Pollination – A Primer

Tony Jadczak, former State Apiarist

Spring has sprung in many parts of the US, and thousands of hives have been rolling across interstate highways during winter months to service a variety of crops in southern and western areas. Springtime in Maine is only weeks away and soon gardeners, farmers and beekeepers will be thinking about planting, blooms, bee management, pollination and the weather.

With all of the recent media attention concerning the necessity for pollination and the deficit of pollinators, it is important to have perspective about the variety of crops grown and cultural requirements. Friends and neighbors often have questions about bees and pollination. Inform them that not all crops require pollination for production and certain crops that do require pollination for success don't necessarily need a pollinator.

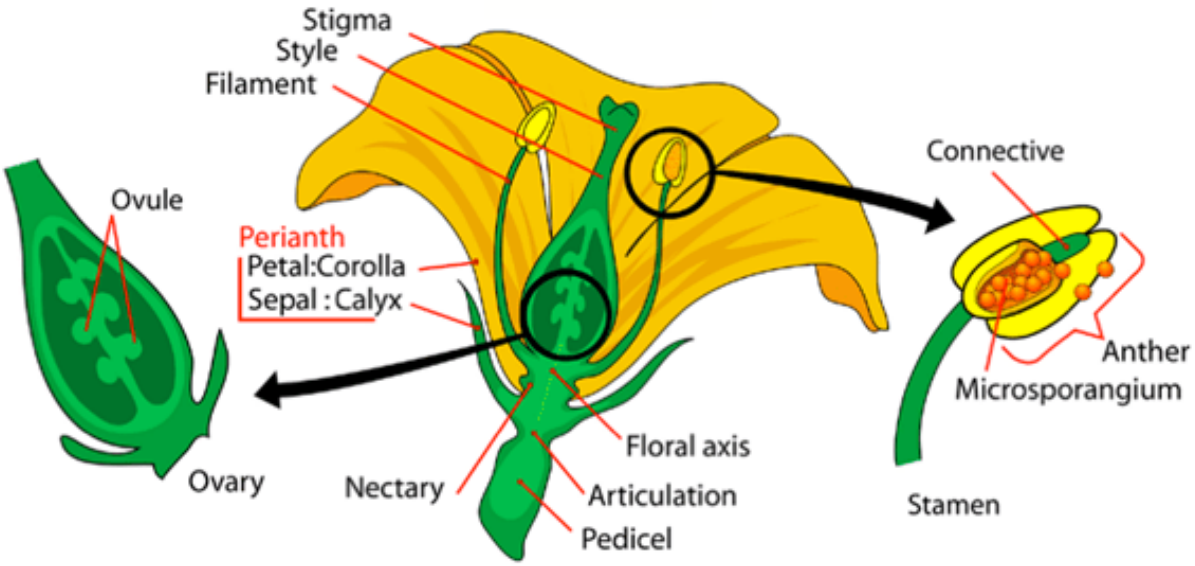
For readers who weren't paying attention during health class, and need a refresher on "the birds and the bees," here are the basics.

Pollination is the transfer of pollen from the anther (male) part of a flower to the stigma (female) of the same or another compatible flower in order to set seed or a fruit crop.

When the pollen adheres to the stigma, it germinates a pollen tube that grows through the stigma and style to the ovary. Fertilization occurs in the ovary when the nucleus of the pollen (male germ cell) unites with the nucleus of the ovule (female germ cell) within the ovary thereby setting seed. The number of fertilized ovules effects crop production by influencing the size, shape and ripening period of the fruit, vegetable, seed or nut.

Wind, gravity, water, birds, bats and insects are vehicles that typically accomplish pollination. Plants that produce numerous light non-sticky pollen grains that are easily blown by the wind are referred to as wind-pollinated plants. Examples of wind-pollinated plants include grasses, pine trees and corn.

In contrast, insect- and/or animal-pollinated plants usually produce heavy, sticky pollen grains that are not easily blown by the wind.



Main parts of a mature flower. ILLUSTRATION: MARIANA RUIZ VILLARREAL

Definitions

Pollination is the placement of pollen on the stigma, the first step in plant fertilization.

Self-pollination occurs when a plant is capable of placing its own pollen upon its own stigma. The flower must be self-fertile or self-compatible.

Cross-pollination occurs when pollen is transferred from one flower to the stigma of another. The flower must be cross-compatible. Cross pollination is common among almonds, apples and blueberries where different varieties or compatible clones are needed for seed set.

Nearly 75% of the world's 240,000 species of flowering plants are dependent on pollinators for reproduction. Therefore, many plants have flowers that secrete nectar (sugary scented liquid located at the flower's base) or a particular scent (such as rotting flesh) in order to attract animals or insects for the purposes of pollination. Other plants reward pollinators by producing excessive amounts of pollen or a specific chemical necessary for the pollinator's survival.
There are about 90 crops grown in the US that require insect pollination, and bees are the primary insect pollinators. Bees are efficient pollinators since they are vegetarians and are well adapted for pollen collection with hairs covering their bodies and appendages specifically adapted for pollen collection and

transportation. Bees gather and use pollen as their protein source for brood rearing/nutrition and nectar as their source of carbohydrates. Honey bees differ since they are able to produce and store honey made from nectar for consumption during the winter or periods of dearth.

There are approximately 3,500 wild bee species in N. America, with the majority being solitary bees. Honey bees and bumble bees are the only social species in N. America. Except for the honey bee, all of the solitary and bumble bee species have an annual life cycle with the colony started and offspring produced from a single female or queen that was produced during the prior seasonal cycle or previous year.

There are five common families of solitary bees.

1. **Megachilidae** (leaf cutters or mason bees) are the most popular solitary bee family among orchardists and gardeners. The Megachilids vary in color from metallic green and blue to black with yellow bands on the abdomen. The female bees have scopa (rows of hairs) under the abdomen that are used to carry pollen. These bees are gregarious and nest communally when nest- ing sites are abundant. Certain species are managed and commercially available (blue orchard bee, Japanese hornfaced bee, alfalfa leaf cutter) for pollination of fruit and seed crops. Most Megachilids are tunnel nesting bees and readily nest in drilled wood or polystyrene blocks, straws and phragmites reeds. An excellent reference on raising leaf cutters is SARE Handbook #11, Managing Alternative Pollinators — A Handbook for Beekeepers, Growers and Conservationists.
2. **Andrenidae** are black, moderately hairy bees that are solitary ground nesters. The female carries pollen on scopa (hairs) on the hind legs and excavates a vertical shaft with lateral tunnels that are provisioned with pollen and used as brood chambers. A species common to Maine emerges in early- to mid-April and initiates telephone calls from concerned citizens to my office each year. A sure sign of spring!
3. **Colletidae** (also known cellophane bees) are soil nesters and large numbers are known to nest in suitable habitat. This bee is black with white pile on the head and thorax. The bee has dense body hair and conspicuous white strips on the abdomen. The females line their brood cells with a liquid mixture of chemicals that dries to form a clear cellophane-like membrane that is waterproof and resistant to fungal attack.
4. **Halictidae** are known as sweat bees and are about the size of a carpenter ant. In hot weather, the bees are attracted to human perspiration and alight

on people to drink their perspiration, presumably for moisture and the salts within. The bees are sparsely to moderately hairy and vary in color from black to brownish with certain species appearing metallic green. A number of species have stripes on the abdomen. The females carry pollen on the hind legs and posterior thorax. The Halictids are soil-nesters and line their cells with a shiny varnish-like finish that impregnates the soil. The alkali bee is reared in the western US for alfalfa pollination.

5. **Anthophoridae** consist of cuckoo bees, digger bees and carpenter bees. The cuckoo bees
6. are black and yellow or black and white, hairless, and look wasp-like. These bees do not collect pollen since the female lays her eggs in the nests of other bees that raise her offspring. The digger bees are stout and vary from bare to hairy according to species. The coloration varies from pale brown to black, yellow or red. Carpenter bees are wood- boring bees that vary in size and appearance. The *Xylocopinae* resemble bumble bees and are found in southern Maine. The *Certina* are more ant-like and are found state-wide.
7. **Apidae** include the bumble bees and honey bees. Both of theses bees have hairy bodies with variable coloration and striping patterns. Bumble bees are native to both hemispheres, in contrast to honey bees which have been introduced from Europe and Africa. Asian honey bees exist but have not as yet been introduced to the western hemisphere. By far, honey bees and bumble bees are the most frequently used pollina- tors in agriculture.

   Bumble bees are commercially reared and are primarily used for crop pollination in greenhouses. Commercially reared bumble bees are also used in field crops such as blueberry, cranberry and strawberry. Honey bees are used on a variety of crops because of their ability to pollinate many different plant types and ease of management and availability.

Are additional pollinators needed?

Depending upon the crop type, the acreage and local situation, the need for additional pollinators varies. For example, on small diverse acreage (not huge monocultures), over forty-five species of bees have been observed pollinating berry crops in Maine and Massachusetts and sixty-seven bee species were documented in Nova Scotia. In cases where there are abundant native pollinators or a local beekeeper is nearby, gardeners and growers can relax and save money since there is minimal or no need for imported or rented hives. The only way to know is to look at the various plants in bloom.

Growers and gardeners can enhance native pollinator populations by maintaining refuge areas on the property or farm. Bee refuge areas are common near wood lines and field perimeters. These areas can be perpetuated by avoiding the use of herbicides and insecticides and not disturbing the soil in areas where bumble bees and native solitary bees nest. Solitary bee populations are also enhanced by providing nest sites such as drilled wood and/or polystyrene blocks in sheltered locations.

For large acreage or areas that lack sufficient numbers of pollinators, bumble bee, leaf cutter or honey bee rental is recommended.