Plant Rhizosphere Contributions To Soil Aggregation In A Riparian Buffer

Grant Falvo[1]

[1]Arizona State University, Tempe, Arizona, USA; gfalvo@asu.edu

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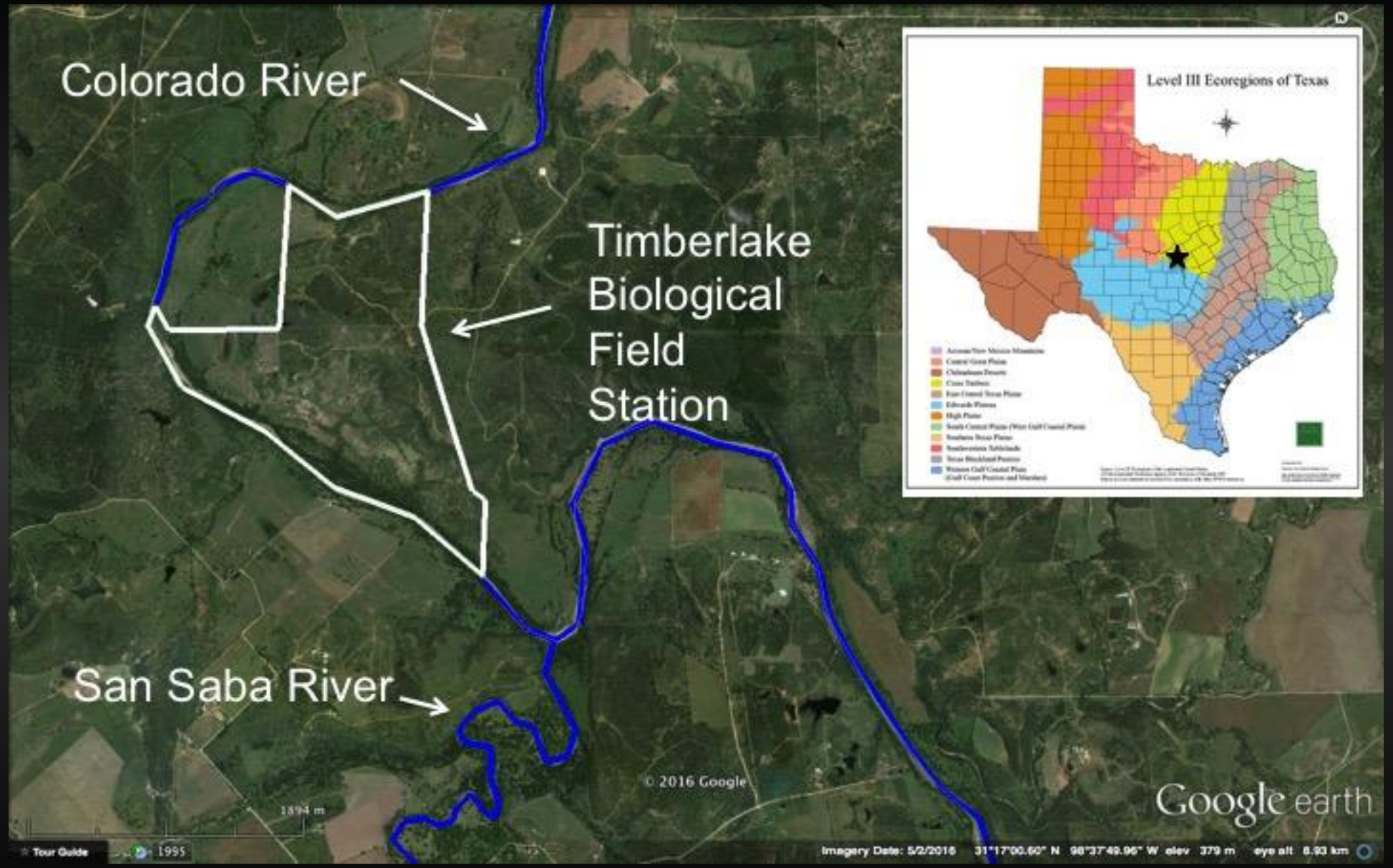
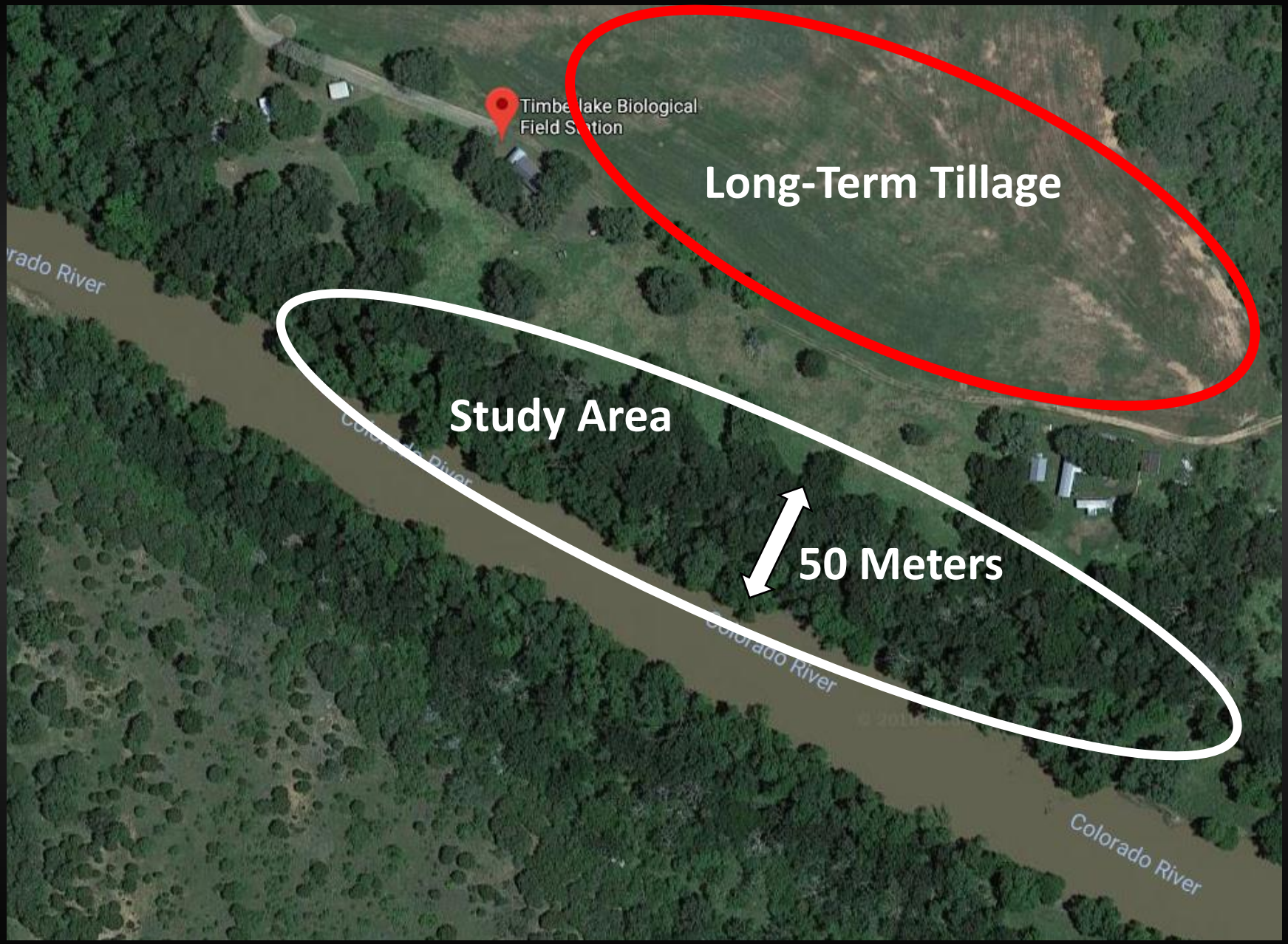
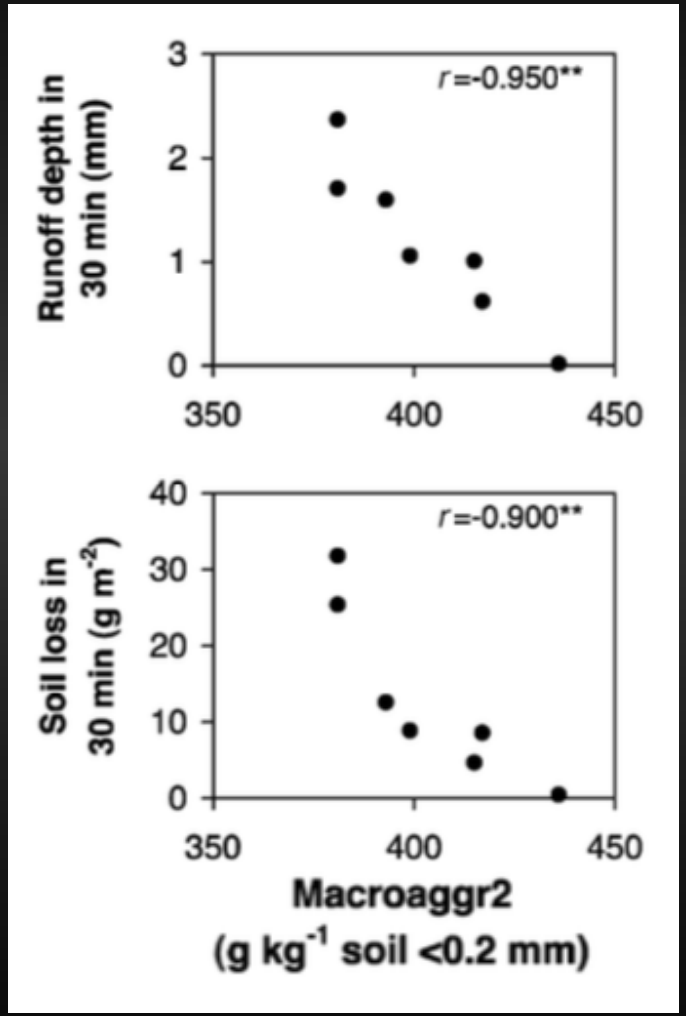

Colorado River
Timberlake
Biological
Field
Station
San Saba River
Level III Ecoregions of Texas
© 2016 Google
Google earth
1894 m
Tour Guide
1995
Imagery Date: 5/2/2016 31°17'00.60" N 98°37'49.96" W elev 379 m eye alt 8.93 km


Long-Term Tillage
Study Area
50 Meters
Colorado River
Colorado River

Soil Aggregation Predicts Runoff And Soil Loss In The Field

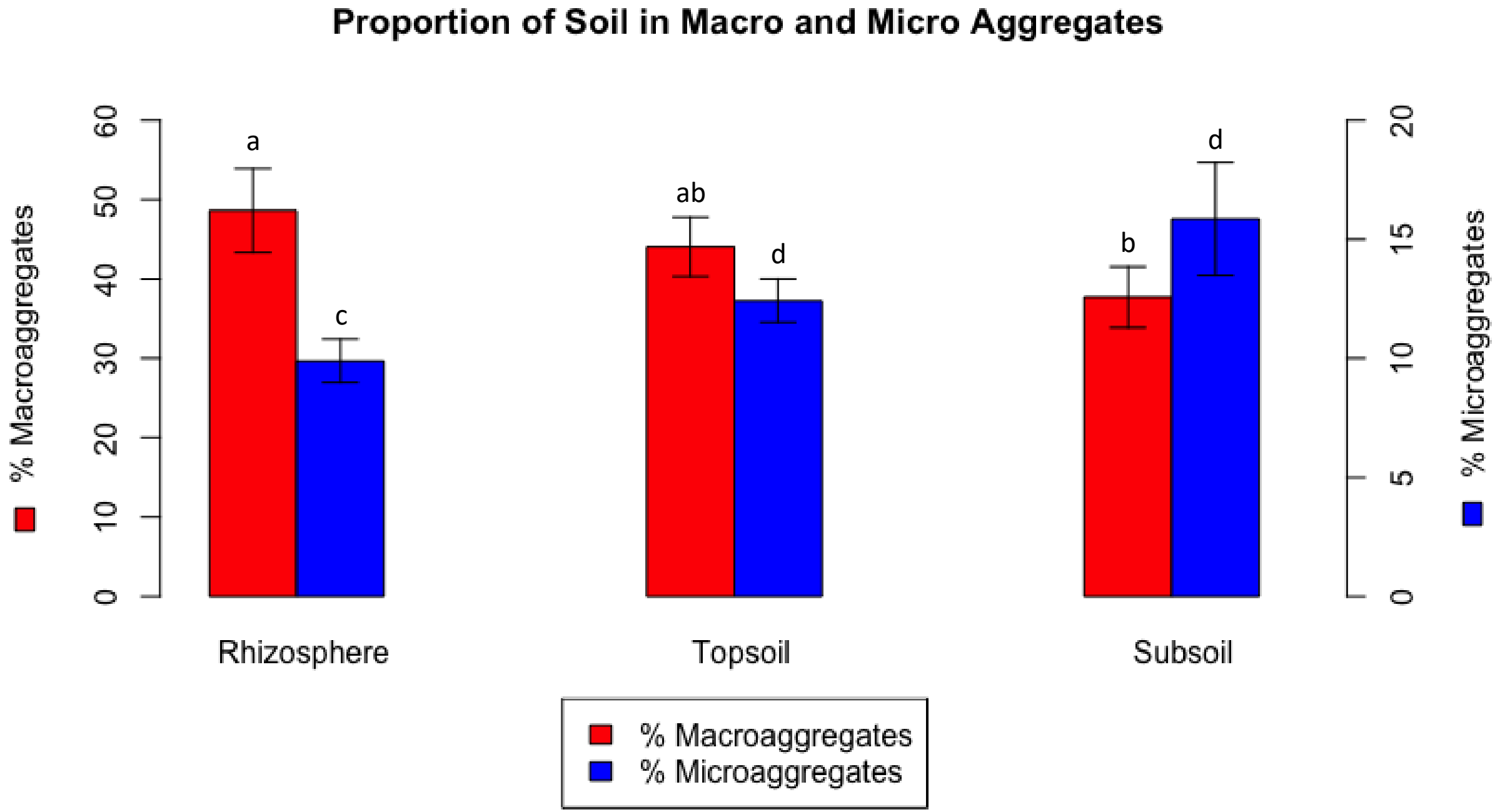


The difference between loosing 0.3 T/ha in an afternoon, or not.

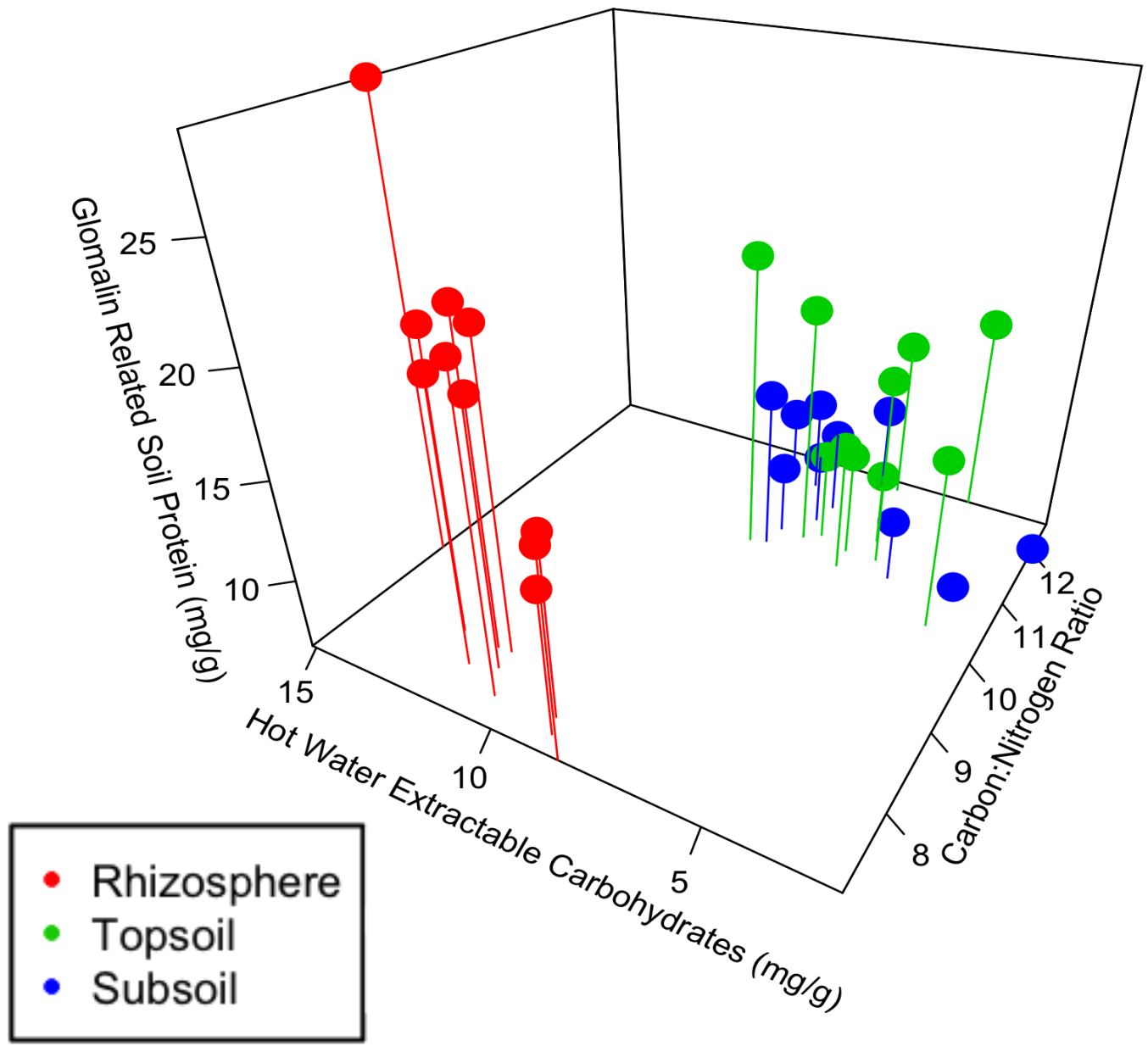
Source: B. Barthes, E. Roose / Catena 47 (2002) 133–149

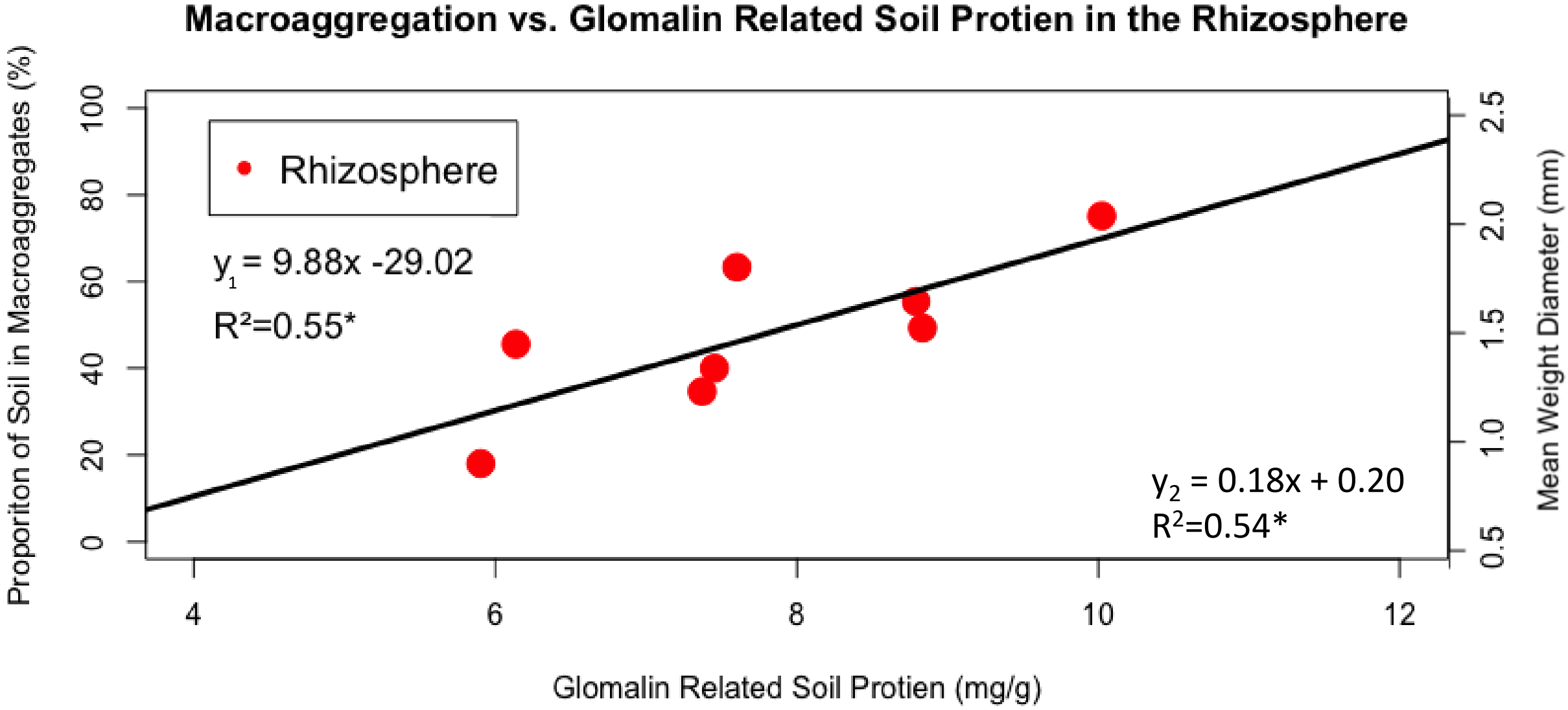
Source: Iowa NCRS 2014.

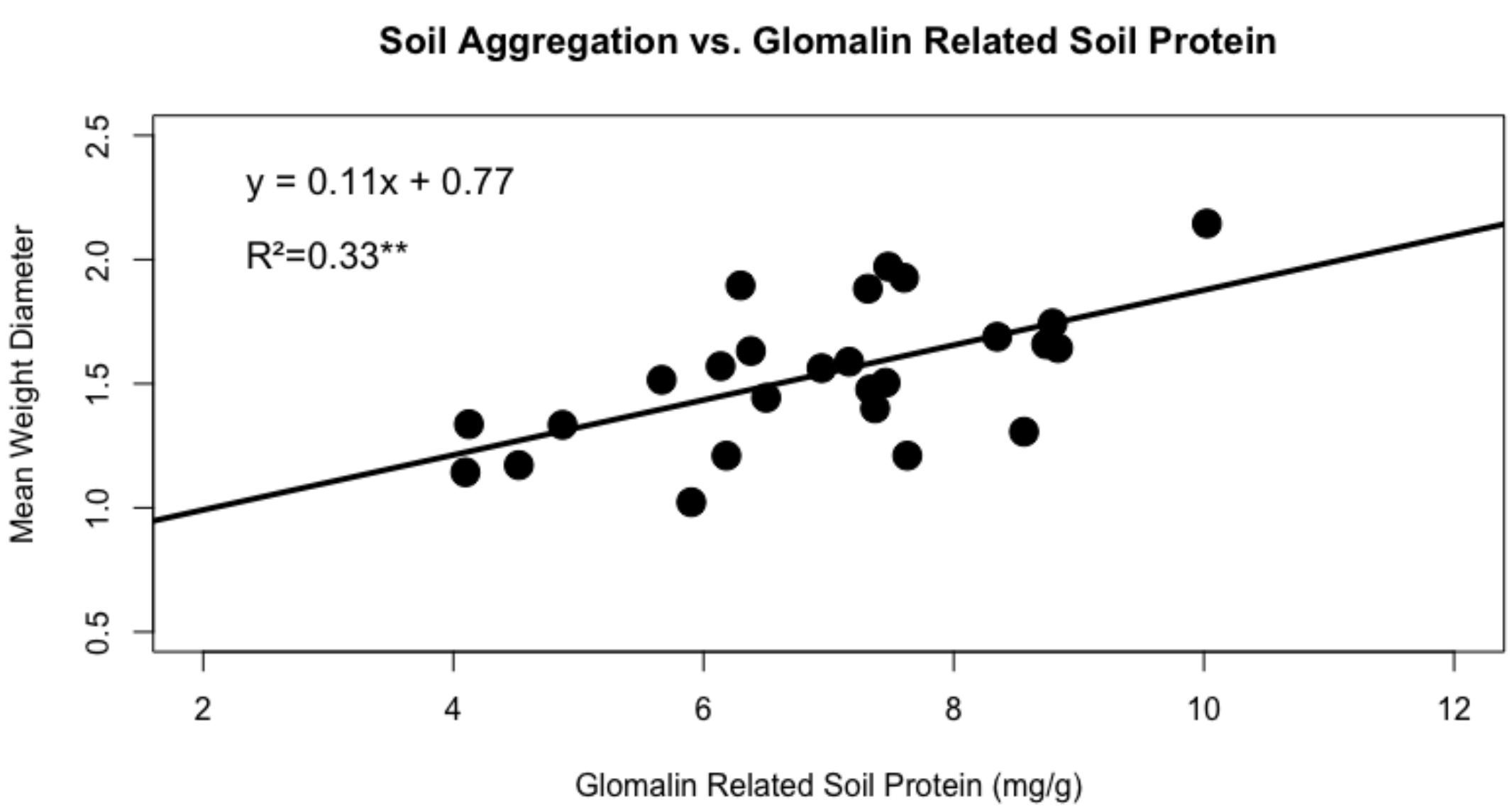
Source: Wissocq, 2016.

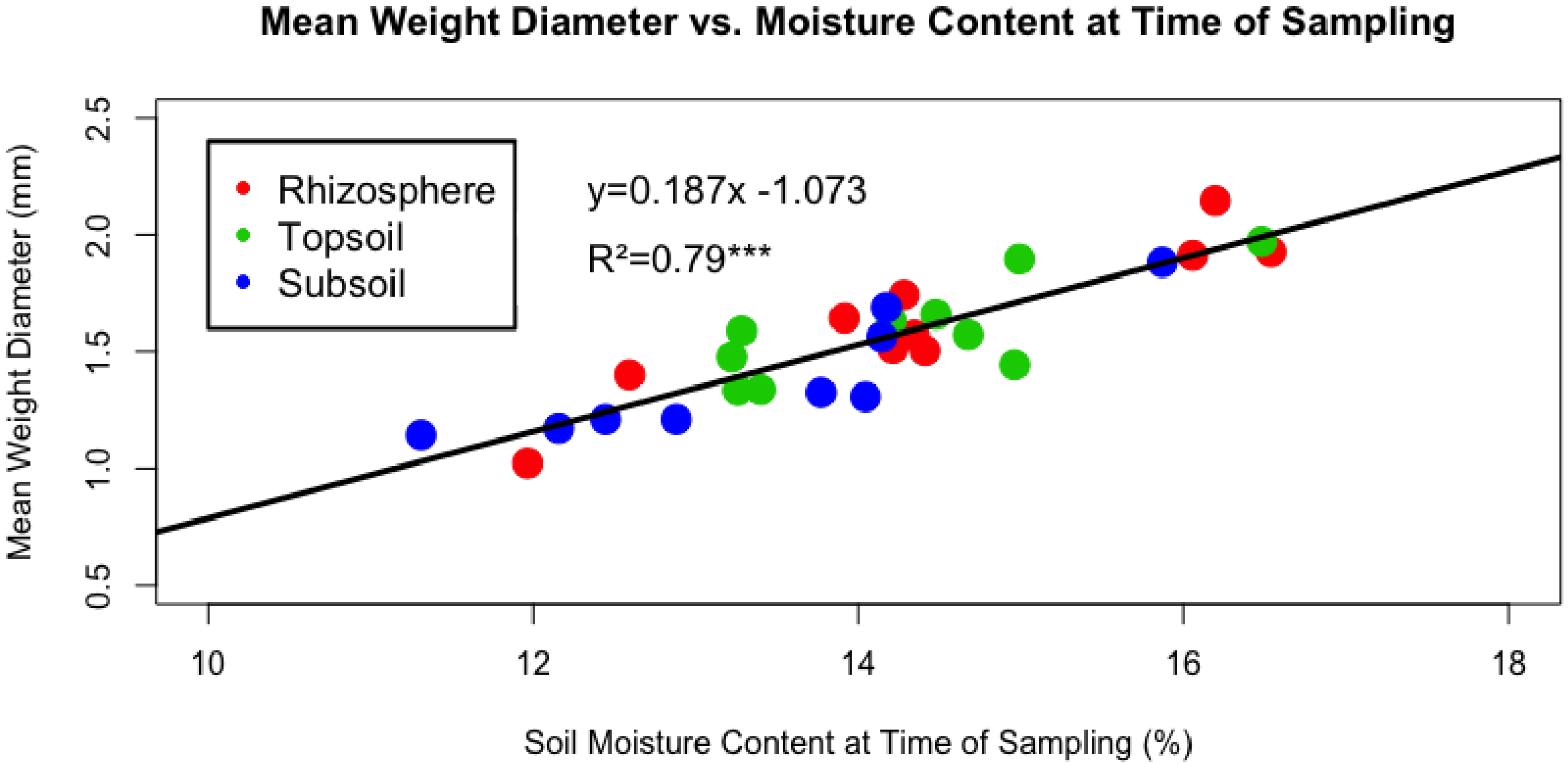

Proportion of Soil in Macro and Micro Aggregates
% Macroaggregates
0
10
20
30
40
50
60
% Microaggregates
0
5
10
15
20
a
c
ab
d
b
d
Rhizosphere
Topsoil
Subsoil
% Macroaggregates
% Microaggregates

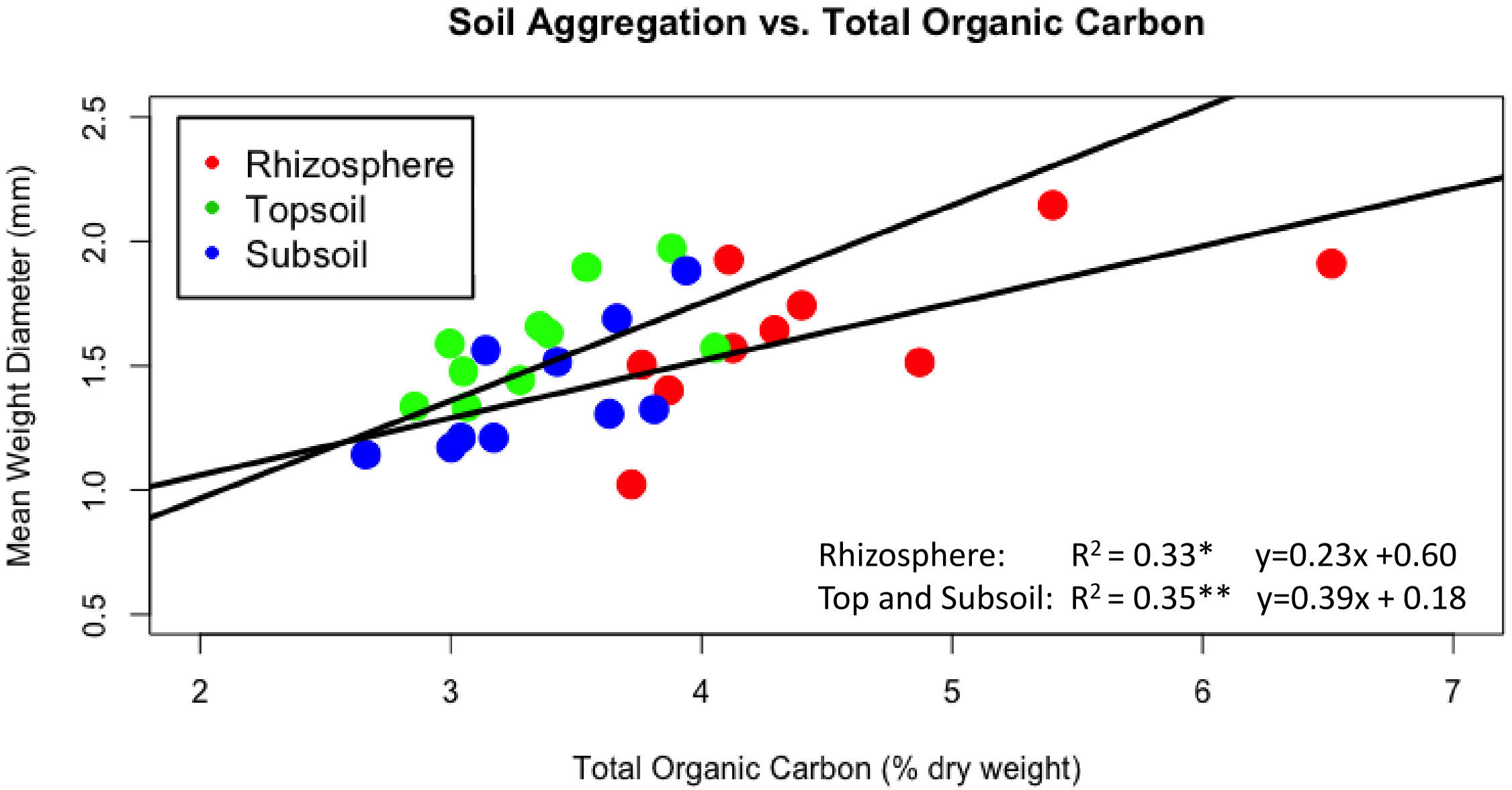
Unique Signature of the Rhizosphere

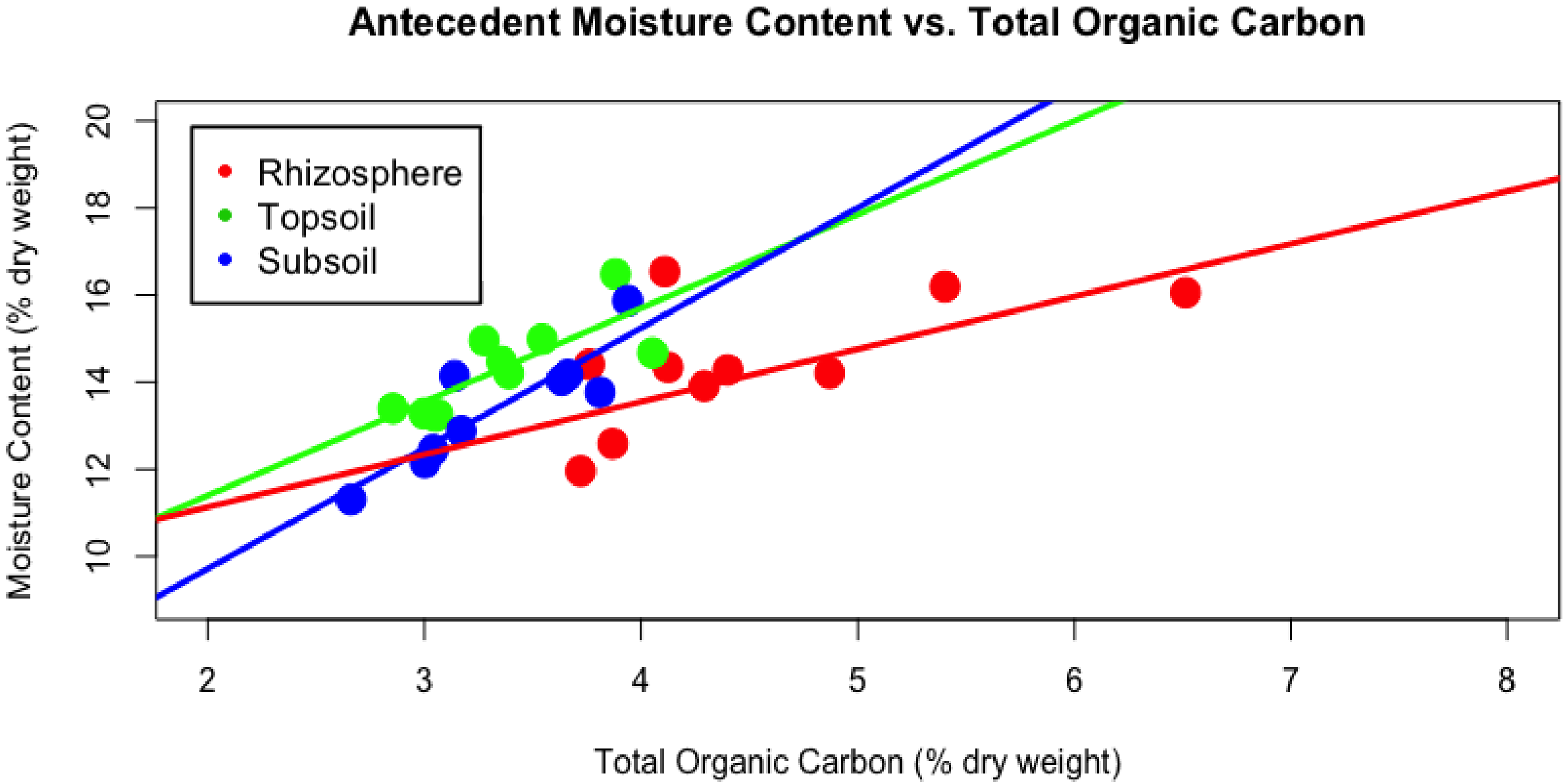



Macroaggregation vs. Glomalin Related Soil Protien in the Rhizosphere
Proporiton of Soil in Macroaggregates (%)
0
20
40
60
80
100
Rhizosphere
y_1 = 9.88x -29.02
R^2=0.55*
y_2 = 0.18x + 0.20
R^2=0.54*
4
6
8
10
12
Glomalin Related Soil Protien (mg/g)
0.5
1.0
1.5
2.0
2.5
Mean Weight Diameter (mm)


Soil Aggregation vs. Glomalin Related Soil Protein
y = 0.11x + 0.77
R²=0.33**
Mean Weight Diameter
0.5
1.0
1.5
2.0
2.5
2
4
6
8
10
12
Glomalin Related Soil Protein (mg/g)


Mean Weight Diameter vs. Moisture Content at Time of Sampling
Rhizosphere
Topsoil
Subsoil
y=0.187x -1.073
R²=0.79***
Mean Weight Diameter (mm)
0.5
1.0
1.5
2.0
2.5
10
12
14
16
18
Soil Moisture Content at Time of Sampling (%)


Soil Aggregation vs. Total Organic Carbon
Rhizosphere
Topsoil
Subsoil
Rhizosphere: R² = 0.33* y=0.23x +0.60
Top and Subsoil: R² = 0.35** y=0.39x + 0.18
Mean Weight Diameter (mm)
0.5
1.0
1.5
2.0
2.5
2
3
4
5
6
7
Total Organic Carbon (% dry weight)



R^2 values for the rhizosphere, topsoil, and subsoil are **0.60****,**0.59****,and **0.74****, respectively.
However, the rhizosphere regression slope value was roughly ***half*** that of the top and sub soil regressions.

Soil Take Away Conclusions:

- Plant Fed-Microbial “glues” facilitate aggregation which prevents erosion and runoff and increases infiltration and productivity.
- Slaking (water-holding capacity) is a key process controlling erosion in seasonally dry soils.
- Future studies should examine how microbial aggregation agents affect moisture content throughout the year.

Riparian Restoration Take Away Conclusions:

- Restoration of functioning rhizosphere microbiomes can make riparian areas
  - 1) more resistant to erosion and runoff
  - 2) more productive (i.e. increased infiltration)
  - 3) contribute more to baseflow and less to nutrient and sediment pollution

- Restoration Methods:
  - 1) Reestablish and maintain sufficient soil cover with plants and residue
  - 2) Do not disturb the soil (e.g. tillage, grazing, recreation)
  - 3) Sequester organic matter (i.e. for climate change adaptation)

- Implementation in the riparian area is **reactionary** and may be insufficient
- Implementation in the adjacent uplands is **proactive** may be necessary

Acknowledgements

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