

## Managing Weeds with Less Chemical Use in No-Till

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Greetings. Welcome to today's webinar entitled Managing Weeds with Less Chemical Use in No-Till Systems. My name is Jennifer Ryan with the natural resources conservation services technology support center. I will be your host.

I want to take a moment to remind participants that the use of training is for information purposes. Mention of a trade name does not constitute guarantee of product or imply endorsement by the department of a comparable product. Without, we will now begin. I would like to welcome our moderator Steve who is with NRCS at the national technology support center located there 12 years spending his entire career in his home state of North Carolina. He has held several positions including district conservationist and grazing lands specialist. Steve, you may now begin.

Thank you. I am glad to have everyone here this afternoon a couple of days before Thanksgiving. I hope that you enjoy this topic, Managing Weeds with Less Chemical Use in No-Till Systems. This topic initially came as a request. It came along because a lot of NRCS planners and conservationists were working with producers who really liked the idea of no-till systems and building good soil health in their system, but they were getting a little discouraged. We are looking for maybe some ways to not eliminate herbicide but just two more manage the amount that they were having to use with maybe some of the pesky weeds. This really got the topic going and I know a lot of you have been exposed to cover crops and the last decades or so as a relief to soil health. I think this is a good topic to get more specific in how they can be used for specific weeds. I am pleased to introduce errors speakers. These guys are experts in this field. We have John Wallace with Penn State and also Dr. Mark VanGessel as an extensive weeds specialist at the University of Delaware . With that, I am going to turn it over to John.

All right. Thank you. Mark and I appreciate the invitation we are looking forward to talking about the subject. It is a timely subject, this idea of thinking of ways to reduce our reliance on nonchemical inputs to manage weeds. Right now, we are looking at a season next year where there might be some supply shortages for particular herbicides reinforcing how reliant we are on herbicides to manage weeds and no-till systems. We are starting to see increases in herbicide inputs in the landscape as well as multiple resistant weeds which just means certain types of weeds are resistant to modes of action of herbicide. It is a timely subject.

I like to think that in conservation ag systems that really apply all of the principles of conservation ag and really going beyond minimizing disturbances and maximizing soil cover to no-till systems, but finding ways to add diversity to a crop rotation were innovating cover crops into the rotation and looking for opportunities to lengthen the growing season windows and provide cover. Of those principles are being applied, there is likely opportunities for reducing reliance in the systems. I think it is useful to think about what we need herbicides for and we cannot and I suggest three kind of goals to think about herbicide use and the first is it is a management tool and we have to have good and effective ways to kill those cover crops and really herbicides our most effective tool and really have the greatest reliability control mechanism. When we are using cover crops, herbicides they become a tool in the IPM toolbox. It is to make them a bigger management tool so that we can rely less on herbicides. I do not think we will have time to go into detail today what if we really think about using diverse rotation and the growing season windows, there is likely to be trade-offs between having to decide how to adjust your cover crop program to use the herbicides you need or how do we modify programs in order to allow for integration. I just want to provide this in no-till systems.

I will talk about the basis of weeds subversion in no-till systems and it is good to think about two different phases of the cover crop lifestyle. We can do a pretty good job suppressing we in a living cover crop which is an active form of competition. In no-till systems when we allow the cover crop to get big and leave it on the surface, the mulch that results can also have additional benefits. We think about the active growing cover crop and then the terminated mulch left on the surface. There is a lot of trees, in which they have the different growing system with. It is really hard to be prescriptive about what set of cover crops to use in different circumstances. I like to talk about general goals, no matter what mixtures you see elect to maximize weed suppression. Biomass production is related to the weed suppression that you will get so finding ways to really maximize total biomass production is important for weed suppression. Also important is finding management strategies for achieving groundcover cover crops. We are thinking about cover crop performance in two ways. Biomass production and if we can achieve high levels of groundcover. Those are really important for both managing weeds in the growing cover crop as well as for the mulch suppression. If

we are thinking about making the most out of the mulch and a mixture would allow on the surface and if those are the goals, optimizing biomass production for a management objective. There are certain tactics that you can adjust and your practice is to target those performance goals. The first is understanding the growing season windows. Orville Fleming, the earlier the seeding in late summer or early fall the better as far as getting a good established cover crop going into winter. And the Northeast we have a lot of small greens that are grown that are not going to double crop soybeans so there is a nice long growing season there to establish a cover crop. It is a nice long window that you can establish those cover crops, affording you opportunities to use different mixtures with grass. Certainly, in our region in the up the Midwest and others, after grain crops so corn or soybeans we have a very narrow or a short growing season in the window to establish those cover crop. There is a rule in those scenarios really increased interest in delaying termination of the cover crop later in the spring, closer to the cash crop planted to really get the greatest benefit of the cover crop and increased biomass production. Feeding and termination method can be important when it comes to getting the rapidly established cover crop in a really uniform stand to give you good groundcover. Search and a uniform stand under some circumstances in which broadcast can work well. There has also been some work that we will touch on a little bit about how to terminate that cover crop and going nuclear with the herbicide and on the surface. And cover crops differ in their biomass potential. They differ in trades and those types of things. To Berkeley we think about using mixtures when we are targeting multiple production objectives one of which might be increasing weed suppression. If we are focused on optimizing weed suppression, we might think of joining a monoculture of rye which has been hard to beat. And soul it can be establish lead from the growing season for NRCS and it is really a great scavenger on how the really high biomass put Joel. Those traits make it a really good tool. One would think about managing something like cereal rye to maximize weed suppression material, we are thinking of getting one of those days and she's out of the method is to establish the cover crop. It is established in the fall with greater groundcover going into this potential there can be a real benefit. Just a 14-day delay in killing cereal rye in the spring on that account sometimes more than double the biomass project Shannon about point started team to move from the flag leave starting to really move into the heady stage. Also, certainly in Pennsylvania and the Derry crop system. And we want to see the levels of biomass production that we would otherwise. A little bit about wins. If we are going to use cover crops with the IPM approach, the first thing that we really need to know is to tailor to target those Reid bombs. And certainly we have the potential with the cover crop. The figure that you see on the right is for emerging cover systems. It would mean to you to Berkeley see those weed species Germany. It was the winter annual weed with the overlapping lifecycle with a cover crop. I will use that as an example here later to talk about how we can use cover crops to manage winter annuals. As far as visitors, in late May we will see the higher levels of weed suppression coinciding with when mulch biomass is at its highest.

The other thing is that we see differences between annual species, depending upon seeds trades. And depending if it is a small Cedar large needed and there is not a cut and dry and we do see a range mean Jean to less than one order of magnitude smaller. And because they have a harder time growing and establishing that they have been a Cedric Soares to get through the mulch. The larger seated annuals we might still with in Pennsylvania were cucumbers as are most significant. Some of those have NFC reserves underweight and sensitive when it comes to germination but we will have a tougher time getting high levels of weed suppression and cover crops for those types of species.

In no-till systems we also deal with perennial weeds species issues. Like the Canada thistle or milkweed and because of those underground reserves associated with those perennials, we should not ask to see high levels of suppression for perennial species.

Which of the time is spent thinking about management tactics or strategies for controlling multiple resistant weeds species. I have here on this slide the three big ones in Pennsylvania. Those are just three. There is others with the right weed species, for instance. Several of these problematic herbicide spaces or small seated annuals. Either winter annual or summer annual species. That means that we really the potential to use cover crops in to manage these species, based on their lifecycle. This is really an opportunity to use cover crops in order to reduce the reliance on herbicide or herbicide input. Right now they herbicide base each to managing this would include multiple passes during a season and probably multiple active ingredients per paths we are putting a lot of herbicide to control the species to a significant cost another thing that contributes to the reliance on herbicide to manage these receipts is that there is really this emphasis on trying to eliminate the steep bank of these multiple species in order to drive those populations to reduce the chance of resistance evolution to another effect herbicide. There is a zero management strategy for resistant weeds species.

Cover crops, and certainly cover crops that are employed endeavors crop rotations in no-till systems can also be an effective tool for see you back management pack there is a number of mechanism in which having those actively growing cover crops can be a good management to. We can reduce the seed production of

plants so that viewers see going back to the soil that germinates or promotes decay in the soil. Doing more with cover crops is really a resistance management tactic.

I'm just going to walk through for handmaiden over to Mark Walter one example of how we think about this and employed tactics to manage these types of species and trend in the ways horse weed is an example. And it is a winter annual weed and so I think about three different objectives or goals for cover crops when we are using it to manage maretail. I consistently when I talk to growers talk about the benefits of cover crops to slow or reduce the spread of herbicide resistance for the currently effective purpose that we use to keep those effectiveness. So with the cover crop iodine to that management ever. Another tangible bond is the potential to lengthen windows for making the effective herbicide to control the species. Where we see them running into trouble with maretail is when they leave field fallow and we to burn down weeds prior to obtaining that maybe they do not get planted until May and maretail has gone unchecked until that point. It can be to go large to be effective with herbicide. The result is higher rates are needed to control it or if you do not get complete control you are coming with another herbicide and we see this treadmill and those types of scenarios. If we make more use of the cover crops, we could potentially eliminate the need for additional herbicide passes.

Archive. Just quickly maretail is a prolific seed producer but we typically see it start to see. It is also a very small seeded species recounts start to see this link somewhere in the summer or early fall at a time we might be harvesting cash crops are establishing cover crops picture team that emerges in the fall will grow. It will start to form these Rosa, which we can see here and resume growth in the spring. Those fall emerging plants tend to be the ones that are larger in size when it comes time to kill weeds. We also potentially see maretail emerging in the spring as well.

But we are really trying to avoid from a herbicide stewardship standpoint is waiting to control maretail until he gets to the signs that you see in the picture, 6 inches or 8 inches tall and we are probably increasing selection pressure for resistance using this type of approach. This is just a picture of one that compounds. Now we have to come and in this case this is soybeans. It is in order to really control maretail, which can be telling. As far as using cover crops to manage maretail, star team clean and provide you with a competitive event can result in high level. This is a picture you see that is a natural experiment that illustrates this point effectively take the left side of the field was interceded and then you will rye grass was taken and what they really must catch the cover crop actively growing. It is about the time that we might start to see maretail germinate in the fall. You can see the level of maretail pressure the following spring break you can hardly see any maretail on the left side. H-E-B this to the vector is already it will stop just cover crop prior to the time you may see maretail number. Some of our other work has demonstrated fall management is key for wintering annuals and it is more important than termination methods are strategy so they figure you are looking at there is the number of maretail suppression that we get by planting a cereal rye cover crop. We were getting greener suppression upwards of 85% relative to follow treatment you want to post them in October compared to about 65 or 70% when we planted in September and the reason for that is perhaps after a small grain, that coincides with when we might start to see maretail number with a newly established cover crop in comparison to October where we had some trend Tina merge and we were able to control it with a burnt application. The benefits of integrating a good herbicide to present with a competitive, we are getting about 95% suppression of maretail.

Some of the other work has shown two of the drivers potential we suppression potential for maretail is yours ECC election as well as soil fertility. In this picture reluctant mixtures in either a high nitrogen fertility scenario or a now nitrogen fertility scenario. What came out of this work is the importance of biomass production and crown, but you can see it is oats grown in a high nitrogen and that was our highest fall biomass producer, but it did not suppress maretail as well as cereal rye the you can see next to it. The reason why is good I am mass production but complete grown. There are differences in trade that can be important when you think about the man's.

And so while we can't see who are between 50 and 75 pounds suppression of wintry manual we when we have a well-established cover crop, still means where winter annual weeds growing in the cover crop. Depending on what weeds those commit maker may not matter that some of them will likely go ahead and complete their lifestyle prepare. For maretail continues to grow and can be a probable. It would be important to think and it could be growing within cover crop. Some of the key consideration with his VCs dictate the truly. To skip baseline here? I did. The last note on the slide that you are looking at is the see the rings differences that we found that one established in early October when you have growing days available and low rate of cereal rye at 45 pounds or so but we still saw really high levels of cereal rye suppression, which means that there can be a cost saving. You can potentially reduce seat cost that you might be thinking about you still get pretty high levels of weeks suppression. Apologies there. I just wanted to finish that up. I

got a little bit ahead of myself but when we are thinking about managing weeds like marestail and the cover crop, these PCs selection is going to dictate the options I get one of the benefit growing winter wheat is that you do have the opportunity to integrate herbicide passes to control some of those these in the cover crop. A good example of that is we have some data way reluctant controlling cereal rye thing within a cover crop by using low rates either in late fall or early spring. Integrated those tactics we are able to start cash crop planting clean.

Okay. I will turn over to Mark here. Just in summary, thinking about some consideration's for two suppress the weeds with overwhelming lifestyles like where Sweden others pixel important consideration would be trying to maximize the fall growing degree days and knowing something about your levels of soil fertility will tell you what the biomass potential is. Thinking about integrating your herbicide or perhaps controlling some of those problematic we in the of those problematic we in the cover crop is also important. Leslie, it is also important. Leslie, it is also important to have a good plan for terminating your company for terminating your company go hand it over to Mark .

Right. Thank Mark .

Right. Thank you, John . Looking at cover crops as it relates to termination of cover crops and Paris through two methods: mechanical termination or herbicide use. There has been a lot of talk about roller crimper's s and using them for cover crop termination to really be effective termination with his is that you target the plant of the cover crop species. Terminating them in that early reproductive stage is important. It tends to be the time when they're stems are easier to crimp and more effective to control to crimp with a lot less regrowth. It is also early enough to minimize seed product. You do not necessarily want the cover crop producing seed that could be a volunteer going forward. Crimping too early can be challenging. He gets regrowth of this cover crop. The TOMAL timing with most of these and with cereal rye is in the early reproductive stage. We are finding it is a fairly narrow window in some cases. It in the sweet spot that is late enough that we terminated but early enough that we do not impact the production. That could be volunteered in the future. The challenges we helpful ties that they do not necessarily lineup and we have done a fair amount of cereal rye . It can be challenging thinking that time to maximize both of the of the we get asked occasionally about mowing the cover crop for successful termination. We have had limited success, particularly in our experiment looking at cover crop for wheat management. We do not have to stop to provide stem suppression into the season. If you do it too early you can get quite a bit of regrowth from early mowing.

We have more flexibility when we terminate the cover crop. For a number of errors the scenes is a window. Which we have also found is with the differencee VCs have to be careful about the herbicides that we saw and I think in general the attitude is glyphosate is the best option but is often not the case as we get into some of the lagoons. Glyphosate can be quite effective on cereal rye or annual rye grass but not always an effective herbicide . It is much the herbicide and herbicide companies with the cover crops that are out there.

A lot of our work particularly with cover crops for wheat suppression is the leader termination and terminating it later in the spring closer to cash crop planting. One of the things we that is beneficial for us to send the spring often times the better environmental conditions we have for spraying and successful kill, This is just some data from last year . We look at 55 degree day is to be a realistic the starting point for spraying in the spring. That is what the old dash lines the blue solid line is there a 20 year over for a temperature that is the high for the day. The blue nine is what we actually ask variance in 2020. Temperature is in 2020. Temperature is one consideration. Finding days to spray. Over the course of April, we only had five days that fits the criteria for this very. Fairly few opportunities to spray it in April. With cover crops where we sprayed later Kemeny look at the May weather, a 20-year range we were well above the 55 big three day on our brand. In the year 2012 we had a number of days that were up 55. We had a 10 day window that was ideal for spraying. Often times we are also into a better time to spray these cover crops and determine a large cover crop. Beidel a application terminates, we end up with more residue, which can give us some issues for planting and making sure that we have adequate planter set up . Things like add additional weight to the planter to cut through at this glazed. It is so set up proper depths with the course here and it is hard to get a per scan with these high cover crop scenarios. There are modifications that can be made. A lot of bad I would say there is an art to it. It depends upon the operator and it depends upon the modification made. There is one side where it is not at all in terms of consideration and modeling case for planting in these cover crops.

Questions often come up about roller crimp a. If you are using crimp a. If you are using a chemical, is there a benefit to roller crimping? It really depends on your termination time. The earlier it is terminated, the less

of a need. And also claimed the depends on the planter setup that you have. And also the plant green, meaning to terminate your cover crop after planting. It is much more difficult. Stem cells started to use their turgor. It can be a little bit challenging in getting it could stand on the cover crop is at that stage. It is the ideal of the two best options.  
best options.

A number of planter considerations are shown here with a couple different planters that we have used over the years. Upper left-hand corner and upper middle. Here's the roller crimp mount on a tractor that is a quarter Hillstrom mount on a tractor which just crushes the instant and does a nice job of laying it flat. It developed a hydraulic group crimper that fashions right to the developed a hydraulic group crimper to the planter bar that generates quite a bit of force for rolling the cover crop and laying it down. It does a very a very nice job. Some of the things that we have been working with is how critical is it that we roll out cover crop? It is with their settled that we tend to have better success if we planted when the cover crop is standing or for well-rounded after the seed is in the ground. There are fewer stems to cut through in that situation. It does require having a good sharp cutting this narrow blade tending to keep the planter up on top of the cover crop. These are some of the modification we have seen. Some of the other considerations are they have some planters with the 15 inch row and a splinter unit on the part but they're all on a single toolbar. That set up alone does a good job knocking down the cover crop. We have done some work with a 30 inch row without roller crimp and you can see in the bottom right here that are soybeans responded pretty well. We still ended up with a good stand and by years end it helps to provide good closure for suppressing late emerging weeds. One of the things about cover crops is there is a lot of biomass out there and they are using an awful lot of soil moisture . Depending on the spring, it could be a benefit it or it could be not a benefit. This is a benefit. This is the data from Penn State looking at the soil and moisture. The blue bar is the relative water in a no-till scenario. Early in late May there was a definite water deficit delaying out planting by a week or 10 day and waiting for a timely rainfall allowed the soil to the charge and then have the proper time to plant. The flipside of that is later into the season here serving as a barrier it does help to conserve moisture. If you are in a summer with good rainfall you might see that but where it turns dry that moisture conservation can no-till compete to increased fields in some situations. Looking at a trial we did at the University of Delaware a couple years ago , looking at soybeans for cereal rye wheat suppression, we are looking at terminating the trend in various stages either four weeks before planting or two weeks or we planted green. We can see before planting or two weeks or we planted green, we can see as John mentioned earlier , you just delay your termination a 10 or that bears it out here. We planted into it and something to consider something that gives back to having good planter set up. In a trial we were looking at palmer amaranth identifying optimal herbicide strategies with the leader terminated cover crops. The green bar to the left is the local standard on how this field would have been managed for palmer amaranth with a nonselective herbicide to bring it to the post emergence of location five or six weeks after planting. The red bar next to we added on it additional herbicide without post emergence application to give us residual but that was in an additional herbicide. The pink bar next to it we split our pre-emergence application and burned down the cereal rye.

This post emergence spray would have been extra herbicide application in the scenario and then the last one was we burned out two weeks before planting and then came in with a post emergence application. A little bit more intensive and when you look at the plants and green, all three of those additional approaches were given as 100 percent control. John mentioned troublesome weeds like palmer amaranth increasing their level of control to the point of eliminating weed seed production. It is so then we have been focusing on in our programs and one of the things was we had 100% control indicating we had some room to improve in terms of reducing the amount of herbicide and still maintaining amount of excellent control. It is in a number of places to integrate herbicides with cover crops and returned reduced herbicide quotes. One of the things we see with cover crops is as close growth of the wheat that is there, which then allows a window everything herbicide application. In the case here on the left you can see the waterhemp in a limited scenario cover crops and on the right is smaller growth cover crops . A similar study done in Tennessee found that palmer amaranth that emerged with no cover crop reached 4 inches in height in just over two weeks it was already 4 inches in height which is a standard for timing of application . It took 25 days to reach boot height which shows cover crop really slows down the growth rate of weeds providing us a window of application.

Cover crop mixes. We have talked a lot about cereal rye . We find it to be one of the more effective cover crops. This was a study that looked at cover crops going from 100% cereal rye to 100% hairy vetch. Cereal rye provided better wheat suppression than 100% stand of hairy vetch. Another consideration for planting into the cover crop if you are using row cleaners to improve your cash crops standing getting better soil to

seat, with it, you will disturbing quite a bit of the cover crop and providing exposed soil for better weed growth . Which is something to be considered. I guess the other way of looking at it is you are not able to come back on your input will proceed row.

We talked about the cover crop can slow the growth rate as well as emergence of weeds. This is again something that we talked about before about the cereal rye slowing growth of summer annual weeds and in this case pigweed.

An issue that comes up often with using cover crops is when the cover crop is rolled and providing herbicide use? We see that often with the cover crop. This is some work that John did a few years of where he was using water sensitive papers and how much of that herbicide was deposited on the soil surface. The cover crop did interfere with that. There are other dynamics that come into play as far as herbicide retention on the cover crop and doesn't wash up and move into the soil at a later time. It is something to be aware of and something to be aware of and something to consider in terms of when to apply your residual herbicide and application that needs.

Just a few other considerations. It can provide a very valuable tool that gives us more options and improves overall control. The red clover cover crop can be beneficial where we get to let the soils to dry out so that we can get into them sooner. And from observation at this point is we have seen the benefits of cereal rye cover crop extend beyond the season of the cash crop that the residue remaining on the surface suppresses the growth of the winter annual weeds the following fall. There can be some benefits behind that one season. What we do with cover crops is it requires more planning and more flexibility. It is hard to plan three months out. That is going to be dependent upon the environment. Effectiveness can vary based on species. John talked about that with the carbohydrate reserves. An area that we are looking at is making sure we have an adequate stunned. How much biomass is needed to see significant from the cover crop. You can see some of the slides we have shown with barely modest level of cover crop biomass, yet having a tremendous impact reducing weed cover as well as weed growth. We find cereal rye can replace in many cases the use of residual herbicide, particularly in soybean. We need more work to to understand where we can have further herbicide reduction. I put in the chat box a couple of websites and resources. Cover crop for integrative weed management and one of them is the GROW website and also the northeastern cover crop. COME has just launched their website. Included is a seed selection tool that allows you to put in your location and purpose and it gives a recommendation for the seeds that meet those ecological services that you are looking for. Lastly, the take action website just published a series on cover crops just published a series on cover crops. With that, I will wrap it up. I know that we are going a little long, but I do have time for questions and hopefully if you have questions you can answer what is in the chat were take your questions live. I guess they have to be in the chat were take your questions live.

Thank you, Mark, that was really some good information. We do have several questions not only from the Q&A but I received other questions by email. I want to be mindful of everyone's time. We've already gone over. Jen says there is a way we can get these questions to you and get them answered and posted because I don't want to answer one or two and then leave somebody out and they wonder why their question did not get answered. There are really good questions here and I would like to keep you guys involved with answering some of those questions, if possible. I apologize to everyone for not doing that now but we are seven minutes after 3:00. Thank you. If you are listening, we will get those questions answered and get them posted. Thank you for your time. With that, I will turn it back over to Jennifer.

On behalf of the Natural Resources Conservation Service, I would like to say thank you to Mark, John, and Steve for providing an excellent presentation. And thank you to everyone for attending for attending. Participants, do not forget to provide your feedback about the webinar and if you selected to earn CEUs, please continue offered by Step 2. For the folks interested in the responses for the questions, they will be posted along with the recording on the webinar portal page. Just give us a couple weeks to get it finalized. This concludes our webinar presentation. Thank you

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