



BEES AND COVER CROPS: USING FLOWERING COVER CROPS FOR NATIVE POLLINATOR CONSERVATION

INTRODUCTION

Pollination services are essential for the production of the majority of our fruit, vegetable and nut crops including apples, tomatoes, and pumpkins. Although much of the world's primary staple crops are wind pollinated (e.g., corn, rice, wheat), a third of the food we eat every day can be attributed directly to pollinators. While managed colonies of European honey bees are most frequently used for crop pollination, wild or native bees commonly provide the same pollination services for 'free' without the costs of renting or maintaining honey bee hives. Native bees only require adequate food and habitat resources to sustain the healthy and diverse bee populations needed for effective pollination.

Agricultural landscapes can present many threats to native bee communities. Such threats include destruction or fragmentation of natural habitat and the food and nesting resources it provides for pollinators, as well as exposure to potentially toxic agricultural pesticides. However, there are many conservation strategies that can be employed across your farm or in your garden to help maintain healthy native bee populations.



Bumble bee queen (*Bombus sp.*) visiting red clover.
 (Photo by Katie Ellis)

Typical pollinator conservation practices include:

Enhancing off-field floral resources

- Planting diverse wildflower patches that bloom all season long
- Installing hedgerows with blooming shrubs or trees

Providing nesting habitat

- Leaving areas of grass or bare soil un-tilled for ground nesting bees
- Leave some tree snags or dead pithy-stemmed shrub stems for wood and tunnel nesting bees
- Build or install artificial bee nesting blocks

Providing access to clean water

- Bird baths
- Irrigation or natural ponds

Creating buffers from insecticide exposure

- Don't spray insecticides on crops when they are in bloom
- Select insecticides designed to target specific pests
- Install non-flowering hedgerows or tree lines in areas with high pesticide drift risk

While all of these practices can help conserve native bee populations, considering alternative approaches that can be incorporated directly into cultivated fields can potentially benefit crop productivity as well as the local pollinator community. Growing flowering cover crops during fallow periods in your crop rotation is one such multi-purpose strategy.



Comparison of two types of cover crops in a field in Centre County, PA; on the right is a monoculture of winter-killed oats and on the left, a diverse cover crop mixture containing spring blooming canola.
 (Photo by Katie Ellis)

Cover Crop Benefits:

Cover crops can provide many benefits for soil health.

These include:

- Cutting fertilizer costs
- Suppressing weeds
- Increasing soil health and subsequent crop yield
- Preventing soil erosion
- Conserving soil moisture
- Protecting overall water quality

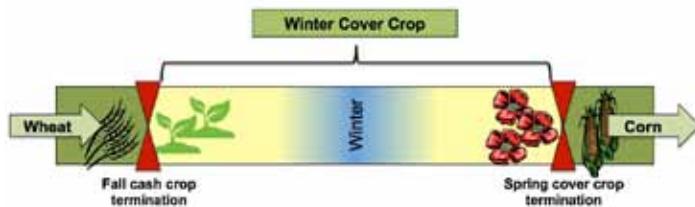
Flowering Cover Crops:

Considerations for using flowering cover crops on your farm for conserving native pollinators

What planting windows are available in my rotation? Consider the crops that are grown on your farm. Are there fallow periods in the rotation, e.g., from fall to spring? Are there breaks between crops mid-summer? Knowing when is the most appropriate time for cover crops in your system is important for selecting appropriate cover crop species. Additionally, if one of the goals is to provide flower resources for native bees, knowing the limits of a window between main crops will help to understand if a cover crop is likely to flower before the next cash crop needs to be planted.



Flowers of Austrian winter pea (Left) and canola (Right) showing diversity in flower shape and pollinator accessibility.
(Photos by Katie Ellis)



Example of a typical overwintering cover crop window in an agronomic crop rotation between winter wheat harvest and corn planting.

Cover crop species selection. Differences in flower shape, size and color can all influence what pollinators are attracted to a particular cover crop. For example, canola flowers have open petals which allow the pollen and nectar resources to be available to all shapes and sizes of native bees. Because of this, high pollinator diversity has been observed on spring-blooming canola flowers. However, the more closed petals of flowers in the pea family make it more difficult for some types of pollinators to reach the pollen and nectar reward. In this scenario, larger bodied or very tiny bees are most likely to be observed visiting these flowers due to their ability to push aside or crawl through the petal tunnel.

Therefore, if the goal is to provide resources to a variety of pollinators you may select a crop with open-access flower shape, or consider planting a diversity of cover crop species. If, however, the goal is to focus on a particular group of pollinators (e.g., bumble bees to help pollinate your summer tomato crop), you may want to select cover crop species that are most attractive to that group of bees.

Cover crop mixtures or monocultures? Recent research has shown that flower density has a significant influence on the number of bees that are attracted to a particular patch of cover crop flowers, with greatest bee visitation in those with highest number of open blooms per area. Therefore, a monoculture of canola will be more attractive at peak flowering than a neighboring cover crop mixture that contains a lower total seeding rate of canola plants mixed with non-flowering cover crops (e.g., cereal rye), and thus more widely dispersed flowers. However, if there are goals beyond providing resources for pollinator benefit, planting a diverse cover crop mixture that includes other cover crop species (e.g., legumes or grasses) as well as flowering species can provide maximum potential benefit for soil health, crop productivity and pollinator conservation.

It is also important to note that different cover crop species will likely have different flowering times, even if planted at the same time. Therefore, if a diverse cover crop mixture has multiple flowering species the bloom periods of those crops may or may not overlap.

Additional Considerations:

If a cash crop rotation window is short and you are uncertain that the cover crop will have sufficient time to produce flowers before termination, consider leaving some un-managed cover crop strips in the field a few extra weeks. This will allow time for the cover crop to reach full flower potential and can still be mowed or terminated by tillage or herbicide application before they set seed.

Annual variations in weather patterns will likely influence the initiation and duration of cover crop flowering time, as well as a cover crop species' over-wintering hardiness. Keep this in consideration when selecting cover crop species or identifying ideal cover crop rotation windows and know that a crop that flowers early in a year with a warm spring may flower a few weeks later in years with cold spring weather.

Some common flowering cover crop species for the Mid-Atlantic region:

Open Flower Type: Available to a Wide Variety of Bees

Cover Crop	Cover Crop Type	Best Planting Times	Blooming Times
Winter or Spring Canola (Rapeseed) (<i>Brassica napus</i> or <i>B. rapa</i>)	Winter annual	Fall or Spring	Early-spring to Early-summer
Mustards (<i>Sinapis alba</i> , <i>Brassica juncea</i> , <i>B. nigra</i>)	Winter or Cool season annual	Spring or Late Summer	Summer or Fall
Buckwheat (<i>Fagopyrum esculentum</i>)	Summer annual	Spring to Late-Summer	Summer to Early-fall

Closed Flower Type: Available to Specialized Bee Groups

Cover Crop	Cover Crop Type	Best Planting Times	Blooming Times
Field Peas (Austrian Winter Pea) (<i>Pisum sativum</i> subsp. <i>arvense</i>)	Winter annual	Fall or Early-spring	Early-spring to Summer
Red Clover (<i>Trifolium pratense</i>)	Biennial or short-lived perennial	Late-summer or Early-spring	Summer
Crimson Clover (<i>Trifolium incarnatum</i>)	Winter or Summer annual	Late-summer or Early-summer	Mid-Spring or Summer
Hairy Vetch (<i>Vicia villosa</i>)	Winter or Cool season annual	Early-fall or Early-spring	Spring to Early-summer



Flowering buckwheat
(Photo by Jermaine Hinds)



Male bumble bee (*Bombus sp.*) visiting red clover (Photo by Katie Ellis)



Carpenter bee (*Xylocopa virginica*) on Austrian winter pea flower
(Photo by Katie Ellis)



Andrena species on canola flower
(Photo by Katie Ellis)



Flowering crimson clover in a diverse cover crop mixture (Photo by Katie Ellis)



Carpenter bee (*Xylocopa virginica*) on hairy vetch (Photo by Katie Ellis)

Additional cover crop resources:

Clark, A. (Ed.). 2007. Managing Cover Crops Profitably, 3rd edition. Sustainable Agriculture Research and Education (SARE). Available in print or at <http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>

Penn State Extension

Soil Management: Cover Crops. Penn State Extension. <http://extension.psu.edu/plants/crops/soil-management/cover-crops>

Soil Management: What Cover Crop Should I Plant? Penn State Extension. <http://extension.psu.edu/plants/crops/soil-management/cover-crops/what-cover-crop-should-i-plant>

Additional resources and information on native pollinator conservation:

Penn State Extension

Conserving Wild Bees in Pennsylvania.

Agroecology in Practice No. UF023.

<http://pubs.cas.psu.edu/FreePubs/pdfs/uf023.pdf>

The Xerces Society for Invertebrate Conservation
<http://www.xerces.org/pollinator-conservation/>

Mader, E., M. Shepherd, M. Vaughan, S. H. Black, and G. LeBuhn. 2011. Attracting Native Pollinators: Protecting North America's Bees and Butterflies. Storey Publishing, North Adams, MA.

Natural Resources Conservation Service (NRCS)
<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plants-animals/pollinate/>

Using Farm Bill Programs for Pollinator Conservation
http://plants.usda.gov/pollinators/Using_Farm_Bill_Programs_for_Pollinator_Conservation.pdf

Native Pollinators (PDF) from the Natural Resources Conservation Service (NRCS)
http://plants.usda.gov/pollinators/Native_Pollinators.pdf



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