Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 03, Issue: 01 (JAN-FEB, 2023)
Available online at http://www.agriarticles.com

Chemical Communication in Insects

(*Jyotsana Chauhan, Arvind, Neha Panwar and Suraj)
Department of Entomology, College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University, Hisar (125004)
*Corresponding Author's email: chauhanjyotsana260@gmail.com

Any information exchanged between people, whether orally or in writing, sign language, body language, braille, morse code, or by another cultural or technological innovation, is referred to as communication. Every person has a unique "vocabulary" at birth that is only accessible to people of the same species. A communication act is not necessarily evident or overt. Looking for signs of a change in another person's behavior (or occasionally, physiology) is the sole method to tell communicative behavior from non-communicative behavior. The "language" of insects is largely inherent. Although our brains are specially designed for symbolic communication, the majority of our "language" abilities are learned. In order to establish an insect's credentials within its species and to recognize the credentials of other insects as being similar to or different from themselves, communication is essential. There are further different methods of insect communication, and among these, chemical communication is crucial, which we will further explore in detail.

Chemical communication

Insects rely more heavily on chemical signals than on any other form of communication. These signals, which are frequently referred to as semiochemicals or infochemicals, work as a type of "language" that facilitates interactions between different creatures. These are of further two types i.e., interspecific (Allelochemical) and intraspecific (Pheromone).

How are these chemicals received by insects?

The numerous chemicals in their environment can be detected by insects. Olfactory receptors detect chemicals in their gaseous state, while gustatory receptors detect them in their solid or liquid form.

How are tastes and smells received?

The external surface of insects is covered in cuticle, so it is the place to begin. Chemoreceptor cells serve as "windows" to the outside world on a variety of structures, including the antennae, mouthparts, legs, and ovipositor. These are surrounded by the characteristic cuticular sensilla. They occur in at least four morphological forms: bristles or hairs, pegs, plates, and pits. There are one or more pores in each chemosensory sensilla that allow chemicals to pass through. Although the anatomical similarities between gustatory and olfactory sensilla are relatively great, the former only has one pore and the latter has several. The moment an odour molecule enters a pore, it binds with particular proteins and sets off a chain of events that transports it through the fluid media of the sensillum lumen to the dendrite of a nerve where it activates receptors and is converted into electrical action potentials that travel along axons. Axons from the gustatory sensilla on the head lead to the subesophagael ganglion; those from the olfactory sensilla terminate in the deutocerebrum.

The neurological system has numerous degrees of sensory filtering, but the odorant binding proteins provide the first level of specificity and sensitivity.

Taste: Gustatory receptors are commonly described as thick-walled hairs, pegs, or pits where the dendrites of several (usually up to five) sensory neurons are exposed to the environment through a single opening (pore) in the cuticle. Each neuron seems to react to a separate set of substances (e.g. sugar, salt, water, protein, acid, etc.). The mouthparts have the most taste receptors, although they can also be found on the antennae, tarsi, and genitalia (particularly close to the female's ovipositor).

Smell: Olfactory receptors are usually thin-walled pegs, cones, or plates with numerous pores through which airborne molecules diffuse. Within these holes, sensory neurons' dendrites branch profusely, and they may be sensitive to even very low quantities of detectable substances (e.g. sex pheromones). While some receptors are extremely selective, others are sensitive to a large range of chemicals. The antennae have the most olfactory receptors; however, they can also be found in the mouth or on the external genitalia.

Common chemical sense

Ammonia, chlorine, acids, essential oils, and other irritating substances in high concentrations mimic avoidance reactions and cleaning behavior. Even in the case of completely covered or destroyed chemoreceptors, insects can still detect these substances. Evidently, other types of sensory neurons respond broadly to the irritants.

Functions of Chemical communication

1). Finding and Choosing Mates: Species recognition, mate recognition, and mate assessment are all non-exclusive functions of sex pheromones. Most often, however, the scenario begins with a female insect producing pheromones to which males respond, often over extraordinary distances. However, in a few instances, it is also claimed that males use chemical cues to entice females for the goal of mating. Such pheromones have a gradient of concentrations, and occasionally the same molecule attracts the other sex at a distance when present in low concentrations while evoking courtship behavior when present in high concentrations at close proximity. Alternatively, different components of a pheromone blend come into play at different points in the attraction process. During pheromone release, certain stereotyped postures called 'calling behaviors' are common among a wide variety of unrelated insects

2). Assembly, Aggregation, and Recruitment: The process by which both sexes of a species gather before engaging in an activity, like as feeding, mating, or hibernating, is known as assembly; in every case, the signals that summon them together are unrelated to the ensuing action. Aggregation, the crowding together of individuals, is the assembly's result. Recruitment is, communication that brings conspecific individuals, often nest-mates, to some point in space where work is required. Because under-population has a multitude of detrimental effects, aggregation size assumes special significance in the context of threatened and endangered species in conservation biology.

3) Alarm and Alert: Alarm and defensive behavior frequently go hand in hand, and occasionally one chemical might trigger both reactions at once. For example in the case of certain bees which are subjected to raids by giant hornets that attempt to recruit additional raiders by marking the victim's nest with pheromones from sternal glands. Guard bees respond by releasing an alarm pheromone that gathers a force just inside the nest entrance for a counterattack. A humming ball swiftly engulfs a hornet if it tries to enter the nest.

4). Host-Marking: Females of certain insects draw their ovipositor tip across the cap of the host egg, marking the spot where they had just laid their own egg. Such chemical marking reduces the possibility of multiple oviposition on a single host and repels additional conspecific females.

Advantages of chemical communication

1. Not limited by environmental barriers
2. Effective over distances and around corners
3. Effective either day or night
4. Longer lasting than visual or auditory signals
5. Metabolically "inexpensive" because only small quantities are needed

Disadvantages of chemical communication

1. Low level of information (presence/absence)
2. Not effective in an upwind direction