Soil Biometer™ Package Insert

This product was developed at BCC under a grant from the National Science Foundation.

Purpose: The commercial Soil Biometer™ semi-quantitatively estimates the number of microbes in compost, soil, and extracts or teas that are soil or compost based and varies slightly from that of this kit. For educational purposes we provide a “control sample” which is the over the counter product Ridex because the level of microbes in home soil and compost samples is generally below the detection level of the commercial kit.

Background: Microbes are important to the health of the soil for two main reasons: 1) they fix nutrients in a form that makes them available to plants and 2) they form symbiotic relationships with plants that facilitate the uptake of nutrients and strengthens the resistance of plants to plant predators. It is well established that the number of microbes, bacteria, protozoa, and worms in a soil or compost sample is an index of fertility. The fertility value of a compost sample is in microbial population as the carbon and other nutrients are in this population. Horticulturists now know that they can extract the nutrients and organisms in compost into water to form Compost Extract (CE) or Compost Tea (CT) and the potency of this solution is dependent on the concentration and composition of microbes in the sample. This makes it very advantageous for a horticulturist to know the number of organisms in a sample of soil, compost, compost extract or compost tea etc. The estimation of the number of microbes by traditional laboratory methods, culture, is cumbersome and requires the use of many different types of media and takes up to a week, by which time the tested sample may not at all resemble the sample sent for testing. Soil Biometer™ allows the estimation of the number of organisms in a sample in the field within 2 minutes. The data may be used to determine whether a solution has sufficient potency to be used, how much a solution may be diluted, what corrective steps need to be implemented or to evaluate compost or soil samples.

Principle of the Test: As we all are aware, cloudiness or turbidity is a characteristic of microbial contamination. The turbidity of microbially contaminated samples is a function of the fact that the microbial bodies impede the passage of light through a sample because like a mirror they reflect light, therefore, light that flows through such a sample does not pass through in a straight line but is deflected by the bodies of the microbes. Obviously the more microbes the greater the deflection. In the laboratory we measure this by several methods all requiring sophisticated optical equipment. In the field, the ability to measure turbidity has traditionally been done using an instrument called a Turbidity Tube: This device developed by Secchi in the mid nineteenth century to estimate the particulate matter in water is now used by the forestry industry to evaluate water. We have developed an instrument we call the Biometer™ which operates on the same principle as the Turbidity Tube. The sensitivity of the Biometer™ is equal to that of hand spectrophotometers and its value for field use exceeds them in that it does not require batteries or calibration (using standards) before use.

The Biometer™ is a variation on the Turbidity Tube. A filtered sample is poured into a 10 cc graduated cylinder, the Biometer™, and the Biometer™ is placed over the black and white sample on the heading of this package insert. One then peers down the tube attempting to visualize the line between white and black. At the level of fluid where the line becomes not visible, the markings on the side of the Biometer™ tube indicate the number of organisms. The level correlates with the number of microbes (see chart).

Materials needed by not provided in 10 test kit: 10ml graduated cylinder (Biometer™) and clean water. To download the Powerpoint Life in the Soil, additional copies of the package insert and other experiments suggested for you, go to www.bergen.edu/qg and select Soil QC from the menu on the left.
Materials Provided in 10 test kit

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<td>Vial of Releasing agent</td>
<td>Disposable pipettes</td>
<td>Package of Control Sample</td>
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<td>Reaction Vials</td>
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Procedure

1. Pack the cup with the control sample and add to the reaction vial.
2. Fill reaction vial to 10 ml line with water.
3. Add 2 drops of Releasing Agent and cap.
4. Shake vigorously for 5 minutes or vortex for 1 minute.
5. Insert the filter onto the head of the syringe and remove the plunger.
6. Place the syringe and filter over the Biometer™.
7. Pour the fluid in the reaction vial into the 10 ml syringe attached to the filter.
8. Insert the plunger till all fluid is expressed into the Biometer™.
9. Place the graduated cylinder over the half black/half white circle at the top of this page.
10. Look down into the Biometer™ and using your disposable pipette remove sufficient fluid that you can just see the black/white divide. Anything that reads less than 5 has at least a billion microbes/ml.
11. To reuse the filter back rinse it with 10 ml of DI.
12. The Biometer™ is quite linear between 1.5 and 7. If your sample reads higher than 1.5, you can get an accurate reading by diluting it in half and multiplying your result by the dilution factor.

Activities

Count the number of bacteria in your sample.

Place 20ul of the material in your Biometer™ on a hemocytometer and count a total of 100 to 125 bacteria by counting the number of bacteria in a square in each corner (to account for bacteria that are on lines, count the bacteria that are touching 2 sides of the four sides of the square). If you don't have 100 with those four squares then count squares till you have counted at least 100 bacteria. Now divide the number you got by the number of squares and multiply by 1 million. This gives you the number of bacteria/ml in the Biometer™. However you diluted the sample 1/100 (the cup holds about 0.1gm and the water is 10 gm) so you must multiply by an additional 100. In summary:

Average # of bacteria per square x 100 Million = the # of bacteria/gm of your starting material.

Make a graph. After you have done the first reading remove the contents from the Biometer™ and dilute it 1:1 with water. Now read it in the Biometer™. Repeat to get readings at a 1:4 and 1:8 dilution. Use the readings to make a graph using excel or graph paper.

How much variation did the class get? Record the number of bacteria and the Biometer™ reading of each test for everyone in the class. Are they all the same? What might be the source of variation?

What happens when you use 2 capfuls of sample?