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

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Spring 2014, No. 1

PLANT NUTRITION FOR COOL FORAGES

Declining crop prices may concern forage producers as they plan fertilizer purchases for the coming year. Recent government price surveys, however, indicate price declines for fertilizers similar to those for forages. The USDA-NASS prices paid report shows fertilizer prices down by 12% for February 2014 compared to a year ago. Prices received for hay declined by a similar amount, over the same period.

Forages remove large amounts of nutrients. When hay, haylage or silage is analyzed to formulate feed rations, the analysis report also provides information relevant to managing crop nutrition. Removal equals yield times concentration. Replenishing removal to maintain soil tests in the recommended range is a sound principle of plant nutrition that doesn't depend on prices. Applying the right nutrient source at the right time and in the right place assures optimum quantity and quality of forage, while protecting environmental quality.

Prices may have changed, but the principles of fertilizing forages have not. A new book called "Cool Forages" explains those principles well. It comprises 50 chapters of science-based information useful to forage producers in northern temperate climates. Here is a short list of important points it underscores, related to plant nutrition.

- Many economic analyses show production of alfalfa to be at least as profitable as corn. Return on fertilizer investments that correct nutrient deficiencies can be expected to be high.
- Perennial forages provide predictable N credits for following crops.
- An on-line soil-crop N modeling tool at www.NLOS.ca can improve understanding of N cycling and adapt its management to local weather conditions.
- Perennial forages lose less nutrients in drainage water than annual crops, but a greater fraction of the P loss may be in the dissolved form.
- Understanding the methods of testing for soil P can help predict crop response to applications of P, and the potential for its loss in drainage water.
- The mysteries of variable response to applied S are important for both the yield and quality of forages.
- Whole-farm N budgets can help identify changes in diets, species selection and grass harvest frequency that improve nutrient use efficiency on dairy farms.
- Manure application timing and placement require innovative tools to optimize nutrient use.
- Stand termination method and timing need careful management to minimize losses of nitrate and nitrous oxide.
- Carefully managed manure applications can effectively supply nutrients for alfalfa production.
- Mineral balances to produce a quality of timothy grass hay appropriate for the Ca nutrition of the dry cow in transition can be achieved by cutting at the right growth stage, managing soil P levels, and applying Cl^- fertilizers.

The book was edited by Shabtai Bittman and Derek Hunt, scientists with Agriculture and Agri-Food Canada. Published by the Pacific Field Corn Association, the book can be ordered at www.farmwest.com.

Managing plant nutrition for forages is at least as technical as it is for corn. Using information sources like these ensures the highest level of precision in nutrient application for sustainably intensified forage production.

– TWB –

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Abbreviations: N = nitrogen; P = phosphorus, K = potassium, S = sulfur, Ca = calcium, Cl^- = chloride.

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Spring 2014, No. 2

SO GRAIN PRICES DROPPED, HOW DO YOU ADJUST FERTILIZER RATES?

Supplemental nutrients applied as fertilizer are important to yearly crop yields and the long-term production capability of soils. They are also one of the largest input costs farmers have. It is estimated that fertilizer can be as high as 55% of total crop input costs on many farms in the Northern Great Plains. For this reason farmers want to invest wisely in their fertilizer spending. The key economic strategy is to apply sufficient fertilizer to increase crop yields to the point where net returns are maximized.

Farmers are always subject to fluctuating crop prices, and changing fertilizer costs. The crop year of 2014 is no exception. Above average crop yields in 2013 have caused crop prices to drop in early 2014. It is common for farmers to consider reducing their fertilizer rates when crop prices decrease. They will sometimes cut back too much and reduce their net incomes.

Fertilizer rate decision support programs are designed with economic consideration. These can help farmers determine an economically effective fertilizer rate. One example is the Manitoba Nitrogen Rate of Return Calculator for Wheat, Barley and Canola (http://www.gov.mb.ca/) which can be used to help make N fertilizer rate decisions. The yield responses and projected net returns are based on over 67 site years of research conducted in Manitoba and northeast Saskatchewan by the Westco Agronomy Research unit during the years 1989 to 2004. A wheat grower in Manitoba is able to input agro-climatic region, soil test information, N fertilizer cost, and expected grain prices to calculate an economic rate of N fertilizer.

The Manitoba N rate calculator is useful to observe how the calculated N rate is influenced by changes in grain prices. For example if granular urea costs $700 per metric tonne and remains at this price, and spring wheat grain prices decrease in 25% increments from $10.00/bu, to $7.50, $5.00, and lastly to $2.50/bu, the calculated optimum N fertilizer rates are respectively 100, 90, 80 and 30 lb N/A. This shows that economically optimum N fertilizer rates decrease slower as a percentage compared to grain prices, as shown in the Table below.

The effect of decreasing spring wheat prices on optimum N rate calculations and projected net returns.

Urea cost/tonne* (short ton)	Spring wheat grain price/bu	**% Decrease in grain price**	Optimum N rate, lb N/A	**% Decrease in optimum N rate**	Net return, $/A
$700 ($635)	10.00	-	100	-	139
	7.50	25	90	10	87
	5.00	50	80	20	38
	2.50	75	30	70	2

*tonne = 1,000 kg or 2,205 lb, short ton = 2,000 lb.

How do optimum N rates compare in January 2014 to a year earlier in January 2013? Using the same Manitoba N rate calculator it is possible to calculate the optimum N rates and net returns for these two periods in time. In January 2013 the spring wheat price was $7.80/bu, with granular urea cost at $570/tonne, and the potential net return was $106/A. The calculated optimum N rate was 100 lb N/A. As of January 2014 the spring wheat price has decreased to $5.62/bu, a 28% decrease, but the optimum N rate only lowered to 90 lb N/A, a 10% decrease—admittedly net returns decreased to $66/A. Even though farmer projected net returns decreased 38% with the drop in grain prices it still pays to not lower fertilizer N rates in direct proportion to decreases in grain prices.

Use of a fertilizer rate decision support tool, such as the Manitoba N Rate Calculator, can help a farmer obtain a positive net return from spending on fertilizer. It pays to use fertilizer even when grain prices decrease.

– TLJ –

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Abbreviations: N = nitrogen.

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SO MANY CHOICES - SELECTING THE RIGHT NUTRIENT SOURCE

The 4R principles of nutrient stewardship involve selecting the "Right Source" of nutrients to meet plant demands. This fundamental decision of nutrient source influences the process of choosing the Right Place, Right Time, and Right Rate for each field.

A misconception persists that using manufactured fertilizers means opposing the use of organic nutrient sources. Most agronomists agree that selecting the right source of nutrients begins with first considering the supply of on-farm nutrients and then supplementing them with commercial fertilizers.

Integrated Plant Nutrient Management is the term used by agronomists to describe the appropriate use of both fertilizer and organic sources of nutrients. Every farming operation will differ in its access to various nutrient sources and there is a range in specific crop requirements, but all farmers have the goal of maximum crop output and harvest quality from the right nutrient application.

Organic nutrient sources can include soil organic matter, a small portion of which decomposes and releases nutrients each year. Crop residues vary greatly in nutrient content, but can be a contributing nutrient source in many situations. Animal manures are commonly used as a valuable source of plant nutrients. Manures and composts can have a wide range in nutrient composition, so it is useful to have them chemically analyzed to assess their fertilizer-replacement value. Cover crops can also be a useful nutrient source. Legume cover crops have the benefit of providing extra nutrients by hosting N-fixing bacteria. Grass cover crops can capture and retain nutrients that might have otherwise leached past the root zone, then release their nutrients again as they decompose.

Many excellent commercial fertilizers can be used to deliver nutrients that are lacking for successful crop production. Commercial fertilizers are most commonly used as <u>bulk blends</u> of popular granular fertilizers; <u>compound fertilizers</u>, which are a mixture of multiple nutrients within a single fertilizer particle; <u>fluid fertilizers</u>, homogeneous clear liquids which can be blended with materials such as micronutrients, herbicides, and pesticides, or diluted for foliar application; and <u>suspension fertilizers</u> which use a suspending clay or gelling agent to keep small fertilizer particles from settling out of the liquid.

Additional considerations in selecting the Right Nutrient Source might include:

- The soil chemical and physical properties (such as avoiding nitrate application in flooded soil, or surface application of urea on high pH soils).
- Availability of fertilizer application equipment to get the nutrients delivered properly.
- Blends of multiple fertilizer materials must account for their chemical properties and compatibilities.
- Recognize sensitivities and secondary benefits of specific fertilizer materials (such as chloride additions that may be beneficial for small grains, but possibly detrimental for the yield and quality of other crops in excessive concentrations).

Selecting the Right Source of nutrients is too often overlooked due to tradition and the ease of doing the same thing every year. Remember that crop production is very complex and that successful farmers need to be both artists and scientists with an understanding of all the 4R's to meet their goals.

– RLM –

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THE LONG AND SHORT OF POTASSIUM FERTILIZATION

Farmers have flexibility in managing soil K. They can choose short-term or long-term strategies.

A single application of K can increase crop yields for many seasons. How long this impact lasts depends at least in part on the rate applied. Higher rates are longer lasting and will be reflected in higher subsequent soil tests.

Studies that look at long-term residual effects of a fertilizer application are rare. The study below compared 1) annual applications of K to 2) an initial build up of soil K followed by no subsequent applications. The total amount of K applied was the same. It just took the annual application 10 years to reach the total amount of K applied in the initial build up applications. The total increase in yield for both corn and soybean were not significantly different, regardless of approach.

A comparison, at the end of ten years, of corn and soybean responses and agronomic efficiency of 600 lb K_2O/A applied by the initiation of the experiment to that of annual applications of 48 to 72 lb K_2O/A applied each year (Mallarino et al., 1991. J. Prod. Agric. 4:562-466).

Ferilizer rate	Total K applied after 10 years	Cumulative yield response of the 5 corn years	Cumulative yield response of the 5 soybean years	Total corn and soybean yield response after 10 years	Agronomic efficiency
	lb K_2O/A	------------------ bu/A ---------------			bu/lb K_2O
Annual applications (48 to 72 lb K_2O/A)	600	83	28.6	111.6	0.19
Residual effects (600 lb K_2O/A)	600	89	17.6	106.6	0.18

Note: Corn grain yield was adjusted to 15.5% moisture, but soybean grain yield was not adjusted for moisture content. Initial soil test levels for the annual K applications were approximately 50 ppm K. Soil test levels after the application of 600 lb K_2O/A before the study were approximately 100 ppm K. Soil K was extracted on field moist samples.

This study demonstrates that there is flexibility in how to apply K. Farmers can apply for a single cropping season or for many seasons to come.

Which approach to choose depends heavily on land ownership, the amount of operating capital available, crop prices, fertilizer prices, and market volatility. When K fertilizer becomes cheaper, investing in larger, build-up applications can produce greater net returns over time than when annual purchases of K are made in volatile markets that include periods of K fertilizer prices that are high enough to outweigh periods of lower prices. On the other hand, annual applications allow the farmer to evaluate the current economic environment before making any short-term investments.

Regardless of which approach is better for an individual farmer or an individual field that a farmer manages, the lasting effects of larger rates of K provide flexibility in management, and that's the long and short of it.

–TSM –

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Abbreviations: K = potassium.
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ARE COTTON YIELD MONITORS CONSISTENT ACROSS VARIETIES?

Since the early 1990s, yield monitor adoption has increased rapidly, with nearly 50% of corn and soybean acres in the U.S. being harvested using yield monitors by 2006. However, cotton acres harvested using a yield monitor during the same time period was only estimated to be around 3% and more recent data suggest that not more than 10% of current cotton acres employ yield monitors.

The slower adoption rate in cotton was primarily due to equipment problems in the early models including poor accuracy, failure to maintain calibration, and sensors becoming blocked by dust and other materials. Recent evaluations conducted at the University of Georgia have identified several models of cotton yield monitors to be accurate within 10-15% and some models were within 5% of actual bagged cotton weights. This research shows that current cotton yield monitors, when properly calibrated are very accurate compared with the earlier models.

Current yield monitors typically utilize optical sensing or microwave technologies to estimate seed cotton weight. As the research in Georgia demonstrated, this method is fairly accurate; however, the ability of light-intercepting yield monitors to accurately estimate yields for different varieties without being re-calibrated is not well documented. Nonetheless, the sole use of yield monitors in replicated on-farm cotton variety trials is not uncommon.

Cotton Incorporated recently funded a study to evaluate the performance of different cotton yield monitors across several varieties. Dr. Randy Taylor, Oklahoma State University, coordinated the project, which included research sites in six states across the cotton belt. The main objective was to determine the actual error associated with using yield monitors to evaluate on-farm cotton variety tests.

Depending on the model of yield monitor used, mean error ranged from -2.6% to -24.5%, with error being highly significant by variety. Some of the yield monitors grouped the varieties similar to the reference scale (were accurate within a variety); however, the researchers noted that there might be additional error among variety comparisons when yields are calculated to a field scale.

Another study conducted in Arkansas reported similar results, with error ranging from -6.6% to +16.5% across varieties. However, a positive finding in that study was a lack of variety-by-test interaction that suggested a good level of yield monitor accuracy for a particular variety across different locations.

Data from these studies suggest that, at this point, yield monitor data alone should not be relied on to determine yields from cotton variety comparison studies. Dr. Taylor noted “no clear methods to adjust for error among varieties have been discovered, but hope is not lost (but is fading significantly).”

To learn more about using yield monitor data and other cutting edge precision ag research, make plans to attend the next InfoAg July 29–31 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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CORN NITROGEN UPTAKE: SUSTAINED INTO LATER MATURATION

We have all heard the old adage "start right to finish well", but also recognize that the actions and effort between the start and finish lines will also reflect just how well we cross the finish line: top 20, top 10, or in the lead. This applies to plant nutrition also.

Having adequate N available to corn plants at key growth stages is a principle that is fairly well understood by most corn growers. There is fairly good recognition that much of the "grain-producing factory" is being built within the plant prior to the V6 (6 leaves with visible collars) growth stage, that kernel row numbers are established by V12, the number of kernels per row are decided by V18, and the final kernel number and size are largely determined by R1 (silking). By R6 (black layer), kernel weight and grain yield have been set.

Maximum corn N uptake rates, which may exceed 10 lb/A/day, usually occur 30 to 70 days after planting (V6 to V14). Forty to 70% of the N taken up may be partitioned to leaves before R1. Growing degree or heat unit accumulation governs the rate of change from one growth stage to the next. The rate of biomass (dry matter) accumulation proceeds rapidly before R1, and is strongly correlated with crop total N uptake. Nitrogen uptake is affected by the N supply, planting density or population, and the corn hybrid. Recent research has shown that across various plant populations, the N uptake rates on a per plant basis are rather similar. Higher plant densities result in higher total plant N uptake demand per acre. Purdue University scientists have compared data on old era (1940 to 1990) hybrids with new era (1991 to 2011) hybrids. They found that grain yield per unit of applied N increased with the new era hybrids at the same applied N rate as with the old era hybrids. New era hybrids may be more tolerant of stresses, and new era hybrids may accumulate more N during silking than the old era hybrids. Work by scientists at the University of Illinois has shown that today's hybrids develop as much as 35% of their crop biomass by silking, and up to 65% of the total N uptake. Clearly, that means a large portion of the crop's N uptake continues to take place after R1 …… and until R6. A sustained N uptake rate is governed by a sustained crop growth rate, which helps to feed the "sink" or ear demand. Sustained N uptake, together with an efficient remobilization of N from leaves and the stalk to the ear, help satisfy individual kernel growth demands and improves the harvested grain yield potential.

As important as N nutrition is, growers must also remember the full-season need for other essential nutrients like P, S, and zinc (Zn). For example, the total uptake and the pattern of plant demand for K are similar to those for N. A balanced supply of these nutrients helps keep leaves photosynthetically active longer, and also helps increase crop N recovery and use efficiency. This year, be sure that your crop growth rates and nutrient uptake do not fizzle out during the early reproductive growth stages, and shrink your grain-producing factory. Keep that factory producing efficiently and profitably by either side-dressing or top-dressing any needed N and other essential nutrients that were not applied before crop emergence. Sustained, full-season nutrition leads to good yields, and raises the prospects of good profits.

– CSS –

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

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DON'T OVERLOOK THE POTENTIAL OF ZINC

It has been estimated that nearly half of the world's cultivated soils are affected by low levels of plant available zinc (Zn). A 2010 IPNI soil test summary available at http://ipni.info/soiltestsummary included an evaluation of Zn levels on approximately 1.4 million samples from across North America (NA). Of this NA total, 37% tested below the general critical level of 1 ppm Zn. The percentage of soil samples having low Zn levels (<1 ppm) was substantially higher in states such as Texas (79%), Oklahoma (71%), Kansas (75%), Colorado (60%), and Nebraska (44%). While these figures do not address a specific farm or field, they do indicate that Zn nutrition should be on the radar, especially for sensitive crops.

Some crops are more sensitive to Zn deficiency than others. Crops that are listed as highly sensitive include corn, soybeans, rice, citrus, pecans, and onions. Sorghum, cotton, wheat, alfalfa, and sugar beet are in the mild sensitivity category.

Soil conditions that favor Zn deficiency are alkaline or calcareous conditions; low soil organic matter; high clay content; acid, sandy soils; subsoils that have been exposed by land leveling or erosion; soils very high in available P; and some organic soils. Although other factors may come into play, the effect of soil pH and calcium carbonate are the most noteworthy in the Great Plains and western U.S.

Most micronutrient and Zn fertilizer sources fall into one of three general categories: 1) inorganic sources (e.g., sulfates, oxides, oxysulfates, chlorides, and nitrates), 2) synthetic chelates (e.g., EDTA), and 3) natural organic complexes (e.g., lignosulfates). Several factors affect Zn source selection for specific conditions. These factors include Zn concentration, cost, water solubility, soil type, and method of application. Method of application considerations include whether it will be soil or foliar applied, and if soil applied then whether it will be banded or broadcast. Zinc application rate generally varies from <1 to 10 lb/A depending on source, application method, and objectives.

Zinc sulfate is the most commonly used of the Zn fertilizer sources because of its high water solubility and relatively low cost. Oxysulfates are a mix of Zn sulfate (water soluble) and Zn oxide (mostly insoluble). The more Zn sulfate in the oxysulfate mix the higher the solubility, and vice versa. It is generally recommended that oxysufates be at least 35 to 50% water soluble to be effective in the season of application. One Kansas study (Seymore, D. and D. Leikam, 2009. Fluid Journal, Vol. 17, No. 1, Issue 63) evaluated oxysulfates of differing solubility along with Zn sulfate (100% soluble) to determine source and rate effects on soil test Zn level one and two years after application. The work was done across differing production systems and soil types. They concluded that the water soluble (sulfate) fraction of the materials was 3x more effective in increasing Zn soil test level (DTPA) than was the non-water-soluble (oxide) fraction. They further noted that it took about 5 lb water soluble Zn to increase soil Zn (DTPA) by 1 ppm, while it took 15 lb non-water-soluble Zn to effect the same change.

Some relatively new and noteworthy technologies have been developed to help overcome some of the physical and chemical factors affecting Zn performance. One such product incorporates Zn and elemental S in granules of ammoniated phosphate fertilizer. This product provides four nutrients in each granule and thus eliminates segregation problems associated with bulk blends. The elemental S also creates an acid environment around the granule (in the soil) to help keep Zn and P available.

This brief publication is not meant to provide a complete coverage of Zn nutrition and fertilization, but rather to encourage evaluation of the potential for Zn.

– WMS –

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Abbreviations: P = phosphorus; S = sulfur.

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