

UMN Extension Nutrient Management Podcast

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In this episode of the Nutrient Management Podcast, we're talking about cover crops. What should farmers who are considering growing cover crops this year be thinking about? What are some tips for getting a cover crop established in Minnesota? Should growers consider applying fertilizer to help get a cover crop established? What recent cover crop studies have U of M researchers been doing, and what have we learned from them?

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University of Minnesota Nutrient Management Podcast Episode: "Cover crops"
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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. In this episode, we're talking about cover crops. We have four members of Extension's crops team. Can you each give us a quick introduction?

Anna Cates: Hi, I'm Anna Cates. I'm the Extension soil health specialist, based in St. Paul.

Fabian Fernandez: I'm Fabian Fernandez, a nutrient management specialist focused on nitrogen management for corn cropping systems, and I am based out of St. Paul campus.

Carl Rosen: Hi, I'm Carl Rosen. I'm focused on nutrient management, and I work primarily with irrigated crops, and processing crops as well.

Lizabeth Stahl: Hi, I'm Liz Stahl. I'm an Extension educator in crops. I work out of the Worthington Regional Extension office, and focus on corn and soybean management issues.

Paul McDivitt: Great. So starting off, what should farmers who are considering growing cover crops this year be thinking about?

Anna Cates: Well, we usually tell people who are thinking about growing cover crops to start with your goals. What are your goals with cover crops should determine how you manage your cover crops, especially for the first time. Pretty common goals are to prevent erosion, to assist with water quality goals and your watershed, which is a big reason why growers get

cost share. Sometimes people are trying to provide forage for a livestock operation or to sell, and some people are trying to preserve nutrients in their soil to hopefully give some nitrogen or phosphorus to their next crop.

Anna Cates: So if you want to grow a lot of forage, you're probably going to be trying to plant something at a higher density and things like that, whereas if you are just trying to prevent erosion, keep your soil from moving, we've had quite a lot of erosion events around the state this year, then a lighter seeding mix might be fine. Another thing I'd be thinking about this year is that it has been a dry year, and so people are going to want to monitor moisture. It wasn't a great year for interceding early into corn, and ideally, you're going to try and make sure you have the moisture for your cover crops to use some of it, without depleting moisture for your cash crop.

Fabian Fernandez: And one thing that, I started doing research with cover crops a few years ago, and I figured that it would not be as simple as sometimes it's presented, especially by people that are really excited about cover, crops and think that they will solve a lot of problems. And they can certainly do that, but sometimes they're presented as this great thing that it's easy to manage, and it's not easy to manage. Even for us, we are doing research in small plots that it's easier to manage compared to large, extensive land, it is a challenge.

Fabian Fernandez: There are a lot of things that I think farmers that are interested in cover crops need to understand in terms of weed management, in terms of managing the cover crop in rotation with the cash crops. And so I think there is not enough time in the podcast to go dive into all of these things, but certainly, I think it's very important for farmers that are considering cover crops that have not done work with cover crops to realize that it is a more difficult system to manage, and that getting information on how to manage these things before you start is really important.

Anna Cates: Yeah. I'll add to that. We think of the whole farm system, it includes labor, equipment, finances, as well as your interests, and what you're excited to do on your farm, and so when you're starting with cover crop, take all those things into account. We do have some resources on our website and on the Midwest Cover Crops Council website that I'd recommend people look at and explore if they're new to cover crops, or even if they want to try something new that's going to change how the system works.

Lizabeth Stahl: Yeah. And I think just to add onto your comments as well too is just I always encourage people, you know, start out small. It's not something you want to do on all your acres or all your soybean acres or all your corn acres. Just start out small, and I always tell people hit the easy button. Try easy entry points first, and then as learn as you go because again, you're doing something different, and you can't just change one piece of it. There's a lot of things that are going to be affected if you start planting cover crops, so again, just start small. That's what I encourage people to do.

Carl Rosen: Yeah. And I'd echo all of those comments. Cover crops can be a challenge, especially if you haven't done that before. I think one of the things to really consider is what kind of cover crop you're going to grow. Are you going to grow one that is going to be terminated in the spring, or are you going to grow one that is going to winter kill before the next crop? So those are things that need to be considered, and that will also affect how they're managed as well.

Fabian Fernandez: Yeah. And the other big thing is because cover crops have become an important part of what many farmers are interested in looking at is seed availability. Sometimes you may be planning to plant cover crops, and then you find out that there is no seed available, so those are other things that are important to keep in mind. The resources that you will need in terms of equipment, time, seed to manage this new system. And the other thing that I also think that it's important to consider is if you're going to grow cover crops, just like if you're growing any other crop, you're not an expert after one year, the same thing is true for cover crops.

Fabian Fernandez: Cover crops, just like crops, respond to weather, and so your experience this year may be completely different next year, just simply based on the growing season conditions, how fall or spring conditions are when you're terminating the crop, if you're terminating it before planting, things like that. All of those things, like I say, I've done research now for a number of years, and it seems like every year is a little bit different, and I learn something new that I didn't know before. And all of that is related to how much precipitation we have, what kind of temperatures we have, and how those cover crops developed.

Paul McDivitt: What are some tips for getting a cover crop established in Minnesota?

Lizabeth Stahl: Well, that's a great question too, and something, again, that relates to what your goals are, because that's going to determine when you're seeding that cover crop. But again, getting to establish the key thing with cover crops, you want to optimize that biomass so you can optimize the benefits that you might get from that cover crop. So some of the things, when we're looking at cover crops, seeding date, that really matters. I've been working with Axel Garcia y Garcia at the Southwest Research and Outreach Center in Lamberton. He's been doing some really great work looking at seeding date of serial rye in the fall, for example, and it's been very striking, the differences that you can see versus looking at serialized seeded in September versus say into October.

Lizabeth Stahl: And it's not just the difference that you see in biomass in the fall, but also in the spring that October seeding dates, we just haven't seen that be able to catch up to what those earlier September seeding dates are. Now, when you look at our corn/soybean system, that can be a challenge. How are you going to get that cover crop seeded in September? But we do know that, again, if you can get it seeded in September, how you're

going to do that, odds are that's going to have better biomass than if you seed it at later. And that's where, again, you're getting the most benefits from the cover crop, and you have more biomass.

Lizabeth Stahl: Other things to be looking at besides seeding date, look at your seeding rate. That's an area where we've done a little bit of work. We could still do some more. We use a pretty standard rate of 60 pounds per acre of cereal rye. That's been very typical. We are looking at some work where we've increased that seeding rate up to 90 pounds versus 120 pounds. 120, I think we pretty much agree that that's too much. We actually got too much, because he want to have enough, you got to be able to get a cash crop out of this too. But again, that's one thing to tweak around. You don't want to go too low, because again, like we were talking about with moisture, if you don't have adequate moisture, now you're just reducing them out, that you'd get from that in itself. So again, you want to start out with a decent enough rate.

Lizabeth Stahl: Also, another thing we've talked a lot about is your herbicide program. Again, that's a big part of my work is looking at weed management, herbicide-resistant weeds. So you want to be able to manage those weeds. Well, the products that you're using, you don't want that to manage your cover crop as well. Most corn and soybean herbicides have something like cereal rye that's been able to establish pretty well, and other research would agree with that too, from other states as well. So that's been a pretty safe cover crop to use for good establishment, but if you're putting some other diverse mixes out there, that's where again, that herbicide program, you got to even look at that even closer because you can have some sensitivity issues, and unfortunately, can kill your cover crop with that herbicide.

Lizabeth Stahl: Seeding method matters, too. We've seen drilling, you're getting better seed of soil contact, so thus, you can get better establishment say than aerial, where it's just laying on the ground. You can get some predation. Again, that seed to soil contact moisture, if you can time it to have moisture right after seeding, that increases your chances of getting a good stand as well. But again, just look at what your goals are. I know again, here a lot of people look at should we do a mixture versus just a single species? I come at cover crops a lot of times from the wheat management standpoint and erosion control, so if those are your main goals, something like rye in itself, that can be very successful, with minimal input costs as well.

Fabian Fernandez: And in terms of crop system and the rotation, I think it's also an important thing to keep in mind we have seen, especially for aerial seeding, that when you have a lot of crop residue on the surface, that can create some challenges on establishing the cover crop in terms of uniformity. We have a study looking at continuous corn and a corn/soybean rotation, and consistently, we see that with aerial seeding. The continuous corn where you have a lot more crop residue, and this is in a conservation tillage system where you have some buildup of crop residue on the soil surface, the soil to seed contact is not very good, and you end up with clumps all over the field, and you don't have that uniformity.

Fabian Fernandez: And one of the things that we have seen is that even in a corn/soybean rotation, we have both both crops every year, so under the same conditions, we are able to look at what happens in terms of cover crop establishment, specifically I'm talking about this is what we are using, but it would be, I imagine, applicable to other cover crops as well, is that even in the corn/soybean where you have corn residue, so where you're going to plant soybeans the next year, the establishment is not as good as in the soybean ground, where you have soybean residue that they decomposes quickly, and you have better seed to soil contact, and you get a much better establishment. We have circumvented some of those issues by looking at possibilities of removing some of the corn residue after harvest, but of course, you have to see if that works for your system, what are you going to do with that residue?

Fabian Fernandez: Are you going to bale it and be able to use it? How much of it you remove? Because one of the reasons people like to establish cover crops is because of soil conservation, and so if you're now removing residue, that can be a problem. If you remove too much residue, you can lower the carbon inputs into that farm system. Things like that are, I think, very important to consider. And then in terms of circumventing some of these issues with residue, one of the things that we have tried is doing drilling, but of course, that also gets into some of the stuff that Liz was talking about with planting date. Typically, unless you have very high clearance equipment, you have to wait until harvest to be able to do the drilling.

Fabian Fernandez: In our experience, last year especially, we had a study where we drilled the seed. We did get a very good establishment, very uniform, but we were very concerned that we may not get any growth. In fact, I was worried that it would not even germinate in time because again, you're waiting until harvest, so that means you delay planting for the cover crop. And depending on how the fall comes, sometimes we don't have many warm days after that, and so there may not even be much germination happening. For our conditions last year, I was surprised, we did get enough snow cover to protect the very small seedlings that we have emerge in the fall, and so that helped us protect the cover crop through the winter. But if it's a winter where we don't get a lot of snow, you can potentially run into issues where you may not have any cover crop the next spring. Those are certainly things you consider.

Carl Rosen: Yeah. Just to follow up on the drilling, I realize with corn and soybeans that could be a challenge, but for some of the processing crops, I think that's the way to go. They're harvested a bit earlier. And also with silage, if you're harvesting silage, you might be able to get in, and get in a reasonable time. And so depending on your cropping system, there's some flexibility if you're harvesting a little bit earlier, and depending on the types of crops that you're using.

Lizabeth Stahl: Yeah. Carl, that's the easiest entry points, really, I look at for cover crops, is after canning crop, because you get a nice window to get established, you can get a drill out there, or corn silage and that can shift later on in the season, but still you should have a nice window to get out there and use a drill because Fabian, like you were talking about, it can be tough. How are you going? You need some special equipment to seed a cover crop into a standing cash crop late in the fall to get that window, to get early enough establishment, because if you wait until after harvest, we know harvest can be sometimes into November, so that just doesn't leave us much time at all to get anything out there and established.

Anna Cates: Yeah. And from a practical standpoint, when you're starting out, I always recommend that people go to their local Soil and Water, see if there's any cost share available. Maybe you've got to apply through the federal EQIP program that has a cost share bucket of money, or maybe there's local money where they have different parameters they're trying to hit. The One Watershed, One Plans working through the state often have cost share for cover crops as part of their implementation funding, and that can help. Like Liz said, start small and get the help you need both technically and financially to experiment a little bit.

Fabian Fernandez: And one thing that we haven't really talked about much is perennial cover crops. All the stuff that we've been talking about is mostly related to annual crops that you plant after harvest, or sometime during the growing season and then terminate the following spring or winter kill, but we are also doing some work with perennial cover crops, specifically kura clover, and that is certainly an interesting system. Some of the things, if you're planning to do something like that to establishing that cover crop is that the first year, you really have to baby that cover crop. You really have to manage for that cover crop. Everybody that has done work with kura clover says that it takes three years for that cover crop to really develop full. Everybody says that the first year it sleeps, second year it creeps, and the third year leaps, and we certainly have seen that.

Fabian Fernandez: The first year we planted the kura clover, it grew very little. We tried to manage for the cover crop. In fact, and this is looked at as a long-term investment in cover crop because actually, you cannot intercrop that crop the first year, you have to let it grow by itself, and so that could be a huge hit. And that's where what Anna said in terms of cost sharing would be an important thing, because it's very difficult to just take it out of production for a full year, and some people actually even suggest two years. In our case, we did it for one year. We were able to get enough establishment that first year without a cash crop intercrop with kura, and then second year we start in inter cropping, which also has some challenges and things to keep in mind.

Fabian Fernandez: For instance, you cannot do full-width tillage. You have to do something like strip till for that system, so that you can have kura clover between the rows growing. One benefit that we've seen with kura clover is specifically in terms of water quality, it does scavenge for residual nitrogen very well, and so you reduce nitrate leaching substantially

after that cover crop is established. But as I mentioned earlier, it is a challenge when it comes to managing weeds and pests, because it is a legume, and so you have to manage it carefully.

Fabian Fernandez: And then the other part too is that after the third year, once it's completely established, if you don't manage it correctly, you can actually end up having a pretty stiff competition with kura clover that will take resources, water, nutrients from the cash crop, and so you can end up having lower yields. And so you have to look into suppressing that cover crop once it's established so that it doesn't compete with the cash crop. So those, again, more on the more intense kind of system. I would not recommend starting with a system like that if you have never done any work with cover crops, but it is certainly one that could have some benefits, especially if you're doing grazing, for instance, or things like that could lend itself very well to those kinds of systems.

Anna Cates: Yeah. I'm so glad you brought up that system, Fabian, because it's such a neat one, and it represents an ideal, really low input system, where you've got the clover providing some nitrogen to the corn, and continuous living cover on the landscape. I would just think it's cool to bring up because it shows this breadth of research that we're doing. We're looking at the really obvious entry points into cover crops, after canning crops, after silage, and we're also trying to figure out what are going to be good systems in 10 years, if we want to fully perennialize the landscape in a different way? What are some options for that? I feel like that represents the breadth of things we do here.

Anna Cates: The other thing is I can't believe, Fabian, that was the first time we've said anything about tillage, which is a really important aspect of cover crop management. Even if you're not doing kura clover, if you do full-width tillage of your cover crop, A, it'll probably be pretty messy, depending on your implement, the time of year, and the state of your cover crop, it could be just a hard residue to till through, and B, you'll lose a lot of the benefits you gained in terms of soil structure if you till up your cover crop residue. So we try to do a low till, no-till system to get the full benefits of cover crops.

Lizabeth Stahl: That's interesting you mention about the tillage aspect too, because you're making me think about some of the first work that we did as well, was looking at when we had a [inaudible 00:22:02] plant situation, or you've got drawn out spots too. So that's where a lot of people, their first time trying cover crops was putting cover crop out into those areas when you couldn't get your cash crop out, so playing it in the middle of the season. But it just made me cringe when you'd hear about people that were tilling up these cover crops in the fall, and you're like, "Ugh. That's destroying the whole benefit of putting the cover crop out there. So tillage is a really key thing. full-width tillage just doesn't work that great with cover crop. Strip tillage, we've been looking at that. That can work well, or doing no-till in one crop and tillage in another. We can make that fit, but you don't want to do just full scale tillage because you're just losing the benefits, I think.

Paul McDivitt: Should growers consider applying fertilizer to help get a cover crop established?

Fabian Fernandez: That's always an interesting question, and one that I think depends quite a bit on your goals. Speaking specifically on a corn and soybean cropping system, I would say no, typically you would not want to apply fertilizer, because most often, one of the benefits of the cover especially after corn, but I would say even after soybean, is to try to scavenge any nitrogen that may be still in this soil. And the reason I mentioned after soybean too, even though we don't apply nitrogen fertilizers on soybean typically, is that between the time of physiological maturity and harvest, there is quite a bit of mineralization that takes place in a lot of our soils, and so you can actually end up with quite a bit of nitrogen present in the soil and that cover crop.

Fabian Fernandez: One of the major reasons that I think people use cover crops is to keep that nitrogen in the system, to take it up, and so from that standpoint, yes, I would not apply nitrogen. And then in terms of other nutrients, like phosphorus and potassium, typically, if you're managing things correctly for your cash crop, you should be in medium to high potassium and phosphorus test levels in the soil, which would be sufficient to supply what the cover crop would need to get established correctly. So again, from that standpoint, I would say you should not really be looking at applying a fertilizer. Of course, if you're growing a cover crop as a second crop for some kind of yield or harvest, then that would be a different story. But again, this is very focused on corn after soybean, and trying to use a cover crop as a scavenger for nutrients.

Carl Rosen: Yeah. And I'd agree with that, Fabian. Particularly for a system where you're trying to scavenge nutrients with canning crops or processing crops, you actually are harvesting those crops fairly green, so there's quite a bit of nutrients available after those crops, and so you'll be using say something like a winter rye to help scavenge some of those nutrients. So I would say definitely in those situations, do not apply fertilizers. There could be some situations, as Fabian said, if you're growing for another cash crop, where you might want to apply.

Carl Rosen: Also, we're doing some work with mustard as a way to control soil-borne diseases. So you really want to try to maximize biomass, and in that case, some fertilizer may be needed to do that. We often grow following say a small grain or even a legume on a sandy soil. We plant the mustard in say August or maybe early September, but we really want to try to maximize the biomass so that when it is incorporated, you get release of the chemicals within the biomass to suppress some of the diseases that may be there for the following crop, which is usually potatoes.

Anna Cates: And just to put that in context, we're saying there's enough nutrients left for the cover crop after your cash crop, and that's because these cover crops are just not getting that big. They're not using that much nutrients compared to your cash crop, so your silage

yields are maybe around 20 tons an acre, your cover crop biomass, if we're good, we're at half a ton to a ton of acre.

Carl Rosen: Yeah. And when you're trying to maximize biomass in say a mustard, you're looking at probably double or triple that. And so that's why having a little bit of nitrogen there, particularly for those mustards, to get that biomass going would be beneficial.

Fabian Fernandez: Yeah. And again, coming to corn and soybean systems where typically, the harvest happens a little bit later, more often than not, the limitation for growth is not nutrients, but it's temperature and sometimes moisture. And so if it's a dry fall, for instance applying fertilizer, likely it is not going to help that cover crop take up those nutrients because maybe the limiting factor is the lack of enough moisture. And then with temperature, like Anna mentioned, the growth is pretty limited, typically. We don't really get a lot of biomass with annual cover crops, and so they don't really have a huge demand for nutrients. And if you're applying or planting cover crops for water quality benefits, the typical time when we lose most of our nutrients is in the spring, not so much in fall.

Fabian Fernandez: Typically, we come to the fall with soils that are dry or drier than in the spring, and so they have quite a bit of a capacity to absorb and retain water, and so we don't get nutrient loss out of the system typically in the fall. It is in the spring when we have the potential for nutrient loss, and so that's when the cover crop will really start to grow. And as I mentioned, the nutrients should be there for the cover crop to have enough to create enough biomass that it will, on one hand, take nutrients out of the system, immobilize those nutrients, and also use water, which is the other part when we are talking about nutrients leaching is the two things. It is the amount of nutrient present in the soil, and then the amount of water moving through the soil. So if we can limit the amount of water that moves through the soil because we have an active crop taking up water, then we reduce the amount of leaching potential.

Carl Rosen: Yeah. And I did mention about putting some nitrogen on for the mustard, and then incorporating that mustard. So the one way to help reduce losses is to also then plant another cover crop of winter rye at the time you terminate the mustard, and so that the following spring you'll have some rye in there early on to perhaps help reduce some losses of nitrogen.

Paul McDivitt: What recent cover crop studies have U of M researchers been doing, and what have we learned from them?

Lizabeth Stahl: Well, it's pretty exciting times, I think. We've got a lot of neat projects that are going on right now, and have been wrapping up a few of the ones that I've been working with, for example. And before I start talking about those too, I just again want to mention that it's just really exciting that we're able to do the work here in Minnesota, because one of the things, when we didn't have that research there, people might think we know all these basic things about cover crops, but there's so many things that we really don't know. And you can't

just take research from down south, where they have a much longer growing season, a different cropping system, different soil types, different moisture, environmental conditions, all those things, and just expect that all to work the same up here, because more often than not, it's probably not going to.

Lizabeth Stahl: So again, been really exciting to have a number of projects going. For example, we've got a project that's just wrapping up. Greg Johnson, he's out of the Southern Research and Outreach Center in Waseca has been the lead on this project, and they're looking at trade offs in weed control with cover crops. And basically, can we use some pre-emergence herbicides? What kind of impact does that have on the cover crops? And we looked at three different cover crops there. We had red clover was one of them. We just never got very good establishment of that one, so really the results right now, we're looking at cereal rye and camelina. But the take home message from that so far so far, and we didn't have a huge number of herbicides that we could look at. I got to put the caution on that, but the products that we did look at really didn't have an impact on our fall established cover crops, so that was a plus. That's encouraging.

Lizabeth Stahl: Again, a lot of the work that we do deals with cereal rye. One of the reasons that we have had good success, I think, with that is because that does tolerate a lot of the herbicides that we use in a corn/soybean system here, plus it's easy to establish, and it's very cost-effective, has grown well. So a lot of our work, again, focuses around that. We also have termination trials when working with these with Axel Garcia y Garcia at Lamberton, and we've been looking at, over the years, either with corn or corn and soybeans. In a nutshell, what we've seen so far, if you compare terminating that cover crop before planting of your cash crop, and the standard time has been 10 to 14 days prior, that's where you're optimizing your corn yield.

Lizabeth Stahl: We have seen an issue, you're seeing a reduction in corn yield if you delay termination until planting in corn, and certainly, if you delay termination after, so planting green, where you're planting that cash crop into a living cover crop, that certainly is more of a challenge with corn, and you can expect to have a yield trade off there. So again, it depends what your goals are, what you want to do. Now, with soybean, that planting soybeans into standing cover crop, we haven't seen that so far in most of our work to really have an impact on yield, and even if you terminated that cover crop a little bit after. Not always, though. Some years, we do see an impact when you delay the termination of the cover crop. Again, that's some of our termination trial work, so less risky to plant green in soybean overall.

Lizabeth Stahl: Also, we have a big project that just started up, looking at managing herbicide-resistant weeds using cover crops. Here again, we're looking at seeding rate, number of seeding rates, different planting dates, different termination timing, so stay tuned. We'll have more results on that in the future as well. But one thing we did see I think's pretty clear, in a year where we're planting late like we did this year, you don't want to delay that termination of the cover crop too late, because it was really a challenge in corn to plant into

that significant amount of biomass. And especially, we looked at a seeding rate up to 120 pounds, that was just too much to really get into. So again, some of the work there. Also, Axel's been working with interseeding cover crops into corn.

Lizabeth Stahl: Here, his work has basically looked at seeding with the cash crop, don't recommend that, or V2, V4, V6, or V8 in corn. And around that V2 stage, that's where we've actually gotten biomass produced, and this was with annual rye grass and crimson clover. Once you seed it later, it just gets shaded out, or they've had establishment issues, moisture. We're just not getting enough moisture around that time. So that's some of the work that we're doing, and also this cover crop options, like seeding in the summer, just seeing how much biomass gets produced by these different cover crops. That's not a great time to plant cereal rye if you have [inaudible 00:35:26]. Sorghum sudan, tremendous amount of biomass can be produced, pearl millet and so forth. Again, that's just some of the work that I've been involved with.

Fabian Fernandez: And with our group, one of the things that we have been looking at is in irrigated sense. The concern there, of course, is water quality, trying to minimize leaching to ground water. And so we have established since 2016 a site where we have corn, soybean, and continuous corn, and this has been funded through Minnesota Department of Agriculture with I think Water Funds, where we have rye planted in the fall, and then we have a living mulch of kura clover. We have been monitoring the water quality for since 2016 for this cover crop system, but in the last two years, we have added a whole bunch of additional measurements to try to understand the cover crop system a little bit better.

Fabian Fernandez: We know that everything related to nitrogen and the nitrogen cycle is connected., and so in addition to looking at nitrate leaching, we are also looking at the effect of these cover crops in terms of ammonia volatilization, nitrous emissions, and nitrogen mineralization and immobilization in the soil to try to understand in a more complete way the nitrogen budget that we have for this system. The data is preliminary right now, but the idea behind looking at all of these things is if we reduce let's say leaching, are we increasing volatilization losses as this residue decomposes in the soil surface, or are we increasing the amount of immobilization during the earliest spring, but then the nitrogen that is immobilizing the residue decomposes in time for it to be actually available for the crop, and reducing the total nitrogen needs through fertilizer for that crop. So those are some of the things that we are looking at in that study.

Fabian Fernandez: And then we have another very large study in south central Minnesota on a fine texture soil. This is a project that is being funded through the Fertilizer Research and Education Council, as well as the Minnesota Soybean Growers, where we have many different variables that we are looking at with cover crops. It's a poorly drained soil, so we have treatments that have drain and then drain conditions without drainage, so we have those two comparisons. And then we have three tillage systems, no-till conventional, till, and

a strip till, and then three crop residue management systems where we leave the crop residue as you would normally, another one where we remove some of the residue, and then another one where we are planting a rye cover crop in the fall.

Fabian Fernandez: And so we are looking at all those variables of drainage, tillage, and the crop residue and the response that we get to nitrogen, both in the corn side, as well as in soybean. We have both crops present in this study. So we are looking at those effects on the yields of corn where we add nitrogen, we have several different nitrogen rates in there, and then on soybean, just to see how these cover crop and management systems impact the yield of soybean. So those are two very large studies in two cover crops, and as we mentioned throughout the podcast, we are just really learning a lot. Every year, we are learning new things. It's uncharted territory when it comes to some of these things, so we are learning how the different cover crops and different management systems work in relationship to the cash crops.

Lizabeth Stahl: And you reminded me, Fabian, there's another project I need to mention too, because we talk about cover crops how to establish them, but it's also very important to know how to best terminate them as well too. And that's one project Debalin Sarangi, he's our new Extension weed scientist, he started this project this year, and looking at different herbicide treatments. Also had a mowing treatment in there, and a tillage treatment. And as we have seen in other states as well, glyphosate, that's been the most effective way to terminate a cover crop. I know sometimes people have tried products like Liberty or Paraquat. Liberty, great product, but for the time of year that we're trying to terminate that cover crop, glyphosate still has been the best performing. So again, that's something that first year is this year, but just the general results that we've seen so far. So that's one of the projects going on right now too.

Anna Cates: And I'm so excited hearing about all these different ways we're studying cover crops. I was looking at my own research project list and thinking I don't have that many cover crop studies. That's because in most of my on-farm studies, we're trying to look at a whole soil health system that incorporates principles of increase living cover, reducing tillage, keeping the ground covered, that kind of thing, and so cover crops ends up being part of this larger system. One of my students is trying to tease apart specifically the effect of having living cover in that shoulder season, either spring or fall, and which soil health variables it changes.

Anna Cates: So I look at a lot of active carbon and nitrogen pools, and it seems like the living cover, even more than tillage, has an effect on some of those pools. But like I said, when we think about a farm, we got to think about all those pieces together, and so my on-farm research usually looks at a whole system without the effective cover crops isolated. I do have some research looking at water use in plots with cover crops, and breaking news, they are

using water, and that's good in some years and harder in other years, so we continue to monitor that to try to understand when we get a good benefit from that water use by cover crops.

Carl Rosen: Yeah. And we finished a three-year study looking at how cover crops affect nitrogen fertilizer use in a subsequent field corn trial, and this was following sweet corn with and without a cover crop, and what we found, as long as you terminated at an appropriate time, you did not have a nitrogen penalty in our particular situation. We're also looking at, as I mentioned before, the mustard cover crops, and we're finding that they're very effective at reducing some of the soil-borne diseases, and we think that might be a way to reduce the amount of fumigation that's actually being used on some potato crops at this time. So I think we're also looking at the soil microbiome as affected by some of these cover crops, and that's a whole new area that I think can open up some new avenues.

Anna Cates: One other thing I forgot to mention is that I think everywhere likes to say that their site is the hardest place to plant cover crops, but in northwest and western Minnesota, they have some unique challenges with the slightly shorter growing season, sugar beets in rotation, really fine textured soils that don't dry out fast. And so I'm working with collaborators at the Northwest Research and Outreach Center and then our Extension collaborators in west central Minnesota to look at cover crops and beet rotations, and also to look at planting soybeans green in those systems to see how it works in a slightly shorter growing season.

Fabian Fernandez: I also wanted to mention that the one study that I mentioned earlier with kura clover and rye, it is in a sandy soil, so it's irrigated. And because we are very interested in water budgets to measure nitrate leaching loads and things like that, we are monitoring very closely the water budget for this system, so trying to understand what happens in terms of water use when you have rye, or when you have a living mulch in the system, how much water is being used? Even though it's irrigated, and so potentially moisture is not as much of our concern, it's still an expense because if this cover crop is using water and you need to replenish it with irrigation, that adds to the cost. And so we want you to understand that piece as well.

Paul McDivitt: All right. Any last words from the group?

Lizabeth Stahl: We have a cover crop field day coming up on August 18th. That's at the Southwest Research and Outreach Center by Lamberton, and we'll have check-in at 8:30. The program will run from 9:00 to 1:00. We'll be highlighting the interseeding research, our planting green research. I'll have Bruce Potter there talking about insect interactions with cover crops, and also grad students highlighting their research. And also, real highlight will be we'll have Nancy Elke come down, and she'll be talking about the breeding work that's been going on with cover crops too. So again, just really neat angles from everything. So again, that goes from 9:00 to 1:00. We do have lunch included, but if you want to reserve your lunch, make sure you register by August 12th.

Lizabeth Stahl: There's no cost to attend, but we do ask if people register, just to make sure that you get a meal. And the field day, we're having the official wrap up at 1:00, we'll have from one to two o'clock a little focus group, needs assessments, so everybody's welcome to attend that, but just discussing what they see as research and education needs. Now that we do have a few years of cover crop research, where do we go from here, and what are those burning questions people are having? So we're hoping to gather that information. So again, that's on August 18th at Lamberton, and we have registration. Just go online to our Extension Crops website, and you should be able to find where to register for that field day.

Fabian Fernandez: And also, on the same day on August 18, there is a field day at the Rosholt Farm in Pope County, and that's where we will be talking about some of the research that we are doing there with kura clover and rye in this irrigated system that I mentioned earlier. And that field day starts at 10:00 in the morning. It also has lunch included, and it finishes right after lunch.

Anna Cates: One more to bookmark, September 9th at Brent Fuchs' farm in Rice County. There'll be information on our MOSH website about that's mosh.umn.edu. And we're going to talk about soil function, and really try to get at how the whole farm system interacts when you apply the different practices.

Paul McDivitt: All right. That about does it for this episode of the Nutrient Management Podcast. We'd like to thank the Agricultural Fertilizer Research and Education Council, AFREC, for supporting the podcast. Thanks for listening.

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