2015 Annual Tri-Societies Meeting- Minneapolis, Minnesota

- A Small Overview of a Big Meeting

The 2015 Annual Meeting for the American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA) was held this year together with the Annual Meeting for the Entomological Society of America. The event was held in Minneapolis, Minnesota from the 15th-18th of November and was attended by more than 7,000 scientists, professionals, students, and educators.

I represented Azotic Technologies at the meeting on Monday through Wednesday. The meeting was packed full of information in the form of presentations, posters, and discussion panels on varying topics. These included:

- irrigation and fertilizer N management in residential lawns in Texas
- increasing fertilizer efficiency in China, to nitrogen fertilizer equivalency in crops amended with manure in Kentucky
- unexpected plant defense responses to caterpillar frass
- use of Unmanned Aerial Vehicles (UAV) or "drones" to enable early detection of crop deficiencies.

Over the course of three days, I attended more than thirty talks and read as many posters as I could take-in and other than a presentation of research done in collaboration with Azotic on the impact of using N-Fix on the establishment of a cool-season amenity turf grass field, I did not come across any research having to do with nitrogen fixation in non-legume plants. There were many talks on:

- utilizing legume cover crops in rotation with non-legume cash crops to replace some nitrogen fertilizer needs
- how to most accurately determine nitrogen fertilizer needs to determine the amount, form, and time to apply N,
- utilizing new monitoring technologies and precision agriculture to detect nutrient deficiencies and fertilize according to crop needs across a large field
- how to increase nitrogen use efficiency (NUE) and improved fertilizer management to benefit the environment

While there were no presentations that directly related to biological N fixation in non-legume crops, there were many that detailed research on topics that could apply to N-Fix® directly in the description of a new crop or research area generating a yield or sustainability benefit and indirectly by describing a diagnostic tool farmers may be able to utilize to better manage crops grown with N-Fix®.

Travis Luc Goron from the University of Guelph in Ontario, Canada presented research on using a genetically engineered strain of *Escherichia coli* known as *GlnLux* that emits light in the presence of exogenous glutamine as a biosensor in order to determine the nitrogen needs of a maize plant during the growing season (Goron, 2015). Goron and his colleagues determined that *GlnLnx* output correlated well with the level of applied nitrogen in glasshouse and field studies and that *GlnLnx* performed as well as or better than other commercially available tests. *GlnLnx* could be a useful diagnostic test for growers to use as a guide for a side dress N rate in maize and could eventually be a useful tool for growers using N-Fix® in maize to determine how much nitrogen is in the crop during the growing season.

I attended two talks that described diagnosing N deficiencies in the field using Unmanned Aerial Vehicles (UAV) or “drones”. This research was presented by Dimitris Zermas from the University of Minnesota and Hengbiao Zheng at Nanjing Agricultural University. Zheng and his colleagues studied the use of an octocopter with a 6-Band Multispectral camera to monitor rice nitrogen status under different growing conditions in Jiangsu, China (Zheng, 2015). A field trial was set up with two rice cultivars under two planting densities and four N rates. Five flights with the octocopter were carried out over the course of the growing season along with field measurements. The data collected by the Multispectral camera on the octocopter demonstrated that:

- it is a useful and accurate tool for determining nitrogen needs on small-scale level in an agricultural setting.
- it lays the groundwork for the use of UAVs in precision agriculture in order to improve nitrogen efficiency in rice production.

Zermas and his colleagues took the approach of “fly low and pay attention to details” and they analyzed each high resolution image captured for stress by looking at leaf color and shape. They determined that utilizing their methods, they were more accurate at detecting N stress at the R1 stage than a SPAD meter and that there was a significant correlation between the aerial density of N deficient leaves detected and amount of N fertilizer applied. Utilizing UAV’s to detect deficiencies in the field on a small-scale level is an exciting field that is developing quickly. These detection methods, along with precision fertilizer application capabilities should increase fertilizer efficiency. These types of tool could also be helpful for growers making management decisions when utilizing N-Fix® in commercial crop production.

There were a number of talks given by scientists on increasing the efficiency of fertilizer inputs in Chinese agriculture. Ping He from International Plant Nutrition Institute (IPNI) China Program in Beijing, China, presented a nutrient recommendation tool 'Nutrient Expert' that can be utilized by growers to better estimate their fertilizer needs (He, 2015). While the total fertilizer consumption of China is one third of the total world fertilizer consumption, the average fertilizer rate is 3x the world average and fertilizer efficiency is quite low. This is due in part to the fact that there are many small-holder growers with little access to timely and affordable soil testing and nutrient recommendations. Nutrient Expert was used to determine crop nutrient needs for 290 wheat and 544 maize fields from 2010 to 2014 and compared yield and nitrogen use efficiency in systems that utilized the tool and those that followed grower standard practices. Results indicated that utilizing Nutrient Expert can improve grain yield and nitrogen use efficiency and reduce greenhouse gas emissions through improved nutrient management practices compared to using grower standard practices.

Jianbin Zhou from Northwest A&F University in Xianyang, China and his colleagues studied the utilization of manure with fertilizer applications in order to increase NUE and decrease the loss of applied fertilizer in crop production (Zhou, 2015). In his presentation, Zhou said that China produces food for 21% of the world’s population on only 9% of its arable land. On addition, it has an objective for 0 growth rate of chemical fertilizer consumption by 2020. Zhou and colleagues compared the impact of utilizing manure in combination with and without chemical fertilizer to only chemical fertilizer compared to a wheat-fallow and wheat-maize rotation. They found that utilizing manure along with chemical fertilizer inputs increased fertilizer uptake and yield and decreased fertilizer loss compared to not fertilizing and using chemical fertilizer alone, possibly because utilizing manure in the system increased buffering capacity, coupled the carbon and nitrogen cycles, and improved synchrony between the N supply and crop demand.

It is clear that improving fertilizer efficiency, especially nitrogen efficiency, is an important and timely issue in China. Also important is supplying farmers with access to tools to acquire accurate nutrient recommendations and conducting studies to determine how to change common practices to increase fertilizer efficiency, Agricultural advances such as Azotic's N-Fix® technology could be a part of the solution to China's, and the world's, fertilizer efficiency problem.

Biofuel production in the US has fallen a bit out of the spotlight recently with a decrease in US fuel prices but there is still a lot of research being conducted to improve the efficiency and sustainability of biofuel production. A good example of research in this area was presented by Sougata Bardhan (University of Missouri in Columbia, Missouri). The US Department of Energy has mandated that 5% of the nation's power and 2% of the nation's transportation power must be produced in a sustainable and profitable way by 2030. However, the lack of a sustainable and continuous supply of biomass hinders progress. Bardhan's team are studying how to grow switchgrass for biofuel on non-agricultural and marginal lands in Missouri (Bardhan, 2015). Their results suggest it is possible to grow switchgrass on land not currently planted to crops or land planted to maize with a shallow soil depth that has a low nutrient utilization efficiency provided nitrogen use efficiency and overall yield of switchgrass can be improved. Using N-Fix® on switchgrass produced in marginal lands for biofuel could help increase yields without increasing fertilizer input needs and nutrient losses (due to shallow soil). This could help make sustainable and profitable biofuel production from switchgrass a much more attainable goal and help reach the 2030 DOE mandate.

The presentations at this year's Annual Meeting of ASA, CSSA, SSSA, and ESA reported interesting advances in research in agronomy, soil science, crop physiology, genetics, entomology, and more. It was energizing to see so many undergraduates and graduates achieving great things in agronomy in their research projects, exciting to hear talks from scientists who have spent entire careers working to solve emerging problems in agriculture, and exhausting to take in all of the information coming just a fraction of the talks, posters, and discussions at the short and busy meeting. Overall, it's an excellent event and I highly recommend attending it next year November 6-9 in Phoenix, Arizona if you're interested in agronomy, crop science, soil science, or a myriad of other topics and pressing issues in US and world agriculture sure to be covered!

Erika Roach, Azotic Technologies Agronomist – 23rd Nov 2015

References

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Zermas, Dimitris (2015, November). *Early Detection of Nitrogen Deficiency in Corn Using High Resolution Remote Sensing and Computer Vision.* PowerPoint presentation at the ASA, CSSA, SSSA Annual Meeting, Minneapolis, MN.

Zheng, Hengbiao (2015, November). *Nitrogen Status Monitoring in Rice Based on Unmanned Aerial Vehicles (UAV)*. PowerPoint presentation at the ASA, CSSA, SSSA Annual Meeting, Minneapolis, MN.

He, Ping (2015, November). *Nutrient Expert, an Environmental Friendly Fertilizer Recommendation Tool, Improves Crop Productivity and Nutrient Efficiency.* PowerPoint presentation at the ASA, CSSA, SSSA Annual Meeting, Minneapolis, MN.

Zhou, Jianbin (2015, November). *Coupling Nitrogen and Carbon Cycles in Soil to Increase N Use Efficiency and Decrease Its Loss.* PowerPoint presentation at the ASA, CSSA, SSSA Annual Meeting, Minneapolis, MN.

Bardhan, Sougata (2015, November). *Nitrogen Dynamics in Corn and Switchgrass Production Influenced By Soils of Varying Depths in Central Missouri.* PowerPoint presentation at the ASA, CSSA, SSSA Annual Meeting, Minneapolis, MN.