ALTA

AGRICULTURAL LABORATORY TESTING ASSOCIATION

Overview:

- Illinois Soil Testing Association (ISTA) was founded in 1981 address Illinois growers' needs for quality soil test information. ISTA rebranded as the Agriculture Laboratory Testing Association (ALTA).
- ALTA's mission is to promote the interests of the Ag testing industry and advance high-quality soil & plant-tissue analysis data for farm profitability, and sustainability in the US.
- ALTA is committed to ensuring the quality of data to agricultural communities by encouraging the development, use, and acceptance of proven agricultural testing methods.

Soil Scooping II
Assumptions and Issues

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ALTA-SPAC Webinar
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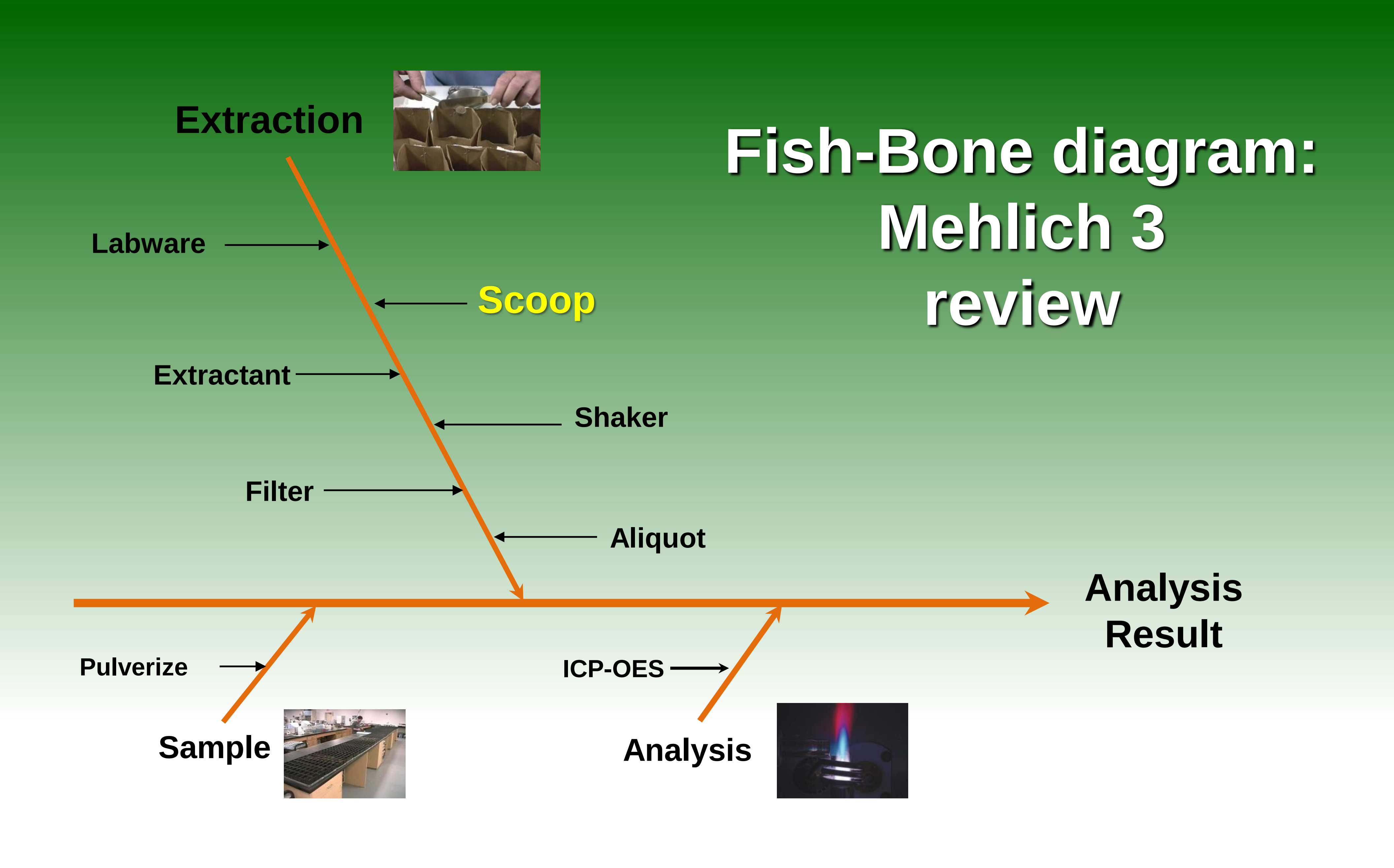
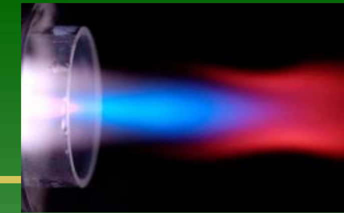
ALTA AGRICULTURAL LABORATORY TESTING ASSOCIATION

CTS Worldwide Interlaboratory Testing
Collaborative Testing Services

ALP


Fish-Bone diagram:
Mehlich 3
review
Extraction
Labware
Scoop
Extractant
Shaker
Filter
Aliquot
Analysis
Result
Pulverize
Sample
ICP-OES
Analysis

History review

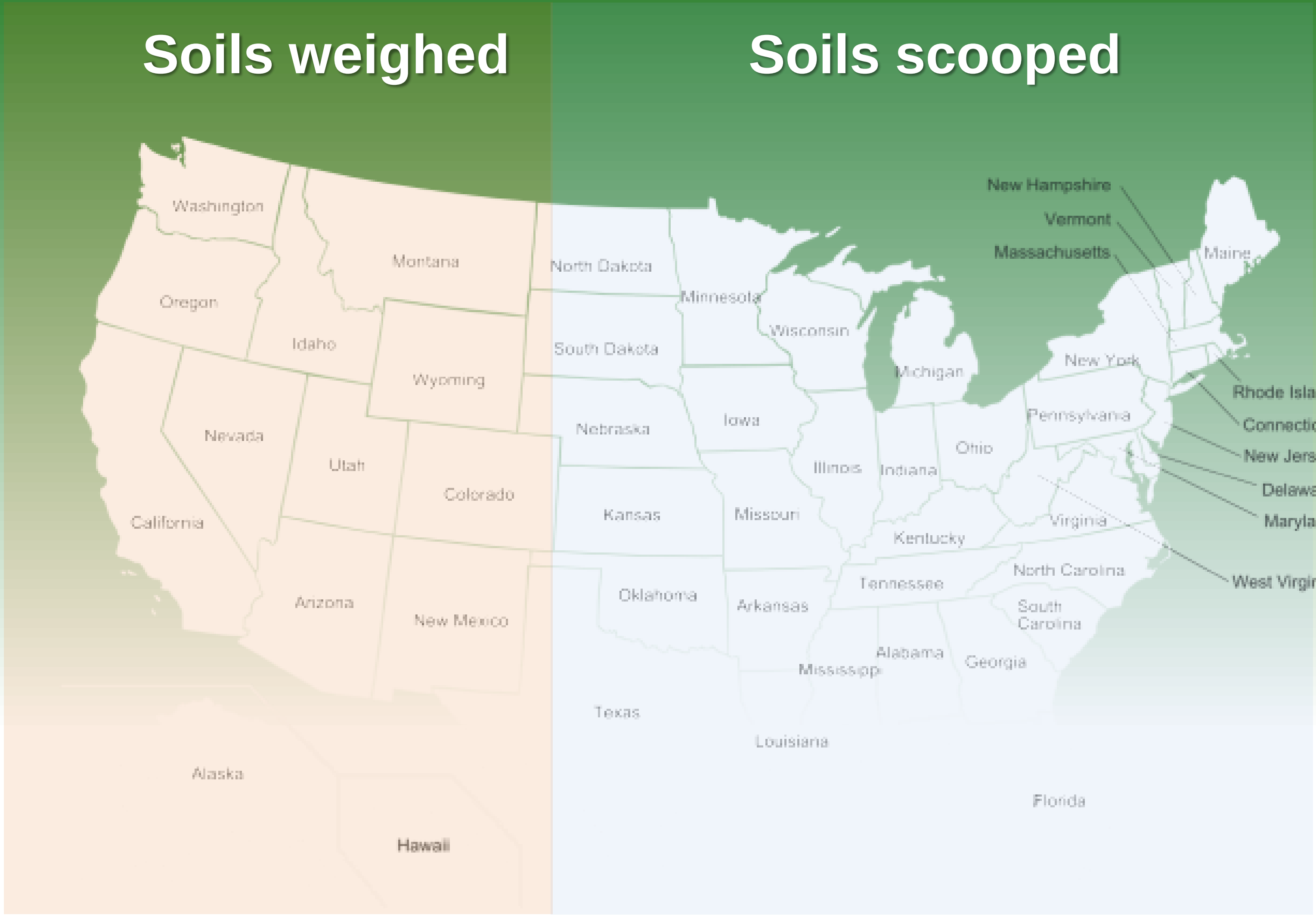


The North Carolina Dept of Agriculture Services laboratory was an early adopter of Soil Scooping II. Subsequently was implemented by the University of Illinois and across the NERA-13 Region in 1967. Developed to facilitate processing.

Soils are scooped by volume by North Carolina Department of Agriculture, Agronomic Division.

Three scooping procedures are practiced today: (1 soils scooped based on a volume basis (cm^3); (2 on a mass basis (g) and (3 weighed. Procedure is regionally specific.

Regional differences

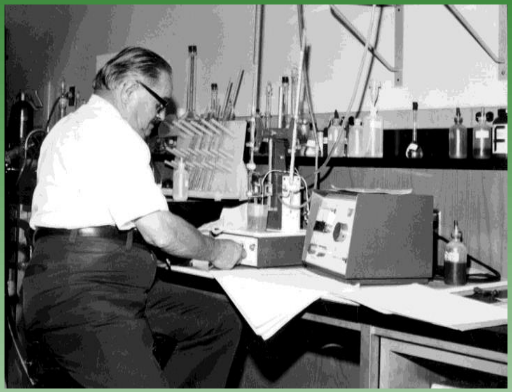


Basis of scooping review

Soil Scooping on a volume basis was reported by Adolph Mehlich (1953 and 1973) and is based on the premise plant roots grow in volume, results expressed as g dm^{-3}.

Soil Scooping, on a mass basis, was reported by Bray (1946), Jackson (1958) and Melsted and Peck (1967) and is based on chemistry expression for concentration mg kg^{-1}, and reported in the Midwest as lbs ac^{-1}.

The mass basis assumes a defined soil density, with literature values reported of 1.18 – 1.32 g cm^{-3} (Peck, 1967; Page 1965; and Christenson, 1971).



Adolph Mehlich, NCDA Agronomic Division - 1970.

Soil density values vary across University testing laboratories ranging from 1.10 to 1.30 g cm^{-3} with 1.18 g cm^{-3} the most common.

John Spargo, Penn State Univ.

Soil scoop review

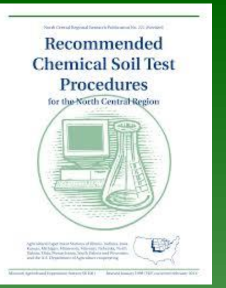
A scoop mass, as defined by the NCERA-13 Workgroup, is based on an assumed soil density of 1.18 g cm^{-3}. Thus a mass of 2.00 g requires a scoop volume of 1.70 cm^3. A range of scoop sizes are available ranging from 0.5 – 15.0 g, dependent on the method.

Standard soil scoops, based on NCERA-13 scooped mass and volume basis, are available from the Soil and Plant Analysis Council (SPAC).

Soil Scoop	Volume (cm^3)
0.5 g	0.425
1.0 g	0.85
1.5 g	1.28
2.0 g	1.70
5.0 g	4.25
10.0 g	8.50

Soil scoops based on volume are also available : 0.5, 1.0, 2.0, 4.0 5.0 and 10.0 cm^3 sizes.

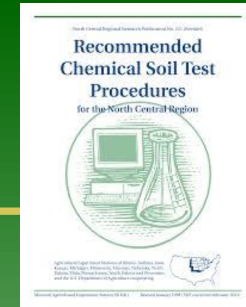
Soil scooping procedure NCERA-13



1. Stir crushed soil with spatula to loosen prior to measuring.
2. Dip into the center of the soil with scoop, heaping it full without pushing against the side of container.
3. Hold scoop firmly, tap the handle <u>three</u> times with a spatula from a distance of 2-3 inches.
4. Hold spatula blade perpendicular to the top of the scoop and strike off excess soil.
5. Empty scoop into extraction vessel.

Peck, T.R. 1998. Recommended chemical soil test procedures for the North Central Region, page 7-9. Missouri Agricultural Experiment Station SB 1001.

Procedural assumptions



For scoop mass the *"typical soil"* is an assumption. Its been shown soil scoop density ranges from 0.8 -1.5 g cm^{-3} dependent on texture and SOM. Thus a high soil density will result in a low M3 extraction ratio (7:1) and conversely low soil density soil a high M3 extraction ratio (12:1).

What's the impact of the extraction ratio on M3 extractable nutrients?

Peck, T.R. 1998. Recommended chemical soil test procedures for the North Central Region, page 7-9. Missouri Agricultural Experiment Station SB 1001.

Soil extraction ratio

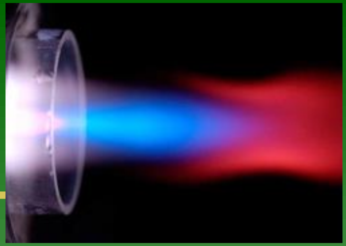
A scoop mass study was conducted using five ALP reference soils ranging in density from 1.04 - 1.56 g cm^{-3}, sand 12.9 - 64.2 %, pH 4.6 - 6.9, and M3-P from 11 - 65 mg kg^{-1}.

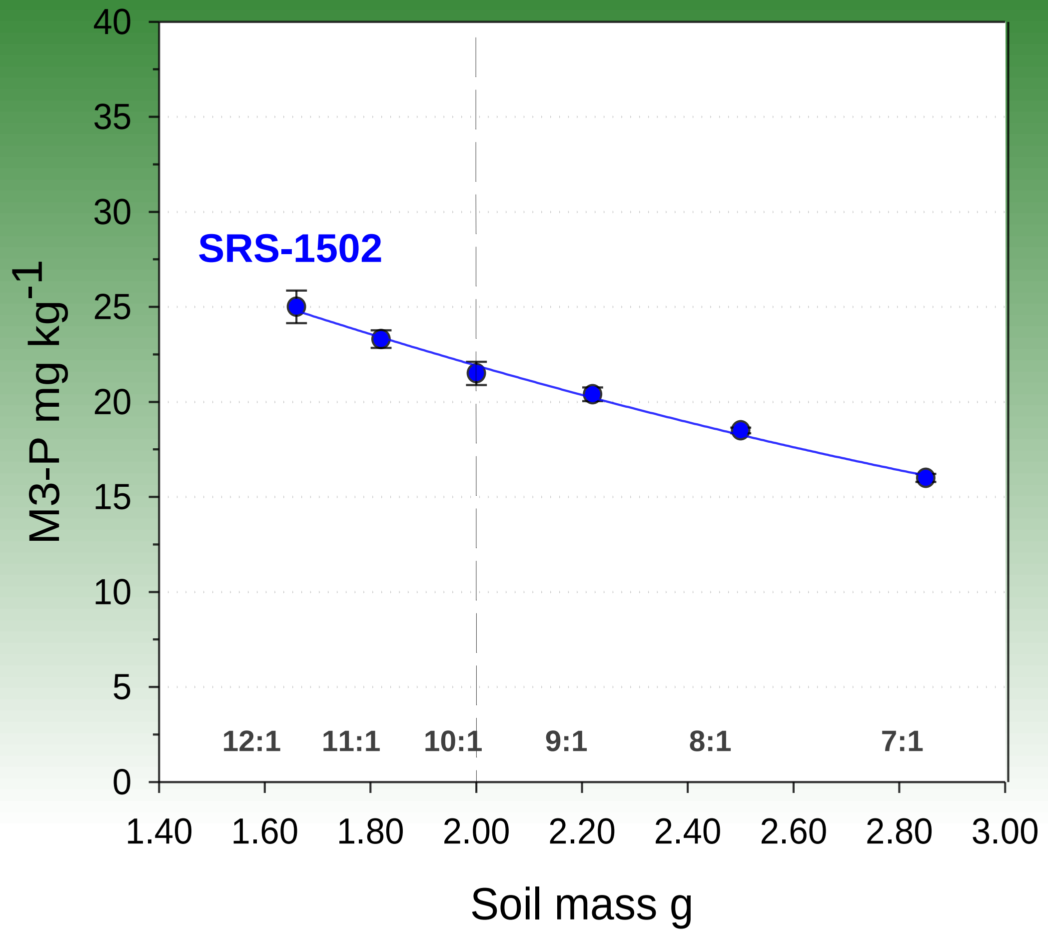
Soils were weighed based on extraction ratios (extractant:soil) of: 7:1, 8:1, 9:1, 10:1, 11:1, and 12:1; using Mehlich 3; analysis by ICP-OES for P, K, Ca, Mg, S and Zn; four replications. Results reported based on 1:10 basis.

Soil ID	Density	Sand	pH
	g cm^{-3}	%	
SRS-0812	1.56	64.2	6.90
SRS-2011	1.45	40.7	6.91
SRS-1914	1.37	28.2	4.60
SRS-1502	1.15	12.9	6.23
SRS-2105	1.04	30.4	6.26

Source: ALP Database, 2008 - 2021.

Soil M3-P extraction ratio



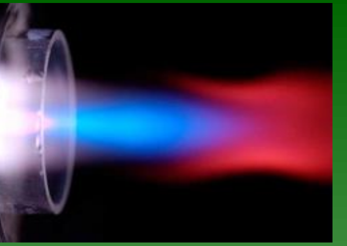


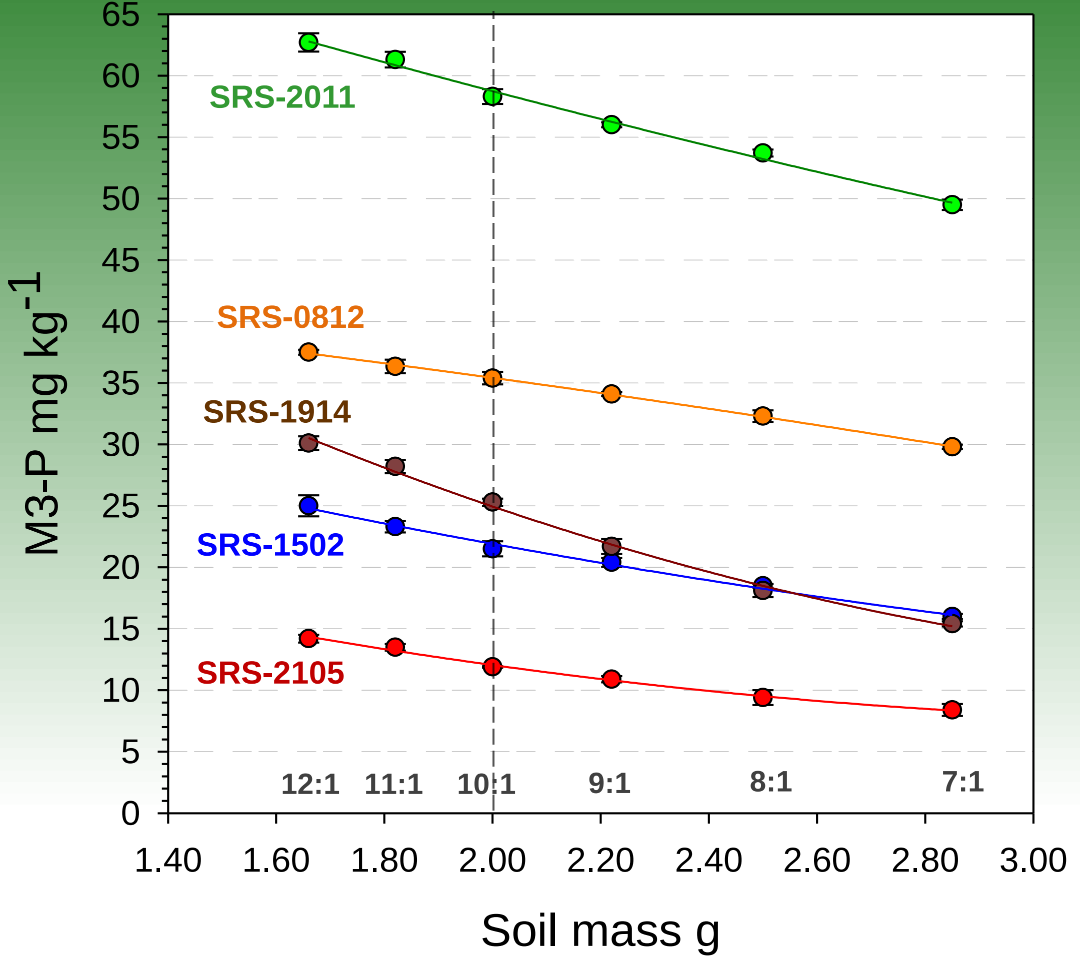
M3 extraction of ALP SRS-1502, soil weighed and extracted based on ratios ranging from 7:1 to 12:1 with 20 mL of extractant, analysis by ICP-OES.

Results: M3-P concentration declines with decreasing extraction ratio. Actual 10:1 mass ratio denoted by dashed vertical line.

Data supplied by Steven Piercy, ICP Technician A&L Great Lakes Laboratory.

Soil M3-P extraction ratio





M3 extraction of five reference soils showed consistent M3-P declines with decreasing extraction ratio, independent of soil concentration.

Soil SRS-1914 had a steeper slope than the other four soils and was the lowest in pH, 4.6.

Data supplied by Steven Piercy, ICP Technician A&L Great Lakes Laboratory.

Scoop follow-up

Based on feedback from the soil scooping presentation in August, we were asked to perform a follow-up study comparing soil scoop techniques using a volume scoop, mass scoop and weighed mass on the same five soils.

Scoop comparison

A scoop volume, scoop mass and weighed mass study was conducted using of five ALP reference soils.

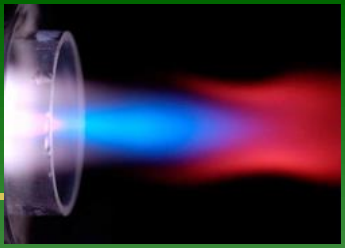
Soils were processed with 2.00 cm^3 scoop, 2.00 g scoop (1.70 cm^3) and weighed 2.00 g mass. Soils were subsequently extracted with 20 ml of Mehlich 3, and analysis by ICP-OES for P, K, Ca, Mg, S and Zn, four replications. Results reported on 1:10 basis volume or mass.

[1] Soils scooped, tapped three times, leveled, weighed and extracted with 20 ml M3, five minute extraction.

Soil ID	Sand	SOM-LOI
	%	%
SRS-0812 (NE)	64.2	1.27
SRS-2011 (KY)	40.7	4.64
SRS-1914 (QE)	28.2	2.53
SRS-1502 (KS)	12.9	3.67
SRS-2105 (IA)	30.4	3.70

Source: ALP Database, 2008 - 2021.

Scoop comparison: volume vs mass



Soil ID	Scoop Volume [1] 2.00 cm^3		Scoop Mass [2] 2.00 g	
	mass g	g / cm^3	mass g	g / cm^3
SRS-0812	2.81	1.41	2.51	1.48
SRS-2011	2.77	1.39	2.41	1.42
SRS-1914	2.63	1.32	2.30	1.35
SRS-1502	1.95	0.98	1.66	0.98
SRS-2105	1.91	0.96	1.61	0.95

[1] Density values, based on four replications, each scoop.

[2] Based on a theoretical soil density of 1.18 g/ cm^3.

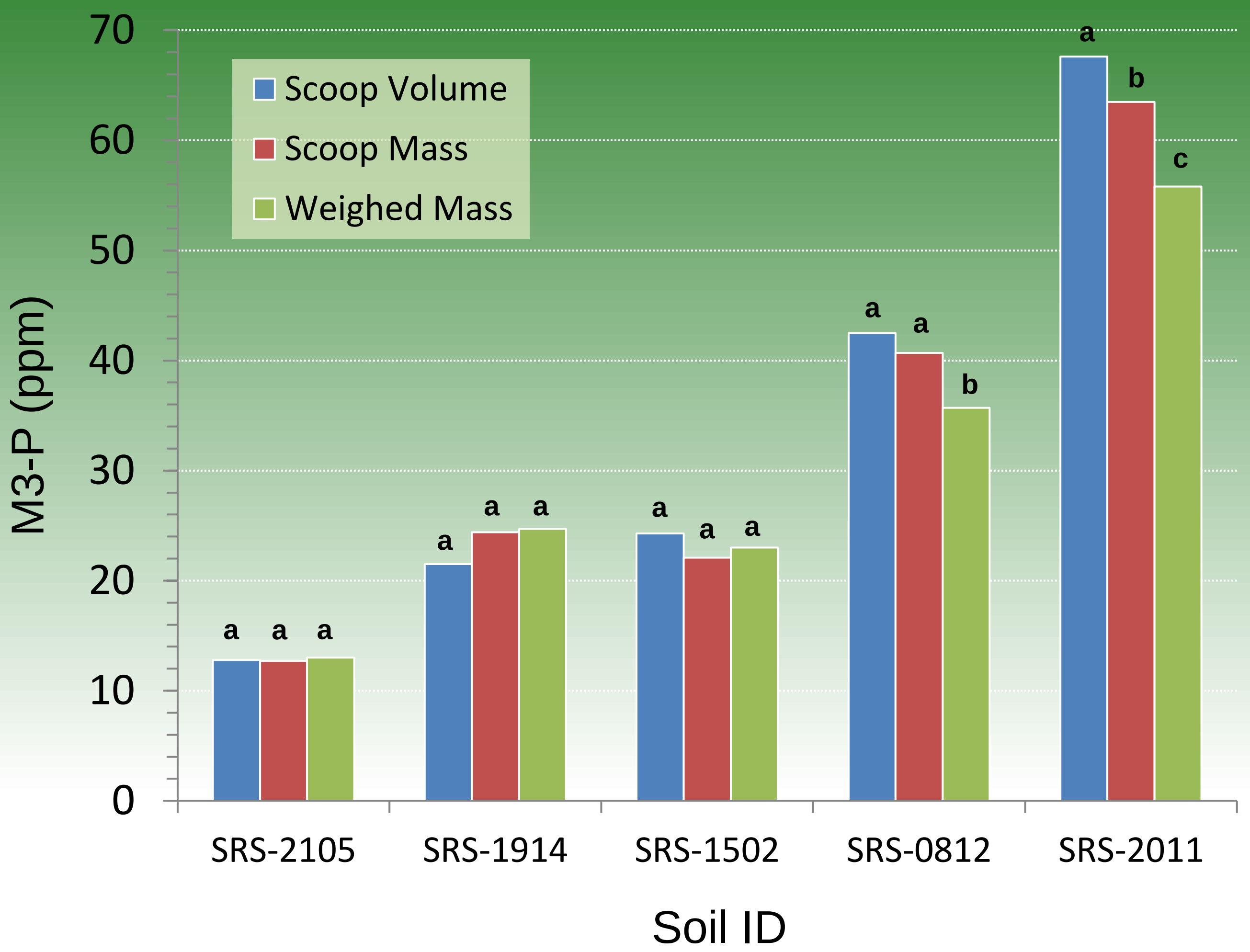
Five soils, two scoops types, 1st 2.00 cm^3 volume, 2nd 2.00 g mass based on assumed density 1.18 g/cm^3.

Results, scooped volume for sandy soils consistently had a higher mass regardless of scoop method.

Scoop volume resulted in 12-18% greater soil mass than scoop mass, final soil densities were identical.

Data supplied by Steven Piercy, ICP Technician
A&L Great Lakes Laboratory, Fort Wayne, IN.

Scoop comparison: M3-P

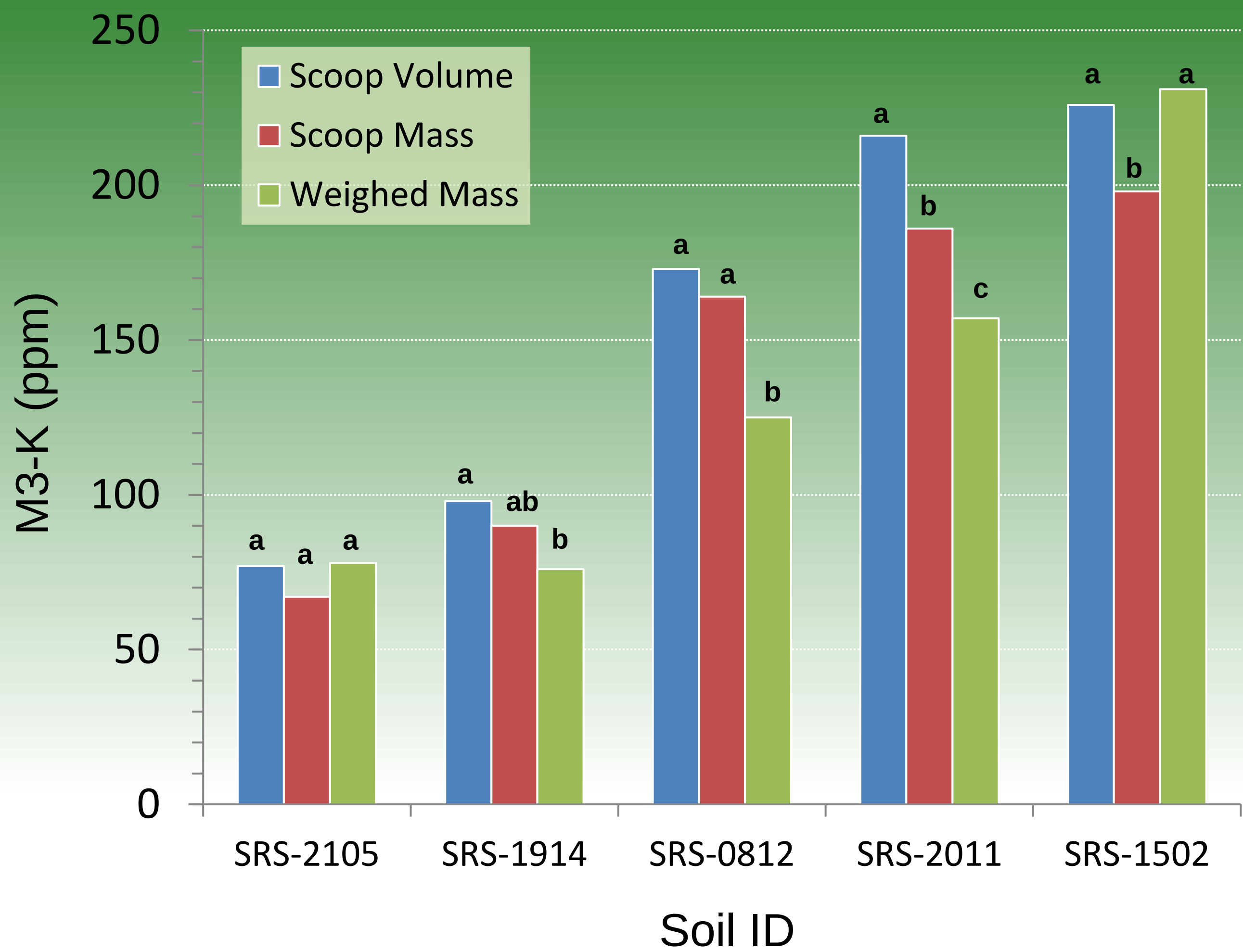


M3-P analysis five soils, scoop volume, mass and 2.0 g weighed mass, sorted low to high.

Results: No differences in M3-P for scoop volume and scoped mass for 3 of 5 soils. Weighed soils were significantly lower for soils highest in M3-P content.

[1] Values followed by the same letter are not significantly different within a soil. Data supplied by Steven Piercy, ICP Technician A&L Great Lakes Laboratory.

Scoop comparison: M3-K

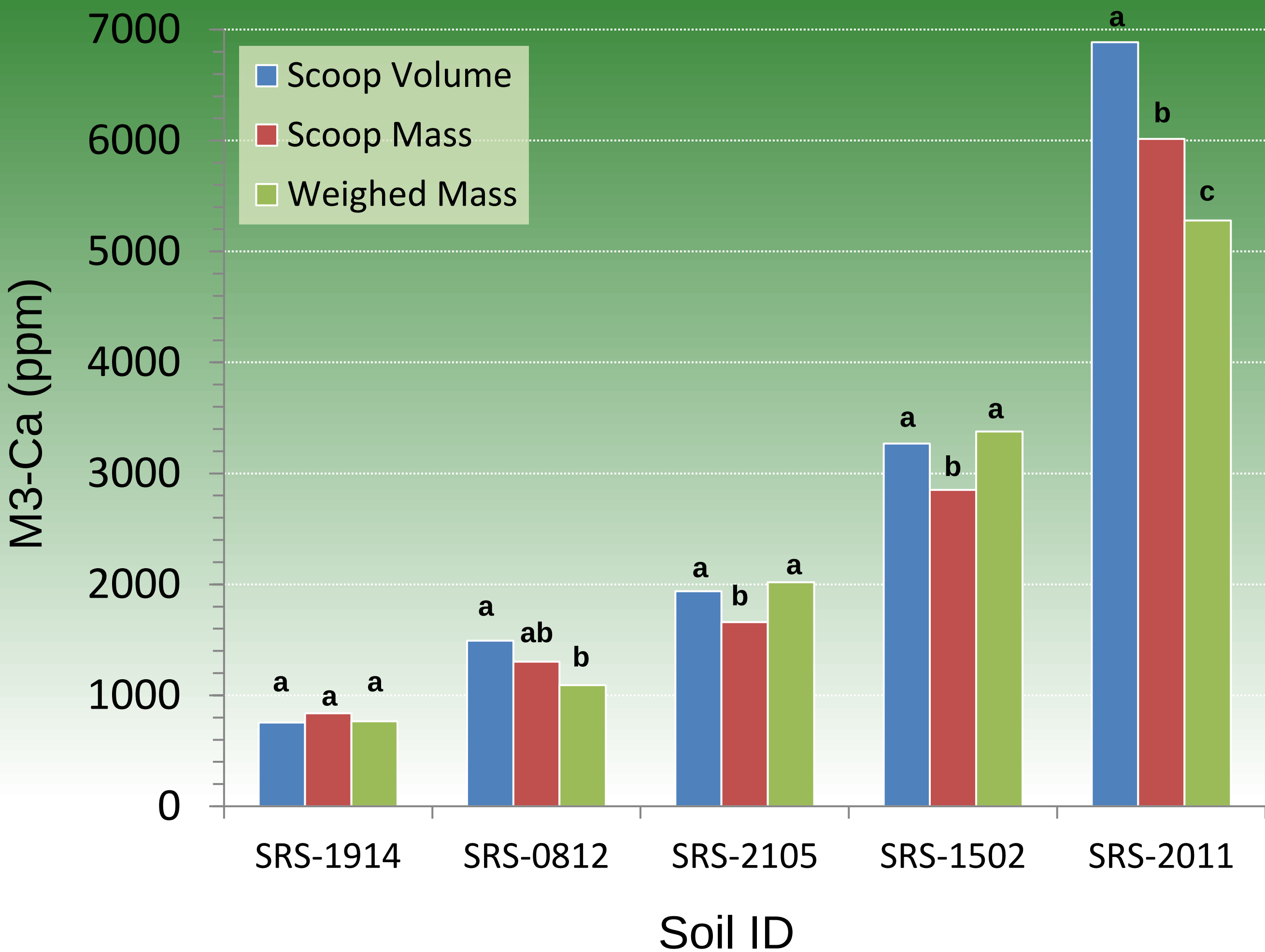


M3-K analysis 5 soils, scoop volume, mass and 2.00 g weighed mass, sorted low to high.

Results: M3-K was more variable than P. No difference for lowest M3-K soil. Weighed mass was significantly lower for three soils. SRS-1502 scoop mass significantly lower.

[1] Values followed by the same letter are not significantly different within a soil. Data supplied by Steven Piercy, ICP Technician A&L Great Lakes Laboratory.

Scoop comparison: M3-Ca

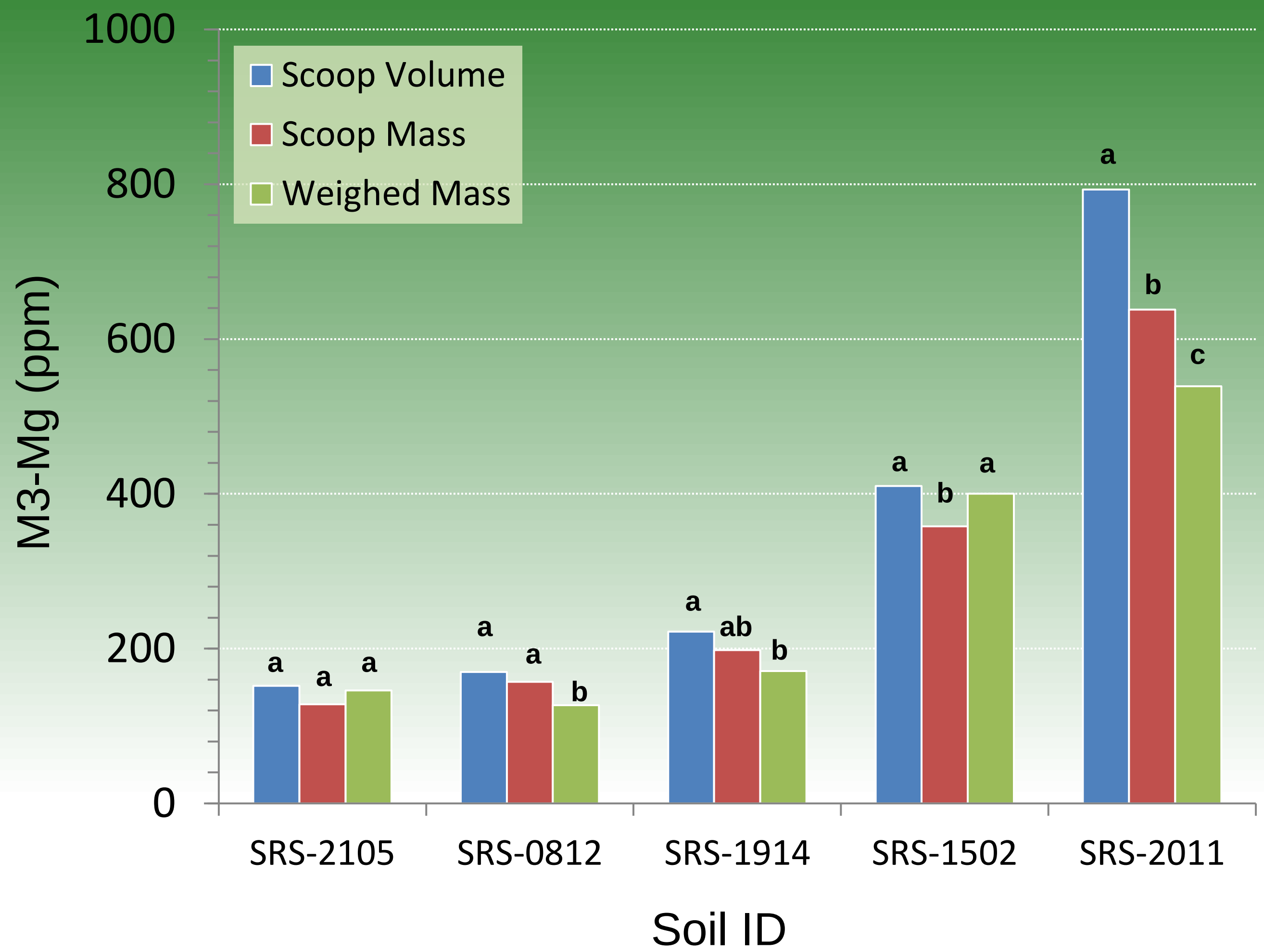


M3-Ca analysis 5 soils, scoop volume, mass and 2.0 g weighed mass, sorted low to high.

Results: Small differences for lowest M3-Ca soils. Weighed mass was similar for 4 of 5 soils. All methods were significantly different for the highest M3-Ca soil.

[1] Values followed by the same letter are not significantly different within a soil. Data supplied by Steven Piercy, ICP Technician A&L Great Lakes Laboratory.

Scoop comparison: M3-Mg



M3-Mg analysis five soils, scoop volume, mass and 2.0 g weighed mass, sorted low to high.

Results: Small differences for low M3-Mg soils, < 250 ppm. Results were inconsistent on the higher testing soils.

[1] Values followed by the same letter are not significantly different within a soil. Data supplied by Steven Piercy, ICP Technician A&L Great Lakes Laboratory.

Scoop comparison

Differences were noted between scooped volume, mass and weighed mass for Mehlich 3 P, K, Ca and Mg.

Scoop type had minimal impact on low testing soils.

For high testing soils, the volume scoop trended higher than scoop mass and weighed mass.

M3-K had the highest variability across soils, 60 – 230 ppm.

Weighed mass Mehlich 3 P, K, Ca, Mg, S and Zn was consistently lower relative to Volume and scooped mass for SRS-2011, and was unique to this soil.

Summary

Low testing soils, no substantial scoop differences across M3 analyte concentrations.

For specific soils such as SRS-2011, however, significant differences in M3 analytes between scoop volume, scoop mass and weighed mass were observed. Possibly linked to soil SOM or mineralology.

M3-K was the most variable and unique to specific soils. Likely associated with soil extraction factors and/or ICP-OES analysis.

Soil scooping

We had planned to show video of soil scooping.

However, converting soil scoop video recorded in the mini – DV format from 2002 to MP4, was a more difficult task than initially estimated. We will try to post these at a later date.

Scooping videos

Iowa State University lab video

https://www.youtube.com/watch?v=f5CdV2FnnpE

University of Arkansas lab video

https://www.youtube.com/watch?v=C13CUfEIfNI

University of Kentucky lab video

https://www.youtube.com/watch?v=64OdBComtg0

Special thanks

Special thanks to Steven Piercy, ICP Technician and Greg Neyman of A&L Great Lakes Laboratory, Fort Wayne, IN

Byron Vaughan, of Lawns by Dr. Vaughan and former lab Director Harris Laboratory, Lincoln, NE

Mike Lindaman, ALTA-SAC assessor, Boone, IA

Jodi Jaynes, Sure-Tech, Indianapolis, IN

John Spargo, Penn State University

ALTA-SPAC Webinar - March 2022

When: March 3rd 2022, 10:00 am CDT

Topic "Basics of Quality Control"

Thank you for your time and attention

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ALP Agricultural Laboratory Proficiency Program

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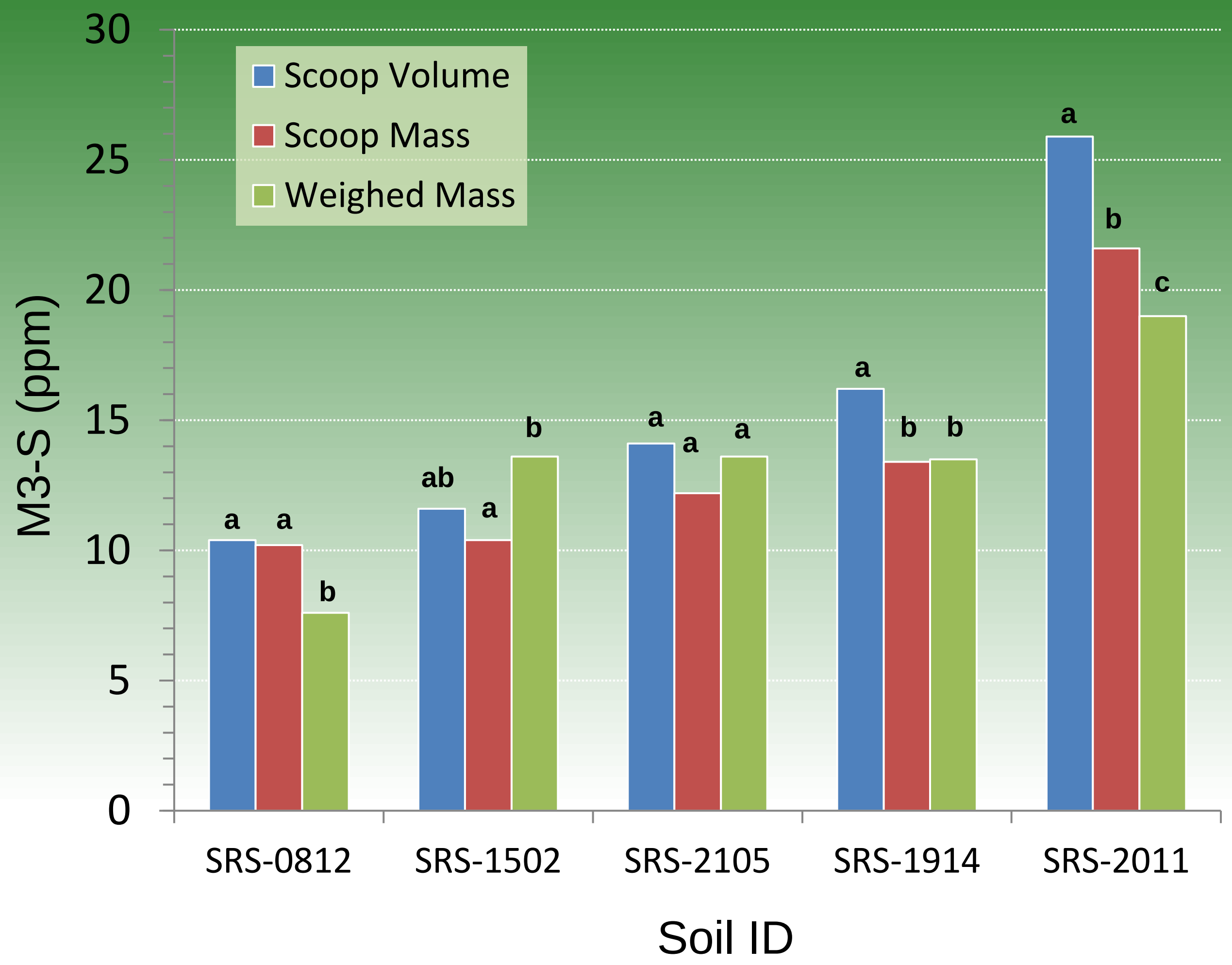
Scoop comparison: M3-S

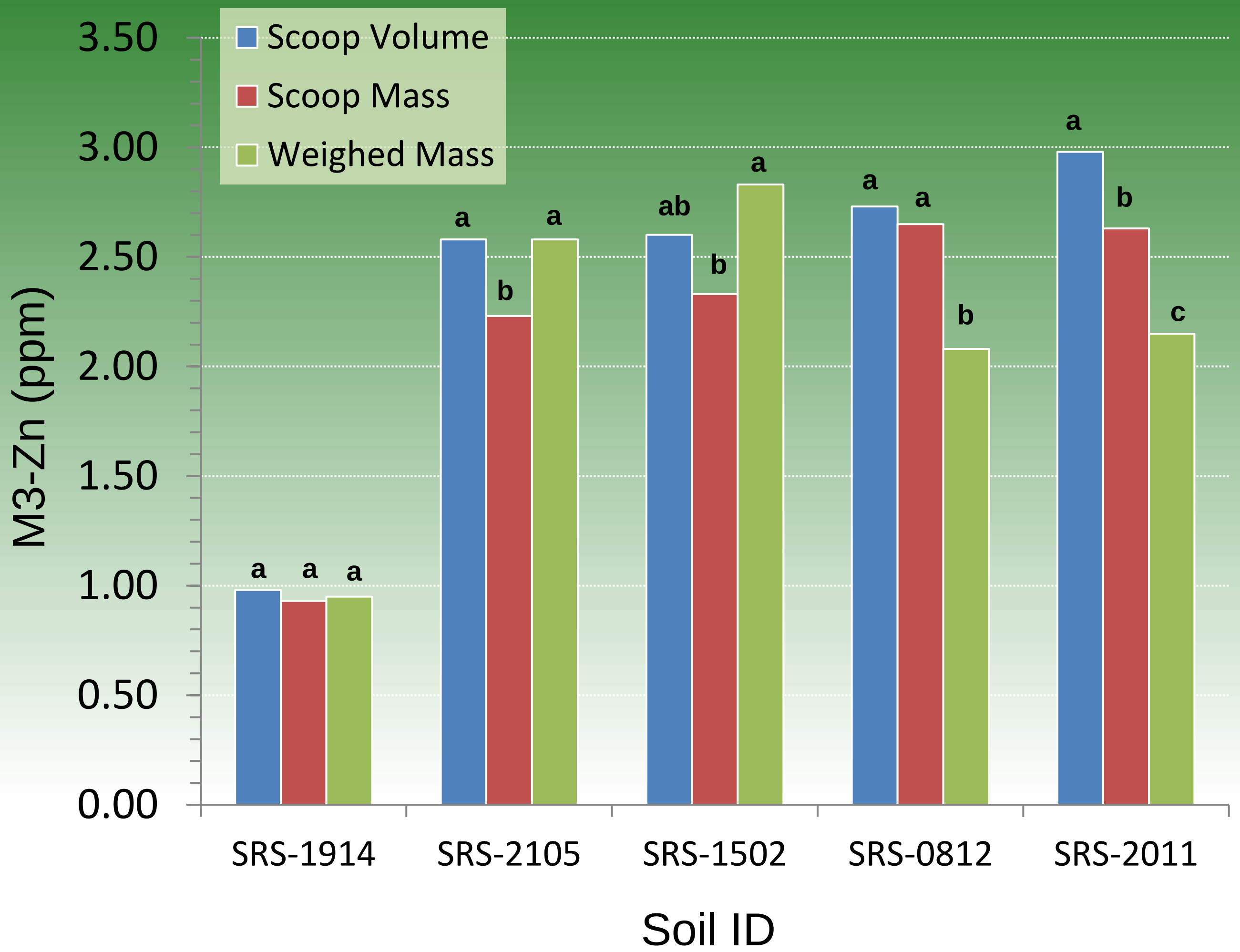


M3-S analysis five soils, scoop volume, mass and 2.0 g weighed mass, sorted low to high.

Results: Small differences for low M3-S soils, < 15 ppm. Results were inconsistent on the highest testing soil.

[1] Values followed by the same letter are not significantly different within a soil.

Scoop comparison: M3-Zn



M3-Zn analysis five soils, scoop volume, mass and 2.0 g weighed mass, sorted low to high.

Results: Small differences for low M3-Zn soil, < 1.00 ppm. Results were inconsistent on the higher testing soils.

[1] Values followed by the same letter are not significantly different within a soil.