

US Dept of Agriculture - NRCS | Using Diverse Cover Crop Mixes to Improve Soil Health

Today's webinar moderator is Steve Woodruff. Steve is an agronomist here at the East National Technology Support Center. And with that, Steve, I'm going to turn the webinar over to you so you can introduce the topic and our presenter.

Thanks, Holli. I appreciate everyone being on today. I think you're really going to enjoy this webinar we've got for you today. As all of you know and are aware of, soil health has been elevated over the last two years, and it's a hot topic for everyone. And it's now moved not just from cropland but over to other land uses, including grazing lands and including perennial grazing lands.

And so we're excited today to have Dr. Matt Poore on to talk about some of the work that he and his group has done in the past, and are continuing to do now in the area of soil health and grazing systems. I'm so happy that Matt could do this. I've known Matt for probably eight or 10 years. And he and his group at the Animal Science Department at North Carolina State University have been such good partners with NRCS.

And we work together on a lot of projects, and I'm just really pleased that he's able to help us out here today. So with that, Matt, I'm going to turn this over to you. And you're going to talk a little about forage grazing systems and using annuals to improve soil health and improve livestock. So, Matt?

OK. Thank you, Steve. and welcome to everybody that's involved in this today. And I think Steve is going to monitor for some questions, and we'll stop at least one place through the talk and take some questions.

So really, want to move right into this. I'm going to show you quite a bit of experience items that we've had over the last number of years. I'm going to show you just a very little bit of data. This is an area, as you well know, that is hard to pull a single piece of data that says much about soil health and some of these systems. So not going to spend a lot of time on that, but talk to you rather about a lot of the educational activities and other stuff that we have going on.

Again, just to introduce myself a little bit more detail, I'm Matt Poore. I am an extension beat specialist. I work for North Carolina Cooperative Extension. My primary role is to support extension agents and train them, but also do quite a bit of interagency training and work directly with producers as well. And I'm housed in the Department of Animal Science at NC State University.

That's me in the green shirt. You'll see me in a few of these slides, but I could have put a formal, office-type slide in here, a picture of me. But I'd rather have you think of me like I'm seen in this particular picture. And kind of sums up a lot about what I do right now and what I enjoy.

Now, just to back up a little bit and give you some historical perspective on why I'm interested in this area so much is that I am from the area up north of Raleigh, North Carolina right on the Virginia border. Actually, this piece of property is in Virginia. And this is one of the beautiful views that I have the privilege of being part of most every weekend.

And this is my parents' farm. When I went back to the farm and started helping, when I took this job here in North Carolina, it looked like the top panel of this picture. That essentially was what the land looked like, and this was one of the, maybe one of the rougher places. But you can see the very low-quality species, very low fertility, low level of management, and very typical of a lot of the Piedmont areas that don't have poultry and a lot of nutrients.

And so we're in that situation. And I'll just note, if you look at this picture, look at some of the trees up here on the top of this ridge and then drop down, this second photo is after about 12 years of doing a little bit of fertility improvement on this land, but not very much.

You can't afford to do much fertility improvement here, but it did need some lime and some phosphorus. But this is after about 12 years, some low-level fertility inputs and then rotational grazing management. And again, in the top panel, that was continuous grazing.

The cows, they run about 100 cows here and they would break into three or four groups, and just kind of spread out. And the bottom is after putting them through not really intensive mob grazing or anything like that, but just good rotational grazing, two or three-day stay and then move on for a long period of time.

And basically the story here, these are different seasons and all that. But nevertheless, the land does respond. And this really poor-quality land can be quite productive agricultural land, if we look and see the potential there.

Unfortunately, most people look at that top kind of picture and say well, there's just nothing there to work with. It's all rock, there's not much soil. But this kind of land will grow grass very, very well if you do

have improvements in soil health and water infiltration and some of those things that go along with some of the practices we're talking about.

Now another experience that kind of shaped me and convinced me to get more involved in this area starting about 15 years ago, was a day I returned to the farm after being out on the road during the winter mating season. And I walked back to where the cows were, and this view up here in the upper part of this slide, upper left hand corner, is what I found where the cows were.

And essentially that's a small creek was the water source for those cows-- very eroded, very polluted, and really was kind of a wake-up call for me, that here I am out talking to people about conservation and this is what it looks like in my backyard. So we did what a lot of producers have done. We decided to do something about it. And we went ahead and installed water, fenced out that creek.

And so if you drop down, you know this is the type. We just gravity feed, very simple water. We put in that particular area. And then we fenced out with a single strand of poly wire. It doesn't show very good on this slide, but you see a little white line here. And that's not an imperfection in the photo. That's actually a single strand of poly wire.

And within two years of protecting that little creek, it started to heal up. As we know, this kind of land has a great ability to recover. And then I went back 12 years later. This was last winter. I went to that same spot, and tried to get myself lined up as closely as I could. And this is what that spot looks like now. And I think you can see more clearly in this one, the little single strand of poly wire.

Now this is not something that we recommend to people to do, but it's amazing what you can do with temporary fencing. And I'll talk about that as we get into it. But these kinds of projects don't have to be extremely expensive. This was a Virginia cost-share program. And they didn't require the fence out of that creek at that time, and we did it anyway with that poly wire. And it's been a really good experience to see that improvement on my own farm.

So as Steve said, the soil health thing has gotten to be really popular the last few years. Lot of debate about what it is, how we measure it. And I don't want to spend a lot of time on that. All of you know a lot more about that than I do, probably. And we're just getting into some early measurements on this, trying to figure out what we can do.

But it's easy to say that many pastures throughout the world are overgrazed. And certainly the US is not

any different. A lot of our pastures here in North Carolina are overgrazed. And even in times when we have plenty of rainfall, you'll see pastures that are just severely overgrazed.

So we know that this overgrazing causes problems with runoff of rainfall, and it takes nutrients with it of course, and then also really reduces our potential productivity and the stand life of our forages and all those kinds of things. So we also know on the flip side that a well-managed pasture can really be beneficial because of good rainfall infiltration, good water cycle benefits, and also the improvement in the cycling of nutrients and how productive these systems are.

So it's no mystery that people are interested in this, simply because we've got more and more people out there saying, hey, I'm not using near the fertilizer I used to use. My animals are doing well. And with animal prices high right now, those savings that people think they see that they could achieve, result in some real serious profit for them, or improved return. So I think that's why we have so much interest in this area at the current time.

Now I kind of hunt through my slide set, tried to find a good cattle pasture that was overgrazed because that is the area that I work with. And I came across this one, and I guess I just decided to use it. But certainly, this type of situation on land that's got a little bit of slope to it is not a good thing. I think we all know that. All the problems associated with this are pretty easy to identify.

And yet, a lot of our landowners just don't see it. They say, this is a pasture, and they call and say, what species can I plant because obviously this one is not doing well. But they just don't have a concept for what is possible. So we can show a lot of data. And I'm going to show a few little data slides here. This is from some work that we did here with Dave Butler, back in the mid 2000s.

And Dr. Jim Green was involved in this work. And you all probably know him, or have known him in the past. And what we did was we had plots that were either managed to have low, medium, or high forage cover, as you can see in this particular bar graph. And then we had other plots that were bare, compacted land. And this was all in a riparian area. We used rainfall simulation to determine this.

And without telling you a lot of detail about the study, basically having some ground cover in those areas really reduced our overall runoff of water, in this particular slide, and then similar effects for the nutrients as well. And so we know we know that these really badly-managed situations, very, bare ground near the creek is basically a really bad thing.

Now we had this little thing happened here earlier. I think it'll come right back. OK. Thanks, Holly. So the point being, we can have some problems with poorly-managed situations. But we can also remedy that by keeping some ground cover out there.

Now partially combined with that, in 2007 we had a terrible drought here in North Carolina. And that resulted in a group of agencies working together to come up with some cost share money to help producers replant pasture. And as part of this process, pretty much everybody at the table recognized that this overgrazing of pastures during that drought was what resulted in the death of the pastures. It was places where people managed and used a sacrifice area, as we would recommend.

Their pastures survived. People that just kept grazing them, the pastures died. And it was recognized that if we went into that same management and planted new pastures, the next drought they would just die again. So we went ahead-- and again, I'll wait for this to come back on-- but we went ahead and started to expand our educational program with some funding from those groups at that time. That was very, very beneficial that we were able to do that.

Actually, our tobacco trust fund funded that work. And we started into an educational program to get people to think about what their pastures are. And basically, we expanded a program we've had for a while called Amazing Grazing. I'll tell you just a little bit about that, but that's something that has caught people's attention and their imagination on this.

And basically, Amazing Grazing is this overall educational program where we are striving to improve our pasture management and profitability through a better understanding of pasture ecology. So the idea of this program is to get not only the advisors, but also the producers, the landowners too, to think a little bit more about the system as an ecological system out there, as opposed to just not understanding what's going on.

So we have a lot of training for extension agents, conservationists, both NRCS and our soil and water folks, and veterinarians as well as other industry consultants. And that's a continuously ongoing program. We also have quite a bit of training for producers through publications, hands-on workshops, demonstrations, and applied research that we do. And I will especially be talking about some of the demonstrations that we've done as we go on into the rest of the presentation.

Now we get this question a lot, because we have farmers that go into a farm that's been doing good

management for a long period of time. And it's really a great situation. They hear about, well, I don't use much fertilizer, this and that, all things look really good. But it's hard for them to see how they might get there from where they're at on their farm.

And so we need to get them thinking about how complex the pasture is. We need to get them thinking about their animals and their plants, both at the same time and how they grow and interact together. And then we also really need to work with them to make them understand that they can have a good system that maybe doesn't include mob grazing, or that they can move cattle once a week or twice a week and have a very good system.

So we just need to get away from the cookie-cutter type approach and get them to think about their system as unique and get excited about implementing some aspect of what we're talking about at home and then try to develop their system. So that's kind of the logic and the approach we take with our program.

I just throw a few little tidbits in here about some of the things that we look at and talk about, but things like dung beetles are really interesting to people. They don't know much about them, and it's something that you could hold their attention for a long time with that. Of course, we've adopted Ray Archuleta's philosophy of carrying a shovel with us to pasture, and getting people to think about what's going on below the surface and looking at earthworms and aggregate stability and some of those sorts of things. And really, people are very, very interested in taking these types of opportunities and learning about these systems.

Now as we got into that situation after the drought was over and we started working with farmers, we recognized that the wintertime is probably the ideal time to capture their interest and get them doing things out there on the land, because this particular photo here shows what they have to deal with. They do deal with situations just like this in this picture, with a lot of mud and a lot of heavy impact on the land.

And they recognize, if I did not have to do this, I'd be a lot better off. And so we have done a lot of work for the last-- guess we spent three years during 2011, 2012, and 2013 doing wintertime work. We used this kind of information quite a lot in that kind of an educational program associated with our winter feeding, where we show folks how their impact out there on the land looks.

This is a phosphorus map of our farm down in Goldsboro, our research farm. And I'll just-- one of the things that we try to point out to people is that the colors on here are the phosphorus indexes, with the oranges being low phosphorus index. And once you get to green and blue, you're very high. And so for example, in this pasture here, you can see that this precision fertility map shows the way that this is heavily loaded in the corner near the gate, where historically, hay was fed.

And then farther out, there's a lot less of that. And that's an indication of how much manure has been deposited here by those cows. So if we can get people thinking about this nutrient picture and thinking about their winter activity, relatively easy to get them to think about going out and doing better management.

Again, a little bit of data here. This is from a study by the caption there that shows where this was from. But this is from Owens and [? Chapitolo ?], a publication that came out in 2009. And this particular data is from 1974 to 1986. But in this study, what they did was they looked at two systems, one system that is the, I believe the two pastures here, WS 106 and WS 121.

Those were in a high-fertility system that involves eight paddocks, four of which were hayed during the summer and then grazed during the fall. And then that hay was fed back on those pastures during the winter. So that's those two. And then the top one, WS 129, was a lower fertility system.

But it was only a four paddock system. And hay, purchased hay, was fed on one of the paddocks during the winter time. And so they're just comparing two systems. It's a historical, retrospective look at some of the work that they did over the years. But as this shows, the sediment loss-- and this is the total for the time period for each month-- during the winter is very high in that low-fertility, low-management system, where the animals were concentrated for winter feeding, a very high loss of sediment during April, some obviously during March and May.

And basically, ground cover in that feeding pasture decreased to about 50% during that winter period. And so obviously, a big difference between that concentrated winter feeding and the more rotational winter feeding and winter grazing. So pretty dramatic difference here. A point that they make on all of these pastures and all of this data-- this was still below t. And so we need to kind of take a different attitude about grazing systems, I think.

And I just think we should have very, very little erosion at all. And that's just my opinion, but

nevertheless they point out that even though with this amount of erosion, it still doesn't meet that, quote, "tolerance" for the soil type. But we can debate that maybe more. Nevertheless, working with that kind of data and working with farmers and showing them that you can actually get out there and graze cows and have good nutrient distribution and grow grass with that nutrient the next spring has gotten people very interested.

This is a picture from our farm in Virginia. The next picture is from a place that I was invited out today in Mineral County, West Virginia a couple of winters ago when I went up there and talked to them about this very concept. And it seems like wherever I go, there's a few people that come up and say hey, we're doing it. And this really works.

And so that excites me and makes me continue to be interested in it. A lot of challenges out there with a lot of folks, as I'm sure most of you know. But certainly, there are people that are starting to see the potential for this kind of management out there.

This kind of brings us back to where we're at in terms of our educational programs. This one of our workshops out on a farm. The gentleman standing here in the orange shirt is Mike Jones. And he's a farmer that's probably amongst about 25 that we have worked with over the last few years to develop a network of folks that are not afraid to try some new things.

He's got all kinds of things that he's tried. He's got native, warm-season grasses. He's doing some annuals. He's stockpiling fescue. And this obviously is a stockpiled fescue situation, where he was helping us to teach his neighbors, basically, and other folks they came how he's able to graze through the winter. Very little fertilizer, and control cows, and not have to feed hay.

So very productive and very timely. Now with this, I think I'm going to stop and ask for questions. Steve, I'm about halfway through, probably. I cannot see the question list right now, so do you have any that have come up?

Well, one specifically is on your farm, where you could fenced off the stream and it healed itself after that. Do you go back in and flash graze? Do you go back and flash graze those areas ever, or do you just leave them natural? What are you do on those?

OK, that's a good question, Steve. And I think that that's all probably pretty terrain-driven. As I said, that particular stream I was showing, we don't have any contract that says we can't have cattle graze that.

But I've made about maybe a 10- to 15-foot buffer outside of the really wet area, where I know they really sink up and do a lot of damage. And so we have not flash grazed that at all.

I guess I'll caveat that a little bit by saying that that is single strand, 30-inch high poly wire. And calves will go in there some. But we've not really made an attempt to flash graze that because it was so degraded. And we might do that in the future. It is starting to grow up in trees now. And that's kind of the inevitable progression there. And I'm not sure exactly how to manage around that. But no, that one has not been flash grazed at this point.

Also, and you might get to this more later, compaction issues-- do you think improving soil health, doing practices that improve soil health, will be adequate to alleviate those compaction problems, or do you think you might have to have some kind of mechanical treatment prior to implementing those soil health treatments, or will the management of the grass be enough?

OK. That's an excellent question, Steve, and I think it's going to depend some on the type of forage crop that you have there, and the type of land that you have. Again, a lot of the work that we've done in the Piedmont has been on land like you're looking at right here with Mike Jones. Really hard to get on there and do anything mechanical that might help things.

You could do some aeration or something like that, but most of the aerator designs just sort of do a little bit and not a lot. So I think the key here is to let the land rest long enough to where plants can exhibit their rooting potential, if you will. Fescue in these soils can go pretty deep, couple feet at least, with active roots, and enough rest and time.

And I think some of those issues can be healed up. Now this is very clay-oriented type land. It's clay-type soils. In a lot of these farms, you get into silt and other things. Then you could have some different problems. So again, quite a bit of soil differences there, I think, in what will work and what won't. But we'll talk about that a little as we go on.

One more quick one, and then we've got to move on. Using hay-- have you ever measured how much hay you lose unrolling hay versus unrolling versus rotating hay rings, those kinds of things. Have you done any measurements on that?

Yes. I've done a little bit of that, but there is some published work with that from a couple of different groups. And the overall interpretation of that is that unrolling hay can be a really good way of

distributing nutrients and feeding cows. The limitations of it are when the soil is very, very wet, you can have a lot of waste of that hay.

And then also, you have to worry a little bit about having the right size package of hay to go with the number of cattle that you have. So if you unroll hay and it's more than they need, then they'll waste it. And being able to match exactly the size of your bales to the cows that you have is not as easy-- I mean, it sounds easy, but it's not.

Most folks that do it will have some hay free choice and then unroll less than they need, so that they clean it up quickly. And that's really the key to it. So as I work with folks that are trying to put in an unrolling program, it's unroll less than they need in a day so that they'll clean it up, and use as high a quality hay as you can. So again, they're going to be eager to eat it and wanting to eat it and clean it up.

OK. Well, we've got a couple more, but let's keep going because I know you want to get in some of the meat of your presentation.

10% loss on unrolling hay, similar to a good round bale trailer with offset bars. And that can be a size, probably 15 to 20% percent if the conditions are wet. Again, the benefits of distributing nutrients are probably make that not a bad number.

OK. So I want to move into a little different tack. And as Steve said, this is supposed to be about cover crops and I'm getting to that. But we have a terrible problem in the region of the country I'm in. And this is actually increasing in size. It's moving north. And that's the fescue issue. Within the fescue belt, we have an awful lot of livestock that experience fescue toxicosis. And it's really a serious problem. I don't know of anybody with fescue that doesn't have some problems with it.

So to deal with this toxic fescue, we have to think about several things. One, the main thing people have done is to shift to fall calving. We know that that can work and can help to alleviate some of the stress on these cows. They're in cooler conditions when they're having to breed. And so that can work.

But when you have a winter like we had last winter with fall calving cows, poor quality hay, it's not the greatest system. So that's what most people have done, but certainly we're kind of calving out of sync with nature, in terms of our forage supply. We could shift to fertilization in late summer, and a lot of people have done this as well. So those that are fertilizing to get a stockpile for winter grazing may lay

off the fertilizer in the spring.

What that does is that increases the clover, and also gives you a better balanced yield, and helps you from having a whole lot of toxic fescue you have to try to eat up in June and July. So that's another option for people with all fescue pastures. Of course, a lot of people just pull out a feed bucket and know that if they feed 10 pounds of feed to a calf after weaning, they'll grow a little bit even if they're grazing fescue.

And then more of our progressive producers are realizing that they need to add a warm-season perennial, some kind of, perhaps Bermuda grass or a native, warm-season grass, or that they need to add some nontoxic fescue-- MaxQ or [? Bar Opto ?], MaxQ2 some of the others that are available as part of their system. And we're really focused a lot on that right now with a lot of our work. And then some of our other research is looking at genetic resistance in cattle to fescue.

And that'll be kind of long term, but definitely we're always going to have some toxic fescue on land that really just can't practically be renovated. And so we'll have to have some tolerance in our cattle, as well as one of the tools we have. But we're really focusing now on getting people to think about taking part of their land, looking at their forage system and trying to build in some nontoxic components, if they need that. If they're not getting the performance that they need, that's definitely possible.

So this is not going to show you data from this particular project, but this is a couple of slides from a long-term project that we did with fescue grazing, looking at either MaxQ, the nontoxic, friendly fescue if you will, whatever you want to call it, versus the toxic fescue. And so you see these pictures all the time, but I guess just to show you that I could take pictures too of this crazy thing. But this heifer here is in a day in mid-June-- very heat stressed, very muddy, typical fescue look.

This heifer here is in the next pasture over, at least about a half a body condition score higher. Very clean, very slick hair coat. Neither of these cattle had any shade during this project, and we ran them through the end of June. And this was very typical of what we saw. So there's no question that the fescue thing is a major issue that we've got to deal with. In situations like this, where producers really need some performance, they need heifers to grow and to reproduce. And most folks, again, do this with a feed bucket. And there's got to be a better way for us to approach that in the long run.

So to keep from talking on and on and on about that, because the fescue thing is such a major

problem, and such a big topic, I'm just going to use this slide to transition me to the next little piece of this talk. And just to tell you that we have got people's attention on this. This is one of our winter workshops.

But as we've started talking about these topics and having these hands-on workshops, we've had more and more folks coming. We've not had any trouble getting audiences. Early on in the educational process, we'd have 8 or 10 at these and be glad we did. Steve Woodruff was involved in a lot of those early ones. But we've started to have good turnouts. We've had more and more people wanting to cooperate with us.

And this peer-to-peer teaching that we try to do has really been beneficial. So folks, there's a current out there of folks that really want to kill fescue, want to improve their system. We're working with them in a lot of different ways. But certainly, one of the most exciting ways right now is in doing active renovation projects where we're going out and working with people, using annuals to go through this transition.

So basically, our focus is to deal with toxic fescue and then add back to these systems either nontoxic fescue and/or native warm-season grasses. And those two fit very well into what producers need in terms of balancing their system. When they sit down and do an overall system balance, they find they need warm-season stuff, and they possibly need something that's going to give them better performance than toxic fescue.

So some of things that we have learned or have tried to point out to people as we go through this-- number one is, it takes time to do these conversions. And that's the reason that I really am stressing use of annuals, because there's been a lot of situations where people get in a hurry. They want to get the toxic fescue killed. They want to get MaxQ planted.

They try to do it all in one year. And within three or four years, they've got a substantial amount of toxic fescue that's come back on them. Now that's not just producers. There's some research that shows that as well. And so just one season of burning down that fescue is not necessarily going to get the job done. So we encourage people to take their time.

Don't do too big of an acreage at one time, because it does disrupt your system quite dramatically. And then use annuals there for several years, so that you really can get the fescue gone or get the other

weeds or the other things you're worried about for your native warm-season grasses can be cleaned up.

So if we have that annual for several years, it's going to improve our ability to kill this toxic fescue. It's going to break the weed cycles that are out there on a lot of these older pastures, and try to kind of get that under control. It will also help us with soil health, if we can select the kind of annuals that will give us those kinds of benefits.

Now that's an easy thing to say and a hard thing to do. And I know that you all deal with those kinds of questions all the time. But we have been working with these annuals now for the last three years. This is our third year. The first year started largely experimentally on my home farm, because I just was scared to death about what was going to happen.

And being like a lot of our clients that we work with, I'm a part-time farmer, and approaching these kinds of projects as a part-time venture is kind of scary. But I'll tell you a little bit more about that as we go into it. But we are three years into this process.

Now just a little bit of an aside, and I usually get a chuckle whenever I show this. But part of what's happened to our group and our program is, we've started to work with Ray Archuleta. And Ray has kind of taken me from being a conservative scientist that would never dream of planting something like this to being really excited about it.

And so I've been kind of through that little bit of a transformation because of Ray's input. But we started calling this mix "Ray's Crazy Mix." And I don't know why we did that. I guess it was just for fun to start with. And I think I did it just to dare Ray come out to some of our workshops, because I knew if we did that, he'd probably come to tell everybody he's not quite as crazy as we think.

But anyway, one of our undergraduate students, Paige Kennedy, who's running this project this summer, really has gotten along well with Ray, and she thinks it should be called "Crazy Ray's Mix," but we're keeping the name. The point being that people-- so there's a lot of psychology in this. And people will come to a workshop to see "Ray's Crazy Mix" that might not come to see annuals, just for what it's worth.

So the big question comes up, how in the world do you design these mixtures? We're trying to do something that is based on science. There's really very little data out there, especially for a specific soil

or a specific situation, from research that would help us to decide how to design the mixtures. I think we all can agree that there are different functional groups that we need to be thinking about. The grasses, obviously not all created equal, but most of them are fibrous root systems. The legumes, they can either be tap and/or fibrous or a little bit of both.

They give us the nitrogen fixation benefit, of course. And then some of the forbes, the brassicas-- those can provide the tap root in some situations, but also are a good scavenger of nutrients. And in situations where we have quite a bit of nutrients and have weed pressure potential, then oftentimes these brassicas can come out and quickly give us some ground cover, and maybe not compete so much with the upright grasses we're planting, but maybe compete with some of the weeds.

So that's about all we've got to go on at this point with our specific situation. But certainly we know that at this point, our thinking is that the success of the mix will be determined by your initial plant population. And that's driven by the number of seeds you put in the ground. Pretty obviously, but sometimes we don't think about that. The condition specifically during establishment, moisture, and fertility and all of that obviously has an effect and will affect a specific mixture.

And then the competitiveness of the various species and the varieties of species that we get in those mixtures. So there's a lot to this that we don't know. And so again, my initial reaction to these kinds of mixtures was, we shouldn't do this because we don't know anything about it. But based on some of the theoretical reasons why we would want mixtures, we're trying it. We're trying to do some side-by-side plantings with stuff that's not these complicated mixtures where we're doing that. But lots of farms are just planting just this "Ray's Crazy Mix" that we've come up with and our 2014 type.

Now again, I'm going to try to have a little bit of data and show you why I'm kind of really-- I keep having these little situations where I see somebody speak and I have an epiphany and realize that I've been missing out on a half a lifetime's worth of understanding. But this is a data slide from Ray Weil in Maryland. I saw him present at a soil health field day at Dave Brant's this spring.

And the two green lines are two different types of radish cover crops. Again, this is a cropping situation in Maryland, so put it in the perspective of where it's from. But this is the nitrogen level. So going here to your right is the amount of nitrogen in a 15-centimeter layer of soil and at depth.

And so what this shows is that in the control with no cover crop, you basically have a lot of nitrogen here

that's at that 60, 75 to maybe 100 centimeter of depth. Then there's less, and it goes down. And then there's another peak, another big amount out here that's deeper. And that's approximately six feet. And his interpretation, Ray's interpretation is this is the fertilizer that's leached from two successive crop years.

And by using the radishes, they have been able to scavenge that nitrogen from down that deep and pull a lot of it back up to the surface. So the total amount of nitrogen in this soil was 173 kilograms per hectare with no cover, and only around 50 to 60 with the two types of radishes. Now where is that nitrogen? Well, it's up here on top in this scavenge crop. And again, this is pretty well understood, but again for me was pretty neat.

And Ray made the point at this particular talk that he thinks there's roots below this level. This is as deep as they could go. But the deeper they look for roots, the deeper they find roots. And Steve challenged me here a week or so ago. We had a workshop, and one of my grad students stated that this radish could go down 12 feet.

And I think she'd heard me say that. And so I had to go and do a little digging, and actually went back to Ray Weil And he said he had data down to eight feet that he had the radish root there, but that he felt like there was no reason it couldn't go to 12 if the soil was of such a nature that it could be penetrated. So this deep rooting, tap root stuff is very interesting to me, especially in these very poor Piedmont soils that we know are hard as a rock.

And again, the question earlier about what we might do about compaction is a really good one. And on these clay-type soils, they're hard as a rock all the way down. There are some compaction layers, obviously, from former plowing activity and stuff. But they're just plain old hard. So getting some living roots deep in those soils is going to be a challenge. I'm sure that-- I don't think we'll have the depths that we have, certainly in this type of a soil.

Now going on to some of the planting considerations-- and after this, I'm going to show you what the mixes were for the three years. But this year-- this is that year's mix. And it's roughly based on some mixes that were being used in the upper Midwest. But we have some grazing corn, some soybeans, some cowpeas two types of sorghum Sudan, a pearl millet, a sunflower, a hybrid brassica that is the t raptor, hybrid brassica, and then the daikon radish.

And the seeding rates are here on the side. And I guess I knew this all along, but what we need to be doing is looking at our plant populations. And it's easiest for me to think in terms of per square foot. So I'm going to jump over here so we don't take up too much time. But you look at seeds per pound, we can determine that. And these are actually determined on the pure seeds that we used this year, ranging from anywhere from 1800 for the corn up to 113,000 for the brassica.

And so if you see that range, that nearly 100-fold range in that, obviously that's going to drive a lot of what's in there. And so it should be no surprise when we get over here to the seeds per square foot that we have very, very little corn and we have an awful lot of these brassicas and millet, the two smallest seeds. And that was really not-- we knew that, but it's easy to get carried away with that and up that component just a little bit and affect that plant population a lot.

Don't know if that's a problem. But again, I just think that as we think about these seeds, we really need to be looking more at what we have out there. The total plant population here that was put out in seed is about 18 plants per square foot, lower than what we sometimes say we want for these mixtures. But some of these are pretty big plants. So a couple of sorghum Sudan plants per square foot and a couple of millets is actually quite a bit.

So again, work in progress. But this is where we are at right now in how we've designed the mix that we're using this year. And this is basically the three years that we've used. And again, I'm combining varieties and everything here. I'm not just showing the species that we use. But you can see that this has evolved some over the years.

And I'll show you some pictures of that in a minute of why that might be. But we started with this mix that we bought from Nebraska, and then we designed this 2013 mix ourselves and mixed it here, and then as well as 2014. This was custom-mixed for us. So we're evolving through this and trying to see how-- try to do it logically, and then see what it looks like. So this was the first year.

We had more sunflowers the first year, so it was probably our prettiest year. We had a lot of brassicas, good diversity. This is from one of our producer's farms. And the perception was we had an awful lot of brassica. We didn't really have as much yield as we'd like. And so we wanted more of the grasses. This was a very dry year, and so we didn't really know how that affected us.

So we also had some side-by-side, sorghum Sudan that year, as well as some of the mixes. And

sorghum Sudan is a good annual crop, so we don't want to forget about that. And this particular one shows some cows grazing some stuff that pretty much got away from us and the poly wire there we're using to graze that land with. Also a lot of interest here in cowpeas and sorghum Sudan, some of these simpler mixtures.

We did have some of that side-by-side the first year to get some experience with it. And it looks quite good. They seem to have a good relationship when you get a good cowpea stand, and they start climbing up that sorghum Sudan as it gets bigger.

Nevertheless, a lot of curiosity and interest in the stuff like the radishes and the other stuff and those diverse mixtures. And so we've tried to keep that out there. It's as much an attention-getter as anything, but if we can get people on the land looking, trying to do something with their fescue-- if this is what it takes, I'm all for it.

Now jump to 2013, this being the second year. And this is on our farm. This is the mixture. And the second year we increased sorghum Sudan a little bit in the mix. We also had about eight inches of rain during the first three weeks after establishment.

And what we learned is that sorghum Sudan grows like mad when it rains a lot. This is a fescue pasture that was killed, and this is with no nitrogen. There was about five tons of biomass out there, and that biomass was about 80% sorghum Sudan. And so plant as you will, these mixtures will respond to the environmental conditions. And we had almost no legumes in this mixture, even though we planted soybeans and cowpeas. You could find a little one here and there, but we just didn't get a lot of them because of the competition.

Now folks say, you'd think this is awful from a traditional grazing management standpoint. But again, the goal in here is to kill fescue. And so if this is a fescue renovation project and this is the goal, this is not near as bad as if we're trying to get good performance on the cattle. So this particular situation, yearling cattle gained about 1.3 pounds per day, grazing through this kind of big mass. And that you can see how this was done with temporary fencing, the foreground here being an area that was grazed.

And you see when it's big like this, they pretty well stomp it all down. We did do a few little estimates-- not something that would be scientifically publishable, but we did some estimates here that looks like they're probably stomping down 2/3 of the biomass out there and doing a lot of ground cover. So again,

if I'm trying to kill fescue and improve soil at the same time, this is a pretty darn good approach. So we need to be a little more open-minded about whether farmers are doing the right thing or not as they do this.

Now this is one of our main cooperators, Johnny Rogers and he's been around. Many of you know him already. But Johnny's a little more performance-conscious than I am. He's a purebred breed, got some purebred cattle, and that sort of thing. So this is his Red Angus heifers. And he was able to get about 1.7 pounds per day on these heifers on that mix, grazing at about the size of what you see there. So his wasn't quite as far away from him as mine was, because our land just seemed to have a little bit more nitrogen to it than his did. Again, this is unfertilized stuff.

But a little better mix, a little better diversity. But again, a lot of sorghum Sudan at his place. So we learned that when it rains a lot, you want less sorghum Sudan. I wish we could predict that, but that's kind of the case. You see, we backed off our sorghum Sudan a little bit in this year's mixes. And we'll find out how that works.

Next one. One thing, Johnny pulled this one up. And really, he had some cowpeas and sorghum Sudan as well. And really, we're debating this. Do you want to put in a system where you're going to have lots of legume in it? Is that what you need? And if so, we need to be thinking about that in these mixtures. And those are not easy decisions to make.

The overall sort of observation from last summer is that we had very good luck with all of our systems, very good luck in terms of us being able to have cattle perform well, be comfortable, be in these situations where folks were not used to them on these higher-quality forages in the summer. Body condition's great in these animals. And again, a very lot of interest in terms of trying to do this particular approach.

Now some of the things that I'll give you as recommendations, just kind of what we've learned, and again, many of you know more about this than I do-- but I think it's important for producers to know their goal. I get this question all the time. When do we start grazing this stuff? And I think if you want quality forage production, you want animal performance, you need to graze it earlier and graze it more traditionally like we would-- 4 to 6 week regrowth at the very most, and then rotational grazing.

But if you're looking for conversion project, you want a lot of biomass, you want a lot of cover left, then

maybe letting it get a little bigger before you graze it is a good idea. So we need to work out some work to really test that approach and see if that's true or not. I think that that's got some good sense in it.

think we also want to plant into a non-competitive situation. I'll show you a picture here in a minute about that. But there are a lot of weeds that will compete with plants for moisture. There are a lot of situations where you could have some perennial plants out there that, if the weather turns dry, that you'll have your problems with that. So we get a lot of debate about whether we burn this down with Roundup or something before planting.

And so you really need to think about your situation. But if you're in a situation where you want to kill fescue, then I would kill it. I mean, I think that saying, well, we really don't want to use Roundup. We can live with a little bit of fescue-- I don't think that's good advice. I think getting the fescue out of the system if that's your goal is really important.

Just based on what we've seen so far, we seem to see better results where we have used a burn-down, typically with glyphosate for our farmers. But we do have some successes where they have not done the burn-down. So again, no absolutes here. But most situations, we would recommend that that stand be done in and the annuals be used then to restart the system.

Just a few little pictures here to show you at the end. This is an example of kind of what I'm talking about. This is a mix that was-- this is our winter mix on that same land where I showed the sorghum Sudan earlier. And again, we planted an eight-way mixture. Most of this is going to be pea and vetch, oats and wheat, a little bit of rye grass and crimson clover, because those are the ones that didn't winter kill. Some of the other stuff winter killed. But nevertheless, this was a very thin stand.

In my mind, come the first of April it was just a disaster. It was the biggest problem I've ever been involved in, in terms of trying something so hard and having it turn out so bad. This picture was taken towards the end of April. And a little bit of rain and a little bit of warm weather, and these annuals can really come on and do a lot.

And so this was a steer grazing that we got. I did weigh these cattle out of this when they were done with that. And these animals gained right at about 2 and 1/2 pounds a day, and did quite well on it. And we got a lot of grazing out of it. And if we had been doing our traditional approach and getting this ready to be planted by the middle of April, or first of May or so with these other summer annuals, we would

have missed out on a lot of this biomass and this nitrogen that we brought into the system.

So we've got to be really careful about how we approach managing these, and understand we have a lot to learn about it. We can't make absolute statements about this. And in this case, I think it was the right thing to graze this late, assuming that it rains. Because we're way behind on our summer annual now, but we're not that far behind because nobody else has had much rain.

The other thing, the last thing I'm going to throw in here about our current summer this year, we do have about 20 locations where we have planted the "Ray's Crazy Mix" this summer. Six of those locations we're monitoring pretty carefully, as a part of a grant from USDA. And this is two of those locations. Somebody I'll point out, the young lady here in the pink shirt, is Paige Kennedy. She's the graduate student that's working on this this summer, and then we're not sure what she's going to do for her grad project.

But this is a site in Union County. This is the farmer right here. And this is a site in Stanley County. This particular site-- that's Nathan Lowder right there. This shows the kind of team we're trying to work with. This is Amy [? Poirier ?], who's the agronomist with the Department of Agriculture. This is Steve [? Lemons ?] our extension agent. Nathan, within NRCS.

This guy here behind Paige-- I can't remember his name, but he's an intern with Nathan, Paige, and then this is Elaine Moore, the farmer. So we're working as a team here. We're assessing what's out there. And Elaine drilled hers into a stand of triticale that she grazed pretty hard. She didn't want to kill it because she thought she might get a little more out of it. It's also got a little bit of fescue and another stuff in there she didn't want to kill. So she elected not to burn it down and just to drill directly into it, and to do it early, because she knew that annuals, she needed to be early. So that was the first one planted.

This site was planted later. The farmer burnt down after taking off a rye grass hay crop, planted it in there. And then he decided he wanted to do a little nitrogen on his. So he came back and he put some nitrogen on, about 40 units after this stuff had emerged. And he's got a really good mixture-- again, dominated by sorghum Sudan, which is being fed by that nitrogen. But he wants performance, so he's going to graze this off, and hopefully the other stuff will come back in the second grazing.

Elaine's-- at her farm, it's mostly triticale, weeds, other junk out there that it would have been really nice to have cleaned that up. So in retrospect, this site, probably the burn-down would have been worth it, to

allow the mixture to get off to a good start. You can kind of see it in here, and we are collecting data on what the stand looks like.

But well over 50% of this stand was the stuff that we sowed. So under 50% was sown. On this site, about 75% of what was out there was what we planted. And then there's some broadleaf signal grass as the main species coming in, in combination with what we planted. So again, we're going to get experience with a bunch of different sites with this particular mix.

But I think it shows you that it really depends on the site and the farmers, as to how this stuff is going to work out. So I'll end, and Steve, it's been a real pleasure. I think we're right at an hour. Sorry, I went a little over what I planned. But I just want to leave you with one thought. Everywhere we've gone and worked with farmers and tried to find out what it is that's limiting them from adopting better grazing management, it really becomes fencing.

We have a need to get folks to learn more about temporary fencing. We have these workshops that we have this last couple summers have focused on this. And that's what we're going to be focusing on this summer. But getting this stuff into people's hands, getting them out and realizing that, like shown here with Johnny Rodgers, that this is honorable work. This is good exercise.

This gets you on the ground with your cattle. It's so different from managing them from the cab of a pickup truck. And people like it, if they just get out and start doing it. And so we're not going to stop on this. We're going to keep pushing, keep showing examples, keep expanding our group of cooperators, and trying to get people to realize that there is something to be found here, and there are some good in land that we've formerly thought was just poor quality land.

OK. With that, Steve, I'm going to stop and I'll take some more questions.

Well, Matt, I sure do appreciate that. That was a really good presentation. We'll take about-- see if we can take about five or six or seven minutes or so, and get at a few of these questions, as many as we can knock out. One that came in-- you talked a lot about converting from toxic fescue and using annuals to do that.

What about when you have pastures that are in pretty good shape, but you are thinking about annuals in the system? What's your thought process on that, when to consider using annuals when maybe it's not a toxic fescue situation?

OK. I think that's really good question, Steve. And the thing about annuals is, annuals have a few characteristics in grazing that are important. One is that-- and again, if I focus right now on the time of year it is here, thinking about summer annuals, they do have the potential to help balance the system from a warm season, cool season standpoint. And something like a sorghum Sudan can give you a lot of yield during the summer.

Obviously warm season perennials would be a benefit to that, but something that it takes a lot more time, a lot more management to get to that. So again, we are normally thinking in terms of conversion. But if it's not a toxic fescue situation, but just a farm plan that maybe says you need more warm season or more cool season, or whatever it is, then some of these annuals are a way of getting there.

And so another example would be a situation where it was all Bermuda grass, and what do you do? How do you control Bermuda grass enough to get something else planted if it's been there for a long time? And so again, an annual to kind break up that Bermuda grass, something that would be competitive with it to get it out of the system so that you could put what you really want would probably be a better approach that you could use. The other thing is just the overall performance of animals.

The annuals typically will give you a little bit better performance than most of the perennial species. And so we can capitalize on that in situations where producers have a high need for nutrition for the animals. Where we have that here is people that are trying to-- for example, they're trying to grass-finish beef on their farm. They may have perfectly good perennial pastures that have served them well for their cow herd.

But they just can't get animals finished. And so they may put in a little niche part of their system to try to get the performance on those animals. And so that's the main place where they would be used. And that's typically the people that are interested in working with us on this are people that have realized they need to change, mostly because of the performance of their cattle. And a few of those that go into it thinking, I'm going to do a conversion, and then they go into it and realize, man, there's room for annuals in my system.

Again, the one caveat on that is if you do a winter and summer annual double crop, essentially, you're always behind, you're always late. It takes good farming skills. There's all sorts of things about it there that maybe make it something that annuals just as a part of the system is not going to work for a lot of

our producers that just don't farm regularly. And so they're always struggling, trying to make it work.

OK, thanks. And you hit on this a little bit when you talked about the time to convert from toxic fescue to other uses. But how many years do you think you need to put these annuals in when converting-- and maybe not necessarily just for the toxic fescue, but just for any reason. Somebody like yourself could be using these annuals on a pasture. And you say, boy, I really enjoyed it. So you just keep doing it over and over again in the same pasture. And I'm sure economics comes into play at some point as well.

Yes absolutely. So I didn't mention the economics part. You all have seen it as well. The annuals are the most expensive thing we can put in. The seed cost was around \$70 an acre this year, and we could have planted a straight sorghum Sudan for about half that. And then our perennial pastures are going to be much below that, in terms of the overall cost. But again, there are so many factors that are stacked on top of each other here, it's hard for me to sort it out.

But again, if we're going into an old pasture and we're thinking, OK, we want to renovate it, we have this compaction issue, probably, from lots of animals. And these are usually not the best managed pastures, maybe. Maybe some of them are. But I think we have the opportunity to go in there and get some benefits from the deep rooting crops, especially the radish, the deep tap roots.

And sorghum Sudan is a very aggressive root, very deep rooted kind of a crop. And I think that can help to set up a better soil health situation, as we go back into establishing the perennial crops behind that. And again, that's just my gut feeling. I wish I had more data on that. And we probably can scrounge some data that's somewhat related to that.

But again, we need some practical research on this stuff that's going to give us some idea of, for example, is there any benefit to that radish for a few years as you bridge between a toxic fescue and a nontoxic fescue crop. Or if you're just renovating a pasture that's kind of gone downhill and just obviously not as productive as it once was. These kinds of things have me a little bit interested in going into some pastures that we would normally just leave alone, because they're pretty good, but thinking about the benefits we might get beyond just the forage production that we would get.

OK. And so you'd also talked a little about establishment. And you said that you used a chemical burn-down. What other site prep-- and I know that Johnny just did not do that-- Johnny Rogers. He just no-tilled directly into the grazed down pastures. Was there any other site prep for either one of you guys?

Basically, no. At our place-- again, I'm at war with fescue on the pastures we're doing. So I'm really wanting to kill all that off. Johnny is on leased land, and he doesn't know for sure how long he's going to be there. He's not quite as worried about long-term eliminating fescue from the pastures he's working with. But he did burn down the fescue with glyphosate the first year. And then after that, he's continued with annuals on that land and has not used any herbicides.

Again, I think it'll be interesting to see this year what happened. Because he did-- we have had a lot of dry weather, and some of the stands are really struggling to survive. And in this kind of situation, then any of those living plants, even right now vetch and other stuff like that's holding on, using the moisture and competing with those summer annual plants that are trying to get going.

So a lot of debate and discussion there, Steve. I think you've got to ask yourself, how much competition are you going to have? And that can be done through scouting. I know that the cropping system guys do the same thing. They roll down. And that usually gets a good kill on the vetch and rye or whatever it is that they're cover cropping with.

But if they don't get a good kill, they'll go back and they'll spray that because of that competition issue. So there's a lot of art in this. And the thought process I go through is to go out there. And I walk and I look for undesirable stuff. First, stuff that I really would like to kill, and then think about the competition from desirable plants as a secondary thing.

And we'll try to finish up with this one more. What percentage of your grazing system-- I guess it depends on what kind of if it's a cow, calf, or stock or replacements. What percentage do you think you maybe should keep in annuals throughout a season?

Well, again, this is really not to say that we think that everybody ought to have annuals in their system. I think that that would be the wrong message. And that's why we really are stressing the conversion thing. Because again, last winter was a good example of the worst that can happen with annuals.

I mean, if you got it planted real early, you got something. If you were planting late, after summer annuals and that sort of thing in October, like a lot of people did, you just didn't get any production on that winter annual all through the winter. And I think I relayed to you that we did have some erosion and stuff off the land that we have. Even though we had a lot of sorghum Sudan cover out there, a lot of cover on the soil, we had some major rain events in the winter that caused some erosion.

So I'm not a big fan, still, of the annuals as a major part of anybody's system. I think here are finishers that are trying to have some really high quality stuff to finish cattle on. They may want 10% or 20% of their acreage-- and this is if they're a cow or calf producer.

But they need a substantial amount of acreage in something other than toxic fescue or Bermuda grass. So they do need some nontoxic fescue, some native warm season, or something like that. And then a little bit of annuals to kind of transition through and maybe take advantage of some quick yields after rain. I think there are some benefit there to that. But it's got to be for specialty uses.

OK I've tried to combine a lot of these questions, as many as I could, and we still ended up with a lot more. But what we can do, if you have some that you felt like you really needed answered, you could shoot me an email and I could forward those on to Matt. Maybe he could help us answer those. But I did combine most of the ones together. We need to wrap up. I did want to make one quick point. And thank you, Matt, for doing a great presentation. As always, you do a great job.

I did also want to point out, most of you know that Matt heads up the Pastureland Ecology course, the NEDC course, the two-week course, which is taught at North Carolina State University. And that course is always well-received as a great course. it's coming up, coming up in early July.

We actually have a few spots left open. If you know anyone in your states that would be interested in that, please, you can let NEDS know or let me know and I can pass that on as well. But with that, thank you, Matt, and thanks to everyone for being here today. And we'll see you next time. Goodbye.

Thank you.