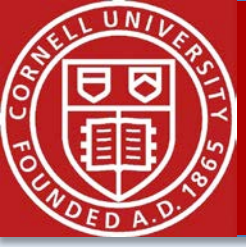


Cornell University

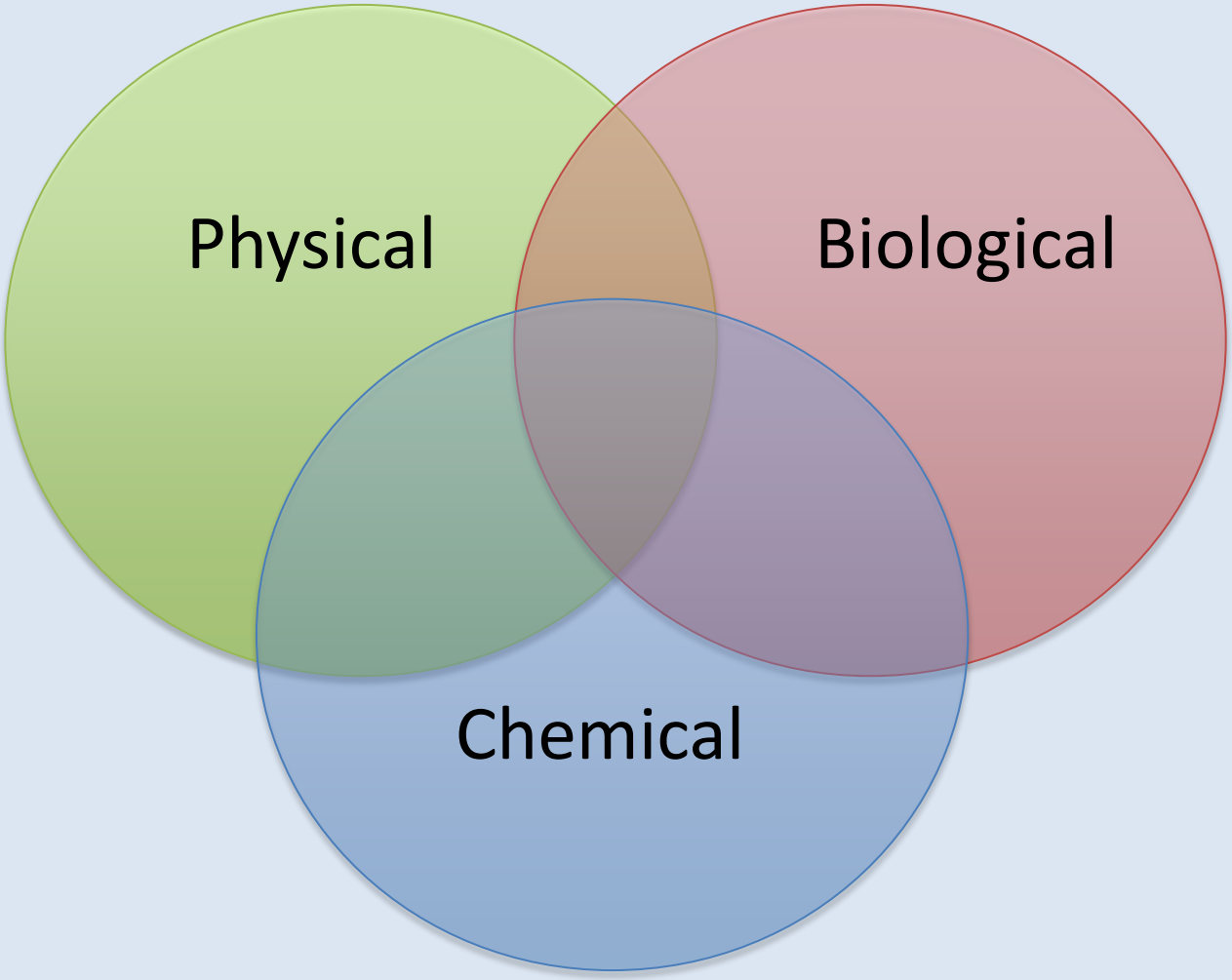
Soil Health and The Scoop & Dump method of Remediation

By

Miles S. Sax & Nina Bassuk

Urban Horticulture Institute
Dept. of Horticulture

Soil Health



Soil Health Indicators

- **Physical**
  - Aggregate Stability (%)
  - Water Holding Capacity (m/m)
  - Bulk Density (g/cm^3)
  - Texture
  - Resistance (PSI)
- **Biological**
  - Organic Matter (%)
  - Active Carbon (ppm)
  - Soil Respiration
  - Soil Protein
- **Chemical**
  - pH
  - Nutrients (P,N,K,Ca,Mg,Fe,Mn, Zn)

What Are Urban Soils?

"Non agricultural man made surface layer more than 50 cm thick that has been produced by mixing, filling, or by contamination of land surface in urban and suburban areas" (Bockheim 1974; Craul 1992)

Urban Soil Characteristics

Urban soils have distinct characteristics

- High Soil bulk density
- Decrease in Organic Matter
- Poor structure
- High pH
- Low Water Holding Capacity
- Decreased Aggregate Stability
- Inadequate soil depth for root growth
- Decrease in microbial biomass & activity

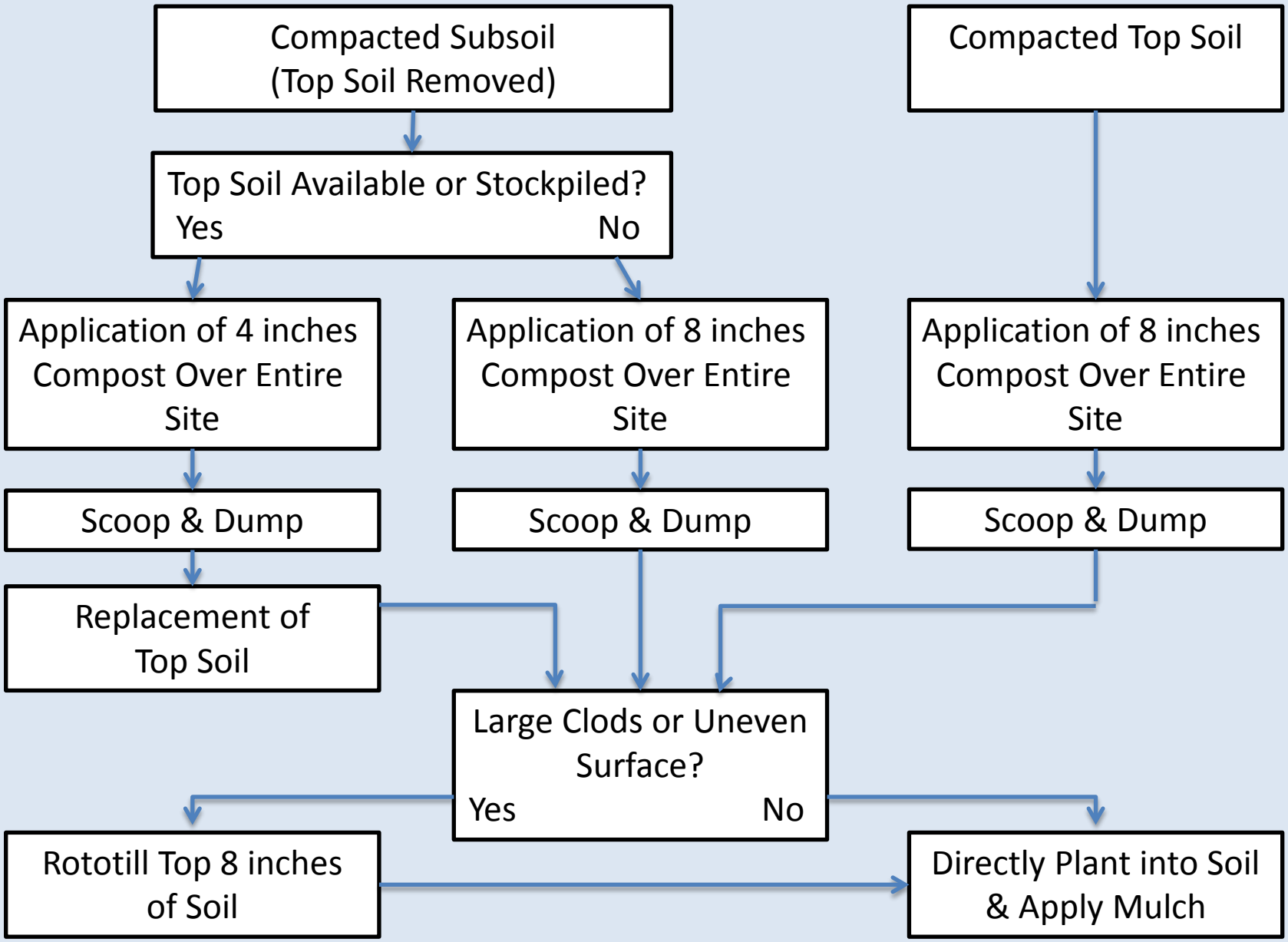
(Jim, C. 1998, Scharenbroch et al 2005)

Effects of the Scoop & Dump Soil Remediation Technique on Urban Soil Quality

Scoop & Dump Technique

- **Apply 6-8” of compost to compacted soil**
- **Use backhoe bucket to dig down to 18”**
- **Mulched added every year to replenish organic matter**

Scoop & Dump Work Flow



(Adapted from "The Sustainable Sites Handbook: Chapter 5 Site Design Soils")

Similar Research & Recommendations

- “Profile Rehabilitation” – Virginia Tech
- Site Design Soils - Sustainable Sites Initiative
- “Soil Modification Fracturing” – Urban Tree Foundation

Scoop & Dump at Cornell

Creating The Urban Eden

Woody Plant ID & Landscape Establishment Class


2005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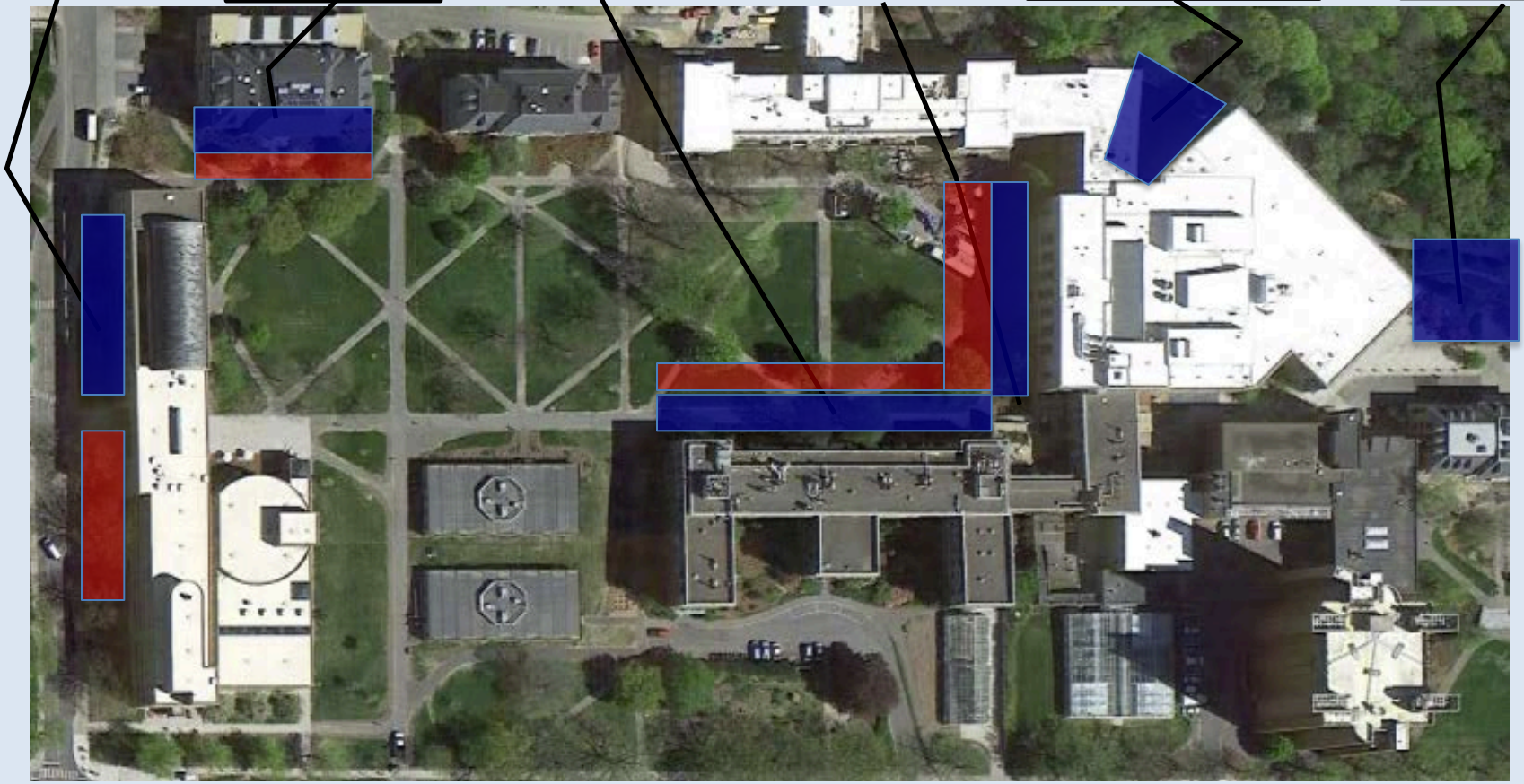
Study Sites



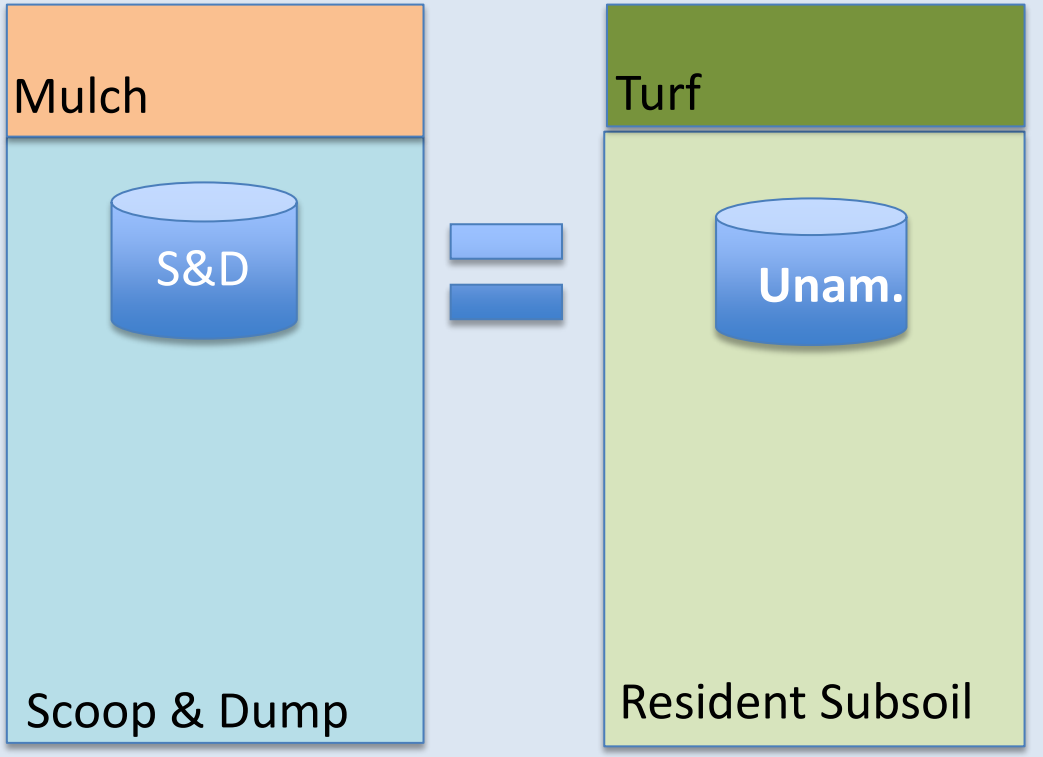
= Study Site (n=6)

= Control (n=4)

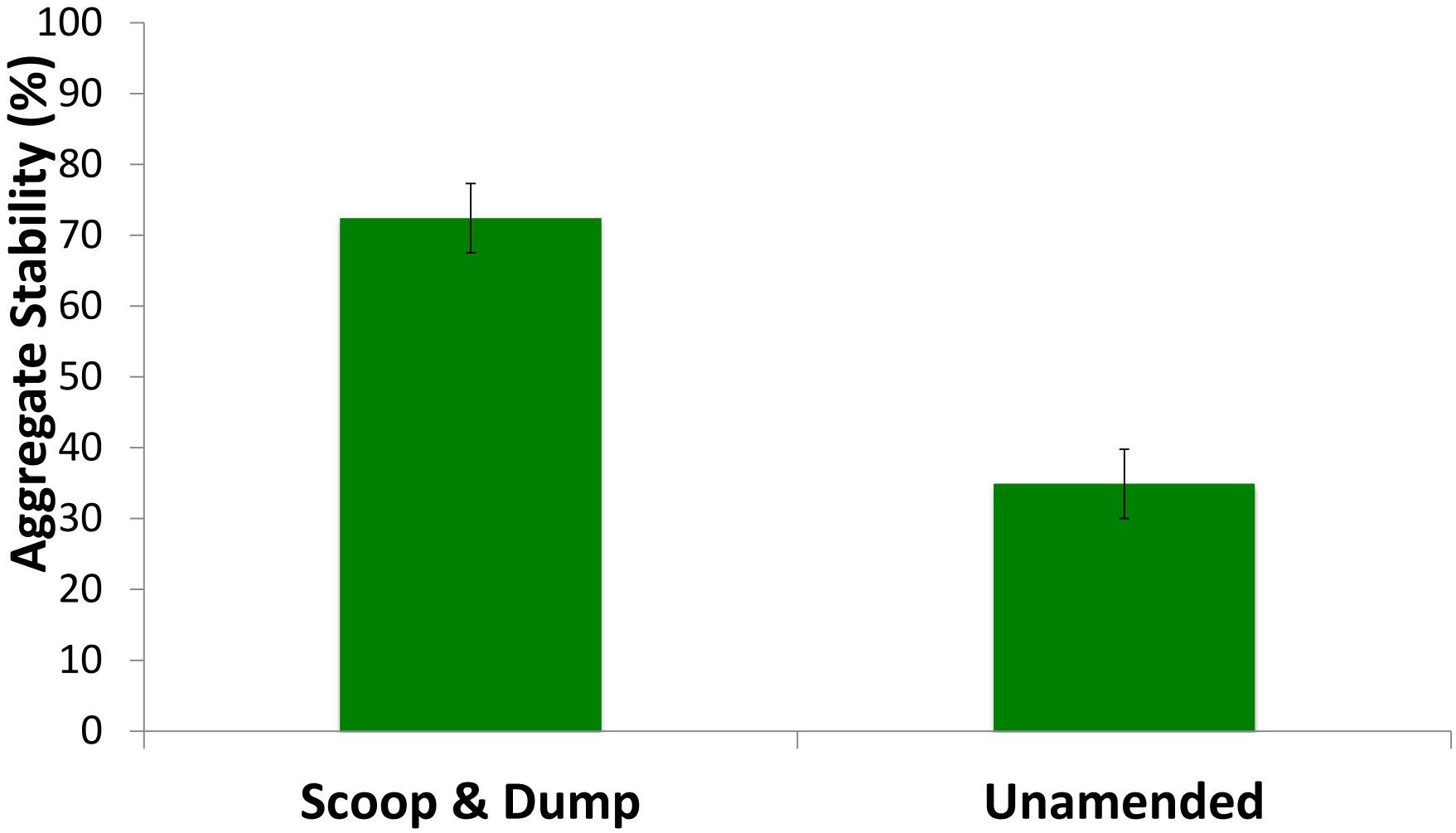
Scoop & Dump vs. Unamended

Study Site: In garden bed

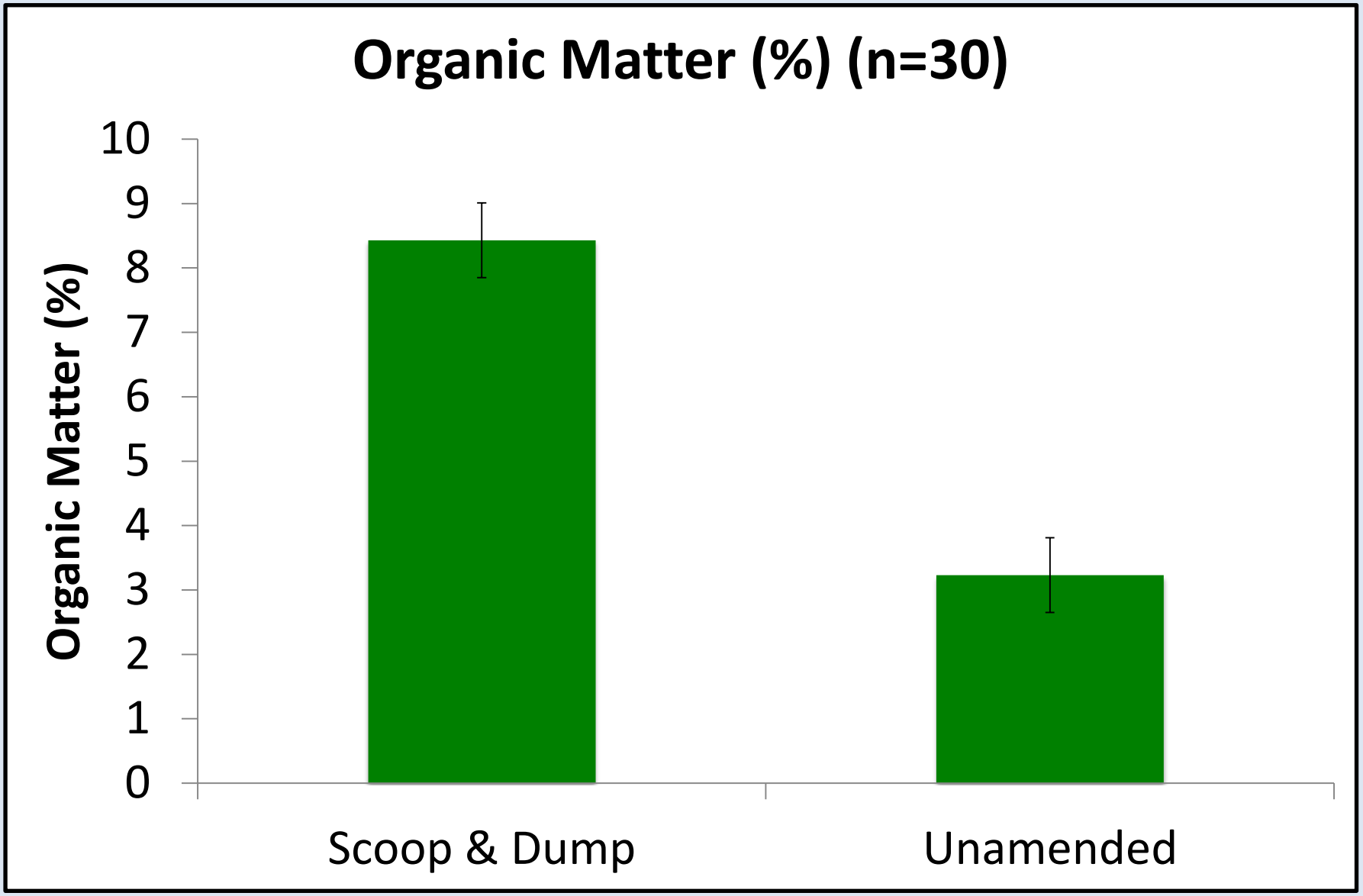
Control Site: In turf



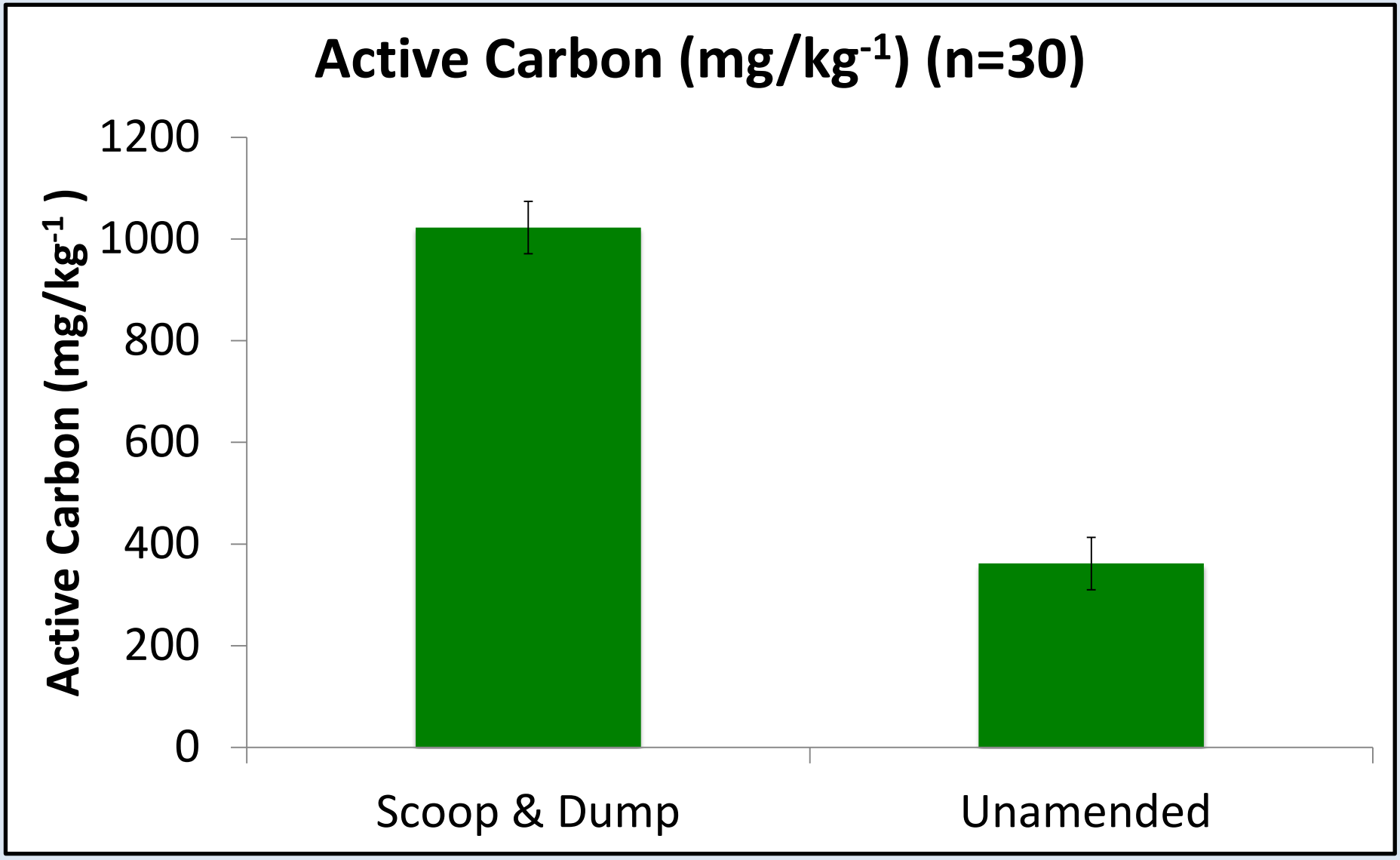
Aggregate Stability (%) (n=30)



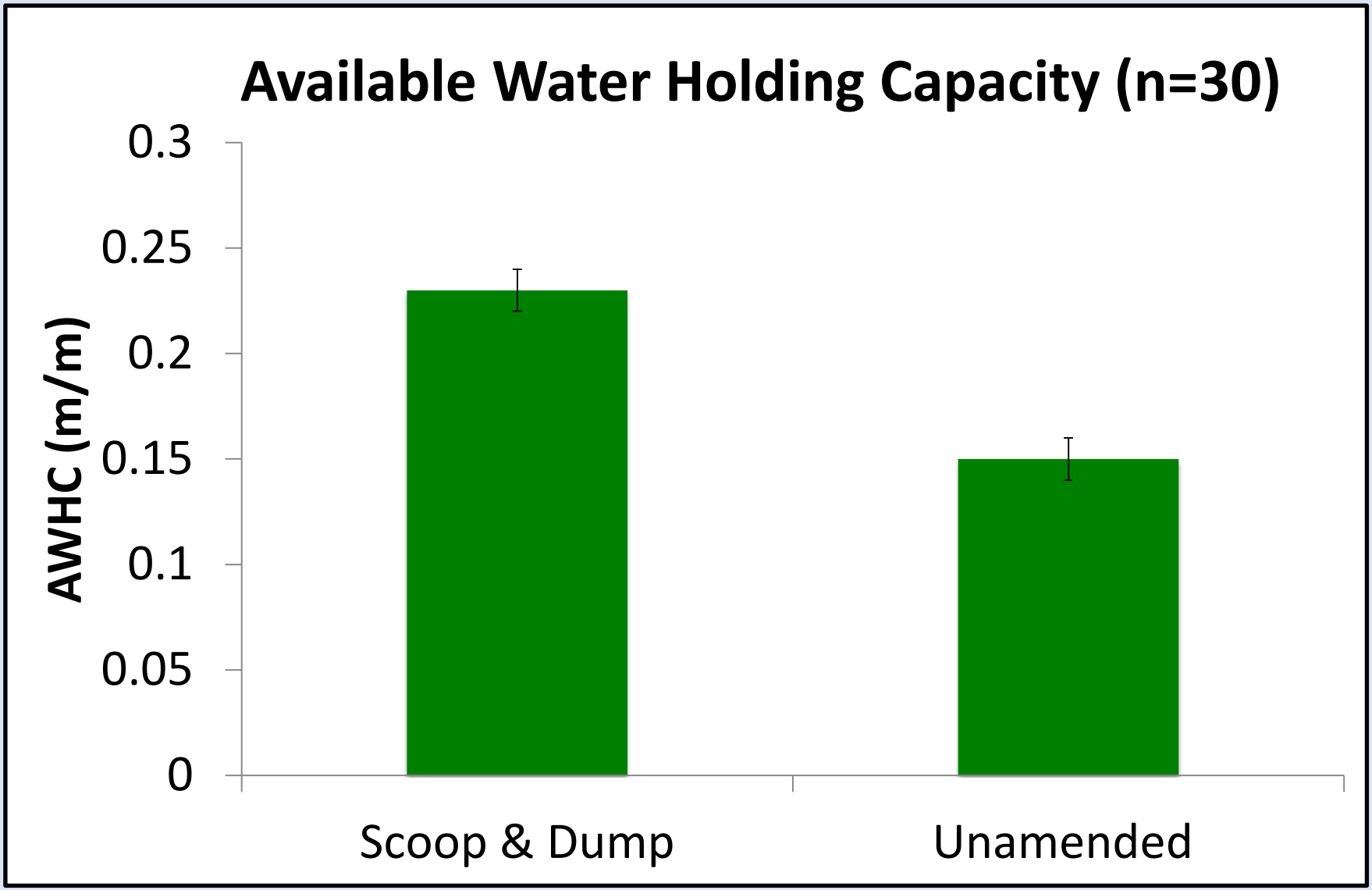
Scoop & Dump	Unamended	Std. Err.	P Value
72.41	**34.90**	**4.88**	**<.0001**



Scoop & Dump	Unamended	Std. Err.	P Value
8.43	**3.23**	**0.58**	**<.0001**

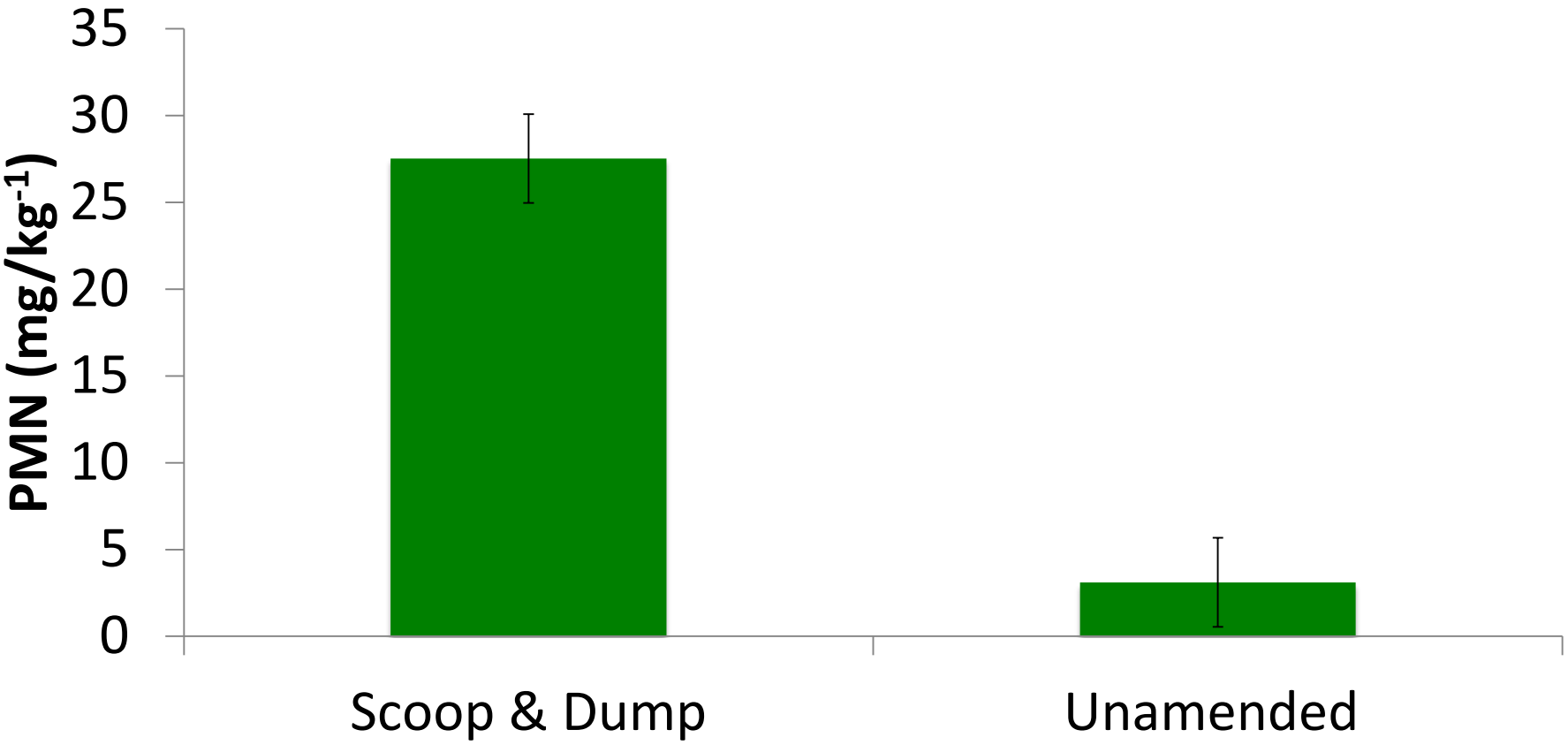


Scoop & Dump	Unamended	Std. Err.	P Value
1022.47	**361.60**	**51.51**	**<.0001**



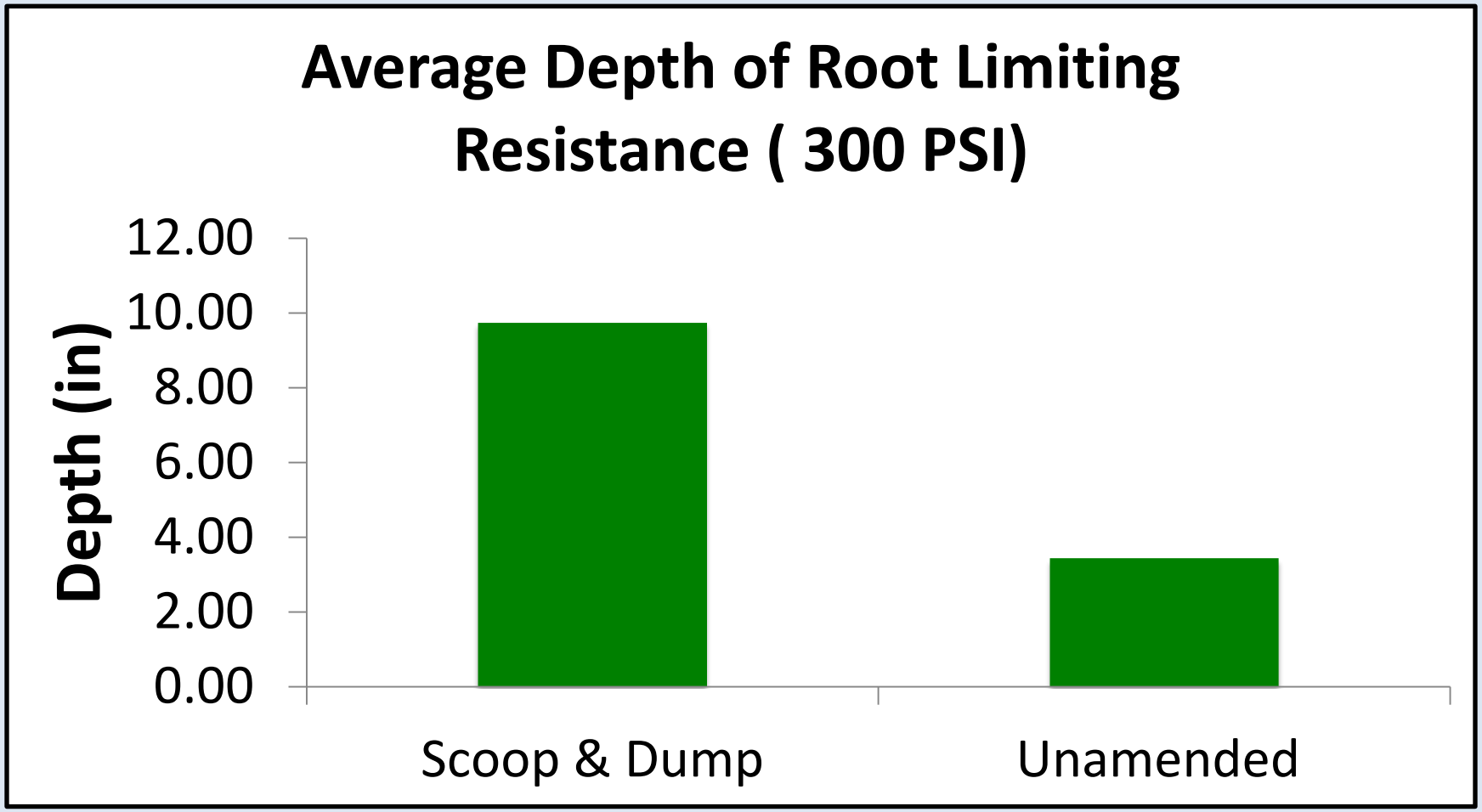
Scoop & Dump	Unamended	Std. Err.	P Value
0.23	**0.15**	**0.01**	**<.0001**

Potentially Mineralizable Nitrogen (mg/kg^{-1}) (n=30)

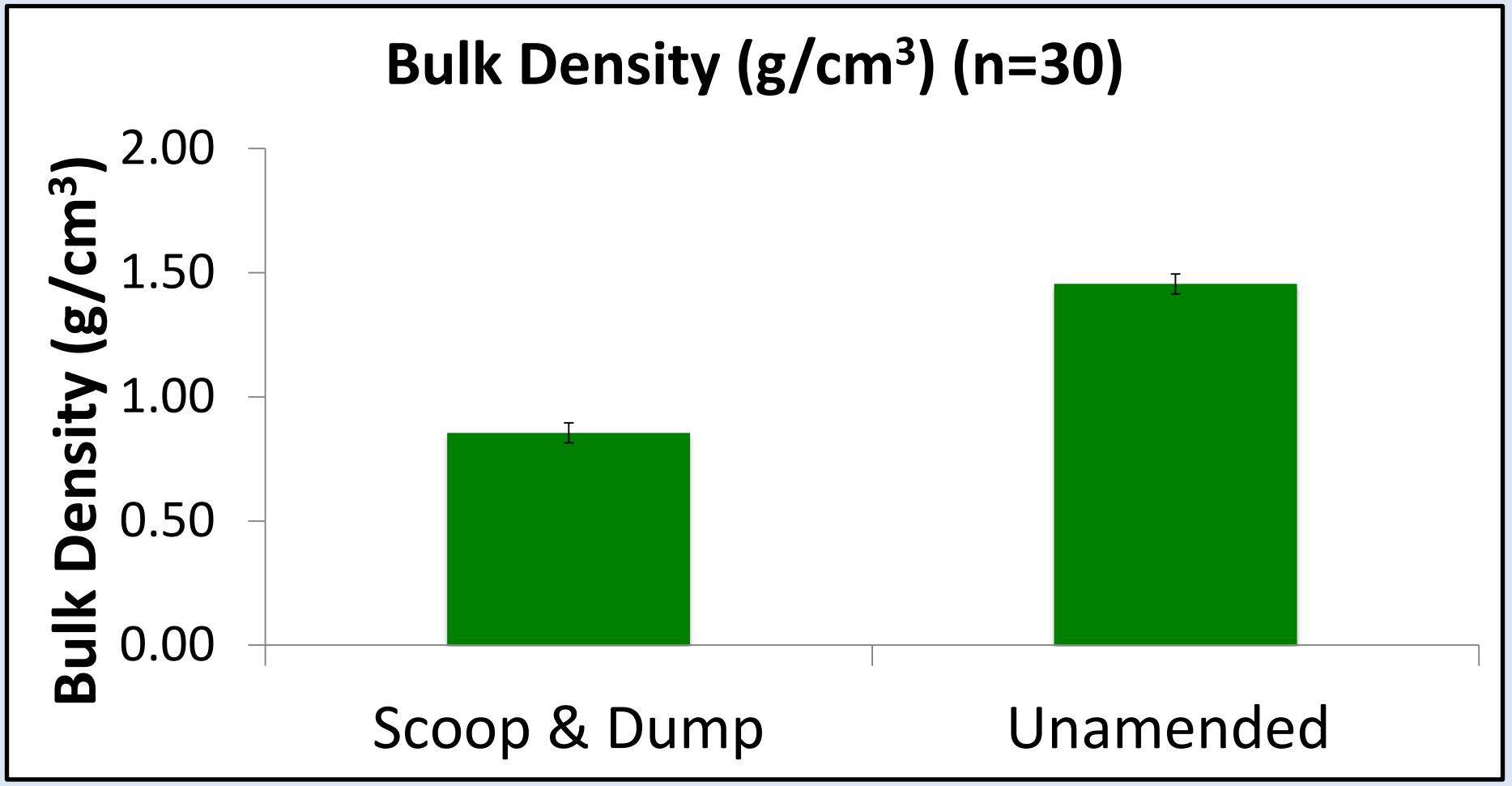


Scoop & Dump	Unamended	Std. Err.	P Value
27.53	**3.11**	**4.41**	**.0005**

Resistance (Penetrometer)



Treatment	Mean	St. Dev.
Scoop & Dump	9.74	2.24
Unamended	3.44	1.65



Avg. Bulk Density

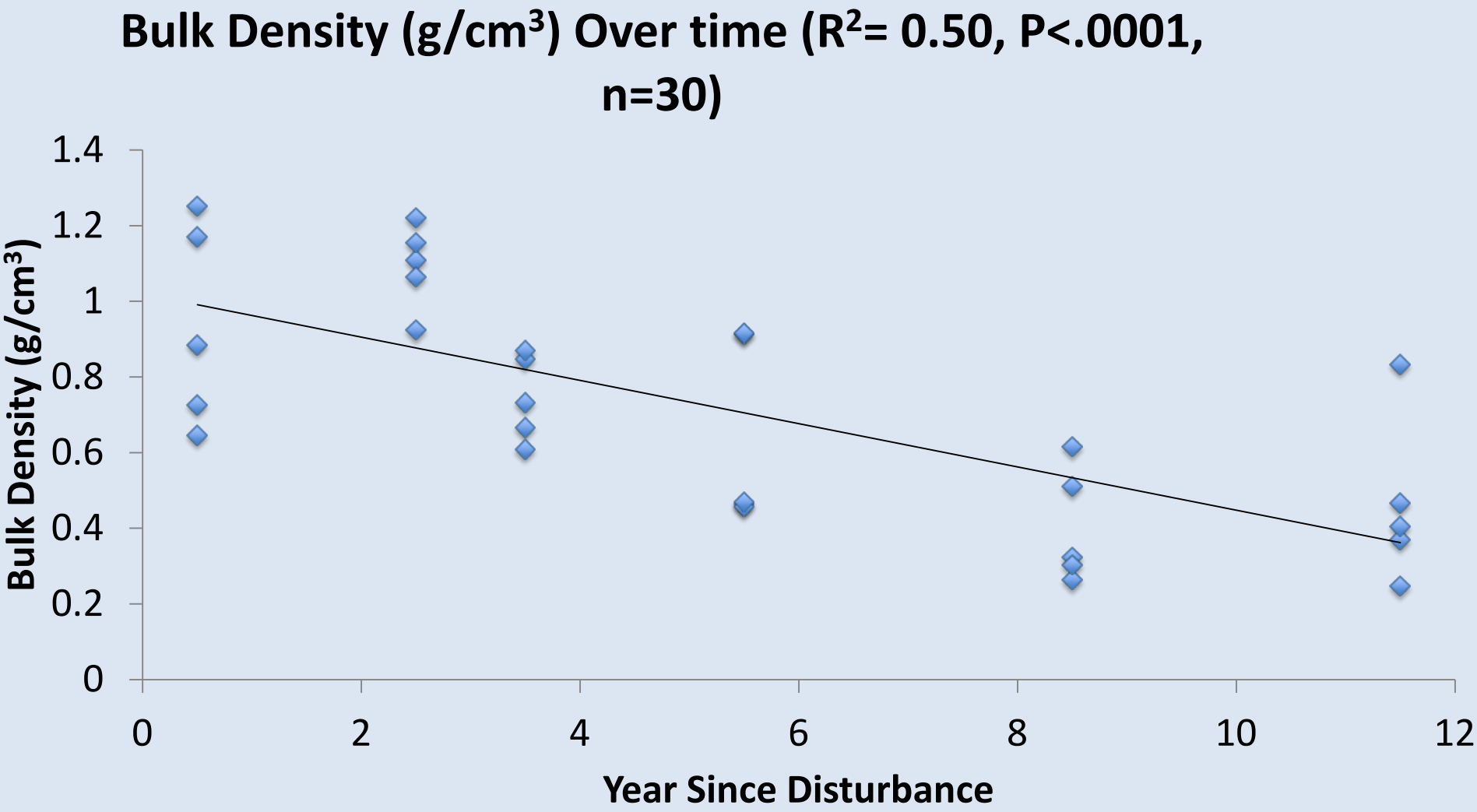
S&D	Unam.	Std. Err.
0.89	1.47	0.06

Root Limiting Bulk Density

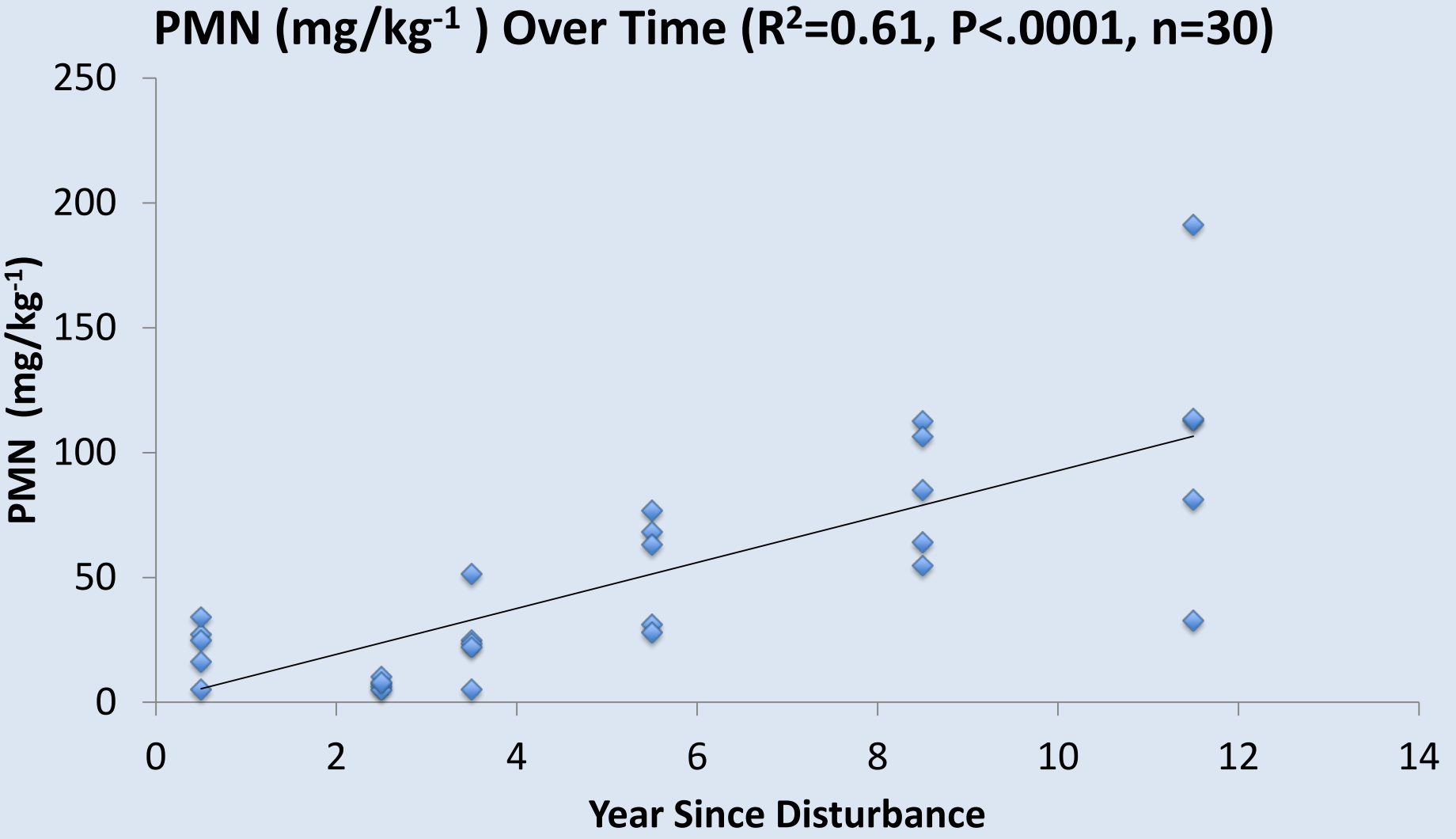
Texture	Bulk Density
Sand	1.75 (g/cm³)
Silt & Clay	1.40 (g/cm³)

Scoop & Dump Over Time

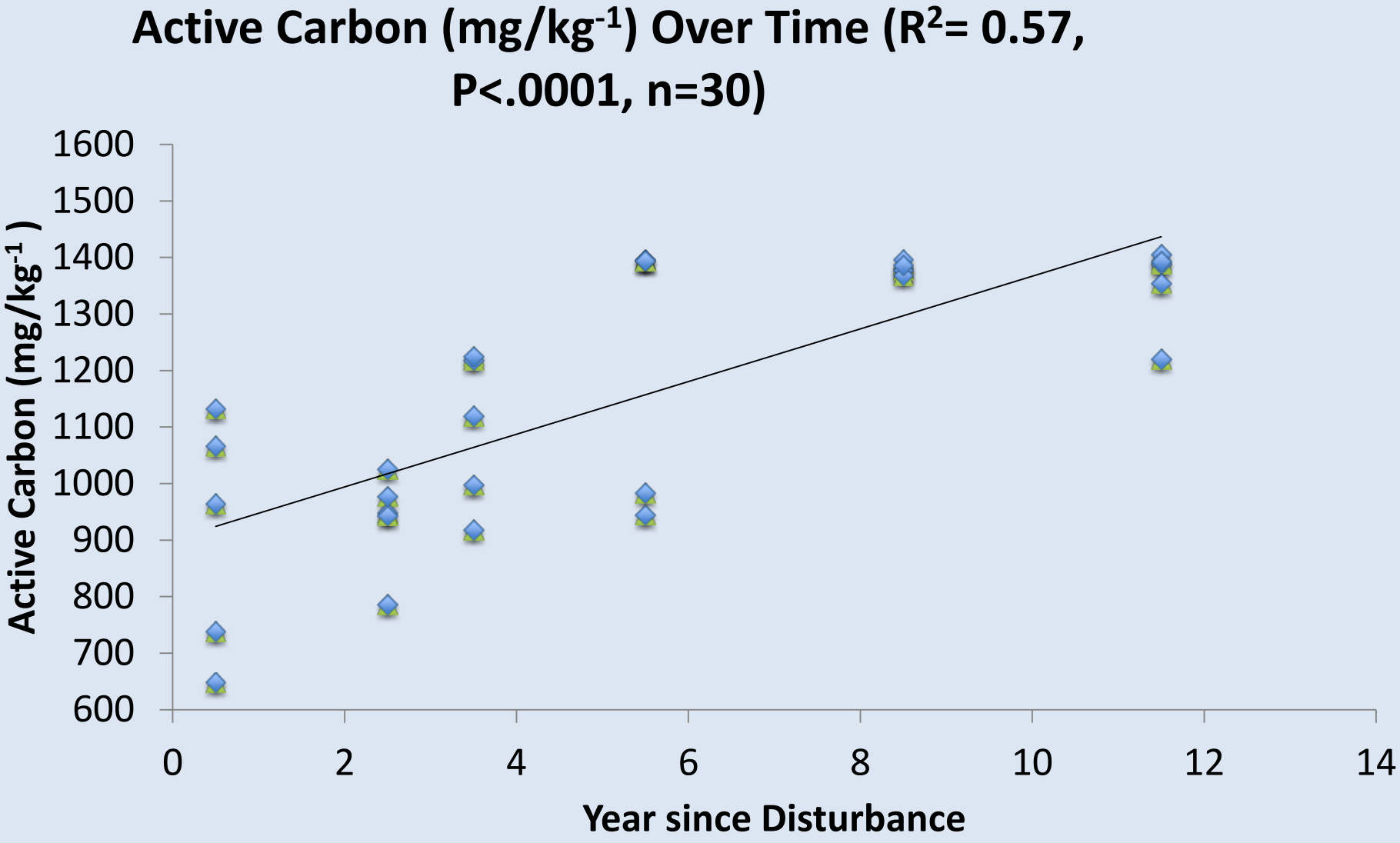
Bulk Density



Potentially Mineralizable Nitrogen

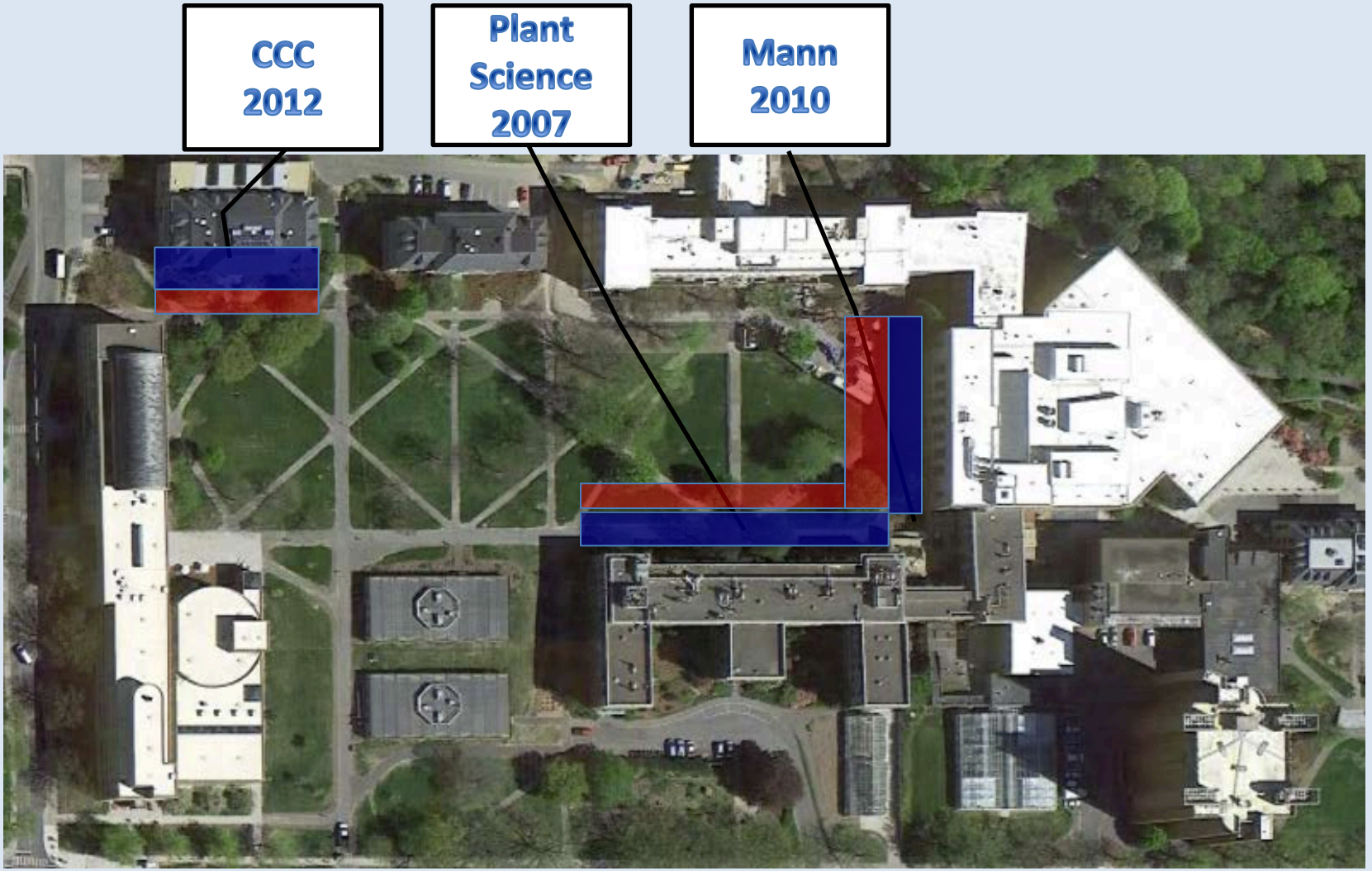


Active Carbon



Soil Container Study

Study Sites



= Study Site (n=3)

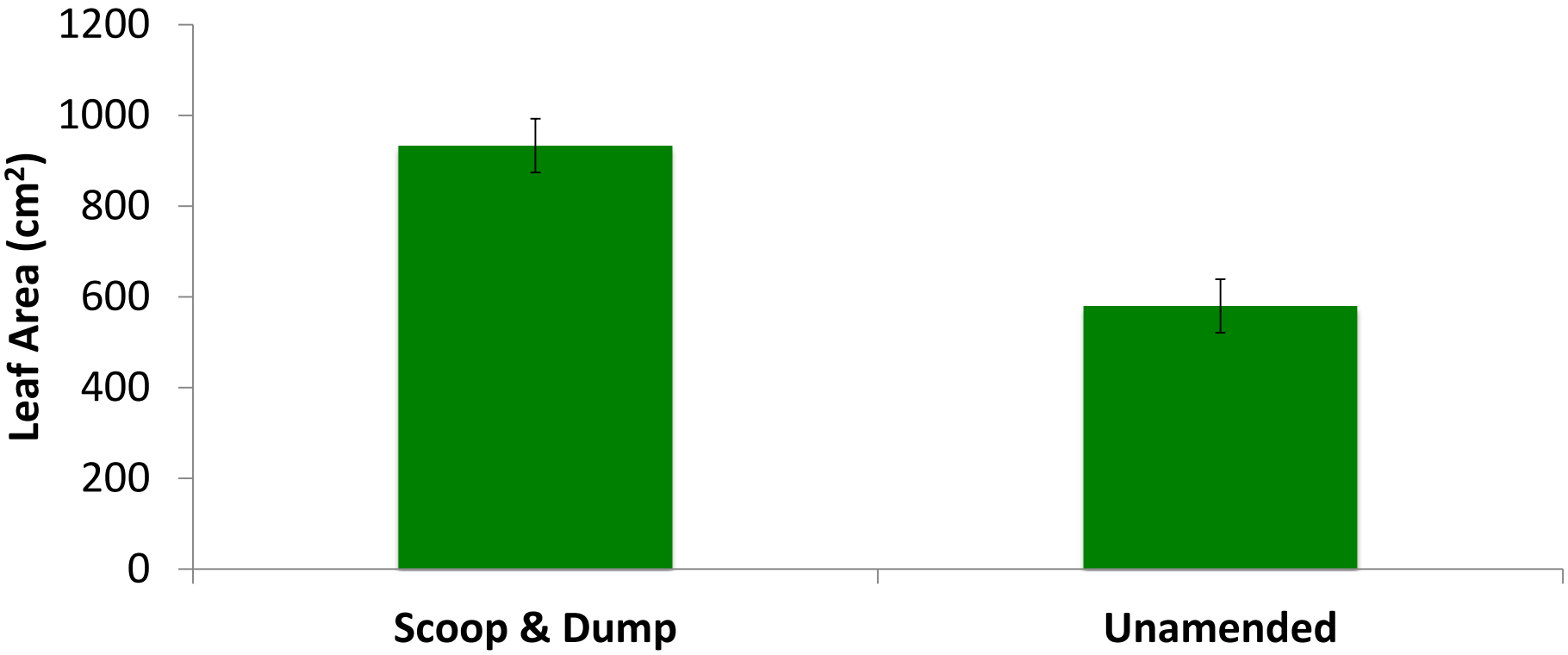
= Control (n=3)

Soils Collected

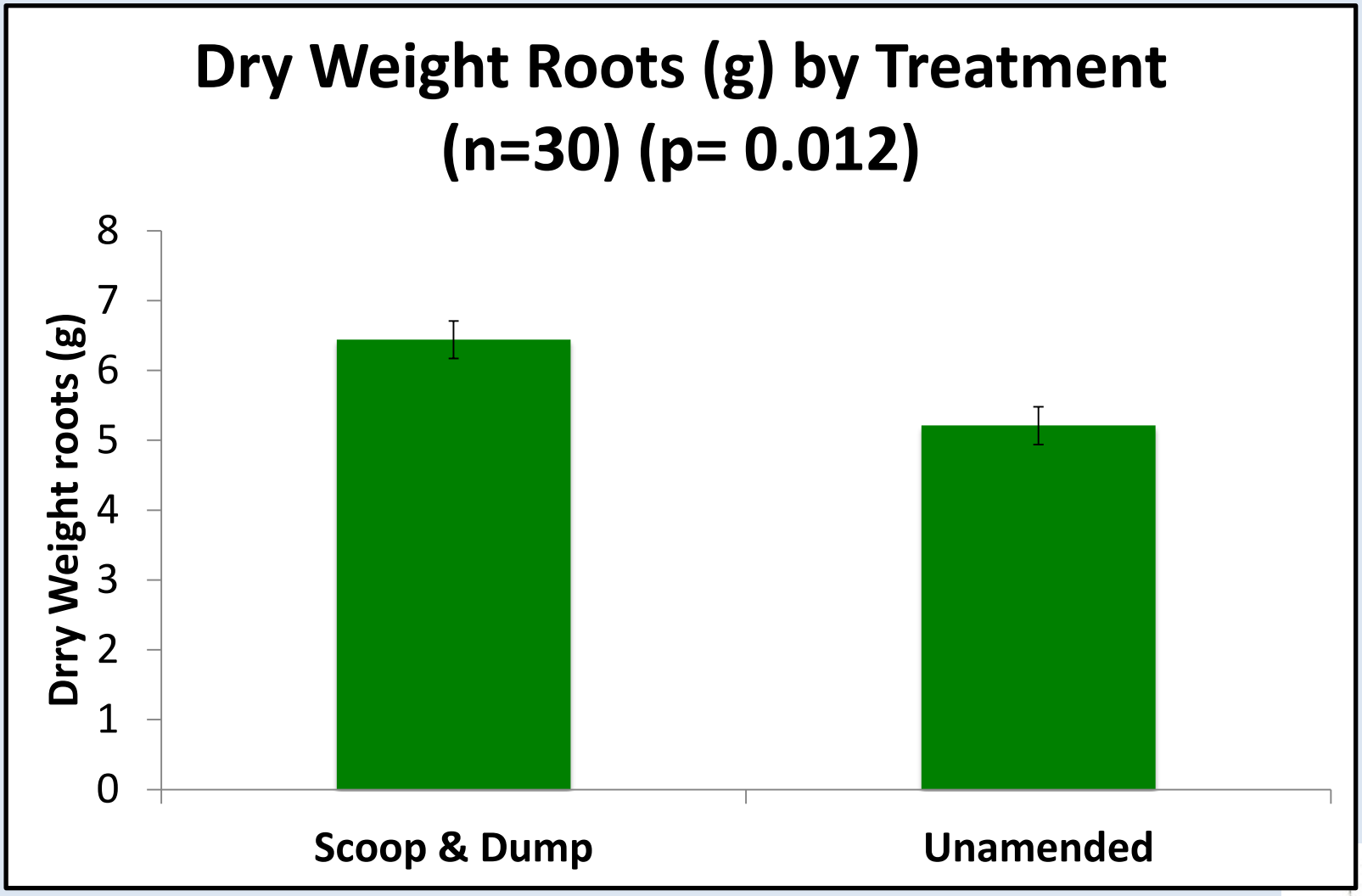
Ficus benjamina as a Street Tree

Photo courtesy Jonathan Wright- Mexico

Leaf Area (cm^2) by Treatment (n=30) (P<0.0002

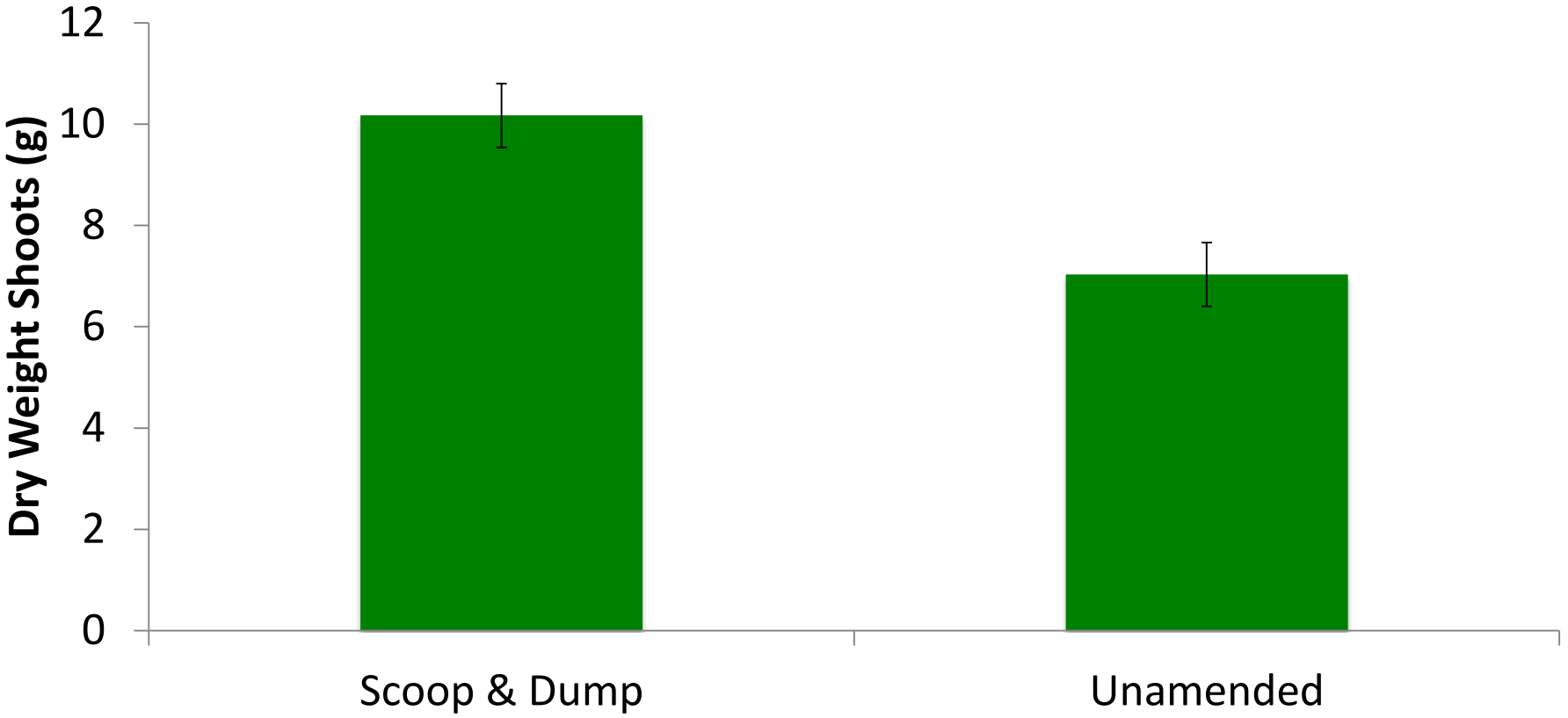


S&D	Unam	Std. Err.	P-value
933.18	579.89	59.14	0.0002

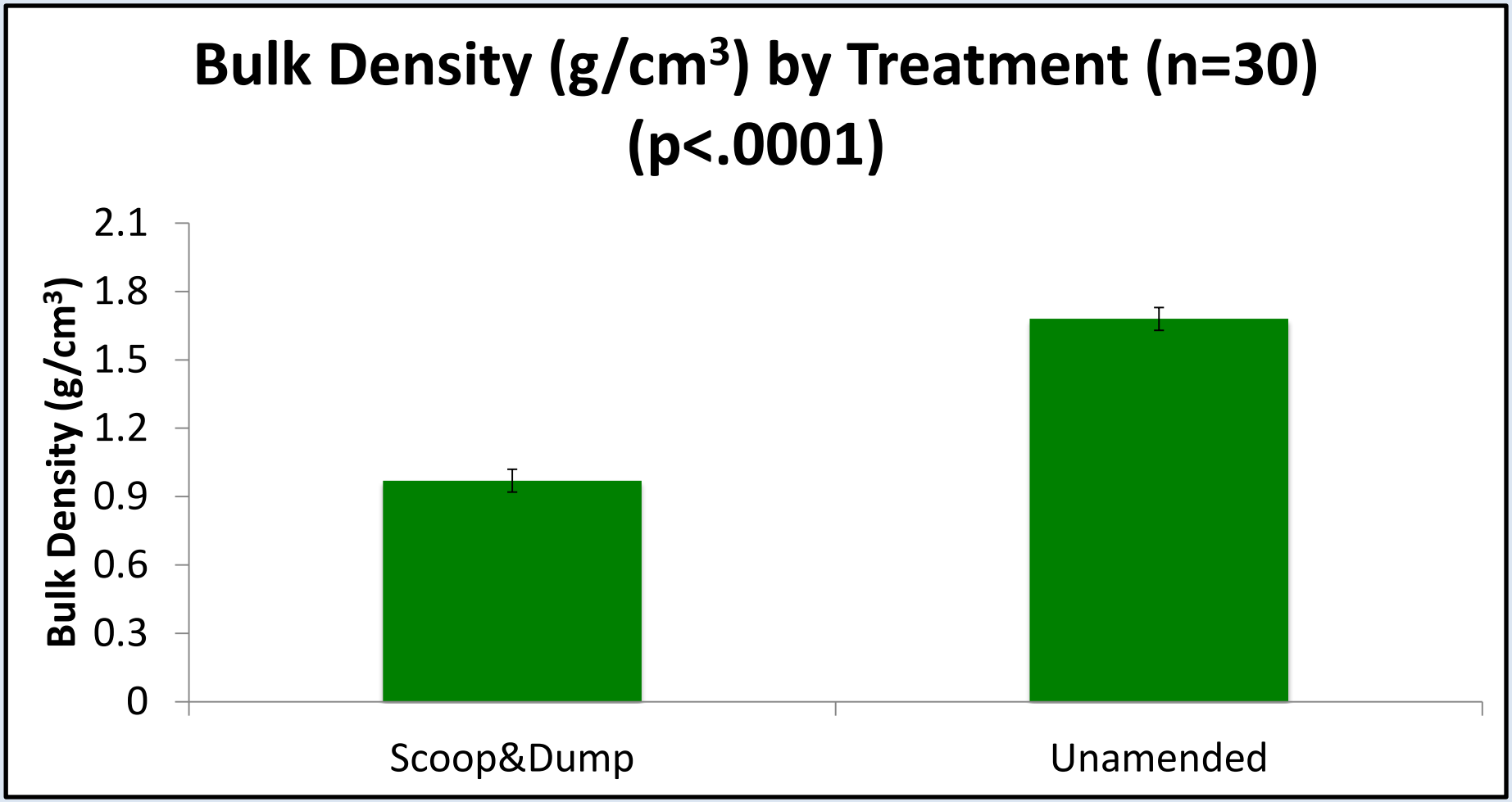


S&D	Unam	Std. Err.	P-value
6.44	5.21	0.32	0.012

Dry Weight Shoots (g) by treatment (n=30) (p=0.0015)



S&D	Unam	Std. Err.	P-value
10.17	7.03	0.63	0.0015



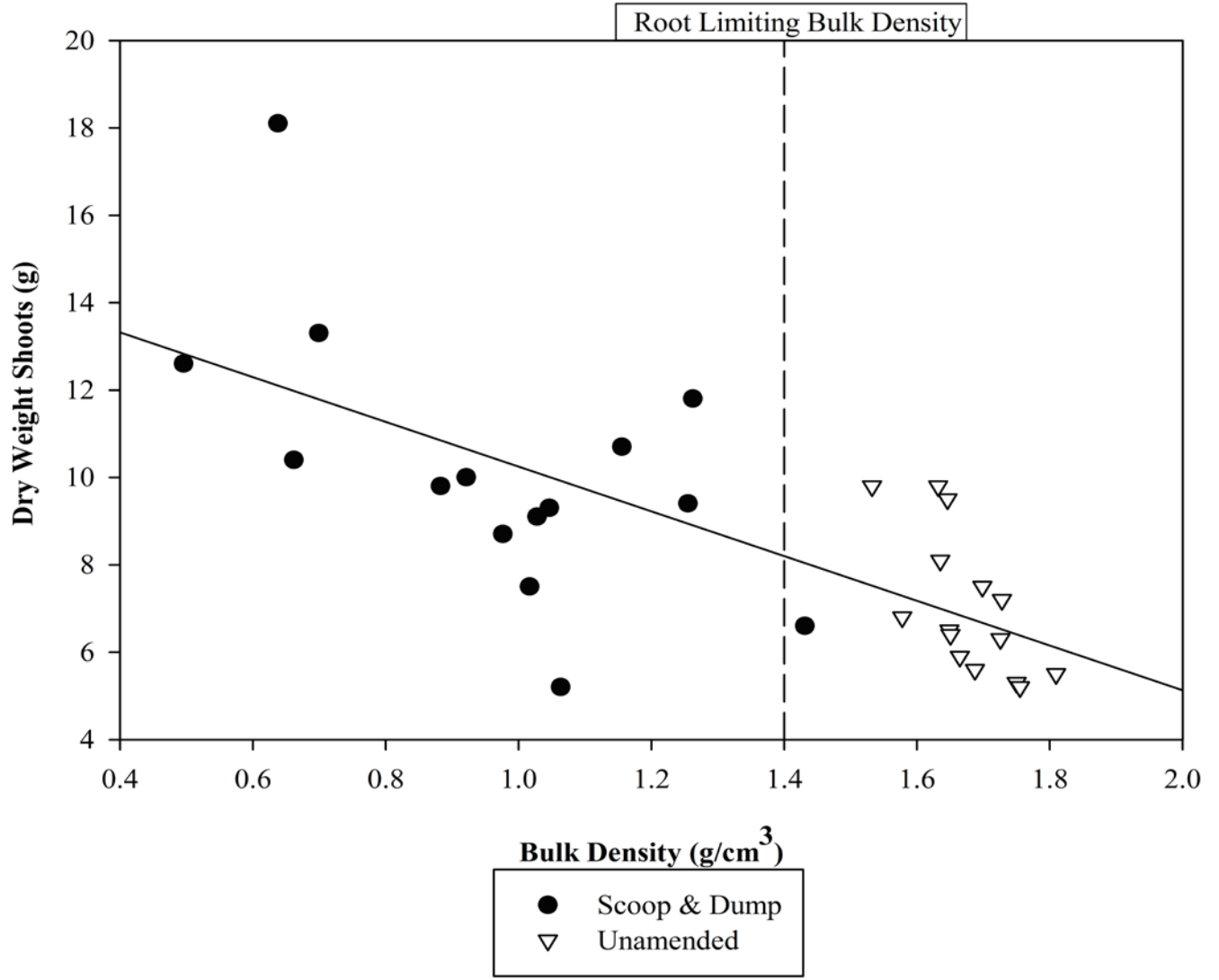
Avg. Bulk Density

S&D	Unam	Std. Err.	P-value
0.97	1.68	0.05	<.0001

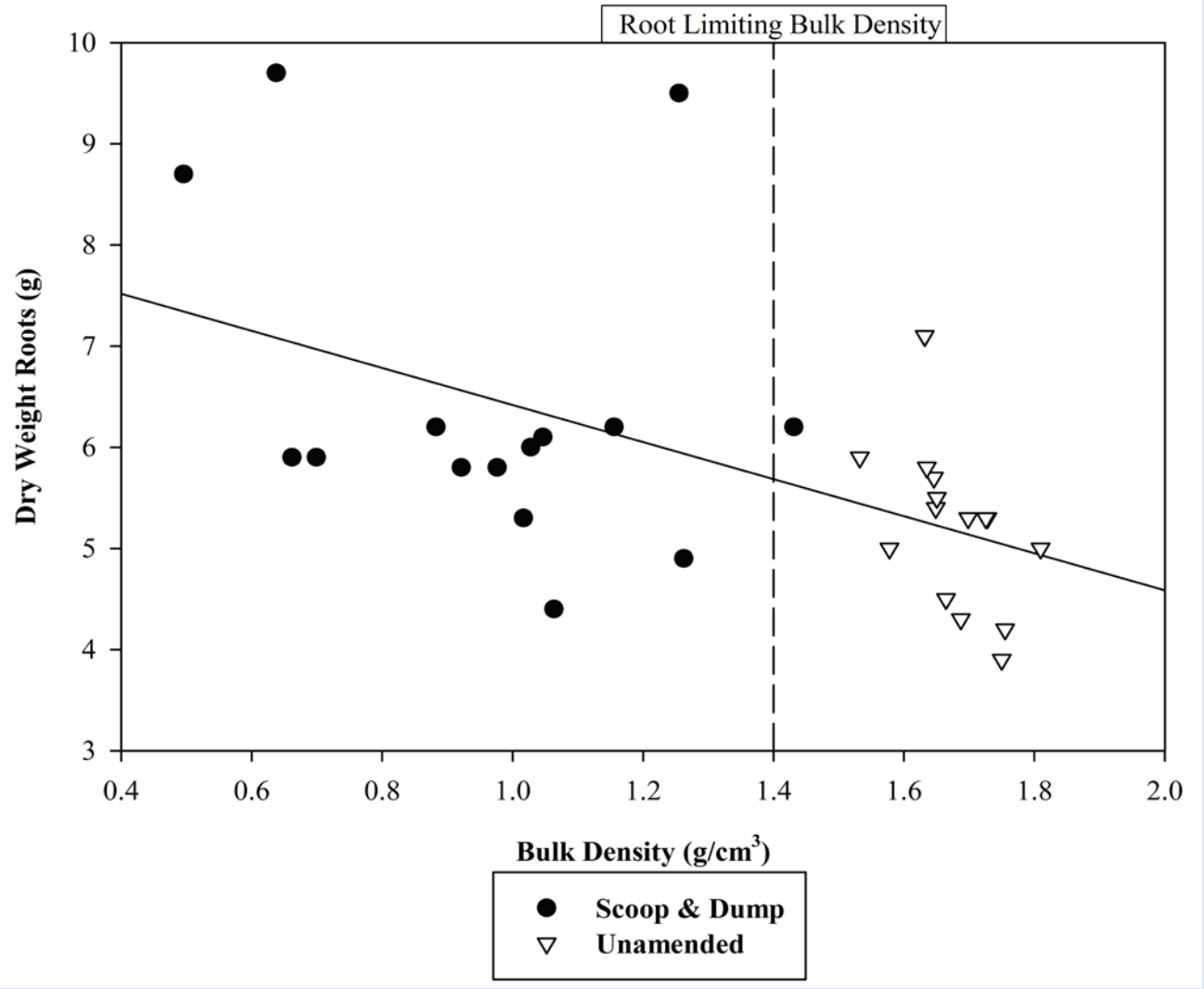
Root Limiting Bulk Density

Texture	Bulk Density
Sand	1.75 (g/cm³)
Silt & Clay	1.40 (g/cm³)

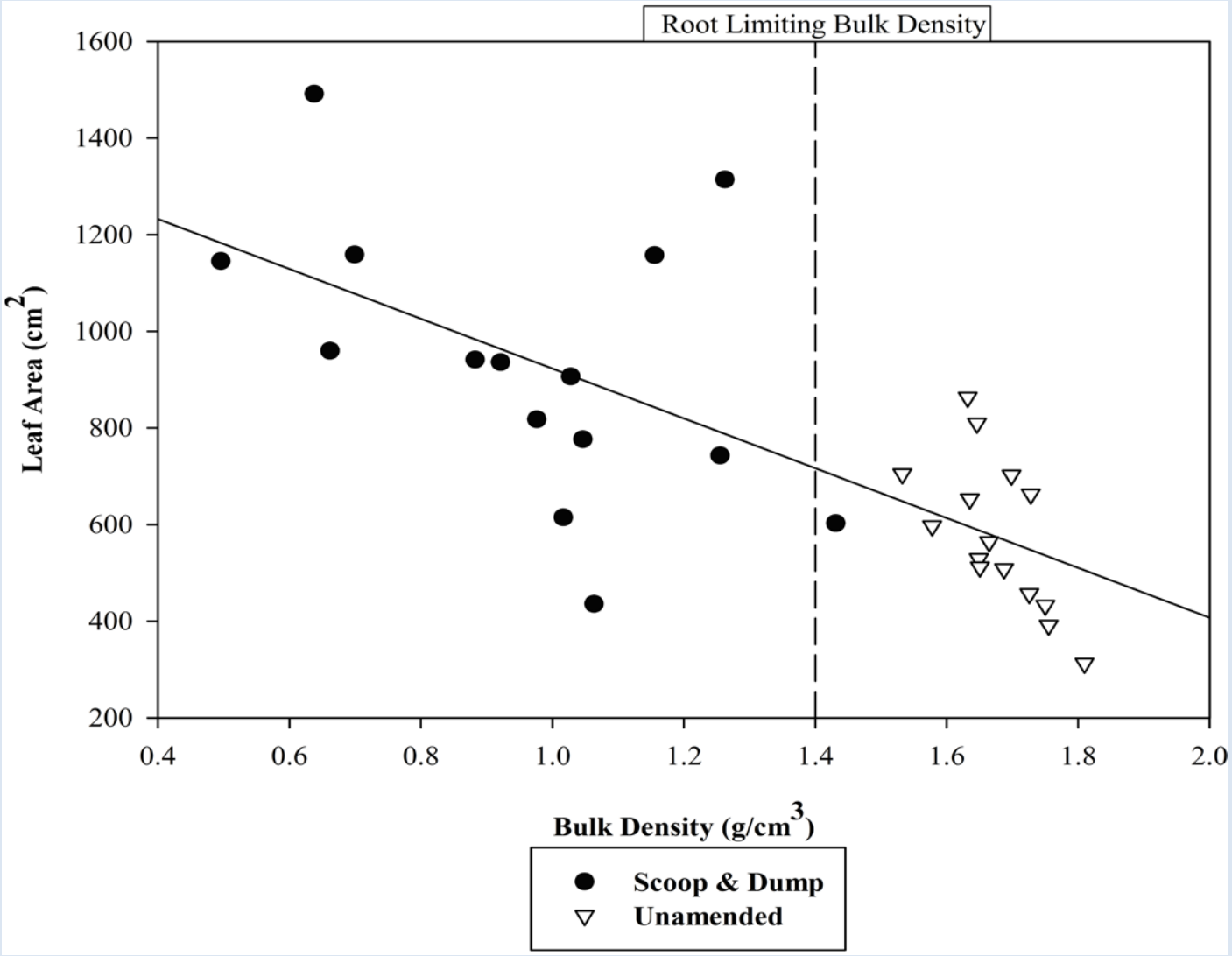
Linear regression show effect of bulk density on dry weight of shoots (R^2=0.47)(p=<.0001)(n=30)



Linear regression showed effect of bulk density on dry weight of roots (R^2= 0.25)(p=0.005)(n=30)



Linear regression show effect of bulk density on leaf area (R^2= 0.47)(p=<.0001)(n=30)



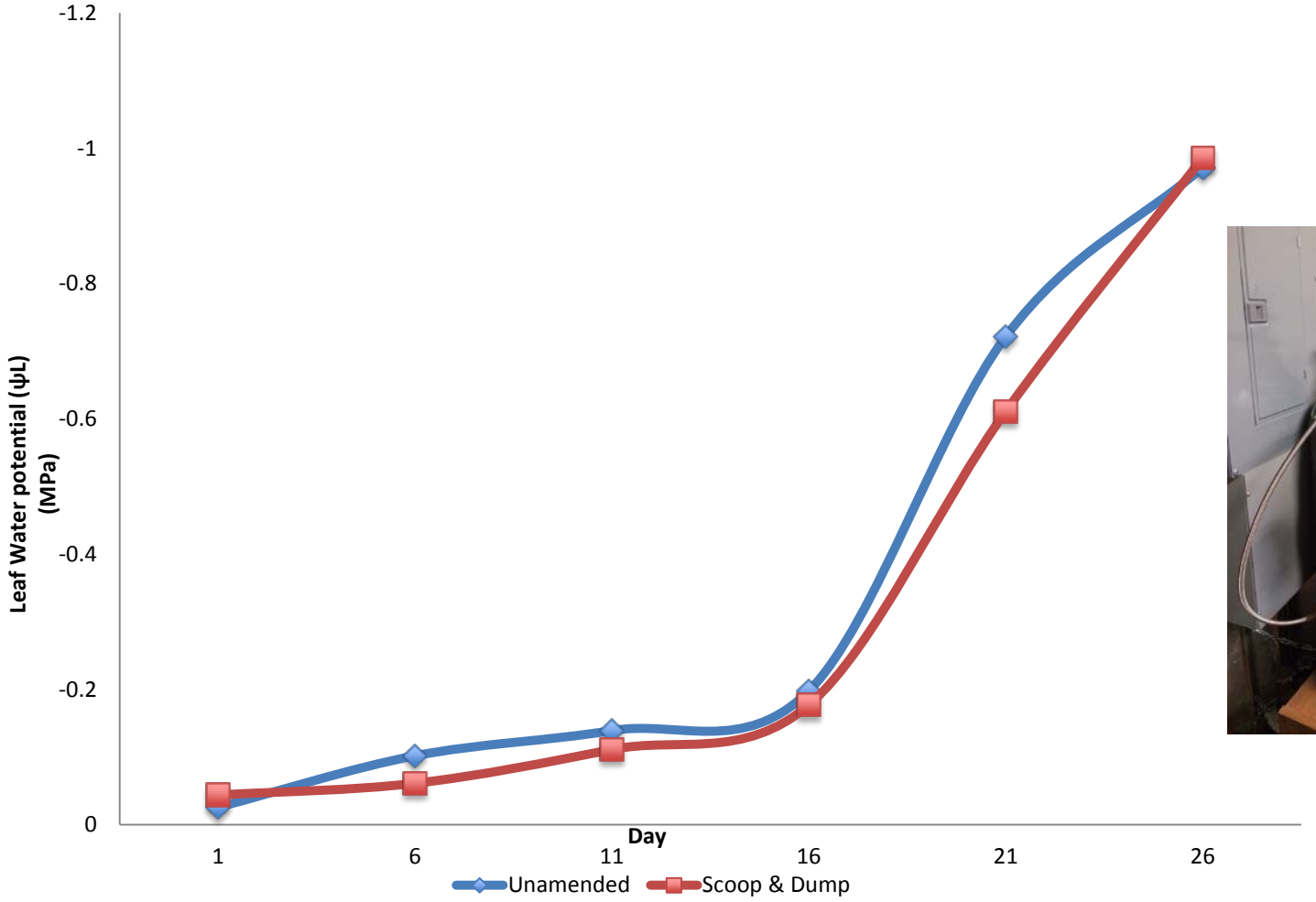
Destructive Harvest Observations

Root avoidance of compact soils

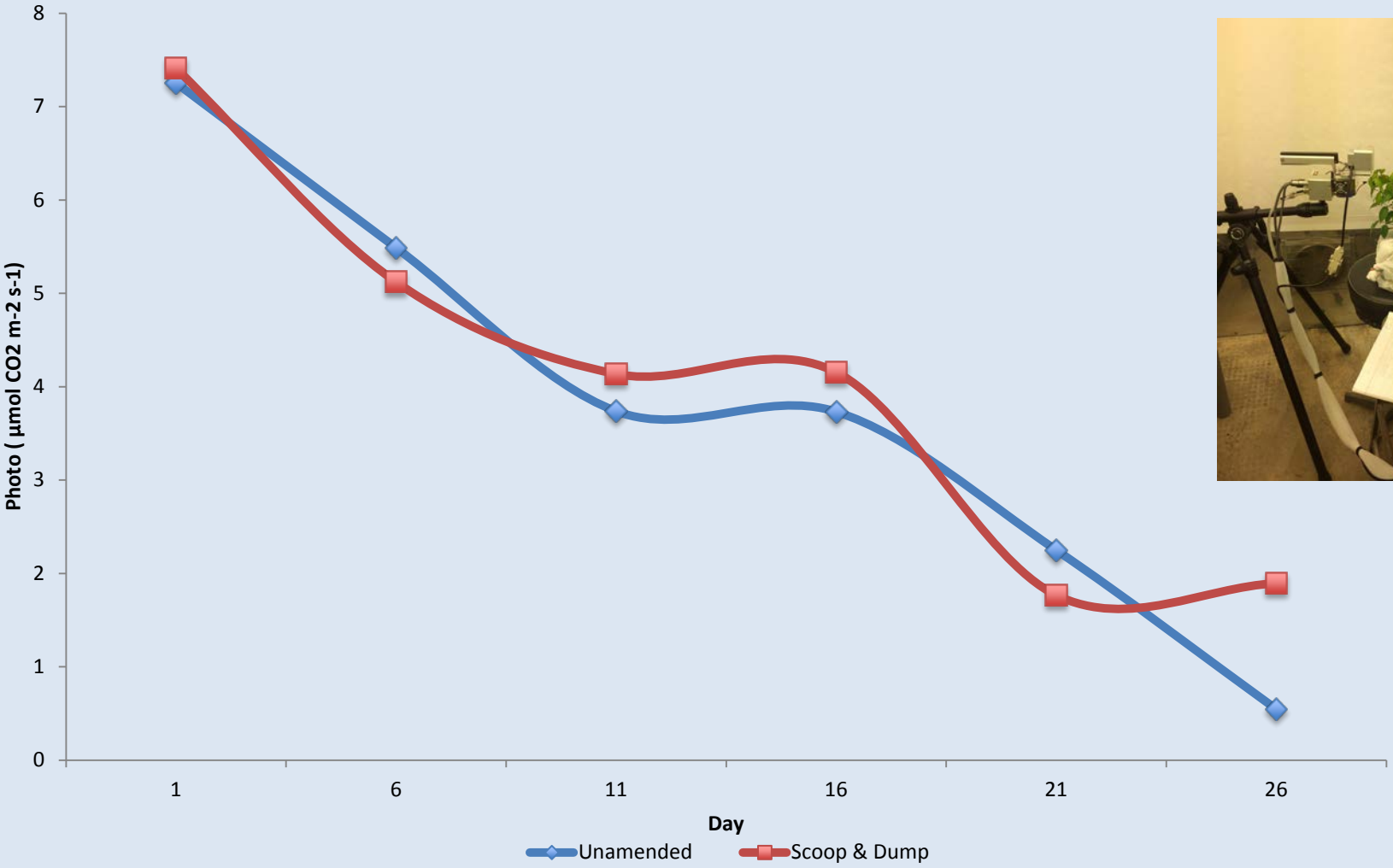
Destructive Harvest Observations

Root Exploration

Leaf Water Potential ψL (MPa) by Day

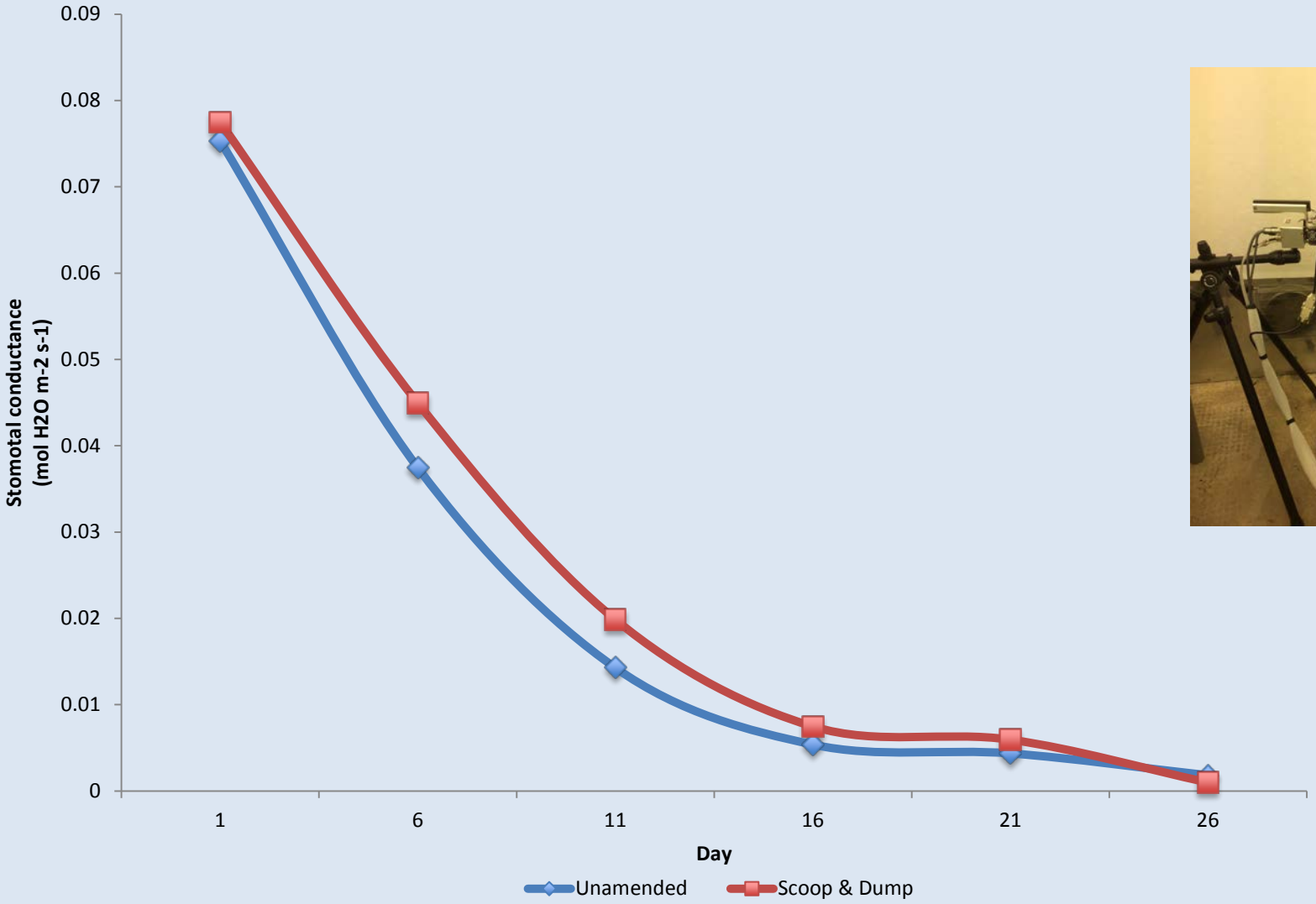


Photosynthetic Carbon Assimilation Rate ($\mu mol\ CO^2\ m^{-2}\ s^{-1}$)

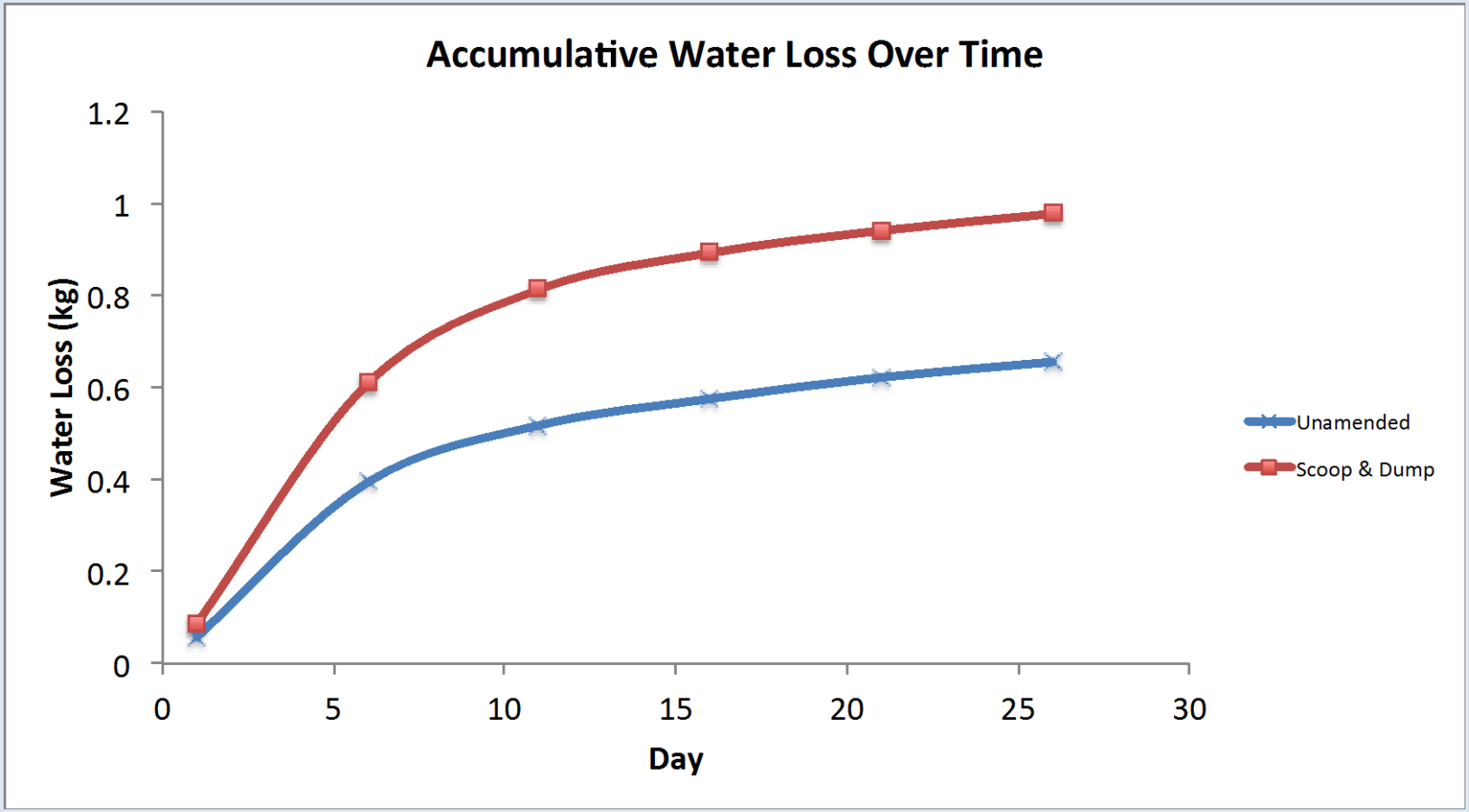


Average Stomatal Conductance

(mol H_2O m^{-2} s^{-1})



Accumulative Water loss

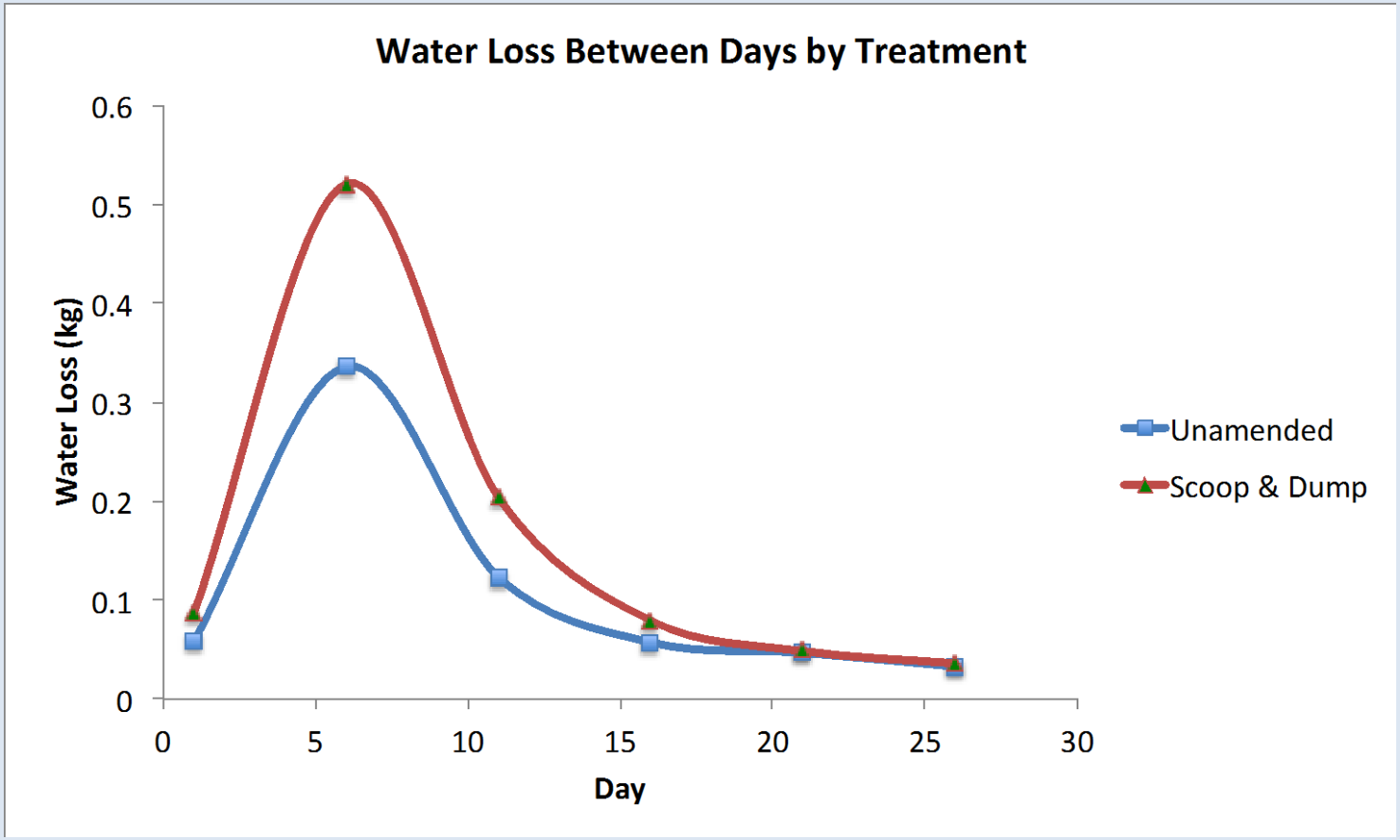


Accumulative Water Loss (kg)

Day	1	6	11	16	21	26
Unamended	*0.058	*0.39	*0.052	*0.58	*0.62	*0.65
S&D	*0.017	*0.61	*0.97	*0.89	*0.94	*0.98

*= statistically different mean values

Water Loss Between Days



Water Loss Between Days (kg)

Day	1	6	11	16	21	26
Unamended	*0.058	*0.34	*0.12	*0.06	0.05	0.03
S&D	*0.088	*0.52	*0.2	*0.08	0.05	0.04

*= statistically different mean values

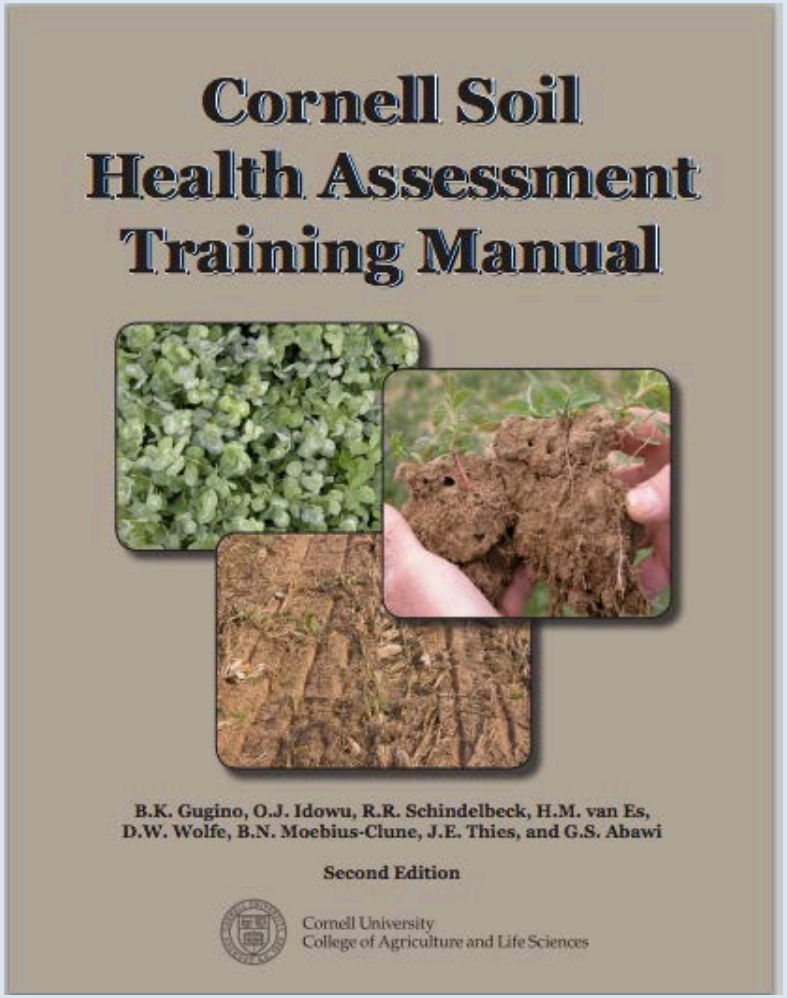
Scoop & Dump Remediation Improves Urban Soil Characteristics

Urban soils distinct characteristics:

- **High Soil bulk density***
- **Decrease in Organic Matter***
- **Poor structure***
- High pH
- **Low Water Holding Capacity***
- **Decreased Aggregate Stability***
- **Inadequate soil depth for root growth***
- **Decrease in microbial biomass & activity***

(Scharenbroch et al 2005, Jim, C. 1998)

Soil Health Test



Thank You

- Nina Bassuk
- Harold VanEs
- Don Rakow
- Tom Whitlow
- Bryant Scharenbroch
- Sunshine Horticulture
- Cornell Soil Health Lab
- Cornell Urban Horticulture Institute
- Morton Arboretum
- Cornell Plantations
- International Society of Arboriculture

Cornell University

Questions

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