Sensor-Guided Sidedressing

By Peter Scharf

It could be one of those years again. A 'sidedress' year. Last year was one of them. Sidedress treatments out-yielded preplant treatments by an average of 44 bu/acre in an experiment near Columbia.

With the recent heavy rains in Missouri, and warm soils, we could be in line for substantial losses of nitrogen fertilizer applied before planting (see other article this issue). Even pre-plant anhydrous ammonia, the most resistant to loss, has probably completely converted to nitrate by now (unless N-Serve was used) and is vulnerable. With much of Missouri's corn crop re-planted in late May, it will be July before rapid uptake begins in those fields. More losses could easily happen between now and then.

Sidedress N applications have a very low risk of being lost before uptake, but create the risk of not getting finished before the corn is too tall for tractor clearance. Availability of equipment to apply nitrogen to taller corn may be an obstacle. The yield effects of the delay are not a problem in most cases. Research in Missouri, Minnesota, Nebraska, Iowa, and Oklahoma suggests that applying N by the time the corn is four feet tall will on average give the same yield as applying all N preplant. Even when N was delayed until tasseling, average yield loss was only 10%.

In February, I reported in this newsletter that we were planning on-farm demonstrations of sensor-based sidedressing this year. So far, we have carried out demos on nine fields in Dunklin (injected solution), Barton (broadcast urea with Agrotain), and Cooper (anhydrous ammonia) Counties. One striking thing in these demonstrations is how variable the corn color has been in nearly all of these fields. It looks to me like there is wide variability in how much N the soil is supplying this year, possibly because N has been lost from some areas more than from others.

This wide variability in appearance also provided an opportunity for the cooperating producers to see how the sensors changed N rates in response to the variable corn color. It is a huge selling point when they see the rates go down while driving through dark green corn, then back up when they get into light green, stressed corn. When you see it happening, it just makes sense.

Sometimes people want to use sensors to 'top up' a crop. They don't work well for this. They're not really able to distinguish between corn that has enough N and corn that needs 30 more pounds. What they do work well for is telling whether the crop needs a little, a medium amount, or a lot. When preplant applications are kept in the neighborhood of 60 lb N/acre, they get a chance to do this. Not only have we seen that most fields this year appear to have places that need a little, a medium amount, and a lot, we have the past research to prove it. We measured the most profitable N rate all across eight fields in three regions of Missouri, and all of them had a spread of at least 150 lb N/acre from the lowest to the highest N rate needed within that field.

Carrying out field demonstrations of sensor-based sidedressing taught me how limited liquid (this includes anhydrous) application rates are. This is because with a fixed orifice, you have to quadruple pressure to double flow. Not many liquid systems can handle more than a four-fold range of pressures–too low and distribution along the boom or bar is not even, too high and a hose pops off or the pump gets damaged. So you're pretty much limited to a top rate that is twice your bottom rate. Often the crop will need a wider range than this.

There is a new innovation on the market that helps with this situation: spring-loaded nozzles. As pressure increases, springs compress and effective orifice size increases. This allows a much wider range of flow rates for the same range of pressures. SprayTarget and Greenleaf are both making and marketing this type of nozzle.

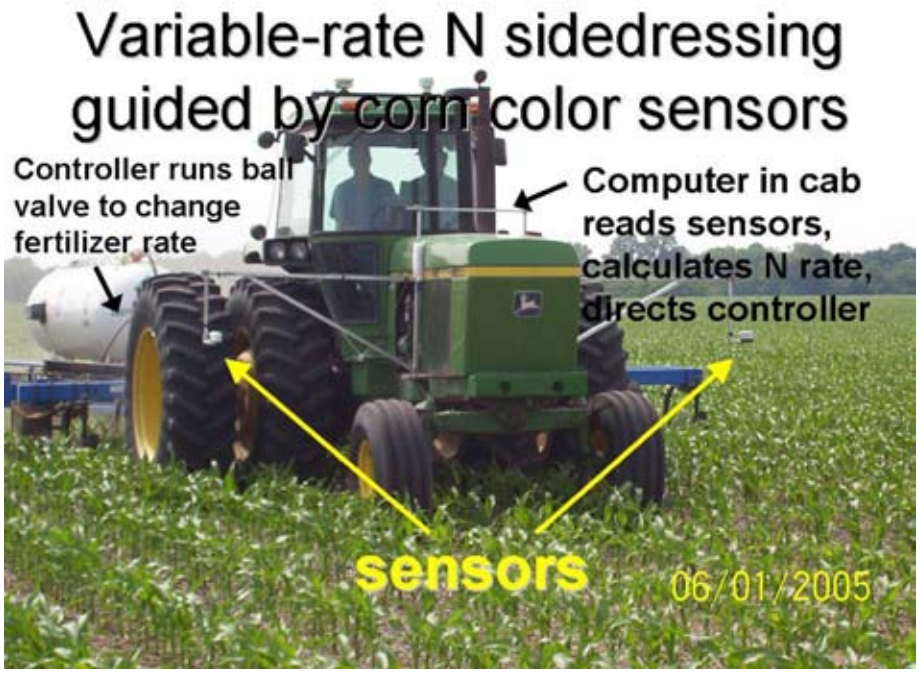

Figure 1. Crop sensors can diagnose com N need based on color and control variable-rate sidedressing to accurately meet crop needs. Demonstration fields in 2009 have (so far) been highly variable in crop

Getting a wide range of N rates with a dry application system is generally easy, since it just relies on changing the speed of the delivery belt. There may be some issues in spinners with the pattern changing as the rate changes.

Our demos all rely on a small high-N 'reference' area. This area shows how dark green the corn can be with plenty of N for given genetics, weather, and soil. Everything

Continued on page 89

Sensor-Guided Sidedressing *continued from page 88*

else is based off of this yardstick. In a wet year, even this area can lose so much N that it is no longer fully green at the time of sidedressing. We have not seen that so far this year, but have seen some reference areas with severe stand loss. In past years, when we've had poor reference areas (applied too late, not marked, leaf burn, atypical area of field) we've lost money with the sensors. When we've had good reference areas, we've made money.

One problem that we ran into in a bootheel demo several years ago resulted from starting the field in the evening and finishing in the morning. The value for the high-N reference was not re-checked. When we made the application rate map, there was a sharp line where N rate dropped off from evening to morning. There was a heavy dew that morning which apparently changed the sensor readings. We later confirmed this in experiments where we measured the change in sensor values as dew dried off the leaves, or as we sprayed water on the leaves. Re-checking the reading of the high-N reference area before starting to apply in the morning almost certainly would have solved this problem.

Followup research has showed that sensor readings change even when leaf wetness does not change. We are not sure why. Our current recommendation is that a high-N reference area should be measured at least every two hours while sidedressing. The Greenseeker brand of sensors, which is currently the most widely available sensor for sidedressing N, is especially changeable, possibly due to temperature sensitivity. With this sensor, we recommend checking the high-N area hourly if possible.

One approach we've come up with for re-checking the appearance of high-N corn is to apply a high rate of N crosswise to the corn rows. Then we cross this high-N strip every time we drive the length of the field. We program in its location, and our system automatically checks it every time we drive across. This will take care of any drift in sensor readings due to a rain shower, dew drying, leaf rolling or wilting, temperature effects, and so on.

Greenseeker sensors can be purchased in sets of 4 (about $18,500) or 6 (about $22,500). The 4-sensor setup is intended for applicators with narrower swaths. I'm not convinced that even four sensors are needed, much less six. The research that I've seen suggests to me that three sensors is probably the point of diminishing return, and we use three in all of our field demos. Greenseeker has recently been acquired by Trimble, which should give them some stability and product synergy. Sidedressing is a lot less work with autosteer, although my experience this year is that autosteer is not always good enough to keep the sensors directly over the corn rows.

Ag Leader is beta-testing sensors this year that were designed by Holland Scientific and plans a full release for 2010 if all goes well. They are re-designing their InSight field monitor to add the capability to receive sensor inputs and calculate N rates. This is a brand-new sensor design and in my opinion they need a better understanding of how it reacts when it moves from N-sufficient to N-stressed corn before their rate recommendations can be considered reliable. Nonetheless, my previous experience with Holland Scientific sensors is that they work well and are stable. I think the odds are good that the Ag Leader sensors will develop into an excellent product. I haven't heard anything about their pricing plans, but individual sensors of an earlier model sell for about $2500 each (including cables etc.) from Holland Scientific.

AGCO is also looking to enter the North American N sensor market with a European sensor that has been re-engineered by Toshiba. I do not know what launch timing, pricing, or bundling are planned for this product.

Interest in sensor-controlled sidedressing is growing among both producers and companies. The sidedressing aspect is an obstacle to many corn producers, but if we get more years with massive N loss like 2008, they will start to find ways to make it work. And the opportunity to diagnose and apply the correct rate is appealing to them.

Links to Powerpoint presentations about our on-farm demonstrations of sensor-based sidedressing for corn and cotton can be found at the bottom of this web page: **http://plantsci.missouri.edu/nutrientmanagement/nitrogen/rate.htm**

Peter Scharf
ScharfP@missouri.edu
(573) 882-077