Garden Mastery Tips
from Clark County Master Gardeners

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Partners in Pollination

Pollination is the result of pollen being transferred from an anther to the stigma of a flower. This must happen in order for a plant to produce seed. Most pollination happens with the help of animal vectors. In order to effectively use an animal pollination vector, a flower needs to attract an animal for the first visit. This is done in one of two ways: visual and olfactory cues.

What is a visual cue?

An example of a visual cue is a Rudbeckia. It uses the "bull's eye" target approach. The bull's eye is black and the yellow ring of petals surrounds it to make it quite noticeable. The Hemerocallis also uses the bull's eye technique, only in reverse, with the yellow center and dark petals. The effect is the same. The flower is going to be obvious to a potential pollinator flying overhead.

It is important that whatever color pattern is used be within the pollinator's visible range of colors. Colors obvious to one animal may be invisible to another. Bees have no ability to perceive red colors, but their vision does extend into the ultraviolet. In other words, bees see colors that are invisible to us! Using their sensitivity to UV light, they see patterns on flowers, which lead them to the pollen. These patterns are called nectar guides. Like paint on an airport runway, the nectar guides essentially guide the pollinator in for its reward.

Visual cue colors known to attract pollinators:

- Purple, brown, greenish – flies
- Dull white, green – bats
- White, pale green – moths
- Bright red, yellow or blue – butterflies
- Bright red – hummingbirds
- Variable, but no pure red – bees
- Variable, usually dull – beetles

What is an olfactory cue?

It essentially is a smell emitted from the plant that becomes an attractant for potential visits from animals. During these visits is when pollination happens. In essence, the more times a plant can attract visitors, the better likelihood it will be successfully pollinated and in turn produce seed for future plants.

Definitions

Aminoid

The aminoid group of flowers smell unpleasant to attract flies or beetles, their odor being of decayed fish or ammonia. This group includes many umbel flowers such as giant fennel.

Animal Vector

Refers to any animal involved in the process of picking up and transferring pollen to another plant.

Anther

The pollen bearing part of the flower.

Nectar Guides

Contrasting ultraviolet patterns invisible to humans, that lead bees to the flower center.

Some olfactory cues known to attract pollinators are:

- Rotting flesh or dung – flies
- Sweet or spicy – bees
- Strong fruity, fermented or musky – bats
- Heady sweet fragrances – moths
- Strong, fruity or aminoid – beetles
- Slight to moderately sweet – butterflies
- No odor – hummingbirds

Why do animals visit flowers?

Bees, beetles, and others visit flowers for the pollen reward. What is pollen? Pollen grains are composed of starches, proteins, oils, vitamins and minerals. It's a balanced diet for the pollinator. Beetles are big eaters of pollen and need a lot to sustain themselves; therefore, flowers they visit must provide them with lots of reward.

Pollen isn't the only thing pollinators are after. Nectar is the sole energy source for most butterflies. Bees collect nectar and evaporate it down to make honey for winter supplies. Hummingbirds must consume vast quantities of nectar to continue their high-energy method of flight. Nectar is rich in carbohydrates, but is a weak source of most other nutrients.

Nectar is produced in the nectary which can be on any flower part, and is simply some epidermal area composed of many permanently open stomata. Beneath the nectary epidermis are vein endings that continually unload sugar from the phloem. Water follows by osmosis and the result is a "bleeding" of sugary liquid through the stomata. The nectar may accumulate in the base of the flower, or perhaps even in a long pouch called a nectar spur. *Aquilegia* flowers have long spurs that contain nectar.

Definitions cont.

Olfactory

Relating to, or contributing to the sense of smell.

Phloem

Food conducting tissue of vascular plants.

Proboscis

The long slender tubular feeding and sucking organs of certain invertebrates such as insects, worms and mollusks.

Samara

A dry, indehiscent (not splitting open at maturity), winged, often one-seeded fruit of the ash, elm or maple trees.

Stigma

The receptive apex of the pistil of a flower, on which pollen is deposited.

Stomata

Minute pores in the epidermis of a leaf or stem through which gases and water vapor pass.

Ultraviolet

Refers to the range of invisible radiation wavelength just beyond the violet in the visible spectrum.

But as we said before, flowers attract pollinators by visual and olfactory cues. We just talked about some of the visual cues. The olfactory cues are just as important in attracting the right pollinator for the job.

What about the shape of the flower?

The shape of the flower is not what attracts the pollinator; however, it can be helpful in completing the pollination process once the animal vector visits.

The simplest flowers, such as daisies and magnolias, display several identical petals arranged in a disc shape around a central cone. Crawling beetles or flies easily pollinate these flowers. Others, such as snapdragons require their pollinators, (usually bees or wasps) to exhibit greater dexterity or persistence to get their pollen and nectar reward. For example, the Scotch broom explodes when a large bumblebee lands on its lower petal, the keel. The five stamens and the style are curled up inside the keel, which is hooked into the wing petals on both sides. The weight of the probing bee causes the petals to come apart, creating a tiny pollen cloud that settles on the bee's back.

Fuchsia, trumpet vine, hibiscus, and highly specialized tubular flowers exclude insect pollinators because their nectar is hidden deep in the bottom of the tube. These flowers also lack a "landing pad" so it is difficult for flying insects to alight on the flower. That's where the hummingbirds come into play.

Bird pollinated flowers are often larger, brush-like flowers, such as *Protea* and *Eucalyptus*, or sturdy flowers with rigid perching platforms which can hold the weight of birds that don't hover. These perches are often in the form of small twigs or stiff leaves near the flower.

Who are some of our pollinators?

Our pollinators come in all shapes and sizes with different reasons for visiting plants.

The Moth

Moths are nocturnal and are mostly attracted to white or drab colored flowers with absent nectar guides. The flower usually has a strong, heavy, sweet perfume or soapy odor. Moths wave their feeders, which serve as olfactory organs to locate flowers. Moths pollinate such plants as honeysuckle, *Nicotiana* and *Yucca*.

Charles Darwin, who based much of his evolutionary theory on observations of orchid pollination, predicted that a large, ivory-colored orchid flower he found, must be pollinated by a hawk moth with a proboscis long enough to reach the nectar at the bottom of the tube. Forty years later, he was proved right when a hawk moth with a 12-inch long proboscis was found on Madagascar and named *Forma predicta*, or "predicted form".

The Butterfly

Butterflies are daytime visitors to blossoms that are erect with a flattened rim. The flowers usually are brightly colored and contain lots of nectar in well-hidden narrow tubes or spurs. Like moths, butterflies use their proboscis to reach the nectar.

The Beetle

Beetles most likely evolved when flowering plants as a group were born. Although they were our first pollinators in pre-historic times, today their performance in pollination is disappointing. Some modern beetles do visit smelly flowers of an open type, such as elderberry and hawthorn, but with few exceptions they are still mainly pollen eaters. The voraciousness of flower beetles demonstrates the futility of enticing insect pollinators solely with such an indispensable material as pollen. As a defensive strategy, certain nectar-free flowers that cater to beetles and bees – such as wild roses, peonies, and poppies – produce a superabundance of pollen.

The Fly

Flies are important in that they are out early in the year when bees aren't. There are two kinds of fly flowers: the fly blossom and the carrion/dung flower. The carrion/dung flower speaks for itself, but the fly blossoms are often light in color and dull. The blooms may have a sweet odor or none at all. They provide nectar guides and have short tubes for easy access to the nectar.

The Bat

Bats are among the most important seed dispensers and pollinators of tropical rain forest trees and plants. Many economically important crops such as bananas, avocados, mangoes, cashews, dates, vanilla and tequila are all dependent upon bats for pollination. Bats are in serious decline nearly everywhere in the world due to habitat disruption and destruction. Several of our American bats are on the Endangered Species List. The bats we have here in the Pacific Northwest are better known for their ability to eat bothersome insects, such as mosquitoes, than pollinating our cool weather crops.

The Wasp

Wasps visit flowers mostly for the nectar. There are some Mediterranean and Australian orchids that mimic female wasps so successfully that male wasps try to copulate with the flowers and receive pollen masses on their bodies in return. Some wasps also use diminutive flowers as incubators for their young and in doing so, help in the pollination process.

The Slug and Snail

Slugs and snails, by far, are more destructive to plant life than they are effective as pollinators. However, they pollinate flowers as they crawl over them and the pollen sticks to their slime and is deposited onto the next flower.

The Bird

About 2,000 species of birds, belonging to 50 families, visit flowers regularly to feed on nectar, pollen, spiders, and flower-inhabiting insects. Most of these bird species have special physical adaptations: curved beaks, tongues shaped into tubes, or tongues provided with brushes. Some flower-pollinating birds are: sunbirds, honey eaters, hummingbirds, honeycreepers, flower-peckers, white-eyes, and bush-tongued parrots.

Generally, the sense of smell in birds is poorly developed and not used in their quest for food. Instead they rely on their powerful vision and their color sense, which resembles man's. As might be expected, bird flowers generally lack odor, are brightly colored, open in the daytime and are bigger than most insect-pollinated flowers. They are sturdily constructed as a protection against the probing bill. Pollinating birds are much larger than insects and have a very high rate of metabolism; therefore, they need much more nectar per individual than insects do.

The Bee

Today bees are probably the most important insect pollinators we have. They do a great job and they visit the widest range of plants in their pursuit of pollen and nectar. Fragrance may be the decisive factor in establishing the honeybee's habit of staying with one species of flower as long as it is abundantly available. Also, honeybee workers can communicate to one another both the distance and direction of an abundant food source by means of special dances.

Honeybees have been nearly wiped out by parasitic mite infestations, therefore, our solitary bees, such as mason bees and leaf cutter bees, are becoming more important as pollinators. These bees are easy to attract to your yard by building a nest for them.

Miscellaneous Others

There are several thousand species of birds, mammals and reptiles that are known pollinators. Ants help pollinate when they are searching out nectar from blossoms. The Capuchin monkey (organ grinder monkey) laps up nectar from plants at the upper levels of the rain forest canopy. When doing so, the fur on its face gets a coating of pollen. The same type of thing goes on with the honey possums when they visit *Eucalyptus* and the South African rock mouse when they visit *Protea* flowers.

The bush cricket deposits her eggs in the tissue of flowers and then feeds on the pollen. Spiders, dragonflies, and damselflies all have limited use as pollinators. Even mosquitoes, thrips, aphids, and midges get in on the act of pollination. And let's not forget human beings.

Wind and water also aid in pollination. Large conifer forests, as well as most grasses are wind pollinated. Wind is not only a pollinator but also a seed disperser. Just think about the dandelion blowing in the wind and those samaras ("helicopters") from the maple tree settling down to earth.

Water is the most ancient method of pollination. Algae and some mosses continue to use this method today. The powerful wave action of the ocean also aids in the dispersement of seeds from surfgrasses.

Something to consider

As you can see, there is a large variety of animals needed to pollinate our plants. As the world's population grows, the need for food crops increase, as well as oxygen production from our green plants, and the cleansing of the air by our large trees. These are all-important factors for us humans. We need to ensure proper habitat for our pollinators so they can do their job.

Links

Additional information on beetle and fly pollination

The Role of Odoriferous Chemical Compounds and Thermogenesis in the Pollination Ecology of Certain Plant Species. Phyllis M. Pineda.

Olfactory cues

A Garden Worth 10 Scents. The Green Mountain Gardener. Leonard Perry, Extension Professor, University of Vermont.

Fragrant Perennials. Leonard P. Perry, Extension Professor, University of Vermont Extension, OH 66.

Building a Mason Bee nesting block

Mason Bees as an Alternative. Bill Anderson. Oregon State University, Douglas County Master Gardeners.

For additional information on bat conservation

Bat Conservation International.

For a look at nectar guides

Nectar Guides. North Carolina State University.

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Arrillagga, Pauline. CANOE's *Invasive Mites Threaten U.S. Honeybees, Beekeepers.*

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