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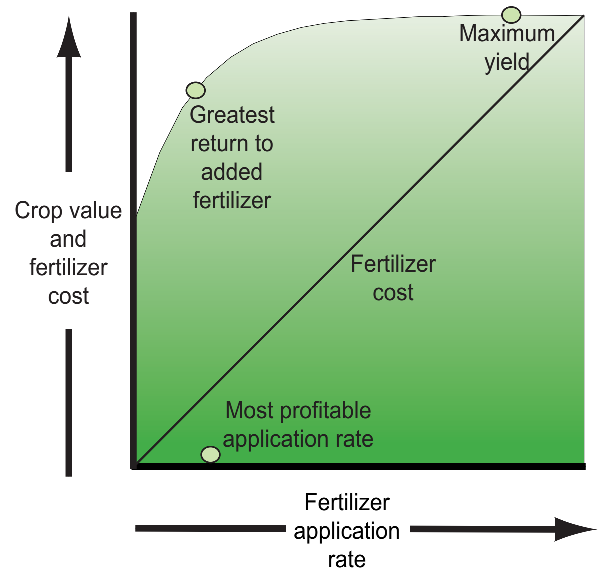
Colorado State University Cooperative Extension

Putting Knowledge to Work

FROM THE GROUND UP

Agronomy News

Nitrogen Fertilizer



High N Prices Hit Again

The cost of nitrogen (N) fertilizer, an essential input in our crop production system, has increased to levels we have not seen since 2001 (Table 1). Similar to 2001, the primary driver for this price increase was high natural gas prices and increased demand for natural gas throughout the winter. All synthetic nitrogen fertilizer products begin as ammonia. Ammonia is the product of nitrogen gas (N_2) from the atmosphere and hydrogen (H_2) from either fossil fuels or water ($3 H_2 + N_2 \rightarrow 2 NH_3$). Natural gas is the primary source of hydrogen in this process and therefore N prices are sensitive to natural gas supplies. The natural gas price this winter (Figure 1) was not quite as high as it was in 2001, but changes in the fertilizer industry and increased demand from household and electric utility providers for this clean burning fuel have bumped N prices to similar levels. Furthermore, a colder than average winter and limited alternative energy supplies have added to the pressure on natural gas.

After the N fertilizer price spike in 2001, N prices declined during the 2002 and 2003 growing seasons, although not to the low price levels producers enjoyed prior to 2001.

High N Prices Hit Again (continued)

Table 1. Nitrogen fertilizer, fertilizer grade, and price (US$) in 2004

	Grade	Price/ton	Average	Price/pound	Average
	---%---	----------$/ton----------		---------$/pound N ---------	
Anhydrous ammonia	82-0-0	350-470	397	0.21-0.29	0.24
Urea Ammonium Nitrate	32-0-0	180-280	208	0.28-0.44	0.33
Ammonium nitrate	34-0-0	300-440	370	0.44-0.65	0.54
Urea	46-0-0	260-400	302	0.28-0.43	0.33

FROM THE GROUND UP

Agronomy News is a monthly publication of Cooperative Extension, Department of Soil & Crop Sciences, Colorado State University, Fort Collins, Colorado.

Web Site: http://www.colostate.edu/Depts/SoilCrop/extension/Newsletters/news.html

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This year's prices may not be as much "sticker shock" as in 2001, but they still hit growers during a time of economic stress with additional drought pressure and relatively flat commodity prices.

What can growers do to deal with a large increase in an input so essential to crop productivity? There are several interrelated practices that growers should consider in order to more efficiently manage N to achieve the best return for their fertilizer dollar. In this issue we review many of these practices and provide information on new N management strategies.

Besides prices, growers using N fertilizer also need to be aware of several issues regarding the security and stewardship of their N fertilizer during transportation and storage. Three articles in this newsletter offer suggestions for keeping your N fertilizer supply from being stolen or lost to undesirable locations in our environment. Nitrogen fertilizer is more valuable than ever. The following articles discuss strategies on how to best utilize N purchased at a premium.

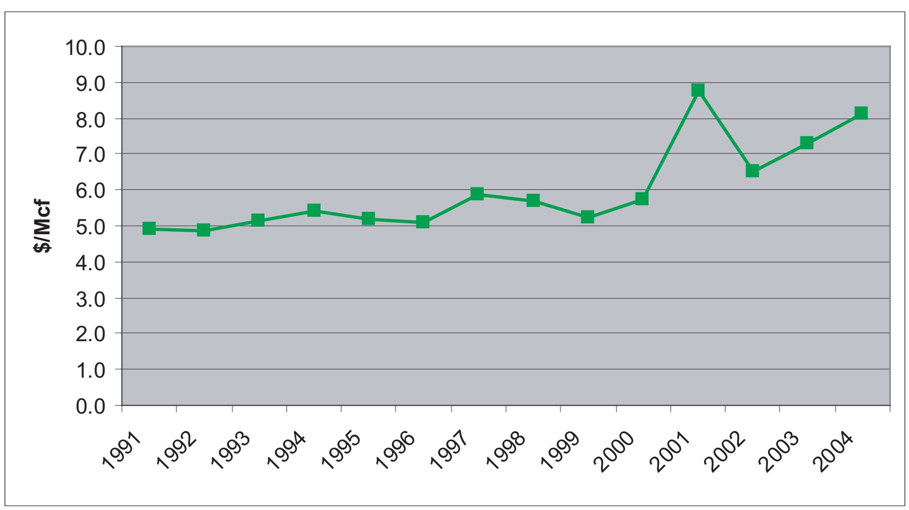

Figure 1. Average price (winter commercial) for natural gas.
Source: U.S. Department of Energy at: http://www.eia.doe.gov/oil_gas/natural_gas/info_glance/natural_gas.html

Soil Testing and Fertilizer Recommendations for Nitrogen Use

Soil testing and sound recommendations are the foundation of good nitrogen management.

Soil testing and development of a soil fertility management program can help save money, and with rising energy costs, will provide vital information to maximize dollars invested in fertilizer.

Soil testing programs begin with organizing planting areas into sites that are similar in soil texture, slope, location or other characteristics that set them apart from other areas. Generally, taking 15-25 sub-samples from a uniform area and compositing them will provide the most unbiased sample. Under-sampling may result in striking a fertilizer band or an over fertilized area that doesn't represent the entire field. Fields applied with manure or biosolids should have more sub-samples taken to avoid abnormally high or low levels of nutrients. Samples can be taken with coring devices, sampling tubes, augers or shovels. They should be rust free to avoid sample iron contamination. Avoid zinc coated galvanized tools or buckets to prevent sample zinc contamination.

The sampling depth for most row crops using conventional tillage methods is usually 8-12 inches. For no-till or minimum tillage, a 4-6 inch surface sample may be more representative since phosphorus levels may be much higher than phosphorus levels from 4-12 inches. Subsoil samples taken from 8-24 inches or 12-24 inches are necessary to fully evaluate nitrate levels. Subsoil samples are especially needed for corn, small grains and sugarbeets. Additional subsoil samples of 24-36 inches and 36-48 inches are needed for sugarbeets to measure nitrate levels throughout the soil profile.

Sub-samples should be well mixed and 2-3 cups removed, air dried, and packaged in an appropriate container. A plastic lined soil-sampling bag is ideal, however a plastic resealable bag can also be used. Bags can be obtained from laboratories, crop consultants or Cooperative Extension agents. Do not use glass containers since they easily break when sent through the mail.

Once a soil sample has been analyzed for its nutrient content, the laboratory can make a fertilizer suggestion. Growers should be aware that contrasting philosophies exist between laboratories, which can result in different recommendation for the same field, soil, and crop (Figure 2).

Recommendation philosophies include the sufficiency level approach, sufficiency plus buildup, and basic cation saturation ratio. The sufficiency level approach suggests only the amount of fertilizer needed for one season's crop growth. The sufficiency plus buildup is used to increase nutrients such as phosphorus or potassium in the soil above those levels actually needed for one year's growth. The buildup of nutrients ensures that a particular nutrient is always available for plant growth even if adverse growing conditions arise. The basic cation

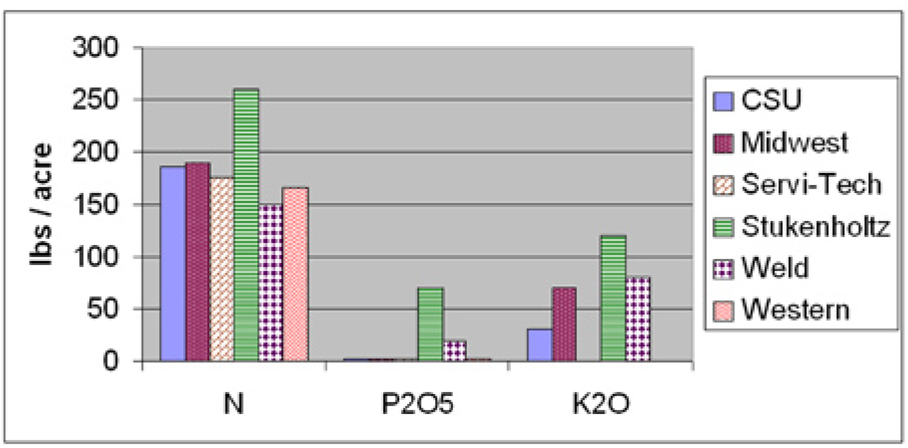

Figure 2. Fertilizer recommendations for grain corn from a field sample that was split and sent to six different laboratories*. Differences result largely from recommendation philosophy rather than analytical quality.

*No endorsement of services provided by these labs is intended nor is criticism implied by the results shown or labs not mentioned.

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Soil Testing and Fertilizer Recommendations for Nitrogen Use (continued)

saturation ratio (BCSR) promotes the idea that maximum yields can only be achieved by creating an ideal ratio of calcium, magnesium and potassium. The BCSR is not concerned with recommendations for nitrogen, phosphorus, sulfur and micronutrients. Field evaluations however, have shown that cation ratios have no impact on the response of crops to calcium, magnesium and potassium. A major disadvantage of the BCSR is that even if the ratio of cations in the soil is considered optimum, a nutrient deficiency may still exist. During this time of higher fertilizer costs it is most economical to apply only those nutrients needed by the crop for one growing season. With the exception of alfalfa, the fertilizer suggestions at Colorado State University are designed to add only those nutrients necessary for one growing season, thus following a sufficiency level approach.

While fertilizer suggestions are made using the nitrate-nitrogen (NO_3-N), phosphorus and potassium levels in the soil, other information, such as yield goal, percent organic matter, previous crop, manure application rate and water usage are also needed. Growers should base yield expectations on a 5-year field average and provide this information, along with the previously mentioned information, to the laboratory.

If a yield goal is not provided, the lab uses a default yield goal to determine the N fertilizer rate. However, the grower can later adjust the amount of fertilizer needed depending on their actual yield goal. Past manure applications and previous crops, especially legumes, may reduce the final N fertilizer recommendation. Laboratories use this information to estimate N credits and suggest the most economical fertilizer rate.

For most crops, the NO_3-N in the surface soil samples is used for N fertilizer suggestions. However, for corn and sugarbeets the amount of total soil nitrate-nitrogen is determined from both the surface and subsoil levels, if subsoil is provided. If a subsoil sample is not provided, it is assumed that the subsoil contains one-half of the NO_3-N found in the surface soil sample. If a soil sampling depth is not provided, it is assumed that the surface soil sample depth is to twelve inches and that the subsoil depth is 12 to 24 inches. For corn, a weighted average of surface and subsoil NO_3-N is used, and is obtained by multiplying the amount of NO_3-N by depth.

When a subsoil sample is not provided, the subsoil nitrate level could be underestimated resulting in less NO_3-N in the two-foot profile and a greater suggested N fertilizer rate. Therefore, it is important to provide a subsoil sample to more accurately ascertain subsoil nitrate levels, possibly reducing the suggested N fertilizer rate.

Fertilizer suggestions provide a guideline for growers to make management decisions regarding the addition of nutrients. Fertilizer suggestions from CSU provide the most economical fertilizer rates to provide the best return on a crop yield within a given growing season.

By Jim Self
Manager
Soil, Water and Plant Testing Lab

It Pays to Manage Nitrogen Using Precision Agriculture Techniques

Productivity level "Management Zones" enhances net dollar returns and nitrogen use efficiency.

Recent increase in N fertilizer prices would result in increased production costs to producers. As the price of natural gas rises, N fertilizer will undoubtedly follow the same trend. These increases in N fertilizer prices create hard decisions for producers. However, the current challenge could be viewed as an opportunity to be creative in ways that would boost net dollar return by enhancing the N fertilizer use efficiency and optimizing yields.

The implementation of precision fertilizer management techniques provides an opportunity to increase net dollar return while enhancing N fertilizer use efficiency through the identification of production level "management zones". Management zones are sub-regions of the field that are similar in productivity potential. We all know by experience that grain yields harvested from different areas of a field are not uniform. Through our research over the last several years [research conducted by scientists from Colorado State University (CSU) and USDA-ARS] we have been able to develop a technique to divide fields into different sections or areas, called "productivity level management zones". Management zones can be identified based on the following information:

1. Aerial imagery of bare soil and other stable soil properties, such as soil organic matter content,
2. Topography of the field, and
3. Farmer's personal experience and grain yield history across the field.

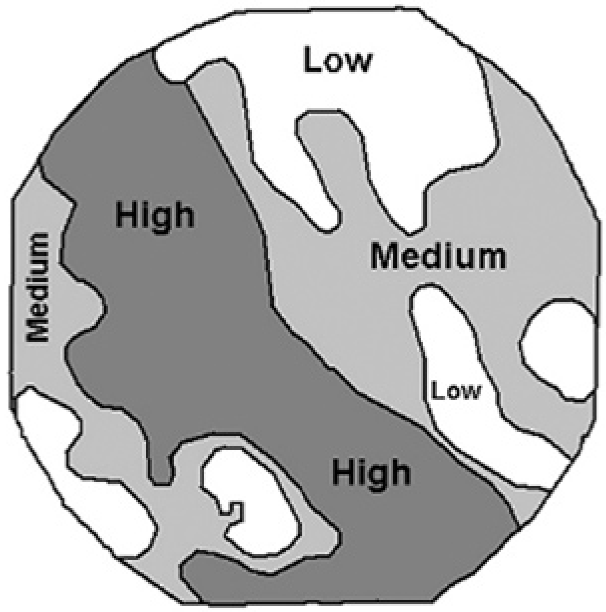

Figure 3. An example of "Management zone" delineated on a farmer's field in northeastern Colorado.

Using this method we can divide fields into at least three different management zones, "High, Medium, and Low" based on the productivity potential of these areas, as shown in Figure 3.

Our study over two years (Table 2) clearly demonstrates the economic advantage of utilizing the management zone approach to manage N fertilizer. The management zone approach optimized N fertilizer applications across the field and at the same time enhanced the net dollar return to the land and management, as presented in Table 2.

Optimizing N fertilization means that the areas of the field that traditionally yield high would get a high N rate, medium productivity areas would receive a medium N rate and low producing areas would receive a low N rate. This insures that N use will be maximized and the crop will have adequate N to optimize yield across the entire field. It can also reduce the total amount of N applied without affecting yields. In some cases, grain yields may even increase using the management zone approach (Table 2) because higher N rates are applied to those areas of the field with higher yield potential. On-farm research conducted in Colorado has proven that these management zones are real, and there are significant differences

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It Pays to Manage Nitrogen Using Precision Agriculture Techniques (continued)

in grain yield across management zones. Therefore, such an approach may reduce N fertilizer costs. In the two fields shown in Table 2, we were able to decrease the average N application rate across the field by 30 to 40 lb N/Acre while increasing net return by $11-12/Acre.

Although the management zone concept presents itself as a positive response to higher N prices, there are also other considerations. Precision fertilizer management may require more time and planning by the producer. Also, there may be start-up costs associated with this management practice. Growers will have to look hard at the cost/benefit issues associated with precision fertilizer management that are specific to their farm operation and compare it to their current situation. Some presume that the hike in N fertilizer is temporary in nature and as natural gas supply increases, costs will decrease. Therefore, why adopt a new management strategy that may require more management input? This is a valid concern. However, adoption of precision fertilizer management will prepare the grower for current and future price increase in N fertilizer while enhancing N use efficiency. By beginning to adopt this new management practice now, a grower can reduce inputs, save money, and plan for the future.

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Extension Specialist
Precision Agriculture
and
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Table 2. Nitrogen management strategies and corresponding grain yield, nitrogen use efficiency and net dollar return for each strategy for 2 years of research.

Nitrogen Management Strategy	Mean N fertilizer	Mean Grain Yield	Nitrogen Use	Net return**
	- Lbs/acre -	- Bu/acre -	-Bu/lb-	------ $ ------
	-----------------------Year 1	--------------------------		
Traditional Uniform	91	171	1.9	$ 83.00
Management Zones	51	174	3.4	$ 94.20
	-----------------------Year 2	--------------------------		
Traditional Uniform	179	232	1.3	$155.00
Management Zones	149	236	1.6	$163.20

* Nitrogen use efficiency refers to bushels (bu) of corn grain produced for every pound (lb) of nitrogen fertilizer that was applied.

** Net $ return presented in this table is calculated as net $ return/acre to the "land and the management".

To learn more about Precision Agriculture visit:
http://lamar.colostate.edu/~rkhosla/

Nitrogen Credits Reduce Fertilizer N Need

Consider all nitrogen sources to reduce N fertilizer requirements.

If you have applied manure or grown alfalfa on a field within the last three years, or your irrigation water contains nitrate, you may get by with less N fertilizer this year. The crop does not care if the N comes from legumes, irrigation water, or fertilizer. In some cases, these N credits may entirely satisfy crop needs and no additional fertilizer is required. A starter fertilizer may be the only supplemental fertilizer needed to enhance seedling vigor. Table 3 shows various N credits. Be sure your crop advisor or soil testing lab knows whether any of these N nutrient credits apply when requesting a recommendation for a field.

Legumes

Legume crops can be a significant source of plant available N due to bacterial N_2 fixation in root nodules. Plowing down a good stand of alfalfa may release more than 100 lbs. of N per acre in the first year after plow down, and 50 lbs. in the second year. Crops following dry beans will benefit also from a small amount of N fixed. Don't underestimate the contribution of this N source.

Manure

We cover this topic in more detail in the next article, but Table 4 provides approximate manure credits for Colorado. Keep in mind that a manure application to a field within the past three years will still be supplying some N to this year's crop. A rule of thumb for N release from manure is that 40% of total N is available in the first year, 20% in the second, and 10% in the third year.

Irrigation water nitrate

Nitrate enriched irrigation water can supply considerable amounts of N because it is applied during the growing season and is immediately available for crop uptake, thus potentially reducing fertilizer required. Consider calculating a credit if your irrigation water contains more than 10 ppm nitrate-nitrogen (NO_3-N) concentration. Crediting water nitrate also improves water quality by removing it from the ground water through crop uptake. Six years of trials at several locations in Weld County showed that reducing the N rate (by up to 120 lbs N per acre) to account for the irrigation water nitrate did not significantly reduce corn grain yield. The economic return on this practice was favorable in most years.

Remember that reducing a fertilizer rate by crediting irrigation water nitrate should not be practiced without using soil testing to initially determine a crop's N needs. Refer to the 2001 From the Ground Up Agronomy Newsletter on Nitrogen Fertilizer at http://www.colostate.edu/Depts/SoilCrop/extension/Newsletters/2001/Nitrogen/index.html for more information on how to use irrigation water nitrate crediting.

by Troy Bauder
Extension Specialist
Water Quality

Table 3. Estimates of N credits from various sources.

N Source	N Credit
Soil organic matter*	30 lb N per % OM
Residual soil nitrate*	3.6 lb N per ppm NO_3-N (1 ft. sample)
Previous alfalfa crop**	
>80% stand	100 - 140 lb N/acre
60 – 80% stand	60 - 100 lb N/acre
<60% stand	30 - 60 lb N/acre
Dry Beans	25 - 30 lb N/acre

*These credits are often factored in N fertilizer rates recommended by soil testing labs and should not be deducted twice.
**For the second year, use ½ of the first year N credit.

Table 4. Manure N credits.*

Manure (solid)	% H_2O	Total N	Available 1st Year
		---- lb N/ton Manure ----	
Beef	32	23	9
Dairy	46	13	5
Swine	82	10	4

*Credit based upon average values for Colorado
Sample manure for actual nutrient content when feasible.

When Fertilizer is Expensive, Think Manure!

Improve soil quality while applying this nitrogen source.

With nitrogen (N) fertilizer prices high, it's a good time to reconsider having manure hauled in and applied to your farm ground. Different types of manure have varying nitrogen contents, and even within a manure type, there is a lot of variation depending on feeding and management practices. Table 5 shows average nutrient concentrations for different kinds of manure.

Table 5. Approximate nutrient content of various types of manure at the time of land application.

Manure Type	Total N (lbs/ton)	P_2O_5 (lbs/ton)	Value of N and P_2O_5 ($/ton)
Beef	23	24	$13.60
Dairy	13	16	$8.32
Sheep	29	26	$16.04
Chicken	33	48	$23.04
Turkey	27	20	$13.84
Horse	19	14	$9.72
Swine	10	9	$5.54

Dollar value is based on $0.32/lb for nitrogen and $0.26/lb for phosphorus ($P_2O_5$).

Based on the current value of the nitrogen and phosphorus in the manure alone, beef manure is worth $13.60 per ton. So if you can get manure for less than that, consider that a good deal! Sheep and poultry manures would be valued even higher due to their higher nutrient concentrations. But be careful to avoid spring applications of fresh poultry or swine manures due to their high ammonium levels that can burn plants.

Of course, manure's value is actually greater than the numbers shown above since manure is also a good source of potassium and micronutrients such as zinc, iron, sulfur, and boron. Plus, manure is a terrific soil amendment. By increasing soil organic matter levels, manure can improve a soil's water and nutrient holding capacity and also improve drainage and aeration. Improved water holding capacity is especially important as we possible head into another year of drought. Manure also makes a good food source for the bacteria, fungi, and worms that recycle soil nutrients and improve soil physical properties.

One important thing to remember about manure nitrogen is that it will mineralize or become available to crops more slowly than commercial fertilizers. In effect, manure acts as a slow release N source, releasing the N over about a three year period. So will applying manure now (in the spring) delay the availability of the manure N even more? Dr. Merle Vigil of the USDA Great Plains Research Center in Akron and Brad Jakubowski (CSU graduate student) studied N availability from fall and spring applied beef manure. Under irrigated conditions, N availability to corn was identical for either application time (measured at both V6 and tassle growth stages). On the other hand, under dryland conditions, fall applications had significantly more N available at V6 than spring applications. By the time corn was tasseling, there was no significant difference in N availability from fall and spring applications, even under dryland. This research demonstrates that under irrigated conditions, manuring now (in the spring) will not delay N release from manure.

When you are spreading manure, choose fields with the lowest soil NO_3-N levels and the highest N need, rather than those with a long-term manuring history. Choosing crops that will give you a yield response for the added manure nutrients makes the most out of the manure application, and saves you the most in fertilizer costs. If there are other yield limiting factors such as heavy weed populations, high water table, or poor irrigation uniformity, this will limit the impact of the manure nutrients on yields. Apply manure where nutrients are the greatest yield limiting factor to get the most bang out of your manure spreading dollar.

If you value manure for its N content, it is critical to conserve that N so that plants can use it. It is important to minimize volatilization losses (losses of ammonia gas into the air). If manure is broadcast and not incorporated, up to 30% of the ammonium in the manure will be lost to the air within just four days of spreading. Incorporating immediately will reduce that loss to less than 5%.

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When Fertilizer is Expensive, Think Manure! (continued)

So to get the most N value from the manure, be sure to incorporate as soon as possible.

If you manage a feedlot, leaving manure in open lots results in the greatest N losses to the air. Storing manure in a manure pack reduces N loss by about a third. Scraping pens and hauling manure out on a daily basis reduces N losses even more. So, if you value manure for its N content, manage manure to minimize N volatilization and add value to the manure.

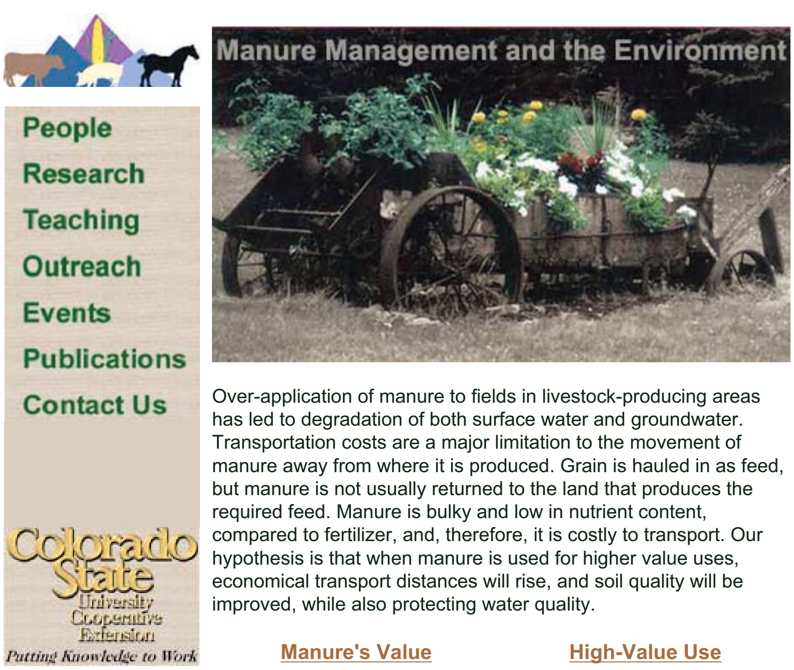
If you have a Concentrated Animal Feeding Operation, the new EPA regulation requires that you evaluate the risk for P runoff to occur from each field where you intend to apply manure. The best way to evaluate this risk in Colorado is with the Colorado Phosphorus Index, a simple tool that considers the texture and slope of the land, the soil test P, the amount of P applied, and how P is applied (more information available at your local NRCS field office). If the P Index is high, then manure has to be applied at rates to meet the crop's P requirements, not the N requirements. This will significantly reduce application rates, and most crops will require N fertilizer supplementation. However, the new regulation does allow for multi-year P applications up to the agronomic N rate. In other words, you can apply three or four years' worth of P at one time, as long as you do not apply P again until three or four years later and as long as this manure application rate does not exceed the N agronomic rate. We compared N-based and P-based manure application rates in a recently completed four-year study and found that although N-based rates significantly increased soil test P, there were no cases of soil NO_3-N or NH_4-N buildup in the N-based rates exceeding those for the P-based rates.

Lastly, you'll get the most out of the manure application if it is applied as uniformly as possible with properly calibrated equipment. When you load the spreader trucks, be sure to even out the load in the truck, because uneven loading results in uneven application. Monitor the distribution of manure as it comes out the back, so you can get the proper overlap to even out the application rate. Otherwise, you may end up with N deficiencies in some spots and too much N in other spots, even though over the whole field, the application rate was correct.

Manure spreader

You may have avoided manure application in the past because of high transportation costs. But check your figures again this year, since the fertilizer value of the manure may outweigh the transportation costs. And what other fertilizer increases soil organic matter and improves soil properties!

by Jessica G. Davis
Extension Specialist
Soils



Visit

www.manuremanagement.info

for more Manure Management Information

In-Season Tools Manage N Closer To Margin

Pre-sidedress nitrate test (PSNT) offers corn growers confidence.

Current nitrogen (N) fertilizer recommendations in Colorado are based on soil samples taken in the fall or in the early spring. However, most N uptake by corn occurs in midsummer from the 8-leaf growth stage to pollination. Mineralization of N from manure or other organic matter, and nitrate leaching, can significantly change soil N status before this time. The pre-sidedress nitrate test (PSNT) measures these potential changes. By complementing preplant soil testing with PSNT, growers can better predict yield response from N fertilizer, saving unnecessary fertilizer costs.

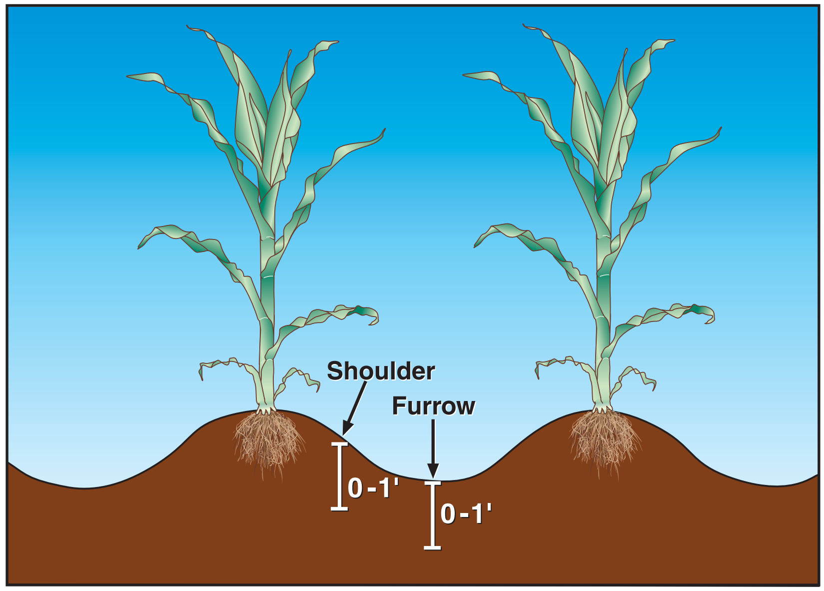


Figure 4. Recommended sampling positions for PSNT testing of irrigated fields.

The PSNT is based on nitrate concentration in the top 12 inches of soil when corn is 6 to 12 inches tall (V6 growth stage). Under typical Colorado conditions, CSU researchers found the critical PSNT level is 15-ppm nitrate-N (NO_3-N) in the top foot of soil at this growth stage. If the PSNT level is lower than 15 ppm NO_3-N, sidedress N should be applied. If the PSNT level is higher than 15 ppm NO_3-N, the probability of a yield response to additional N is very low (see Table 6). Although the PSNT was originally calibrated for non-manured fields in Colorado, the 15 ppm NO_3-N should also be sufficient for fields with recent manure applications or legume crops. The test is most useful for predicting whether or not soil N is sufficient - not for making an N rate prediction. You must assess yield potential as well as soil nitrate levels to determine how much additional N is needed if the PSNT is below 15 ppm.

Proper soil sampling may be the most critical step in the PSNT procedure. To sample a field, take a minimum of 15 to 20 random soil core samples from a uniform soil area or 40-acre field. On surface irrigated fields, we recommend collecting equal numbers of soil samples from the furrow and shoulder of the bed and sampling depth of 12 inches (see Figure 4). Get the soil sample to a testing lab right away and tell the lab you are evaluating the sample for PSNT and need your results quickly. Using the PSNT will give you more confidence to evaluate your sidedress decision, and you may see savings in both fertilizer and sleep.

by Reagan Waskom
Extension Specialist
Water Resources
CSU Water Center

Table 6. The yield response of corn to sidedress N application of 60 lbs/acre when PSNT was above or below the critical NO_3-N concentration at V6.

(Sampling Depth: 0 - 12")	Number of Observations	Yield response from sidedress N	Prediction accuracy
		# of Sites	%
Below critical level (15 ppm)	35	19	54**
Above critical level (15 ppm)	21	0	100
Total	56		71

*Based on equal sampling intensity from both furrow and shoulder positions
**16 sites did not respond to additional N

Nitrogen Application

What, when, where and how you apply nitrogen matters.

Well-timed and placed nitrogen (N) fertilizer applications can greatly enhance plant uptake of nitrogen and maximize return when you're trying control input costs. The greatest N use efficiency occurs when N fertilizer is applied in increments to match crop needs. If possible, reduce or eliminate application of preplant N. When this is not an option, consider applying an ammonium N form, such as urea or anhydrous ammonia, because the ammonium ion (NH_4^+) is not subject to immediate leaching. Nitrate (NO_3) forms of N fertilizer are readily available to crops, but are subject to leaching losses. Although transformation of NH_4 to NO_3 under warm, moist soil conditions occurs rapidly, applying ammonium forms early in the season may reduce leaching losses. Slow release N fertilizers may also be feasible this year, particularly for high value crops. Immediately incorporate all surface applied fertilizers to reduce runoff and volatilization.

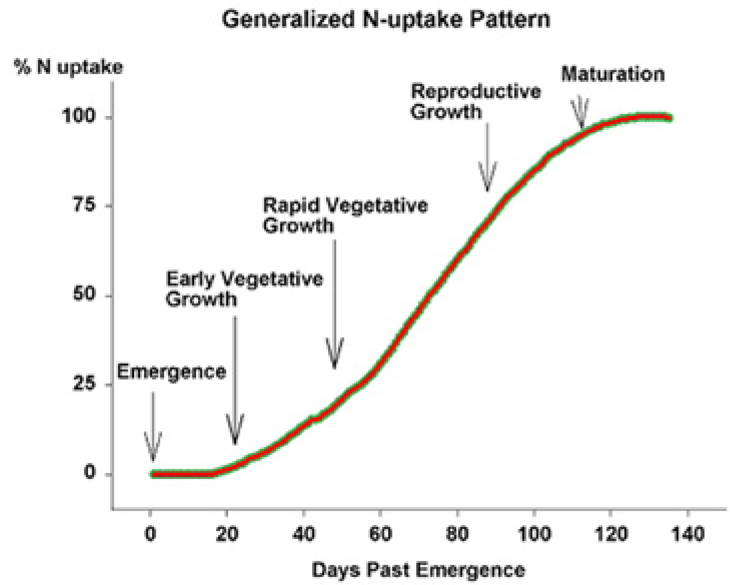


Figure 5. Generalized nitrogen uptake pattern across growth

Fertilizer applications should be timed to coincide as closely as possible to the period of maximum N uptake which is during rapid vegetative growth (see Figure 5 and Table 7). A starter fertilizer, followed by sidedress application or fertigation improves crop N uptake efficiency and is a good strategy this year. Application of N through high efficiency irrigation systems such as center pivot or surge systems during rapid growth maximizes crop N uptake. It is not recommended that

Table 7. Time of application has a big impact on efficiency.

Nitrogen use efficiency	Time of Application
Highest	Sprinkler applied during rapid growth
↓	Sidedress applied immediately before rapid growth
	Post-plant incorporated
	Pre-plant incorporated
Lowest	Fall application

Interested in Trying the PSNT?

With N fertilizer costs high and water supply projections low, this is a good year to consider using an in-season N assessment for determining side dress needs for corn. However, many folks may be nervous about trying a newer practice without some technical support. Growers or county faculty that would like to try using the PSNT should give Troy Bauder (970-491-4923) a call. He is willing to provide advice and field support to increase the use of this practice among Colorado corn producers.

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Nitrogen Application (continued)

nitrogen be applied through low efficiency furrow or flood systems due to runoff and deep percolation losses. Waiting until the crop is well established before applying large amounts of N also allows you to more accurately determine the crop yield potential. Poor stands, weed control, and below average precipitation are good reasons to adjust N rates downward at sidedress time. Conversely, exceptional conditions warrant increased N at sidedress.

Another thing producers must keep in mind when making fertilizer choices is how much you are actually paying for the element nitrogen. Often producers will price fertilizers by the ton rather than by the pound of actual N. This is unfortunate because price per ton can be misleading. Table 8 presents a comparison of cost of nitrogen fertilizer per ton and per pound of N. Notice that 28% UAN has the cheapest price per ton, but is expensive on a price per pound of N basis. Conversely, anhydrous ammonia is the most expensive N fertilizer in price per ton, but is the cheapest source for actual price per pound of N.

Table 8. Comparison of cost average of nitrogen fertilizer per tone and per pound of N in 2004.

Fertilizer	%N	lb N/ton	$/ton	$/lb N
Anhydrous-NH_4	82	1640	397	0.24
32% UAN	32	640	208	0.33
NH_4-NO_3 *	34	680	370	0.54
Urea	46	920	302	0.33

* Based on only two sources handling NH_4-NO_3.
Reduced availability due to security concerns.

Nitrogen is not a stable element in soil and some portion of your fertilizer will be lost to leaching and other transformations. Application timing, technique and fertilizer form all can help reduce these loses and optimize your N dollar.

by Reagan Waskom and Raj Khosla
Extension Specialists
Water Resources and Precision Agriculture

For past issues of the Agronomy News on agricultural topics such as:

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Managing Irrigation Water

Efficient water application is key under tight nitrogen management scenario.

Using atmometers to schedule irrigations is one cost-effective technique.

Efficient water management is critical to achieving high nitrogen (N) use efficiency. Nitrate-nitrogen is soluble and moves readily downward with soil water. Applying more irrigation water than can be stored in the crop root zone will increase nitrogen losses through nitrate leaching and negate other positive N management strategies. Adjusting irrigation management to increase both efficiency and uniformity will result in more N available for crop uptake throughout the growing season.
Producers should reevaluate their irrigation scheduling method when growing crops under a tighter nitrogen budget. Decide when to irrigate based upon an estimate of crop and soil water status, as labor and water delivery permits. If currently irrigating on a fixed day schedule, consider whether increasing the length of time between irrigations is feasible, especially when the crop is not in a sensitive growth stage.

Experienced producers know how long it takes them to get water across their fields and are proficient in avoiding crop stress during years of average rainfall. The difficulty lies in applying only enough water to fill the effective root zone without unnecessary deep percolation or runoff. Several devices, techniques, and computer aides are available to help producers in determining when they need water and how much is required.

Producers should choose the scheduling method which best suits their needs and management capabilities. Information necessary to improve scheduling includes:

- soil water-holding capacity
- current plant available soil moisture content
- crop water use or evapotranspiration (ET), daily ET rates available at www.coAgMet.com
- crop sensitivity to moisture stress at current growth stage
- irrigation and effective rainfall received
- availability of water supply
- length of time it takes to irrigate a particular field.

Consider using an irrigation scheduling service offered by crop consultants as a cost-effective method of scheduling irrigations to maximize return from N fertilizer inputs.

Improving the water distribution across a field (uniformity) is also important when focusing on keeping N in the root zone under surface irrigation. Producers should probe fields within 72 hours after irrigation to find depth of application along the irrigation gradient. Checking for visual signs of plant stress can also show areas of poor water penetration. Most commonly, the upper end of the field is over-watered and the lower end under-watered.

Surface irrigators should consider using surge irrigation or adjusting irrigation set size, stream size, set time, and length of run to improve both efficiency and uniformity. When properly used, surge valves can save labor and water with no loss of crop yield. Irrigators currently using conventional furrow irrigation on coarse-textured soils, fine soils with cracking problems, or slopes greater than 1% would benefit most from using surge valves

Using polyacrylamide (PAM) allows irrigators to use a higher stream flow rate (2x or higher), which also can improve application uniformity. However, using PAM without increasing flow rate is not recommended. Driving all rows can reduce excessive water intake on coarse soils early in the crop season before the first irrigation. Another irrigation strategy is to

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Managing Irrigation Water (continued)

irrigate every other row and band apply nitrogen fertilizer on the ridge of the nonirrigated row. Researchers in Idaho (Lehrsch et al., 2000) found that this practice maintained or increased yields and increased N uptake on a silt loam soil. However, this practice may not be as beneficial on finer textured soils (clay loams).

Upgrading to an improved irrigation system usually results in improved water and nitrogen efficiency. Among these are systems such as low-pressure center pivot, LEPA (Low-Energy Precision Application), surge, and drip-irrigation. However, these improvements require capital, energy, or increased management costs, that may not pencil out in the short term. However, in some cases the additional labor savings will justify installation of improved systems over a period of several years.

by Reagan Waskom and Troy Bauder
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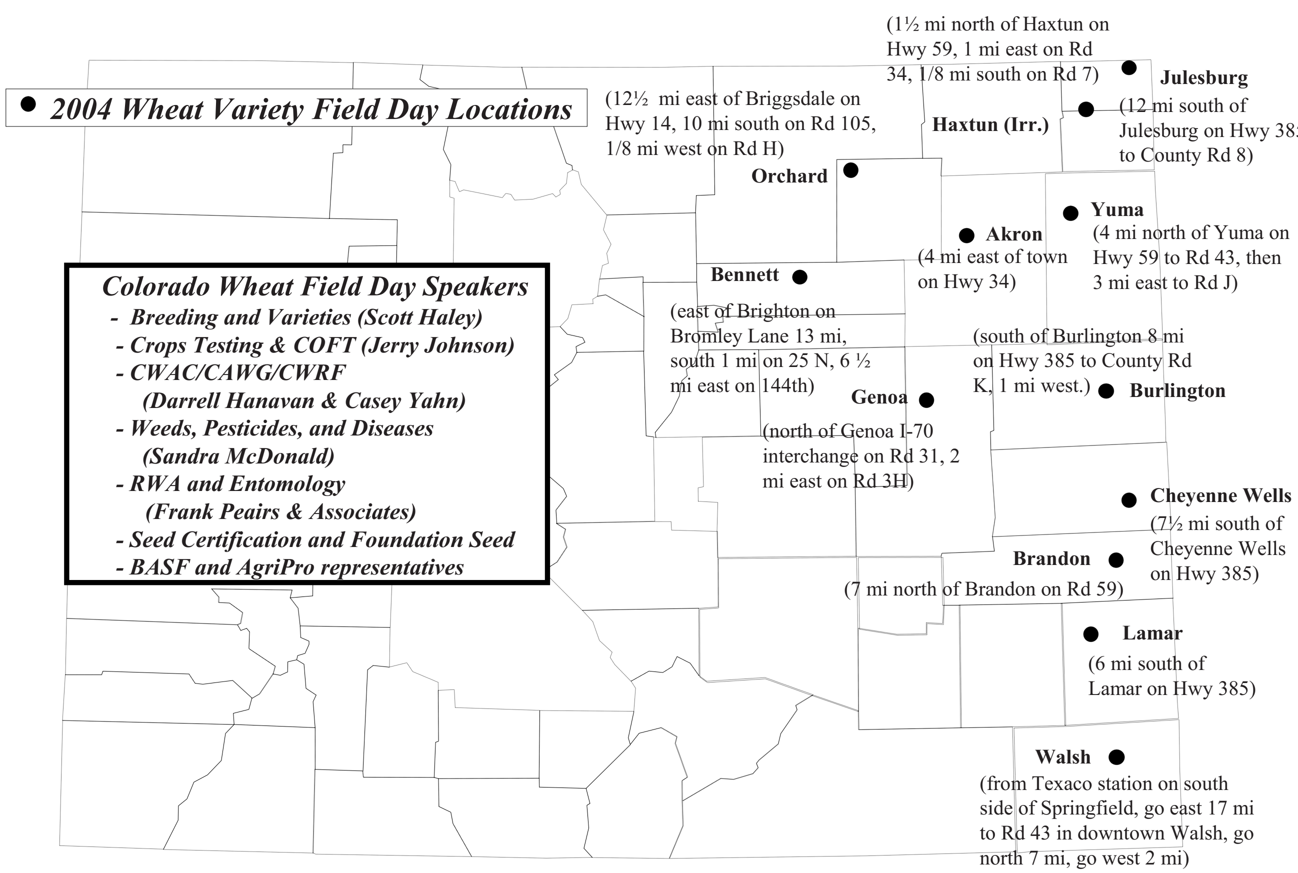
Water Quality

Colorado Wheat Field Days 2004

Walsh	June 14 (Mon)	9 a.m. at Plainsman Research Center, Baca County
Lamar	June 14 (Mon)	6 p.m. at John Stulp's house, Prowers County
Brandon (Sheridan Lake)	June 15 (Tues)	8 a.m. at Burl Scherler Farm, Kiowa County
Cheyenne Wells	June 15 (Tues)	12 p.m. at Tom Heinz Farm, Cheyenne County
Burlington	June 15 (Tues)	4 p.m. at Randy Wilks Farm, Kit Carson County
Akron	June 16 (Wed)	8 a.m. at Central Great Plains Res. Station, Washington County
Yuma	June 16 (Wed)	4 p.m. at Andrew Brothers Farm, Yuma County
Julesburg	June 17 (Thurs)	9 a.m. at Walt Strasser Farm, Sedgwick County
Haxtun (Irrigated)	June 17 (Thurs)	12 p.m. at Steve Smith Farm, Phillips County
Orchard	June 17 (Thurs)	5 p.m. at Cary Wickstrom Farm, NW Morgan County
Genoa	June 21 (Mon)	12 p.m. at Ross Hansen Farm, Lincoln County
Bennett	June 21 (Mon)	5 p.m. at John Sauter Farm, Adams County



Considerations for On-Farm Fertilizer and Pesticide Storage

Growers storing large amounts of fertilizer on-farm may fall under storage regulations.

High N fertilizer prices may persuade some growers to buy liquid or dry fertilizer products in bulk and store on-farm until they are ready to apply them. Other growers may be storing fertilizer on-farm due to the size of their operation or custom work they perform. Regardless of the reason, growers choosing to store large amounts of fertilizer need to be aware that their activity may be regulated by the Colorado Department of Agriculture (CDA) under the Agricultural Chemicals and Groundwater Protection Act. This law requires storage facilities and mixing and loading areas for fertilizers and pesticides when they are stored and handled in quantities that exceed set minimum thresholds. The rules also establish performance standards for the construction and operation of secondary containment of bulk liquid fertilizer and pesticide storage facilities; fertilizer and pesticide mixing and loading areas; and bulk dry fertilizer and pesticide storage.

The purpose of these rules is to prevent spills and leaks that may occur during the storage and mixing and loading of agricultural chemicals from contaminating groundwater. These rules and regulations apply to all operating bulk agricultural chemical storage and mixing/loading facilities, commercial or private that exceed the set minimum thresholds.

Answer the following questions to determine if these regulations apply to your operation.

Fertilizers

1. Do you store liquid fertilizer in a container or series of interconnected containers with a *capacity* of greater than *5,000 gallons* for a period of *30 consecutive days or more*?

2. Do you store bulk (containers larger than 100 pounds) dry fertilizer in quantities of *55,000 pounds or more* for a period of *30 consecutive days or more*?

√ *If you answered yes to either question 1 or 2, secondary containment and a mixing and loading pad are required.*

Field mixing and loading of fertilizers is exempt.

Pesticides

Secondary Containment

1. Do you store pesticides in containers larger than *55 gallons* for liquid pesticides or *100 pounds* for dry pesticides for more than *15 consecutive days*?

√ *If you answered no to question 1, secondary containment is not required, skip questions 2 and 3.*

2. Do you store pesticides in containers larger than *55 gallons* that are not Department of Transportation (DOT) 57 or MACA 75 approved?

3. Do you store pesticides in containers larger than *660 gallons*?

√ *If you answered yes to either question 2 or 3, secondary containment and a mixing and loading pad is required.*

Mixing and Loading Pads

4. Do you mix and load at *one site annually* (any site within 300 feet of another site is considered one site for these regulations) more than:

   a. 500 gallons of liquid formulated product (concentrate as it comes from the supplier), OR

   b. 3000 pounds of dry formulated product, OR

   c. 1500 pounds of active ingredient of a combination of liquid and dry product?

√ *If you answered yes to any part of question 4, a mixing and loading pad is required.*

Field mixing and loading of pesticides is exempt.

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Considerations for On-Farm Fertilizer and Pesticide Storage (continued)

Regardless of whether you fall under these regulations, growers should consider implementing certain minimum standards for the storage and handling of agricultural chemicals for security reasons and water quality protection. These include: keeping separate, weather proof, secured storage areas for fertilizers and pesticides; having secondary containment in place for stored products; and using a mixing and loading area that won't impact water resources. Best Management Practices for Pesticide and Fertilizer Storage and Handling, XCM-178 (http://www.ext.colostate.edu/PUBS/CROPS/xcm178.pdf) is a good resource for assessing your storage situation.

If you have any questions regarding on-farm storage, please call Rob Wawrzynski with the CDA's Groundwater Protection Program at (970) 223–7017. The CDA web site (www.ag.state.co.us) also contains information regarding these rules and regulations.

by Rob Wawrzynski
Groundwater Protection Coordinator
Colorado Department of Agriculture

Websites

Nitrogen from legume crops:
University of Wisconsin Integrated Crop and Pest Management page provides a table for calculating nitrogen credits from legumes at: http://ipcm.wisc.edu/pubs/cards/a3591.htm

Nitrogen from manure:
Colorado State University Fact Sheet 0.560 Cattle Manure Application Rates discusses value of manure and how to calculate rates: http://www.ext.colostate.edu/PUBS/CROPS/00560.html

Using chlorophyll meters to manage nitrogen:
University of Nebraska NebGuide G93-1171-A Using a Chlorophyll Meter to Improve N Management:
http://www.ianr.unl.edu/pubs/soil/g1171.htm

Tips on improving nitrogen and irrigation management:
Crop Production with Limited Water
http://www.colostate.edu/Depts/SoilCrop/extension/Newsletters/2003/Drought/index.html

Daily Crop Water Use (ET) Reports
http://www.coagmet.com

Various issues of this newsletter provide information on these topics. See the index at :
http://www.colostate.edu/Depts/SoilCrop/extension/Newsletters/news.html

Various publications from University of Nebraska Institute of Agriculture and Natural Resources address this topic. See the index at: http://www.ianr.unl.edu/pubs/water/index.htm#WATER

Various articles at the University of Nebraska CropWatch Newservice address this topic.
See the index at: http://cropwatch.unl.edu/

Security Requirements Affect Fertilizer Transport

Growers that transport fertilizers or other hazardous materials need a security plans.

Homeland security begins at home and in this case "down on the farm". The Federal Department of Transportation (U.S. DOT) has issued a new rule that applies to producers who transport fertilizer and other hazardous materials from the dealer to their farm. This rule is aimed at deterring terrorist and other illegal acts while at the same time limiting a producer's exposure to liability in the event that an illegal act occurs.

Who has to comply?
Agricultural producers who ship or transport certain hazardous materials in quantities that require placards (diamond shaped signs) must develop and implement a transportation security plan. If you do not ship or transport hazardous materials in amounts that require placards you do not need a security plan. Also, if suppliers deliver hazardous materials to your operation, it is their responsibility to have a plan.

What fertilizer materials are covered?
Anhydrous ammonia and ammonium nitrate and any other materials that require a placard (see Table 9) are covered under this new rule. This also includes: pesticides; fuels such as gasoline, diesel, and propane; and explosives such as dynamite and detonators.

When does this rule take effect?
The rule took effect on September 25, 2003.

What does this plan need to cover?
Security En Route: Your security plan must include measures to ensure the security of the materials between the time you pick them up and the time you arrive at your farm. In this case, the most effective security measure would be to minimize the time that the shipment is in transit by going directly from your supplier to your farm. The security plan does not apply to transportation between fields.

Unauthorized Access: Your security plan must include measures to protect against unauthorized access by using locks or physical/visual observation. For example, if you stop on the way back to your farm for a snack or a meal, you should keep your vehicle in sight and/or lock or secure the material in the vehicle.

Personnel Security: If you use employees to pick up and transport placarded hazardous materials from your supplier to your farm, your security plan must include measures to confirm information provided by the employee on his/her job application or resume. This only applies to employees hired after September 25, 2003, and who are involved in the actual shipment or transportation of the materials covered by the plan.

The U.S. DOT wants producers to consider:

- Your plan can be tailored to your operation.
- You need to keep your plan on file to comply, but it will not be collected by or kept on file at State or Federal DOT offices.
- Your plan will be enforced by State or Federal DOT as part

Table 9. Examples of the types and quantities of hazardous materials that require a placard and, thus, a transportation security plan.

Material	Quantity
Anhydrous ammonia	More than 119 gallons in a single container
Ammonium nitrate fertilizer	OR
Pesticides that bear a DOT poison label	More that 1,000 pounds in multiple containers in a single shipment
Propane	
Gasoline	
Dynamite	Any Amount

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Security Requirements Affect Fertilizer Transport (continued)

of the general enforcement program for the HAZMAT carrier and shipper community but *not as part of any roadside stop inspection.*

- U.S. DOT is taking an educate over regulate approach to these transportation requirements.

You may have a plan already in place currently that meets these requirements, such as one drawn up in accordance with agribusiness guidelines issued by The Fertilizer Institute, the Agricultural Retailers Association, CropLife America, or other industry groups or associations, or a plan implementing safety and security measures for pesticides in accordance with Environmental Protection Agency regulations.

How can I get more information?
Visit: http://hazmat.dot.gov/hmt_security.htm for the complete rules, a sample plan (in Transportation Security Evaluation & Planning for Farmers, Ranchers, & Agricultural Production Operations), and additional facts from U.S.DOT. or Contact the HAZARDOUS MATERIALS INFORMATION CENTER at 1 (800) HMR-4922

by Troy Bauder
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More Websites

Soil Testing
Colorado State University Fact Sheet 0.500
Soil sampling at: http://www.ext.colostate.edu/PUBS/CROPS/00500.html

Colorado State Unviersity Fact Sheet 0.501
Soil testing at: http://www.ext.colostate.edu/PUBS/CROPS/00501.html

Colorado State Unviersity Fact Sheet 0.502
Soil test explanation at: http://www.ext.colostate.edu/PUBS/CROPS/00502.html

Colorado State Unviersity Fact Sheet 0.520 Selecting and analytical Laboratory at: http://www.ext.colostate.edu/PUBS/CROPS/00520.html

Colorado State University publications on CSU fertilizer recommendations, nitrogen management, and related topics see index at : http://www.ext.colostate.edu/PUBS/CROPS/pubcrop.html

Tips on Preventing Anhydrous Ammonia Theft

Methamphetamine dealers target fertilizer supplies to manufacture illegal drugs.

According to federal law, it is unlawful for any person to: "….steal anhydrous ammonia, or to transport stolen anhydrous ammonia across state lines, knowing, intending, or having reasonable cause to believe that such anhydrous ammonia will be used to manufacture a controlled substance in violation of this part….." However, this law does not seem to be deterring criminals from targeting farmers' and dealers' N supplies. Theft of anhydrous ammonia is a serious problem and the contraband is not being used to grow better crops, legal or otherwise. Thieves use the anhydrous to produce methamphetamine (meth), a powerful central nervous system stimulant that has a high potential for abuse and dependence. Seizure of meth labs increased by 300% from 2001 to 2002 and local authorities are dealing with increasing theft and tampered anhydrous tanks throughout rural Colorado. One Northeastern Colorado County conservatively estimated the number of thefts at 50 in the past two years.

Victims of anhydrous ammonia theft may not realize a theft has occurred because the amount of material stolen is relatively small compared to the overall volume of a tank. A large quantity of meth can be manufactured with less than 10 gallons of anhydrous ammonia. Evidence of tampering with tank valves or the presence of items left behind by thieves is ways that you may know a theft has occurred. These include:

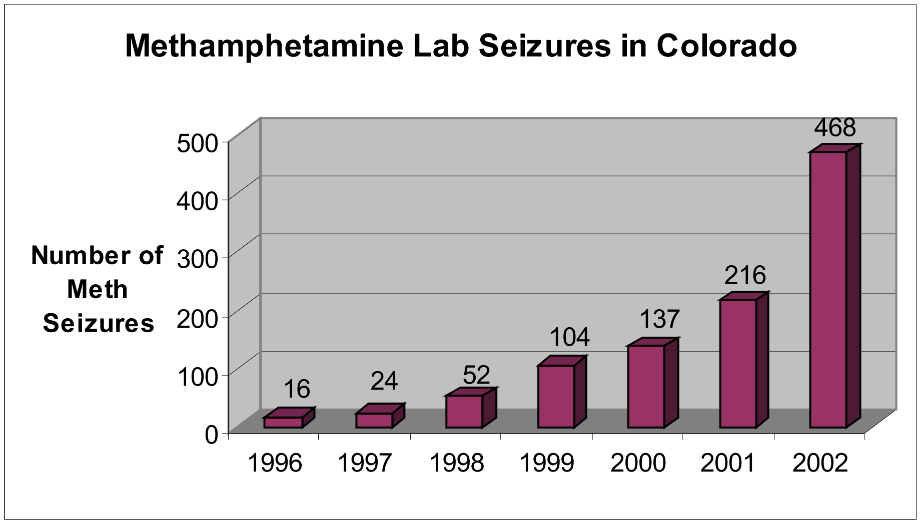

Figure 6. Methampehtamine is a growing problem in Colorado.

Source: Drug Enforcement Administration and Colorado Bureau of Investigation.

- Partially opened tank valves and/or leaking tanks;
- Buckets, coolers, duct tape, garden hoses and bicycle inner tubes are used to steal anhydrous. If you find empty containers around your tanks, be extremely cautious, especially small barbeque tanks. The valves may be compromised and dangerous to handle.
- The presence of unfamiliar or suspicious-looking individuals during daylight hours (thieves often scout the property beforehand);

Consider the following procedures to protect your N-supply from theft:

- Have tanks delivered as close to application as possible and immediately return them when you are done with them.
- Consider obtaining locking devices for nurse tank valves.
- If you are holding multiple tanks for an extended period of time, it may be helpful to visit with rural law enforcement about the location and amounts of anhydrous ammonia.
- Ensure that tanks are placed in lighted, secure areas. If possible, place tanks where they can be seen from the residence and where the flow valves face either the drive lane or residence.
- Bleed and remove hoses to remove excess liquid. This small amount can be enough to produce meth.
- Check tanks frequently since unattended tanks are often targeted

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Tips on Preventing Anhydrous Ammonia Theft (continued)

- Block road lanes or entrances near the tank with a gate or barricade to complicate theft of the entire tank.
- Post *No Trespassing* signs and label tanks with caution labels to warn of the highly hazardous nature of anhydrous ammonia and to reduce your liability should an injury occur during theft.
- Brightly colored plastic wire ties or seals between the valve wheel and the roll cage will help make quick visual checks for tampering. A broken tie or seal indicates a likely tamper incident.
- Do not confront suspicious individuals near your tank. Call the police, because users of meth may become violent with little provocation.

Taking a few simple steps and being a little more vigilant about where and when anhydrous tanks are stored may prevent your N supply from being used in a drug wave that is impacting your community. Paying attention to potential signs of tampering with tanks may prevent a serious accident with your family, employees or neighbors.

by Troy Bauder
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Sources:

Colorado Bureau of Investigation – June 2003.

Chemical Safety Alert, March 2000, U.S. Environmental Protection Agency: http://yosemite.epa.gov/oswer/ceppoweb.nsf/content/ConsolidatedPubs.htm

The Fertilizer Institute, http://www.tfi.org

Code of Federal Regulations Pub. L. 91-513, title II, Sec. 423, as added Pub. L. 106-310, div. B, title XXXVI, Sec. 3653(a), Oct. 17, 2000, 114 Stat. 1240.

Preventing Theft of Anhydrous Ammonia, Ohio State University Fact Sheet:
http://ohioline.osu.edu/aex-fact/0594-1.html