University of Minnesota Nutrient Management Podcast Episode "Nitrogen economics"

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Paul McDivitt: Welcome back to University of Minnesota Extension's Nutrient Management Podcast. I'm your host, Paul McDivitt, Communication Specialist, here at U of M Extension. Today on the podcast we're talking about nitrogen economics. We have three members of Extension's nutrient management team and a special guest from the Minnesota Department of Agriculture. Can you each give us a quick introduction?

Dan Kaiser: This is Daniel Kaiser. I am a state nutrient management specialist with the University of Minnesota Extension. My background is in crop nutrient guidelines.

Fabian Fernandez: I am Fabian Fernandez, also at the University of Minnesota in nutrient management research and extension work. I am located at the St. Paul Campus.

Brad Carlson: This is Brad Carlson, I'm an extension educator. I work out of our regional office in Mankato. I work a lot with nutrient management issues, water quality issues, and more or less statewide.

Jane Boerboom: This is Jane Boerboom, and I work at the Minnesota Department of Agriculture. I'm the supervisor of the facility management unit, and we provide a lot of the permitting functions for pesticides and fertilizers for the bulk storage of those. We also permit chemigation systems and work with the waste pesticide collection program as well.

Paul McDivitt: All right. So starting off, how does the sale of nitrogen fertilizer in Minnesota break down by source? What trends have we seen in nitrogen use for crops in Minnesota?

Dan Kaiser: This is Dan Kaiser. I guess just to start, I've been here since 2007, and one thing that we've seen pretty consistently since that point in time is an increased use of urea, particularly for nitrogen. What that's meant is at the loss of anhydrous. We've seen some facilities start to go away from that, and it's caused some challenges when it comes to management, because the two products themselves aren't the same. So that's one of the things I know Fabian has been, since he's been here, been working on some projects, looking at comparing

some of these products, just to see, particularly with some of the application timings.

Dan Kaiser: What we're seeing currently with the weather conditions that we're having in terms of loss potential, because that's the main thing with this that I really stress to a lot of growers, is that particularly with application timing, if you look at source by timing interactions that these two things have to be taken to account for, and we just can't use the same or different sources the same way in all circumstances and get the same results.

Fabian Fernandez: Yeah. Just to add a little bit to what Dan was saying, before coming to Minnesota, I came in 2013, I was in Illinois, and of course over there anhydrous ammonia was the primary source. So moving here to Minnesota, it really was a change in terms of the work that I was doing with nitrogen, because as Dan mentioned, anhydrous ammonia really has become less of a, it's still a very important source, but it's definitely not the main source. Urea is definitely a main source.

Fabian Fernandez: One thing that I've noticed coming to Minnesota is that many farmers were used to anhydrous ammonia. Now they're making a switch to urea, and trying to continue to use the new source as urea the same way that they did with anhydrous ammonia, particularly when it comes to fall obligations. That got me going in terms of some of the research that we are doing right now to look at different nitrogen sources and seeing how well they work with fall or spring versus a split applications, things like that.

Brad Carlson: I think this has been a bit of a slow train building. If you go back 20 years ago, when anhydrous really dominated, there still was a general feeling in the farm community. Farmers particularly have never been real fond of anhydrous just from a safety standpoint and a comfort standpoint. A lot of cases, farmers just preferred to have that custom applied by the dealer as opposed to doing it themselves. There's all kinds of horror stories about hose breaks and equipment failures, and guys getting burned and so forth. So I think there's just been this overriding feeling in the farm community of disliking anhydrous.

Brad Carlson: That being said, I think we've all recognized that anhydrous is a pretty good nitrogen source as far as from a economic standpoint, as well as it's got some significant environmental benefits. So a lot of us don't really want to necessarily see anhydrous disappear for that reason. Couple that together with some of the weather trends in the last decade, with it being wetter, it's been a lot more difficult to do nitrogen applications in the fall. Anhydrous is the primary product that's fall applied in Minnesota in parts of the state where we do fall application. So the extent to which you haven't been able to do application at all in those places has made some kind of question it. Then add also to some of the, again, the safety concerns, I think, particularly on the retail level. You get a mixed message as far as what those actual restrictions are, and the implication on the retailer, but there's no doubt that there's a significant cost on their end as far as

maintaining safety standards and so forth. So I think all these things have also led to some of the shift too over time.

Jane Boerboom: Well, I'll comment on the anhydrous ammonia storage facilities that Brad was talking about. There's been a change over time, and we permit those facilities. So those large white bullet tanks, if you're storing those tanks in a stationary way, we permit those at the Minnesota Department of Agriculture. It is to ensure that they are safely installed and maintained. We also inspect those nurse tanks, the application equipment that's used. So for some perspective, in 1997, we did have 437 of those facilities permitted in Minnesota. As of 2020, it went from 437 to 237. So there have been a lot of facilities that have gone either out of the anhydrous ammonia business, or have merged by other facilities and have created efficiencies in those delivery and sales systems for anhydrous ammonia. That could also be related to a change in use. Like you guys were saying, that urea is on the uptake for those sales.

Jane Boerboom: Regarding the sales information, yeah, since 1989, urea has definitely increased. The tons of nitrogen for urea has changed from 150,000 tons in 1989. Now we're up to over 350,000 tons. So that is a large increase versus the decrease in anhydrous from 350,000 tons in 1989, down to, we're only down to 150,000 tons of anhydrous. So the sales data does correlate with what you are saying.

Jane Boerboom: I would say we have some other information on other types of potash sales, and also phosphorus sales. We saw an uptake in those in the phosphorous sales from '89 to 2010 at about 25%. Those have now leveled off. Potash has remained the same through time for those sales as well. So that's a snapshot of some of the sales data that we have.

Paul McDivitt: Great. Then are farmers shifting towards more on-farm storage of nitrogen fertilizer? What do farmers interested in storing and applying their own fertilizer need to be aware of?

Jane Boerboom: Yeah, we definitely have on-farm storage of fertilizer, and that includes anhydrous ammonia. We have 18 permits of those permits that I mentioned before are farmer storage facilities. We have seen a change over the last probably five years of farmers who want to have easy access to anhydrous. So they do install their own bulk tank storage systems. I'd say that since 2010 to now we've seen a slow increase in farmers doing that. Again, that may be just that the interest in using anhydrous cycling out of these systems. But we do have some farmers that are interested in having their own anhydrous ammonia storage.

Jane Boerboom: As far as liquid fertilizer and dry fertilizer, we definitely have seen an increase in farmers wanting permits to store dry fertilizer. You need to have a permit to store dry fertilizer, and we have seen an increase. We've got about 140 farmers that have either liquid fertilizer tanks or dry bulk storage on their own farm. So that's of the 665 permits that we have, 21% of those are farm storage. We have seen an increase and an interest in having on-farm storage. For liquid bulk

fertilizer, we do have an exemption for farmers. They can store 6,000 gallons or less of fertilizer on their property. That's a total of 6,000 gallons. So they can store that without a permit from the MDA. But if they exceed that amount, they do need to contact us, and we do need to work with them to get them permitted. That involves installing safeguards to prevent contamination to the environment. Say, if a tank would leak or something, we permit and work with a farmer to get those safeguards installed. We definitely have seen an increase.

Jane Boerboom: The last year was a really hard time for farmers to get their nutrients on the field in the fall due to those wet conditions. We've had some interesting discussions with people on how to have more access to, say, dry fertilizer in preparation for possibly a bad year like that again. So I think those types of weather situations make people be creative and interested in having easier access and have an onsite storage. So we have seen more interest from farmers and co-ops of getting different types of storage systems ready quite quickly, so they can have those accessible to them.

Brad Carlson: So, Jane, there's been a lot of talk over the last few years with farmers who have their own semi trucks with the concept of, for instance, hauling grain farther down the river and taking advantage of a better basis, and then coming back with a load of fertilizer. If a farmer is interested in doing something like that, first of all, what are the requirements as far as the facility? What does that look like? Then also, what steps do they go through to get permitted? I guess, I don't know if inspection is required or not. But what do they need to do if they'd like to do that?

Jane Boerboom: If a grower does go ahead and either hauling down grain, selling the grain, and then filling up that truck with some dry fertilizer, if they use it immediately and don't dump it on the ground or don't need to store it, obviously there's no permit required. But if they do want to dump it at their facility or at their farm site, they do need to have safeguards in place. So what that looks like for dry fertilizers, obviously a covered system. What the first step would be for them to contact us. We have a couple of lead workers who will work with their grower to either utilize existing structures at a farm site, or in some cases install new ones. But they do need to contact us. They need to pay a minimal fee. It's a one-time permit fee, and they'll fill out some paperwork, and then we'll work with them to get a system in place that will safeguard that dry fertilizer or liquid fertilizer, again, beyond 6,000 gallons. But they do need to contact us and get us storage facility in place if they're going to store dry fertilizer, specifically, at their farm site.

Fabian Fernandez: Just one comment, something that I've noticed is that it doesn't happen too often, but in those years where maybe because of fall obligations not being able to be done, or the market shifting and things like that, there have been times where there's not enough availability of fertilizers in the spring. So that's when I've noticed people being more interested in exploring the possibility of storing their own fertilizer on their farms so that they don't have the issue of having to wait for the fertilizer to come up the river.

Fabian Fernandez: Then another note that I have, a couple of times that people have asked me about storage facilities, more in terms of the guidelines that the university provides. The main question was, if I make these huge investments, are things going to change in the near future, for instance, with fall applications? Would that still be an option? I've noticed that people that are looking into storing fertilizer in their farms are wondering about fall obligations, if that will continue to be an acceptable practice.

Dan Kaiser: That's one of the major questions I guess I've seen, really, is from growers, has been, or actually comments more than anything, is just the ability to get the fertilizer on. I know that's been the struggle the last few years, these wetter years in having the ability for these co-ops to get in and apply all the fertilizers for these growers in a timely fashion where they're not waiting. So I guess it's interesting to see some of these trends. Particularly, what I find interesting is the growers that are looking at on-farm storage of anhydrous, because that's one of the things I guess I never really expected. That it's a lot easier to handle urea, that they'd look at storing anhydrous. But we see, especially some of these shifts in these co-ops, the areas shrinking, particularly in taking in some areas a lot larger or takes it longer to get anhydrous out to the farm you're going. It doesn't, I guess, surprise me, see this occurring. So it'd just be interesting to see how this goes.

Dan Kaiser: We look at the last, I'd say, two, three years having some really tough short springs. This year, we'll see what happens, because we've had a relatively decent spring at this point in time to see how things differ. But I know I'm hearing comments from growers, particularly on applications with the airplane. That doesn't seem to be a very good option. So we need to really, I think, start thinking about this to maybe have some backup plans in place for applications to allow us to get into the field, get all the nitrogen applied, particularly in these springs like we saw in 2018 and 2019, where it was really a struggle to get things in the field.

Paul McDivitt: Yeah. The past few years have been challenging with respect to nitrogen management due to the weather. How might this have affected the nitrogen sales figures with respect to source? Do any of you anticipate a correction with a better spring this year?

Brad Carlson: Well, I think there's been no doubt that the last few years have been wet enough that it's caused some significant challenges with application of anhydrous ammonia. One is how wet it's been in the fall as far as delaying a harvest and tillage and other activities. That just simply squeezes the window for doing an application. Of course, the other part of this is, is that anhydrous is performed with not aggressive, but at least some minimal type of tillage, and anhydrous knife is at least something. When it's wet, no one wants to be out, A, potentially rutting up the field and getting a tractor stuck, but, B, dragging a knife through the ground. Then in addition to that, there's always the specter of losing a lot of that nitrogen if you have high clay content soils and you slice a

trench through, and it's really wet, it may not seal behind the knife. Some of that can be corrected if you're applying deeper. But still, not an ideal situation.

Brad Carlson: So we've had a lot of that the last few years, and it's really put the bite on farmers wanting to do anhydrous applications. I mentioned earlier the extent to which a lot of farmers who do their own application were never probably greatly comfortable with the product anyway from a safety standpoint. Then beyond that, the fact that it's really the only product we widespread endorse for fall application under most circumstances, at least in major parts of the state. If you're not going to do a fall application, it begs the question then is, are you still stuck with anhydrous? So obviously, there's a higher cost associated with other fertilizer types, urea and so forth. If for no other reason, just simply because the nutrient is a lot more dilute and you're dealing with more pounds of product.

Brad Carlson: But because for instance, urea can be spread over the surface so quickly, and without invasiveness to the soils, it's actually more amenable to a wider range of conditions. I guess ultimately, it's going to be difficult to predict whether what has happened or transpired over the last few years is simply been an adjustment to the weather, or whether farmers themselves are thinking on account of the change in the weather conditions, this may be a permanent feature, and I'm going to adapt what I consider to be ideal management in the long-term.

Dan Kaiser: I guess, as I said before, I'm really curious to see some of the results from the trials this year. I know Fabian, you ended up getting some of these fall-spring urea comparisons in place this spring just to see what the numbers look like, because I think this will be telling to us, at least with the timing aspect, particularly with fall urea. If we have a drier spring, I guess we were a little bit warmer than normal, so that may hasten some of the changeover. But without some of these spring rains, like we've normally gotten, just where things are going to be at this year. That's one of the things I think we've been discussing, kicking around what to do with our fall urea BMPs, because the data really hasn't looked good up to this point.

Dan Kaiser: So that's, I guess, the big thing will be just seeing this year, and things aren't stacking up. I think it'll be probably further evidence that we need to maybe make some change, and some things that growers really need to be thinking about, because as some of these co-ops shift towards different sources, particularly being more reliant on a urea-base and application system, we really just need to be sure that that isn't the best option for fall, and it just really hasn't looked that great just based on some of the data.

Fabian Fernandez: Yeah. That's exactly right. When we look at urea fall apply, it has just not been a practice that I would recommend at all, because the potential for loss is just too great. Again, just like you, I'm thinking well, this is out of all the years where we have done the studies. This is, I think, the first spring where it's been drier, and the loss really happens in the spring. Sometimes if it's warmer during the winter, we may start getting a little bit of mineralization, and then this organic matter,

and then a nutrification of the nitrogen that we apply in the form of urea a little bit earlier. But then again, if the spring is dry and there is no much drainage happening, then the nitrate just sits there and is not really lost. So it's available to the crop. So it will be interesting to see how those results look like this year.

Fabian Fernandez: The other thing that is very interesting in some of the stuff that I have been doing quite extensively since I came here is looking at the split application. So applying a little bit of nitrogen pre-plant, and then really applying the bulk of the application later in the season. We have been doing this mostly in really wet springs, because as has been the case since I've been here since 2013, I think most springs have been fairly wet, except for, I guess, this one. So far, what we've seen with the split application, logistically makes sense, or applying a little bit of nitrogen early in the spring where you have higher potential for loss, and then applying the bulk later when there is less potential, it makes sense. In reality, when we look at the numbers, we find that except for very sandy soils, the split application doesn't always make much of a difference compared to our spring pre-plant application when it's done close to planting time.

Fabian Fernandez: We had a study that we have actually in Minnesota and across the Midwest. Basically 65-88% of the sites where we did this comparison with only applying all nitrogen pre-plant or doing a split application where we saw there was no difference between either one of those systems. So again, the only time where we really saw a benefit was mostly in sandy soils where the split application made great sense because of the potential for nitrogen loss early in the spring. So again, it will be, I think, important to continue to look at these questions, and especially years like this year where it's been drier than typical for the spring, and see how things work out this year.

Brad Carlson: Yeah. I'll just take a what Fabian just said, just a tiny little step farther. That just has to do with the trend towards doing split applications, particularly as it pertains to nitrogen advisory tools and variable rate applications. Obviously, we don't do very much side dress anhydrous ammonia. There's some spots of the state where there are sandier soils where they do a little bit of that. But the extent to which we keep going in that trend, and yes, our research has been shown that there isn't really a consistent return on investment to that. But if the trend continues, that probably will continue to also push the source as far as the type of fertilizer use, because again, anhydrous just isn't used very much when it comes to a side dress in-season application.

Fabian Fernandez: One more thing that I was going to mention in terms of these split applications that often it's actually not mentioned much is the fact that you do have an additional trip through the field. So that adds some of the cost. Typically, we talk about these things in terms of the agronomic, in terms of how much yield we get, and things like that. But we hardly ever talk about the fact that there is an additional cost. So when you put that additional cost to the application, and some of the logistics associated with the obligation in season, then it may even look a little bit less favorable even.

Fabian Fernandez: One more thing that I was going to mention that the question always comes up with these split applications about, how much nitrogen do I need to apply pre-plant in order to wait until I do my side dress application? We had a study looking at basically 45, or 40 to 80 pounds of nitrogen applied pre-plant, and then doing the side dress application the rest around V8, V9. We found that for the most part, over 90% of the time, 40 pounds of nitrogen were sufficient to hold the crop until the side dress time. These, of course, were corn after soybean in most cases. If you're in a continuous corn, then maybe upping the application a little bit would be good. But again, you don't need a huge amount of nitrogen applied pre-plant if you're going to do a side dress application.

Paul McDivitt: That about does it for the podcast this week. We'd like to thank the Agricultural Fertilizer Research and Education Council, AFREC, for supporting this podcast. Thanks for listening.

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