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Mechanical Test Methods for Compost Maturity

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Manure-based composts can have detrimental effects on the agricultural lands and crops if they are applied without proper stabilization process. Composting is well-known method for the stabilization of manure-based composts and the extent of composting could be examined by maturity test. Among various methods to examine compost maturity, the performances of two mechanical methods (Solvita and CoMMe-100) were examined and the test results were compared with seed germination test. The mechanical methods are considered to be simple and relatively objective. Also they are cost- and time-efficient. Ten commercially available composts collected in Korea were used for this study. Basically, the maturity determined with these mechanical methods was in good agreement with the seed germination test. However, it appeared that the index levels of compost maturity indicated more maturity by CoMMe-100 than Solvita for the same compost. The differences between maturity index levels determined by both methods were able to be minimized through extending the reaction time for CoMMe-100 and adjusting index level for maturity determination in the standard color chart.

Key words: Compost Maturity, Solvita, CoMMe-100, Germination Index

Introduction

Manure composting is a well established approach for the stabilization of nutrients and the reduction of pathogens and odors in manures (CCQC, 2001), which can be evaluated as compost maturity. The compost maturity is one of the significant parameter to evaluate the quality of compost and hence a wide range of maturity test has been developed and applied. The maturity can be estimated by self-heating reaction, seed germination rate, oxygen consumption rate, respiration rate, earthworm response, and generation of CO_2/NH_3. Each method has disadvantage such as time consuming, less accuracy, and high cost. Also, in most case, maturity test by only one method does not reflect the actual extent of maturity. Hence, application of multi methodologies has been recommended. The current study was conducted to compare two commercially available maturity testers, Solvita and CoMMe-100 in association with comparison with seed germination test. Solvita and CoMMe-100 use colorimetric method to examine the amount of CO_2 and NH_3 generated from the sample compost.

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Materials and Methods

Composts Commercially available composts in Korea were collected for this study. The composts consisted of about 50 % animal manure and the rest of organic materials such as hulks and saw dusts. From the preliminary test, ten composts at different stages of composting were selected and their maturity index levels were determined by the selected methods.

Measurements Solvita: Moisture adjusted compost (100 mL) was incubated in 200 mL container with solvita reactor for 4 hours and then the extent of color change was measured using DCR (Digital Color Reader, Solvita®). The maturity index level was determined through comparison between measured DCR value and the standard color chart (Changa et al., 2003).

CoMMe-100: Measurement using CoMMe-100 was similar with the procedure of Solvita but for the comparison study, measurements were conduced at different reaction

times (1, 2, and 4 hours).

Seed germination test: Germination test was conducted with radish and lettuce seeds being sown in the water extractants from composts. Five days after sowing, the root elongation and germination rate were measured (Zucconi and de Bertoldi, 1987).

Results and Conclusions

Both mechanical methods showed a similar trend in maturity for ten samples even if there was some differences regarding the absolute maturity level (Table 1). For example, CoMMe-100 appeared to be fully matured for C2 sample while Solvita showed it was still in the last stage of composting for the corresponding sample. The discrepancy between two methods was minimized by adjusting the reaction time and changing the index level in the standard color chart. In the seed germination test, lettuce seed was more sensitive than radish seed but the trend of germination rate to reflect compost maturity was similar (Table 2). Also the mechanical methods were in good agreement with the seed germination test (Table 3). Therefore, all the methods tested were suitable for the compost maturity determination.

Table 1. Comparison of two tests using color reaction of ammonia and carbon dioxide for compost maturity test.

Sample	Solvita[†]								CoMMe-100[†]				
	← raw							mature →	← raw				mature →
	1	2	3	4	5	6	7	8	1	2	3	4	5
C1	●										●		
C2						●							●
C3					●							●	
C4			●								●		
C5					●							●	
C6					●							●	
C7							●						●
C8			●						●				
C9		●							●				
C10							●						●

[†]Both tests were adjusted same reaction time as 4 hours.

Table 2. Seed germination index for compost maturity.

Sample	Radish			Lettuce		
	GR[†]	RE[‡]	GI[§]	GR	RE	GI
C1	9.2	8.9	0.8	79.5	0.0	0.0
C2	101.1	89.4	90.4	86.6	93.6	81.1
C3	95.3	58.5	55.7	66.8	55.6	37.2
C4	100.0	71.6	71.6	91.6	59.8	54.7
C5	101.1	77.4	78.2	88.0	51.9	45.6
C6	101.1	74.5	75.3	83.7	67.7	56.7
C7	101.1	70.8	71.6	75.3	47.0	35.4
C8	102.3	100.0	102.3	2.9	0.0	0.0
C9	75.8	52.7	40.0	0.0	0.0	0.0
C10	98.9	79.4	78.5	57.0	61.7	35.2

[†]GR, Germination ratio; [‡]RE, Root elongation; [§]GI, Germination index.
GR = (germination rate/germination rate of control) × 100.
RE = (root length/root length of control) × 100.
GI = GR × RE / 100.

Table 3. Pierson correlation coefficient between compost maturity tests.

	Solvita	CoMMe-100	Radish GI†
CoMMe-100	0.830**		
Radish GI	0.586	0.196	
Lettuce GI	0.675*	0.724**	0.498

†GI means seed germination index.

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