To Attract or Repel, That Is the Question

Investigators characterize a sex pheromone from tsetse flies and cockroach repellents from cucumbers and bay leaves

Attraction and repulsion are two of the key tenets of integrated pest control. Insects are attracted with sex pheromones to lure them into traps, to count them, or simply to confuse them so as to interfere with mating. Alternatively, repellents can be used to keep insects out of a specific area where spraying pesticides might not be desirable, as in the kitchen. Two good examples of this approach were described at the recent meeting of the American Chemical Society (ACS).*

A team headed by David A. Carlson of the U.S. Department of Agriculture (USDA) Laboratory in Gainesville, Florida, reported the characterization and synthesis of a sex stimulant for male tsetse flies, the primary vector for trypanosomiasis. Clifton E. Meloan of Kansas State University reported the isolation and characterization of two naturally occurring cockroach repellents and the synthesis of some that are even more potent.

Trypanosomiasis, known as sleeping sickness in humans and nagana in cattle, is a major problem in the dry savannah regions of central southern Africa. These regions cannot be used to raise domestic cattle and draft animals because the animals are killed or incapacitated by the disease. The disease's natural reservoirs are wild warthogs, and the primary vectors between wildlife and man and his animals are two closely related species of tsetse fly, *Glossina morsitans* and *Glossina pallidipes* Austen. These insects are already somewhat resistant to pesticides, but spraying and other methods of control, such as release of sterile males, may be too expensive for developing countries.

Investigators thus hope to find a less expensive approach to control, such as use of sex pheromones. Carlson and his colleagues had previously characterized the sex pheromone from *G. morsitans*, 15,19,23-trimethylheptatriacontane, and have now shown that it is active in the field. At the ACS meeting, Carlson, Dennis R. Nelson, and Terry L. Davis of USDA, and Timothy W. Coates and Peter A. Langley of the University of Bristol, reported the synthesis of a sex pheromone from *G. pallidipes*.

The pheromone is 13,23-dimethylpentatriacontane, which is closely related to the previously identified pheromone; there is, however, only limited cross-reactivity between the species. Both pheromones are high molecular weight, nonvolatile chemicals, and neither attracts flies at a distance. The flies mate by striking objects of an appropriate size that are raised above a background surface, just as a female fly would stick out from the surface of a cow.

If the object has no sex pheromone, the male will strike other objects. If it is a female, the two will copulate. But if the object is cork or rubber impregnated with a small amount of pheromone, the male may cling to it until he becomes exhausted. The male is then subject to debilitating heat and predatory flies and ants. Alternatively, Carlson says, the object can be co-impregnated with a chemosterilant that will render the males infertile in less than a minute. A recent trial of the new pheromone in Zimbabwe failed because flies would not strike either treated or control targets. The group is now trying a second approach on an island in Lake Kariba in Zimbabwe.

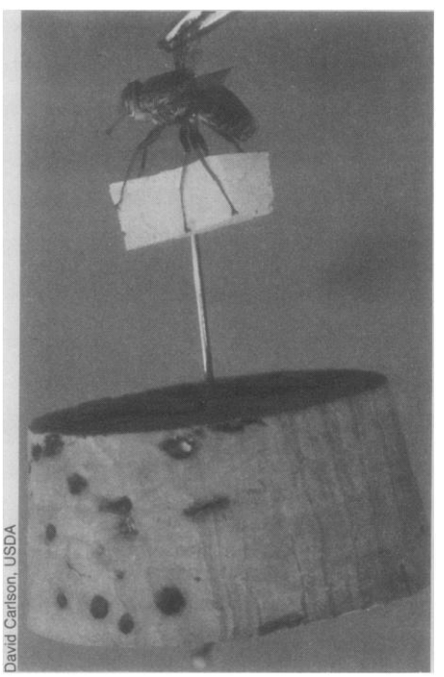
Meloan's studies are proof that some "old wives' tales" have a basis in reality. Meloan had been told by housewives that bay leaves could repel cockroaches. His interest piqued, he bought some fresh bay leaves and gave them to a graduate student to test in his roach-infested living quarters. Satisfied, Meloan eventually found six active compounds. The most potent was the bicyclic compound known as cineole.

Meanwhile, he also received reports that cucumbers were a repellent. "I didn't put much faith in the reports until one day when I walked into the kitchen of a large hotel and found that the chef had placed slices of cucumber around the edges of his work area. He said that the health inspector was scheduled to visit that day and they didn't want to have any roaches." Back in the lab, Meloan found that intact cucumbers had little effect on roaches, but that sliced ones repel 80 percent of roaches from a test area. The active ingredient proved to be *trans*-2-nonenal, which would repel 100 percent of cockroaches.

Investigation showed that an isopropyl group attached to an oxygen is the active moiety in cineole, while a carbon-carbon double bond attached to a third, electron-rich carbon is the active moiety of *trans*-2-nonenal. Combining the two groups into one molecule produced very potent synthetic repellents. Both diisopropyl ether and diisopropyl fumarate, for example, repel 100 percent of roaches at concentrations of 30 to 50 parts per million. Another compound, 5,5-dimethyl-3-ene-butyrolactone, is so effective that, even at very low concentrations, it keeps roaches out of the control as well as the test area.

The new repellents are now being studied by S. C. Johnson and Son, Inc. and Aeroxon, Inc., a manufacturer of flypaper. All of the chemicals are very volatile, says Meloan, so they would probably have to be manufactured in the form of timed-release capsules. One good use for the chemicals might be incorporated into paper grocery bags and cardboard containers for soda and beer. Roaches thrive in such environments, eating the glue that shapes the packages, and most roaches are brought into the home by these routes. Only a very small amount of the chemicals mixed into the glue would greatly reduce or eliminate transportation of the pests.

—THOMAS H. MAUGH II



David Carlson, USDA

Tenacity

A 20-milligram tsetse fly grasps a rubber decoy impregnated with a sex attractant. The decoy, pin, and cork weigh 1200 milligrams.

*184th National Meeting, 12 to 17 September, Kansas City, Missouri.

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