

ALTA

**AGRICULTURAL LABORATORY
TESTING ASSOCIATION**

Proficiency Information and Procedures

Mike Lindaman

ALTA-SAC Program Assessor

centraluslab@gmail.com



Why ALTA certification

Certification demonstrates commitment to superior professionalism, upholding industry standards, and continued learning.

MBO Partners

It provides a path continuing incremental quality improvements.

If we don't regulate ourselves, then outside entities with lesser knowledge of our industry will regulate us.



ALTA-Soil Lab Certification Program

Program Objective: Critically assess soil testing laboratory performance based on single blind proficiency soil samples¹ .

Methods:

pH (1:1)_{H₂O}, pH (1:1)_{Salt}, BpH pH Sikora

Bray P1, M3-P (Spec), M3-P (ICP)

NH₄oAc K, M3-K

SOM-LOI, M3-Zn (optional methods)

Certification: Independent assessment of lab bias and precision based on an industry set performance standard, three times annually.

¹ ISTA-LAP an approved certification program under NRCS 590 requirements.



Proficiency Process Steps

ALP samples sent out.

Lab processes samples.

Lab reports results to ALP

ALP processes data

ALP sends ALTA subset data to Dr. Miller.

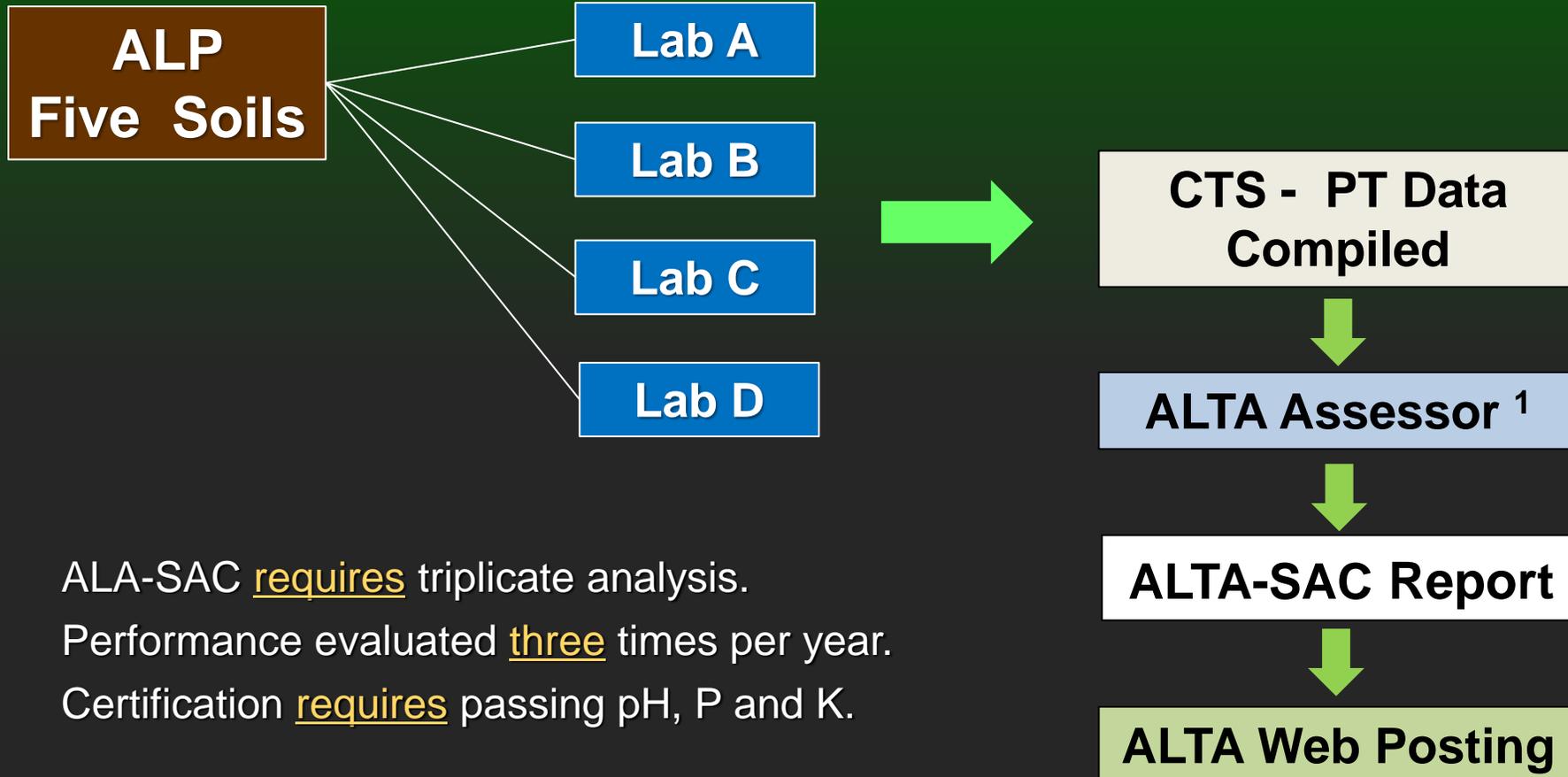
Dr. Miller generates first iteration of bulk report, and sent to Mike Lindaman (ALTA assessor) for review.

Assessor verifies labs and methods for certification. Bulk report and individual reports are emailed to labs. Lab method failures are noted and those meeting 80% score compiled. Certified lab list sent to ALA secretary (Gary Fisher) and posted on web site.

Labs requiring retests submit requests and payment to Dr. Miller. Rechecks sent out the lab . perform analysis and submit results to Dr. Miller. Retest results informs the assessor and labs that successfully pass the retest are passed to ALTA secretary who updates the web site.



ALTA-SAC operation



ALA-SAC requires triplicate analysis.
Performance evaluated three times per year.
Certification requires passing pH, P and K.

¹ Mike Lindaman, ALTA Assessor

ALTA.ag



ALTA-SAC evaluation criteria

ISTA Soil Testing Report 2014 ALP Cycle 23
June 26, 2014

pH (1:1)	Lab ID	SRS - 1401		SRS - 1402		SRS - 1403		SRS - 1404		SRS - 1405	
		Mean	Precision %								
Water	US004	6.90	0.0	5.93	0.0	6.27	0.0 *	6.97	0.0 *	6.97	0.0 *
	US022	6.95	0.2	5.91	0.1	6.21	0.2	7.01	0.2	6.91	0.2
	US023	6.99	0.1	5.92	0.0 *	6.11	0.1	6.93	0.0 *	6.93	0.1
	US718	7.04	0.4	5.81	0.1	6.46	0.4	7.07	0.6	7.22	0.4
	US787	7.06	0.1	5.96	0.2	6.36	0.2	7.20	0.1	7.14	0.2
	US791	7.00	0.0	5.90	0.0	6.30	0.0	7.15	0.0 *	7.10	0.0
	US021	6.91	0.0	5.91	0.0	6.31	0.0	7.09	0.0	7.01	0.0
	US024	6.94	0.7 *	5.97	0.7 *	6.26	0.3	7.10	0.1	7.07	0.6 *
	US024	6.70	0.0	5.84	0.0	6.20	0.0	6.93	0.0	6.93	0.0
	US735	7.00	0.2	5.89	0.2	6.34	0.1	7.14	0.2	7.10	0.1
	US757	6.99	0.2	5.88	0.1	6.18	0.3	7.02	0.2	6.94	0.1
	US760	7.03	0.2	5.76	0.3	6.43	0.2	7.12	0.2	7.16	0.2
	US761	6.96	0.1	5.90	0.2	6.31	0.2	7.06	0.2	7.07	0.2
	US762	6.99	0.1	5.87	0.4 *	6.32	0.4	7.09	0.0	7.04	0.4
	US763	7.01	0.1	5.87	0.1	5.95	0.0	7.16	0.2	7.16	0.1
	US770	6.79	0.6 *	5.83	0.6 *	6.37	0.2	6.94	0.2	7.10	0.6 *
	Median	6.97		5.91		6.30		7.09		7.07	
	±CL 95%	0.21		0.20		0.20		0.20		0.20	
	μ _p %	0.14		0.14		0.16		0.22		0.16	
pH (1:1)	Lab ID	SRS - 1401		SRS - 1402		SRS - 1403		SRS - 1404		SRS - 1405	
		Mean	Precision %								
0.01 M CaCl ₂	US003	6.27	0.0	5.96	0.0	6.17	0.0	6.88	0.0	6.88	0.0
	US023	6.62	0.8	5.62	0.1	6.16	0.2	6.98	0.3	6.74	0.6
	US024	6.28	0.8	5.67	1.1 *	5.95	0.2	6.77	0.4	6.71	0.5
	US735	6.37	0.2	5.32	0.3	5.90	0.3	6.81	0.3	6.74	0.4
	US760	6.50	0.0	5.30	0.0	5.95	0.3	6.87	0.1	6.81	0.2
	Median	6.36		5.35		5.93		6.86		6.74	
	±CL 95%	0.41		0.20		0.20		0.20		0.20	
	μ _p %	0.49		0.29		0.23		0.29		0.40	

Soil Test ¹	Method Criteria ²
pH	Median ± 0.15 or 95% CL
P	Median ± 95 % CL
K	Median ± 95% CL

¹ Modus Methods: S-PH-1:1.02.07, S-PH-1:1.02.08, S-P-B1-1:10.01.03, S-P-M3.01.03, S-P-M3.04, S-K-NH4AC.05, S-K-M3.05

² Data collected on Sikora Buf, M3-Ca, M3-Mg, DTPA-Zn and SOM-LOI.



ALTA-SAC definitions



Method Warning:

A single lab soil PT value exceeds the ALTA-SAC ¹ median 95% CL for a test method in a PT cycle.

Soil	2301	2302	2303	2304	2305
pH	✓	✗	✓	✓	✓

Performance Failure:

Multiple (> 1) method warnings of a test method across five PT soils in a cycle. **Passing - 80%.**

Soil	2301	2302	2303	2304	2305
pH	✓	✗	✗	✓	✓

Precision Failure:

Intra-lab method repeatability exceeds ALA-SAC inter-lab precision for any soil.

Soil	2301	2302	2303	2304	2305
pH	P	F	P	P	P



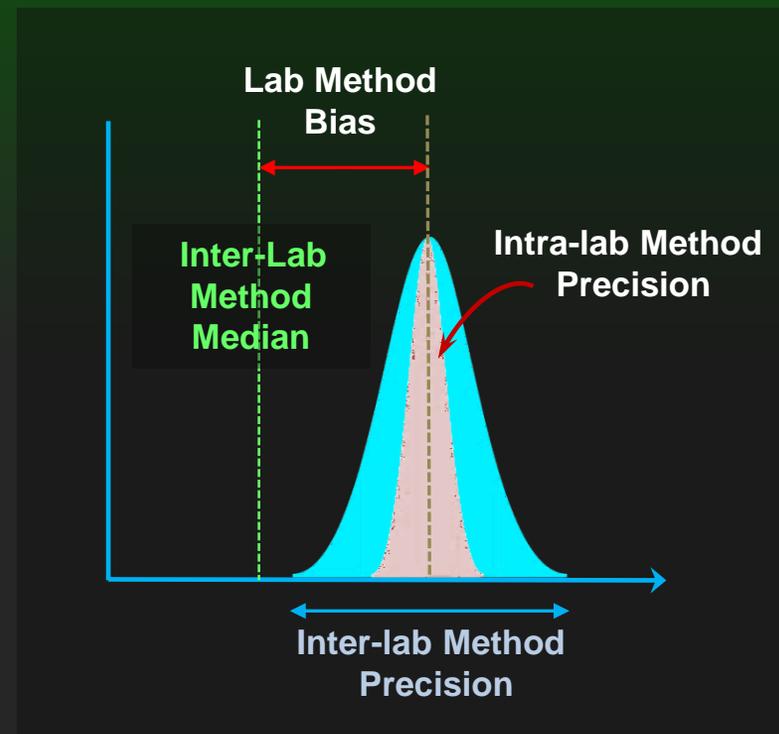
ALTA-SAC QC requirements



Laboratories are required to pass three soil methods: pH, P and K, each cycle.

Labs with a performance failures (bias), offered a method retest. Re-test failure¹, removal from ISTA web site.

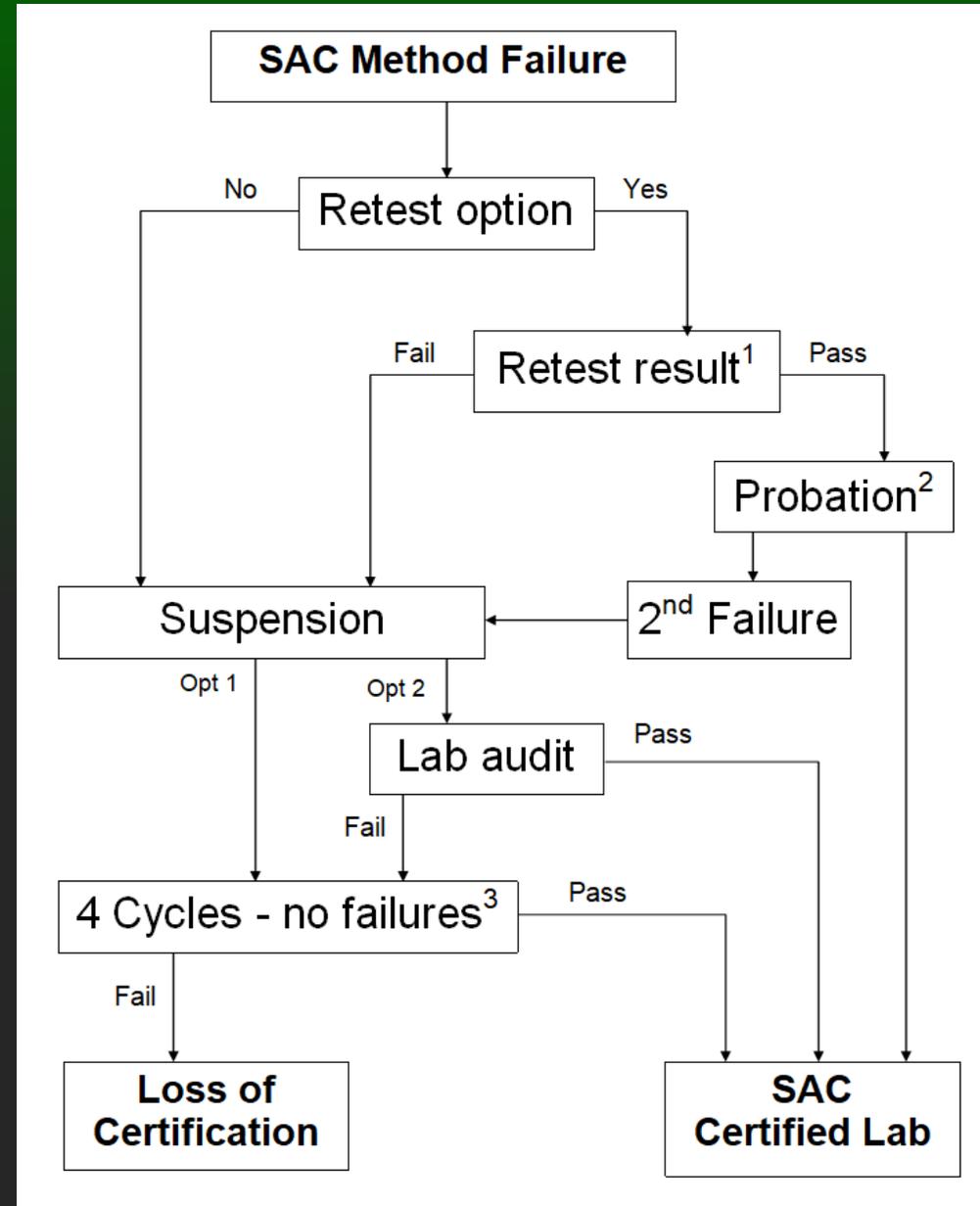
Lab intra method precision reported to each participant.



¹ Retest failure, optional onsite or virtual visit and method audit.

ALTA Soil Analysis Certification (SAC)

Method Failure Flow Chart



¹ Retest pass requires 80% score, four of five results.

² Probation, 80% minimum passing score for two consecutive SAC proficiency cycles.

³ Four consecutive SAC cycles no method failures



ALTA-SAC Program Results

Example

ALTA Round30 cycle 50

Dear Lab xxxx

Here are your results for this round of the ISTA proficiency testing program.

pH 1:1 water	Passed
pH 1:1 0.01M CaCl	
Buffer pH	
Bray P	
M3P-Spec	
M3P ICP	Passed
Amm K	
M3-K	Passed
OM	Passed
Zinc	Passed

Congratulations on the successful completion of this round

Note: If you need to do rechecks, the website won't be updated for you until the rechecks are completed.

To order recheck samples please contact Bob Miller at robert.miller@cts-interlab.com

All rechecks come as a complete set. The charge for this set of rechecks is \$200.00.

Recheck samples must be ordered by 6/7/23

Recheck results must be returned by 6/18/23

If you are requesting a retest, Dr. Miller will not ship your rechecks until payment is received.

Please pay by credit card to Dr. Miller.

If you have any questions or comments, please feel free to email me at centraluslab@gmail.com.

Zinc has been added as a voluntary parameter and does not affect certification



ALTA Retest Outcomes

Retest Passed	<u>Certified for method.</u> Must pass method next cycle with no retests Lab must pass method next cycle, or corrective action required
Retest Failed	If method is <u>required</u> for lab certification, Lab not certified. Must pass corrective action protocol to be certified
Retest Failed	If method is <u>not required</u> for certification, method not certified Must pass corrective action protocol to be certified for method
No Retest Done	Lab <u>not certified.</u> Method failures prevent lab from being certified. Must pass corrective action protocol to be certified for method.

Note Lab certifications are identified on ALTA website as being certified.
If lab is not certified, it will not be identified on ALTA website as certified.
If method isn't certified for lab, ALTA website will be blank.



Online Corrective Action Protocol

Steps:

Lab requests corrective action protocol, fees paid and corrective action protocol samples shipped.

Lab arranges Facetime/Zoom appointment with ALTA assessor for opening samples. Lab submits results by end of next day

Dr. Miller reviews results and notifies assessor and lab of findings.

Based on lab success or failure, lab is notified of status consistent with ALTA policies.

The lab is entitled to 1 hour of online consulting with assessor after fees are paid but prior to opening samples.

Dr. Miller can also be consulted at the shown rate. Additional consulting time with assessor can be scheduled at posted rate.



Corrective action outcomes

Lab successfully completes analysis

Lab is fully certified for analytes passed.
No probation for those analytes.

Lab unsuccessfully tested analyte(s)¹

Lab can not be shown as proficient in failed analytes for next 3 cycles.
If lab's failed analytes is a required analyte for certification, then lab can't be certified for next 3 cycles.

¹ Method failure probability: One of five soils 1:20; two soil failures 1:400; three of soil failures 1:8000; four soil failures 1:16000; five soil failures 1:320000.

Troubleshooting

Contact Mike if:

You aren't receiving either individual or bulk reports.

Your contact person or email changes.

The methods shown on your individual report are incorrect.

You wish to begin the corrective action protocol for a method(s).

At the beginning of the year you wish to add or change methods.

Contact Dr. Miller if:

You wish to order recheck samples.

You have questions about the bulk report.

You feel the results shown on the bulk report aren't what you submitted.

Lab Quality

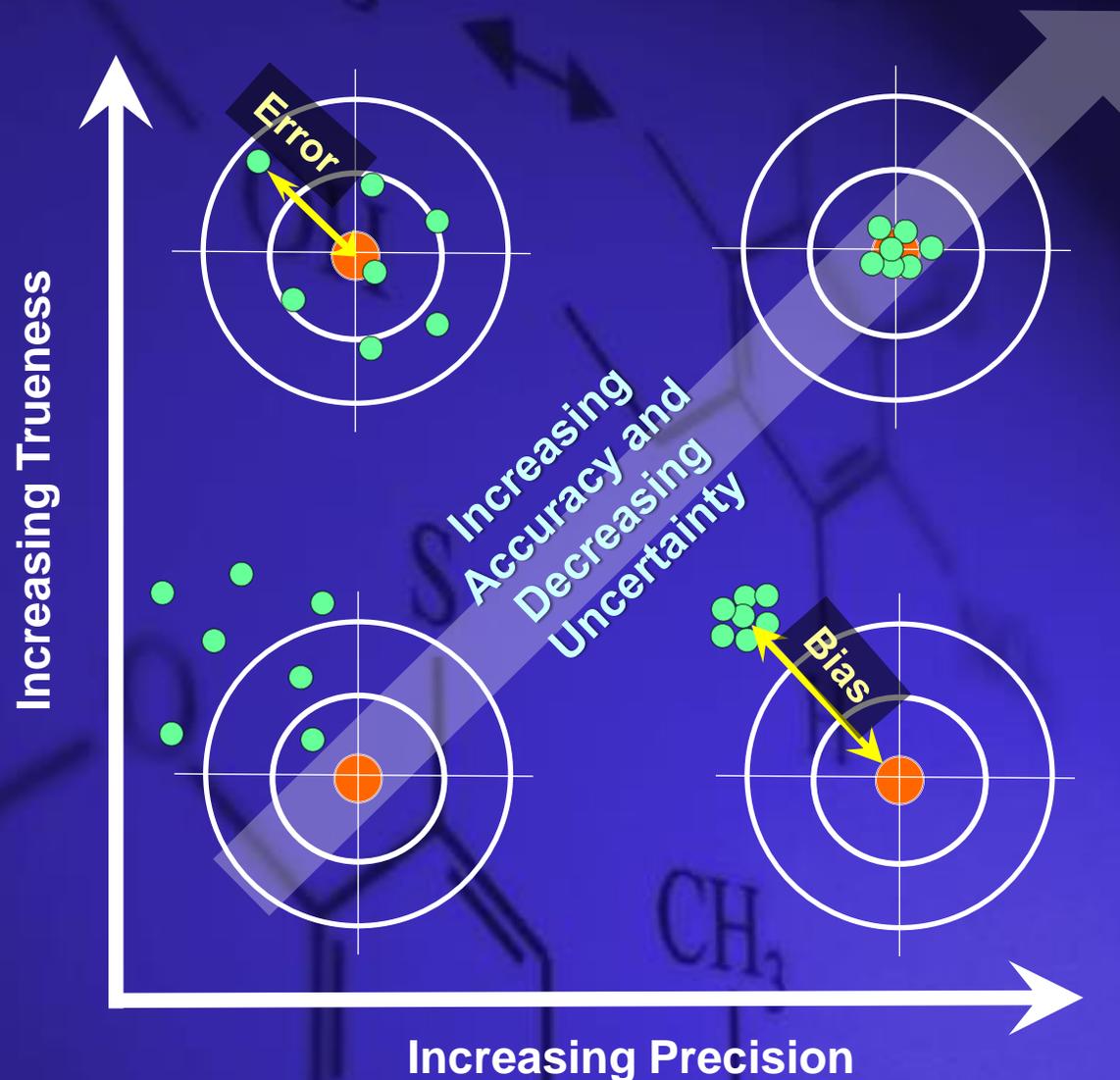
Uncertainty is part of the measurement

“ Precision “

Measurement, variance

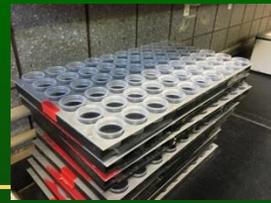
Accuracy of the Measurement,

“bias”





ALTA-SAC performance report



Listed are ALTA-SAC results cycle 31, M3-P_{Spec} 5 labs



Soil Testing Report 2016 ALP Cycle 31

November 17, 2016

Mehlich 3 P Spec (ppm)	Lab ID	SRS - 1611		SRS - 1612		SRS - 1613		SRS - 1614		SRS - 1615	
		Mean	Precision %								
	U68	29.3	*H 3.9	10.3	*H 5.6	24	4.2	93	6.2	*P 25.7	2.2
	U68	25.0	0.0	7.0	0.0	21	0.0	97	0.0	24.0	0.0
	U72	24.7	2.3	6.7	8.7	20	0.0	91	0.0	23.7	2.4
	U73	26.2	1.1	7.0	0.0	21	1.2	97	0.5	23.3	0.9
	U84	27.8	2.7	9.0	*H 5.6	23.8	7.4	107	0.5	27.3	*H 3.8
	Median	25.5		7.0		21.0		96		24.0	
	± CL 95%	2.4		1.0		3.0		11		1.7	
	R _d %	1.9		5.6		4.3		0.5		2.3	

Method Failure

Soil ID

Precision Failure

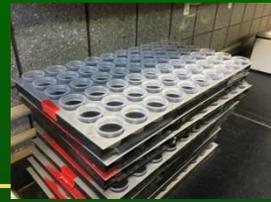
Method Median

Method Precision

Method 95 % CL



ALTA-SAC performance report



ALA-SAC results cycle 31, M3-P_{Spec} five labs¹

M3-P_{Spec} data two PT soils.
Lab #38A two method warnings,
result a performance failure.

Lab #15A precision failure on
SRS-1612.

Mehlich 3 P Spec (ppm)	Lab ID	SRS - 1611		SRS - 1612	
		Mean	Precision %	Mean	Precision %
	38A	29.3 *H	3.9	10.3 *H	5.6
	74A	25.0	0.0	7.0	0.0
	68A	24.7	2.3	6.7	8.7
	15A	26.2	1.1	7.7	27.2 *P
	24A	27.8	2.7	9.0 *H	5.6
	Median	26.0		7.0	
	± CL 95%	2.9		1.5	
	R _d %	1.9		5.6	

¹ M3-P_{Spec} 15 lab results (5 labs x 3 reps).



ALTA-SAC performance failures



Soil pH and M3-K had the highest number of labs with > 2 performance failures over 15 PT cycles, 2013-2017.

Across methods, > 50% of all performance failures are associated with 6 labs.

Soil Test Method ¹	Number of Labs < 2 Performance Failures	Number of labs > 2 Performance Failure cycles
pH 1:1 H ₂ O	15	5
pH (1:1) _{Salt}	7	1
Bray P	5	2
M3-P Spec	4	1
M3-P ICP	9	4
M3-K	8	9

¹ Lab performance failures, <80% score over 15 PT cycles, 2013-2017.



ALTA-SAC Issues



Certification Rule: for a specific method, a passing score is 4 of 5 soil analysis results within 95% CL of the median. Labs with method failure, passing retest placed on certification list, but on probation for following two cycles, a 2nd failure is lab audit or loss of method certification.

The implementation of revised ALTA-SAC lab performance rules in 2017, has significantly increased the assessor workload, with retests and tracking of labs method failures over multiple cycles. Currently 13 of 22 labs on probation over 5 methods.



Going Forward

Some labs have forgone doing retests so they end up having to do corrective action for those methods. They continue to do those methods and produce results for ALP.

I respectfully suggest that if they have passing results for 3 consecutive cycles (Instead of 4) that they be certified for that method.

As always: I will abide by what ALTA leadership and membership decides for this issue.

Acknowledgments

Dr Robert Miller
ALP Technical Director

Who assisted with this
presentation.





Special Thanks

The certification process works because of the following entities:

Dr. Robert Miller

Gary Fisher

Terry Lindaman

Current and past ALTA presidents

Current and past ALTA boards

The ALTA membership

Thanks for all listed above. It is a privilege to work with all of you.

Why ALTA certification

Certification demonstrates commitment to superior professionalism, upholding industry standards, and continued learning.

MBO Partners



Online Corrective Action Protocol

Costs:

Retest soil samples:	\$175
Assessor fee:	\$200
Dr. Miller consulting:	\$100 / hr
Additional assessor consulting:	\$75 / hr
Total cost with no extra consulting:	\$375

¹All fees paid in advance.



ISTA-LAP median and confidence limits (CL)

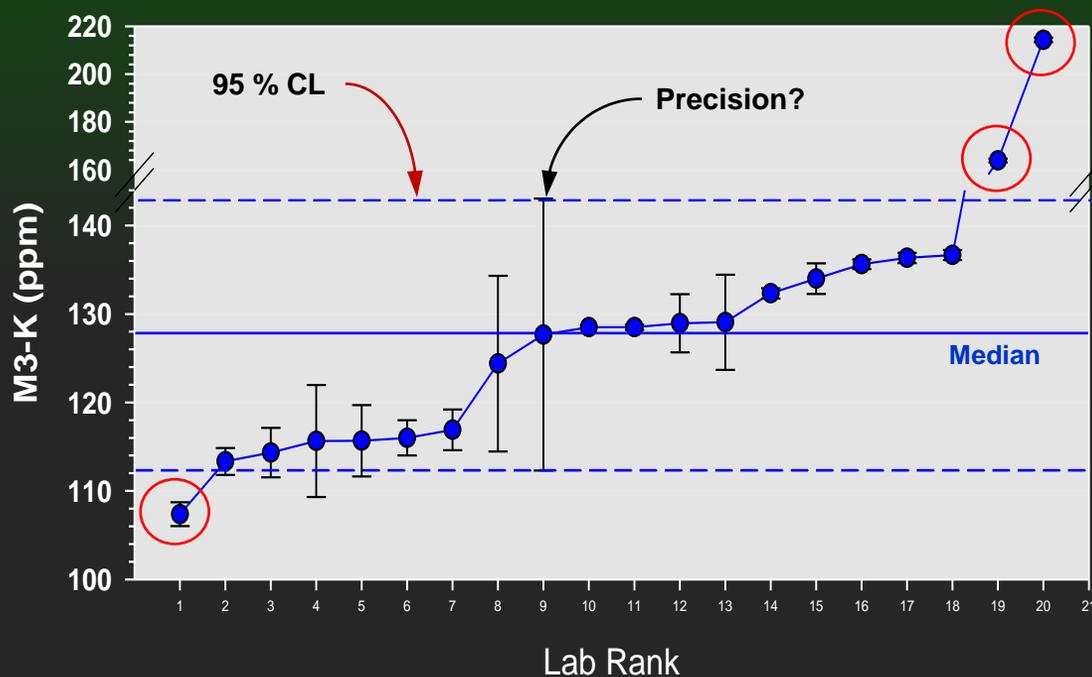


Data from ISTA-LAP participants sorted low to high, median and 95%CL determined.

Example: SRS-1712, median M3-K of 128 ppm and 95% CL of ± 16 ppm.

M3-K method warnings (labs value exceeds 95% CL) three labs; four with precision failures.

Soil ID SRS-1712 ¹



¹ Cycle 34, 60 M3-K laboratory soil results.



ISTA-LAP participants 2012 - 2018



A & L Great Lakes Laboratories, Inc
AgSource Cooperative Services – WI
Black Log Ag Services
Charter Soil Service
GMS Laboratories, Inc.
Ingram's Soil Testing Center
Key Agricultural Service
KSI Laboratory
Midwest Laboratories
MSE Laboratories
Precision Soil Labs
Pro Ag Consulting
Rock River Laboratory, Inc.
SGS North America, Toulon

SGS Alvey Testing - Belleville
SGS Testing – Hamel
Soiltech, Inc.
Solum Laboratory - IA
Southern Illinois Ag Solutions Inc.
Southern Illinois Soil Laboratory
Spectrum Analytic
Sure-Tech Labs
The Farm Clinic Inc.
United Soils Inc.
Waters Agricultural Laboratory – KY
Way Point Analytical – Atlantic, IA
Way Point Analytical – Memphis, TN
Way Point Analytical – Champaign, IL

ISTA-LAP soil method warnings 2013 - 2017



Soil Test Method ¹	Number of labs reporting	Total number of results ²	Soil method warnings
pH (1:1) _{H2O}	29	1500	152
pH (1:1) _{Salt}	9	455	52
Bray P1	15	790	91
M3-P Spec	8	350	37
M3-P ICP	22	1045	134
M3-K	29	1385	172
SOM-LOI	24	1060	110

¹ Soil method warnings based on 95% CL of median, all reporting labs, 75 ALP soils.

² Total number of results based on number of labs x number of soils evaluated.



ISTA-LAP M3-K lab deviation plots

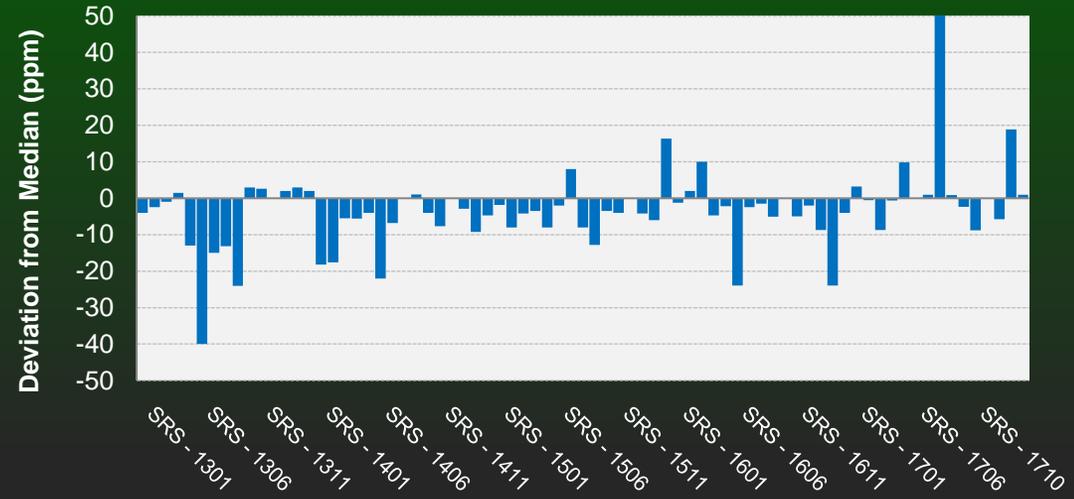


M3-K deviation plots, two ISTA labs over 12 PT cycles, 4 yrs.

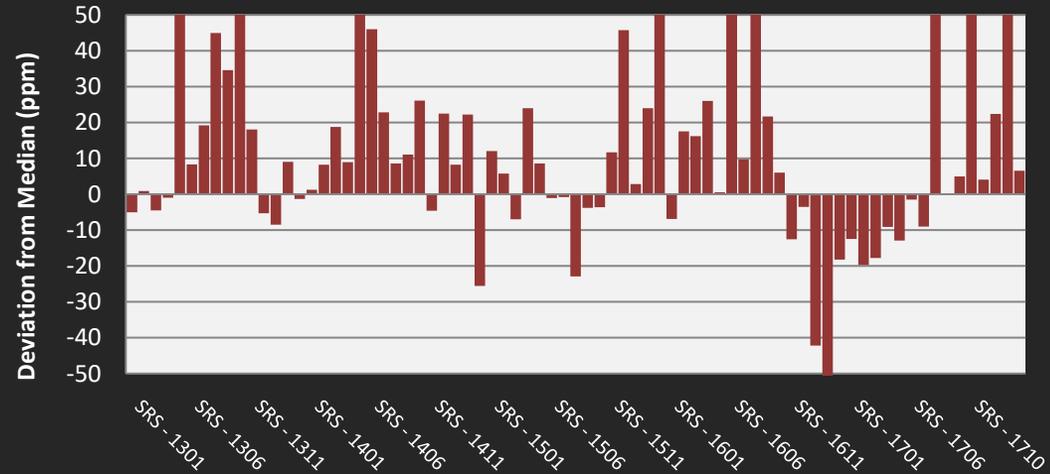
Lab at upper right shows high consistency with 96% of results within 20 ppm of ISTA median of 75 PT soils.

Lab at lower right shows consistent bias with nine values > 50 ppm high bias.

M3-K Deviation Plot Lab ID U4874



M3-K Deviation Plot Lab ID U4353



ISTA-LAP lab method failures 2013 - 2017



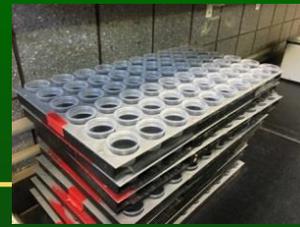
Method Warnings¹, six labs over 15 PT cycles, 75 soils.

Lab ID	pH (1:1) _{H2O}	Bray P	M3-P ICP	M3-K
XX04	2	2	<u>15</u>	<u>20</u>
XX18	8	9	1	4
XX33	9	9	0	0
XX35	4	8	6	6
XX68	0	0	-	0
XX72	<u>19</u>	-	9	0

¹ Method failures based on 95% CL of median, of reporting lab over 75 soils.



ISTA-LAP lab precision failures 2013-2017



Precision Failures¹, six labs over 15 PT cycles, 75 soils.

Lab ID	pH (1:1) _{H2O}	Bray P	M3-P ICP	M3-K
XX04	<u>17</u>	1	1	0
XX18	4	4	5	4
XX33	8	4	2	3
XX35	4	1	1	1
XX68	1	8	-	2
XX72	0	-	3	9

¹ Precision failures based on lab R_p and ISTA-LAP inter lab R_d , over 75 soils.



ISTA-LAP performance failures 2013 - 2017



Performance Failures¹, six labs over 15 PT cycles.

Lab ID	pH (1:1) _{H2O}	Bray P	M3-P ICP	M3-K
XX04	0	0	4	6
XX18	2	3	0	1
XX33	2	2	0	0
XX35	1	0	1	2
XX68	0	0	-	0
XX72	4	-	1	1

¹ A performance failure, cycles with > 1 method warning, within a single PT cycle.



ISTA-LAP lab performance – two labs



ISTA-LAP Lab Performance Failures¹, 12 PT cycles.

Lab ID ¹	2013			2014			2015			2016		
Cycle	20	21	22	23	24	25	26	27	28	29	30	31
Lab XX35 pH 1:1	-	-	F	-	-	-	W	-	-	-	-	-
M3-P ICP	-	-	W	-	F	-	-	-	W	-	W	-
M3-K	-	-	-	-	F	-	-	-	-	-	-	-

Lab XX53 pH 1:1	F	-	F	W	-	-	W	-	-	-	-	-
M3-P ICP	W	-	F	-	W	-	W	-	-	W	-	W
M3-K	-	-	-	W	W	W	-	-	F	F	F	W

¹ Performance failure, cycles with > 1 method warning.



Method performance failures 2013 - 2017



Performance failures cycles 20 - 34

Over 15 PT cycles for soil pH (1:1)_{H2O} there were 26 performance failures across 23 labs. Four labs constitute 41% of performance failures.

M3-P ICP had 30 performance failures across 16 labs. Four labs constituted 50% of M3-P performance failures.

pH 1:1 H ₂ O	
Lab ID	# Cycle Failures
XX89	1
XX22	2
XX33	2
XX53	4
XX18	2
XX91	1
XX68	3
XX38	1
XX23	4
XX35	1
XX20	4
XX67	1
Total	26

M3-P ICP ¹	
Lab ID	# Cycle Failures
XX04	4
XX22	2
XX33	2
XX53	1
XX91	1
XX23	4
XX35	1
XX30	2
XX37	1
XX96	3
XX20	1
XX29	2
XX67	4
Total	30

¹ Only labs with performance failures shown, 15 PT cycles, 2013-2017.



ISTA-LAP performance failures



Soil pH and M3-K had the highest number of labs with > 2 performance failures over 15 PT cycles, 2013-2017.

Across methods, > 50% of all performance failures are associated with 6 labs.

Soil Test Method ¹	Total number Labs x cycles	Number of labs > 2 Performance Failure cycles
pH 1:1 H ₂ O	280	5
pH (1:1) _{Salt}	104	1
Bray P	158	2
M3-P Spec	72	1
M3-P ICP	168	4
M3-K	298	9

¹ Lab performance failures, <80% score over 15 PT cycles, 2013-2017.





Sources of lab performance failures



- Insufficient and/or an ineffective lab quality control (QC) program.
- Lab staff transitions and/or insufficient training of laboratory technical staff.
- Unresolved analytical Issues: instrument stability, calibration drift, contamination or lab technique.



ISTA-LAP program summary



The ISTA-LAP program has set a standard of soil analysis performance in the lab testing industry, evaluating bias and precision on pH, P and K, across 28 Midwest laboratories since 2012.

High performance methods: pH (1:1)_{salt}; Bray P and M3-P_{Spec}. M3-K the lowest, 9 labs had > 2 repeated performance failures.

Three labs failed to meet ISTA-LAP performance criteria for pH, P and K.

Stricter certification criteria in 2017, has improve quality, fewer failures.

www.soiltesting.org



Illinois Soil Testing Association

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ISTA-LAP
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Join ISTA

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ISTA-LAP

- The most rigorous lab certification program for pH, P and K
- Assessment of lab method bias and precision, 3 times/yr
- Requires 80% score on each method, each cycle
- A re-test and site visit option(s) are offered
- Comprehensive performance reports: by method, lab and soil

www.soiltesting.org



ALP 2019 Projects

Pacific Northwest Laboratory Tour sponsor, March 27-29, 2019. Tour four soil testing labs and vineyard.



Collaboration with ASPAC Proficiency Testing program in Australia, to exchange two ALP soils the ASPAC program in 2019.



Collaboration with WEPAL Proficiency Testing Program (Europe) to provide two ALP botanical materials for the WEPAL Program 2019.



Gold sponsor of the 16th ISSPA International Symposium in Wageningen, The Netherlands June 17-20, 2019.



ALP Accredited under ISO/IEC 17043:2010





ISTA-LAP data 2018, cycle 36



CL of the median is dependent on analysis method, concentration and soil matrix.

Example at right, ISTA-LAP data for pH and Bray P1 for five soils ALP cycle 36.

Soil ID	pH (1:1) _{H2O}		Bray P1 (ppm)	
	Median ¹	95% CL	Median	95% CL
SRS-1806	5.33	± 0.14	92.7	± 8.5
SRS-1807	5.60	± 0.15	80.0	± 11.0
SRS-1808	6.60	± 0.18	41.8	± 9.6
SRS-1809	7.80	± 0.23	27.1	± 4.4
SRS-1810	6.72	± 0.18	10.0	± 1.9

¹ Median and 95% CL confidence limits across ISTA reporting labs.

ISTA-LAP performance failures 2017



Performance Failures: > 1 method failure of a test method across five PT soils in a cycle.

Cycle ¹	pH (1:1) _{H2O}		M3-P ICP		M3-K	
	# Labs	Performance Failures	# Labs	Performance Failures	# Labs	Performance Failures
32	21	4	15	2	20	1
33	21	2	17	1	20	5
34	20	1	16	2	19	2

¹ Number of laboratories with Performance failures for the method failures in each PT cycle.





ISTA-LAP program summary



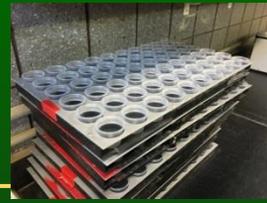
The ISTA-LAP has analyzed 90 soils across 29 Midwest laboratories since 2012 . Sixty-eight percent of labs results within performance limits for pH, P and K.

Highest performing methods were: pH (1:1)_{salt}; Bray P and M3-P_{Spec}. M3-K the lowest, with nine labs having > 2 repeated performance failures over 15 PT cycles.

Since 2017 three labs failed to meet ISTA-LAP performance criteria for pH, P and K.

www.soiltesting.org

ISTA-LAP pH (1:1)_{H2O} lab deviation plots

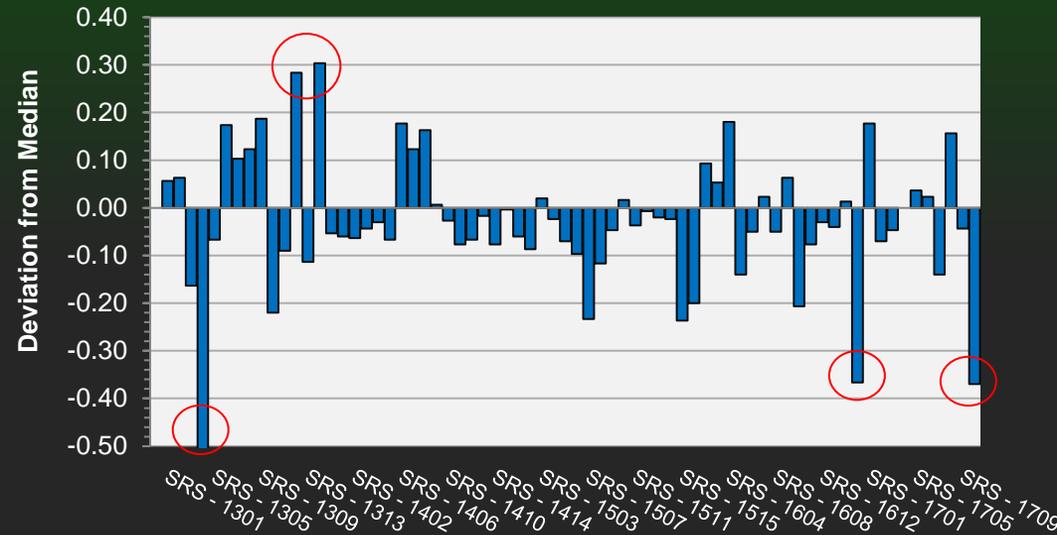


pH (1:1)_{H2O} median deviation plot over 15 PT cycles, five yrs.

Lab at right shows high consistency with 91% of results within ± 0.20 units of ISTA median for 75 soils. Five method failures.

Over 15 PT cycles lab U4135 had one performance failure, cycle 22.

pH Deviation Plot Lab ID U4135



ISTA-LAP Soil pH 2016



Comparison of soil pH methods shows $\text{pH (1:1)}_{\text{Salt}}$ is 0.5 pH units lower than $\text{pH (1:1)}_{\text{H}_2\text{O}}$.

95% CL of $\text{pH (1:1)}_{\text{Salt}}$ are significant lower than the method across all soils.

Note: $\text{pH (1:1)}_{\text{Salt}}$ has the fewest lab method failures of any method over 15 PT cycles.

Soil ID	pH (1:1) H ₂ O		pH (1:1) Salt	
	Median ¹	95% CL	Median	95% CL
SRS-1611	5.29	± 0.19	5.81	± 0.12
SRS-1612	5.12	± 0.20	4.66	± 0.13
SRS-1613	6.67	± 0.17	6.19	± 0.12
SRS-1614	4.61	± 0.26	4.22	± 0.08
SRS-1615	5.82	± 0.15	5.34	± 0.11

¹ Median and 95% CL confidence limits across ISTA reporting labs. 23 labs pH (1:1) H₂O and 8 labs pH (1:1) Salt.



Performance Failure Summary 2013-2016



Performance failures by labs cycles 20-32 by soil method.

pH 1:1 H ₂ O	
Lab ID	# Cycle Failures
U6289	1
U6322	1
U6333	1
U6353	4
U6718	3
U6791	1
U6833	3
U6838	1
U7023	3
U7135	1
U7720	3
U8367	1
Total	23

Bray P1	
Lab ID	# Cycle Failures
U6289	2
U6353	1
U6718	2
U6791	3
U6833	1
U7230	1
U7237	1
U7630	1
U8299	1
Total	13

M3-P ICP	
Lab ID	# Cycle Failures
U6304	3
U6322	1
U6333	2
U6353	1
U6791	1
U7023	5
U7230	2
U7237	2
U7396	2
U7720	2
U8029	1
U8367	3
Total	25

M3-K	
Lab ID	# Cycle Failures
U6289	1
U6304	3
U6322	3
U6333	1
U6353	3
U6718	1
U6791	1
U6838	3
U7023	5
U7135	2
U7203	1
U7230	1
U7237	3
U7315	1
U7396	1
U7630	4
U7720	1
U8299	1
U8367	3
Total	39



ISTA-LAP Comparison of soil pH Methods



Comparison of $\text{pH (1:1)}_{\text{H}_2\text{O}}$ and $\text{pH (1:1)}_{\text{Salt}}$ values indicate 0.50 units lower values for the latter, and reduced 95% CL.

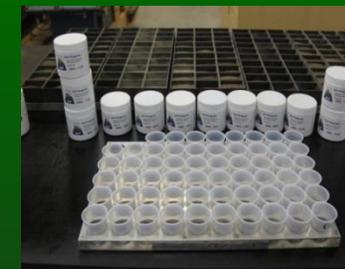
Soil ID ¹	$\text{pH (1:1)}_{\text{H}_2\text{O}}$		$\text{pH (1:1)}_{\text{Salt}}$	
	Median	95 % CL	Median	95 % CL
SRS-1611	6.29	± 0.19	5.81	± 0.12
SRS-1612	5.12	± 0.20	4.66	± 0.13
SRS-1613	6.67	± 0.17	6.19	± 0.12
SRS-1614	4.61	± 0.26	4.22	± 0.08
SRS-1615	5.82	± 0.15	5.34	± 0.11

¹ Soils ALP Cycle 30, 22 labs $\text{pH (1:1)}_{\text{H}_2\text{O}}$ and 5 labs $\text{pH (1:1)}_{\text{Salt}}$.





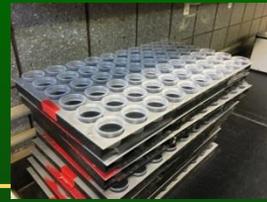
ISTA-LAP Program



Program Points

- ✓ Certification of lab performance 3 times per year
- ✓ Inclusive of pH, P and K primary soil test methods
- ✓ Performance assessed by independent entity
- ✓ Requires > 80% score on all methods, every PT cycle
- ✓ A re-test option is offered

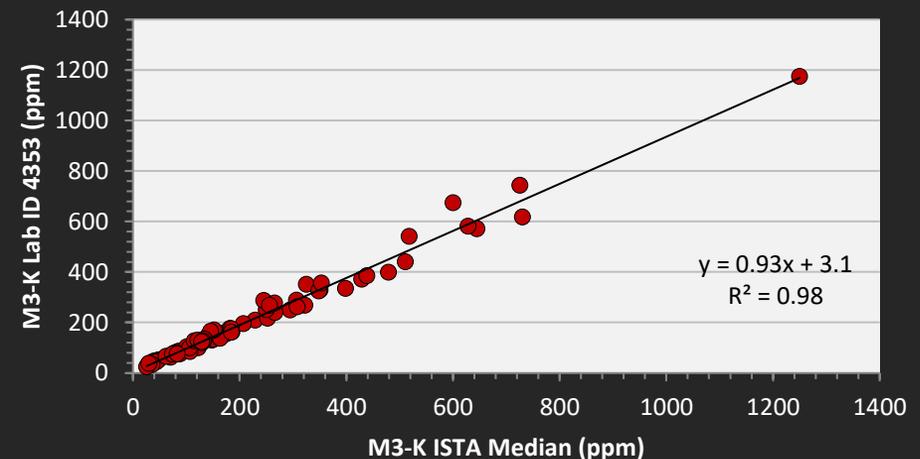
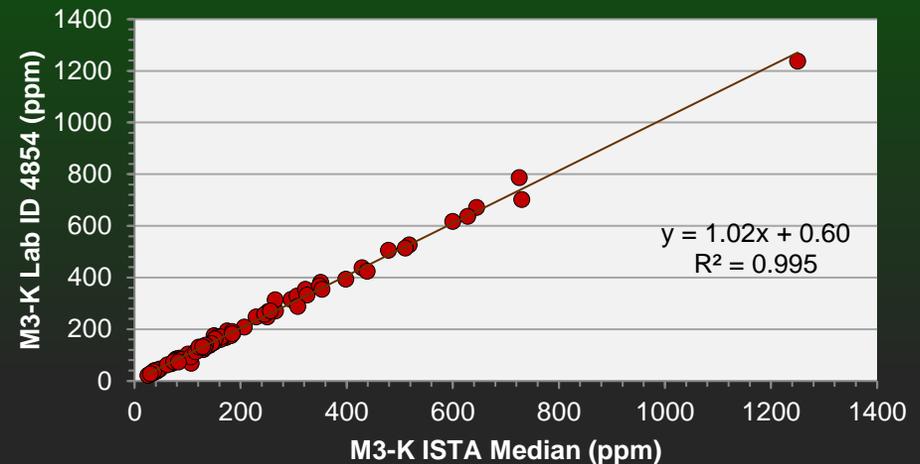
ISTA-LAP M3-K Lab Linearity Plots



M3-K linear plots, two ISTA Labs over 15 PT cycles.

Lab at upper right shows high near perfect correlation, slope 1.02.

Lab at lower right indicates 7% low bias (slope 0.93), Variability on high M3-K soils.



ISTA-LAP Performance Failures 2013-2014



Performance Failure \geq 2 method failures per cycle (< 80%)

Cycle ¹	pH (1:1) _{H2O}		M3-P ICP		M3-K	
	# Labs	# Failures	# Labs	# Failures	# Labs	# Failures
2013 - 2014						
20	18	3	8	1	15	0
21	14	2	8	1	13	1
23	18	2	9	2	16	5
24	18	1	11	2	16	2
25	20	0	13	3	17	4
26	21	3	13	1	17	4

¹ Performance failure based on the number of laboratories which had proficiency scores < 80% on two or more soils each PT cycle.



ISTA-LAP Performance Failures 2017-2018



> 1 Method Failure per Cycle

Cycle ¹	pH (1:1) _{H2O}		M3-P ICP		M3-K	
	# Labs	Failing	# Labs	Failing	# Labs	Failing
2017 - 2018						
32	21	4	15	2	20	1
33	21	2	17	1	20	5
34	20	1	16	2	19	2
35	18	1	16	2	18	2
36	21	3	17	2	20	1
37	19	0	16	0	19	2

¹ Performance failure based on the number of laboratories which had proficiency scores < 80% on two or more soils each PT cycle.





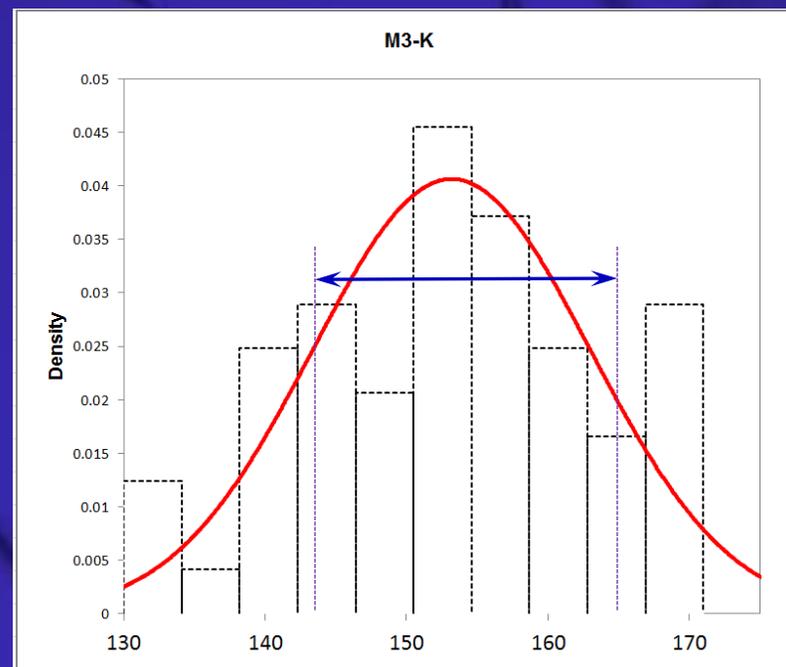
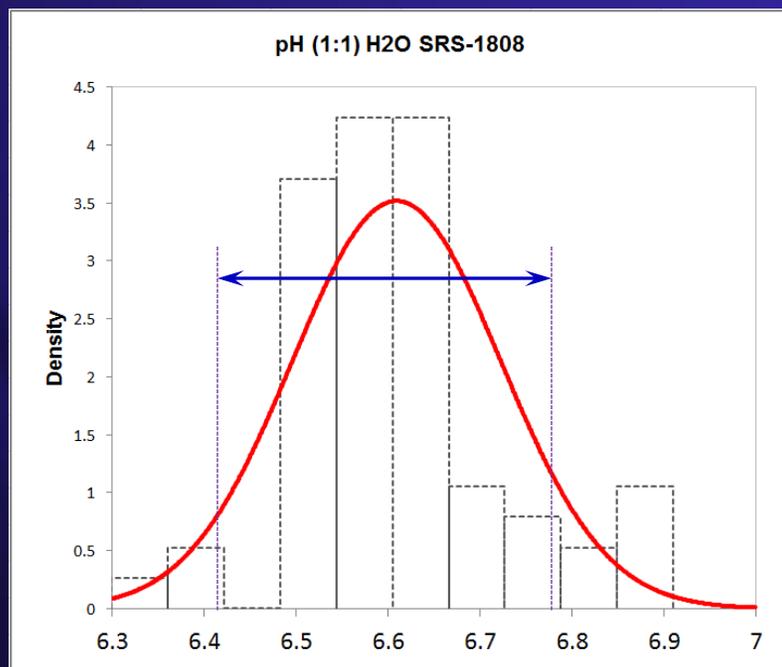
ISTA Method Performance 2015 - 2016



Soil Test Method	Number of Labs	Units	Median Concentration	Median Intra-lab RSD %	Median Inter-Lab Confidence Limits %
pH 1:1 H ₂ O	29		6.23	0.30	± 3.3
pH 1:1 Salt	9		5.81	0.32	± 2.2
Bray P1	15	ppm	38.9	1.8	± 19.5
Amm-K	14	ppm	156	1.7	± 14.4
M3-P Spec	8	ppm	42.0	1.0	± 14.0
M3-P ICP	22	ppm	52.5	1.8	± 17.8
M3-K	29	ppm	162	1.5	± 15.4
SOM-LOI	24	%	2.80	1.9	± 13.5

¹ Results based on 60 PT soils submitted over 12 cycles.

pH and M3-K Distributions SRS-1803





ISTA Soil Testing Performance 2013 - 2016

Soil Test Method ¹	Number of labs reporting	Total number of results	Total number of soil results > 95% CL	% All soil results within 95% CL
pH 1:1 H ₂ O	29	1170	102	89.5 %
pH (1:1) Salt	9	345	29	91.5 %
Bray P1	15	625	77	87.7 %
AMM-K	14	500	62	87.6 %
M3-P Spec	8	290	33	88.6 %
M3-P ICP	22	790	113	85.6 %
M3-K	29	1075	141	86.9 %
SOM-LOI	24	875	89	90.0 %

¹ Results flagged based on values exceeding 95% CL of median, across all reporting labs by method, 60 PT soils 2013-2016.



ISTA-LAP pH Comparison 2017



Soil ID ¹	ALP		ISTA-LAP	
	Median	95% CL	Median	95% CL
SRS - 1701	8.13	☐ 0.34	8.16	☐ 0.29
SRS - 1702	5.25	☐ 0.17	5.26	☐ 0.23
SRS - 1703	6.81	☐ 0.19	6.83	☐ 0.21
SRS - 1704	6.13	☐ 0.20	6.17	☐ 0.20
SRS - 1705	5.50	☐ 0.16	5.55	☐ 0.20
SRS - 1706	5.34	☐ 0.16	5.32	☐ 0.17
SRS - 1707	4.20	☐ 0.15	4.22	☐ 0.14
SRS - 1708	7.65	☐ 0.19	7.67	☐ 0.17
SRS - 1709	5.68	☐ 0.22	5.67	☐ 0.23
SRS - 1710	6.95	☐ 0.17	6.96	☐ 0.16

¹ Results flagged based on values exceeding 95% CL of median, across all reporting labs by method, 15 PT soils 2017.



ISTA-LAP M3-K Comparison 2017



Soil ID ¹	ALP (ppm)		ISTA-LAP (ppm)	
	Median	95% CL	Median	95% CL
SRS - 1701	227	75	265	62
SRS - 1702	150	43	145	28
SRS - 1703	724	134	725	101
SRS - 1704	122	26	121	25
SRS - 1705	260	63	256	50
SRS - 1706	71	27	74	15
SRS - 1707	30	9	30	7
SRS - 1708	1244	220	1250	174
SRS - 1709	137	30	134	24
SRS - 1710	137	31	132	22

¹ Database: ALP 48 Labs, ISTA-LAP 20 labs, 95% CL based on 2.9 x MAD, soils 2017.



ISTA Method Performance 2017

Soil Test Method	Number of Labs	Units	Median Concentration	Median Intra-lab RSD %	Median Inter-Lab Confidence Limits %
pH 1:1 H ₂ O	22		6.33	0.2	± 3.1
pH 1:1 Salt	7		5.82	0.12	± 2.1
Bray P1	11	ppm	68.8	13	± 18.8
Amm-K	10	ppm	144	18	± 12.5
M3-P Spec	5	ppm	77.7	7.2	± 9.2
M3-P ICP	17	ppm	98.2	11.6	± 11.8
M3-K	22	ppm	145	28	± 19.3
SOM-LOI	14	%	2.90	0.57	± 19.6

¹ Results based on 15 PT soils submitted over 12 cycles.

ISTA Lab Performance 2016



ISTA-LAP Percent of Labs Passing by Method

Method	Cycle 21	Cycle 22	Cycle 23	Cycle 24	Cycle 25	Ave.
pH 1:1 w	92 %	90 %	94 %	100 %	83 %	92 %
pH 1:1 _{CaCl2}	95 %	85 %	80 %	100 %	80 %	88 %
Bray P	86 %	91 %	100 %	83 %	90 %	90 %
M3-P Spec	90 %	87 %	80 %	100 %	75 %	86 %
M3-P ICP	87 %	82 %	80 %	92 %	87 %	86 %
NH ₄ oAC – K	83 %	91 %	87 %	78 %	100 %	88 %
M3-K	91 %	81 %	78 %	76 %	84 %	82 %





ISTA Soil Testing Performance 2017

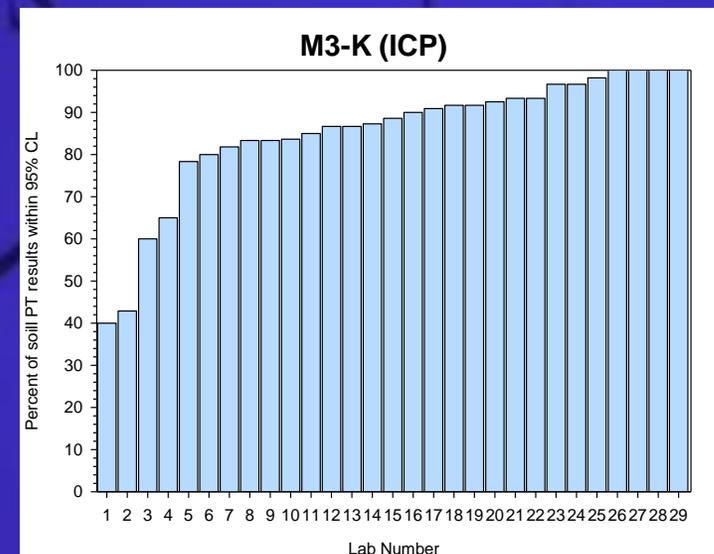
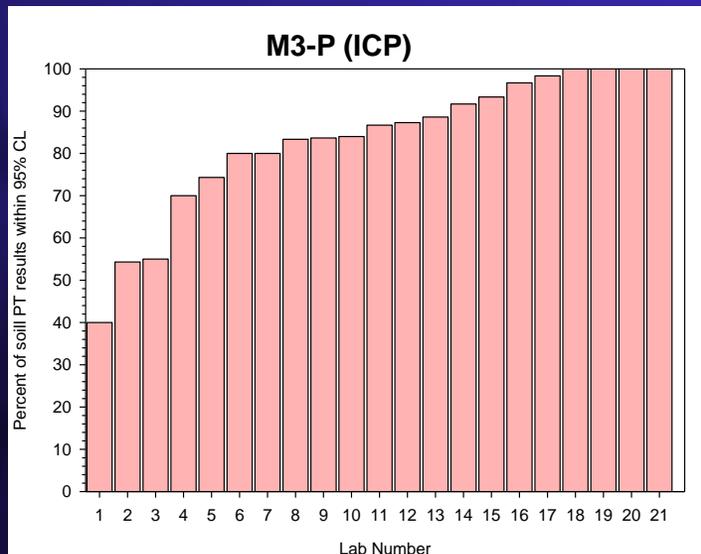
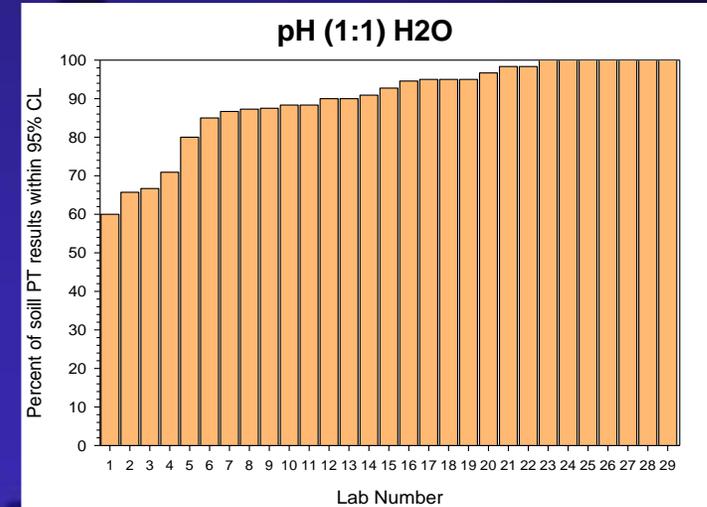
Soil Test Method ¹	Total number of results	Total number of soil results > 95% CL	% All soil results within 95% CL	% of results passing precision
pH 1:1 H ₂ O	310	33	89.3	86.2
pH (1:1) Salt	110	7	93.6	92.2
Bray P1	165	15	90.9	91.1
AMM-K	135	11	91.8	98.1
M3-P Spec	60	4	93.3	100
M3-P ICP	240	20	91.7	94.3
M3-K	295	30	89.8	93.8
SOM-LOI	170	21	84.9	86.9

¹ Results flagged based on values exceeding 95% CL of median, across all reporting labs by method, 15 PT soils 2017.



ISTA Soil Performance 2013 - 2016

PT Performance plots for ALP cycle 20-31 show 5 labs have overall performance < 80% for pH and M3-P (ICP), and six for M3-K.





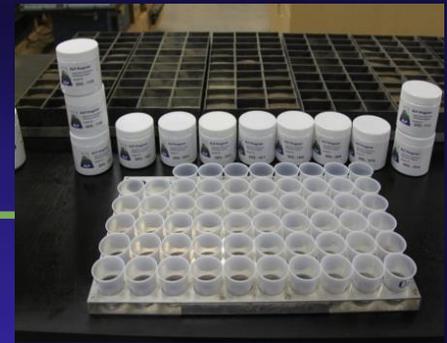
ISTA Laboratory Performance 2017

Soil Test Method ¹	Total number of lab x cycles	Total number of ISTA-LAP failures (score < 80%)	Percent ISTA-LAP passing lab x cycles (score > 80%)	Number of labs with >2 failures over 12 cycles
pH 1:1 H ₂ O	62	9	85.4	2
pH (1:1) Salt	22	2	90.9	0
Bray P1	33	2	93.9	0
AMM-K	24	1	95.8	0
M3-P Spec	12	0	100	0
M3-P ICP	48	5	89.6	1
M3-K	59	8	86.4	2
SOM-LOI	32	6	81.2	0

¹ Lab method failures, <80% score for one PT cycle, 2018.



ISTA Proficiency



Note: ISTA rules for a method, a passing score is 4 of 5 results are within 95% CL of the median each cycle. A failure is > 1 soil result exceeding 95% CL for a cycle.

2017 four laboratories had > 1 failure over the three cycles for a specified method, and are either on probation or lost accreditation.

Methods impacted: pH 1:1 and M3-K.



ISTA-LAP Assessor Workload



Example: Cycle 32 method performance tracking, 8 labs had 6 method failures and placed probation for cycles 33-35.

June 2017 Failures Cycle 32

6353	S alvey Belleville	Salt pH	Passed Retest	Must Pass Next 3
6838	y Ag	Water pH	Passed Retest	Must Pass Next 3
6304	Rock River	M3K	No retest	Off List Must Pass Next 3 to get ba
6304	Rock River	M3P-ICP	No retest	Off List Must Pass Next 3 to get ba
6718	SGS Mowers	P Bray	Passed Retest	Must Pass Next 3
7023	Farm Clinic	Water pH	Passed Retest	Must Pass Next 3
6333	Suretech	Water pH	Passed Retest	Must Pass Next 3
8367	Blacklog Ag	Water pH	Passed Retest	Must Pass Next 3
8367	Blacklog Ag	M3P-ICP	Passed Retest	Must Pass Next 3
8424	Pro Ag Consulting	Water pH	Passed Retest	Must Pass Next 3

Cycle 33, 6 lab method failures across 3 methods, and cycle 34 6 lab method failures across 6 labs. Tracking 13 labs on probation through cycle 36.



ISTA-LAP Issues



Alternative Option: for a specific method, a passing score is 4 of 5 results within 95% CL of the median each cycle, and a failure is > 1 result exceeding 95% CL. Labs passing retest placed on accreditation list.

A method failure in successive cycle, results in a lab assessor audit, and relisting with passing retest score.

Audit process: lab prepares a root cause failure report, followed by assessor audit visit (at lab's expense), and retest during visit. Failure to complete audit, loss of accreditation 1 year.



SPAC Activities

Journals: Communications in Soil and Plant Analysis and Journal of Plant Nutrition, Discounted subscription rates.



Soil Scoops for purchase: 1.5, 1.0, 2.0, 4.0, 5.0, 10.0, 15.0 g size scoops. New for 2018 are 1.5 g scoops and longer handles.



International Symposium - 2019

Laboratory Analysis Quality



The foundation of a lab's reputation is the quality of its analysis.

How does one measure quality?

Does a proficiency program indicate lab quality?

What is a standard of acceptable lab quality? Performance?

Soil Test Method	ALP Median ¹	Lab A	Lab B
pH (1:1) _{H2O}	4.21	4.60	4.40
Buffer pH	5.83	6.00	6.79
Bray P1 (ppm)	9.5	12	22
X-K (ppm)	36	28	32

¹ Soil ALP SRS-1707, submitted as double blind evaluation sample in 8/2017.