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DETERMINATION OF THE COMPOSTER VOLUME REQUIRED FOR GARDEN GRASS TREATMENT

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Summary

The paper presents results from an experiment focused on the establishment of total grass biomass amount grown in the house garden during the growing season and volume of the domestic composter required for biomass treatment.

Grass in the experimental part of the garden (area 43.75 m^2) was cut at regular intervals (1x2 weeks) during the growing season. The cut green biomass was mixed with wood shavings at a volume ratio of 3:1 and the mixed material was placed inside a home composter (volume 300 dm^3). During the composting process, the blended biomass was mixed and aerated for 1x4 weeks.

The total amount of grass biomass from the experimental plot was 44.8 kg; the amount of added wood shavings was 13.9 kg. The total volume of raw mixture (fresh) was nearly 370 dm^3 but due to the composting process during the growing season, the volume of composted raw materials was reduced at the end of the growing season to about 168 dm^3.

The measured and calculated values show that the composter volume required for the treatment of grown-up and cut grass biomass per 1m^2 of garden lawn is 3.83 dm^3. Due to fluctuations of grass biomass production in individual years, it is recommended to increase the required composter volume to 4 dm^3 per 1m^2 of garden lawn.

Key words: biodegradable waste, decomposition, home composting, garden grass treatment

INTRODUCTION

The high share of biodegradable communal waste deposited in landfills is one of the most serious problems for the today's waste management in the Czech Republic. The main effort of waste treatment should be to prevent the generation of biodegradable communal waste. Kotovicová and Vaverková [2008] dealt with the given issue including the proposal of methodology to forecast the development of ecological load with biodegradable communal waste in the region. According to the interpretation of applicable legislation in the Czech Republic, home composting is considered a method of prevention to waste generation.

It is estimated that during the last 10–15 years, composters were sold in the Czech Republic at hundred thousands for home composting. The predominant input raw material for home composting is grass cut from garden lawns. The problem of this biodegradable waste increases with the increasing size of intensively kept green areas. The lawns are cut 3-20 times per season. New grass cutters are equipped with a collecting hopper and thus the freshly cut green biomass becomes undesirable biodegradable waste. The waste after cut is structured of grass stalks 15-20 mm in length. Due to the cut-off blade, the moisture content of waste (grass) ranges from 50 to 70%. The grass cut from these lawns is not good even for feeding to animals. The C:N ratio is 30:1. The content of nitrogen in grass DM ranges from 1.6 to 2.9%, the contents of potassium, phosphorus, calcium and magnesium range from 1.2 – 2.0%, 0.2 – 0.4%, 0.5 – 0.7% and 0.2 – 0.3%, respectively [Váňa, 1999; Filip, 2004].

The process of grass biomass composting is different from the process of composting other types of biodegradable waste. The successful composting of large volumes of grass requires a carefully prepared mixture of materials [Váňa, 2002].

This is why the amount of cut grass from the chosen garden and volume changes of the composted material (mixture of grass biomass and wood shavings) during the degradation in the composter were monitored during one (so far) growing season.

The objective of our experiment was to determine the amount of grass biomass growing up at a regular maintenance of the ornamental garden green and the minimum volume of composters required for the treatment of the given amount of grass waste.

MATERIAL AND METHODS

The experiment took place on a private garden in the village of Hrotovice (Czech Republic) and lasted from 24 April to 25 September 2011. Climatic regionalization according to Quitt is MT 11 – mildly warm locality with the long dry and warm summer and with the short slightly warm spring and autumn. The average annual precipitation amount is 478.6mm.

Site preparation and characterization

The experimental plot is oriented towards the south and is located between family houses with gardens. Altitude of the location is 426.07m above sea level. The soil type in this area is classified as Haplic Gleysol.

The garden green was sown in 2008 with a "sport grass mixture", composed of *Lolium perenne*, *Festuca rubra*, *Agrosic capillaris* and *Cynosurus cristatus*. The pre-outlined area sized 43.75 m^2 (12.5x3.5m) was cleared of old growth. There were no woody plants occurring on the experimental plot.

Description of the composter

The composter used in our experiment was the model "Super Komposter Thermo" sized 61x61x83cm with the working volume of 300dm^3. The composter was designed without the bottom; its sidewalls were perforated and a lid was used for its closure.

Description of the lawn mower

The grass was cut by using the petrol lawn mower Hecht 546 SH with the collection bin. The cutting width was 460mm and the cutting height was adjusted at 45mm.

Composition of the composted raw-material

In order to ensure the composting process (C:N ratio, regulation of water amount in the composter), a mixture was prepared of grass and wood shavings at a volume ratio of 3:1. No other biodegradable waste was added to the composter.

Measurement of atmospheric precipitation

Total precipitation amount was measured daily during the experiment. The measurements were made by rain gauge with the measuring range up to 35mm.m^{-2}. Because of the grass cutting frequency, total precipitation amounts are presented for intervals of 14 days.

Measurement of grass weight

The grass was mowed at regular intervals (1x2 weeks), always on the same day. After the grass cutting, the content of the collection bin was emptied into a 20 dm^3 container, in which the grass biomass was weighed with an accuracy of 1g. The weight of the empty container was subtracted.

Measurement of composted material volume changes

After weighting, the cut grass was mixed with wood shavings at a volume ratio of 3:1. Inside the composter, the height of the composted material was measured first (on the day of cutting), then the new (fresh) raw-material (grass and wood shavings) was added and the height of the composted material was measured once again. The volume of the added raw material and volume changes of the composted material during the composting process were calculated from the measured heights.

Controlling the composting process

During the experiment, the composted material inside the composter was mixed and aerated at regular intervals of 28 days. After the measurement of the composted material height, the composter content was emptied on a mat; the material was manually mixed and returned into the composter. The relatively long interval for mixing was chosen with regard to the small amount of inserted raw-material and due to the unwillingness of most citizens to actively maintain an intensive composting process inside the composter.

RESULTS AND DISCUSSION

Total atmospheric precipitation

Precipitation amounts related to 14-day intervals are shown in Table 1.

Table 1. Total precipitation in the growing season

Date	Precipitation amount [mm]
24 April – 7 May	9
8 – 21 May	12
22 May – 4 June	45
5 – 18 June	27
19 June – 2 July	18
3 – 16 July	35
17 – 30 July	34
31 July – 13 August	13
14 – 27 August	18
28 August – 10 September	45
11 – 24 September	24

[Nováková, 2012]

Data of the Czech Hydrometeorological Institute show that the mean annual precipitation amount in this locality is 478.6mm. During the growing period of 2011 (24 April – 24 September 2011), the total precipitation amount was 280mm while temperatures in this period were above average. The mean daily precipitation amount in the growing period was 1.8mm but in the month of August it was only 1mm. Due to high temperatures in August, the precipitation was insufficient and the grass became rusty. In line with the methodology of the experiment, the lawn was not watered.

Amount of cut grass

The amounts of cut grass and added wood shavings are shown in Table 2.

Table 2. The amounts of cut grass and added wood shavings

No.	Date	Cut grass [kg]	Added wood shavings [kg]
1.	24 April	5.8	1.7
2.	8 May	5.8	1.7
3.	22 May	5.9	1.7
4.	5 June	5.9	1.7
5.	19 June	7.2	2.4
6.	3 July	3.3	1.1
7.	17 July	1.2	0.4
8.	31 July	3.2	1
9.	14 August	2.3	0.8
10.	28 August	1.4	0.5
11.	11 Sept.	1.6	0.5
12.	25 Sept.	1.2	0.4
Total		44,8	13.9

[Nováková, 2012]

The highest amount of cut grass was measured at the fifth measurement (19 June) – 7.2 kg. Before that period, the rainfall was abundant and distributed across several days while air temperatures were not too high. The lowest amount of cut grass was measured at the twelfth measurement (25 Sept.) at the end of the growing season – 1.2 kg. The amount of green biomass was decreasing with the beginning of summer months.

Volume changes of the composted material

Measured values of composted material volume are shown in Figure 1.

It is evident from the above diagram that a large volume reduction of the composted material occured during the composting process. Within the experimental period of 6 months, the volume of the composted material was reduced by nearly 55% as compared with the volume of the fresh material. Volume reduc-

tion in the 1st month of composting corresponds to values measured by Bo Yue et al. [2008]. However, the authors did not measure a further volume reduction in time. By contrast, Odstrčilová [2010, 2011] measured the volume reduction of the composted material at approx. 80% after 18 months of composting. It can be supposed that the volume of the composted material will continue to decrease before the beginning of the next growing season. Also, the composted material will be biologically stabilized during that time (approximately 6 months).

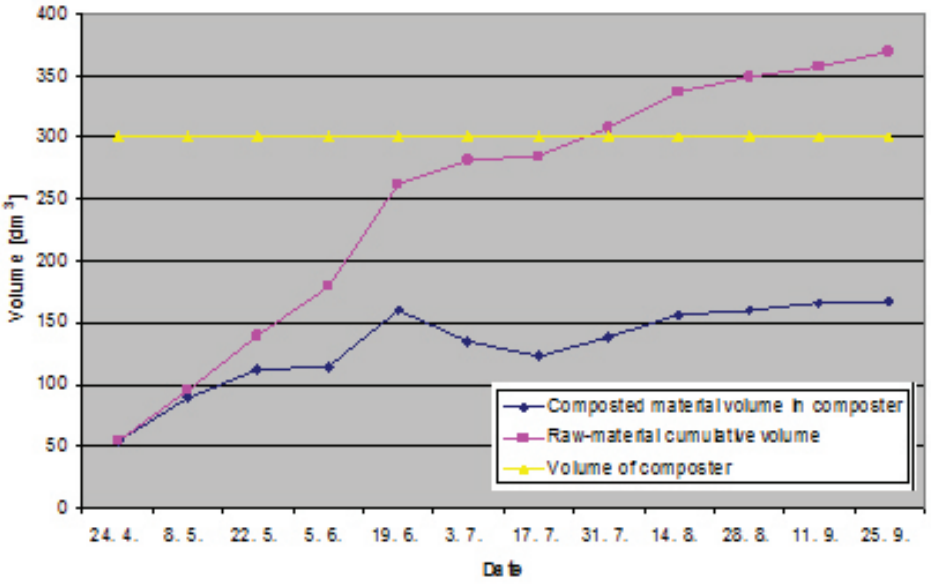

Figure 1. Composted material volume in the composter and raw-material cumulative volume

CONCLUSION

The main aim of our experiment was to find the volume of home composter that is required to treat the green garden biomass cut during the growing season. The data gained during the experiment on the maintenance of the experimental garden plot and on the control of the composting process in the composter (cut-

ting of grass 1x2 weeks, no irrigation, no fertilization of the lawn, mixing of the composted material 1x4 weeks) correspond to the maintenance of garden lawn at a recreational house/cottage.

The measured and calculated values show that the composter volume required for the treatment of cut grass is 3.83 dm^3 per $1m^2$ of garden lawn. Due to irregular grass production during the years, it is better to have the composter volume of 4 dm^3 per 1 m^2 of garden lawn.

The described experiment will be repeated and the measured values will be verified in the coming years. The gained data can be used to optimize selection of the type, size and number of composters for home composting of garden grass.

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