

# Evaluation of Solvita™ Compost Maturity Test Kit

- ✓ Comparison to Germination and Respiration Tests
- ✓ Reproducibility
- ✓ Commercial User Survey

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## Summary

Joe M. Regenstein and Erin McDonnell of Cornell University (Ithaca, NY) were contracted by the Department of Economic Development to investigate the potential value of Woods End's Solvita Compost Maturity Test to commercial compost manufacturers in New York. Erin McDonnell developed several lab studies to examine potential problems associate with biological activities of compost which may affect results of the test, and also a survey for commercial facility reviewers of the test.

In laboratory studies, the test was compared with standard cress seed germination and CO<sub>2</sub> evolution (respiration) tests for accuracy and repeatability. The Solvita Maturity Test was a good indicator of stability of the sample under best conditions. The test gave essentially the same results when conducted on the same compost sample by a variety of first time people, and by the same person testing multiple samples simultaneously. The test did not give accurate ratings of the true potential of the biological activity of the compost when the samples were abused in anaerobic ( no oxygen) or cold treatments before testing. This is to be expected for a rapid test based on biological activity, and means that good education about the importance of proper sampling and sample preparation needs to be done before effective utilization of such a test.

A group of high school teachers and seven commercial compost facility operators reviewed the test kits. For the most part, they found the test materials easy to handle and the instructions clear, and easy to follow. The buffer packets tended to spill on opening. There is still some confusion on when to add the buffer packets, but the manufacturer realizes this and is rewriting the pertinent instructions. Some people, including this reviewer, found it difficult to match some of the colors on one of the printed charts, but the manufacturer is also already working to improve the printing.

There was some division as to the dollar value of the test, but clearly those compost operators who were in the position to sell their compost or use it in production of high value agricultural products were interested in purchasing such a test for use in their monitoring program. If the test was less than \$10, two of the reviewers would also use it in evaluating experiments of new mixtures.

The methods used in each section of this study are described at the beginning of the pertinent section, followed by results and comments. Information on comparisons to traditional maturity tests is presented first, followed by evaluations of the test by various potential users.

## Comparison of the Solvita Maturity Test to germination and respiration tests

The cress seed germination test adapted by The Compost Council (Alexandra, VA) in its January 1995 draft of The Recommended Test Methods for the Examination of Composting and Compost from the work of Zucconi et. al. (1981a and b) was used to determine the phytotoxicity. The CO<sub>2</sub> evolution test described in the same draft and adapted from Iannotti, et. al. (1993) was used to assess stability. Phytotoxicity and stability are the two key components of maturity for any given compost.

Two studies were conducted to determine important aspects of the Solvita Maturity Test's ability to accurately determine the maturity of a compost. While it is true for any test that the material tested must be properly sampled and prepared, it is important to determine how robust this test, conducted by non-laboratory trained personnel working in a variety of non-laboratory equipped sites, is in order to meet its targeted use. The largest concern would not come from a person's ability to follow the directions written in the guide after a sample is taken, but in the understanding of how to properly obtain and prepare a sample such that the test is performed when the sample is at its maximum potential biological activity. Therefore, the first study presented assesses the comparative maturity of composts from the same processor at different ages. The second study assesses the

comparative maturity of the same compost sample after being divided and undergoing two realistic abusive treatments. For easy reference, the ratings for the standard tests conducted are given below in Tables 1-3.

<b>Table 1. Zucconi Germination Index</b>	
<b>Germination Index</b>	<b>Rating</b>
*1.0-.08	no inhibition of plant growth
0.8-0.6	mild inhibition
0.6-0.4	strong inhibition
< 0.4	severe inhibition

\* values greater than 1.0 indicate stimulation of growth over distilled water control

<b>Table 2. Compost Stability Index</b>	
<b>Respiration Rate (mg CO<sub>2</sub>-carbon/g BVS/day)</b>	<b>Rating</b>
<2.0	very stable
2-5	stable
5-10	moderately unstable
10-20	unstable compost
>20	unstabilized material

**Table 3. Solvita Maturity Test**

Solvita Test Result	Approximate Stage of the Composting Process	Major Class
8	Highly matured compost; well aged; possible over-aged; like soil; ready for most uses.	finished compost
7	Well-matured, aged compost; cured; ready for most uses.	
6	Aeration needs are reduced; curing; significantly reduced management requirement.	active compost
5	Compost is moving past the active phase of decomposition; ready for curing; reduced need for intensive management.	
4	Compost in medium or moderately active stage of decomposition; may be ready for curing.	
3	/active compost; young materials, high respiration rate; still needs intensive oversight and management.	
2	Very active, moderately fresh compost; very high respiration rate; needs very intensive aeration and/or turning.	raw compost
1	Fresh, raw compost; typical of new mixes; extremely high rate of decomposition; very putrescible or odorous materials; high in volatile organic acids.	

**Study 1:** Samples of two month, eleven month and two year old food and wood chip compost from Ithaca College (Ithaca, NY) were obtained and the Solvita Maturity, Zucconi Germination, and CO<sub>2</sub> Evolution tests were performed according to standard procedures. Results of the tests are given in Table 4.

Compost Sample by Age	Solvita Rating <sup>1</sup>	Zucconi Germination Index <sup>2</sup>	CO <sub>2</sub> Evolution Index
2 month old	4,4+,4	1.05, 0.72, 0.68	7.2
11 month old	5,5-,5-	0.41, 0.69, 0.69	5.3
2 year old	8,8-,8	0.49, 1.11, 1.11	1.7

<sup>1</sup> Results of three repetitions of the test, with +/- signifying paddle color between indicated level and the next higher or lower level.

<sup>2</sup> Results of 0x, 3x and 10x dilutions of water extract of compost.

The Solvita ratings compare reasonably with those from the respiration test. The Solvita ratings are all consistent, which is also good. Young, aerobically curing food is often stimulating to cress seed, so the favorable Zucconi Germination Index for the two month old compost is not unexpected. The Solvita rating, though, appropriately predicts the moderate stability of the compost at two months. Thus, the Solvita Maturity Test functions well in predicting the stability of variously aged composts when the compost sample has been properly prepared.

**Study 2:** A sample of three month old food and wood chip compost from Ithaca College (Ithaca, NY) was divided into 3,000 g lots. The moisture content of the first and third lot was adjusted according to the "squeeze test." The second lot was saturated with water to the point where it would freely emit several drops of water in the "squeeze test". The first lot (ambient) was then left with the container cover slightly ajar in a 22 °C room, the second (anaerobic) in a 37 °C incubator with the lid tightly sealed, and the third (cold) in a -1 °C incubator with the cover slightly ajar. The Solvita Maturity, Zucconi Germination, and CO<sub>2</sub> Evolution tests were performed after 48 hr of incubation. Two buffer packets were added to the anaerobic samples, but no other treatment was given to any of the lots. The results of the tests are given in Table 5 below.

Compost Sample Incubation Treatment	Solvita Rating <sup>1</sup>	Zucconi Germination Index <sup>2</sup>	CO <sub>2</sub> Evolution Index
ambient	6-,6-	1.08, 1.82, 1.21	5.4
anaerobic	4-,3+	1.01, 1.50, 1.96	7.2
cold	6+,6+	1.37, 1.56, 1.41	5.6

<sup>1</sup> Results of three repetitions of the test, with +/- signifying paddle color between indicated level and the next higher or lower level.

<sup>2</sup> Results of 0x, 3x and 10x dilutions of water extract of compost.

The anaerobic sample, incubated at the higher temperature shows the effects of its abusive treatment and elevated activity in its Solvita Rating and CO<sub>2</sub> Evolution Index, but the effect is much less in the later. The CO<sub>2</sub> respiration test is also conducted at 37 °C, but

the samples are preincubated at 37 °C to allow the microbial populations to equilibrate before readings are made.

The effect of preincubating the sample in the cold is very slight as the ambient and cold activities are nearly the same. Thus, the Solvita Maturity Test is responsive to a slight temperature abuse of the sample.

Further tests of the Solvita Maturity Test with a variety of abused samples could be conducted, but the point here is that the test does require careful preparation in order to give results representative of the true potential of the compost. When used properly, the test is a quick and useful indicator of the activity of the compost.

### **Repeatability of results**

The repeatability of the test was assessed two ways. First, nine one pint sub-samples were taken from a bulk sample of three month old food scrap and wood chip compost, the moisture levels were adjusted, and the samples then equilibrated for 28 hr. The Solvita test was conducted on each pint by Erin McDonnell. Second, a gallon, approximately, of the same compost was sampled, its moisture was adjusted, and then it was allowed to equilibrate for 28 hr before being tested by six people participating in a summer compost research program for high school teachers. They were allowed to take their own sample from the gallon tub, told no moisture adjustment was needed, and then asked to follow the test directions. They were observed by Erin McDonnell and asked to evaluate the test and written materials afterward.

The results of the tests run by Erin McDonnell were: 3,3,3,4,3,3,3,4,3. The results of the tests run by the teachers group were: 3,3,3,4,3,3. It was concluded that the Solvita test was reasonably repeatable for a properly prepared compost sample.

It was observed that the teachers group started performing the test step-by-step before they had thoroughly read the instructions, which would be expected for commercial users as well. Thus, it is good that the directions are written step-by-step, but it would also help to have a brief summary of the materials and time required at the beginning so people won't start the test and find out they can not finish it. Several people also spilled the buffer packets while opening them. They also commented that it was difficult to determine how much buffer to add, and would prefer to test pH to determine this. They suggested that the steps concerning equilibration and buffering be rewritten and clarified. Otherwise, they found the directions easy to follow.

The second problem noted was that the colors in the brochure and jar do not match, and that some of the gradations between colors are poor. One teacher commented that the print was very small. Another teacher commented that she would like an explanation, briefly, of the scientific principles on which the test was based so she could decide when it was best to use it. Though they were not the target for the economics portion of this study, the teachers commented that the test would need to be \$2-3 per test before they would be affordable for classroom use.

Woods End was consulted after this portion of the testing and had already noted the problems in the buffer use and color charts and are working to remedy the problems. The feedback from the teachers and advice from Woods End was used to construct the survey for commercial composters in the following section.

### **Commercial facility operator review**

Operators or supervisors from seven commercial composting operations throughout the state volunteered to examine the test kit and give feedback on its performance and economic value. The names and addresses of the participants are given in Appendix A. The participants were asked to conduct three simultaneous tests on a sample of their compost to help determine repeatability of the test in realistic situations and answer the questions in Appendix B, the commercial survey form. In addition to the professional test

kit and instructions, an addendum was included outlining some recent improvements in test instructions. No other instructions in how to use the kit were given, as we wanted to understand any problems encountered by a first time user. Copies of the participants surveys are available from Erin McDonnell.

Composts tested were made from food scraps, yard trimmings, horse and cattle manure, waste paper, sewage sludge, paper pulp, and fish. Three operators used primarily temperature drop after a reasonable composting time to determine when their compost could move to the curing phase. Four operators supplemented temperature with additional analytical tests including pH, C/N ratios, smell after saturation and enclosure in a jar for a week, oxygen demand reduction, and nutrient and physical properties analysis by a qualified lab. Operators were asked the expected level of maturation of their compost before conducting the test and how well the test results matched their expectations. Only one operator needed to adjust the moisture level of the compost before running the tests. Generally, tests on individual composts were fairly repeatable with variance of only one color level on several of the composts. One evaluator found a difference of two color levels, with the lowest result originating from the sample with added buffer.

For the most part, evaluators found the test kit materials easy to handle, the instructions clear and easy to understand, and the resultant colors on the paddles easy to match to the jar or instruction sheet charts. Two evaluators commented that the buffer packets were a bit awkward, as was noted by several of the teachers. Several evaluators also noted that many people do not have a means of measuring pH to determine if the buffer should be used, and suggested including several litmus paper strips with the kit, as well as more educational information on why pH needs controlling. Two evaluators also had trouble distinguishing colors, especially in marginal light. One evaluator voiced a concern that inexperienced users may get false high (stable) readings by not moistening the sample enough.

All evaluators found the information on page 7 very helpful in evaluating their compost and deciding how to improve the maturity of their compost. Several evaluators cut it out and posted it.

Assessment of the value of the test to individual operators was more varied. Several operators use the finished compost on their own grounds and have sufficient space to let it cure for well over 1.5 years. They did not feel the test was of value to them. However, those releasing their compost to the public or engaged in intensive food or horticultural cropping did feel that the test was valuable and put price tags of \$5, \$8, and \$12 on it. Most of the evaluators would use the Solvita test in conjunction with other tests, listed earlier, to prove the quality of a compost to potential users or buyers. Two operators noted that if the test was inexpensive enough, it could be used to help monitor experimental compost piles.

## Conclusions and additional information

The Solvita Maturity Test is an accurate, repeatable, quick and convenient means of assessing the activity, or stability, of a given compost. With additional information on the reasonable treatment and length of curing of the sample it could be used as a predictor of maturity. The various reviewers of the test kit found it to be simple to use and the results easy to interpret. What few problems were found in handling of the materials and interpretation of the manual can easily be remedied by the manufacturer. There was some division as to the dollar value of the test, but clearly those compost operators who were in the position to sell their compost or use it in production of high value agricultural products were interested in purchasing such a test for use in their monitoring program.

Caution should be given that the test can not entirely screen for improperly treated compost samples and, thus, may give false negatives or positives. While any improperly conducted test can give false results, it is this reviewers concern that because this test may be conducted in a variety of settings and by people who have not had education in quality

assurance/control, that it will require careful instructions if it is to be used as a regulatory tool. As an additional positive attribute of the test kit, the jars can be used to conduct the anaerobic odor test used by many composters after the Solvita test is finished. The material in the jar must first be moistened just above the "squeeze test." If the compost is truly stable, no mold or actinomycete filaments should be visible after several days of incubation at room temperature(20-25 °C) in the jar, and no bad odors should be present after a week of incubation at room temperature.

## References

- Iannotti, D.A., T. Pang, B.L. Toth, D.L. Elwell, H.M. Keener, and H.A.J. Hoitink, 1993.** A quantitative respirometric method for monitoring compost stability. *Compost Science and Utilization*. 1:52-65.
- Standards and Practices Committee of the Composting Council. 1995.** Recommended Test Methods for the Examination of Composting and Compost, draft 4.4, January 7, 1995. The Compost Council. Alexandria, VA.
- Zucconi, F., A. Pera, M. Forte, and M DeBertoldi. 1981a.** Evaluating toxicity of immature compost. *Biocycle*. 22:54-57.
- Zucconi, F., A. Pera, M. Forte, and M DeBertoldi. 1981b.** Biological evaluation of compost maturity. *Biocycle*. 22:27-29.



**Appendix A**  
**Commercial facility reviewers**

R. Adams, Compost Operator  
Washington Correctional Facility  
P.O. Box 180, Lock 11 Rd.  
Cornstock, New York 12821-0180

David Stern, Farm owner and worker  
Rose Valley Farm  
Rose, New York 14542-0149  
315-587-9787

Auralie Ashley-Marx, Solid Waste Program Coordinator  
Oswego Co. Division of Solid Waste  
3105 State Rt 3  
Fulton NY 13069  
315-592-2120

John Malarchuk, Site Manager  
McEnroe Organics  
Rd.2 Box 347  
Millerton, NY 12546  
518-789-3252

Charles Nickolaus, Filter Plant Operator  
Summit-Shock Correctional Facility  
Box 56 HRC2  
Summit, New York 12175  
518-287-1721

Lance Minor, Compost Site Manager  
Queens Botanical Garden  
43-50 Main Street  
Flushing, NY 11355  
718-539-5296

Mark Dahrling, Compost Site Manager, Auxiliary Services  
201 Physical Plant  
Ithaca College  
Ithaca, NY 14850  
607-274-1777

**Appendix B  
Commercial user survey form**

**Solvita maturity test kit questionnaire**

**Please return questionnaire to:  
Erin McDonnell  
Food Science, Rice Hall  
Cornell University  
Ithaca, NY 14853-5201  
607-255-3195  
email: emm4@cornell.edu**

The New York State Department of Economic Development and the Cornell Food Science Department are conducting an evaluation of the Woods End Research Laboratory, Inc. Solvita Maturity Test Kit (Mount Vernon, ME) to determine its reliability and usefulness for New York State commercial compost producers. All information gathered will be made available to the public. We appreciate your evaluation of the product and hope you enjoy the experience of testing this new product. If you have any questions about this survey, please contact Erin McDonnell at the above address and phone number.

Please take a three pint sample of your compost and run three simultaneous tests on it. This will help us determine how repeatable the results are.

This test comes with the standard test kit color manual and an addendum sheet from Erin. As some recent changes in the directions have been made and new standard test kit color manuals are still being printed by Woods End Research Laboratory, Inc., the addendum clarifies several of the directions.

And just one more thing; please put this in the mail to Erin by Mon., Sept. 30, 1996

Thank you for your assistance! Erin

\* \* \* \* \*

**Background information**

Test Date: \_\_\_\_\_

Your name and title: \_\_\_\_\_

Your address and phone: \_\_\_\_\_

Briefly describe what you currently do to determine the maturity of your compost:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Please begin the Solvita Test and answer the following questions as best you can. Feel free to comment on any aspect of the test kit at any time.**

1. Type of compost being tested (materials in your recipe and approximate volumetric ratios): \_\_\_\_\_
2. Referring to page 5 of the manual, what is your expected level (1-8) of maturity of the compost?: \_\_\_\_\_
3. Referring to Step 2 of the test on page 2, describe any moisture adjustments you made to the sample: \_\_\_\_\_
4. If you adjusted the moisture of the sample, about how long did you let the sample equilibrate before proceeding with the test? \_\_\_\_\_

**Answer the following questions after the test is finished and you have read the results of the paddle.**

5. Were the test paddles easy to handle and the finished colors easy to match to the color chart? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6. What were the results of your test?
  - a. paddle 1) \_\_\_\_\_
  - b. paddle 2) \_\_\_\_\_
  - c. paddle 3) \_\_\_\_\_

7. After seeing the results of your paddles, are the results what you expected, and if not, what do you conclude about your compost? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8. Are the directions in the manual, with the clarification in the included addendum, clear and easy to follow? If not, what caused problems?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

9. Referring to pages 4-6 of the manual and the enclosed addendum sheet, is the information on evaluating the test results clear and easy to follow? If not, why?

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10. Given your understanding of composting, how valuable is the information presented on page 7 of the manual?

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11. Do you feel that the test could be useful to you? Why or why not?

12. With your intended use in mind, what is the approximate dollar value to you of a single Solvita test? \_\_\_\_\_

13. Please comment on any aspect of this experience not covered above that you think is still important, e.g., what should I use to mix the buffer with the compost?

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