Honey Bee Nutrition

Sharon Schmidt - Director, Cascade Girl

Watch a little forager honey bee interact with a flower and you will find a pretty tableau. But there is so much more going on with the bee and the target of her interest. While the bee desires food, the flower "desires" pollination. The feedback loop between the two influences the present and the future of both. The bee "helps" the flower to reproduce and also influences the behavior of the flower. The flower helps the bee to thrive by imparting sugars in the form of nectar and proteins and fats in the form of pollen plus other micronutrients.

As the bee flies through the air in a landscape of naturally occurring dust particles she picks up a positive electrical charge. Flowers have a negative charge; the shape of which bees can often distinguish and identify. Thus, in addition to the visual stimulus provided by the flower, received by the bee's five eyes, as well as the feedback provided by the flower's scent, the bee can also discriminate between the shapes of many flowers she flies over simply by detecting their magnetic field!

As she draws closer, pollen actually leaps from the flower to the bee due to the electric charge of each. The bee's visit to the flower changes the flower's electrical charge for a few minutes and that change is detectable to other bees that might fly over that same flower. Thus, subsequent potential visitors save time and energy knowing that the nectar resources are already depleted and they go elsewhere to forage (Clarke, Whitney, Sutton & Robert, 2022).

But there is more in this "dance" between flower and bee: the bee influences the flower's production of nectar. Each flower has a certain amount of nectar depending upon the species, availability of nutrients, water, sun, and so forth. After the bee's visit, flowers may take anywhere from hours to over a day to refill. But one flower species, the beach primrose (*Oenothera drummondi*), has been documented to actually respond to the vibration of bees buzzing. The Beach Primrose has been shown to increase the sweetness of its nectar as much as 20 percent within minutes of exposure to buzzing (Veits, M., Khait, I., Obolski, U., Zinger, E., Boonman, A., Goldshtein, A., Saban, K., Ben-Dor, U., Estlein, P., Kabat, A., Peretz, D., Ratzersdorfer, I., Krylov, S., Chamovitz, D. Sapir, Y., Yovel, Y., Hadany,

L., 2018). The extra sweetness makes the flower more appealing and therefore more likely to be pollinated.

Nectar is a watery solution composed of sucrose, glucose, and fructose along with trace elements and trace essential oils. Sugar concentration in nectar stimulates certain biological tasks in the honey bee; a thin, watery nectar prompts comb building necessary for nest expansion in the spring.

When a honey bee draws nectar, she stores it in her honey stomach. Processing nectar occurs when it is passed from bee to bee in the nest at which time it mixes with the enzyme, invertase in the honey stomachs of each bee. Given that nectar is passed back and forth it is easy to understand how a whole colony will have a similar microbiome (helpful gut bacteria) footprint.

As weather changes from spring to summer to fall, the honey bee's task is to build up as much food (pollen and nectar) in the hive and as much body weight as possible. This issue of body weight during fall is crucial and foreshadows the honey bee's ability to live through the winter. Therefore, being a "fat" bee is desirable!

The availability of enough varied pollen (and nectar) in the fall can't be underestimated because it is mostly from pollen that the honey bee will derive vitellogenin, a fatty protein that allows her to live longer by reducing oxidative stress, an imbalance leading to tissue damage in the body (Harwood, G., Amdam, G., 2021).

The organs and tissues of a winter bee need to function longer than they would at any other time of year given that she will be locked into her hive for many cold months during which few (if any) young bees will be produced. Therefore, pollen that allows her to make vitellogenin which, in part, extends her life from the normal 6 weeks to 4 or more months is a crucial element of overwintering success for the honey bee and her hive.

Food availability plays a key role in native bee health too and specific foods may play a bigger role than was previously imagined. For example, in the native eastern bumblebee (*Bombus impatiens*) sunflower pollen was found to reduce the common gut parasite, *Crithidia*. The reason for this seems to have less to do with nutrition and more to do with the spiky outer coating of sunflower pollen granules and their ability to interfere with the Crithidian protozoa. Unfortunately, sunflower pollen has not been shown to reduce levels of infection by the microsporidian *Nosema* in honey bee colonies (University of Massachusetts Extension, 2022).

However, supplementation of honey bee colonies with sunflower pollen or increasing sunflower plantings was also correlated with decreased levels of the parasite *Varroa*

destructor which has the reputation of wreaking havoc upon managed honey bees and the pollination industry (Palmer-Young, E.C., Malfi, R., Yujun Zhou, Joyce, B., Whitehead, H., J Van Wyk, J.I., Baylis, K., Grubbs, K, Boncristiani D., Evans, J.D., Irwin, R.E, Adler, L.S., 2023).

I remember sunflowers of my youth as having huge droopy heads which, when placed in a bouquet on our kitchen table, dripped pollen that stained my mother's tablecloths, a fact about which she was not happy. This pollen "problem" was eradicated in 1986 when the first pollen free sunflowers were introduced. Unbeknown to many gardeners, most of the ornamental sunflower seed sold in the US produces flowers bearing *no pollen* (Tempest, G., 2021). Therefore, *caveat emptor*!

Although pollen-bearing sunflowers appear to have medicinal value to both native and wild bees, these flowers and other members of the Asteraceae family are actually poor sources of protein. They have a role in pollinator survival but that is not necessarily the only role. Research has shown that diversity is extremely important in the health of both native bees and managed bees. For example, a delicious cocktail of bee plants in the Pacific Northwest where I live includes Hazelnut (*Corylus*), Oregon Grape (*Mahonia*), Heath and Heather (*Erica* and *Calluna*), Winter jasmine (*Jasminum nudiflora*), Witch Hazel (*Hamamelis*), Rosemary (*Rosmarinum officinalis*), Chaparral (*Ribes malvaceum*) and Manzanita (*Archostaphylos* spp).

Gardeners mindful of fall and winter bee health can find more information specific to their ecoregion on the Pollinator Partnership website at https://www.pollinator.org/guides

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