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Pheromone Control OF Insects

Editor's Note: In last month's column, we looked at the insect produced chemicals known as pheromones and how they were laboriously discovered. In this month's column, we will examine how these substances are being used to fight the endless battle with insects and how current research is discovering the unique properties of these amazing communication chemicals.

In 1960, chemist Morton Beroza of the U.S. Department of Agriculture suggested using sex pheromones to jam the insect long-distance mating communication system. In 1967, entomologist Harry Shorey at the University of California, Riverside, followed Beroza's lead and was the first to show that pheromones could be used to disrupt the mating of an insect-in this case cabbage looper moths in the field. Precisely how the pheromones do this job is not known. Researchers speculate that the high loads of pheromone not only confuse male insects, but also camouflage a female's pheromone emission and cause some males to tune out all sources of the pheromone.

Mating disruption has had a significant impact on insects that had become immune to broad-spectrum insecticides. In Mexico,where nearly half the tomatoes consumed in the United States are grown, the pinworm once regularly destroyed more than three-quarters of a year's crop. Growers began broadcasting the pinworm's sex pheromone throughout tomato fields. Results were dramatic. Only about 4% of the females were able to mate under these conditions. By contrast, 50% of the female pinworms mated in neighboring untreated fields. Only about 30% of a year's growth of tomatoes was lost to pinworm damage in crops treated with mating disruption and other management tools compared to as much as 80% of the tomato crop with conventional insecticides.

Pheromones can be used to help determine when to spray crops with pesticides. The timing can be crucial; to be effective against the codling moth, for example, orchards must be sprayed during a critical period after the caterpillars have hatched but before they burrow into the fruit. Farmers check traps baited with the moth's pheromone each day to detect when the number of moths peaks. After a certain number of days, during which time the eggs are hatching, farmers spray the orchards with insecticide so that most of it lands on newly emerging caterpillars.

Pheromones also are used as the bait for mass trapping of pests such as bark beetles. Unique research is being conducted with pheromones as lures for devices designed to spread disease in targeted insect populations to render the insects sterile; in these cases, the temporarily trapped insects are released to affect the wild population.

Pheromone monitoring traps are being used to determine when pests approach damaging levels so that spraying insecticides is timed to reduce insecticide levels in the environment. An added benefit of limiting insecticide spraying only to infested areas is that many beneficial insects are saved from destruction. The beneficial insects effectively control many pests.

Pheromone monitoring has proven particularly valuable in setting off early alarms to indicate that certain pests have invaded new territory and require pest control measures. When an area of boll weevil infestation is detected, for example, farmers can destroy the weevil using insecticides, plant destruction, or pheromone traps. These efforts have been immensely successful at eradicating the cotton boll weevil from much of the southeastern cotton belt.

Investigators also are discovering the neurological pathways the pheromones stimulate in a responding insect, and the enzymes the insects use to break down the pheromone so as to shut off its signaling. This basic research should lead to the design of new molecules that affect an insect's response to pheromones, as well as to better ways to use pheromones or other compounds to manage insect pests.

Researchers continue to study how insects produce pheromones, how they trigger a response, and what influences that response. Pheromone chemistry research and related insect response to pheromones will uncover the hormones that trigger pheromone production as well as the binding proteins that bring the pheromones to their receptors response to pheromones.

As insects have become increasingly resistant to conventional insecticides, and as the American public has became increasingly wary of the adverse effects of insecticides; conventional use of insecticides by growers of all kinds of crops might have been unable to control the insects that threaten their livelihoods. And many fruit crops would be unable to pass the low limit for insecticide residues recently required for their sale in this country. SJ