In-home processing of organic kitchen waste using a worm-composter prototype

Deliverable D4.5 | Evaluation of sideflows for upcycling, soil improvement and fertilizing resource: Worm composting

Auteurs | H. J. H. (Hellen) Elissen, S. (Saskia) Gaastra, S. (Simone) Brandt & K. (Klaas) van Rozen

WPR-OT 966

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Authors: H. J. H. (Hellen) Elissen, S. (Saskia) Gaastra, S. (Simone) Brandt, K. (Klaas) van Rozen

Institute: Wageningen Plant Research

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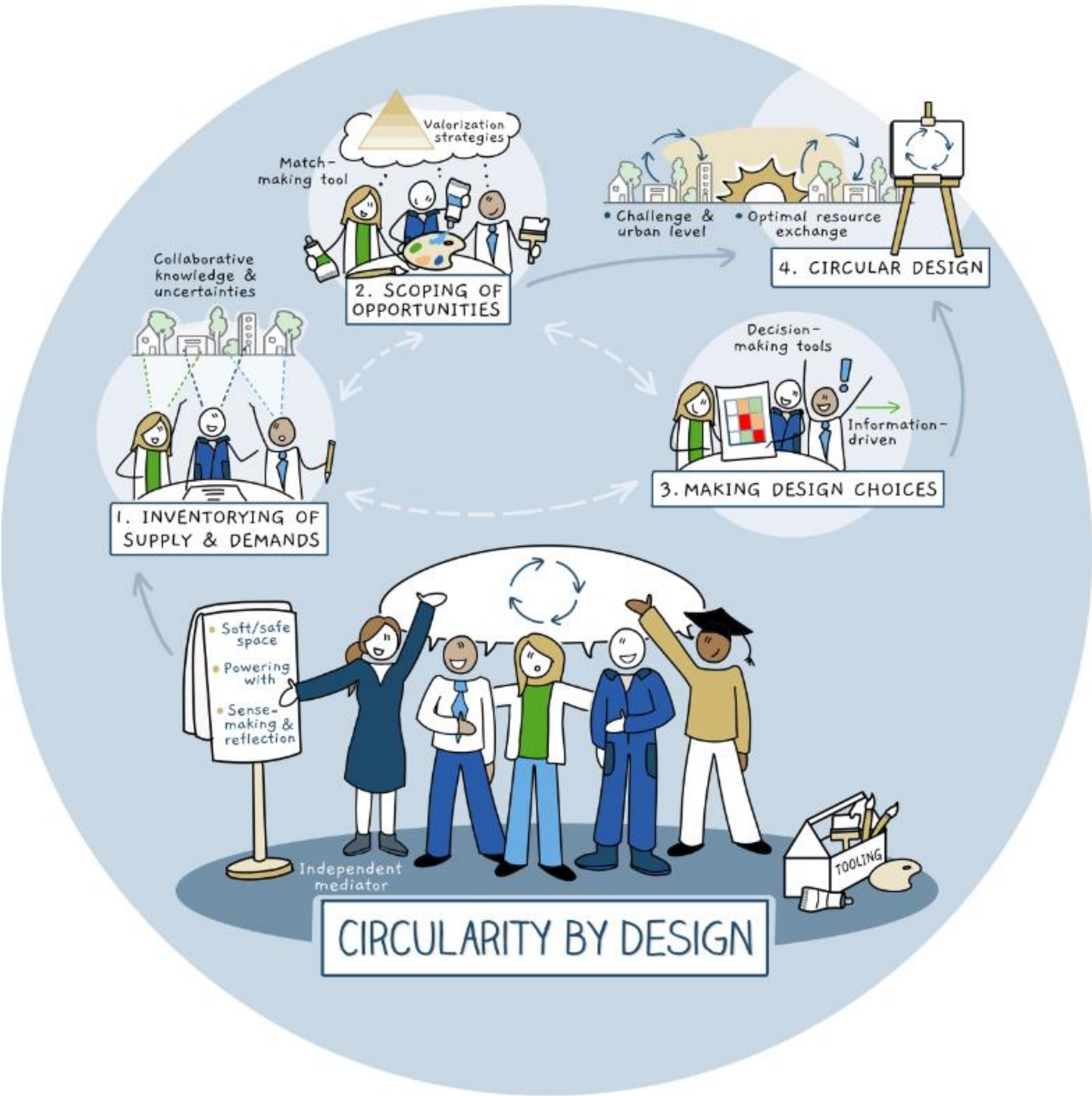
Contents

Preface

This report is part of the WUR flagship project Circularity by Design, embedded within the strategic investment theme Connected Circularity. The project aims to apply (re)design principles to develop a sustainable agri-food system within the Amsterdam Metropolitan Region. A critical question to design for circularity, is how to optimise the allocation of resources, including the current waste streams in the city, with the ambition to (re)use them in the agri-food system. Creating a coherent chain in which both the final product and the waste streams are recycled requires an integrated approach.

Within the project, we have developed a 4-step approach (figure below) to translate a circular bio-economy within the urban environment. This requires close collaboration between stakeholders involved, and a connection between technological opportunities and societal needs. Collaboration is key! Based on experiences in creating circular designs within four Amsterdam Challenges, we have created and tested tools to support stakeholders with inventorying, data collection, scoping of opportunities, design choices and how to translate circular dreams into practice. This allows us to support decision making processes, including repurposing of side streams and upcycling of agri-food resources within different scenarios.



The 4-step Circularity by Design approach (Graphic designer: Bureau voor Beeldzaken, 2022).

The following challenges have been identified:

- Urban food systems
- Organic household waste
- Urban food production
- Circular way of living

In a joint effort between the AMS Institute, researchers from 12 different expertise areas of Wageningen University and Research (WUR) and local stakeholders (‘Challenge Owners’) in Amsterdam, we have created a scientific foundation for Circular Designs in the urban environment. This report shows the results of a study on the technical feasibility of applying a worm composter (vermi-composter) to process organic kitchen waste in households.

Summary

This report is part of the WUR flagship project Circularity by Design, embedded within the strategic investment theme Connected Circularity. The project aims to apply (re)design principles to develop a sustainable agri-food system within the Amsterdam Metropolitan Region.
The organic fraction of household waste in urban areas in the Netherlands is mostly not collected via a source-separation waste management system, but usually ends up within municipal residual solid waste fractions at central waste processing facilities. Source separation is seen as a way to lower financial and environmental burdens. The European revised Waste Framework Directive (2018/851/EU, §10) requires that all municipalities must plan and implement separate biowaste collection schemes (either via curb side or drop-off collection systems). Alternatively, municipalities can encourage citizens to dump their biowaste directly into home or community composting so it does not end up in the public collection systems. One means of doing so is decentralized (small-scale) worm composting, in which compost worms partly break down this waste and convert the remainder into worm compost and new worms/biomass. A prototype household worm composter was tested during 50 days on its ability to convert a defined food waste mixture (representative of what is wasted on average in Dutch households minus the unsuitable items such as sauces etc) into worm compost and new worm biomass. It was concluded that compost worms can be fed 72.6 % of the food waste produced in a typical Dutch household and almost 38 % of the food waste dry matter was broken down by the worms. The food waste contained ~72 % water. The compost samples had at least the same nitrogen use efficiencies as cattle dung slurry. Regarding heavy metals and pathogens, a food waste/worm compost sample from a similar composter complied with the standards for Keurcompost. Initially, conditions in the composter were beneficially for worm growth and waste processing but during the course of the experiment, there was too high moisture build-up. The design should be further improved to allow for more aeration and better passage of the processed food waste/worm compost out of the reactor. After solving these issues, the composter is useful for decentralized waste recycling/upcycling.

1 Introduction

The organic fraction of household waste in urban areas in the Netherlands is mostly not separated at source but collected and processed in central waste processing facilities. Separation at source and processing of (a large part of) this fraction could lead to lower financial and environmental burdens. In this experiment a prototype household worm composter was tested in a lab environment at Wageningen University & Research, Lelystad, the Netherlands. The goal was to feed a population of worms in a worm composter, with a defined mixture of food waste and to investigate the practical feasibility of the current prototype for waste conversion into fertiliser, as well as user friendliness (daily operation).

2 Materials and methods

2.1 Food waste

The mixed food items ('waste') represented the average household food waste composition in the Netherlands. This selection was based on data in van Dooren (2019) (Annex I). Based on previous experiences and references, 72.6% (w/w) of the average food waste was included in the mix for feeding the worms (Annex I). Examples of excluded food wastes are oils/fats and dairy wastes. Table 1 shows the exact composition of the feed mix. All components were kept in a cooling cell at 4 °C and cut into smaller pieces (Figure 1) before addition to the composter. Besides food waste, other organic waste items originating from households, such as egg cartons and toilet rolls, can also be processed by the worm composter. This was done in the second half of the experiment.

Table 1 Basic composition of the worm food mixture as percentage of total applied fresh weight and dry matter content of the components (dried overnight at 105 °C, results from first test: 12/4/22). nd= not determined. Components listed were uncooked/raw, unless stated otherwise

Component	% of total mix	DM %
Broccoli	28.0	8.9
Onions		12.3
Potatoes		15.8
Carrots		10.3
Coffee grounds	19.5	39.3
Brown bread	17.4	64.3
Mixed raw Dutch vegetables (Albert Heijn)[1)]	8.8	7.4
Apple	7.1	12.7
Banana		19.6
Pear		16.3
Tangerine		13.2
Greek potato dish (Aviko)[2)]	6.9	25.7
Bami (Albert Heijn)[3)]	4.3	41.8
Grilled vegetables (Albert Heijn)[4)]	2.9	10.5
Egg carton torn in large pieces (6 eggs carton)	1.9	nd

1) carrot, celery, broccoli, paprika, cauliflower and green beans

2) pre-cooked meal with a.o. potatoes, vegetables (20%), pig meat (10%)

3) pre-cooked meal with a.o. bami (64%), leek, ham (6,8%) and scrambled eggs

4) eggplant, zucchini, yellow, red and green paprika and onion

Based on the dry matter percentages and proportions of all products in the mix, the average dry matter percentage of the mix was 28 %. At t=0 days (start of the trial) and t=28 days fresh food items were purchased.

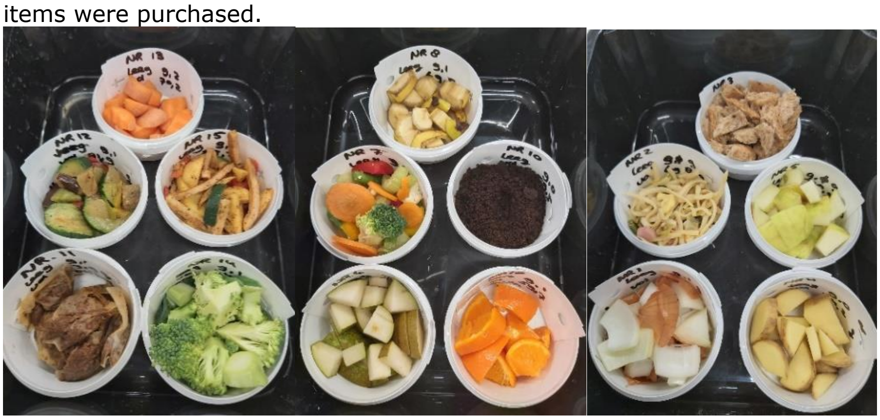


Figure 1 Pictures of some of the individual food items after cutting

2.2 Date, running time and temperature

The test was started on May 19th 2022 and ended on July 8th 2022. The total running time was 50 days. The composter was kept at 20 °C. The composter was placed in an insect tent, to prevent fruit flies from entering.

2.3 Worms

Worms (Figure 2) were a mix of *Eisenia fetida* and *Dendrobaena veneta* in a ratio of ~8:2 and had been purchased from WormsSystems (Oostwold, the Netherlands). Worm soil/compost was also obtained from the same supplier and used for creating a bottom layer in the composter at the start-up.

Figure 2 Worm sizes at the start (left) and in the transport material (right)

2.4 Start-up procedure

Figure 3 shows the worm composter. The screw inside the composter provides for a habitat for the worm population in between the blades of the screw. After removal of the lid at the top of the composter, organic (household) waste can be fed into the composter. Via the opening at the bottom (and after removal of the bottom lid), compost can be harvested. The main tube of the composter was marked to keep track of turning the screw (on the inside of the composter) with the handle and for estimating the food waste volume within the reactor.

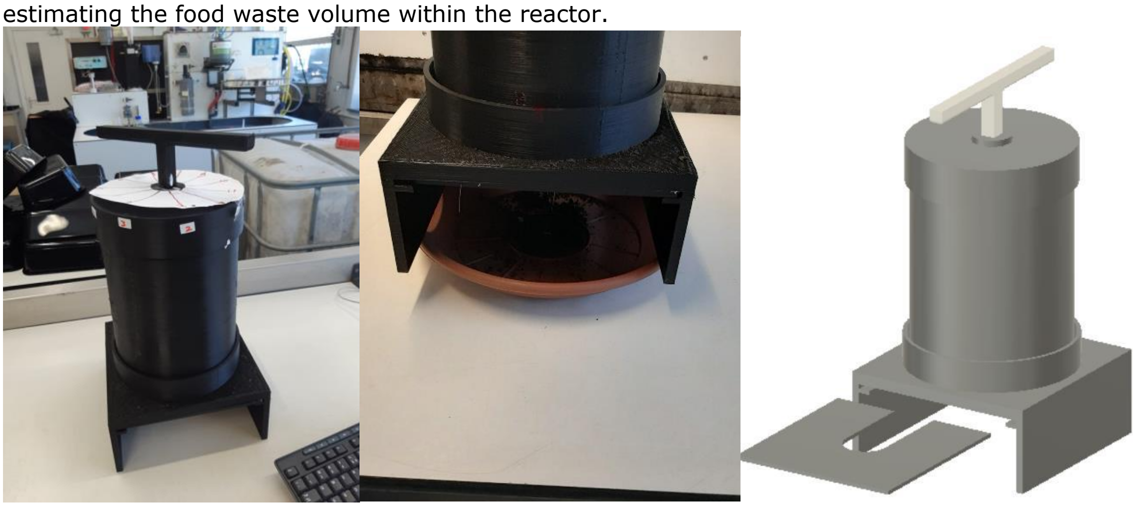


Figure 3 Picture of empty composter (left) with collecting tray below (middle) and 3D drawing of all components

The lid and handle could be removed to add start soil, worms and food waste. After adding materials to the composter, the lid was closed again and the handle placed back. Table 2 shows the weights of all components at t=0.

Table 2 Weights of the composter and additions at the start

Item	Weight in grams
Worm composter empty	2097
Start soil	1245 (55 % DM)
Worms (live weight)	408 (~0.76 g/specimen)
Feed	200

The screw was not removed from its surrounding tube, and material was added through the tube aperture at the top of the composter. This was repeated during the test when adding food waste. The bottom of composter contained a hole, which was designed for worm compost to fall out. This hole was at first covered with a thin layer of brown paper, to prevent spillage of worms at the start. Worms that fell out during the test (after 13 days the brown paper had fallen out, Figure 4), were placed back in the composter. Spilled worm compost/start soil/food waste that fell out during the test was weight and discarded.

Figure 4 Fallen out brown paper and start soil/ worm compost at t= 13

2.5 Analyses

At t=50 days (end) the composter was taken apart, all contents of the composter were weighed and samples were taken. The contents were separated in worms, an upper layer (mainly uneaten food waste) and a bottom layer of worm compost/food waste (there are always some parts of the food waste that have not been converted (yet), for example due to their hardness or particle size). 835 g of the bottom layer was sent to Eurofins Agro (Wageningen, the Netherlands) for fertilizer value, compost quality and N-NH_3 analyses (Annex 2: 'Mestonderzoek bemestende waarde' and 'Kwaliteitsonderzoek compost'). Dry matter analyses of the different layers were done at the end of the test (drying overnight at 105 °C). Dry matter analyses of the input materials had been done in a previous experiment (Table 1).
In addition, since no further samples of the Lelystad composter were left after the former analyses, analyses were done on a sample of a similar composter run in Amsterdam from its mixed food waste/worm compost mixture for *Listeria monocytogenes* (method ISO 11290-1:1996), *Salmonella* spp. (method ISO 6579-1), STEC (method ISO/TS 13136) and *Escherichia coli* (own method Eurofins) by Eurofins Lab Zeeuws-Vlaanderen (LZV) B.V. (Graauw, the Netherlands). This composter had been run in a (less defined) 'live' household environment and the additional data are not further described in the current report. Results will however give an idea of bacterial pathogen presence in a comparable system.

3 Results

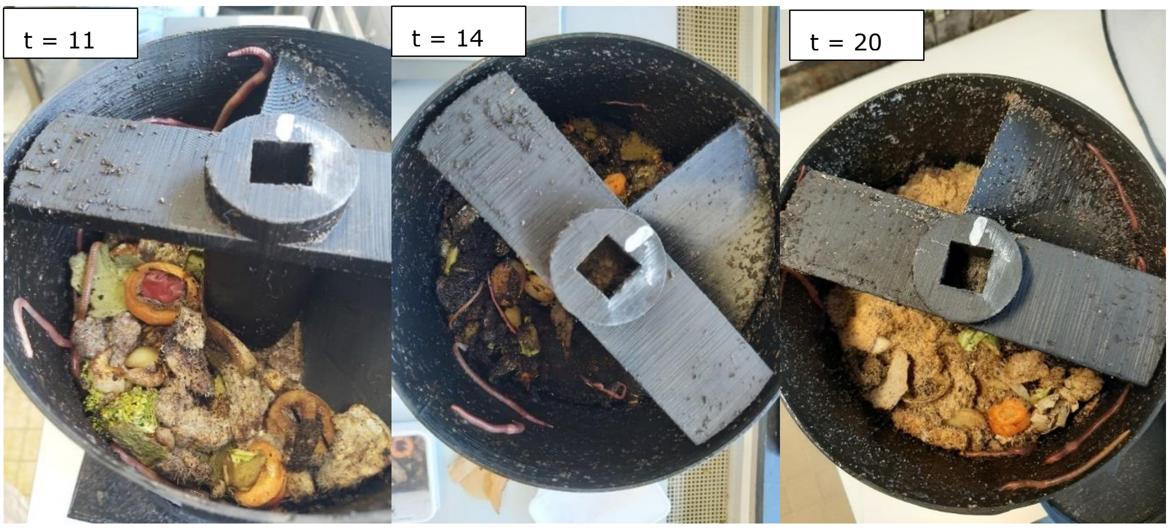
3.1 During the test

During 50 days feeding regime and general observations were recorded (Table 3).

Table 3 Feeding regime and observations during the test (May 19th 2022 = t=0). Turning of the screw was done after all feeding moments, in total 2 complete rotations during the experimental period. Feeding amount and frequency was based on visual observation of the speed with which the food waste had been processed or what was available from the food waste stock

Day	Feed grams	Additions	Remarks
0	200	+ 408 g worms + 1245 g start soil	Newly cut mix (on all other feeding moments, this mix, kept in the fridge, was used)
4	311		
8	500		Newly cut mix
11	200		
14	200		Brown paper fell out (t=13)
19	200		
22	250		Newly cut mix
25			Start of bad smells and massive ingrowth of mites, almost no worm compost produced from this day on
26	250	+ 27 g egg carton	
28	140		New food waste, newly cut mix
29	202		
32	208		
33	203	+ 3 g egg carton	
39	64		
43	192	+ 26 g egg carton + 100 g brown bread	
46			Newly cut mix
50			End of test, composter taken apart
Total	3123		

Figure 5 shows top views of the composter during the test after lid removal



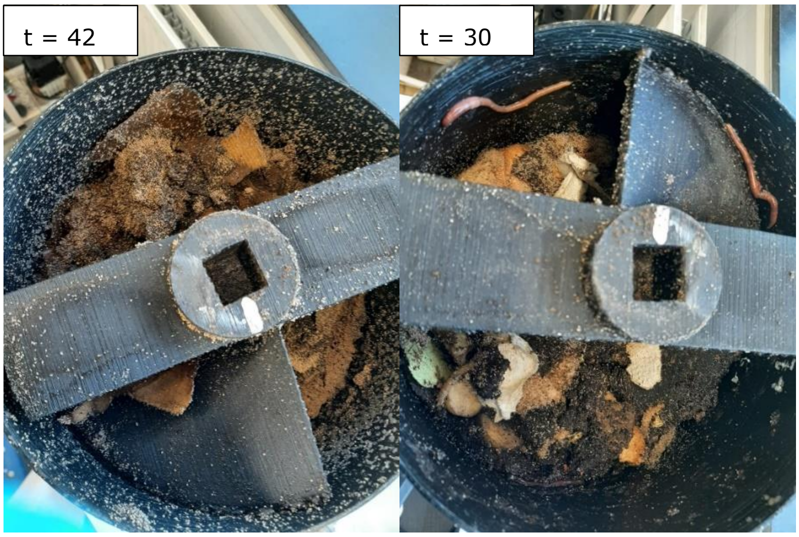


Figure 5 Top views of the composter at different times during the test.

Worm faeces (dark coloured) were initially visible on the walls of the composter. Towards the end of the test, an increasing amount of mites was growing in the composter (Figures 5 and 6). They were mainly located on the food waste surface and the visible upper composter components. As well as in the first test, pot worms (Enchytraeidae) were also found in the composter. Both species originated from the worm stock and bedding material that came with it

Figure 6 Close-up of mites (species were not identified) from the composter

Mostly in the first half of the experiment worm compost was produced (627 g in total), which mainly consisted of the start soil, that was dry/crumbly enough to fall out. The food waste did not fall out but also did not move to the bottom of the composter quickly enough unless it was being pushed. In the second half of the test conditions deteriorated: bad smells occurred, and many mites and fewer worms were visible in the upper layers. This coincided with the most worms falling out during one day (day 25): 20 grams, of which 11 grams appeared dead. In the weeks before, worms had hardly fallen out of the composter. In the two weeks after t=25, more worms fell out. After t=40 this stopped. During the whole test, a total of 164 dead worms fell out of the composter (of the original ~ 500 worms present at the start) and were discarded. Additionally, 32 live worms fell out and were placed back in the composter.
To counteract the adverse conditions in the composter, food waste was mixed on several occasions with the older upper layers in order to bring in fresh air and loosen the structure. Extra brown paper or egg carton were also added for balancing the moisture. Adding cardboard to the composter generally also helps to improve the C:N ratio in the composter, which should lead to a higher quality, more consistent worm compost product. However, this did not lead to a structural improvement of conditions in the composter.

3.2 After the test

At the end of the test two distinct layers were visible: the top layer appeared to be non-digested food waste, while the bottom layer appeared to be digested food waste, with worm tunnels visible (Figure 7).

Figure 7 Pictures of the composter content at the end, with a visible two layered composition. A) layers in the composter, B) layers in the composter, C) bottom layer with worms, D) top layer with mainly undigested food waste

Samples of both layers were taken and analysed for dry matter content: the top layer contained 22.7 % DM while the bottom layer contained 34.3 % DM (more digested material, which had released water).
At the end of the test only 44 worms were recovered from the bottom layer (Figure 8), weighing 14.8 g in total (~ 0.33 g fresh weight per worm). This means that less than 4 % of the worm biomass survived the test, since at t=0 days 408 g of worm biomass had been added. According to the worm breeder the surviving specimens were both *E. fetida* and *D. veneta* (Mekelenkamp, 2022a).

Figure 8 Worms found in the bottom layer of the composter at t=50

3.3 Mass balance

A mass balance was set up for the worm composter (Table 4).

Table 4 Mass balance (fresh weight/dry matter) (FW/DM) of the worm composter in grams

Item	IN	OUT	NET LOSS
Worms	408/98*	15/4	-393/-94
Start soil	1.245/685		
Food waste	3.223/902		
Egg carton	53/53		
Outlet (processed soil/food waste)	0/0	627/345**	
Leftover food waste/worm compost/start soil	0/0	3.060/680***	
Total contents	4.929/1.738	3.702/1.025	-1.227/-709

* *Eisenia fetida* worms contain 24 % DM and 3 % ashes ** Nd, assuming the same DM percentage as the start soil *** Based on the two separate DM percentages of the layers

In total, 3,223 g of fresh food waste was added during the test plus an extra 53 g of egg carton. Together with 1,245 g of start soil and 408 g of worms, 4,929 g of organic material had thus been added (including the worms). At the end of the test the total weight of the composter was 5,173 g, including 2,098 composter weight and 14.8 g of worms. This means that the composter contained 3,060 g of residual food waste, worm compost and start soil at the end. During the test, 627 g of start soil/processed food waste had fallen out of the composter. Overall, 1,227 g (4,929 g – 3,060 g – 627 g – 14.8 g) of organic material had been converted during the test, including 393 g of worms. This means that 834 g of food waste and start soil had broken down (due to evaporation and respiration by the worms and bacteria in the composter) based on fresh weight. On dry matter basis 709 g (1,738 g -680 g -345 g - 4 g) of organic material had been converted during the test, including 94 g of worms. This means that 615 g of food waste/start soil had broken down based on dry matter content (due to respiration by the worms and bacteria in the composter). The approximate FW and DM breakdown percentages of the food waste/start soil were thus 18.4 (834/,521*100) and 37.5 (615/1640*100) % respectively. 3,191-2,677= 514 g of water (~16 % of the total amount added) had evaporated during the test, judging from the differences between fresh weight and dry matter at the start and end of the test.

3.4 Analyses

Analysis reports of the mixture of worm compost with leftover food waste are shown in Annex 2. Table 5 shows the values of the worm compost of the Lelystad composter, alongside the results of a similar composter tested in Amsterdam (Annex 3) and two types of worm compost from the Netherlands (Mekelenkamp, 2022b). Comparing these analysis results directly is difficult as for all worm composts different input materials had been used and we cannot rule out that part of the material had not yet been digested.

Table 5 Analyses of different worm composts at the end of the experiments in Lelystad and Amsterdam and compared to reference worm composts (Mekelenkamp, 2022b). VC1 = worm compost Lelystad composter, VC2 = worm compost Amsterdam composter, VC3= reference worm compost on waste streams (added digestate/biogas slurry), VC4 = reference worm compost on regular substrates (mostly cereals)

	VC1	VC2	VC3	VC4	Limits
Fertilizer analysis Eurofins					
• Dry matter g DM/kg	338	224	367	277	
• Ash g ash/kg DM	615	406	619	303	
• Organic matter g OM/kg DM	385	594	381	697	
• Nitrogen g N/kg DM	20.4	17.7	11.5	15.8	
• C/N ratio	8.0	15.0	15.0	20.0	
• Ammonia-nitrogen g NH_3-N/kg DM	1.5	2.7	1.4	1.1	
• Organic nitrogen g N-org/kg DM	18.9	15.2	10.1	14.8	
• Phosphorus g P/kg DM	2.8	2.5	2.8	2.0	
• Phosphate g P_2O_5/kg DM	6.6	5.6	6.5	6.5	
• Potassium g K/kg DM	9.8	7.6	3.3	0.0	
• Kali g K_2O/kg DM	11.8	8.9	3.8	0.0	
• Magnesium g Mg/kg DM	2.7	2.2	3.3	3.6	
• Magnesia g MgO/kg DM	4.4	3.6	5.4	6.1	
• Sodium g Na/kg DM	4.7	1.8	0.8	0.7	
• Natron g Na_2O/kg DM	6.5	2.2	1.1	1.1	
Compost analysis Eurofins					
• DM g/kg product	339	209			
• OM % of DM	41.5	62.5			<10
• C-anorganic %	0.6	0.1			
• Kali K_2O g/kg DM	13.0	16.0			
• S-tot g/kg DM	2.5	1.9			
• Magnesia MgO g/kg DM	3.5	2.8			
• Chloride g/kg DM	5.7	2.6			
• pH-KCl	7.0	6.9			
• pH-H_2O	7.4	7.5			
• KZK carbonated lime %	4.7	0.7			
• EC conductivity mS/cm 25°C	5.9	4.1			
• Cadmium mg/kg DM	0.3	0.3			>1
• Chromium mg/kg DM	12.0	8.3			>50
• Copper mg/kg DM	20.0	21.0			>90
• Mercury mg/kg DM	0.0	0.0			>0.3
• Nickel mg/kg DM	6.7	4.9			>20
• Lead mg/kg DM	14.0	13.0			>100
• Zinc mg/kg DM	78.0	76.0			>290
• Arsenic mg/kg DM	3.4	2.9			>15
• Ash g/kg DM	585	375			
• Potassium (K) g/kg DM	11.0	13.0			
• Magn. (Mg) g/kg DM	2.1	1.7			

When we assume that all worm composts had been digested by the worms and we first focus on the difference between the Lelystad and Amsterdam composter we can draw some conclusions: the

Lelystad compost contained less moisture and the (higher) ash content, (lower) OM content, and lower C/N ratio suggest more breakdown of the input material. N, P, K and Mg contents (different forms) were all comparable. However, the Lelystad worm compost contained less ammonia, which could be due to better aeration or better digestion of the food waste, relatively to the Amsterdam worm compost. It was also found that Lelystad worm compost contained more sodium, chloride, lime and a higher EC, most likely due to salt in some of the food waste items, such as bread or prepared meals. Even though the worm composts contained different metals, none of them exceeded limits according to Uitvoeringsbesluit Meststoffenwet. The pH was comparable for both worm composts.
When comparing the values of the composters to the reference worm composts the following was seen: DM percentages were in the same range and OM and ash contents were as variable as between the two composters. Values of N components (including ammonia) were lower in the reference worm composts, which contained mostly cereal-related streams, and (thus) the C/N ratios were higher. K and Na were lower in the reference composts, while Mg was higher. The reason for this is unknown, since the exact composition of the 4 different substrates is also unknown.
Table 6 shows an overview of values from different sources.

Table 6 Chemical composition of different worm composts

Author	Adhikary, 2012	Bhat et al, 2013	Fernández-Gómez et al, 2011	Composter Lelystad
Substrate	Unknown	Dairy manure	Different types (worm composts from damaged tomato fruits , winery wastes, olive-mill waste mixed with biosolids, and cattle manure).	Food waste
pH	8.1	8.9	7.4-10.4	7.4
EC mS/cm	0.18	2.82		5.9
DM g/kg FW	465			339
C/N	20.9	15.5		8.0
NH_4^+ mg/g DM	<0.1			1.5
N g/kg DM	11-34.6	24	10.1-22.5	20.4
P g/kg DM	4.1-21.9	14.9		2.8
K g/kg DM	3.2-15.7	19.0		9.8
Na g/kg DM	1.3-3.4	14.1		4.7
Zn mg/kg FW	4-110			78
Cu mg/kg FW	2.6-4.8			20
Mg g/kg FW	0.9-5.7			2.1

Note: it is not always clear if the data are on dry matter (DM) or on fresh weight (FW) basis. Assumptions were made based on the Materials and methods sections of the references.

The worm compost from the composter in Lelystad seemed relatively rich in nutrients, and most values were within the ranges found in literature.
Sherman (2018) mentions target values for worm compost: pH 6.5, EC 150-350, C:N ratio < 30 (preferable 10-20), < 30 % C, Na < 750 ppm, B < 20 ppm, Zn < 300, Cu < 50, Fe < 15,000 ppm, Mn < 700 ppm, Ca 1-3 %, Mg 0.2-0.8 %, P 0.15-1.5 %, S 0.1-1.0 %, N 1-1.5 % (acceptable is 0.75-3.0 %), K 0.4-2 %. It is not known whether these are based on dry or fresh weight basis, so we cannot compare them to our analyses (and therefore they were not mentioned in Table 6). In her book she also mentions analyses of 42 samples of worm compost from food waste, which show a very large variability (CV between 27 and 164 %).
In addition to the nutrient content, calculations were made on the efficiency of the nitrogen content of the Lelystad compost. This efficiency is defined as the ratio of the crop nitrogen uptake to the total input of nitrogen fertilizer. The higher the ratio the better the nitrogen use efficiency. The composts had at least the same nitrogen use efficiencies as cattle dung slurry (CDS) (Table 7).

Table 7 Efficiency on arable land, spring application

	Lelystad VC	Amsterdam VC	CDS [1)]
Efficiency N-NH_3 (%)	75	75	48
Content N-NH_3 (g/kg)	0.5	0.6	1.9
Efficiency N-NH_3 (g)	37.5	45	91.2
Efficiency N-org (%)	30	30	20
Content N-Norg (g/kg)	6.4	3.4	2.1
Efficiency N-org (g)	192	102	42
Total (g)	230	147	133

[1)] Handboek Bodem en Bemesting

The bacterial analyses did not detect any pathogenic bacteria in the mixture of food waste/worm compost from the Amsterdam composter, or the concentration was below the detection limit (Table 8 & Annex 4).

Table 8 Results of the bacterial analyses in the mixture of food waste/worm compost of the Amsterdam composter

Bacterial species/genus	Result
Listeria monocytogenes	Not detected
Salmonella spp.	Not detected
Escherichia coli	< 10 CFU/g (detection limit)
STEC	Not detected

4 Discussion

Based on the results and daily observations, the contents of the composter contained too much water and aeration was insufficient. This led to the food waste not being 'transported' by the screw to the bottom of the composter but build-up of a sticky massive moist mass (instead of a drier, crumbly worm compost). This led to anaerobic conditions which is detrimental for worm survival. In addition, harvesting of worm compost could not take place. No leachate of the food waste was found in the tray below the composter during the test and evaporation + diffusion through the composter's tube wall was presumably limited, so most moisture remained in the food waste. This was illustrated by the DM percentages in the food waste at the end (22.7-34.3 %) that were comparable to that at the start (28 %).

The mites must have originated from the worm stock as the food waste added was directly purchased from the supermarket. What caused the mites to grow in these high numbers is unknown. According to the worm breeder (Mekelenkamp, 2022a) they can be present in worm cultures but do not interfere with the worms. Their population size can increase under food shortage conditions, according to the worm breeder, but this was not the case in the current worm composter. In addition, it is not known what their effect was on organic waste breakdown and other parameters in the composter.
In this test the food waste (cut and mixed) was preserved at fridge temperature, while in a previous test the food waste (cut and mixed) was kept at room temperature for longer periods, the temperature being more representative of a household. The latter however led to a massive ingrowth of moulds, a very fast decomposition and the waste being no longer suitable for feeding the worms. When collecting food waste for several days, care should be taken that decomposition processes are limited: some decomposition benefits worm growth, but foul smells indicate that food wastes are no longer suitable for feeding the worms. For eventual use of the composter in a real life household setting, daily operation of the worm composter should be very well described and evaluation of the conditions in the composter and viability of the worms by checking smells, moisture, moulding etc should be an important part of the manual. It seems that food waste of 0.5-1 week old can be used and regular feeding small portions is preferred.
When comparing the composition of the worm compost harvested in this test to values in literature, they were more or less in the same range. However, worm compost as such is a very variable fertilizer product, depending on the substrates the worms feed on. No standards for its nutrient contents are known.

The hole at the bottom of the composter and the material of which the composter was made (recycled degradable bioplastic) did not result in enough moisture loss. In turn this led to anaerobic conditions and clogging of the composter, and finally worm death. The composter material could be replaced by for example a more 'breathable' variant, or a perforated bottom plate / hollow central screw axis could be tested for providing sufficient aeration for the worms to survive.
It is assumed that dead worms likely decompose very quickly into CO_2, NH_3 and water as a result of their very high organic matter (and protein) content (~ 88 % of DM). It is unclear which part of the biomass remains in the composter.

Few worms of both species survived the adverse conditions in the composter. A mix of *Eisenia fetida* with *Dendrobaena veneta* is often advised, as both worm species prefer slightly different feed materials and colonize different parts of the food waste (*D. veneta* prefers deeper layers).
In this test, the screw could be turned a little bit regularly (averaging a quarter rotation every six days) without problems. However, in the first test (preceding the second test described in this report) bigger pieces in the waste or start soil got stuck between the screw and the wall, as a result of which the screw could no longer be turned.

Bacterial pathogens were either absent (*L. monocytogenes*, *Salmonella* spp., STEC) or below detection limits (*E. coli*). In the Netherlands there are limits for certain composts such as Keurcompost (Beoordelingsrichtlijn Keurcompost, 2021). *E. coli* should be below 1000 CFU/g and *Salmonella* should be completely absent for example. The worm compost thus complies with these standards. Heavy metal contents of the worm compost were also (much) lower than the standards for Keurcompost.

5 Conclusions

Worms can be fed 72.6 % of the food waste produced in a typical Dutch household (a mix representative of the food wasted mainly consisting of vegetables, coffee grounds, bread and fruit) and in addition, some quantities of (egg) cartons and similar materials can also be fed to the composter.

The approximate FW and DM breakdown percentages of the food waste/start soil were 18.4 and 37.5 % respectively.

Most worms did not survive because of adverse conditions in the composter. There was too high moisture build-up in the composter and the design should be further improved to allow for more aeration and the passage of the processed food waste/worm compost out of the reactor. After solving these issues, the composter is potentially useful for decentralized waste recycling/upcycling.

6 Recommendations

- Test new designs for improved aeration/ evaporation and downward transport of the food waste/worm compost
- Optimization of the screw as larger hard pieces (e.g. broccoli stalks) can get stuck between the screw and the walls and prevent turning
- Be on the safe side with food waste: avoid adding cooked, meat/fish or rotting items. In this first trial, small amounts of cooked food waste, containing some meat were added. However, even though this did not seem to cause direct problems, it should be avoided, as in a regular household these food items are usually discarded in larger amounts incidentally.
- Food pathogens were not found or were below detection limits in the food waste/worm compost mixture from the Amsterdam composter. Samples from the main composter in Lelystad described in this report were not analysed for pathogens. In every future test it is advisable to sample for the presence of food pathogens.

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Annex 1 Data on food waste in Dutch households

Data were obtained from van Dooren, 2019.

Table A Food waste amounts in the Netherlands (van Dooren, 2019) and selected food wastes for worm composter. Red = unsuitable (25.6 % of the total fresh weight of food waste), orange = suitable in small amounts/questionable (18.3 % of the total fresh weight of food waste), green = suitable (56.1 % of the total fresh weight of food waste)

Food waste category	% of category	kg pp py	% of total	% of total selected wastes
Avoidable		30.6	55.5	
• Bread & bread-based products	21	7.3	13.2	18.3
• Dairy products	15	5.1	9.3	
• Vegetables	11	3.7	6.7	9.3
• Fruit	9	3	5.4	7.5
• Potatoes	8	2.9	5.3	7.3
• Sauces and fats	8	2.7	4.9	
• Meat and meat products	7	2.3	4.2	
• Pasta	3	1	1.8	2.5
• Pastry and cake	3	1	1.8	
• Sweets and snacks	2	0.8	1.5	
• Rice	2	0.8	1.5	2.0
• Unavoidable		24.5	44.5	
• Peels and stalks	48	11.8	21.4	29.5
• Wax rinds of cheese	1	0.2	0.4	
• Eggshells	3	0.7	1.3	1.8
• Coffee grounds	33	8.2	14.9	20.5
• Tea bags	2	0.6	1.1	1.5
• Meat and fish remains	5	1.2	2.2	
• Fats	0	0	0.0	
• Unsortable	7	1.8	3.3	
• TOTAL WASTE		55.1	100.0	

The selection criteria were based on former experiences with worm composting (Elissen, 2022) and on several references/internet sources (e.g. https://stadswormerij.nl/zelf-aan-de-slag-diy/, https://wormenhotel.nl/voeren/, https://opgroenevoet.nl/wp-content/uploads/2021/07/Wormenhotels013-wormen-voeren.pdf, https://balkonton.nl/wp-content/uploads/2015/01/HandleidingWormenbakvoorwebsite.pdf, https://oudersvannature.nl/wp-content/uploads/2018/07/Handleiding.pdf).

All 'green' and 'orange' wastes were selected for the test with the worm composter, to use as much as possible: 72.6% of the total household food waste (fresh weight based). Only pastry and cakes were left out. Also, meat was included in very small amounts in some of the pre-cooked meals that were added to the mix.

The last column shows the mixture of food waste that was applied in the worm composter. In the Materials and methods section the specific products are described.

For vegetables equal amounts of carrots, potatoes, onions and broccoli were used in the mix. For fruits equal amounts of bananas, pears, apples and tangerines were used in the mix (https://mrjuice.nl/blogs/blog/top-10-meest-gegeten-soorten-fruit-in-nederland).

Annex 2 Analyses of worm compost/food waste at t=50 in Lelystad composter

eurofins Agro

Rapport

Mestonderzoek
Bemestende waarde
Compost Lelystad

Eurofins Agro
Postbus 170
NL - 6700 AD Wageningen

T monstername: 088 876 1006
T klantenservice: 088 876 1006
E klantenservice.mest@eurofins.com
I www.eurofins-agro.com

Uw klantnummer: 8278474

Acrres WUR PPO
D. Durksz
Edelhertweg 1
8219 PH LELYSTAD

Onderzoek

Onderzoek-/ordernr:	Datum monstername:	Datum verslag:	Subsidieverlener:
846268/005789626	08-07-2022	03-08-2022	Eurofins Agro, Kortingsregeling Postbus 170, 6700 AD WAGENINGEN

Compost Lelystad

Resultaat weergegeven in het product

	Eenheid	**Resultaat**
Droge stof	g ds/kg	338
Ruw as	g RAS/kg	208
Organische stof	g os/kg	130
Stikstof	g N/kg	6,90
C/N-ratio		8
Ammoniak-stikstof	g NH_3-N/kg	0,5
Organische stikstof	g N-org/kg	6,4
Fosfor	g P/kg	0,98
Fosfaat	g P_2O_5/kg	2,24
Kalium	g K/kg	3,3
Kali	g K_2O/kg	4,0
Magnesium	g Mg/kg	0,9
Magnesia	g MgO/kg	1,5
Natrium	g Na/kg	1,6
Natron	g Na_2O/kg	2,2

Toelichting

De werkingscijfers voor deze mestsoort zijn op de achterzijde vermeld. Indien er geen mestsoort is opgegeven, zijn er standaard werkingscijfers afgedrukt.

Contact & info

Datum ontvangst:	18-07-2022
Dierlijke mestsoort:	Wormenmest
Monster genomen door:	Derden
Contactpersoon monstername:	Hans Kolk: 0611301436

Na verzending van dit verslag wordt, indien de aard en de onderzoekmethode van het monster dit toelaat, het monster nog twee weken bij Eurofins Agro voor u bewaard. Binnen deze tijd kunt u eventueel reclameren en/of aanvullend onderzoek aanvragen.

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RvA L 122

Compost Lelystad

Methode				
Droge stof		Em: LDS8	Fosfaat	P uitgedrukt als P_2O_5
Ruw as	Q	Em: VAS1	Kalium	Em: NIRS
Organische stof		afgeleide waarde	Kali	K uitgedrukt als K_2O
Stikstof	Q	MEST-OVB + CFA8 cf AP05	Magnesium	Em: CFA8:(Gw NEN 6966)
C/N-ratio		afgeleide waarde	Magnesia	Mg uitgedrukt als MgO
Ammoniak-stikstof		Em: NIRS	Natrium	Em: CFA8:(Gw NEN 6966)
Organische stikstof		afgeleide waarde	Natron	Na uitgedrukt als Na_2O
Fosfor	Q	MEST-OVB + CFA8 cf AP05		

Q Methode geaccrediteerd door RvA
Em: Eigen methode, Gw: Gelijkwaardig aan, Cf: Conform
Alle verrichtingen zijn binnen de houdbaarheidstermijn tussen monstername en analyse uitgevoerd.
Het monster is geanalyseerd in het Eurofins Agro laboratorium in Wageningen, tenzij anders is vermeld.
De resultaten hebben uitsluitend betrekking op het aangeleverde materiaal, dat Eurofins Agro heeft ontvangen en in behandeling is genomen op 18-07-2022 en daarmee op het geanalyseerde monster. Nadere omschrijving van de toegepaste monstername en analyse methoden is te vinden op www.eurofins-agro.com

Werkingscijfers
grasland

	Stikstof		Fosfaat		Kali	
Snede na aanwending	**1e**	**overige**	**1e**	**overige**	**1e**	**overige**
Bovengronds						
werking minerale stikstof (%)	22	6	100	0	100	0
werking organische stikstof (%)	6	18				

bouwland

	Stikstof	Fosfaat		Kali
Jaar na aanwending		**1e**	**overige**	
Bovengronds				
werking minerale stikstof (%)	75	60	40	100
werking organische stikstof (%)	30			

Toelichting

De werkingscijfers bouwland gelden wanneer de mest in het voorjaar wordt aangewend.
Bij najaarstoediening bedraagt de werking circa 25% van de totale hoeveelheid stikstof.

werking minerale stikstof = % werking van het gevonden resultaat stikstof-ammoniak ($N-NH_3$)
werking organische stikstof = % werking van het gevonden resultaat stikstof-organisch (N-org)

Voor het bepalen van de totale stikstofwerking moet de werking van het minerale en organische deel worden opgeteld.

De totale werkzame hoeveelheid is als volgt te berekenen:
gehalte x werking x DM-gift

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Rapportidentificatie:
846268/005789626, 03-08-2022

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Rapport

Kwaliteitsonderzoek
Compost
Compost Lelystad

Uw klantnummer: 8278474

Acrres WUR PPO
D. Durksz
Edelhertweg 1
8219 PH LELYSTAD

Eurofins Agro
Postbus 170
NL - 6700 AD Wageningen

T monstername: 088 876 1006
T klantenservice: 088 876 1006
E klantenservice.mest@eurofins.com
I www.eurofins-agro.com

Onderzoek

Analyse-/ordernummer: 2022902345/005789157

Datum verslag: 03-08-2022

Subsidieverlener:
Eurofins Agro, Kortingsregeling
Postbus 170, 6700 AD WAGENINGEN

Type monster: Compost (overig)

Datum monstername: 08-07-2022

Datum ontvangst: 15-07-2022

Compost Lelystad

Resultaat		Eenheid	Resultaat	Toetswaarde	Resultaat in produkt (g/kg)
bepaald in het monster volgens de op de hieronder vermelde normen	Droge stof	g/kg product	339		
	Ruw as	g/kg ds	585		
	Org. stof	% van de ds	41,5	10,0	
	Kalium (K)	g/kg ds	11		
	Kali (K_2O)	g/kg ds	13		4,4
	Zwavel (S)	g/kg ds	2,5		0,8
	Magnesium (Mg)	g/kg ds	2,1		
	Magnesia (MgO)	g/kg ds	3,5		1,2
	Chloride	g/kg ds	5,7		
	Zuurgraad (pH)		7,0		
	pH-water		7,4		
	C-anorganisch	%	0,57		
	Koolzure kalk	%	4,7		
	Geleidingsvermogen	mS/cm 25°C	5,9		
	Cadmium (Cd)	mg/kg ds	0,26	1,00	
	Chroom (Cr)	mg/kg ds	12	50	
	Koper (Cu)	mg/kg ds	20	90	
	Kwik (Hg)	mg/kg ds	0,04	0,30	
	Nikkel (Ni)	mg/kg ds	6,7	20	
	Lood (Pb)	mg/kg ds	14	100	
	Zink (Zn)	mg/kg ds	78	290	
	Arseen (As)	mg/kg ds	3,4	15	

Toelichting De vermelde toetswaarden staan vermeld in de Uitvoeringsbesluit Meststoffenwet.

Contact & info Monster genomen door: Derden
Contactpersoon monstername: Hans Kolk: 0611301436

Na verzending van dit verslag wordt, indien de aard en de onderzoeksmethode van het monster dit toelaat, het monster nog twee weken bij Eurofins Agro voor u bewaard. Binnen deze tijd kunt u eventueel reclameren en/of aanvullend onderzoek aanvragen.

Compost Lelystad

Methode	Droge stof	*	Em: LDS2
	Ruw as	Q *	Em: VAS1
	Org. stof	Q *	Em: VAS1
	Kalium (K)	*	Em: ICP2:(Gw NEN 6966)
	Kali (K_2O)		afgeleide waarde
	Zwavel (S)	*	Em: STT6:(Cf NEN 17294-2)
	Magnesium (Mg)	*	Em: ICP2:(Gw NEN 6966)
	Magnesia (MgO)		afgeleide waarde
	Chloride	*	Em: WTR1
	Zuurgraad (pH)	Q *	PHK1: Cf NEN ISO 10390
	pH-water	*	Em: PHW4
	C-anorganisch		CAN8: Cf NEN-15936
	Koolzure kalk		
	Geleidingsvermogen	*	Em: GVM5
	Cadmium (Cd)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Chroom (Cr)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Koper (Cu)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Kwik (Hg)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Nikkel (Ni)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Lood (Pb)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Zink (Zn)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Arseen (As)	Q *	Em:KNW6(Cf:CSS99025B/027)

Q Methode geaccrediteerd door RvA
Em: Eigen methode, Gw: Gelijkwaardig aan, Cf: Conform
* Bij deze verrichting is de gestelde houdbaarheidstermijn tussen monstername en analyse overschreden. Dit heeft mogelijk de betrouwbaarheid van het resultaat beïnvloed.

Het monster is geanalyseerd in het Eurofins Agro laboratorium in Wageningen, tenzij anders is vermeld.
De resultaten hebben uitsluitend betrekking op het aangeleverde materiaal, dat Eurofins Agro heeft ontvangen en in behandeling is genomen op 15-07-2022 en daarmee op het geanalyseerde monster. Nadere omschrijving van de toegepaste monstername en analyse methoden is te vinden op www.eurofins-agro.com

Annex 3 Analyses of worm compost/food waste from Amsterdam composter

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Rapport

Mestonderzoek
Bemestende waarde
Compost Amsterdam

Uw klantnummer: 8278474

Acrres WUR PPO
D. Durksz
Edelhertweg 1
8219 PH LELYSTAD

Eurofins Agro
Postbus 170
NL - 6700 AD Wageningen

T monstername: 088 876 1006
T klantenservice: 088 876 1006
E klantenservice.mest@eurofins.com
I www.eurofins-agro.com

Onderzoek

Onderzoek-/ordernr:	Datum monstername:	Datum verslag:	Subsidieverlener:
846269/005789627	08-07-2022	25-07-2022	Eurofins Agro, Kortingsregeling Postbus 170, 6700 AD WAGENINGEN

Compost Amsterdam

Resultaat weergegeven in het product

	Eenheid	**Resultaat**
Droge stof	g ds/kg	224
Ruw as	g RAS/kg	91
Organische stof	g os/kg	133
Stikstof	g N/kg	3,97
C/N-ratio		15
Ammoniak-stikstof	g NH_3-N/kg	0,6
Organische stikstof	g N-org/kg	3,4
Fosfor	g P/kg	0,55
Fosfaat	g P_2O_5/kg	1,26
Kalium	g K/kg	1,7
Kali	g K_2O/kg	2,0
Magnesium	g Mg/kg	0,5
Magnesia	g MgO/kg	0,8
Natrium	g Na/kg	0,4
Natron	g Na_2O/kg	0,5

Toelichting De werkingscijfers voor deze mestsoort zijn op de achterzijde vermeld. Indien er geen mestsoort is opgegeven, zijn er standaard werkingscijfers afgedrukt.

Contact & info

Datum ontvangst:	18-07-2022
Dierlijke mestsoort:	Wormenmest
Monster genomen door:	Derden
Contactpersoon monstername:	Hans Kolk: 0611301436

Na verzending van dit verslag wordt, indien de aard en de onderzoekmethode van het monster dit toelaat, het monster nog twee weken bij Eurofins Agro voor u bewaard. Binnen deze tijd kunt u eventueel reclameren en/of aanvullend onderzoek aanvragen.

Pagina: 1
Totaal aantal pagina's: 2
Rapportidentificatie:
846269/005789627, 25-07-2022

RvA TESTEN RvA L 122

Dit rapport is vrijgegeven onder verantwoording van F.B. Fabri, Business Unit Manager.
Op al onze vormen van dienstverlening zijn onze Algemene Voorwaarden van toepassing. Op verzoek worden deze en/of de specificaties van de analysemethoden toegezonden. Eurofins Agro Testing Wageningen BV stelt zich niet aansprakelijk voor eventuele schadelijke gevolgen voortvloeiend uit het gebruik van door of namens ons verstrekte onderzoeksresultaten en/of adviezen.

Eurofins Agro Testing Wageningen BV is ingeschreven in het RvA-register voor testlaboratoria zoals nader omschreven in de erkenning onder nr. L122 voor uitsluitend de monsternemings- en/of de analysemethoden.

Compost Amsterdam

Methode						
	Droge stof		Em: LDS8	Fosfaat	P uitgedrukt als P_2O_5
	Ruw as	Q	Em: VAS1	Kalium	Em: NIRS
	Organische stof		afgeleide waarde	Kali	K uitgedrukt als K_2O
	Stikstof	Q	MEST-OVB + CFA8 cf AP05	Magnesium	Em: CFA8:(Gw NEN 6966)
	C/N-ratio		afgeleide waarde	Magnesia	Mg uitgedrukt als MgO
	Ammoniak-stikstof		Em: NIRS	Natrium	Em: CFA8:(Gw NEN 6966)
	Organische stikstof		afgeleide waarde	Natron	Na uitgedrukt als Na_2O
	Fosfor	Q	MEST-OVB + CFA8 cf AP05		

Q Methode geaccrediteerd door RvA
Em: Eigen methode, Gw: Gelijkwaardig aan, Cf: Conform
Alle verrichtingen zijn binnen de houdbaarheidstermijn tussen monstername en analyse uitgevoerd.
Het monster is geanalyseerd in het Eurofins Agro laboratorium in Wageningen, tenzij anders vermeld.
De resultaten hebben uitsluitend betrekking op het aangeleverde materiaal, dat Eurofins Agro heeft ontvangen en in behandeling is genomen op 18-07-2022 en daarmee op het geanalyseerde monster. Nadere omschrijving van de toegepaste monstername en analyse methoden is te vinden op www.eurofins-agro.com

Werkingscijfers

grasland

	Stikstof		Fosfaat		Kali	
Snede na aanwending	**1e**	**overige**	**1e**	**overige**	**1e**	**overige**
Bovengronds						
werking minerale stikstof (%)	22	6	100	0	100	0
werking organische stikstof (%)	6	18				

bouwland

	Stikstof		Fosfaat		Kali	
Jaar na aanwending			**1e**	**overige**		
Bovengronds						
werking minerale stikstof (%)	75		60	40	100	
werking organische stikstof (%)	30					

Toelichting

De werkingscijfers bouwland gelden wanneer de mest in het voorjaar wordt aangewend.
Bij najaarstoediening bedraagt de werking circa 25% van de totale hoeveelheid stikstof.

werking minerale stikstof = % werking van het gevonden resultaat stikstof-ammoniak (N-NH_3)
werking organische stikstof = % werking van het gevonden resultaat stikstof-organisch (N-org)

Voor het bepalen van de totale stikstofwerking moet de werking van het minerale en organische deel worden opgeteld.

De totale werkzame hoeveelheid is als volgt te berekenen:
gehalte x werking x DM-gift

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846269/005789627, 25-07-2022

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Rapport

Kwaliteitsonderzoek
Compost
Composter Amsterdam Comp

Uw klantnummer: 8278474

Eurofins Agro
Postbus 170
NL - 6700 AD Wageningen

T monstername: 088 876 1006
T klantenservice: 088 876 1006
E klantenservice.mest@eurofins.com
I www.eurofins-agro.com

Acrres WUR PPO
D. Durksz
Edelhertweg 1
8219 PH LELYSTAD

Onderzoek	Analyse-/ordernummer: 2022902344/005789156	Datum verslag: 04-08-2022	**Subsidieverlener:** **Eurofins Agro, Kortingsregeling** **Postbus 170, 6700 AD WAGENINGEN**
	Type monster: Compost (overig)	Datum monstername: 08-07-2022	Datum ontvangst: 15-07-2022
	Composter Amsterdam Comp		

Resultaat		**Eenheid**	**Resultaat**	**Toetswaarde**	**Resultaat in produkt (g/kg)**
bepaald in het monster volgens de op de hieronder vermelde normen	Droge stof	g/kg product	209		
	Ruw as	g/kg ds	375		
	Org. stof	% van de ds	62,5	10,0	
	Kalium (K)	g/kg ds	13		
	Kali (K_2O)	g/kg ds	16		3,3
	Zwavel (S)	g/kg ds	1,9		0,4
	Magnesium (Mg)	g/kg ds	1,7		
	Magnesia (MgO)	g/kg ds	2,8		0,59
	Chloride	g/kg ds	2,6		
	Zuurgraad (pH)		6,9		
	pH-water		7,5		
	C-anorganisch	%	0,08		
	Koolzure kalk	%	0,7		
	Geleidingsvermogen	mS/cm 25°C	4,1		
	Cadmium (Cd)	mg/kg ds	0,32	1,00	
	Chroom (Cr)	mg/kg ds	8,3	50	
	Koper (Cu)	mg/kg ds	21	90	
	Kwik (Hg)	mg/kg ds	0,04	0,30	
	Nikkel (Ni)	mg/kg ds	4,9	20	
	Lood (Pb)	mg/kg ds	13	100	
	Zink (Zn)	mg/kg ds	76	290	
	Arseen (As)	mg/kg ds	2,9	15	

Toelichting De vermelde toetswaarden staan vermeld in de Uitvoeringsbesluit Meststoffenwet.

Contact & info Monster genomen door: Derden
Contactpersoon monstername: Hans Kolk: 0611301436

Na verzending van dit verslag wordt, indien de aard en de onderzoeksmethode van het monster dit toelaat, het monster nog twee weken bij Eurofins Agro voor u bewaard. Binnen deze tijd kunt u eventueel reclameren en/of aanvullend onderzoek aanvragen.

Pagina: 1
Totaal aantal pagina's: 2
Rapportidentificatie:
902344/005789156, 04-08-2022

TESTEN RvA L 122

Composter Amsterdam Comp

Methode	Droge stof	*	Em: LDS2
	Ruw as	Q *	Em: VAS1
	Org. stof	Q *	Em: VAS1
	Kalium (K)	*	Em: ICP2:(Gw NEN 6966)
	Kali (K_2O)		afgeleide waarde
	Zwavel (S)	*	Em: STT6:(Cf NEN 17294-2)
	Magnesium (Mg)	*	Em: ICP2:(Gw NEN 6966)
	Magnesia (MgO)		afgeleide waarde
	Chloride	*	Em: WTR1
	Zuurgraad (pH)	Q *	PHK1: Cf NEN ISO 10390
	pH-water	*	Em: PHW4
	C-anorganisch		CAN8: Cf NEN-15936
	Koolzure kalk		
	Geleidingsvermogen	*	Em: GVM5
	Cadmium (Cd)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Chroom (Cr)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Koper (Cu)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Kwik (Hg)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Nikkel (Ni)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Lood (Pb)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Zink (Zn)	Q *	Em:KNW6(Cf:CSS99025B/027)
	Arseen (As)	Q *	Em:KNW6(Cf:CSS99025B/027)

Q Methode geaccrediteerd door RvA
Em: Eigen methode, Gw: Gelijkwaardig aan, Cf: Conform
* Bij deze verrichting is de gestelde houdbaarheidstermijn tussen monstername en analyse overschreden.
Dit heeft mogelijk de betrouwbaarheid van het resultaat beïnvloed.
Het monster is geanalyseerd in het Eurofins Agro laboratorium in Wageningen, tenzij anders is vermeld.
De resultaten hebben uitsluitend betrekking op het aangeleverde materiaal, dat Eurofins Agro heeft ontvangen en in behandeling is genomen op 15-07-2022 en daarmee op het geanalyseerde monster. Nadere omschrijving van de toegepaste monstername en analyse methoden is te vinden op www.eurofins-agro.com

Annex 4 Analyses of bacterial pathogens of worm compost/food waste mixture from Amsterdam composter

eurofins **Analyserapport**

Monsternummer	**893-2022-00079604**	**Datum**	**29/09/2022**	**Pagina 1/1**
Analyserapport	**AR-22-ZV-017848-01 / 893-2022-00079604**			

Wageningen Plant Research

Ter attentie van **Mevr. Hellen Elissen**
Droevendaalsesteeg 1
6708PB Wageningen
NEDERLAND

Email hellen.elissen@wur.nl

Onze referentie :	893-2022-00079604/ AR-22-ZV-017848-01	**Type :**	EX
Identificatie van het analysemonster :	1. Worm compost 250 g Amsterdam composter bacteria		
Datum ontvangst :	15/09/2022	**Datum aanvang analyses :**	15/09/2022
Gevraagde analyses :	ZVMI3: Listeria monocytogenes ZVMI4: Salmonella spp. ZVMI5: STEC ZVMI6: Escherichia coli		
Monsternemer	Unknown (extern)	**Datum monstername**	05/09/2022
Monsteromschrijving	Compost		

Microbiological Analysis			Resultaten
ZVMI3	**ext**	**Listeria monocytogenes Methode : ISO 11290-1:1996 (Enumeratie-kweekmedia techiek (spiraal plaat))**	
(#)		Listeria monocytogenes	Niet aangetoond kve/g
ZVMI4	**ext**	**Salmonella spp. Methode : ISO 6579-1 (Enumeratie-kweekmedia techiek (spiraal plaat))**	
(#)		Salmonella spp.	Niet aangetoond kve/g
ZVMI6	**ext**	**Escherichia coli Methode : Eigen methode, Enumeratie-kweekmedia techiek (spiraal plaat) (Enumeratie-kweekmedia techiek (spiraal plaat))**	
(#)		Escherichia coli	<10 kve/g

			Resultaten
ZVMI5	**ext**	**STEC Methode : ISO/TS 13136 (Real-time PCR)**	
(#)		Shigatoxineproducerende e-coli	Niet aangetoond kve/g

HANDTEKENING

Niels Martha
BUC Manager Contaminants

Rapport elektronisch gevalideerd door Sylvia Capet

TOELICHTING
Dit certificaat mag niet worden gereproduceerd tenzij in zijn geheel, zonder schriftelijk toestemming van het laboratorium. De analyseresultaten hebben betrekking op het monster zoals dit is ontvangen.
De meetonzekerheden van de analysemethoden zijn opvraagbaar bij de afdeling ASM. Opinies en interpretaties in dit certificaat vallen buiten de scope van de accreditatie.
De analysemonster(s) worden 91 dagen na ontvangst bewaard.
De analyse waarbij achter de referentiemethode -M staat moet worden gelezen als gelijkwaardig aan de genoemde referentiemethode.

De testen geïdentificeerd met het symbool "ext" zijn uitgevoerd onder subcontracting naar een laboratorium buiten de Eurofins groep. Het symbool (#) identificeert testen uitgevoerd zonder accreditatie in dit laboratorium

Eurofins Lab Zeeuws-Vlaanderen (LZV) B.V.
Zandbergsestraat 1
NL-4569 TC Graauw
NEDERLAND

Tel. +31 114 635400
Fax +31114635754
contaminantsbnl@eurofins.com
https://www.eurofinsfoodtesting.nl

To explore the potential of nature to improve the quality of life

Wageningen University & Research
Open Teelten
Edelhertweg 1
Postbus 430
8200 AK Lelystad
T (+31)320 29 11 11

www.wur.nl/openteelten
Report WPR-OT 966

De missie van Wageningen University & Research is 'To explore the potential of nature to improve the quality of life'. Binnen Wageningen University & Research bundelen Wageningen University en gespecialiseerde onderzoeksinstituten van Stichting Wageningen Research hun krachten om bij te dragen aan de oplossing van belangrijke vragen in het domein van gezonde voeding en leefomgeving. Met ongeveer 30 vestigingen, 7.200 medewerkers (6.400 fte) en 13.200 studenten en ruim 150.000 Leven Lang Leren-deelnemers behoort Wageningen University & Research wereldwijd tot de aansprekende kennisinstellingen binnen haar domein. De integrale benadering van de vraagstukken en de samenwerking tussen verschillende disciplines vormen het hart van de unieke Wageningen aanpak.