DOWNLOAD PDF INSECT SEX PHEROMONES.

Chapter 1 : The Pherobase: Database of pheromones and semiochemicals

Insect Sex Pheromones is a revised and expanded edition of the book ""Insect Sex Attractants"" and covers greater discoveries in the field of sex pheromones. It is discovered that many sex pheromones are sexually excitatory rather than attractive.

Insect Pheromone Background Pheromones are substances produced as messengers that affect the behavior of other insects, animals and members of the same species. In order to engage in routine activities, each species of insects relies on more than one hundred chemicals during its life. Pheromones can be mainly divided into the following species in function: Simple insect pheromones are straight chain compounds, including hydrocarbon, alcohol, ester and aldehyde. Others are side chain compounds. In addition, ketones and epoxy compounds are also included. For example, alarm pheromones always possess the structure of aldehyde and highly unstable hydrocarbons. Illustration of the role of insect pheromones. How an insect affects an insect by insect pheromones. Alfa Chemistry offers a wide range of different insect pheromones that respond to control pests effectively and respectfully with the environment. If you do not find what you need please contact us. Application Insect pheromone interference is one of the pest control technologies since s. Compared to others, insect pheromone is famous of its high efficiency, non-toxicity, no pollution, no harm insects and other advantages. And the technology is available to be used both indoor and outdoor. Pheromones can be used to control different lives phases of pests in the following aspects: Detecting the presence of the insect, indicating the level of infestation and evaluating the most suitable treatment and application time. Capturing the highest number of insects in a trap to reduce or eliminate other phytosanitary treatments. Attract the insects to the designated location and kill them, just similar to the previous technique. Impeding the encounter between both sexes by creating an atmosphere. Insect pheromones can act on different insects Products.

Chapter 2 : Chemoreception - Pheromones | calendrierdelascience.com

Pheromones have long been known to be important to the lives of insects in mating, as witnessed, for example, in some of the larger silkworm family moths, where males are noted to travel nearly 30 miles to a female, following a pheromone trail in the air.

Alarm Pheromone When an ant is disturbed, it releases a pheromone that can be detected by other ants several centimeters away. They are attracted by low concentrations of the pheromone and begin to move toward the region of increasing concentration. As they get nearer to their disturbed nestmate, their response changes to one of alarm. The higher concentration causes them to run about as they work to remedy the disturbance. Unless additional amounts of the alarm pheromone are released, it soon dissipates. This ensures that once the emergency is over, the ants return quietly to their former occupations. Honeybees also have an alarm pheromone which is a good thing not to elicit around a colony of "Africanized" bees. Trail Pheromone Certain ants, as they return to the nest with food, lay down a trail pheromone. This trail attracts and guides other ants to the food. It is continually renewed as long as the food holds out. When the supply begins to dwindle, trailmaking ceases. The trail pheromone evaporates quickly so other ants stop coming to the site and are not confused by old trails when food is found elsewhere. And at least in one species of ant, trails that no longer lead to food are also marked with a repellant pheromone. A stick treated with the trail pheromone of an ant left can be used to make an artificial trail which is followed closely by other ants emerging from their nest right. The trail will not be maintained by other ants unless food is placed at its end. Photos courtesy of Sol Mednick and Scientific American. Honeybee queens spend their lives literally surrounded by a retinue of worker bees. The queen emits a pheromone that is a complex mixture of unsaturated hydrocarbons , fatty acids , and other organic molecules. Sex Attractants Hundreds of pheromones are known with which one sex usually the female of an insect species attracts its mates. Many of these sex attractants â€” or their close chemical relatives â€” are available commercially. They have proved useful weapons against insect pests in two ways: This "communication disruption" has been used successfully against a wide variety of important pests. For example, the sex attractant of the cotton boll weevil has reduced the need for conventional chemical insecticides by more than half in some cotton-growing areas. Insect Monitoring Insect sex attractants are also valuable in monitoring pest populations. By baiting traps with the appropriate pheromone, a build-up of the pest population can be spotted early. Even if a conventional insecticide is the weapon chosen, its early use reduces the amount needed cost to the grower possible damage to the environment. Early detection of pest build-up is a key ingredient in the system known as integrated pest management IPM. The photo courtesy of USDA shows the feathery antennae of a male gypsy moth. These detect the pheromone released by the females who do not fly. In some insects, a single molecule of sex attractant is enough to elicit a response. By an animal Many species of spiders prey exclusively on moths of certain species and only on the males. Studies of one species of spider, Mastophora cornigera, show that it releases a mixture of volatile compounds that mimic the sex pheromone of the moth species it preys upon. Male moths flying upwind in search of a female end up eaten instead! By a plant A number of species of orchids â€” each pollinated by the males of a single species of insect wasps or bees â€” emit the same pheromone that is the sex attractant by which females of the insect species attract the males for mating. Releaser Pheromones Many mammals e. As these vaporize, they signal to other members of the species of the presence of the occupant of the territory. Domestic rabbit mothers release a mammary pheromone that triggers immediate nursing behavior by their babies pups. A good thing, too, as mothers devote only 5â€”7 minutes a day to feeding their pups so they had better be quick about it. Many animals, including mammals, signal with alarm pheromones. Although neither the source nor the chemical nature of alarm pheromones are known in any mammal, stressed animals release something that triggers quick behavior e. The pheromone is detected in a special cluster of cells located at the very tip of the nose and thus in a position to detected airborne molecules even before the vomeronasal organ next paragraph or nasal epithelium can. The detectors on these cells are primary cilia. Primer Pheromones Rats and mice give off pheromones that elicit mating behavior. However, the response is not immediate as it is in the releaser

pheromones of mother rabbits and insects. Instead, detection of the pheromone primes the endocrine system of the recipient to make the changes, e. Primer pheromones are detected by the olfactory epithelium with which normal odors are detected and also in most mammals but not humans by the vomeronasal organ VNO. The VNO is a patch of receptor tissue in the nasal cavity distinct from the olfactory epithelium. The receptors are G-protein-coupled transmembrane proteins similar to those that mediate olfaction, but encoded by entirely different genes.

Chapter 3 : Pheromones in fight against pests

Sex pheromones have found applications in pest monitoring and pest control. For monitoring, pheromone traps are used to attract and catch a sample of pest insects to determine whether control measures are needed.

Pheromones Chemicals produced by an animal to affect the behaviour or physiology of another member of the species are called pheromones , and at least some species in all the major animal groups are known to produce pheromones. These chemicals attract a potential mate from a distance, have specific sex or kin recognition, and involve many aspects of social behaviour. Among mammal s, pheromones may provide information about sex, age, genetic similarity, reproductive state, sexual arousal, dominance status, territorial boundary, time of last marking, and even emotional state, such as fear or anger. A pheromone may consist of a single compound but usually involves a mixture of different compounds. For the most part, the individual chemicals are not unique to the organism producing them, although the combinations of chemicals may be unique. Pheromones may be categorized as releasers and primers. This is probably also true of primers, although this is not always known. To have an effect at a distance from the producer, the compound must be volatile, enabling it to be readily dispersed. In general, within a class of compounds, smaller molecule s are more volatile than larger ones. On the other hand, larger, nonvolatile compounds may be important when animals are in close contact, when taste is important. A second critical feature of many pheromones is specificity. A sex-attractant pheromone would be disadvantageous if it also attracted individuals of other species. Specificity is dependent to some extent on the degree to which a particular molecular structure can be modified; for example, there are more possible permutations of the structure of a molecule with a backbone of 10 carbon atoms than of a molecule with a backbone of only 2 carbons. The need for volatility may conflict with the need for specificity, and the animal may need to compromise in an evolutionary sense to produce molecular structures that meet both requirements. Distance-attractant pheromones require both volatility and specificity. For example, the sex-attractant pheromones of most moths are molecules containing 12, 14, 16, or 18 carbon atoms, and the aggregation pheromones of bark beetles , which attract huge numbers of conspecifics members of the same species , comprise molecules with about 8â€”10 carbon atoms. An alternative way to achieve specificity is to use mixtures of compounds and to vary the relative proportions of the components. An example of this is seen in moths of the genus Spodoptera. Numerous species in this genus have sex-attractant pheromones with carbon atom compounds, but all these species produce more than one compound, and some are known to produce more than seven compounds. The compounds differ primarily in the presence or absence and position of double bonds located between the carbon atoms that form the backbone of the molecule. By using different proportions of the same compounds, each species can produce its own specific odour. This approach makes it possible to achieve not only species specificity but also individual specificity within a species, which is important in social contexts. Large numbers of compounds, often more than 50, in secretions of the preorbital and pedal glands of antelope and the urine of many mammals appear to reflect the need for individual specificity. Social hymenopterans use cuticular hydrocarbons in kin recognition, and there may be 20 or more such compounds on the surface of a single insect. Alarm pheromones , produced by some animals and best known in insects, have quite different requirements. An alarm pheromone needs high volatility, since it is used to quickly warn other individuals and must rapidly decay from the immediate environment. With a persistent compound the insects would be in a continual state of alarm or would habituate to the odour, thus reducing its value as an alarm pheromone. On the other hand, an alarm pheromone does not require a high degree of specificity, since it is usually not a disadvantage if other species detect the odour. As a consequence, very small molecules are used as alarm pheromones. In formicine ants , formic acid HCOOH often serves this function, and, in general, the alarm pheromones of ants and bees are compounds with 5â€”9 carbon atoms. Marking pheromones require characteristics opposite those of alarm pheromones, since their function is to convey a signal to other members of the species for a relatively long term. Thus, they demand some persistence, though not so much that they remain when their utility is past. Trails marked by pheromones are commonly produced by worker ants as they return to the nest from foraging. The trail persists as long as the

food source that it is connected to remains available and as long as the trail pheromone is reinforced by the returning workers. The territorial marks of vertebrates are also maintained by periodic reinforcement. Persistence can also be achieved in other ways. The persistence of territorial marks made by tigers is aided by the presence in the pheromone mixture of compounds that delay the loss of volatile compounds. The marking scents of skunks , which are also used for defense see below Behaviour and chemoreception: Defensive odours , may retain persistence by incorporating a chemical that breaks down slowly to produce the dominant effective compound. Red imported fire ants Solenopsis invicta , as well as other ant species, create marker trails using pheromones. A pheromone trail is followed by worker ants traveling between the nest and a food source. This appears to be true of some antelope markings that change with time, enabling the recipient to adjust its behaviour appropriately. Leafcutter ants genus Atta have alarm pheromones consisting of four components with different volatilities. Coupled with differences in the sensitivity of worker ants, the different volatilities produce different areas over which the compounds are most effective, and they stimulate different behaviours. Hexanal, with the greatest effective area, alerts worker ants, and hexanol has an attractant effect. In contrast, 3-undecanone and 2-butyloctenol, the least volatile and thus most concentrated closest to the pheromone source, initiate biting behaviour. Pheromone perception The specificity of pheromones depends on the specificity of perception as well as production. Little is known of the physiology of individual receptor cells outside the insects, which have receptor cells that are highly specific, at least for the major pheromone components. In many cases, when an attractant pheromone has two major components, the recipient has large numbers of cells specific to each of the compounds, often in the same sensillum. Very often the cells are extremely sensitive, enabling the animal to respond to very low concentrations of compounds. Primer pheromones Primer pheromones are important in aspects of social physiology in a range of animals. In mammals they are influential in coordinating reproductive physiology, and compounds excreted in the urine are especially important see below Behaviour and chemoreception: For example, the physiology of female mice is affected by the odour of urine produced by males and other females. Dominant males have the greatest effect, causing the release of luteinizing hormone in the female, which leads, together with contact with the male, to ovulation. In contrast, the urine of other females tends to delay ovulation. In the presence of a male, a female increases the rate at which she produces urine, and this causes the release of testosterone in the male. Comparable pheromones are produced by locusts. A mature male desert locust produces a maturation pheromone from glands scattered throughout the epidermis. The pheromone can act via the olfactory system of the recipient or, if the insects come into contact, via the contact chemoreceptor system, although this is not known with certainty. The pheromone speeds up sexual maturation by affecting the endocrine system in individuals of both sexes, with the result that in a swarm of locusts sexual maturation tends to be synchronized. Primer pheromones are especially important in the maintenance of colony structure in social insects. When an unfertilized queen leaves the colony, queen substance acts as an olfactory attractant for males. The same compound within the colony modifies the behaviour of workers, preventing them from rearing more queens, and also affects their physiology, disrupting the development of their ovaries. Movement toward an odour source Attraction to the source of an odour poses problems for all animals using the sense of smell. It had been supposed that animals simply moved up a concentration gradient, from an area of low odour concentration to an area of high odour concentration, ending near the source of an odour. However, consideration of the movement of odour molecules in air or water showed that, in general, such gradients do not exist under natural conditions. Wind flow varies in both direction and strength. In addition, during the day, when the ground is heated, rising and falling air movements contribute to turbulence. As a result, odour molecules, even when continuously released at the source, become dispersed as a series of wisps, similar to the way that smoke from a chimney becomes dispersed. As a consequence, a stationary animal or an animal moving toward an odour source in a straight line will encounter bursts of odour with relatively long intervals between bursts. This is true whatever the distance from the source, although at short distances bursts contain more peaks with high concentrations of odour molecules. Only by averaging the concentration over a period of time and distance is it possible to follow a gradient of odour. Some animals may do this, but insects and probably many other organisms use a different strategy. In these organisms an odour has the effect of

switching on a behavioral program that uses some signal other than odour to locate the source. In many cases the other signal is wind direction, and the animal moves upwind, ultimately arriving at the source of an odour. This mechanism is called odour-modulated anemotaxis. It is used by male moth s to locate females, by moths flying to a flower odour to obtain nectar , and by cabbage root flies flying toward a cabbage plant to lay eggs. Wind direction may be determined by its mechanical effect on the body, and in insects this involves structures at the bases of the antennae and mechanosensory hairs on the head. The behaviour involved in moving upwind varies. Larval insects such as those of the desert locust walk directly upwind if they smell food after having been without it for some time, and adult golden rod beetles exhibit similar behaviour. Cabbage root flies, when they perceive the host odour, orient into the wind while still on the ground and then make a short, straight flight of perhaps one metre before landing. The arrival of a new puff of odour causes them to reorient to the wind and repeat the process. Thus, their movement toward the odour source involves a series of short flights. However, in many insects odour causes takeoff into the wind, followed by a zigzagging flight toward the source, much as a sailboat might tack into the wind. During most of the movement, the insect is flying across the wind with its body oriented obliquely upwind. As a result, it drifts sideways, as an airplane does in high winds. The same mechanism is used by nocturnal insects. However, in some day-flying insects such as tsetse flies , the flight toward an odour source may be much more direct, with the odour causing takeoff but flight being directed toward any moving object that is visible upwind. Odour gradients, in which the concentration declines progressively with increasing distance from the source, probably do exist in very still environments such as those occurring in the soil. The soil-dwelling larvae of some insects that feed on roots, such as the corn root worm the larva of a beetle , have been shown to move along chemical gradients.

Chapter 4 : What are pheromones of insects and what role do they have? | eNotes

Pheromones are described to be like signals that are secreted by an insect. To be able to receive this chemical signal, one must consist a receptor that is familiar with pheromones. After it binds to a receptor of another insect, translation begins.

Lintner , Adolf Butenandt , and ethologist Karl von Frisch who called them various names, like for instance "alarm substances". For this reason, bacteria are too small to use pheromones as sex attractants on an individual basis. However, they do use them to determine the local population density of similar organisms and control behaviors that take more time to execute e. In similar manner, the simple animals rotifers are, it appears, also too small for females to lay down a useful trail, but in the slightly larger copepods the female leaves a trail that the male can follow. A group of individuals at one location is referred to as an aggregation, whether consisting of one sex or both sexes. Male-produced sex attractants have been called aggregation pheromones, because they usually result in the arrival of both sexes at a calling site and increase the density of conspecifics surrounding the pheromone source. Most sex pheromones are produced by the females; only a small percentage of sex attractants are produced by males. In recent decades, the importance of applying aggregation pheromones in the management of the boll weevil Anthonomus grandis , stored product weevils Sitophilus zeamais , Sitophilus granarius , Sitophilus oryzae, and pea and bean weevil Sitona lineatus has been demonstrated. Aggregation pheromones are among the most ecologically selective pest suppression methods. They are nontoxic and effective at very low concentrations. For example, Vespula squamosa use alarm pheromones to alert others to a threat. Certain plants emit alarm pheromones when grazed upon, resulting in tannin production in neighboring plants. These tannins make the plants less appetizing for the herbivore. Fabre observed and noted how "females who lay their eggs in these fruits deposit these mysterious substances in the vicinity of their clutch to signal to other females of the same species they should clutch elsewhere. For example, some organisms use powerful attractant molecules to attract mates from a distance of two miles or more. In general, this type of pheromone elicits a rapid response, but is quickly degraded. In contrast, a primer pheromone has a slower onset and a longer duration. For example, rabbit mothers release mammary pheromones that trigger immediate nursing behavior by their babies. For instance, GnRH molecule functions as a neurotransmitter in rats to elicit lordosis behavior. In cats and dogs, these hormones are present in the urine, which they deposit on landmarks serving to mark the perimeter of the claimed territory. For example, ants mark their paths with pheromones consisting of volatile hydrocarbons. Certain ants lay down an initial trail of pheromones as they return to the nest with food. This trail attracts other ants and serves as a guide. The pheromone requires continuous renewal because it evaporates quickly. When the food supply begins to dwindle, the trail-making ceases. In at least one species of ant, trails that no longer lead to food are also marked with a repellent pheromone. When species of wasps such as Polybia sericea found new nests, they use pheromones to lead the rest of the colony to the new nesting site. Gregarious caterpillars, such as the forest tent caterpillar , lay down pheromone trails that are used to achieve group movement. Sex pheromone Male Danaus chrysippus showing the pheromone pouch and brush-like organ in Kerala, India In animals, sex pheromones indicate the availability of the female for breeding. Male animals may also emit pheromones that convey information about their species and genotype. At the microscopic level, a number of bacterial species e. Bacillus subtilis, Streptococcus pneumoniae, Bacillus cereus release specific chemicals into the surrounding media to induce the "competent" state in neighboring bacteria. Among eukaryotic microorganisms, pheromones promote sexual interaction in numerous species. In addition, male copepods can follow a three-dimensional pheromone trail left by a swimming female, and male gametes of many animals use a pheromone to help find a female gamete for fertilization. In addition, Colias eurytheme butterflies release pheromones, an olfactory cue important for mate selection. Even after these contacts virus-infected females made many frequent contacts with males and continued to call; they were found to produce five to seven times more pheromone and attracted twice as many males as did control females in flight tunnel experiments. Some pheromones can be used to suppress the sexual behavior of other individuals allowing for a reproductive

monopoly â€” the wasp R. Boar pheromones are sprayed into the sty , and those sows that exhibit sexual arousal are known to be currently available for breeding. Sea urchins release pheromones into the surrounding water, sending a chemical message that triggers other urchins in the colony to eject their sex cells simultaneously.

Chapter 5 : Insect Pheromone Traps

A pheromone trap usually consists of a small glue trap that is impregnated with sex pheromone or it comes with a small vial of sex pheromone that will be placed on the trap. Sex pheromones are hormones scents that are usually emitted by the female insect and picked up by the male as a cue for mating.

In most situations, it is recommended that you wear long pants, a long sleeved shirt, closed toe shoes with socks, chemical resistant gloves, and goggles. In areas where ventilation is poor, a manufacturer may recommend you wear a mask or a respirator. We have put together two different safety kits that will make selecting the correct safety gear easier for you. Insect Pheromone Traps Print Article Pheromone traps are a great pest control tool that is used to help monitor and control insect infestations. There are pheromone traps for many different types of insects including flies, pantry moths, pantry beetles and cockroaches. Pheromone traps, when used correctly, are a very effective part of a pest control program. What is a pheromone trap? A pheromone trap usually consists of a small glue trap that is impregnated with sex pheromone or it comes with a small vial of sex pheromone that will be placed on the trap. Sex pheromones are hormones scents that are usually emitted by the female insect and picked up by the male as a cue for mating. Male pests are drawn to the trap for the purpose of mating and are then caught. What types of pests are caught with pheromone traps? There are many different traps on the market, each geared toward specific pests. How are pheromone traps used? Pheromone traps are usually simple to use. Some traps only require you to peel the protective paper from the glue area. Other traps also require you to place the pheromone vial on the trap to attract the insects. Traps should be placed in the area where the target pest is a problem. For example, Indian Meal Moths can be found in or near pantries and so traps should be set up in those areas. Pheromone trap do require some air flow to allow the pheromone to properly attract the insects. Moth trap can be hung or set on a shelf in the pantry. Roach and beetle traps can be placed wherever activity has been noted. How effective are pheromone traps? Pheromone traps are very effective when used as directed. Since the traps attract and catch only male insects, some situations may require additional insecticide treatments and very thorough cleaning for effective control. Pantry moth, pantry beetle and cloth moth infestations will require that an inspection be completed to find infested items. Infested food items should be discarded and clothing items should be cleaned to get rid of the larvae that are causing damage and to stop future infestations. Cabinets, pantries and closets may need to be sprayed with a residual insecticide to gain faster control of the adult insects that have not been captured by the traps. Pheromone traps are also great for monitoring a pest infestation and for use in facilities where the use of insecticides is prohibited. Each box contains 2 traps. ProPest Pheronet Pantry Pest Traps - Protects grain based foods such as cereals, flour, meal and pasta, pet and bird food, popcorn and more. ProPest Pheronet Clothes Moth Traps â€” These traps will lure and kill webbing cloth moths, the most common type of clothes moth. Victor Roach Pheromone trap M â€”This trap is designed with an alluring scent that traps and kills German roaches. These Pheromone traps have twice the trapping power of other comparable traps because they are "double" baited, they contain both a roach pheromone and a food scent lure. Safe to use in sensitive accounts. Each case comes with larger traps that can be split along a perforated edge to create smaller traps.

Chapter 6 : Insect pheromones - NIAB EMR

The principle use of insect sex pheromones is to attract insects to traps for detection and determination of temporal distribution. In most instances, it is the males who are responders to female-produced sex pheromones.

August 3, , Technical University of Denmark Nowadays, everybody is aware of the toxic effects of the conventional insecticides that are used to protect plants from pest insects. The insecticides are harmful to the farmer who sprays them on the field and for the pollinating insects, e. But are there any safer ways to protect the plants from pest insects? One of the most promising methods is mating disruption, where small amounts of insect sex pheromones are released in the field to prevent the males from finding the insect females. This way, females do not get fertilized and cannot lay eggs that develop into larvae eating the plants. The technology is simple and effective, but until now quite expensive. Currently, pheromones are produced by chemical synthesis, which is an expensive and polluting process. Novo Nordisk scientists will use biotechnology instead to produce pheromones at low cost by fermentation, in the same way that insulin is produced for diabetes treatment and enzymes are produced for laundry detergent. We aim to produce pheromones by fermentation, which is potentially a much cheaper route than chemical synthesis, and will make the pheromones affordable for row crop protection as well," says Senior Researcher at the Novo Nordisk Foundation Center for Biosustainability, DTU, Irina Borodina. Calls for urgent action One of the pests that are targeted is the fall armyworm which poses a major threat to food security and agricultural trade. The fall armyworm, so called because it eats its way through most of the vegetation in its way as it marches through crops, is native to North and South America but was identified for the first time in Africa last year. The main challenge right now is bringing down the cost of the technology so the farmers can afford to use it. Most of the applications use hand-applied dispensers and that is not really scalable. It is still too expensive," according to Irina Borodina. Several industrial partners, including BioPhero, Novagrica, ISCA and Biotrend, are now engaged in the OLEFINE project to make pheromones an affordable alternative to insecticides, thus contributing to a more sustainable, low-carbon economy through reduced reliance on petrochemical-based processes. At the same time, many large insecticide companies are monitoring the current development. According to Irina Borodina, these examples are only the first indicators that prove the need of switching away from using conventional insecticides to protect plants from pest insects. Both the companies and the farmers are aware of this. Pollinators, birds and other animals are not directly affected by pheromones and local ecosystems. Thereby it benefits in terms of preserved biodiversity of beneficial organisms," she says. Bio-pheromones developed as part of the OLEFINE project will replace pesticides in the management of major pests of grapes, soybean and cotton. Education is crucial It is absolutely essential that farmers, especially in the third world countries, are educated on how to use pheromones. When the farmers spray the field they are used to seeing the insects, but that is not the case when applying the method of mating disruption. This is one of the biggest challenges in the transition from conventional insecticides to pheromones. You do not only have to compete on price, people will also need education. But Irina Borodina stays optimistic. To succeed in bringing down the cost we just need to be really smart and a little bit lucky with what we do. We have to use all the fantasy and knowledge that we have," she emphasizes.

Chapter 7 : Sex pheromone - Wikipedia

Pheromones are a means of communication in the insect family. They convey messages of alarm, set trails to follow, death pheromones, provide sexual attractants, sexual deception, and instruction.

Evolution[edit] Sex pheromones have evolved in many species. The many types of pheromones i. However, sex pheromones are particularly associated with signaling mating behaviors or dominance. The odors released can be seen as a favorable trait selected by either the male or female leading to attraction and copulation. Chemical signaling is also used to find genetically different mates and thus avoid inbreeding. Sexual selection[edit] Females of the tiger moth Utetheisa ornatrix choose males that produce more pheromones. Common crow butterfly male Euploea core with hair pencils everted to disperse sex pheromone at Sattal India [2] Further information: Sexual selection and Signalling theory Odours may be a kind of male "ornament" selected for by female choice. After many years of study the importance of such chemical communication is becoming clear. In tiger moths Utetheisa ornatrix , females choose the males that produce the most pheromone; an honest signal of the amount of protective alkaloids the male has, as well as an indicator of the size of female offspring females fertilised by such males lay more eggs. Some female moths signal, but this is cheap and low risk; it means the male has to fly to her, taking a high risk. This mirrors communication with other sensory modalities, e. Male long-range pheromone signals may be associated with patchy resources for the female. In some species both sexes signal. Males can sometimes attract other males instead, the sex pheromone acting as an aggregation pheromone. This coordination is very important because sperm are diluted easily, and are short-lived. Coordination therefore provides a selective advantage to both males and females: An inherent difficulty in studying human pheromones is the need for cleanliness and odorlessness in human participants. Different species use a wide variety of chemical substances to send sexual signals. It is detected in the antennae of the male moth by a pheromone-binding protein which carries the bombykol to a receptor bound to the membrane of a nerve cell. For example, the Eastern spruce budworm Choristoneura fumiferana female pheromones contain a

Chapter 8 : Insect Pheromone - Alfa Chemistry

Insect Monitoring Insect sex attractants are also valuable in monitoring pest populations. By baiting traps with the appropriate pheromone, a build-up of the pest population can be spotted early. By baiting traps with the appropriate pheromone, a build-up of the pest population can be spotted early.

Insects of different orders responds to some pheromones with aggregation behavior. Male-produced sex attractant have been referred to as aggregation pheromones, because they typically result in the arrival of both sexes at a calling site leading to an increase in density of conspecifics in the vicinity of the pheromone source. Aggregation pheromones have been reported for members of the Coleoptera, Dictyoptera, Hemiptera, Homoptera and Orthoptera and have been identified for hundreds of species. During the last two decades the attention has turned to economically important species especially members of the Coleoptera, Curculionidae. The value of applying aggregation pheromones in the management of the boll weevil Anthonomus grandis Boheman , pea and bean weevil Sitona lineatus L. These are some examples in which the communication code of the insects leads to improved methods of monitoring and control. There is a wide range of tactics or methods of pest management and aggregation pheromones are among the most ecologically selective pest suppression agents. Unlike the conventional insecticides , they are no toxic and they are effective at very low concentrations. Key words Aggregation pheromones, Curculionidae, boll weevil, pea and bean weevil, stored product weevils. The most outstanding characteristic about insect odor sources has been their variety and complexity. Chemical come not only from the abdomen but often from head and thorax. They have a variety of exocrine glands, clusters of secretory cells whose products are discharged to the outside of the body. Insects receivers are no less complex; chemoreceptor cells are surrounded by characteristics cuticular specialization called sensilla which comprise the most obvious external parts of the chemosensory organs. One important function of intraspecific communication systems is species and sex recognition. Pheromones are chemical signals from one organism that stimulate a response in another organism of the same specie. Generally, this behavior is either attraction to the opposite sex or part of courtship interaction and are referred as sex attractants pheromones Landolt Aggregation pheromones have been reported for members of the Coleoptera, Dictyoptera, Hemiptera, Homoptera and Orthoptera and have been identified for hundred of species. The production of aggregation pheromones by several weevils, including Anthonomus grandis, three Sitophilus spp. Overall the use of pheromones has a number of potential advantages. The compounds are naturally occurring, generally non-toxic and should not pollute the environment. Pheromones are insect-specific and their safety to beneficials makes them ideal components of integrated pest management systems. Insect olfactory orientation and chemical communication. One important function of intraspecific communication system is species and sex recognition. Of all the various shemes that have been developed to classify communication, perhaps the most widely accepted and utilized has been the one based upon the receptor involved. Chemical communication is the most thoroughly studied because of is the arguably primary mode of information transfer in members of the class insecta. In insects, a distinction is often made between two types of chemoreceptor; the one receptive to vapors at relatively low concentration, normally referred to as olfactory, and the other mediating a response to substances in solution are relatively high concentration , usually called a gustatory , or contact, chemoreceptor. The role of odors in communication is very important and the variety and complexity of their sources has been one the most outstanding characteristics. Exocrine glands , and clusters of secretory cells whose products are discharged to the outside of the secretory cells, send forth single liquids or blends, releasing them as streams, droplets, thin films or gases. Insect chemoreceptor cells are surrounded by characteristics cuticular specialization called sensilla, which comprise the most obvious external parts of the chemosensory organ. These occur in at least four chemical sensitive forms: They may occur in the antennae, mouthparts, ovipositor, cercy and other structures. Insect antennae are by far the most common organ of olfactory reception. A single antennae may have in more of sensilla of different classes which respond to a wide range of chemical stimuli present in the environment. Chemical communication in insects is highly developed. They can perceive and, under the correct physiological conditions, respond to

remarkably small quantities of chemicals. Insects generally perceive odors and the peripheral part of any sensorial cell reacts to these adequate stimulus with a temporary change in the electric charge of its membrane, in a measurable response of receptor potential. This technique was termed electroantennography EAG , and the EAG response is considered to represent a summation of despolarizations of all the stimulated sensillae on the antennae. Electroantennogram EAG , gives a measurement of the summed receptor potentials of a number of olfactory receptors responding to a stimulus Cork et al What do flying insects do when they orient to distance source of chemical?. The basic strategy which leads insects to arrive at the source of an attractant chemical is to fly up-wind as long as there is any wind when stimulated by the chemical, and to land or to fly cross-wind when they lose the chemical. Most insects can orient in relation to the wind whilst airborne. This means that they can determine the particular value of airspeed and heading which will overcome the speed and direction of the wind. An airborne insect cannot determine these value through mechanoreceptive reactions to the direction of the air flow past itself because this flow depends on its own flight direction and airspeed, and not on the direction or speed of movement of the air over the ground. Chemical signal are compounds employed for both intraspecific and interspecific communication and are termed semiochemicals. Within semiochemicals, allelochemics are those that have interspecific effect, and is subdivided into kairomones, which attract exploiters, and allomones, which are advantageous to the odor-releasing individuals. Pheromonal communication is present in insects, pheromones being employed to mediate a wide variety of behaviour. Aggregation pheromones function in many ways including mate selection, defense against predators, and overcoming host resistance by mass attack. A group of individuals more than a pair at one location may be referred as aggregation, whether comprised of one sex or both sexes. Male-produced sex attractants often are referred as aggregation pheromones because they typically result in the arrival of both sexes at the calling site. Although there is a considerable variation in how sex attractant pheromones function in the mate-finding strategies of insects, the norm, and often the expected, involves sex pheromones produced by the female that is attractive to males. Most of the insects that use male-produced sex attractant are found within the Coleoptera and according to Landolt , up to males pheromones attractive to females had been identified for 54 species. Forty of these species are coleopterans, 9 are dipterans, 2 are hemipterans, and 3 are lepidopterans. In addition, he found that since another 40 males pheromones attractive to females species were identified; 18 coleopterans, 12 dipterans, 7 hemipterans, 2 lepidopterans and 1 dictyopteran. This contrast with the identification of females-produced sex attractants, which are predominantly within the Lepidoptera. In pest management survey and monitoring with pheromones and other attractants are practiced worldwide against a broad array of insect pest, and these techniques are integral parts of a growing number of control programs Silverstein, These include Coleoptera, Curculionidae species, such as the boll weevil Anthonomus grandis Boheman , pea and bean weevil Sitona lineatus L. Cotton boll weevil Anthonomus grandis Boheman. The boll weevil Anthonomus grandis B. Since its introduction into U. Attemp to solve the boll weevil problem resulted in considerable research in the past decades directed toward the development of ways to reduce the boll weevil problem and , as hoped by many, to eliminate it entirely from all infested cotton growing areas in the U. Once male boll weevils locate their host plant, feeding ensues, and the weevils release in their frass an aggregation pheromones Tumilson et al. In his study Dickens , determined the mechanisms by which both pheromones and green plant volatiles, are detected by the boll weevil. Single cell recording and electroantennograms techniques used in the laboratory, clearly showed that boll weevil posses receptors to pheromones and green leaf volatiles. In field studies the technique used is called mass trapping. Male or grandlure baited traps have been used to determine the feasibility of mass trapping the boll weevil for many years. This trap has a conical body surmounted by a screen funnel and collecting container in which the lure was placed. The body of the trap was painted fluorescent yellow because findings that this color was attractive to the weevil. Boll weevils responded to the airborne pheromones and the color of the traps. On reaching the cone, they moved upward through the funnel into the collection container and were then ere unable to leave because they could not find the funnel opening.. The infield trap is smaller that Leggett trap but a wire mesh funnel is used to provide better ventilation. Cigarette filters are used as release substrate. An essential prerequisite for the most efficient operation of pheromone traps against boll weevils is the reduction of overwintered weevils population Ridway

et al. Diapausing hibernating adult weevils spend the winter in leaf litter and other protected sites close to the cotton fields. In the spring, emerging weevils move into the cotton fields in search of food. About 4 generation occur during the cotton growing- season and then at the end of the season , the weevil leave the fields to find shelter for overwintering. Therefore, in the spring, the most effective placement of traps is along the borders of the cotton fields, to intercept the emerging weevils as they search for cotton. Has been shown that in spring, trap baited attract both sexes of overwintered adults,, and again in the fall, weevils of box sexes respond, reducing the weevil population. Pea and bean weevil Sitonia lineatus L. This weevil is a pest of leguminous crops and is widely distributed throughout Western Europe, the middle East and the north west region of North America. According with Bight et al pea and bean weevil produce aggregation pheromones and presumably does assist the aggregation of the weevils in legume fields for the purpose of both feeding and mating. The aggregation pheromone, 4-methyl-3,5-heptanoide, has been utilized in mass trap of these insects and to time insecticide application. Adults weevil make characteristics notches on the leaf margin of host plants, and the larvae cause serious damage by feeding on nitrogen-fixing root nodules. In spring overwintered adult males invade newly emerging leguminous crops and produce an aggregation pheromone that attracts adults of both sexes. Mating occur and eggs are deposited on the soil around the host. Studies with in-field trap baited shown that S. Trap baited with aggregation pheromones, could be used to attract overwintered weevils during the spring dispersal, and accurately timed application of insecticides or other control agents Smart et al. Stored product weevils Sitophilus zeamais L. These three weevil species have long been recognized as a serious pests of stored grains in all the world. In some parts of the world, infestations may extend to field crops as well. Both adults and larvae can survive on a wide variety of food substances, but gain notoriety as a pest species primarily from their infestations of corn, wheat, rice, and sorghum Walgenbach et al. Evidence for the existence of a male-produced aggregation pheromones by these weevils and interspecific attraction between weevils that suggest that are very closely related is well documented Phillips ; Faustini ; Wangelbach According to Burkholder for practical trapping effort, the aggregation pheromones are specially useful because both long-lived sexes respond. Besides, the strong cross interspecific attraction facilitates the control of the weevil using trap baited with aggregated pheromones. Conclusions There is a wide range of tactics or methods of pest management and aggregation pheromones are among the most ecologically selective pest suppression agents. Unlike the conventional insecticides, they are no toxic and they are effective at very low concentrations. Suppression by mass trapping has been demonstrated in a number of experiments but few are reported to be successful in providing adequate control of the pest species. The most promising results are obtained with the combination with other techniques such as color attractants and the application of lower doses of insecticides. Several conditions must be fulfilled if successful mass-trapping is to be achieved: In addition, the insect must be the main pest to avoid use of high doses of insecticides and the trapping devices must protect predators and parasites from being captured.

Chapter 9 : Insect aggregation pheromones

Wittko Francke, Stefan Schulz, in Comprehensive Natural Products II, Female Lepidopteran Sex Pheromones. Sex pheromones of female moth constitute the best-investigated group of insect pheromones, primarily because of their economic importance.

An adult female German cockroach top right being courted by 3 males. Upon touching the female, the male perceives a multi-component contact pheromone that elicits courtship. The male turns away from the female and raises his wings, thus exposing a tergal secretion, and in this image, the female is mounting a male and is feeding on this secretion. German cockroach females emit a volatile pheromone, Blattellaquinone, which attracts males from a distance. The pheromone is produced in a gland located in the last abdominal tergite. In this area the cuticle forms deep depressions in which a large number of cuticular orifices are located. These orifices are connected to secretory cells via cuticular ducts blue surrounded by duct cells yellow. Our research concentrates on sex pheromones that are used in mate-finding and recognition and aggregation pheromones that mediate group formation. Our current projects include: Investigation of the anatomical sites, biochemical pathways, transport routes, and neuroendocrine regulation of pheromone production in cockroaches. Role of contact pheromones in cockroach communication and courtship. Behavioral studies of calling - the behavior responsible for emission of volatile pheromones. Isolation, purification, and identification of pheromones. Role of microbial symbionts in aggregation pheromone production. Development of pheromone-based tools for monitoring, sampling, and controlling cockroach pest populations. Our lab has had a long-term interest in studies of the behavioral ecology of temperate pest cockroaches and non-pest tropical rain-forest species. We are particularly interested in the evolution of mating systems, parental contributions and sexual gift-giving, and mate-finding tactics. Recently, we initiated studies of the mating system of Parcoblatta wood cockroach species. This genus is native to N. America and common in forests throughout the Southeast.