2025 Volume 1

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ALP Program Report

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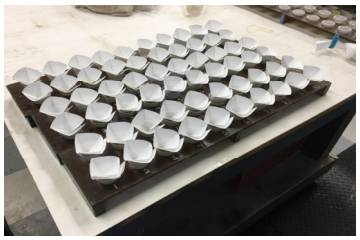
ALP Overview

The Agriculture Laboratory Proficiency (ALP) Program spring 2025 Round Cycle 56 was completed May 21, 2025, with results from one-hundred sixteen labs enrolled from the US, Canada, South Africa, Italy, Guatemala and Philippines. Proficiency samples consisted of five soils, four botanical and three water samples. Analytical methods are base on those published by AOAC, regional soil work groups, the Soil Plant Analysis Council and Forestry Canada. ALP has completed nineteen years of service to Ag laboratory industry.



Data was compiled for each method (test code) and proficiency material. Data analysis of each material include: the number results; grand median value; median absolute deviation (MAD), 95% Confidence Interval; method intra-lab standard deviation (*s*); lab mean, and standard deviation. Additional information on methods and statistical protocols can be found at the program web site.

Special points of interest:

- An assessment homogeneity of all ALP proficiency materials indicate were highly uniform for Cycle 56.
- Sixty-nine laboratories provided soil pH (1:1) H_2O results, medians ranged from 5.69 - 8.18.
- Soil M3-P ICP for Cycle 56 ranged from 13.8 to 81.1 mg kg^{-1} with intra-lab stdev MAD values ranging 2.7 - 7.6 mg kg^{-1} across the five soils.
- Soil M3-K values ranged from 76 - 396 mg kg^{-1} for the five ALP soils of PT Cycle 56.
- Results for botanical Cl indicate a range in concentrations with SRB-2504, having a median concentration of 0.047 %.
- Botanical N by combustion was reported by 43 labs, with two labs showing low bias across all PT materials for Cycle 56.

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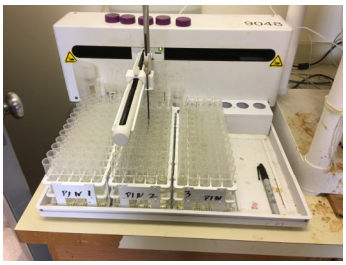
Proficiency Materials

Standard Reference Soils (SRS) materials utilized for Cycle 56 were: SRS-2501 Madison sandy loam, collected Jackson Cty, GA; SRS-2502 Otero sandy loam collected Weld Cty, CO; SRS-2503 an Ontario loam collected Cauyga Cty, NY; SRS-2504 a Thurman loamy fine sand collected Pierce Cty, NE; and SRS-2505 a loam collected Huron, Ontario, Canada. Chemical properties of the SRS materials ranges: pH (1:1) H_2O 5.69 - 8.18; SMP Buffer 6.57 - 7.47 mg kg^{-1}; Bray P1 (1:10) 1.6 - 75.9 mg kg^{-1}; SO_4-S 2.3 - 46.5 mg kg^{-1}; M3-K 76 - 396 mg kg^{-1}; M3-Ca 809 - 23040 mg kg^{-1}; DTPA-Zn 0.32 - 3.96 mg kg^{-1}; SOM-LOI 1.36 – 5.19%; CEC 5.5 - 15.7 cmol kg^{-1}; clay 7.3 - 30.3% and NO_3-N 12.2 - 121 mg kg^{-1}.

Standard Reference Botanical (SRB) materials for Cycle 56 were: SRB-2501 almond leaf composite from CA; SRB-2502 a buck wheat composite; SRB-2503 a pumpkin leaf composite from CO; and SRB-2504 a composite corn grain from SD. SRB median analytes concentrations: NO_3-N 20 - 6810 mg kg^{-1}; Dumas N 2.10 - 4.47 %; wet digestion total P 0.065 - 0.467 %; total K 0.115 - 4.43 %; total Ca 0.011 - 5.94 %; total S 0.091– 0.328 %, total B 1.3 - 65.5 mg kg^{-1}; and Zn 4.2 - 42.2 mg kg^{-1}.

Standard Reference Water (SRW) samples represent an agriculture water samples collected: SRW-2501 an irrigation well water sample collected near Mesilla, NM; SRW-2502 a domestic well water collected near Burwell, NE, and SRW-2503 from rapid creek, SD. SRW median concentrations: pH 6.95 - 8.08; EC 0.034 - 1.21 dSm^{-1}; SAR 0.25 - 11.6; Ca 0.15 - 6.84 mmolc L^{-1}; Na 0.082 - 4.93 mmolc L^{-1}; HCO_3 0.21 - 3.85 mmolc L^{-1} ; and NO_3 0.015 - 0.54 mmolc L^{-1}.

Homogeneity Evaluations



"..soil pH, Buf pH A&E, Olsen P and SOM-WB analysis Stdev values for Cycle 56 met homogeneity standards."

SRS material homogeneity was evaluated based on soil test codes pH (1:1) H_2O, buffer pH Adams Evans, EC (1:1), P Olsen, K Olsen, NO_3-N, SOM-WB and DTPA-Zn on analysis of six jars of each PT soil, each in analyzed in triplicate by an independent laboratory. Homogeneity results were within acceptable limits for all soils, with the lowest noted for pH H_2O, Table 1. Proficiency soil antecedent moisture contents were: 8.1 ± 0.1, 3.4 ± 0.4, 3.3 ± 0.3, 0.93 ± 0.05 and 3.8 ± 0.1 %, respectively.

Homogeneity was also evaluated on SRB and SRW matrix samples. Botanical results indicate all samples were well homogenized for N, P, Zn and C, with RSD values less than 0.5% of N and C on three of botanical samples, Table 2. Water results for EC, Ca, NO_3 and NH_4 were well homogenized with RSD values for EC less than 1% for all three of the PT samples, Table 3.

Table 1. ALP soils homogeneity evaluation Cycle 56, 2025.

Sample	pH (1:1) H_2O		EC (dS m^{-1})		P Olsen (mg kg^{-1})		NO_3-N (mg kg^{-1})	
	Mean [1]	*Std*	Mean	*Std*	Mean	*Std*	Mean	*Std*
SRS-2501	5.69	*0.02*	0.44	*0.008*	28.5	*2.2*	16.2	*0.5*
SRS-2502	8.17	*0.01*	0.37	*0.013*	31.2	*2.1*	20.7	*0.4*
SRS-2503	7.33	*0.03*	0.24	*0.005*	5.1	*0.6*	19.8	*0.3*
SRS-2504	5.77	*0.02*	0.16	*0.007*	9.9	*0.6*	10.3	*0.5*
SRS-2505	7.59	*0.01*	0.98	*0.030*	16.0	*0.8*	141.6	*5.2*

[1] Statistics based on five randomly selected soil replicates, each analyzed in triplicate.

Table 2. ALP botanical homogeneity evaluation Cycle 56, 2025.

Sample	N (%)		Mg (%)		Zn (mg kg^{-1})		C (%)	
	Mean [1]	*Std*	Mean	*Std*	Mean	*Std*	Mean	*Std*
SRB-2501	3.33	*0.047*	0.491	*0.012*	38.67	*0.8*	43.1	*0.23*
SRB-2502	3.27	*0.102*	0.772	*0.018*	35.1	*1.9*	39.9	*0.14*
SRB-2503	3.31	*0.067*	1.358	*0.016*	20.7	*1.0*	36.6	*0.19*
SRB-2504	0.987	*0.027*	0.022	*0.004*	0.78	*0.4*	40.4	*0.28*

[1] Statistics based on three randomly selected botanical replicates analyzed.

Table 3. ALP water homogeneity evaluation Cycle 56, 2025.

Sample	EC (dS m^{-1})		Ca (meq L^{-1})		NO_3 (meq L^{-1})		Na (mg L^{-1})	
	Mean [1]	*Std*	Mean	*Std*	Mean	*Std*	Mean	*Std*
SRW-2501	1.98	*0.04*	14.8	*0.12*	0.010	*0.004*	3.70	*0.070*
SRW-2502	0.35	*0.01*	2.18	*0.07*	0.009	*0.003*	0.20	*0.009*
SRW-2503	0.38	*0.02*	2.92	*0.03*	0.011	*0.004*	0.34	*0.010*

[1] Statistics based on three randomly selected soil replicates, each analyzed in triplicate.

SRS - pH (1:1)$_{H2O}$

Seventy laboratories provided ALP results for soil pH (1:1) H_2O (test code 116). Soils ranged from acid to alkaline, median range 5.69 - 8.18. Lab results were ranked low to high based on sample SRS-2501 (see Figure 1) with median pH designated by horizontal lines for each soil. Generally across labs all soils showed good consistency across labs. Labs #1 through #3 showed low bias across all four soils. Labs #14 #30, #41, #57 and #66 were inconsistent. Source of bias is likely associated with ISE performance and/or method compliance. Inconsistency could be result of extract carry-over.

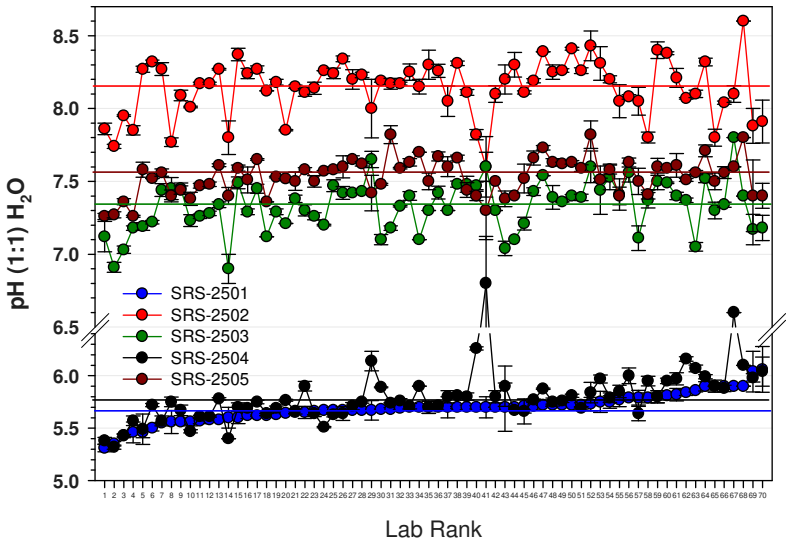


Figure 1. pH (1:1) H_2O distribution plots for SRS materials, ALP 2025 Cycle 56.

pH precision across the five ALP soils indicates very high precision, with median intra-lab standard deviation (*s*) values ranging from 0.052 to 0.063 pH units, the lowest noted for SRS-2504. Eight labs had poor precision, with standard deviations exceeding intra-lab stdev. Specifically *s* for labs #4, #53, #69, and #70 exceeded 0.10 pH units for SRS-2412. Soil SRS-2501 was the least variable with respect to intra-lab variance.

SRS - Phosphorus: Bray P1 and Olsen P

Bray P1 results were reported by thirty-two labs. Olsen-P was reported by fifty labs and M3-P ICP was reported by 48 labs. Median soil Bray P1 values ranged from 1.6 - 75.9 mg kg^{-1} PO_4-P; Olsen P 5.3 to 34.3 mg kg^{-1} P; Bray P2 ranged from 1.3 to 111 mg kg^{-1} P; and M1-P from 10.3 to 51.6 mg kg^{-1} P, across the five soils. Ranking lab results based on sample SRS-2503, median Olsen P concentrations are shown in indicated in Figure 2. Soil SRS-2501, highest in concentration was variable between labs. Soils SRS-2503 and SRS-2504 had similar concentrations. Labs #9 and #28 had in consistent results across all five soils. Lab #1 and #2 had low bias for all five soils.

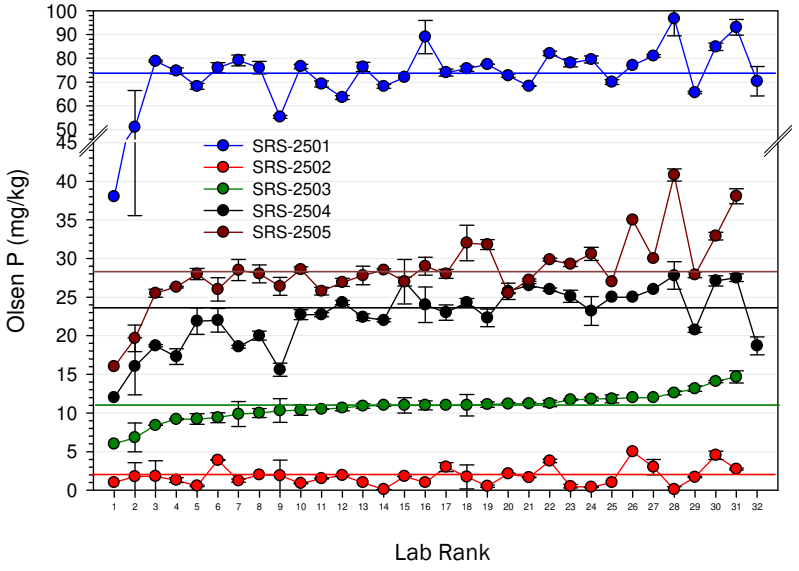


Figure 2. Olsen P distribution plots for SRS materials, ALP 2025 Cycle 56.

Three labs reported saturated paste PO_4 with median concentrations of 0.19 - 0.41 $mmol_c$ l^{-1}. Nine labs reported M3-P Spec median concentrations ranging 12 - 69.8 mg kg^{-1} P. Twelve laboratories reported Bray P 1:7 with medians ranging from 0.7 - 62.1 mg kg^{-1} PO_4-P. Two results for Modified Morgan P, with medians ranging from 1.7 - 67.7 mg kg^{-1} PO_4-P. Modified Kelowna was reported by two laboratories ranging from 7.5 - 53.3 mg kg^{-1} P and total P (US-EPA 513) ranged 158 - 677 mg kg^{-1} P with the highest concentration noted for SRS-2501.

SRS - Potassium

Forty-seven laboratories provided ALP results for soil M-3 K (test code 159) results. Results were ranked low to high based on sample SRS-2503 (see Figure 3). Soil SRS-2504 and SRS-2505 were the most inconsistent across labs. The source of the variability for SRS-2504 is likely associated with higher coarse sand. Lab #46 had high bias on all soils. Across all soils labs #1, #5, #11 and #14 were inconsistent across soils. Source of inconsistency is likely related to extraction, analysis instrument and/or method compliance.

M3-K intra-lab *s* values were lowest for soil SRS-2503, with a median intra-lab value of 3.5 mg kg^{-1} K and highest for SRS-2501 with a value of 19.6 mg kg^{-1}. M3-K within-lab precision across the ALP soil materials indicates very good precision, generally, for soils with less than 100 mg kg^{-1} K. Precision was poor (based on intra-lab *s*) for nine labs which exceeded 10 mg kg^{-1} K on SRS-2503. Across the five soils for Cycle 56 eight labs were flagged for poor intra-lab precision. Poor precision is attributed to extraction and/or analysis instrument operation.

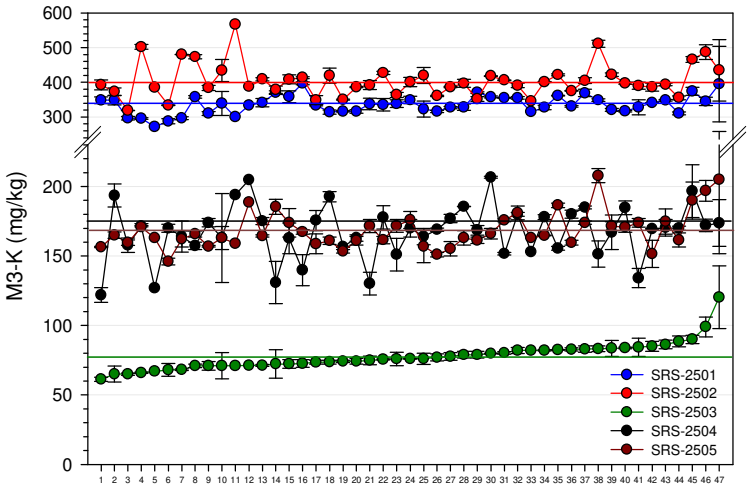


Figure 3. Extractable M3-K distribution plots for SRS materials, ALP 2025 Cycle 56.

SRS - SOM-LOI

Forty-six laboratories provided ALP results for soil SOM-LOI (test code 183). Soil Median SOM-LOI values ranged from 1.36 to 5.19%. Results were ranked based on sample SRS-2504 (see Figure 4) and had high consistency. Lab #1 had consistent low bias across all soils. Labs #3, #18, #44 and #45 were inconsistent across the five soils. Source of bias is likely related to muffle furnace operation and/or method compliance.

SOM-LOI precision across the five soils indicates high median intra-lab precision *s* values ranging from 0.055 to 0.12% SOM-LOI, highest for SRS-2501. Across labs, *s* values for SRS-2501 ranged from 0.002 - 0.254%. Across soils low precision was noted for several laboratories. Specifically *s* for labs #13, #18, #34, #35, #42, and #44 exceeded 0.10% SOM-LOI for SRS-2502. Lab #13 had poor precision on all Cycle 56 samples. Poor precision may be associated with the muffle furnace and heating time.

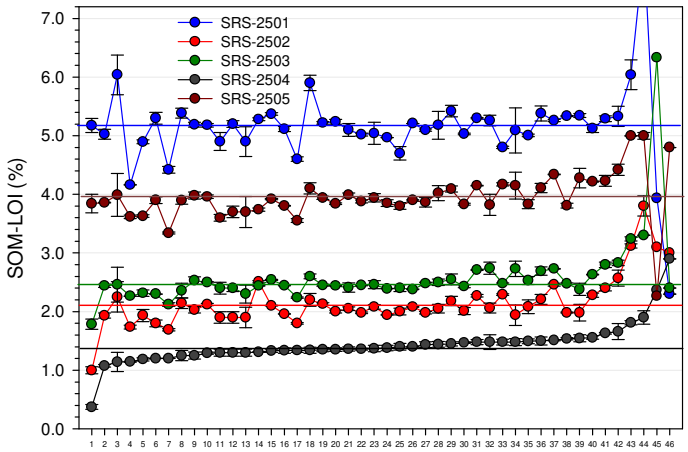


Figure 4. SOM-LOI distribution plots for SRS materials, ALP 2025 Cycle 56.

SRS - Total Carbon

Twenty eight laboratories provided ALP results for soil total carbon (test code 1802) results. Results were ranked low to high based on sample SRS-2504 (see Figure 5). Soil SRS-2502 was the most inconsistent across laboratories. Lab #1 showed low bias on all five soils and lab #27 high bias on all five soils. Laboratories #28 and #29 were inconsistent across soils. Source of inconsistency is likely related to extraction, analysis instrument and/or method compliance.

Soil total carbon median intra-lab *s* values were lowest for soil SRS-2503, with a median intra-lab value of 0.017 % and highest for SRS-2502 with a value of 0.036 %. Generally Total carbon within-lab precision across the ALP soil materials indicates very good precision. Precision was poor (based on intra-lab *s*) across all soils for Lab #23 and #27, exceeding 0.10% on soils SRS-2501 and SRS-2504. Across the five soils for cycle 56 seven PT measurements were flagged for poor precision.

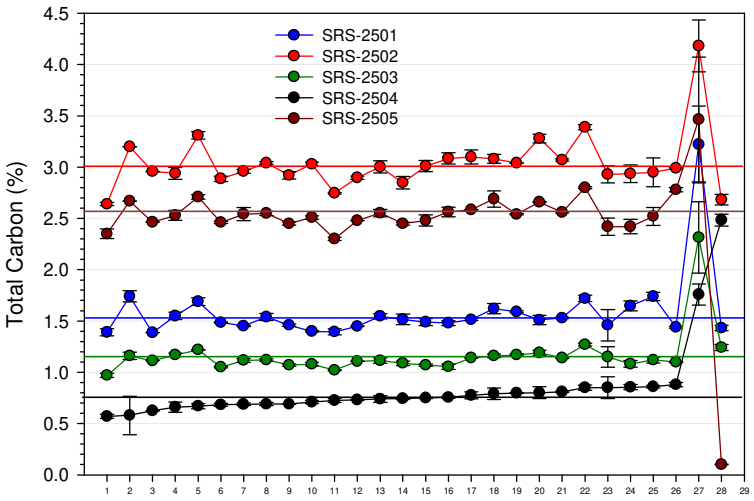


Figure 5. Soil total carbon distribution plots for SRS materials, ALP 2025 Cycle 56.

SRB - Chloride

Eighteen laboratories provided ALP results for botanical extractable Cl (test codes 208). Median values are designated by horizontal lines for each of the four botanical materials labs based on sample SRB-2502 (see Figure 6). Lab #1 had low bias results for three materials and Lab #18 had high bias across all four botanical materials. The data plot shows labs #7, #10, #12 and #17 were inconsistent on two of four samples.

Botanical Cl (test code 208) results for Cycle 56 indicate very high precision, with intra-lab median standard deviation (*s*) values ranging from 0.011 to 0.039 % Cl across the four samples. Cl intra-lab *s* values for SRB-2501 ranged from 0.001 – 0.038 %; SRB-2502 ranged from 0.002 - 0.093 %, SRB-2503 ranged from 0.001 – 0.122 % and SRB-2504 ranged from 0.001 –0.026 %. Lab and #18 had consistently high standard deviations for samples SRB-2503 and SRB-2502 highest Cl content. Five of 18 labs were flagged for poor precision across the four botanical samples for cycle 56.

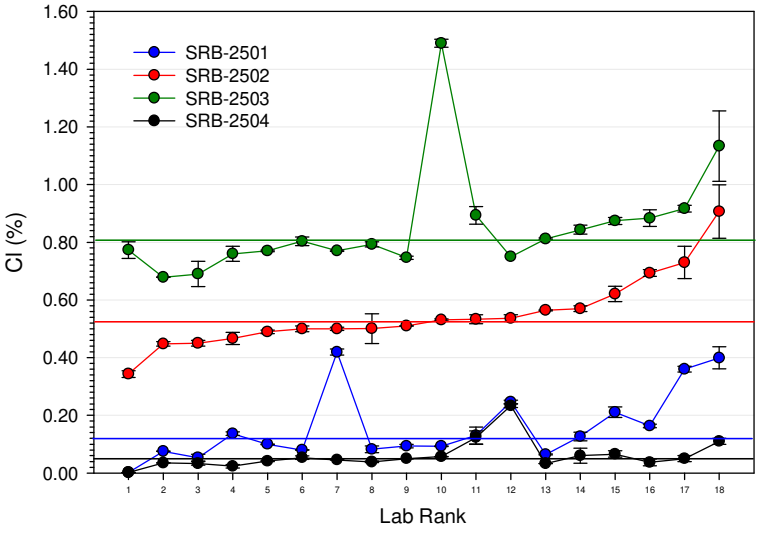


Figure 6. Chloride distribution plots for SRB materials, ALP 2025, Cycle 56.

SRB - Combustion Nitrogen and TKN

Forty-two laboratories provided ALP results for botanical combustion (Dumas) nitrogen (test code 210) and eight labs for TKN (Test code 209) for Cycle 56. Median values are designated by horizontal lines for each material and labs results ranked low to high based on sample SRB-2503 (see Figure 7). Unique for this cycle were three botanical material had very similar median nitrogen values: 3.54%, 3.50% and 3.51%. As a result one can assess differences in materials and lab consistency across PT materials. SRB-2502 showed the most inconsistent combustion N across labs. Similar results were found for TKN.

Combustion N results indicate very high intra-lab precision across all labs for all samples. Intra-lab median N lab *s* values were 0.016% N for SRB-2501; 0.019% N for SRB-2502; 0.021% for SRB-2503; and 0.015% for SRB-2504. Lab #2, #13, and #29 had consistent high standard deviations on three of four botanical PT samples.

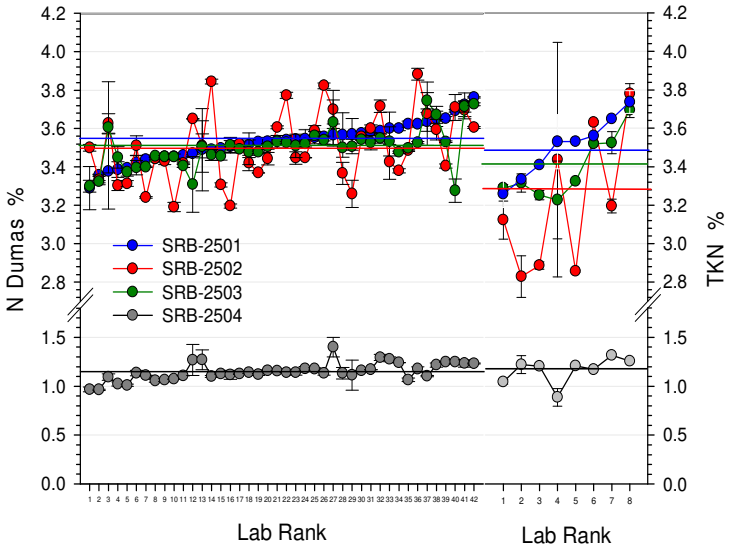


Figure 7. N distribution lab plots for SRB materials, ALP 2025 Cycle

SRB - Phosphorus

Forty-eight laboratories provided ALP results for Cycle 56 phosphorus (P) (test code 212). Botanical results median values are designated by horizontal lines for each botanical material and labs results are ranked low to high based on sample SRB-2501 (see Figure 8). Labs #1, #20, #28 and #38 showed inconsistency. Source of inconsistency is likely related to sample digestion, analysis instrument and/or test code method compliance.

Botanical P results indicate very high precision, with median intra-lab standard deviation (*s*) values ranged 0.003 to 0.013 % P for test code 212 across the four botanical samples. Individual lab intra-lab *s* values for SRB-2501; ranged from 0.001 - 0.015% P; SRB-2502 ranged from 0.001 – 0.034 % P and SRB-2503 0.001 - 0.044 % P; and SRB-2504 0.001 - 0.010 % P. Five labs were flagged for poor precision for botanical P for Cycle 56.

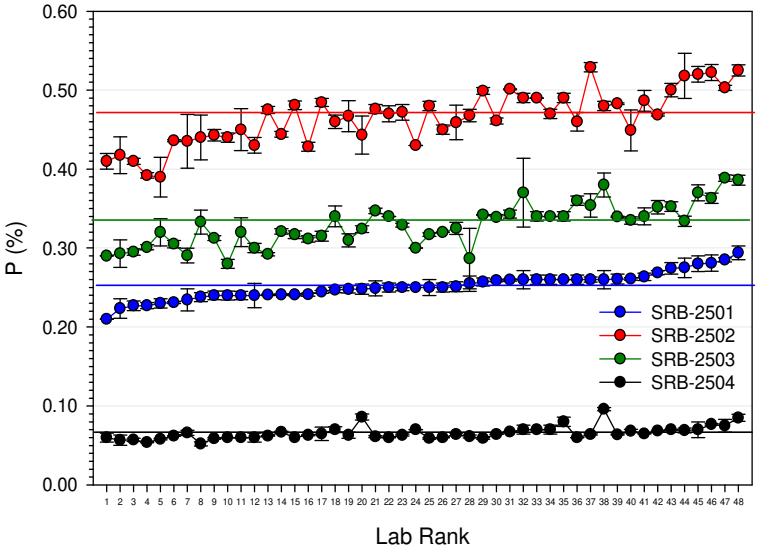


Figure 8. Phosphorus distribution lab plot for SRB materials, ALP 2025 Cycle 56.

SRB - Potassium

Forty-eight laboratories provided ALP results for potassium (K) (test code 213). Median values are designated by horizontal lines for each botanical material and labs results are ranked low to high based on sample SRB-2501 (see Figure 9). Labs #1, #5, and #48 were inconsistent. Source of bias is related sample digestion, analysis instrument and/or method compliance.

Botanical K results indicate very high precision, with intra-lab median standard deviation (*s*) values ranging from 0.013 to 0.110 % K for test code 213 across the four samples. Individual lab intra-lab *s* values were: SRB-2501, ranged from 0.006 - 0.255 % K; SRB-2502, 0.011 - 0.323 % K; SRB-2503, 0.010 - 0.310 % K; and SRS-2504, 0.002 - 0.051 % K. Lab #46 had high standard deviations exceeding 0.20 % K on two of four samples. Across samples five labs were flagged for poor K precision for Cycle 56.

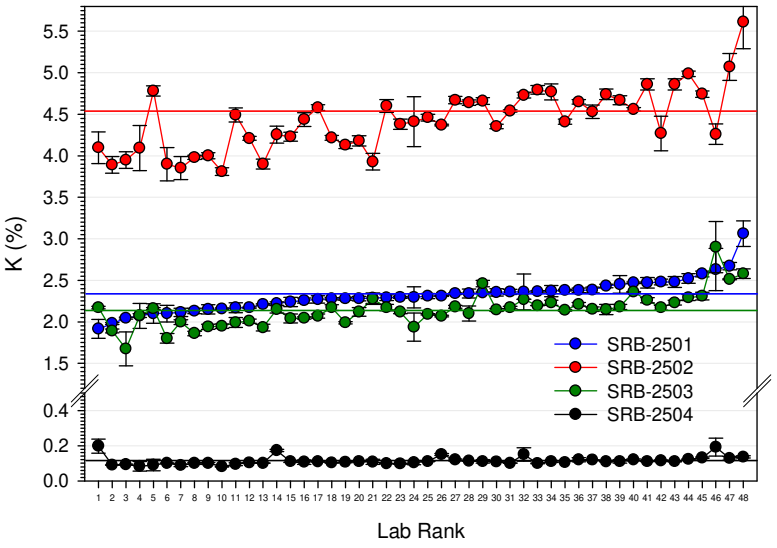


Figure 9. Potassium lab plot for SRB materials, ALP 2025 Cycle 56.

SRB - Calcium

Forty-six laboratories provided ALP results for calcium (Ca) (test code 214). Result median values are designated by horizontal lines for each botanical material and individual labs results are ranked low to high based on sample SRB-2502 (see Figure 10). Across samples labs #2 had low bias on all samples. Labs #11, # 20 and #38 were inconsistent. Source of bias is likely related sample digestion, analysis instrument and/or method compliance.

Botanical Ca results indicate very high precision, with median intra-lab standard deviation (*s*) values ranged from 0.005 to 0.22 mg kg^{-1} Ca for across the four botanical proficiency samples. Individual lab intra-lab *s* values for SRB-2501; ranged from 0.001 - 1.19 mg kg^{-1} % Ca; SRB-2502 ranged from 0.001 – 0.20 mg kg^{-1} Ca; SRB-2503 0.001 - 0.89 mg kg^{-1} % Ca; and SRB-2504 0.001 - 0.017 % Ca. Lab #42 had consistently high standard deviations.

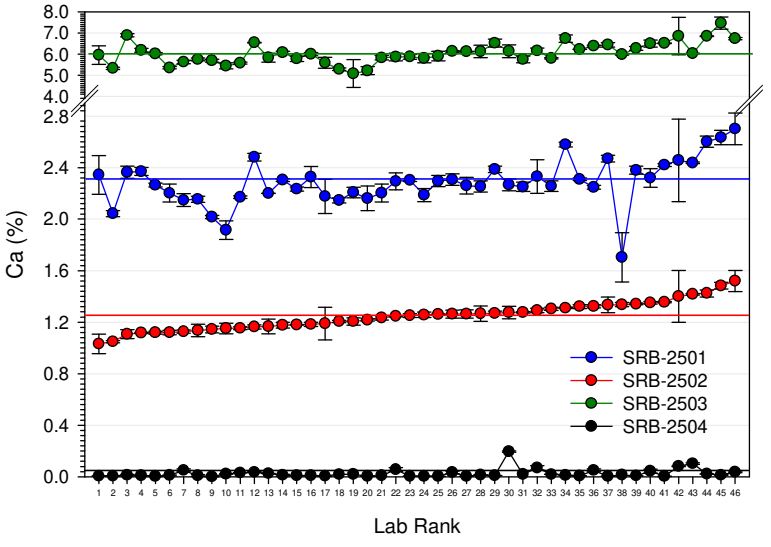
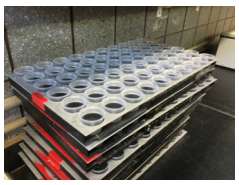


Figure 10. Calcium (code 214) lab plots for SRB materials, ALP 2025 Cycle 56.

SRW - Water EC



Twenty-two laboratories provided ALP results for water pH (test code 302) and EC. Lab results were ranked low to high based on sample SRW-2502 (see Figure 11). Labs #1 and #12 indicated low bias on two of three samples. Labs #1, #2 and #6 indicated inconsistency across samples. Source of bias is likely associated with EC probe performance and/or calibration.

EC precision across the three water materials indicates very high precision, with intra-lab median *s* values of 0.012, 0.004 and 0.002 dSm^{-1}, for the three water samples, respectively. Precision for sample SRW-2501 was the most consistent across the twenty-two participating laboratories. Intra-lab *s* values for lab #21 exceeded 0.07 dSm^{-1} on SRW-2503. Highest precision was noted for lab #8 with intra-lab *s* values of < than 0.008 dSm^{-1} for all three samples. Three labs were flagged for precision for EC.

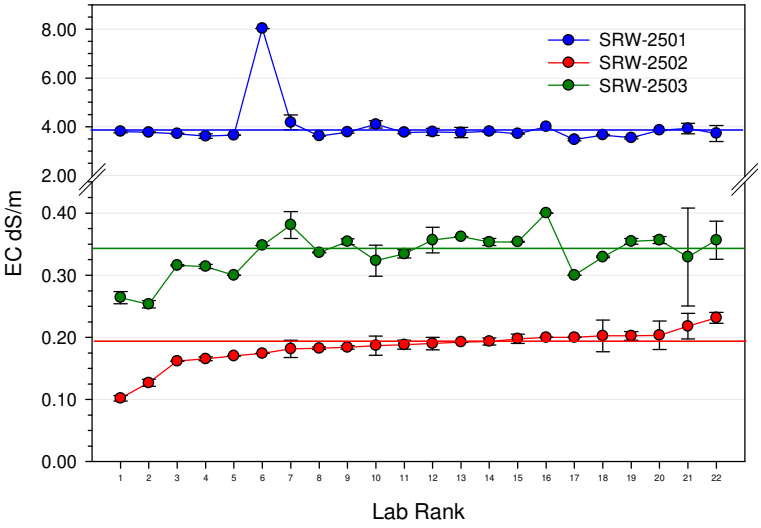


Figure 11. Water EC distribution plots for SRW materials, ALP 2025 Cycle 56.

SRW - Na

Twenty-two laboratories provided ALP results for water Na (test code 304). Lab results were ranked low to high based on sample SRW-2502 (see Figure 12). Median values are designated by horizontal lines. Labs #1 and #2 showed low bias on two of three samples and lab #6 was inconsistent. Bias is likely a result of a calibration error.

Sodium precision across the three water solution matrices indicates excellent precision, with median intra-lab *s* values of 0.045, 0.006, and 0.004 mmolc L^{-1} for SRW-2501, SRW-2502, and for SRW-2503, respectively. Water Na precision was excellent with only labs #20 and #21 exceeding 0.03 mmolc L^{-1} Na on sample SRW-2503. Four labs was flagged for poor precision on Na for ALP Cycle 56.

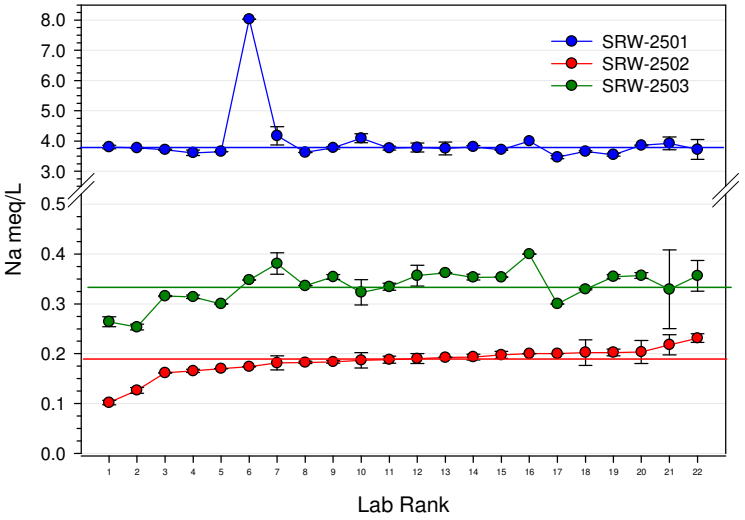


Figure 12. Water Na distribution plots for SRW materials, ALP 2025 Cycle 56.

Announcements

- The ALP program in August 2025 will launch the soil carbon proficiency program. Test parameters include, total Soil Carbon (SC), soil organic carbon (SOC), soil inorganic carbon (SIC), Total soil carbon, pH and moisture content. The program will consist three cycles per year each with four soils. The soil carbon proficiency program will be required for labs seeking ALTA-SAC certification.

- The 18th International Symposium on Soil and Plant Analyses (ISPPA) was held June 9-13, 2025 in Durham, North Carolina. Topics included soil, plant and water analysis, soil health, proximal sensors and plant nutrition. Information on the symposium can be found at: https://www.isspasymposium.org/

- ALTA has a summer Workshop scheduled for August 19-20, 2025 in St Joseph MI. Topics include lab analysis and a tour of the LECO Technical application center. For more information contact Gary Fisher at info@ALTA.Ag.

- ALP has secured new proficiency soil materials from Florida, Georgia, Oklahoma, and Texas for the 2025 and 2026 proficiency program.

- ALP has standard reference soils and botanical tissue materials available for purchase. For more information on these contact the ALP Technical Director, Robert.Miller@cts-interlab.com.

Summary

ALP has provided twenty years of service with the completion of Cycle 56. Since 2005 ALP has completed the analysis of 280 soils, 196 plant samples and 180 water samples providing comprehensive proficiency data on inter and intra laboratory performance across a range of analytical methods.

We thank all laboratories who participated in Cycle 56. As the coordinators of the program we appreciate your consideration and participation in the proficiency program. We continually seek feedback from laboratory participants to improve the service and function of the program. Please forward all comments to info@cts-interlab.com.

Cycle 57 Ship

June 19, 2025

"Consistency is what transforms average into excellence. "

– Tony Robbins, 2020

ALP
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