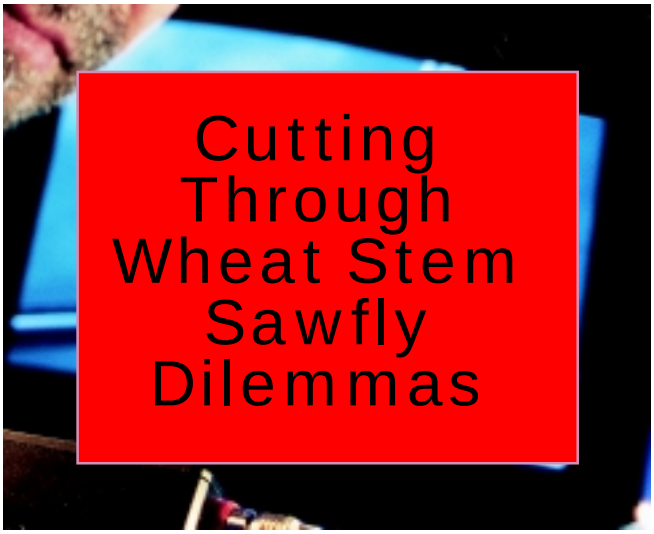
Cutting Through Wheat Stem Sawfly Dilemmas

The wheat stem sawfly, *Cephus cinctus*, is a pest that poses dilemmas for Northern Great Plains farmers, and entomologist Allard A. Cossé and his colleagues hope to help make their decisions a bit easier one day.

Thanks to plant breeders who have developed thick-stemmed, sawfly-resistant wheat varieties, catastrophic yield losses can be avoided—but at the cost of forgoing a potential bumper crop. Only in some years do hordes of the pest bore through wheat stems and drastically cut yields. So first the farmer must decide whether to plant a higher yielding, nonresistant variety or one that's resistant and that directs more of its energy into making thick stems.

If the farmer chooses a nonresistant variety and the spring emergence of adult sawflies is large, there is only a 1- to 2-week period in which to spray insecticides. Once the eggs are laid and the larvae are feeding safely within wheat stems, insecticides have little effect. Knowing exactly when and where adults are emerging and whether the population is dangerously large could help the farmer make timely and effective pest-control treatments. Someday, traps baited with attractants for adult sawflies could provide the needed information, says Cossé.



A chemical ecologist, Cossé is interested in sawfly attractants as potential trap baits or for any other novel sawfly-control approaches. But the first step is to learn what the natural sawfly attractants—pheromones—are. To take some of the mystery out of what causes sawflies of one gender to be attracted to the other, the scientist gets down to one of the basics—the sawfly's antennae, where its sense of smell is located.

In the laboratory at the National Center for Agricultural Utilization Research, in Peoria, Illinois, a sawfly antenna that's suspended between tiny electrodes sends out an electrical signal when exposed to any of the airborne components of sawfly pheromone. An instrument called a gas chromatograph separates the complicated blend of chemicals found in the air around wheat plants swarming with sawflies. The compounds emerge from the instrument one by one and are sent simultaneously to two detectors—one that senses all compounds and the one that includes the antenna. The antenna detector senses just a few compounds, such as pheromone components, that are essential to sawfly biology. The results are recorded on two graphs, one for each kind of detector.

The technique is called coupled gas chromatographic-electroantennographic detection (GC-EAD). It allows the scientist to pinpoint exactly which chemicals are critically important to the sawflies from among the myriad, mostly inert, compounds. And once scientists know which chemicals to concentrate on, they can focus on determining their chemical structure and how they function.

"We've found that the sawfly pheromone system is unusual," says Cossé. Unlike most insects, both genders of sawfly produce the same odors, but in different proportions. Adding to the complexity is that scents from the wheat plant also influence sawfly behavior. That's useful information as the scientists formulate various mixes of volatile chemicals to research the insect's behavior.

Wind-tunnel experiments simulate conditions sawflies might respond to in the field. The wind tunnel offers a quick way to evaluate the importance of various compounds as the scientists develop synthetic blends as trap baits. The complete blend isn't always needed to get a response. David Weaver, Cossé's collaborator at Montana State University, found that one of the body odor chemicals, which project leader Robert J. Bartelt produced synthetically, was potent enough by itself to attract sawflies to traps in the field.

Among the odors produced mainly by male sawflies are 9-acetyloxynonanal, phenylacetic acid, and tetradecanal. When two or more males are together, they emit musky-smelling phenylacetic acid in amounts large enough to be sensed by the human nose. In nature, clouds of aggregated males advertise themselves to nearby females, which in turn signal their readiness to mate by emitting their own unique blend of compounds. The emissions from female wheat stem sawflies are relatively rich in hexadecanal.

While some sawfly species produce volatile chemicals similar to those of the notoriously destructive pine sawfly, the wheat stem sawfly produces vastly different chemicals.

The Peoria scientists are using GC-EAD to research other insects, such as sap beetles, which are pests of figs, dates, and corn; other sap beetles that spread a fungus which causes oak wilt of trees; exotic leaf beetles, which may someday control weedy tamarisk trees along western U.S. streams; exotic flea beetles, which are being used as biological control agents against leafy spurge; and flea beetles, which are pests of canola and other cruciferous crops.—By **Ben Hardin,** ARS.

This research is part of Crop and Commodity Pest Biology, Control, and Quarantine (#304), an ARS National Program described on the World Wide Web at http://www.nps.ars.usda.gov.

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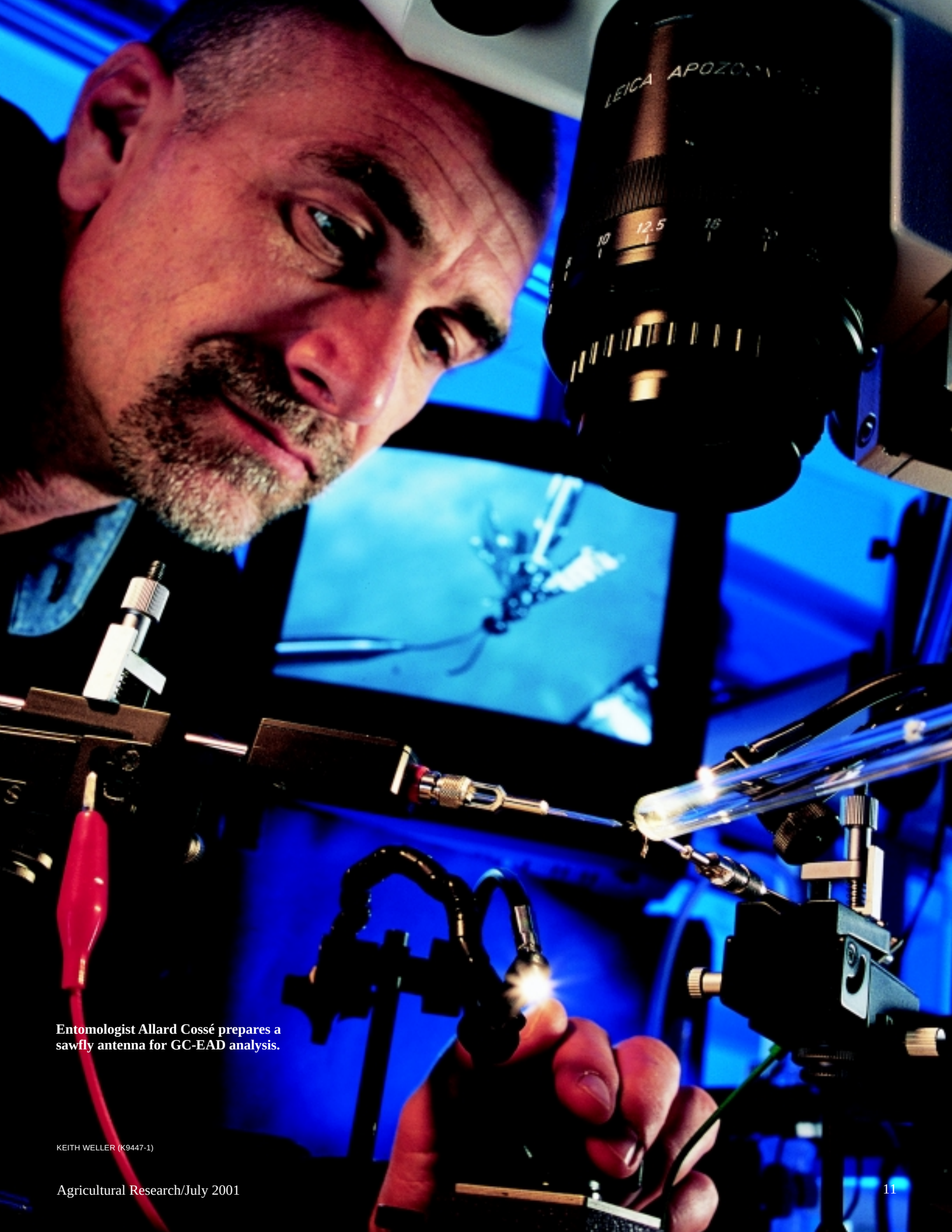

Entomologist Allard Cossé prepares a sawfly antenna for GC-EAD analysis.

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