

University of Minnesota Nutrient Management Podcast Episode “On-farm research”

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- Nora Nolden: Welcome back to University of Minnesota Extension's Nutrient Management Podcast. I'm your host, Nora Nolden, communication specialist here at Extension.
- Nora Nolden: Today on the podcast, we're talking about on-farm research. We have three members of Extension's nutrient management team, Dan Kaiser, Brad Carlson, and Anne Nelson, to cover the basics and beyond. Welcome everybody. Let's do a quick round of introductions.
- Dan Kaiser: This is Dan Kaiser. I'm a state nutrient management specialist at the University of Minnesota. I do a fair amount of work on-farm, with some smaller plot and larger plot trials. This is my tenth year here in Minnesota.
- Anne Nelson: Anne Nelson, here. I work out of the St. Cloud regional office as a regional extension educator, working with nitrogen management and water quality on coarse textured soils.
- Brad Carlson: Brad Carlson. I work out of our regional office in Mankato. I do, also, water quality related work and other nutrient management topics. I cover the whole state, at least at this point.
- Nora Nolden: All right. So let's talk about the basics about what makes a good on-farm test.
- Dan Kaiser: Well, one of the things you have to remember is, with on-farm testing, I think the first thing is just getting your expectations to a point at which you can set something up you can effectively test. That's always, I think, the issue I see with a lot of people. You get a lot of expectations in terms of having a lot of treatments out there, you can test a lot of things.
- Dan Kaiser: When we're starting to talk about research, particularly with large-scale field trials, you really need to temper things down and look at trying to parse it down into maybe some smaller questions, and not trying to answer everything all at once. Doing a good job really, in terms of the design, is really important, in terms of making sure you're getting good data.

Brad Carlson: I think the advent of having yield monitors has really changed this dramatically, over what it used to be. I've been involved with doing on-farm trials since before yield monitors, when we were simply weighing everything out with weigh wagons. Obviously, this has put it in the grasp of most farmers to do these things.

Brad Carlson: It's quite frequent when I'll hear farmers say, "Well, I tried this on one field, so we'll see how that looks." Or, "I split the field in half, and I applied such-and-such, and so forth."

Brad Carlson: What we really need to do is really remind farmers that if you're actually going to answer the question that you're trying to get at, you need to design this properly. We could take any field that you farm, let's just say you've got ten of them, and there'll be a rank of one to ten, and which one yielded the best and which one yielded the worst. Similarly if you just simply split the field in half, there will always be one half that yielded higher than the other half.

Brad Carlson: It's really important that if you're going to do on-farm research, that you ... First of all, you define your question properly. Then, you design it properly.

Anne Nelson: There's a few things I think you should be looking at when you're designing this. One of them would possibly be your location. That's just choosing the right field to do this on. Maybe you have done research in the past, on your farm, that's in a field really close to the home. There's been a bunch of different products on there, or maybe you have a manure history on there. That's really going to affect your results.

Anne Nelson: So, really thinking about where you want to put this trial. Maybe you have some place that gets more sunlight. Maybe you have a spot that's eroded. Thinking about those things before you really pick on specific field, maybe that's just for convenience issues.

Dan Kaiser: Brad brought up, I think, a really good point, about your different fields and ranking them in terms of yield. It's one of the things that concerns me with some of this testing. A lot of people get really wrapped up in these one, two bushel yield increases, because a lot of times, that's all it would take to pay for product X and put it in the field.

Dan Kaiser: The issue, though, is what you need to consider is, say you split a field. You put a product on a half. If the product did nothing, granted if you didn't do anything, would those two halves of the field yield the same? That's why we use statistics, which I know seems to be, a lot of times, we seem to kind of go the way of a lot of people not really wanting to get heavy into statistics.

Dan Kaiser: Really, with these on-farm, you don't really need to do anything major. It's just mainly getting an idea with your replication what your error is, which essentially is that variation that that field's imposing, versus what the variation that your treatment's imposing. Getting a good handle on what that is, to make sure that when you make a decision based on your data, that that decision is accurate based on something that's meaningful. That's really the problem is, without statistics, that's why we use it, we really don't know if that product does something; or whatever you're doing or you're trying to do, does something.

Brad Carlson: That's right. Even before that, you need to make sure that you're actually even able to collect numbers. I was familiar with a situation a number of years ago, where a farmer was encouraged to try a fungicide. The dealer actually applied fungicide in a diagonal stripe across the field and said, "Well, let's see if you can see this when you harvest next fall."

Brad Carlson: Lo and behold, they did see it when they harvest. But if you looked at the individual data points, what you'll discover was that the fungicide delayed maturity by a little bit, and the crop was actually a lot wetter in that stripe. In addition, because it was diagonal, you couldn't ever really actually pull out what the yield difference was. In that particular instance, it really was what I would define as a poorly designed trial. You saw something in the field, but you really had no way of quantifying it when it was all said and done.

Dan Kaiser: The other thing too, is I get a lot, everybody says, "Well, this is easy. We can do it. It's easy. We just need a yield monitor. We can measure it."

Dan Kaiser: That's really not the attitude you want to see in terms of setting these things up. Really, you want to take your time and make sure that you're doing a good job. You can really screw these things up really quickly, if you're not thinking ahead. Particularly when you're out there with the planter, if you put something out pre-plant. You've got two hybrids in the planter, or something else where you confound your treatments. Then, essentially what you did with all the planning, really goes out the window and you really can't get a whole lot out of it.

Dan Kaiser: It shouldn't really be easy to do that good of a job. I know it's easy to collect the data with your yield monitor, but you really have to put some thought, in terms of what you're doing for treatments, how it's being set up. Making sure that everything is there, that you're making a good direct comparison, and that you're not confounding a bunch of factors together, where you can't really separate out, if you do get a yield response, what's giving you that effect.

Brad Carlson: That's a good point, Dan. You're familiar with a project we did a few years ago, that was a fertility trial. Our cooperator really wasn't on the same page as we were. He ended up planting, literally, four different corn hybrids in the field that

was to house the trial. That just messed everything up, because obviously, we weren't running a variety trial, we were running a fertility trial. At that point, we really had a mishmash of where the varieties fell, from one to the other.

Brad Carlson: I'm even familiar with a different project that I was involved in a couple years later. I happened to be riding along with the farmer when we were planting, and he made a comment to me that he was running out of corn and we were going to have to stop and put some more in the seeder. You just, off-hand, based on the experience previously, said, "Of course, you have the same hybrid, right?"

Brad Carlson: "Oh, no, I'm out of this one. We're going to switch to whatever."

Brad Carlson: I said, "Well, we can't do that. We're running a trial in this field, and you can't switch corn hybrids in the middle of the field." Those are some of the small things where it seems really obviously, and maybe like humorous, or so forth, or like we're poking the people that we're involved; well, we're not mentioning names.

Brad Carlson: In reality, when things get busy in the spring, these are the things that happen. Then you're sitting there in the fall, trying to decide, "I looked at such-and-such, now how do I evaluate this?" In reality, you are left with a situation that can't be evaluated.

Dan Kaiser: That's one of the things we run into a lot. As Brad mentioned, it's a major issue, is too, when you start looking at your planning, is that if you start taking to your co-op agronomist, you make a plan in terms of, "We want to do X," they aren't necessarily the person that goes out there and actually does the work. Maybe Y gets done, and then it messes things up.

Dan Kaiser: That's the thing why I really stress, is not taking the attitude that this is really easy, that anybody can do it. While there's a lot of opportunities out there, you really need to have some thought into it and some careful planning, just to make sure what gets done is what you intended. Otherwise, you just, really salvaging data at that given point and time. It's really not worth it, because you can make some pretty erroneous results, bad results, if you've got confounded data.

Brad Carlson: Yeah, and in addition to that, as far as your crop input are concerned, we also need to be careful beyond the seed. We ran into a situation a couple years ago, where it turned out that the cooperate we had identified was going to apply his herbicide with 32% urea ammonium nitrate, and that was going to mess up or fertility trial.

Brad Carlson: It's like, you need to think about those things where you're doing a nitrogen trial and all of the sudden, "Well, I was going to apply my herbicide, pre-plant, as impregnated urea," or something like that, well you can variable rate your

herbicide. All of the sudden, that also messes things up. There's really a lot of advanced planning that needs to go into this, just simply to make sure that the site is going to be able to, I guess for lack of a better term, accept the project that you want to put there, or the evaluation that you want to do there.

Anne Nelson: Yeah. We really encourage you, if you're interested in answering a question, or looking at a new product, to do a field trial on your farm; but really thinking critically about what is the question you want to answer. Going back to those confounding factors that Dan and Brad mentioned, picking one thing and keeping everything else the same.

Anne Nelson: Also, going back to the importance of the randomization and the replication, at the University, we're known for doing a lot of replication. Some people may not understand why, but it really is to look at if these things actually make a difference out in the field. If you're looking at one thing versus your normal practice. Maybe you want to bump down your N rate, or up your N rate, or use a different product, doing about six strips, three of one and three of the other, is a good comparison, instead of just doing half the field and another half the field in one thing.

Dan Kaiser: One of the things I see a lot, too, with product testing out there, too, is you see a lot of trials where they'll maybe use a farmer rate and a farmer rate with a product, and then the product with a reduced rate. That's an issue where you start looking at it is, you really need to have that comparison or that reduced rate without that product, as well. Again, that goes back to just making sure you're comparing apples to apples. Otherwise, essentially what you're running into is an uncertainty whether you could have reduced that rate without that product, if that treatment wasn't in there.

Dan Kaiser: That's really where the planning needs to come in. Just make sure that you have good direct with and without comparisons for whatever you do. Then you can make some comparisons based on that data.

Brad Carlson: I've occasionally run into farmers who wanted to test a "system" where they were looking at some interaction with tillage and fertility and pest management and so-forth. Very, very difficult to do on a field strip. If you've got, say managing it one way versus managing another and all those things are different, now you don't really know whether or not it was just simply one of those factors, or whether it actually was the system that drug that out. It is important to isolate the what we're trying to look at, in addition to the replication part.

Brad Carlson: I also had experience with a project a few years ago, that had a tillage component. The farmer said somewhere towards fall, "Keep an eye on that last strip out there, that you're harvesting."

Brad Carlson: "Why?"

Brad Carlson: "Well, because I went over that twice, I wanted to see if it made a difference."

Brad Carlson: "Well, oops. Now we don't know whether the treatment actually affected things, or whether it was because you tilled this a second time." All those things have to be kept under control in order to make sure we actually end up with usable data.

Brad Carlson: The other thing is to make sure it's actually randomized. I had a situation back a few years ago, this actually covers a lot of ground, or a couple of different topics. We had a situations with a tillage trial that I did. It's probably almost 15 years ago, now. We were looking at strip till, versus just simply going in with a spring field cultivator on soybean stubble for corn.

Brad Carlson: We replicated three times. I just simply randomized by flipping a coin, because there was two treatments. Of course, if you've got treatment A and treatment B, it could either be AB or BA. One of those in three replications is going to be repeated twice, and the other one time. When we went across the field and we were taking the yield data, the yields went something like this. Starting on the south, they were 174, 182, 189, 195, 200, 207, and so-forth.

Brad Carlson: What we actually saw when all was said and done was that the yields got increasingly better as we moved from south to north. If you didn't actually randomize your treatment, if you were just simply going every other one, well, obviously it didn't even matter what the treatment was. Every treatment that you placed on the north side was going to yield higher than the treatment on the south side did. In our particular instance, we decided that this trial really wasn't even salvageable at all, on account of that factor.

Brad Carlson: Something that we also wanted to mention was passing the smell test. When you look at the data and you see that trend, in this case, there was a statistical difference that said the strip till was better. But yet when we looked at it, I said, "We don't really know that. All we really know is that the north side of the field yielded better than the south side of the field. The farther north we got, I don't know what previous management happened out there to cause that effect."

Brad Carlson: Again, it really brings home why you need to randomize. Had you just simply said, "It's going to be this one, this one. It's going to be BA, BA, BA, all the way across the field," it didn't matter what the treatment was, whichever one was the north side was going to be your better yielding.

Nora Nolden: At the end of a trial, what should you do with your data? How do you handle it and how do you analyze it?

Dan Kaiser: What I really suggest is really looking at your data. Brad brought up that point with those alternating strips, and I've seen that, too, with randomized strips, where we ended up just by chance and placement, where our applied strips were in higher yielding areas, that we ended up with a large yield response. These were boron trials.

Dan Kaiser: You look at the data, the data really indicates to me, that if you look at just how we had that trial laid out, that was why we had the yield response. It wasn't anything to do with the treatments, it was just we had higher-yielding areas of the field where we had the applied treatments, for some reason, just by chance, even with the replication.

Dan Kaiser: Really, that's the starting point. You really, one, need to make sure your data is clean. Getting rid of some of those outlier points. Then, two, then look at it. Just an overall map of the field. Look at it how your strips lay in there and just see if there's any patterns.

Dan Kaiser: This was pretty clear, that that boron data was by soil type. You could just see it, clearly, how the yield was following the soil map. Looking at that, that's one of the reasons why you use that kind of data, then you start saying there's a large yield response, when there might not necessarily be and you're going to make a wrong decision.

Dan Kaiser: Now, on that particular trial, if you're applying a few pounds of boron incorrectly, you're wasting money. I mean, it probably isn't the end of all things. There's certainly circumstances out there where you could actually be harming yield by some over applications if you made a wrong decision.

Brad Carlson: Yeah, I think probably the next thing with collecting good data is to make sure that your yield monitor is calibrated. Obviously, the gold standard would be to have a weigh wagon out there and check what the weigh wagon says to what the yield monitor says. That's really not feasible in most cases, it kind of takes away your advantages of doing on-farm research, which is to not have to stop and slow everything down.

Brad Carlson: It is important, though, to make sure, for one thing, that your combine passes are actually over your treatment. That you don't end up splitting, because that will happen, particularly with fertilizer treatments, which are in feet, versus other treatments which are in rows. That can happen.

Brad Carlson: The other thing, of course, is to make sure that your yield monitor is calibrated. We have been witness to various situations where farmers have not calibrated their yield monitor appropriately. Or where we've been there when it was being calibrated, and we know enough to say, "I don't think that's the proper

procedure," to which the operators manual got pulled out and we ended up spending a bit more time on it. That's probably the next step.

Brad Carlson: I think the last thing, involving that, though, is also to try and harvest the plot area all in one time. If you are having storage and dryer issues, where you say, "Well, I'm only going to be able to talk half this field, and then I'm going to have to wait for the dryer to catch up. I don't know if the truck's going to show up to unload," or something like that. If you're collecting part of your yield map in the morning and part of it at night, we've seen a lot of instances, just simply looking at yield maps, where you'll see difference from morning to night.

Brad Carlson: Particularly in cases where a field was started to be harvest, and they came back say a week or two later, because, say, it was raining, which is another point. Don't start collecting yield data on a plot area when the forecast is bad. If you think you know that you're going to get rained out at some point, go somewhere else. Because if you come back several days later, you're going to see some differences. Again, that gets very difficult to interpret the data at that point.

Dan Kaiser: Well, it's one of the things, too, I'd like to suggest is, as Brad said, you really need to have some planning when you start talking about how you overlay your strips. With a lot of our fertilizer trials, I really try to keep it so our strips are at least around three times the header width. I like to have two passes, up and back, on each strip, just to mitigate any issues we may have with the flow going through the combine, if you're going up a hill, down a hill. Then it gives you more data points, as well. That takes careful planning, in terms of that. Making sure that everything is where it should be.

Dan Kaiser: I'm kind of about 50/50, usually on my on-farm trials. We try to set them up counting planter rows, whether or not we're going to be in the right spot at the end of the season. It is something to really try to do as much as you can, because you don't want to be harvesting an edge row, where you're harvesting two strips at once. Really, because then your data's no good. There's not anything you really can do about it at that point in time.

Brad Carlson: You do need to also give some thought, when you're laying it out, about your harvest width. The advent of big corn heads has caused some problems with that, also. When we've got 12 rows that we're trying to take out all at once, that makes it much more difficult than when we were only taking six rows or eight rows out. It just adds a little extra complication to that.

Anne Nelson: Yeah. I think moving on from collecting good data, those are all great suggestions, but what do you do after you get this good data? That comes down to your analysis and statistics.

- Anne Nelson: You yield monitor or weigh wagon's just going to give you an average of what that strip was. What you really should do is go back and plug in all your treatments, maybe to an Excel file, and look at the difference between all these treatments. Maybe you have some that are really high, and maybe you have some that are really low. Looking at something that we call LSD, least significant difference, and finding whether plus or minus this treatment was maybe plus or minus maybe five pounds different than the next treatment.
- Anne Nelson: Is there really a difference between something that averaged 200 bushels and something that averaged 205 bushels. Maybe there's a lot of noise in that data. A lot of high ones and a lot of low ones, but you're getting an average. That's something, really, to educate yourself about, if you're unsure of it, and look at that before making any conclusions.
- Dan Kaiser: That's one of the things, and I think I said this before, that if you have no treatment effect out there, don't expect that, essentially, your yields are going to be exactly the same. By chance, if you did nothing in that field, if you have the same treatment structure, you're still going to have difference out there that could exist just because of the variability that's within that field.
- Dan Kaiser: Excel, if you do have that, there are some options with the analysis tool pack, depending on what version you have, where you can do some analysis of variance, which is a pretty simple technique for it. You can actually find on the web, in terms of how to do that. It's actually pretty simple to do in Excel. I think there's some websites, too, that you can go in and plug your numbers in. It'll just calculate a probability value, based on the data you have. There's some options out there, if you have some pretty simple studies in terms of what you can do for statistical analysis, just to see how your data stacks up.
- Brad Carlson: In addition to finding that least significant difference, it's also worth looking at just what that number is. If the least significant difference is 8, 9, 10 bushels an acre and you have that, obviously you've got something going on.
- Brad Carlson: Dan's familiar with a trial we did a couple of years ago, when all was said and done, the LSD on a field that was a half mile long was two bushels an acre. Incredible consistency in that field. A lot of us that have done a lot of on-farm research question like, "If you find a difference that's three bushels an acre, even though the statistic says that it's significant, we really have a hard time believe that was accurate."
- Brad Carlson: The point of that is, most of those are done to say a 90% confidence interval, and a lot of times in agricultural, we'll go lower than that. We'll go 80%. Let's just say 90%. That means that 10% of the time, it's going to tell you that there was a difference out there, but it was false. We need to also take a look at that data

and say, "Okay, so statistically, this was significant, but was it really?" In the case where it was a very small difference, we need to somewhat question that, too.

Nora Nolden: What should you look for in your reporting to ensure that your data is good?

Dan Kaiser: Well, I think some of the tools that we're talking about, with the statistical tools that are out there, there are some options that are out there that you can at least generate some of those probability values. If you're below a probability of .1, then there's a good chance that there's a real difference out there.

Dan Kaiser: One of the things, though, that you have to realize, and this is when you're looking at any data, particularly when you're looking at product data, is you're going to be getting, essentially, the best of the best, in terms of what they found. Really, what I like to see when I look at a lot of our product testing is both the responsive and non-responsive. Just to get an idea of what percentage of the time did it work.

Dan Kaiser: It gets back to what Brad was talking about with those error rates, that even with a .2, we'd expect one out of five chance for a false positive. At a .1, it'd be one out of ten. They're going to be out there. They happen. You can expect, possibly, to see some of that, if you see reporting values.

Dan Kaiser: Really, a lot of times, too, it is kind of what we deal with a lot, is the testimonials that are out there. A lot of times, too, the data is a little bit marginal. You look at some of the ads you're seeing, but the testimonials go a long way, in terms of selling a lot of these products and practices. Wading between those two, trying to figure out the good and the bad, is really the issue when you start looking at trying to make decisions based on the data that's out there.

Brad Carlson: Yeah, I'd be really careful if I look at non-replicated data, but collected over many sites. I know that we, in Extension, do use that type of data, particularly for like variety trials, where we'll have a marker of variety that we plant in all of the trials. Then, instead of replicating, we let our sites be the replication.

Brad Carlson: One thing you need to be very, very careful about when looking at data like that is to ensure that whoever collected it didn't cherry-pick the right strip coming out of the field to make it look the way they wanted to. Is it the whole field average, or did they take combine passes, multiple times, until they finally got the number that they wanted?

Brad Carlson: Again, I'm not saying that this is a real wide-spread practice. We've also heard first-hand from instances where this has happened. I think you do need to at least be on guard for that situation.

Brad Carlson: I think the other thing is you also have to keep in mind, this gets a little back to what we were talking about before, regarding whether you've got significant difference, is putting the economics to this. Is not just simply, did you find a significant difference, but did it even pay for itself? Did it pay for the product? Are there other costs?

Brad Carlson: For instance, when we're talking about doing a lot of fertility work, if we're talking about side dress, you've got an entire application cost. Maybe a \$9 or a \$10 an acre application cost that you wouldn't have had at all. It's not just simply the product, it's going back over the field.

Brad Carlson: Did you use some technology that you had to pay for? Is it a crop model that was \$4, \$5, \$6 an acre? Did you do extra soil sampling or tissue sampling that had a per acre cost? All those things need to be considered, when looking at.

Brad Carlson: I've heard a lot of the advertisements where they've said things like, "Well, the cost of this is only a couple of bucks an acre. You only need a third of a bushel to pay for this." Also, a reminder, you can't really measure a third of a bushel with any on-farm technology, for measuring yield, so you'll never know with that kind of stuff. It is important to also think about the economics.

Dan Kaiser: There's a lot of reliance on yield. We do understand that yield pays the bills, when it comes down to it, in terms of deciding what these products are doing anything. The main issue, and it's what I'll be talking about on CPN short course, is looking at a lot of the product claims in terms of what they do. A lot of times, just measuring a yield increase doesn't necessarily prove that that product's doing what it's supposed to be doing.

Dan Kaiser: A lot of times we run into issues with a product that might be a microbial enhancer, something that claims that it works by enhancing microbial activity, but they throw a micronutrient package in with it, as well. How do you sort out what did what, and is there a different option with that? That's really the main thing, with that.

Dan Kaiser: When I look at really passing the smell test, when I look at data, is really, again, looking at that apples to apples comparison. Showing me a farmer rate versus product X plus a reduced rate really doesn't prove to me that that product works if they yield the same. All it really tells me is that the farmer may have been over applying whatever fertilizer they were applying at that given point in time, because there just isn't that direct comparison. You really want to look at it with and without comparison, because that's going to be the best data, in terms of determining what's going on.

Brad Carlson: Yeah, I think another thing related to that is getting back to the economic standpoint, is not just simply the yield. Your result might be that the yield was identically, but now we've got to look at what the management was. Was there more economical management that produced an identical yield?

Brad Carlson: A lot of times farmers get real caught up in saying, "Well, if it didn't find a yield difference, then you didn't find anything." Well, if you're actually changed your management and there was no yield difference, maybe you did find something related to, "I can do whatever," it's a reduced rate, or apply this product instead of that product, and still get the same yield. That's still a result that you need to be thinking about and looking at.

Brad Carlson: Looking at the smell test part, about when you're all said and done and you're looking at the data, I think it's important to really focus on that whole field and whether you feel like there was quality data. We lost a project this year because a tornado went through. We're not going to use that data. We're not going to try and pretend that somehow the loss from what happened in that field was reciprocal across all of the treatments, and that they were all the same, and therefore we still have a result.

Brad Carlson: I was a part of a project a number of years ago where some results were being presented. I had to ask a farmer, kind of on the sly at the end, I had him off in the corner and I said, "When you showed that yield map, there's some spots in the field where the yield looked like it went to zero?"

Brad Carlson: He said, "Well, yeah. We had some giant ragweed get away from us."

Brad Carlson: I said, "So you mean it literally was zero? That the giant ragweed was that bad that the yield was zero right there?"

Brad Carlson: "Yeah, it was."

Brad Carlson: I said, "Well, I don't really know that we can trust any of the results from this field if you had spot in the field where the weed control was so bad the yield went to zero." Even though everything might have been laid out properly, you still had to back off and look at what happened out there and say, "This trial didn't turn out the way we wanted it to. We really can't use this data."

Anne Nelson: Brad brings up a really good point about tornadoes and weed control. Hopefully you don't have a tornado every year. Something we also want you to consider if you're doing these trials, is possibly conducting the same trial over a number of years. In the University, we really like to look at research for at least two years, just in case something changes. Maybe you have a drought year and that affects your results. Maybe you have a wet year and that affects your results. Or you

have something happen in your field that's mitigating your treatment effects. Consider that, possibly, before you start something.

Anne Nelson: Then, also, a good point about keeping good notes. Maybe you're working with a cooperate and they're not quite sure, they're not out there every day like you are looking at things. So keeping those good notes so you know at the end of the season if something wonky is going on, that that's what it was.

Brad Carlson: Yeah, you had a hotspot with soy bean aphids, but it didn't justify treating the whole field. Maybe in the case of a research project involving soy beans, maybe you need to treat it anyway, just to make sure you didn't find out how bad the aphid problem was, and so-forth.

Brad Carlson: You bring up another good point, Anne, about multiple years, in particularly because we're all soil scientists here. I think we need to point out that the loss process for nitrogen is water driven, and this was a very wet year. We're going to see data this year that indicates you probably needed more nitrogen or got a better response to side-dressed nitrogen. I anticipate all these things, because that was the kind of year that we had. It is important to put your data in the context of the year.

Brad Carlson: Your point being, on doing it multiple years, one of the reasons we usually do our research projects over, say, at least two years, but really preferably four, is hopefully in four years, you got a wet one, a dry one, and at least two normal ones that you can actually get a better picture of what's going on. You do need to look at the context of what the year has been like, when you're looking at your results from that trial, in order to explain that as well as to decide whether that's usable from here going forward, or whether it really just simply told you what happens in a year like this.

Nora Nolden: Any other closing thoughts?

Brad Carlson: I'd just say, like my case in particular, I'm always willing to help farmers with designing, randomizing, laying these things out. I don't know that I can physically go to everybody's farm and help stake them out, but we could certainly talk over the phone or through email, so forth. If you want, I'm willing to let you contact me. My email address is bcarlson@umn.edu. It's a very simple one to remember. Or you can just find me on the extension webpage and let me know. Of course, we're also always willing to help you with pointing you in the right direction or getting you going in the right way with statistical analysis, when you're got your yield results, also.

Anne Nelson: Yeah, Brad brings up a good point. I would say the exact same thing. We really encourage you, if you want to look at something, to set up a good trial. We can definitely help with that. Brad and I are here and we have a lot of crops

educators throughout the state who can help you put something together and look at your data, if you're interested in that.

Dan Kaiser: There are a lot of tools out there. I think we can point you in the right direction, if there's some issues, if you're trying to set something up, if you're trying to figure something out. It's always there, because that's good interest of ours, in terms of on-farm data, at least to make sure that people are getting it right and getting the best out of it.

Nora Nolden: All right. Well, that about does it for the podcast this week. We would like to thank the Minnesota Agricultural Fertilizer Research and Education Counsel, AFREC, for supporting this podcast. For the latest information on nutrient management, you can follow us on Facebook and Twitter @umnnutrientmgmt, where you can also send us your questions for the next podcast episode. Thanks for listening.