1.26.21

Greetings. Welcome to today's webinar entitled cover crops, herbs, and cut flowers for pollination and pest management. My name is Jen Ryan and I'm national resource specialist for the national resources conservation services East national technology support Center and I will be your host.

I want to remind participants that the use of trade names during any of our webinars is for information purposes only. Mention of a trade name does not constitute a guaranty of the product by the U.S. Department of agriculture nor does it imply endorsement by the department or the national resources conservation service over comparable products that are not named. With that we would now again. I am pleased to turn the webinar over to Nancy Adamson. Nancy supports habitat restoration on farms and in communities as a partner biologist with the USDA national resources conservation services in Greensboro, North Carolina. You may now begin.

Thank you, so much. I am very happy to introduce a Lena Harris, a pollinator conservation specialist with a focus on integrated pest management is at the Xerces Society for invertebrate conservation. Also partner ball just with the national resources conservation service where she is helping farmers and my managers the Northeast create habitat for pollinators and help them and protect them from pesticides exposure. For those of you who are not to move NRCS eight used to be the soil conservation service. As U.S. Department of agriculture NRCS partner biologist, we help promote and implement farm bill conservation practices that support wildlife while also protecting watershed health, clean air and clean water. Thank you so much for sharing your knowledge and experience with us today. Take it away.

Thank you, permits for the introduction, Nancy. Hopefully everyone can hear me all right. Today I will give an overview of cover crops, herbs and cut flowers for pollination and pest management. The first slide shows a field of blue bachelor buttons in bloom mixed with nitrogen axing Partridge peas in the alleys of a young establishing organic apple orchard. These species are part of an annual insect cover crop mix designed by the Xerces Society through NRCS conservation innovation grant and is taken at Scooter's farm in Hollis, New Hampshire. It's a little bit blurry but there I am in the corner on another farm probably holding some of my research Brussel sprouts that were grown nearby flowering in sector he plants.

If you have not heard of Xerces, the nonprofit has been around since 1971 and we worked to protect life through the conservation of invertebrates and their habitats. Our namesake is the Xerces lube letter for pictured here which is thought to be the first American butterfly to go extinct due to human urbanization and loss of habitat. The Xerces blue but if I lived in the coastal sand dunes around San Francisco.

Our main office is in Portland, Oregon that we have staff all across the country working on pollinator habitat restoration, conservation planning and providing technical assistance and agriculture in both natural and urban areas. This map shows the location of our technical support or supervisory with blue stars -- I think we have someone who needs to mute their phone.

The main office is important, Oregon but we have staff all across the country working on pollinator habitat respiration, conservation planning and providing technical assistance and agriculture both in natural and urban areas.

This map shows the locations of our technical support or supervisory staff with blue stars and the rest indicate Xerces staff that is also a partner biologist such as myself, coming at you from New Hampshire.

Xerces has a plethora of free resources on plants, pollinators, other insects and habitat restoration. I invite you to visit Xerces.org to access them. I wanted to start a print with acknowledgments and thank Dr. Nancy Lee Edmondson, for coordinating and organizing this webinar. Special thanks to the NRCS, the Xerces Society members and other supporters that allow us to continue on the ground conservation work and educational presentations like this one. I would also like to express my gratitude to each and everyone of you who is watching and listening and taking time out of the day to learn about invertebrate conservation. Thank you for joining us.

To give you an overview of today we will cover the diversity of native pollinators and beneficial insects. The habitat needs of those invertebrates and a big part of that is pesticide protection. Next we will delve into biological control, what it is and how it differs from conservation biological control. And then as the title of the webinar promise, we would begin to cover crops, insect array strips, couplers and woody ornamentals and then herbs that benefit ever based we will reference NRCS caution or practices that could be considered when using techniques.

When we get started on educational content, I want to reiterate all the resources noted in this webinar will be provided in the conservation webinar.net where you access this webinar into these handouts. Called additional resources. We will also provide a PDF of this presentation with detailed notes so please do not fret about taking notes. For now, sit back and try to absorb as much as you can about invertebrate conservation. Let's dig into it. Pollen is paid a lot of different animals of visit flowers usually for sugar nectars and pollinate those plants from butterflies, to moss, to flies and hummingbirds. These are the most important polymers. We have a amazing diversity of bees in the U.S. with nearly 3600 species. They range in size from big carpenter bees that get into your sheds to tiny bees about the size of a freckle. Many of them don't look like what you my picture when you think of a bean a bee. There are thousands of different species of B6 and beneficial invertebrates, I want to focus on the foundational needs of these animals. Food, shelter and protection.

For food, pollinators and many invertebrates require diverse, season-long bloom to provide nectar and pollen for multiple overlapping flowering species. Some require a host plant for their larval stage such as monarch caterpillars requiring milkweed in caterpillar stage or other most needing host trees. Next is shelter. Most species of native bees are quite different than honeybees. The vast majority, about two thirds, lived below ground with tiny holes that give any sign that they are there. The other one third lives above ground in tunnels and in hollow plant stems. We have a corny phrase which is, don't be a flower weather friend because most people recognize that pollinators need flowers for food but it is key to underscore the need for undisturbed habitat to conserve these animals through their entire lifecycle.

Shelter can be dead fallen logs or standing dead trees which refer to as snags. Other nesting habitats include Sandy undisturbed soil, bunch grasses and plants with hollow or pithy stems such as elderberry, raspberry, sumac or Joe Pike weed. In New England, we have a lot of rock walls which are great undisturbed habitat because we cannot legally disturb the rock walls. Other habitats on the farm might be rock piles on the edges of the crop fields.

Here are some actual photos of brush piles, bunch grasses and hollow and pithy stems that have been left as nesting habitat.

When we think about annually tilled vegetable fields and cover crops, unfortunately these practices disturb nesting and overwintering habitat. The ideal pollinator and beneficial habit would be a primly undisturbed habitat such as these pollinator metals. Ideally, it will consist of mostly native plants which have coevolved alongside native pollinators and can thus support one another. NRCS practices 327 conservation cover is one of the most commonly used practices for pollinator habitat with the goal of providing season-long bloom and overwintering habitat. A very similar potential and more fitting practice for planting native plants to support pollinators is wildlife habitat planting practice for 20 and has been adopted in a number of states. Depending on the scenario use, this could include herbaceous forest and grasses but may include flowering shrubs.

Trees and shrubs also provide perennial undisturbed habitat that could be implemented through practice 612 three shrub establishment. Or in some states, practice for 22 hedgerow planting. As mentioned in the previous slides, states that have adopted the shrub scenario could also use for 20 wildlife habitat planting for shrubs but practice for 20 cannot be used to plant trees. Overall, these woody perennials provide bloom very early in the season. When working with herbaceous flows, there are less early flare ups and so these flooring woody plants can really fill the gap particularly on farms as prudent to cross reference alternative hopes of crop pest. We want to avoid recommending plants that harbor tests or diseases for nearby crops. However, today, we will focus mostly with in the crop field on mostly annual practices such as cover crops, herbs and cut flowers. Many of these crops are non-native but commonly grown in the region or have been naturalized. The annual system that we are coming today could be a nice way for producers to dip their toe into the proverbial water of pollinator conservation before committing to a long-term perennial planting.

Circling back, the foundational habitat needs for invertebrates, no matter which practices are being implemented, we need to protect these flooring habitats from pesticides. There are at least three methods methods to achieve this but the first is to eliminate the use of pesticides. Though through the use of cultural techniques as possible. Many operations to reach economic thresholds of pest and will utilize pesticides. An option to minimize pesticide exposure is to use vegetative barriers such as non-flowering hedges or windbreaks.

Here is a diagram that shows a tractor applying pesticides and pesticide drift. The diagram shows a vegetative buffer between the crop field in the flowering pollinator habitat. Vegetative barriers should not be attractive to beneficial's. Evergreens are best. Recommended options for non-flooring vegetative barriers are sprays, Juniper, for him and arborvitae. Very thought full planning is used, vegetative buffers may include flowering species if the grower is confident that the pesticide application in crop rotation does not overlap with the bloom time of the flowering buffer.

Here is another diagram where there is a vegetative buffer between the crops and the flowering habitat. This buffer utilizes a non-flowering conifer followed by a grassy strip before leading to the pollinator habitat. Another way to protect flowering habitat is through a spatial buffer or a setback which is just a way of think there should be distance between where the pesticides are applied on the cash crop in the pollinator habitat. If the gross cannot implement a setback outside of the crop yield, it could purposely not apply pesticides to the arrows of the cash crop that are near the invertebrate, habitat paid this management technique could be cost shared through practice 595 pest management conservation system. Depending on the method of application, the spatial buffer should be 40 or 60 feet or 125 feet if the crops are treated with Neil neo-Neo nicotine Lloyd's are a particular class of pesticides. Neo-Nick have many application methods. Many people seem to be familiar with sprays apply to leaves and above

grantee tissue but near it can be a soil drench and treated seed as seed coating. Some commonly you used are corn, soybean and canola.

And sunflower. When applied to any of these methods, the systemic action the pesticide is taken up into the plant work and laid be expressed in the pollen and nectar of flowering plants. Forging pollinators and beneficial's then collect this contaminated pollen and nectar and bring it back to their nests and young. Neo-Nick's are the most commonly used pesticide in the world so keep your eyes out. Neo-Nick exposure levels that have been detected in the apartment can sometimes be high enough to kill bees out right and it can reduce the reproduction of negative bees. You may be thinking to yourself, but corn is wind pollinated. Is pesticide still needed for this crop protection. Here we see a bumblebee loading up on corn pollen. Many bees will visit cornflower and caulk palm. Avoid spring corn when in flour and avoid using neo-Nick corn seed and if Neonic Quincy is used include a setback in your La'el layout plan. Additionally here's a photo of a hover flight. It's Lori eat corn pollen, corn sap and Caterpillar pests of corn. This photograph highlights a key characteristic of distinguishing overflights from bees. Notice the shadow of the stubby antennae as opposed to a bees which have longer thinner antennae.

When we think about managing pesticide risk to punish company plants learn could be considered a vervet habitat from crops to cover crops and even flowering weeds. You see this beautiful cover crop as the understory of this orchard. But if the producer were to apply pesticides, it would be key for them to mow the flowering habitat prior to the pesticide application. In this way, we can encourage beneficial insects to forage outside of the crop field during this risky time within the orchard. Here is an example of a peach orchard in New Hampshire where the understory has been mowed. Even I'm planted habitat such as English should be mowed to reduce pesticide exposure. Another option is creating a no spray buffer area in the habitat. Here, NRCS practice 595 pest management conservation system could be considered.

All right. Switching gears here, I have already begun to hit toward biological control when talking about the hover flight that eats corn pass. But what exactly is biological control? It's the use of living organisms to provide pest control. There are three types of biological control in today we will briefly touch upon two of them. Augmentative biological control and conservation biological control.

Augmentative bio control is a temporary control measure using living organism but not designed to be long-term management solution. This is when producers purchase and release mass reared insects but it tends to be most effective in greenhouses or combined spaces on high-value crops which justify the expense of the augmentative releases. It is only a temporary measure because these beneficial's cleanup all of the pests on the crops but once they cleaned them all up on the crops they will likely fly away to the crop where they can find shelter, food or more preferred food.

This concept of providing habitat brings us to conservation biological control. What is it? It's attracting and conserving natural enemies of crop pest providing habitat. Here is an example of conservation biological control in my Masters research at the University of New Hampshire. It shows flowering alyssum planted in rows as in insectary plant abutting a Brussel Brussel sprouts cash crop. This way predators that rely on floor resources also have easy access to the Brussel sprouts crop to attract crop pest but this could be implemented through 328 conservation crop rotation or practice 340 cover crops.

There is an amazing diversity of natural enemies that attack crop desperate you will see that I wrote a.k.a. beneficial insects. The reason for that is that not all invertebrates that attack crop pests are technically insects. For example, the spider that is on the blue Bellflower is technically an arachnid. By

saying natural enemies, we can correctly include all of the invertebrates that are associated with pest control. There are a lot of different terms including these predators and calling them bio control agents. Starting from the top left going clockwise, there is a tiny wasp patching out of a mummified cabbage aphid. Next is a predatory wasp hunting among Brussel sprouts. Continue to the right on top is a tiny Amaya library which is orange preying on cabbage aphid which is the white gray color. On the right we have the spider. And continuing clockwise toward the yellow and black striped insect is the flying hover flight adult observing a colony of cabbage aphid's on Brussel sprouts preaching will likely lay her eggs nearby. Her eggs will hatch into predatory larvae that eat aphids and other soft bodied insects picnics is the red lady beetle adult forging on a flower. And I went back to the last we conclude with a tiny wasp on the left resting on a Brussel sprouts leaf is a lady beetle larvae approaches from the right.

Again, you can see the wide array of invertebrates that are associated with biological control of crop pest. It's unfathomable how large and diverse the word world of invertebrates is. With this diversity of natural enemies comes differences in which prey they regulate. The place to start with a producer is to 1st determine the pest species of concern and then use this fabulous resource called habitat planning for potential facial insects to determine which natural enemies you are aiming to conserve by establishing or maintaining habitat.

The, natural enemy groups consist of insect editors that directly consume insects such as this lace wing in the photo that eating and aphid. Insect parasitoids attack other insects by laying their eggs on or in the body of the host or the host eggs. Once the larva hatch, they consume the host. Then there are the non-insects such as spiders as we mentioned earlier, and a lot of overlap between many of these natural enemies and pollinators since flies, wasps and beetles also pollinate flowers as they visit them for alternative food.

Hover flies are an example of predators of crop pests. The reason I'm showing this diagram is to illustrate the relationship between natural enemies and flowers. If the it is the hover flight larvae eat crop pests however the adults, the flies, require floral resources first. I will walk you through the lifecycle of an example of how some natural enemies of crop pest feed from flowers as well as invertebrate pass. Starting with the upper top left, we see a female hover flight adult. In the lower left corner we have a flowering white alyssum plant. The adult hover flight flies to the flowering plant and provisions herself with nectar for energy and pollen for protein which give her reproductive power to mate with a male and lay fertilized eggs. We are now in the center of the diagram where you see a green Russell sprout plant. The hover fly flies to the crop were soft buddies and pests are detected. In the green circle is a hover flight adult checking out and aphid calling on the Brussel sprouts leaf like shown any previous light. Now we are on the right side of the diagram within the wheel. The hover flight adult then lays her eggs onto a leaf nearby and an egg hatches into a larva which look somewhat like a legless caterpillar. This one is yellow but different species can be other colors including green, or pinkish salmon. The next photo shows two orange hover flight feeding on aphids which are the crop pests and all of this is to say that many natural enemies need both flowers and pray to survive and stick around as biological control agents.

Again, parasitoid wasps and flies also attack crop pest by laying eggs on or in the past or in their eggs. The quick take away here is that the adults are also nectar feeding meaning that these natural enemies be from both flowers and invertebrate pass.

We know that diverse habitat supports beneficial insects. If more than 20% of a farm in diverse habitat pest control by beneficial insects is observed throughout the field.

One of the ways we can improve biodiversity is through cover crops. Many interrelated benefits of cover crops for they can support natural enemy pollinators. They can support soil life. And can increase water filtration and biodiversity and cover crops can help reduce weeds, ration, chemical fertilizers and pesticides. These are some of my favorites resources to use when planting cover crops.

This first resource that I would like to highlight is cover cropping for pollinators and beneficial insects which is a SAR republication. I like the table where it shows conservation services that a given species may contribute. Depending on LAN order they may want to include nitrous resources such as alfalfa, white clover or son hemp or vetch or using canola or sunflower. Other conservation is erosion control, 412, we management, nematode management and reducing compaction. You can see the species associated with that.

This resource also has a simple cool season cocktail mix which uses Wassily as nitrogens amateur. Crimson clover is nitrogen source. Reddish for reduction income packs and or four gone too far. Harry vetch and feel peace as nitrous resources paternity to reduce compaction and for forage if left to flower. Fava bean as a nitrogen source. And right and outs for erosion and nurse crops.

Similarly there is a one season cocktail warm season cocktail and tropical cocktail crop mixed which you can reference in the additional resources in today's handout.

It is fun and has multiple benefits to do a cocktail of cover crop species but as a single species, buckwheat is a classic. Once the weather has warmed up, it usually needs irrigation and can be exits mother crop for weed control or site preparation method for perennial plantings if we pressure is relatively low. Buck week winter kills and doesn't have much biomass and can be used as a very quick cover crop for part of the season to cover the ground and feed some of our favorite farm invertebrates. The first photo is a pretty impressive basic mimic but it is actually hover flight. Some hover flies have predatory larvae that eat small somebodies incidents such as, skill, spider mites and drips. The second step of this pyramid boasts a native pink spotted lady beetle that is predatory in larva estate as well as in the adult stage and preferreds aphids, and mealy bugs but will feed on alternative prey such as whiteflies, mites, and insect eggs. Next is this orange relatively large soldier beetle. The soldier beetle requires pollen and nectar to survive but also eat test eggs, caterpillars, various insect larvae, aphids, snails and slugs.

The bottom tier of the array is native politics and honeybees enjoy forging from buckwheat as well. Note that while monarch caterpillars required milk wheat for food that we can support monarch adults by providing them with nectar plants that bloom later in the year when they are present in your region. The monarch really need our help in every square foot of pesticide protected nectar plant apps but if there's a bare patch of ground for part of the season, consider throwing down buckwheat. As pictured, in my field research at the University of New Hampshire, Cecelia was wavered by bumblebees. Cecelia has special value to flies, wasps and beetles. Faye Celia is native in California while flower and can be use as a mother crop in parts of the nine states but from my experience in conversations with a few other growers in multiple years in the Northeast, germination rates were quite low and Cecelia establishments had very limited success. It seems to thrive at West and it's native but seems to be fickle in the Northeast. I wanted to mention that since it is included in the previous mix of this as a nitrogen scavenger. The one pictured here were transplanted, irrigated and handed we did.

Common legume cover clubs is Crimson clover, red clover, and white clover. Additionally, Partridge P and vetch are great options.

One of my favorite resources to navigate cover crops in the Northeast is this cover crop planting specification guide put together by Brandon Smith here in New Hampshire and people all across the United States have loved it as well. Most dates will have their own guidance through the field office technical guide and its regional expertise needed then reach out to your local Cooperative extension.

This table allows you to determine which cover crop you would like to use based on its intended purpose. You can choose cover crops based on their ability to reduce erosion and improve biodiversity or suppress weeds, for example.

The check marks show that a given choice is a good choice on average whereas a check plus indicates it's above average option. And a check minus indicate it's a below average or unknown. Blanks indicate that it is not recommended. For example, you can quickly note that Crimson clover is excellent for improving biodiversity where's it is not recommended to to be used to suppress weeds.

This table is also very helpful which shows you the seeding rate and pounds per acre seeding depth and the suitable planting season. I find that planting seeds season can be key and use Harry vetch as an example. You might encounter a grow that says they tried Harry vetch but could not get successful establishment. In using the table, you have felt information to help you troubleshoot and you can see the window of opportunity for an above average cover crop of Harry vetch is very slim and it's going to be important for the growth to seek during early fall. Reps they seated outside of that window and that is why they had establishment issues. The termination method will be largely determined by the equipment and tools available to the grower so you will certainly want to discuss that with them.

Over the past couple of years, the NRCS and Xerces society has been working closely with scooters farm of Woodmont and its owner operator Mike Madden. He's doing thoughtful integrated pest management work since his orchard is young, during those establishment years, he knew he could limit his organic pesticide rates. We have come up with a cover cropping schedule where he could mow or incorporate the cover crop before any applications of pesticides to the orchard. As displayed on this photo, he currently has seated crimson clover highlighted in purple in the upper left. Two types of red clover highlighted in yellow and orange. And vetch which is shown in blue. By planting these nitrogen and cover crops between the apple trees, he is providing forage for beneficiaries and decreasing his need for other supplemental nitrogen fertilizer inputs. In the center, that black and white speckled rectangle is a tarp where he's doing site preparation to direct seed and other parental herbaceous minnow. Previous years he was when people use the simple annual insectary mix. There's a beautiful photo that he took in the grapes highlighted in green I will show in this slide.

My former colleague at Xerces, Eric, developed three one-page guides for growers for insectary seed mixes. The word insectary implies that it is a plant that attracts a host beneficial insect. Each one-page guide describes the purpose of the mix, basic instructions on establishment, and mix components. These are written as job seats for the new Hampshire NRCS. First is the annual complex mix which includes cilantro, dill, chamomile, bachelors button, wild type sunflower, and planes coreopsis. This is a spring planted annual mix.

Next is a very popular simple annual mix. Which is a shorter stature and somewhat early blooming mix. It should be planted in the spring and both of these annual mixes require simple bed prep as you would

for spring planted veggies. This one can be planted in tunnels or in the field. If tunnel planting, use a thermometer and get the seed in the ground when the sweat attempts reach about 60 degrees Fahrenheit weird in some tunnels, this may happen in March. As long as the soil is warm enough, the sooner you get them in the ground, the sooner you will have blooms which gives those beneficial as a boost early in the season which can really make a big difference. This cover crop insectary mix can be sewn in strips into annual row crop systems and it won't flop over into rows or shade in neighboring rows. The last one describes the perennial simple mix. Though today's focus is not a perennials, as a much permanent undisturbed habitat are desirable to host these natural enemies and pollinators.

Here is a photo of the simple annual insectary mix that was sown in between the rows of the scooter farms establishing grape vineyard. This light also straddles the blurry boundary between a cover crop, insectary strip and also including these two cut flowers. Here marks the beginning of the cut flower section starting with bachelors button. Bachelors button has a valuable parasitoid, cover flick a monthly swing and beetles. Bachelors button will readily self so under optimal conditions.

Next is coreopsis. On the left is a need to be foraging in the sunshine leaf coreopsis. On the right is a planes coreopsis. This new photo on the left shows a light-colored spider that is hunting on the underside of the length leaf coreopsis flower. Coreopsis also provide special value to cover flies, solitary wasps, beetles and assassin bugs.

Annual blanket flower is gorgeous and has special bell to soldier beetles, assassin bugs and lady beetles. Pictured in the center is a forging wild bees. Annual blanket flower is drought tolerant and adapted to disturbance.

Cosmos are another right and beautiful cut flower which can be seen here in dark and light as well as the white. The white sensation variety is especially recognized for its attractiveness to natural enemies such as lace wings, cover flies, wasps and the minute pirate bug.

Finney you are a bright and happy Zinnia are attracting butterflies these are from the University of quite where I manage educational gardens. When giving tours of the garden, visitors were always thrilled to see the butterfly garden. Zinnia is a great for your picture on garden around the farmstead and could be an add-on to a CSA program. Finney is Zinnia's attract cover flies and trickle grandma Wass. Another night because nice cut flower is on it which is false quaint hands lace or what deal. It has a combined lower called umbel which boasts many small shell flows to allow beneficial invertebrates with shorter mouthparts to excess nectar. You will note that many of flows discussed today have a very open shape. Notice the similar flower shapes of the cilantro, fennel and deal as they come up in this presentation. And also note that many are white or yellow which insects find highly attractive. In field trials at UMass and in New York, this Omni attracted different wasps which are parasitoids and many of which attack vegetable pass. Pierce a trade Wass are particularly difficult to photograph. Here's a pink native spotted lady beetle on the left and two lady beetles loving it up on the right. In this circle here, it's not a Wass but to give you 90, it would probably be smaller than the insect encircled it read here.

One of the most studied and utilized insectary plants is sweet alyssum which I showed earlier and showing conservation biological control in the Brussel sprouts appeared small white flowers that continually bloom the entire season and has a low growing habit. You can see that the University of New Hampshire college campus as a landscape plan on the left and on the right my friend group in pots and placed it on the ground under these posts for his wedding where they appeared to be planted in the ground because of their low growing draping habit. Growers that want to plant lugs of insectary strips

on their own operation might opt to also sell these plugs to home gardeners in the spring or grow them up to size in draping pain or mental basket for sale in mid-summer. They are also fragrant.

Alyssum has been studied and used in large commercial scale and enter planted with lettuce in California was successful control of aphids that previously needed pesticide protection. This one we see is purple in a more urban environment. I just wanted to show that again kind of like how it is shown at the UNH campus.

One of the main natural enemies in California where alyssum was so successful were hover flies which are pictured on the left. In the larger field photo, we see it again as a refuge planting which is more of a block on the edge of the field abutting a Brussel sprouts field at the University of New Hampshire. When there are larger plantings like this, it has an amazing fragrance but it's almost like a honey aroma when working in the fields and the wind blows the right way. One of the reasons that alyssum is lovable is because that with one planting in the spring, it has this indeterminate growing habit that will continue to bloom all summer long. In contrast, other beneficial herbs may require multiple succession plantings to achieve a continuous bloom period throughout the growing season. Such as cilantro or deal.

It's important to note that some insectary plants may support crop pests and important to cross reference and be aware of alternative hosts when selecting the right insectary plants for the farming system. Here we see cruciferous Christopher Lee Biddle feeding on the alyssum plant and they are also a pest of Brussels press, cabbage and broccoli and leafy greens. Error on the side of caution with producers that will lot of Brassica's and have flea beetle issues. Consider other insectary plants for that system pitifully beetles on this field were not economically tempting to the Brussel sprouts crops but that cannot be assumed for all sites or more susceptible crops.

Perhaps one of the reasons that flea beetle infestation did not reach economic thresholds is because alyssum also supports natural enemies of flea beetles. The alligator looking insect in the lower left corner is a predatory lady beetle larva in the insects with two wings are to connect flights which are parasitoids. Each farm is a complex open system and will be different even from year-to-year.

Pot marigold is another vivacious annual that is attractive to a variety of invertebrates. On the left two photos we see wild bees pollinating. In the upper right is a showy larger hover flight and as we talked about, some species of hover flies have predatory larva that eat crop pests. Next is the same orange and black to soldier beetle that we saw on the buckwheat cover crop. The soldier beetles require pollen and nectar to survive but also eat past eggs, caterpillars, there is insect larvae, aphids, snails and slugs. I enjoy growing this at home work continually flowers all summer long and are gorgeous in weekly bouquets and for making skin the Sabbath. The other great feature about calendula is it blooms all summer long. Each individual flour will expire but another fresh flow will open. For many species of flowers, it is key to harvest or deadhead them to continue to flower but even with that regular harvest, the calendula will bloom all summer. As the season progresses, each individual flour make it smaller but they keep coming.

Imported cabbage worm adults have been observed feeding on calendula letters. These adults meet and late eggs and then those eggs become caterpillars. These caterpillars are common pest of Brassica such as broccoli, Brussels sprouts and cabbage. This is important for growers who have issues with this pass. This pass is commonly controlled using BT, a bio pesticide made from bacteria.

Sunflower support alternative prate and provide nectar and pollen for predators and parasitoids. Here the circles highlight how many happy bumblebees are entering the trial garden at Johnny selected seeds in Maine. It's also another great plan for people love to take photos with. Consider practice 328 conservation crop rotation or practice 340 which is cover crop.

This is a poor quality photo is taken at the UNH greenhouse where they grew some flowers specifically to provide alternative food to these beneficial insects. These dice I fess that were purchased and placed for pest control on cash crops. Once these printers cleaned up of the pest from the cash crops, if they didn't have some flowers to Pete from, they would die due to poor nutrition and have to be bought in again as an additional expense. So, the grow provided insect habitat with alternative food within the greenhouse. With all the sunflower benefits, again, proceed with information and caution. Because remember, Neonic treated seats can be highly talk this to the zik and natural enemies. Search for seats that are not treated.

Beyond herbaceous and cut flowers there are some woody ornamentals and if managed properly can support pollinator and beneficial insects with floral resources and also have the option of being cut for profit. Dr. Kathy Neil from UNH Cooperative extension put out a nice fact sheet on her research on growing woody cut branch crops. I will highlight the ones that could be beneficial for both invertebrates and for the producers bottom line. On the left we have pushy Willow. The top photo with the cat shows its marketable form in a vase. Those great cat cans are the flowers. Firstly, from a protective upon these and beneficial scum it seems the flowers are harvested and sent to market before the pollinator can collect the yellow pollen. However, with thoughtful management, a portion of the budget could be cut while some are left to flower in the field. Pruning and cutting back these plants can promote vigorous growth and more stems for more flowers. Willows are also very easily propagated.

And edible woody ups and would be elderberries which are not shown which have hollow stems for nesting habitat. On the right is winter Holly, Winterberry Holly. The plant blooms and invertebrates can thoroughly feed from those floral resources prior to harvest because the crop is the bears on the branches which form the pollinated from the pollinated flowers. In the fall, the leaves fall to the ground and expose these attractive berries that are sold as ornamentals. From the standpoint of other wildlife, they miss out on eating the berries but the goal for pollinators is that they already got their fill for that year and the ground is left undisturbed for nesting sites.

Here marks the switch to edible annual herbs or seeds. As mentioned before, cranial plants are excellent and this also goes for perennial plants excellent and that goes for perennial herbs. I'm simply focusing on more annual herb options today. This first is Dale. It's planted as an insect or row or row as her so harvestable. Deal attracts flies and wasps and lady beetles. It also serves as a host plant for the swallowtail caterpillar. These caterpillars could potentially be viewed as pass but in my experience, they don't seem to cause economic damage and have always just let them live their lives out jumping on the deal and then they go through metamorphosis and turn into this gorgeous swallowtail butterfly.

Next is fennel. Which also serves as a host plant to the black swallowtail caterpillar and some people plant them specifically for this reason. Here we see a beautiful photo of a beneficial assassin bug on fennel flowers. Fennel also has special value to hover flies in many species of parasitoids. I put this part of the lease here to mention that in my field research, I transplanted them in New Hampshire but I was somewhat surprised and disappointed when it did not bloom before it was killed by the frost. So, take care with fennel when selecting transplant dates for your region if the goal is for flowers. There are many different kinds and it is sort of a rabbit hole. I will see that even when these insect replant herbs

have yet to flower, they still appear to attract beneficial insects such as lady beetle adults and larvae that predate on crop pests. Even if it doesn't plow, it can still serve as a host plant to the black swallowtail to fly.

Here we have a similar example with cilantro where the lady beetle is using this habitat plant despite the lack of flowers. Here we see cilantro in flower and the diverse array of beneficial insects that it attracts from predatory wasps to B's and hover flies. It can also attract soldier beetles come parasitoid, lay slings and pink spotted ladybird beetles and parasitoids.

Borage has edible blue flowers that commonly hang downward. Large photo on the left shows the honeybee in the upper right is a bumblebee in the lower right is a hover flight. Forage also provides habitat for ground beetles, predatory and a bid bugs, lay swings and spiders.

This photo shows a married bug on the leaves of holy basil. You may see on might or might eggs, if it eggs, small larvae or soft easily subdued adults. To the right is a leaf cutter be provisioning from holy basil flowers. And also can be called Tulsi.

Thai basil provides forage for beneficial invertebrates and to punish such as these bumblebees provisioning them from Thai basil flowers. Notice bright color of the pollen packed on the right.

Another kind of basil such as Genovese basil also support pollinators and beneficial insects as the two spotted Longhorn music pictured sipping from the floor. Other nice options that are not shown in photos include caraway, cumin, and sesame. Sesame not only has attractive flowers but additionally has extra floor nectar is that supply invertebrates with nectar that are located outside of the flow on the stock of the plant. We will discuss more about extra floral victories on this next slide.

Other edibles to consider are flowering legume such as this vibrant lab lab or purser purple Hyacinth beans in white. Other warm season options include soybeans, LPs, fava beans, and field peas. Four season, try Austrian winter P. Here on the left we see photo of a native be foraging from the very specific shape of the legume flower. Due to their floor architecture, legumes may be challenging for species of pollinators to forage from a really cool aspects of legumes is that many times they will have extra floral victories. To the right of the B we see a predatory wasps drinking drinking nectar from the green gland which is not a flower good that's extra flour nectar. For more information, visit extra floor nectar.org.

Another couple method is letting the cash crops go to bloom. Here on the left is a flowering topsoil which is a leafy green vegetable pit to the right is a photo of Johnny's selected seeds in Maine where there growing at the Frasca seed crops in flower and seed crops can be very beneficial to these invertebrates that we have been talking about today. Up close on the right is a hover flight foraging from a flowering Brassica.

Grasses can also provide important habitat for beetles and spiders that prate on crop pests. Here between vegetable rose, the producer has seeded down grasses and clover which provide multiple other conservation benefits. If the producer wanted to maintain this perennial cover practice 327 conservation cover could be considered. If the producer plans to till the cover under, practice 340 cover crop could be considered.

This table outlines some other NRCS practices that support invertebrates through provision of floral resources, pollen and nectar, or providing undisturbed habitat. The check marks indicate the practices that we touched upon today are quite a few. But there are a plethora of other practices than can be explored. This table will be provided in the additional resources that are posted with this presentation and will also provide some extra information on conservation stewardship programs, CSP enhancements, based upon these EQIP practice but were too cumbersome to provide on the slide.

This is a beautiful one page double-sided brochure called farming for pest management found@Xerces.org that shows the array of habitats and can be used to promote beneficial insects and pollinators. I then overlaid some NRCS practice codes nearby the topics we touched upon today.

This is another wonderful one page double-sided brochure which is similar to the first called farming for Palma Nader's. Pollen is. Buffers 391 and 66, since we didn't get a chance to discuss them today, they could be other NRCS practices to consider for pollinator conservation. I encourage you to check out these pamphlets to think about the array of habitat that can be planted or managed to support invertebrates in the form skate.

As ever you, and a main take away, the member that the three foundational habitat needs for pollinators and many natural enemies. Food, shelter, and protection from pesticides. And annually till systems, many times nesting and overwintering sites are destroyed but we can recommend leading plant residue over the winter and can focus on excellent floral resources and thoughtfully planned integrated pest management and pesticide protection. Once a producer has experienced the joy of insect replant they may be more likely to plant and protect a permit undisturbed habitat such as parameter pollinator metals are flowering hedgerows.

With that, that concludes this presentation. I would like to thank you for your interest in invertebrate conservation and hope that you can spread the word. My email is at the bottom where you can reach me and I can take some questions as time allows. Thank you, very much.

Okay. Take you so much. That was great. And we have a bunch of really good questions. Just for Evan, I just wanted to reiterate to compile a set of additional resources that are up in today's handouts. And so some of the things she referred to, there are live links if you download that. And it is now 3:00 PM but we scheduled the program today for an hour and a half so we have plenty of time to go through these questions. As Jen mentioned at the beginning, this will be available to view or listen to later and there is also a set of additional of all the slides in the handouts. Those will also be posted on the replay site. So, I will go ahead and ask some questions. Is there a place to see which NRCS programs are verbal by separate such does Texas offer 612 and 422? Do you want to answer that?

Feel free to answer if you want. So, there is the field office technical guides. Each estate is slightly different but if you were to search field office technical guide then there is a drop-down menu that you can select your given state. And then from that, I believe you would go to section 4 and then conservation practices. And from that it will show you the model.

I just wanted to point out that in her handout, her first link is actually to the New Hampshire job sheet and it shows the photon address. You can grab that until.gov then that will take you right there. Another feature in the field office technical guide is there is now a search tab. So you can just use a search feature. We really would recommend that you talk with your field office staff so that you can locate your local USDA service Center. If you have any trouble finding them, then we can help you find the pit you

are welcome to contact me and my address is listed on the website. Or a Lena if you have any issues with that.

Gary fish asked, arborvitae are likely to be destroyed by deer in the Northeast.

Yes. This is true. So, even pollinator habitats, special even during establishment, can also be destroyed even if you are using tarps, the deer can destroy the tarps, etc. Yes, being aware of that. If that is an issue you might want to consider additional sensing. I know it gets to be a nightmare to have sensing on top of sensing. But if deer are there then they will attack your crops as well so you could extend your crop fences to around that.

And also, I would add that the deer don't like some of the more meta-training herbs that are perennial herbs. Like Rosemary and sage and things like that. So those might be something you could use as a perimeter planting if the deer are a big issue. Brett asked, are there Neonic treated corn varieties readily available without being organic? I did a quick Google search is to only found some in Canada in development.

Okay. Was the question that they want organic or non-organic?

The question is, are there any non-Neonic seats available that are not organic?

Yes. There are very few. It is a big challenge. But if you are thinking about planting pollinator habitat and if you are instead planting something that is talks is toxic to them, it's not a great method. I would certainly search and certainly reach out to seed companies and let them know that concern is there and that the market is there for them to sell those to us. And also, saving seat is something you can do on your own farm. It's an annual and if you can get to those seeds before the birds do or the other animals do, that could be one of the ways as long as it is not an hybrid, you should be able to save those. And that could be a way of reducing your cost. Also they could be sold, the seed heads, as little natural bird feeders.

Okay. Craig mentioned that bachelors button was mentioned as a desirable flower pots it is a type of nap we'd that should not be encouraged. And I know it's not toxicity as nap we'd is to touch.

It was Eric that designed that insectary annual mix but I could double check. I believe that those bachelors buttons are naturalized at least in our area. And so a lot of times, if possible, we use native flowers for sure. But a lot of times in these more annual systems, we don't have very many native flowers and sometimes cost is an issue. And so we just found this was a cost-effective method that worked here. But if you are concerned about it, like I said in the presentation, they can readily reseed themselves. In ideal situations. And if that is not ideal for you, I would not plant them.

And then Gary fish asks, lady beetles or ladybugs are not allowed to be released in the state of Maine. And I'm glad you brought this up. Because you probably want to adjust this but I will finish this question. You should contact your state fisheries and wildlife apartment or state regulatory official before releasing any natural enemies.

Yes. That is a very great point. And Nancy, go for it.

It's just that Xerces generally doesn't support releasing except in maybe like within a greenhouse. And so, please go ahead.

Some of these weird insects, there is a chance that their genetics could be different than these native invertebrate as well as they could be harboring diseases that they could pass on to some of our native beneficial invertebrates. And so, if possible, yes we would really recommend planting habitat that encourages these native ones to come in and some may already be established and not needed. But all the photos that I showed you in this presentation beside the one that was talking about augmentative biological control, all of those lady beetle photos that we saw were not released. Those were just ones that were already present in the environment and by planting that beneficial habitat, they were attracted to the field. And so, I appreciate you mentioning that. It hits home further that we want to do conservation biological control and not just stopping at biological control.

Rex comments, it can attract a kind of stink bug which is important for Brassica. This came early in the program and you talked about Brassica later with Ellison.

Correct. And so that is true. And there is all of these different relationships to all of so many different pests and crops and insectary plants. That is where it is important to talk with your rower and really understand the system. And know what they are dealing with. And so if they historically have issues with those pasts, you could select another insectary plant that is not in that family. There is just a lot of benefit to that one because you only have to plant it once. But there is definitely some other options. Each system will be different. Some people are very open to multiple succession planting of cilantro or deal in some know they will not have the farm labor and ability to do multiple plantings throughout the year. It will be just dependent on the farm system.

Okay. Jim Spencer asks, which plant best attracts over flies? Are they dependent on it was some? Why did you choose that plant for your research?

So, alyssum is probably the most well-known one and that is why I researched it. I was just pulling from previous literature in previous studies that had shown some promise. And yes, all of the ones I selected for my research, I studied alyssum, buckwheat, cilantro, facility, fennel and ami. And calendula. And all of those were mentioned in the literature all around the world for bringing in over flies. But there is 2000 different types of over flies in the world and different cover flies live in different areas of the world. The most common overfly is one that we know really loves alyssum. And supported by that. I would say the top ones for hover flies in general would be alyssum, buckwheat, cilantro. So, we need to learn a lot more about hover flies. For instance, a lot of literature is out of New Zealand but we don't have the same over flies as them. They have great success but we don't have great success in the Northeast. So we just got to keep pushing for more research in these areas because I surely want to know.

And then Jeff Hughes asked if the cover crop seating mixed by weight or see It the question relates to the number of plants you are aiming for based on seed size.

I think it was by square foot is usually how we do it. If you look on the additional resources, I believe it does say it on the printout. If you're still wondering, you can contact me.

Edward Henry asked what is the seasonal overlap needed for pollinator food versus the timing of cover crops and their flowering quips?.

I'm not sure I understood that question.

Is it best to have something in flower all the time on the farm? I think that's what they mean.

Yeah. Ideally you would provide something in flower at all times. And depending on what you are trying to promote, it might be a different type or a different architecture of a flower. But that's why I mentioned trees and shrubs are some of the best for early-season. And then we can use some of our more herbaceous plants. And basically so you could use a mix of all of the above. You could have an early flowering tree and say you had a willow tree and that was providing porridge in the spring. And then come in the summer or early summer you have alyssum going and then later in the season you have your sunflowers. Ideally you would have at least three flowering species at all times just to give some diversity there. Different plants have different quality of pollen. For instance, it is blueberries don't have very high quality pollen for instance. So even though natives highly utilize them, it would be really nice to have something else flowering at that time. So the more the merrier. The practice standards through NRCS a lot of times a reference three flowering in the beginning of the season. Three flowering in the midseason and three flowering toward the end of the season.

Mary Brown ask, is there a seed mixture for the southern region?

That publication I talked about, there is a warm season cover crop cocktail and I don't know if it would be 50. You would probably know your area more but there is that tropical makes as well. And then also you can reach out to your local Cooperative extension and again through that field office technical guide, hopefully in your state, there are some options under their specifically developed for your state.

I will put a plug in for Debbie Ruth growing small farms website. She has an excellent list of cover crops in various seasons. A lot of times the extension tends to focus on winter covers. And then the links that Alina provided, she gave the cover crops for pollinators but also gave links to the USDA plants site that has excellent cover crop resources and the fair website itself besides that and manual has a ton of information on cover crops as well.

That USDA link, you can go through and it's on that website where you can download a fact sheet for each individual cover crop which is really cool.

Lynn asked what spaces of Cecilia and I will enter this. The species is Cecilia tendency to folia but in the east we have a bunch of facility that is native but none is available as cover crops. So one of the seed companies is asking if there's anything I wish they would work on and one of the things I said was that I wish they would look at some of these sort of little bit weedy. They are very inconspicuous but that might make them very good for a lot of our predatory and parasitoid insects. And then here in North Carolina, we have a few species of for Celia that are actually rare. Common locally but they are only found in very limited locations.

Sandra just wanted to say thank you so much for speaking on behalf of of the monarch butterflies.

Yea.

Sherry Frick said do you have links to have that planning for beneficial insects cover cropping pollinators and victory seed mixes. And all of those are on the handouts that Alina put together.

Correct. Yes.

Robert wood asked if any good research of use of granulated activated carbon and biochar to reduce Pyro foes. I'm not sure.

That is something we could pose to -- we have a pesticide team within the Xerces society that focuses on pesticide protection. So if you wanted to follow up with me and send me an email, I could ask some of our experts in that specific topic. But I will mention that I believe it is NRCS practice 808 that does utilize some of that biochar in it. If that is something that you are interested in, I hope you check that out.

That can be used in CFP as well.

And then Gary fish S again come other concerns about invasiveness of some of these plant?

Yes. The ones that I was potentially concerned about, I did put an asterisk on there. Again, it's always good to cross reference with your local experts in your region. You could always run this list by them and ask them that question. We tried to avoid including those without letting you know. Most systems that are annually are pretty easy to kill a lot of these. Even Buck week for example is notorious for becoming weedy in areas but I think it is one of the easiest things to weed out of a garden.

And in vases Neff's invasiveness will vary depending on where you are. If anybody has trouble finding a list of invasive species in their state, please don't hesitate to contact me. I will be happy to help you find that.

Paul asked, which would be best for hosting predators of sunflower pasts such as sunflower beetles?

I would point you toward that habitat planning for beneficial insects. And it goes over the different groups of those beneficial insects and any that mentions beetle may potentially help but starting with those, that would be a good place to start with that and then hone in your search from there.

A lot of grasses tend to host spiders which would probably be pretty good predators of those, I'm just guessing.

Paul asked, are there any natural predators for grasshopper nibs.

That when I am not sure about.

Birds are good.

I'm not positive about that but again I would check out that publication habitat planning for beneficial insects. It has a blue cover and it has some really nice photos but unfortunately with this presentation, the photos have to be put through Adobe connect so they lose some of their quality. But that had some really nice photos that you could enjoy. And will likely point you in the right direction.

Okay. Gary has one more question. Do you recommend planting straight species as opposed to improved cultivars.

Anywhere that is possible, I would stay with the straight species. Particularly if it is a native plant and you are trying to encourage these native or wild beneficial's. The straight native species is usually best and usually has -- it has already been adapted to your region if it is needed there. Times when I might consider improved cultivars would be if you were growing plants that you knew were prone to disease and you were going to have to spray those because of that disease that you might plant a disease-resistant plant. But yes, in general, go more with the straight species but a lot of times, it will be determined by the cost of some of these species as well.

Okay. Kim ask, do any of these plants also attract pests. Glendale, for example and then draw away pests from crop plants but she said she had good luck with ground cherries drawing tortoise beetles away from my tomatoes.

That's good to hear. Some of these good act as trap crops for sure. We also want to be really careful when using trap crops that we are not terminating the trap crop wall they are still in flower. Even if those pests were brought out to those tomatillos and then you destroyed the tomatillos with the pass. You want to make sure that you are not also destroying pollinators. So it might be way out of the question to pick off all the flowers of the tomatillos. I know a lot of times people recommend spraying trap crops with pesticides which if you're trap crop is flurry then you have to be really careful about that. I worry about that with the classic Luke Hubbard example. I just would say that if you're killing trap crops, try to pick off the flowers first so you reduce that damage to pollinators.

Martha is asking the question that this program was really annual oriented but she ask him what are the best methods to prevent succession in a cranial pollinator meadow?

That would be regular high mowing or I guess it depends on your definition of rigor. In the establishment years of a perennial meadow, you would be mowing any time it reaches maybe 10-12 inches. In those first three years or so to reduce weedy competition. Once those are established and weeds are more or less kept under control, what we recommend is a rotational blade mow. If you have say you have an acre of pollinator meadow, you could mow one third of that field in the fall after a few hard frosts. High mow it. And then the next year you could mow the next one third and the next year you could mow the next one third so that you are disturbing a little bit by doing that high mow but at least you are leaving two thirds of that pollinator habitat undisturbed. And that way those weedy encroachments can be kept at bay. With the more you would be cutting early successional Woody's.

In many parts of the country prescribed burning is a really great way but you would still want to divide up your field if possible to only disturb one third or less at any given time. In the southeast, where we haven't really high rainfall, depending on your equipment, you might need to disturb the all of it at some point during one year. So that is a little bit different from the Northeast. So then we just really encourage you to avoid the bird nesting season.

Ashley ask, if harvesting for cut flowers in medicine and food, how do you make sure to harvest not too much or too early so you are leaving enough behind for pollinators and officials. Then she said you had an example with woody shrubs and said it could be managed in a way that left some flowers behind and wondering how to play that same mentality to annuals.

So I think with annuals, the interesting part is that if the goal is for conservation and especially if they are getting a cost share for conservation, we don't want to pay them to harvest that and just so it and

take away all the floral resources that they are being paid for. But in the same token, as I mentioned, a lot of these annual flowers actually respond to cutting so if you two just let it go to flower, some of them might just go to seed and then stop flowering. But if you were to harvests them then they would continue to flower. Basically every organism goal in life is to reproduce and if you steal its first set of children, it will make more. I think it is just that you have to play with each individual plant and see how it response. Like I mentioned, calendula and alyssum you don't need to cut them. Same with Amy I didn't cut it at all and it continued to flower. But it also could simulate it to flow more. I think I would just say in an annual system, maybe lead about 50% flowering and harvest about 50% and then also what you can do is even just harvest the flowers that have gone by for the ones that begin to set seed good if you're not making use of that seed, you can cut those seeds off which again is just promoting that plant to flower more in response to stealing its children.

It is nearly 3:30 PM. So we want to be able to answer everybody's question today but we could do a couple more. How do you recommend small community gardeners leverage planting for pollinators having single planting their is helpful or does it need to be mass plantings to be helpful?

Single plantings are helpful. A lot of pollinators will respond to clumps of plants. Of all the same color. But that clump could still just be one square foot. So the more square feet, the better. But one is always better than none. So I would incorporate them wherever you can and in a community garden situation, depending, like a mansion, some of those could be potted plants. So if you you were concerned about taking up areas, you could bring in those potted plants when it comes to plant your tomatoes, you could move those potted plants aside and have room for your cash crops. I have seen people being creative and taking even milk crates and putting landscape fabric in that and putting in sums soil substrate in that and you could move those milk crates in and out of your high tunnel and in and out of a community garden and then you can even stack them depending on the height, etc. There is different ways to do it. And I think for your community garden to put up a pollinator habitat sign and get people engage and they will be more interested. And maybe you can make the space bigger.

Okay. Thank you so much. I think we are going to end here. The recording will stop now at 3:30 PM. So if there are any additional questions that we think would be helpful for us to answer, then we will add them to the additional resources and repost that. I am pretty sure you answered most of the questions. So, thank you so much. That was really excellent and there is many additional comments about what a nice program it was.

Thank you. Thank you to everyone who listened.

Okay. On behalf of the USDA, and the natural resources conservation service, I wanted to say thank you to Alene and Nancy for taking time out of their busy schedule to provide an excellent presentation about cover crops, herbs and cut flowers for pollination and pest management. Thank you again for everyone to attended today's seminar.