USDA National Agroforestry Center

AGROFORESTRY NOTES

AF Note — 33 August 2006

Improving Forage For Native Bee Crop Pollinators

Introduction

Agroforestry practices can provide essential habitat for bees, our most important crop pollinators. The European honey bee receives most of the credit for crop pollination, but the number of managed honey bee hives is half of what it was in the 1950s; and this number continues to decline because of disease and the immigration of aggressive races of honey bees. Native bees, however, significantly contribute to crop pollination – and, in some cases, provide all of the pollination.

An *Osmia aglaia* female pollinates a black raspberry flower. *Photo courtesy Xerces Society For Invertebrate Conservation.*

In order to support the native bee community, a wealth of flowers is necessary. Unfortunately, heavily managed farm landscapes often lack the diversity and abundance of flowers that native bees require. By providing abundant and diverse pollen and nectar sources, a diverse community of native bee species will increase, adjacent crops may yield more, growers could rely less on imported European honey bees, and farm biodiversity and other wildlife species will benefit.

This *Agroforestry Note* discusses how to maximize the ability of an agroforestry practice to support crop-pollinating bees, including a step-by-step method for planning forage enhancements. Other floral visitors, like butterflies, do not pollinate crops, but will also benefit from the techniques below.

Step 1: Identify and protect bee forage already in place

Existing pollen and nectar sources can often be found near fencerows or hedgerows, riparian buffers, other natural areas, or any place on or around the site where a variety of plants (weeds or otherwise) grow. To identify good forage plants, observe flowers early in the morning and in the middle of the day to note how intensively each species is visited by bees and other insects. Honeybees and bumblebees are both good, recognizable indicators of flowering plants that other native bees will use. Try to protect these sites and their flowering plants within the constraints of the landowner's goals.

Step 2: Ensure that flowers are present throughout the growing season

Bees are most active from February to November, longer in mild climates. The social bumble bee is often seen in any of these months, whereas the emergence and short (two to four weeks) active adult life of many solitary-nesting bees depends upon the species, and can occur from early spring to late summer. Therefore, a sequence of plants that provide a diversity of flowers throughout the growing season is necessary to support a diverse community of native bee species.

Bumble bees are some of our most efficient crop pollinators. When forage is available early in the growing season (like willow, red bud, maple, or manzanita), freshly emerged, overwintering bumble bee queens are more successful in establishing their colonies. Also, some solitary bees produce multiple generations each year, so reproductive success in the spring and early summer can lead to larger populations in the mid- to late-summer, when many fruits and vegetables are in bloom.

Remember to include plants that bloom in the fall. When plants such as goldenrod and asters are in bloom, some native bee species, as well as honey bees, will benefit from the abundant late-season forage. For example, the next year's bumble bee queens will be able to go into hibernation with more energy reserves than they would otherwise.

Step 3: Identify the best sites to enhance forage

Agroforestry provides a unique opportunity to enhance nectar and pollen sources and nesting sites for crop-pollinating bees. Weed control should be concentrated to a narrow strip nearest the trees to leave as much undisturbed area as possible for flowering plants and nesting sites.

Riparian forest buffers are excellent locations to incorporate early flowering willows, as well as shrubs and forbs that require more water than is naturally available elsewhere. Riparian buffers are especially important for bees during hot summer months in areas where plants in upland areas dry out.

Windbreaks and hedgerows, by design, reduce wind velocity in adjacent fields. Windbreaks provide places to plant flowering trees and shrubs and other blooming perennials close to fields. Make a special effort to include flowering forbs on the margins of the windbreak or hedgerow. The area between the trees could also be used for beneficial forbs during the establishment period of the windbreak.

Silvopasture provides an open understory where a variety of flowering forbs, like alfalfa or clover, can be over seeded. When combined with rotational grazing practices, these legumes will have an opportunity to flower before being eaten. Clusters of flowering shrubs could provide benefits for pollinators and other wildlife. Depending on the location, harvestable flowering trees, such as black cherry, black locust, or maple, can be included into a silvopasture system.

Alley cropping presents an opportunity to grow plants in close proximity that have complementary flowering periods. By paying careful attention to bloom periods and using multiple species, an alley cropping system can provide nearly continuous pollen and nectar forage within a single farmscape. Consider flowering trees like black cherry or basswood along with the more typical alley cropping trees of walnut, pecan, or oak. A legume forage crop between rows will not only fix nitrogen but also provide nectar and pollen for bees. Diverse native forbs and shrubs, may be planted in rows for cut flowers, berry production, or the nursery market, as well as for pollinators.

Forest farming simultaneously manages both forest overstory and understory plants. Include insect-pollinated valuable crop trees, like yellow (tulip) poplar, maple, basswood, and black cherry, in the overstory to benefit pollinators. Some cultivated understory plants, such as ginseng, goldenseal, or black cohosh, may also benefit from pollinators. For example, black cohosh generally relies on bumble bees for pollination, but it does not produce nectar to attract the bees. It must rely on nearby prolific nectar producers, such as pale touch-me-not or whiteflower leafcup, to attract the bees. The pollination of these different forest understory plants is not well understood, but pollinators should be encouraged.

Other sites, such as existing natural habitat, field and road edges, drainage ditches, land around buildings, and fields that are too wet or too dry for crop production, also provide convenient, underutilized places to cultivate bee forage.

Step 4: Identify the best plants

Wherever possible, consider how to include trees that provide pollen and nectar for bees (see *Table 1*). Around and under each tree provide a diversity of plants that, together, produce continuous, abundant flowers.

For the maximum benefit to pollinators, as well as ease of implementation, consider the following criteria:

Locally native plants are generally well-adapted to an area's growing conditions; can thrive with minimum attention; are good sources of nectar and pollen for native bees; and are usually not "weeds."

Flowers with a diversity of shapes, sizes, and colors will support the greatest variety of crop pollinators.

Alternative, specialty crops provide a product for landowners and are also great for pollinators. For example, berry-producing shrubs such as blueberries and raspberries, ornamental plants such as curly willow and red twig dogwood, medicinal plants such as goldenseal, and hardwoods such as black cherry and maple all provide a harvestable crop as well as pollen and nectar for bees.

Highly invasive plant species are aggressive and can spread to dominate other species; will reduce the diversity and value of the habitat; and will increase maintenance. Check with your county for code restrictions on noxious weed species.

Step 5: Plan ahead to ensure successful installation and maintenance

Post signs and educate others. It is important to make sure that farm staff, neighbors, and county road and electric crews know about the habitat. Signs help educate others about what is happening on the farm and, potentially, encourage them to do similar work.

Eventually replace mulch. Weed control and irrigation (in drier climates) is often needed to establish new agroforestry plantings. While mulch helps conserve water and control weeds, it may also prevent ground-nesting bees from accessing the soil surface. After trees are established, consider replacing mulch with an understory of bunch grasses or flowering forbs, which will help control weeds and, at the same time, provide opportunities for solitary bees to construct ground nests.

Table 1: Trees and shrubs that provide significant forage for native bees

Common name and genus *	Approximate flowering period in native range **
Native Trees	
Willow (*Salix*)	Early spring
Sassafras (*Sassafras*)	March to May
Redbud (*Cercis*)	March to May
Horse chestnut (*Aesculus*)	March to June
Maples (*Acer*)	March to June
Madrone (*Arbutus*)	Mid-March to June
Cherry (*Prunus*)	Late March to June
Sumac (*Rhus*) ***	Spring to summer
Black locust (*Robinia*)	May to June
Palo Verde (*Parkinsonia*)	May to June
Honey locust (*Gleditsia*)	Mid-May to June
Serviceberry (*Amelanchier*)	Early summer
Basswood (*Tilia*)	Late May to July
Sourwood (*Oxydendrum*)	Mid-summer
California-laurel (*Umbellularia*)	November to May

Common name and genus *	Approximate flowering period in native range **
Native Shrubs	
Barberry, Mahonia (*Berberis*, *Mahonia*)	March to May
Serviceberry (*Amelanchier*)	April to June
Golden currant (*Ribes aureum*)	April to June
Buckbrush (*Ceanothus*)	April to June
Blueberries (*Vaccinium*)	May to June
Raspberry, Blackberry (*Rubus*) ***	May to August
Elderberry (*Sambucus*) ***	May to August
Wild rose (*Rosa*)	June to August
Oceanspray, Cliff spirea (*Holodiscus*)	June to August
Spirea (*Spirea*)	July to August
Fruit Trees	
Almond, Apple, Cherry, Plum, Persimmon	Spring

* Check sources for species and varieties that are adapted to your area.

** The actual flowering period depends upon species, latitude, elevation, and year-to-year variation, and may only last for a short time (a couple of weeks) within these ranges. It is important to consult with local native plant experts to develop a list of plants with overlapping bloom times

*** When twigs are clipped on these plants, the soft pith provides nesting opportunities for small, tunnel-nesting bees.

Minimize herbicide use. If herbicides are necessary to control noxious weeds, only spot treat weeds and completely avoid important flowering plants.

Conclusion

The best way to attract and support a healthy pollinator population is to ensure a rich, diverse plant community. Agroforestry practices can help provide this rich source of pollen and nectar. In return, an abundance and variety of insect pollinators will yield a fertile and productive landscape.

Well-placed, visible signs inform neighbors of the need to avoid pesticide applications that could kill desirable bees. *Photo courtesy Sam Earnshaw, Community Alliance With Family Farmers.*

Additional information

AF Note – 32: "Agroforestry: Sustaining Native Bee Habitat For Crop Pollination," Vaughan, Mace and Black, Scott Hoffman, 2006. USDA National Agroforestry Center.

AF Note – 34: "Enhancing Nest Sites For Native Bee Crop Pollinators," Vaughan, Mace and Black, Scott Hoffman, 2006. USDA National Agroforestry Center.

AF Note – 35: "Pesticide Considerations For Native Bees In Agroforestry," Vaughan, Mace and Black, Scott Hoffman, 2006. USDA National Agroforestry Center.

Conservation Security Program Job Sheet: "Nectar Corridors," Plant Management EPL 41. USDA NRCS, *www.wv.nrcs.usda.gov/programs/csp/06csp/JobSheets/nectarCorridorsEL41.pdf.*

Xerces Society Pollinator Program, *www.xerces.org/Pollinator_Insect_Conservation/*

USDA ARS Logan Bee Lab, *www.loganbeelab.usu.edu*

USDA NRCS PLANTS database *http://plants.usda.gov/*

Authors
Mace Vaughan and Scott Hoffman Black, Xerces Society For Invertebrate Conservation, 4828 SE Hawthorne Boulevard, Portland, Oregon 97215. Phone: 503–232–6639; fax: 503–233–6794; e-mail: *info@xerces.org*.

Acknowledgements
James Cane, USDA ARS; T'ai Roulston, University of Virginia; Blair Sampson, USDA ARS.

USDA National Agroforestry Center

A partnership of

USDA Forest Service
NRCS Natural Resources Conservation Service

Contact: USDA National Agroforestry Center (NAC), UNL–East Campus, Lincoln, Nebraska 68583-0822. Phone: 402-437-5178; fax: 402-437-5712; Web site: *www.unl.edu/nac*.

The USDA National Agroforestry Center (NAC) is a partnership of the Forest Service (Research and Development and State and Private Forestry) and the Natural Resources Conservation Service. It is administered by the Forest Service, Southern Research Station; its program manager and headquarters are located in Huntsville, AL, on the campus of Alabama A&M University, while its research, clearinghouse, and technology transfer staff are concentrated in Lincoln, NE, at the University of Nebraska. NAC's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land use systems. To accomplish its mission, NAC interacts with a national network of partners and cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.