IPNI
Plant Nutrition TODAY
Better Crops, Better Environment...through Science

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WHEN IS A BIOSOLID THE RIGHT SOURCE?

Assessing all available nutrient sources is a sound principle of nutrient stewardship. Avoiding the waste of whatever is available can save money through efficient recycling, and reduce impacts on the environment.

The U.S. Environmental Protection Agency (EPA) defines biosolids as "treated sewage sludge; nutrient-rich organic materials resulting from the treatment of domestic sewage." The biosolids produced annually in sewage treatment plants across North America contain substantial amounts of N and P; equivalent to about 3% and 8%, respectively, of total N and P removal by crops. Currently, just over half of the biosolids produced are applied to farmland. The area receiving these materials each year amounts to less than 1% of the total cropland.

When biosolids are applied to meet crop N needs, the P supplied usually exceeds the needs of the current crop by two or three times, but is available to succeeding crops. Thus most biosolids are applied only once in five or more years, rather than on an annual basis, and they are best suited to soils testing low in P; soils that benefit from the buildup of available P.

Across North America, the N contained in biosolids amounts to about one-fifth of the total N supply in the human diet, but the amount of P they contain is roughly the same as total dietary P supply. Thus one can conclude that the current methods of processing sewage recapture P efficiently, but lose a very considerable amount of N.

One difficulty with biosolids as a nutrient source is handling the volume, since it is a low-nutrient source. Some processes have succeeded in extracting the nutrients in more concentrated form. In particular, struvite extracted from sewage sludge is a much more easily managed slow-release form of P, suitable for band placement near seedlings. Research continues to seek lower cost extraction methods.

In biosolids, the proportion of N in the available form (mostly ammonium) varies. It can be as much as 35% in anaerobically fermented materials, but is typically 2% or less in aerobic or dewatered materials, particularly those stabilized with lime. The less-available organic form of N continues to mineralize slowly for years after application. For this reason, fall nitrate levels in soils that have received biosolids can be high, and can become a potential source of nitrate leaching. Cover crops can use this N.

The availability of biosolids P to plants will vary among materials, depending on the treatment process. If Fe, Al or Ca has been added, P availability can be lower.

Biosolids generally contain very little K. The K is usually discharged in the effluent from the sewage treatment plant. Biosolids can contain substantial amounts of secondary and micronutrients, particularly Zn. Research has shown higher concentrations of Zn in crop products harvested from biosolids-treated land. When biosolids have been stabilized with lime, the effects of application on soil pH need to be taken into account. As soil pH rises, deficiencies of some micronutrients, particularly manganese, can become more frequent.

Decades ago, there was much more concern with heavy metals in biosolids than there is today. The reason is that industrial discharges containing such materials have been diverted from sewage treatment systems. Biosolids materials in most areas are still regulated, requiring a certificate of approval. Responsible use requires attention to food safety risks including pathogens, pharmaceutical residues, endocrine disruptors, and heavy metals.

While biosolids supply only a small portion of the nutrients required by crops in North America, their utilization for crop nutrition in appropriate situations contributes to improvements in nutrient use efficiency.

– TWB –

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Abbreviations: N = nitrogen; P = phosphorus; K = potassium; Ca = calcium; Al = aluminum; Fe = iron; Zn = zinc.

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PROTEIN QUALITY ENHANCEMENT WITH SULFUR FERTILIZATION

Sulfur is a macronutrient that requires more attention. It is required by all crops and is the fourth number on a fertilizer legal analysis. For example, granular ammonium sulfate has a legal analysis of 21-0-0-24, the 24 indicating 24% total S. Crops use a considerable amount of S and this is why it is called a macronutrient. Small grain cereals do well with a tissue concentration of about 0.2% S, while an oilseed crop such as canola needs a tissue concentration of 0.5% S. A 50 bu/A wheat crop or canola crop takes up about 11 and 27 lb S/A respectively, with about 6 and 16 lb S/A removed respectively with the harvested grain.

Several factors are behind the increased need for S fertilization. In many soils the main source of S is its mineralization from soil organic matter. As most Northern Great Plains (NGP) soils have seen 100 to 150 years of grain crop harvests, crop removal has gradually removed S, leaving less S in soil organic matter. Monoammonium phosphate (MAP)—one of the first fertilizers used by farmers in the NGP—has seen a change from its original analysis of 11-48-0 as a result of evolving fertilizer production methods. The analysis of MAP is now commonly 11-52-0 and the S content has fallen from about 5% to less than 1%. Also, considerable S deposition on land as “acid rain” from SO_2 air pollution, primarily from the burning of fossil fuels, has been mitigated and aerial deposition of S per area of farmland is now much less than crop removal. The use of supplemental S fertilization is beneficial in many areas to improve crop growth.

There can be both yield and crop quality benefits to using S fertilizers. Sulfur is a vital component of some proteins needed for plant, animal and human growth. These vital proteins are formed using S containing amino acids such as cysteine, cystine and methionine. If a plant lacks S, the production of necessary proteins will be restricted and growth and yield potential will be reduced. If S availability is only moderately low, there may not be a noticeable reduction in yield, but protein quality will suffer. A good example is in high protein spring wheat grown for use in bread production. A portion of a wheat field only moderately low in plant available S may yield as well as the portion of the field where supplemental S fertilizer is applied. However, the bread making quality of the flour from wheat receiving S fertilizer is much superior. This principle of enhanced protein quality also applies to feed grains and forages fertilized with S and fed to livestock.

It is important to assess the S status of your soils and crops. In many areas of the NGP it is beneficial to determine whether or not addition of S containing fertilizers will be beneficial. It is useful to test for S availability when doing routine soil sampling and analysis, and also take plant samples to analyze for and assess the S status of crops. If either the soil test or plant analysis results show low to marginal levels of S, there could be significant benefits to adding S in a blend with the regular N, P and K fertilizers applied. Having an adequate supply of S for a crop helps the crop make good use of all other plant nutrients available for growth. Including S as part of balanced nutrient management is a good investment.

Post planting S applications can help rescue an S deficient crop. If a severe S deficiency is diagnosed early enough in the growth cycle of a crop, it is possible to top-dress the crop with S fertilizer and correct the S deficiency. It is advised to apply a sulfate containing fertilizer, such as granular ammonium sulfate, or liquid ammonium thiosulfate while deficient crops are in the vegetative stage prior to stem elongation and flowering.

– TLJ –

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Abbreviations: N = nitrogen; P = phosphorus; K = potassium; S = sulfur; SO_2 = sulfur dioxide.

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THE FACTS ABOUT PHOSPHATE ROCK… ARE WE RUNNING OUT?

Most of the phosphate rock that is mined from the earth goes towards making fertilizer for crop production. Every cell in plants and animals requires P to sustain itself and there is no substitute for it in nature.

During the past five years, there were several well-publicized reports suggesting the world phosphate rock supply was rapidly dwindling. In response, there was widespread concern about whether we were reaching our “peak” supply of phosphate rock and if fertilizer shortages are on the horizon.

Recently updated estimates report that the earth has at least 300 years of known phosphate rock reserves (recoverable with current technology) and 1400 years of phosphate rock resources (phosphate rock that may be recovered at some time in the future). These numbers fluctuate somewhat since companies do not intensively explore resources that will only be mined far in the future.

Phosphate fertilizer can be a significant cost for crop production and an important mineral for animals. However from a global perspective, phosphate is considered as a low-price commodity. One recent publication estimated that each person consumes an equivalent of 67 lb phosphate rock each year. This results in an annual consumption of about 9 lb P per person (or 0.4 oz. daily consumption), which is equivalent to 1.7 cents per day.

Phosphorus atoms do not disappear in a chemical sense, but they can be diluted in soil or water to the point where it is not economical to recover. Annual P losses to the sea by erosion and river discharge roughly balance the quantity of P that is mined. This shows that there is substantial room for improvement in efficiency. Implementing appropriate recovery and recycling of P from animal manure, crop residue, food waste, and human excreta would make a major step in this direction.

Efforts to improve P efficiency and build soil P concentrations to appropriate levels, serve to enhance its use. In developed countries with a history of adequate P fertilization, the need for high application rates diminishes over time. This contrasts with the situation in many developing countries where low soil P concentrations still require significant fertilizer inputs to overcome crop deficiencies.

Members of the public are encouraged to engage in debate over important issues, but there is a danger that oversimplification leads to incorrect conclusions. The case of looming P scarcity is an example where insufficient information led to a wrong conclusion. Somehow the incorrect notion still persists that there is an impending shortage of P and that limited fertilizer availability will soon lead to global food insecurity.

There may be a scarcity of many earth minerals some day, but the P supply will not be a concern for hundreds of years. However responsible stewardship of rock phosphate resources still requires a close examination of improving efficiency throughout the entire process, including mining, fertilizing crops, and implementing strategic waste recovery. Working together to improve P management will allow us to conserve this precious resource for future generations.

– RLM –

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Abbreviations: P = phosphorus.

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RESOURCES FOR ON-FARM RESEARCH

The 4Rs – right source, rate, time and place – set "right" as a target. Getting it "right" requires a solid scientific basis followed by local refinement. The approach many top producers and advisers follow is to start with university nutrient recommendations and then adjust them to local conditions with on-farm research. "Adaptive management" is currently being used to describe such a process.

Getting a start on this process, or improving your existing one, requires knowing where to look for guidance and tools.

Many on-farm networks have developed over the years and they serve as valuable resources for sampling protocols, experimental designs, and guidance on data handling:

Iowa Soybean Association On-Farm Network®
(http://www.isafarmnet.com)

Nebraska On-Farm Research Network
(http://cropwatch.unl.edu/web/farmresearch/home)

Penn State On-Farm Research
(http://extension.psu.edu/on-farm)

Purdue Collaborative On-Farm Research
(http://www.agry.purdue.edu/ext/ofr/)

Sustainable Agriculture Research and Education Program
(http://www.sare.org)

Kansas Ag Research and Technology Association
(http://www.kartaonline.org)

Ohio On-Farm Research
(http://agcrops.osu.edu/on-farm-research)

Practical Farmers of Iowa Cooperator's Program
(http://practicalfarmers.org)

Solutions to Environmental and Economic Problems II
On-Farm Testing Project
(http://pnwsteep.wsu.edu/onfarmtesting/)

Statistically analyzing data is daunting for many and most farmers and advisers defer that task to a university, association, or government agency scientist; however there are a few resources that make analyses easy enough to do on your own.

A free online tool for statistically analyzing an experiment conducted in one year and in one location is AGSTATS02, which was developed by a consortium of scientists from Washington State University, University of Idaho, and Oregon State University (http://pnwsteep.wsu.edu/agstatsweb/).

The Crop Nutrient Response Tool, an Excel spreadsheet developed by Dr. Tom Bruulsema from IPNI, fits a number of models through data generated from nutrient rate studies. The tool automatically determines the most economic rate of fertilizer (http://nane.ipni.net/article/NANE-3068).

Cleaning up yield monitor data is a necessary first step to ensuring accurate conclusions from statistical analyses. Yield Editor 2.0 is a free tool developed by the USDA-ARS that applies a number of filters to yield data, getting rid of the "garbage in" that leads to "garbage out" in an analysis (http://www.ars.usda.gov/services/software/download.htm?softwareid=370).

There are many resources available now that help move nutrient management away from "average" toward "right." Check out a few and begin building your own set of 4Rs.

–TSM –

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THE INFOAG CONFERENCE – CONNECTING 4R NUTRIENT STEWARDSHIP AND PRECISION AGRICULTURE

In the wake of the largest InfoAg Conference ever, it is a good time to emphasize the importance of this event and precision agriculture to the fertilizer industry. Since 1995, IPNI has partnered with PAQ Interactive and CropLife Media Group to put together a biennial gathering of manufacturers, retailers, researchers (industry and university), advisers and consultants, producers, and policy makers within the precision ag industry. The conference has become the premier event to discuss and view applied precision agriculture technology. The question that gets asked is "Why does IPNI, a fertilizer industry-supported organization, invest so much time and so many resources into a conference focused largely on technology and information management?" The answer relates to IPNI's organizational mission.

The mission of IPNI is 'To develop and promote scientific information about the responsible management of plant nutrition for the benefit of the human family.' Responsible management refers to following 4R Nutrient Stewardship, which is applying the right nutrient source at the right rate, at the right time, and in the right place. The management decisions are made within the context of the cropping system and will work toward meeting economic, environmental, and social goals of a sustainable agricultural system. The 4Rs are interconnected and must be considered holistically as any change made to one factor affects, and is affected by, the other three. The complexity of this puzzle is best solved using the tools, technologies, and information management strategies that are found in precision agriculture.

In addition to the jigsaw puzzle that is the 4Rs, InfoAg also helps solve another type of puzzle— connecting the dots; and in this case, the 'dots' are people. InfoAg was started as a way to bring together vendors and practitioners of precision ag technologies. Building and fostering these relationships remains one of the greatest attributes of the conference today. Social media is one of our most valuable communication tools for sharing information, but following each other on Twitter doesn't result in the depth or quality of the relationships that face-to-face time at InfoAg can accomplish.

The goal of a connect-the-dots puzzle is to create a picture. InfoAg creates a picture of partnerships. Connecting the right people at the InfoAg conference creates the partnerships that are necessary to overcome the obstacles production agriculture will face in the coming decades. Producing the food, feed, fiber, and fuel needed to sustain a population projected to surpass 9 billion people by 2050, is not a task that science, technology, or policy can accomplish alone. This massive challenge will only be met by creating partnerships that combine the accuracy of science, the precision of technology, and the support of policy.

In a response to the challenges ahead and feedback from participants, InfoAg will leave its traditional biennial format and become an annual event beginning in the summer of 2014. The next InfoAg will be held July 29 – July 31 at the Union Station Hilton in downtown St. Louis, MO. Stay informed by visiting www.infoag.org and following @InfoAg.

– SBP –

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FALL NITROGEN APPLICATION – IS IT RIGHT FOR YOUR SPRING-PLANTED CROPS?

Recent USDA Economic Research Service (ERS) data indicate that farmers are achieving higher corn yields, which is resulting in higher N recovery and greater crop harvest nutrient removal than in the past. Data from 2010 by the ERS showed that 25% of corn fields (range from 11 to 49%) in surveyed northcentral states received some amount of fall N. In states where university research and recommendations supported some or all of the N for corn in the fall from specified fertilizer sources, farmers and agricultural retailers have increasingly waited to fall-apply until soil temperatures at the 4- to 6-in. depth were consistently below 50^{o} F. That fall application timing helps reduce the risks of nitrification (microbial conversion of ammonium to nitrate) and lowers the risks of nitrate leaching losses from the root zone and soil profile before active crop uptake in the spring.

The unparalleled, back-to-back, record-breaking drought of 2012 … and record-breaking spring rains in much of the upper Midwest in 2013 … have made many re-think their N crop nutrition strategies. Crop advisers and knowledgeable farmers are striving to better synchronize the soil supply of N with dynamic corn uptake demand. That synchrony leads to improved crop yields, higher farmer profits, and increased crop and soil recovery of the applied N.

Agricultural retailers, seed companies, leading farmers, some farmer organizations, crop advisers—as well as university and government scientists—are conducting more in-field and on-farm N experiments and demonstrations. Changes in crop N source, rate, time, and place of application—more consistent with 4R Nutrient Stewardship—are being evaluated to learn what may work best for different rotations, soils, climate, and individual farmer's management abilities. The agricultural community is also trying to learn what also works within the confines of the existing N supply, storage, and delivery infrastructure. In addition, new and novel soil testing for plant-available N is being explored along with in-season crop N monitoring and variable rate technologies.

Clearly, the present and future of corn N management is evolving from some of the past paradigms, as farmers—and their industry partners—focus on getting more of the applied N in the crop, and retained in the field in forms that are less prone to environmental losses.

Since it is absolutely clear that we cannot accurately predict the weather from year to year, or even within a season, … the time is right to re-examine the logistic, economic and environmental costs and benefits of fall N applications for spring-planted crops like corn. Where the research clearly supports economic benefits and low risks for environmental losses, perhaps there is little need for change from the status quo. **If recent data and common sense indicate unacceptable risks for loss and low recovery of the applied N, … maybe it is time to develop new, innovative, profitable and responsible N management strategies.**

– CSS –

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Abbreviations: N = nitrogen.

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WINTER CANOLA NUTRITION

Canola was developed in Canada from rapeseed using traditional breeding techniques to make its oil fit for human consumption and improve the meal for feed. The Western Canadian Oilseed Crushers Association trademarked the term Canola in 1978, and today Canola oil is a popular, healthy and widely consumed product in North America.

In the late 90s and early 2000s winter Canola varieties became available as an alternative to winter wheat in the central and southern Great Plains. The rotation of a broadleaf (canola) with a grass (wheat) provides several advantages such as disruption of wheat disease cycles and expanded weed control options. Winter Canola popularity has grown considerably in states like Oklahoma where plantings for the crop years 2009 to 2013 increased by a factor of about six, from 42,000 to 250,000 acres (USDA-NASS).

Nutrition plays an important role in the winter survival, yield and oil quality of canola. Fertility requirements are similar to wheat with two notable exceptions—it needs more N and S than for comparable yields. It is also more sensitive to soil acidity than is winter wheat, with best growth between pH 6.0-7.0. Lime is normally recommended below pH 5.8.

Good N management is critical in Canola production. A misstep in any of the 4Rs of N management can result in serious penalties. Too much or too little N in the fall can reduce the likelihood of winter survival. Both KSU (Great Plains Canola Production Handbook) and OSU (Fertilizer and Lime Recommendations for Canola in Oklahoma) published guidelines base N recommendations on yield goal, and calculate it as follows:

Total Fertilizer N = Yield Potential (lb/A) x 0.05 - soil nitrate-N (lb N/A; 0-24 in. sampling depth)

Deep sampling for nitrate-N (and sulfate-S) is usually recommended as close to planting in the fall as possible. Applying N at the right time is especially critical with winter Canola. The OSU extension guidelines recommend that one third (about 35-50 lb/A) of the total season's N be applied preplant, with the remainder applied topdress in the spring.

Phosphorus and K application rate, as for other crops, should be based on soil test results. Crop removal in the grain, according to the KSU handbook, is approximately 0.9 lb P_2O_5 and 0.45 lb K_2O/bu. Preplant broadcast-incorporated, or side band applications of P and K are recommended over in-furrow (seed placement) application because Canola, like other oilseed crops, is especially sensitive to seedling damage from fertilizer. Thus, placement of fertilizer and seed together should be done cautiously, or avoided altogether.

Canola has a relatively high S requirement. Deep (0-2 ft.) soil samples taken for nitrate-N analysis should also be analyzed for sulfate-S. A good rule of thumb is to keep available S:N ratio at about 1:7 (KSU). When soil test level is <10 ppm sulfate-S the crop will likely respond to supplemental S (KSU).

Winter Canola has gained in popularity in recent years in the central and southern Great Plains, and has considerable potential for even further growth. The success in production of winter Canola is highly dependent on managing according to 4R principles—application of the right fertilizer source at the right rate, time, and place.

– WMS –

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Abbreviations: N = nitrogen; P = phosphorus; K = potassium; S = sulfur; ppm = parts per million.