POLLEN

Larry **Connor**

Pollens are complex materials required for growth, and health.

All animals, including humans and honey bees, require the same 10 essential protein components, called amino acids. These molecules are not and cannot be produced by their own bodies' metabolism. While humans obtain protein from a wide range of plant and animal sources, honey bees obtain all ten amino acids from pollen. Estimates of pollen collection by honey bees range from 10 to 25 kg (22 to 55 lbs.) per year. Pollen also supplies minerals, fats and vitamins and other elements essential for healthy bee development and growth.

When diverse pollen is in short supply, several serious conditions develop within the hive. Shortages result in reduced worker brood rearing, shorter worker bee lives, low sperm formation and migration in drones, inadequate populations of drones necessary for adequate queen mating and much lower growth of the hive. Extreme shortages of pollen eventually lead to colony death. Hive nutrition depends heavily upon good foraging weather and suitable forage. If bees are restricted from food gathering, there can be an immediate termination of new brood rearing and extensive cannibalism of first drone brood and then worker brood, with the youngest bees consumed or removed first. Poor nutrition has been also linked with increased problems from nosema and *Varroa* mites in the hive. Feeding natural pollen or artificial pollen supplements results in stronger colony growth, healthier bees, fewer disease problems, increased worker and drone bee population numbers, and increased pollination effectiveness and greater honey production.

When I speak to beekeepers, I am often shocked to learn how little they know about pollen and how much of what they do know is misinformed. Some beekeepers see filled frames of stored pollen in their hives and panic, wanting to know how to get rid of it. This demonstrates a failure to understand how important pollen is to the hive and that full frames of pollen occur in healthy hive biology, such as during queen replacement when brood rearing is temporarily halted. Failing to grasp the importance of pollen and protein feeding is a potentially serious flaw in a beekeeping operation. Mastering the process of protein management and supplemental feeding, by contrast, can ensure the successful growth of a colony, especially new increase colonies.

Pollen

Pollen is produced by flowering plants as part of their male flower reproductive system. Evolved from the spore-like structures utilized in plants like ferns, pollen serves the role of transferring male sexual materials within a flower, or from flower to flower, thus providing out-crossing (the mating of two unrelated individuals) and genetic diversity in the plant species. Pollen grains are elaborate, intricately packaged microscopic spheres that alight on a flower's reproductive structure, the stigmas, which then germinate by rupturing the pollen coat and growing a pollen tube down the stigma and style to reach the ovaries. There, male sexual material combines with female sexual materials in the ovule to form an embryo that becomes part of the seed.

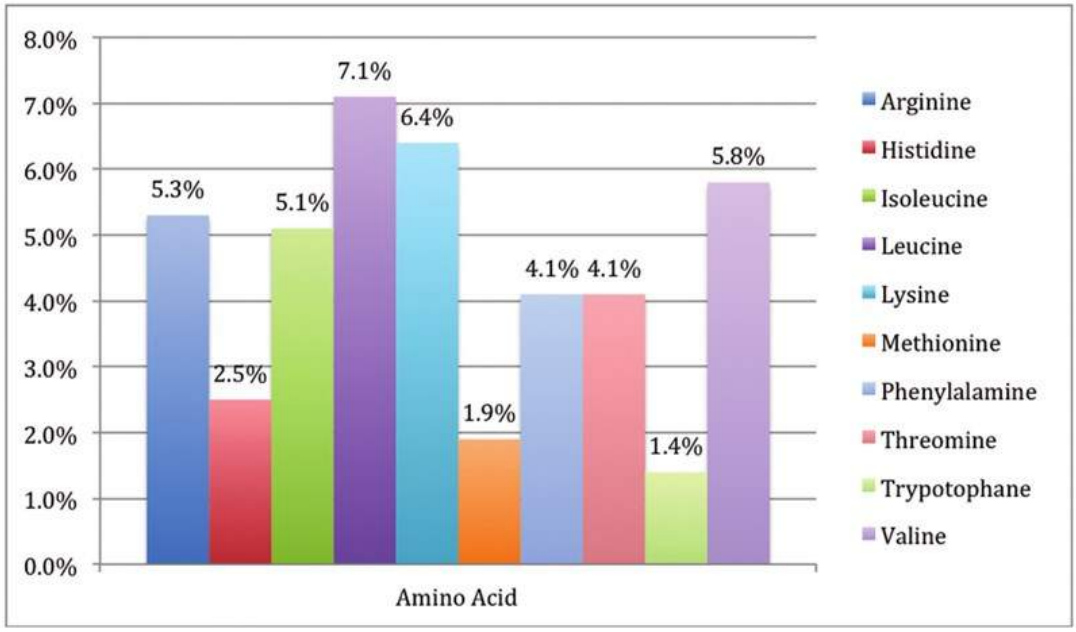
There are endless complexities to this system, and the role of bees as pollinators is only one of the variations that have evolved since the appearance of the first flowers. Every species of flower and every species of pollinator has its own unique tale to tell. Depending on the plant species, flowers release pollen at different times of the day. Morning foragers may be loaded with pollen while afternoon foragers have little. Each flower, each plant species, has its own tale to tell.

Pollens are complex materials. They have a hard protective coating (the exine) that protects the contents from environmental travel and extremes in weather. Inside this coat are the materials required for plant sex: proteins, enzymes, vitamins, lipids (fats), carbohydrates (sugar, starch and cellulose), minerals (calcium, magnesium, phosphorus, iron, sodium, potassium, aluminum, copper, manganese, sulfur) and pigments.

Pollens from different plant species vary in the composition of these components. The most important to the beekeeper is protein levels. Bee collected pollens vary from seven to 35 percent protein. The average crude protein percentages are shown in Table 1. Wind-borne pollen is usually very low in protein, usually under 5%, which explains why bees only gather pollen from wind-pollinated flowers like oak, grasses, and ragweed when there is little else to collect. It is generally thought that bees need a minimum 20% protein level in their own physiology in order to sustain colony growth, so low protein pollens must be consumed in larger quantities than high protein pollens to obtain the same food needs.

Not all bee-collected pollens are nutritionally complete, or balanced, as they lack some of the building block amino acids. Dandelion pollen, for example, has a multi amino acid deficiency and cannot sustain bee growth. Other plant species supply the missing elements. Fortunately, this is what bees do in nature – they collect a highly varied supply of pollen. One analyses of trapped pollen in Michigan showed that the most frequently collected pollen may contribute only five percent of the total volume the bees collected for the entire season. Bees make multiple trips to nature's buffet table and sample everything there, rather than ordering a single dish off the menu. This is of great interest and importance to beekeepers who keep bees in areas of extensive monoculture, either natural or human-created. Orchards and fields of a single plant species, like almonds, must be constantly evaluated for their nutritional status. In Australia, colonies of bees in large natural forests of eucalyptus often need to be either fed protein patties or moved to another location with better protein forage, even though the nectar flow has not finished.

In Arizona studies, scientists sorted pollen by plant species and fed them, independently or mixed, to caged bees. The results supported the need for a diverse (polyfloral) diet of different pollen sources resulted in bees that lived longer than bees fed a single pollen source. Recent work indicates that mixed pollen improved the immune



functions of the bee in regards to glucose oxidase activity and this helps the hive with disease control.

I have seen sellers of honey-bee trapped pollen claim that pollen is nature's "most perfect food." This claim once appeared on egg cartons and, again, may be an overreaching claim. We must honor the fact that, in bee colonies, pollen is the sole source of all nutritional requirements, supplementing carbohydrates from nectar and water. This may be different for other animals, including humans, a subject requiring further investigation.

Pollen collection by bees in the field

During the foraging season, scout bees constantly search for new and richer sources of nectar and pollen and return to the hive with samples to share with their housemates during their dance communication. How waiting bees determine the relative attractiveness of different pollen sources is unclear but we could imagine they discriminate food value rather accurately. Though pollen cannot be evaluated by sweetness like nectar's sugars can, bees apparently evaluate the quality of the pollen by sampling it. Only a few scout bees return with both nectar and pollen, making the evaluation process easier, based on the overall attractiveness of the pollen brought in by the foragers that is evaluated. About five percent of all foraging honey bees gather both pollen and nectar from flowers until their pollen baskets are full or their honey stomach is full, or a combination of both.

Bees that forage solely for pollen carry in their honey stomachs honey from the hive and add it to the pollen as they pack it onto their bodies. Once they use this supply, the bee is running on empty, and must return to the hive. Pollen foragers often exhibit a different set of foraging behaviors than nectar gatherers. They run actively or "scrabble" over the area of the flowers where the anthers are located, and rapidly collect pollen on their bodies. They then fly off the flower and pack the pollen with their legs, adding honey/nectar while packing the pollen into their two hind leg pollen baskets (corbiculae). In pollen rich flowers, the bees attack the anthers with such power that it is surprising to watch. While they hover in front of the flower, they add a droplet of honey from their honey stomach to keep the pollen together in the pellet and to start the pollen fermentation process.

A few flowers have pollens that are repellent to the bees and they discard the pollen by reversing the combing action of their legs while grooming their bodies. They do this with some oil-rich cultivars of sunflowers, after which the pollen will fall onto the leaves of the plant underneath the grooming bees.

Bees may collect a full load of pollen from one large flower, or need to visit hundreds of flowers to get a small load as they collect nectar. To obtain a load of pollen from the following flowers, observers have determined that it takes 346 visits to red clover florets, 84 visits to Bartlett pear blossoms and 350 to alfalfa florets. There should be little doubt as to the significance of honey bees as pollinators based on their pollen collection behavior. BC

Larry Connor has written and published several books. He is the owner of Wicwas Press.