"The 4Rs of Nutrient Stewardship"

November 30, 2012

The webcast is archived at:
http://www.extension.org/pages/66384/the-4rs-of-nutrient-stewardship

To what extent is climate change affecting the nutrient situation in Lake Erie?

Tom Bruulsema: It's hard to say what specific impact climate CHANGE has had, but increased frequency and amount of late fall, winter and early spring rains have increased in the past 15 years up to 2011. The increased rain lead to greater flows of water into Lake Erie, and dissolved P concentrations are usually higher when flow is increased. In 2012 there was much less winter and spring rain, and much less algae in summer 2012. A recent special report on extreme weather events, from the Intergovernmental Panel on Climate Change, forecasts increased severity and frequency of winter rains for most of central North America for the next 50 to 100 years.

Greg LaBarge: As we look at water testing data from Heidelberg University, which has significant monitoring in the watershed dating back to the 1970's, we find that much of the total contribution does come in 3-5 rainfall events each year. Like many areas of the country, the Great Lakes region has experienced its share of increases rainfall events greater than 1 inch. Also our average rainfall in the last century has increased 3.38 Inches as well. More water moves more soluble nutrients.

Why no discussion about nitrogen deposition (both wet and dry)? Is it so insignificant from a loading perspective?

Tom Bruulsema: The aquatic specialists tell us that the Lake Erie algal issues are controlled by P, not by N.

Greg LaBarge: The driving nutrient for algae growth in fresh water systems in P. There is some relationship to the species lumped in the harmful algal bloom that relate to water P:N ratio so it is not totally to be ignored. There has been research on the nitrogen in the watershed and the focus comes back to P. Nitrogen is a nutrient in higher concentration in waters going in to Lake Erie so from an economic standpoint we continue the discussion on nitrogen stewardship. If the focus was the Ohio River and ultimately the gulf then N becomes the topic of focus.

Which Water Quality Index you plan to integrate with you sustainability model?

Tom Bruulsema: I'm not sure which water quality index will be part of the Keystone Alliance's fieldprint calculator, but I believe it is being done in dialogue with the USDA-NRCS.

Could no-till be significantly affecting the amount of phosphorus running off since a natural barrier at the soil surface is formed when ground isn't tilled that allows for more runoff?

Tom Bruulsema: In some soils, no-till is effective at increasing infiltration and reducing the volume of runoff. In other soils, runoff can increase. Tillage needs to be specific to the soil and to the crop rotation. In general, no-till is effective at reducing losses of particulate P (the kind lost with sediment) but is not effective at reducing the concentration of dissolved P in runoff water.

Greg LaBarge: We tend to see better infiltration of water in our no-till fields and less surface ponding of water. In fact we often see more preferential flow to the tile and that is where we have a concern. The other concern often brought up in relation to long term no-till is stratification of nutrient at the surface with broadcast application and residue breakdown. As soil test levels go up the potential for loss goes up. That is why the 4Rs of Nutrient Stewardship are so important. We look at rate, source, placement and timing as they work with the system. Reverting back to tillage gives us a greater potential for soil erosion and increased total P loading. With no-till we can adapt row placement or other methods that place nutrient below the soil surface. The 4Rs of Nutrient Stewardship is a system approach versus fertility management which has a focus primarily in rate of application.

Do you consider buffers around a site to contain nutrients on the site?

Greg LaBarge: Buffers are most effective with sedimentation. The only benefit for soluble nutrients is when there is retention time to allow plant up take. That is why we are discussing biofilters at the end of tile in the field edge or two stage ditches which slow water flow.

Tom Bruulsema: Buffers are not particularly effective in reducing concentrations of dissolved P in runoff water.

When you variable rate apply MAP, how do you handle the subsequent N application given that MAP also contains N?

Greg LaBarge: This is a potential loss since our climatic conditions do not give much chance that surface applied N will be available to subsequent crops. So use of cover crops can at least capture nutrients. Some farmers have also moved to strip tillage and nutrient placement. It also may be an opportunity to look a placement and spring applications. So there are options, and as yield increase resulting in higher crop removal rates, this N quantity is greater making farmers take another look at it. It ties right into the 4Rs of Nutrient Stewardship principals.

Why has K not been followed like N and P?

Greg LaBarge: Potassium is not known to cause any harmful effects in water at least in current concentrations. It is very import as we look at crop production and edge of field loss is an economic concern.

Tom Bruulsema: There have not been environmental impacts associated with losses of K. However, it is important to remember that N and P use efficiency are affected by K nutrition of plants, and that losses of nitrate and phosphate can increase when crops are grown under K deficient conditions.

Can you point out any dietary manipulation on swine and poultry diets that could contribute to the reduction on risk of nutrient build up in solid through manure application to cropping soils?

Tom Bruulsema: Use of phytase with lower levels of feed phosphate can reduce considerably the amount and concentration of P in the manure, resulting in a better balance of P inputs and outputs on soils of farms that have a P surplus.

Can you discuss manure vs. commercial fertilizer in nutrient uptake rates?

Greg LaBarge: From a plant standpoint either source provides the nutrient needed. P_2O_5 concentrations in manure are equally effective and available for plant production as those from commercial fertilizer. The nitrogen content in manure is often in an organic form and so the question of when this becomes available is the question that needs to be asked. If the manure contains high levels of NH_4 from urine then this is readily available.

Tom Bruulsema: Most manures have phosphate that is almost equal in availability to fertilizer phosphate. It is harder, however, to apply manure in the "right place" – that is, in rather than on the soil, and in bands near the seedlings.

Are there any concerns about restoring the trace elements in the soils with sustainable approaches?

Greg LaBarge: Micronutrients do need to be available to the crop and is an important factor in 4R Nutrient Stewardship as we look at efficiency of use of all nutrients by the plant. This is a basic principle dating back to Liebig's Law of the minimum. In many cases a tissue testing program to compliment the soil testing program needs to be established. The correlation with soil test for micro nutrients and the amount of nutrient actually available to the crop are not as great as with our macro nutrients.

John Oster: As we analyze our soil test data we are looking, as well, at the micronutrients and working those into our future recommendations. There must be a balance of all nutrients in order to achieve maximum economic yield. We present the recommendation for the grower's approval.

Tom Bruulsema: A 4R approach assesses all nutrients that could be limiting crop yields and crop quality.

If that is 129 lbs P_2O_5 broadcast then sub-surface placement would help reduce runoff of DRP, correct?

Greg LaBarge: Some rainfall studies here in Ohio have shown a 60% decrease in runoff DRP levels with just a light tillage pass after broadcast applications.

John Oster: Correct, and that is why we so strongly encourage the grower to follow our variable-rate application unit with his tillage unit, which he does in almost all cases, thereby moving the P_2O_5 under the surface.

Tom Bruulsema: Sub-surface placement strongly reduces the risk of elevated P in runoff water, no doubt. Incorporation after broadcasting, applying with regard to weather forecasts, and considering the soils relative propensity to generate runoff (that is, the environmental P index) are other practices that can reduce risk of P loss arising from broadcast application of fertilizer P.

In Manitoba we don't have too much tile drainage, how does slowing the flow out of the tiles help? It seems to me that if the water has time to interact with the soil particles, especially if anaerobic would increase DRP in the outflow tile water?

Greg LaBarge: The nature of phosphorus has not changed. It is a negative ion in a positively charged environment there just need to be available sites so contact time should reduce DRP.

John Oster: Here in Ohio, $3 million in research funds have been earmarked to find, analyze and report on the sourcing of DRPs in our waterways. It is very likely that the results of this research could have a very significant impact upon our fertilizer application and tillage practices as to rate, timing, placement and even product source. Obviously, if the phosphate entering the tile system is already in a DRP state, slowing the rate will merely serve to delay the impact until the next major flowage event.

Tom Bruulsema: Several studies have shown that controlled drainage can be effective at reducing P losses while maintaining or increasing crop productivity.

How many years of variable rate application are required to provide a relatively uniform field for P?

Greg LaBarge: We do not necessarily need any nutrient (including pH) even across the field. The goal should be to put all nutrients in the desirable range for the crop we are producing. For our tri-state recommendation, the desirable range is corn/soybean 15-30ppm and for a rotation with wheat/alfalfa 25-40 ppm when we talk about phosphorus. As far moving soil test here is a recent article that maybe be of interest http://corn.osu.edu/newsletters/2012/2012-38/how-much-fertilizer-does-it-take-to-move-soil-test-levels. Contact your local extension or university sources for your location as these may vary with soil types.

John Oster: You must realize that our recommendations are based upon the Tri-State recommendations, which are crop-removal-based. And you must also understand that much of our ground is rented to the grower by the landlord on a year-to-year basis. We are almost always directed to apply only as much N, P, K and micronutrients necessary to grow the projected yield for that seed variety and plant population. That being the case, there is no nutrient buildup in the soil, and therefore, no balancing of the overall nutrient level in the field. And when you think about it, practicing buildup would run contrary to the 4R program, as it would set the stage for significant loss of nutrient were a major weather event to occur.