University of Minnesota Nutrient Management Podcast Episode “Fall fertilizer economics”

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(Music)

Paul McDivitt: Welcome back to University of Minnesota Extension's Nutrient Management podcast. I'm your host Paul McDivitt, communications specialist here at U of M Extension. Today on the podcast we're talking about fall fertilizer. We have three members of Extension's nutrient management team, Dan Kaiser, Fabian Fernandez, and Brad Carlson. Can you each give us a quick introduction?

Dan Kaiser: Hi, this is Daniel Kaiser. I'm a nutrient management specialist with the University of Minnesota Extension. I'm located on the St. Paul campus.

F. Fernandez: Fabian Fernandez, also located in the St. Paul campus. I'm a nutrient management specialist focused on nitrogen for corn cropping systems and the impact of fertilizers and water quality.

Brad Carlson: Brad Carlson, I'm an extension educator. I work out of our Mankato regional office. I work more or less statewide extensively on issues related to water quality, but also other nutrient management topics like precision ag and so forth.

Paul McDivitt: All right. Starting off, how early is too early when planning nitrogen applications?

F. Fernandez: It is too early right now. We are the first day of October today. And we look at the temperatures, that's the main indicator. It's never really a good idea to look at the calendar date to decide when to apply nitrogen. And so, but for Minnesota conditions we are really looking at sometime in November when the temperature starts to go below 50 degrees Fahrenheit, six inches below the surface and staying at that or going cooler.

Brad Carlson: One of the things we talk about a lot in our area in Southern Minnesota is kind of looking at that date. And we do not use a date as a recommendation, although I know Jeff Vetch did some calculation a few years ago and he found that the average date that we hit 50 degree soil temperature is about the 25th of October. And they put that out a long time ago. And again, we don't use that as a, oh go out on the 25th of October. But it's sort of a way of thinking about when is it getting close. So, we're still about three weeks away from that.

Brad Carlson: But the thing about that is, of course, is I pay attention then too to date as well as where the soil temperature is at at that date or in the vicinity of that date. And it's been pretty close. And so, in a lot of cases, I think, if you're looking at making an application, you can think about that date, but then of course you have to stay in tune with what exactly the soil temperature is after that point. And the way I look at it is, when you realize if it's too wet, you can't go out. Well, if it's too warm, you can't go out either. So, it's just simply a weather based situation.

Dan Kaiser: Yeah. And we don't really know. I mean, I guess this year, fortunately or unfortunately, the way things have been delayed, I mean, I think we're probably looking at pushing a few things back, particularly just with being able to get into the field right now as we're sitting here on the 1st of October. And I've seen a few soybean fields I know being harvested, but not too many. Brad, in old Southern Minnesota, I was just driving kind of Southeast of the cities there and I saw a few fields out.

Dan Kaiser: But I know we're starting to have some growers think about that. And you get these wet years, kind of one of the things that worries me a little bit is just the grower attitude in terms of waiting, because it's difficult. And you look at logistics, you look at the co-ops, and you're having to get so much done. We just don't know what we're going to run into.

Dan Kaiser: And last year, we kind of saw things start to get a little bit colder a little earlier than we expected. But we have seen years where we've been able... we've seen warm ups around that Thanksgiving time frame, and we still go out and do things. But that also means that there's also some risk for some nitrogen conversions. So, one of the things, kind of playing, I think, this game of trying to figure out what's the best thing to do, it becomes kind of a challenge, particularly the last few years when we've just had this up and down weather in the fall.

F. Fernandez: Yeah. In terms of the temperature, the magical number really is 32 degrees. That's where nitrification will stop, where bacterial activity will stop and there will be no nitrification happening. But the 50 degree temperature that we always talk about is kind of a nice compromise between what we should do and what is okay to do. Because obviously, if you went off 32, the soil is frozen, you cannot redo anything at that point. But 50 degrees is kind of a sweet spot where bacterial activity is diminish sufficiently that you don't get as much conversion of ammonium to nitrate. And so, that's why we talk about 50. So, it's kind of trying to compromise, minimizing the transformation of nitrogen, and also still have time and conditions where we can actually do field work.

F. Fernandez: And so, but it is a challenge, like Dan mentioned. You look at the forecast and you see that it's going to be wet. And what do you do? It is always a challenge,

but keep that in mind as you look at the temperatures and the weather, that 50 degrees, you're still at a point where you can get nitrification going. And, as Dan also mentioned, it's not unusual to see these warm ups that happen late November, sometimes even in December. And some of that transformation continues to take place.

Dan Kaiser: Yeah. And I think with... we talk about nitrogen, I mean, you the 50 degrees. With P and K we don't necessarily have to worry too much about that temperature because we don't have that conversion. I mean, those forms that are there are already going to be the ones that are available. The main thing on those two though is really not delaying too late. Because, while it's better to wait with nitrogen, with phosphorus and potassium, I mean, really we want at least some interaction with the soil. Because, if we don't get that, what you're going to have is some very soluble forms of fertilizer sitting near the surface. And, if that soil is near frozen, you get a runoff event that occurs or some water movement off the site that fertilizer can solubilize and move off the site itself.

Dan Kaiser: So, it's one of the things. Usually we see P and K going on earlier, which isn't necessarily a bad thing. Although, with the phosphorous sources we end up getting a little nitrogen there where it becomes very difficult to predict availability at that point in time because the earlier you go the less likely that it's going to be there because it should be converted. And so, that's the main thing with looking at those rules is make sure... or what we say, rules of thumb. I wouldn't necessarily say a rule. I mean, it's a rule of thumb that we say 50 degrees. Just know what you're looking at there in terms of the forms of nutrients and kind of how things need to be in place to make sure that they're there in spring or in that early summer time frame when that crop is going to need it.

Brad Carlson: Yeah, it's also worth... and we've been talking a lot about the weather and you bring that up Dan, most of that P and K growers are going to apply that and try and incorporate it, use a field cultivator, or something like that. And, of course, that tillage pass is going to be somewhat dependent on the weather because no one is going to go out there when it's real muddy. So, you do need to pay some attention to the weather forecast to realize that, for instance, a harvested bean field is quite trafficable, even when it's fairly wet. It's easy to go out and make a fertilizer application. But, if you're not likely to be able to get that incorporated in a somewhat timely fashion, you are setting yourself up to a little bit of risk.

Brad Carlson: We've been getting some pretty significant fall rainfalls. I mean, we wouldn't want that laying on the surface and then get two inches of rain before it got incorporated. Similarly, we don't want to be playing games with whether the soil is going to freeze and you're never going to get out there at all. Because we definitely don't want fertilizer laying on frozen ground. That's just inviting trouble.

Dan Kaiser: I've had some interesting conversations with some colleagues from other States talking about this particularly what Brad, what you said with the application to soybean stubble and what's the best option. Because normally we get situations where we want to try to prevent erosion. And, with soybean stubble, it's really not the best idea, particularly on rolling ground, to go in and heavily till that stubble.

Brad Carlson: Well, it's worth mentioning, we actually have tillage best management practices and researchers showing fall tillage of soybean stubble isn't even necessary. So, in most cases, yeah. It's an incorporation of fertilizer.

Dan Kaiser: But, yeah. It's an incorporation because, if you don't do that, I mean you look at soybean stubble versus corn stubble, you look at essentially impedance of that water flow across that field that there are definitely more risks, particularly with P and K and with surface applications. And we want more general rainfall to try to get that to bind.

Dan Kaiser: One thing that we've seen is you give yourself ten, 15 days, you get a little bit of just reaction of that fertilizer with the soil, it tends to really reduce some of the runoff risk with that. But it's kind of that guessing game because, yeah, it's been amazing what we've gotten for rainfall events in September and even October last few years.

F. Fernandez: And I would say, for P and K, really looking at the forecast and making sure that you apply not ahead of a big storm, that's the key. Because, as Dan mentioned, I mean there have been plenty of studies where, looking at especially at phosphorus runoff because of the environmental consequences of phosphorus getting into the water that, if it sits there in the soil for a week, ten days, the potential for the runoff really gets minimize because that means it had time to interact with the soil. And so, looking at the forecast, making sure there won't be a torrential rain event happening right after the application is probably the best thing to do.

F. Fernandez: Another thing I want to mention, since we were talking about residue and going back a little bit to soil temperature, you can go to... in Minnesota, there is a website for soil temperatures where you can look at where it is. But soil temperature, of course, varies drastically, depending on the conditions of your soil, the moisture content of the soil, the darkness of that soil, cover, residue cover on that soil. All of those impact the temperature. And so, the best way to really know what the temperature is on your particular soil is you take a temperature probe and just measure that temperature before you start doing nitrogen applications.

Dan Kaiser: Yeah. And then too, we talked about P and K too, Fabian. And I think urea, we could make some of the same too, in terms of how do we treat that with fall

applications. I mean, urea itself is mobile. So, we could have some of the same issues too. So, it's really kind of, I think, trying to be a little more aware of... it's really hard, I think, to look at some of the extended forecast anymore because you never really know. Just looking at predicting the weather, it's amazing to me. And how, watching news in the morning, and you get weather four times and I get four different forecasts from the same person of what's going to happen there. But you really have to kind of be a little bit more aware of that, particularly these highly water-soluble sources. Because urea itself will move as well.

F. Fernandez: Yes. That is an important one. Yes. I mean, if you are in an area where urea is an okay practice for fall application, or for a spring application for that matter, urea does move as nitrate does until it converts. I mean, it converts quickly to ammonia, but it takes a couple of days. And so, if you apply urea, and then you get two inches of rain, that urea is going to move freely with the water.

Dan Kaiser: Really tillage, I mean, subsurface application, I know Brad was mentioning that banding. I mean, really that really reduces your risk. So, that's one of the main things that... tillage is a BMP, when it comes to fertilizer application. It's just whether or not you're increasing the risk for sediment loss. I mean, then it becomes some other issues that really... it's a whole nother topic, I think, for another day.

Paul McDivitt: Are we looking at a year where farmers should consider inhibitors?

F. Fernandez: Well, anything that we can do to minimize the nitrification process is useful, especially when you're applying fertilizer so early in relationship to when the crop will need it. And so, if you look at the efficiency of a nitrification inhibitor, the fall is really the best time where you would get the most return on that investment, just simply because you have such a long window of opportunity for that nitrogen application to transform to nitrate and then be subject to loss, if the conditions are such. And so, yes. I would say using a nitrification inhibitor is important.

F. Fernandez: The other piece that sometimes gets confused with inhibitors is, urea's inhibitor, sometimes people don't recognize that they're completely different things. That urea's inhibitor does very little for you if you're incorporating your nitrogen source. And so, it's really what we are most concerned about when we talk about inhibitors in the fall is nitrification inhibitor.

Brad Carlson: It's worth mentioning that fall application of anhydrous ammonia with a nitrification inhibitor in South Central Minnesota is a best management practice. We say acceptable with risk, but it's very important to point out that that risk is just simply will it pay for itself. There's no environmental risk for using a nitrification inhibitor. It will either produce good results or no results. It's not going to produce bad results. So, the question is whether it paid for itself or not.

Brad Carlson: And it's really kind of a sweet spot. Minnesota happens to be kind of in the cross hairs of where it tends to be most effective, in terms of whether it's warm enough that you needed that to prevent the conversion of ammonium into nitrate, versus whether it's too cold and it really doesn't experience that pressure. As well as, of course, if we have too long of a window of time, it does wear off. And so, it's kind of all these factors that kind of go into did it work as far as preventing loss in nitrogen and therefore pay for itself.

Brad Carlson: And so, when we talk about acceptable with risk, the way of kind of looking at it is like how many years out of five did it work? Was it necessary? Did you receive an economic payback? I look at the data from Waseca and typically it's about three out of five. So, on average, it does pay for itself. But, of course, the things that you need to realize is, it won't every year. Some years it wasn't necessary at all. Just using straight anhydrous was the same. And there's other years where it already wore off and then you lost nitrogen anyway. And so, both of those things can occur.

F. Fernandez: And I always remind people that nitrification inhibitors are not bulletproof. They help but they wear off. And so, using them is not an excuse to use poor practices, agronomic practices, right? I mean, we would not apply anhydrous ammonia when the temperature is 60 degrees in the soil and say, well, I'm protected here because I applied an inhibitor. Well, the inhibitor will wear off faster with warmer temperatures. The breakdown of the inhibitor happens faster. And so, you're basically having less potential for the inhibitor to be beneficial to use. So, again, trying to wait as long as you can until temperatures are cool. The cooler they are, the less nitrification you get, but also the more benefit you get from that inhibitor.

Brad Carlson: Yeah. If I went back in my career back when I first started, we weren't seeing a large percentage of farmers using nitrification inhibitors. Primarily at that time nitrogen was really cheap. I mean, we were like eight, ten cents a pound, something like that. And the prevailing thought was, well I'll just buy more nitrogen and lose some. But, of course, I think we recognize the environmental concerns now, as an industry. We really can't have that mindset that, I'm just going to apply more than I need, knowing I'm going to lose a bunch of it because of the weather conditions. And so, realistically you should be looking at applying the correct rate. And then, if you think you have risk, you should be buying a nitrification inhibitor and not just simply buying more nitrogen so that you can lose it.

Dan Kaiser: And one thing I guess I would kind of have too, as a consumer, farmers just to look a little bit more into, if they are buying inhibitors, there's a lot of products out there that initially when they came on the market were claiming to be inhibitors. Now, I think a lot of them, since they've seen no inhibition ability, have kind of termed themselves nitrogen additives or products. And it's one of

the things to kind of look at the data a little bit more, because there's some cheap products out there that are just cheap products that aren't really going to work. So, even spending a couple of bucks an acre on something that really seems cheap, you will be better off saving your money because you're really not doing anything or any good if it's not something that's been identified as an inhibitor.

Dan Kaiser: And we've got very good data, particularly with like the N-Serve products, nitropyrene. Not maybe as much, Fabian, with the Instinct product. I mean, certainly Instinct with manure has shown some benefits, maybe with banded urea a little bit better than broadcast urea. But we know that those products are out there. DCD products, there's some newer ones in the market, I think, now for nitrification that have shown to help. That product, particularly DCD, has been more mobile. So, that one's a little bit more problematic, particularly in the field to kind of keep it around for longer. But other than that, I mean, there just really hasn't been anything else out there that's really, if you look at testing it in a lab setting to look at whether or not it can inhibit nitrification, that really works.

Brad Carlson: It's important to remember that what you're inhibiting as microbial activity in the soil. You're not affecting the fertilizer. And so, from that respect, if you're looking at using the inhibitor, you realize that the more soil you're trying to affect, the less likely it is to be effective. So, one of the issues, for instance, with Instinct on urea is that, if you're doing a broadcast application, you're trying to affect all of the soil all the way across it. There's a lot of stuff to try and interact with, versus, for instance, N-Serve in an anhydrous band that's a concentrated little, small, little area where it has to impact, versus all the way across the surface. And so, some of those things also are important to realize when purchasing these products and how you're going to use them.

F. Fernandez: Yeah. And we are looking actually at the questions with urea. Obviously, urea is easier broadcast incorporated in doing a subsurface band with a dry product. But we are actually testing that. And, in some situations, we've seen some benefit with the banding and, again, with the inhibitor. Not consistent but, if you are going to have a benefit, tends to be more certain when you're banding the fertilizer simply because of that concentration. You're putting a lot of more of that active ingredient in close proximity to the fertilizer that is in contact with less oil.

Dan Kaiser: But still, we look at our BMPs and that's one of the things that concerns me a little bit, particularly for retailers wanting to go away from anhydrous is using urea with a product like Instinct and claiming that's just as good as the anhydrous, particularly for a broadcast application. And going with that in areas where we don't recommend fall urea. And it's getting harder and harder in a lot of areas to recommend it just with the rainfall we're getting.

Dan Kaiser: So, looking at it, I think, what we really want growers or kind of the end user to just start asking some questions in terms of management. Because it's just not a time right now where you can invest a lot of extra money in things that aren't really going to make you any money back. So, it's just challenging. And when you're looking at trying to cut costs a little bit, you look at some of these little costs that they tend to add up over time. So, you really want to try to make sure that what you're doing is doing exactly what you want it to do, or at least has the potential to do that, versus just throwing your money out there.

Brad Carlson: Well, and if you really want to simplify that argument, Dan, I mean, even if people.... if they don't want to believe us or if they say, well, my dealer told me it's fine. You do recognize that we as a university are saying it's not fine in a lot of places and a lot of situations. So, do you want to go with practices where there's an argument about whether it's fine? Or do you want to just choose practices where no one has an argument at all? And that's obviously a safe bet, particularly given the economics in agriculture.

F. Fernandez: That's right. Yeah. And we could go on talking a little bit more about this, but there is not really time. But you look also at fall versus spring applications. That's another question in terms of safe bets of what works and what does sent or what works better. And I'm seeing more and more with the data that we're collecting that even a fall application with anhydrous ammonia with an inhibitor doing it correctly at the right time and everything typically tends to produce less yield and you need more nitrogen than doing the same application in the spring.

Brad Carlson: Yeah. And I've done a lot of presentations over the last few years related to nitrates moving through drainage water. One of the seminal studies we've got here in Minnesota, some of Gyles Randall's work at Waseca with the drainage plots, they were finding that fall application of anhydrous with an inhibitor with N-Serve, they were not losing any more nitrogen when they did the spring application. Okay? So, for environmentally, they were equal practices. But the yield was reduced an average of eight bushels an acre when you did the fall application.

Brad Carlson: And we pretty much ascribed that to the heavy texture sells, glacial sales in Southern Minnesota, the clay loams and so forth. We're getting denitrification. It's not ending up in the tile water, but we are losing nitrogen. And so, from that perspective, it did have an economic penalty.

Brad Carlson: And I think, one of the things that we need to think about, and Dan, you brought up the whole logistic issue, and of course we keep hearing this, well we can't get it all put on in the spring. I'm somewhat questioning that now because pretty much every dealer has the ability to apply in season. And so, as long as we've got some put on, particularly like for corn on corn situations, in some cases corn on beans, you really don't need to worry about whether you got it on or not. Get

it planted. I think we've got a whole lot more ability to be applying in the spring and into the growing season than we had ten years ago. I'm not sure it's just as big of a concern as it was. In fact, realistically, when I talk to dealers, it's more of a logistics issue with their storage and their capacity than it is their ability to apply it.

F. Fernandez: Yeah. The big question, I think, that continues to be a driver is the cost in terms of a fall price versus spring price. And that is one of the things that people obviously consider. But, yeah. I agree with what you're saying, Brad. That there are so many options right now for a spring application that it's not any longer the issue of, well if I don't apply it in the fall, then I'm really looking at a big problem in the spring.

Brad Carlson: And all you have to do is look at last year where it got so wet that most of the application didn't happen at all. And obviously we had parts of the state that we had a lot of crop didn't get planted either. Of course, in those circumstances, it would have been wasted money if it had gotten too wet and you hadn't been able to plant at all. But, that being said, the nitrogen did get onto the crop that got planted after we had a bad fall where we couldn't do a lot of applications. So, it did happen.

F. Fernandez: And, whether we like it or not, I think things are changing in terms of the weather and the weather we experience, I mean, I've been in Minnesota for six years and I don't think we have had any growing season that was like a dry growing season or a dry spring. It has all of them have been wet springs. And with applying nitrogen too early in the fall or too early in the spring, actually, that's one of the challenges because we are seeing situations where you end up not having a crop in there or having to maybe go for soybeans or something different simply because you could not get the... this year was a perfect example of that. Where there were a lot of acres where you just had to simply make a change. And so, if you don't have that investment already in the field, it makes that decision a little bit easier.

Paul McDivitt: We talked about this already a little bit, about the economics, but what makes the most sense economically for all fertilizers, N, P and K this fall?

Dan Kaiser: Well, we talked about P and K a little bit. And I think one of the things that's a kind of stress is, when you start looking at making your decisions is that, use the best information you have. I mean, don't go out and just say, okay, I'm just going to put on what I took off. Because you start looking at the overall costs of that.

Dan Kaiser: And I think one of the things that hit home a few weeks back, we were at our staff development, we had one of the economists in talking a little bit about that and talking about reducing costs across the board to maintain profitability. I think fertilizer is one of the ones that, we're so ingrained that, particular with phosphorus and potassium, of what it has done historically when we look at

applications. And certainly you go back 50 years when we were just really starting to get fertilizers in the market, a lot of things... started looking at our soils were low, started to get a lot of high return on investment where we started to see soil tests increase and start to build over time. That, we get situations like this, it might be a good time to start drawing things out of the bank.

Dan Kaiser: So, looking at not maybe eliminating applications but at least reducing it. And, if you're looking at variable rate, I know, Brad, kind of one of the things you've talked a little bit about has been, how do you make variable rate pay with that? And I think that's where a lot of growers... I mean you go in and just think, okay, well you can just go and take my yield map and put on variable rate what I took off. And I'm just going to stick with that because that's going to make me money. And really you got to start looking at it, I think, of trying to reduce on cost because that's really where we're looking at really making your money back on variable rate.

Brad Carlson: Yeah. Crop removal is a scheme. We've just shown that consistently through the decades that that's not a viable concept to be fertilizing a field with. That you can't just simply take how much P and K, and I guess nitrogen too, went off in the grain. I need to put that much back on. There's just too many dynamics in nature to do it that way. It just doesn't work out.

Brad Carlson: And so, we've talked about this, I think, in the past too. That I've looked at the data relative to our adult farm management program that looks at crop budgets. And the 20% most profitable farms in Minnesota spent 30% less on fertilizer per acre than the 20% least profitable farms. No other crop inputs have that kind of spread. There's, obviously, your most profitable farms typically do have lower costs than your least profitable farms. But like for seed and herbicide it's only 10%. So, why is it 30% on fertilizer. It's very clear that there's some people engaging in practices that just flat out don't return investment. And this crop removal strategy is one of them. You need to base fertility recommendations on a soil test. And, if you're in that very high range and above, skip it. It just doesn't need it.

Dan Kaiser: And maintenance may not be the same thing as crop removal too. When you start looking at it, I mean, I've seen that be consistently and across a number of our longterm trials is, in order to maintain soil tests, I could be applying downwards of about 60% of crop removal and still maintain my zero to six inch soil tests. So, if you've got the soil tests, I mean the main thing is to look at where you're at. And, if you're in those very high categories you can cut the rates back a little but you don't need to eliminate. But trim them back a little bit to the point at which you're not spending upwards of what may be for removal of about 80 units of P205. If you're with a soil test of a 30 parts per million Brae there's just no chance you're going to return that.

Dan Kaiser: In most cases, what we see in that circumstance is maybe seeing a small starter rate being ideal, about 20 pounds. So, it's one of the things that really needs to be kind of looked at is, if you're using variable rate, you got to identify those areas that are being grossly over fertilized. And try to make some money back on saving on costs. And then, maybe you have a few areas that are under fertilized that you can increase yield by additional fertilizer. But I think, for the most part, the way a lot of these fields are is that, as long as you have more acid soils and not real high pH soils that tend to fix phosphorus, that I think most of a lot of these fields are going to be in pretty good shape, unless you've got a rented piece of ground that was mined out pretty heavily before you got that particular piece.

F. Fernandez: Yeah. And we always think about P and K together. But the reality is that we don't have to apply both nutrients in every situation. And this goes back to my days when I was in Illinois. I actually did a survey of soil fertility across that state in Illinois. And it was very surprising to me to see a large percentage of fields that had really high phosphorus, that there was no need for phosphorous, that were in the deficient category for potassium. There were very few of the other kinds of fields where you had a really high potassium and deficient phosphorus.

F. Fernandez: And so, I think typically people talk about phosphorus, making sure that you have phosphorus. And then, well that's typically kind of come second. But, in reality, looking at the soil test values to determine what you need to be applied. It may be that you apply a good amount of potassium and very little or no phosphorus. And that would be the most profitable thing that you can do, instead of just applying the typical rate that you've been applying.

Brad Carlson: I'm not a hardcore a soil chemist, but through all my experience in Extension now, typically speaking, when we get to the Southeastern part of the state, we have a lot of natively higher phosphorus levels and a lot less response to phosphorous. And then, as we move to the Northwest, it's higher levels of potassium. And so, they do kind of flip flop based on what you're dealing with with soils. Obviously, if you're an individual farmer, you're just used to dealing with what you deal with on your own farm. You don't need to worry about it across the state. But it's worth noting that we do see those differences as we go, particularly from Southeast to Northwest in Minnesota, just based on what was put in place from the glaciers.

Paul McDivitt: Alright. 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. If you haven't already, subscribe to the podcast on iTunes and Stitcher. You can also find out about new podcast episodes as well as our blog posts and videos by subscribing to Minnesota Crop News email alerts. Just Google Minnesota Crop News and click, get Minnesota Crop News by email, on the

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