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# TECHNICAL NOTES

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U.S. DEPARTMENT OF AGRICULTURE    STATE OF COLORADO    NATURAL RESOURCES CONSERVATION SERVICE

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**BIOLOGY TECHNICAL NOTE NO. 01**

November 2016

## **Habitat Development for Beneficial Insects** for conservation biological control of agricultural insect pests

Provided is guidance on the conservation biological control of agricultural insect pests, by creating habitat to support beneficial predators and parasitoids that attack those insect pests.

Conservation biological control is a science-based pest management strategy that seeks to integrate beneficial insects back into cropping systems for natural pest control, ultimately reducing and in some cases eliminating the need for pesticides.

In addition to enhanced crop pest control, this conservation practice can provide additional farm benefits, including:

*Improved water quality and soil health § Replacement of under-used areas for those that work to support the farm § Farm beautification by establishment of wildflowers and other blooming plants § Support conservation standards for various farm certification programs*



### **Ecology of Native Beneficial Insects and the Pests they Control**

The foundation of using conservation biological control for agricultural insect pests is understanding the interrelationships between organisms and their environment. [Appendix 1](#) provides a table to help determine what native beneficial insects should be targeted for habitat development based on the ecology of the species, its habitat requirements and the pest it controls.

#### ***What pest species is of concern?***

Photo identification and information on “pests to be controlled” can be found using USDA-APHIS’ Identification Technology Program (ITP), ID Tools: <http://www.idtools.org/>

#### ***What beneficial insects would you like to target?***

Often there are several beneficial insects to control the pest species of concern, your strategy may be to target all of them or just to focus on one species or group of species (i.e. predatory bugs).

### **Designing the Insectary or Trap Crop**

The insectary is a habitat area established primarily of perennial plants that provides long-term habitat. The trap crop is a yearly habitat area established by creating a cover of primarily annual plants. Both serve useful purposes and it’s recommended to plan for both types on the farm. The insectary will provide a longer term sanctuary to keep the insects on the farm, while the trap crop will focus their presence on a specific field where they are needed to control the pest insects.

Habitat areas are planned on field borders or other odd or unused areas adjacent or near-to the cash crop fields. Take an inventory of the farm to locate these potentially suitable areas. They can be as small as quarter acre but the generally recommended minimum size is 0.5 acre.

If any insecticides are used on the farm or known to be used on adjoining farms, ensure that the habitat areas are protected from potential drift or runoff, and consider posting signs around the habitat areas to prevent accidental spaying on the habitat areas. A useful resources can be found online provided by the NRCS and Xerces Society: [Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators Using Integrated Pest Management and Other Conservation Practices](#).

### Plants Suitable for Beneficial Insect Habitat

Review [Appendix 1](#) for the plant families and requirements that create habitat for the desired beneficial insects. The plants listed are referred to by their family grouping (i.e., mint family). Use [Appendix 2](#) to obtain a listing of plant species (sorted by their family grouping) that are suited to Colorado.

- Select a mixture of species that consist of at least three plant species for each blooming period (spring, summer, fall); to ensure that habitat will sustain the beneficial insects.
- Plantings should consist of a diversity of plants with at least six species in the mix.
- Provide consideration for incorporating as many native species as possible.

Appendix 2 is a starting point for determining which plants to use. To find species adapted to the habitat area consult the Soil Survey and other resources such as climate data (planting zones). Use the USDA PLANTS database (<http://plants.usda.gov/>) to further refine the selection.

### Selecting Suitable Plants based on Blooming Periods

As a general rule, insectary bloom periods are defined for Colorado in Table 1. The intent of providing boom periods is to help select plants that will blooming throughout the growing season. This is particularly helpful for selecting insectary plants. However, for trap crops you may only want to select the bloom periods that precedes and coincides with the cash crop.

Table 1: Insectary Bloom Periods

Early Season Bloom Period:	April 15 <sup>th</sup> - June 15 <sup>th</sup>
Mid-Season Bloom Period:	June 15 <sup>th</sup> - July
Late Season Bloom Period:	August - September

### Establish Beneficial Insect Habitat

NRCS provides several conservation practices that may be used to establish habitat for beneficial insects. For the selected practice, the purpose and associated criteria will be for Pollinators/Beneficial Insects. Table 2 lists the most appropriate and commonly used practices.

Table 2: Conservation practices commonly used to establish beneficial insect habitat.

For Insectaries (permanent cover)	For Trap Crops (annual cover)
327 - Conservation Cover	340 - Cover Crop
386 - Field Border	328 - Conservation Crop Rotation
393 - Filter Strip	
332 - Contour Buffer Strips	
342 - Critical Area Planting	
422 - Hedgerow Planting	

## Manage Beneficial Habitat

The following conservation practices are commonly used to ensure that the habitat area functions as intended for the lifespan of the insectary or trap crop.

Table 3: Conservation practices commonly used to manage beneficial insect habitat.

### 645 - Upland Wildlife Habitat Management

*Commonly used to provide a management & monitoring plan, which often includes: strategies for early detection of factors that may adversely affect the habitat area (i.e. scouting for newly emerging invasive weeds); a contingency plan for stressors such as drought; best management practices such as promoting insect overwintering areas; and a plan for record keeping.*

### 472 - Access Control

*This management practice may be useful for sites that require additional planning and thought regarding how to protect the habitat area from accidental spraying, mowing, grazing etc.*

### 315 - Herbaceous Weed Control

*Where weeds may become an issue, this practice can help to differentiate between beneficial “weeds” and those that could threaten the integrity of the habitat area or cause a concern for the adjoining cash crops. When control is needed, it will provide a weed suppression strategy to minimize the adverse effect to the non-target plants (such as spot spraying/wick application or by using non-chemical control methods).*

## Measures for a Successful Beneficial Insect Habitat Area

- Prevent insecticide use within the habitat areas and if used on nearby fields ensure that measures are in-place to prevent chemical drift onto the habitat areas (i.e., create a buffer, check wind directions before application, avoid application upslope from the habitat area, etc.).
- Prevent disturbances that could affect blooming or insect health, such as grazing, mowing, tillage, burning, or herbicide application. If they are necessary to manage for the health of the habitat area, then use mitigation techniques such as spot treatments and/or waiting until after the bloom periods.
- Have a contingency plan in place for unexpected events such as drought or if the habitat area is lost.
- Maintain the beneficial “weeds” that establish naturally within the habitat areas, such as milkweed, sunflowers, asters, and yarrow. As a general rule, maintain plants unless they are on the Colorado Noxious Weed List (lists A, B, or C) or they have the potential to cause an issue for the cash crops.
- Consider keeping a record to evaluate the effectiveness of promoting beneficial insects on the farm and to watch for when adaptive management may be needed to improve habitat conditions.
  - (i) Dates of when flowering starts and ends for each of the habitat plants.
  - (ii) Observations of the type and quantity of beneficial insects found in the habitat area.
  - (iv) Crop records or observations of pest type and quantity in the cash crop field.

## Additional Resources

- Hopwood, J. et. al. 2017. [Habitat Planning for Beneficial Insects](#). Guidelines for Conservation Biological Control. The Xerces Society for Invertebrate Conservation. Portland, Oregon. <http://www.xerces.org>
- Lee-Mäder, E. et. al. 2014. [Farming with Native Beneficial Insects](#). The Xerces Society for Invertebrate Conservation. Portland, Oregon. <http://www.xerces.org>
- Vaughn, M. et. al. [Agronomy Technical Note No. 9: Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators Using Integrated Pest Management and Other Conservation Practices](#). USDA Natural Resources Conservation Service and The Xerces Society. <http://www.xerces.org>

## APPENDIX 1 - Ecology of Key Native Beneficial Insects

Pest to be Controlled	Ecology of the Native Beneficial Insects that controls the pest species	Plants Suitable for Habitat <sup>1</sup> - Insectary Plants -	Other Habitat Requirements
<p><b>Aphids</b> (primary)</p> <p><i>Plus other soft-bodied insects:</i> thrips, mealybugs, bean beetles, immature whiteflies, scale, moth eggs, very small caterpillars, spider mites</p>	<p><b>Lacewing</b> (Chrysopidae and Hemerobiidae families)</p> <p><u>Description.</u> Adults are light green or brown with long slender antennae, golden eyes and long delicately veined wings. Adults fly, larvae do not.</p> <p><u>Life Cycle.</u> Complete metamorphosis. Females lay eggs in groups on slender stalks which keep young larvae from eating each other after they hatch. Larvae grow through three stages for 2 to 3 weeks before each spins a white silken cocoon. The adult emerges in about 5 days. Winter is spent in the cocoon or adult stage, depending on species. Adults disperse widely after emerging. Some species have several generations per year while others have one.</p> <p><u>Behavior.</u> Predator. Wingless larvae have sickle-shaped jaws that contain tubes with which they can inject prey with paralyzing venom and then suck out the body fluids. The larvae are carnivorous and predaceous on many soft-bodied plant feeding insects and mites, including eggs. They can consume over 425 aphids or other prey per week. Some species are predaceous as adults to a limited extent.</p>	<p>Carrot family Daisy/Sunflower family Legume family Buckwheat family Goosefoot family Mallow family Cabbage family Casper family</p>	<ul style="list-style-type: none"> <li>▪ Adults are mostly active from dusk to dawn when temperatures are milder and relative humidity higher;</li> <li>▪ Adults are poor fliers, active at night (nocturnal);</li> <li>▪ Attracted to lights and are among those burned up in electric bug-zappers;</li> <li>▪ Adults feeds on nectar, pollen, and honeydew.</li> </ul>
<p><b>Aphids</b> (primary)</p> <p><i>Plus other soft-bodied insects:</i> mealybug, spider mite, soft scales adelgids, chinch bugs, bean beetle, asparagus beetle larvae, alfalfa weevils, bean thrips, grape root worms, CO potato beetle larvae, whitefly, mites</p>	<p><b>Ladybird Beetle / Lady Bugs</b> (Coccinellidae family and others)</p> <p><u>Description.</u> The adult is a small, oval beetle 1/4" to 3/8" long with orange-red elytra (hardened wing-covers) with 6 black spots each. Adults fly, larvae do not.</p> <p><u>Life Cycle.</u> Complete metamorphosis. The female lays up to 1,500 small eggs over several months during spring and early summer. The eggs are laid near the prey in upright batches of fifteen to thirty eggs. The larvae are dark and somewhat alligator-shaped. Once the larvae begin feeding, they grow quickly and molt four times over a period of up to a month. The pupal stage lasts about a week and mating takes place soon afterwards. If there is an abundant supply of aphids the female may start laying within about a week of mating, but if the supply is scanty, she may wait for up to nine months.</p> <p><u>Behavior.</u> Predator. When the larvae encounter prey, they generally bite a hole in the body and suck out the contents. The non-flying larvae consume about 50 aphids or similar prey per day. Some species of adults also prefer to eat aphids, however most eat other soft bodied insects.</p>	<p>Carrot family Daisy/Sunflower family Legume family Figwort family Buckwheat family Milkweed family Goosefoot family</p>	<ul style="list-style-type: none"> <li>▪ In order to breed, they need an abundance of aphids;</li> <li>▪ These insects have a diverse diet so they can survive when aphids are scarce, including honeydew, nectar, pollen or even petals and other soft parts of plants;</li> <li>▪ Once aphids leave a crop, beetles will also. To retain active beetles, maintain cover crops.</li> </ul>
<p><b>Aphids</b> (primary)</p> <p><i>Plus other soft-bodied insects:</i></p>	<p><b>Hoverflies / Syrphid flies / Flower flies</b> (Syrphidae family, many species)</p>	<p>Carrot family Daisy/Sunflower family Waterleaf family</p>	<ul style="list-style-type: none"> <li>▪ Adults are often seen hovering at flowers and quickly darting away;</li> </ul>

Scales	<p><b>Description.</b> Adults are generally 5-20mm in size, often with a yellow stripe and black body resembling small honey bees or wasps, and have large compound eyes that nearly cover the head. Adults fly, larvae do not.</p> <p><b>Life cycle.</b> Females lay eggs near aphid colonies. The slug-like, pale green to yellow maggots feed on aphids, scales, and other insects, growing to 10-15mm in length. Some pupate on the foliage near the feeding site, other pupate in the soil. The life cycle for most species lasts 2-4 weeks.</p> <p><b>Behavior.</b> Predator. The larvae of many species of slyphids are insectivores. Larvae can consume as many as 400 aphids during their development. However, in the absence of aphids, larvae of some species can subsist and develop entirely on diets of pollen.</p>	Buckwheat family Mint family Goosefoot Family Figwort family Mallow Family Cabbage family Casper family	<ul style="list-style-type: none"> <li>▪ Resemble bees or wasps, but they do not sting;</li> <li>▪ Larvae of hoverflies are often found in stagnant water;</li> <li>▪ Adults of many species feed mainly on nectar and pollen;</li> <li>▪ Maintain cover crops (buckwheat).</li> </ul>
<b>Parasitic Mini-Wasps</b>			
Flee beetle, Armyworm, cabbageworm, codling moth, gypsy moth, European corn borer, beetle larvae, flies, caterpillars, sphinx moths, cabbage (see description)	<p><b>Braconid &amp; Chalcid parasitoid wasp</b> (Braconidae/Chalcididae families among others)</p> <p><b>Description.</b> Adults are typically under a half-inch; may be slender or stout, with long antennae; frequently, a dark spot on the forewing; color varies.</p> <p><b>Life Cycle.</b> Complete metamorphosis. The life cycle length will vary by species.</p> <p><b>Behavior.</b> Parasites. Braconids usually parasitize the immature stages of their hosts. The adult females have long ovipositor and lays eggs inside of an insect host. The larva feeds on the inside of the host until it is ready to pupate. The wasp can either pupate inside the host, or on the outside of the host. The wasps will then emerge and look for more hosts.</p> <p>Also controls: butterflies, almond moth, Indian meal moth, grain weevil, leaf miners</p>	Carrot family Daisy/Sunflower family Cabbage family Casper family Legume family Buckwheat family Mallow family Mint family Legume family Mint family	<ul style="list-style-type: none"> <li>▪ Adult wasps are attracted to the color yellow, so any yellow sticky cards used to monitor pests should be removed;</li> <li>▪ Generally not strong fliers and are generally moved through the air by the prevailing winds;</li> <li>▪ Important in preventing crop damage because they kill their hosts before the insect causes damage to the plant;</li> <li>▪ Maintain cover crops (alfalfa).</li> <li>▪ Harmless to people, animals, and plants (they do not sting).</li> </ul>
<b>Aphids</b> (primary) green peach aphid, melon aphid, pea aphid, cotton aphid, green peach aphid, potato aphid, foxglove aphid and many other aphid species	<p><b>Aphid parasitoid wasp</b> (Aphidiinae subfamily)</p> <p><b>Description.</b> A subfamily of parasitoid wasps that use aphids as their host.</p> <p><b>Life Cycle.</b> Complete metamorphosis. A complete life cycle takes 10-14 days. Females lay eggs singly in aphid nymphs. As the larvae mature and the aphids are killed, the aphids turn into mummies.</p> <p><b>Behavior.</b> Parasites. In addition to killing aphids directly, mechanical disturbance of aphid colonies by the searching behavior of the adult wasps causes many aphids to fall off the plants and die. Each female lays about 100 eggs in aphids but may attack 200 to 300 aphids in the process.</p>	<i>Other nectar-rich plants with small flowers. Attracted to yellow.</i>	
<b>Moths and butterflies</b> Spruce budworm, cotton bollworm, tomato hornworm,	<p><b>Parasitoid wasp of eggs</b> (Trichogrammatidae family)</p> <p><b>Description.</b> Tiny wasps that include some of the smallest of all insects, with most species having adults less than 1 mm in length.</p> <p><b>Life Cycle.</b> Complete metamorphosis. The female lays an egg into a recently laid host egg. As the wasp develops, the host egg is killed. The wasp's short life cycle of 8-10 days allows for their population to increase rapidly.</p>		

corn earworm, corn borer, codling moth, other moths	<b>Behavior.</b> Parasite. See life cycle. Each female parasitizes about 100 host eggs.		
Cutworm, armyworm, tent caterpillar, corn earworm, cabbage looper/worm, gypsy moth; some attack sawfly larvae, Japanese beetle, May beetle, squash bug, green stink bug, sowbug, grasshoppers	<b>Tachinid fly</b> (Tachinidae family)  <b>Description.</b> Adult flies may be brilliantly colored and they resemble blow-flies (family Calliphoridae), or rather drab, and then resemble house flies but tachinid flies are more bristly and more robust. Adults fly, larvae do not. <b>Life Cycle.</b> Reproductive strategies vary greatly between species. The female may lay white oval eggs on the skin of the host insect, or insert eggs into the host's body, or leave them in the host's environment, as for example on leaves, where the host will ingest them. Some tachinids that are parasitoids of stem-boring caterpillars deposit eggs outside the host's burrow, letting the larvae do the work of finding the host itself. In other species, the maggots use an ambush technique, waiting for the host to pass and then attacking it and burrowing into its body. The larvae feed on the host tissues. <b>Behavior.</b> Internal parasitic of caterpillars. See life cycle.	Carrot family Daisy/Sunflower family Cabbage family Casper family Legume family Buckwheat family Mint family Waterleaf family	<ul style="list-style-type: none"> <li>▪ Adult flies feed on flowers and nectar from aphids and scale insects;</li> <li>▪ As many species typically feed on pollen, they can be important pollinators of some plants, especially at higher elevations in mountains where bees are relatively few.</li> </ul>
<b>Predatory Bugs</b>			
Flea beetles, spider mites, pink bollworm, cabbage loopers, whiteflies, aphids, insect eggs and small caterpillars	<b>Big-eyed Bugs</b> (Lygaeidae Family, <i>Geocoris</i> spp.)  <b>Description.</b> Big-eyed bugs are small black, gray, or tan with proportionately large eyes. <b>Life Cycle.</b> Simple metamorphosis. Eggs are deposited singly or in clusters on leaves near potential prey. They take approximately 30 days to develop from egg to adult depending on temperature. <b>Behavior.</b> Predator. Both nymphs and adults are predatory. Big-eyed bugs have piercing-sucking mouthparts and feed by stabbing their prey and sucking or lapping the juices. Nymphs can eat as many as 1600 spider mites before reaching adulthood, while adults have been reported consuming as many as 80 mites per day.	Carrot family Daisy/Sunflower family Cabbage family Casper family Legume family Waterleaf family Buckwheat family Mint family	<ul style="list-style-type: none"> <li>▪ Will also feed on various seeds and suck plant juices but are not considered to be injurious to plants;</li> <li>▪ Build up cool season cover crops;</li> <li>▪ Can survive on nectar and honeydew when prey are scarce.</li> </ul>
<i>Anything smaller than itself:</i> Aphid, thrips, leafhopper, treehopper, small caterpillars.	<b>Damsel bug</b> (Nabidae family)  <b>Description.</b> They are soft-bodied, elongate, winged terrestrial predators. Adults are tan or grey, with piercing-sucking mouthparts and enlarged front legs. They have slender bodies, and about 10 to 12 mm long. Nymphs resemble adults. <b>Life Cycle.</b> Simple metamorphosis. Eggs are deposited in soft plant tissues. Nymphs resemble adults and develop through 5 nymphal stages in about 50 days. <b>Behavior.</b> They are generalist predators, catching almost any insect smaller than themselves, and cannibalizing each other when no other food is available.		<ul style="list-style-type: none"> <li>▪ Numerous in fields of legumes such as alfalfa, buckwheat;</li> <li>▪ Adult damsel bugs spend the winter in groundcover and winter crops such as winter grain and alfalfa.</li> </ul>

<p><i>Wide variety of small insects:</i> Aphids, thrips, bean beetles, spider mite, leafhopper, corn earworm, small caterpillars, insect eggs</p>	<p><b>Minute Pirate Bug</b> (Anthocoridae Family, <i>Orius</i> spp.)</p> <p><u>Description.</u> Adult minute pirate bugs are small, 2-5 mm long, oval, black to purplish with white markings, and have a triangular head.</p> <p><u>Life Cycle.</u> Simple metamorphosis. Eggs are inserted into plant tissues. These hatch into nymphs. Developmental time for minute pirate bugs is very short, only 3 weeks from egg to adult. Several generations may occur during a growing season.</p> <p><u>Behavior.</u> Predator. Generalist predators are often the first predaceous insects to appear in the spring. Nymphs and adults feed on a variety of small prey, including insect eggs. Both feed by sucking juices from their prey through a needle-like beak.</p>		<ul style="list-style-type: none"> <li>▪ Maintain permanent plantings for refugia;</li> <li>▪ Feed on pollen and plant juices when prey are not available.</li> </ul>
<p><i>Soft-bodied insects:</i> Small to medium sized armyworms, earthworms, rootworm and cucumber beetle adults</p>	<p><b>Assassin bug</b> (Reduviidae family)</p> <p><u>Description.</u> Commonly have an elongated head with a distinct narrowed neck, long legs, and a prominent, segmented tube for feeding (rostrum). Most species are dark in color.</p> <p><u>Life Cycle.</u> Simple metamorphosis. Females lay eggs which are stuck in clusters to leaves and stems. After hatching, the wingless nymphs grow and molt 4-7 times before becoming full-sized, winged adults. Adults are usually the overwintering stage.</p> <p><u>Behavior.</u> These predaceous bugs suck body fluids from prey using their long rostrum to inject a lethal saliva that liquefies the insides of the prey.</p>		<ul style="list-style-type: none"> <li>▪ Generally poor fliers;</li> <li>▪ Maintain permanent plantings for refugia;</li> <li>▪ Capable of biting humans.</li> </ul>
<p><b>Aphids</b> (over 60 species)</p>	<p><b>Aphid midge</b> (Cecidomyiidae family, <i>Aphidoletes aphidimyza</i>)</p> <p><u>Description.</u> Adults are small delicate black flies (&lt; 2mm long).</p> <p><u>Life Cycle.</u> Females deposit 100-250 tiny (0.3 mm) shiny orange eggs singly or in small groups among aphid colonies that hatch in 2-3 days. After 3-7 days the larvae drop to the ground and burrow into the soil to pupate. Lifespan is 10 days.</p> <p><u>Behavior.</u> Predator. The small, bright orange, slug-like larvae inject a toxin into aphids' leg joints to paralyze them and then suck out the aphid body contents through a hole bitten in the thorax. Larvae can consume aphids much larger than themselves and may kill many more aphids than they eat when aphid populations are high. A single larva kills 4-65 aphids per day.</p>	<p>Carrot family Cabbage family Casper family Legume family</p>	<ul style="list-style-type: none"> <li>▪ Adults feed primarily on pollen and honeydew;</li> <li>▪ Shelter the site from strong winds (i.e. hedgerows);</li> <li>▪ Prefers to reside in dark, humid areas near the lower plant canopy;</li> <li>▪ Active at night.</li> </ul>

**APPENDIX 2 - Recommended Plants for Beneficial Insect Habitat**

The following list includes species which are commercially available, not known to be invasive, likely adapted to cropland settings, and that have geographic occurrences within the state. The species selected should be based on the actual site conditions, the purpose, and the plant species known establishment and growth requirements. Use the USDA PLANTS database (<http://plants.usda.gov/>) to further refine the selection.

**CAUTION:** If you select other species, use caution to ensure that they are not invasive. Many references for creating beneficial insect habitat include garden variety species that are not appropriate for farm settings.

Plant Name	Scientific Name	Native Status <sup>1</sup>	Duration	Flower Color	Bloom Period		
					Early	Mid	Late
<b>Carrot Family (Apiaceae)</b>							
Biscuitroot, fernleaf <sup>Top Pick!</sup>	<i>Lomatium dissectum</i>	N	perennial	yellow			
Dill <sup>Top Pick!</sup>	<i>Anethum graveolens</i>	I	annual	yellow-green			
Fennel, sweet	<i>Foeniculum vulgare</i>	I	biennial/p erennial	yellow-green			
Parsley	<i>Petroselinum crispum</i>	I	annual/ biennial	yellow-green			
<b>Figwort Family (Scrophulariaceae)</b>							
Penstemon, narrowleaf <sup>Top Pick!</sup>	<i>Penstemon angustifolius</i>	N	perennial	blue-purple			
Beardtongue, bluestem <sup>Top Pick!</sup>	<i>Penstemon cyanocaulis</i>	N	perennial	blue-purple			
Penstemon, Rocky Mountain (Bandera) <sup>Top Pick!</sup>	<i>Penstemon strictus</i>	N	perennial	reddish purple			
Penstemon, Rydberg's	<i>Penstemon rydbergii</i>	N	perennial	blue-purple			
Beardtongue, Large-flowered	<i>Penstemon grandiflorus</i>	N	perennial	blue-purple			
<b>Mint Family (Lamiaceae)</b>							
Mint, wild <sup>Top Pick!</sup>	<i>Mentha arvensis</i>	N	perennial	Pink-white			
Bergamot, wild <sup>Top Pick!</sup>	<i>Monarda fistulosa</i>	N	perennial	Lavender-ink			
Basil, sweet	<i>Ocimum basilicum</i>	I	annual/ perennial	white			
Catnip <sup>Top Pick!</sup>	<i>Nepeta cataria</i>	I	perennial	pink			
Sage, Azure Blue	<i>Salvia azurea</i>	N	perennial	blue			
Balm, common (lemon)	<i>Melissa officinalis</i>	I	perennial	white-lavendar			
<b>Milkweed Family (Asclepiadaceae)</b>							
Butterfly milkweed <sup>Top Pick!</sup>	<i>Asclepias tuberosa</i>	N	perennial	orange			
Milkweed, showy	<i>Asclepias speciosa</i>	N	perennial	pink			
<b>Legume Family (Fabaceae)</b>							
Leadplant <sup>Top Pick!</sup>	<i>Amorpha canescens</i>	N	perennial	purple-silver			
Prairie clover, white <sup>Top Pick!</sup>	<i>Dalea candida</i>	N	perennial	white			
Prairie clover, violet <sup>Top Pick!</sup>	<i>Dalea purpurea</i>	N	perennial	purple-pink			
Prairie clover, silky <sup>Top Pick!</sup>	<i>Dalea villosa</i>	N	perennial	white-purple			
Thermopsis, prairie	<i>Thermopsis rhombifolia</i>	N	perennial	yellow			
Alfalfa	<i>Medicago sativa</i>	I	perennial	purple			
Trefoil, bird's-foot	<i>Lotus corniculatus</i>	I	perennial	yellow			
Sweetclover	<i>Melilotus officinalis</i>	I	annual	white			
Sainfoin <sup>Top Pick!</sup>	<i>Onobrychis viciifolia</i>	I	perennial	pinkish red			
Clover, strawberry	<i>Trifolium fragiferum</i>	I	perennial	purple			
Clover, alsike	<i>Trifolium hybridum</i>	I	annual/ perennial	white			



Clover, red	<i>Trifolium pratense</i>	I	biennial/ perennial	pink/red			
Clover, white	<i>Trifolium repens</i>	I	perennial	white			
Milkvetch, chickpea (cicer)	<i>Astragalus cicer</i>	I	perennial	yellow			
Vetch, American	<i>Vicia Americana</i>	N	perennial	purple			
<b>Daisy/Sunflower Family (Asteraceae)</b>							
Tickseed, lanceleaf	<i>Coreopsis lanceolata</i>	N	perennial	yellow			
Tickseed, golden	<i>Coreopsis tinctoria</i>	N	annual	yellow/red band			
Sunflower, maximilian <sup>Top Pick!</sup>	<i>Helianthus maximiliana</i>	N	perennial	yellow			
Goldeneye, showy	<i>Heliomeris multiflora</i>	N	perennial	yellow			
Oxeye, smooth <sup>Top Pick!</sup>	<i>Heliopsis helianthoides</i>	N	perennial	yellow			
Balsamroot, arrowleaf	<i>Balsamorhiza sagittata</i>	N	perennial	yellow			
Gayfeather, dotted <sup>Top Pick!</sup>	<i>Liatris punctata</i>	N	perennial	purple			
Coneflower, prairie	<i>Ratibida columnifera</i>	N	perennial	varies: red/yellow			
Goldenrod, Canada <sup>Top Pick!</sup>	<i>Solidago canadensis</i>	N	perennial	yellow			
Goldenrod, gray <sup>Top Pick!</sup>	<i>Solidago nemoralis</i>	N	perennial	yellow			
<b>Buckwheat Family (Polygonaceae)</b>							
NRCs Policy Reminder: <i>Fagopyrum esculentum</i> is not approved for use in any conservation planting (NB 190-16-8)							
Buckwheat, sulfur <sup>Top Pick!</sup>	<i>Eriogonum umbellatum</i>	N	perennial	bright yellow			
Buckwheat, redroot	<i>Eriogonum racemosum</i>	N	perennial	bright yellow			
Buckwheat, james'	<i>Eriogonum jamesii</i>	N	perennial	bright yellow			
<b>Waterleaf Family (Hydrophyllaceae)</b>							
Phacelia, silky <sup>Top Pick!</sup>	<i>Phacelia sericea</i>	N	biennial/ perennial	purple			
Phacelia, lacy <sup>Top Pick!</sup>	<i>Phacelia tanacetifolia</i>	N	annual	blue			
Phacelia, gypsum	<i>Phacelia integrifolia</i>	N	annual- perennial	purple			
Phacelia, varileaf	<i>Phacelia heterophylla</i>	N	biennial/ perennial	white			
<b>Cabbage Family (Brassicaceae)</b>							
Princesplume, desert <sup>Top Pick!</sup>	<i>Stanleya pinnata</i>	N	perennial	yellow			
Bittercress, heartleaf	<i>Cardamine cordifolia</i>	N	perennial	white			
Bladderpod, Fendler's	<i>Lesquerella fendleri</i>	N	perennia	yellow			
Wallflower, western	<i>Erysimum asperum</i>	N	Biennial, perennial	orange to yellow			
Wallflower, Pursh's	<i>Erysimum capitatum</i>	N	Biennial, perennial	orange to yellow			
Alyssum	<i>Lobularia maritima</i>	I	annual, perennial	white/purple			
<b>Casper Family (Capparaceae)</b>							
Beeplant, rocky mnt. <sup>Top Pick!</sup>	<i>Cleome serrulata</i>	N	annual	pink to purple			
<b>Mallow Family (Malvaceae)</b>							
Poppymallow, purple	<i>Callirhoe involucrata</i>	N	perennial	redish pink			
<b>Goosefoot Family (Chenopodiaceae)</b>							
Four-wing saltbush <sup>Top Pick!</sup>	<i>Atriplex canescens</i>	N	perennial	yellow			

\*Potential cover crops that are good for insectory habitat.

<sup>1)</sup> I - Introduced, non-native. N - Native