

September 30, 2009

RD 1

Report 1st Round 2009

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Compost Analysis Proficiency Program

The 1st Round of CAP 2009 had sixteen labs enrolled, with sixteen submitting results for Tier I inorganic analyses and ten Tier II, inorganic + biological analyses. We would like to thank all participating laboratories for their cooperation in completing these analyses in a timely manner.

The 2009 the proficiency data report list results by analysis followed by compost material. For 2009 95% Confidence Limits (CL) based on the median $\pm 2.9 \times \text{MAD}$ is used to assess lab bias. Individual lab values exceeding this range are flagged for bias as **L* or **H*. This statistical approach is more robust to the influence of data set extreme values and conforms to 95% confidence limits based on two standard deviations (*s*) for normal populations. The data analysis report lists: the number of lab results reported; minimum value reported, maximum value reported; median value of reported; 95% Confidence Limits; overall reproducibility (R_d) across laboratories; individual reported lab values; repeatability (R_p) of a single lab value; and mean lab value reported. Lab R_p values exceeding three (3) times the R_d , are marked with a colored **P* adjacent to the R_p results indicating the individual lab precision exceeded the database median for the compost analysis.

Compost Materials

SRC 2009 - A: represented by sub samples *SRC-0901*, *SRC-0902* and *SRC-0903* is a brewery compost obtained from Pioneer Sand and Gravel, labeled as Premium 3, Fort Collins, CO.

SRC 2009 - B: represented by sub samples *SRC-0904*, *SRC-0905* and *SRC-0906* was a obtained from A-1 Compost Eaton, CO.

SRC 2009 - C: represented by sub samples *SRC-0907*, *SRC-0908* and *SRC-0909* was a cattle manure feedstock material obtained from Natural Compost, Platteville, CO .

Selected Points of Interest:

- *Ninety-nine percent of the variability in compost TOC can be explained by LOI , where TOC is 52% of the LOI value for 48 compost materials evaluated, 2004-2009*
- *Across the CAP 2009 RD1 samples, the ammonium-nitrogen median concentrations values were less 20 mg kg⁻¹.*
- *Copper results indicate a consistent high bias trend for 1 of 14 reporting labs for two of the three compost materials.*

CAP Proficiency Results

Compost total solids median values were 71.7, 75.2, and 51.3% for the three compost materials, respectively. Intra-lab reproducibility (R_d) values for the 105° C for 2.5 hr ranged from 0.80 to 2.6%, indicating a high degree of homogeneity for all three compost materials. Loss on Ignition (LOI) medians ranged from 25.3 to 37.4% with reproducibility (R_d) values ranged from 0.30 to 0.86%. Based on four reporting labs median CEC values, ranged from 30.9 to 53.0 cmol kg⁻¹ across the three compost materials. Saturated paste pH median values for the three materials ranged from 7.41 - 8.25. Sample **SRC-2009-C** had high saturated paste EC value, with a median of 28.6 dS m⁻¹.

Median results reported for EC 1:5 extract ranged 3.1 to 14.7 dS m⁻¹ across the three samples, with R_d values ranging from 2.6 to 4.2%. Confidence Limits (CL) across materials ranged from 0.8 - 8.4% of the median for Ca, Mg, Na. 1:5 PO₄-P concentrations ranged from 9 - 1559 mg L⁻¹ with an average R_d value of 6.4% for the three materials. Extract 1:5 SO₄-S median results was 1850 mg L⁻¹ for sample **SRC-2009-C**.

Three labs provided TKN results and fourteen for N-combustion. Comparison of nitrogen method median values indicates a low bias that ranges from 0.09% to 0.25% for TKN relative to N-combustion across the three samples. TKN R_d values ranged from 1.2 - 2.5% and 2.3 - 4.8% for the N-combustion method for the three materials. Total organic carbon (TOC) median values were 12.5%, 13.8% and 19.1% TOC respectively with the 95% CL averaging 4.3% TOC. Median C:N ratios ranged 10.1 to 12.3, the highest for sample **SRC-2009-B**. Three laboratories reported total sulfur (S) by combustion, median values which ranged from 0.19 to 2.12% S for the three materials.

*SRC 2009-C, NO₃-N
was 807 mg kg⁻¹*

Nitrate and ammonium results were provided by seven labs. NO₃-N median results ranged from 318 to 807 mg kg⁻¹ and CL was 56% of the median for sample **SRC-2009-C**. NH₄-N median values ranged from 16 to 116 mg kg⁻¹ with CL for NH₄-N averaging 180% of the median. NH₄-N/NO₃-N ratio, calculated for each lab, ranged from 0.02 to 0.52. An average of fourteen labs provided results on total P, K, Ca, Mg and Na. Phosphorus medians concentrations were 0.46, 0.20 and 0.88%, respectively. R_d values averaged 2.5% for P. Potassium median concentrations ranged from 0.95 to 1.98%. Across the three materials Ca median concentrations ranged from 2.28 to 7.10% and Mg values ranged from 0.34 to 0.91%.

Compost Ba median concentrations ranged from 97 - 135 mg kg⁻¹, Cu 22 - 271 mg kg⁻¹, and Zn 99 - 165 mg kg⁻¹ across the three materials. Strontium median concentrations ranged from 78 - 256 mg kg⁻¹; Pb from 3.3 - 18.7 mg kg⁻¹; and Ni from 5.9 - 11.8 mg kg⁻¹. Cadmium median concentrations ranged from 0.42 - 0.47 mg kg⁻¹, Co 2.3 - 4.5 mg kg⁻¹ and Cr 11.3 - 21.3 mg kg⁻¹ across the three materials. Arsenic median values ranged from 2.3 - 7.1 ug kg⁻¹ for each of the three samples. Generally CL were greater than 50% of the median for elements: Be, Cd, Cr, Li, Mo, Sb, V, Hg, As, and Se which is associated with concentrations approaching the method detection limit. Generally R_d values for AL, B, Ba, Be, Ca, Co, Cu, Fe, K, Mg, Mn, Sr, V, and Zn were less than 5% across all compost materials.



http://farm3.static.flickr.com/2306/1935293760_c4253b94f8_m.jpg

Tier II results for the 2009 CAP RD1 contents were performed by seven labs, dependent on the test. Sieve size classification (>9.5 mm) were less than zero for all samples. All three materials were blended, but not pulverized or screened, and thus represented compost samples closely representing real world materials. (Continued Page 4)

Compost LOI vs TOC Observations

In October 2007 the CAP Program assessed the relationship between Loss-on-Ignition (LOI) and Total Organic Carbon (TOC) for 27 compost samples that had been evaluated in the CAP Program from 2004 through 2007. For 2009 we have updated this regression, based on CAP program median for LOI and TOC values for 48 CAP materials 2004-2009, analyzed in twelve analysis laboratories. Results indicated that 99% of the variability in TOC values is explained by LOI (see Figure 3) and that 52% of the LOI value is total organic carbon. Although ideally the one would expect intercept to be “0”, the value of a -0.38 closely approaches this value and represents inter-lab method errors. This is a significant relationship as materials utilized represent diverse compost materials across the United states, comprised of dissimilar feed stock materials (wood, bio-solids, and hay) evaluated over a five year period. Although a good relationship would be expected between LOI and TOC, the high correlation indicates the relationship is highly significant. It is further suggested based on this equation, that LOI in conjunction with combustion TN values could be used to estimate compost C:N ratios.

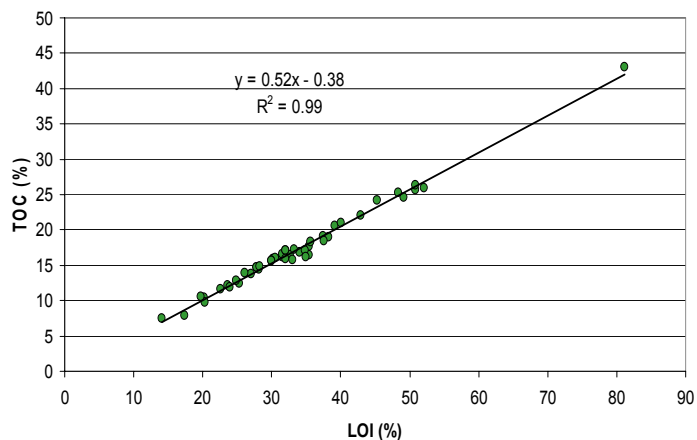


Figure 1. Relationship of LOI and TOC 48 Compost Materials 2004-2009.

Total Calcium Observations

Total Calcium (Ca) sample results for 2009 Round 1 indicate a range in median values, 2.28 –7.10 % Ca, across the three samples. This is best illustrated in Figure 2, which plots individual lab results ranked from low to high, based on compost sample **SRC-2009-A**. Sample **SRC-2009-A**, indicates one lab exceeding a CL of ± 0.35 % Ca. Listed is the median, standard deviation error bars and the 95% confidence limit for each compost material. Sample **SRC-2009-B**, has a wide distribution in total Ca values ranging from 1.80 to 2.76% Ca, resulting in one of fifteen labs exceeding confidence limit of ± 0.38 % Total Ca. Sample **SRC-2009-C** shows a distribution in Ca values ranging from 5.0 to 7.86% Ca, again resulting in one lab exceeding a confidence limit of ± 1.0 % Ca. Generally standard deviation error bars across labs were higher for sample **SRC-2009-A** over the two other samples. Across the three compost samples labs #2, #3 and #8 had inconsistent results, indicating bias trends on two of three compost materials. Lastly, across samples, labs #4 and #12 had the largest error bars across all three compost materials for CAP 2009 Round 1.

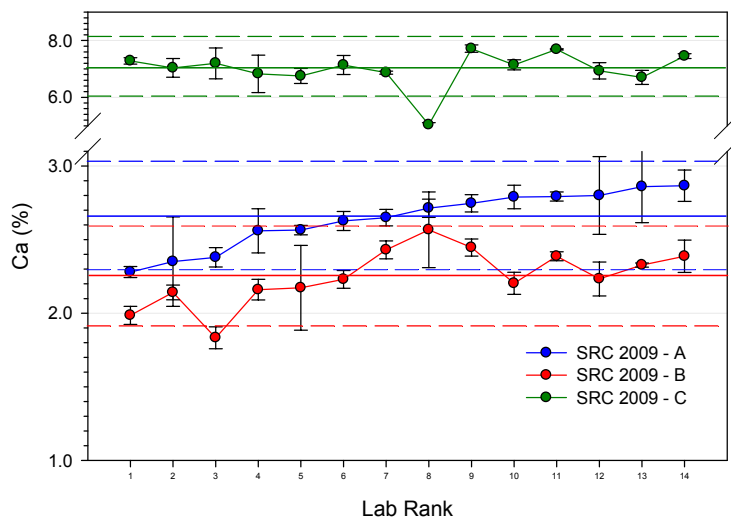


Figure 2. Total Ca results, CAP 2009 RD1.



Copper Observations

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Ship week of October 19, 2009

Observations for 2009 Round 1 indicate the three materials had a wide range in median copper concentrations ranging from 22 to 271 mg kg⁻¹ (see Figure 3). Listed is the median (solid lines) and standard deviation (error bar) for each compost material. Sample **SRC 2009-A**, shows a wide distribution in Cu values ranging from 145 to 324 mg kg⁻¹, for labs #1 through #14 with confidence limit of ± 47 mg kg⁻¹. Lab #1 was found to have a low bias, for **SRC 2009-A**, whereas lab # 14 had a high bias on compost samples **SRC 2009-B** and **SRC 2009-C**. Generally standard deviation error bars across labs were higher for sample **SRC-2009-A** over the two other samples. For this sample, labs #2, #8 and #11 had the highest standard deviations on which the median standard deviation was 8.1 mg kg⁻¹ for the fourteen reporting labs.

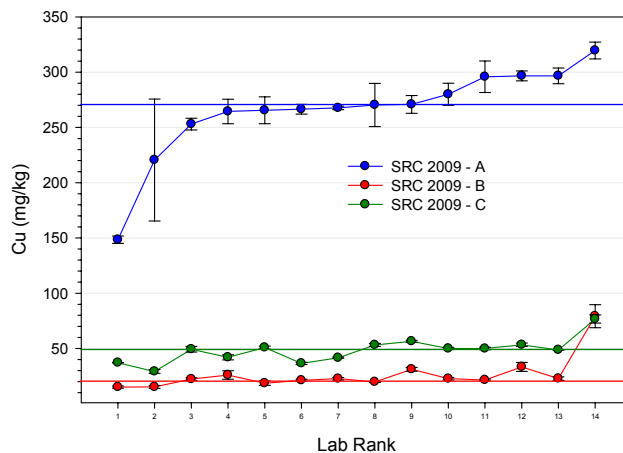


Figure 3. Cu for three compost materials, CAP 2009 RD1.

CAP Proficiency Results (Continued)

Ten laboratories provided results on seedling germination and growth. Median seedling cucumber emergence was 96.0, 100.0 and 75.0% for the three materials respectively, with R_d values averaging 1.0%. Poor seedling vigor was likely associated with the high EC, in particular sample **SRC-2009-C**. Total solids respirometry (% w/w basis) was provided by five labs with rates of 51.0 to 68.2%, and R_d values averaged 1.3% for sample **SRC-2009-B**. LOI OM respirometry values ranged from 26.2 - 39.5% with R_d values averaging 2.6%.

Carbon Dioxide Evolution I indicated a range of 0.20 - 0.39 (mg/gTS/d) across the three materials. SOUR has been deleted from the database as no data has been provided. Solvita Maturity Index data tests data was provided by no labs. Biological Available Carbon (BAC) and I and II was provided by one lab. Pathogen analyses was provided for Fecal Coliform Bacteria by an average of seven labs with a median value of 20 MPN/g for sample **SRC-2008-B**.



Source: www.compostsystems.com/blog/media/1/20071214-compost-pile-building.jpg



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