MAGRUDER NEWSLETTER

Winter 2021 Edition

CONTENTS:

CHAIRMAN NOTES

The year 2020 has been an exceptionally challenging year for many professional and personal reasons with the emergence of COVID-19. Maintaining quality service in the Magruder fertilizer check sample program was no exception. The last time the Magruder committee met in person was in New Orleans in February right before COVID and pandemic became commonplace in our vernacular. Many of us were enjoying evening activities with the crowds on Bourbon street before the advent of the restrictions and guidance for us all to maintain social distancing. Our next usual in-person meeting in August was converted to a virtual meeting. Back in April, I thought for sure all would be cleared by the 2021 February meeting for us to meet in person. How naïve that thought was. That meeting will be virtual, and we all hope to soon get back to some normalcy with vaccines that have been developed.

A saying that I am reminded of often is “the only constant is change”. Changes have occurred in the program this past year. One of the changes is reestablishing a newsletter. The last newsletter was in May 2015. This newsletter is viewed as an important tool for communication and education. There are many changes that occur with time and much data in the program that can be presented and explained in this forum. The plan is to prepare a newsletter twice a year with a winter and summer edition.

This newsletter presents information on other changes that have occurred in 2020. Challenges have occurred with shipping samples due to international shipping restrictions and lab closures. The Magruder committee has experienced change with the election of a new chair, vice-chair, and members. Technical information is presented on the investigational allowances (IAs) in the American Association of Plant Food Control Officials (AAPCO) official publication and IA ratios presented in the Magruder reports.

The goal of the newsletter is to inform and enlighten on matters concerning laboratory analysis of fertilizer. We hope this goal is met for all in your lab.

- *Frank Sikora*

INVESTIGATIONAL ALLOWANCE DEFINED

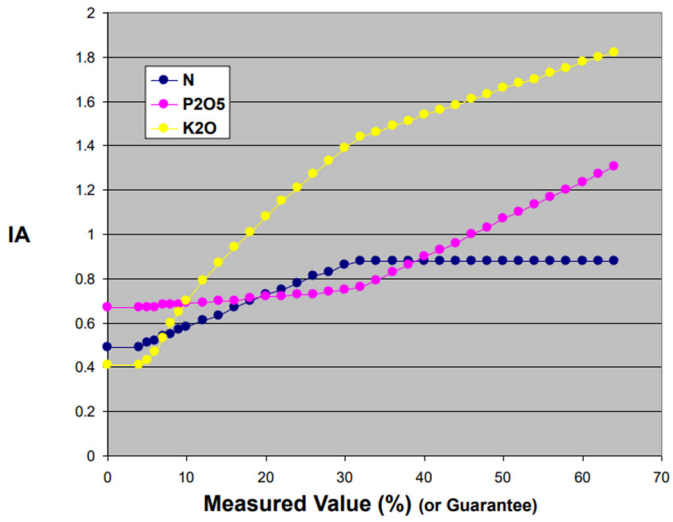
Some common questions we get asked are what is an "IA" or Investigational Allowance and is an IA the same as a tolerance? For this article, I will mainly focus on what is an IA. From the AAPFCO Official Publication, the IA is interpreted as "A commercial fertilizer shall be deemed deficient if the analysis of any nutrient is below the guarantee by an amount exceeding..." the IA. At this point, regulatory action may be taken.

All analytical measures have some degree of error or measurement uncertainty. The three main components of the fertilizer Investigational Allowances are: 1) sampling/sample variance, 2) intra or within-lab variance, also referred to as repeatability and 3) inter or among-lab variance, also referred to as reproducibility. Collecting and reducing a field sample to much smaller laboratory test portions has its own set of error sources. Since one field sample is generally collected, sampling errors can be harder to quantify; however, a couple points are important. First, the IA is not intended to compensate for fertilizer products that are not sufficiently blended and/or do not blend well. Second, an estimate of sample variance can be relatively easily identified by taking multiple subsamples of the main field sample and removing the analytical error. With similar fertilizer particle sizes, adequate blending, good techniques and consistency, sampling and sample variation should be one of the smaller contributing factors to the IA.

Repeatability or intra-lab variation relates to differences associated with determining test results on different days over a short period of time. Different calibrations, different laboratory environmental conditions (such as temperature and humidity), instrument variability, etc. can all contribute to slight differences between separate measurements taken at different times by the same lab. The differences between your two separate reported results is an indication of repeatability or intra-lab variation.

Finally, the largest contributor to the IA is generally inter-lab variation or reproducibility. Different labs use different analytical methods (e.g. gravimetric, spectrophotometric, ICP), different instruments, different chemists, different environments, etc. so this contributes to differences in test results reported among different labs for the same sample. The goal of the IA is to combine these three primary error sources for an estimate of pooled measurement uncertainty. Historically, AAPFCO has suggested 2.33 times the pooled analytical standard deviation as the basis for producing the IA value. If a laboratory produces a test result that is less or greater than the guaranteed value by more than the IA, there is a 98% probability that the fertilizer product has a value different from its guaranteed value and regulatory action can be taken.

We would not expect two labs to produce identical test results; however, it is the goal of different labs to produce results that fall within the investigational allowance. It is important to note that IA's are not the same for all nutrients and/or concentrations given the differences among test methods, sensitivities, optimal method performance ranges and relative standard deviations. It is also important to note that IA's can and will change over time as analytical techniques evolve and new test methods and new fertilizer products are introduced. This is a simplified explanation of the IA and a much more detailed explanation is available at: JAOACI Vol 49, No. 5, 1966 pp. 915-943. The AAPFCO IA should not be interpreted as a tolerance, which will be discussed in a future issue of the Magruder Newsletter.



- *James Bartos*

IA RATIOS

Proficiency testing programs have value for laboratories to assess how their result compare with results from other laboratories. The common measure for this comparison which we use in the Magruder program is a z-score. This value is a parameter where a lab result is normalized to the standard deviation of all laboratory results. A z-score between -1 and +1 indicates the lab result is in between the robust mean plus and minus 1 standard deviation. A z-score between -2 and +2 indicates the lab result is in between the robust mean plus and minus 2 standard deviations. The larger the absolute value of the z-score, the greater the lab result is from the robust mean. Z-scores between -2 and +2 are colored green indicating lab result is okay compared to all other results. A z-score less than -2 or greater than +2 are colored orange providing a warning to lab on the deviation of the lab result from the robust mean. A z-score less than -3 or greater than +3 are colored red indicating action is required to determine why the lab result was so far from the robust mean.

The z-score is useful to evaluate a lab result with respect to the dispersion of all lab results. What if the dispersion of all lab results is very high? A z-score may provide an indication that a lab result was okay being within a widely dispersed set of lab results. However, it does not provide a measure of the magnitude of the dispersion itself which is an indicator of how well all the labs can analyze a particular analyte. A measure of the dispersion of all results would be a useful indicator on the lab community's performance as a whole.

A standard dispersion of laboratory results can be taken as the investigational allowance (IA) discussed in the previous article. Since an investigational allowance is an accepted deviation of a laboratory result from a guarantee, this allowance was introduced in the Magruder reports for comparison to the dispersion of laboratory results. Based on the IA, a standard deviation around the robust mean (IA_{SD}) can be calculated as IA/2.33. The IA ratio is the standard deviation of a laboratory data set divided by IA_{SD}.

IA Ratio = standard deviation of data set / IA_{SD}

If the IA ratio is less than 1, the dispersion of the laboratory results is acceptably less than dispersion defined by the IA. If the IA ratio is significantly greater than 1, then the dispersion is greater than dispersion defined by the IA. The IA ratio provides a measure to assess which analytes, methods, and samples have sets of data that are less than or exceed the standard dispersion defined by the IA. IA ratios are presented on both Analyte and Method Summary reports for nutrients with IAs.

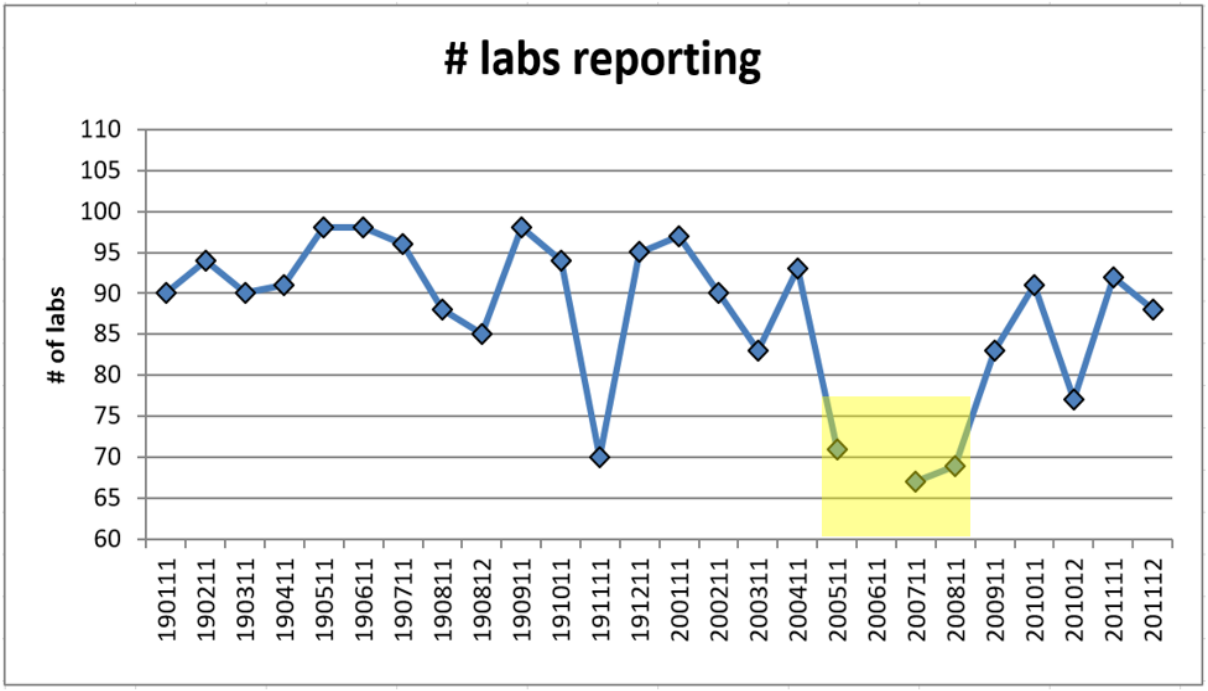
A presentation prepared by our statistician, Andy Crawford, on this subject is available at: http://www.magruderchecksample.org/presentations/2018W_NewIAMetrics.pdf. Another measurement that utilizes IA on the Method Report Cards for individual labs is Method IA Status. A future issue will discuss the meaning of this parameter.

- *Frank Sikora*

EFFECTS OF COVID-19 ON SAMPLE SHIPMENTS

The pandemic of 2020 caused some interruption of services in the Magruder program. Laboratory closures and shipping restrictions resulted in a decision not to send a June sample (sample 200611). Samples were sent out after that but there were several shipments to international labs that were postponed due to shipping restrictions. By the end of the year, international shipping restrictions had been lifted. The samples scheduled in 2020 were adjusted with double shipments in both October and November to make up for no shipment occurring in June.

The graph below shows the number of labs reporting values from samples 190111 to 201112. The effect of COVID-19 on labs reporting data is apparent for samples 200511, 200711, and 200811 shown in yellow. It appears the effect of COVID-19 has dissipated with approximately 90 labs reporting for the latest samples 201111 and 201112.



- *Frank Sikora and Robert Kieffer*

COMMITTEE CHANGES

The Magruder program is overseen by a committee of 20 individuals from regulatory and industry laboratories in the United States and Canada. Significant changes occurred on the committee at the summer 2020 meeting. Bill Hall, who has provided excellent leadership as chairman for many years, has retired from that position. Bill will remain as a member on the committee. It is with deep gratitude from industry and regulatory labs that we recognize his many years of dedicated service as chair of the committee.

Three other retirements from the committee include Tim Fau from Nutrien, Sanford Siegel from Anuvia Nutrients, and Teresa Grant from the North Carolina Department of Agriculture. Their years of service on the committee are also greatly appreciated.

Frank Sikora, who served on the committee as vice-chair from the University of Kentucky Division of Regulatory Services, succeeds Bill Hall as chairman. Job Fugice from the International Fertilizer Development Center (IFDC) was also selected to begin serving on the committee as vice-chair. Two other members selected to serve on the committee are Maryam Khosravifard from the California Department of Food and Agriculture and David Collier from Nutrien.

- *Frank Sikora*

UPCOMING MEETINGS:

2021 AAPFCO Winter Annual Meeting (Virtual) February 15-17, 2021
2021 Methods Forum (Virtual) February 17-19, 2021
Online registration available from:
AAPFCO 2021 Virtual Winter Meeting and Methods Forum FASS, Inc.

2021 AAPFCO Summer Annual Meeting (Omaha, NE) More information to come

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MAGRUDER COMMITTEE ROSTER

Name	Organization
Frank Sikora, Chairman	University of Kentucky, Division of Regulatory Services, Lexington, KY
Job Fugice, Vice Chair	IFDC, Muscle Shoals, AL
Patricia Lucas, Secretary	Florida Department of Agriculture and Consumer Services, Tallahassee, FL
Jamey Johnson, Treasurer	Arkansas State Plant Board, Little Rock, AR
Andy Crawford, Statistician	Crawford Science Consulting, Hacienda Heights, CA
Robert Kieffer, Sample Preparation	Able Laboratory, Inc., Pikeville, TN
Sally Flowers, Newsletter Editor	Kansas Department of Agriculture, Manhattan, KS
Ametra Berry	Georgia Department of Agriculture, Atlanta, GA
Bill Hall	N-P-K Consulting, LLC
David Collier	Nutrien, Aurora, NC
Deion Tsourides	Spectro Analytical Instruments, NJ
Hugh Rodrigues	Thornton Laboratories, Tampa, FL
James Bartos	Office of Indiana State Chemist, West Lafayette, IN
Lawrence Mayhew	Humic Products Trade Organization, WI
Lise-Anne Prescott	Canadian Food Inspection Agency
Maryam Khosravifard	California Department of Food and Agriculture
Michael Hojjatie	Tessenderlo Kerley, Tucson, AZ
Nadia Guagliardo	CF Industries, Inc., Donaldsonville, LA
Scott Roalofs	Colorado Department of Agriculture, Broomfield, CO
Sharon Webb	University of Kentucky, Division of Regulatory Services, Lexington, KY

Thanks to Allyssa Davis, Kansas Department of Agriculture Laboratory, for creative input in this newsletter.

Association of American Plant Food Control Officials
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