

WHAT IS CO₂-BURST vs 3 OR 7-DAY RESPIRATION?



TECH MEMO 0317-5

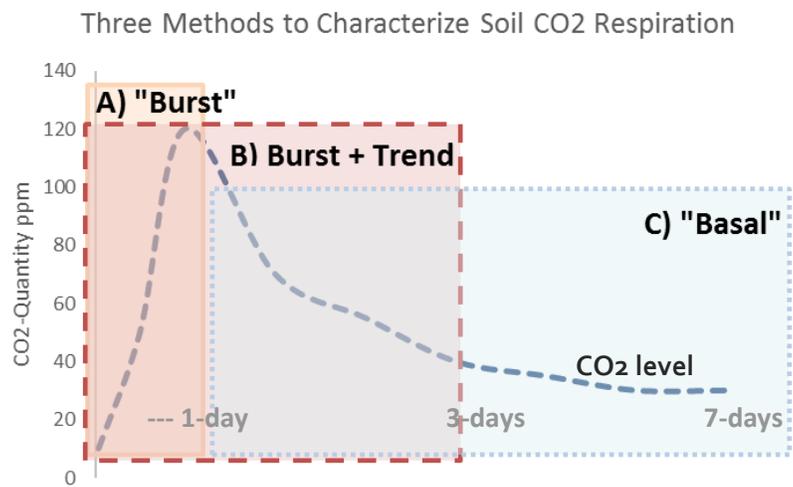
SOIL RESPIRATION : VARIOUS MODES OF CHARACTERIZATION

CO₂-Burst is based on a flush of soil microbial CO₂ which occurs after moistening dry soil. It is measured by Solvita at 24-hrs, an application that is widely used in soil health labs to gauge microbial soil activity. The original discovery of CO₂-burst around 1955 was made simultaneously in Africa and Germany¹. While several explanations have been advanced as to the cause of the burst, a current popular view is that microbes accumulate osmolytes during prolonged dryness and these are dumped into the soil solution at the onset of rewetting triggering a microbial burst of growth². The phenomena is fairly robust and is repeatable over several drying-rewetting cycles.

Recent discussions on soil health indicators have considered at least 3 modes of testing respiration (see figure). When dry soil is re-moistened, the large surge of CO₂ within 24 hrs is the CO₂-Burst (area "A"). Another mode is to measure the decline over 1-4 days (area "B"). A final approach is to wait as respiration approaches equilibrium, this 7-day rate often called "basal" respiration (area "C") and sometimes reported only after clipping the first 24-hr spike. It is now

established that the 1-day burst is highly correlated with the later measurements³ whether in the "B" or "C" form. This is not hard to grasp since the same microbial population is involved.

While the Solvita® test is used mostly in labs in a 24-hr mode, it need not be limited to this and may be readily adapted to be a 3-day or even 7-day test, - simply by changing the jar size. Solvita behaves like a buffer to CO₂-concentration in the air-space, a reaction quantified by the Ideal Gas Law. Changing the jar volume proportional to the difference in time means the uncorrected Solvita results will be the average rate for that period of time. The following table illustrates the desired length of time and jar size involved (with soil mass held constant at 40 g, the normal amount for a Solvita test).



Jar Size to Obtain A Solvita 1, 2, 4 or 7-day result

Size	Metric	FAS/M*	Equiv Days
8 oz	250	13.7	1.0
16 oz	475	26.5	1.9
32 oz	946	50.8	3.7
Gallon	1890	104.9	7.6

* Free Air Space: Absolute Mass Ratio inc water

Adjusted SOP: To obtain a Solvita result equivalent to the indicated number of days from 1-day to 7-day basal, place soil in indicated jar sizes and read after the given time-period. The longer the periods the more the actual CO₂-burst effect is integrated into the basal rate. For more information please contact the technical team at Solvita. Δ

¹ Birch H.F. Effect of Soil Drying on Humus Decomposition and N-availability. Plant & Soil No 1:9-31 1956 / Koepf H.H. Soil CO₂ from Intermittent Moistening [in German]. Zeitschr. Bodenk. 1955

² Fierer & Schimel: Proposed Mechanism for the Rewetting CO₂ Pulse. Soil Sci. Soc. Am. J. 67:798-805 (2003)

³ Franzluebbers, A.J. Should Soil Testing Services Measure Soil Biological Activity? Agric. Environ. Lett. 1:150009 (2016)