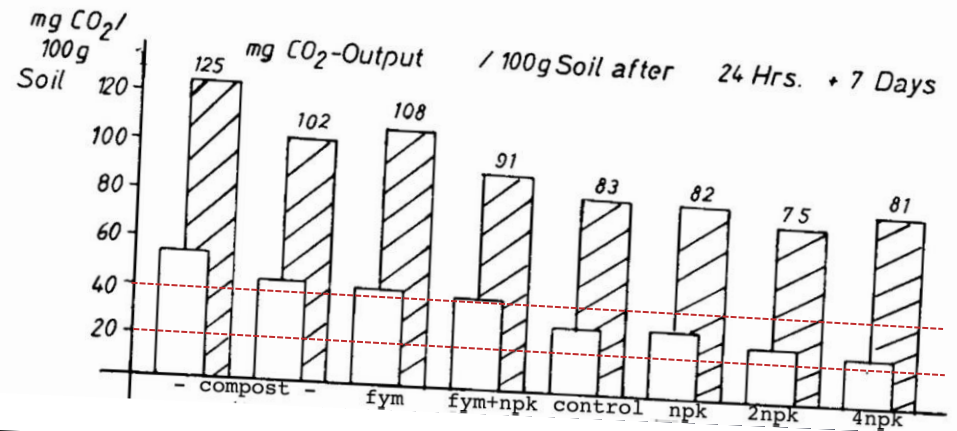


CO₂ Respiration

Behavior of soil
and composts:
effects of mass
and volume



By William F Brinton © 2010

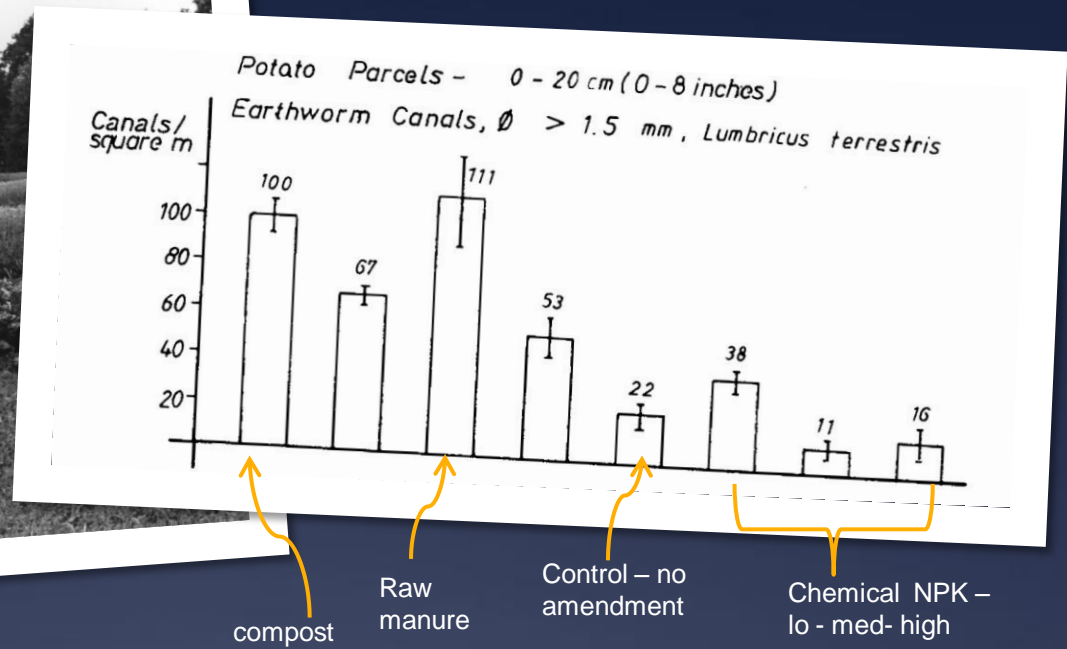


mg/100g CO₂ * 2.7 = ppm CO₂-C

Early soil plot CO₂ respiration

Focus on field effects of manure, composts, vs intensification of NPK
 Ex situ respiration testing principle focus in observing biological effects

Reports: Pettersson, Wistinghausen & Brinton (1978) Sweden Long Term Effects of Organic and Inorganic Fertilizers. Nordisk Forskningsring Report Nr. 30. Järna



17 yr effect of soil amendments

CO₂ respiration in soil reflected a nexus of biological effects of fertilization, including earthworm populations.

Reports:

- Pettersson, Wistinghausen Brinton (1978) Long Term Effects of Organic and Inorganic Fertilizers. Nordisk Forskningsring Meddelande Nr. 30. Järna
- Dlouhy, J. 1981. Alternativa odlingsformer - (Alternative forms of agriculture - with English summary). Swedish University of Agricultural Sciences. Dep. of Plant Husbandry. Report 91. Uppsala
- Granstedt, A & Lkjellenberg. 1997 Long-Term Field Experiment in Sweden. *In Proceedings*, Tufts University, Agricultural Production and Nutrition, Massachusetts March 19-21, 1997.

Measuring Respiration

- * **GRAVIMETRIC** : reducing CO₂ rate to a physical unit of mass (as in mg / g TS or mg / g VS). Considered the absolute quantitative approach.
- * **VOLUMETRIC** : Expressing respiration per unit of as-is volume, as in mg / liter. This approach *integrates* weight and its volume (density) relationship.
- * BOTH APPROACHES ARE NEEDED.

Gravimetric (quantitative) CO₂ Respiration

- * Soil method first standardized in 1950
- * CO₂ test in disturbed (removed, weighed) soil samples
- * Gives results per unit of weight; volume aspect factored out.
- * Same method adapted to compost



Two Volumetric Procedures

Dewar Self Heating



Solvita Probe





SOIL In situ volumetric CO₂ Tests

CO₂ evolution per unit area (acre, hectare, m²) shows undisturbed status – helpful for carbon sequestration, soil/atmospheric balance

USDA SQI recognized two protocols: Dräger and Solvita

Refs:
USDA-ARS (1999) Soil Quality Test Kit Guide, NRCS-Soil Quality Institute (on-line)
Doran J., M Tsvou (1997) Field and Laboratory Solvita Soil Test Evaluation. USDA-ARS, University of Nebraska, Lincoln

Expanding the Audience

Recognizing Soils Value

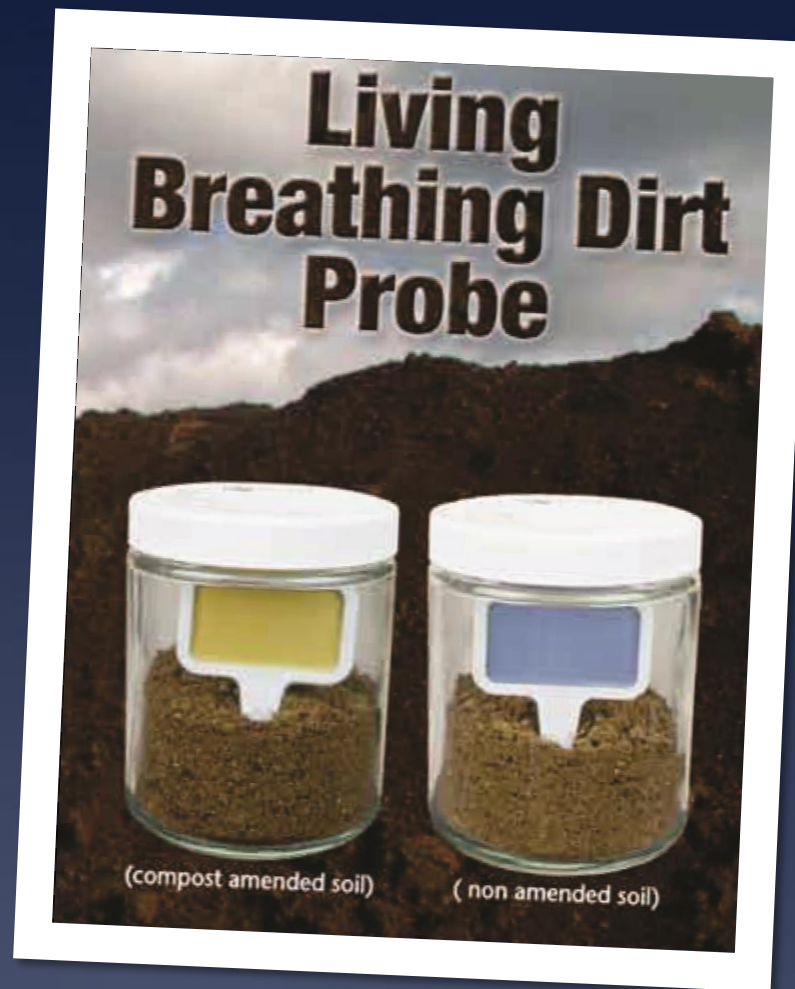
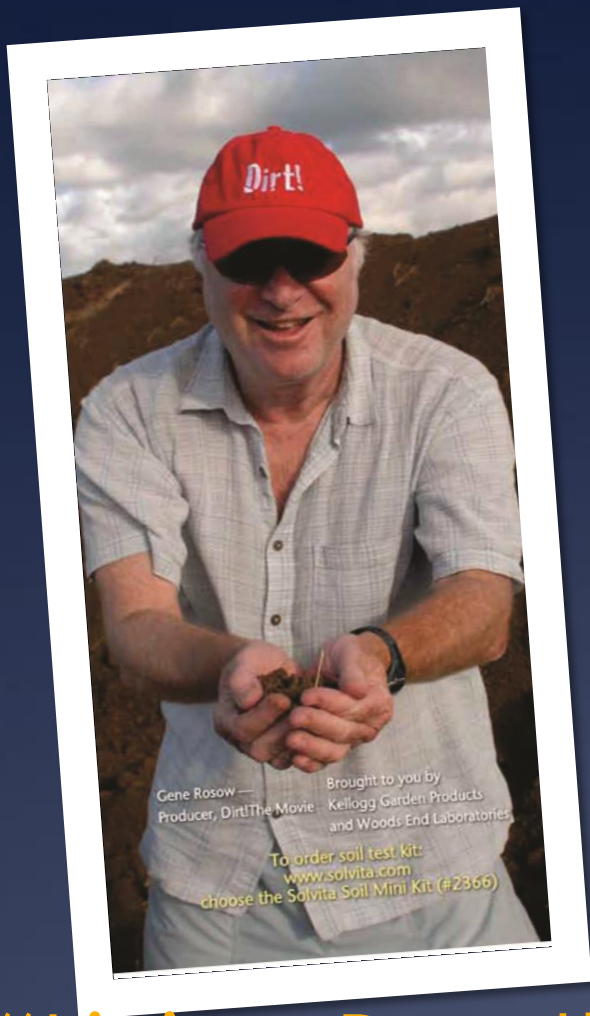


William Bryant Logan reads from *Dirt, The Ecstatic Skin of the Earth*. Woods End Farm, Maine Aug 2007

Dirt! Focus for Uniting
Compost and Soil



On Location for the film: (r/l)- Rosow, Logan, Brinton –
The compost linkage (2007)



“Living-Breathing Dirt! Probe”

Common Ground Media, Woods End Labs and Kellogg’s joined forces to demonstrate that soil CO₂ respiration testing (volumetric) reveals benefits of compost for a “living soil”.

Perspective: Soil CO₂ and Compost CO₂

- * SOIL CO₂ respiration is about 1/100th per unit volume as per compost respiration and rarely competes with plant roots for oxygen, but can in rare circumstances.
- * COMPOST CO₂ respiration is relatively high in proportion to mass and volume. Theoretically possible to significantly alter soil respiration.

Proper understanding of the differing roles CO₂ respiration plays going from soil to compost could help unify approaches.

Compost in Pots- new challenge for volumetric respiration:

Roots expand through available volume only



Pot volume defines limits of resources



Peat moss relatively sterile and stable and exerts little influence on respiration.



Matured Compost :
Med-Low Respiration

High
respiration
challenged
plant root



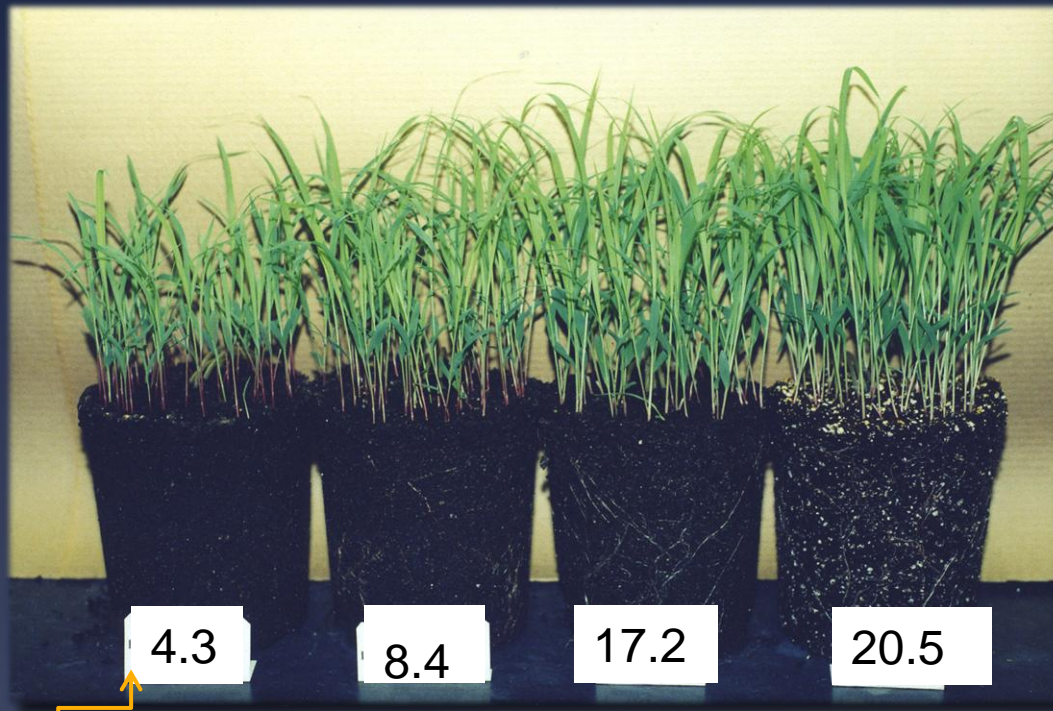
Composts in Pot Trials (2010) NCSU, Woods End

Volume-Based Growth Studies

Identifying optimizing factors based on volumetric compost nutrients + respiration.

Refs: Brinton & Evans (2002) Plant Performance in relation to Oxygen Depletion in Container Media Composts. *in* Microbiology of Composting Ed. H. Insam. Springer Verlag Berlin, New York.
Jeong, K Y, P. Nelson, J. Krantz, W. Brinton (2009) Impact of Composted Dairy Manure on Soilless Substrate. *In press* Acta Hort.

Plant Response to Compost Respiration Indicates Upper Limits



Oxygen vol% in Core of Pots, @ 21- DAP

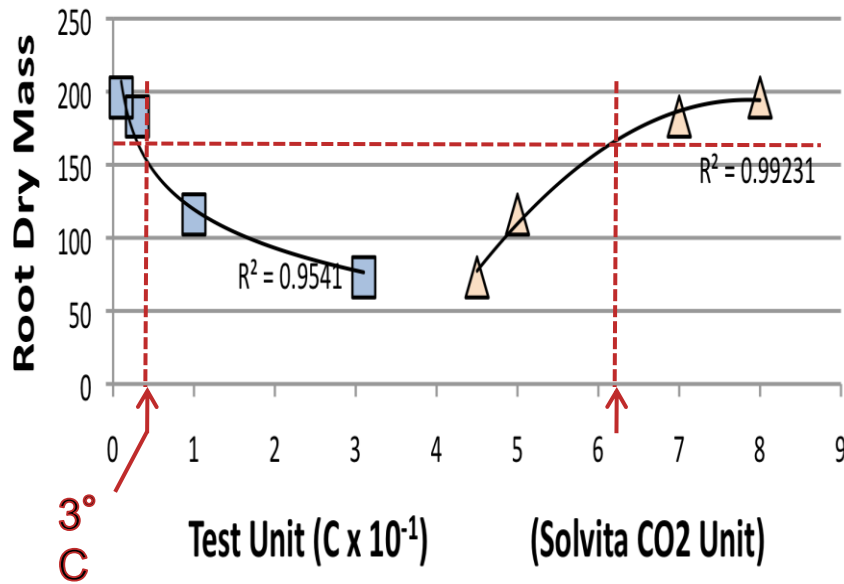


Respiration in situ

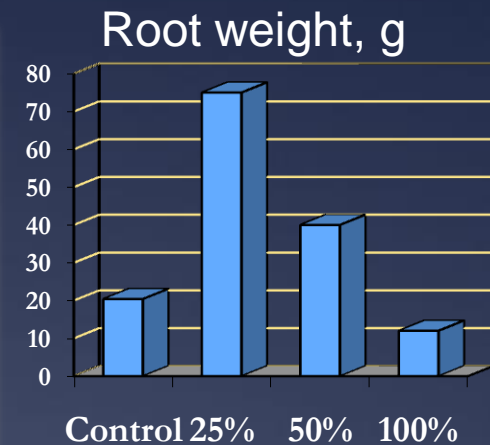
Reports:
Brinton & Evans (2002) Plant Performance in Relation to Oxygen Depletion in Container Media Composts. *in* Microbiology of Composting Ed. H. Insam. Springer Verlag Berlin, New York
Brinton, W. E. Evans (2001) How compost maturity affects container grown plants. *Bicycle*. Vol. 42, no. 1, pp. 56-60. Jan.

Volumetric Indicators of Container Plant Root Mass

Volumetric Respiration vs Plant Performance



Finding the right amount of compost!



Reports:

- Brinton et al; (2002) NYC-DOS Quality of Mixed Green-Waste Compost
- Univ. ME-Ext Compost School, Maturity and Plant Effects. : 2009 Curriculum

Concluding remarks

- * Soils respond very positively to compost and manures as indicated by CO₂ respiration; attaining “high biological fertility” is possible and threshold numbers are now well known.
- * Dirt! Test seeks to expand consciousness of soil’s natural “living” (= respiration) quality and promotes use of compost in context of its contribution to carbon balance.
- * Compost (compared to soil) exhibits high volumetric CO₂ respiration which at too high applications can compete with plant roots for air. Optimization is the goal.
- * Volume-based tests such as Solvita and Dewar will not necessarily give the same information as gravimetric tests. Volumetric offers do perspective relevant to CO₂-exchange and for growing plants.



Thank you!

Woods End Laboratories :
“ the Science for Innovation “

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