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

From Scientific Staff of the
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NITROGEN NUTRITION FOR WINTER WHEAT

The nitrogen (N) nutrition of winter wheat is key to its yield and quality. Management choices for the right source, rate, time, and place of N application support the sustainable intensification of wheat production needed to continue improving food and nutrition security for people.

Source: Since winter wheat often needs a topdress application, choosing the right source can help minimize ammonia loss. Urea on the soil surface has high potential to lose ammonia. The proportion lost increases with rate of application and soil pH, and can be influenced by soil moisture. Sources containing urea can be treated with a urease inhibitor—or protected with a slow-release coating—to slow hydrolysis, reduce loss, and supply more ammonium and less nitrate for plant uptake. As the levels of carbon dioxide in the air increase, wheat increasingly favors the uptake of ammonium over nitrate. Ammonium sulfate and ammonium nitrate sources are less prone to loss. The choice between fluid urea-ammonium nitrate and granular urea is tricky. Fluids can be applied more uniformly. Less ammonia is lost with fluid, but more leaf burn can occur. Leaf burn can be minimized with streamer nozzles and early application. Inhibitors or controlled-release forms do not always pay for themselves in terms of yield increase, but the benefits of reduced loss to the environment should also be considered.

Rate: The rate to apply depends on yield potential and previous crop. Rate predictions can also be aided using sensors that provide some measure of the canopy cover and its greenness. The optimum rate depends on cultivar as well. Hard red cultivars require more N for optimum protein levels. Cultivars susceptible to disease require lower rates. Production systems with weather-specific use of fungicide and plant growth regulators can produce higher yields with higher rates of applied N. For example, research conducted in Ontario, Canada from 2008 to 2010 demonstrated that, when combined with a fungicide strategy that controlled disease, increasing rates of N in the spring topdress from 90 to 150 lb/A raised average yields from 90 to 112 bu/A in soft red winter wheat. These higher yields were accompanied by changes in grain quality considered desirable by millers, including increased protein and decreased levels of fungal toxins. Recent research in China and Turkey found that increasing rates of N increased the concentration and bioavailability of the micronutrient zinc (Zn) in wheat grain. Considering the widespread distribution of Zn deficiencies in the human diet, increased Zn is a good thing.

Time: At wheat seeding in the fall, soils often contain sufficient N to start the crop. Exceptions occur, such as in sandy soils, or soils that have recently grown a N-depleting crop. Going into winter, the plant should not be deficient, but excess N can lead to disease infection and winterkill. Thus the decision to apply a small amount at seeding should be guided by a soil test. Topdress applications need to be timed according to the growth condition of the crop. Thin stands may benefit from early applications in the tillering phase, but only a low rate should be applied to prevent excessive tillering. By the beginning of stem elongation, Zadoks growth stage 30, most of the N should be applied, since from this stage the crop takes it up rapidly. A split application at both those stages may sometimes pay. After heading, N uptake slows down, but foliar applications, or controlled-release forms applied earlier, boost protein in the grain.

Place: The logical place for N fertilizer at seeding is with the seed. Wheat seedlings can tolerate the low rates required at planting. For topdress fertilizer, broadcast is often the only choice. Ensuring uniformity of broadcast is important for avoidance of uneven maturity. Uneven applications lose yield to both deficiency and lodging.

Nitrogen nutrition for wheat offers big opportunities to sustainably improve food and nutrition security.

– TWB –

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WHY IS MICRONUTRIENT AVAILABILITY SO PATCHY IN A FIELD?

When we think of applying fertilizer the nutrients that come to mind initially are the major nutrients nitrogen (N), phosphorus (P), potassium (K), and sulfur (S). However there are ten other mineral elements or nutrients needed by plants—most are micronutrients. In most agricultural soils, widespread shortages of micronutrients are uncommon, but when one or two of them are in short supply, crop growth can be severely restricted and crop yields depressed.

In the Northern Great Plains (NGP), it was only a couple of decades ago that micronutrient deficiency began to be considered a significant occurrence. Now, most areas readily accept that micronutrient deficiencies can occur. There are a number of reasons why this has happened. **First,** farm soils have been cropped longer, with most fields having a crop production history of over 100 years. **Secondly,** as higher yielding varieties and hybrids have been developed, crop yields and nutrient removal through harvest have continued to increase. **Third,** agronomic science has continued to improve soil and plant analysis techniques to better detect low availability of micronutrients. This probably means that moderate to slight deficiencies were present in the past, we just didn't have the experience and ability to test for and detect these deficiencies. **Lastly,** education of field agronomists and crop advisers has increased the awareness and ability to look for, and diagnose possible micronutrient deficiencies.

It is important to understand how micronutrient deficiencies are distributed and observed within a field. A micronutrient deficiency will not occur over a whole field, but will be present in irregularly shaped areas within a field. Patches are often severely affected, and these graduate into moderately affected areas, and finally transition into areas that do not exhibit or have any micronutrient deficiency. This is the result of natural spatial variability in soil characteristics that affect micronutrient availability. These characteristics include soil pH, texture, organic matter, cation exchange capacity, electrical conductivity, and soil drainage.

One challenge for a farmer, or field agronomist is to accurately assess to what extent a field has severe enough micronutrient deficiencies to warrant an in-crop application. Just because there are some areas of micronutrient deficiency doesn't necessarily mean a whole field should receive a micronutrient application. For example, while field scouting with a farmer for the presence and severity of an insect pest so he could make a decision whether to apply an insecticide or not, he asked me to look at an area of canola that had poor growth. I was able to recognize B deficiency symptoms and took both soil and plant samples from the poor growth area, as well as from an adjacent area with better crop growth. The analyses confirmed my visual diagnosis of B deficiency, but I'll admit his response at first was a bit disappointing. He said "I realize you did a great job, but it's only 5 acres and there is no sense getting too excited for such a small portion of the field." His response made sense after some thought as the benefit of correcting the deficiency on such a small area didn't justify the time and cost**.**

The patchiness of micronutrient deficient areas in a field, and the difficulty of assessing the true extent of a micronutrient deficiency is challenging. I suggest we approach the challenge in much the same way crop advisers approach pest infestation assessments. First, confirm the suspected problem and next assess the extent of the field that is affected. Next, make an estimate of what the economic cost will be if nothing is done to correct the problem. Lastly, compare the cost of treating the problem with the value of the expected yield increase if treated with an in-crop foliar micronutrient. If there is sufficient net return from applying a micronutrient to the crop, go ahead with the application.

One last word of advice. Even if an in-crop micronutrient application isn't justified using this assessment procedure it is useful to conduct further soil sampling on the field after harvest to more accurately assess the extent of a micronutrient deficiency. Further investigation may show more of the field may be moderately deficient, and a blanket application of a soil-applied micronutrient containing fertilizer may be a useful decision for longer-term crop production on the field.

– TLJ –

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STEP UP AS A SOURCE OF INFORMATION!

We live in an age of information overload, with an avalanche of information arriving each day. It can become a struggle to decide what information to accept and listen to, or judge which new ideas can be disregarded.

Getting reliable agronomic information is a challenge for everyone. We are all looking for innovations that will help improve efficiency and profitability. Plant nutrition products are evaluated for safety and for concerns arising during manufacturing and shipping, but there are no labels that tell you if they will work in your individual situation.

Several recent surveys of farmers from across the U.S. confirm the fact that crop advisers are the most frequently consulted source of agronomic information. Although the specific questions vary across regions and crops, farmers consistently look to their trusted adviser to help them sift through the information to get to the truth.

Given this critical role, it is essential to maintain that trust by staying current with the latest developments in agronomic science. This can be done through activities such as reading the latest trade journals and magazines, attending educational seminars, and asking probing questions. Practicing successful agronomy and horticulture requires using all the resources available and then using your experience to sort out what will work locally. For example, do you know how to implement the 4R's of Nutrient Stewardship in each field where you work? Can you clearly explain the cropping decisions you recommend if asked by a member of the general public?

Many new alternative fertilizer products have been introduced in the past decades. Some of these new products are based on sound science and their performance has been carefully evaluated in various scenarios. There are other products that have not been tested in a scientifically credible way, and lack results that are explainable and reproducible. Instead, many of these products simply rely on endorsements and testimonials as a substitute for good science and statistical analysis.

Economic and environmental pressures on farmers seem to increase every year. Crop advisers have the unique opportunity to directly influence the success of farmers by providing the best possible information. The relationship of trust between farmer and adviser is reinforced each time accurate and useful information is transferred.

Certified Crop Advisers are tested to demonstrate proficiency in the areas of nutrient management, soil and water management, pest management, and crop management. Additionally, they are required to take 40 hours of continuing education every two years to keep current with the latest agronomic developments.

Whether you are a Certified Crop Adviser or any other type of farm adviser, remember that you are viewed as a trusted source of information in your community. Now you need to maintain your reputation by staying current in providing accurate and reliable agronomic information.

– RLM –

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WHICH IS BETTER FOR SOYBEANS: FALL OR SPRING APPLICATIONS?

There have been many questions about fall versus spring applications of phosphorus (P) and potassium (K) to soybeans. Does it really matter if P and K are applied in the fall or in the spring? We looked at published studies to see what we could find.

First, there are very few studies that directly compare a fall to a spring application. In fact, only two were found. In both cases, broadcast applications were used.

The first study was conducted in Iowa during 2005 to 2007 and examined P at 20 sites under no-till. Although an application of P did increase soybean yield at seven locations, application timing did not make a difference. So even when soil test P levels were low, soybeans were not sensitive to when the P was applied.

The second study was conducted at two locations in Arkansas from 2009 to 2010 and examined both P and K. Whether K was applied in the fall or spring did not affect soybean yield. At one site in one year, there was an interaction between the rate of P applied and the time of application. The spring application performed better at the higher P rate while the fall application improved yield more at the lower rate. Overall effects were 4 to 5 bu/A. In the other cases, P application time did not affect soybean yield.

With so few data, we don't have much to go on. With the evidence before us, it looks like soybean may not be sensitive to fall versus spring application times; however, many more studies are needed before we have any certainty.

So what could influence soybean response to P and K application timing? There are lots of things that are site-specific: soil texture, soil moisture, rainfall distribution and intensity, fertilizer placement, fertilizer source, fertilizer rate, and soybean variety to name a few. None of these factors, except fertilizer rate, appears to have been researched in the context of P and K application timing.

So which is better for soybeans? Sparse evidence indicates fall or spring applications produce essentially equivalent results; however, there is a lot of room for discovering what works best under local conditions. Testing this effect for yourself will likely be the most expedient way to find an answer.

Further reading:

Mallarino et al. 2009. Soil Sci. Soc. Am. J. 73:2143-2150.

Slaton et al. 2009. p. 48-53. In Wayne E. Sabbe Arkansas Soil Fertility Studies 2009.

Slaton et al. 2010. p. 34-37. In Wayne E. Sabbe Arkansas Soil Fertility Studies 2010.

–TSM –

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4R AND PRECISION AGRICULTURE – WHERE'S THE PAYBACK?

Considering the current state of declining crop prices, discussions at the 2014 InfoAg conference were focused on the return on investment (ROI) of precision agriculture (PA) practices. Growers typically have little control over pricing and attempt to manage profitability in challenging economic times by controlling input costs while continuing to optimize production. However, simply lowering input costs doesn't guarantee greater profitability if it results in lower production. "Yield matters, even when prices are low", is a quote I've taken home from the conference. It reminds us that spreading input costs over higher yields lowers unit costs of production, thus increasing net returns.

Dale Bartholomew of Growmark said, "ROI [for PA] comes by doing what needs to be done when it needs to be done." One could also add, "where it needs to be done", thus implying that the profitability of PA is enhanced when used in accordance with 4R stewardship. Take for instance the idea of "right place"; RTK auto-guidance on planters, tillage equipment, sprayers, and combines has been shown to result in an average savings of 5% (ranging from 2 to 7%) on input costs. Another study conducted by Dr. John Fulton at Auburn University indicated that auto-swath technology could result in a 4.3% average savings on input costs for a farm with a payback of around two years. If the savings due to GPS guidance were included, the total cost savings could be in the 20 to 30% range.

Variable-rate fertilizer technology (VRT) was another popular topic at this year's InfoAg conference. Allan Baucom of A.L. Baucom Family Farms in N.C., spoke on several ways VRT is being utilized profitably in his operation. Baucom has been using variable-rate applications for nitrogen (N), potassium (K), gypsum, and lime since 1997. One of the keys to their success has been well-defined management zones based on 17 years of consistent soil sampling, harvest data, and other agronomic research. They also supplement the map-based prescriptions with on-the-go, in-season NDVI measurements for fine-tuning N recommendations using a GreenSeeker® crop sensor. In 2014, using PA technology to manage N application in cotton saved Baucom Farms $12.50/A.

Well-developed management zones can guide not only variable-rate applications, but an entire 4R Nutrient Stewardship program as well. The 4R approach is holistic—considering source, rate, timing, and placement of nutrients simultaneously within a specific cropping system context. The right combination of these factors is driven by many site-specific factors; thus management zones for 4R stewardship should include information on as many of these factors as possible. Tyler Lund of Veris Technologies gave a presentation at InfoAg 2014 that demonstrated how fusing CEC, soil EC, slope, and surface curvature could create "N loss risk" management zones that could be used to minimize N denitrification and leaching losses by guiding source, rate, timing, and placement decisions within a 4R program, optimizing profitability of N fertilizer application, while minimizing environmental risk associated with misapplication.

The profitability of precision management was also evident in presentations on multi-hybrid corn planting and variable-rate seeding. Again, the key to success was management zones. Jason Webster of Beck's Hybrids said in his presentation, "Without management zones, multi-hybrid planters are worthless." By clearly delineating high and low yielding zones in the field and changing hybrids between "offensive" in the high potential zones and "defensive" on the low yielding areas (the right hybrid in the right place), Webster was able to raise corn grain yield by 9.5 bu/A and increase net profits by over $50/A. John McGuire of Simplified Technology Services discussed variable-rate corn seeding and pointed out that profitable variable-rate seeding required two things—knowing where to change rates (right place) and how much to change rates (right rate). His data demonstrated that varying seeding rate from 28,000 to 38,000 seeds/A compared to a flat rate of 33,000 seeds/A resulted in net profits of $6.53/A in their 2013 studies.

So where's the payback? A profitable PA program must be based on sound agronomic science, such as the fundamental principles that guide 4R Nutrient Stewardship. Without an agronomic foundation for everything from data collection, data analysis, decision-making, technology implementation, and record keeping, PA will just be gadgets and useless data that don't result in knowledge leading to more efficient input management, higher yields, and greater profits.

The next InfoAg will be held July 28 to July 30, 2015 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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Note: ***Plant Nutrition TODAY*** articles are available online at the IPNI website: www.ipni.net/pnt

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NITROGEN KNOWLEDGE – IS YOURS INCREASING?

Nitrogen (N) is fundamental to the growth and reproduction of every living creature. It naturally dominates the gases in the air that we breathe (along with oxygen), enables us to grow food—both vegetable and animal—for human nutrition, and it provides many other beneficial uses and resources for society. Fertilizer N makes it possible to provide abundant, safe and nutritious food that sustains the human family; at least half of the people on Earth owe their daily existence to fertilizer N use.

More and more farmers in the U.S. are using fertilizer N more efficiently and effectively than their forefathers, by implementing 4R Nutrient Stewardship in their crop production and soil and water conservation plans. Most farmers are striving to achieve more production on the same or less land area, with only modest increases or similar rates of N as used in the past five to ten years. On-going changes in crop varieties and hybrids, reduced tillage practices, improved irrigation management, modern farm equipment, computer-based and GPS-capable tools, and newer fertilizer technologies make farming more complicated than in the past. The science on the wise use of these tools and technologies is advancing also, making it more and more challenging for farmers and their advisers to stay current and competitive.

The International Plant Nutrition Institute has developed, and will continue to develop, many useful educational articles and other resources that offer agricultural professionals valuable learning opportunities. General soil fertility and plant nutrition articles like **Nutri-Facts**, nutrient source articles like **Nutrient Source Specifics**, and nutrient stewardship articles like **Stewardship Specifics** are informative and easy to read. More robust crop and site-specific N guidance can be found in regionally oriented **Insights** articles. Concise research reports are included in quarterly **Better Crops** articles, which are written by university, government and IPNI scientists. All research supported by IPNI is open to the public and project descriptions and reports are accessible in our on-line research database (for example, see current and past N projects at: http://research.ipni.net/toc/nutrient/Nitrogen_%28N%29. Other helpful nutrient management resources are available on-line (http://www.ipni.net/toolbox), including an IPNI crop nutrient removal software application, which is compatible with all computers and mobile devices.

If you are a crop adviser, agri-business professional, or a farmer striving to keep your soil, fertilizer and crop N knowledge sharp, you may want to hone your educational edge by visiting the IPNI website (www.ipni.net), to explore and take advantage of the resources available to you and the rest of the world - - - with just a few clicks of the computer mouse.

– CSS –

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NUTRIENT INPUTS AND COOL SEASON FORAGE GRASSES

Cool season grass species can provide high quality forage and pasture for the fall and spring months. The general ranking of the different forage classes for nutritive value are: legumes > cool-season annual grasses > cool-season perennial grasses > warm-season annual grasses > warm-season perennial grasses. The yield and quality of cool season grasses can be significantly affected by nutrient inputs, so it's a good idea to evaluate fertility programs for these systems going into the fall.

It is well known that nitrogen (N) fertilizer can impact forage grass yield. For example, over 31 site years N alone (120 lb N/A) increased smooth bromegrass forage yield by an average of about 3,600 lb/A (141% over control) in a Kansas study (Lamond, 2002). Nitrogen nutrition also influences forage quality, mostly by increasing crude protein (CP) content. In this study bromegrass CP was increased from 7.2% in the control to 10% by application of 120 lb N/A, based on a 15 site year average. Another example of the quality effect is in an irrigated ryegrass study in Texas where CP was increased from 12% in the control to 20% by application of 240 lb/A (Lippke, 1999).

The application of phosphorus (P) can also significantly impact cool season grass yield. In the above-mentioned irrigated ryegrass study by Lippke the application of P fertilizer (40 lb P_2O_5) increased yield by 4,100 lb/A (163% over control, 3-year average) where 240 lb N was applied annually. Aside from the yield impact, P is most often associated with early root development, but is also affects winter hardiness, disease resistance, drought tolerance, early growth, and seedling vigor. It can also impact N and water use efficiency. Winter forages usually have higher P content than summer forages, and P fertilizer application can increase P tissue levels, thereby impacting forage mineral content. In the above-mentioned bromegrass study application of 30 lb P_2O_5/A increased tissue P levels by 29%, from 0.14 to 0.17%, at the 80 lb N/A rate (11 site years).

Where soil levels are low, potassium (K) can improve pasture and forage crop performance. Where forage is mechanically harvested substantial amounts of K can be exported from soils, thus levels should be monitored by periodic soil testing.

Other nutrients may also be needed for optimal cool season grass nutrition. Deficiency of sulfur (S) is not uncommon in cool season production. Yields may be increased and forage digestibility enhanced by application of S where deficient. In the work reported by Lamond (2002) a S treatment was evaluated where 80 lb N and 30 lb P_2O_5 were applied. Sulfur application (20 lb S/A) increased average yield over 11 site years by 400 lb/A and increased tissue S by 31%, from 0.13 to 0.17%.

A general point to consider is that nutrient release from organic matter in soils tends to be reduced during cool season forage species production periods as compared to warm season species because of lower soil temperatures, thereby increasing the probability of need for nutrient input from external sources.

Information from a sound soil test is usually a good foundation upon which to make nutrient input decisions. Complete and balanced fertility, including consideration of the 4Rs of nutrient management, is critical to producing optimal yield and quality of cool season forages and helps assure the ultimate goal—top animal performance.

– WMS –

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