Understanding and Promoting Crop Pollination

by Blaine Butchart, Agriculture Solutions

Every year, pollination is worth billions of dollars to the agriculture business. It provides stability in the food web and the whole food chain of life. Pollination is key to the success of the entire food industry. Consider an arch that has a keystone piece keeping two halves together; remove the "keystone" and the arch collapses. Honey bees are a chief pollinator in agriculture. Albert Einstein said, "If honey bees became extinct human society will follow in four years."

The Basics of Pollination

Pollination all begins in the flower. Flowering plants have male and female parts. The male parts, called stamens, produce a sticky powder called pollen. The female part, called the pistil, has a tip called the stigma which is often sticky.

For a flower to be pollinated, pollen must be moved from a stamen to the stigma. When pollen from a plant's stamen is transferred to that same plant's stigma, it is called self-pollination. When pollen from a plant's stamen is transferred to a different plant's stigma, it is called cross-pollination. Cross-pollination produces stronger plants. However, the plants must be of the same species. For example, only pollen from a tomato can pollinate another tomato. Pollen from a rose or an apple tree will not work.

For the most part, plants rely on insects, animals or the wind to pollinate them. When insects and animals such as bees, butterflies, moths, flies, and hummingbirds visit flowers, they're looking for food. They like the sticky pollen or a sweet nectar made at the base of the petals. While feeding, the insect or animal accidentally rubs against the stamens and gets pollen stuck all over themselves. When they move to another flower to feed, some of the pollen inadvertently rubs off onto this new plant's stigma, thus pollinating that plant's flower.

When a flower from one plant variety is fertilized with the pollen from another plant variety of the same genus, it has been hybridized. New seeds that are produced from this are called hybrids. Hybrids can be planted back but with typically lower quality results. Hybridization has made it possible for seed companies to keep farmers coming back for machine counted, high priced seed, instead of being able to grow their own seed.

Soybean Pollination

Soybeans have small flowers with a typical legume flower structure. Some cultivars are entirely cleistogamous, which means that the flower buds do not open and fertilization takes place with self-pollen without any outside influence. Other cultivars have flowers that open only under the right environmental conditions. In the early history of soybean culture, it was believed that plants were fully self-compatible and fully self-pollinating, and that flowers were not visited by insects. However, it is estimated that most (75%) of soybean flowers abort, and this could be due to poor pollination or to limited resources.

Because some cultivars have flowers that only open under the right conditions, bloom can vary within an area or even within a single field. When conditions are suitable, soybeans will produce some nectar but are usually a poor pollen resource. Research results have been ambiguous but there is anecdotal evidence that the presence of honey or wild bees may increase the yield of soybean. The benefits of either cross- or self-pollination may depend on cultivar.

Further research on the value of adding pollinators to soybeans is needed. Honey bees are the most likely candidate, as they appear to be among the most enthusiastic foragers in this crop. A stocking rate of 1.5 colonies per hectare has been proposed based on foraging rates and bloom density.

Corn Pollination

Corn, on the other hand, is not self-pollinating as it needs pollen from other corn plants in order to form kernels. Pollen from the tassels of other corn plants, even from different varieties, will pollinate the female silk on the ears of corn on any other corn plant. Corn is unique among grain crops in that it is monoecious. This means that it possesses flowers that have only male sexual parts and flowers that have only female sexual parts on the same plant. Also unique among grain crops, these flower types are separated on a plant by a distance of several feet. To compensate for this physical separation of male and female flower parts, the corn plant produces copious amounts of pollen and its pollen is easily moved by wind. Corn relies largely on the wind for pollination. For this reason, different corn varieties should be planted at least 150 meters apart in order to avoid cross pollination.

Normal tassels have a central stalk (rachis) and several branches. Each of the nearly 2000 florets on the tassel produces three stamens composed of an anther and a filament. The filament elongates and pushes the anther out of the floret, which exposes the anther to the air. Weather parameters, including temperature, humidity, and wind speed influence the timing and the amount of pollen shed. Under normal conditions, temperature rises and relative humidity decreases as the morning progresses. This triggers the anthers to dehisce, which allows pollen grains to spill from pores located near one end of each anther. A slight breeze is necessary for pollen shed and helps with pollen dispersal.

Pollen shed begins shortly after the tassel emerges from the top leaf sheath and lasts about 8 days for an individual tassel. Because of differences among plants in a field for maturity, pollen shed within a field may last two weeks. This "flowering period" for corn is relatively short, and corn yield can be highly influenced by stresses that occur during it.

You can test your pollination strength with a visual inspection. Anthers that are fully exposed across the entire tassel indicate that pollination is nearly complete. Pollen release normally begins near the middle of the tassel and then upwards and downwards. If the plant is still pollinating, a gentle shake of the tassel should release some of the small pollen grains. If there are no pollen grains, then pollination is probably complete. Brown silks are an indication that pollination is complete as well. These indicators are important, because in many fields, pollen drop has occurred before silk emergence.

Gently cutting open the husks around the ear can reveal the silks and developing ear. Once pollen travels down the silk and fertilizes an ovule, the silks detach from the young kernel. A gentle shake of the ear will help you identify the amount of pollination that has occurred. As kernel development progresses, identifying pollination success becomes easier. Developing kernels are easy to see while the blanks are easy to see as well. An ear where all almost all kernels are developing is evidence of excellent pollination. Although the science is a little foggy, it appears that both heat and drought can damage pollen. Some reports state that temperatures above 95ºF kill corn pollen. It is not clear, though if pollen death is a reaction solely to temperature or from dehydration.

Canola Pollination

Canola has entomophilous flowers which are flowers that are capable of both self- and cross- pollination. Fertilization of ovules usually results from self-pollination since, in a flowering crop, each flower produces a large amount of pollen and usually out competes with the pollen from adjacent flowers.

Crosses with other plants can occur in two directions: canola can act as either a pollen donor (male) or pollen recipient (female). Under field conditions, canola has the ability to cross pollinate through physical contact between neighbouring plants and/or insect pollination and whose pollen can also become airborne and potentially travel at least several kilometres downwind.

It is interesting to note that 80% of Canada's honey crop is from Canola flowers.

Building °Brix

In order to promote a high pollination rate, it is important that your plants have a high brix (measure of carbohydrate solids in plant sap) levels for many reasons. High brix levels indicate high nutrient and mineral content in your plants. A refractometer is a good tool to read brix levels in your plants. A female bee is innately equipped with an internal refractometer that allows her to determine the quality of the plant nectar. Bees prefer nectar from flowers whose nectar has a brix reading above 7. The higher the brix reading, the better the chance that the flower will be pollinated.

In corn, extremely hot days can hinder pollination and adult corn root worm beetles can cripple the pollination process by removing the ear silks. A high brix level in your corn will indicate high insect resistance. If the refractometer readings in the corn stalk opposite the ear shank are 8 brix or higher, the corn root worm beetles will not cut the silks.

The Economics of It All

Pollination is a critical stage in crop production and pollinators are essential for the development of seed for many root and fibre crops as well as in forage, horticultural, and orchard production. Bees, birds, and other pollinators affect 35% of the world's crop production, responsible for increasing yields in 87 of the top food crops, worldwide. Food security, food diversity, and human nutrition all rely strongly on pollinators. As farm fields grow larger and the use of agricultural chemicals increase, mounting evidence points to a potentially serious decline in the health and population of pollinators under agriculture development.

Supporting Pollinators

As a farmer, you are in a position to promote the health and welfare of pollinators.

Where possible, avoid the use of chemical fertilizers and any substance that ends in the letters "cide" such as insecticide, herbicide and pesticide. These substances kill beneficial insects and beneficial soil life that are essential to good crop health. Biological farming is easier on the soil, the environment, and also on the underappreciated agriculture workforce-the native bee.

Use biological and diverse farming practices; Use natural fertilizers and other biologically-friendly inputs; Seek alternatives to agri-chemicals.

Encourage natural vegetation close to farmlands; Plant habitat that supports pollinators; Create naturalized borders that can also help heal areas affected by soil loss from erosion. Plant hedgerows and promote wild flower growth to attract pollinators.

Attract native bees to help honey bees be more efficient. Native bees can force honey bees to do a better job through competition. When there is competition, the honey bees must to travel farther, and visit more plants to gather pollen, therefore doing a broader job of pollination.

Make adequate, balanced nutrients available to your crops to increase plant nutrient and brix levels that will build higher inherent disease and insect resistance. ■