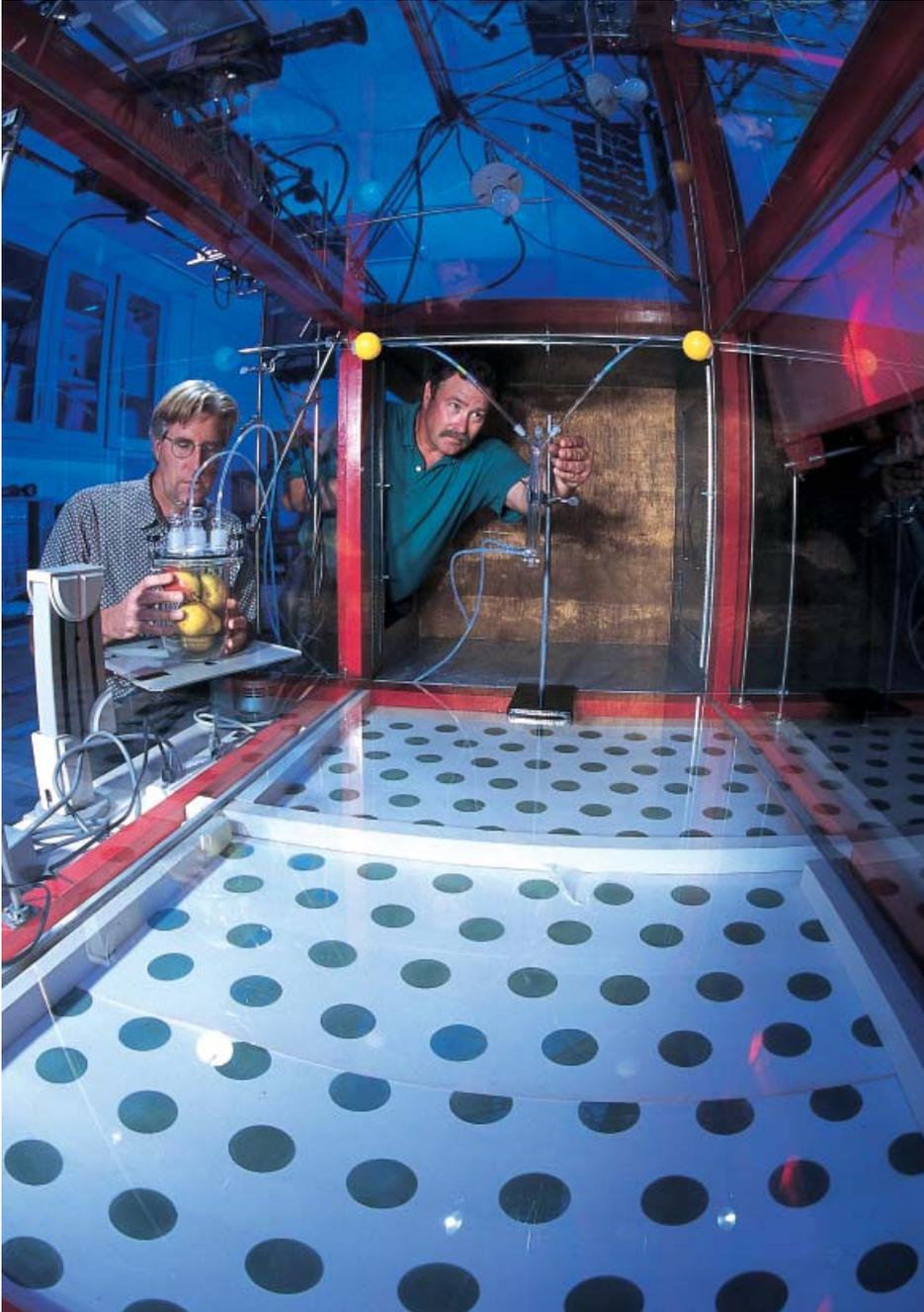


Fruit **Perfume** Lures Female Codling Moths

SCOTT BAUER (K9201-1)



In the laboratory, entomologists Alan Knight (left) and Doug Light set up a flight tunnel experiment to test which pear odors attract female codling moths.

The luscious aroma of ripe pears could spell doom to codling moths. Agricultural Research Service scientists have discovered that a certain chemical in pears provides just the right perfume to attract female codling moths to traps. That's a breakthrough that may revolutionize integrated pest management (IPM) in apple, pear, and walnut orchards worldwide—and will help growers to continue providing safe food more economically.

Codling moths are the most severe and widely distributed pest of apples, pears, and walnuts in the world. The moths were accidentally introduced into the United States from Europe in the 1700s and have been a menace ever since.

Uncontrolled, the larvae—the worm in the apple—can destroy up to 95 percent of an apple crop and up to 60 percent of a pear crop. Feeding by larvae creates holes in walnut hulls and shells that can allow fungi to enter and infect the kernels. Some fungi produce toxins that at high levels are a food safety concern. Both federal and international regulations prohibit growers from selling toxin-contaminated nuts.

The Main Attraction

“Sex attractants called pheromones have been the main tool available to growers for monitoring codling moths in orchards,” says ARS entomologist Douglas M. Light.

Pheromones, which are chemicals given off by female moths to attract males for mating, have allowed scientists and growers to trap and monitor male moths in orchards.

A synthetic version of the codling moth pheromone has been available for 30 years and provides the basis for mating-disruption programs. Growers can disrupt the ability of males to find a mate by flooding the orchard canopy with pheromone. Or they can time insecticide sprays according to the number of moths found in traps baited with pheromone.

Now Light has found a new, potentially more useful tool.

“We’ve found a natural chemical in a fruit that is as effective as pheromones in attracting moths. But more importantly, this compound not only attracts males, it lures females,” Light says. He works in the USDA-ARS Plant Protection Research Unit at the Western Regional Research Center in Albany, California.

While pheromone-based programs target male moths, the real goal has always been to reduce the female’s ability to reproduce. Females can lay 50 to 100 eggs, and two or three generations can hatch each growing season. Attracting females directly would allow growers to eliminate the females and their unladen eggs and to monitor mating cycles more precisely.

“IPM programs are based on the relationship between the time when male moths appear in pheromone traps and the time eggs begin to hatch,” says ARS entomologist Alan L. Knight. To predict insect development, scientists use a measurement tool called a degree-day model. For codling moths, eggs are believed to hatch after the accumulation of 250 degree days—which ranges from 15 to 30 calendar days—after the males emerge and are detected in sex-pheromone-baited traps.

“There’s a lot of potential error in estimating egg hatch based on the number of males trapped,” says Knight. “We think that being able to monitor females should be a lot more accurate.”

In field tests, Knight verified that the pear-derived attractant is more effective than pheromones in monitoring—and potentially predicting—mating and egg laying.

New Strategies Needed

“In the past, growers would use long-lasting insecticides that would cover the range of possible days when moths could lay eggs and larvae could hatch,” Knight says. “But as environmental regulations

require use of less toxic and shorter-lived pesticides, it becomes important to know exactly when the females mate and begin their egg laying.”

Once the larvae hatch, there is only a short time before they crawl to and bore into the developing fruit, where they are safe from external controls.

Although apples and pears generally suffer more from codling moth attacks, Light was looking for a way to protect walnut orchards. He wondered if using one of their preferred foods—pears—would lure the insects away from the walnuts.

Finding What Rings Their Bell

Light worked with a team of ARS chemists at the Albany laboratory to obtain 37 combinations of the chemicals that make up pear odors and flavors. Improvements in chemical detection methods over the last two decades allowed the scientists to isolate and identify the many components that make up a wide range of fruit and nut odors and flavors.

One of the mixtures showed extraordinary promise as a codling moth attractant. They discovered that the key attractant was a chemical known as the pear ester, or ethyl (2E, 4Z)-2,4-decadienoate.

To pursue the commercial potential of his discovery, Light established a cooperative research and development agreement with Trécé, Inc., of Salinas, California. Clive Henrick, vice president of research and development at Trécé, used synthetic chemistry techniques to confirm that one key chemical in pears attracted the moths.

Pear ester, they found, acts as a kairomone. Unlike a pheromone, which involves only one species, kairomones are chemicals emitted by one species—in this case pears—that attract and benefit another, such as codling moths. The moths have apparently evolved to detect this odor and use it to locate a preferred food.

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SCOTT BAUER (K9206-1)



Codling moths of both sexes are strongly attracted to a chemical in pears.



Entomologist Alan Knight places a pear-based kairomone trap in an apple orchard to attract codling moths.

SCOTT BAUER (K9205-1)



The high level of attractiveness of the pear ester could be useful in developing “attract and kill” traps that reduce pesticide use while removing moths from orchards before they reproduce.



Technician Kathy Reynolds, entomologist Doug Light (center), and Trécé field development manager Scott Lingren inspect a trap baited with pear ester for use in codling moth monitoring in a walnut orchard.

mones, but most are worthless for commercial applications to monitor insects under field conditions,” Henrick says. “This one is fantastic.”

ARS and Trécé have applied for a patent on use of the pear ester for codling moth monitoring and control.

Doing More With Less

Trécé also plans to include the attractant in a lure containing insecticides. This attracticide will kill moths that contact it. “This approach will use less than 10 percent of the amount of insecticide that would normally be used,” Henrick says.

Researchers estimate that 90 to 95

percent of male codling moths in an orchard must be trapped or prevented from finding a mate to reduce the number of fertile eggs laid to an economically manageable level. “But for each female trapped, dozens of eggs are immediately eliminated,” says Knight.

“Right now, there is no effective and economical way to determine how many females are in an orchard,” says Light. “Female lures may help growers reduce pesticide use either by disrupting mating or by helping growers time their pesticide use more precisely.”—By **Kathryn Barry Stelljes**, ARS.

This research is part of Food Safety

(#108) and Crop Protection and Quarantine (#304), two ARS National Programs described on the World Wide Web at <http://www.nps.ars.usda.gov>.

Douglas M. Light is in the USDA-ARS Plant Protection Research Unit, Western Regional Research Center, 800 Buchanan St., Albany, CA 94710; phone (510) 559-5831, fax (510) 559-5777, e-mail dlight@pw.usda.gov.

Alan L. Knight is with the USDA-ARS Yakima Agricultural Research Laboratory, 5230 Konnowac Pass Rd., Wapato, WA 98951; phone (509) 454-6566, fax (509) 454-5646, e-mail aknight@yarl.ars.usda.gov. ♦