

Pollinator Friendly Gardening

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The Importance of Pollinators

Pollinators are an extremely important part of the natural world and provide *billions* of dollars of benefit yearly through their pollination of a wide range of ornamental and food crops.

There is growing concern over honey bee and insect pollinator health and an increasing desire to create gardens that are safe for pollinators and beneficial insects. As a formally trained entomologist, it is exciting to see such a strong change in public opinion about insects, as gardeners are overcome the “ick” factor and taking steps to better understand and protect insects.

Factors Affecting Pollinator Health

A number of factors have negative impacts on pollinator health. One of the most important is habitat loss. Habitat loss has a range of causes, including urban development, changes in agricultural practices (like harvesting alfalfa before it blooms), removal of hedgerows, and increased average farm field size. Climate change is another factor that will increasingly affect pollinators and may impact the distribution of various species in the future.

Pesticide exposure also has important effects on pollinators. In addition to being toxic, some pesticides have sub-lethal effects, including hindering foraging ability, learning, and reproductive success. Effects can vary by bee species.

Colony Collapse Disorder (CCD) & Honeybees

CCD is the term to describe annual losses in honey bee colonies where workers disappear, leaving the queen and brood behind with ample pollen and honey stores in the hive. Without sufficient workers, the colony can't survive. The term was coined in 2006. This is not a simple disorder, and it has multiple causes. The factors noted above that are affecting pollinator health are important aspects of the problem, but there are additional factors affecting honey bees. These include diseases (fungal, viral, and bacterial), plus mite parasites that feed on honey bees and spread viruses. Nutritional factors likely also play a role.

Recently systemic neonicotinoid pesticides have received a lot of attention. These pesticides are translocated through plant tissue and may be present in pollen and nectar. Recent research indicates that many types of pesticides used by homeowners, including those used for mosquito, flea, and tick control, are very commonly found in pollen collected by honey bees.

Despite some claims on the internet and in popular media, neonicotinoids pesticides are not a “smoking gun” for CCD. They are just part of the problem in this multi-faceted issue.

Fungicides are also increasingly of concern, as they may alter the composition of the beneficial gut microbes in honey bees. These natural microbes allow bees to process nectar and pollen into stored food for the hive.

Some Biodynamic farming practitioners believe that managing honey bees in square colonies is also a factor in CCD. There is increasing interest in alternative hive designs, like horizontal top bar hives, for managing honey bees more naturally.

Types of Beneficial Insects

Pollinators

Pollinators actively move pollen from flower to flower, allowing plants to create seed and fruits. There are a wide range of insect pollinators, including: honey bees, bumble bees, numerous types of solitary bees, some types of flies, certain wasps, butterflies, and some types of moths. In some plants species, birds or even bats serve as pollinators.

Predators

Predators eat other insects, including pest insects. They can be generalists, feeding on a wide range of insects, or have a more specialized diet. Examples include: ground beetles, praying mantids, lady beetles, syrphid fly larvae, and lacewings. In some cases, an insect species will act as a predator in only one part of its development. In other cases, both adult and immature insects are predaceous. Spiders, which are related to insects, are also effective predators.

Parasitoids

Parasitoids are a special type of parasite that kills its host. Think of the movie Alien and you will understand how these insects work. Examples include many types of wasps that lay eggs inside insects. Developing larvae feed on and eventually kill the host insect.

Hyperparasitoids are a type of insect that lay their eggs inside parasitoid species.

Creating Habitat for Pollinators in Your Garden

Basic Habitat Needs

Beneficial insects need **food**, **water**, and **shelter** in order to thrive in your garden. Though careful choices of what plants are included in the garden and how they are managed, you can significantly improve the quality of habitat in your garden.

Having a diverse range of plants in bloom throughout the season ensures that a garden is continually attractive to pollinators and beneficial insects and provides food throughout the growing season.

Flowering plants that are native to a region are particularly good for attracting native species of pollinators to the garden. In general, ornamental flowering plants with single flowers are more attractive to pollinators than those with double flowers.

Plants that flower early in the season and those that flower late in the season are particularly important for pollinator gardens. Many types of early spring blooming bulbs are an excellent early pollen sources. Species tulips are generally more beneficial to pollinators than hybrid types of tulips, because hybrid tulips have very large pollen grains that are difficult for most pollinators to carry. In fall, late-blooming perennial species like asters, goldenrod, helenium, and sedum are excellent choices.

Planting groups of at least 3 to 5 plants of a species together in the garden provides a better habitat than planting single plants.

Having a landscape with a range of plant heights, from groundcovers to shrubs and trees, including evergreens, helps to provide good sheltered spaces for pollinators to take refuge and seek shelter at night and during storms. Diversity and randomness in height provides better quality habitat than a very formal, highly managed garden with well-manicured plants.

A water source in the garden also helps to encourage pollinators. This can be as simple as

a birdbath with small rocks on one side to provide a shallow area easy for insects to access or a more complex water feature such as a small pond.

Many types of solitary bees build their nests in bare ground. Other species make nests in hollow plant stems or in rotten wood. Leaving some areas in the garden with bare, unmulched ground can provide access to nesting sites for ground-nesting pollinators. Including some brush piles, particularly piles of pithy-centered woody material, can provide nesting habitat for additional species. In addition, a number of different types of houses can be made or purchased designed to provide housing for solitary bees. Different sized holes attract different bee species. Holes generally should range from 3/32 to 3/8 inches in diameter. Drill smaller diameter holes (1/4 inch or less in diameter) 3 to 4 inches deep, and larger diameter holes 5 to 6 inches deep. For mason bees, a 5/16 inch diameter holes are recommended. Make a roof to protect homemade bee houses from rain.

Butterflies appreciate having warm, flat surfaces, to sun on to warm their wing muscles. Incorporating some large stones, like stepping stones or rocks used as features or bed edging, can provide this type of habitat in your garden.

Choosing Species to Plant

Native vs. Non-Native vs. Lawns

Native plants are excellent choices, but gardeners should not feel pressured to plant only natives. Native species generally provide better habitat for native pollinators than non-native species. However, some groups have become overly native plant snobbish, considering any non-native plants undesirable and going so far as to require native species be grown only from seed collected within a county's borders, and not considering varieties hybridized from native species as "true" natives. I can accept arguments that using native species collected from an area's bioregion can be beneficial, but limiting them to the borders of a county that was created arbitrarily is nonsensical, especially during a time of significant climate change. And there are many excellent varieties of native species that make excellent garden plants.

Replacing areas of lawns with flowering plants – native or non-native – is a great way to create beneficial habitat and reduce energy and chemical intensive lawns.

Important Plant Families

It can be helpful to learn something about plant classification when choosing plants beneficial to pollinators. Certain plant families include species with special benefit to pollinators. Plants with strong benefit to beneficial insects are sometimes called "insectary plants".

Having a diverse range of plants in bloom throughout the season ensures that a garden is continually attractive to pollinators and beneficial insects. In general, flowers with single flowers are more attractive to pollinators than those with double flowers.

Apiaceae (Umbeliferae) – Carrot Family

Produces characteristic "umbel" shaped flowers, many species are very attractive to syrphid flies, wasps, and other beneficial insects. Examples: carrot, cilantro, dill, fennel, parsley, and parsnip. Note that some umbel species are larval food plants for black swallowtail butterflies. These caterpillars usually don't cause significant damage to plants from their feeding.

Asteraceae (Compositae) – Aster Family

A very large family, with many important species. Forms “composite” flowerheads made up of many small individual flowers. Examples include: aster (many reclassified recently to *Symphotrichum* species), coreopsis, dandelion, echinacea, echinops, gaillardia, heliopsis, helenium, rudbeckia, sunflower, and many more

Fabaceae (Leguminosae) – Bean Family

Famous for their ability to capture or “fix” unavailable nitrogen gas from the air and transform it into a form useable by plants, though nitrogen fixation by symbiotic bacteria. Examples: clovers, lupine, alfalfa, sweet clover, baptisia, lupine, and many more.

Lamiaceae – Mint Family

Mint family plants have square stems, opposite leaves, and characteristic flowers with enlarged lower lips. Many, but not all, are fragrant. Many of the herbs we grow are in this family, as are many ornamental plants. Examples: rosemary, oregano, lavender, culinary sage, annual flower sages, perennial flowering sage, and thyme.

Rosaceae – Rose Family

Another large family with lots of important plants. The rose family includes fruit trees like apple, cherry, peach, plum, and pear; shrubs like potentilla and spirea; and common weeds like cinquefoil

Brassicaceae (Cruciferae) - Mustard Family

Contains a large number of edible crops, weeds, and some ornamentals. Flowers have a characteristic shape with 4 petals arranged in a cross and 4 long and 2 short stamens. Examples: broccoli, cabbage, kale, sweet alyssum (*lobularia*), *erysimum* (wallflower).

Note that not all butterflies should be considered beneficial insects. The cabbage white (*Pieris rapae*, aka imported cabbageworm) is a pest of cole crops like cabbage, broccoli, and cauliflower. I always cringe when I see butterfly food plant references include this pest species, as it was the study of my master’s research and is something of a nemesis.

Specific Plants: Perennials

Agastache (Hyssop)

A range of species, some native, with fragrant foliage that can be used for herbal teas. *Agastache foeniculum* (anise hyssop) is a native species with dense spikes of purple flowers. ‘Blue Fortune’ is a long-blooming vegetative selection with *A. foeniculum* parentage. *Agastache rupestris* (threadleaf hyssop) is native to the southwestern US and has loose spikes of long, tubular flowers. It has been used as a parent of many new hybrids with an expanded color range. All are excellent butterfly and pollinator plants, and many attract hummingbirds. Many are hardy, but there are also tender perennial types. Types with elongated tubular flowers are also attractive to hummingbirds.

Asclepias (Butterfly Weed)

A premier butterfly plant, providing nectar and it is the larval food plant of monarch butterflies. There are multiple species, including *Asclepias tuberosa* (butterfly weed), *Asclepias incarnata* (swamp milkweed), *Asclepias syriaca* (common milkweed), *Asclepias speciosa*

(showy milkweed), and others. For best monarch attraction, grow species native to a specific region, and not “exotic” natives from outside the region. The above are all Wisconsin natives.

Aster

Many have recently been moved to Genus *Symphotrichum*. Includes native and non-native species with a range of heights and bloom times from early summer to fall. Many excellent pollinator species, a great group overall. *Aster novae-angliae* (New England aster) and *A. novii-belgii* (New York aster) are natives and are excellent fall bloomers for pollinators.

Buddleia (Butterfly Bush)

Can be invasive in mild (zone 8) climates, due to spread by seed. Some sterile varieties are available. Not a problem plant in zone 5 and colder in my experience, though some native plant purists get uppity about it, even in cold climates. Varieties available in a range of colors and heights. Very fragrant and a great butterfly plant.

Coreopsis (Tickseed)

There are several good North American native species, including *Coreopsis lanceolata*, *Coreopsis grandiflora*, and *Coreopsis verticillata*. Many newer hybrid varieties with an expanded color range have been developed, some of which are annual or tender perennials.

Echinacea (Purple Coneflower)

A number of North American native species are highly recommended. *Echinacea purpurea* (purple coneflower) is available in single or double flowered forms in white, purple, or pink shades. *Echinacea pallida* (pale purple coneflower) has drooping pink to lavender petals on leafless stems. *Echinacea paradoxa* (yellow coneflower) has drooping, yellow petals and is fairly uncommon in gardens. *Echinacea tennesseensis* (Tennessee coneflower) has uniquely upturned pink to lavender petals.

New hybrids of the above species are also available in an expanded color range. Not all are long-lived in cold climates. Recommended hybrid varieties include: the Sombrero® series (single flowered), the Double Scoop™ series (fully double flowers), the brand new Prima™ series (which includes single and anemone double flowered types), and ‘Cheyenne Spirit’ (a seed propagated, single flowered, mixed color variety.)

Gaillardia x grandiflora (Blanket Flower)

An excellent North American native species. There are also some annual types, including *Gaillardia pulchella* and hybrids. These tend to be a bit short lived in the garden (3 years or so), but often reseed. Available in yellow, red, orange, and bicolor shades.

Helianthus (Sunflower)

Excellent pollinator plants, providing nectar and pollen. There are both large-flowered annual types, available in a range of heights and colors, and smaller-flowered native hardy perennial types. Note that some annual varieties are “pollen free” and are not as good a choice as pollen fertile types for a pollinator garden. Pollen free types are primarily used as indoor flowering potted plants and cut flowers, as the flowers have a longer lifespan and are less messy, as they do not drop pollen. Succession planting of annual varieties extends their flowering season.

Helenium (Helen’s Flower / Sneezeweed)

A late summer and fall blooming North American native plagued by an unfortunate common name (“sneezeweed”), due to its use as a snuff by some Native American tribes. The industry is trying to rebrand it “Helen’s flower”. An excellent fall blooming species. New varieties include several interesting bicolored types.

Liatris (Blazing Star)

Liatris spicata is an excellent North American native butterfly plant. Available in tall and dwarf forms, with either purple or white flowers. Songbirds including goldfinches enjoy the seeds. There are a few other less commonly grown native species with less dense flower spikes, including *Liatris pycnostachya* (prairie blazing star).

Marigold (Tagetes)

Very popular annual plants. There are taller and shorter types and a range of flower forms in solid and bicolor shades. Very easy-to-grow and excellent pollinator plants. Flowers are also edible. Often used as companion plants in the vegetable garden, and some types produce soil compounds that help to suppress nematode populations. Note that even double flowered varieties tend to be attractive to pollinators.

Penstemon (Beard Tongue)

A North American native with elongated, tubular flowers. *Penstemon barbatus* is a commonly grown species available in a range of colors and heights. Hummingbird attractive. There are a large number of species and an increasing number of hybrid varieties. Many of the native species are difficult to start from seed due to seed dormancy.

Phlox

North American natives. Most commonly grown are *Phlox subulata* (creeping or moss phlox), a late spring blooming groundcover which is an excellent butterfly plant, and it makes an attractive display when massed. *Phlox paniculata* (garden phlox) is an upright species with panicles of large flowers. It is available in dwarf to tall varieties in a range of colors. The Flame series is a good, mildew resistant semi-dwarf series available in multiple colors. ‘David’ is a white flowered variety with good mildew resistance.

Pulsatilla vulgaris (Pasque Flower)

A fantastic, underused spring bloomer with a long period of interest. Emerges with a fuzzy texture and produces large flowers followed by attractive seed heads. This species always gets a lot of interest in the early season garden. Available in purple shades, white, and red-purple.

Rudbeckias – Coneflowers

Excellent North American native species. There are both annual and perennial types. All are drought tolerant and excellent butterfly and pollinator plants. Great used in combination to extend the bloom season. Very highly recommended, these include some of favorite species.

Rudbeckia hirta (black-eyed susan) is an annual (or short lived perennial). Taller (3’ +) varieties tend to be short lived perennials. Often reseeds. Good varieties include: ‘Denver Daisy’ a variable bicolor yellow with red; ‘Indian Summer’ a 1995 All-America Selections winner with large flowers with brown eyes; ‘Prairie Sun’ a 2003 All-America Selections winner with large bicolor flowers with green eyes; and ‘Tiger Eye Gold’ is a newer F1 hybrid variety with excellent

landscape performance and powdery mildew resistance.

Rudbeckia triloba (three-lobed coneflower) is a tall, small-flowered species that is a short-lived perennial, but reseeds and tends to “wander” in the garden. ‘Prairie Glow’ is a newer variety with red-orange flowers with yellow tips. Both are easy to start from seed.

Rudbeckia fulgida (orange coneflower) is an excellent, popular species. ‘Early Bird Gold’ is a newer vegetative variety that is compact and early blooming; ‘Goldsturm’ is very popular and can be grown from seed; ‘Viettes Little Suzy’ and ‘Little Goldstar’ are newer vegetative varieties with compact habits.

Rudbeckia subtomentosa (sweet coneflower) is less common in gardens, but worthwhile. It is taller than *R. fulgida* and has smaller flowers with narrower petals. ‘Henry Eilers’ is a variety with a unique appearance due to its tubular, rolled petals.

Salvia – Annual types

Salvia coccinea (Texas sage) and *Salvia greggii* (autumn sage) are natives that are also good hummingbird plants. *Salvia greggii* is summer to fall blooming. *Salvia farinacea* (mealycup sage) and *Salvia splendens* (scarlet sage) are other good annual species. Most annual sages grow well in either part shade or full sun.

Salvia – Hardy Perennial Types

Salvia nemorosa / *S. x sylvestris* (flowering sage) is available in a range of heights and in colors from purple to pink to white. ‘May Night’ is a dark purple variety that was Perennial Plant of the Year in 1997. ‘Marcus’ is a compact, light blue-purple flowered variety.

Salvia – Tender Perennial Types

There are some striking tender perennial salvias often grown as annuals. These make good annual landscape or container plants. *Salvia guaranitica* ‘Black & Blue’ (Blue Anise Sage) has large flowers with prominent, very dark purple calyxes. *Salvia patens* (Gentian Sage) has large, sky blue flowers that are very attractive. ‘Wendy’s Wish’ is a hybrid with large, rose flowers that are extremely attractive to hummingbirds.

Sedum (Stonecrop)

Available in a range of colors, sizes, textures, and heights. Many are excellent groundcovers, others are upright. All are very drought tolerant. Excellent pollinator plants, and fall-blooming types are especially valuable as late season food sources.

Thymus (Thymes)

Some are culinary herbs as well as ornamental, including *Thymus vulgaris* (English thyme) and *Thymus x citriodorus* (lemon thyme), which is also available in variegated leaf varieties. *Thymus serpyllum* (mother-of-thyme or creeping thyme) is an attractive ornamental groundcover. All are drought tolerant and low maintenance.

Additional Plant Recommendations

Notable Early Spring Blooming Perennials

- *Anemone blanda* (grecian windflower) – very early blooming, compact habit, daisy-like flowers
- *Aubrieta deltoidea* (false rock cress) – compact habit, purple, pink or white flowers
- *Aurinia saxatilis* (basket of gold) – compact habit, yellow flowers.
- Spring-blooming Crocus – *Crocus chrysanthus* (snow crocus), *Crocus vernus* (Dutch crocus). White, yellow, purple, or bicolor flowers. Bulb.
- *Chionodoxa forbesii* (glory of the snow) – Compact, with bicolor flowers. Bulb.
- *Helleborus* (Hellebore) – Excellent, long-lived, perennial groundcovers that bloom in very early spring.
- *Muscari* (grape hyacinth) – Bulb.
- Squill – Siberian (*Scilla siberica*), alpine (*Scilla bifolia*), and striped (*Puschkinia scilloides*). Excellent bulbs for mass planting and naturalize well. Flower early enough in the season that they can be grown in lawns, as foliage dies back before the need to mow.
- Species tulips – many types, including *Tulipa bakeri*, *Tulipa batalinii*, *Tulipa biflora*, *Tulipa clusana*, *Tulipa humilis*, and *Tulipa tarda*. These naturalize very well and tend to be much longer lived than hybrid tulips in the Midwest. Bulb.
- Wallflower – *Erysimum* species. Fragrant.

Notable Fall Blooming Perennials

- Helen's Flower (aka sneezeweed) - *Helenium autumnale*
- Fall Asters – *Aster novae-angliae*, *Aster novi belgii*, *Aster dumosus*
- Fall Flowering Sedums – *Sedum* and *Hylotelphium* species.
- Fall Flowering Crocus
- Goldenrods - *Solidago* species

Notable Annuals

- Basil (*Ocimum* species) – Best harvested at or before developing flower buds when used as a culinary herb, and will branch and regrow after harvest. Plant extra and allow some to flower in the garden, as they are very attractive to beneficial insects. Some varieties were bred for their ornamental flowers.
- Borage (*Borago officinalis*) – Attractive, star-shaped blue flowers. Edible (but fuzzy) leaves with mild cucumber flavor. Often reseeds in the garden. Edible flowers.
- Cleome (*Cleome species*) – aka Spider Flower. An old fashioned annual.
- Cosmos (*Cosmos bipinnatus*) – available in a range of heights and colors. Single types are best for pollinators.
- Lantana (*Lantana camara*) available in a range of colors. A good hanging basket and container plant.
- Mexican sunflower (*Tithonia rotundifolia*) – easy-to-grow, heat tolerant, and tolerates poor soil. Daisy like flowers.
- Marigold – Single-flowered French varieties (*Tagetes patula*) and Signet types (*Tagetes tenuifolia*) are best. Edible flowers, often used as companion plants, as their strong fragrance is thought to help repel pests.
- Pentas (*Pentas lanceolata*)
- Pot marigold (*Calendula officinalis*) – Edible flowers.

- Sunflower (*Helianthus annuus*) – available in a range of heights and colors. Choose pollen-containing (vs. pollen-free) types for best results. North American native.
- Sweet Alyssum (*Lobularia maritima*) – cold tolerant annual with fragrant flowers. Sometimes used in commercial vegetable production as an insectary crop to promote beneficial insects. Newer varieties have improved heat tolerance for extended bloom .
- Texas sage (*Salvia coccinea*) – Native. Also attractive to hummingbirds.
- Verbena – a good groundcover, hanging basket, or mixed container plant. Available in a wide range of solid colors and bicolors.
- Wallflower (*Erysimum* species) – cool season crop with fragrant flowers.
- Zinnia – Single and semi-double flowered types are best for pollinators. The ‘Profusion’ and ‘Zahara’ series are highly recommended.

Notable Shrubs

- Buttonbush (*Cephalanthus occidentalis*)
- Dogwoods (*Cornus* spp.)
- Smooth hydrangea (*Hydrangea arborescens*)
- Mockorange (*Philadelphus lewisii*)
- New Jersey tea (*Ceanothus americanus*)
- Ninebark (*Physocarpus opulifolius*)
- Oregon Grape (*Mahonia aquilifolium*)
- Rose (*Rosa* species) – single and semi-double flowered varieties are best. *Rosa rugosa* is good, and produces large hips
- Shrubby cinquefoil (*Potentilla fruticosa*, aka *Dasiphora floribunda*)
- Spicebush (*Lindera benzoin*) – Early spring blooming, also produces fruit eaten by birds. Larval food plant of the spicebush swallowtail butterfly.
- Spirea (*Spiraea* species)
- Viburnum (*Viburnum* species)

Notable Shade Plants

- Bleeding heart (*Dicentra* species)
- Cardinal flower (*Lobelia cardinalis*) – native, and a fantastic hummingbird plant. Tolerates wet soils.
- Columbine (*Aquilegia* species) – Red columbine (*Aquilegia canadensis*) and golden columbine (*Aquilegia chrysantha*) are native species. There are also hybrid types in a range of colors and flower forms.
- Foxglove – *Digitalis purpurea* and other species
- Great blue lobelia (*Lobelia siphilitica*) – native, tolerates wet soils.
- Green and gold (*Chrysogonum virginianum*) – a creeping, yellow flowered native.
- Lungwort (*Pulmonaria*) – attractive silvered leaves
- Spotted deadnettle (*Lamium maculatum*) – white to pink flowers and silvered leaves
- Yellow archangel (*Lamium galeobdolon*) – yellow flowers

Select Butterfly Larval Food Plants

- Black swallowtail – carrot family plants including carrot, parsley, dill, fennel, wild carrot
- Checkerspot – Aster species
- Clouded sulphur – alfalfa, clovers, pea
- Common tortoise Shell – aspen, willow, birch
- Coral hairstreak – plum, wild plum, chokecherry
- Fritillary – violets
- Giant swallowtail – prickly ash
- Mourning cloak – aspen, birch, elm, nettle, willow,
- Monarch – milkweed species
- Painted lady – Aster species
- Red admiral – elm, nettle
- Silver spotted skipper – honey locust, wisteria
- Spicebush swallowtail – sassafras, spicebush
- Tiger swallowtail – basswood, cherry, chokecherry, willow
- Viceroy – apple, aspen (poplar) plum, willow species
- White admiral – aspen (poplar)

Low Impact Pest Control

In addition to having a garden that blooms over a long season, pest control choices play a key role in making a garden healthy for pollinators. One of the most important steps is reducing or eliminating the use of toxic pesticides and choosing pest control products that are safe for pollinators and beneficial insects. By providing good habitat for beneficial insects and using non-toxic pest control options, predatory and parasitic insects that attack pests will flourish in the garden, often naturally controlling pests before they can damage your plants.

There are a number of options besides pesticides for controlling insect pests, and pesticides should generally be considered a last resort.

Scouting

It is very helpful to closely inspect plants for signs of insects and diseases when in the garden. Take the time to look at the undersides of leaves here and there in the garden, looking for both pest and beneficial insects. By finding pest populations early, they can often be controlled more easily before a large outbreak occurs.

The goal in controlling pests is not to completely eliminate them from the garden, but to prevent them from damaging plants enough to reduce performance. Thus, a key goal is preventing buildup of large pest populations.

Small populations and young insects are generally easier to control than large populations and more mature insects. Finding and destroying the eggs of pest insects before they hatch will prevent damage.

Resistant varieties

One of the best ways to reduce pesticide use is to grow varieties that are naturally resistant to problems. Disease resistant varieties are available for many types of fruit and vegetable crops. Check the variety descriptions for information on specific resistances. Insect resistance is less common, but there are breeders working on pest resistance in vegetable crops.

Exclusion

Insect pests can be prevented from harming plants by excluding them from the crop with protective coverings like floating row covers or fleece grow tunnels. This is an excellent strategy for protecting young seedlings or transplants when they are especially sensitive to damage from feeding insects. Row covers can be a good choice to protect crops from highly damaging, difficult to control pests like cucumber beetle, onion maggot, and Colorado potato beetle.

Remember that covers will also exclude pollinating insects that are needed by some crops. For these crops, covers should be removed once flowering begins, to allow pollinators access to the plants.

In general, leaf and root vegetables do not require pollination and can be kept covered. Some vegetables that flower and fruit are self-pollinating and will produce just fine if they are kept covered. Certain vegetables, like cucumbers, have varieties that are parthenocarpic and produce seedless fruit without being pollinated, while other varieties require pollination.

Physical Control

The “two bricks” approach, a low-tech control method that can be highly effective in small scale gardens. Hand picking and squishing (or dropping into soapy water for the squeamish) is the most common strategy. For the adventurous, there are additional options for some pests. For instance, tomato hornworms are edible!

Pollinator-Friendly Pesticides

Pesticides include compounds designed to control insects (insecticides), mites (miticides), diseases (fungicides), and weeds (herbicides). Not all pesticides are made of toxic compounds, and not all organic pesticides are safe for pollinators. It is wise to choose the least toxic options when using pesticides, as they are safer to apply and are not harmful to beneficial insects and pollinators.

Always carefully read and follow all label directions when applying pesticides to ensure they are mixed, used, and disposed of properly without causing any harm to the applicator, the environment, or non-target organisms. A good general rule of thumb is to avoid applying pesticides to plants that are blooming and to spray late in the day when pollinator activity is low.

Diatomaceous earth is a natural abrasive dust that can be sprinkled on plants to control leaf-chewing insects, including caterpillars and beetles. When eaten, the abrasive diatomaceous earth damages the insect digestive system, killing them. Diatomaceous earth is effective against both adult and larval stages of insects. It can also be spread on the soil surface to help protect plants from slugs and snail damage.

Bacillus thuringiensis (Bt) is a natural bacterial toxin that is primarily used against caterpillar pests. There is also a strain of Bt used against Colorado potato beetle larvae. Bt must be eaten to be effective, so it is very safe for pollinating insects. All types of Bt are most effective against very small growth stages, and should be applied when the targeted pest is very small. Be sure to thoroughly cover leaves when applying Bt. **Thuricide** is an example of a Bt product. Avoid using Bt products on butterfly larval food plants.

Horticultural oil is an excellent option for controlling soft-bodied insect pests like aphids and whiteflies, and can also be effective against mites. Oils are contact insecticides and act by smothering insects, so thorough coverage is needed. Oil sprays are often used on dormant fruit trees to control overwintering pests and diseases. Newer oil products can be used on actively growing plants. Avoid applying oils when temperatures are very warm (over 85 degrees), as high temperatures may promote damage to leaves. Horticultural oils are safe for

pollinators when applied at times when the pollinators are not active on plants.

Insecticidal soaps are another good, safe insecticide. Insecticidal soaps are contact insecticide and have no residual activity, so be sure to thoroughly cover plants, including leaf undersides, when spraying.

Neem oil is a product made from a tropical tree. It contains azadirachtin, which reduces feeding and egg laying by insects, and also interferes with the molting process in insects if consumed, acting like a pesticide. It also has some activity in controlling diseases by preventing disease spore germination. It can also control soft bodies insects like aphids and whiteflies by smothering them, as a horticultural oil does.

A bacterial toxin called spinosad (pronounced “spin-OH-sid”) is available in products like **Colorado Potato Beetle Beater** and **Captain Jack’s Deadbug Brew**. Though it is toxic to honey bees if they come into contact with the solution directly, once it has dried it is considered safe. Studies on bumblebees have shown spinosad to potentially have some sub-lethal effects on larvae fed with pollen containing spinosad residue, so avoid spraying it on plants that are budded or in flower. It can be used safely on non-flowering crops if applied when bees are not present.

Beneficial microbial products

There is a new class of biological fungicides that are non-toxic. They use beneficial microbes that grow on plants and provide protection from diseases. These are very safe and non-toxic to pollinators. These are preventative in action, so they should be used before disease symptoms occur. They can be a good option for protecting young seedlings from damping off disease. They can also be helpful in preventing early and late blight disease on tomatoes.

Actinovate is a natural bacterial product that can be used both as a soil drench or a foliar spray. When applied to the soil, the bacteria colonizes plant roots and helps them to take up water and nutrients, as well as protecting them from disease infection.

Serenade is a natural bacterial product that is used as a foliar spray. It can be a good option for protecting a wide range of plants from diseases, from ornamentals to fruit and vegetable crops.

Honey bees have beneficial gut microbes that are involved in their processing of pollen and nectar into food for the colony. Even fungicides that are not directly toxic to bees can potentially have effects on a colony by influencing this rich gut microflora. Reducing the use of conventional fungicides in the garden will help to reduce potential problems.

Tips for Effective Use of Low Impact Pesticides

Understanding something about the life cycle of pest insects can help gardeners to make good choices about how to control them most effectively.

Applying pesticides properly is also very important in achieving good control. There are several important keys to consider to maximize the effectiveness of pesticides.

Spot spraying is a technique used to minimize the amount of pesticide needed by applying it just to areas where a pest is present. This is helpful for pests that tend to form colonies, like aphids. Treat just the areas where the pest is present, ensuring that coverage is good.

Spray areas where pests congregate to ensure that they are exposed to the pesticide that is used. When spraying for pests like squash bugs that usually hide under leaves, make sure that your spray thoroughly covers both sides of leaves. When treating squash vine borer, a pest which burrows into the bases of squash vines and sometimes leaf petioles, it is more important to treat the lower part of the vines and leaf petioles than to spray the leaves.

Additional Resources

The Pollinator Partnership has free regional planting guides with good choices for pollinator-friendly plants. See <http://www.pollinator.org/guides.htm>

Scientific Beekeeping (<http://scientificbeekeeping.com/>) an excellent site with good scientific information on beekeeping, colony collapse disorder, and pesticides.

The Xerces Society has a reference for making solitary bee houses http://www.xerces.org/wp-content/uploads/2008/11/nests_for_native_bees_fact_sheet_xerces_society.pdf

The Monarch Joint Venture Milkweed Info Sheet contains good info on milkweeds: <http://monarchjointventure.org/images/uploads/documents/MilkweedFactSheetFINAL.pdf>