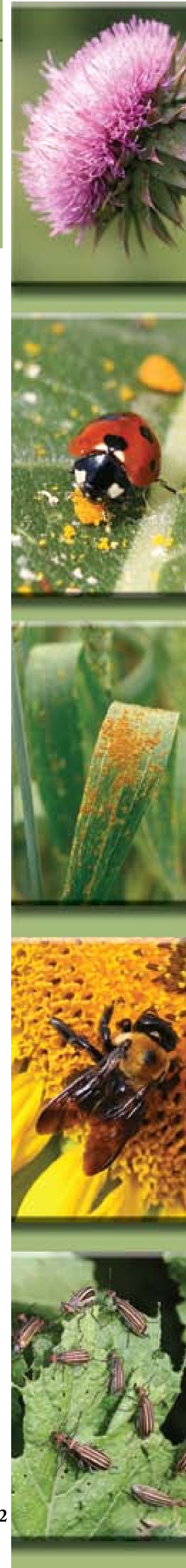
Plant Protection Programs — University of Missouri

Integrated Pest & Crop Management



When Will the New CAFO Rules Affect you?

By John A. Lory

There has been a lot happening in the CAFO regulatory arena. Another final revision to the Federal CAFO rule was published in the Federal Register in October 2008. The Missouri Clean Water Commission reviewed a proposed Missouri Nutrient Management Standard for permitted CAFOs in January 2009 and plans to finalize this new standard by the end of February.

So how do these changes affect permitted animal feeding operations in Missouri? For most operations there will be no immediate impact. Most permitted operations are covered by the Missouri General Permit. The General Permit will expire in February 2011. You can continue operating your farm meeting the terms and conditions of this current permit until it expires. This means all operations under the General Permit have about two years before they need to meet the requirements of the new rules.

There are two exceptions to this advice. Operations that have "site-specific" permits will need to meet the requirements of the new rules when their permit is renewed. These permits have renewal dates that do not correspond with the General Permit. The expiration date will be listed on the permit. Most site-specific permits are held by the largest operations in the state (Class IA).

Any new permits issued by MDNR after February 27, 2009 as either General or site-specific permits will meet the new permit requirements. So any new operations or operations that add a new source such as a new building with a manure storage will have the new regulatory standards in their new permit.

The full impact of the October 2008 Federal CAFO rule is still being sorted out. Some issues include:

- It may be difficult or impossible to have new pig, veal and poultry operations without animals and the manure storage under a roof.
- There is a debate about how best to integrate Missouri permit requirements and the options for permitting or certifying your operation with EPA.
- The new EPA rules will likely involve more extensive public review of permits, just how this will be implemented needs to be worked out.

The good news is that most permitted farms will have two years to determine how these rules may affect them and develop a strategy to implement the new requirements.

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Streaky Fields and Uneven Application of N Fertilizer

By Peter Scharf

(ABOVE) Uneven nitrogen fertilizer applications with a spinner spreader are probably the cause of the streaks taken in this photo late in August 2008.

In the last issue, I wrote about widespread loss of nitrogen fertilizer from corn fields in 2008 (http://ppp.missouri.edu/newsletters/ipcm/archives/v19n1/a2.pdf). Something that always strikes me when I am taking aerial photos in areas that have had excessive rainfall and nitrogen loss is how many fields have obvious streaks of light and dark green. I would say that in 2/3 of all fields where I see severe N stress I also see at least some streaking.

In some of these fields, I have georeferenced the aerial photos so that the distance between streaks can be determined. In all cases, the distance between streaks has matched up with some kind of nitrogen fertilizer applicator–most often 30 or 40 feet for anhydrous applicators, and 40, 50, or 80 feet for spinner spreaders. Occasionally I have run into evidence that there was a pattern problem with application of nitrogen solution, but this is relatively rare.

Why are problems with nitrogen application patterns so common? One important reason is quality of dry fertilizer materials. Over the past ten years, domestic production of nitrogen fertilizer has decreased due to high natural gas prices relative to other places in the world. The cost of natural gas is about 3/4 of the cost of producing nitrogen fertilizer, so it's considerably cheaper to make nitrogen fertilizer in places where gas prices are 10-20% of the prices in the U.S., then ship the fertilizer here. This has resulted in more than a doubling of urea imports over the past ten years (see graph).

By the time it gets to the field where it will be spread, imported urea has been through more augers than domestic urea. This handling can break down individual granules or prills into smaller particles. In the limited amount of dry fertilizer that I see, I have noticed a clear decline in average quality over the past ten years as import levels have increased.

Most dry fertilizer in Missouri is applied using spinner spreaders. These spreaders are very efficient in spreading fertilizer. However, broken granules will not travel as far as intact granules when applied with a spinner spreader. When poor quality fertilizer with lots of broken granules is applied using a spinner spreader, the small particles all fall near the path of the spreader. This results in a high N rate near the path of the spreader and a low N rate midway between passes. It's clear that this problem can cause a lot of yield loss in fields like the one shown above. It's not clear how much yield loss results from the same poor pattern in a year with less loss of N.

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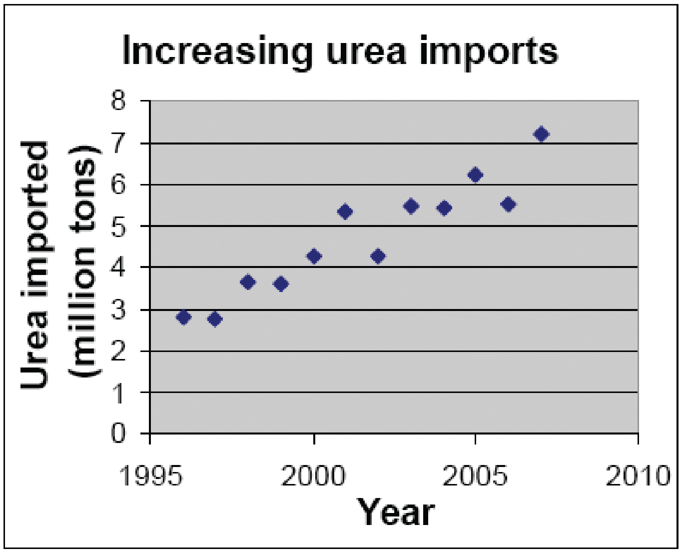

What are the possible solutions to uneven application of dry nitrogen fertilizers? Air boom spreaders probably handle low-quality material better than spinners. You can't throw dust, but you can blow it. This may be the simplest and easiest solution, but I hear more retailers talk about moving from air boom machines back to spinners than the other way around. My thought is that it's worth it to producers to pay enough extra for air boom spreading to make it worthwhile for retailers to use these machines. Another possibility is to start more careful grading of dry fertilizer, and pay a premium for the better-quality material that can be spread evenly using a spinner machine. (This would mean that lower-quality material is cheaper, again creating an advantage for air-boom spreaders). I occasionally hear about conscientious retailers

(ABOVE) Anhydrous ammonia was applied preplant to this field parallel to the corn rows. Dark streaks are about 30-feet apart which was the applicator width. This is probably a case of end knives putting out low rates.

double-spreading poor-quality material. This certainly helps to improve fertilizer distribution, but is not really making an even application–making the pattern of unevenness less obvious may be one of the main benefits. Screening poor quality dry fertilizer is another possibility. This introduces a lot of extra work, but may cost less than poor distribution, especially as the proportion of poor quality material in the system continues to increase.

Anhydrous ammonia applicators also frequently give poor distribution of fertilizer. Uneven splitting at the manifold appears to be the main source of this problem in several studies that I have read or heard of. Newer manifolds with interior structures that are designed to swirl the ammonia around the manifold chamber apparently improve distribution, as do vertical dam manifolds. At the high end, pumping/metering systems provide the most thorough solution. At the low end, simply randomizing hoses is the most effective step that does not involve new equipment. This is a little like double-spreading poor quality dry material: the problem still exists, but the pattern is more complex and the low spots are not as large. When the manifold outlets near the intake are putting out the lowest rates, and on both sides these are attached to the knives near the end of the bar, several rows near the end of the bar will be under-applied, then the adjacent rows will be under-applied on the next pass. This is a pretty common occurrence, judging from what I've seen from the air, and can produce a strong striping effect. Other factors, such as knife inspection/maintenance/replacement and making hoses even in length, can provide a small amount of improvement.

It's very unfortunate to lose as much N as we did this year, but the visual feedback that it gives us on nitrogen fertilizer distribution shows that this is a major problem that needs to be addressed. Air boom spreaders or double spreading are the main ways to improve evenness of poor-quality dry materials, while better manifolds are the key to improve evenness of ammonia application.

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Steps to Minimize Losses from Three Important Soybean Diseases

By Laura Sweets

When asked which soybean diseases consistently cause losses and which are most difficult to manage both producers and agri-business personnel listed Phytophthora root rot, soybean cyst nematode and sudden death syndrome. All three of these diseases are caused by pathogens that are present in the soil, all three are found in all soybean producing areas of the state and all three can be difficult to manage. Management options for these three diseases rely primarily on preventative measures since effective rescue treatments are not available. These three soybean diseases along with management options are described below. For additional information and color pictures please see the University of Missouri Extension bulletin IPM1002 *Soybean Diseases*.

Phytophthora Seedling Blight and Root Rot

Phytophthora seedling blight and root rot is caused by the soil-borne fungus *Phytophthora sojae*. This soil-inhabiting fungus can cause seed decay, preemergence or postemergence damping-off, seedling blight and root rot as well as mid- to late-season wilt and death of plants. *Phytophthora sojae* produces structures called oospores, which enable it to survive from year to year in crop residues or in the soil. In the spring, the oospores germinate to produce sporangia. When soils are flooded or saturated, the sporangia release zoospores, which are attracted to the growing soybean root tip, where infection occurs.

Phytophthora seedling blight and root rot is more severe in areas that are low or poorly drained, in compacted areas or in clay or heavy soils, but the disease can appear on plants growing in lighter soils or higher grounder if the soil remains wet after planting. Significant rain after planting favors the development of *Phytophthora* in all sites. A dry period after planting drastically reduces this disease. *Phytophthora* may occur at soil temperatures as low as 50 degrees F, but greatest root damage occurs when soil temperatures are 59 degrees F or above.

Numerous races of *Phytophthora* sojae have been identified based on their ability to overcome specific Rps genes or combinations of Rps genes in soybean varieties. The most recent Missouri survey found *Phytophthora sojae* in all soybean production areas of the state. When race determinations were done on the *Phytophthora sojae* isolates recovered from 21 counties throughout the state, fourteen different races were identified with no one race being predominant.

Management options for Phytophthora seedling blight and root rot:

1. Select varieties with either race-specific resistance, tolerance or a combination of race-specific resistance and tolerance, especially for use in fields with a history of *Phytophthora*. Race-specific varieties contain a single gene or combination of genes (i.e., Rps1c, Rps1d, Rps1k, Rps3a, etc.) that confer resistance to specific races of *Phytophthora sojae*. Tolerant varieties have a non-race specific, partial resistance and may also be called field-resistant varieties.
2. Plant in good seedbed conditions.
3. *Phytophthora* is more likely to occur in low, wet areas, poorly drained areas or compacted areas of a field. Tiling to improve drainage and taking steps to reduce or prevent compaction may help minimize disease problems.
4. Avoid the application of high levels of manure or fertilizer (KCl) just before planting.
5. Use an appropriate fungicide seed treatment. Products containing either metalaxyl or mefenoxam as an active ingredient are particularly effective against water mold fungi such as *Phytophthora sojae*. If high disease pressure is expected, the use of the higher rate of these seed treatment fungicides may be necessary.

Soybean Cyst Nematode (SCN)

The soybean cyst nematode, *Heterodera glycines*, is a serious problem throughout Missouri and in most soybean producing areas of the United States. Three different surveys for SCN in Missouri have shown that approximately 75% of the surveyed fields have detectable levels of SCN.

Symptoms of SNC range from no obvious symptoms to subtle differences in plant height and vigor or unexpected decreases in yield to severe stunting and discoloration of plants or dead plants. If plants are carefully dug up, females may be evident on the roots. The females appear as tiny (smaller than nitrogen-fixing nodules), whitish to yellow to brownish, lemon-shaped structures on the roots. Symptom expression may be more severe if plants are subjected to other stresses such as moisture stress, nutrient deficiencies, herbicide injury, insect damage or other diseases. The cysts are the bodies of the dead female nematodes. The cysts are actually protective egg cases that contain up to 250 SCN eggs. Eggs in cysts may survive in the soil for extended periods of time even in the absence of soybean crops.

Anything that moves cyst-infested soil can spread SCN, including machinery, animals, migratory birds, people, wind, water and soil peds associated with seed. Once in a field, SCN may take several years to build up to damaging levels. Unfortunately, once SCN is in a field it is likely to be there forever.

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Steps to Minimize Losses from Three Important Soybean Diseases *continued from page 12*

Management options for soybean cyst nematode:

1. Employ a program of soil sampling to identify problem fields and to determine the extent and severity of the problem within the field. For more detailed information on soil sampling for SCN refer to University of Missouri publication G4450, *Soybean Cyst Nematode: Diagnosis and Management* or the Plant Nematology Laboratory website http://soilplantlab.missouri.edu/nematode/ .
2. Select resistant varieties. Most commercial varieties with resistance to SCN have PI88788 as the source of SCN resistance. If PI88788 resistant varieties have been used in the same field for a number of years, that resistance source may not be performing as well as it initially did. If possible rotate to another source of resistance or at least to a different PI88788 variety.
3. Rotate to non-host crops.
4. Maintain good plant vigor.
5. Maintain good weed control.
6. Avoid spreading SCN from infested fields to uninfested fields by working uninfested fields first before moving equipment to infested fields.
7. Although several nematicides are labeled for use on soybeans, economic and environmental concerns limit their use.

Sudden Death Syndrome (SDS)

In Missouri, sudden death syndrome (SDS) has been a problem primarily in river bottom fields in the central and eastern portions of the state. However, the pathogen *Fusarium virguliforme* (formerly called *Fusarium solani* f. sp. *glycines*), appears to be present in soybean-producing areas throughout the state. In years when environmental conditions are favorable for infections and symptom development such as 2008, SDS may be found in most areas of the state.

SDS has been associated with maximum yield potential soybean production, that is, fields with optimum fertility, irrigation and lime applications. Field observations suggest that SDS is more likely to occur and to be more severe with high soil moisture, whether that is supplies by rainfall or irrigation. High soil moisture during vegetative stages of soybean growth seems to be most conducive to disease development. Because early-planted fields have a longer exposure to spring rainfalls than later-planted fields, seedlings in early-planted fields have an increased susceptibility to infection by the SDS pathogen. Later-planted fields in which soybean plants miss early spring rains may have lower levels of root infection and lower levels of SDS throughout the season. The onset of SDS symptoms is associated with wet conditions and below normal temperatures at or near bloom.

Management options for sudden death syndrome:

1. Select varieties that have performed well where SDS has been a problem.
2. Improve drainage in poorly drained fields and avoid compacting soils.
3. Stagger planting dates and delay planting until soils are warm and dry.
4. Rotate crops; avoid continuous soybean cropping.
5. Maintain good crop vigor and avoid crop stress, including soybean cyst nematode.
6. Harvest fields with SDS in a timely fashion.

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Nitrogen Management in Row and Forage Crops Course Scheduled for Feb. 25–26, 2009 *By John Lory*

The course "Nitrogen Management in Forage and Row Crop Systems" will be held February 25-26, 2009 at the Cattlemen's Association Building in Columbia, MO.

This session will provide detailed presentations and panel discussions on how to optimize nitrogen management particularly on farms using manure as a nitrogen source. Presenters include Dr. Michael Russelle, a nationally recognized scientist working on nitrogen management in forage systems. Other presenters include faculty from University of Missouri and Paul Tracy from MFA.

The course has been approval for 6.5 Nutrient Management, 5.0 Soil and Water and 0.5 Crop Management CEUs for CCAs. The course has been approved for 12.0 CAFO Operator and 12.0 Wastewater Operator CEU's. The cost for the advanced course will be $185 and includes the cost of two lunches.

Pre-registration is required by Monday Feb. 23. To register contact Shane Ferguson (573-884-6311; FergusonSS@missouri.edu). For more information about the course contact John Lory (573-884-7815; LoryJ@missouri.edu). More details about the courses including agendas and a speaker list are available on line at http://nmplanner.missouri.edu/training/.

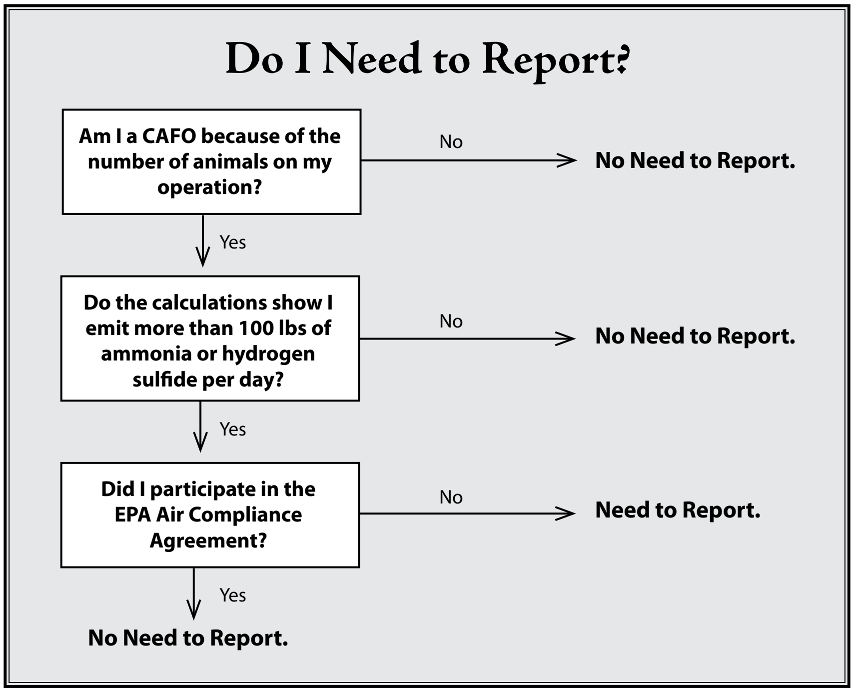
This course is one of a series of courses on nutrient management sponsored by the University of Missouri Commercial Agriculture Program, University of Missouri Extension and the Natural Resource Conservation Service.

EPCRA and Gas Emission Reporting...Does it Affect Me?

By John Lory and Joe Zulovich

The requirement for some animal feeding operations to report ammonia and hydrogen sulfide emissions to state and local emergency planners has created a lot of confusion around the state and beyond.

The first point to clarify is **who is affected by these rules?** The decision tree below outlines who in Missouri needs to report under EPCRA. If your operation does not have a permit than you are exempt from reporting requirements under these rules.



The next question is **"Where do I report?"** If you are required to report, EPCRA requires reporting to state and local emergency planning authorities.

Initially you are required to call the State Emergency Response Committee (SERC). In Missouri their phone number is 573-634-1436. You also need to call your Local Emergency Planning Committee (LEPC). You can learn the contact information for your LEPC by entering your zip code in the search engine at http://yosemite.epa.gov/oswer/LEPCDb.nsf/SearchForm?OpenForm.

After you phone in your report you have 30 days to submit paperwork estimating the amount of ammonia and hydrogen sulfide emission from your farm. You are only required to report if you are a permitted operation and you release at least 100 pounds per day of ammonia and/or hydrogen sulfide. MU Extension has a new web resource that takes you step-by-step through the process of completing this paperwork. Visit http://nmplanner.missouri.edu/regulations/CERCLA_EPCRA.asp.

The last question is **"What about CERCLA reporting requirements?"** CERCLA is the Comprehensive Environmental Response Compensation and Liability Act. An EPA final rule released December 20, 2008 clarified that all animal feeding operations were exempt from any reporting requirements under CERCLA. This means animal feeding operations are exempt from the national reporting requirements of CERCLA but some operations will still need to report to state and local authorities under EPCRA as discussed above.

Some background on EPCRA

What is EPCRA? The initials stand for "Emergency Planning and Community Right to Know Act". These rules were first put in place in the 1980's to facilitate a community's right-to-know what chemicals are released into the environment and to help emergency responders know the potential hazards they may face in a building during an emergency situation. The law has at least three criteria that may require businesses notify local emergency planning. Only one typically applies to CAFOs.

CAFOs reporting to SERC's and LEPC's are reporting under EPCRA section 304 that governs accidental releases. Within that section of EPA regulations are rules that cover "continuous and stable" emissions from a facility, in this case your animal feeding and manure handling facilities. Releases that exceed the "reportable quantity" or "RQ" trigger the requirement to report. The reportable quantities are expressed in "pounds per day". There are hundreds of chemicals requiring reporting if they are released above a reportable threshold, from acetic acid ethenyl ester to zinc phosphide. The two materials most likely to be released in reportable quantities from CAFOs are ammonia and hydrogen sulfide and the reportable quantity for both materials is 100 pounds per day.

In the past, emissions exceeding a reportable quantity required notification of national authorities at the National Response Center under CERCLA and state and local emergency response authorities under EPCRA. In December 2008 EPA released new rules that exempted animal feeding operations from reporting requirements under the CERCLA rules as of January 20, 2009. Specifically, the new rules exempt animal feeding operations from reporting releases of "hazardous substances" under CERCLA section 103.

The new rules that took effect on January 20, 2009 also clarified that CAFOs were still required to report under

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EPCRA and Gas Emission Reporting...Does it Affect Me? *continued from page 14*

EPCRA section 304 to state and local authorities. Smaller operations, based on size (unpermitted operations in Missouri), are exempted from both CERCLA and EPCRA.

From EPA's perspective, animal feeding operations that emitted more than 100 pounds per day of ammonia or hydrogen sulfide have had an obligation to report emissions for over a decade. The new rule has focused the attention of EPA and farmers on these requirements and clarified exactly who has an obligation to report.

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A Six-Pack of Tips for Healthy Cotton

By Allen Wrather

I recently heard a cotton farmer confess that the day he planted cotton was the most important day for that crop. If he planted and the weather was warm for the next 1 to 2 weeks, the cotton would emerge in a few days, the plants would develop a good root system, grow well all summer, and yield well. If he planted and the weather turned cold and wet for the next 1 to 2 weeks, his cotton stand would be thin and uneven due to seedling diseases, the roots of surviving plants would be stunted, the plants would grow poorly and mature slowly, and yield would be low. Farmers can protect their young cotton crop against seedling diseases that may develop during cool wet weather by following the six steps listed below. I call these six steps a six-pack of tips for a healthy cotton corp.

1. Plant only when the soil temperature 4 inches deep has warmed up to about 65°F by 8:00 a.m. and plant only when at least 7 days of warm and dry weather are predicted.
2. Plant only high-quality seed. Seed quality can be partially judged by the warm and cold germination test results. The seed should germinate better than 80% in the warm test and better than 50% in the cold test. The warm test results are printed on the seed bag, but the results of the cold test are not. Ask your seed dealer about the cold germination test results.
3. Plant in fertile soil. Ensure that soil pH, phosphate and potash levels are proper for new plant growth.
4. Plant on high beds. Seedling diseases are worse when the soil is cold and wet. To minimize seedling diseases, plant on raised beds to maximize drainage and soil temperature. The top of a raised bed is generally warmer than flat soil. Make sure field drainage is adequate to quickly eliminate excess water. Internal soil drainage will be improved if hardpans are broken with a ripper.
5. Have the seed treated with extra fungicides when cotton is planted early in the season, in poorly drained fields, or in clay soils, and certainly in fields where seedling diseases have been a problem in previous years.
6. When planting no-till, equip your planter to move trash away from the row, so the sun can warm the soil around the seed faster.

Following these suggested procedures will give cotton farmers a better chance of producing high yield and profit during 2009. More information is available at your county extension office or on the University of Missouri Delta Center Web Page (www.aes.missouri.edu/delta).

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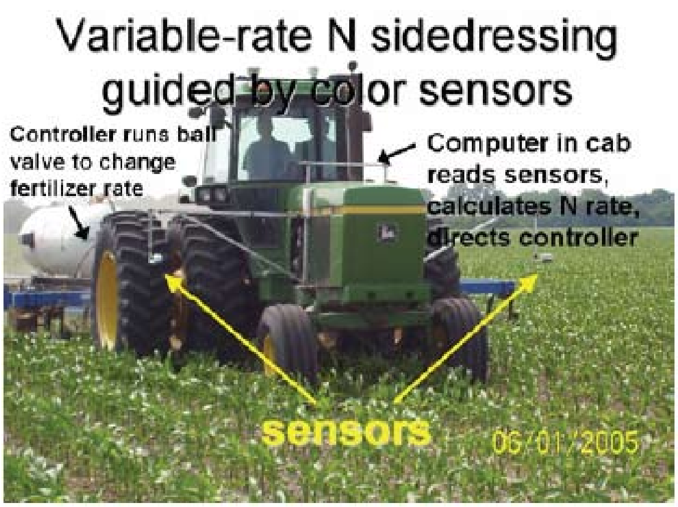
Crop Sensors for Managing Nitrogen

By Peter Scharf

2008 was a challenging year for nitrogen fertilizer management. Much of the fertilizer applied for the corn crop was lost due to heavy rainfall before the crop could take it up. This led to widespread nitrogen deficiency and, in my rough estimate, yield loss of 460 million bushels of corn across the midwest (see article in last issue).



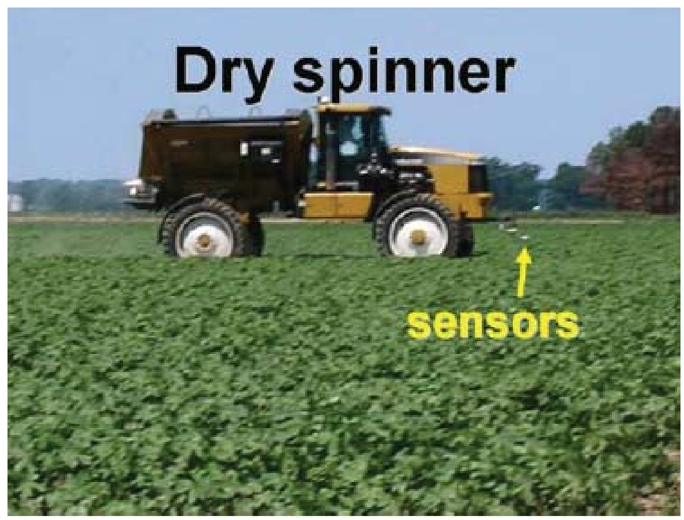
It turned out to be a great year for sensorbased nitrogen management to shine. In this system, the biggest nitrogen application is made to the growing crop. Sensors detect the crop color–when the crop is dark green, a low rate is applied, and when the crop is light green or yellow green, a high rate is applied. Sensors detect crop color around ten times per second, and a new N rate command is given once per second.

This system requires an applicator that has a mechanism for changing rates while driving. Virtually any type of fertilizer application equipment can be set up to do this. The photographs show a range of applicators that we have used in on-farm demonstrations of sensor-based N applications.

We have demonstrated sensor-based N management extensively in corn, had our first demonstration in cotton in 2008, and are starting a project to develop interpretations for wheat. I believe that sensor technology can be successful and profitable in all three of these crops, and potentially in grass and milo as well.

Some people who work with the sensors are hesitant to use them on small corn. My research with John Lory in the late 1990s suggested that they could work just fine on small corn, by which I mean a foot tall. This has recently been confirmed by research in Pennsylvania. Over the past five years, we have done a total of 88 on-farm demonstrations of sensor-based N management with the corn anywhere from 1 to 7 feet tall. In 56 of these demonstrations, we have had good comparisons between sensor-based N management and the current producer rate. There has been no trend for the system to be more successful or profitable on bigger or smaller corn–average profitability has been the same at every height.

However, I am uncomfortable with using sensors to make decisions on corn that is less than a foot tall. None of the three demonstrations that we did on corn less than a foot tall were economically successful.



For most Missouri producers who sidedress corn, they normally start on corn that is 4 to 8 inches tall and finish in corn that is 12 to 20 inches tall. Thus, even for people who currently sidedress, some adjustment to their management is needed to start using sensors. Starting to sidedress when corn is 12, as opposed to 6, inches tall means a higher risk that the job won't be finished by the time the corn is too tall for tractor clearance. My suggestion is either to have a high-clearance backup plan or to limit the acreage managed with sensors to keep the risk low. Targeting fields that have the most variable soils or management histories would be one smart way to limit acreage managed with sensors. Another would be to target fields with the greatest likelihood that lower fertilizer rates could produce full yield, for example manured fields.

Sidedressing, regardless of how N rate was chosen, was an effective strategy for N delivery this year. In my tests near Columbia, sidedress treatments on average yielded 44 bu/acre more than preplant treatments. Plots with sidedress N had N deficiency symptoms in August, but the symptoms were much more severe in plots that received their only N application just before planting.

In twelve 2008 demonstration fields for which our analyses are finished, sensor-based sidedressing is $29/acre ahead of sidedressing a flat rate chosen by the producer. This is due to several fields where the sensors diagnosed that N need was on average higher than the rate chosen by the producer, and the diagnosis was correct, resulting in higher yields than with the producer N rate. This comparison did

not include a timing component. I feel sure that the same producer N rate, applied all pre-plant, would have produced even lower yields due to N loss before crop uptake. The benefits of sensorbased management in 2008 were due to both timing of the main N application and more accurate diagnosis of the crop's N need.

In contrast, economic benefits to sensor use in our past on-farm demonstrations (2004-2007) have been primarily due to savings on nitrogen fertilizer. In those fields, we saved an average of 23 lb N/acre relative to the rate the producer would normally use with no effect

on average yield. Our biggest goal with sensor-based N management is to cut back in smart places–places where the soil is supplying a substantial amount of N to the crop, so that reducing the fertilizer rate doesn't hurt yield.

In those places where cutting back on N fertilizer rate doesn't hurt yield, NOT cutting back on N means that there will be unused N left in the soil after harvest. In winter and spring, precipitation is greater than evaporation, with excess water moving down and sideways off of fields. Chances are good that the unused N will move with the water (as nitrate) and end up emerging in a spring or seep. In order to help producers to avoid this scenario, the Natural Resources Conservation Service has made sensor guided sidedressing eligible for cost-share assistance in its EQIP program. The incentive for 2009 is $36.70/ acre/year with a 2-year commitment to the practice. The Missouri Department of Natural Resources also supports the practice and has funded our on-farm demonstrations in 2007 and 2008.

Everyone wants the nitrogen to end up in the crop and not in the water. Crop sensorsare one of the new tools that can help producers to accomplish this goal.

The main reason that sensors can improve nitrogen management is the wide range in how much N the soil supplies to the crop. The amount supplied by soil can vary widely from field to field, from year to year, and from place to place within a field. This makes the best N fertilizer rate difficult to predict.

From 2000 to 2002, we studied eight production corn fields by putting an average of 50 small nitrogen rate experiments all across the field, allowing us to measure the most profitable rate at 50 different places in the field. We found that, in 7 of the 8 fields, ANY uniform N rate would have been off target by more than 35 lb N/acre in more than half of the field. We also found that the average amount of N needed varied widely from one field to another.

2008 was a good example of year-to-year variability in soil N supply. Typically when I have taken deep soil samples in spring before fertilization, I have found 50 lb N/acre in forms (nitrate and ammonium) available to the crop. This year, that 'baseline' soil N was probably mostly lost before the crop could take it up. More N was released from soil organic matter during the season, but in wet fields the amount released was limited by lack of oxygen and lower soil temperatures than in a normal year.

Not only was 'baseline' soil N lost in 2008, but a great deal of fertilizer N applied preplant was also lost. The biggest benefit to sensor-based N applications this year would have been avoiding the nitrogen loss, yield loss, and environmental degradation associated with preplant applications.

In this article, I have mainly discussed using crop sensors to guide planned nitrogen applications. 2008 gives another example of a highly beneficial use of the sensors: guiding rescue N applications when N has been lost. Nitrogen loss is almost always patchy and is controlled by where water goes in fields. This can be easily seen in the photograph in the last issue (http://ppp.missouri.edu/newsletters/ ipcm/archives/v19n1/a2.pdf). Applying the same rate of rescue N to a whole field would result in a lot of fertilizer being wasted on areas that don't really need it. Sensors can identify the areas where the crop is N-deficient and put on high rates, while cutting back in areas where deficiency is not detected.

We will be conducting on-farm demonstrations of crop-sensor-guided nitrogen applications again in 2009 for both corn and cotton. We bring sensors, computer, and GPS, temporarily install them on your (or your retailer's) fertilizer applicator, and fertilize part or all of a field so that you can see them in action without an up-front investment of money and time. If you're interested in participating, call me at (573) 882-0777.

I'm also planning another newsletter article dealing with more advanced and practical aspects of using sensors to manage N–watch for it within the next month or so.

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Weather Data for the Week Ending February 9, 2009

By Pat Guinan

Station	County	Weekly Temperature (oF)						Monthly Precipitation (in.)		Growing Degree Days‡	
		Avg. Max.	Avg. Min.	Extreme High	Extreme Low	Mean	Departure from long term avg.	Feb 1-Feb 9	Departure from long term avg.	Accumulated Since Apr. 1	Departure from long term avg.
Corning	Atchison	52	25	68	4	38	+14	0.06	-0.18	*	*
St. Joseph	Buchanan	51	25	67	4	39	+13	0.14	-0.11	*	*
Brunswick	Carroll	51	23	70	0	38	+12	0.04	-0.25	*	*
Albany	Gentry	50	22	67	1	36	+12	0.02	-0.23	*	*
Auxvasse	Audrain	52	25	71	3	38	+11	0.13	-0.33	*	*
Vandalia	Audrain	51	23	69	4	36	+9	0.12	-0.24	*	*
Columbia-Jefferson Farm	Boone	53	26	70	4	39	+11	0.12	-0.37	*	*
Columbia-South Farms	Boone	53	26	70	4	39	+11	0.12	-0.37	*	*
Williamsburg	Callaway	52	25	71	4	38	+11	0.17	-0.41	*	*
Novelty	Knox	49	21	68	1	35	+10	0.04	-0.29	*	*
Linneus	Linn	50	23	69	2	37	+12	0.02	-0.32	*	*
Monroe City	Monroe	50	22	69	3	36	+9	0.06	-0.15	*	*
Versailles	Morgan	55	31	68	5	43	+13	0.08	-0.36	*	*
Green Ridge	Pettis	54	29	68	5	41	+13	0.07	-0.39	*	*
Lamar	Barton	56	37	69	13	46	+14	0.14	-0.30	*	*
Cook Station	Crawford	54	28	68	8	41	+9	0.34	-0.26	*	*
Alley Spring	Shannon	*	*	*	*	*	*	*	*	*	*
Mountain Grove	Wright	53	32	64	9	41	+10	0.65	-0.08	*	*
Delta	Cape Girardeau	46	27	67	12	36	+3	0.53	-0.28	*	*
Cardwell	Dunklin	54	35	72	19	44	+8	0.15	-0.92	*	*
Clarkton	Dunklin	52	33	70	15	43	+9	0.03	-0.82	*	*
Glennonville	Dunklin	52	35	70	17	44	+9	0.06	-0.79	*	*
Charleston	Mississippi	51	33	70	15	43	+11	0.01	-1.09	*	*
Portageville-Delta Center	Pemiscot	52	36	70	17	44	+9	0.00	-0.92	*	*
Portageville-Lee Farm	Pemiscot	53	36	71	18	44	+9	0.00	-0.92	*	*
Steele	Pemiscot	54	35	71	19	45	+9	0.04	-1.03	*	*

* Complete data not available for report

‡Growing degree days are calculated by subtracting a 50 degree (Fahrenheit) base temperature from the average daily temperature. Thus, if the average temperature for the day is 75 degrees, then 25 growing degree days will have been accumulated.

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