Fertilizer Management Considerations for 2008

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Fertilizer Price Overview

Fertilizer prices have increased significantly over the past six months and are at record levels. The Fertilizer Institute (www.tfi.org) has described the reasons behind the high fertilizer prices. I will briefly summarize The Fertilizer Institute's information. First, fertilizer is a world commodity and global demand for nitrogen, phosphate, and potash are up 14, 13, and 19 % respectively from 2001 to 2006, because of increased demand from China, India, and Brazil. Second, U.S. corn acres increased from 78.3 million in 2006 to 93.6 million in 2007 largely because of ethanol production. More corn acres mean more fertilizer is used, in particular nitrogen. Third, all transportation costs have increased. Fourth, a weak U.S. dollar increases the cost of imported goods to the U.S. consumer. The U.S. imports more than 50% of its nitrogen and over 90% of its potash, but is the largest exporter of phosphate. Fifth, high natural gas prices have driven up the cost of producing ammonia, which results in higher prices for all nitrogen and ammoniated phosphate fertilizer materials.

Fertilizer prices from around Wisconsin for the time period of roughly March 1 through March 15 are presented in Table 1. When contacted, most retailers said that current March prices were valid now, but subject to change, perhaps on a weekly basis. They also said that it is difficult to estimate May/June or fall pricing. The range in prices can be attributed to when and for what price retailers purchased the fertilizer. There appeared to be no regional differences in price; that is prices near the maximum and minimum could be found in any given county or region. To put these fertilizer prices into perspective, the increase in price relative to 1998, 2003, and 2006 are shown in Table 2.

Table 1. Reported fertilizer prices from numerous Wisconsin locations during the period of March 1 through 15, 2008.

Fertilizer Material	Fertilizer Price, $/ton			Average Nutrient Price, $/lb			Number of locations
	Average	Min.	Max.	N	P_2O_5	K_2O	
Ammonium sulfate	352	310	400				9
Anhydrous ammonia	777	750	805	0.47			5
Urea	523	495	599	0.59			16
UAN, 28%	374	359	408	0.67			11
UAN, 32%	423	411	435	0.66			2
DAP*, 18-46-0	820	650	926	0.47	0.71		15
10-34-0	673	655	690	0.47	0.85		2
Potash, 0-0-60	566	486	600			0.47	49
9-23-30	659	643	675	0.47	0.53	0.55	4

* Price of MAP (11-52-0) per ton was similar to DAP.

Table 2. Approximate percentage increase in fertilizer prices as of March 2008 compared to 1998, 2003, and 2006.

Year	NH_3	UAN, 28%	Urea	MAP (11-52-0)	Potash (0-0-60)
	% price increase = [(current price – past price) / past price] x 100				
1998	204	190	170	200	252
2003	111	128	105	219	249
2006	43	55	42	142	109

Several but not all retailers said that current supplies of 10-34-0, anhydrous ammonia, ammonium sulfate, DAP, and/or potash may be tight this spring. Of particular concern is 10-34-0 and any other liquid fertilizer that is a derivative of it, because 10-34-0 is in shortest supply. Availability in May/June will likely be a concern for these same fertilizer materials along with 28% UAN. *Thus, it is important for farmers to communicate with their suppliers regarding changes in prices and current/future fertilizer needs.*

While these fertilizer prices are at record high levels, we need to keep in mind that grain prices are currently very good. Figure 1 shows corn, soybean, and wheat grain prices over the last 7 years. Average alfalfa hay price as of March 7 was 122 $/ton FOB for prime hay (http://www.uwex.edu/CES/forage/pubs/hay_market_report.htm). Thus, decisions regarding how much fertilizer to apply to maximize return may not be all that different than in years past, but availability of fertilizer might influence decisions more. The remainder of this article will discuss various things to consider when making fertilizer decisions this spring.

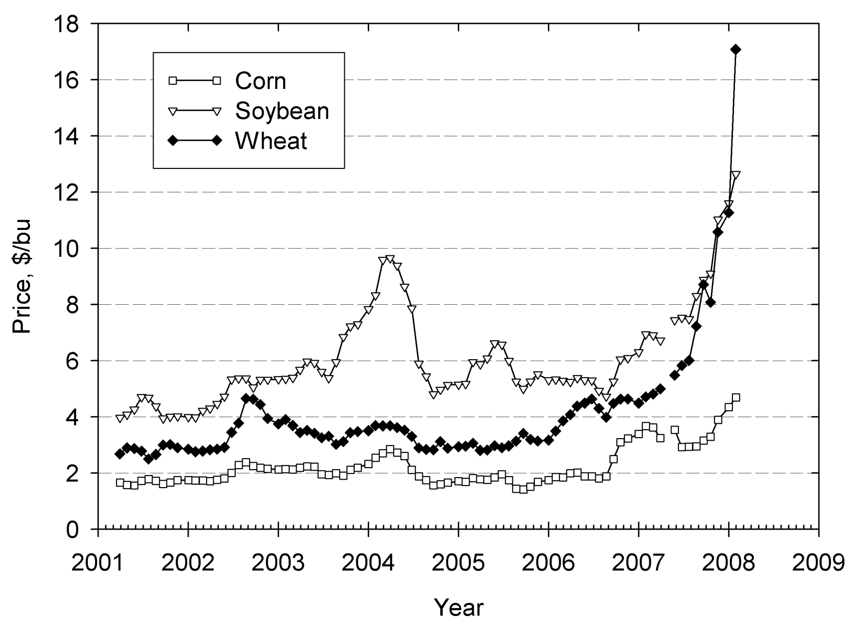

Figure 1. Average corn, soybean, and wheat prices from five Wisconsin locations by month from 2001-2008. Source: www.aae.wisc.edu/renk

General Considerations for Phosphorus and Potassium

If phosphate and/or potash fertilizer supplies becomes limited, or if a farmer is unable to afford all of the P and K fertilizer that they would like to apply, then it may be necessary to prioritize which fields should have fertilizer applied. *A current soil test is crucial for prioritizing fertilizer applications.* A current soil test is one that is no more than 3 to 4 years old and is based on samples collected following guidelines in UWEX A2809. Crops such as alfalfa and corn silage remove large quantities of P and K relative to other crops. A more recent soil test (within the past 2 years) may be beneficial in fields where these crops have been recently grown. With the higher costs of nutrients, the value of good soil tests has increased because soil tests are the primary tools used to assess nutrient need.

After assessing the soil test P and K levels and determining how much fertilizer is suggested, subtract P and K credits from any manure, biosolids, or other waste materials applied to the field since the harvest of the previous crop. Use UWEX A2809 *Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin* (http://www.soils.wisc.edu/extension/) to assist in determining nutrient credits. High fertilizer prices have dramatically increased the nutrient value of manure. For example, solid dairy manure was worth $2.90/ton in 1997 and $5.10/ton in November 2007 based on the first year available nutrient content of the manure and the price of fertilizer. Today solid dairy manure is worth $8.00/ton in nutrients. Depending on how much a farm is paying for manure hauling/application costs, it may be beneficial to spread manure over more acres and purchase less fertilizer, as long as the manure applications are in compliance with the farm's nutrient management plan.

After subtracting manure P and K credits from the nutrient needs of a field, P and K fertilizer should be allocated in such a manner as to obtain the greatest return on the fertilizer investment. In many Wisconsin fields, soil test P levels are above optimum and the expected yield response to phosphate fertilizer is small and may or may not be economical. Thus, when soil test P levels are high or excessively high, consider not applying P fertilizer or consider using lower rates (less than 10 lb P_2O_5/a) in starter fertilizer. This strategy will permit growers to allocate limited dollars for other more needed nutrients. Where soil test P levels are optimum, apply the recommended rate. P application rates should be maintained near the recommended rate on low and very low P testing soils, but could be reduced by 10% in the short term if needed.

Soil test K levels are much more variable across Wisconsin fields. All fields that test low or very low should have K fertilizer applied. Fields with optimum soil test K levels will also benefit from potash application. If possible apply some of the required K in bands to increase efficiency. This is especially important in no-till corn or on soils where compaction is a concern. There is a smaller probability of a yield response to applied K on soils testing high or above; thus K application rates may be reduced or deferred on these fields. Caution is advised when deferring K applications on fields in corn silage and alfalfa because these crops remove large quantities of K which may result in soil test levels moving into the optimum or low soil test category before the next soil sampling time period.

Don't Forget About Lime

In the current fertilizer price climate, it may be tempting to ignore lime recommendations and focus solely on fertilizer prices and application rates. Farmers should avoid this temptation. Maintaining pH at the target level for the most sensitive crop in a rotation is the cornerstone to a good soil fertility program. If the pH is not suitable for crop production, yields will suffer and applied fertilizers will not be used efficiently. Table 3 demonstrates how soil pH influences alfalfa yield response to K fertilization.

Table 3. Effect of soil pH and annual topdressed potash applications on alfalfa yield and stand density from 1998 through 2001 at Hancock, Marshfield, and Spooner, Wisconsin.

Soil pH	K_2O rate	Yield			Stand Density		
		Hancock	Marshfield	Spooner	Hancock	Marshfield	Spooner
	lb K_2O/a	Yield (T/a)			Plants/ft^2		
5.0-5.3	0	2.03	1.97	2.24	3.3	1.3	3.2
	100	2.32	2.20	2.41	3.5	1.0	4.5
	200	2.41	2.33	2.00	3.6	1.1	3.2
	400	2.42	1.94	2.00	3.3	1.0	3.8
6.5-6.8	0	3.42	3.47	3.47	4.0	6.0	7.5
	100	3.53	3.95	3.77	5.1	6.5	7.9
	200	3.54	3.96	3.74	4.1	7.2	8.2
	400	3.48	4.22	3.79	4.5	9.7	7.5

Additional Considerations for Alfalfa

In addition to making sure pH is adequate for alfalfa, annual potash applications are necessary for good yields and maintenance of stand (Tables 3). Splitting higher K application rates will reduce luxury consumption of K and help maintain feed quality. It may be tempting for producers to reduce K applications on alfalfa given the current potash prices and generally larger K application rates compared to other crops. This decision should not be taken lightly for several reasons. First, alfalfa removes approximately 60 lb K_2O/ton of dry matter. Thus, reducing or eliminating K fertilization will cause soil test levels to decrease and may limit production in future years particularly on low testing soils. Second, K is required to enhance disease resistance and winter hardiness as shown by the data in Table 3. Nitrogen credits from alfalfa to future crops is dependent on stand at the time the alfalfa is killed, ie. better stands produce more N credits. With high N fertilizer prices it may be beneficial to consider the N credit to future crops as part of the overall economic evaluation of a rotation. Finally, if producers are feeding all of the alfalfa produced on their own farm, they may want to produce the highest alfalfa yields to insure an adequate feed supply.

Remember that annual applications of sulfur and born may be required on sandy soils. For medium- and fine-textured soils use soil and tissue tests to evaluate sulfur and boron needs.

Additional Considerations for Corn

Nitrogen fertilizer is probably the biggest concern for most corn growers. Fortunately the high fertilizer prices are offset by good grain prices. Depending upon when N fertilizer was purchased and if/when grain was contracted the N:corn price ratio for any particular farm may range from 0.05 to 0.15. The maximum return to N (MRTN) fertilizer rate is influenced by price ratios not prices of fertilizer or grain. For example, the MRTN for corn following corn on a high yield potential soil is 135 lb N/a at a price ratio of 0.10 regardless of whether that price ratio was obtained with \$0.33/lb N and \$3.30/bu corn or \$0.55/lb N and \$5.50/bu corn (Figure 2); but when the price ratio is 0.05 (for example \$0.30/lb N and \$6.00/bu corn) the MRTN is 165 lb N/a. To select the most appropriate N rate use the MRTN rates outlined in UWEX A2809.

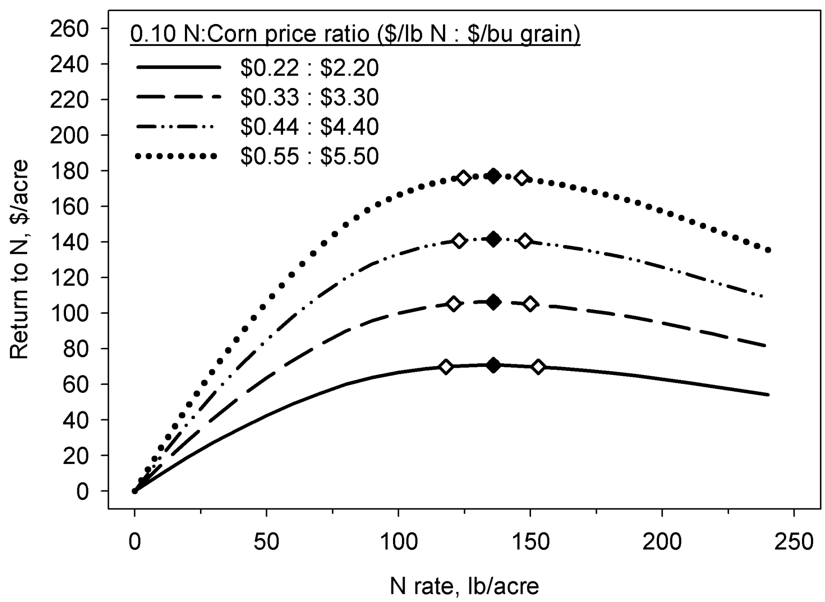

Figure 2. Effect of price level on return to N fertilizer at the 0.10 N:corn price ratio for corn following corn on a high yield potential soil. Black diamonds indicate the MRTN of 135 lb N/a. White diamonds indicate the range of N rates that have profitability within \$1/acre of the MRTN.

High prices have increased the economic risk of over and under application of N fertilizer. Figure 2 shows the effect of the price level on return to N fertilizer at a N:corn price ratio of 0.10 for corn following corn on a high yield potential soil. Higher grain price levels result in more economic risk for under fertilization as shown by the steepness of the left hand side of the curves in Figure 2. At current record high N fertilizer prices, the economic penalty for over application of N fertilizer is greater than at fertilizer prices more typical of 5 to 10 years ago as shown by how quickly the right hand side of the curve drops. The profitable range of N fertilizer rates become narrower at higher price levels. At current higher price levels, there is still over lap in the MRTN profitable range for different price ratios, but the overlap is not as great as when price levels are lower.

Because of high N fertilizer prices, many farmers are asking if there is an ideal timing of N fertilizer that would result in greater efficiency for crop uptake. For sandy soils, sidedress N applications are a must to reduce the probability of N leaching before the crop has a chance to use it. On medium- and fine-textured soils that are moderately well- to well-drained, there is probably minimal benefit to sidedressing N compared to preplant applications because there is usually not much opportunity for N loss via leaching or denitrification. However, some preliminary research results from Lancaster Ag Research Station in 2007 suggest that there is likely a benefit to having some N applied preplant or in a starter fertilizer if the majority of the N will be applied at sidedress, if growing silage corn. On poorly- and somewhat poorly-drained soils, there may be a benefit to sidedressing N to minimize the opportunity for denitrification. If conditions for denitrification exist (warm, wet soils), then use of a nitrification inhibitor would be economically beneficial. Remember that urea containing fertilizer must be incorporated into the soil by tillage or rainfall. Ammonia volatilization will usually be prevented if 0.1 to 0.2 inches of rain falls within 24 hours of application. If 0.1 to 0.2 inches of rain falls within 2 to 4 days after application, then some ammonia volatilization will occur. Significant volatilization losses occur if no rainfall occurs within 5 days of surface urea application. If physical incorporation is not possible and rainfall is not predicted, consider using a urease inhibitor to prevent urea volatilization for 10 to 14 days. Use of both nitrification and urease inhibitors is economically viable only if conditions for N loss are likely.

Fertilizer N use efficiency is maximized when weeds are controlled as shown in research conducted at Arlington Ag Research Station in 2006 and 2007. When weeds were controlled preplant or when 4 inches tall, the economic optimum N rate was generally similar and less than the MRTN rate at the 0.05 N:corn price ratio. However, when weed control did not take place until the weeds were 12 inches tall, corn required about 100 lb N/a more to maintain yield compared to when weeds were controlled earlier. Failure to control weeds resulted in yield losses that could not be over come by applying more N. Thus, the moral to the story is to control weeds early to maximize N use efficiency.

With high fertilizer prices, producers are wondering if they should be applying P and K with the planter as starter fertilizer. If soils test optimum or lower in P and K, then starter placement is an excellent way to supply P and K and increase fertilizer use efficiency. On irrigated sandy soils when soil test P and K levels are high or greater, then response to starter fertilizer is unlikely. On these same soils, if soil test P is high or greater and soil test K is optimum or lower, then it may be beneficial to use a starter fertilizer that contains K. On medium- and fine-textured soil (eg. silt loams) with excessively high soil test P and K levels, the benefit of obtaining an economic response to starter fertilizer increases with both later planting dates and longer relative maturity hybrids. On these soils, yield can be maximized with application of about 10-20-20 (lb N-P_2O_5-K_2O/a) in a 2x2 band and rates lower than this, typical of seed-placement, have been shown to be inadequate to produce an economic yield response. When using seed-placed fertilizer, a general rule of thumb is that no more than 10 lb/a of N + K_2O should be applied in order to reduce the risk of injury.

Additional Considerations for Soybean

Manganese (Mn) is a key micronutrient of concern for soybean production. Manganese deficiency in soybean is more likely on Wisconsin soils with high pH (>7.0) and/or higher soil organic matter contents (>6.0). Soils that meet these criteria are typically, but not exclusively, found in eastern Wisconsin. In 2007, Mn was confirmed to be deficient in many fields over an area from eastern Waupaca Co. south to Jefferson Co., and mostly east of Lake Winnebago. In every case that was confirmed with soil and tissue analysis, the soil had high pH and/or higher organic matter content. In most cases, glyphosate resistant soybean varieties were planted in the field. Research in Indiana has shown that application of Mn, in starter fertilizer or as a foliar applied at least 8 days after glyphosate, increased yield of glyphosate resistant varieties growing on soils where Mn would not be considered limiting. Research in Kansas found that application of Mn to conventional varieties resulted in reduced yields because of Mn toxicity.

Start with a soil test to determine if Mn application may be justified. If soils have organic matter ≤ 6.0%, have your soil tested for Mn and then follow the recommendation. For soils with organic matter > 6.0% and pH > 6.9, apply starter fertilizer containing 3-5 lb/a Mn in the sulfate form or apply foliar Mn (1.25 or 0.2 lb Mn/a as sulfate or chelate forms, respectively) at first flower and/or first pod. If Mn is not recommended based on the conditions above, it would be best to not apply Mn because there is a risk of Mn toxicity especially on acid soils in central Wisconsin. Further research on this topic is beginning this spring.

Additional Considerations for Wheat

With the current high price of N fertilizer and very good wheat prices, some growers are wondering if 70 lb N/a for soil with 2.0 to 9.9% organic matter is still valid. To answer this question data collected over the past 12 years in southern Wisconsin was re-evaluated using current wheat and N fertilizer prices following the MRTN approach used for corn N recommendations. The amount of N needed for wheat is strongly related to preplant soil nitrate levels (PPNT). PPNT for wheat is determined on 0-1' and 1-2' soil samples taken in late summer prior to planting wheat in the fall. If the PPNT is < 50 lb NO_3-N/a, then the MRTN rate is 70 lb N/a (with a profitable range of 65 to 80 lb N/a) which matches the recommendations for soils with 2.0 to 9.9% organic matter. If the PPNT is between 50 and 100 lb NO_3-N/a, then the MRTN rate is 45 lb N/, and if the PPNT is > 100 lb NO_3-N/a, then the MRTN is 0 lb N/a (no N is needed). In these studies if wheat followed soybean then the MRTN rate was about 20 lb/a less. If PPNT soil samples were not collected last year, then it would be appropriate to use 70 lb N/a on soils with 2.0-9.9%. Also remember to take any N credits for manure applications or legumes if appropriate.

Resist the Temptation

With high crop prices, there will likely be any number of products marketed to farmers that will claim to boost yield. Resist the temptation to use products that sound too good to be true. Ask to see independently verified research results. To learn if any university has conducted research on a non-traditional soil additive or growth stimulant, check out Iowa State University's Soil Fertility web page at http://www.agronext.iastate.edu/soilfertility/nutrienttopics/addbyproducts.html and follow the link to the searchable compendium of non-traditional soil amendments and growth stimulants.

Additional materials

For additional information on **macro and micro nutrient fertilizer recommendations, benefits of starter fertilizer, manure and legume credits, and lime recommendations** see UWEX A2809 *Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin*. It is a featured topic at http://www.soils.wisc.edu/extension/

For additional information on the benefits of **N inhibitors and salt index of fertilizers**, use the searchable online Proceedings for the Wisconsin Fertilizer, Aglime, and Pest Management Conference to find papers and presentations on these topics and more. Visit http://www.soils.wisc.edu/extension/wfapmc/