The chemistry of attraction — Insect pheromones at work

Casting an appraising eye over the field of rapeseed flowering yellow under the blue Prairie sky, the farmer reaches into the insect trap fastened to a nearby fence. An unusual plastic cylinder flared at each end, it contains male Bertha Armyworm moths tricked into captivity by a sexual "scent" dabbed on the inner surface. After counting the insects and consulting the leaflet relating moth numbers to the date, he relaxes. The catch is far lower than the danger level on the prediction chart — no need to worry about a Bertha Armyworm infestation of the crop later in the summer. The insecticides can stay in the storage shed. He replaces the empty trap and moves across the field to another one, seeking verification of the encouraging count.

If a group of scientists at NRC's Prairie Regional Laboratory in Saskatoon, Saskatchewan, have it their way, such a scenario could become routine for farmers in western Canada and elsewhere. Over the last five years, they have developed a promising new technique for monitoring populations of insects (primarily moths) that relies on "sex pheromones", substances released by females to attract males for egg fertilization. By identifying the molecular structures of these compounds, the Prairie scientists have effectively "broken" long-standing chemical communication codes vital to the survival of flying insect species. In concert with specially-designed traps (often customized to a given insect), these natural lures are now being used to monitor population levels, alerting farmers to impending insect invasions.

What makes the system so effective, according to group member Warren Steck, a chemist, is its simplicity. "A good sex attractant works for one moth species only," he explains. "There is virtually no overlap. If you place the pheromone for Bertha Armymoths in a trap, you can be certain that all moths collected are Berthas. Males of other species are simply not attracted, and the traps are designed to minimize accidental entrapment. A farmer doesn't have to be an insect specialist then — all he needs to know is the information in our pamphlet."

How do scientists isolate and identify the pheromones of a given moth species? "Not easily," says plant biochemist Ted Underhill. "The most direct way is to collect and chemically extract the glands producing the attractants from large numbers of female moths. You then fractionate the mixture and test each fraction on males of the species, progressively reducing the options to an ever-smaller number of chemicals." The problem with this method, however, lies in the potency of pheromones. Because male moths can perceive such fantastically low concentrations of the compounds (another reason for the monitoring system's effectiveness), very little is released by each female. Hence, thousands of glands are required to produce micrograms of pheromone — it's like looking for a single, sharp odor structure in a chemical haystack.

Fortunately for scientists in the area, the accumulating knowledge of moth pheromones has shown that they are often variations on a single structural theme. With such information, PRL chemists expert in building organic molecules have produced many of the attractants by simply juggling the elements that make up the common structural schema. "This has been our most successful approach," comments organic chemist Mel Chisholm. "There are about 200 compounds that fall into this family, and we have synthesized most of them in the laboratory."

With either method, gland extraction or chemical synthesis, there is still the considerable task of testing the compounds for pheromone activity. And here another problem presents itself. "Successful sex attractants are usually mixtures of more than one

Prairie Regional Laboratory/Laboratoire régional des Prairies

These traps, positioned along the fences of a farmer's field, monitor the population of particular insect species. This specificity is made possible by placing sex pheromones, chemicals given off by female insects to attract males of the same species, inside the trap. By isolating natural products and building molecules in the laboratory, PRL scientists have identified a number of pheromones from insects that damage Prairie crops.

Ces pièges, installés le long des clôtures du champ d'un agriculteur, permettent de déterminer la densité de population d'une espèce particulière d'insectes. Cette spécificité est rendue possible en plaçant des phérormones sexuelles à l'intérieur du piège. Ces phéromones sont des produits chimiques libérés par les insectes femelles pour attirer les mâles de la même espèce. En isolant les produits naturels et en construisant des molécules en laboratoire, les scientifiques du LRP ont identifié un certain nombre de phérormones provenant d'insectes qui s'attaquent aux récoltes des Prairies.