Fumigants & Pheromones

Fumigation Service & Supply, Inc.

David Mueller, BCE

How Fumigants Kill Insects

It is important for professional pest managers involved in fumigation work to understand how insects are killed by this highly effective treatment technique. In general, fumigants reach the tissues of insects through the process of respiration. If an insect is placed in an atmosphere containing noxious gas, a certain amount of the gas will be taken into the body cells.

Fumigants are absorbed mainly through the respiratory system of the insects. An examination of this system shows that oxygen is taken in through spiracles to tubes that extend and branch out to individual cells. The spiracles are present on the sides of the insect's thoracic and abdominal segments. The larger respiratory tubes in the insect's body are known as the trachea, and these attenuate into smaller tubes known as tracheoles. It is through the thin wall of tracheoles that the oxygen diffuses to enter the cell properly. Active insects "breathe," that is, the air sacs and larger tracheae in the thorax and abdomen are alternately compressed and relaxed. The more rapidly the fumigant enters this tracheal system, the more readily the insect is affected.

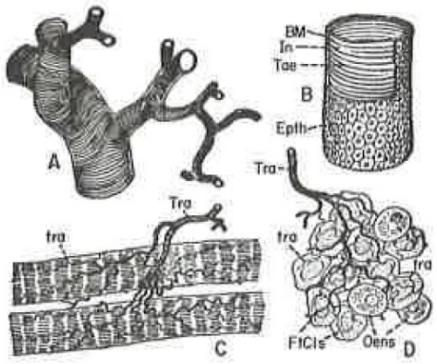

FIG. 3.14. Structure and terminal branches of trachea. *A*, a piece of trachea showing characteristic cross-striated appearance, due to spiral taenidia, and method of branching. *B*, basement membrane (*BM*) and inner cuticular lining or intima (*In*) with spiral thickenings of taenidia (*Tae*). *C*, tracheal branches (*Tra*) ending in tracheoles (*tra*) on muscle fibers. *D*, tracheation of piece of fat-body, showing tracheoles on fat cells (*Ft Cls*), but not on oenocytes (*Oens*). (*From Snodgrass, "Anatomy of the Honeybee."*)

It is believed fumigants greatly affect the enzymes concerned with oxidation and respiration in the insect body. The fumigants exert a deleterious effect upon the activities of the enzymes that are associated with cell respiration, preventing the tissues from uniting with oxygen in a normal manner. Carbon dioxide accelerates the rate and amplitude of respiration in insects as well as in warm-blooded animals and is believed to affect the tracheal valve control in insects. For this reason, carbon dioxide can be mixed with several fumigants.

It seems likely that it is the action of fumigants on the respiratory enzymes of the cell that is largely responsible for the ultimate death of the insect, although the effect of certain fumigants on the nervous system may hasten death.

Many insects are inactive at low temperatures and their rate of respiration is correspondingly reduced, making them more tolerant to fumigants. With an increase in temperature, up to a certain point, they become more susceptible to fumigants. Also, gasses are more active at high temperatures than at low temperatures and can penetrate warm commodities at a more rapid rate.

Renowned stored-product entomologist R.T. Cotton (1932) found the susceptibility of an insect to a fumigant varies with the rate of respiratory metabolism. The three most important factors that increase the susceptibility of the insects to a fumigant are:

1) An increase in temperature.
2) An increase in the carbon dioxide content of the fumigation chamber.
3) A decrease in the oxygen content of the fumigation chamber.

All stages of insects breathe (egg, larva, pupa, and adult), but the egg and pupa, being physically

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inactive, do not breathe as readily as the larva and the adult; therefore, as a rule, they are not as readily affected by equal concentrations of gas as are the larva and adult.

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Fumigants & Pheromones

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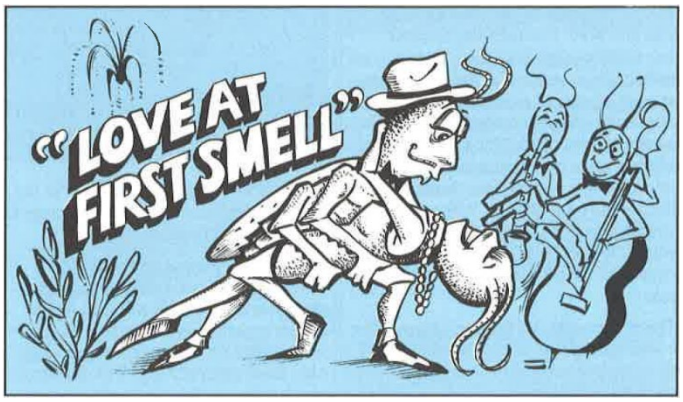
Pheromones

Pheromones, fer-e-mone\ noun



Insects live in a world of odors. They use these olfactory cues to direct a variety of complex social behaviors, including courtship, mating, and egg laying. Although pest managers and entomologists have been aware of this highly sophisticated form of communication for about one hundred years, only in the last four decades has our industry begun to use this language to misdirect harmful insect pets through the use of pheromones.

Pheromones are chemical substances that insects use to communicate with each other. The term pheromone was coined in 1959 by two German scientists. It comes from two Greek words: *pherein*, which means "to carry" and *horman*, which means "to excite or stimulate".

Ways to Use Pheromones

There are several ways for the pest manager to use pheromones. First, they can be used in *monitoring* insect activity. In this method, small amounts of pheromone, literally micrograms or nanograms, are released from lures which are then placed carefully in entrapment devices. These devices are usually wax covered paper with sticky glue coated on the inside.

The purpose of using pheromone traps to monitor insect populations is to enable one to accurately assess the size of the population and the timing of emergence. If the population reaches an alarming size, appropriate corrective action can be taken. (e.g. Insecticides or other control action can be taken). Insecticides or a chemical fogging can be coordinated with the life cycle of the target insect. Eliminating the first generation of a pest population will greatly reduce pest populations in the following months. Pesticides are applied only when the pest population reaches an unacceptable level, and one can vary the amount of insecticide which is used while timing the application to correspond with the emergence of new generations of pests.

A second way pheromones can be used to control insects is through *mass trapping*. In this method, large numbers of traps are placed in an account to trap large quantities of insects. The key to successfully implementing a mass trapping strategy is to create a lot of individual point sources. In addition, this method works best where a relatively low number of insects exist.

The third method to use pheromones is for *mating disruption*. Imagine that you are blindfolded, and you walk into a large room and are asked to pick out the mate that is wearing Chanel #5. Before you enter the room, and someone spills a whole bottle of Chanel #5 throughout the room. How do you find your mate, and how long does it take? In the insect world, male moths will hesitate to fly to look for a female if the room is flooded with pheromone. They sometimes even die before mating. The female moths will become desperate and look for a male moth to mate with if she remains unmated. She may or may not find a male and mate with hm. A combination of monitoring and mating disruption

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or mass trapping and mating disruption can reduce the pest populations even more.

The Future

Using the insects predetermined and predictable biology to gain control over them will continue to blossom in the coming years. Today "Being Green" is good and pheromones have been very green for the past four decades.

It is encouraging to know that there are many new technologies being developed to satisfy the needs of our quality standards and the needs of our environment. Pheromones and other less toxic chemicals that change the behavior of insects are being called upon more and more to monitor and control a variety of insect pests.

The new SightTrap™ from Insects Limited is a good example of new technology and innovation for the pest management industry. The more you know the better you are at making intelligent decisions.

SightTrap is an automated remote pheromone monitoring device that will capture an image of your pheromone traps, automatically identify and count the insects in the trap, and create clean data graphs and charts for review.

For more information on pheromones, visit www.insectslimited.com

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William Schoenherr; Pioneer in Pest Management

In 1983, Mr. Bill Schoenherr, Vice President of Lauhoff Grain Company in Danville, Illinois wrote this article on Pest Management. Bill was a graduate entomologist and a silent leader in teaching stored product protection worldwide. His words have proven timeless.

Excerpt from Fumigants & Pheromones Newsletter, Issue 4, 1983:

Let us begin by asking questions: Why pest management? What changes have taken place in the past 40 years? Where and why has there been progress and success? Who has been instrumental in the development of workable pest management programs?

Let us reconstruct the conditions that existed in the early 1940's and the changes that made it necessary to establish effective pest management programs. At that early date, much of the food was consumed in the home and in restaurants. It was prepared from fresh and locally grown raw materials. As this country reconstructed following the financially difficult period between the 1930's and 1940's, the food processing industry also changed. Small companies that survived the depression began to expand, while large companies became even larger. The use of locally grown foods became the exception rather than the rule. Both in the home and in-service outlets, we relied upon commercially canned, dried, or frozen foods prepared, processed, or manufactured at some distant location. Dependence upon the commercially prepared foods that shipped long distance and stored for long periods of time made it necessary to develop protective measures.

Stricter legal requirements were enacted along with stricter enforcement. Equally important, it necessitated a commitment by industry to develop pest management practices in order to comply with the legal requirements of food protection. Also, credit should be given to the community for its acceptance of the legal and humane responsibilities.

The responsibilities and credit for the spontaneous and rapid development of safe and realistic pest management programs represents the challenges of the future that will be met by qualified scientists, persons who have been trained to recognize the potential for quality failure and to set in motion the preventative measures to assure safe and nutritious foods. With prevention now the rule, not the exception, and an ever-increasing number of qualified individuals directing the programs, along with new and vastly improved procedures, we can expect the high quality of food that we are privileged to enjoy in this country and many parts of the world to remain safe and sure.

Improved methods of construction for processing equipment and buildings and for storage and transportation facilities have reduced the need for time-consuming control procedures and likewise have reduced the need for expensive and often hazardous preservatives and pesticides. The use of pheromones is another example of progress. The food industry is ready for this advanced monitoring technique.

The need to 'put out fires' is fading into the past, and the true science of pest management is coming of age.