RHIZOTERRA
Healthy Soil for a Healthy World

Solvita® Soil Respiration Procedure

Solvita® Soil Respiration* is performed with undisturbed or fresh, moist soil that has not been adjusted or pre-dried. The test may also be performed directly in the field with a cylindrical chamber inserted into the soil. This method gives results typical of actual field conditions but tend to be inherently more variable than lab results.

1. **SAMPLING:** Soil should be freshly sampled in a normal moist condition shortly before the test is performed. Take at least 6 random samples 0 - 3” (0 - 7.5cm) depth from various locations and mix thoroughly, removing stones, roots and organic debris.

2. **IDEAL SOIL MOISTURE:** For this test the soil should be sampled moist as would be normal for optimal growing conditions. If moisture is added to a very dry soil, the sample should be allowed to equilibrate for 24 hours before testing. If performing in-situ (field) tests, soil is tested in the as-is condition.

3. **PUT SAMPLE IN SOLVITA® JAR:** Put the fresh, moist soil in the jar up to the fill line. A natural soil profile or turf plug may also be inserted in the jar to reproduce actual field conditions. Alternatively, a 3” (7.5cm) cylinder may be inserted into the field soil for in-situ testing as per the USDA-NRCS instructions*. If a scale is available, the soil should weigh 100-110grams (3.5 - 4 oz).

4. **START THE TEST:** When you are ready to start the test, open the Solvita foil pouch and carefully remove the probe. *Do not touch the gel surface, and don’t allow soil to touch it.* The fresh gel should appear to be close to color #0 (blue).

5. **INSERT PROBE:** Push the probe into the soil. Do not jostle or tip the jar. Screw the lid on tightly, and record the start time. Keep the jar at 68 - 75^{o}F/20-24^{o}C *out of sunlight* for 24 hrs.

6. **READ THE GEL COLOR**: At 24 hours compare the color of the probe to the Color Key chart provided. Alternatively, a DCR may be used in the ALT mode (Model 700 only). For visual readings note that the printed color key has two charts, one for fluorescent/daylight, and the other incandescent lighting.

7. **INTERPRETATION**: Table for guidelines on the results.

Alternative Soil Respiration method, USDA-NRCS Soil Quality Manual (2001).The test is also the basis in NRCS “Soil Quality Kit - Educators Guide” (2012).

This is a reprint from Solvita® Soil Respiration Test Procedure.

Solvita® Soil Respiration

The Solvita® Soil test can be used with fresh-soil in the lab or in the field to reveal total biogenic CO_2 emissions. This CO_2 is primarily from decomposition of soil organic matter (humus and litter), but includes respiration of plant roots (if growing plants are present) and respiration of soil arthropods, if present. Because of the positive association of these factors with soil fertility, the test is considered an indicator of "soil health". The rate of emissions per area of soil is overall an environmental indicator of soil contribution to atmospheric CO_2. The following table shows the soil biological activity curve to illustrate the range in which most soils are likely to fall under basal respiration conditions. Basal tests may also be performed with the field soil-cylinder method of USDA-NRCS. Precise interpretation of the test results will depend on a variety of factors.

Soil CO2-Rate Index of Fertility

Color 0 - 1 Blue-Gray	Color 1 - 2.5 Gray-Green	Color 2.5 - 3.5 Green	Color 3.5 - 4 Green-Yellow	Color 4 - 5 Yellow
VERY LOW ACTIVITY Associated with depleted and dry sandy soils, and little or no organic matter	ACTIVITY Soil is marginal in terms of biological activity and organic matter	ACTIVITY Soil is moderately balanced and has likely been receiving organic matter additions	IDEAL ACTIVITY Soil is well supplied with organic matter and has an active microbial population	ACTIVITY High or excessive organic matter

EMISSIONS (FLUX) OF CO_2 as LBS / ACRE/ DAY and kg / m_2 (a)

2 - 5 lb/acre **0.2 - 0.5 kg/m_2**	**5 - 16** **0.5 - 2.5**	**16 - 32** **2.5 - 6.0**	**32 - 64** **6.0 - 9.0**	**64 - 140** **9 - 20**

BASAL CO_2-C RESPIRATION RATE, mg/kg (b)

< 2	**2 - 6**	**6 - 14**	**14 - 22**	**22 - 55**

(a) Compare to USDA NRCS "Soil Quality Kit for Educators". Results are likely to depend on a variety of factors such as depth of sampling, temperature and field moisture. **The environmental rate often cited for average fertile arable land is 4.5 kg CO_2 m_2 day^{-1}.**

(b) DCR 700 ALT-Mode shows this range of ppm (mg/kg) at these colors. To convert ppm CO_2-C tolb/a CO_2 use a factor of 2.68 and to get kg/m_2 from ppm use factor 0.4.

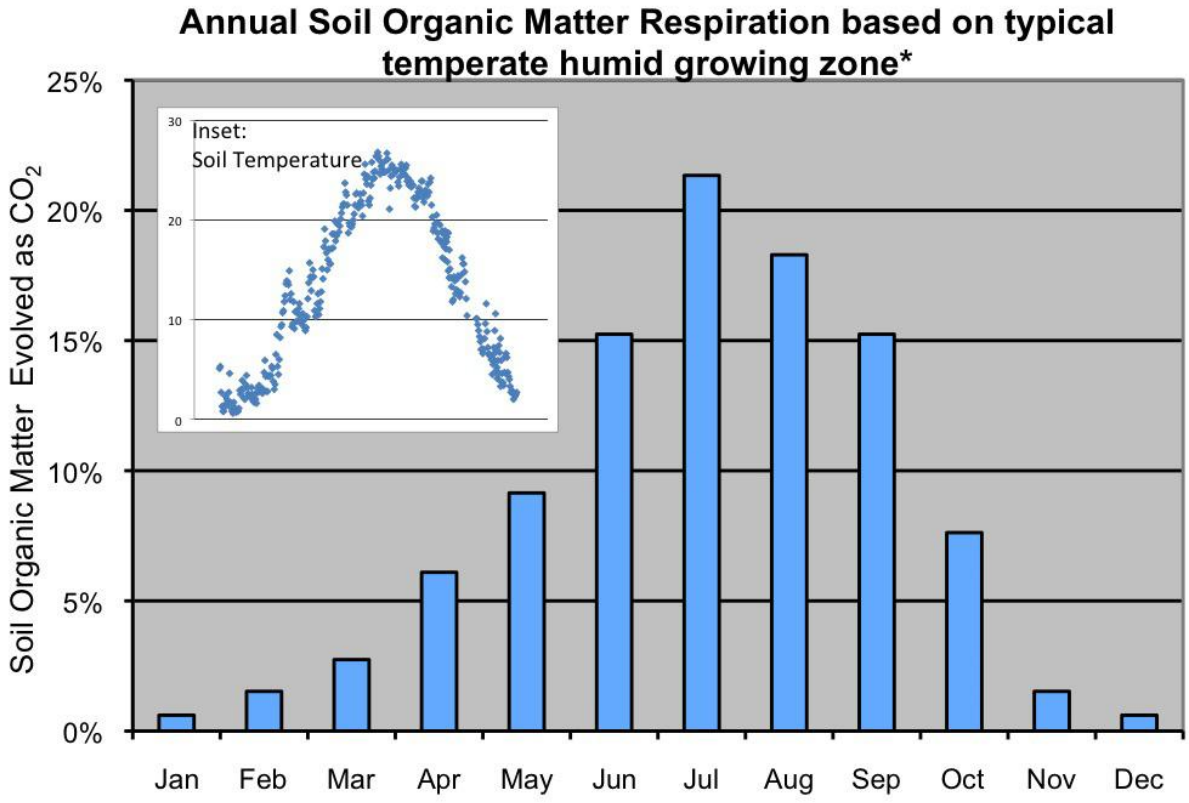
Measuring Basal Respiration in the field: The test kit may be used to directly measure soil surface CO2 emissions with the buried ring method. A 3" ring with a sharp edge is pushed 3" deep into the soil. A Solvita® probe is inserted into the soil inside the ring and a tight cover of Saran wrap is securely affixed with tape. Cover with reflective aluminum foil to prevent warming from sunlight. Read the results after 24 hours. Use the conversion in (b)-above, for area values.

SOIL CARBON MINERALIZATION

The release of carbon dioxide from surface soils is closely dependent on key factors including moisture, temperature and the level of microbial activity. To standardize the test as a lab procedure, the Solvita® protocol is to adjust the soil to optimal moisture by a specific re-wetting method, and hold the sample at room temperature. As a field or ecological method (basal respiration) the test is conducted with fresh, unadjusted soil and therefore the results are dependent entirely on environmental circumstances at the time of the test.

Soil respiration, or the mineralization of soil carbon as CO2, should be seen in context of the course of a year. Figure 2 (below) shows the amount of SOM released or metabolized to CO2 in the course of a year for a temperate-humid zone (PA). In Figure 2, 80% of the respiration activity occurs in the 5 warmest months. Under these circumstances the nitrogen associated with the soil carbon will be mineralized and made potentially available to crops. Performing a single respiration test under optimal conditions may not represent all conditions, but it accurately indicates the potential behavior of that particular soil.

Soils that are periodically dry during warm months may not exhibit optimal CO2 respiration at that time, yet the potential appears to accumulate. Soil enzymes remain active and the return of moisture induces a significant pulse of CO2 which is associated with a nutrient burst. The principle of the Haney-Brinton CO2-Burst procedure is to capture the potential magnitude of this soil event.



**Adapted from*: SCAN (Soil Climate Analysis Network) 2012 Data, Central-PA, USDA-NRCS

TROUBLESHOOTING GUIDELINE FOR SOLVITA® SOIL PROBE RESULTS

Indicated Problem or Result	Possible Explanation	Possible Remedy
Solvita® test indicates high respiration but plant growth is not satisfactory	There are pH and/or nutrient imbalances C:N ratio of soil organic matter may be too high	Test for pH, N, P, K and possibly add these nutrients if indicated Use available nitrogen or only low C:N organic matter additions
Solvita® test indicates moderate to low activity even though organic matter was added recently	Soil pH may be low and is depressing microbial rate Added organic matter has not yet been metabolized by soil organisms	Check pH and correct with limestone if indicated Retest later after organic matter has fully decomposed
Solvita® test result declined after the soil was fertilized or treated	Fertilizer salts may be excessive or are limiting soil microbes Ammonium fertilizer caused drop in soil pH which lowered activity	Check salts in soil and leach with water if excessive May require limestone to compensate
Solvita® test was low at first but is high shortly after adding organic matter	An excessive application of active organic matter may have occurred A clump of organic matter/manure may have been put in test jar	Use organic matter more sparingly or use more stable compost Re-mix soil sample and be careful to avoid clumps
Solvita® test is variable with differing samples from same area	Soil is strongly profiled, non homogenous or contains clumps of sod or other matter	Re-design sampling area; cultivate, rototill or disc soil, watch depth of sampling
Solvita® test was low after biochar added	Inert carbon is non-responsive to microbial activity in short term	Inert carbon is non-responsive to microbial activity in short term
For CO_2-Burst test, soil did not wet properly	Soil is moderately hydrophobic	Allow more time for remoistening before starting the test
Field test shows low results compared to lab	Soil is not optimally moist in field; Chamber may have leaks	Note: field conditions are basically variable and require more samples

HOW MUCH ORGANIC MATTER (CARBON) IS ENOUGH? This will depend on the agro-ecoclimate.
Adding large amounts of organic carbon may not always lead to improved soil respiration or crop performance — particularly if the organic matter lacks nutrients or is not well decomposed (N-immobilization danger). Heavy additions of cover crop green manures and animal manures may give a temporary spike of CO2 activity — test later after soil equilibration has taken place.

RHIZOTERRA
Healthy Soil for a Healthy World

Rhizoterra Inc.
Po Box 1778
Lolo, MT 49847
info@rhizotera.com
rhizoterra.com

This is a reprint from Solvita® Soil Respiration Test Procedure.