

Evaluation of optimum soil water content in the analysis of potentially mineralizable carbon

INTRODUCTION

- Both short-term (e.g., CO₂-Burst Test) and long-term incubations are a common method for estimating potentially mineralizable carbon [1,2].
- The water content at which these are conducted has strong effect on the measured outcome.
 - Many researchers do not report their method for determining a soil's water content, but maximum water holding capacity (MWHC) is one of the most frequent [3]
 - Those that do report the method, most use 60% of maximum water holding capacity (n = 76 studies).
 - However, there is a range from 10% to 100% maximum water holding capacity.

Research Questions:

- What is the optimal water content for the CO₂-Burst Test? And does soil texture matter?
- Does the water content interact with management practices to affect the CO₂-Burst?

MATERIALS & METHODS

1. Experiment 1 (Figure. 1):

- 2 soils:

Soil	Sand (%)	Silt (%)	Clay (%)	SOM (%)	MWHC (%)	pH
Loam	24.4	42.8	32.8	6.4	64	6.3
Loamy Sand	86.5	10.9	2.6	2.0	39	5.7

- 12x water content treatments: 5-150%

2. Experiment 2 (Table. 1, Figure. 2):

- 9 Long-term Studies Located in Iowa, USA (Table. 1)

Treatment Abbr.	Conventional Practice	Soil Health Promoting Practice	Years Est.	Ref.
+Cover Crop	Continuous Corn	Cont. Corn + Cereal Rye Cover Crop	15	[4]
+Biochar & Residue	Continuous Corn (Residue Removed)	Cont. Corn with Residue + Biochar	11	[5]
Cropped Prairie	Corn-Soybean	Cropped Prairie with Fertilizer	9	[6]
+Cover Crop & No-till	Corn-Soy with Chisel Plow Tillage	Corn-Soy + Cover + No-tillage	8	[7]
Perennial Biomass Crop	Cont. Corn	Miscanthus	3	[8]
Diversified Rotation	Corn-Soy + Synthetic Fertilizer	Corn-Soy-Oat/Alfalfa-Alfalfa + Manure	16	[9]
Organic Management	Corn-Soy + Synthetic Fertilizer	Corn-Soy-Oat/Alfalfa-Alfalfa + Manure	12	[10]
Perennial Groundcover	Cont. Corn	Cont. Corn + Kentucky Bluegrass	3	[11]
No-tillage	Corn-Soy with Moldboard Plow	Corn-Soy with No-tillage	16	[12]

- 4x water content treatments: 20%, 30%, 50%, 60% (20% and 30% were optimal in Experiment 1 – see Figure 1)

CO₂-Burst in both experiments was measured using MicroResp for 24 h at 6 h increments [13]

RESULTS

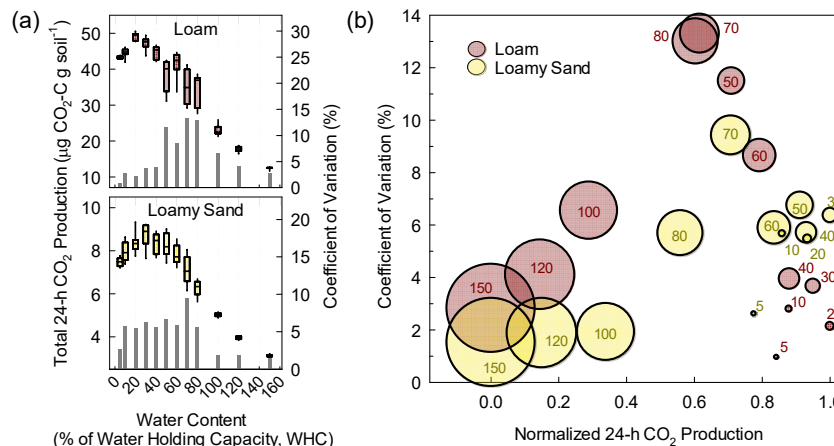


Figure 1. The effect of water content on respiration in two soils – Clarion loam (red) and Spartan loamy sand (yellow). (a) boxplots showing 10th, 25th, Median, 75th and 90th percentiles of 24-hour CO₂ production, and bars represent coefficient of variation (%). (b) normalized CO₂ production versus coefficient of variation for each soil, with bubbles representing the water content as % water holding capacity.

CONCLUSIONS

- Although most people use 60% MWHC for short- and long-term incubations, it is not optimal with regard to magnitude nor precision.
- Maximum CO₂-Burst was closer to 20-30% of MWHC.
- Water content and soil health practices do not interact, therefore they do not affect interpretations of soil health treatments.

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For More Information, References, & Acknowledgements Scan Me

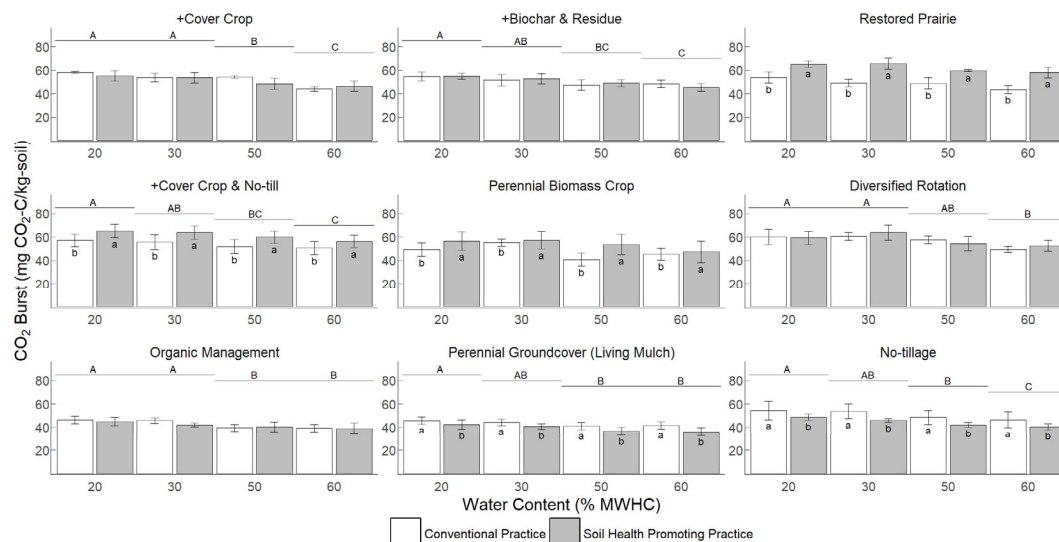


Figure 2. The effect of 20, 30, 50, and 60% of MWHC on 24 h CO₂ production for nine soil health promoting practices. Small lsd values denote a significant (p < 0.1) difference between conventional and soil health treatments. Large lsd values denote a significant (p < 0.1) difference between water contents.