

On-Farm Soil Quality Testing in Organic, Integrated and Conventional Peach Orchard Systems



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Introduction

As input costs rise and water resources are increasingly limited, effective methods of evaluating soil quality and fertility is of growing importance. Standard commercial tests typically quantify soil chemistry. Soil chemistry alone can't predict soil aggradation or degradation trends due to management. The objective of this research is to identify a subset of user-friendly tests that are most sensitive indicators of soil quality. The goal of this study is to increase the role of farmers in the maintenance and health of their soils, which could potentially reduce nutrient overload, soil erosion and degradation of ecosystem services on and off-site.

Objectives

- Compare results of simple soil quality testing strategies (biological, physical and chemical) to comparable lab tests.
- Earthworm abundance test, on-site berlese test, litterbag test, Solvita respiration test and soil biodiversity test vs. microbial biomass and dehydrogenase activity.
- In field soil slaking test, NRCS slaking test and hose test vs. in lab aggregate stability test
- Lamotte's, Rapid test NPK and Mosser test kit vs. lab NPK analysis

Methods

Tests were conducted in the peach (*Prunus persica*) orchard established (2008) at the Utah State Agricultural Experimental Station in Kaysville on the following four treatments:

SG) straw mulch with grass (*Festuca rubra* and *Lolium perenne*) alleyway

ST) straw mulch with Birdsfoot Trefoil (*Lotus corniculatus*) alleyway

TG) tillage with grass alleyway

HN) herbicide with NPK with grass alleyway

Alleyway treatments



Birdsfoot Trefoil



Perennial Grass

Tree-row treatments



Straw



Tillage



Herbicide

Methods

Soil Quality Indicators: Biological

Field Test: Earthworm abundance test

1'x1'x1' hole was dug in each designated test plot. The soil from the hole was removed into a bucket. One handful at a time, the soil was taken from the bucket and searched for worms and other soil organisms. The number of worms and different kinds of organisms was recorded.



Field Test: Solvita Respiration test kit



Approx. 100g of wet soil was placed in a Solvita respiration cup. A probe was inserted into the soil and the lid tightly closed. After 24 hours, the colors on the probes were matched to the color indicator chart to determine CO₂ reading.

Lab Comparison: Soil Respiration Incubation

Mineralizable carbon (MinC), basal respiration (BR), and microbial biomass (Cmic) determined by substrate induced respiration (SIR) were measured with an infrared CO₂ analyzer (Model 6251, LICOR Biosciences) on day 12, 13, and 14 of an incubation at 25°C and 22% moisture as described by Anderson and Domsch (1978) and Davidson et al. (1987).

Soil Quality Indicators: Physical

Field test: Slaking Test

A large sieve was filled to the rim with dried unsieved soil. Note was taken on the structure of the soil. The sieve and soil were soaked in a bucket of water for 5 minutes, then the sieve was briefly immersed 5 more times into the bucket. Percent soil aggregates were measured after this process.



Lab Comparison: Mechanical aggregate stability instrument

4g of sieved and dried soil, was pre-moistened with steam to 4.75g soil wet weight, and placed into mechanical sieves. The instrument submerges the sieves in and out of water for three minutes. The soil that washes into the water after the sieving process, was dried and weighed. The sieves were then submerged into a salt water to attain the stable soil aggregate. The salt water is dried, and the initial soil lost is added to the stable soil lost minus the salts and divided by the stable aggregates, for % stable aggregates. (Kemper and Rosenau 1986)

Soil Quality Indicators: Chemical

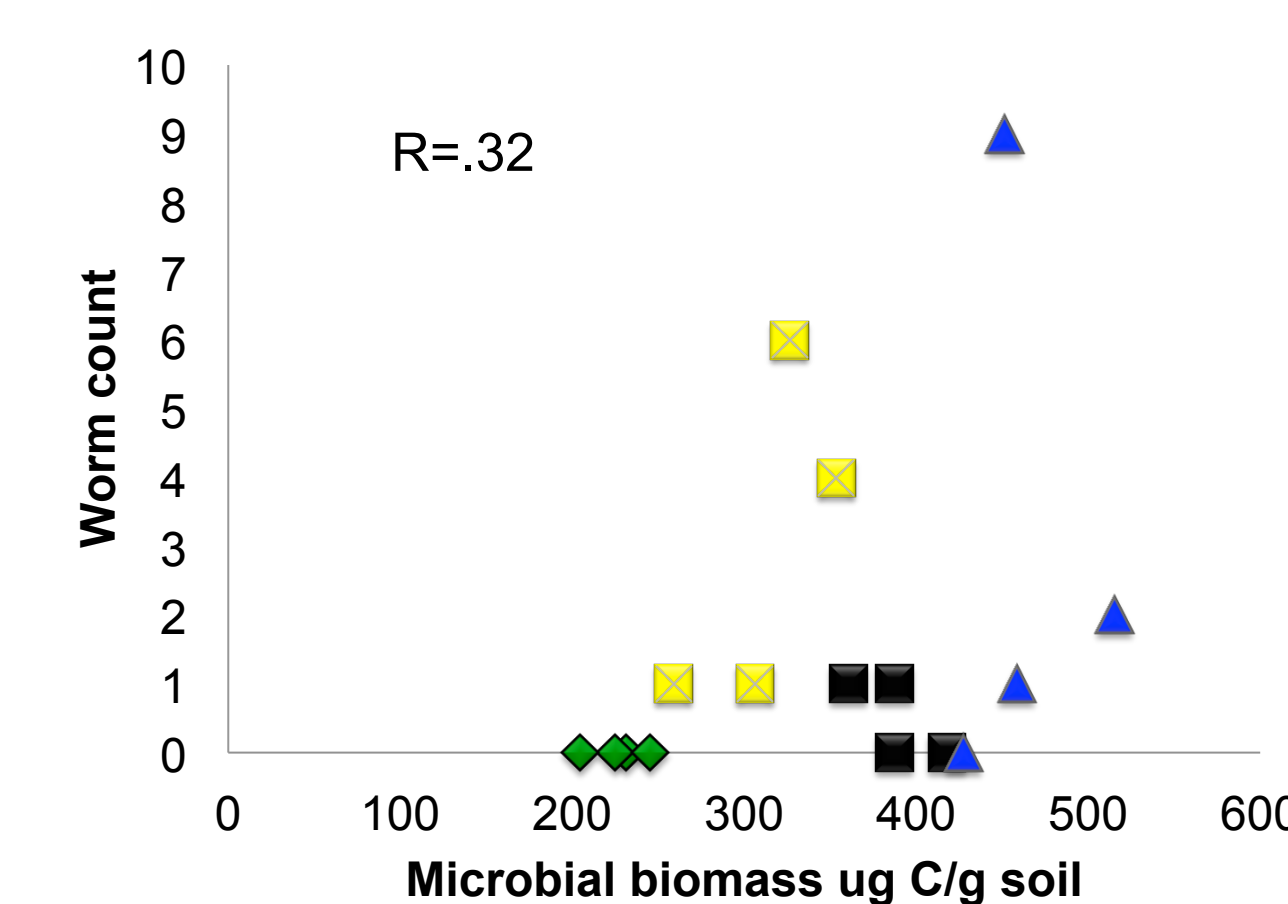
Field test and lab comparison: Commercially available on-site chemical tests for farmers, include the Rapid test and the Lamotte test kit. These tests were rated for their accuracy when compared with standard laboratory methods for nitrogen, potassium, phosphorus and pH.

Statistical Analysis

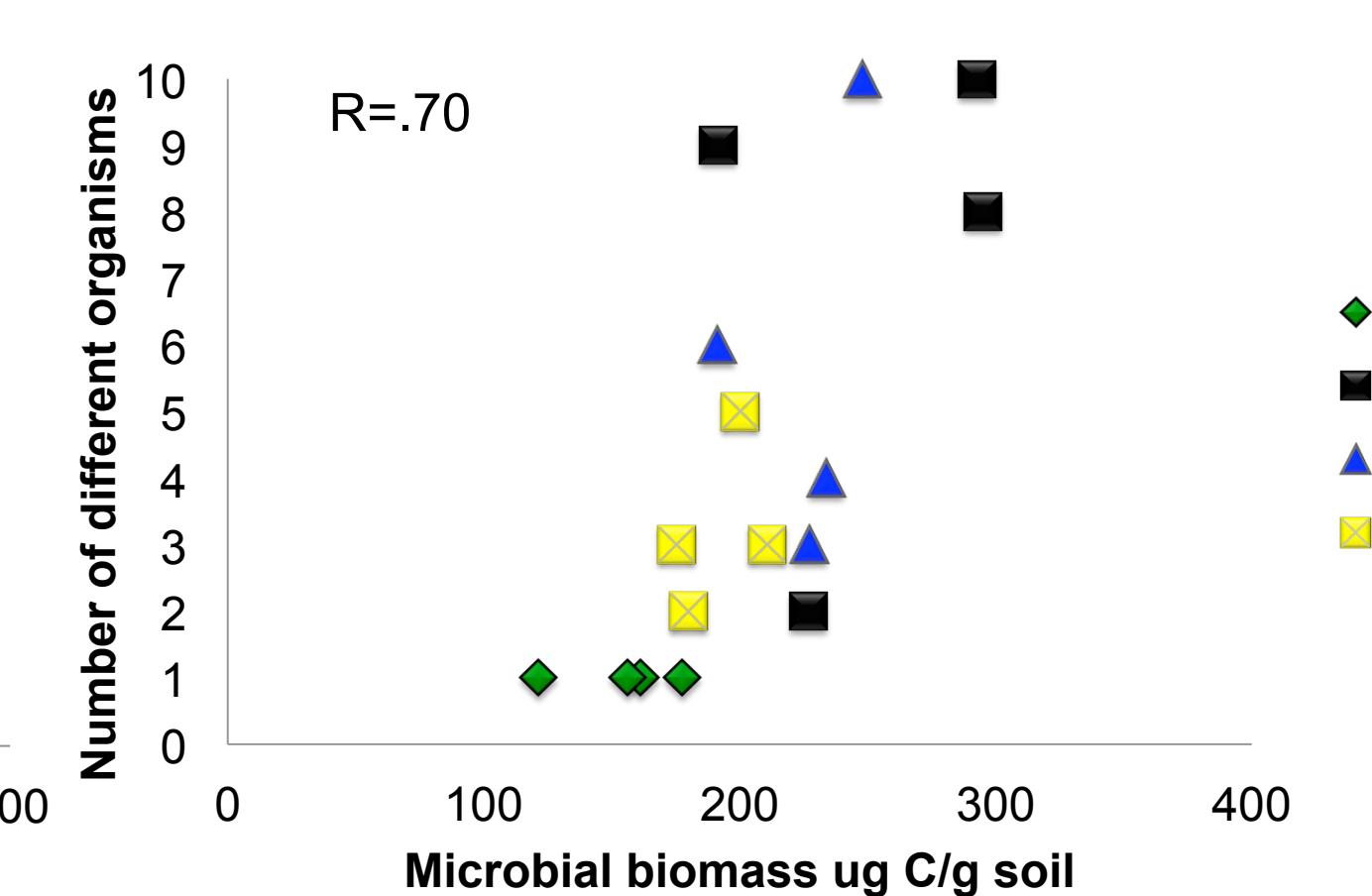
All simple tests were compared to laboratory tests using Pearson's Correlation.

Results for Biological, Physical and Chemical tests

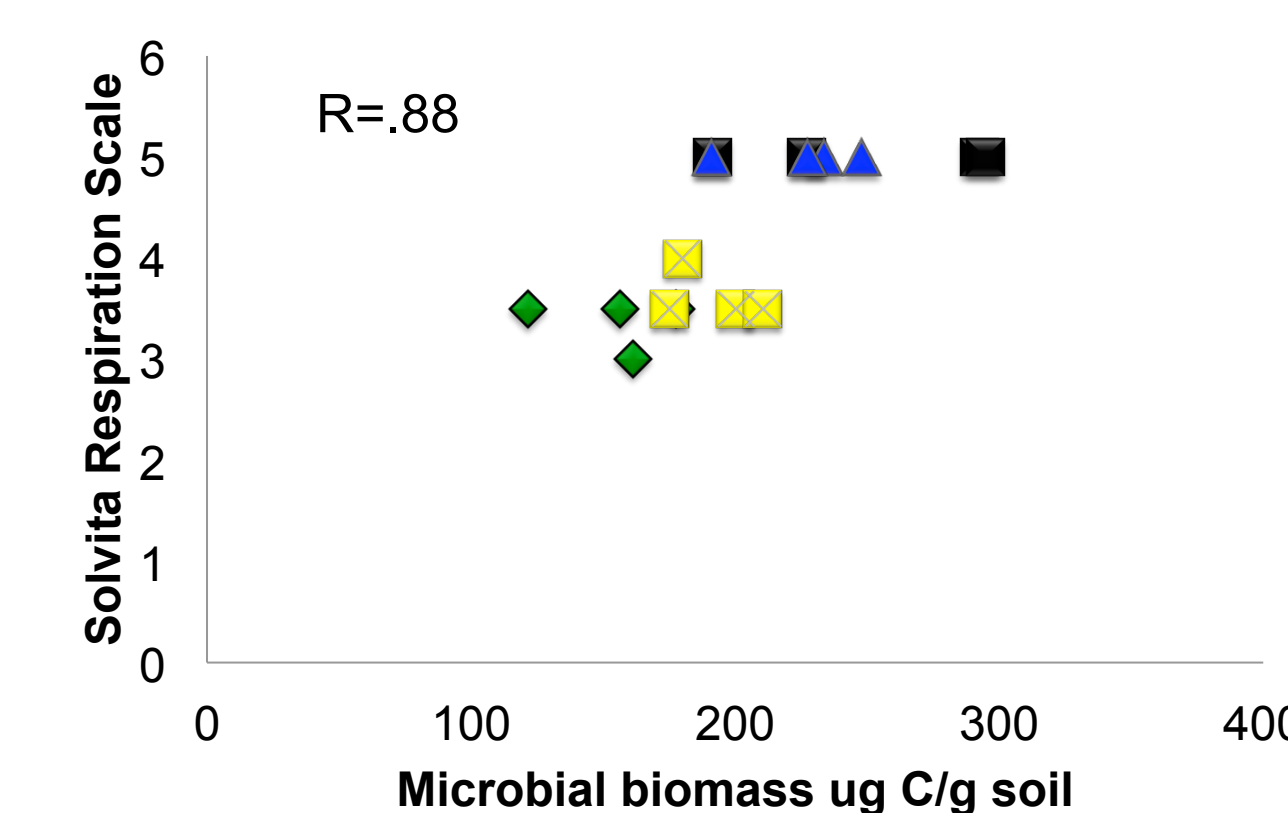
Earthworm abundance test vs. microbial biomass



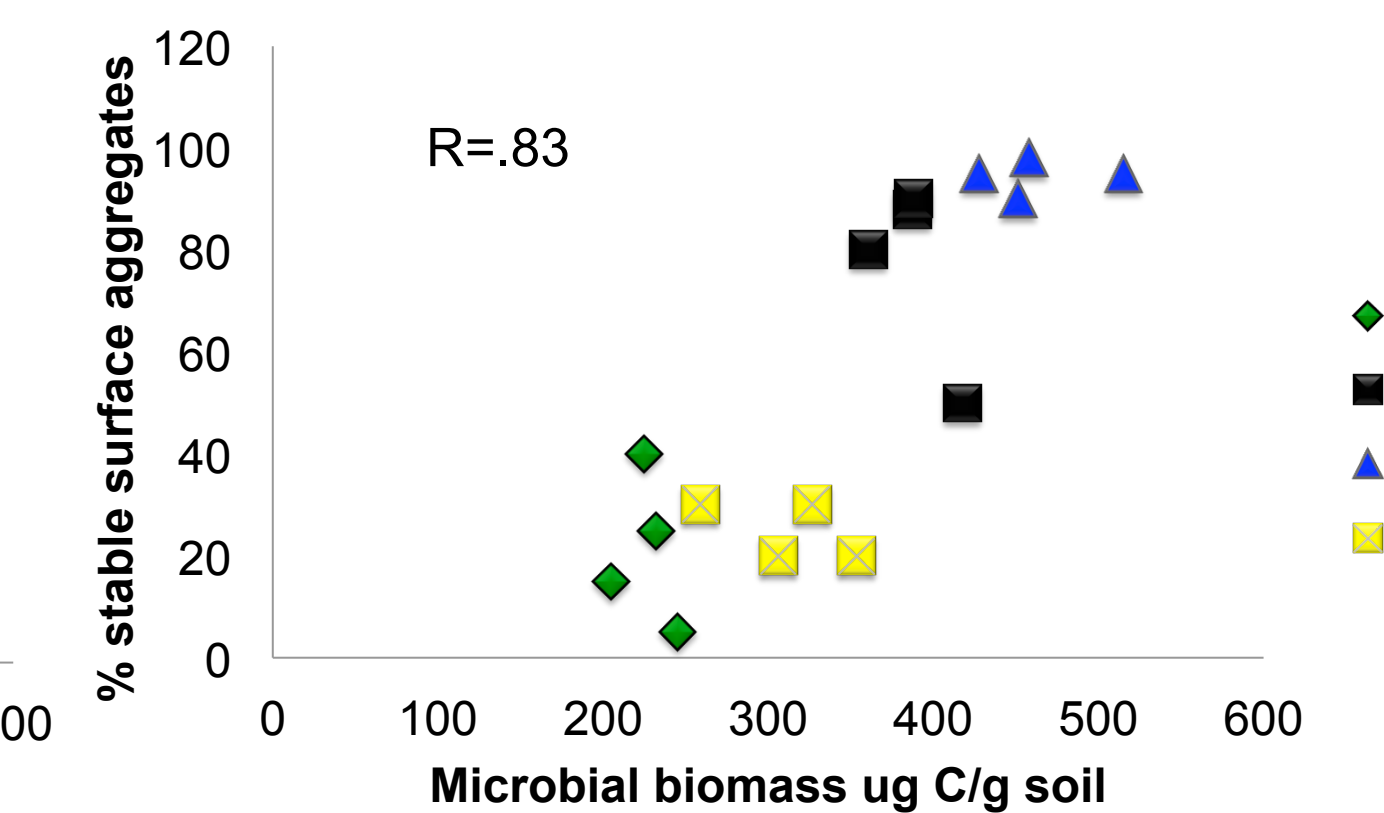
Soil biodiversity vs. microbial biomass



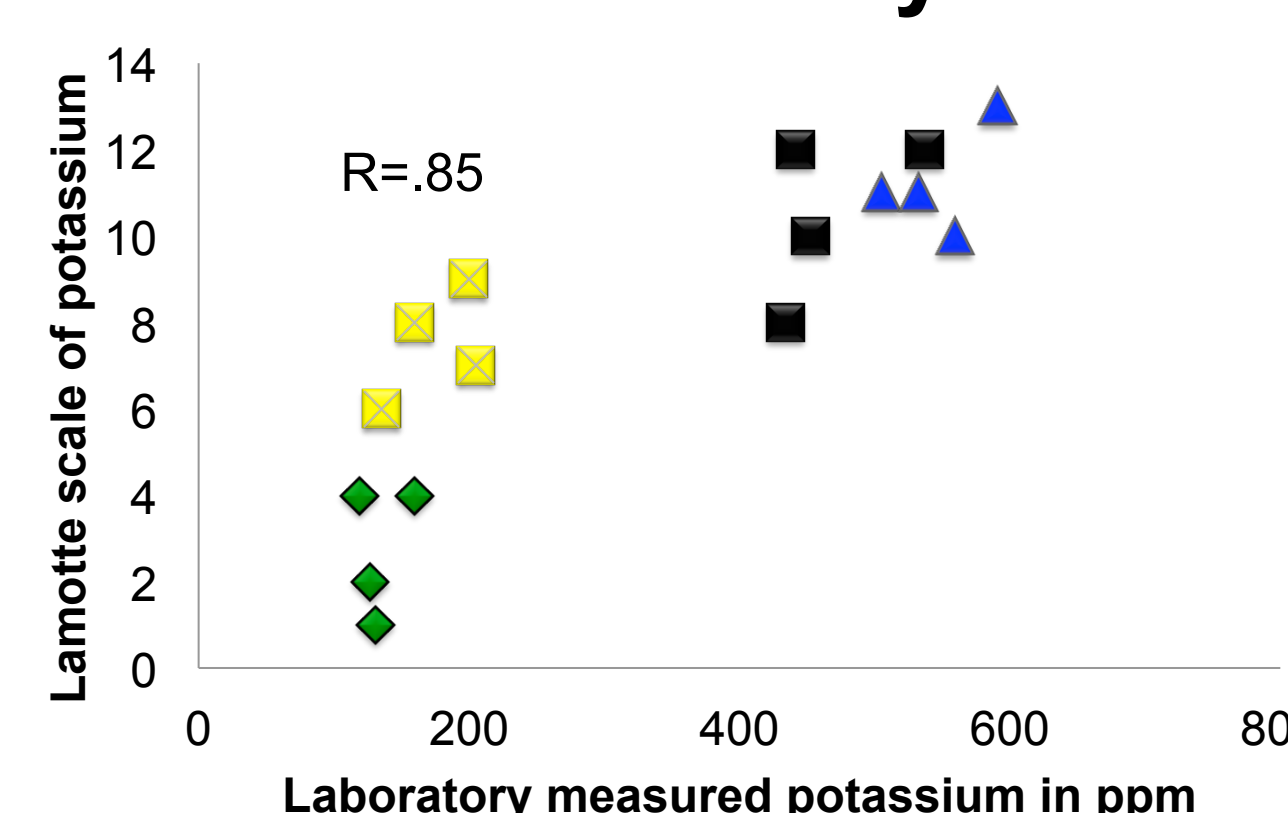
Solvita respiration vs. microbial biomass



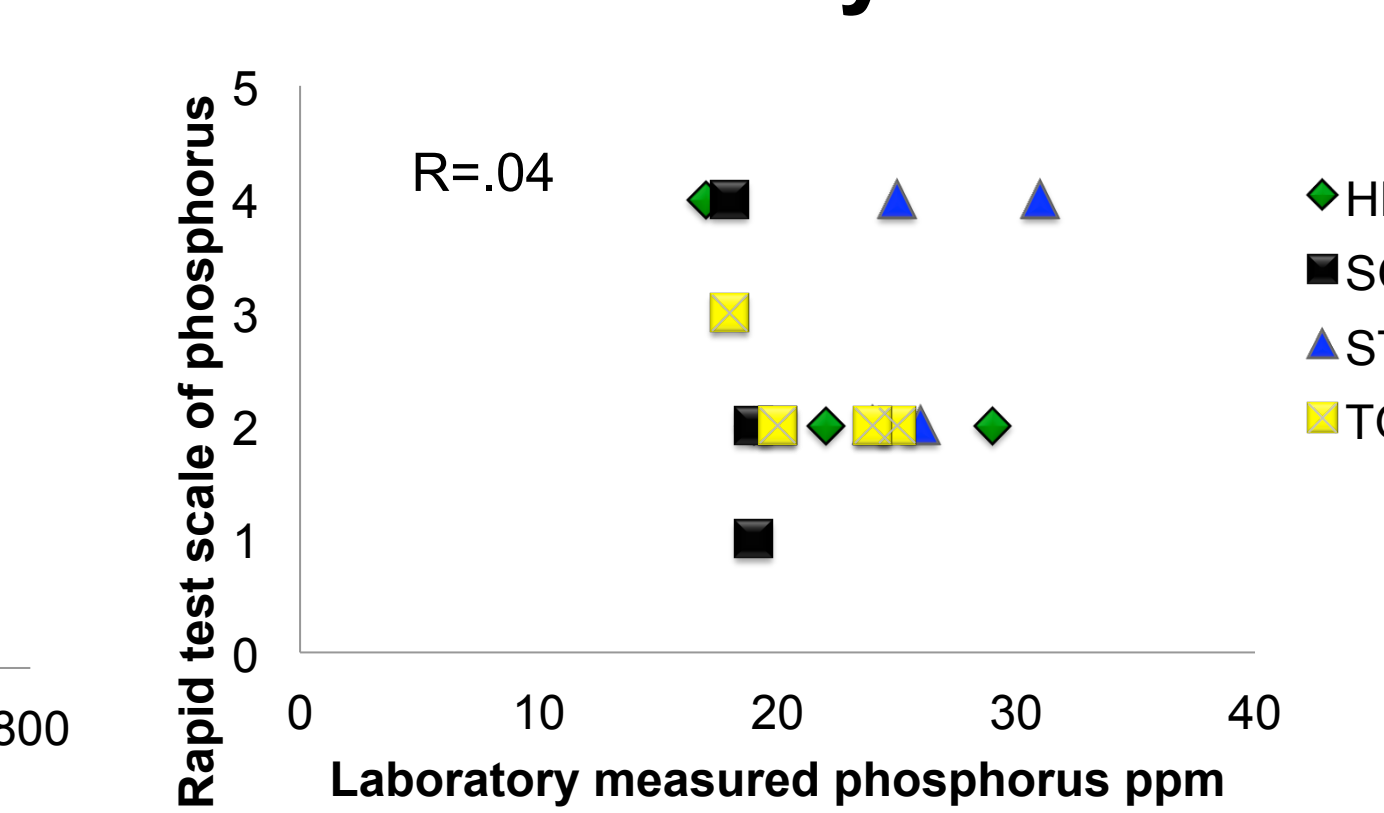
Slake test vs. microbial biomass



Lamotte simple test K with Laboratory K



Rapid Test P with Laboratory P



Conclusions

The best correlation was found between Solvita respiration and microbial biomass (R = 0.88). Followed by the Lamotte simple potassium test compared to laboratory measured potassium (R = 0.85). The best correlation among physical tests was the slaking test, and although it did not correlate to the lab aggregate stability test it was closely correlated to microbial biomass (R = 0.83). The weakest simple chemical test was the Rapidtest for phosphorus (R = 0.04). Modified slake tests, Solvita respiration and soil organism diversity counts may be efficient and cost effective tools for monitoring soil quality on site. The Lamotte potassium test was the only test out of the simple chemical tests that was not a weak indicator of soil nutrients.

References

- Anderson J.P.E., Domsch K.H. (1978) A physiological method for the quantitative measurement of microbial biomass in soils. *Soil Biology and Biochemistry* 10:215-221.
- Davidson E.A., Galloway L.F., Strand M.K. (1987) Assessing available carbon: Comparison of techniques across selected forest soils 1. *Communications in Soil Science and Plant Analysis* 18:45-64. DOI: 10.1080/00103628709367802.
- Kemper W.D. and Rosenau R.C. (1986) Aggregate Stability and Size Distribution. *Methods of Soil Analysis, Part 1. Physical and Mineralogical Methods-Agronomy Monograph no. 9* (2nd Edition).