THE UNIVERSITY OF GEORGIA
COOPERATIVE EXTENSION

College of Agricultural and Environmental Sciences
College of Family and Consumer Sciences

Bee Conservation in the Southeast

By Keith S. Delaplane,
Extension Entomologist

WHY CONSERVE BEES?

As bees visit flowers to collect pollen and nectar as food, they transfer pollen from flower to flower in a process called *pollination*. Pollination helps seeds and fruits develop. Many row crops and garden crops require bee pollination. Good pollination makes higher yields, larger fruit, faster ripening fruit and better tasting fruit.

When most people think of bees they think about the familiar honey bee, *Apis mellifera*. This remarkable insect is the source for honey, beeswax and a variety of other health and nutritional products. As important as these products are, their value pales in comparison to the value of honey bees as crop pollinators. Honey bees are responsible for $14 billion added value to American food production annually[1] and more than $215 billion worldwide[2]. They can live in colonies managed by beekeepers and as wild colonies in nature. Both managed and wild honey bees are valuable pollinators.

American crop growers and home gardeners are concerned about declining numbers of wild honey bees. There is evidence for this decline from scientific surveys[3,4]. Honey bees, both wild and managed, are dying from a variety of reasons including exotic diseases and parasites, deteriorating habitat quality, and pesticide exposure — both environmental and intentional — as part of remedial action against bee parasites. The complex issue of honey bee decline is a matter of intense interest among scientists and agriculturists.

Non-honey bees are also threatened. These include wild bumble bees and solitary bees that nest in thick grass, soil, wood or tunnels in wood. These different types or *species* of bees are easily overlooked because they are rarely kept in hives, do not make surplus honey and do not form large colonies. Their nesting sites and food plants are frequently destroyed by human activities.

A pollination vacuum occurs as bees of all kinds decline. Less pollination means lower food quality and higher food prices; thus, large bee populations are in everyone's best interest. Anyone who grows or uses plant products is a stakeholder in bee conservation.

This publication is for people who want to know how to make land parcels more bee-friendly. The goal is to increase the number of bees foraging and nesting on one's property, which will lead to improved pollination of row crops or garden crops. A healthy bee population needs long-lasting nesting sites and plants that produce nectar and pollen during bee nesting season. These facts are the foundation of any bee conservation program.

SOME IMPORTANT BEE POLLINATORS IN THE SOUTHEAST

Honey Bees — These are the most well-known bees (Figure 1). They are social, which means they live together in large colonies. Honey bees thrive in man-made hives in which populations can reach as high as 60,000 individuals.

The beekeeping industry is an important part of the U.S. agricultural economy. In the Southeast, the industry produces honey and beeswax and provides crop pollination services. Honey bees are historically the most important crop pollinator. A specialized branch of the industry, concentrated in south Georgia, raises bees and queens for sale to beekeepers around the world.

Figure 1. Honey bees form long-lived colonies and nest in hollow trees or beekeepers' hives.

Bumble bees — These are large, fuzzy bees (Figure 2). Although they are social, the life cycle begins with a solitary overwintered queen. She emerges from hibernation in early spring and finds a nest site — usually a cavity in thick grass or an abandoned rodent nest — and singlehandedly forages for nectar and pollen. She raises a batch of worker bumble bees who help her forage and care for more young. Eventually the worker population increases enough that the queen can stay at the nest and concentrate on laying eggs. The colony population peaks at a few hundred individuals.

In mid- to late summer the colony stops rearing workers and begins rearing new queens and males. New queens mate and overwinter to start the cycle over again. Workers, males and the old queen die at the end of summer.

Figure 2. A queen bumble bee. These large, fuzzy bees nest in grass hollows or abandoned rodent nests. Their colonies live for only one season.

Soil-nesting bees — This group includes thousands of species. Three important pollinating soil-nesters in the Southeast are polyester bees, Southeastern blueberry bees and squash bees. Polyester bees and Southeastern blueberry bees pollinate blueberry crops, and squash bees pollinate cucurbit crops. These bees are solitary. This means individual females emerge in the spring and mate, forage and singlehandedly rear the next generation of offspring. Females dig simple tunnels in soil in which they lay their eggs and in which the immature bees develop and spend the winter (Figures 3-4).

Figure 3. Polyester bees are solitary bees that nest in tunnels in soil. Their name comes from the biological polymer they produce to line their subterranean brood cells.

Figure 4. Squash bees, another solitary soil nester, pollinate squash, pumpkin and gourd. Their nest entrances are visible as small mounds of soil, or tumuli, in areas of mixed grass and exposed ground.

Mason bees — These solitary bees nest in pre-existing tunnels such as old nail holes, beetle tunnels or soda straws. They are called mason bees because they seal their tunnels with mud or finely-chewed leaf material. They are important pollinators of many early spring-blooming plants.

HABITAT CONSERVATION

The information in this section can help you assess the conservation value of your lands and identify steps for improving them for bees. The immediate goal is to increase the density and species diversity of flowering plants and the density of good bee nesting sites. This section discusses the most important principles of bee nesting biology and the practices that you can use to put the knowledge to work.

Principle 1

Bees thrive best in open, sunny habitats with an abundance and diversity of flowering food plants rather than in flower-poor, shaded woodlands.

■ *Practice*

Focus your habitat conservation efforts on sunny, open, undisturbed meadows (Figure 5), field margins, sun-drenched patches of bare soil, roadsides, ditch banks and woodland edges. Undisturbed areas like these can increase the abundance of bee nesting sites and diversity of flowering plant species on a farm. A farm can have large areas of such idle land, and using it for a bee sanctuary costs next to nothing and involves mostly a willingness to leave it undisturbed for the long term. "Undisturbed" means no draining,

plowing or compacting with heavy machinery. Periodic mowing, however, is required (see Principle 3 below).

Figure 5. Bumble bees prefer old rodent burrows in areas of un-mown grass; in these photos the observer is exposing a subterranean bumble bee nest to reveal the irregular wax combs and some of the bees.

■ *Practice*
Avoid heavily wooded areas for bee sanctuaries. The only exception is those areas with nectar-producing understory and margin plants such as bramble, gallberry and palmetto. Certain tree species, for example red maple, sourwood and tulip poplar, are good pollen or nectar sources, but even with these types of forest the bees are more likely to nest at the forest margins that have sun and a variety of nesting sites and flowering plants.

Principle 2

The richness of plant and bee species increases with time in undisturbed fallow fields. As the diversity of flowering plants increases, so does the diversity of bee species. A large diversity of bee species is good insurance for crop pollination.

■ *Practice*
Plan bee sanctuaries for the long term. In time, you can expect increasing numbers of plant and bee species in these undisturbed sanctuaries. But one catastrophic event, plowing for example, can undo years' worth of progress.

Principle 3

The most effective bee sanctuaries are mid-successional plant communities with an abundance of herbaceous perennials and few or no invading trees.

■ *Practice*
Biannual mowing is advisable to keep a sanctuary from succeeding into shaded woodlands or scrub lands. It is best to mow in winter when destroying active bumble bee colonies is less likely. A light mower is preferable to a heavy tractor-mounted implement that may crush the nests of overwintering soil-nesting bees.

Principle 4

Even managed pastures can be made more hospitable to bees.

■ *Practice*
The older the pasture, the more likely it is to have suitable bee nest sites and numerous plant species. This means it is best to keep pastures more-or-less permanent. Temporary pastures, such as those grown in crop rotation, have very low plant diversity even though the cover crop (such as clover) may be a rich bee resource for one season. Do not allow over-grazing because it promotes invasion of fast-growing grasses that crowd out nectar-yielding herbaceous plants. Herbicides can similarly reduce the number of pasture plant species. It is also important to not cut forage plants before they bloom — as is commonly done for making hay or silage — because this makes the pasture useless to bees.

Principle 5

Bees need nesting materials.

■ *Practice*
This applies mostly to mason bees that need mud to seal their nests. Make sure there is a mud source near nest holes where mason bees are active.

HABITAT IMPROVEMENT WITH INSTALLED BEE PASTURES

Bee conservation can go beyond passive habitat *preservation* to active habitat *improvement* by installing permanent bee pastures. Bee pasture is a permanent planting of flowering annuals or perennials designed to attract bees over many weeks or months. The goal is improved bee nutrition, which will encourage high bee numbers, either by attracting them to the area, increasing the number nesting in the area or by increasing their reproductive output. Long-term payoff of perennial pastures can be good, especially since non-honey bees tend to nest near where they were reared the previous year.

Candidate bee pasture plants should be rich in nectar and pollen, easy to grow, cost-effective, non-invasive, long-blooming, and not bloom at the same time as the crop and thus compete with it for pollinators. Here are some principles and practices for bee pasture plantings.

Principle 1

Bees reproduce better in habitats that have an uninterrupted season-long succession of bloom. This is best illustrated with bumble bees. The number of queens a colony can produce depends partly on the number of workers it can produce in the weeks leading up to the queen production period in late summer. Producing workers requires energy, so a colony's queen output ultimately hinges on season-long food availability.

■ *Practice*

In planning a bee pasture, it is important to choose a collection of plants that will produce an unbroken succession of bloom throughout the season. Local beekeepers, county Extension agents and horticulturists are good sources of information about the important bee plants in an area and their historic bloom times. This information can help you identify dearth times in the natural bloom calendar. Your county Extension agent, horticulture specialist or the Appendix at the end of this publication can help you select bee pasture plants that bloom during those dearth times (Figure 6). Avoid installing pasture plants that bloom at the same time as the crop or else you run the risk that bees may prefer the pasture flowers over the crop flowers.

Here is a seed blend of 11 annuals that provides long-blooming bee pasture for set-aside farmlands. Although this list was developed in Germany[5], these plants are available as seed in North America:

40% phacelia (*Phacelia tanacetifolia*)

25% buckwheat (*Fagopyrum esculentum*)

7% white mustard (*Sinapis alba*)

6% coriander (*Coriandrum sativum*)

5% calendula (*Calendula officinalis*)

5% black cumin (*Nigella sativa*)

3% red radish (*Raphanus sativus*)

3% cornflower (*Centaurea cyanus*)

3% mallow (*Malva sylvestris*)

2% anethum (*Anethum graveolens*)

1% borage (*Borago officinalis*).

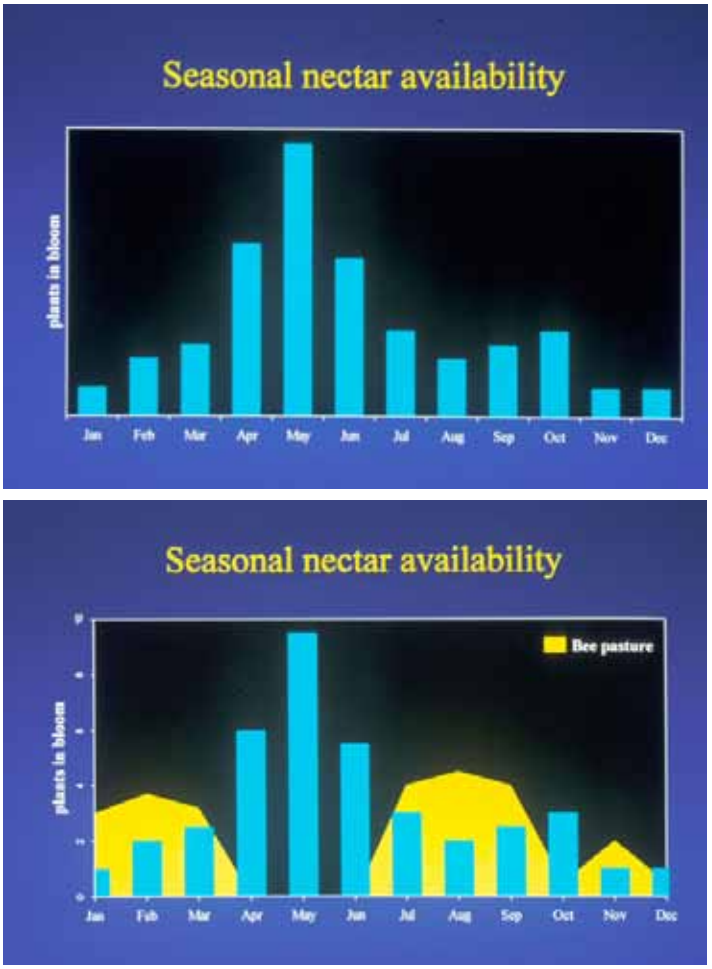

Figure 6. Most flowering and nectar production by plants in the Southeast is in early spring and autumn. Mid-summer is often a nectar dearth and a difficult time for bees (top). One goal of a managed bee pasture is to introduce plants that bloom during the natural dearth times (bottom).

Principle 2

Perennials are better bee pasture plants than annuals (Figure 7). Although some annuals provide quick and relatively abundant bee forage, perennial herbs and shrubs are superior bee forage plants and deserve special attention by bee conservationists. Compared to annuals, perennials are generally richer nectar sources. Because of their longevity, perennials provide bee populations a more-or-less dependable food source year after year and encourage repeated nesting in the area. This partly explains why the number of bee and plant species increase together over time in undisturbed meadows.

■ *Practice*

When possible, plant perennials for bee pasture. Considering the repeated labor and inputs required for annuals, perennials are a cost-effective, low-maintenance choice for bee conservationists.

Figure 7. Perennials are generally better bee pasture plants than annuals. Perennial Vitex trees bloom in mid-summer and are very attractive to bumble bees.

Principle 3

Bee nesting and foraging activities center on flower-rich habitats. Bumble bee queens prefer to nest in flower-rich meadows, and most bee species prefer to forage close to their nests. The foraging range of non-honey bees is probably smaller than that of honey bees[5].

■ Practice

Place bee pastures as near as possible to the crop of interest. This increases the chance of bees nesting near, and foraging on, the crop.

BIGGER IS BETTER

Conservationists thinking of bee sanctuaries and pastures need to think big. The diversity of bee species is highest in large, continuously-connected areas of suitable habitat. Unfortunately, farming and urbanization do the exact opposite — break up habitats into small fragments or "islands." When there are many edges to a species' natural habitat, the edges may increase invasion of competitors, parasites and predators, decrease the species' dispersal ability and increase chances of inbreeding.

Thus, bee sanctuaries and pastures should be as large as possible. One large, connected bee sanctuary, ideally on a scale larger than that of an individual farm, is better than several small, disconnected sanctuaries. One expert recommends that for a normally functioning agricultural landscape the area of land in cultivated fields or mowed meadows should not exceed 75 percent of the total area. The remaining 25 percent should be left as bee sanctuary.

BEE CONSERVATION AND PLANT CONSERVATION

Altered natural habitats are a prime cause of species loss not only of bees but also of native plants. Plants whose habitats become fragmented are widely separated from each other and may have trouble attracting pollinators. One can imagine the vicious cycle at work: habitat fragmentation separates the plants from their pollinators; plant numbers decline for lack of pollinating bees; bee numbers decline for lack of food plants.

Some modern agricultural practices may also rob native plants of habitat and lure away their pollinators. Large acreages of bee-attractive crops, such as canola, may lure all bees, native and exotic, away from native plants, depriving them of pollination and contributing further to their decline.

Native bee conservation goes hand in hand with conservation of native plants that depend on them for pollination. Without their pollinators, the colorful bee-pollinated plants that beautify our surroundings, control erosion and increase our property values would decline with unknown effects on the wildlife that depends on them for food. Thus, bee conservation is not just an issue for beekeepers and crop growers and home gardeners, although food production is by far the most important arena. It is at the very center of plant production and conservation, and all who use and enjoy plant products are stakeholders.

Appendix

Below is an incomplete list of wild and commercially available plants that provide prolonged-blooming bee pasture in the Southeast. It is important for bees, especially bumble bees, to have an unbroken succession of bloom all season to build up their local populations. If you want to encourage large bee populations, consider growing an assembly of plants from this list so that bloom is more or less continuous. It is important to choose bee pasture plants that are rich in nectar and pollen, easy to grow, cost-effective, non-invasive, long-blooming and do not bloom at the same time as the crop. Plants in the table are listed in chronological order of their average first month of bloom.

Plants for prolonged-blooming bee pasture in the Southeast

Common Name	Scientific Name	Type	Availability	Resource (nectar or pollen)	Bloom Dates
Cajeput (Tea Tree)	*Melaleuca quinquenervia*	tree	feral	n, p	much of the year
Chickweed	*Stellaria* spp.	ann. or per. herb	feral	n, p	much of the year
Cucumber	*Cucumis saliva*	ann. herb	cultivated	n, p	much of the year
Pumpkin	*Cucurbita* spp.	ann.	cultivated	n, p	much of the year
Alder	*Alnus* spp.	tree	feral	p	January-June
Blueberry	*Vaccinium* spp.	shrub	cultivated, feral	n, p	January-June
Maple	*Acer* spp.	tree	feral	n, p	January-May
Cantaloupe	*Cucumis melo*	ann. herb	cultivated	n, p	February-August
Citrus	*Citrus* spp.	tree	cultivated	n, p	February-May
Dandelion	*Taraxacum* spp.	bien. or per. herb	feral	n, p	February-September
Dead Nettle (Henbit)	*Lamium* spp.	ann. or per. herb	feral, ornamental, sometimes invasive	P	February-October
Elm	*Ulmus* spp.	tree	feral	n, p	February-April
Groundsel	*Senecio* spp.	ann. or per. herb, shrub	feral, ornamental	n, p	February-May
Hawthorn	*Crataegus* spp.	shrub, tree	feral	n,p	February-June
Peach	*Prunus persica*	tree	cultivated	n,p	February-April
Pine	*Pinus* spp.	tree	cultivated, feral	P	February-April
Skunk Cabbage (Polecat Weed)	*Symplocarpus foetidus*	per. herb	feral, ornamental	p	February-April
Titi (Spring Titi)	*Cliftonia* spp.	shrub	feral	n,p	February-April
Willow	*Salix* spp.	tree	feral	n,p	February-June
Apple	*Mains* spp.	tree	cultivated	n,p	March-May
Ash	*Fraxinus* spp.	tree	feral	p	March-May
Blackberry	*Rubus* spp.	shrub	cultivated, feral	n,p	March-June
Black Locust	*Robinia pseudoacacia*	tree	feral	n,p	March-June
Cherry (cultivated and uncultivated)	*Prunus* spp.	tree, shrub	cultivated, feral	n,p	March-May
Cottonwood	*Populus* spp.	tree	feral	p	March-May
Flowering Dogwood	*Cornusflorida*	tree	feral	n,p	March-April

Common Name	Scientific Name	Type	Availability	Resource (nectar or pollen)	Bloom Dates
Gallberry	*Ilex glabra*	shrub	feral	n,p	March-June
Mustard	*Brassica* spp.	arm. Or bien. herb	feral	n,p	March-September
Oak	*Quercus* spp.	tree	feral	p	March-May
Persimmon	*Diospyros virginiana*	tree	cultivated, feral	n,p	March-June
Plum (cultivated)	*Prunus* spp.	tree	cultivated	n,p	March-April
Rape (Canola)	*Brassica napus*	arm. herb.	cultivated oil¬seed	n,p	March-May
Rattan Vine	*Berchemia scandens*	shrub	feral	•	March-June
Redbud	*Cercis* spp.	shrub, tree	feral, ornamental	n,p	March-May
Tupelo	*Nyssa* spp.	tree	feral	n,p	March-June
Vervain	*Verbena* spp.	ann. or per. herb	feral, ornamental	n,p	March-October
Alsike Clover	*Trifolium hybridum*	per. herb	cultivated forage	n,p	April-September 1
Bindweed	*Convolvulus* spp.	ann. or per. herb	feral, ornamental, sometimes invasive	n,p	April-September
Buckeye	*Aesculus* spp.	shrub, tree	feral	n,p	April-May
Buckthorn	*Rhamnus* spp.	shrub, tree	feral, ornamental	n,p	April-June
Catclaw	*Acacia greggii*	shrub, tree	feral	n,p	April-July
Coneflower	*Rudbeckia* spp.	ann., bien, or per. herb	feral, ornamental	n,p	April-September
Cora	*Zea maize*	ann.	cultivated	p	April-September
Crimson Clover	*Trifolium incarnatum*	ann. herb	cultivated forage	n,p	April-June
Elderberry	*Sambucus* spp.	shrub, tree	feral, ornamental	n,p	April-July
Holly	*Ilex* spp.	shrub, tree	feral, ornamental	n,p	April-June
Honey Locust	*Gleditsia triacanthos*	tree	feral	n,p	April-June
Honeysuckle	*Lonicera* spp.	shrub	feral	n,P	April-August
Horsemint (Bee Balm)	*Monarda* spp.	ann. or per. herb	feral, ornamental	n,p	April-October
Huckleberry	*Gaylussacia* spp.	shrub	feral	n,p	April-June

Common Name	Scientific Name	Type	Availability	Resource (nectar or pollen)	Bloom Dates
Johnson Grass	*Sorghum halepense*	per.	cultivated forage, feral, sometimes noxious		April-November
Marigold	*Gaillardia pulchella*	ann.	feral, ornamental	n,p	April-October
Mesquite	*Prosopsis glandulosa*	shrub, tree	feral	n,p	April-June
Pear	*Pyrus* spp.	tree	cultivated, ornamental	n,p	April-May
Pepper Vine	*Ampelopsis* SOD.	vine, shrub	feral	n,p	April-August
Persian Clover	*Trifolium resupinatum*	ann. herb		n,p	April-September
Privet	*Ligustrum* spp.	shrub	feral, ornamental	n,p	April-July
Red Clover	*Trifolium pratense*	short¬lived per.	cultivated forage	n,p	April-September
Sage	*Salvia* spp.	ann. or per. herb, shrub	ornamental	n,p	April-May
Sweet Clover (White, Yellow)	*Melilotus* spp.	bien. herb	cultivated forage	n,p	April-October
Thistles	*Cirsium* spp.	ann., bien., or per. herb	feral	n,p	April-October
Tickseed	*Coreopsis lanceolata*	per. herb	feral	n	April-June
Titi (Summer Titi)	*Cyrilla racemiflora*	shrub	feral	n,p	April-July
Tulip Poplar	*Liriodendron tulipifera*	tree	feral	n,p	April-June
Vetch	*Vicia* spp.	ann. or bien. herb	cultivated forage	n,p	April-September
White Clover (White Dutch, Ladino)	*Trifolium repens*	per.	cultivated forage	n,p	April-October
Yellow Rocket	*Barbarea vulgaris*	bien. or per. herb	feral, some-times noxious	n,p	April-June
Alfalfa	*Medicago sativa*	per. herb	cultivated forage	n,p	May-October
American Beautyberry (French Mulberry)	*Callicarpa americana*	shrub	feral, ornamental	n	May-June
Aster	*Aster* spp.	per. herb	feral	n,p	May-November

Common Name	Scientific Name	Type	Availability	Resource (nectar or pollen)	Bloom Dates
Bermuda Grass	*Cynodon dactvlon*	per. grass	cultivated forage	•	May-November
Bitterweed	*Helenium amarum*	aim.	feral	n,p	May-November
Carpet Grass	*Phyla nodiflora*	per. herb	feral, groundcover	n	May-frost
Catalpa (Catawba)	*Catalpa* spp.	tree	feral	n,p	May-June
Chinese Tallow Tree	*Sapium sebiferum*	tree	ornamental	n	May-June
Grape	*Vitis* spp.	per. vine	cultivated	n,p	May-July
Palmetto (Cabbage Palm)	*Sabal* spp.	palm	feral	n,p	May-July
Palmetto (Saw Palmetto)	*Serenoa repens*	palm	feral	n,p	May-July
Prickly Pear	*Opuntia* spp.	cacti, tree¬like	feral, ornamental	n,p	May-June
Raspberry	*Rubus* spp.	shrub	feral	n,p	May-June
Smartweed	*Polygonum* spp.	ann. or per. herb	cultivated, feral, ornamental	n,p	May-November
Sorghum	*Sorghum bicolor*	ann.	cultivated	P	May-October
Sourwood	*Oxydendrum arboreum*	tree	feral, ornamental	n,p	May-July
Spanish Needles	*Bidens* spp.	ann. or per. herb	feral, ornamental	n,p	May-November
Sumac	*Rhus* spp.	shrub, tree	feral	n,p	May-September
Virginia Creeper	*Parthenocissus quinquefolia*	vine	feral, ornamental	n,p	May-August
Watermelon	*Citrullus lanatus*	ann.	cultivated	n,p	May-August
Anise Hyssop	*Agastache* spp.	per. herb	feral, ornamental	n,p	June-September
Balloon Vine	*Cardiospermum halicacabum*	ann. or bien. vine	feral, ornamental		June-August
Basswood	*Tilia* spp.	tree	feral	n,p	June-July
Vitex (Chaste Tree)	*Vitex* spp.	shrub, tree	ornamental	n,p	June-July
Broomweed	*Gutierrezia texana*	per. herb	feral	•	July-October
Goldenrod	*Solidago* spp.	per. herb	feral	n,p	July-November
Ragweed	*Ambrosia* spp.	herb	feral, often noxious	P	July-October
Snowvine	*Mikania scandens*	per. vine	feral	n,p	July-frost
Soybean	*Glycine max*	ann. herb	cultivated	n,p	July-October
Woodbine	*Clematis virginiana*	per. herb	feral, ornamental	n,p	July-September

Common Name	Scientific Name	Type	Availability	Resource (nectar or pollen)	Bloom Dates
Brazilian Pepper Tree	*Schinus terebinthifolius*	shrub,tree	feral, ornamental, sometimes noxious		August-October
Crown-beard	*Verbesina* spp.	ann or per. herb, shrub, tree	feral	n,p	August-October
Matchweed (Snakeweed)	*Gutierrezia sarothrae*	per. herb	feral	n,p	August-October
Prairie clover	*Dalea* spp.	herb, shrub	feral	n,p	September-October
Baccharis (Groundsel)	*Baccharis* spp.	shrub	feral, ornamental	n,p	October-November
Strawberry	*Fragariax ananassa*	per. herb	cultivated, feral	n,p	December-May
Blue Vine	*Cynanchum laeve*	per. herb	feral	n,p	June-September
Boneset (Joe-Pye Weed)	*Eupatorium* spp.	per. herb, shrub	feral, ornamental	n,p	June-November
Buckwheat	*Fagopyrum esculentum*	herb	cultivated	n,p	June-frost
Buttonbush	*Cephalanthus* spp.	shrub, tree	feral	n,p	June-September
Clethra (Sweet Pepperbush)	*Clethra alnifolia*	shrub	feral	n,p	June-September
Cotton	*Gossypium* spp.	ann. herb	cultivated	n,p	June-September
Cowpea	*Vigna unguiculata*	ann. herb	cultivated	n,p	June-September
Cranberry	*Vaccinium macrocarpon*	ever-green	cultivated, feral	n,p	June-July
Ironweed	*Vernonia* spp.	per. herb, shrub, tree	feral, ornamental	n,p	June-October
Lespedeza (Bush Clover)	*Lespedeza* spp.	per. herb, shrub	feral, ornamental	n,p	June-October
Lima Bean	*Phaseolus lunatus*	herb	cultivated	n,p	June-July
Loosestrife (Purple Loosestrife)	*Lythrum salicaria*	per. herb	cultivated, feral	n,p	June-September
Mexican Clover	*Richardia scabra*	ann. herb	cultivated, feral	n	June-frost
Milkweed	*Asclepias* spp.	per. herb	feral	n	June-August
Mint	*Mentha* spp.	per. herb	cultivated, feral, ornamental	n	June-September
Partridge Pea	*Cassia fasciculata*	ann. herb	feral	n,p	June-October
Prickly Ash	*Aralia spinosa*	shrub, tree	feral	n	June-August
Star Thistle	*Centaurea* spp.	ann., bien., or per. herb	feral, ornamental	n,p	June-October

References

[1]Morse, R.A. and N.W. Calderone. 2000. The value of honey bees as pollinators of U.S. crops in 2000. Bee Culture 128: 1-15

[2]Gallai, N., Salles, J-M., Settele, J., and B.E. Vassiére. 2008. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecological Economics 68: 810-821

[3]vanEngelsdorp D., Hayes J., Underwood R.M., and J.S. Pettis. 2008. A survey of honey bee colony losses in the U.S., fall 2007 to spring 2008. PLoS ONE 3(12), e4071. doi:10.1371/journal.pone.0004071

[4]vanEngelsdorp D., Hayes J., Underwood R.M., and J.S. Pettis. 2010. A survey of honey bee colony losses in the United States, fall 2008 to spring 2009. Journal of Apicultural Research 49(1): 7-14 doi:10.3896/IBRA.1.49.1.03

[5]Heinrich, B. 1979. Bumblebee economics. Harvard University Press, Cambridge, Massachusetts

Bulletin 1164 **Reviewed April 2013**