The Soil~Plant Analyst

A NEWSLETTER DEDICATED TO THE AGRICULTURAL LABORATORY INDUSTRY

A Quarterly Newsletter of the Soil and Plant Analysis Council, Inc., July 2020

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Message from President John Spargo

Agricultural analytical testing in the time of COVID-19.

The COVID-19 pandemic has disrupted all our lives and will change daily business practices for the foreseeable future. At some-point in the last two months, all but a handful of states have been under state-wide or partial *stay at home* orders. In implementing these orders, selected businesses and industries, identified as *life sustaining*, were exempted. In most cases, agricultural analytical testing labs were among those enterprises deemed essential. This is recognition of our important role for providing critical knowledge to inform important management decisions in support of food and fiber production.

Like other essential industries during this crisis, agricultural analytical laboratories have had to adapt in order to continue to meet our clients needs while minimizing the risk to staff and our local communities. Managers have developed strategies to promote physical distancing, such as modifying staff schedules, revising workflows, and setting sample priorities. At the same time, we are all dealing with issues related to supply chain disruptions, shipping delays, logistical challenges, and shortages of PPE. Over the last several weeks I have communicated with many of our laboratory colleagues to find out how they have been managing. I am truly impressed by how well laboratories are adapting to this new set of challenges. Their ability to plan for contingencies and revise and refine plans as conditions

(continued on page 2)

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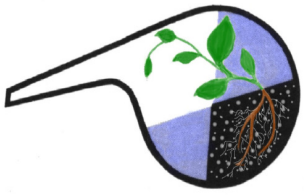
Membership Privileges

SPAC membership offers discounted rates for two journals: Communications in Soil Science and Plant Analysis and the Journal of Plant Nutrition. Journal subscription includes on-line access to past Journal issues. Membership in the Soil and Plant Analysis Council for 2020, includes quarterly newsletters, announcements on laboratory analysis workshops, laboratory supply discounts, discount registration for the international symposiums. To renew for 2019: contact Dr. Robert Miller, SPAC Secretary.

Continued From Page 1

warrant is truly remarkable. What has been equally impressive is how willing colleagues have been to share their experiences and advice with others. The laboratory listservs I subscribe to have been especially active — members with questions or concerns have received generous support.

All indications are this pandemic will continue to impact the way we do business for some time. Our ability to persist and succeed in meeting our client's needs, while ensuring the health and safety of our staff and communities, requires that we continue to be diligent and responsive to safety recommendations and remain willing to adapt to new challenges. Stay safe and be well, friends.



Manure Methods Manual

Dr. Melissa Wilson, Assistant Professor and Extension Specialist Manure Nutrient Management & Water Quality at the University of Minnesota, is coordinating the 2nd edition of the "Methods of Manure Analysis" laboratory manual. Manure methods include total solids, ash content, organic matter content, electrical conductivity, ammonium-nitrogen, nitrate nitrogen, total nitrogen, total phosphorus, water extractable phosphorus, total alkali metals (K, Ca, Mg, Na), sulfur, chloride, micro nutrients (Zn, Mn, Cu and B). Included will be sections on laboratory quality management, method detection limits and sample preparation. Co-authors are Dr. John Spargo, Penn State University; Dr Kristin Hicks, North Carolina Department of Agriculture Service Laboratory; Dr. Robert Miller, ALP Technical Director; Mr. Bryan Thayer A&L Great Lakes; Jerry Floren, former MAP program coordinator. Estimated publication date October 2020.

www.mda.maryland.gov

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ALTA (formerly ISTA) Meeting

The Agricultural Laboratory Testing Association (ALTA), formerly identified as the Illinois Soil Testing Association (ISTA), met February 25-26, 2020 in Galena, IA. The two day meeting included eight presentations: ISTA Introduction, *Tim Smith, Crop Smith, Farmer City, IL*; Hemp Testing, Dustin *Sawyer*, Rock River Labs, Watertown, WI; Farmers Edge - Digital Ag Experience, *Patrick Visser, Farmers Edge Winnipeg, Canada*; Continuum Ag - Soil Health Review ; ISTA LAP Update & PAC Program, *Dr. Robert Miller, ALP Program Technical Director*; Oklahoma St. Univ. - A Different Take on Soil Sampling, Brain *Arnell, Oklahoma State University*; Pattern Ag - Soil DNA Analysis, *Michael Ely / Gordy Martin, Pattern Ag*; and Weather Outlook: "2020" Vision, *Dr. Elwynn Taylor, Iowa State Univer*sity.

ALTA announced a new web site ALTA.Ag and reviewed informational elements of the site. The for-named ISTA-LAP program, established in 2012 to certify soil testing laboratories in Illinois was renamed the Soil Analysis Certification (SAC) Program. The ALTA board approved logos for the SAC and the proposed Plant Analysis Certification (PAC) Program which will launch in the summer 2020. Gary Fisher of USI Laboratory was directed to draft the new ALTA web site, and the board will have monthly teleconference meetings to facilitate completion of program tasks. The next ALTA meeting is scheduled for July 2020, contact Gary Fisher, gfisher@unitedsoilsinc.com.

ALTA
AGRICULTURAL LABORATORY TESTING ASSOCIATION

The Agricultural Laboratory Testing Association is an organization of professionals dedicated to:

- Quality soil testing and analysis
- Accurate reporting
- Sound management advise
- Information sharing

For more information visit www.ALTA.AG

MASTPAWG - Meeting

The Mid-Atlantic Soil Testing and Plant Analysis Work Group (MASTPAWG) met North Carolina State University in Raleigh, NC, February , 2020. The meeting was hosted by *David Hardy, Soil Testing, Agronomic Division, NCDA&CS.* The program included presentations: Nutrient Management: Future Direction of NRCS – *Dana Ashford Kornburger-NRCS;* Soil Test Levels of P and Zn in NC Soils, *Stephanie Kulesza, NCSU*; Experiences with N Volatilization, *Alex Woodley, NCSU*; Impacts of Tropical Cyclone Flooding on Hydrology, Nutrient Cycling, and Fishery Habitat in Eastern NC, *Hans Paerl, UNC-CH Institute of Marine Sciences*; NC Preparedness and Composting Strategies as Related to Catastrophic Events on Farms, *Joe Hudyncia, NCDA&CS*; Nitrogen and P Needs in Three Cultivars of CBD Hemp Andrew *G. Ristvey, Univ. of Maryland;* Validation of NC Lime Recommendations, *Joseph Wilson, NCDA&CS*; An Overview of Lime Production and Use in NC, VA and TN, *Jake Moser, Tennessee Valley Resources*; Soil CEC: Comparison of Measured vs Estimated Methods, Robert *Miller, ALP Program Technical Director;* Soil Fertility Challenges in Brazilian Agriculture – *Luke Gatiboni, NCSU*; Overview of Water Analysis and Recommendations at Agronomic Division -– *Kristin Hicks, NCDA&CS;* Phosphorus Management in High Yielding Environments, *Bryan Hopkins, BYU*; Management of Na in Land Applied Waste, *Steve Stadelman, Soil Scientist*; Perspective on Nutrient Management in Absence of IPNI, John *Jones, TFI*; UAV Technologies / Sensors – Applications in Agriculture and Experiences in NC, *Rob Austin, NCSU*; Soil Testing Recommendations – Pieces of the Puzzle, *David Hardy, NCDA&CS*; Update of P and K Soil Test Calibration Project, *Sarah Lyons, Crop and Soil Sciences, NCSU*. Sponsors included EA Consumables, Elementar Americas; Skalar, Agricultural Laboratory Proficiency Program (ALP); Fritsch Milling & Sizing, Inc., Spectro Instruments, Texas Scientific Instruments; SEAL Analytical, Inc.; and NAPT. Then next meeting is set for February 2021.

A Primer on Hemp Testing

Dustin Sawyer, Rock River Laboratory

2019 was an exciting year for agriculture. It wasn't only the horrible weather and the record-breaking number of prevented plant acres. Even more exciting was that hemp was planted as a major agricultural crop for the first time in more than 60 years. The Agriculture Improvement Act of 2018 brought hemp back as an agricultural crop and became the most exciting thing to happen to the agricultural community in a generation, prompting an explosion of interest. As with all things, the best path to understand where we are with hemp today is to understand the history that brought us here, most importantly the very definition of hemp.

Hemp has traditionally been cultivated for three primary purposes: food, fiber, and drugs. No matter the end use, there is only one species of plant: *Cannabis sativa.* The end use is determined through selective breeding and the expression of various traits. This is not unlike man's best friend. Whether we enjoy the company of a Great Dane or a Shih Tzu, all dogs are the same species: *Canus familiarus.* Selective breeding brings out various traits such as being tall or being annoying. Traditionally the common name used for *Cannabis sativa* has been chosen based on the end use. Plants produced for fiber and food have historically been referred to as hemp or industrial hemp while plants raised for the psychoactive effects have been called marijuana. The relationship between these two uses has caused, and continues to cause, trouble and confusion among lawmakers and the general public.

Now that we understand the plant in general, let's look deeper at what makes this plant so special. Cannabinoids are organic compounds produced within *Cannabis sativa* to which humans have a psychoactive reaction. The most popular of these compounds, THC, is well known for causing a euphoric high and its production is the desired trait in marijuana. THC has its own complex chemistry and comes in several varieties, causing additional significant communication and legal barriers. That chemistry could be an article in itself so the generic term THC will be used for the sake of this conversation.

The Agricultural Marketing Act of 1946 created a legal delineation between hemp and marijuana based on the dry weight content of THC, setting 0.3% as the upper allowable limit for hemp. If plant material has more THC than that, it's marijuana and it's illegal. Historical cultivation techniques didn't look at cannabinoids separately when selecting for hemp or marijuana.

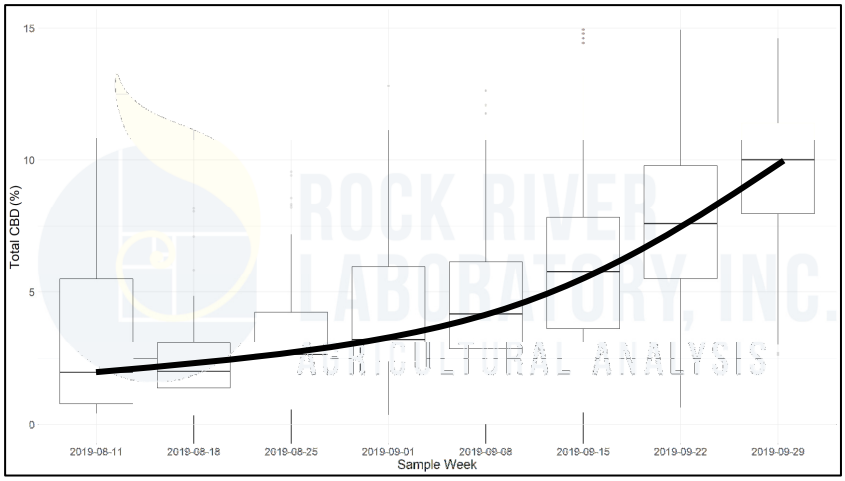

Figure 1. Box-whisker plot of the median total CBD of hemp samples collected 2019 with respect to time.

One either expressed cannabinoid production for marijuana or suppressed cannabinoid production for hemp. This approach has worked well, and industrial hemp varieties have no problem coming in under the 0.3% delta-9-THC threshold. Until now.

The rise in state-level decriminalization of marijuana has allowed researchers to study *Cannabis sativa* freely for the first time in decades, resulting in a deeper understanding of cannabinoids and their various psychoactive effects. To date, more than 100 different cannabinoids have been identified and more will certainly be discovered. The better understanding of cannabinoids has led to a completely new type of hemp – cannabinoid hemp; hemp designed for human consumption of cannabinoids other than THC. In cannabinoid hemp production, a blanket suppression of all cannabinoids doesn't work, so breeders are trying only to suppress the production of THC.

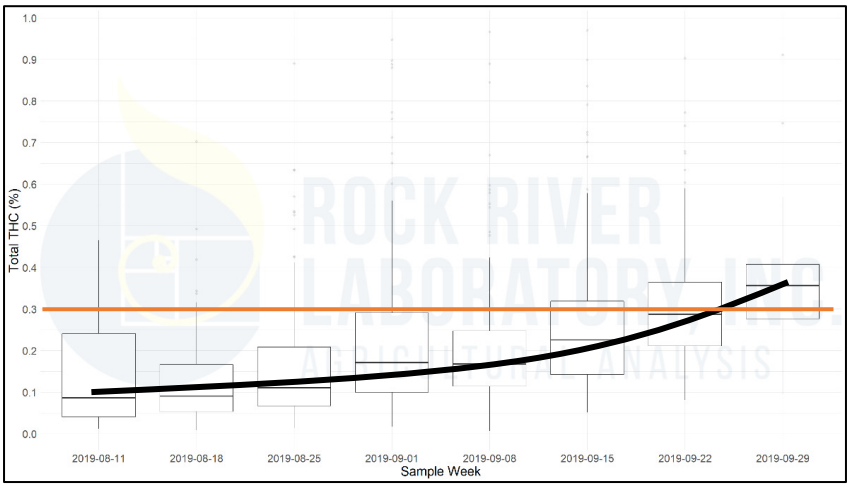

Figure 2: Box-whisker plot of median total THC of hemp samples collected 2019 with respect to time. The legal limit of 0.3% total THC is highlighted.

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The targeted approach isn't as effective and many cultivars of cannabinoid hemp will breach that threshold of 0.3% THC, making the product illegal. When a hemp sample exceeds 0.3% THC, it's said to have gone "hot".

In order to provide much-needed service to this new sector of agriculture, Rock River Laboratory, through our sister company Pride Analytics and Consulting, dove headfirst into the science of hemp analysis in 2019. What we found was confusion, market saturation, hot samples, and unsafe material. During the busiest time of the season, just prior to harvest, roughly 40% of samples submitted to our lab were above the 0.3% THC limit. This is largely because the cannabinoid hemp market values the plant material on the cannabinoid content. In 2019, CBD was the cannabinoid of interest and growers let the plants go longer and longer to boost the CBD content, they were also increasing the THC content, Figure 1 and Figure 2.

Some of our customers chose to analyze their harvested material for human safety. Tests included heavy metals, pesticide residues, and microbial content. The great news is that no pesticide residues were found in any of the samples tested. The bad news is that it was common to find samples contaminated with heavy metals, mold, and yeast.

To date, there is no government body that is overseeing the safety of cannabinoid hemp, and the cannabinoids analysis is still largely unstandardized. This new use of hemp seems to have caught lawmakers unaware and for the time being nearly anything goes. There is an effort to catch up, and regulations are updating frequently. Just last month the Association of Official Analytical Chemists (AOAC) approved a method for cannabinoids in hemp. There are several additional analytes currently under review by the AOAC and more approved methods will be arriving soon. This ever-changing environment makes it difficult to set up and operate a lab within the industry. 2019 saw a lot of labs start up with "turnkey" solutions, but time will tell if they are able to keep pace with the industry.

SPAC Standard Soil Scoops

The Soil and Plant Analysis Council offers standard soil scoops for soil testing laboratories. Standard scoops sizes are: 1.0g, 1.5g 2.0g, 5.0g, 10.0g and 15.0g based on an assumed soil density of 1.18 g per cubic centimeter. Scoops are manufactured from high quality steel with wooden handles. Soil scoops are offered in multiple handle sizes, 4.0" and special order 5.0" in length, along with optional high density foam grips. Additional scoop sizes of 0.50g, and 4.0g, are now available, and special scoops based on volume or scooped mass can be fabricated. New for 2020 SPAC offers soil spatulas for tap and soil leveling.

Scoops can be purchased via an order addressed to the SPAC secretary, RMiller@SP-Council.org.

Assessment of the Accuracy and Precision of Soil Chemical Analysis Laboratories in California

Andre Biscaro, Robert Miller, Dirk Holstege, Steve Orloff, Tim Hartz and Eryn Wingate

Soil chemical analysis is the cornerstone of an effective nutrient management program. Without a reliable soil test result, significant miscalculations in fertilization recommendations may occur, which can dramatically affect profitability and can potentially have negative environmental consequences. Despite the large number of analytical commercial laboratories serving California agriculture, there is no public data reporting on lab accuracy and there isn't a "true" certification program in the United States. Although a lab may participate in a proficiency programs such as the Agricultural Laboratory Proficiency (ALP) program or the North American Proficiency Testing (NAPT), these programs are not mandatory nor do they certify lab quality. Because of the absence of data, growers, farm managers, consultants, environmentalists and researchers are left without a reliable means by which to select a testing laboratory. In 2019 a study was conducted to assess the performance of soil testing laboratories.

Four reference soil samples from the Agricultural Laboratory Proficiency (ALP) program were submitted to eight commercial Ag-laboratories in the Western US (seven in California and one in Idaho) for standard fertility analysis. Samples were submitted in three rounds, approximately three months apart, in order to assess analyte precision of each laboratory. Standard reference soil samples were selected from the ALP program archives, each previously analyzed by a minimum of thirty credible laboratories, in triplicate for each soil sample. Soil analyses included, saturated paste pH and EC; soil organic matter; nitrate; extractable phosphorus by the method of Olsen; extractable cations; and micronutrients. Sample IDs were modified and submitted to each laboratory by a local consultant so the laboratories wouldn't be aware of the objectives of the project. Laboratory accuracy was based on ALP consensus statistics and precision assessed over the three submissions. Names of laboratories are not disclosure to follow university policy; laboratories are referred as #1 to #8 for discussion purposes.

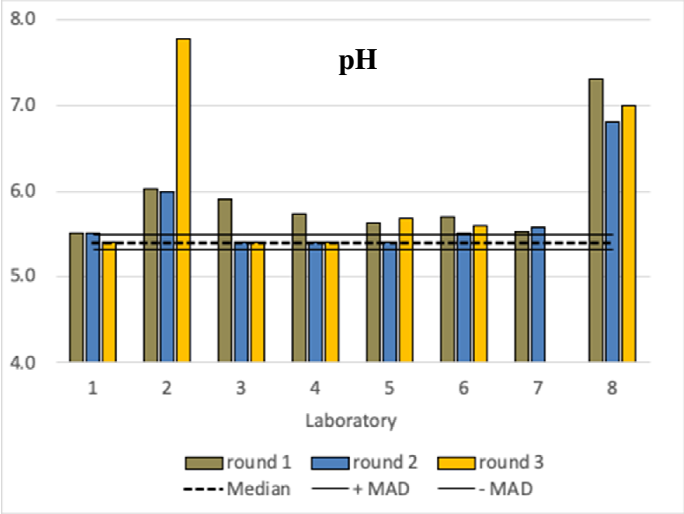

Figure 1. Soil saturated paste pH analysis performed by eight commercial laboratories, soil C (SRS-1604).

Results for soil saturated paste pH for soil C is shown in Figure 1. Listed is the pH median and the Median Absolute Deviation, with results for each lab for each round. Labs #1, and #5 - #7 generally were accurate for pH over the three rounds. Labs #2 and #8 had high bias and lab #2 was inconsistent. Result for Olsen extractable phosphorus (P) for soil A is shown in Figure 2. Labs #2 - #7 accurately measured 10 ppm P, whereas lab #1 and #8 had high bias P and inconsistent over rounds. Lab #8 results were 2-3 times higher than the median.

Results for exchangeable potassium analysis by ammonium acetate for soil C indicated greater inconsistency across the eight labs, with two labs with low bias. Generally labs #1, #4, #6 and #7 consistently reported results near the median. Labs #3, #5 and #8 were inconsistent across rounds , with lab #5 highly inconsistent. Labs #1, #4 and #7 were the most consistent across rounds.

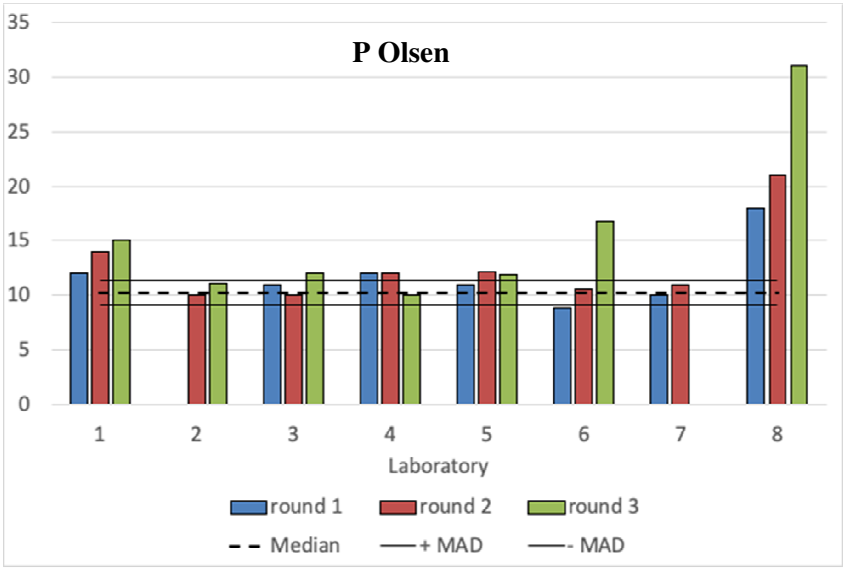

Figure 2. Phosphorus analysis performed by eight commercial laboratories with the Olsen extract for soil A (SRS-1809).

Results for Zn extractable by DTPA for soil A is shown in Figure 4 and illustrates the frequent occurrence of inaccuracy and imprecision observed across all reference soils used in this study.

There was a generally trend of all eight labs reporting high Zn values relative to the median for this standard reference soil of 0.9 ppm. Labs #1, #4, #5 and #7 generally reported equivalent Zn concentrations for each round. Labs #2, #6 and #8 were inconsistent across each of the three rounds. In particular lab #6 reported values varied by 300% across the three rounds.

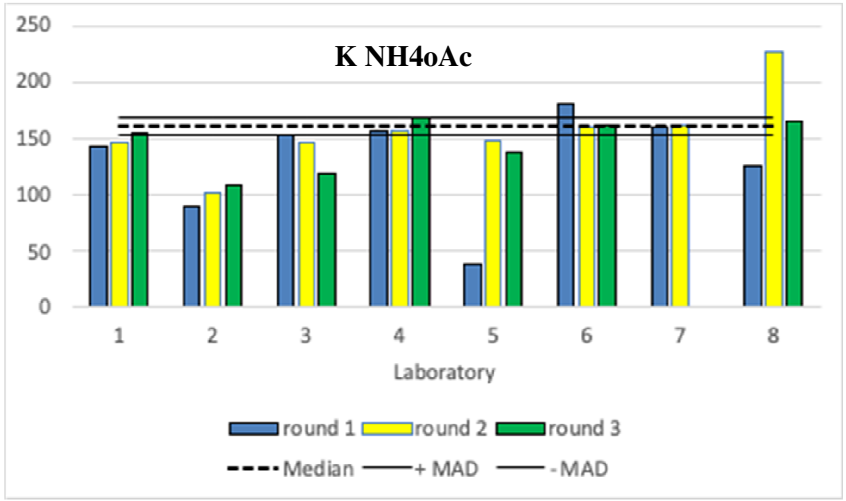

Figure 3. Exchangeable potassium analysis by ammonium acetate extract performed by eight commercial laboratories soil C (SRS-1604).

Conclusions

Although all labs presented certain inaccuracy and imprecision, some stood out. Laboratories #2 and #8 were consistently inaccurate and imprecise regardless of the analysis type and reference soil; Laboratories #1, #4 and #7 were the most accurate and precise; laboratories #3, #5 and #6 presented fluctuating accuracy and precision. Overall, the main challenge of the lab testing industry is consistency.

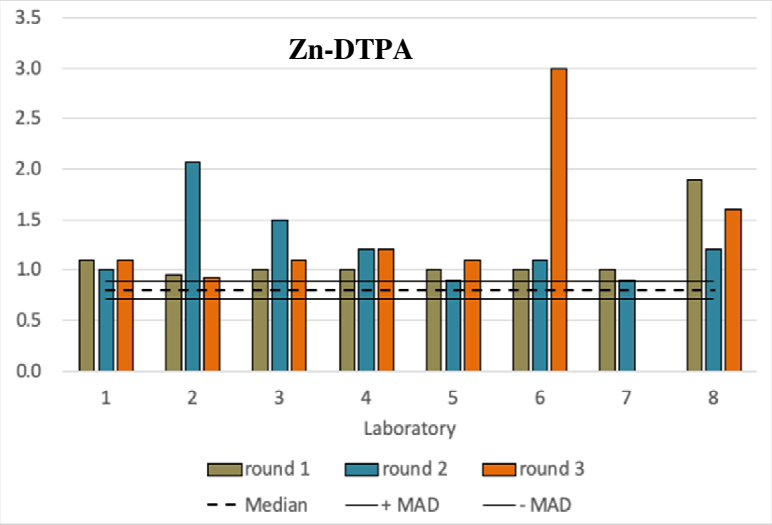

Figure 4. Zinc analysis by the DTPA method performed by eight commercial laboratories for soil A (SRS-1809).

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Calendar of Events for 2020 - 2021

July 27, 2020. Agriculture Laboratory Testing Association ALTA, St. Louis, MO, USA.

July 28-30, 2020. InfoAg 2020, St. Louis, MO, USA.

November 8-11, 2020. ASA-CSSA-*SSSA* International Annual Meeting, Phoenix, AZ, USA.

January 27-28, 2021. Precision Agriculture Conference & Ag Technology, London, ON, Canada.

January 26-29, 2021. US Compost Council Ontario Convention Center, Ontario, CA, USA.

February 2021. North Central Laboratory Workshop Iowa, City, IA.

March 4-5, 2021. Western Nutrient Management Workshop, Reno, NV.

June 2021. Joint Meeting of Soil Regional Workgroups, SERA-6 NEC-67 and NCERA-13. Clemson, SC, USA. *(rescheduled from 2020)*

June 2021, Canadian Society of Soil Science Annual Meeting. Charlottetown, PE, Canada. *(rescheduled from 2020)*

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