Streaky Nitrogen Applications: Why They Happen and What You Can Do About Them

By Peter Scharf

Nearly every year, excessive rainfall causes loss of soil and fertilizer nitrogen to the extent that visual deficiency symptoms are seen in corn somewhere in Missouri. During the past two growing seasons, nearly all of Missouri and large swaths of the midwest have been affected in this way, causing about a billion bushels in lost yield potential by my estimation (see article in the last issue of Insect, Pest and Crop Management).

Every year I take aerial photographs of areas where the corn is experiencing N deficiency (figure 1). In these photographs, at least half of the fields show the deficiency occurring in streaks. When I georeference the photos and measure the distances between the streaks, they always correspond to common swath widths of fertilizer applicators.

Figure 1.

I believe that we have a serious, and increasing, problem with uneven distribution of N fertilizer. This problem sticks out like a sore thumb when nitrogen loss occurs, because the areas receiving low N rates have a light-green or yellow-green color that is very visible. But the uneven applications are still happening in years with low N loss, and potentially are causing yield loss in those years as well.

Uneven application of granular N sources

Granular N sources (urea and ammonium nitrate) are increasingly susceptible to uneven application. This is because more and more of our supply of granular N is imported. Urea imports more than doubled from 1997 to 2007.

Figure 2.

Why is imported granular N more susceptible to uneven application? It's due to the increased handling that these materials go through. Every time granular N is handled, especially when it goes through an auger, forces on the granules tend to break them into smaller pieces. My observation in the urea and ammonium nitrate that I have handled is that the proportion of fine particles has increased over the past 15 years.

Most granular N applications are made using spinner spreaders to throw the fertilizer. Unfortunately, you can't throw dust very far. When spreading material with a lot of fine particles, the rate immediately behind the spreader will be much higher than the rate at the edge of the pattern. This results in streaks of high and low N availability which can be seen in aerial photographs of corn fields that have experienced N loss (figure 2). The corn in the N-deficient streaks will have lower yields due to this deficiency.

Spreading granular N evenly

There are several potential solutions to the problem of uneven application of granular N. One is the use of air-boom spreaders. Fine particles can be blown down the boom tubes on a stream of air to produce a relatively even application. This is a pretty good solution, except that I've heard from operators that the fine materials will collect at the places where the boom folds, clogging it up. My understanding is that these places are difficult to access and clean. Maintenance costs and operator fatigue are also issues with air-boom spreaders, and I've heard several people who have these applicators say that they intend to go back to using spinner spreaders in the future.

From the producer point of view, one option is to inspect the fertilizer material before agreeing to purchase it. This requires

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time and hassle, along with a backup plan of how to proceed if the fertilizer material is not up to par.

Another possibility is to screen out the fine particles and only apply the larger particles. I'm not aware of anyone doing this. It would require a plan for how to still get value out of the fine particles, and how to charge enough extra to cover the labor and management costs of implementing this solution. Part of my aim in writing this article is to convince producers (and therefore retail outlets) that they can afford to pay more for quality materials. Or, from the other direction, that they can't afford to continue having streaky N applications.

The last option is to 'double-spread' which can either be done by spreading in narrower swaths than the machine is designed for, or by spreading a half-rate in one direction and then spreading the other half crosswise to the first. This practice certainly helps to even out applications, but it's potentially very expensive because it cuts the applicator's total acreage by as much as half. It makes it harder to pay for the applicator and cuts into precious field time. Especially in a year like this one, when very little fertilizer (ammonia, phosphate, potash) got applied in the fall, applicators will be going full bore this spring when conditions are right (and even when they aren't) to catch up. I predict that very little double-spreading of granular N will happen this spring.

Figure 3.

In the long run, we need to re-granulate the dry N that we import. This will take advantage of low natural gas prices (and therefore fertilizer production costs) elsewhere in the world while still delivering a quality product that can be spread evenly on our crops. Until producers are willing to pay a premium for this product, and someone invests in the infrastructure to make it happen, we'll have to get by with the solutions above.

Uneven application of anhydrous ammonia

Streaks associated with uneven applications of anhydrous ammonia are narrower than those associated with granular N, and may also be less common. I've seen them both parallel to the row and at an angle to the row (figure 3).

Spreading anhydrous ammonia evenly

I hear a wide range of opinions about how to get even N applications from anhydrous ammonia. Work done by Gerry Gogan, formerly of Farmland, showed clearly that the main problem with uneven distribution of anhydrous ammonia was poor splitting at the manifold. Progress has been made in manifold design over the past 15 years, but I am not familiar enough with these products to know which one to recommend. 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 but can be very expensive.

With old-style manifolds that put out uneven rates, randomizing the hoses can undo a lot of the damage. If one manifold port is putting out a low rate, the port next to it is likely to put out a low rate as well. If the hoses from these two ports go to adjacent knives, then both knives will be putting out low rates and the corn in between will not get as much N as intended. If one is putting out a low rate and the other a high rate, the corn will be much happier. Other practices, such as making all hoses the same length, inspecting knives for burs/blockage, and replacing knives regularly can all help to make applications more even, but are considerably less important than how evenly the material stream is split by the manifold.

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