UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Introducing a "Plastic Bag Only" Bin to Reduce Contamination in Compost

Fantastic Five: Georgia Wearmouth, Zeyi Zhang, Stella YingYi Hong,

Lizzy Jiang, Steven Tao

University of British Columbia

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Executive Summary

Plastic contamination in compost is a serious issue that affects not only the composting process, but also natural life and the environment. Though many materials are considered pollution in compost, plastic bags seem to be the most prevalent and concerning, especially at the University of British Columbia and their endeavor to reduce waste and increase diversion (Zero Waste Action Plan, 2014). The present study examined whether the introduction of a bin solely for plastic bags would reduce the number of plastic contaminants in the compost bin. To determine this, two conditions were observed: the control condition with no bin for plastic bags, and the experimental condition in which the bin was implemented, along with a poster, and a sticker that clearly says "No Plastic". Statistical analyses of the data, collected over 22 days, revealed that there was no significant relationship between the implementation of a plastic bag only bin and the number of contaminants in the food scraps bin. These results demonstrate an increased need for more substantial research toward zero plastic pollution in student residence compost bin.

Keywords: plastic, compost, environment, waste, contamination

Introduction

Nonbiodegradable, polyethylene plastic bags pose a threat to the environment and composting processes when incorrectly sorted into the food scraps compost. Plastic bags are highly regulated in many countries, since they can cause destruction to the environment (Mogomotsi et al., 2018). Compostable plastic bags, opposed to their name, are not accepted in compost in many compost recycling facilities. They take much longer to degrade and are built to be tough, meaning they are always present, and when they do begin to degrade they create microplastics, which are still extremely harmful to the environment (Palmisiano et al., 1992). The biodegradable plastics are only accepted in the compost cycle if they degrade at the same rate as other natural compostable materials (Song et al., 2009). However, it has been found that these materials still risk contamination of the humus that is created. Unmar and Mohee discovered in their 2008 study that plastic contamination severely decreases the quality of the compost. Plastic bags are to be disposed of in the garbage, or in the plastic recycling. Considering this, will the presence of dedicated bins for plastic bags reduce the rate of plastic contamination in compost bins? We hypothesize that the existence of a bin specifically for plastic bags will reduce the amount of plastic pollution in a compost bin.

Methods

Participants

The participants were approximately 500 students who live in the student residence Ponderosa Commons, specifically in the Arbutus and Maple houses, at the University of British Columbia ("Ponderosa Commons"). There are 8 floors in the Maple house and 16 floors in the Arbutus house. As this was an observational study, there is no specific data on gender, age, or student status.

Conditions

This study had 2 conditions, and was conducted as a within subject's design, as both were measured in the same garbage room. In the control condition, there was a standard student residence garbage room set up: garbage bins, plastic recycling bins, paper recycling bins, and a compost bin (Appendix A). The experimental condition maintained the standard garbage room set up, along with the introduction of a black bin labelled "Plastic Bags Only", a poster outlining the use of the new bin, and a red sticker placed on the lid of the compost bin which states "NO PLASTIC BAGS" (Appendix B). Data was collected for 11 days for each condition.

Measures

The dependent variable evaluated in this research concerned the amount of plastic in the compost bin, and the independent variable was the implementation of the bin for plastic bags only. The dependent variable was measured by the physical removal and counting of each contaminate. Items such as plastic bags, compostable plastic bags, and other non-organic material (cardboard or plastic recyclables). The weight of the compost bin was also recorded in kilograms, before removal of contaminants and again after the contaminants were removed. When we had finished our research, we did not include the weight in our analyses as the scale was too imperfect too much of the time, and did not produce viable results.

Procedure

The data collection period, beginning on March 4th and terminating March 26th, took place in the Arbutus house garbage room in Ponderosa Commons. Each day at around 5:00 pm PT, data was collected. We first weighed the compost bin using a Smart Weigh Digital Scale. Once we had gotten an accurate reading, we then physically removed the contaminants by delving through the contents of the compost bin. Any food scraps that were inside of a plastic bag or compostable plastic bag was disposed back into the compost. The collected contaminants were placed on the scale, weighed, and counted. A plastic bag with additional contaminants inside was counted as one item. After the results had been documented using a table outline (Appendix Table 1), we discarded the pollutants in their rightful disposal bin and proceeded to weigh the bin again. This procedure stood for both the control and experimental conditions. During the experimental condition, a further step was required. After the weighing and counting of contaminants in the compost bin, we proceeded to count each bag in the implemented "plastic bag only" bin. Each bag was also examined to determine if the bag was used for food scraps or whether a student had simply placed any empty bags in. Data from March 19th had to be removed due to a removal of the "plastic bag only" bin; the reason for which is unknown.

Results

A paired sample t-tests were conducted to measure the number of contaminants in the compost in the no bin condition and the plastic bag only bin condition. We found two t values: one regarding all contaminates in the bin, and one with only plastic bag contamination. The total number of contaminants counted and what they are can be found in Appendix C. The results revealed that there was not a significant difference in the number of all contaminants for the control condition (M = 3.73, SD = 2.53) and the experimental condition (M = 3.09, SD = 1.92); t(10) = 1.0232, p=0.33 (Appendix D; Appendix E). This demonstrates an overall weak relationship when measuring all contaminants. When a paired t-test was run on the number of plastic bag contaminants only, in the no bin condition and the plastic bag bin condition, there was a suggestive trend towards significance for the control condition (M=1.73, SD=1.56) and the plastic bag only condition (M=0.82, SD=1.07); t(10)=2.0851, p=0.0637 (Appendix D; Appendix E). Ultimately, the results were not statistically significant, but when comparing the qualitative data, people disposed of 24 plastic bags, after using them to carry food scraps, into the plastic bag only bin. It is also clear that there was a decreased number of plastic bags in the compost bin, with 21 before the bin was inserted, and 17 after the application of the bin. With an increased number of data collection days, these results could be found to be significant, as the p value is very close to being considered significant.

Discussion

The goal of the current study was to examine the impact of the implementation of a plastic bag only bin on the number of contaminants in the compost bin. The main focus of our study was the ultimate protection of the environment, by decreasing the number of contaminated compost bins that are required to be disposed of in the landfill. This will also subsequently improve the quality of the humus, which UBC uses in their own gardens, including the UBC Farm (Waste Action Plan Discussion Paper, n.d.). These results show that behaviour can change with simple interventions. Introducing another bin will decrease the number of plastic bags in compost compared to a no bin condition, even if it does not reduce the number of other contaminants. It is clear that even though the statistical significance is small, it is still an effective method for reducing contamination in

compost. There are a small group of possible confounds and limitations that may have affected the results of this research.

First, we cannot be sure that the plastic bags in the designated bin were bags that students disposed of after dumping food scraps. These could simply be bags that were used to carry other recyclables, or bags that were going to be thrown in the garbage but were sorted correctly along with other waste. This may affect the main goal of determining whether the decreasing number of contaminants was actually due to the intervention. Moreover, the size, height, and color of the bin were different between the compost bin and plastic-bag bin. Since the plastic-bag bin was smaller and less noticeable than the compost bin, people may not have seen it or paid attention to it, despite its close proximity to the compost receptacle.

Additionally, the experiment time was short with only 11 days of data collection for each condition, for a total of 22 days altogether. Therefore, the collected data may have a lower reliability, and this may have an impact on the degree of significance that was found between the two conditions. There were many days in the data collection where the bin was either empty or had not been changed for several days. It also of concern that we introduced the "plastic bag only" bin, the red sticker on the compost bin, and the new poster during the same intervention period. This leaves an unsureness around whether the poster encouraged students to dispose of their compost properly, or whether the bin itself was enough encouragement.

Next, there are inconsistencies in the sorting guidelines in different municipalities. Between UBC, the City of Richmond, and the City of Burnaby there are different regulations, and since some of the residents who live in Ponderosa Commons may be coming from Richmond or Burnaby, they may become confused. For example, soiled pizza boxes go into the compost bin in Burnaby, but this cannot be placed in the compost bin at UBC (Single Family Green Bin Guidelines, n.d.). In Richmond, all paper take-out containers can be composted, but not at UBC (Curbside Green Cart Recycling, n.d.). This would account for the number of non-plastic bag contaminants that were discovered. This could create awareness of the difference within municipalities and that there is a need to set up standard and consistent sorting guidelines and procedures.

Moreover, the data of March 19th had to be eliminated as the plastic bag bin was removed by an unknown person and we were unaware of where it had been taken. We had to extend the experimental data collection one day longer to ensure an equal number of data collection points. The 19th of March would have been the fifth day of experimental data collection, in which some people may have been getting used to the new container. The seemingly inconsistent availability of the bin may have affected the data negatively.

Lastly, Student Housing Services commonly have posters on the wall encouraging students to dispose of their plastic bags in the garbage, but we included a poster persuading students to now dispose of their plastic bags in the new bin. The conflicting information may leave the participants unsure regarding where they should put the plastic bags as it requires them to change a routine and a habit. This may lead to students not using the bin, continuing to dispose of their compost in a plastic bag in the food scraps container. Similarly, the abundance of posters (two we arranged to be introduced, two that were already there) could further perplex students, as there is an overload of information.

One of the most important limitations that was discovered was that many people do not understand that compostable plastic bags are not compostable at UBC, or in many other municipalities in Metro Vancouver. A large amount of the contaminants that were discovered were compostable plastics.

Future research should focus on implementing the plastic bag bin along with a "No Plastics" sticker, while avoiding imposing other posters on the wall, or solely implementing the bin without any other recycling reminders. These studies would demonstrate what aspect of our experiment was the principal reason students discarded their plastic bags in the specified bin. This research is important as it can divert many tonnes of compost from the landfill to be composed into humus. If people adapt and are able to change their habits, UBC can avoid producing so much waste which would be an important move towards the Zero Waste Action Plan.

Recommendations

Even though the effects of this research are not statistically significant, it still resulted in some recommendations for further consideration. Foremost, placing a bin for plastic bags beside the compost bin in residential garbage rooms can marginally reduce the number of plastic bags. Although the results of our research are not significant, it still shows the effect of decreasing contamination rates with the introduction of an extra bin for plastic bags. Having a clear secondary option for the disposal of plastic bags may decrease any effort students might feel when having to dispose in the large garbage bins and may feel more inclined as there is a specific, labelled receptacle. Second, educate students to be more aware of the correct disposal of compostable plastic bags. A notable amount of compostable plastic bags was found in the compost bin in both conditions of our study, which shows a discrepancy within student knowledge and UBC's "Sorting it Out" guideline (Appendix F). Since this statement is made in small print on the left bottom of the guideline, students may easily miss or ignore it. This indicates that this education needs to be in the forefront of the Zero Waste Action Plan, as students can easily transition to paper compostable bags.

Third, placing a food waste bin on each floor of a student residence would decrease the need for plastic bags to transport food scraps from individual rooms to the ground floor garbage room. Although each unit is provided with a compost bin, residents may find it easier to carry their scraps in a bag as opposed to taking their personal bin to the garbage room and then back up to their room. DiGiacomo et al. (2018) argued that the composting and recycling rates would be 70% higher when setting up a compost bin on each floor rather than only on the ground floor. Convenience raises the recycling rates and would reduce the contamination in the compost bin; thus, it would be beneficial for the University of British Columbia to administer more compost bins per housing building.

Since UBC has a very specific and attainable goal of reducing landfill waste by diverting 80% by 2020, the research outlined within this study can assist in the completion of this goal (Luo et al., 2015). By launching a program that installs bins specifically for plastic bags, UBC can decrease the amount of compost sent to landfill and take further steps towards their Zero Waste goal. Not only does this help the composting process, but also any wildlife and plants, since they can become within the animal and can grow into the plant (Balestri et al., 2019). This idea can be cost effective as UBC would simply need to order more of the same bins they already have.

References

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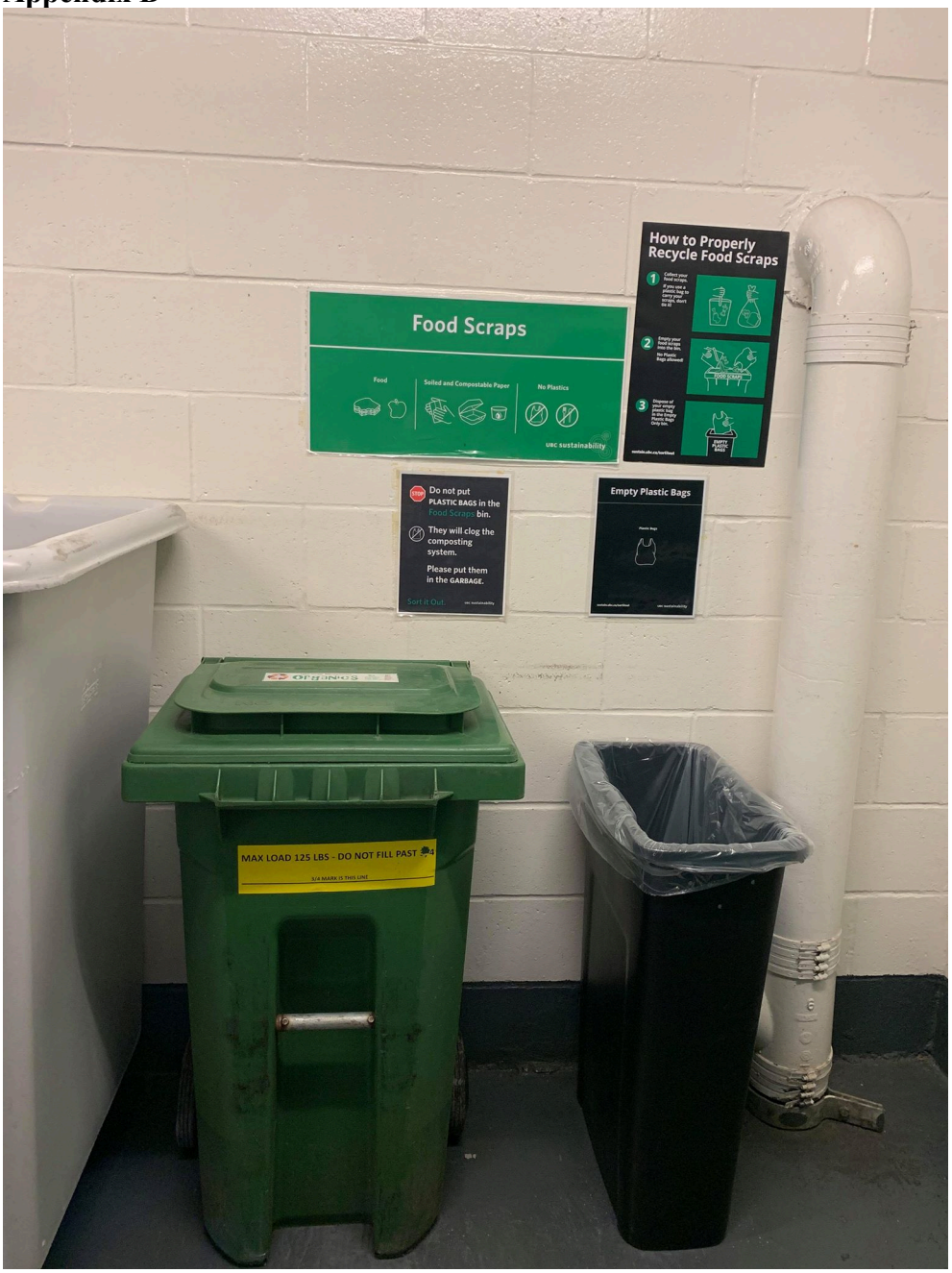
Appendix

Appendix A

Appendix B


Food Scraps
Food
Soiled and Compostable Paper
No Plastics
UBC sustainability
How to Properly Recycle Food Scraps
Do not put PLASTIC BAGS in the Food Scraps bin.
They will clog the composting system.
Please put them in the GARBAGE.
Sort it Out.
Empty Plastic Bags
MAX LOAD 125 LBS - DO NOT FILL PAST

Appendix C

BASELINE DATA:

DAY	TIME	WEIGHT OF BIN BEFORE	WEIGHT OF BIN AFTER	WEIGHT OF CONTAMINANTS	# OF CONTAMINANTS	TYPE OF CONTAMINANTS	OTHER COMMENTS
04.03.19	5:10PM	---	---	0.5 KG	7	3 plastic bags 2 plastic packages 1 yoghurt container 1 egg box	----
05.03.19	4:40pm	29.20 kg	28.85 kg	0.20 kg	5	1 plastic bag with compostable bag inside 1 plastic bag with plastic recyclable container inside 3 plastic bags with compost inside 1 rubber band	Same garbage from previous day, recounted same contaminants and removed them for the next day's audit
06.03.19	5:06pm	15.05 kg	15.05 kg	0.00 kg	0	1 compostable fork	Very few items in the compost bin
07.03.19	4:42pm	21.6 kg	21.6 kg	0.00 kg	3	2 plastic bags 1 plastic flower pot	Contaminants too light to be weighed
08.03.19	4:25 pm	31.40 kg	31.25 kg	0.15 kg	7	2 plastic lined paper compostable bags 1 compostable plastic bag 1 cardboard food box 2 pieces of cling wrap 1 plastic garbage bag	
09.03.19	4:15 pm	14.04 kg	14.04 kg	0.00 kg	0	----	There were no contaminants in the bin
10.03.19	2:30 pm	22.50 kg	22.50 kg	0.00 kg	2	1 plastic bag 1 McFlurry cup	The contaminants were too light to be weighed; incorrect weight measurement
11.03.19	4:30 pm	12.8 kg	12.65 kg	0.15 kg	2	1 paper retail bag 1 plastic food package	
12.03.19	4:40 pm	23.90 kg	23.40 kg	0.50 kg	6	2 plastic bags 1 pizza box 1 piece of aluminum foil 1 plastic food container 1 plastic food package	All contaminants had food inside them
13.03.19	4:33 pm	25.4 kg	24.95 kg	0.45 kg	5	3 plastic bags 1 compostable plastic bag 1 net mandarin orange food package	Garbage had not been changed from yesterday
14.03.19	4:55 pm	28.40 kg	27.10 kg	0.00 kg	4	2 compostable plastic bags 1 recyclable box 1 piece of plastic coated cardboard	Scale did not accurately read measurements of contaminants, after multiple attempts

Appendix D

Data collected during the experimental period,

EXPERIMENTAL DATA:

DAY	TIME	WEIGHT BEFORE	WEIGHT AFTER	WEIGHT OF CONTAMINANTS	# OF CONTAMINANTS	TYPE OF CONTAMINANTS	# OF BAGS IN BIN	OTHER COMMENTS
15.03.19	3:40 pm	42.85 kg	42.65 kg	0.00 kg	4	2 plastic spoons 2 compostable paper bags lined with plastic	4	1 empty carrot bag, no food residue 2 small plastic bags with food residue 1 big plastic bag with food residue
16.03.19	4:17 pm	56.45 kg	56.10 kg	0.35 kg	5	4 plastic bags 1 sauce packet	2	Bin has not been changed for a few days
17.03.19	5:40 pm	17.5 kg	17.5 kg	0.00 kg	0	0	7	4 bags used for food; 3 food packages
18.03.19	4:50 pm	22.65 kg	22.55 kg	----kg	3	1 plastic bag 2 compostable plastic bags	8	4 with food residue 4 plastic bags
19.03.19	4:45 pm	26.20 kg	26.15 kg	0.05 kg	3	2 compostable plastic bags 1 plastic bag	---	Black bin was removed; no data on plastic bag bin
20.03.19	4:24 pm	35.75 kg	35.70 kg	0.00 kg	4	2 compostable plastic bags 1 plastic tea bag 1 plastic cucumber wrapper	1	1 Plastic bag with food remnants
21.03.19	3:59 pm	16.45 kg	16.40 kg	0.00 kg	1	1 plastic bag	2	1 plastic bag no food remnants 1 plastic bag with food remnants
22.03.19	6:19 pm	37.5 kg	36.00 kg	0.00 kg	3	2 recyclable containers 1 plastic snack bag	6	6 bags with food remnants
23.03.19	4:05 pm	27.95 kg	-----	0.00 kg	5	1 plastic bag 3 yoghurt pots 1 ramen sauce packet	1	1 plastic bag with food remnants
24.03.19	12:06 am	36.5 kg	35.7 kg		6	1 plastic bag 1 paper bag	6	4 bags with food remnants 2 plastic bags
25.03.19	4:03 pm	40.65 kg	40.60 kg	0.00 kg	2	1 paper compostable bag lined with plastic 1 recyclable paper bag	3	3 plastic bags with food remnants
26.03.19	4:26 pm	25.25 kg	25.20 kg	0.00 kg	1	1 plastic bag with food in it	2	2 plastic bags with no food remnants

Appendix E

Table 1. The number of the means, standard deviation, degrees of freedom, t-value, p-value from control condition and experimental, with all contaminants and with plastic bag contaminants only.

	Mean	SD	df	t-value	P-value
With all contaminants			10	1.0232	0.33
Control condition	3.73	2.53			
Experimental condition	3.09	1.92			
With plastic bag contaminants only			10	2.0851	0.0637
Control condition	1.73	1.56			
Experimental condition	0.82	1.07			

Appendix F

UBC Sorting Guide. Retrieved from: https://sustain.ubc.ca/get-involved/campaigns/sort-it-out/sorting-guides