The microBIOMETER® Test for Microbial Biomass©

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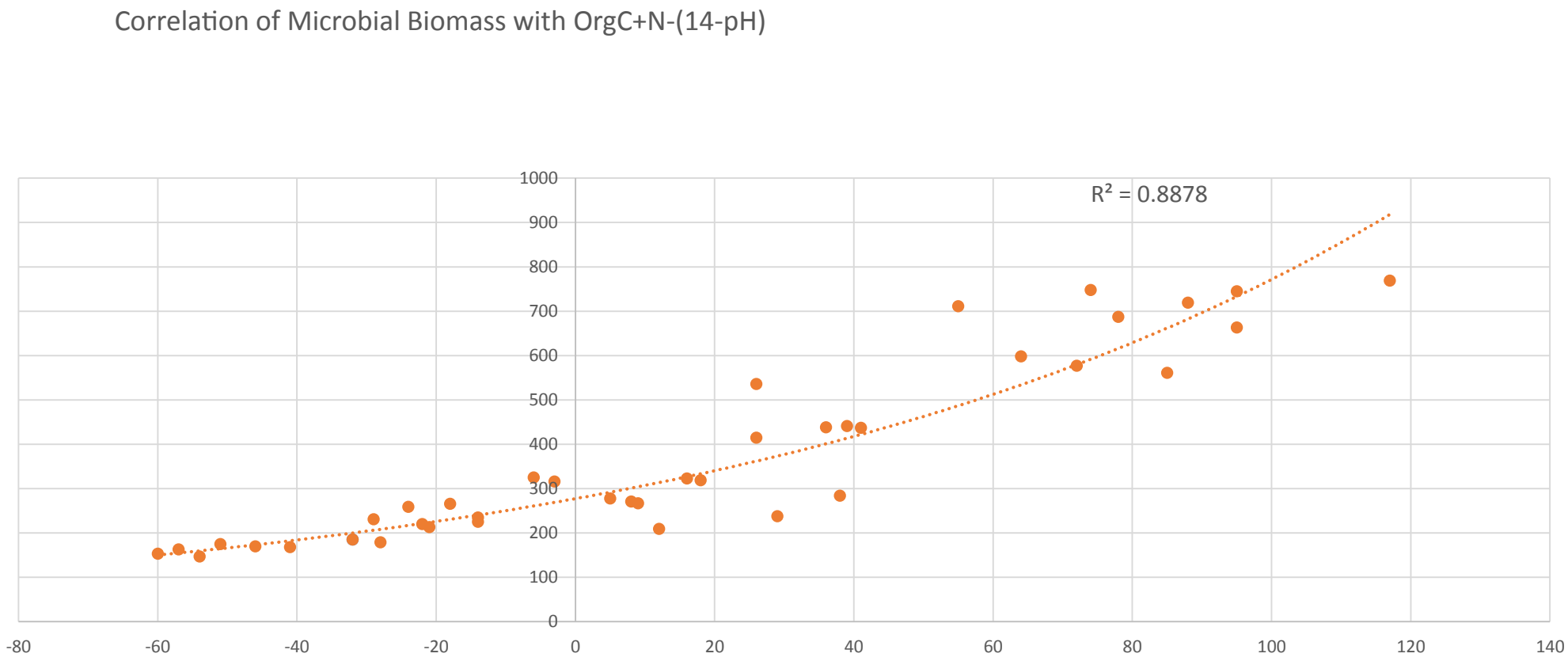
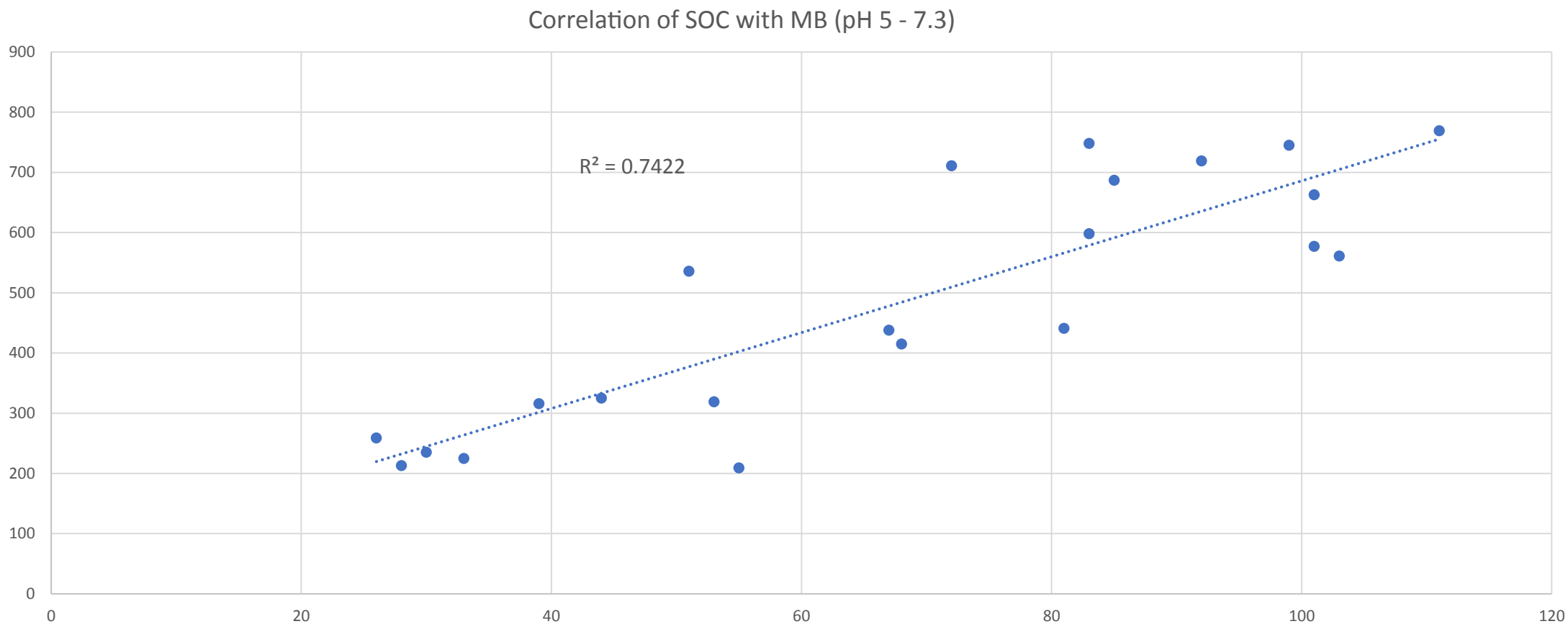
Why measure microbial biomass?

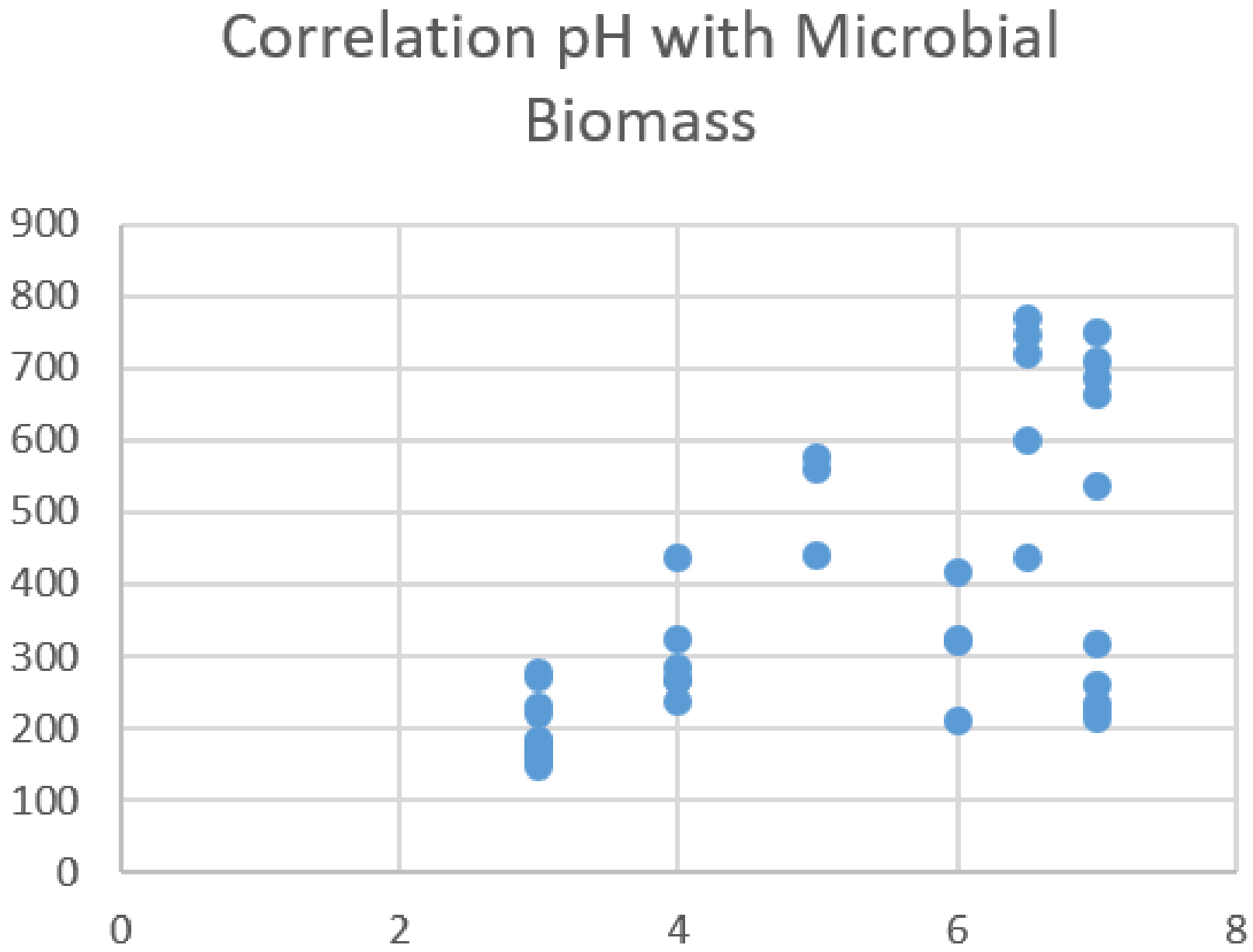
- Microbial biomass (MB) is the best single indicator of soil health (Doran 2000).
- MB is low in any situation that is harmful to plant growth & viceversa.
- MB can predict success before plant outcome.
- MB can indicate that Carbon is being sequestered.
- MB correlates with other widely accepted soil health indicators, such as Nitrogen, Soil Organic Carbon (SOC), and pH as is seen in the following data taken from Anderson and Domsch 1989.

Correlation of microbial biomass with SOC, N,& adjusted for pH (14-pH). Data from Anderson and Domsch.

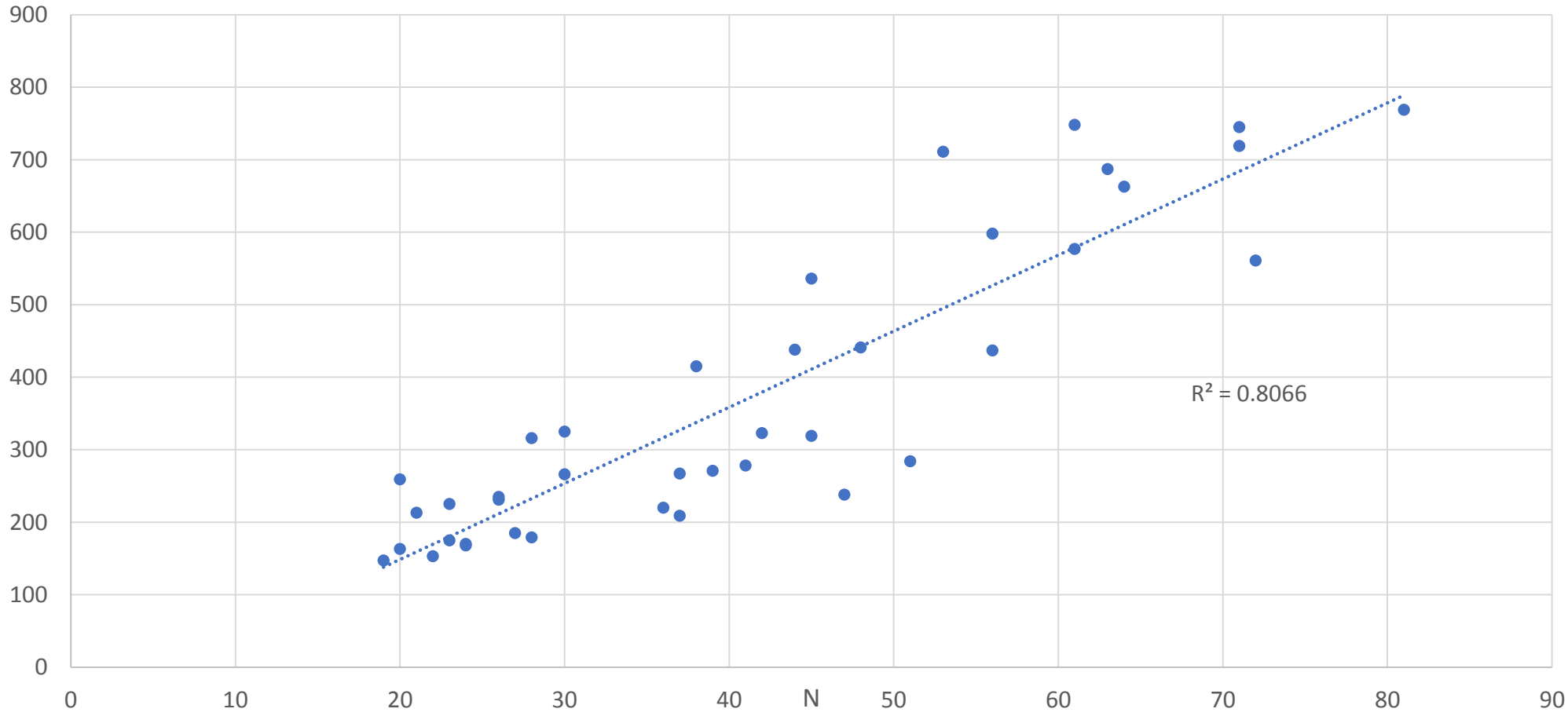


Correlation of SOC with MB for samples at pH 5-7.3




Correlation pH with Microbial Biomass
900
800
700
600
500
400
300
200
100
0
0
2
4
6
8

Correlation of N with MB C (FE) Data from Anderson and Domsch



MicroBiometer®

- 10 minutes
- USD10
- 10X cheaper than any other method.
- Less than 10% Error

- Cell phone calculates results
- Data is stored in the cloud.

The key to success is a good soil sample.

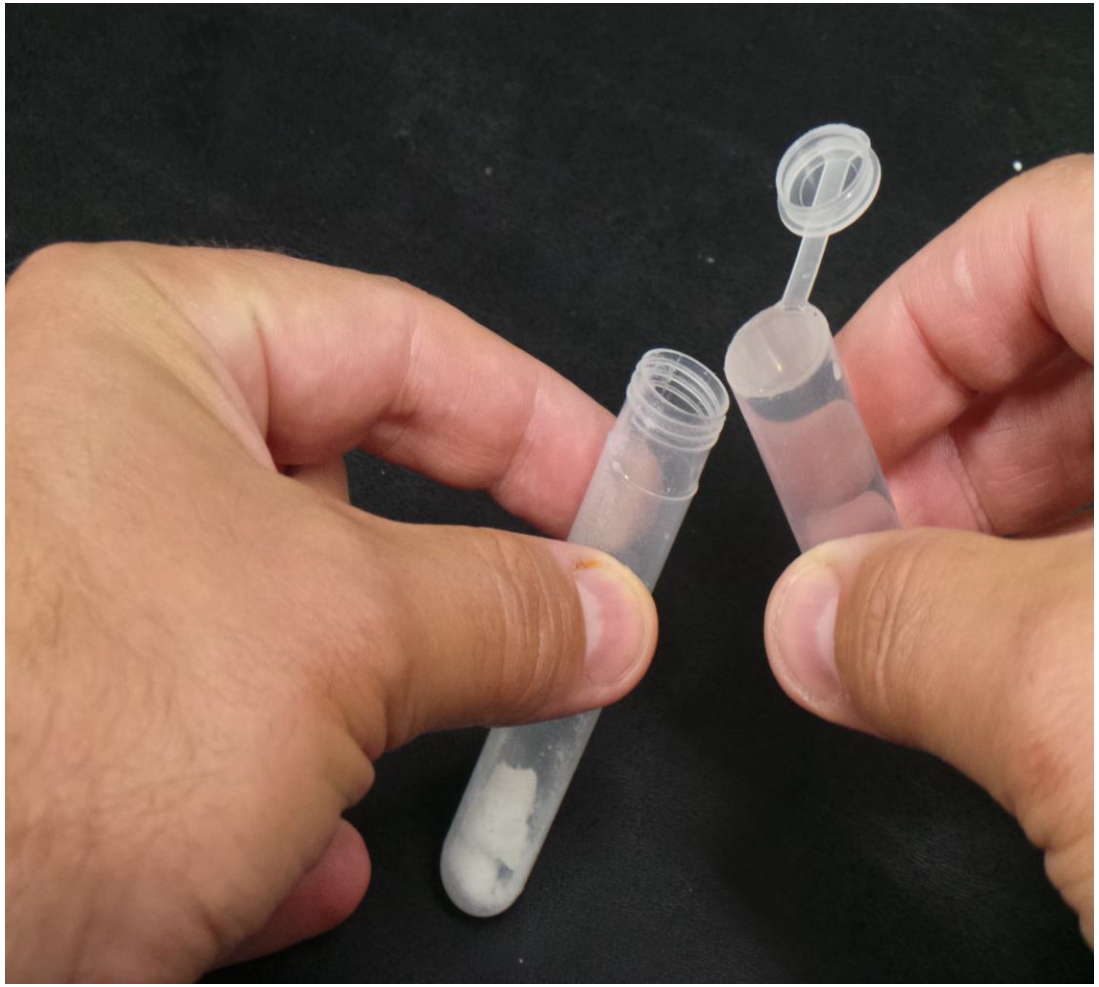
- Soil should be collected within 24 hours of a good rain or drenching.
- Brush away litter or mulch before taking soil.
- Soils should be taken from the top 1-3 inches about 3-6 inches from a plant stem depending on size.
- The soil should be sifted to remove stones, roots or debris.

Accurately measure out your sample.

- The soil sampler allows you to accurately measure ½ cc of soil. If the soil is packed in a tightly as possible then the accuracy of the measurement is 95%.

- The accuracy of your results rely on accurate soil sample measurement.

The extraction powder contains a patented mix of salts and detergent that loosen the microbes from the soil.



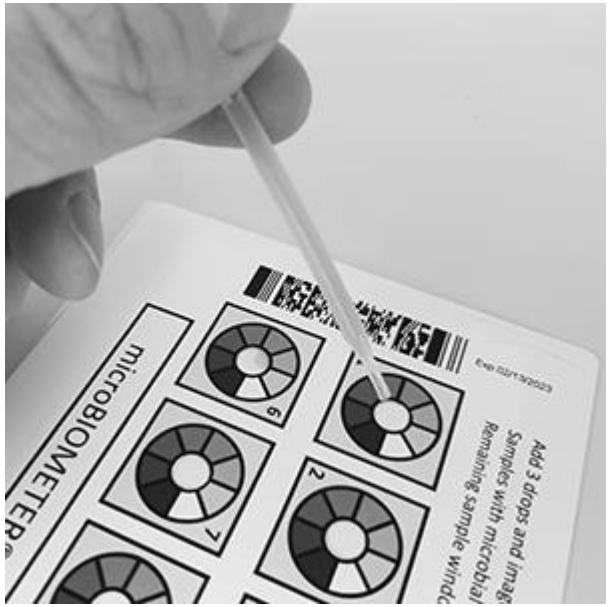
- Fill the measuring vial with water and add the water to the extraction tube that contains the extraction powder. Replace the cap and shake the tube to capture any powder in the cap.
- As with measuring out the soil, measuring the water and making sure that you use all the extraction powder is critical for an accurate result.
- **The extraction powder needs to be used within an hour of water addition. It has no preservatives.**

Add your soil sample to the extraction fluid.

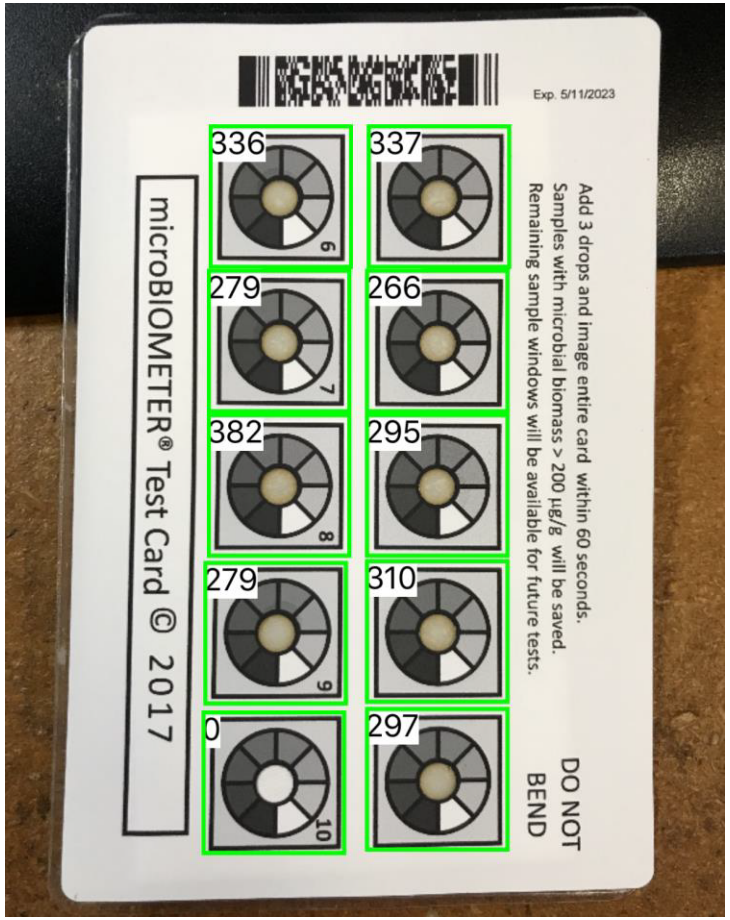
Whisking completes the separation of the microbes from the soil.

- The whisker we provide has been carefully manufactured for us so that a consistent portion of microbes are released from the soil particles in 30 seconds. It is important not to use other whiskers because the power of the whisk can disrupt the microbes or if it is too low, microbes will not be released from the soil.

In 10 minutes the soil particles have precipitated and the beige fluid you see is >95% microbial. We provide a short pipette that delivers 30 ul of soil/drop to the window of our card and limits sampling to the top 1 inch of the tube.



The app takes a picture of the card and calculates the ug microbial carbon/g of soil based on the dry weight of microbes being 50% carbon.



- Based on our correlation with PLFA we suggest the following ranking of results

- <200 very poor
- 200 – 300 low
- 300 – 400 average
- 400-500 good
- >500 excellent

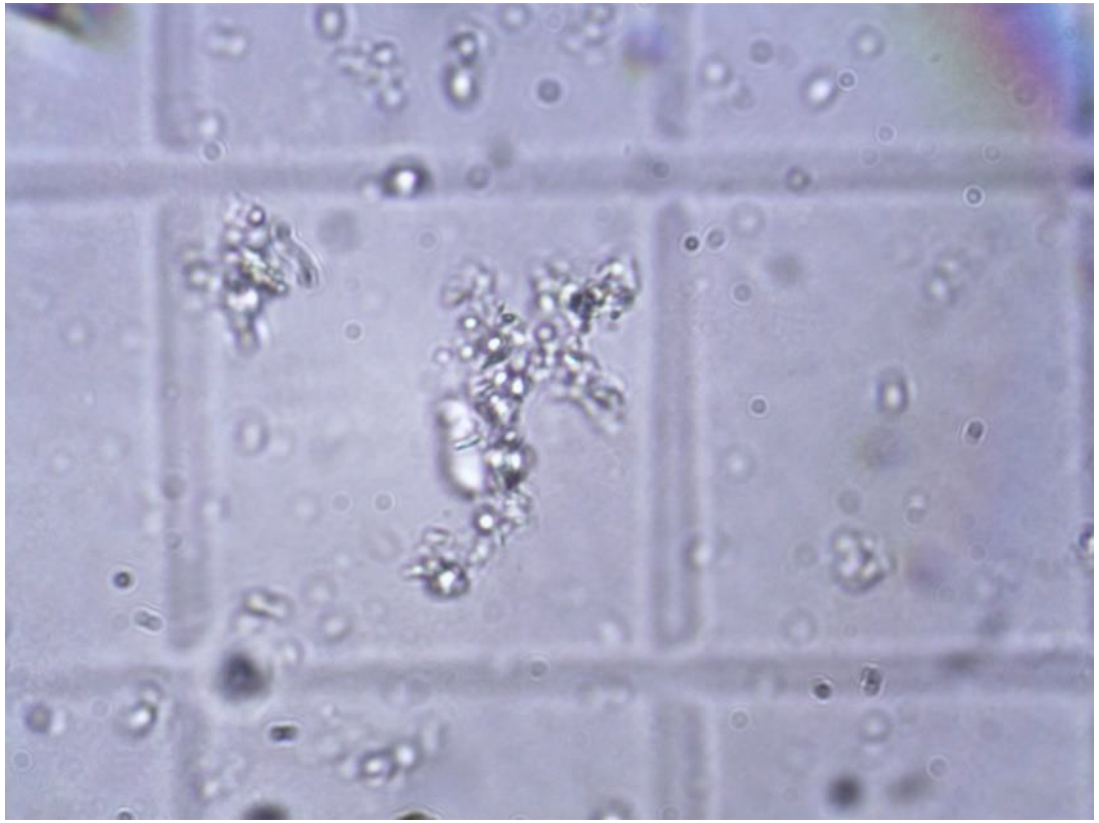
Problems with current methods

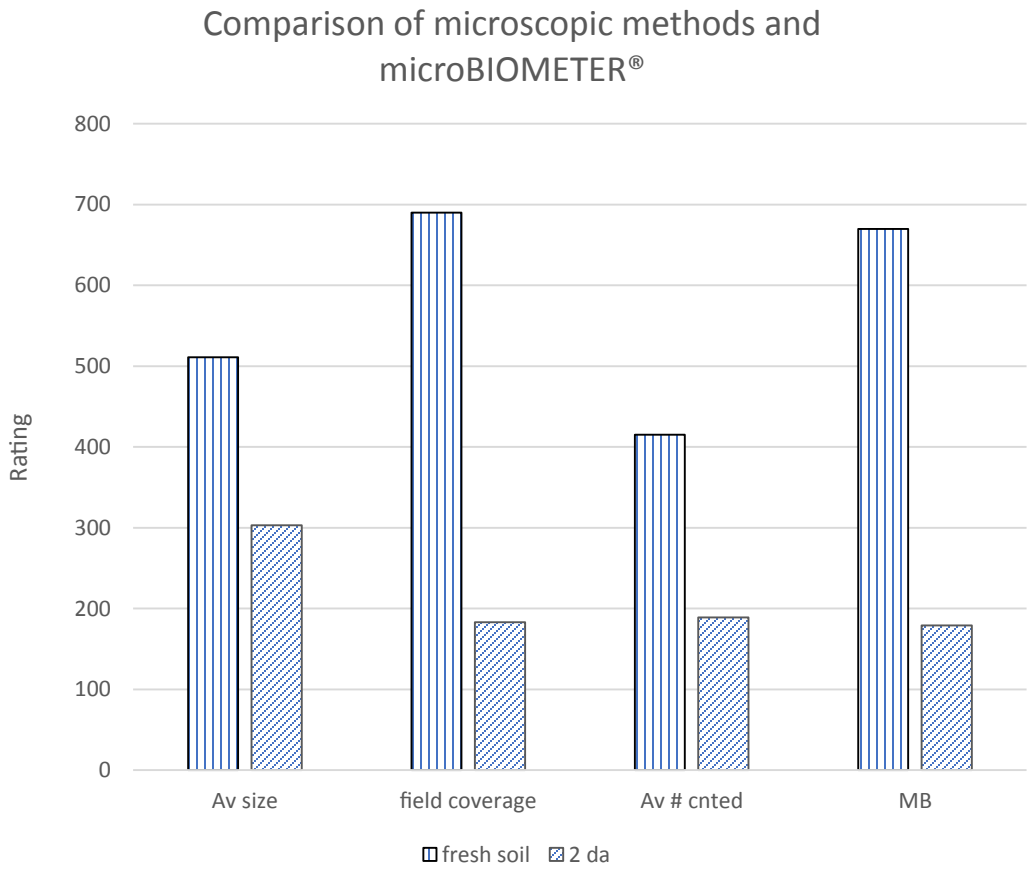
- Standard practices for measuring MB are *error-prone, laborious, inconsistent and expensive*.
- Current methods extract and measure a small component of the MB (e.g. Carbon, phospholipid fatty acids, or DNA) and then multiply the result by 2 factors:
    1. An ***estimate*** of the fraction of that component in the microbial population.
    2. An ***estimate*** of the efficiency of the extraction method(s).
- Uncertainties about extraction efficiencies create uncertainties in measurements.
- Current methods are technique dependent and in many research labs are not routine. Therefore, run-to-run and lab to lab variation can greatly affect consistency, leading to large study-to-study and lab-to-lab variability.
- Current methods are performed in labs and the soil is aged and changed from the time of collection.

How did we calculate microbial biomass

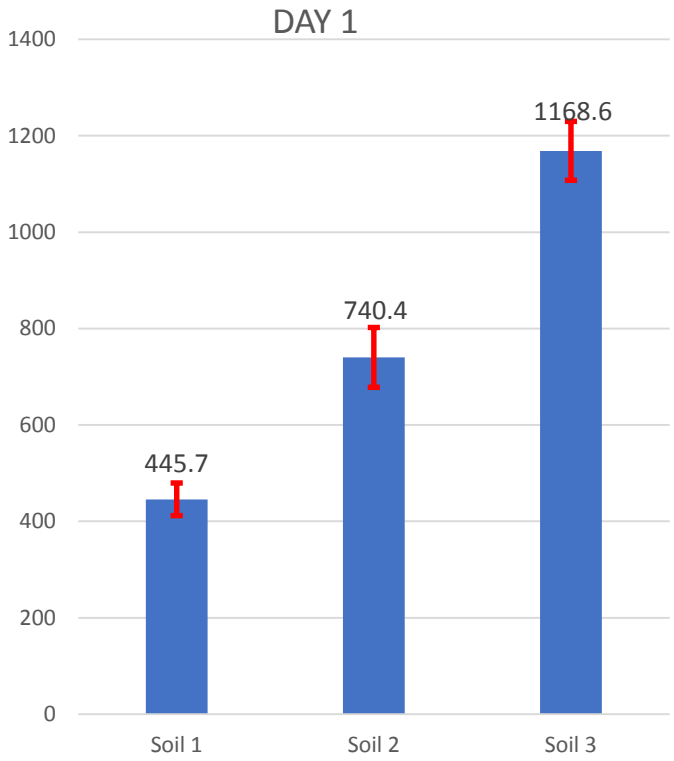
a) We correlated with PLFA
b) We measured the volume of the microbes in a sample.
    a) A Neubauer slide contains a set volume in one of squares show in next slide.
    b) The volume of the microbes in that area can be calculated using Image J
    c) The volume of the Neubauer square is 25ul.
    d) The volume of the tube is 10 ml so multiplying the % volume of the average of squares can be used to multiply by 10. This is the volume of cells in 0.6 g of soil (the average of soil sampler measured soil after drying).
    e) The number is corrected by multiplying by 10/6 and it is halved because the dry weight of microbes is assumed to be 50% Carbon.
    f) The gold standard for estimating microbial biomass is the chloroform fumigation method: it measures microbial carbon. So we express M biomass as ug microbial C.

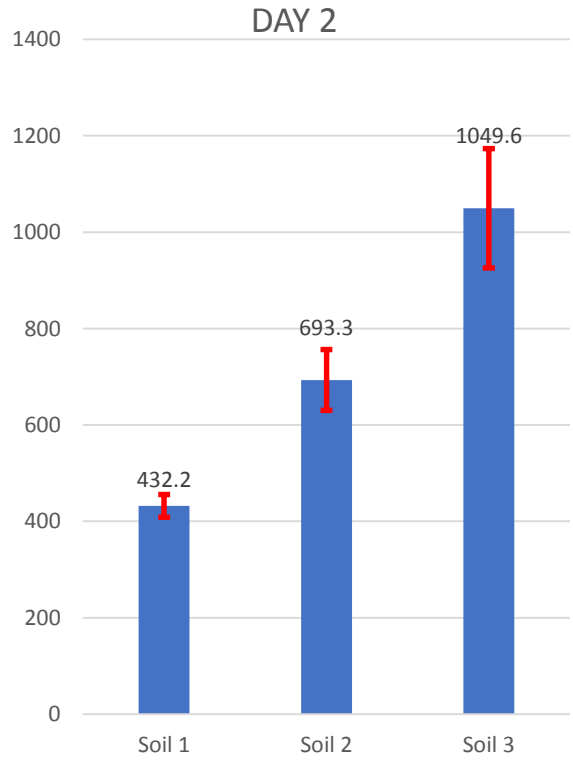
Extracted Microbial Biomass on a Neubauer slide and how Image J correlated with microBIOMETER®

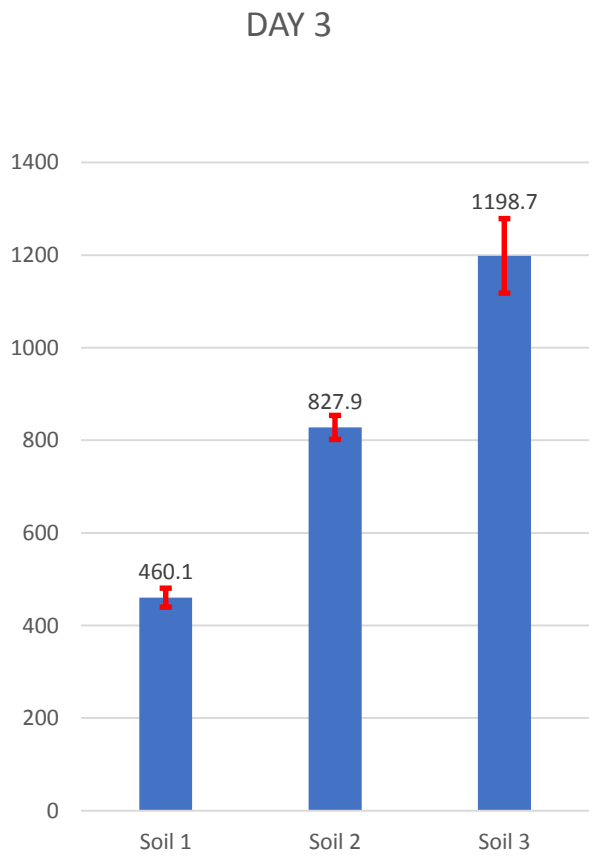




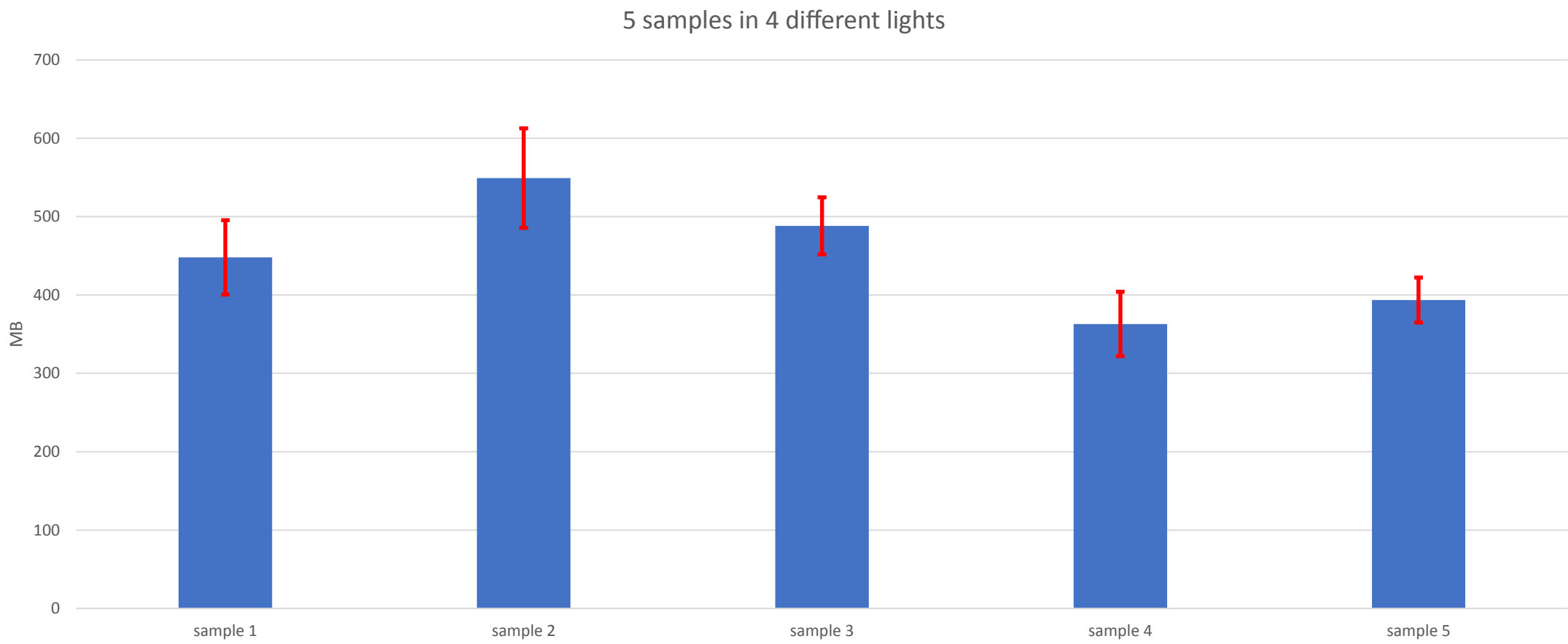
Reproducibility and precision of the Test



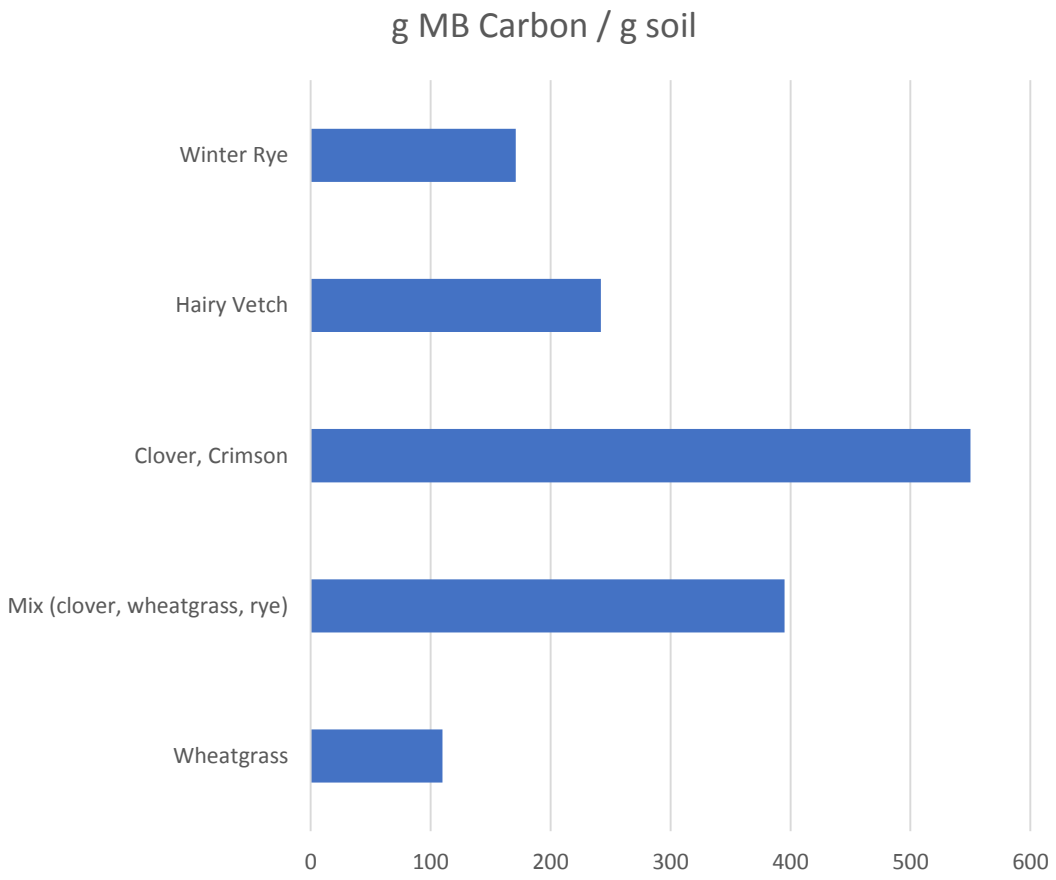


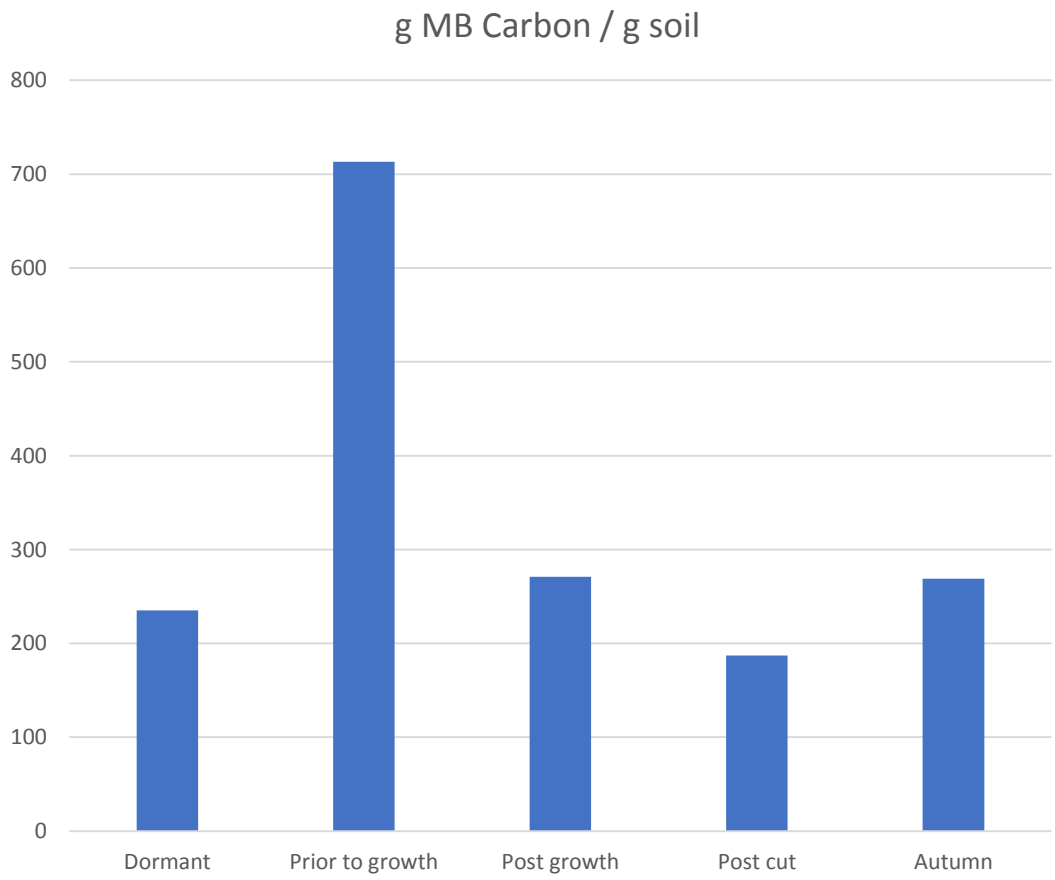


Variation in estimated value for 5 samples read in 4 different light conditions.

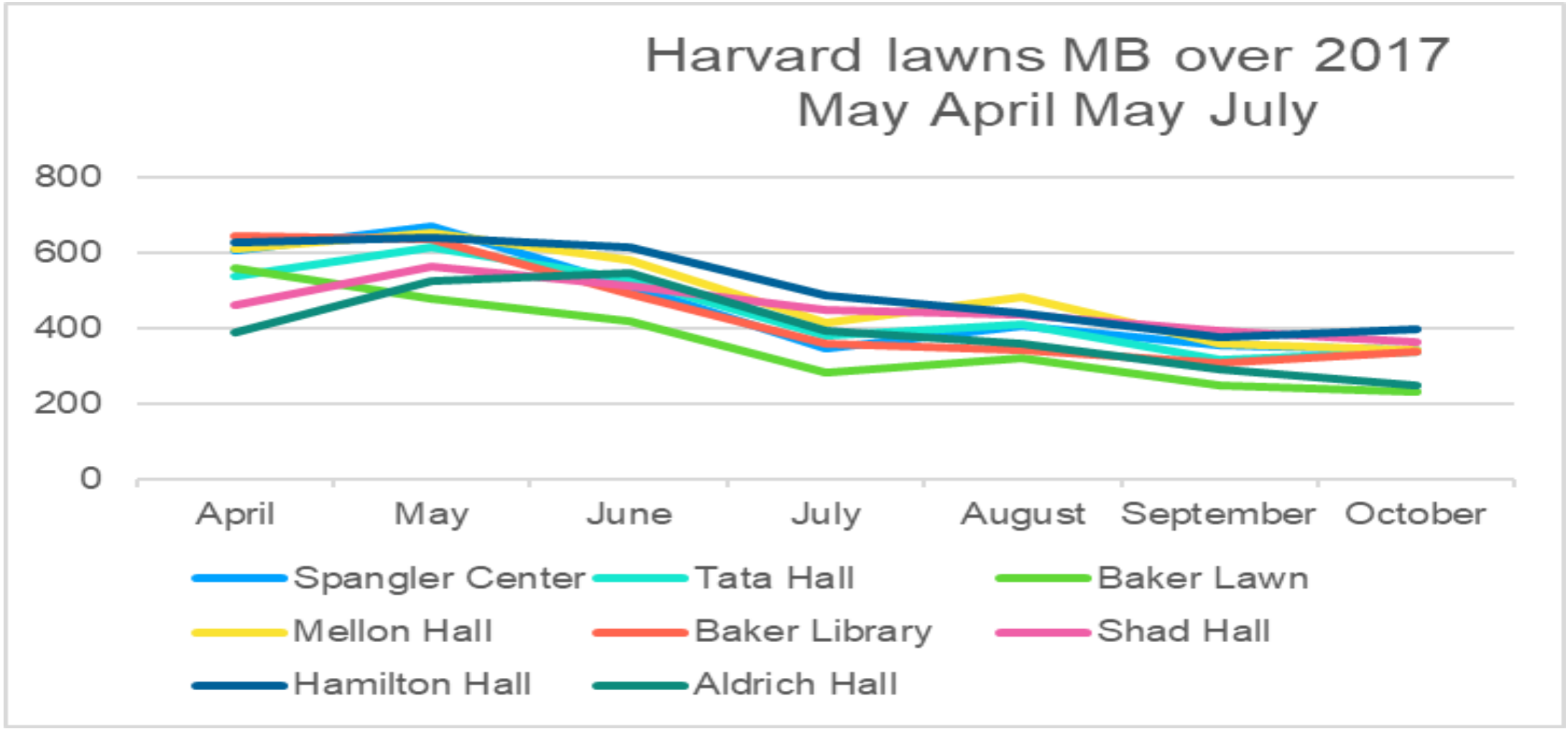


Uses of microBiometer

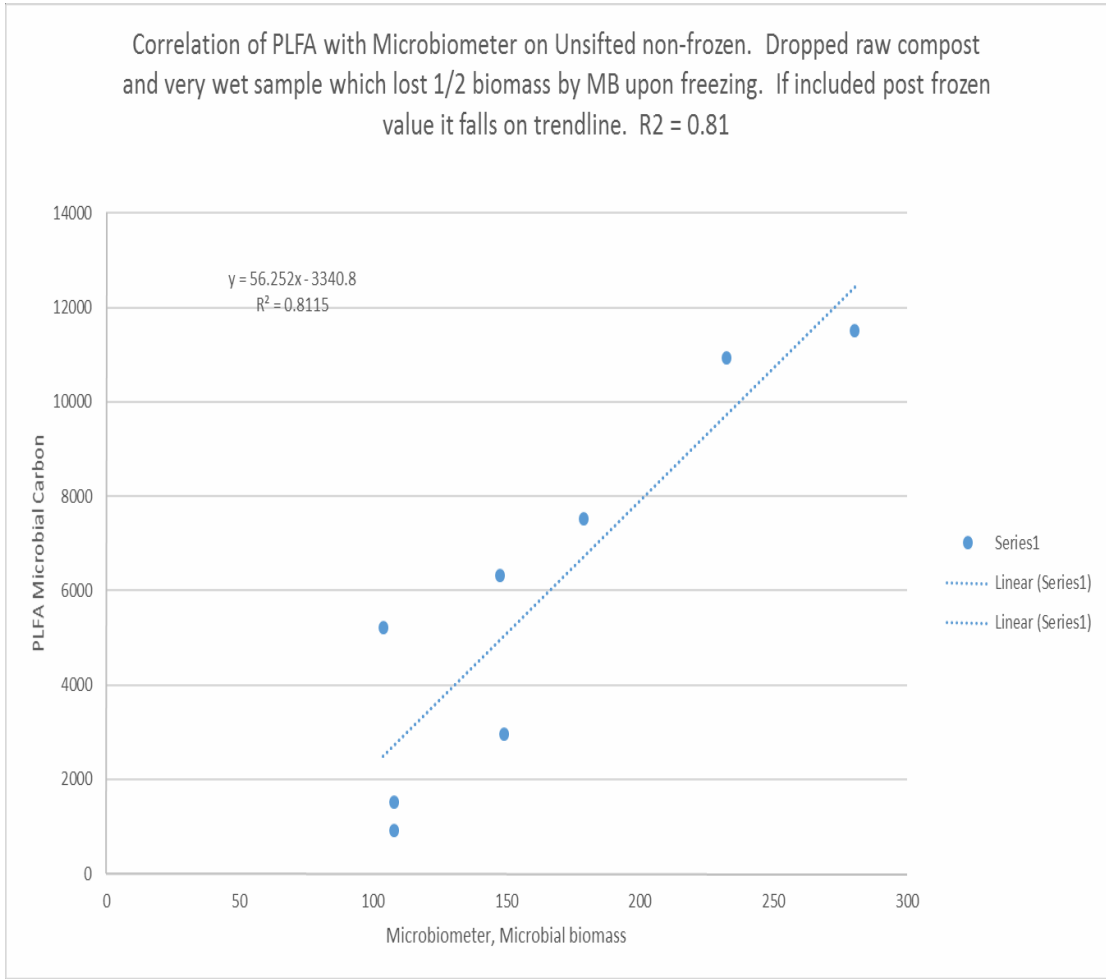




Routinely we see that MB is higher in spring and declines during the year.



Accuracy



Correlation of MicroBiometerTM sample values with Phospholipid Fatty Acid Analysis (PLFA) done at Ward Labs.

Ward freeze thaws the sample (a technique used to kill microbes) and then dries them before extracting the PLFAs which are considered to be good indicators of living microbes as they degrade very quickly upon cell death.

Correlations of PLFA with Carbon Fumigation results are commonly R2 ~0.8 (this number indicates 90% similarity).

The Natural Rhythm of Growth

- The microBIOMETER® is a valuable tool for researchers, growers, and landscapers. We designed the test by adhering to the following constraints:
    - Use no hazardous chemicals
    - Limit the number of steps where errors can occur
    - Provide rapid analysis
    - Be reproducible and consistent in different environments and lighting conditions

The microBIOMETER® test has proved useful for evaluating:

- Soil health – it correlates with soil health assessment by PLFA and microscopy.
- Efficacy of cover crops – some cover crops obviously supplement soil deficiencies better than others. Testing before planting saves money and time.
- Plant health – time and time again we have shown that the soil around dead and dying or unhealthy plants is low and recovers when the deficiency is remediated.
- Efficacy of remediation efforts – if a treatment is working soil microbes respond within days.
- Nutrient level of compost. The higher the microbial count the better the nutrient level.
- Value of different treatments on soil health.
- Carbon sequestration which improves the long term health of soil – humus is ~90% microbial necromass and increasing microbial biomass has been demonstrated to increase humic matter.

Thank you

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