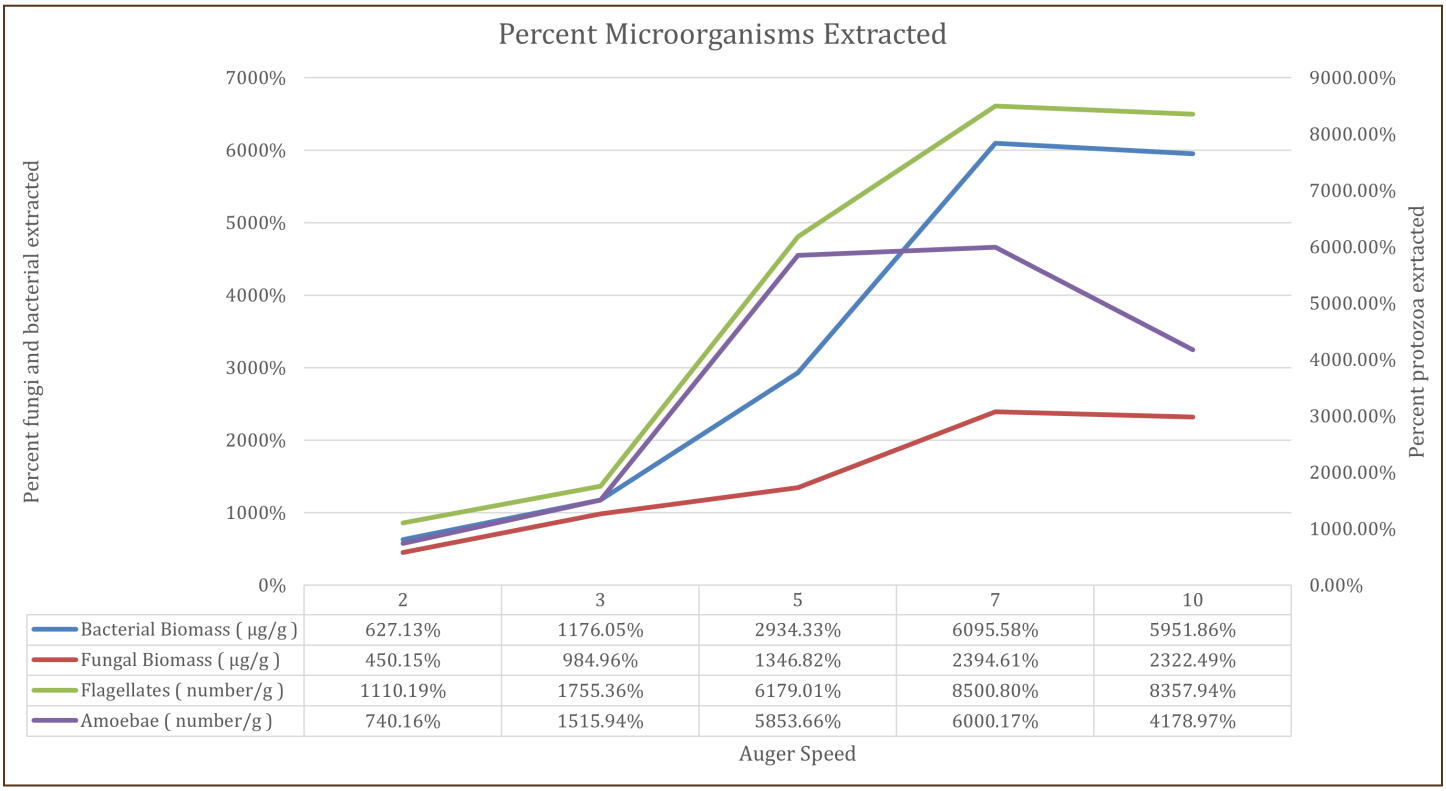
Graph 4C: Percentage Flagellate Extraction Normalized to Control (60 minutes)



Graph 4D: Percentage Amoebae Extraction Normalized to Control (60 minutes)



Graph 4E: Percentage Microorganism Extraction Normalized to Control (60 minutes)



	2	3	5	7	10
Bacterial Biomass (µg/g)	627.13%	1176.05%	2934.33%	6095.58%	5951.86%
Fungal Biomass (µg/g)	450.15%	984.96%	1346.82%	2394.61%	2322.49%
Flagellates (number/g)	1110.19%	1755.36%	6179.01%	8500.80%	8357.94%
Amoebae (number/g)	740.16%	1515.94%	5853.66%	6000.17%	4178.97%

In the comparison of microorganisms extracted using the Bio-Extractor over a time period equal to the control requirement (60 minutes), the results suggest that auger speed 7 outcompeted all other auger speeds for all microorganism groups. The results also show that all auger speeds outcompeted the control method in organisms extracted when normalized to the time required for the control method.

Discussion

Over 100% extraction theoretical explanation

For results that presented a percent extraction of over 100%, it can be theorized that due to the rigorous pressures applied to the compost during the extraction processes used in this study, more organisms were pulled off the compost and sent into solution than could be observed in the compost itself, as the compost is not subjected to such pressures when analyzed.

The theory above is a mental exercise to explain the achievement of over 100% efficiency. No specific experiment was developed to prove this explanation. The following precepts support this theory.

A – It is important to highlight that the SFW microscopy assessment is more of a qualitative/quantitative assessment. Its primary goal is to identify the main organism groups that are present in a soil, compost, or extract, and determine if the minimum number of organisms required for a healthy food web are present. It is not designed to estimate or determine the absolute numbers of microorganisms present.

B – The quantification power of the SFW microscopy method is as strong as its ability to extract from samples pipetted into a test tube and agitated at low intensity. The results provide a reliable representation by correlating the numbers of microorganisms found in the assessment with results observed in field conditions.

C – The SFW microscopy assessment has its own dilution system, that relates to the opacity of a sample on a slide. A sample can be cluttered by debris (minerals, seeds, etc.), microorganisms, or a combination of both. The dilution necessary for an effective assessment on a slide does not have a direct correlation to the dilution of microorganisms in an extract or tea.

D – The correction by dilution adjustment factor applied to the extracts from the Hiwassee Bio-Extractor were similarly applied to the control.

Organism extraction by group

The results allow that different auger speeds can favor the extraction of different microorganism groups. Therefore, it can be assumed that different combinations of Bio-Extractor specifications beyond the standards of the report can be used to customize extracts to suit the needs of the user.

Considerations

It can be argued that the control method is versatile in the sense that users can add more compost to the brewer, to concentrate the number of microorganisms and achieve the minimum numbers sought for a good extract. By achieving higher microorganism concentrations, the extract can then be diluted to apply in the field.

The Bio-Extractor, alternatively, can process more compost in the same amount of time as the control, achieving higher yields of ready extract to be applied in the field. This is why the Bio-Extractor results were normalized by time to match the method adopted for the control. The extraction of 14 pounds of compost using the control method is performed over 60 minutes. When using the Bio-Extractor, the time to extract 10 pounds of compost varied from 7 minutes to 1 minute according to the auger speed (Graphs 2A to 2E). The compost used in both the control and the Bio-Extractor trials are within a similar range but were not the same weight.

It was not possible to achieve the minimum numbers, according to the SFW approach for all microorganisms, because of the poor condition that the compost arrived due to delayed delivery and poor storage during transit. The low levels of microorganisms found in the compost affected the quality of the reported results, especially regarding standard deviations. Repeating this study with a higher quality compost would improve the accuracy of the results.

Not all expected beneficial microorganism groups were discovered in high enough numbers or within a variability range conducive to this report. Further studies are suggested to determine the extraction of bacterial-feeding nematodes.

Conclusion:

Under the parameters used for this study, the results of this trial strongly indicate that the Hiwassee Bio-Extractor is an efficient and user-friendly system for compost extraction that has a higher compost extraction capability than the standard large-scale "brewer" method (as defined in this study). The results also indicate that the Bio-Extractor's extraction process does not negatively impact the survivability of microorganisms, achieving a microbiological quality within the extract that is only limited by the quality of the compost used. Further studies are suggested to evaluate the efficiency of the extraction of other groups of microorganisms within the soil food web. Altering conditions such as water pressure and screened particle size, combined with different auger speeds, could render interesting results such as the ability to target certain groups of microorganisms such as nematodes. Considering the results of this trial, as well as the ease of setup and operation of this system, the Bio-Extractor could be a good option for professionals that need a fast, consistent and high yield solution for biological compost extract production.

Disclaimer:

Soil Foodweb, Inc. is not responsible for the quality of the equipment sold by Hiwassee and the repeatability of results different than obtained under the conditions of this study.