

Investigation on maturing period of compost from composting toilet

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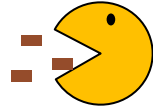
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Composting Toilet

House



Solid matter
are degraded
by microorganisms



- ★ Water-free
- ★ Saving sewer-pipe network
- ★ Recovery of fertilizer components

Human
Waste



Composting Toilet

Compost



Farm Land

The practical application has been attempted in rural and (Ito *et al.*, 2006) urban slum area (Ushijima *et al.*, 2007) in Asia and rural area in sub-Sahel region (Ushijima *et al.*, 2012)

Matrix for Composting Toilet



Matrix (Sawdust)

To expand the availability of the toilet in all over the world, several matrixes as an alternative to sawdust is required

Obtaining sawdust

Forest area



Sawdust



Arid area



Nothing !



Crop in arid area



Millet



Sorghum

Model of crop waste



Rice husk



Charcoal

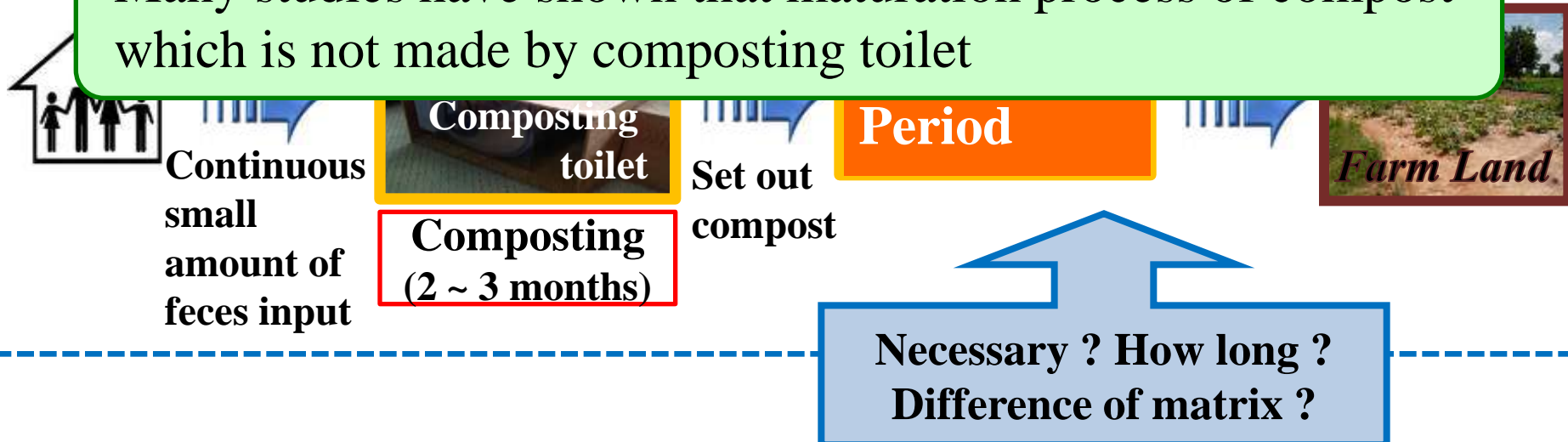
It has been suggested that several agricultural by-product were effective for fecal decomposition as the matrix (Hijikata *et al.*, 2011) and their compost promoted vegetable growth (Hijikata *et al.*, 2011)

Many studies have shown that the application of immature composts may lead to immobilization of nutrients and plant growth inhibition (Cambardella *et al*, 2003)

Adequate maturation of compost is essential

Composting Toilet Operation

Many studies have shown that maturation process of compost which is not made by composting toilet



Short maturation period is better for users

- ✓ Determine a time required for maturation of compost after removing from composting toilet
- ✓ Compare the difference of maturation progress among several matrixes

Composting period (continuous input feces)

- Term **53** days
- Matrix input **1600** g-dry
- Matrix **Rice husk Charcoal** (made by rice husk) **Sawdust**
- Feces input **500** g-fresh/day
- F/M (Total input feces/ Total input matrix) **3.5**
- Measurement ■ **Total C&N** ■ **NH₄⁺- N**

Maturation period after composting term (no input feces)

- Temperature **28° C**
- Humidity **50%**
- Term **13** days
- Sample day 0, day 4, day 9, day 13
- Measurement ■ **Germination Index (GI)** ■ **NH₄⁺- N**

Method



30 Komatsuna
seeds in compost
extract

1 day



Germination
Number

3 days



Measure
root length

$$GI = Gm/Gc \times Lm/Lc \times 100 [\%]$$

※Gm: Number of germination (compost extract) Lm: Root length (compost extract)

Gc: Number of germination (distilled water) Lc: Root length (distilled water)

Target Value of GI

- If GI value is below 50%, the compost is immature (Zucconi *et al.*, 1981 Solano *et al.*, 2001)
- If GI values is greater than 80%, the compost is considered as having completed maturity (Tiquia *et al.*, 1996 Sellami *et al.*, 2008)

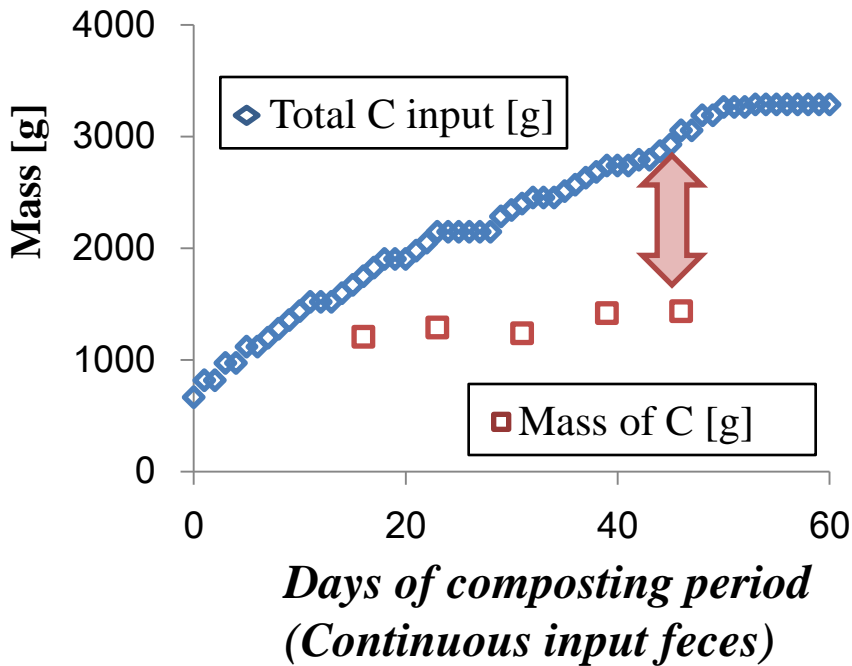
50% > GI: **Immature compost (has plant growth inhibition)**

50% < GI < 80% : **Acceptable compost for plant growth**

GI > 80%: **Best compost for plant growth**

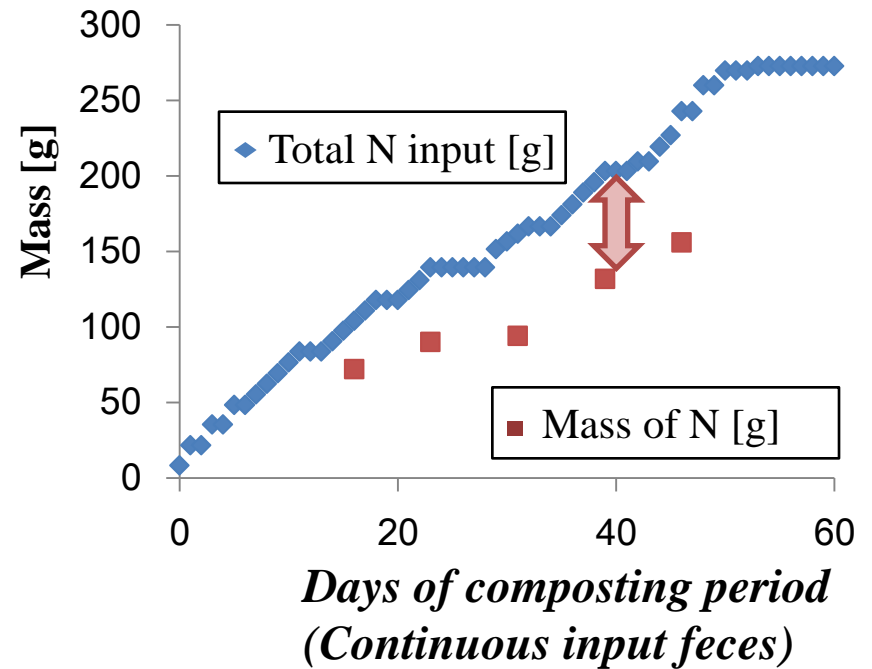
~ *Charcoal Compost* ~

Total C



Carbon volatilized as CO₂

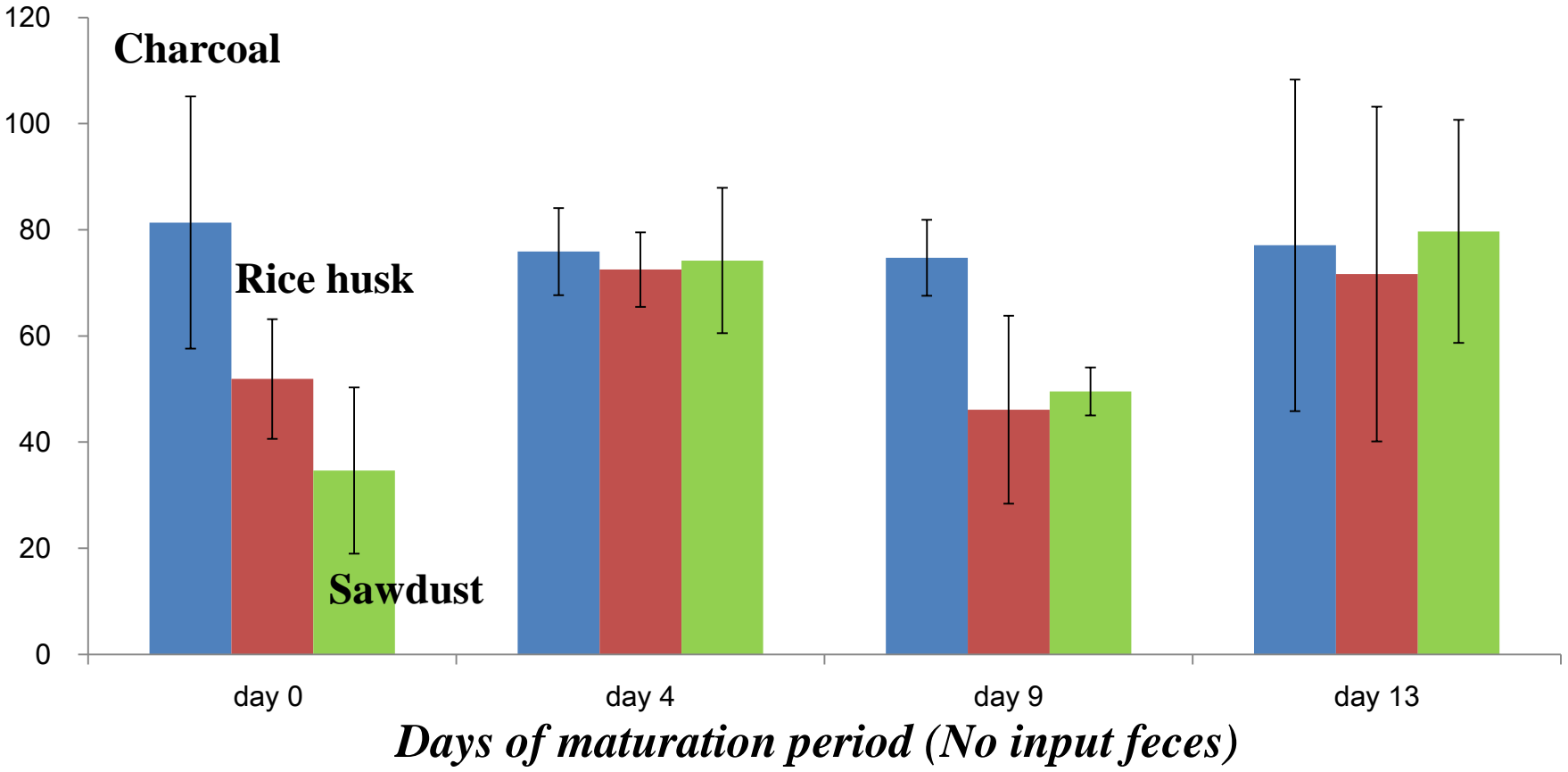
Total N



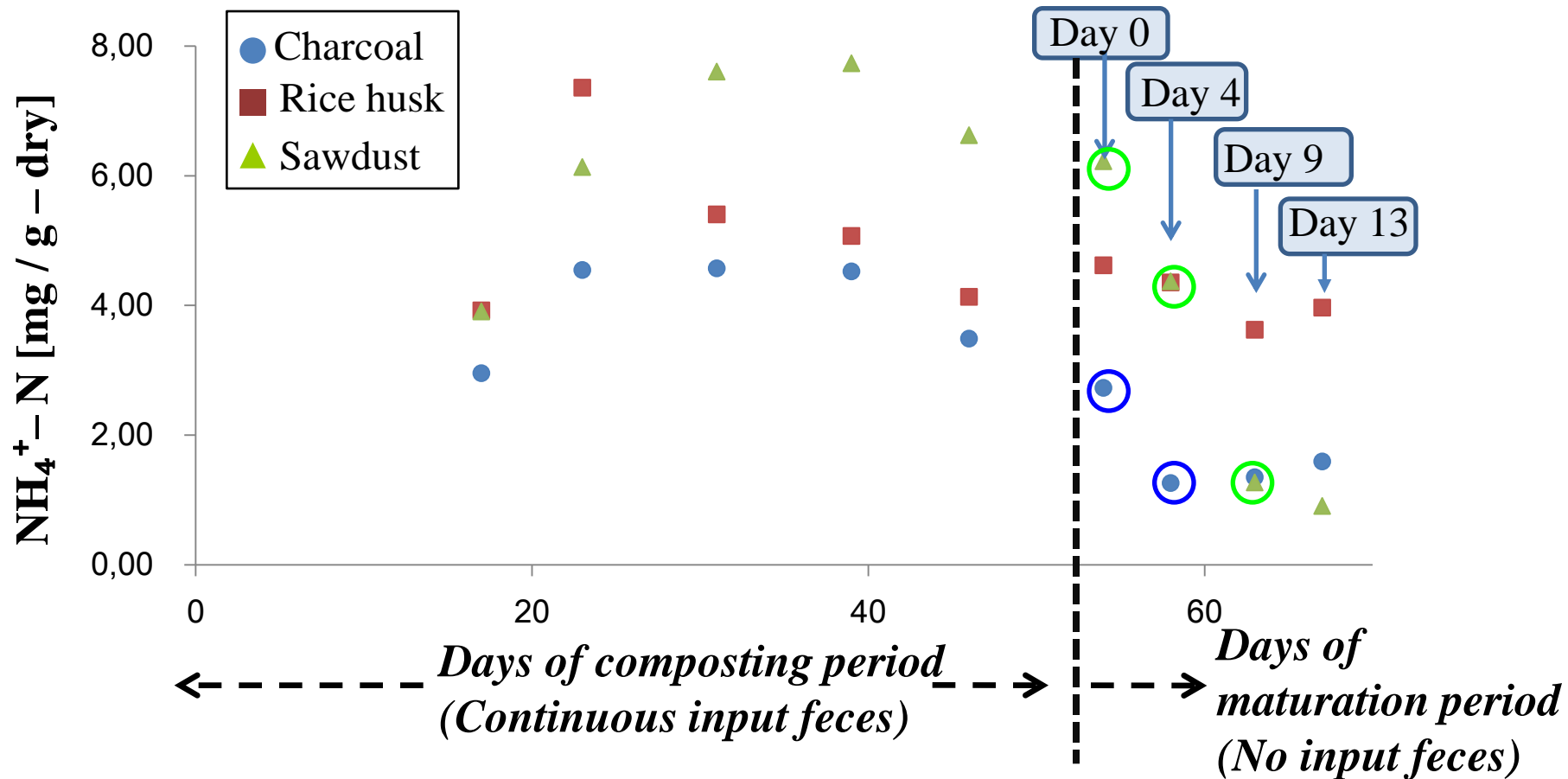
Nitrogen volatilized as NH₃

Germination Test (Maturation Period) *Result & Discussion*

Germination Index (GI)



- GI value of charcoal compost exceeded 80% at day 0 of maturation period
- GI value of rice husk compost and sawdust compost exceeded 50% at day 0 and day 4 of maturation period, respectively.



- There was significant reduction of $\text{NH}_4^+ - \text{N}$ content of charcoal compost and sawdust compost until day 4 and day 9 of maturation period, respectively
- There was no significant reduction of $\text{NH}_4^+ - \text{N}$ content of rice husk compost

Summary of experimental results

- GI value of charcoal compost exceeded 80% at **day 0** of maturation period
- GI value of rice husk compost and sawdust compost exceeded 50% at **day 0** and **day 4** of maturation period, respectively
- There was significant reduction of $\text{NH}_4^+ - \text{N}$ content of charcoal compost and sawdust compost until **day 4** and **day 9** of maturation period, respectively
- There was no significant reduction of $\text{NH}_4^+ - \text{N}$ content of rice husk compost

Suggestions

- Using **charcoal** for matrix, composting toilet can make **best compost without maturation period**
- Using **rice husk** for matrix, composting toilet can make **acceptable compost without maturation period**
- Using **sawdust** for matrix, **4 days** maturation period is required to be **acceptable compost**

*Thank you
for your attention*

