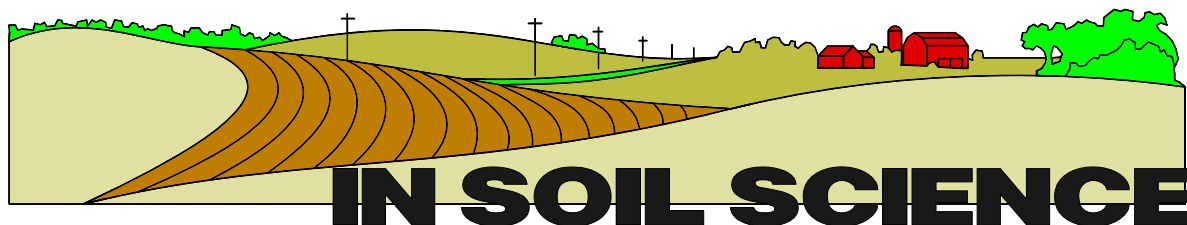


NEW HORIZONS



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Nutrient Management Considerations in a High-Cost Environment

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Fertilizer Price Overview

Fertilizer prices have increased significantly over the past year 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 October 22 through 31, 2008 are presented in Table 1. Spring 2009 fertilizer prices will likely remain volatile. *Thus, it is important for farmers to communicate with their suppliers regarding changes in prices and current/future fertilizer needs.*

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.

Table 1. Reported fertilizer prices from numerous Wisconsin locations during the period of October 22 through 31, 2008.

Fertilizer material	Fertilizer price, \$/ton			Average nutrient price, \$/lb			Number of locations
	Average	Min.	Max.	N	P ₂ O ₅	K ₂ O	
Ammonium sulfate	483	410	540				7
Anhydrous ammonia	1125	1099	1150	0.69			2
Urea	784	490	925	0.85			8
UAN, 28%	521	485	596	0.93			4
UAN, 32%	547	497	585	0.85			3
DAP, 18-46-0	1124	1025	1195	0.69	0.95		7
MAP, 11-52-0	1138	1125	1150	0.69	0.95		2
10-34-0	1478			0.69	1.97		1
Potash, 0-0-60	881	820	938			0.73	10
9-23-30	984	945	1025				4

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 P₂O₅/acre) 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. On low and very low P testing soils, P application rates can be lower than the recommendation but should probably not be less than the recommendation for optimum testing soils.

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 2 demonstrates how soil pH influences alfalfa yield response to K fertilization.

Table 2. 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 ₂ O rate lb K ₂ O/a	Yield			Stand density		
		Hancock	Marshfield	Spooner	Hancock	Marshfield	Spooner
		----- ton/acre-----			----- 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 2). 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 K₂O/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 2. Nitrogen credits from alfalfa to future crops are dependent on stand at the time the alfalfa is killed, i.e., 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 boron 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/acre 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 (Fig. 1); 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/acre. To select the most appropriate N rate use the MRTN rates outlined in UWEX A2809.

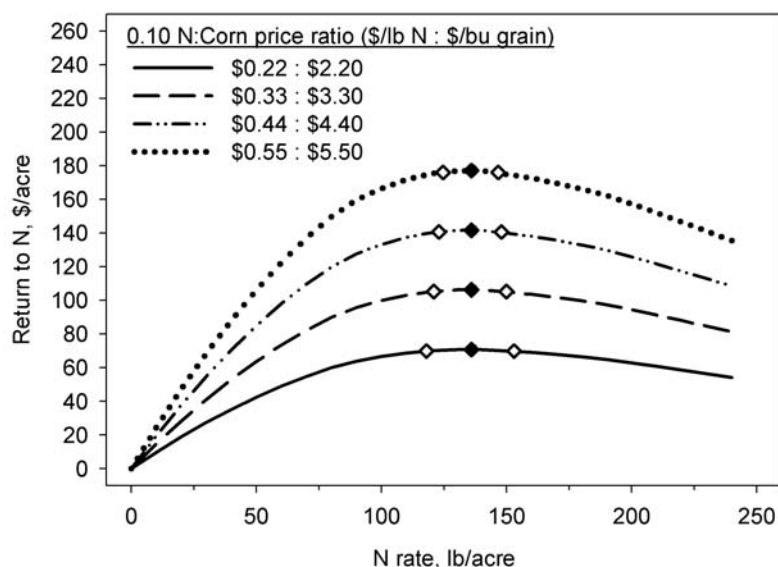


Figure 1. Effect of price level on return to N fertilizer at the 0.10 N:corn price ratio for corn following corn on a high yield potential soil. Black diamonds indicate the MRTN of 135 lb N/acre. White diamonds indicate the range of N rates that have profitability within \$1/acre of the MRTN.

High prices have increased the economic risk of over and under application of N fertilizer. Figure 1 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 1. 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 becomes narrower at higher price levels. At current higher price levels, there is still overlap 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 Agricultural 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 inch of rain falls within 24 hours of application. If 0.1 to 0.2 inch 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/acre more to maintain yield compared to when weeds were controlled earlier. Failure to control weeds resulted in yield losses that could not be overcome 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. Responses to starter fertilizer can be obtained on soils that test greater than optimum in P and K. However, the price of starter fertilizer needs to be considered. Table 3 shows the probability of various levels of increased yield from use of starter fertilizer on high P and K testing soils. Thus, a producer can calculate the amount of yield increase needed to pay for the starter fertilizer and then determine how likely it is that they will obtain a profitable yield increase. Note, on high P and K testing soils, yield can be maximized with application of about 10-20-20 (lb N-P₂O₅-K₂O/acre) 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/acre of N + K₂O should be applied in order to reduce the risk of injury.

Table 3. Yield increase and probability of yield increase caused by use of starter fertilizer with an average application of 15-26-32 lb/acre N-P₂O₅-K₂O at 100 locations on soils testing above optimum in P and K from 1995 to 1997.

Fertilizer material	Fertilizer price, \$/ton			Average nutrient price, \$/lb			Number of locations
	Average	Min.	Max.	N	P ₂ O ₅	K ₂ O	
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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 to 5 lb/acre Mn in the sulfate form or apply foliar Mn (1.25 or 0.2 lb Mn/acre 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.

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 given below and follow the link to the searchable compendium of non-traditional soil amendments and growth stimulants.

<http://www.agronext.iastate.edu/soilfertility/nutrienttopics/addbyproducts.html>

Additional Materials

For additional information on **macro- and micronutrient 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/>