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Importance of communication process in honey bees

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ABSTRACT

Honey bees are social insects where division of labour exists in which worker bees plays a significant role in regulating the hive. Worker bees perform certain duties to maintain the hive in which foraging activity has a paramount importance. The bees indicate the food source and distance to other bees in the hive by bee language or bee dance. Among them Round, Sickle and Waggle dance are popular. Besides, honey bees communicate by chemical responses *viz*., queen pheromones, worker pheromones and brood pheromones followed by chemical cues emitted by flowers.

Key words: Worker bees, Round dance, Waggle dance, Queen pheromones

INTRODUCTION

Communication among insects is extremely important for their survival,especially for social insects that live in complex colonies.Many social insects depend on chemical signals, or pheromones to communicate with each other for guiding nest mates to food source, warn them of danger, and marking territory. Bees especially use pheromones and chemical signals to locate or detect resources. Honeybees are also famous for their remarkable dance language, which is used by workers to recruit nest mates to resources such as food, water, resin and nest cavities. Honeybee complex social behavior is an important and rich source for behavioral genetics, such as forage marking pheromone releasing by foragers while they are foraging, and including the genetics of aggression.

Honey bees communicate to each other by three ways:

1. Physical communication

2. Chemical communication

3. Flower odour cues communication

1. Physical communication

Honey bees communicate with each other by dance language *viz*., Round dance, Sickle dance and Waggle dance given by Karl Von Frisch, 1967.

A. Round dance:

When the resource is within 50 meters from the hive.A scout bee, or returning forager, performing a series of narrow circular movements that may be repeated & suddenly reversing direction to her original course. Resources that are perceived as rewarding will have higher dance circuits performed. This dance only communicates the distance of the supply, not the direction (Karl von Frisch, 1967).

B. Sickle dance

Food sources that are at intermediate distances, between 50 and 150 meters from the hive. This dance involves running in a semicircular (or moon) shape.This dance is crescent-shaped and represents a transitional dance between the round dance and a waggle dance (Karl Von Frisch, 1967).

C. Waggle dance or Wag-tail dance

When the resource is greater than 150 meters from the hive.Communicates both distance and direction. More complex than round dance. Here the bee makes two half circles in opposite directions with a straight run in between. During the straight run, the bee shakes and wags its abdomen from side to side (tail wagging motion). At the same time, the bee emits a buzzing sound, produced by wing beats at a low audio frequency of 250 to 300 hertz or cycles per second. Buzzing occurs in pulse beats of about 20 milliseconds, delivered at a rate of about 30 per second (Karl Von Frisch, 1967).

A. Waggle run direction

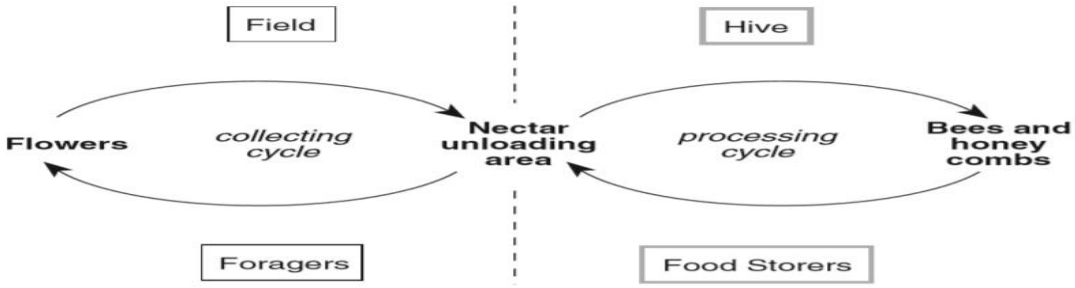
- ✓ The orientation of the dancing bee during the straight portion of her waggle dance indicates the location of the food source relative to the sun.
- ✓ The angle that the bee adopts, relative to vertical, represents the angle to the flowers relative to the direction of the sun outside the hive.
- ✓ In other words, the dancing bee transposes the solar angle into the gravitational angle. (Karl von Frisch, 1967)

B. Wagtail distance

- ✓ The duration of the straight-run portion of the dance, measured in seconds, is the simplest and most reliable indicator of distance.
- ✓ As the distance to the food source increases, the duration of the waggling portion of the dance (the "waggle run") also increases.
- ✓ The relationship is roughly linear **(**Tarpy, 1914**)**

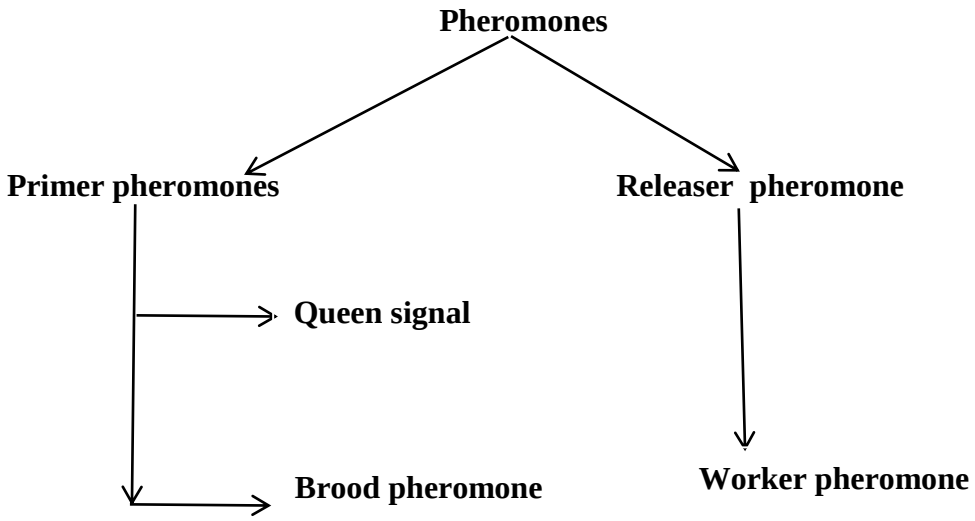
Coordination of nectar collecting and nectar processing in worker bees

An important feature of the organization of nectar collection by honey bee colonies is the division of labor between the foragers and the food storers (Seeley, 1995).



2. **Chemical communication**

- ✓ Together with the honey bee dance, honey bee pheromones represent one of the most advanced ways of communication among social insects.
- ✓ Caste specific pheromone production
- ✓ Pheromones allow communication among all the honey bee castes: queen–workers, workers–workers, queen–drones, and between adult bees and brood (Winston 1987).



Queen pheromones

The honey bee queen represents the main regulating factor of the colony functions. This regulation is largely achieved by means of pheromones, which are produced by different glands and emitted as a complex chemical blend, known as the "queen signal."

The queen signal acts principally as a primer pheromone, inducing several physiological and behavioral modifications in the worker bees of the colony that result in maintenance of colony homeostasis through establishment of social hierarchy and preservation of the queen's reproductive supremacy.

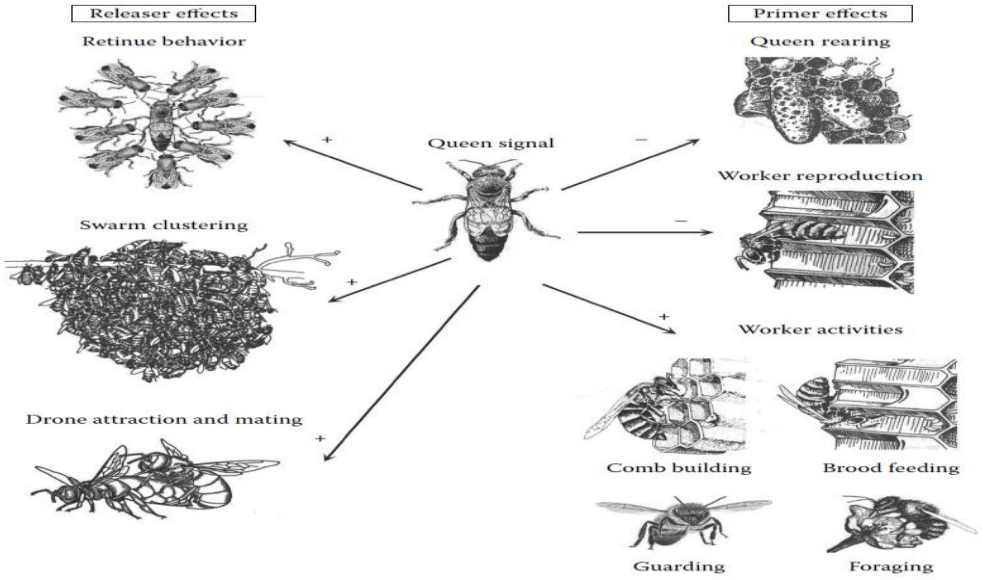


Fig 1. Releaser and primer effects of the queen signal, which regulates colony functions and development. Stimulating effects are indicated as "+" and inhibiting effects as "–."

Table 1. Components of Queen signal

S.no	Component	Compound	Functions	Reference
1.	Queen mandibular pheromone	(E)-9-oxodec-2-enoic-acid	Constitution and maintenance of the swarm cluster, Attracting the drones as a sexual pheromone, Suppression of worker reproduction	(Kaminsky *et al*., 1990)
2.	Tergal Gland Pheromones	(Z)-9 octadecenoic acid	Attraction of worker bees	(Wossler and Crewe, 1999)
3.	Tarsal Gland Pheromones	-	Inhibit queen cup construction by workers.	(Lensky and Slabezki,1981)
4.	Dufour's Gland Pheromones (Fertility signal)	-	Secretion as a caste - specific egg-marking pheromone	(Ratnieks and Visscher, 1989)
5.	Koschevnikov Gland Pheromones (Aging of the Queen Signal)	-	Alarm pheromones and balling behavior	(Pettis *et al*., 1998)

Table 2. Components of worker pheromones

S.no	Component	Compound	Functions	Reference
1.	Mandibular gland pheromones	10-hydroxy-2(E) decenoic acid (10-HDA)	Regulate worker reproduction	(Simon *et al*., 2001)
2.	Nasonov gland pheromones	(E)-citral,(Z) citral,(E-E)farnesol, and nerol	To orient members of the colony to nest	(Pickett *et al*., 1980)
3.	Tarsal gland pheromones	-	Marking and recruiting in foraging behavior	(Williams *et al*., 1982)
4.	Alarm pheromones	Iso-pentyl acetate and 2-heptanone	Defensive behavior	(Ratnieks and Visscher, 1989)
5.	Cuticular hydrocarbons	Aliphatic long-chain hydrocarbons	Nestmate Recognition	(Pettis *et al*., 1998)
6.	Brood pheromone	Fatty-acid esters	Regulation of Brood development and care	(Le Conte *et al*., 1990)

3. Flower odour cues communication

Honeybees use odour cues from food sources to transmit information to other bees. Scout bees carry the unique smell of flowers they visit on their bodies by olfactory map hypothesis in which bees use smells and tastes from returning foragers to locate food sources.

CONCLUSION

Honey bees are social insects that have a very organized social structure. A unique feature of their social life is the communication through dance. They perform round dance to communicate distance of the profitable food source and waggle dance to communicate both direction and distance of the profitable food source. Pheromones play an important role in recruitment communication. They use pheromones to guide nest mates for food sources, warn them of danger signal, mark territory area.

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