DOES LIMESTONE AFFECT CO_2 RESULTS?

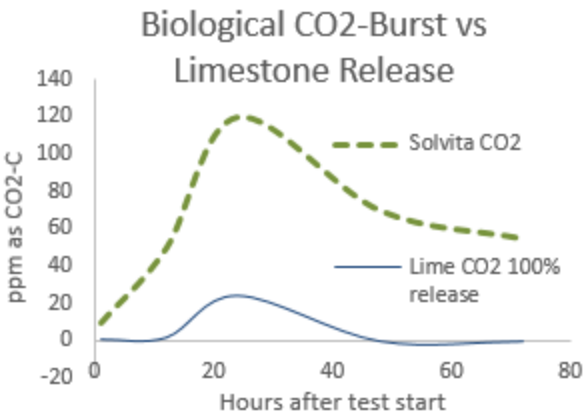
SOLVITA®

TECH MEMO 0317-4

SOLVITA CO_2-BURST : ORGANIC VS INORGANIC CO_2

Solvita CO_2 is a test protocol based on a burst of soil CO_2 respiration following wetting of dried soil, or a natural release of CO_2 with field-moist soil. The release of carbon dioxide during labs tests is considered to be microbial in origin - i.e. due to bacteria, fungi and other soil micro and macro organisms that respire C from consuming organic matter for energy. (If respiration is measured "in situ"- i.e. undisturbed in the field, then up to 50% of the CO_2 may be due to living plant root respiration.)

But what about other sources of CO_2 in soils? Limestone is often cited as a potential source of "inorganic CO_2" as opposed to the organic CO_2 derived from living microbes. If CO_2 emitted from lime was large, then it could be an interference with the test for microbial respiration, leading to potential misinterpretation. This would be like the large error in soil total-carbon (TC) if limestone present is combusted along with organic-C. The analysis method may release all limestone instantly as CO_2, but microbes do not. Some calculations may illustrate this.



Limestone $CaCO_3$ has a molecular weight of 100 with 44% CO_2 in carbonate CO_3 form. Upon acidification in soil, the CO_3 is converted stepwise to CO_2 via bicarbonate, neutralizing acidity and producing water. Hypothetically, if all the limestone reacted *instantly* in the soil, then we would observe a large spike in CO_2 which could confound a respiration test. But this is not likely to happen. As farmers know well, limestone reacts only very slowly in soil over weeks or months, depending on how acid the soil is and on how finely-ground the lime is. At a maximum, if all the lime in a 20 t/a (45 t/ha) rate dissolved *instantly* by calculation it would affect the Solvita CO_2-burst by 24 mg/kg soil (ppm), which is measurable. However, if the lime dissolves over 90 days (which is optimistic) the effect would be < 1 ppm in a 24-hr CO_2 test, less than a margin of detection.

An interesting caveat is that lime additions to soil often *increase soil microbial activity* [1], causing a rise in biotic CO_2 which should not be mistaken for inorganic CO_2. It is also true that use of limestone worldwide is causing a measurable rise in atmospheric CO_2 [2] and that liming peat soils may cause a more rapid release of CO_2 [3]. In conclusion, inorganic sources of CO_2 are not likely to influence interpretation of Solvita soil biological CO_2 respiration tests.

Limestone - potential effect on Soil CO2 as determined by Solvita

liming	ton/a rate	t/ha	as % of soil	CO2 content (44%)	mg/kg CO2 total in lime	as CO2-C ppm (total)	ppm effect "FAST" reaction (30 days)	ppm effect "SLOW" reaction (90 days)
light	5	11	0.005	0.0022	22	6.0	0.20	0.07
medium	10	22	0.01	0.0044	44	12.0	0.40	0.13
heavy	20	45	0.02	0.0088	88	24.0	0.80	0.27

[1] J.P. Fuentes et al. / Microbial activity affected by lime in a long-term no-till soil. Soil & Tillage Research 88 (2006) 123–131

[2] T.O. West, A.C. McBride / The contribution of agricultural lime to CO_2 emissions in the United States. Agric., Ecos. Environ. 108 (2005) 145–154.

[3] C. Biasi et al. / Contribution of lime to CO_2 release from managed peat soil. Soil Biology & Biochemistry 40 (2008) 2660–2669 2661