Honey Bee Communication Part 2:

Pheromones

by

Ellen Miller

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Pheromones

- Greek word "pherein" – to carry
- Greek word "hormone" – to stimulate

- A released chemical that triggers a social response in members of the same species

- The chemical is transmitted by direct contact as a liquid or as a vapor

- Honey bees have one of the most complex pheromonal communication systems
  - Significant diversification
  - Directly linked to social complexity
- Involved in almost every aspect of colony life

Pheromone Odor Detection

- Receptors are located mainly in the antennae
- Sequencing of the honey bee genome identified 160-170 olfactory receptors
  - Fruit fly has 62
  - Mosquito has 79

Types of Pheromones

- **Releaser** pheromones
  - ***Temporarily*** affect the recipient's behavior
  - Have an immediate response
  - Most worker bee pheromones are Releaser pheromones
- **Primer** pheromones
  - ***Long term*** effect on the physiology of the recipient
  - Major force in the evolution of social harmony
  - Maintain colony stability and health

Alarm Pheromones

- Mandibular gland – Releases an anesthetic used to paralyze intruders.
- Koschevnikov gland -- Releases from the stinger shaft.
  - Consists of more than 40 chemical compounds
  - Attracts bees to the location
  - Causes them to behave defensively and aggressively

Bees Using Alarm Pheromones

- **Guard**: patrol the entrance, release alarm scent, recognize hive mates by rubbing antennae

- **Defenders**: respond to danger by flying out of the hive, stinging , and sometimes pursuing intruders.

Guard Bees

Appear at the entrance
Raise their abdomen to expose the sting chamber
Release alarm pheromones
Fan their wings to disperse the scent

Defenders

- "Attack" bees
- Respond to the scent given by the Guard bees

Isopentyl Acetate

- Over 40 different compounds identified from extracts of the sting apparatus
- 15 stimulate one or more alarm behaviors
- Principal active component of the alarm pheromone blend is Isopentyl Acetate – banana odor

Smoking

- Smoking a hive before opening it helps to mask the alarm pheromone
- Some beekeepers recommend not eating bananas before working the hive

Koschevnikov Pheromone

- Reaches its highest level when the worker is about 2-3 weeks old
- This is the time when she begins to perform guard duty
- Amount decreases when she become a forager

Mandibular Pheromone

- The first line of defense – biting to deter

Mandibular Pheromone cont.

- Principal role seems to relate to foraging
  - Higher level in foragers
  - Acts as a repellent forage-marking pheromone to aid bees in identifying recently visited flowers

Mandibular Pheromone cont.

- Recently discovered to aid bees in their grooming behavior, assisting with maintaining a hygienic hive
  - Use their mandibles to bite smaller parasites (Varroa mites and wax moth larvae)

  - Paralyzes for up to 9 minutes, giving the bee time to remove from the hive – particularly effective against pests too small to sting

Nasonov Pheromone

- Marks the hive entrance
- Assist in swarm clustering
- Marks foraging sources

Nasomov Pheromone cont.

- Located on the lower back
- Bee stands with abdomen raised
- Fans its wings to facilitate dispersion of the odor
- Lemony scented pheromone

Nasonov Pheromone cont.

- Uses:
  - Young worker bees release during their first orientation flight
  - Workers selecting young larvae to rear as new queens mark the cells
  - Used with the Queen Mandible Pheromone as a cohesion factor for swarm clustering

Swarm Clustering – Nasonov Pheromone

- Upon leaving the hive, used to mark the temporary location
- Used by scout bees to mark the entrance to a potential new site

Foraging -- Nasonov Pheromone

- Used to mark a profitable food source for hive mates
  - Usually for water collection
  - Only to identify sugar concentrations much greater than those of natural nectars – when the reward is very high

Queen Pheromones

- Act as a general tranquillizer
- Suppress perception
- Stabilize emotional agitation
- May be related to hive weakness if queen is not well-mated
  - Potential link to CCD

Queen Mandibular Pheromone

- Consist of at least 5 active compounds
- Important in its affect on social behavior; maintenance of the hive; swarming; mating behavior; foraging activity; and inhibition of ovary development in the worker bees
- Similar in chemical composition to Dopamine

Queen Mandibular Pheromones cont.

- Glands located inside the head above the base of the mandible
- Secretion runs through a deep channel surrounded by hairs

Queen Retinue Pheromone

- Consist of 9 compounds
- Critical for the attraction of worker bees to the queen for feeding and grooming
- Keeps a swarm together when flying

Brood Recognition Pheromone

- Secreted by larvae salivary glands to alert worker bees that there are young in the hive
- Helps nurse bees distinguish worker larvae from drone larvae
- Regulates the ratio of drones and worker bees
- Increasing the release increases colony growth

Drone Mandibular Pheromone

- Used to attract other drones to sites suitable for queen mating

photo: Eric Tourneret

- Glandular activity increases from 0-3 days old to a maximum of 7 days
- After 9 days the glands are no longer active

Footprint Pheromone

- Produced by the tarsal glands
- Emitted when bees walk
- The queen releases and oily secretion
  - Alerts the hive that the queen is alive and working
  - Inhibits queen cells
  - Decreases as a queen ages

Forager Pheromone

- Released by older forager bees
- Acts to slow the maturing of nurse bees, keeping the ratio of nurse to forger bees balanced for the best use of the hive
  - Potential link to reducing CCD by maintaining a higher ratio of nurse bees to forager bees

Honey Bee Pheromone: Summary

- Complex communication system
- Pheromones are critical for the colony to be successful

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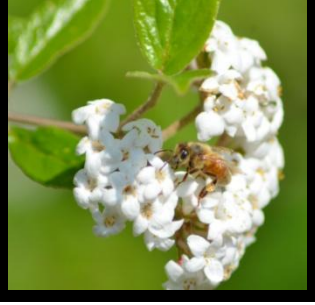

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